WIND GARDEN WIND FARM

Makana Local Municipality, Eastern Cape

Avifaunal Impact Assessment – Report

25 February 2021

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Executive Summary

It is anticipated that the proposed Wind Garden Wind Energy Facility (WEF) will have a variety of impacts on avifauna which ranges from low to medium.

Wind Garden falls in the Cookhouse focus area of the REDZ, Strategic Environmental Assessment (SEA) of the Department of Environmental Affairs (2015). This report list 283 bird species while nine Priority species were recorded during the Pre-construction bird monitoring study.

The site has majority Albany Subtropical Thicket vegetation (bushveld) and to a limited cover of Karoo shrubland.

These include, Blue Crane, Ludwig's bustard, Denham's bustard, Southern Black korhaan, Secretarybird, Verreaux's eagle, Martial eagle, Black harrier, and Lanner falcon.

Two Verreaux's eagle and two Martial eagle and one African Fish eagle nests were found in proximity of Wind Garden WEF but outside the appropriate applied buffers.

Two Secretarybird territories were noted but no nest was recorded while Jackal buzzard, African Harrier hawk, Pale Chanting goshawk and Rock kestrel breed in the wider WEF area. No Lanner falcon breeding was recorded.

The large terrestrial birds were found in low numbers because of the bushveld limiting their distribution and abundance. High abundance of Southern Black korhaan were recorded. No Blue crane nests was found but a few pairs breed in the wider East block of the data collection area. The bushveld has a large diversity of small bush birds.

No large croplands or permanent water occur in the area, therefore no large wetlands other than small ground dams. Therefore no large numbers or diversity of water bird species occur in the area.

Not many migratory bird species were recorded.

This assessment found the following potential impacts assessed on birds according to the methods provided by Savannah, as:

- Bird collision mortality with turbine blades will be of LOW negative significance.
- Destruction bird habitat during construction will be of LOW negative significance.
- Disturbance of birds during construction (and dismantling) of the wind farm and associated infrastructure will be of MEDIUM negative significance.
- Bird fatalities through Collision and Electrocution on the internal medium voltage powerlines are of LOW negative significance.
- Displacement and disturbance of birds during the operation will be of LOW negative significance.

In conclusion, no significant disturbance impacts have been identified, though mitigation measures should still be considered in order to minimise the contribution of the Wind Garden Wind farm site to the cumulative impact of the whole renewable energy cluster.

Section 1 INTRODUCTION

Wind Garden (Pty) Ltd is proposing the development of a commercial wind farm and associated infrastructure on a site located approximately 17km north-west of Grahamstown (measured from the centre of the site) within the Makana Local Municipality and the Sarah Baartman District Municipality in the Eastern Cape Province.

A preferred project site with an extent of ~4336ha has been identified by Wind Garden (Pty) Ltd as a technically suitable area for the development of the Wind Garden Wind Farm with a contracted capacity of up to 264MW that can accommodate up to 47 turbines. The entire project site is located within the Cookhouse Renewable Energy Development Zone (REDZ). Due to the location of the project site within the REDZ, a Basic Assessment (BA) process will be undertaken in accordance with GN114 as formally gazetted on 16 February 2018.

This forms part of a larger cluster of renewable energy facilities, geographically separated into the East and West blocks, consisting of six wind farms, East block - two wind farms and West block – four wind farms, two solar farms and a 400kV Main Transmission Substation (MTS) in the Makana and Blue Crane Route Local Municipalities. The Wind Garden Wind Farm is in the East block and the site is centred on -33.2192° S latitude and 26.3731°E longitude. Wind Garden is neighbouring a second proposed wind farm known as Fronteer Wind Farm (38 turbines), which will be assessed in a separate AIA report. The Wind Garden Wind Farm will connect to the national grid on site to an existing 132kV Eskom power line.

Ecology Consulting (UK based) and in collaboration with East Cape Diverse Consultants has been appointed by Savannah Environmental (Pty) Ltd to conduct the necessary avifaunal impact assessment (including pre-construction monitoring) for this process.

The pre-construction bird monitoring have been designed using the BirdLife South Africa (BLSA) guidance and international best practice (Jenkins *et al*. 2015, SNH 2017) and the information in the Strategic Environmental Assessment (SEA) (Department of Environmental Affairs 2015) for the Cookhouse REDZ Focus Area. The pre-construction bird monitoring data was collected as a combined programme for the entire cluster. With 56 Vantage Point surveys (17 in the East block and 39 in the West block) as the focal strategy (see later).

This report assesses the avifaunal impacts of the Wind Garden Wind Farm only.

1.1 Project Description

The project site comprises the following five (5) farm portions:

Remaining Extent of Farm Brackkloof No 183

Portion 5 of Farm Hilton No 182

Portion 8 of Farm Hilton No 182

Portion 4 of Farm Vandermerweskraal No 132

Portion 1 of Farm Thursford No183

The Wind Garden Wind Farm project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 264MW:

- Up to 47 wind turbines with a maximum hub height of up to 120m. The tip height of the turbines will be up to 200m;
- A 132kV switching station and a 132/33kV on-site collector substation to be connected via a 132kV overhead power line (twin turn dual circuit). The wind farm will be connected to the national grid through a connection from the 132/33kV collector substation via the 132kV power line which will connect to the 132kV switching station that will loop in and loop out of the existing Poseidon – Albany 132kV line;
- Concrete turbine foundations and turbine hardstands;
- Temporary laydown areas which will accommodate the boom erection, storage and assembly area;
- Cabling between the turbines, to be laid underground where practical;
- Access roads to the site and between project components with a width of approximately 4,5m;
- A temporary concrete batching plant;
- Staff accommodation; and
- Operation and Maintenance buildings including a gate house, security building, control centre, offices, warehouses, a workshop and visitors centre.

A development envelope for the placement of the wind energy facility infrastructure (i.e. development footprint) has been identified within the project site and assessed as part of the BA process. The development envelope is ~3400ha in extent and the much smaller development footprint of ~66.6ha will be placed and sited within the development envelope (1.54% of total area).

Section 2 DESIGN OF THE BIRD STUDY

The pre-construction monitoring **plan** have been designed in line with the BirdLife South Africa (BLSA) guidance and international best practice (Jenkins *et al*. 2015, SNH 2017).

The Strategic Environmental Assessment (SEA) report of the Department of Environmental Affairs (2015) was used to design the pre-cons study and to define the Priority Species list in the study area.

2.1 Strategic Environmental Assessment

The site lies within the Cookhouse Focus Area, which the SEA describes as follows:

"This FA (7,366 km^2) falls within the Albany Thicket Biome, at the interface between the Albany Thicket and the Sub-escarpment Grassland Bioregions (Mucina and Rutherford 2006). The area features open, hilly grassland, grading into wooded and succulent-rich thicket vegetation along the drainage lines and forest patches along the base of the escarpment. It is bordered by the Winterberge, the Bloemfonteinberge and the Groot-Bruintjieshoogte mountains to the north, crossed by a series of smaller mountains extending to the north-east of Grahamstown, and traversed by the Great and Little Fish Rivers, and the Koonap River, which form deeply incised valleys through the central plains.

The SEA notes that the Focus Area is not located close to any recognised national Important Bird Areas, but that it does support a diverse avifauna. It identified at least 283 bird species that could regularly occur, using data from the South Africa bird atlas (SABAP) project. This includes 19 red-listed species, six of which are endemic (Barnes 1998, 2000); Ludwig's Bustard, Blue Crane, Cape Vulture, Black Harrier, Melodious Lark and African Rock Pipit. The key ornithological features of the Cookhouse Focus Area SEA (from Table 3 from the SEA Appendix A5) is given in Table 1.

Table 1 Key ornithological features of the Cookhouse REDZ Focus Area SEA (source: Table 3 from the SEA (Appendix A5).

Species	Threat status		SA Endemism	National sensitivity rating (wind only)	SABAP2 Rep Rate (%)	FA-specific predicted susceptibility to	
	Regional	Global				Wind	Solar
Denham's Bustard	Vulnerable	Near-	-	19	1.89	High	Moderate
Ludwig's Bustard	Endangered	Endangered	Near-	14	2.83	High	Moderate
Kori Bustard	Near-threatened	Near-threatened	-	38	1.65	High	Moderate
Southern Black Korhaan	Vulnerable	Vulnerable	Endemic	36	8.96	Moderate	Moderate
White-bellied Korhaan	Vulnerable	Least concern	-	35	3.77	Moderate	Moderate
Blue Crane	Near-threatened	Vulnerable	Near-endemic	13	9.91	High	Moderate
African Fish-Eagle	-	-	-	24	12.50	High	Low
Cape Vulture	Endangered	Vulnerable	Near-	1	0.94	Very high	Low

Species	Threat status		SA Endemism	National sensitivity rating (wind only)	SABAP2 Rep Rate (%)	FA-specific predicted susceptibility to	
	Regional	Global				Wind	Solar
Black Harrier	Endangered	Vulnerable	Near-	7	6.37	Moderate	Moderate
Jackal Buzzard	-	-	Near-	42	26.18	High	Low
Verreaux's Eagle	Vulnerable	Least	-	3	3.30	Very high	Low
Booted Eagle	-	-	-	57	5.19	High	Low
Martial Eagle	Endangered	Vulnerable	-	5	4.72	Very high	Moderate
African Crowned Eagle	Vulnerable	Near-threatened	-	27	4.25	Very high	Low
Secretarybird	Vulnerable	Vulnerable	-	12	5.42	High	Moderate
Lesser Kestrel	-	-	-	64	0.47	High	Moderate
Amur Falcon	-	-	-	65	2.59	High	Moderate
Lanner Falcon	Vulnerable	Least concern	-	20	2.59	High	Low
Melodious Lark	Least concern	Near-threatened	Near-endemic	92	1.42	Low	High

The SEA sensitivity mapping was based on the data available at the time on these species' distributions, and on habitat features associated with these species, including high voltage (>132kV) power lines (which could be used for roosting sites by Cape Vultures and nesting large eagles, buzzards and falcons), larger river corridors (potential bird flyway and waterbird communities), wetlands, and an historic migratory kestrel roost site. The key ornithological features of the Cookhouse REDZ Focus Area SEA sensitivity mapping are given in Table 2 (extract from Table 4 of the SEA Appendix A5).

Table 2 Cookhouse Focus Area SEA key ornithological features used in the sensitivity mapping (source: Table 4 of the SEA Appendix A5).

Ornithological feature	**Information source**	**Sensitivity and buffer extent**
Power lines ≥132 kV possibly used by roosting Cape Vultures and nesting large eagles, buzzards, falcons	Eskom Networks layer, 2014	Medium: 5 km
Great Fish River as an avian fly-way; supports waterbirds and riparian communities	NFEPA Rivers layer, 2011	Very High: 1 km from edge of full river
Little Fish River as an avian fly-way; supports waterbirds and riparian communities	NFEPA Rivers layer, 2011	Very High: 1 km from edge of full river
Koonap River as an avian fly-way; supports waterbirds and riparian communities	NFEPA Rivers layer, 2011	Very High: 1 km from edge of full river
Selected CWAC site, with high total counts, spp. diversities, and presence of Red-listed species	CWAC data base, ADU	Very High: 2 km from edge

Ornithological feature	Information source	Sensitivity and buffer extent
Known Cape Vulture roost site at Agieskloof / Lichtenstein	EWT Knowledge Management Database, BLSA, Boshoff *et al*. 2009 a & b	Very High: 20 km
		High: 40 km
Known Blue Crane nesting areas	EWT Knowledge Management Database	Very High: 150 m
		High: 300 m
Past and possible future migrating kestrel roost site	EWT Knowledge Management Database, BLSA	High: 5 km
Known Lanner Falcon nest sites	A. Stephenson Unpubl. data, Jenkins *et al.* 2012b, 2013a	Very High: 1 km
		High: 3 km
Presence data for a suite of threatened, impact susceptible large terrestrial birds	SABAP2, ADU	Medium: No buffer

Additionally, though not specifically described in the Table, an extensive area of high sensitivity is identified in the SEA mapping as 'Cliffs (slope >75°)', presumably for its potential to support large raptors that could be sensitive to wind farm development (such as Verreaux's Eagle).

A key conclusion with regard to this sensitivity mapping is that although potentially important habitats such as cliffs and wetlands/river corridors have been identified, at the time of the SEA analysis there was a lack of detailed knowledge of the baseline conditions, which could mean that (a) important sensitivities may not have been mapped, and (b) some areas mapped in the SEA as higher sensitivity on a precautionary basis may actually not support important bird populations that would be a constraint to the wind farm.

The proposed Wind Garden Wind Farm site lies outside several of the key constraint areas identified in the Focus Area SEA. The site is located beyond the 40km buffer from the important Cape Vulture roost, which should reduce the likelihood of this species being an issue (though the possibility of other such roosts cannot be ruled out given the general lack of baseline information).

Two of the five Lanner Falcon nests in the Focus Area reported in the SEA lie adjacent to the Eastern Block, though the 2019-20 surveys did not find either territory to be occupied. One is 4.3km from the closest proposed Wind Garden Wind Farm wind turbine, the other 8.7km (Figure 4). The SEA considered the area within 1km of these nests to be of a very high sensitivity, and within 3km to be of a high sensitivity. At this distance from the wind farm (and given the lack of regular flights through the site), any significant effects on this species should be unlikely (though have still been fully assessed).

The SEA identified a range of other key species that are likely to use the area, but no detailed spatial information is available. It is likely that there are other bird sensitives that could be an issue with the proposed wind farm, but there is not any desktop information currently available that would enable that risk to be determined. Some of these will be associated with particular habitats, e.g. cliffs and rocky outcrops for nesting Verreaux's Eagle, open grassland for bustards and cranes, wetlands and river corridors for waterbirds, but specific nesting locations for most of these key species were not identified in the SEA. There would therefore be a higher risk of encountering these species in those habitats, but there may be extensive areas of those habitats where they are not present which requires ground-truthing through pre-construction monitoring. The SEA mapped cliffs as areas of higher ornithological risk for this reason, buffered by a 3km distance. The SEA also mapped river corridors as higher risk areas, with a 1km buffer.

As more information became available from the site's pre-construction monitoring during 2019 and 2020, this was incorporated into the site design in an iterative process. For some species, notably Verreaux's Eagle, specific buffers are now recommended. BLSA recommends a minimum separation of 1.5km from any Verreaux's Eagle nest, up to 3km, but also notes that "*a nest buffer alone is unlikely to be adequate to mitigate potential impacts on Verreaux's Eagles*" and that consideration should be given to avoiding locating turbines in areas used by Verreaux's Eagle that include "*ridge tops, cliffs, steep slopes (Katzner et al., 2012, Gove et al., 2013), escarpment edges and particularly slopes that are perpendicular to the prevailing wind direction (Davies 1994*)."

Section 3 DEVELOPMENT AREAS

3.1 Wind farm areas

Two specific areas have been identified for the development of the cluster of renewable energy facilities, as shown in Figure 1, and Eastern block and a Western block. That Figure illustrates the main habitats across the area (from Mucina and Rutherford 2006). Figure 2 shows the distribution of land cover classes from the 2018 South Africa National Land Cover survey [1] across the area.

These wind farm development areas have been refined to determine possible wind turbine layouts. This has enabled the surveys to be planned to focus on the areas in which the wind turbines would be located rather than the whole of the development areas.

An initial layout (dated 21/2/19) comprised 139 turbines in the Eastern Block and 494 turbines in the Western Block. The initial survey methodology was designed based on that layout.

Though this was refined further following the second layout iteration (dated 22/8/19), with additional VPs added as required. That layout included 128 turbines in the Eastern Block and 297 turbines in the Western Block.

The layout was refined further in October 2020, to the proposed turbine locations, shown in Figures 1, 2 and 3, with 85 turbines in the Eastern Block and 175 turbines in the Western Block, removing turbines from more sensitive areas.

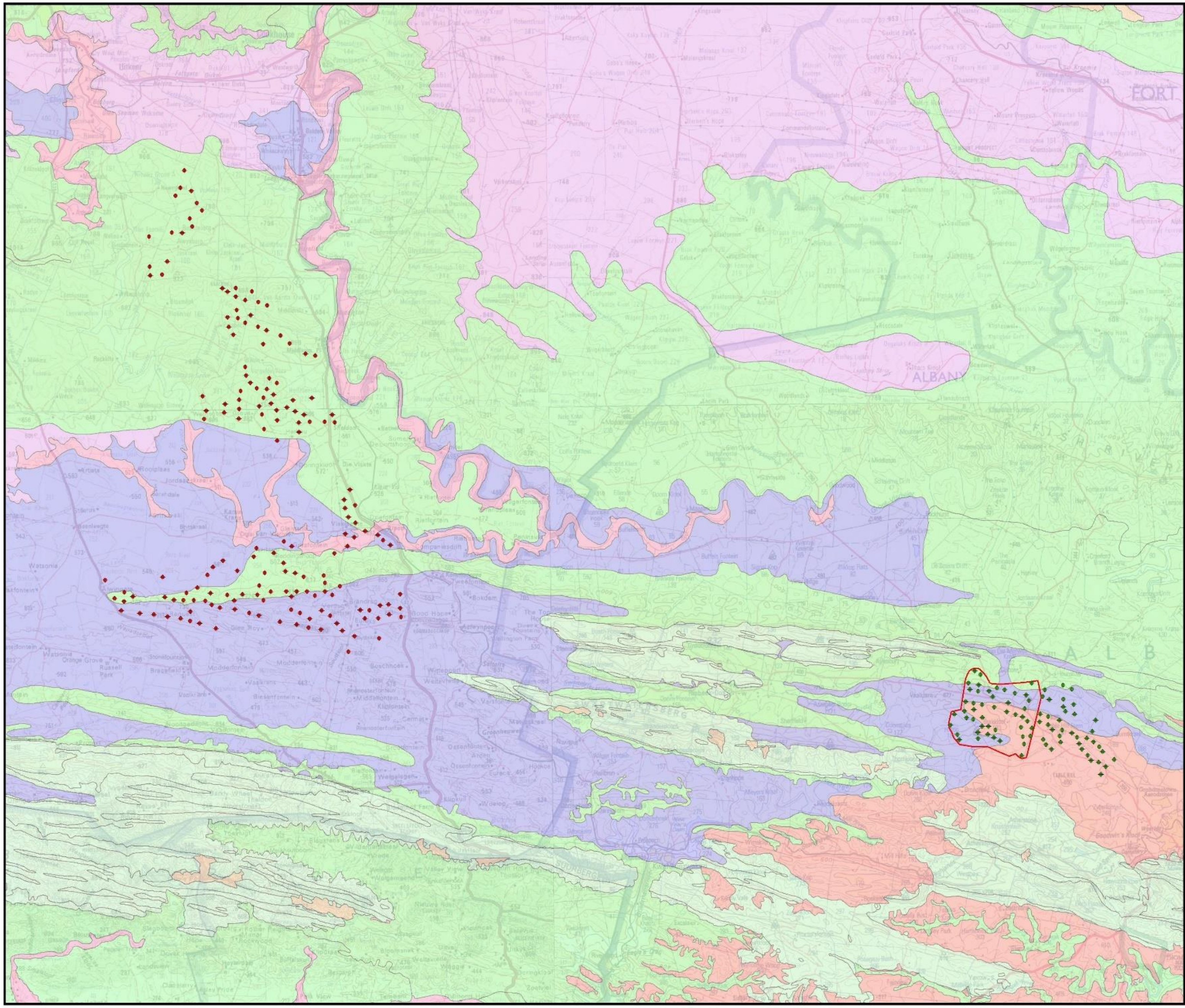
The proposed Wind Garden Wind Farm comprises 47 turbines in the Eastern Block.

Control site

An extensive reference area around the wind farm sites (outside the potential impact zone of the wind farm) was surveyed and will be available for post-construction before/after comparison, for example for before/after gradient analysis. At Wind Garden, for example, a substantial area was surveyed to the south of the wind farm (Figure 3).

Figure 3 Shows a map of the Wind Garden WEF area in the red enclosed area with the 47 turbine positions and the 17 VP positions used with their viewsheds, east of Makhanda (Grahamstown).

[1] https://www.environment.gov.za/projectsprogrammes/egis_landcover_datasets. Accessed 30/6/20.



Wind Garden Wind Farm

FIGURE 1

Current Site Layout and Mucina & Rutherford (2006) Biomes

KEY:

- Choje East turbines EIA
- Choje West turbines EIA
- Wind Garden Site Boundary

BIOME

- Albany Thicket Biome
- Azonal Vegetation
- Desert Biome
- Forests
- Fynbos Biome
- Grassland Biome
- Indian Ocean Coastal Belt
- Nama-Karoo Biome
- Savanna Biome
- Succulent Karoo Biome
- Waterbodies

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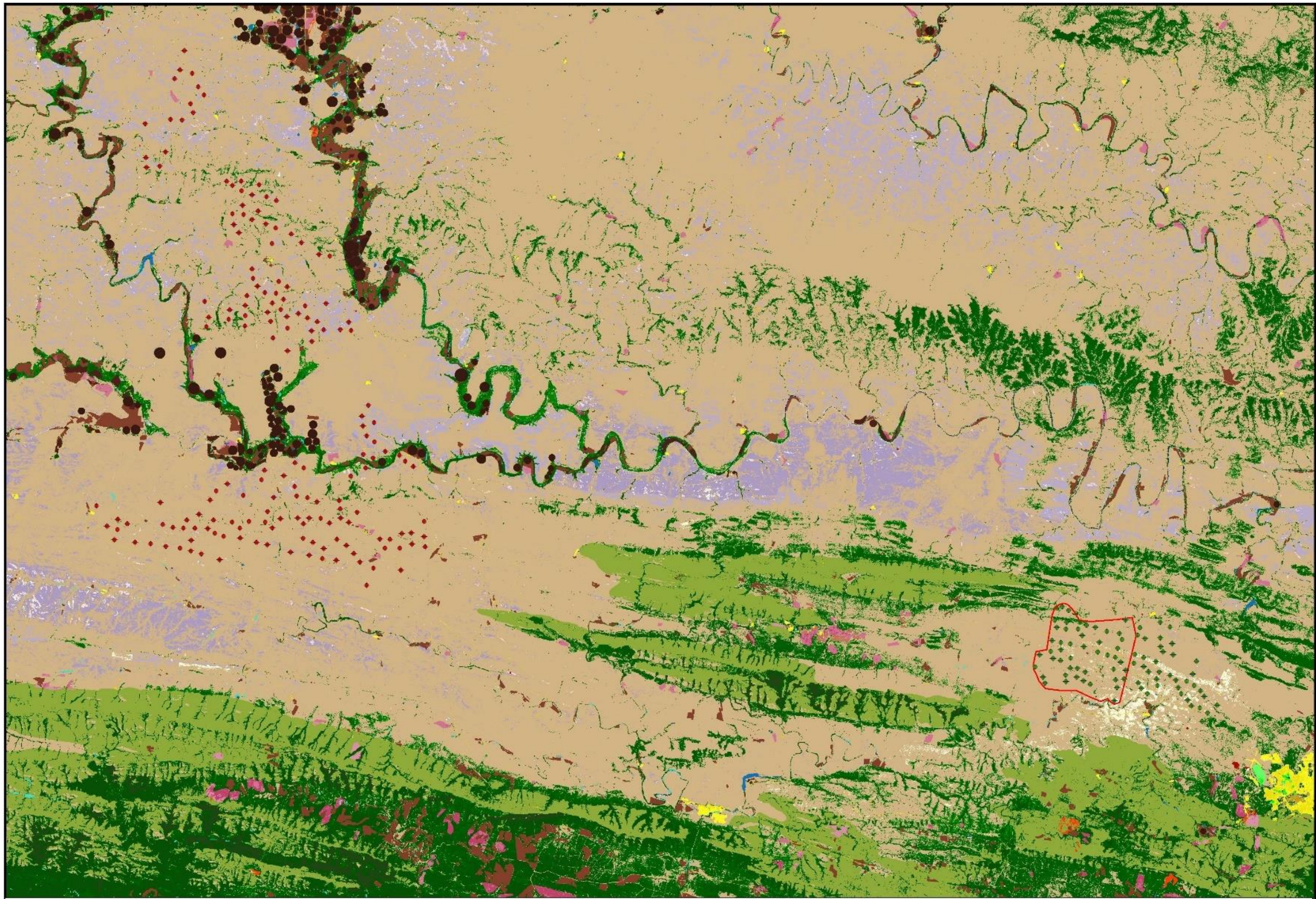
N

0 1.25 2.5 5 7.5 10 Kilometres

LAYOUT DWG	N/A	T-LAYOUT NO.	N/A
DRAWING NUMBER	EC-2020-1		

SCALE - 1:280,000 @ A3



Wind Garden Wind Farm

FIGURE 1b

Current Site Layout and Land Cover (2018) Classes

KEY:

- Choje West turbines EIA
- Choje East turbines EIA
- Wind Garden Site Boundary

Legend

- contiguous (indigenous) forest
- contiguous low forest & thicket
- dense forest & woodland
- open woodland
- contiguous & dense plantation forest
- open & sparse plantation forest
- temporary unplanted (clear-felled) plantation forest
- low shrubland (other)
- low shrubland (fynbos)
- low shrubland (nama karoo)
- sparsely wooded grassland
- natural grassland
- natural rivers
- natural pans (flooded @ observation times)
- artificial dams (including canals)
- artificial sewage ponds
- artificial flooded mine pits
- herbaceous wetlands (currently mapped)
- herbaceous wetlands (previously mapped)
- natural rock surfaces
- dry pans
- eroded lands
- bare riverbed material
- other bare
- cultivated commercial permanent orchards
- cultivated commercial permanent pineapples
- commercial annual crops pivot irrigated
- commercial annual crops non-pivot irrigated
- commercial annual crops rain-fed / dryland
- subsistence / small-scale annual crops
- fallow land & old fields (trees)
- fallow land & old fields (bush)
- fallow land & old fields (grass)
- fallow land & old fields (bare)
- fallow land & old fields (low shrub)
- residential formal (tree)
- residential formal (bush)
- residential formal (low veg / grass)
- residential formal (bare)
- residential informal (tree)
- residential informal (low veg / grass)
- residential informal (bare)
- village scattered (bare & low veg/ grss combo)
- village dense (bare & low veg / grss combo)
- urban recreational fields (tree)
- urban recreational fields (bush)
- urban recreational fields (grass)
- urban recreational fields (bare)
- commercial
- industrial
- roads & rails (major linear)
- mines: extraction pits, quarries
- land-fills
- fallow land & old fields (wetlands)

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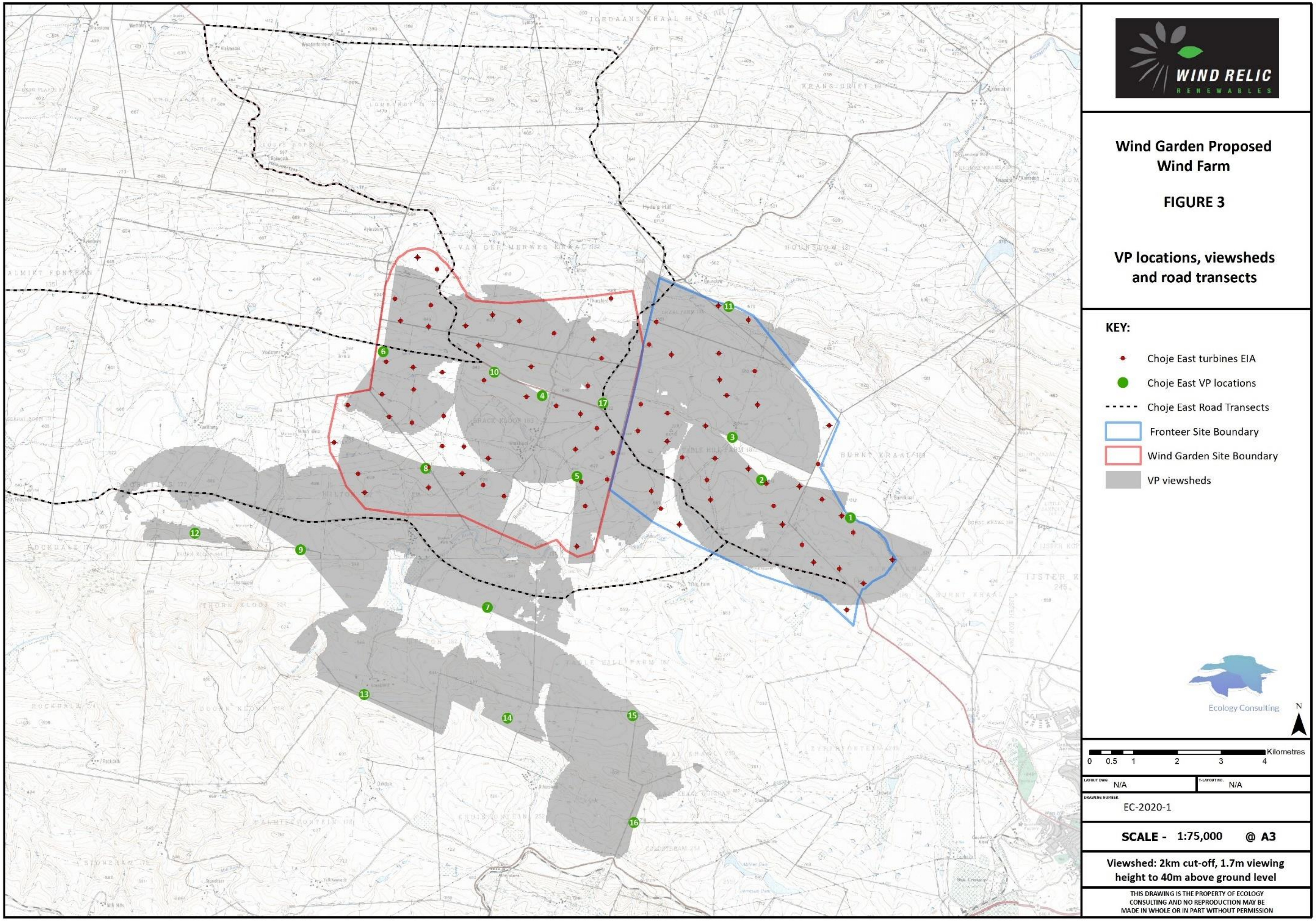
N

Kilometres
0 1.25 2.5 5 7.5 10

LAYOUT DWG N/A | T-LAYOUT NO. N/A

DRAWING NUMBER EC-2020-1

SCALE - 1:280,000 @ A3


Wind Garden Proposed Wind Farm
FIGURE 3
VP locations, viewsheds and road transects
KEY:
Choje East turbines EIA
Choje East VP locations
Choje East Road Transects
Fronteer Site Boundary
Wind Garden Site Boundary
VP viewsheds
Kilometres
0 0.5 1 2 3 4
N/A
N/A
EC-2020-1
SCALE - 1:75,000 @ A3
Viewshed: 2km cut-off, 1.7m viewing height to 40m above ground level
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION
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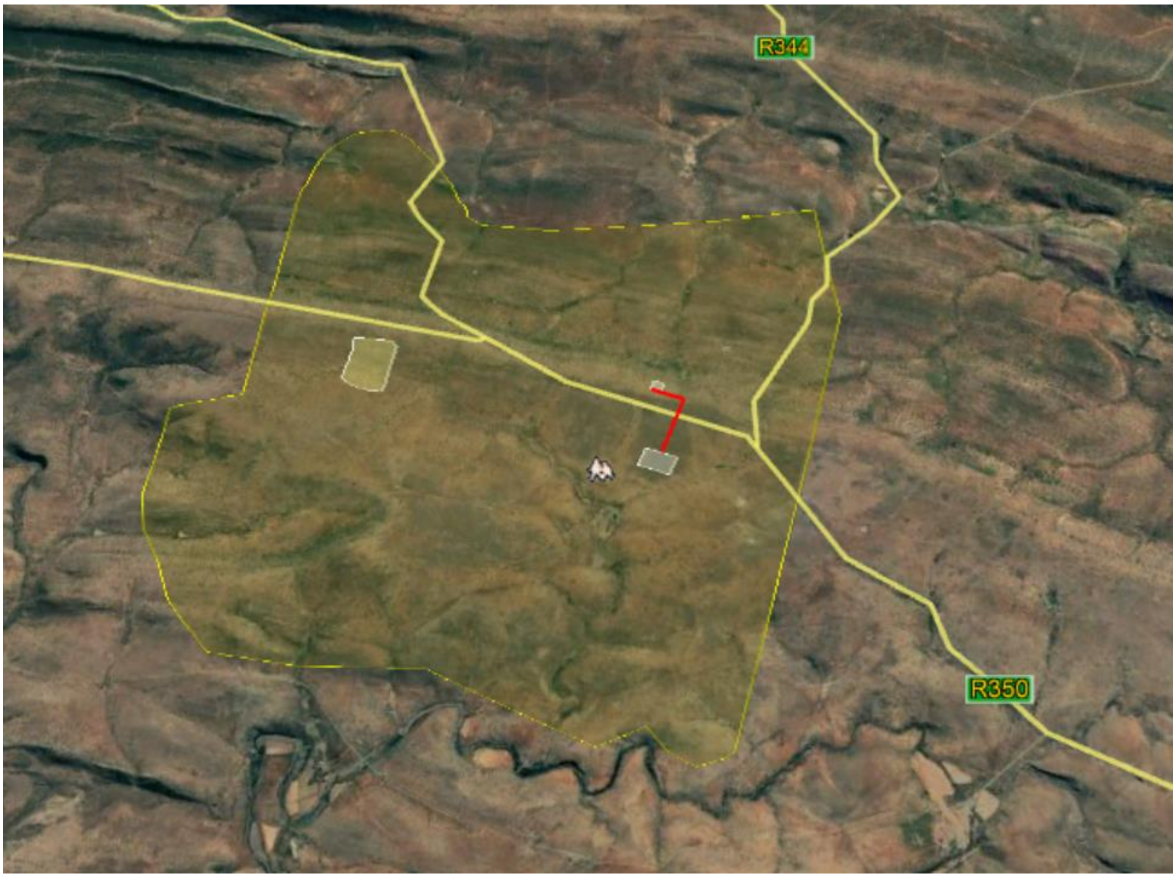


Figure 3a A GoogleEarth image of the Wind Garden WEF area, the BoP area, the switching station and the collector sub, and the 1km powerline (red line) connecting them.

3.2 Power line and Infrastructure

The map in Figure 3 shows the Wind Garden WEF study area enclosed in the red line with the 47 turbine positions and the East block's 17 bird pre-construction vantage points with their viewsheds and part of the 84km road transect (dotted line).

While figure 3a shows a Google Earth image of the study area and the additional infrastructure to be constructed as part of the Wind Garden WEF, as described in the Project Description. These will include, a new 1.0km powerline that will connect the new Collector substation (100x100m area) with the existing Eskom 132kV powerline via a new Eskom substation (100x100m area). And additionally BoP areas that will consist of, the construction site buildings, storage areas and concrete batching of about 12ha and Camp site for staff accommodation of about 6ha.

These areas will all be cleared of natural vegetation. Therefore all these associated infrastructures (power lines, substations, etc.) and the construction thereof will have additional impacts on the bird habitats. Birds will be affected by direct habitat loss and other indirect effects because of disturbance during construction (see later).

Additionally, during the operation of the WEF, birds can collide with powerline conductors or get electrocuted on the pole structures (see later).

Section 4 METHODOLOGY

4.1 Terms of reference

The scope of this report is to assess all expected impacts on birds of the proposed Wind Garden wind farm:

The effects on birds of the habitat loss;

the disturbance and displacement of birds during the construction and the dismantling;

the effect during operation in the wind farm and other infrastructure, the power lines.

This Avifauna Impact Assessment Report is required to inform and contribute towards the Basic Assessment Phase of the environmental application in terms of NEMA, and also to satisfy the requirements of Appendix 6 of GN.R982 of NEMA.

4.2 Pre-construction monitoring Methods

The pre-construction bird monitoring methodology was designed to address the fact that it is not practically possible to cover the whole of the proposed development area for all projects proposed as part of the cluster, including the Wind Garden Wind Farm. An alternative to complete survey coverage was adopted by applying the following principles:

The initial site design has avoided higher sensitivity ornithological features, (where these are known, as identified in the SEA). This continued as an iterative process as more data became available from baseline surveys;

Key ornithological risks from the project are likely to be collision and disturbance. Key species at risk from have been identified on site, and updated as more baseline data became available. These species were the focus of the assessment;

The surveys followed the BLSA (Jenkins *et al*. 2015) recommended survey methodologies as far as possible, but an acceptable sampling regime was developed to inform modelling of ornithological risks. This specifically includes spatial modelling of flight density, flight heights, flights at risk of collision with overhead lines, and bird populations at risk of disturbance (and availability of alternative habitat to better understand impacts of that disturbance). The work draws on the available literature for current developments in bird-habitat modelling, and predicting flight activity (including McLeod *et al.* 2002, Reid *et al*. 2015 and BirdLife South Africa 2017, Fielding *et al.* 2019).

The survey area was defined to cover the maximum extent of the possible wind turbine envelope (plus relevant buffers as appropriate) and other associated development such as grid connection cables.

Surveys have been designed to collect data on (a) key species abundance/distribution, and (b) key species flight activity, to determine the numbers at risk from disturbance and collision.

Control sites

An extensive reference area around the wind farm sites (outside the potential impact zone of the wind farm) was surveyed and will be available for post-construction before/after comparison, for example for before/after gradient analysis. At Wind Garden, for example, a substantial area was surveyed to the south of the wind farm (Figure 3).

4.2.1 Vantage Point Surveys

Flight activity (vantage point, VP) surveys were carried out taking into account the BLSA-recommended survey methodology, based on sample plots viewing to 2km over approximately 180° arcs (giving about 6km^2 coverage per VP). The specific aim of the surveys is to collect data on key species flight activity that will enable estimates to be made of:

The time each species spends flying over the survey area

The relative use each species makes of different parts of the survey area

The proportion of flying time each species spends at different elevations above the ground.

All flight lines of target species were mapped, and the flight height of each flock recorded. As 360° viewing is not required at any VP, a single observer was considered sufficient at each.

A total of 17 VPs were used for the Eastern Block, six of which covered the Wind Garden Wind Farm site. The location of the vantage points and the computer-generated prediction of viewsheds from those VPs (showing the areas visible at 40m above the ground, the lowest point that the rotor sweep of the proposed turbines would reach, from each VP) are shown in Figure 3 in relation to the current proposed layouts for the Wind Garden Wind Farm and for the Fronteer Wind Farm proposal. This covers 84% of the proposed Eastern Block turbines (in line with the minimum BLSA-recommended 75% coverage). For the Wind Garden Wind Farm on its own, coverage of the full risk volume was achieved for 40 of the 47 wind turbine locations (85%).

Current BLSA guidance recommends at least 48 hours per VP, with 12 hours minimum over each of the four seasons, so for the surveys a minimum of four hours surveys have been carried out per VP per month. BLSA also recommends a higher survey effort in higher sensitivity areas (such as within eagle ranges), so additional survey effort was carried out in areas closer to eagle nesting areas and vulture roosts (up to 72 hours per VP). A total of 48 hours of surveys were obtained from each of the six VPs covering the Wind Garden Wind Farm site.

The following species were recorded as target species:

All birds of prey and owls

All cranes and bustards

Large flocks (>100 birds) of other species

Other species/sightings considered of note.

All target birds were recorded, irrespective of their distance from the vantage point. Observations are being carried out throughout daylight hours (planning to cover the full daylight period over the survey visits) but not in periods of severely reduced visibility (<3km). Vantage point surveys were usually carried out for a 4-hour block, with a gap of at least 30 minutes for a rest period between surveys to avoid observer fatigue.

During the observation periods all target species flights were mapped and cross-referenced to a standard recording form using a numbering system, and the flight height of each recorded. To estimate flight height as accurately as possible, available reference features (e.g. met masts, summit/ridgelines) were used. Flight heights were estimated as accurately as possible and recorded on the form, i.e. not summarised to height classes. Below 10m it was possible to estimate to 1m, between 10 and 20m to 2m, between 20m and 50m to 5m, and above 50m to 10m. In any case of uncertainty an estimate of the upper and lower range of height were recorded. When birds were observed over an extended period, estimates of flight height were recorded every 30 seconds. The activity during each flight (e.g. striking prey, displaying, food passing) was also recorded. Particular attention was paid to any observations of birds at rotor height crossing the proposed wind farm site that would be at risk of collision.

4.2.2 Raptor Surveys

Breeding raptor surveys were carried out in June 2019 and August 2020, checking all known and other possible raptor nest sites within a 5km buffer of the wind farm site. These include mini-VP surveys (VP-type watches but for shorter time periods) and walkover surveys, focussing on likely habitat/nesting sites (which have been initially identified from the site visit and from inspection of aerial photographs of the area). Repeat visits were made to monitor range occupancy and breeding success. The following visit protocol for each range was implemented through the breeding period: visit 1 to check for occupancy of the range, visit 2 to locate active nests, visit 3 to check for young, and visit 4 to check for fledged young. This includes surveys for all key raptors that could use the survey area, but with particular focus on Verreaux's and Martial Eagle. A first visit during March 2019 to inform the scoping process was followed up with at least three further visits through the year, focusing on key species' breeding periods.

4.2.3 Vehicle Transect Surveys

Vehicle Transect Surveys were driven along all of the accessible roads within each area (83km in the Eastern Block and 150km in the Western Block), stopping at regular intervals to scan open habitats, counting and mapping the location of all target species encountered. This enabled rapid coverage of wide areas, where vegetation allows adequate viewing, to obtain data particularly on raptors, bustards, storks and cranes. The surveys were undertaken over two days each month for the Western Block and one day for the Eastern Block, to give a total of 12 surveys for each. The vehicle transect routes are shown in Figures 3 (Eastern Block). There was a total length of 12.3km of road transect within the Wind Garden Wind Farm site (plus a 500m buffer).

4.2.4 Wetland Surveys

Though there are no Coordinated Waterbird Counts (CWAC) wetlands of importance within either the Western or the Eastern Block, there are several areas of wetland habitat present (predominantly around reservoirs for agricultural irrigation, along river corridors). Each wetland site was visited at least once each month to undertake a count of all of the waterbirds present. All of these, however, lie outside the Wind Garden Wind Farm site.

It became apparent during the initial surveys that many of the irrigated agricultural area ('pivots') also supported a range of larger terrestrial bird species, so these were also covered as part of these surveys. Again, though, there were none of these areas within the Wind Garden Wind Farm site.

4.2.5 Small Terrestrial Bird Surveys (Walking Transect)

Walking transects were undertaken at each VP location (i.e. at six for the Wind Garden Wind Farm site) to provide sample data on the abundance of small terrestrial birds within the survey area. Transects were walked for 20 minutes at a rate of 5 minutes per 100m at each VP each month, to provide an index of small bird abundance across the survey area. This gave a total of 2.4km of walking transect within the Wind Garden Wind Farm site.

Section 5 DESCRIPTION OF HABITAT

5.1 Biomes and Vegetation types

The climate of the Wind Garden Wind Farm site is semi-arid and comprise predominantly of two natural vegetation types (Mucina & Rutherford, 2006): 'Albany Thicket' (with AT8 Kowie Thicket and AT10 Great Fish Noorsveld) and 'Nama-Karoo' Lower Karoo NKl4 Albany broken veld, dominated by small shrubs (bossies), see Figure1.

Thicket (bush) vegetation covers probably 70% of the site and mainly hosts small bird species (bush birds) while the open Karoo veld covers the remainder and attract mainly large terrestrial bird species. No large agricultural croplands occur on site therefore the Wind Garden site is relatively pristine.

However, the Thicket vegetation occurs in varying states of degradation (openness) likely because of over-grazing by livestock. When the bush is degraded due to over-grazing, the open areas get covered with Karoo bossies (see Figure 3b). A phenomenon not clearly understood by local botanists (Becker et al. 2015). During periods/seasons of good rain the Karoo shrub areas gets overgrown by grass while during times of drought the grass disappears.

Figure 3b Shows the contrast between Thicket bush veld and Karoo shrub vegetation (the short open patches between the trees).

5.2 Bird microhabitats

To determine which bird species are more likely to occur on the proposed Wind Garden Wind Farm development site, it is important to understand the habitats available to birds at a smaller spatial scale, i.e. micro-habitats. Micro-habitats are shaped by factors other than vegetation, such as topography, land use, food sources and man-made factors as mentioned above. Aerial photographs, satellite imagery and a vegetation type layer supplemented the field work of the bird monitoring team and has been used to identify the following micro-habitats on the proposed development site:

Albany Thicket vegetation

Most of the cluster development area, including the Wind Garden Wind Farm, falls within the Albany Subtropical Thicket (Valley bushveld) biome (Mucina & Rutherford 2006), particularly associated with slopes of the ridges and hills. These areas generally coincide with the Great Fish thicket (Western block) and Kowie thicket (Eastern block) vegetation types, with the Kowie thicket present within the Wind Garden Wind Farm. In pristine vegetation these can be 6-8m tall. On the southern slopes (being more moist and shadier) the Thicket is more dense (close canopy) while on the northern slopes (being more sunny and arid) the Thicket is less dense, having more a savanna pattern of cover. Small bush birds inhabit the Thicket.

Nama Karoo veld

The second most abundant vegetation type within the Wind Garden proposed site is the Nama-Karoo biome (Mucina & Rutherford 2006) with Karoo shrubland (bossie veld) vegetation and is described as a complex mix of dwarf shrub (30-40cm) and a grass dominated vegetation type. Large Terrestrial birds inhabit and forage in this Bossieveld.

Rivers and Drainage Lines

No permanent rivers occur in the Wind Garden Wind Farm Site. There are many dry drainage lines that may not always carry water, but these features are dominated by dense Acacia karroo and generally have a higher abundance of small bird life than the surrounding vegetation. These drainage lines are flyways followed by many bird species on daily foraging trips.

Farm Dams

Dams are important attractions for various bird species in the Karoo landscape, and are often the only source of water during the dry season in the area. No large dams are present in the Wind Garden Wind Farm site but many small dams are present and attract various waterfowl, herons and African Spoonbill. African Fish Eagle is often seen at these dams while Blue Cranes use small farm dams as roost sites at night.

Cliffs and rocky areas

Cliffs in deep eroded draining kloofs (small valleys) below ridges occur in the proposed development site, especially in the southern areas of the East block. These cliffs and the surrounding bush with tall trees, especially on south-facing slopes, are important breeding areas for various raptors, e.g. Rock Kestrel, Lanner falcon, African Harrier-Hawk, Jackal Buzzard, Martial eagle and Verreaux's eagle. Rock dassies frequent rocky areas, which are the main prey of Verreaux's eagles.

Natural Forest

Although no forests occur on site, small clumps of Yellowwood trees occur, one such clump has an active Crowned Eagle nest however this is outside the Wind Garden site but in the East block Road transect route. Some deep south draining kloofs in the study area has small patches with tall trees, this is where, for example, Martial eagles nest.

Ridge slopes and Thermal areas

Many raptors use the wind blowing over slopes of ridges and hills (slope soaring) to gain lift and to hunt on the wing. Importantly, wind conditions change daily therefore a change in raptor abundance is noted during a change in wind direction and strength. Verreaux's Eagles appear to use such windy conditions.

In contrast with the above, many areas, especially bare ground and especially in the summer on hot days, bake hotter than their surroundings, this causes the rising of hot air. These can attract large raptors such as Martial eagles to thermal soar.

These two conditions are difficult to pin down therefore problematic to mitigate.

Power lines

One large 132kV (single steel pole) power line crosses the proposed Wind Garden Wind Farm site from Makhanda to the west. Raptors use these poles as hunting perches.

Farmsteads and livestock kraals

Farmsteads are disturbed areas surrounding farmhouses or areas of human activity, while feeding kraals are areas where livestock gather for food, shelter and water provided by the farmers. These habitats are frequented by high diversity of small passerine birds while often have Spotted eagle-owl and Barn Owl breeding around homesteads.

Stands of Alien Trees

Stands of alien trees such as blue gums occur scattered around the landscape, mainly near farmsteads, rivers and drainage lines. These are utilised as roosts and/or perches by raptors while African Fish Eagle often have nests in such clumps.

Bhisho thornveld

The 'Bhisho Thornveld' vegetation type (whether disturbed or natural, depending on land use practises), occurs on the southern end outside the Wind Garden Wind Farm development site. These areas have low vegetation cover and may be important for various priority species

Fynbos vegetation

The topmost areas of ridges and hills have rocky patches and sometimes Fynbos vegetation with mainly Renosterbos, but Proteas were often present.

Section 6 RESULTS

Results of the Pre-construction bird monitoring June 2019 to August 2020

6.1 Key Raptor Breeding Locations

In the Eastern Block and near the Wind Garden Wind Farm (see Figure 4). An eagle nest is a confirmed breeding site while a territory is a suspected nest site because eagles were seen displaying, carry prey, etc. but no access to neighbouring properties could be arranged.

Three Martial Eagle nest sites were located in the East block, one to the west 12km away outside the wind farm site, one to the south and one northeast of Wind Garden site.

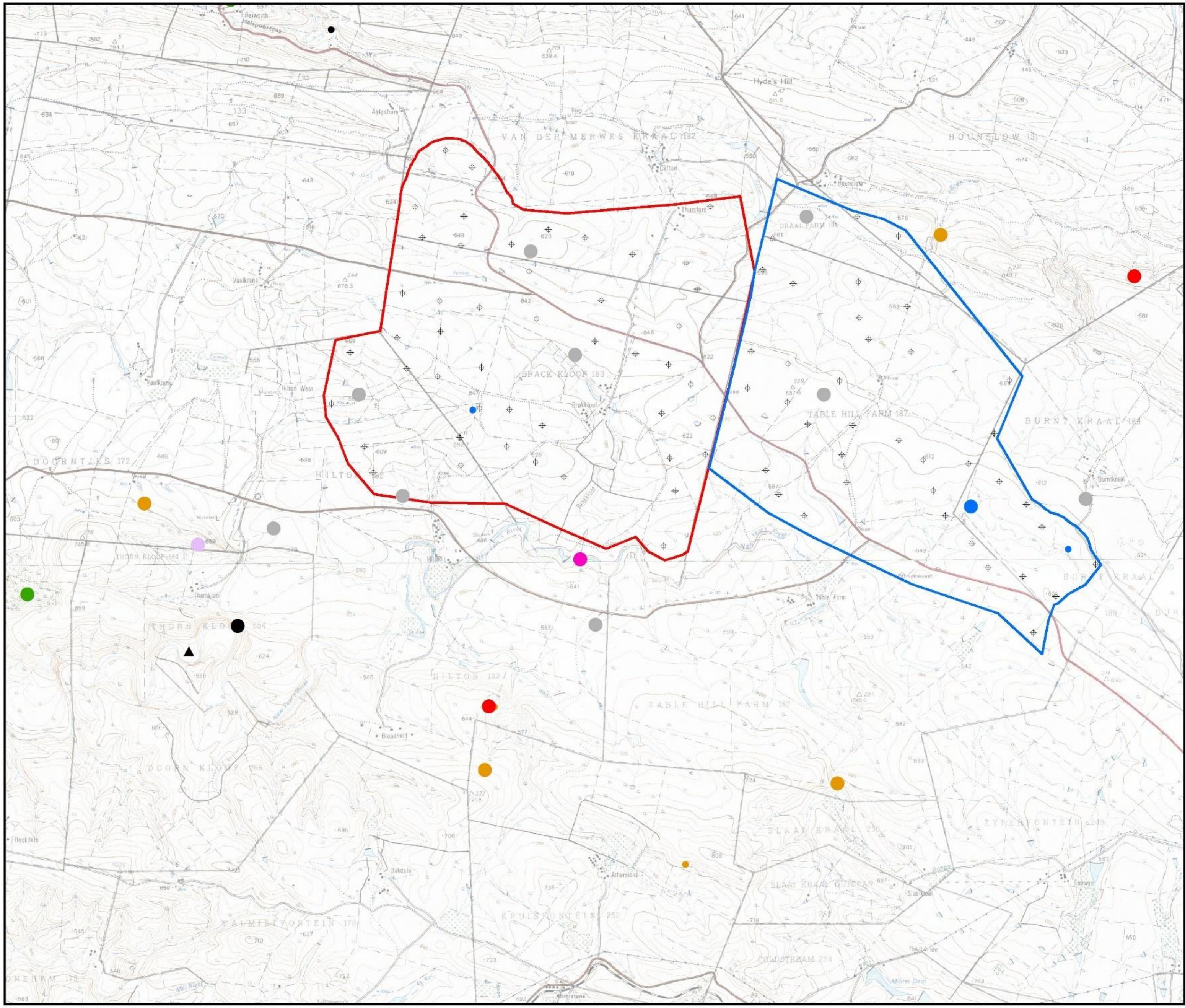
Two Verreaux's Eagle nest sites were located, one southwest and one northwest of the WEF.

Three Crowned Eagle nest and territories were identified, at Palmietfontein (active), Hellspoort (one historic site) and at Smoerfontein (a potential site). All are relative far away from Wind Garden.

One African Fish-eagle territories were located on the edge and south of Wind Garden.

The final turbine layout was positioned to avoid all the close above-mentioned nests by establishing necessary 'no go' areas and repositioning turbines to be outside the required buffers.

Other breeding locations identified included two Secretarybird territories and three Jackal Buzzards nests.



WIND RELIC RENEWABLES

Wind Garden Proposed Wind Farm

FIGURE 4

Eastern Block: Raptor Nest Locations 2019-20

KEY:

- Choje East turbines EIA
- Wind Garden Site Boundary
- Fronteer Site Boundary

Species (large=2020, small=2019)

- African Harrier-hawk
- Crowned Eagle
- Fish Eagle
- Jackal Buzzard
- Martial Eagle
- Pale Chanting-goshawk
- Secretarybird
- Verreaux's Eagle
- SEA avian sensitivity (Lanner)

Ecology Consulting

N

0 0.4 0.8 1.6 2.4 3.2 Kilometres

LAYOUT DWG N/A	T-LAYOUT NO. N/A
DRAWING NUMBER EC-2020-1	

SCALE - 1:60,000 @ A3

Table 3 Flight rates at rotor height of target species through the proposed Wind Garden Wind Farm collision risk zone, June 2019 - August 2020 and their conservation status (IUCN and South Africa Red Data Book Listings) ['-' = no records in that month].

	IUCN	SA	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2020	Feb	Mar	May	Jun	Jul	Aug	TOTAL FLIGHT S @ ROTOR HT	ALL FLIGHT S
Blue crane	VU	NT	-	0.190	0.083	0.417	-	-	-	-	-	-	0.125	-	-	-	19	33
Ludwig's bustard	EN	EN	-	0.190	-	-	0.083	-	-	-	-	0.042	-	-	-	-	7	8
Southern black bustard	VU	VU	-	0.095	-	-	0.042	0.042	0.042	0.041	0.042	-	-	-	-	-	7	23
Black-headed heron	LC		-	-	-	-	0.042	-	-	-	-	-	-	-	-	-	1	1
African harrier-hawk	LC		-	-	-	0.042	-	-	-	-	-	-	-	-	-	-	1	1
Martial eagle	VU	EN	0.048	0.048	0.042	-	-	-	-	-	-	-	-	-	-	0.125	4	6
Verreaux's eagle	LC	VU	-	0.048	0.042	0.042	-	-	-	-	-	0.125	-	-	-	-	6	6
Pale chanting-goshawk	LC		-	0.048	-	-	-	0.125	-	-	-	0.042	0.042	0.042	-	-	7	41
African fish-eagle	LC		-	-	0.042	-	-	-	-	-	-	-	-	-	-	-	1	1
Jackal buzzard	LC		-	-	-	0.083	-	0.042	-	-	0.042	-	-	-	-	-	4	4
Eurasian buzzard	LC		-	-	-	-	-	-	-	0.041	0.042	-	-	-	-	-	2	5
Common kestrel	LC		-	0.048	0.083	0.125	0.042	0.042	-	-	-	-	-	0.083	-	-	10	13

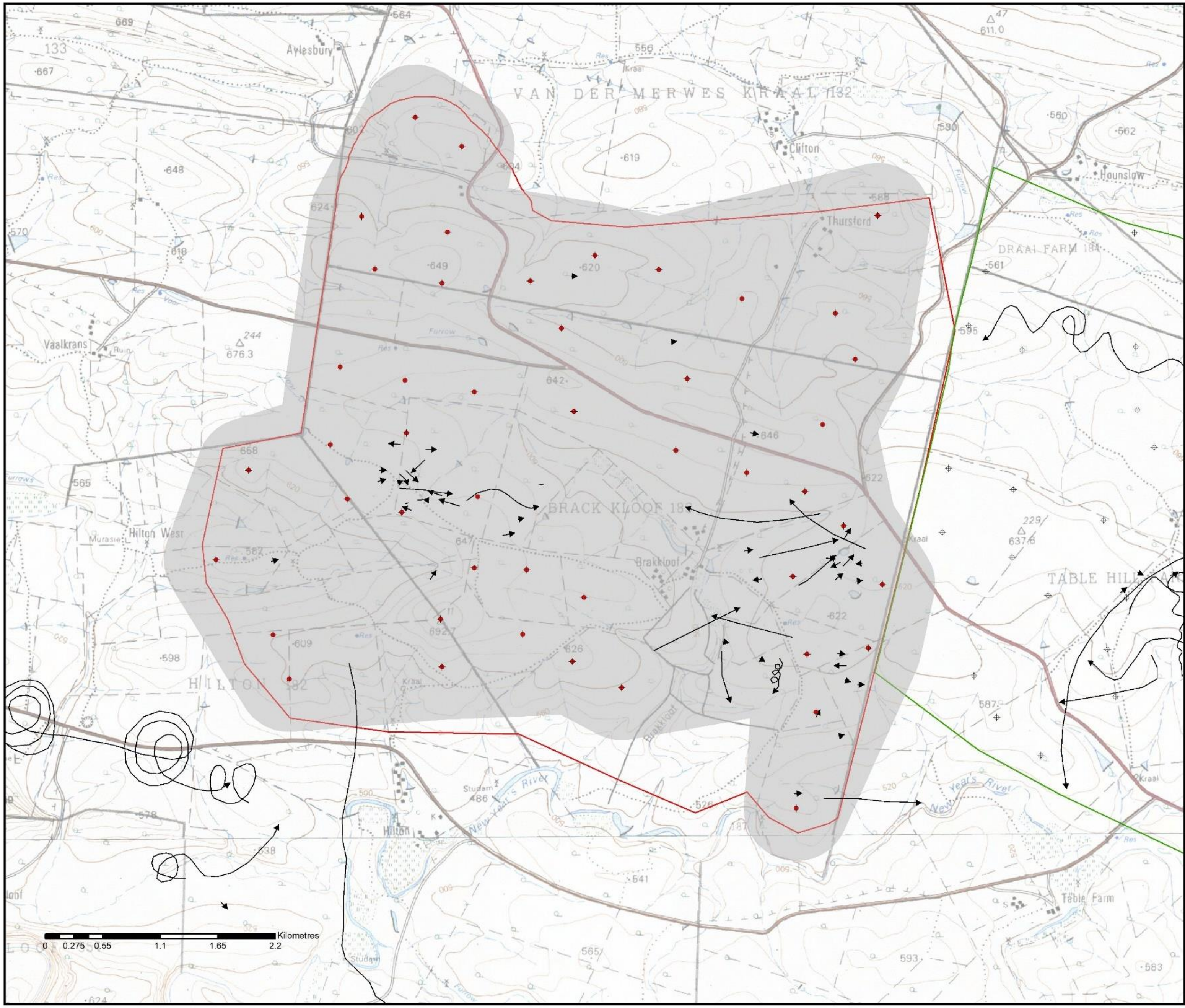
Note: LC = least concern, NT - near threatened, VU = vulnerable, EN = endangered. Species in bold and italics were taken forward for collision risk modelling as species of conservation concern/vulnerable species at risk of collision.

6.2 Vantage Point Survey Results

The flight rates at rotor height recorded during the VP surveys through the Wind Garden collision risk zone is summarised in Table 3. This Table gives the mean number of flights recorded per hour observation for each month from June 2019 through to August 2020. The Table also gives the conservation status of each species (its IUCN 2019 and South Africa Red Data Book Listings), the total number of flights observed at rotor height (taken for the purposes of this assessment conservatively as 35-250m above ground, to allow for errors in flight height estimation (the actual rotor height would be 40-200m above ground level) and the total number of flights observed in that zone.

The Eastern Block VP surveys, which covered the Wind Garden Wind Farm, recorded nine key species of higher conservation importance: Blue Crane, Ludwig's Bustard, Denham's Bustard, Southern Black Bustard, Secretarybird, Martial Eagle, Verreaux's Eagle and Lanner Falcon. Flight line maps for these species at risk of collision (i.e. seen flying at rotor height within the Wind Garden site) are presented in Figures 5 to 9. These show all flights recorded during the surveys, regardless of flight height.

No particular concentrations of flight activity of any of these species was noted in this area. Therefore in considering the potential that the wind farm could create or act as a barrier effect and limit Priority species to fly through or around it, this could be judged at a negligible effect. The bustard species were more frequent in the northern (more open, flatter) part of the site. Eagle and other raptor flights were widely scattered.



Wind Garden Proposed Wind Farm

FIGURE 5

VP survey flight lines
June 2019 - August 2020:
Blue Crane

KEY:

WFZone

- Wind Garden turbines
- Fronteer turbines
- Flight lines June 19 - Aug 20
- Wind Garden Collision Risk Zone
- Fronteer Site Boundary
- Wind Garden Site Boundary

Ecology Consulting

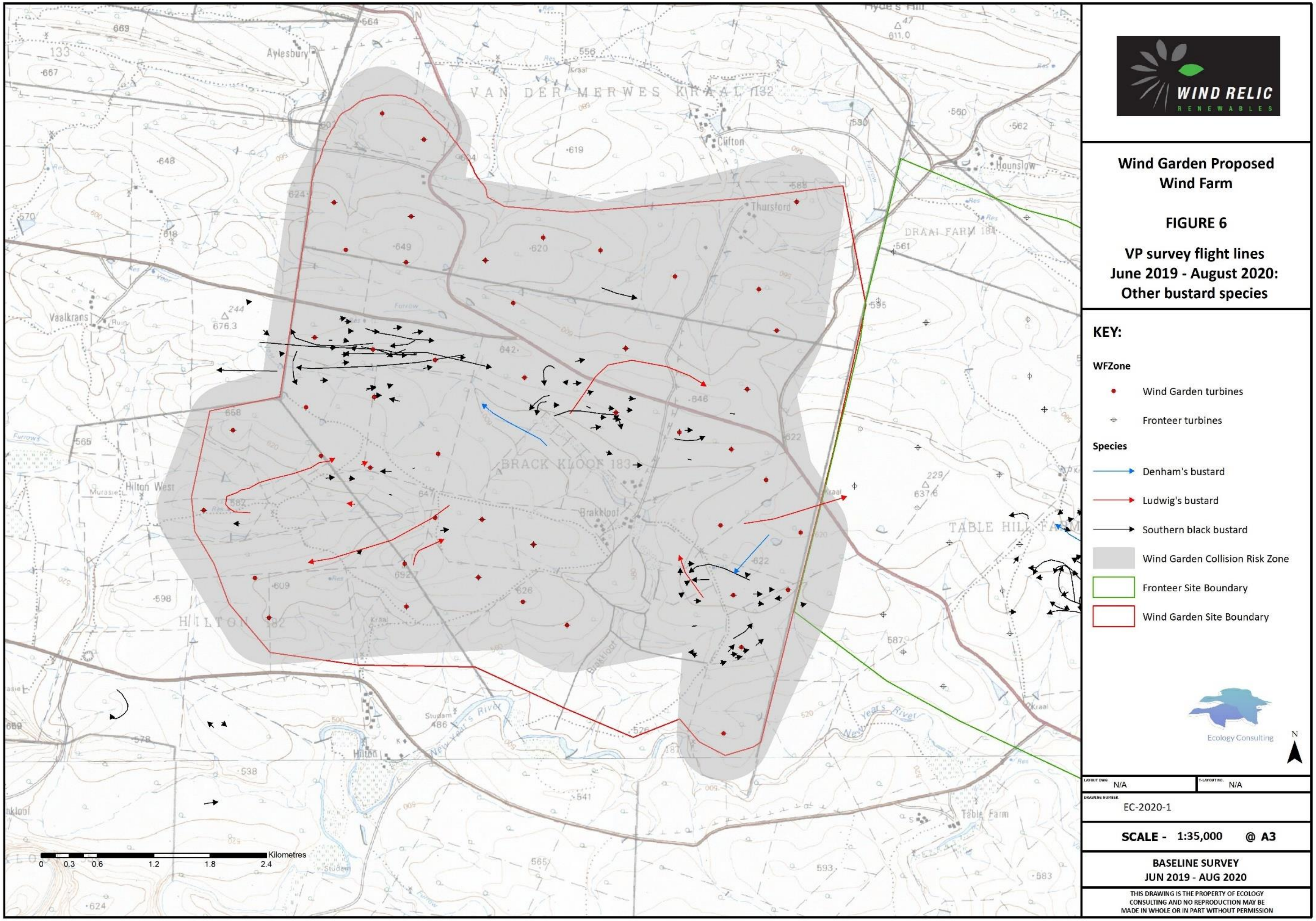
LAYOUT DWG	N/A	T-LAYOUT NO.	N/A

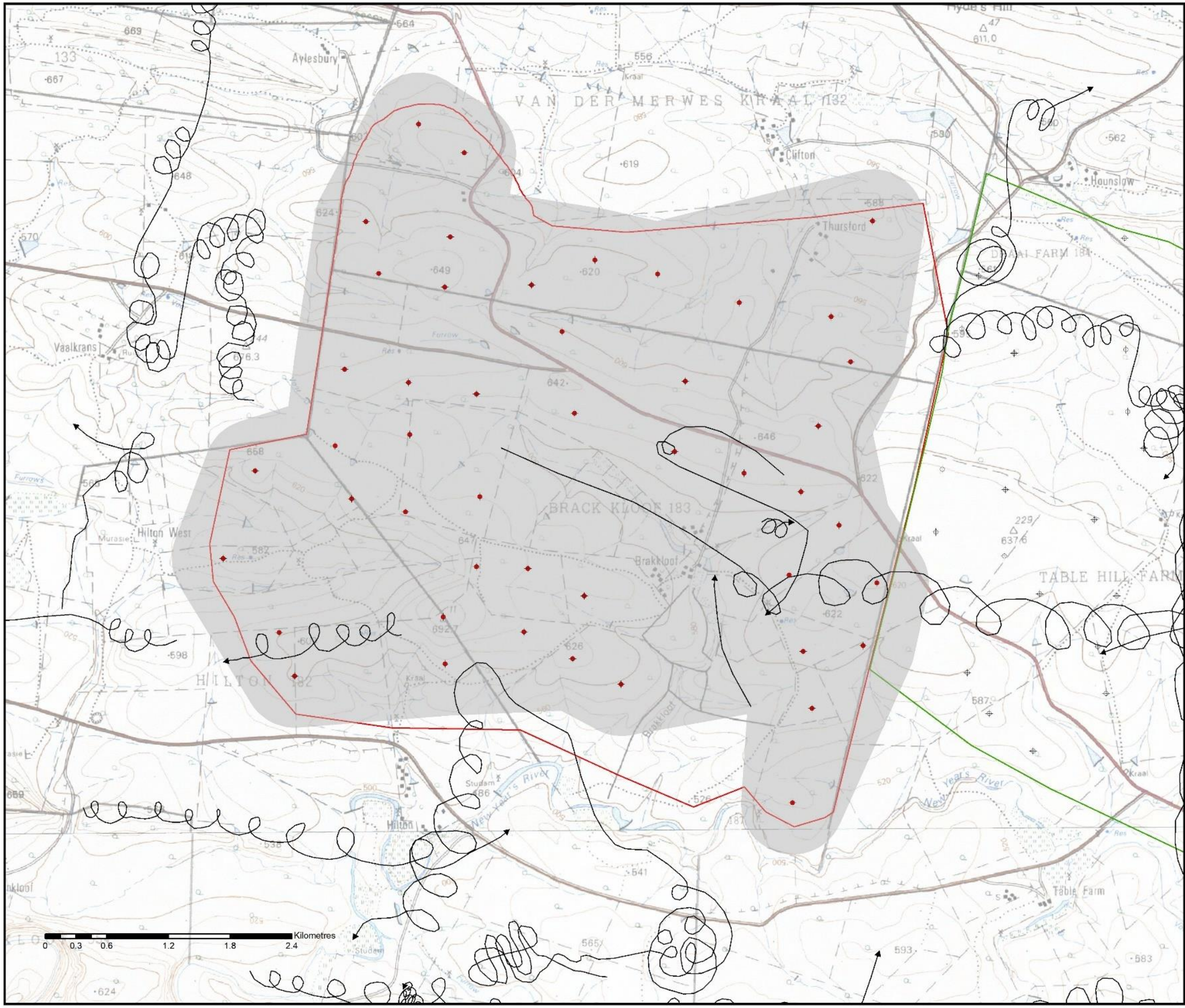
DRAWING NUMBER

EC-2020-1

SCALE - 1:34,359 @ A3

BASELINE SURVEY
JUN 2019 - AUG 2020


WIND RELIC
RENEWABLES
Wind Garden Proposed Wind Farm
FIGURE 6
VP survey flight lines June 2019 - August 2020: Other bustard species
KEY:
WFZone
Wind Garden turbines
Fronteer turbines
Species
Denham's bustard
Ludwig's bustard
Southern black bustard
Wind Garden Collision Risk Zone
Fronteer Site Boundary
Wind Garden Site Boundary
Ecology Consulting
N
N/A
N/A
EC-2020-1
SCALE - 1:35,000 @ A3
BASELINE SURVEY
JUN 2019 - AUG 2020
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION
VAN DER MERWES KRAAL 132
BRACK KLOOF 183
HILTON 182
TABLE HILL FARM
DRAAI FARM 184
Aylesbury
Clifton
Hounslow
Thursford
Vaalkrans
Hilton West
Brakkloof
Hilton
Table Farm
New Year's River
Kilometres
0 0.3 0.6 1.2 1.8 2.4



WIND RELIC RENEWABLES

Wind Garden Proposed Wind Farm

FIGURE 7

VP survey flight lines June 2019 - August 2020: Martial Eagle

KEY:

WF Zone

- Wind Garden turbines
- Fronteer turbines
- Flight lines June 19 - Aug 20
- Wind Garden Collision Risk Zone
- Fronteer Site Boundary
- Wind Garden Site Boundary

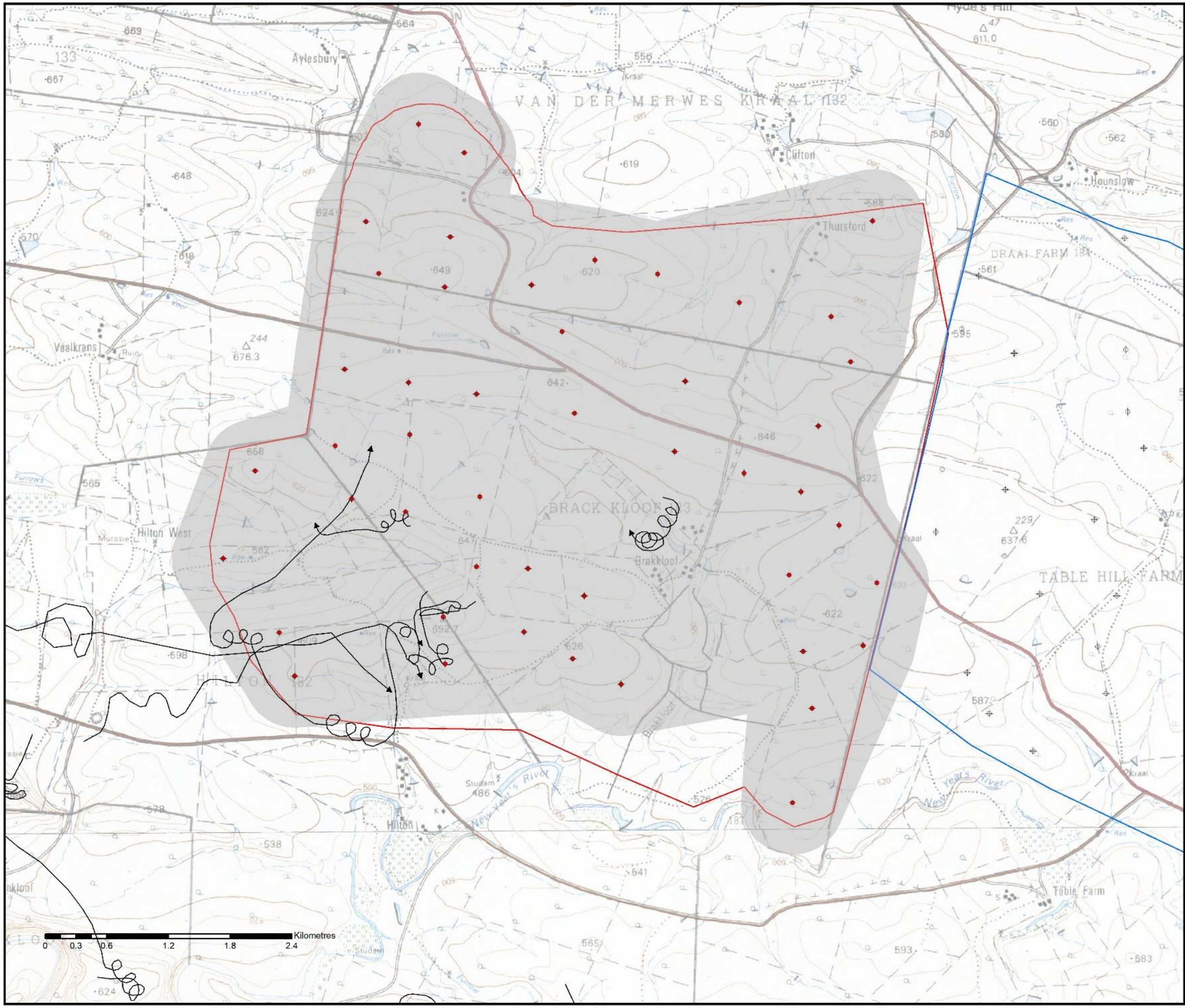
Ecology Consulting

N

LAYOUT DWG	N/A	T-LAYOUT NO.	N/A
DRAWING NUMBER	EC-2020-1		

SCALE - 1:35,000 @ A3

BASELINE SURVEY
JUN 2019 - AUG 2020



WIND RELIC RENEWABLES

Wind Garden Proposed Wind Farm

FIGURE 8

VP survey flight lines June 2019 - August 2020: Verreaux's Eagle

KEY:

WF Zone

- Wind Garden turbines
- Fronteer turbines
- Flight lines June 19 - Aug 20
- Wind Garden Collision Risk Zone
- Fronteer Site Boundary
- Wind Garden Site Boundary

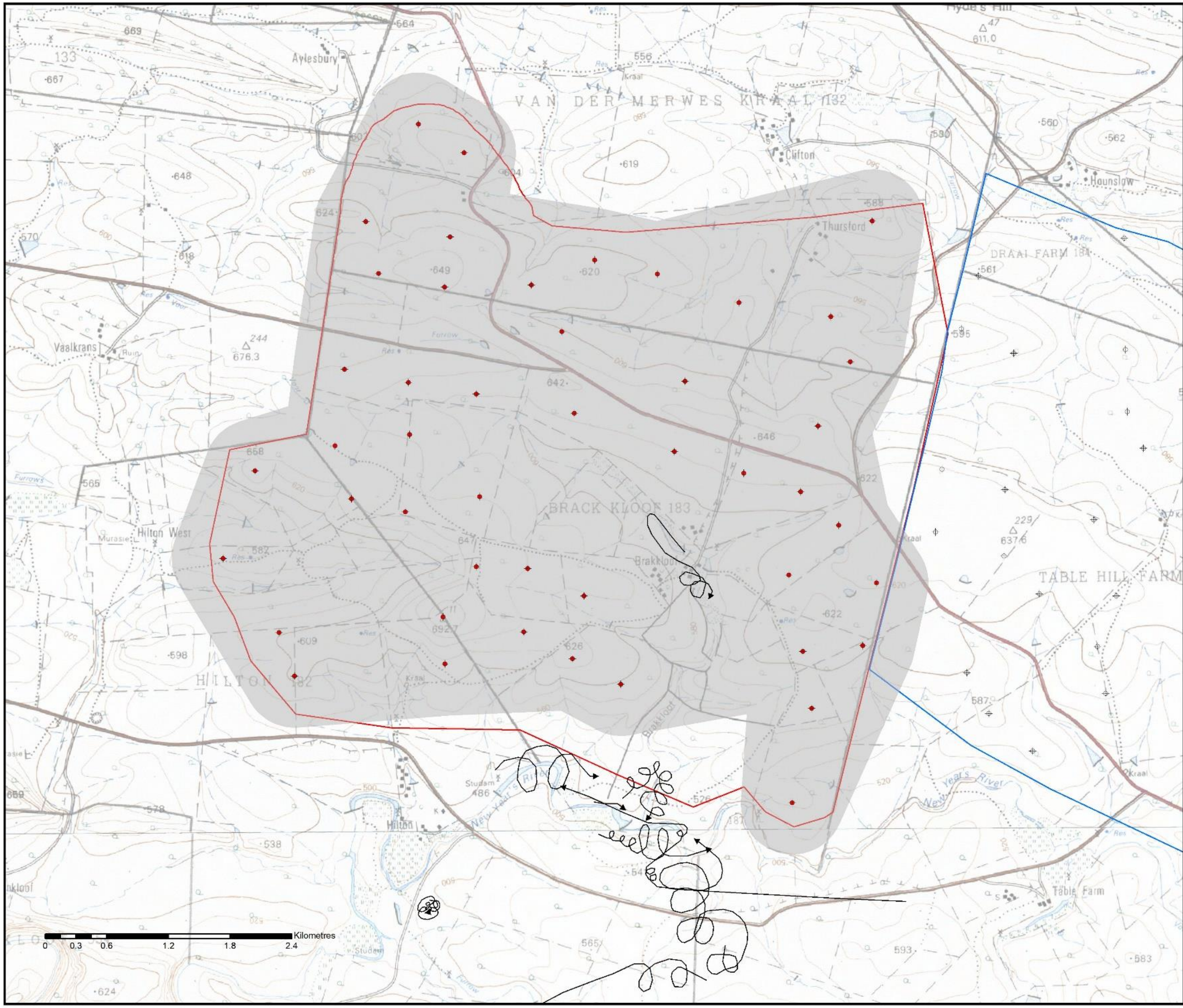
Ecology Consulting

LAYOUT DWG	N/A	T-LAYOUT NO.	N/A

DRAWING NUMBER EC-2020-1

SCALE - 1:35,000 @ A3

BASELINE SURVEY
JUN 2019 - AUG 2020



Wind Garden Proposed Wind Farm

FIGURE 9

VP survey flight lines June 2019 - August 2020: African Fish-eagle

KEY:

WF Zone

- Wind Garden turbines
- Fronteer turbines
- Flight lines June 19 - Aug 20
- Wind Garden Collision Risk Zone
- Fronteer Site Boundary
- Wind Garden Site Boundary

Ecology Consulting

N

LAYOUT DWG: N/A | T-LAYOUT NO.: N/A

DRAWING NUMBER: EC-2020-1

SCALE - 1:35,000 @ A3

BASELINE SURVEY JUN 2019 - AUG 2020

6.3 Road Transect/Wetland Survey Results

The results of the Road transect and Focal Point (mainly dams as wetlands) surveys of the Eastern Block during June 2019 to August 2020 are summarised in Table 4. This gives the total number of target species counted each month, along with their conservation status (IUCN/South Africa Red Data Book). Generally, only low numbers were recorded during these surveys, even of waterbirds from the various wetland areas that were covered.

Distributions of the two more common wetland species, Egyptian Goose (Figure 10) and South African Shelduck (Figure 11), are shown to illustrate the main wetland areas (which lie outside the Wind Garden site boundary). No important concentrations of wetland birds were recorded within the whole of the Eastern Block, including the Wind Garden Wind Farm site.

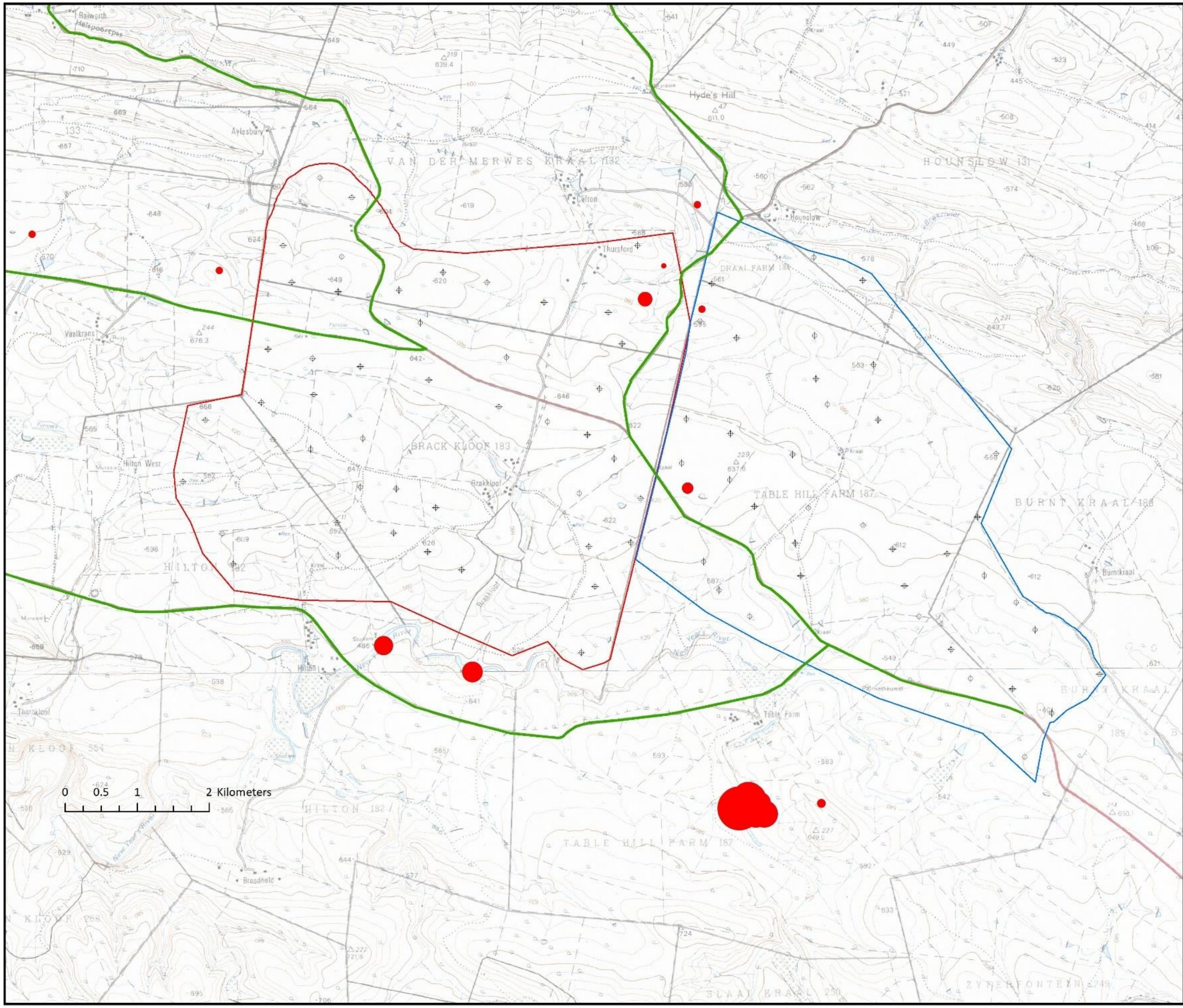
The records of cranes and bustards during these surveys are shown in Figure 12, and other key species in Figure 13. All were widely scattered across the survey area, with no particular concentration identified.

Nine species of higher conservation importance were noted in the road transect survey across the Eastern Block as a whole: Blue Crane, Ludwig's Bustard, Denham's Bustard, Southern Black Bustard, Martial Eagle, Verreaux's Eagle, African Marsh-harrier, Black Harrier and Lanner Falcon, though the number of records of all of these were low. Three of these were recorded within the Wind Garden site, Blue Crane, Southern Black Bustard and Martial Eagle (Table 4).

Table 4

Vehicle transect survey counts (birds/km transect) by month in the proposed Wind Garden Wind Farm site, June 2019-August 2020.

Species	IUCN	SA RDB	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	May	Jun	Jul	Aug
Egyptian goose	LC		-	-	-	-	1.30	-	-	-	0.65	-	0.57	0.08	-	-
South African shelduck	LC		0.16	-	-	-	0.33	-	-	-	-	0.16	-	0.16	-	-
Cape shoveler	LC		-	-	-	-	-	-	-	0.16	-	-	0.33	-	-	-
Yellow-billed duck	LC		-	-	-	-	-	-	-	0.33	0.24	-	-	-	-	-
Red-billed teal	LC		-	-	-	-	-	-	-	0.41	0.57	-	-	0.24	-	-
Little grebe	LC		0.16	-	-	-	-	-	-	0.08	0.16	-	-	-	0.24	-
Red-knobbed coot	LC		-	-	-	-	-	-	-	0.49	0.24	0.16	-	-	-	-
Blue crane	VU	NT	-	-	-	0.24	-	0.33	-	-	0.33	-	0.24	-	-	-
Southern black bustard	VU	VU	-	-	-	-	-	0.33	-	-	0.16	-	-	-	-	-
Black-winged stilt	LC		-	-	-	-	0.08	-	-	-	-	0.16	0.16	0.16	-	-
African three-banded plover	LC		-	-	-	-	-	-	-	0.33	-	-	-	-	-	-
Blacksmith lapwing	LC		0.08	-	-	-	-	-	-	-	-	-	-	-	-	-
White-winged tern	LC		-	-	-	-	0.24	-	-	-	-	-	-	-	-	-
Martial eagle	VU	EN	-	-	-	-	-	-	0.08	-	-	-	-	-	-	-
Pale chanting-goshawk	LC		-	0.24	-	0.08	0.16	0.08	0.16	-	-	-	-	-	0.08	-
African fish-eagle	LC		-	-	0.08	-	0.08	-	0.08	-	-	-	-	0.16	-	-
Jackal buzzard	LC		0.08	-	-	-	-	-	-	-	-	-	-	-	-	-
Eurasian buzzard	LC		-	-	-	-	-	-	0.16	-	-	-	-	-	-	-
Common kestrel	LC		-	-	-	-	0.08	-	-	-	0.24	-	-	-	0.08	-



WIND RELIC RENEWABLES

Wind Garden Proposed Wind Farm

FIGURE 10

Road Transect Survey Jun 2019 - Aug 2020: Egyptian Goose

KEY:

Choje East turbines EIA

Count

1

5

10

Choje East Road Transects

Fronteer Site Boundary

Wind Garden Site Boundary

Ecology Consulting

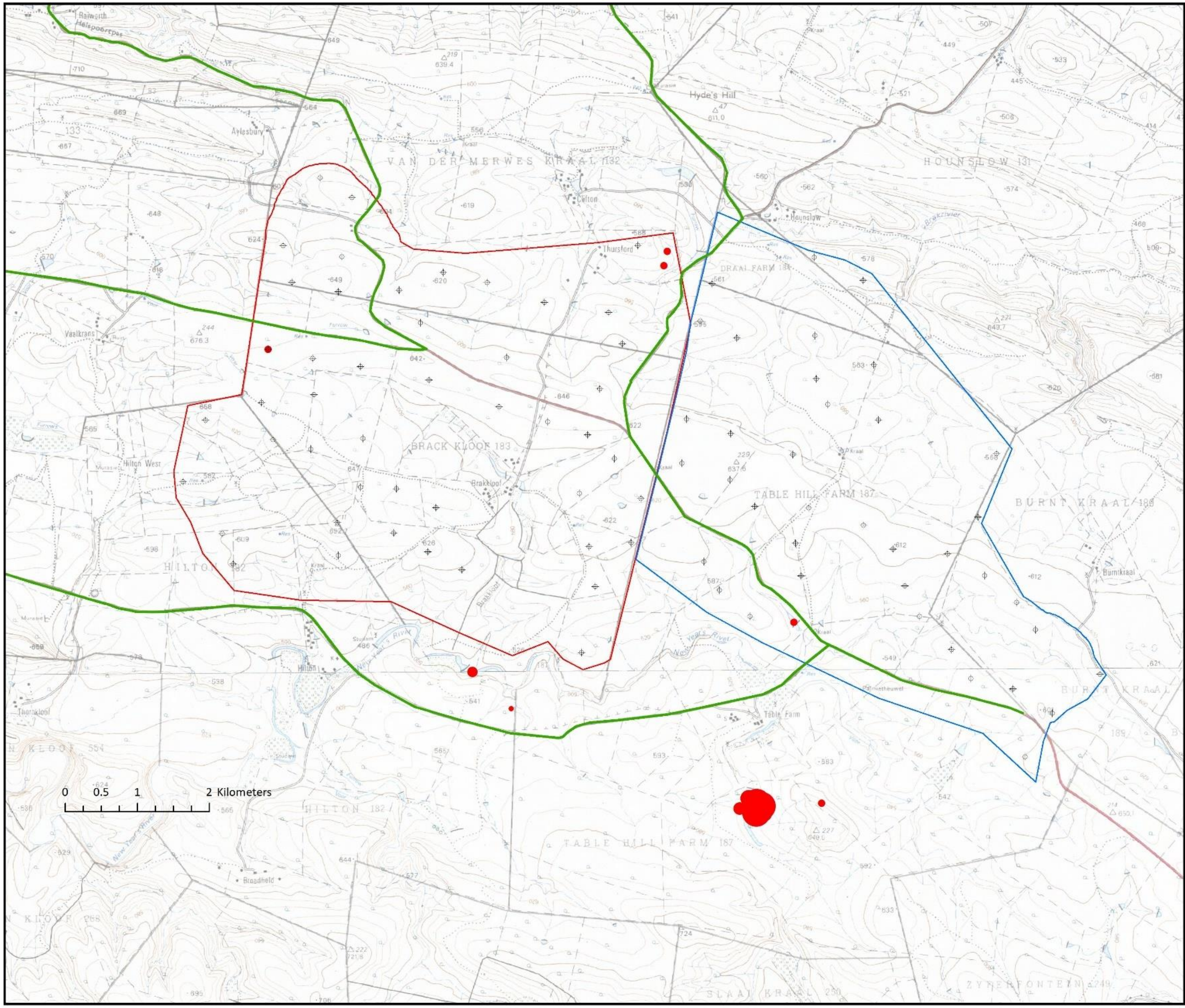
N

LAYOUT DWG N/A	T-LAYOUT NO. N/A

DRAWING NUMBER EC-2020-1

SCALE - 1:50,000 @ A3

ROAD TRANSECT SURVEY
JUN 2019 - AUG 2020



WIND RELIC RENEWABLES

Wind Garden Proposed Wind Farm

FIGURE 11

Road Transect Survey Jun 2019 - Aug 2020: South African Shelduck

KEY:

- Choje East turbines EIA

Count

- 1
- 5
- 10
- Choje East Road Transects
- Fronteer Site Boundary
- Wind Garden Site Boundary

Ecology Consulting

N

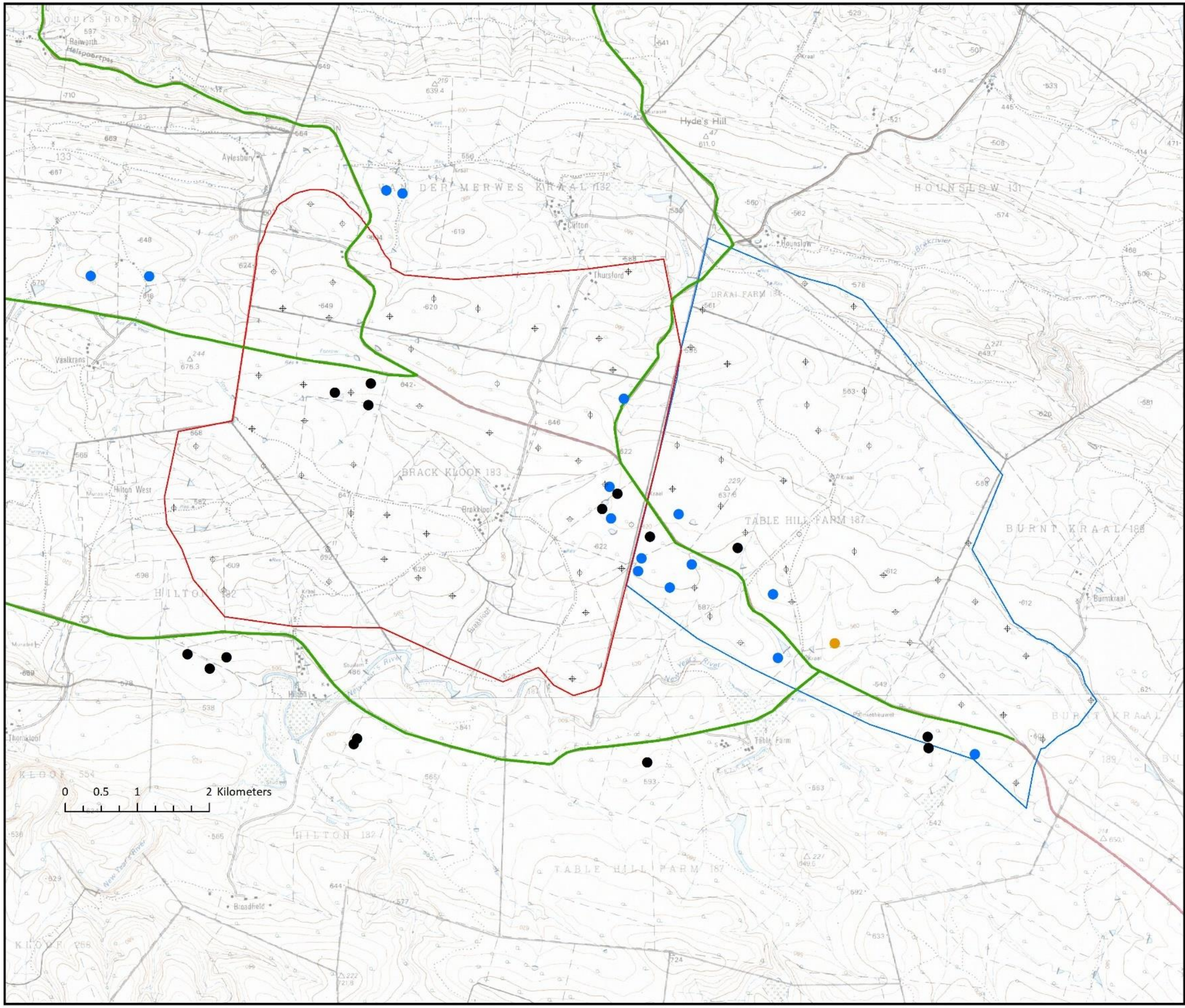
0 0.325 0.65 1.3 1.95 2.6 Kilometres

LAYOUT DWG N/A	T-LAYOUT NO. N/A

DRAWING NUMBER EC-2020-1

SCALE - 1:50,000 @ A3

ROAD TRANSECT SURVEY
JUN 2019 - AUG 2020



WIND RELIC RENEWABLES

Wind Garden Proposed Wind Farm

FIGURE 12

Road Transect Survey Jun 2019 - Aug 2020: Blue Crane and Bustards

KEY:

Choje East turbines EIA

Species

- Blue crane
- Denham's bustard
- Southern black bustard
- Choje East Road Transects
- Wind Garden Site Boundary
- Fronteer Site Boundary

Ecology Consulting

N

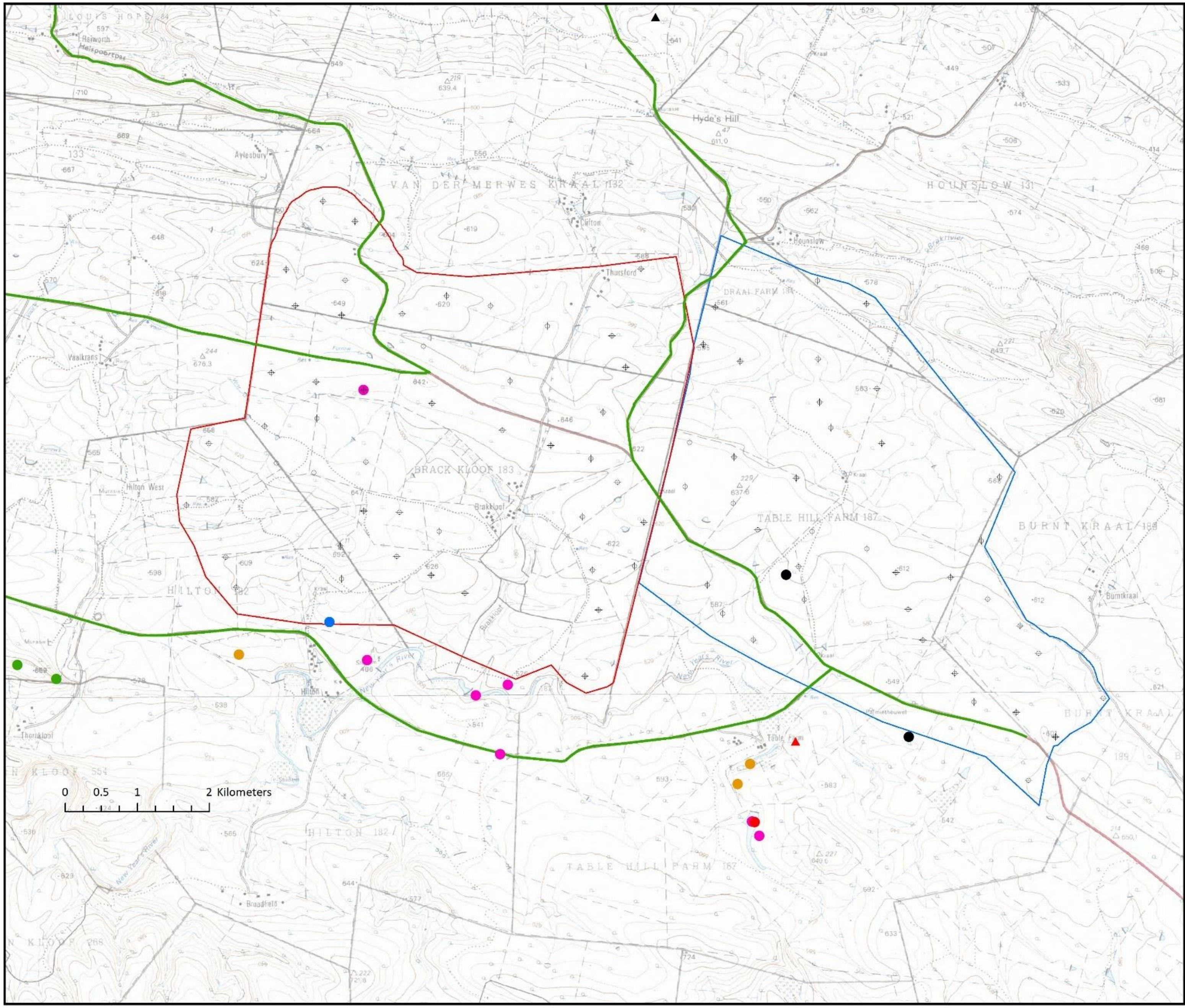
0 0.325 0.65 1.3 1.95 2.6 Kilometres

LAYOUT DWG	N/A	T-LAYOUT NO.	N/A

DRAWING NUMBER EC-2020-1

SCALE - 1:50,000 @ A3

ROAD TRANSECT SURVEY JUN 2019 - AUG 2020



WIND RELIC RENEWABLES

Wind Garden Proposed Wind Farm

FIGURE 13

Road Transect Survey Jun 2019 - Aug 2020: Key Raptor Species

KEY:

Choje East turbines EIA

Species

- African fish-eagle
- African marsh-harrier
- Black harrier
- Booted eagle
- Lanner falcon
- Martial eagle
- Verreaux's eagle
- Wahlberg's eagle
- Choje East Road Transects
- Wind Garden Site Boundary
- Fronteer Site Boundary

Ecology Consulting

N

LAYOUT DWG N/A | T-LAYOUT NO. N/A

DRAWING NUMBER EC-2020-1

SCALE - 1:50,000 @ A3

ROAD TRANSECT SURVEY JUN 2019 - AUG 2020

Table 5: Walking transect survey counts (birds per km transect) by month in the Wind Garden Wind Farm site, June 2019 - August 2020.

Species	IUCN	SA RDB	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec 2019	Jan 2020	Feb	Mar	May	Jun	Jul	Aug 2020
Helmeted guineafowl	LC		-	5.83	-	-	-	-	-	-	-	-	-	-	-	-
Rock dove	LC		-	-	-	-	-	-	-	-	-	-	-	0.42	-	-
Red-eyed dove	LC		-	-	-	-	-	-	-	0.42	-	-	-	-	-	-
Ring-necked dove	LC		-	0.42	4.17	3.33	2.50	2.08	0.83	-	0.83	0.83	0.42	0.42	-	-
Emerald-spotted wood-dove	LC		-	-	-	0.42	-	-	-	-	-	-	-	-	-	-
Klaas's cuckoo	LC		-	-	-	-	-	0.42	-	0.42	-	-	-	-	-	-
Red-chested cuckoo	LC		-	-	-	-	-	-	0.42	-	-	-	-	-	-	-
Blue crane	VU	NT	-	2.50	-	-	-	0.83	-	1.25	-	-	-	-	-	-
Southern black bustard	VU	VU	-	2.50	4.17	2.50	3.33	3.75	4.17	2.08	0.42	0.42	0.42	1.25	-	-
African sacred ibis	LC		-	-	-	-	-	-	-	-	-	-	-	0.42	-	-
Hadada ibis	LC		-	-	0.42	0.42	0.83	-	-	0.83	0.83	-	-	-	-	-
Spotted thick-knee	LC		-	-	-	-	-	0.83	-	-	-	-	-	-	-	-
Crowned lapwing	LC		-	0.83	-	-	-	1.25	0.42	3.33	-	-	-	-	-	-
Black-winged kite	LC		-	-	-	-	-	-	-	0.42	-	-	-	-	-	-
Martial eagle	VU	EN	-	-	0.42	-	-	-	-	-	-	-	0.42	-	-	-
Pale chanting-goshawk	LC		-	-	-	-	-	-	-	-	0.42	-	-	-	-	-
African fish-eagle	LC		-	-	-	0.42	-	-	-	-	-	-	-	-	-	-
Jackal buzzard	LC		-	-	-	-	-	-	-	-	-	-	0.42	-	-	-
Speckled mousebird	LC		-	-	-	-	4.17	-	-	-	-	-	-	-	-	-
Red-faced mousebird	LC		-	3.75	2.08	9.17	2.08	-	-	-	3.33	3.33	9.17	1.67	-	-
Common hoopoe	LC		-	-	-	0.42	-	0.42	-	-	0.42	-	-	-	-	-
Green woodhoopoe	LC		-	-	-	0.42	-	-	-	-	-	-	-	-	-	-
Acacia pied barbet	LC		0.42	1.67	1.25	0.42	-	0.42	0.83	-	-	-	-	-	-	-
Black-collared barbet	LC		1.67	0.42	0.42	0.42	-	-	0.83	-	-	-	-	-	-	-
Greater honeyguide	LC		-	-	-	-	-	0.42	-	-	-	-	-	-	-	-
Cardinal woodpecker	LC		-	-	-	0.83	-	-	-	-	-	-	-	-	-	-
Eastern black-headed oriole	LC		0.42	-	-	-	-	-	-	-	-	-	-	-	-	-
Cape batis	LC		-	-	-	-	-	-	-	-	0.42	-	-	-	-	-
Chinspot batis	LC		0.42	0.42	0.83	-	-	0.42	1.25	-	0.83	-	-	-	-	-
Pririt batis	LC		-	-	0.42	-	-	-	-	-	-	-	-	-	-	-

Species	IUCN	SA RDB	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec 2019	Jan 2020	Feb	Mar	May	Jun	Jul	Aug 2020
Southern tchagra	LC		-	-	-	-	-	0.42	-	-	-	-	-	-	-	-
Southern boubou	LC		-	-	-	-	1.25	-	-	-	0.83	-	-	-	-	-
Bokmakierie	LC		2.50	1.25	0.42	1.25	0.83	2.08	2.08	1.67	1.25	0.83	0.83	0.83	-	-
Fork-tailed drongo	LC		-	-	0.42	-	-	-	-	-	-	-	-	-	-	0.42
Common fiscal	LC		0.83	-	-	0.42	-	0.83	1.25	1.25	-	-	0.42	-	-	-
Cape crow	LC		5.83	5.00	2.08	3.33	0.83	0.83	1.25	5.00	4.17	2.50	0.83	5.42	-	0.83
White-necked raven	LC		-	0.83	-	-	-	-	-	-	-	-	-	-	-	-
Pied crow	LC		1.25	0.83	0.83	2.08	4.58	-	3.33	0.83	-	2.92	0.83	3.75	-	-
Southern black tit	LC		-	-	-	-	-	0.42	-	-	-	-	-	-	-	-
Spike-heeled lark	LC		-	-	-	-	-	-	-	-	-	-	-	-	0.42	-
Eastern clapper lark	LC		-	1.25	1.67	5.83	-	6.67	-	1.25	2.08	2.50	-	-	-	-
Rufous-naped lark	LC		-	0.42	-	-	0.42	-	-	-	0.42	-	-	-	-	-
Bar-throated apalis	LC		-	-	0.42	0.83	0.42	2.50	0.83	0.83	1.25	0.42	0.42	0.42	-	-
Grey-backed cisticola	LC		1.25	3.75	8.75	7.50	2.92	8.75	2.50	-	1.67	3.75	0.42	0.83	-	-
Neddicky	LC		1.67	2.50	2.50	3.33	2.08	6.67	4.58	2.08	2.08	2.08	1.25	-	-	1.25
Karoo prinia	LC		0.42	0.42	0.42	1.67	0.83	1.25	2.08	-	1.25	-	-	-	0.42	-
Barn swallow	LC		-	-	-	-	-	1.67	3.33	1.25	1.25	4.58	-	-	-	-
Sombre greenbul	LC		-	-	0.42	1.25	0.42	-	-	-	-	0.42	-	-	-	-
Common bulbul	LC		0.42	-	-	1.25	0.42	0.42	1.25	-	-	-	1.25	-	0.83	0.42
Chestnut-vented warbler	LC		0.42	-	1.67	1.25	-	0.83	0.42	0.83	0.42	0.42	-	0.42	-	-
African yellow white-eye	LC		-	-	-	-	-	-	-	2.50	-	-	-	-	-	-
Red-winged starling	LC		-	-	-	-	1.25	-	-	-	-	-	-	-	-	-
Cape starling	LC		-	-	-	4.58	1.67	-	-	-	0.83	0.83	-	0.83	-	-
Karoo scrub-robin	LC		-	1.25	2.50	2.92	0.83	1.67	1.25	0.42	0.83	0.42	-	-	0.42	0.42
White-browed scrub-robin	LC		-	-	-	-	-	0.42	-	-	-	-	-	-	-	-
Fiscal flycatcher	LC		1.25	-	0.42	0.42	0.83	-	-	0.42	-	-	1.67	0.42	-	0.83
Cape robin-chat	LC		-	-	-	-	0.83	-	-	-	-	-	-	-	-	-
Common stonechat	LC		-	0.42	1.25	1.25	1.25	0.42	-	0.83	0.42	0.42	0.42	0.83	-	-
Southern anteater-chat	LC		-	-	0.83	-	-	-	-	-	-	-	-	0.42	-	-
Familiar chat	LC		0.42	-	0.83	-	-	1.67	-	0.42	0.42	1.25	1.25	-	-	-
Malachite sunbird	LC		1.67	2.08	0.83	0.83	0.83	3.33	0.83	-	0.42	-	-	1.25	0.83	-

Species	IUCN	SA RDB	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec 2019	Jan 2020	Feb	Mar	May	Jun	Jul	Aug 2020
Greater double-collared sunbird	LC		-	-	0.42	-	0.83	2.92	-	-	0.83	0.42	-	-	-	-
African firefinch	LC		-	-	-	-	-	-	-	-	1.25	-	1.25	-	-	-
Common waxbill	LC		-	-	-	-	-	-	-	-	-	-	-	-	-	-
African pipit	LC		-	-	-	-	-	0.42	0.42	-	-	0.83	-	-	-	-
Streaky-headed seedeater	LC		0.42	-	0.42	-	-	-	-	-	-	-	-	-	-	1.25
Cape canary	LC		-	-	9.58	-	-	-	-	-	-	-	-	-	-	-
Golden-breasted bunting	LC		-	-	0.42	0.42	-	-	-	-	-	-	-	-	-	-
Cape bunting	LC		-	-	-	-	-	0.42	0.83	-	0.83	-	-	-	-	-

6.4 Walking transect surveys

The results of the Walking transect surveys within the Wind Garden site are summarised in Table 5. This gives the total number of birds counted each month, along with their conservation status (IUCN/South Africa Red Data Book). Generally, only low numbers were recorded during these surveys. These surveys did record a high diversity of small terrestrial species. Although only four species of higher conservation importance (Blue Crane, Southern Black Bustard, Martial Eagle and African Rock Pipit).

Important Note:

It is important to remember the present climatic state of the study area. This can change with weather patterns and conditions and these can change from year to year or even decade to decade. And this will in turn influence the ecological state of the area, the soil conditions and every biological organism, the plants, and the animals.

For example during our surveys not many migratory bird species were recorded, and this could change next year or in five years' time. At the current time the entire Karoo region has received very little rain therefore the region and this study area is in a very dry period. Plants adapt to such conditions with limiting their growth therefore insects and other animals adapt similarly, and their population numbers are probably low which in turn this will influence the higher animals e.g. an eagle's reproductive success.

Similarly, birds are attracted to an area for food, especially insect food, since birds clean plants of insects. Hence a general bird principle in this region that results from the large contrast between the height difference of bushveld and shrub vegetation, small birds forage in the bush and large birds forage in the flat, open Karoo shrubland vegetation.

Section 7 INDENTIFYING THE IMPACTS

7.1 Potential Effects of a Wind Farm on Birds

The main potential effects of wind farms on birds are considered to be direct loss of breeding or feeding habitat, potential collision risk and indirect loss of habitat from disturbance (either temporary during construction or more permanent from operating turbines) (Percival 2005, Drewitt and Langston 2006, Gove et al. 2013). Each of these are considered in turn in the following sections.

7.1.1 Direct effects: loss of habitat

This would be an effect of negligible magnitude, with only a very small area taken up by the turbine bases and access tracks/roads. Use of existing tracks/roads and the careful selection of routes for the access tracks/roads and turbine locations, alongside use of proven construction techniques would ensure that such effects on birds would be of negligible magnitude (even in a local context) and would not be significant. In addition, the developer has committed to the production of a Construction

Method Statement that will be agreed with BLSA and other stakeholders before construction commences, and would follow industry best practice.

7.1.2 Direct effects: collision risk

There have been a number of wind farms that have caused bird mortalities through collision, but their characteristics are generally quite different to those at the proposed Wind Garden site. Most notably, at Altamont Pass in California and Tarifa in southern Spain, large numbers of raptors have been killed (Orloff and Flannery 1992, Janss 1998, Thelander et al. 2003). Such problems have occurred where large numbers of sensitive species occur in close proximity to very large numbers (hundreds/thousands) of turbines, and usually also where the wind farm area provides a particularly attractive feeding resource. At Altamont, for example, the wind turbine bases provided an attractive shelter for ground squirrels which themselves provided an attractive raptor foraging resource (Thelander et al 2003).

A specific problem has been identified for old world vultures, which have much the highest numbers of reported raptor collisions (Hotker et al. 2004, Illner 2011). Martin et al. (2012) reported that these species have large blind areas in their field of vision above, below and behind the head, such that with the head positions typically adopted by foraging vultures, they will often be blind in the direction of travel. This would make them particularly vulnerable to collision with wind turbines and the studies that have been undertaken bare out this conclusion (Janss 1998, Lucas et al. 2012). Vultures also have a high wind loading, reducing their manoeuvrability which also increases their vulnerability to collision (Janss 2000, Barrios and Rodríguez, 2004; Lucas et al., 2008). In addition to this, wind farms have been located in areas of high vulture food resource and several of their populations are vulnerable to additional mortality (Carrete et al. 2009).

Another species clearly more vulnerable to collision with wind turbines is the White-tailed Eagle. Small numbers of collisions have been reported at several wind farms including in Germany and Poland, but at one particular site rather more fatalities have occurred, Smøla in NW Norway (an average of 8 collisions per year, May et al. 2010). In Australia, White-Bellied Sea Eagle and Wedge-Tailed Eagle have also both been demonstrated to be vulnerable to collision (Hull and Muir 2013).

Golden Eagles have also been reported as collision victims at wind farms, but generally at a low rate in comparison with vultures and White-tailed Eagles. Whitfield (2009) reviewed the avoidance rates that this species has exhibited and reported estimates varying between 98.64 % and 99.89 % depending on site and uncertainty associated with observed mortality rates before and after adjustment for potential biases. An overall ‘worst case’ estimate weighted by the scale of study was 99.33 % and the mean unweighted ‘worst case’ (lowest) avoidance rate for the four wind farms was 99.19 %, and adoption of a precautionary value of 99.0 % was advised for use in wind farm assessments (and adopted by SNH in their guidance, Urquhart 2010, SNH 2017).

Collision risk of raptors has been shown to be affected by wind conditions (Johnston et al., 2014). That study found that Golden Eagles migrating over a wind farm in the Rocky Mountains experienced lower collision risk with increased wind speed and increased risk under head- and tailwinds when compared with crosswinds.

In wind farm sites with similar large raptor flight densities to Wind Garden, collision rates have generally been very low and are not considered to be significant (Meek et al. 1993, Tyler 1995, Dulas 1995, EAS 1997, Bioscan 2001, Percival et al. 2008, Percival et al. 2009a). A study of Golden Eagles at Beinn an Tuirc in Scotland (Walker et al. 2005) has shown them to largely avoid the wind farm site after construction, with a resultant reduction in collision risk. Marsh Harrier, too, has been found to show a similar avoidance of the proximity of wind turbines, with flight density post-construction reduced by 94% within 200m of turbines (Percival et al. 2009a, Percival et al. 2009b). Studies of Red Kite and Hen Harrier in the UK have found they too have exhibited high rates of avoidance of collision (Whitfield and Madders 2006a and 2006b).

In **South Africa**, Ralston-Paton, Smallie, Pearson & Ramalho (2017) reviewed the results of operational phase bird monitoring at eight (8) wind farms ranging in size from 9 to 66 turbines and totalling 294 turbines (or 625MW). Hub height ranged from 80 to 115m (mean of 87.8m) and rotor diameter from 88 to 113m (mean of 102.4m). The estimated fatality rate at the wind farms (accounting for detection rates and scavenger removal) ranged from 2.06 to 8.95 birds per turbine per year. The mean fatality rate was 4.1 birds per turbine per year. This places South Africa within the range of fatality rates that have been reported for North America and Europe.

The composition of the South African bird fatalities by family group was as follows: Unknown 5%; Waterfowl 3%; Water birds other 2%; Cormorants & Darters 1%; Shorebirds, Lapwings and gulls 2%; Large terrestrial birds 2%; Gamebirds 4%; Flufftails & coots 2%; Songbirds 26%; Swifts, swallows & martins 12%; Pigeons & doves 2%; Barbets, mousebirds & cuckoo's 1%; Ravens & crows 1%; Owls 1%; and Diurnal raptors 36%.

Threatened species killed included Verreaux's Eagle Aquila verreauxii (5 - Vulnerable), Martial Eagle Polemaetus bellicosus (2 - Endangered), Black Harrier Circus maurus (5 - Endangered), and Blue Crane Anthropoides paradiseus (3 – Near-threatened). Although not Red Listed, a large number of Jackal Buzzard Buteo rufofuscus fatalities (24) were also reported.

Figure 13a and b includes the latest review 2019 by Ralston-Paton et al. on bird fatalities and Red List species fatalities.

Common name	Species name	Broad grouping	Status	Endemic	Count
Buzzard, Jackal	**Buteo rufofuscus**	**Diurnal raptors**	**0**	**Near-endemic**	**81**
Kestrel, Rock	Falco rupicolus	Diurnal raptors	0	0	47
Unknown		unknown	0	0	44
Unknown, Passerine		Songbirds	0	0	39
Falcon, Amur	Falco amurensis	Diurnal raptors	0	0	35
Lark, Red-capped	Calandrella cinerea	Songbirds	0	0	28
Swift, White-rumped	Apus caffer	Swifts, Swallows and Martins	0	0	28
Bokmakierie	Telophorus zeylonus	Songbirds	0	0	27
Kite, Black-shouldered	Elanus caeruleus	Diurnal raptors	0	0	20
Unknown, Raptor		Diurnal raptors	0	0	20
Eagle, Booted	Hieraaetus pennatus	Diurnal raptors	0	0	15
Canary, Cape	Serinus canicollis	Songbirds	0	0	14
Goose, Egyptian	Alopochen aegyptiaca	Waterfowl	0	0	14
Swift sp.		Swifts, Swallows and Martins	0	0	12
Lapwing, Crowned	Vanellus coronatus	Shorebirds & Lapwings	0	0	11
Swift, Common	Apus apus	Swifts, Swallows and Martins	0	0	11
Cisticola sp.		Songbirds	0	0	10
Owl, Western Barn	Tyto alba	Raptors (owls)	0	0	10
Pigeon, Speckled	Columba guinea	Pigeons and doves	0	0	10
Vulture, Cape	**Gyps coprotheres**	**Diurnal raptors**	EN, EN	0	**10**

Common name	Family (Suborder)	Broad grouping	Status	Count
Cape Vulture	Accipitridae	Diurnal raptor	EN, EN	10
Blue Crane	Gruidae	Large terrestrial birds	NT, VU	8
Verreaux's Eagle	Accipitridae	Diurnal raptor	VU, LC	6
Black Harrier	Accipitridae	Diurnal raptor	EN, VU	6
Lanner Falcon	Falconidae	Diurnal raptor	VU, LC	5
Southern Black Korhaan	Otididae	Large terrestrial birds	VU, VU	5
Martial Eagle	Accipitridae	Diurnal raptor	EN, VU	4
Blue Korhaan	Otididae	Large terrestrial birds	LC, NT	2
Ludwig's Bustard	Otididae	Large terrestrial birds	EN, EN	1
Cape Cormorant	Phalacrocoracidae	Cormorants and Darters	EN, EN	1
Greater Flamingo	Phoenicopteridae	Waterbirds	NT, LC	1
Striped Flufftail	Sarothruridae	Small-Medium Gruiformes	VU, LC	1
Secretarybird	Sagittariidae	Large terrestrial birds	VU, VU	1
Total				51

Ralston-Paton et al's review included the first year of operational monitoring at the first 8 facilities. At least one more year has elapsed at each of these facilities and additional facilities have come online.

Additional post-construction data were reviewed by Ralston-Paton et al's in 2019 and some results are shown in the two Tables below, for all bird fatalities and for threatened species fatalities.

Sites where higher numbers of raptor collisions have occurred generally have supported a high density of flight activity that has been maintained post-construction, often associated with attractive ecological resources within the wind farm site, resulting in attraction into the wind farm rather than avoidance.

The key risk features can be summarised as:

High turbine numbers

- Turbine design – older design lattice towers can provide a perching resource
- High bird density within the wind farm – particularly where there is a rich food resource within the wind farm, or attractive breeding sites
- Source of distraction in close proximity to turbines, e.g. food resource at turbine bases, breeding displays.
- Vultures have a specific issue with their limited field of vision, and a high wing loading that reduces their manoeuvrability
- Particular vulnerability of populations to additional mortality (e.g. Egyptian vulture – where wind farms have been implicated in population decline often where acting in combination with other factors, Carrete et al. 2009).

The mitigation of collision risk has been recently reviewed by Marques et al (2014). This publication outlined a range of measures that have been implemented at existing wind farms in order to reduce collision risk. It includes details of several successful schemes, including:

- Turbine shutdown on demand - Lucas et al. (2012) showed that wind turbine shutdown on demand halved Griffon Vulture fatalities in Andalusia, Spain, with only a marginal (0.07%) reduction in energy production. This study used human observers but automated (radar and video-based) systems are also now becoming available (Collier et al. 2011; Desholm et al. 2006).
- Restriction of turbine operation – this involves avoiding operation of the turbines at key risk times. This has been very effective for bats (Arnett et al. 2010), where reducing turbine operation during periods of low wind speeds reduced bat mortality by 44% - 93%, with marginal annual power loss (<1% of total annual output). For birds (including at the Wind Garden site) it is less likely to be such a useful tool as defining the higher risk periods is more difficult and it is unlikely that such a large reduction would be achievable without a much greater loss in power output.
- Habitat management – these schemes are usually implemented to reduce the attractiveness of the wind farm site for foraging (e.g. removal of carcasses for carrion feeding species) whilst at the same time increasing food availability elsewhere (to draw birds away from the wind farm and at the same time offset lost foraging opportunity) (Walker et al. 2005).
- Increasing turbine visibility – laboratory experiments have shown this to be a potentially effective tool, and there has been a recent field trials that has demonstrated the benefit of such measures. A study at Smølain Norway (May et al. 2020) found a significant reduction in

White-tailed Eagle collisions following painting of one of the three rotor blades black. The annual bird fatality rate was reduced at the turbines with a painted blade by over 70%, and no white-tailed eagle carcasses at all were recorded after painting.

- Deterrents – bioacoustic or other scaring devices might have the potential to deter birds from flying in close proximity to wind turbines. Smith et al. (2011) showed that use of an acoustic deterrent (Long Range Acoustic Device) elicited strong reactions from 60% of Griffon Vultures but its efficacy depended on the distance from the bird, altitude and flock size. Deterrents also have the potential to be activated by automated real-time surveillance systems as an initial mitigation step and prior to blade curtailment (May et al., 2012; Smith et al., 2011). A possible problem with this mitigation though, as noted by Marques et al. (2014), is that the deterrent may have an unpredictable effect on the flight path and may not always deflect the bird in the desired direction.
- Compensation – these include measures to deliver a wider benefit to the populations that could be affected by the wind farm, including habitat expansion, creation or restoration, predator control and supplementary feeding.

7.1.3 Indirect effects: disturbance

Disturbance could potentially affect a rather greater area than direct habitat loss. Disturbance itself can result from several factors associated with the wind farm, including operational noise, the visibility of tall structures and increased human presence through maintenance activities, as well as the construction works prior to operation. Published studies have only been able to look at all of these factors acting together, so it is not possible to separate out the different aspects of disturbance when assessing the potential effects.

The maximum distance that wind turbines have been shown to affect birds is 800m (Percival 2005; Pearce-Higgins et al. 2009), though most reliable studies have not reported effects further than 600m from turbines (Drewitt and Langston 2006) and displacement is usually partial rather than complete (i.e. a reduction in use not complete exclusion). Displacement has generally been more widely reported and over a greater distance outside the breeding season.

Several of the studies referred to above (e.g. Walker et al. 2005, Percival et al. 2009a, Percival et al. 2009b, Whitfield et al. 2006) have noted some displacement of raptors from a zone around wind turbines. This has typically been reported over a distance of 1-200m of turbines, though Fielding and Haworth (2013) found evidence of displacement of golden eagle up to 500m. Displacement effects have also been reported for White-tailed Eagles at Smøla, in Norway (May et al. 2013). Campedelli et al (2013) found significant reductions in a range of raptor species at a wind farm in Italy. Though disturbance would reduce collision risk it does mean that the development of a wind farm could result in effective loss of habitat if birds are dissuaded from using the area in proximity to turbines. Any impact on the population would be dependent on importance of that area from which displaced and the availability of alternative areas, but any assessment should take into account the possibility of such small-scale displacement.

The most effective way to mitigate any such losses would be through the provision of alternative resources nearby (but outside the potential impact zone of the wind farm). Such measures have been successfully implemented at several wind farms, including for golden eagles (Walker et al. 2005), and have been agreed (though not yet implemented) for Verreaux's Eagle in South Africa (for the Witberg wind farm).

Disturbance is likely to be highest during construction owing to the activities being carried out. Pearce-Higgins et al. (2012) found that Red Grouse, Snipe and Curlew densities all declined on wind farms during construction, whilst densities of skylark and stonechat increased. Construction also involves the presence of work personnel on site which itself can be an important source of potential disturbance. Even at this time displacement from a zone around the wind turbines is likely to be only partial. Pearce-Higgins et al. (2012) for example reported decreases in curlew density during construction of 40% and snipe by 53%.

A further potential disturbance effect could be disruption to important flight lines (barrier effect; Percival 2005, Drewitt and Langston 2006). Birds may see the wind farm and change their route to fly around (rather than through) it. This would reduce the risk of collision but could possibly have other effects, for example potentially making important feeding areas less attractive (by acting as a barrier to the birds reaching them) and (if diversions were of a sufficient scale) resulting in increased energy consumption.

The distance needed to divert around the Wind Garden Wind Farm would be relatively small and would not be expected to act as a major barrier to movements (and the vantage point surveys have not shown any important flight routes through the site). Accordingly, the ecological consequences of any such changes in flight lines would be of negligible magnitude and not significant.

7.1.4 Effects of the Decommissioning Phase

The ornithological effects that are likely to occur during decommissioning will be similar to those during construction, though given the reduced time required, and the presence of existing infrastructure, they would be of a lower magnitude. Significant effects are not likely but precautionary mitigation measures will be implemented to ensure this, as detailed below.

7.2 Potential Effects of Power lines on Birds

In addition to the potential effects of the proposed Wind Garden Wind Farm (above) on birds, a power line will be constructed to connect the electricity generated to the national grid. The construction of the power line will add extra impacts on birds, these can include the disturbance of birds during construction activities and the loss of breeding or feeding habitat.

While during the operation of the WEF, birds can collide with power line conductors or get electrocuted on pole structures (Percival 2005, Drewitt and Langston 2006, Gove et al. 2013).

7.2.1 Direct effects: loss of habitat

The construction of the power lines will result in some disturbance and habitat destruction. New service roads/tracks to be constructed will also have a disturbance and habitat destruction impact.

7.2.2 Direct effects: from operating power lines

Overhead power lines pose a collision and an electrocution threat to certain bird species (depending on the pole top configuration).

Collision with power lines is one of the biggest single threats facing birds in southern Africa (van Rooyen 2004). The most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of these collision sensitive species are considered threatened in southern Africa. The Red List species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions.

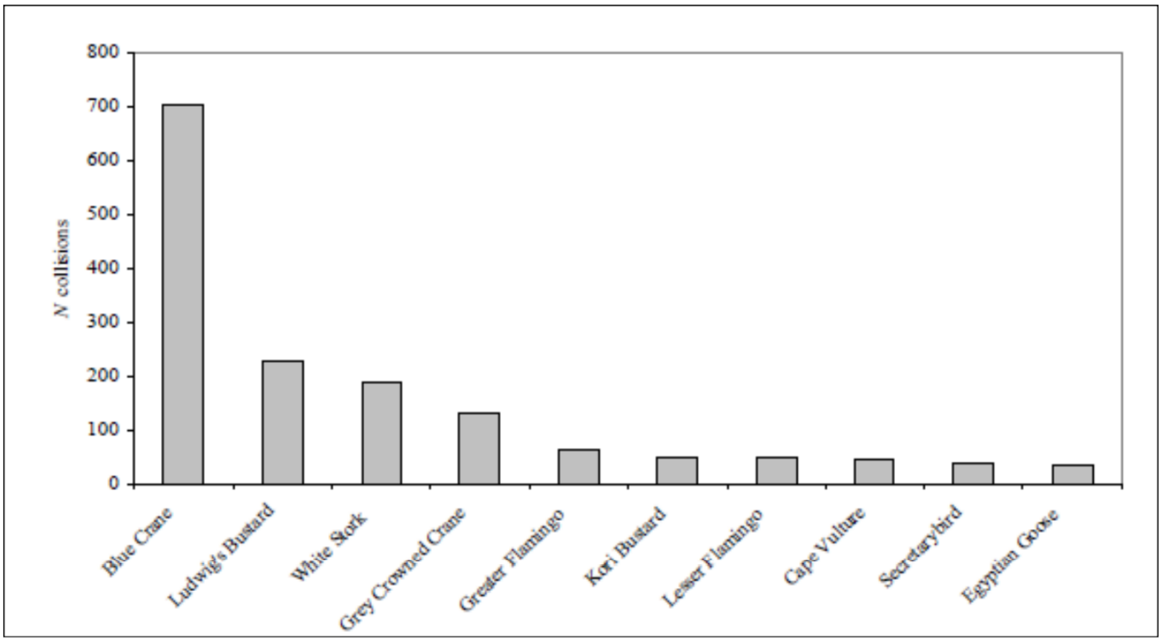


Figure 13c The top ten power line collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins et al. 2010)

Electrocution refers to the scenario where a bird perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The larger bird species (such as eagles and vultures) are most affected since they are most capable of bridging critical clearances on hardware.

7.2.3 Potential Collisions and Electrocutions at Wind Garden Wind Farm

There is a high likelihood that the priority species which occur or potentially occur in the study area will be at risk to collide with power line conductors or get electrocuted on poles or structure. For collision, these include Ludwig's Bustard, Blue Crane, Southern Black Korhaan, Denham's bustard and Secretarybird. For electrocution, these include Verreaux's Eagle, Martial Eagle, African Fish eagle and probably the Spotted Eagle-Owl.

Section 8 BIRD DATA ANALYSIS

8.1 Key Avifaunal Sensitivities

Key species have been identified as those of higher conservation value that would be at risk from the proposed wind energy development.

The June 2019 - August 2020 baseline bird surveys have identified a range of ornithological sensitivities in the area, though much of the area surveyed had a relatively low level of ornithological interest. Sensitivities identified in the Eastern Block, including the Wind Garden Wind Farm included:

Verreaux's Eagle - one active nest was confirmed in the Eastern Block, 3.4km from nearest proposed turbine location. Another potential site was found 2.8km to the north of the nearest proposed turbine. The VP surveys did not indicate any areas of notably higher flight activity.

Martial Eagle - two territories were found in proximity to the proposed wind farm, and a third further to the west outside the surveyed area. Nest site on the eastern edge of the survey area (7.2km from the nearest Wind Garden turbine) was found in May 2019 with prey delivery and the second at a new location (Figure 4), 4.0km from the nearest Wind Garden turbine was found in June 2020. As for Verreaux's Eagle, the VP surveys through to March 2020 did not indicate any areas of notably higher flight activity.

African Fish-eagle - though this species is of lower conservation importance (Least Concern at both international and South Africa level), as a larger raptor it is likely to be at higher risk of collision. A pair was found nesting 1.4km from the nearest Wind Garden turbine location, but very little flight activity was observed through the wind farm site.

Crowned Eagle - this species is of lower conservation importance but as a larger raptor may be at increased risk of collision. The nearest breeding location was 4km from any Wind Garden turbine, and this species was not observed flying through the wind farm site.

Blue Crane, Bustards and Secretarybird - Blue Crane, Denham's Bustard, Southern Black Bustard and Secretarybird were all recorded during the baseline surveys within/in proximity to the Wind Garden site. All are species of higher conservation importance. No particular concentrations of flight activity of any of these species was noted in this area during the VP surveys, and all were widely scattered at low density across the survey area during the vehicle transect surveys with no particularly important areas identified.

Lanner Falcon - two Lanner Falcon nests adjacent to the Eastern Block were reported in the REDZ SEA, though the 2019-20 surveys did not find either territory to be occupied. One is 4.3km from the nearest proposed wind turbine for Wind Garden, the other 8.7km (both are historic records). This species was recorded on only three occasions during the VP surveys and three times during the road transect surveys, with no evidence found of nesting within the survey area.

Other Species of Conservation Importance - Black Harrier - there was a very low level of use of the Eastern Block survey area by this species and no evidence of breeding within the wind farm site. As mentioned before in 2019, a single harrier was regularly see hunting on the road verges of the R335 of the Wind Garden WEF (and rest of Eastern Block). The harrier disappeared and returned a few months later and then left again. It was never seen in 2020.

8.2 Spatial Modelling

Appendix 2 provides further details of the analyses undertaken to explore the survey data and provide more information on key species' distributions and optimal buffer sizes to inform the site design and minimise risk of collision and other impacts from the wind farm. The focus of this work was on the more abundant key species and those with greater spatial overlap with wind farm site (i.e. at higher risk of impact), Martial Eagle and Verreaux's Eagle. It is a general overview of the modelling of all Choje WEFs therefore in includes Cape Vulture and the Large terrestrial bird group, which are more appropriate to the West block.

The Appendix explains the spatial model used to predict flight activity of these two species across the whole of the study area, enabling estimates to be made of flight density in areas that fell outside the VP survey area, and hence enhance coverage of the wind farm site and its surrounds. This could then be used to quantify the benefits of applying buffer zones more fully around nest sites (see following section on mitigation). This clearly illustrates the higher levels of use predicted around the nest sites, with the large majority of the higher use zones within the proposed turbine exclusion zone.

In relation to buffer sizes, Martial Eagle flight density was strongly related to distance from the nest, with the highest densities recorded within 500m and a steady decline in flight density up to 2.5km from the nest. Beyond 2.5km flight density was consistently lower. This provides strong evidence to support a 2.5km turbine exclusion zone around Martial Eagle nests, as flight activity is clearly considerably higher within that zone. Any exclusion of turbines beyond 2.5km would be of much less benefit in reducing collision risk.

The results for Verreaux's Eagle were less clear, as there was less coverage of areas in proximity to nests during VP surveys (which were designed primarily to maximise coverage of the wind farm site). Therefore, a buffer zone of 1.5km from Verreaux's Eagle nests was applied, to comply with BLSA guidance, BLSA 2017), rather than any distance based on site-specific data.

Cape Vultures did not breed within the survey area, so their flight distribution was not associated with any nest sites, but they were strongly associated with their night roost sites (with higher flight densities within 2km of the roosts, so this distance was applied as a buffer zone).

The two Figures below illustrate the modelled areas of high activity, Figure 14 for Martial eagle and Figure 15 for Verreaux's eagle. The dark spatial modelling on the maps, basically shows similar neighbouring areas that was not surveyed, and therefore were avoided with applying the appropriate buffers. These confirmed the applied buffers in contrast to the Wind Garden site, which are shown in Figure 16. The map also shows buffer zones of other species.

Figure 14 Predicted Martial Eagle distribution in the Eastern Block. Darker shading indicates higher predicted use, with the Wind Garden (red) and Fronteer (green) Wind Farm site boundaries, proposed turbines (small white dots) and turbine exclusion zones (larger black extended circles) also shown.

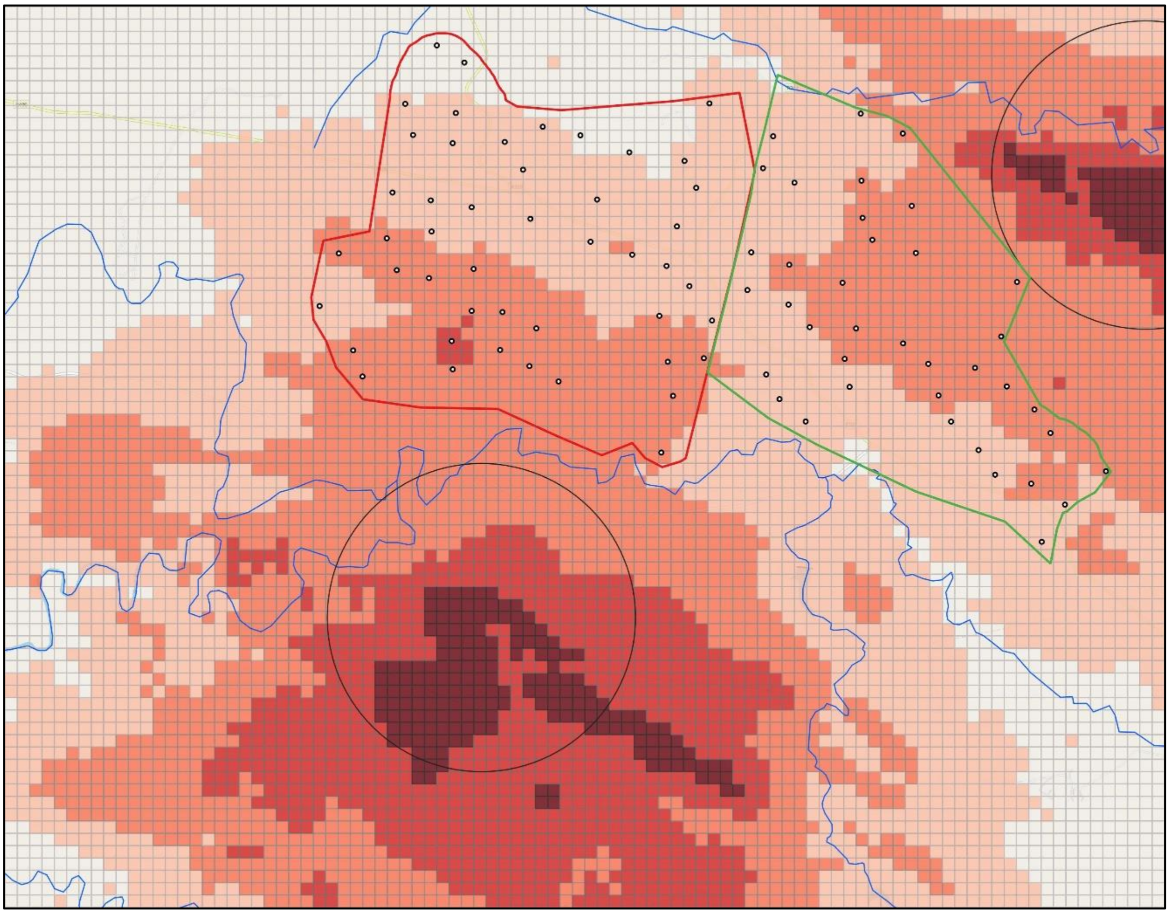


Figure 15 Predicted Verreaux's Eagle distribution in the Eastern Block. Darker shading indicates higher predicted use, with the Wind Garden (red) and Fronteer (green) Wind Farm site boundaries, proposed turbines (small white dots) and turbine exclusion zones (larger black extended circles) also shown.

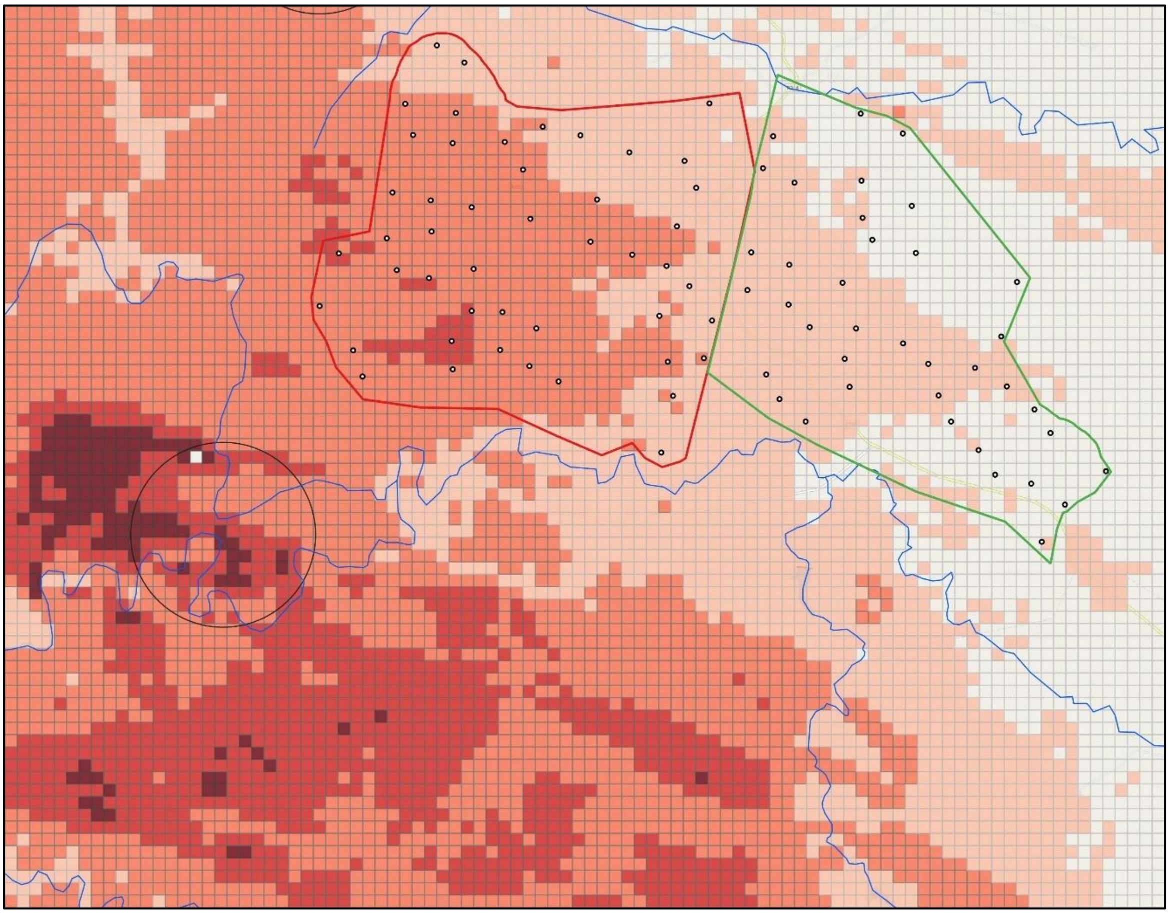
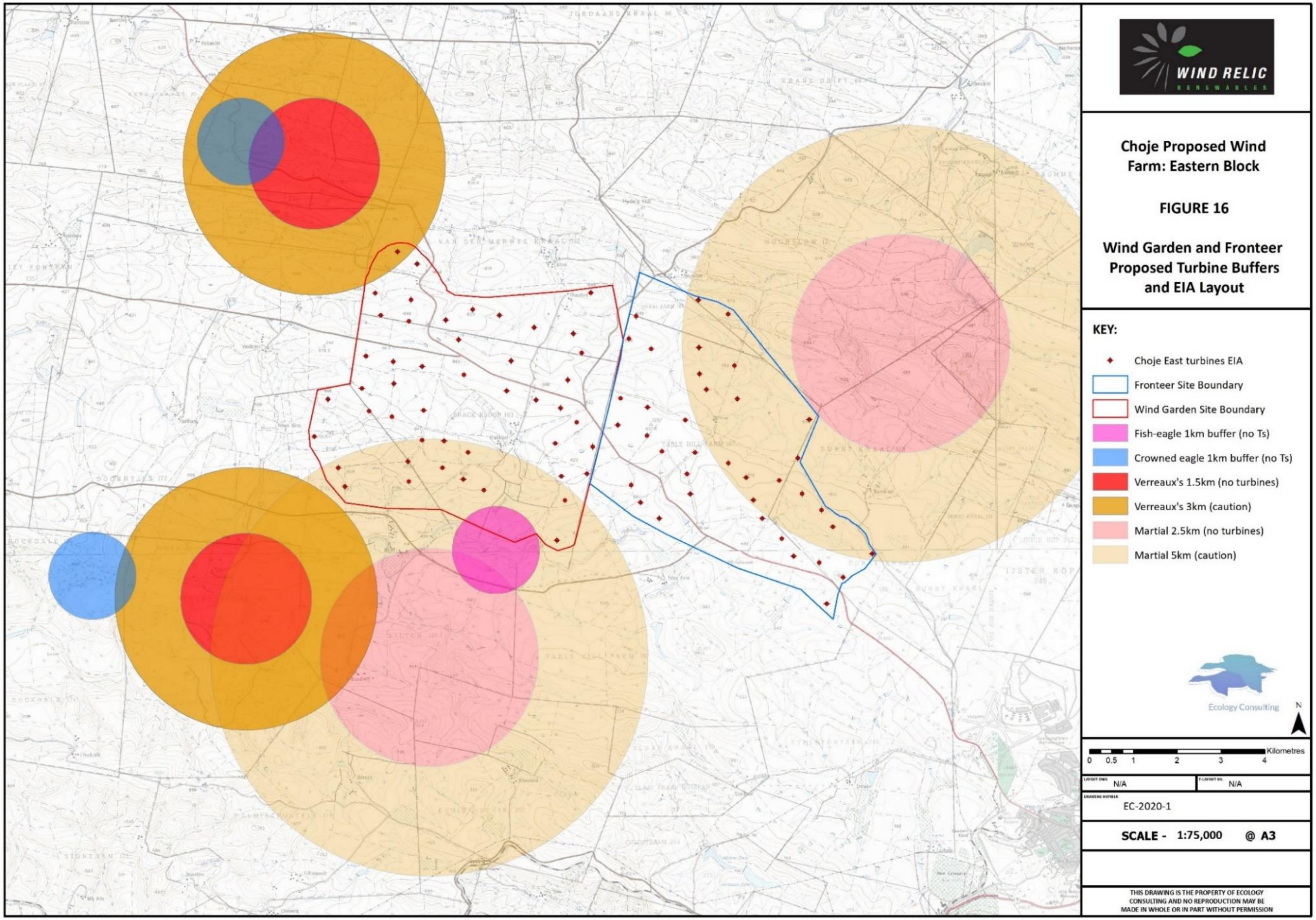


Figure 16 Shows the buffers around eagle nests already implemented in the East block applicable for Wind Garden and Fronteer wind farms.


WIND RELIC RENEWABLES
Choje Proposed Wind Farm: Eastern Block
FIGURE 16
Wind Garden and Fronteer Proposed Turbine Buffers and EIA Layout
KEY:
Choje East turbines EIA
Fronteer Site Boundary
Wind Garden Site Boundary
Fish-eagle 1km buffer (no Ts)
Crowned eagle 1km buffer (no Ts)
Verreaux's 1.5km (no turbines)
Verreaux's 3km (caution)
Martial 2.5km (no turbines)
Martial 5km (caution)
Ecology Consulting
N
0 0.5 1 2 3 4 Kilometres
N/A
N/A
EC-2020-1
SCALE - 1:75,000 @ A3
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION

8.3 Collision Risk Modelling

One of the main potential ornithological impacts of concern for the Wind Garden Wind Farm is collision with the operational turbines. Collision risk modelling (CRM) has been undertaken following the method of Band et al. (2007), as extensively used in the UK and elsewhere. The model runs as a two-stage process. Firstly, the risk is calculated making the assumption that flight patterns are unaffected by the presence of the wind turbines, i.e. that no avoidance action is taken. This is essentially a mechanistic calculation, with the collision risk calculated as the product of (i) the probability of a bird flying through the rotor swept area, and (ii) the probability of a bird colliding with a turbine if it does so. This probability is then multiplied by the estimated numbers of bird movements through the wind farm rotors at the risk height (i.e. the height of the rotating rotor blades) in order to estimate the theoretical numbers at risk of collision if they take no avoiding action.

The second stage then incorporates the probability that the birds, rather than flying blindly into the turbines, will actually take a degree of avoiding action, as has been shown to occur in all studies of birds at existing wind farms (Urquhart 2010). Discussion as to the most appropriate avoidance rates to apply is included in the following section.

The CRM was carried out for all six key species of conservation concern that were observed flying within the collision risk zone at rotor height; Martial Eagle, Verreaux's Eagle, Blue Crane, Ludwig's Bustard, Southern Black Bustard and African Fish-eagle.

It is important to remember that the aim of this collision modelling is not to produce the most likely outcome in terms of the numbers of collisions likely to occur during operation of the wind farm, but rather to produce a reasonable worst-case estimate in order to inform the assessment process, i.e. the highest numbers of collisions that could reasonably occur in the absence of mitigation.

The collision model requires data on bird body size and flight speed. Body sizes and baseline mortality rates were taken from Roberts Birds of South Africa (Hockey et al. 2005). Flight speeds were taken from Alerstam et al. (2007) for ecologically similar species, as none were available for any of the six key species. The data used in the collision risk modelling are shown in Table 6.

Table 6 Key species body size and flight speed data used in the collision risk modelling

Species	Body length (m)	Wing span (m)	Flight speed (m/s)
Verreaux’s Eagle	0.88	2.40	11.9
Martial Eagle	0.81	2.15	10.4
Blue Crane	1.15	1.90	15.0
Ludwig’s Bustard	0.85	1.65	15.0
Southern Black Bustard	0.52	1.01	15.0
African Fish-eagle	0.69	1.93	13.6

The collision modelling requires a range of input data on the wind turbine specifications, which were provided by the client and the turbine manufacturers (Table 7). This modelling has taken a reasonable worst-case approach, running the model for the turbine option likely to give the highest collision risk of the options being considered. The model was run for this report on the current proposed 47-turbine layout being assessed for the Basic Assessment Process.

Table 7 : Wind turbine data used in the Wind Garden collision risk modelling.

Specification	**Wind turbine input data**
Number of turbines	47
Hub height	120m
Rotor diameter	160m
Height to blade tip	200m
Minimum height of blade above ground	40m
Rotational speed (variable – mean of range used)	11 rpm
Blade maximum chord	4.2m
Blade pitch (variable – mean value used)	15°
Turbine operation time (when not constrained by high/low wind speed or maintenance activity)	90%

Data from the VP surveys were used to determine the proportion of flights at rotor height, with all flights between 35m and 250m treated (conservatively to take into account the difficulty of accurately estimating flight heights) as being at rotor height (actual rotor height would be 40-200m above ground level).

The collision risk zone was defined, as per Band et al (2007) and SNH (2017) guidance as a 500m zone around the proposed wind turbine locations.

The VP survey protocol enabled viewing to 2km and enabled a high coverage of this zone (including viewing of the full risk volume of 40 of the 47 turbine locations, i.e. 85%).

The results of any collision risk modelling using the Band et al. (2007) approach is highly sensitive to the avoidance rate used (Chamberlain et al. 2006). Application of an appropriate rate is therefore of fundamental importance in undertaking such modelling. However, there are very few studies at existing wind farms where avoidance rates have been fully determined, comparing pre-construction flight activity with the actual numbers of collisions post-construction (Urquhart 2010). The approach generally used to address this is to apply a precautionary rate based on the available data, such that any collision prediction is unlikely to be exceeded (i.e. represents a reasonable worst case). Where data on actual avoidance rates of particular species/groups have been established, then this has usually enabled a higher rate to be safely applied. For example, SNH has recently recommended a move from a 99% rate to 99.8% for geese based on recent research (Douse 2013). SNH now recommends using a value of 99.8% as an avoidance rate for geese (Douse 2013), 99.5% for divers and several seabird species, 99% for several birds of prey (including Golden Eagle and Hen Harrier), and 98% for most other species (Urquhart 2010, SNH 2017).

There is a lack of specific avoidance rate data from South Africa and on the species of concern at Wind Garden Wind Farm. As collision avoidance rates are not yet known for the species of concern, suitable overseas species have been used as proxies, following the same assumptions as made for the previous CRM. The selection of appropriate rates followed the SNH guidance and with reference to the bird-wind farm literature. As recommended in SNH guidance, a precautionary 98% was adopted as the default value (SNH 2017) but the work has also explored whether particular species exhibit similar behaviour to more vulnerable species such as White-tailed Sea Eagle and Kestrel, or such behaviour that would reduce risk (and hence allow higher rates to be used as is recommended by SNH for Golden Eagle and Hen Harrier for example). The collision risk modelling results have been presented for each layout for a range of avoidance rates to inform the assessment but the most appropriate rate to apply in each specific case is also indicated. Most weight has been given to the precautionary SNH position of applying a 98%, though Verreaux's Eagle in particular shares an ecological similarity with Golden Eagle (albeit at a generally higher breeding density), for which SNH recommends a 99% avoidance rate, so applying that rate could be justified (particularly in relation to adult birds). The Golden Eagle is recognised as the Verreaux's Eagle's closest relative (Wink and Sauer-Gürth 2000).

Collision Modelling Results

The results of the collision risk modelling for the proposed 47-turbine layout for each of the six key species are summarised in Tables 8 and 9. Table 8 gives the number of collisions predicted per year based on a range of avoidance rates (95% - 99.5%). Verreaux's and Martial Eagle are both large non-colonial eagles, and the area in proximity to their nest sites has been avoided in the design process (so 'riskier' display flights and early juvenile flights would be less likely to occur in the wind farm). As a result, 99% should be a suitable precautionary avoidance rate to apply (as is used in the UK for Golden Eagle, an ecologically similar species), and this has been used as the primary value to inform the assessment. For the other species the SNH default precautionary 98% value has been used as the primary value to inform the assessment.

Table 8

Collision risk modelling predictions based on 2019-20 data for the Wind Garden Wind Farm 47-turbine layout, applying a range of avoidance rates. Predictions in bold represent the precautionary result used in the further assessment.

Species	**Precautionary predicted number of collisions per year**			
Avoidance Rate	**95%**	**98%**	**99%**	**99.5%**
Martial Eagle	0.209	0.083	**0.042**	0.021
Verreaux's Eagle	0.640	0.256	**0.128**	0.064
Blue Crane	0.565	**0.226**	0.113	0.056
Ludwig's Bustard	0.121	**0.048**	0.024	0.012
Southern Black Bustard	0.086	**0.034**	0.017	0.009
African Fish-eagle	0.147	**0.059**	0.029	0.015

Table 9

Collision risk modelling predictions based on 2019-20 data for the Wind Garden Wind Farm 47-turbine layout: annual risk, year per collision and total collisions in 25 years.

Species	**Martial Eagle**	**Verreaux's Eagle**	**Blue Crane**	**Ludwig's Bustard**	**Southern Black Bustard**	**African Fish-eagle**
Primary avoidance rate used for assessment	*99%*	*99%*	*98%*	*98%*	*98%*	*98%*
Collision prediction (annual)	**0.042**	**0.128**	**0.226**	**0.048**	**0.034**	**0.059**
Years per collision	24.0	7.8	4.4	20.7	29.2	17.0
Total collisions in 25 years:	1.04	3.20	5.65	1.21	0.86	1.47

Collision Modelling Interpretation

Whilst the Band collision model produces a quantitative estimate of the numbers of birds that might collide with the wind turbines, those numbers need to be put into the context of the existing mortality to enable their significance to be assessed. The same level of additional mortality on a population that has a low level of background mortality could potentially have a much more important effect than on a population with a higher level of existing mortality. The collision mortality needs to be assessed in the context of each species population dynamics. In the UK a 1% increase over the baseline mortality is now frequently being used as an initial filter threshold above which there may be a concern with the predicted collision mortality (and hence requiring further investigation). Collision risks below this level are usually considered not to be significant.

It is not currently possible to carry out a detailed population analysis on any of the species at this site because of a lack of data on the key species from local population studies. We are not aware of such information being available (or presented in any other avifaunal assessments in this region. Rather an alternative approach has been taken, making a professional judgement on the collision impacts, informed by the predicted risk from the collision modelling.

No specific guidance or assessment methodology is currently available in South Africa in relation to the determination of levels of predicted additional mortality that should be considered significant, or the appropriate spatial scale at which population impacts should be assessed.

In the case of the predicted collision risks from the Wind Garden Wind Farm, it is clear that the predicted levels of additional mortality are very low numerically, and as such it can be reasonably concluded without any detailed population analysis that these effects would not be significant, at either the regional or the national scale. Notwithstanding this, it is still recommended that mitigation measures should be implemented to minimise the risk of collision to Martial Eagle and Verreaux's Eagle in particular, so that the Wind Garden Wind Farm site makes as small as possible a contribution to the overall cumulative risk from the cluster as a whole.

8.3 Disturbance Effects – determine Range Loss

The implementation of the recommended buffers from known eagle nest sites that were put in place primarily to reduce collision risk (1.5km for Verreaux's Eagle and 2.5km for Martial Eagle), also removes the possibility of disturbance to these eagle nest sites. The main residual disturbance issue would therefore be the loss of foraging habitat around the wind farm as a result of displacement. From experience at existing wind farms, birds are likely to avoid the close proximity of the wind turbines. There is uncertainty as to the precise extent of such an effect, but it would be reasonable in the assessment to assume that it could occur. Given results from post-construction studies of other raptor species, particularly Golden Eagle (e.g. Walker et al. 2005), it has been considered that these raptors at this site might have reduced flight activity within 500m of the wind farm (as a reasonable worst case). A 500m buffer has therefore been used in this assessment as a precautionary distance over which disturbance to eagles might reasonably occur. The assessment also considered a smaller potential disturbance zone of 250m around the wind turbines, as the area in which disturbance (and hence displacement of foraging eagles) was more likely to occur (though the assessment focused primarily on the more precautionary 500m buffer).

There are two key raptor species using the wind farm site and breeding within the survey area that make repeated use of traditional nest sites (and hence could be more affected by disturbance), Verreaux's Eagle and Martial Eagle. In order to inform the assessment, range analyses have been carried out for these two species, following the process set out by McGrady et al (1997) developed for Golden Eagle:

Determination of range centre – taken as the active nest location for both species. Where more than one nest location was known for a territory the one closest to the wind farm was used (as a worst case). Where the precise nest location had not been determined the best estimate was used.

Determination of territory boundaries with neighbouring eagles – (i) draw a straight line joining the two range centres, (ii) find a point on this line half-way between centres, (iii) draw a line through the half-way point at right angles to the first line.

Determination of territory boundaries without neighbouring eagles – draw a curved line at a 2.9km (Verreaux's Eagle) or 5.8km (Martial Eagle) radius from the range centre to connect adjacent boundary lines drawn in Step 2. These distances were derived from reported territory sizes for these species ($26km^2$ for Verreaux's Eagle, from Davies 1994, and $106km^2$ for Martial Eagle (van Eeden et al. 2017).

Range loss was predicted by overlaying a 500m and a 250m buffer around the proposed wind turbines onto the estimated ranges and measuring the percentage of each range that could be lost through displacement. The results of this range analysis are summarised in Table 10.

For Verreaux's Eagle, there would be no range loss for the only confirmed active territory within the survey area, the south-east range (as its centre lies more than 2.9km from the Wind Garden Wind Farm site). For the potential Verreaux's Eagle range in the north-west of the area, there would be a 2.7% loss from the Wind Garden wind farm site if there were complete displacement to 500m for the 47-turbine layout and a 1.0% loss for complete displacement to 250m.

For Martial Eagle, there would be a 13.6% loss from the confirmed south-west territory for complete displacement to 500m for the 47-turbine layout, and an 11.1% loss assuming complete displacement to 250m from the turbines. For the other territory to the north-east of the site, there would be no core range loss predicted, as its centre lies more than 5.8km from the Wind Garden Wind Farm site.

Table 10

Predicted Verreaux's Eagle and Martial Eagle range loss for the proposed 47-turbine Wind Garden Wind Farm, assuming complete displacement of both species to 250m or 500m from turbines.

Species	**Range**	**Area of range within 250m of proposed turbines (km^2)**	**% range loss if displaced 250m from turbines**	**Area of range within 500m of proposed turbines (km^2)**	**% range loss if displaced 500m from turbines**
Verreaux's Eagle	SW (active confirmed)	0	0%	0	0%
	NW (potential)	0.26	1.0%	0.70	2.7%
Martial Eagle	SW (active confirmed)	11.8	11.1%	14.4	13.6%
	NE (active confirmed)	0	0%	0	0%

The magnitude of these disturbance impacts (and hence significance of effect) relates to the ecological consequences of any range loss. Ranges of golden eagles have been reported as being abandoned following a 40% loss of habitat (Watson et al. 1987) and reduced productivity associated with a 10-15% loss (Whitfield et al. 2001), though not in all cases and the effects of habitat loss generally can be complex. For a heavily constrained range (for example by a close neighbour or reduced availability of suitable habitat in the wider area), any additional loss is likely to be more ecologically important than an unconstrained range (Whitfield et al. 2001, 2007).

The magnitude of the potential habitat loss for Verreaux's Eagles is clearly very low and would not constitute a significant impact for either of the two ranges in proximity to the wind farm site.

Martial Eagles have much larger ranges than Verreaux's Eagles, so would be predicted to be less vulnerable to range loss. The greater impact would be on the south-west range, but even so this would constitute a loss of only 13.6% of the birds' range. Given the low use that these birds make of this area (from the vantage point survey results and from the range modelling), such a loss would not be considered significant.

Section 9 POLICY AND LEGISLATION

The legislation relevant to this specialist field and development include the following:

» National Environmental Management Act, No 107 of 1998 (NEMA). South Africa's framework environmental act was established to provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state; and to provide for matters connected therewith. Through the Environmental Impact Assessment (EIA) Regulations (2014, as amended), the act requires certain activities and developments to undergo an EIA process. Certain specialist studies are required, depending on the development type, scale and location. In the case of a WEF development, and avifaunal specialist study is required.

» The Convention on Biological Diversity (CBD): dedicated to promoting sustainable development. The Convention recognizes that biological diversity is about more than plants, animals and micro-organisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live. It is an international convention signed by 150 leaders at the Rio 1992 Earth Summit. South Africa is a signatory to this convention and should therefore abide by its' principles.

» An important principle encompassed by the CBD is the precautionary principle which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used as a reason for delaying management of these risks. The burden of proof that the impact will not occur lies with the proponent of the activity posing the threat.

» The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention): aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include 117 (as of 1 June 2012) Parties from Africa, Central and South America, Asia, Europe and Oceania. South Africa is a signatory to this convention.

» The Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA): is the largest of its kind developed so far under the CMS. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguin. The agreement covers 119 countries and the European Union (EU) from Europe, parts of Asia and Canada, the Middle East and Africa.

» The National Environmental Management – Biodiversity Act - Threatened or Protected Species list (TOPS).

» The Provincial Nature Conservation Ordinance (Nature Conservation Ordinance 19 of 1974) identifies very few bird species as endangered, none of which are relevant to this study. Protected status is accorded to all wild bird species, except for a list of approximately 12 small passerine species, all corvids (crows and ravens) and all Mousebirds.

» The Civil Aviation Authority has certain requirements regarding the visibility of wind turbines to aircraft. It is our understanding that these may preclude certain mitigation measures for bird collisions, such as the painting of turbine blades in different colours.

Section 10 LIMITATIONS AND ASSUMPTIONS

- The presence of the observers on site is certain to have an effect on the birds itself. For example during walked transects, certain bird species will flush more easily than others (and therefore be detected), certain species may sit undetected, certain species may flee, and yet others may be inquisitive and approach the observers. Likewise with the vantage point counts, it is extremely unlikely that an observers sitting in position for four hours at a time will have no effect on bird flight. Some species may avoid the vantage point position because there are people there, and others may approach out of curiosity. In almost all data collection methods large bird species will be more easily detected, and their position in the landscape more easily estimated. This is particularly relevant at the vantage points where a large eagle may be visible several kilometres away, but a smaller Rock Kestrel perhaps only within 800 metres. A particularly important challenge is that of estimating the height at which birds fly above the ground. With no reference points against which to judge, it is exceptionally difficult and subjective. It is for this reason that the flight height data has been treated cautiously by this report, and much of the analysis conducted using flights of all height. With time, and data from multiple sites it will be possible to tease out these relationships and establish indices or measures of these biases.

- Spotting and identifying birds whilst walking is a significant challenge, particularly when only fleeting glimpses of birds are obtained. As such, there is variability between observers' ability and hence the data obtained. The above data is therefore by necessity subjective to some extent. In order to control for this subjectivity, the same pair of observers has been used for the full duration of the project, and it is hoped this can be maintained for the post construction phase. Despite this subjectivity, and a number of assumptions that line transects rely on (for more details see Bibby et al, 2000), this field method returns the greatest amount of data per unit effort (Bibby et al, 2000) and was therefore deemed appropriate for the purposes of this programme. Likewise, in an attempt to maximise the returns from available resources, the walked transects were located close to each Vantage Point. This systematic selection may result in some as yet unknown bias in the data but it has numerous logistical benefits.

- There is still limited information available on the environmental effects of wind energy facilities in South Africa. Only a summary of the results of post-construction monitoring from eight wind farms in South Africa is available (Ralston Paton et al. 2017), as well as information from BirdLife South Africa (BLSA) in the form of a presentation (2017a). Estimates of impacts are therefore also based on knowledge gained internationally, which should be applied with caution to local species and conditions;

- While sampling effort was conducted as recommended in the guidelines, it represents only a small fraction of actual time, and to achieve statistically powerful results it would need to be increased beyond practical possibilities. The data was therefore interpreted using a precautionary approach.

Section 11 ASSESSMENT OF RISK TO PRIORITY SPECIES

Table 11 presents the six Priority Species (the species marked in bold from Table 3) occurring on the proposed Wind Garden Wind Farm site and a qualitative assessment of the risk for each type of impact (pre-mitigation) if the proposed wind farm is developed. This assessment has been made based on the data collected on site during this pre-construction bird monitoring programme, reported on above.

The proposed facility could pose risk to the six Priority species in six main ways:

- habitat destruction during construction,
- disturbance during construction,
- displacement due to disturbance from the site once operational,
- collision with turbines,
- power line – collision,
- power line – electrocution.

The five Priority species in terms of their occurrence on the site and their Conservation status were used for the assessment while African Fish eagle (Table 3) was added because of an active nest on the southern edge of the Wind Garden site. A discussion of each species follows Table 11.

Note: In this context, risk does not equal significance. Risk to a species as described in this section can be High, but if that species is not Red Listed it is possible that the significance of impacts on the species could ultimately be Moderate (see below).

Table 11

Final priority species with a qualitative assessment of risk to each species, for the six potential impacts, at the Wind Garden Wind Farm site, based on the predicted CRM and predicted Range Loss. All five Priority species while African Fish eagle was included due to the active nest near the southern edge of the Wind Garden.

Species	Power line Risk		500m buffer % Range loss	250m buffer % Range loss	Habitat Loss	Disturbance Effect		*Avoidance rate*	Collision prediction (annual)	Years per collision	Total collisions in 25 years:	Turbine collision Risk
	collision	electro-cution				Construction	Operation					
Blue crane	moderate	low			moderate	moderate	moderate	98%	0,226	4,4	5,65	moderate
Ludwig's bustard	moderate	low			moderate	moderate	moderate	98%	0,048	20,7	1,21	low
Southern black bustard	Low	low			low	moderate	low	98%	0,034	29,2	0,86	low
Martial eagle	Low	low	13,6	11,1	moderate	moderate	moderate	99%	0,042	24	1,04	low
Verreaux's eagle	Low	low	2,7	1	moderate	moderate	moderate	99%	0,128	7,8	3,2	moderate
African fish-eagle	Low	low			low	moderate	low	98%	0,059	17	1,47	low
Wind Garden	low	low			low	moderate	low					low

Blue Crane

The Blue Crane is classed as Near-threatened regionally by Taylor et al (2015) and Vulnerable globally (IUCN, 2017). It is almost endemic to South Africa (a small population exists in Namibia) and is our national bird. It has the most restricted range of any of the 15 crane species worldwide. The population is estimated at a minimum of 25 000 birds (Taylor et al, 2015).

This species is highly susceptible to collision with overhead power lines, and more recently has been recorded as turbine collision fatalities at least three operational wind farms in SA (Ralston-Paton et al 2019). At one of these wind farms, in the Overberg of the Western Cape, Blue Crane abundance on site is high, and the relatively low number of fatalities recorded indicates that the species may be reasonable adept at avoiding turbine collisions. No known fatalities have been recorded at Eastern Cape Wind Farms.

At Wind Garden, this species was recorded in relative low numbers by all data collection methods. Most important of these are flying birds, 19 records during the 14-months of surveys. No large roost sites were recorded but they roost at night in pairs and small groups in or near small dams on the proposed site.

Based on its' prevalence on site and low flight activity in combination with evidence that the species is fairly adept at avoiding collisions.

This species is considered at Moderate risk.

Ludwig's Bustard

The Ludwig's Bustard is classified as Vulnerable by Taylor et al (2015) and Near-threatened globally (IUCN 2017) and its population and range has decreased over the last few decades due to habitat destruction and disturbance.

The southern African population of this species is estimated at < 10 000 birds (Allan 2003, in Hockey et al, 2005). The arid or semi-arid areas of Eastern Cape, to our knowledge, has a relative moderate abundance.

Ludwig's Bustard could be susceptible to all five possible impacts: habitat destruction, disturbance and displacement, collision with turbine blades and power lines. In terms of collisions, this species is well known to be vulnerable to collision with overhead power lines (for e.g. Shaw, 2009). Although an overhead cable is very different to a wind turbine blade, this does give us cause to believe that they could be at risk of collision with the turbines. The 2019 review by Ralston-Paton et al. recorded only one turbine fatality. It does remain a concern though until bustards and turbines can coexisted. In the Western block of the cluster (not near the Wind Garden Wind Farm), this species is often seen near centre-pivot croplands but always on the edge of these sometimes-green areas.

We recorded the species at relative low flight rates at the Wind Garden Wind Farm site, only seven flights in the 14-month period. The habitat at this proposed site, has very little open areas (Karoo shrublands) therefore naturally, these birds are likely restricted by the high coverage of Thicket bushveld vegetation in the area.

Based on the species' conservation status, the low importance of this site, and its susceptibility to collision with overhead power lines, we consider this species to be at Moderate risk at this site, however the recorded numbers were low.

Southern Black korhaan

Five Southern Black Korhaan (Vulnerable) mortalities have been recorded at South African wind farms (Ralston-Paton et al. 2019). The species was only recorded flying on site, 7 times in the 14-month period. This korhaan live and forage mainly by walking on the ground but it displays by making short, low display flights, also this korhaan is flushed reasonably easy in the approach and disturbance of humans. These probably makes them susceptible to turbine collisions. However they seem not to be prone to the powerline conductor collisions (van Rooyen 2004).

We conclude that it is at Low risk at Wind Garden Wind Farm.

Martial eagle

The Martial Eagle is classified as globally Vulnerable and regionally Endangered (Taylor et al 2015, IUCN 2017). Martial Eagle has proven susceptible to collision with wind turbines (Ralston-Paton, Smallie, Pearson & Ramalho, 2017) particularly in close association with nests (MacEwan & Smallie, 2016; Simmons & Martins, 2016). This is a wide-ranging species, which can best be protected from wind turbine collision risk close to its' breeding sites. Two breeding sites exists just south and northeast of the WEF site but outside the buffered area as described earlier.

Despite the proximity of this nest, we have recorded this species flying on the proposed WEF site only four times (4 birds) in the 14-month period. This species' general presence in the broader area, location of two breeding sites (buffered), conservation status and susceptibility to wind turbine collisions (and electrocution and collision on overhead power lines) are all factors which render it at higher risk at a new wind farm site.

However given that we have already applied risk avoidance through the application of a 2.5km buffer around the nest site, we conclude that it is at Low risk at the Wind Garden Wind Farm.

Verreaux's eagle

Verreaux's Eagle is ranked third on the South African Birds and Renewable Energy Specialist Group's priority list and has been confirmed as vulnerable to turbine collisions. During the first year of monitoring at operational wind farms in South Africa, one wind farm recorded four Verreaux's Eagle fatalities in the first year of operation (Ralston-Paton et al. 2017). The fatalities occurred a considerable distance (at least 3.5 km) from suitable Verreaux's Eagle breeding habitat and on relatively flat ground (Smallie 2015). A single adult fatality occurred at another wind farm in August, again some distance from a nest 3.8 km away (Ralston-Paton et al. 2017).

By 2019, six mortalities of Verreaux's Eagle had been recorded at wind farms in South Africa (BLSA 2019). Some of these fatalities were unexpected as they occurred in areas not identified as sensitive during pre-construction monitoring. Therefore it is important to consider that collisions may not necessarily occur where predicted, and that they can occur away from areas perceived to be preferred use areas. However on the Wind Garden Wind Farm site, the necessary avoidance risk measures were taken, by using 1.5km buffers from the two known nest areas.

We conclude that this species is at Low risk at the Wind Garden Wind Farm.

African Fish eagle

Although not Red Listed, this is a species to consider important for this assessment because of the nest on the edge of the development site. It has proven susceptible to wind turbine collision on another wind farm elsewhere (Ralston-Paton et al 2017). It was recorded once flying on site in the 14-month period. These eagles are prone to electrocution on lower voltage pole structures and an existing 22kV power line crosses the area near the nest site (south of Brakkloof homestead).

We conclude on that basis that this species will be at Low risk at the Wind Garden Wind Farm.

Section 12 IMPACT ASSESSMENT

Avifaunal risk avoidance already implemented

The avoidance of avifaunal risk at proposed cluster of renewable energy facilities has been an iterative process resulting from ongoing communication between specialists, the developer and the EAP. The degree to which mitigation or avoidance can make a material difference to avifaunal risk at a wind farm is higher earlier in the project. In the case of proposed cluster, most avifaunal risk avoidance has already been accepted and implemented by the developer at the time the layout was presented for assessment in this Specialist report.

The various avoidance measures already applied are therefore described here, to ensure that this is understood:

The adaptation of the turbine layout to accommodate Martial and Verreaux's eagle nest sites and in particular a large precautionary buffer, 2.5km and 1.5km, around them.

The sensitive features mainly consist of raptor nest sites.

Impacts of the Wind Garden Wind Farm on birds

Using the data and risk assessment for each species described above in Table 11 as the basis, the potential impacts of the proposed Wind Garden Wind Farm site have been formally assessed and rated according to the criteria (supplied by Savannah and shown in Appendix A). Tables 12.1 to 12.8 present these assessments.

12.1 Habitat destruction during Construction

Based on the average of 0.5 hectares per turbine of land that will be and using the maximum of 47 turbines to be constructed over the Wind Garden Wind Farm, it is estimated that approximately 66.6ha of land will be transformed for turbines, hard stands, roads, switching station and electrical cables at the Wind Garden site (from a total area of 4336ha).

Therefore 1.54% of the natural vegetation will be removed, which will consist mainly of Thicket vegetation. It will have a Low effect on small bush birds. While in terms of Priority Species that prefer open habitat, the impact will also be LOW, especially for three large terrestrial birds - Blue Crane, Southern Black Korhaan and Ludwig's bustard.

The potential percentage range loss was calculated to be 13.6% for Martial eagle for the affected nest and 2.7% for Verreaux's eagle for the affected nest, on the proposed Wind Garden site, assuming complete displacement to 500m from turbines (Table 10).

The significance of the impact on all six species is rated LOW (from Table 12.1).

Table 12.1 Impact Table for habitat loss of Priority Species during the construction.

Project phase: Construction		
Nature: Destruction of habitat used by birds during Construction (removal of natural vegetation)		
	Without mitigation	**With mitigation**
Extent	Local (3)	Local (2)
Duration	Permanent (3)	Permanent (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (4)	Probable (3)
Significance	**Medium (48)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	YES – Areas disturbed during construction can be rehabilitated after construction and after decommissioning	
Irreplaceable loss of resources?	NO – rehabilitation of habitat is possible. There is extensive avifaunal habitat on the project site and beyond that which will remain intact and be available for use.	
Can impacts be mitigated?	YES –The total area of impact (and thus the severity rating) can be minimised	
Mitigation: - A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of habitat; - Environmental Control Officers to oversee activities and ensure that the site-specific construction environmental management plan (CEMP) is implemented and enforced; - High traffic areas and buildings such as offices, batching plants, storage areas etc. should where possible be situated in areas that are already disturbed; - Existing roads and farm tracks should be used where possible; - The minimum footprint areas of infrastructure should be used wherever possible, including road widths and lengths; - No turbines should be constructed in no-go areas, while associated infrastructure should be avoided where possible in these areas; - Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final road and power line routes as well as the final turbine positions, to identify any nests/breeding activity of sensitive species, as well as any additional sensitive habitats within which construction activities may need to be excluded; Should priority species nests be located, a protective buffer may be applied, within which construction activities may need to be restricted during the breeding season for that species; - Any clearing of large trees (>5m in height) especially stands of large alien trees (e.g. Blue Gum or Pine) on site should be approved first by an avifaunal specialist. Before, clearing, the location and description of the trees should be provided to the specialist, who may request the ECO to inspect the trees for any nests prior to clearing. . - The construction Phase ECO, the onsite Environmental Manager, and the client's representative on site (e.g. the resident engineer) are to be trained to identify Red Data and priority bird species, as well as their nests. If any nests or breeding locations for this species are located, an avifaunal specialist is to be contacted for further instruction; and - Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a specialist and included within the CEMP.		
Residual Impacts:		

The rehabilitation of disturbed areas will help to mitigate the impact of the habitat transformation to some extent, but the fragmentation of the habitat due to the construction of the internal road network cannot be mitigated, and will remain an impact for the duration of the operational life-time of the facility.

12.2 Disturbance of birds during construction

The avoidance measures already considered and applied to the buffer for the Martial Eagle, Verreaux's eagle and African Fish eagle nests and territory and the avoidance of placement of infrastructure within these buffer areas have reduced the significance of this impact.

It is likely that all these Priority Species will stay clear of areas under construction, which includes Blue Crane, Southern Black Korhaan, Ludwig's bustard, Martial eagle, Verreaux's eagle and African Fish eagle.

Based on the above, we consider this impact to be Moderate for all birds at this proposed site during Construction period (from Table 12.2).

Table 12.2 Impact Table for disturbance of Priority Species during construction.

Impact phase: Construction		
Nature: Disturbance and Displacement of Birds		
	Without mitigation	**With mitigation**
Extent	Local (2)	Low (2)
Duration	Short-term (3)	Short-term (3)
Magnitude	Moderate (6)	Low (5)
Probability	Probable (5)	Probable (4)
Significance	**Medium (55)**	**Medium (40)**
Status (positive or negative)	Negative	Negative
Reversibility	PARTIALLY – In some areas of the operational WEF, birds disturbed during construction may return to their activities after completion of construction.	
Irreplaceable loss of resources?	POSSIBLE – Disturbance and potential displacement of birds may impact breeding and therefore impact on the population of a species.	
Can impacts be mitigated?	PARTIALLY– Some disturbance is inevitable with the activities associated with construction.	
Mitigation: - A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. Environmental Control Officers to oversee activities and ensure that the site-specific construction environmental management plan (CEMP) is implemented and enforced;		

- Prior to construction, the avifaunal specialist should conduct a site walkthrough, covering the final infrastructure (e.g. road, substation, offices, turbine positions etc.) to identify any nests/breeding/roosting activity of sensitive species, as well as any additional sensitive habitats. The results of which may inform the final construction schedule, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise. Following the specialist site walkthrough, any additional sensitive zones and no-go areas (e.g. nesting sites of Red Data species) are to be designated by the specialist who should advise on an appropriate buffer, within which construction activities may not occur during key breeding times; - The construction Phase ECO, the onsite Environmental Manager, and the client's representative on site (e.g. the resident engineer) must be trained by an avifaunal specialist to identify the potential priority species and Red Data species as well as the signs that indicate possible breeding by these species. The ECO must, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed; - During the construction phase, an avifaunal specialist must conduct a nest survey/exploration of the WEF site. This should be done during and after, the breeding season (i.e. approximately in April and again in June) of large Eagles (e.g. Martial and Verreaux's Eagle). The aim will be to locate any nest sites not yet found, so that these may continue to be monitored during the construction and operation phases, along with the monitoring of already identified nest sites (see point below); and - Appoint a specialist to design and conduct monitoring of the breeding of raptors at the various nests identified to date as well as any additionally located nests (see point above). This monitoring can be combined with the exploration described above and should be conducted on two occasions (i.e. approximately in April and again in June) across each calendar year, during construction. The aim will be to monitor any disturbance to or displacement of the breeding birds during construction.
Residual Impacts: It is highly likely that most priority species will be temporarily displaced in the development area during the construction activities, due to the noise and activity. The significance will remain at a medium level collectively for priority species after mitigation.

12.3 Turbine collision fatalities during Operation

Human caused fatalities of Red listed or otherwise threatened bird species are always a cause for concern and should be avoided as far as possible. Estimated fatalities are therefore predicted and a cause for concern. There are currently no established thresholds for acceptable impacts on bird species in South Africa. The Collison Risk modelling for six Priority species, Ludwig's Bustard, Blue

Crane, Southern Black korhaan, Martial Eagle, Verreaux's eagle and African Fish eagle is given in Table 9.

The significance is Low to Moderate for six species (from Table 12.3).

Table 12.3 Impact for Priority species mortality caused by collision with wind turbine blades.

Impact phase: Operation		
Nature: Bird mortality caused by collision with wind turbine blades and/or towers		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (3)
Probability	Probable (4)	Probable (3)
Significance	**Medium (52)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	PARTIALLY – Bird fatalities caused by collisions with turbines are irreversible. However local populations may recover if the occurrence of deaths is low.	
Irreplaceable loss of resources?	POSSIBLY – Collisions with turbines cause bird fatalities, which could significantly impact local and/or regional populations of certain species.	
Can impacts be mitigated?	PARTIALLY – The probability of the impact can potentially be reduced through informed placement of turbines.	
Mitigation: - The minimum number of turbines should be constructed to achieve the required MW output. It is preferable to have a reduced number of turbines with larger rotor compared with more turbines with a smaller rotor; - Turbines must not be constructed within any designated No-Go Areas. The turbine blade should not protrude into these areas, and therefore the bases should be constructed with sufficient distance from these areas to prevent this; - The hierarchy of sensitivity zones identified should be considered where possible with preferential placement of turbines in areas with no sensitivity score, followed by low sensitivity, medium sensitivity and medium-high sensitivity; - Develop and implement a carcass search programme for birds as a minimum during the first three years of operation followed by year 5, 10, 15, 20 and 25, in line with the applicable South African monitoring guidelines; - Develop and implement a minimum 12-month post-construction bird activity monitoring program that mirrors the pre-construction monitoring surveys completed by Ecology Consulting/ECDC and is in line with the applicable South African post-construction monitoring guidelines. This program must include thorough and ongoing nest searches and nest monitoring. The results of this monitoring and the carcass searchers should advise the need for any additional ongoing activity monitoring or nest surveys beyond the 12-month period; - Conduct frequent and regular review of operation phase monitoring data (activity and carcass) and results by an avifaunal specialist. This review should also establish the requirement for continued monitoring studies (activity and carcass) throughout the operational and decommissioning phases of the development;		

- The above reviews should strive to identify sensitive locations at the development including turbines and areas of increased collisions with power lines that may require additional mitigation. If unacceptable impacts are observed (in the opinion of the bird specialist after consultation with BLSA, relevant stakeholders and an independent review), the specialist should conduct a literature review specific to the impact (e.g. collision and/or electrocution) and provide updated and relevant mitigation options to be implemented. Mitigations that may need to be implemented (and should be considered in the project's financial planning) include: a) Onsite and off-site habitat management. A habitat management plan which aims to prevent an influx/increase in preferred prey items in the turbine area due to the construction and operation activities, while improving raptor habitat and promoting prey availability away from the site. b) Implementing a carcass management plan on the WEF site, to remove any dead livestock as soon as possible, to reduce the likelihood of attracting scavenging juvenile eagles to the WEF site. c) Using deterrent devices (e.g. visual and noise deterrents) and/or shutdown systems e.g. Automatic bird detectors (e.g. automated camera-based monitoring systems – McClure et. al. 2018) if commercially available; or Radar Assisted Shutdown on Demand (RASOD) to reduce collision risk. d) Identify options to modify turbine operation (e.g. temporary curtailment or shut-down on demand) to reduce collision risk if absolutely necessary and if other methods have not had the desired results. e) Possibly offset programmes if no suitable mitigation measures can be implemented to reduced impacts sufficiently.
Residual Impacts: The impact is likely to persist for the operational life-time of the project. Implementation of the proposed mitigation measures should reduce the probability and severity of the impact on priority species to such an extent that the overall significance of residual impact should be reduced to low.

12.4 Disturbance and Displacement of birds during operations

The indications from operational wind farms are that this impact may be of fairly low importance, although it is acknowledged that a longer term or more detailed means of measuring this impact may be required. Also disruption of flight paths and local movement patterns of Priority Species during operation of the WEF. Bird might use more energy to get to their normal feeding grounds by flying around the WEF (Table 12.4).

The significance of the impact will be LOW for all six species during Operation.

Table 12.4 Impact for the displacement due to disturbance of Priority Species during Operation.

Impact phase: Operation		
Nature: Displacement due disturbance of birds during Operation		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (2)
Significance	**Medium (39)**	**Low (22)**

Status (positive or negative)	Negative	Negative
Reversibility	NO: While it is expected that most species will continue to use the wind farm area, some species might do so in reduced densities, primarily due to the fragmentation of the habitat.	
Irreplaceable loss of resources?	YES: While it is expected that most species will continue to use the wind farm area, some species might do so in reduced densities, primarily due to the fragmentation of the habitat.	
Can impacts be mitigated?	YES: To some extent by ensuring that no impacts occur outside the immediate footprint	
Mitigation: The recommendations of the Ecological Impact Assessment must be strictly adhered to. Where possible existing access roads should be used and upgraded during the construction while the construction of new roads should be kept to a minimum. Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist.		
Residual Impacts: The rehabilitation of disturbed areas will help to mitigate the impact of the habitat transformation to some extent, but the fragmentation of the habitat due to the construction of the internal road network cannot be mitigated, and will remain an impact for the duration of the operational life-time of the facility.		

12.5 Power line impacts on birds

Birds can collide with power line conductors or get electrocuted on overhead power lines (although unlikely) or on substation and switching gear during the operation of the Wind Garden Wind Farm. Although only a ONE kilometre stretch of new power line will be built between the collector substation and the switching station therefore unlikely. Large terrestrial birds are more prone to colliding with power line conductors (Table 12.6) while large raptors are more likely to get electrocuted on power line poles and structures (Table 12.5).

The short distance of the new power line and pole structure will result in the Electrocution impact to be LOW for all six species during Operation.

Table 12.5 Assessment of Electrocution of Priority Species on power lines during operations.

Impact phase: Operation				
Nature: Direct mortality of priority species due to electrocution associated with the power line at the wind farm development area.				
	Without mitigation		**With mitigation**	
Extent	Local	2	Local	2
Duration	Permanent	5	Permanent	5
Magnitude	Low	3	Low	3
Probability	Probable	3	Probable	2
Significance	**Medium**	**30**	**Low**	20
Status (positive or negative)	Negative		Negative	

Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:
- Placement of electrical infrastructure should consider avifaunal sensitivity zones and avoid areas of higher sensitivities where possible;
- All new internal power lines linking the wind turbine generators to each other on site must be placed underground where technically and environmentally feasible. Certain spans can only be above ground if it is impossible and completely unfeasible to bury them or if there is a reasonable other environmental aspect present which prevents them being buried (e.g. a sensitive wetland area);
- Any new overhead power lines must be of a design that minimises electrocution risk by using adequately insulated 'bird friendly' monopole structures, with clearances between live components and possible bird perches (e.g. cross arms) of 1.8 m or greater. Each pylon should be fitted with a safe bird perch; and
- Develop and implement a carcass search programme for birds during the first two years of operation, in line with the South African monitoring guidelines (Jenkins et al. 2015). This program must include monitoring of overhead power lines.

Residual Impacts:
The electrocution risk will persist as long as the lines are operational, but it can be completely eliminated at the onset, if bird-friendly structures are used.

12.6 Power line collision impacts

As from above, and mainly because the short distance of the new power line, the Collision of bird impact with power line conductors will be LOW for all six species during Operation.

Table 12.6 Assessment of Priority Species collision on overhead power line during operation.

Impact phase: Operation

Nature: Direct mortality of priority species due to collisions with the grid connection power line at the wind farm development area

	Without mitigation		**With mitigation**	
Extent	Local	2	Local	2
Duration	Permanent	5	Permanent	5
Magnitude	Moderate	4	Low	2
Probability	Probable	4	Probable	3
Significance	**Medium**	**44**	**Low**	27
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	Yes		No	
Can impacts be mitigated?	Yes			

Mitigation:
- All new internal power lines linking the wind turbine generators to each other on site must be placed underground where technically and environmentally feasible. Certain spans can only be above ground if it is impossible and completely unfeasible to bury them or if there is a reasonable other environmental aspect present which prevents them being buried (e.g. a sensitive wetland area);
- Placement of electrical infrastructure should consider avifaunal sensitivity zones and avoid areas of higher sensitivities where possible; - If some spans are to be above ground, where possible place new

overhead power lines adjacent to existing power line or linear infrastructure (e.g. roads and fence lines); - Attach appropriate marking devices (BFDs) on all new overhead power lines on the WEF to increase visibility. The advice of a specialist should be sought regarding the type, placement and spacing of the BFDs to be used and the type of pylon structure to be used; and - Develop and implement a carcass search programme for birds during the first two years of operation, in line with the South African monitoring guidelines (Jenkins et al. 2015). This program must include monitoring of overhead power lines.
Residual Impacts: The application of BFDs should reduce the probability and severity of the collision impact to a lower level, but it is likely to remain at the medium level, as the application of BFD's will reduce, but not eliminate the risk.

12.7 The disturbance during the decommissioning (dismantling) phase

Disturbance and displacement of Priority Species during the decommissioning of the WEF turbines infrastructure and the power lines is likely to have a LOW impact on the birds.

Table 12.7 Disturbance of Priority Species due to Decommissioning of Turbines and power lines.

Impact phase: Decommissioning		
Nature: Disturbance and displacement of birds		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Short-term (3)	Short-term (3)
Magnitude	Moderate (5)	Low (4)
Probability	Probable (4)	Probable (3)
Significance	**Medium (40)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Yes but it will be temporary	
Irreplaceable loss of resources?	PARTIALLY– Some disturbance is inevitable with the activities associated with decommissioning.	
Can impacts be mitigated?	YES: To some extent, however the impact will be negated naturally after the closure phase.	
Mitigation: - A site specific Environmental Management Plan must be implemented for the decommissioning phase. - Environmental Control Officers to oversee activities and ensure that the site specific EMP is implemented and enforced; - The appointed Environmental Control Officer (ECO) must be trained by an avifaunal specialist to identify the potential priority species and Red Data species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), activities within 500 m of the breeding site must cease, and an avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed.		
Residual Impacts:		

The dismantling activities associated with all wind farm infrastructure (turbines and power lines) could result in the short-term displacement of priority species from the site. The implementation of the proposed mitigation measures will greatly reduce the probability of disturbance of specifically raptors breeding on the power line.

12.8 Cumulative Impacts of wind energy facilities on birds in the wider area

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

Using a 30km radius, Wind Garden will be 10km away from one operational WEF, Waainek, to the southeast and approximately 15km away from the authorized but not yet operational Albany WEF to the northeast, and neighbouring to the east, the proposed Fronteer WEF. Figure 17 shows a map of the known wind farms within a 30km radius of Wind Garden.

Available operational monitoring reports from these wind farms were obtained from BLSA and were reviewed. The Waainek WEF 12-month Post-construction avifaunal report (Sholto-Douglas et al. no date - 2018) was obtained and considered. However no cumulative bird assessment was done for the Albany WEF, according to its Pre-construction Avifaunal report (Smallie 2020).

The Waainek report shows small changes on bird abundance and species composition and recorded relatively low mortalities but highlight that mortalities of Jackal buzzard are of concern and could be the result that this species may be attracted to turbines to scavenge on small bird carrion underneath turbines.

Cumulative Assessment

The cumulative effect of proposed Wind Garden development along with the actual and predicted impacts of the operational Waainek WEF, the Albany WEF and future impacts of the proposed Fronteer wind farm, has the potential to affect various bird species at a higher significance than the impacts of the proposed Wind Garden alone. Table 20 list the Key species that may possibly be impacted upon cumulatively. Of these, Blue Crane, Martial eagle and Verreaux's eagle are of primary concern, as they might suffer from turbine collisions.

Table 20 also list the calculated Cumulative Collision Risk for each priority species at different Avoidance Rates for Wind Garden, Fronteer and the Total East block, which included the cumulative effects of Waainek and Albany WEFs.

Here it is important to refer back to page 57, the 'Collision Modelling Interpretation'. In the UK a 1% increase over the baseline mortality is now frequently being used as an initial filter threshold above which there may be a concern with the predicted collision mortality (and hence requiring further investigation). Collision risks below this level are usually considered not to be significant.

No specific guidance or assessment methodology is currently available in South Africa in relation to the determination of levels of predicted additional mortality that should be considered significant, or the appropriate spatial scale at which population impacts should be assessed.

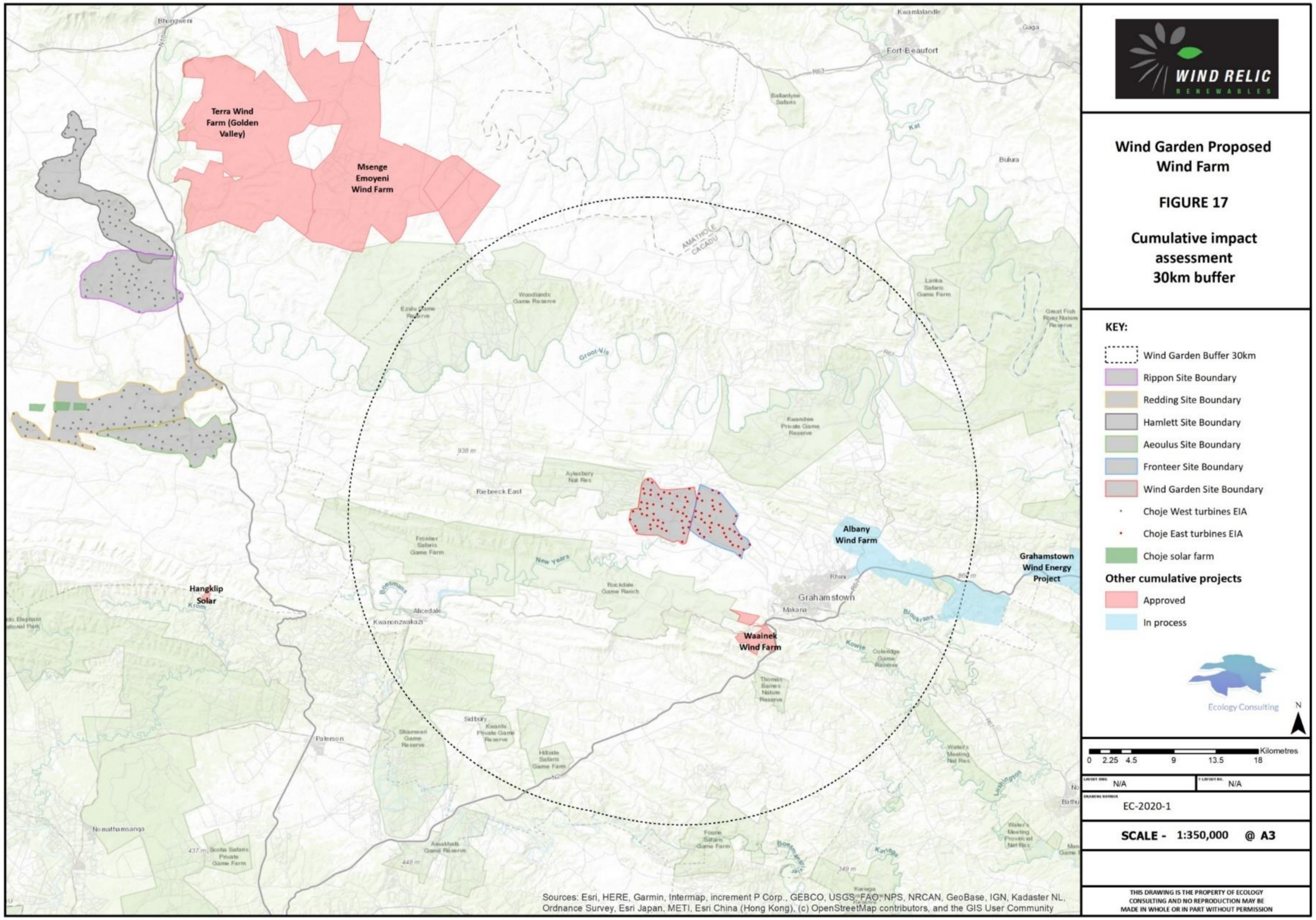
In the case of the predicted collision risks from the Wind Garden Wind Farm, it is clear that the predicted levels of additional mortality are very low numerically, and as such it can be reasonably concluded without any detailed population analysis that these effects would not be significant, at either the regional or the national scale. Notwithstanding this, it is still recommended that mitigation measures should be implemented to minimise the risk of collision to Martial Eagle and Verreaux's Eagle in particular, so that the Wind Garden Wind Farm site makes as small as possible a contribution to the overall cumulative risk from the cluster as a whole.

In conclusion, if all operational and proposed facilities are considered and all appropriate and effective mitigation as outlined by their respective specialists, and if all mitigation measures outlined in this report are implemented for the proposed Wind Garden development, the cumulative impact after mitigation is likely to have a LOW significance.

Table 12.8 Cumulative Impact Table.

Nature: Cumulative impact of all impacts on avifauna at all operational and proposed wind farms in the region.		
	Overall impact of the proposed project considered in isolation	***Cumulative impact of the project and other projects in the area***
Extent	Local (2)	High (4)
Duration	Permanent (5)	Permanent (5)
Magnitude	Medium (2)	Medium (3)
Probability	Probable (3)	Probable (3)
Significance	**Low (27)**	**Medium (36)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: All mitigation measures listed above and recommended for other projects listed above must be adhered to. The applicant and operational neighbouring projects should proactively collaborate in turbine collision research and mitigation if incidents on Priority species occur. Data must be shared, and research efforts co-ordinated to reduce mortalities in the region of the species above, and where applicable and agreed, effort must be made to assist in funding of such research.		

Mitigation for cumulative impacts warrant a cumulative approach to mitigation to achieve maximum effectiveness. In this area, Wind Garden and Fronteer would be the second and third wind farms if authorised, therefore an opportunity exist to initiate a Stewardship programme by the local environmental groups. We recommend that the companies/wind farm owners should collaborate for the purpose of further research and mitigation into the impacts of wind farms on priority species in the Grahamstown area.
Residual Impacts: The impact should be less severe at a regional and national level, due to the large distribution ranges of the species, but should nonetheless be carefully monitored. Although the calculated significance is on the low border of MEDIUM, if all the mitigation measures proposed for the various renewable projects are strictly implemented, the cumulative impacts of these developments, including the proposed Wind Garden WEF, should be reduced to LOW.



Terra Wind Farm (Golden Valley)
Msenge Emoyeni Wind Farm
Albany Wind Farm
Grahamstown Wind Energy Project
Hangklip Solar
Waainek Wind Farm
Grahamstown
Riebeeck East
Alicedale
Fort Beaufort
Paterson
Sidbury
WIND RELIC
Wind Garden Proposed Wind Farm
FIGURE 17
Cumulative impact assessment 30km buffer
KEY:
Wind Garden Buffer 30km
Rippon Site Boundary
Redding Site Boundary
Hamlett Site Boundary
Aeoulus Site Boundary
Fronteer Site Boundary
Wind Garden Site Boundary
Choje West turbines EIA
Choje East turbines EIA
Choje solar farm
Other cumulative projects
Approved
In process
Ecology Consulting
N
0 2.25 4.5 9 13.5 18
Kilometres
N/A
N/A
EC-2020-1
SCALE - 1:350,000 @ A3
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

Table 20 The Cumulative Collision Risk for the entire Choje energy complex, using the Band et al. (2007) collision model, for 11 Priority species. The first row has reference to Wind Garden while the TOTAL EAST if Fronteer is also built, shows the cumulative effect of both WEFs in the East block.

CHOJE CUMULATIVE: COLLISION RISK ALL SITES											
BAND ET AL 2007 COLLISION MODEL (OCCUPANCY)											
	Martial Eagle	**Verreaux's Eagle**	**Cape Vulture**	**Blue Crane**	**Secretary-bird**	**Lanner Falcon**	**Ludwig's Bustard**	**Southern Black Bustard**	**Black Stork**	**Caspian Tern**	**African Marsh-harrier**
Avoidance rate:	*99%*	*99%*	*95%*	*98%*	*98%*	*98%*	*98%*	*98%*	*98%*	*98%*	*99%*
Wind Garden	0.04	0.11	0	0.22	0	0	0.04	0.03	0	0	0
Fronteer	0.15	0.005	0	0.30	0	0.08	0.01	0.02	0	0	0
TOTAL EAST	*0.19*	*0.12*	*0*	*0.52*	*0*	*0.08*	*0.05*	*0.05*	*0*	*0*	*0*

Section 13 RECOMMENDATIONS

Options for Mitigation

Design Mitigation

It is best practice when designing a wind farm to use the baseline ornithological data to inform the design to minimize any ornithological impacts. Where key vulnerable species (such as eagles) use traditional nest sites over many years, it is possible to avoid locating turbines in proximity to known nest sites. For most species it would be expected that flight activity (and hence collision risk) would be higher in closer proximity to nest sites, so leaving a turbine-free buffer around nest sites should reduce collision impacts. At the same time, it should also remove any disturbance impacts on eagles at the nest and reduce any displacement of birds from more important (closer to the nest site) foraging areas.

The surveys have identified a range of key species that could be at risk from the wind farm, including Martial Eagle, Verreaux's Eagle, Blue Crane, Ludwig's Bustard, Southern Black Bustard and Secretarybird. The following design mitigation will be implemented to avoid areas of higher risk to reduce the ornithological impacts of the wind farm, specifically:

Verreaux's Eagle nests - 1.5km buffer - BLSA (2017) has issued specific guidance for this species, recommending avoiding locating turbines within 1.5km of any Verreaux's Eagle nest, and minimising the number of turbines within 3km. These buffers were designated as red (no turbines) and amber (minimise turbines) zones respectively. Where nests were not confirmed, the precautionary assumption has been made that a potential site could be used, and has been treated in the same way as confirmed active sites, as even if not used in 2019 or 2020, it could be in future years;

Martial Eagle nests - 2.5km buffer - there are no specific quantitative recommendations on buffer extent from BLSA for this species. They have a larger home range than the Verreaux's Eagle, with territories of 106km^2 reported for breeding adults (van Eeden *et al*. 2017), equivalent to a range of about 5-6km from the nest, so a core range of 2-3km would be likely. A 2.5km red zone (with no turbines) has been implemented, and a 5km amber caution zone (in which turbine numbers have to be minimised);

The extents of these buffers are shown in Figure 16.

Mitigation of the Construction Phase

The developer has committed to the production of a Construction Method Statement that would be agreed with BLSA and other relevant stakeholders before construction commences and would follow industry best practice.

Designated working areas, storage areas and access routes would be identified at the commencement of the construction phase. The proposed works will be phased so that access tracks/roads are constructed early in the construction programme. Vehicular access would be restricted to designated routes throughout construction and operation as far as possible, thereby minimising potential disturbance of birds.

Several key species potentially vulnerable to construction disturbance were recorded during the surveys, including Verreaux's Eagle, Martial Eagle, Blue Crane, Ludwig's Bustard, Southern Black Bustard and Secretarybird. These should not be disturbed at any nest site during breeding, particularly during the construction phase of the wind farm. Further surveys for these will therefore be undertaken immediately prior to construction if construction were planned for the relevant breeding periods. If any are found then potentially disturbing activities would be suspended until the breeding had been completed within an appropriate zone (dependent on the location of the birds and the species involved, to be agreed with BLSA). This would form part of a Breeding Bird Protection Plan.

Where a disturbance impact on nesting birds is possible, site ground-works (i.e. laying of site tracks, laying out of the temporary construction compound and excavation of the turbine foundations and footings for the substation and meteorological mast) will be scheduled to take place where possible outside the breeding period. Where works affecting habitats that could be used by nesting birds must take place during the breeding season, they will only be carried out following an on-site check for nesting birds by an experienced ecologist. If this indicates that no nesting birds are likely to be harmed by the works, then the works will proceed.

If nesting birds are found to be present, work will not take place in that area until the adult birds and young have left the nest. A protection zone will be clearly marked around the nest site to prevent accidental disturbance or damage.

It is proposed to clearly mark the extent of the working area to minimise the risk of machinery encroaching onto adjacent habitat. It is important to protect habitats adjacent to the working area, since they might be used by nesting birds.

Mitigation of the Operation Phase

Though no significant effects of the Wind Garden Wind Farm have been identified for the site alone, a review of possible operation phase mitigation options has been carried out to inform measures that could reduce the contribution of the Wind Garden Wind Farm to the cumulative impact of the cluster of renewable energy facilities as a whole. This included (a) specific turbine shutdown on demand when risk of collision is imminent, (b) wider restriction of turbine operation in certain seasons/times of days associated with higher risks, (c) habitat management, (d) increasing turbine visibility, (e) use of deterrents and (f) compensation. Of these, (b) and (e) are considered unlikely to provide a deliverable solution at the Wind Garden Wind Farm. With regards to (b), there are not any specific periods/seasons to which risk is restricted, so an economically viable scheme would be unlikely. Option (e) is not a widely proven technique and still in the developmental phase, so could not currently be relied upon. Each of the other four options are discussed below:

Turbine shutdown on demand*:* curtailment of the operation of wind turbines could potentially be a useful mitigation measure to reduce collision risk but is often uneconomic. Recent developments of schemes that have very limited shutdown over short periods has made the implementation of such schemes more viable, and there are now several in operation globally (mainly in southern Europe). These rely either on direct human observers at key risk periods and/or automated detection systems based on radar or video monitoring. Such a system could be implemented at the Wind Garden Wind Farm, if required, to provide a back-up response should the number of collisions actually approach a level that could be significant. However, given the low numbers of predicted collisions, the likelihood of such measures being required is considered to be very low.

Habitat Management (on-site): the raptor food resource must not become more attractive within the wind farm site, drawing foraging birds into the site, as this would increase collision risk. For instance, during access track/road construction, there may be periods of time where imported or excavated aggregate is stockpiled forming potentially attractive habitat for Rock Hyrax. During construction of the wind farm all mounds of aggregate or rocks which could serve as hyrax habitat should be removed prior to the commencement of operation of the turbines and through the operation phase of the wind farm. In addition, the proposed turbine bases should not serve as a refuge for small mammals, and therefore the turbines themselves will not create attractive habitat for potential prey species such a hyrax. As none of key species are predominantly carrion-feeders it is not considered necessary to have a programme of carrion removal from the wind farm site, though this should be reviewed in light of the results of the post-construction monitoring programme.

Habitat management (off-site): in order to address and mitigate the cumulative effects of the Wind Garden Wind Farm in combination with other components of the cluster development, a management programme should be implemented to enhance the food resources away from the wind farms, to reduce eagle flight activity within those wind farms. Management measures that could improve raptor prey populations and habitat over a large area that, if managed appropriately, could deliver a net gain to the local raptor populations. A specific management plan should be drawn up and implemented to integrate the ecological requirements of the local raptors into the management of this area. Measures to enhance local crane and bustard populations should also be considered.

Increased turbine visibility: given the results of the Smøla study (May et al. 2020) that found a significant reduction in White-tailed Eagle collisions following painting of one of the three rotor blades black, it is proposed that all turbines within the amber caution zones (within 3km of Verreaux's Eagle or 5km of Martial Eagle nests) should deploy this mitigation measure, and paint a single blade black during construction. Given this is a novel mitigation, a post-construction monitoring scheme should be implemented to determine its effectiveness.

Additionally, undergrounding of overhead lines in areas used by bustards, cranes and eagles should be considered (e.g. within the red zones and caution areas), or, where that is not possible, measures implemented to ensure that any overhead lines are marked to reduce collision risk.

One option for the implementation of the mitigation measures would be to set a threshold level of mortality (determined from a post-construction monitoring programme) that would trigger specific measures. Such an approach would depend on being able to set a threshold that had a robust scientific base (and hence would require more data than are currently available on the local population status/dynamics).

Instead an alternative, more precautionary approach has been adopted in this assessment, applying a hierarchy of measures to reduce impact magnitude: design mitigation to avoid area of higher flight activity, and mitigation measures to be applied on a precautionary basis ahead of any collisions actually occurring (deploying single back blades in amber zones closer to active eagle nests, implementation of a vulture management plan should these birds be recorded in the area in future years, measures to avoid carrion-feeding birds being attracted into the wind farm, and measures to increase the attractiveness of areas outside the wind farm through habitat enhancement).

These would all be implemented ahead of any collisions occurring at the outset of operation of the wind farm, rather than waiting for collisions to occur.

Mitigation of the Decommissioning Phase

In order to ensure that none of the decommissioning effects on the site's ornithological interest are significant, the same mitigation measures should be implemented as for the construction phase of the development.

Post-construction Monitoring and Adaptive Management

Though the site has been designed to reduce collision risk and other ornithological impacts, there will be some residual risk resulting from the construction and operation of the wind farm. Ongoing monitoring during and after completion of construction should be undertaken as part of an ornithological management plan, and to inform adaptive management through the lifetime of the wind farm. Additional baseline data will help better understand the risk at those specific locations and inform the management of those risks. Adaptive management could, for example, include measures that could be implemented to reduce collision risk further, such as turbine shutdown at higher risk times (if such times could be identified), or if turbines could be installed in these higher risk areas with auto shutdown when large raptors approach collision risk zone. Though unlikely to be necessary for the Wind Garden Wind Farm on its own, such measures may be necessary for the whole cluster development in combination.

Mitigation of Power line incidents

Mitigation of power line impacts is relatively well understood but this includes the compulsory marking of wires/conductors with Bird Flight Diverters for every constructed power line.

Mitigation for habitat destruction consists typically of avoiding sensitive habitats during layout planning. A certain amount of habitat destruction is unavoidable. This report strongly recommends that the wind farm operator make provision for a mitigation contingency budget so that if issues are encountered during operation, the best-suited and proven mitigation at that point in time can be implemented.

Section 14 CONSIDERATION OF ALTERNATIVES

The National Environmental Management Act (NEMA) requires the consideration and assessment of feasible and reasonable alternatives in the BA process. Alternatives can include: Location of the proposed activity; Type of activity; Layout alternatives; Technology alternatives; and No-Go alternative.

No alternatives, other than the No-Go option, have been assessed in this specialist report. The site and layouts considered and assessed in this report are the preferred alternatives.

The No-Go option would result in no wind farm or associated infrastructure being built on site. As a result none of the impacts on birds described above would take place.

The significance of impacts of the No-Go option on avifauna would therefore be Low.

In the ongoing design, various conceptual layouts were considered for the entire wind farm complex but at this stage the final layouts remain as it were in the Project Description (page 10). Micro-siting of the proposed infrastructure will be required as the project progresses and will result in a preferred layout that minimises the predicted negative impacts.

Section 15 CONCLUSION

In conclusion, visualising the many maps of the pre-cons monitoring data collected with the various Methods at the Wind Garden site from June 2019 to August 2020, for the six Priority species (three raptors and three large terrestrial birds) give a better understanding of what areas the two bird groups used, for feeding and breeding, or where they can potentially breed.

Then the pre-cons monitoring data were used to calculate a range of support model and maps such as determining the collision risks, the percentage range loss, the predicted spatial use, etc. This enable us to make confident decisions in terms of nest site buffers, final turbine positions by the avoid potential risk areas. Then we identified six potential impacts and assessed their potential impacts for the six Priority species in six Impact Tables with the Cumulative impacts and make recommendations to mitigate any future risks and negative effects.

Finally we are confident in recommending that the Wind Garden Wind Farm can be authorised subject to the implementation of the recommended mitigation measures.

DATA COLLECTED:

General

Seventy-one bird species were recorded on the Walking transects, generally, only low numbers were recorded but high diversity of small terrestrial species, probably because of the high coverage of Thicket vegetation on site. Twelve water bird species were recorded at the Focal Point surveys, probably because of the semi-aridness of the site and the lack large water bodies/dams.

Raptor Breeding Locations

In the East block and close to the Wind Garden site, three Martial Eagle, two Verreaux's Eagle, three Crowned Eagle, one African Fish-eagle, four Jackal buzzard, two Secretarybird and various smaller raptor nest sites or nest territories were located.

Vantage Point Survey Results

Blue Crane, Ludwig's Bustard, Denham's Bustard, Southern Black Bustard, Secretarybird, Martial Eagle, Verreaux's Eagle, African Fish eagle, Black Harrier and Lanner Falcon are Priority species that flew through the site at rotor height.

Road Transect/Wetland Survey Results

Nine Priority species were noted on the road transect surveys across the Eastern Block as a whole: Blue Crane, Ludwig's Bustard, Denham's Bustard, Southern Black Bustard, Martial Eagle, Verreaux's Eagle, African Marsh-harrier, Black Harrier and Lanner Falcon, though the number of records of all of these were low.

Walking transect Results

The small bird species were mentioned while only four Priority species or species with a higher conservation status were recorded, Blue Crane, Southern Black Bustard, Martial Eagle and African Rock Pipit.

Avifaunal sensitivities

Key species have been identified as those of higher conservation value that would be at risk from the proposed wind energy development. All the raptor breeding sites as mentioned above while large terrestrial birds such as Blue Crane, Denham's Bustard, Southern Black Bustard and Secretarybird were recorded and likely breeding on site but no definite nests were found.

DATA ANALYSED:

Spatial Modelling

The spatial model was used to predict flight activities of Martial Eagle and Verreaux's Eagle across the whole East block study area.

Collision Risk Modelling

One of the main potential ornithological impacts of concern for the Wind Garden Wind Farm is collision with the operational turbines. The CRM was carried out for all six key species of conservation concern that were observed flying within the collision risk zone at rotor height; Martial Eagle, Verreaux's Eagle, Blue Crane, Ludwig's Bustard, Southern Black Bustard and African Fish-eagle.

Range loss

The potential range loss for the Verreaux's Eagle nest site in the north-west of the site, would be a 2.7% loss from the Wind Garden wind farm site if there were complete displacement to 500m for the 47-turbine layout and a 1.0% loss for complete displacement to 250m. While for Verreaux's Eagle nest site south-east as its centre lies more than 2.9km, no range loss is predicted.

For Martial Eagle, there would be a 13.6% loss from the confirmed south-west territory for complete displacement to 500m for the 47-turbine layout, and an 11.1% loss assuming complete displacement to 250m from the turbines. For the other territory to the north-east of the site, there would be no core range loss predicted, as its centre lies more than 5.8km from the Wind Garden Wind Farm site.

RISK TO PRIORITY SPECIES ASSESSED:

The six Priority Species occurring on the proposed Wind Garden Wind Farm site were separately qualitatively assessed for the six potential impacts (pre-mitigation) if the proposed wind farm is developed.

IMPACTS ASSESSED:

Avifaunal risk avoidance was implemented as an ongoing process during the year with the removal and repositioning of turbines until the final layout. Impact Table for each of the six potential impacts on the six Priority species were assessed, these included, Habitat loss, disturbance during construction and during operation, turbine collision risk, powerline collision risk and the electrocution risk on powerline poles.

Cumulative Assessment

The cumulative effect of the proposed Wind Garden Wind Farm development along with the predicted impacts of the future Fronteer Wind Farm and the post-construction impacts of the operational Waainek wind farm. Key species that may possibly be impacted upon cumulatively include Blue Crane, Ludwig's Bustard, Southern Black bustard, Secretarybird, Martial Eagle and Verreaux's' Eagle.

Assessment of Residual Effects

The residual ornithological effects of the Development will be a non-significant loss of a small amount of habitat to turbine bases and tracks/roads, and a non-significant risk of disturbance and collision.

Using evidence from existing wind farms it is considered unlikely that the residual impacts will have any long-term impact on the integrity of the study area's ornithological features or the conservation status of the species found here.

Overall, there are not likely to be any significant residual impacts on ornithology as a result of the Development.

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APPENDICES

Appendix 1 Choje WEFs – Survey Hours for VP surveys

– East block (Wind Garden and Fronteer)

Appendix 2 Choje Wind Farms – Spatial Distribution Modelling of Key Species

Appendix A Impact Assessment Methodology from Savannah

Appendix B Avifaunal Management Plan

Appendix C Declaration of Specialist

Appendix D CV of the Specialist

Appendix E Statement

- referring that the pre-construction bird monitoring started before the publishing of the Government Gazette 43110 (Published in Government Notice No. 320) of 20 March 2020 “Protocol for The Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Avifaunal Species by Onshore Wind Energy Generation Facilities where the electricity output is 20 Megawatts or more”

APPENDIX 1: CHOJE WIND FARMS (EAST)

SURVEY HOURS FOR VANTAGE POINT SURVEYS – EASTERN BLOCK (WIND GARDEN AND FRONTEER)

Wind Farm	VP	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec 2019	Jan 2020	Feb	Mar	Apr	May	Jun	Jul	Aug 2020	TOTAL HRS
Fronteer	1	4	4	4	4	4	4	4	4	4	4	0	8	4	0	0	52
Fronteer	2	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	48
Fronteer	3	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	48
Wind Garden	4	4	5	4	4	4	4	4	4	4	4	0	4	4	0	0	49
Both	5	5	4	4	4	4	4	4	4	4	4	0	4	4	0	0	49
Wind Garden	6	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	48
None	7	4	4	4	4	4	4	4	4	4	4	0	13.5	4	8	8	73.5
Wind Garden	8	4	4	4	4	4	4	4	4.5	4	4	0	4	4	0	0	48.5
None	9	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	48
Wind Garden	10	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	48
Fronteer	11	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	48
None	12	0	0	4	4	4	4	4	4	4	7	0	4	4	8	8	59
None	13	0	0	4	4	4	4	4	4	4	4	0	4	4	8	8	56
None	14	0	0	4	4	4	4	4	4	4	4	0	4	4.5	8	8	56.5
None	15	0	0	4	4	4	4	4	4	5	4	0	4	4	8	8	57
None	16	0	0	4	4	4	4	4	4	4	4	0	4	4	8	8	56
Both	17	0	0	4	4	4	4	4	4	4	4	0	4	4	8	8	56
Hours/month		45	45	68	68	68	68	68	68.5	69	71	0	81.5	68.5	56	56	900.5
Wind Garden Hrs		21	21	24	24	24	24	24	24.5	24	24	0	24	24	8	8	298.5
Fronteer Hrs		21	20	24	24	24	24	24	24	24	24	0	28	24	8	8	301

APPENDIX 2: CHOJE WIND FARMS

SPATIAL DISTRIBUTION MODELLING OF KEY SPECIES

Factors Affecting Key Species' Flight Density and Distribution

This Appendix provides further details of the analyses undertaken to explore the survey data and provide more information to inform the site design and minimise risk of collision and other impacts from the wind farm. The focus of this work was the more abundant key species and those with greater spatial overlap with wind farm site (i.e. at higher risk of impact), Martial Eagle, Verreaux's Eagle and Cape Vulture.

Analysis Methods

Flight activity data from the VP surveys were analysed using a 200 x 200m grid overlaid onto the survey area, to determine a flight activity index (measured as the total observed track length per unit observation time, using ArcGIS) of each key species in each grid square, and this value was used as the response variable in the further analysis. The grid square flight densities were analysed in relation to the following explanatory variables:

- Distance from nest site (Martial Eagle and Verreaux's Eagle);
- Distance from roost site (Cape Vulture) - roost site locations were identified during road transect and additional focal roost surveys;
- Habitat type (derived from South African National Land Cover 2018 survey;
- Altitude (derived from NASA Shuttle Radar Topographic Mission (SRTM) digital elevation data [1]);
- Distance from nearest ridge line, calculated using SRTM data in Global Mapper software to identify ridge lines, using those at higher altitude (>600m);
- Slope (maximum within grid square, derived from SRTM data).

Other measures of local terrain variability were also investigated, including standard deviation of altitude with each grid square, terrain ruggedness index (Riley *et al*. 1999) and mean slope, but as they were strongly correlated with each other only one (maximum slope) was selected for inclusion in the modelling (as the one that gave the strongest relationship with flight activity). Similarly, alternative measures of topographic measures were considered, including topographic position index (Guisan *et al.* 1999) and mean slope, but these did not give as high a correlation with flight activity as maximum slope and were highly inter-correlated, so only maximum slope was taken forward for the modelling. Habitat was initially included in the analysis but was dropped from the final models as it did not improve the precision of those models.

Spatial Autoregressive Modelling (StataCorp 2019) was used to analyse these data to test whether each species' abundance was statistically significantly related to these explanatory variables. This enabled the latitude and longitude of the central point of each grid square to be included in the modelling to take into account any spatial autocorrelation in the data.

This analysis has focussed on data from the Western Block these data are more comprehensive from a wider area. All flight data were included in these analyses to make best use of all the available information. A check was made that this total flight activity was representative of flights at rotor height, and they were highly correlated ($p<0.001$) for all three species ($r=0.94$, 0.998 and 0.81 for Martial Eagle, Verreaux's Eagle and Cape Vulture respectively).

[1] NASA Shuttle Radar Topographic Mission (SRTM) digital elevation data at 30m resolution. NASA, 2018. Earth Observing System Data and Information System (EOSDIS).

Martial Eagle

Martial Eagle flight density was strongly related to distance from the nest, with the highest densities recorded within 500m and a steady decline in flight density up to 2.5km from the nest in the Choje West block (Figure 1). Beyond 2.5km flight density was consistently lower. This provides strong evidence to support the initial suggestion of a 2.5km turbine exclusion zone around Martial Eagle nests, as flight activity is clearly considerably higher within that zone. Any exclusion of turbines beyond 2.5km would be of much less benefit in reducing collision risk. A similar result was found for the Choje East Block (Figure 2), though with higher flight activity within 1.5km of the nest.

Figure 1. Martial Eagle flight density and distance from the nest, Choje West June 2019 - August 2020 (mean ± 95% confidence limits).

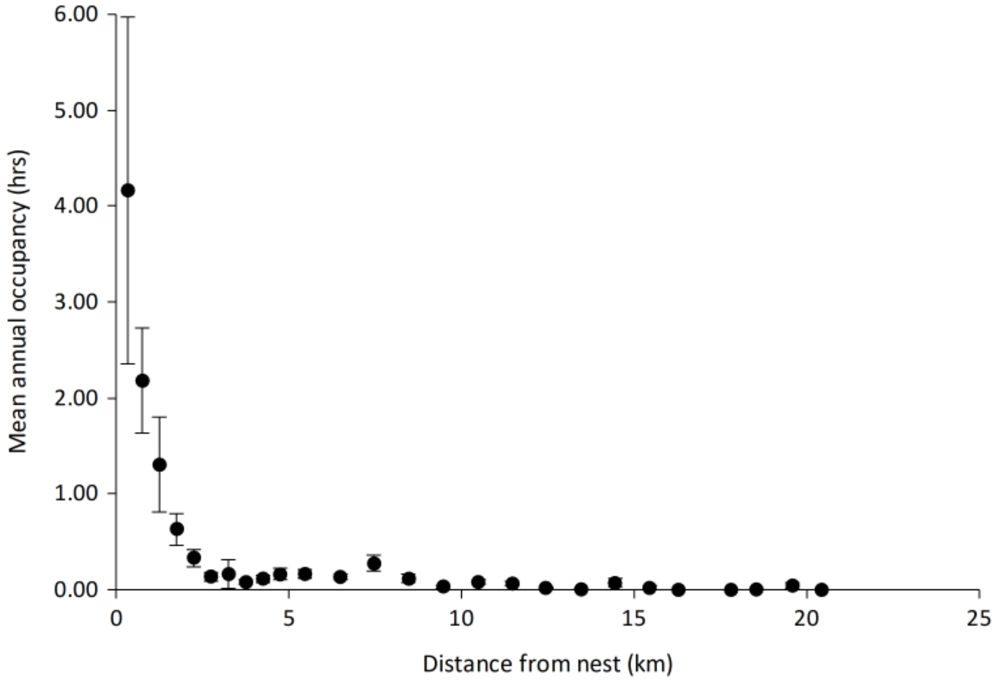
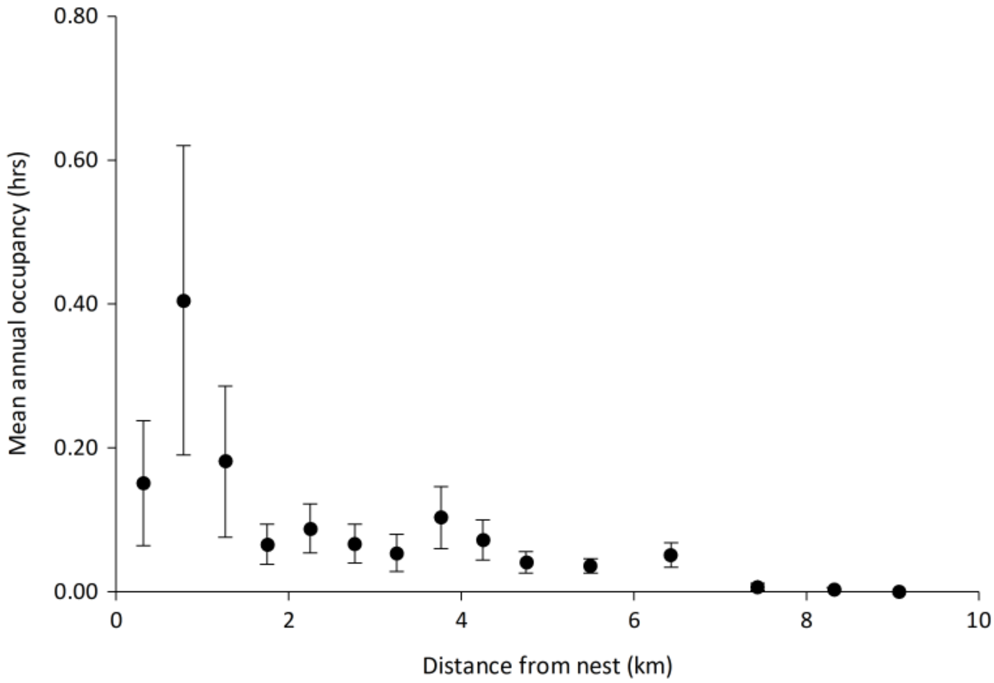


Figure 2. Martial Eagle flight density and distance from the nest, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



Martial Eagle flight density was lower at lower altitudes (below 600m asl) and at higher (above 800m), with higher flight activity in the 600-800m range (Figure 3), probably as a result of the altitudinal zones of the nest locations (and subsequent higher activity in proximity to nests). Flight activity in the East Block (Figure 24 showed a similar peak in the 700-800m altitude range.

Figure 3. Martial Eagle flight density and altitude (m above sea level), Choje West June 2019 - August 2020 (mean + 95% confidence limits).

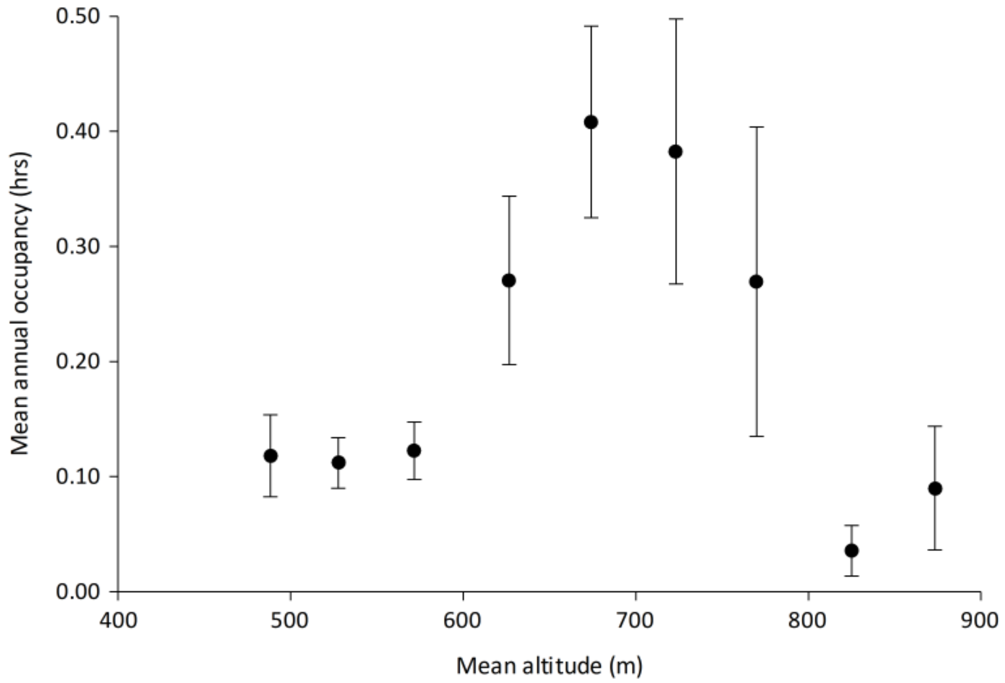
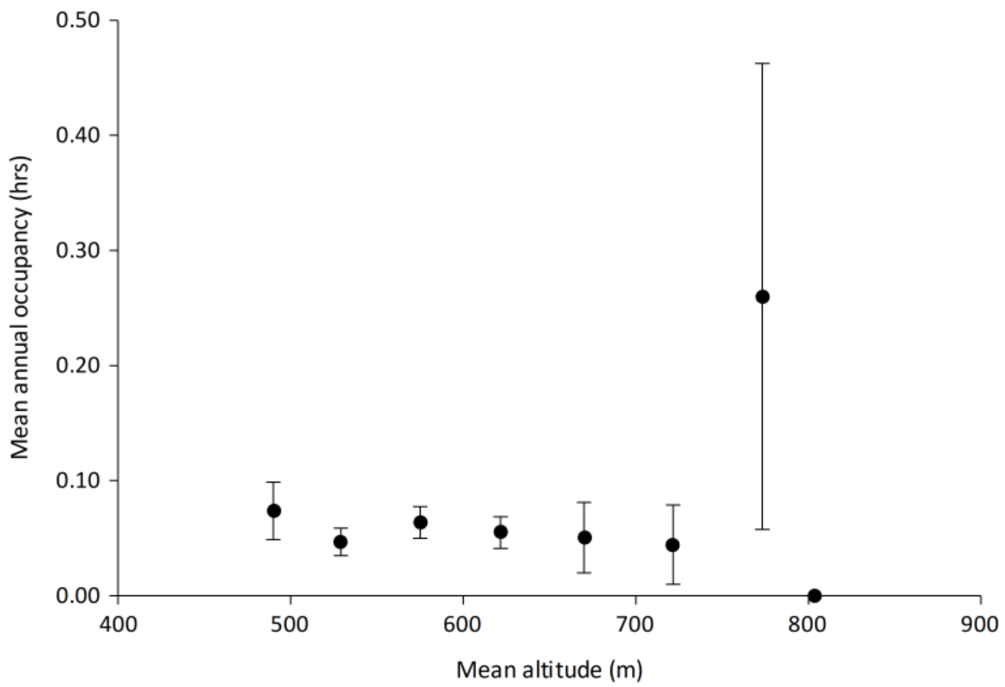


Figure 4. Martial Eagle flight density and altitude (m above sea level), Choje East June 2019 - August 2020 (mean + 95% confidence limits).



Martial Eagle flight density was also strongly influenced by proximity to higher ridge lines, with higher activity within 1km (Figure 5). There was a less clear pattern in the East Block, where there was little variation with distance from ridgelines apart from a reduction beyond 2.5km (Figure 6).

Figure 5. Martial Eagle flight density and distance from higher (>600m) ridge lines, Choje West June 2019 - August 2020 (mean + 95% confidence limits).

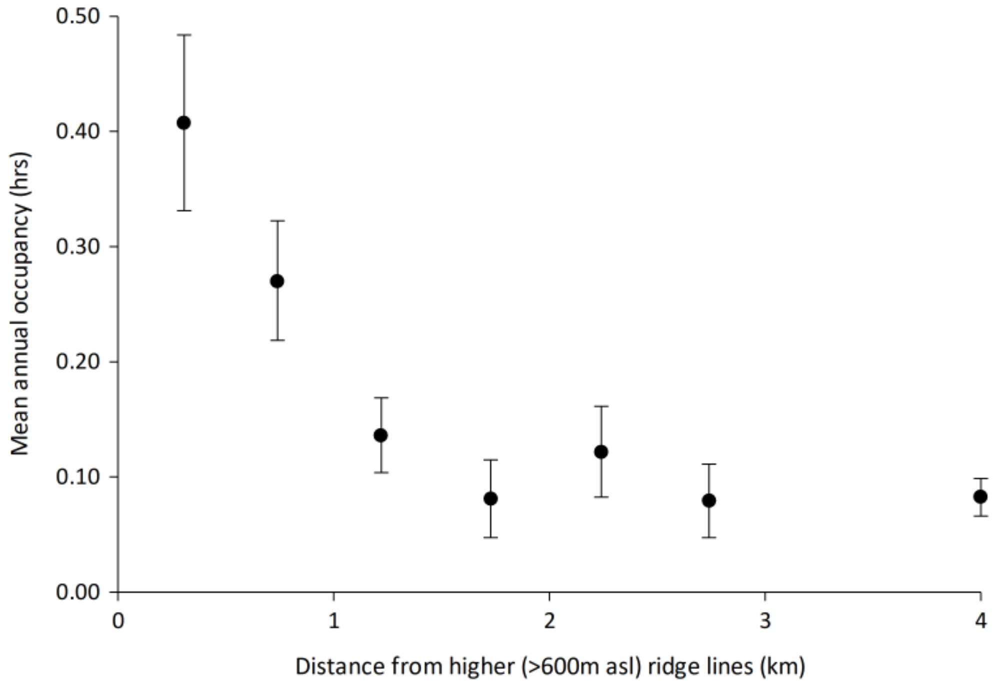
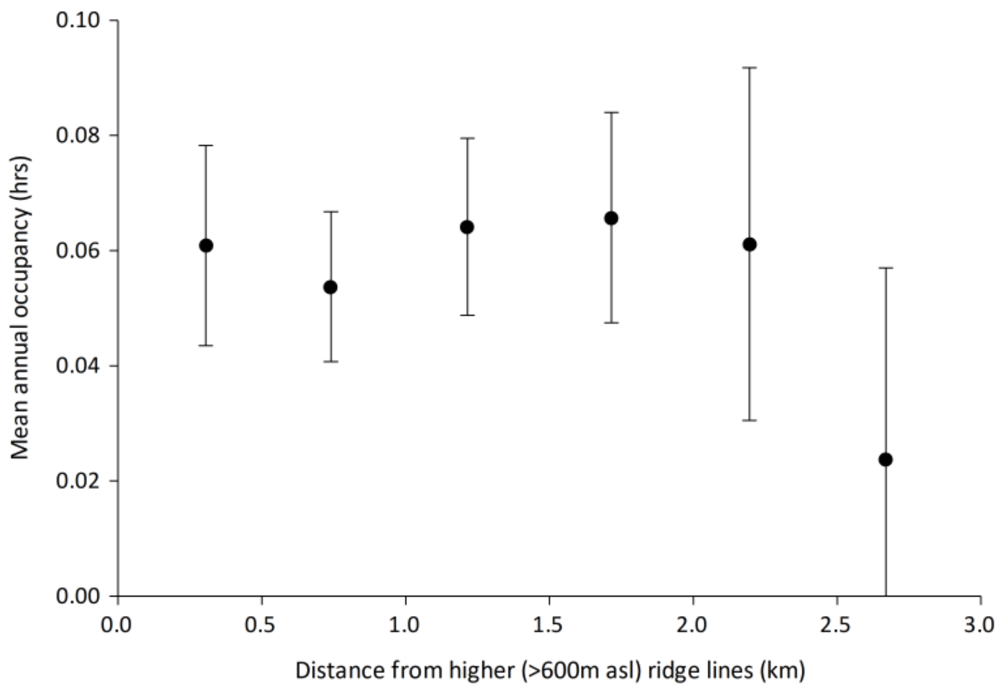


Figure 6. Martial Eagle flight density and distance from higher (>600m) ridge lines, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



Martial Eagle flight density was lower in flatter areas (lower maximum slope), increasing steadily with increasing slope in the West Block (Figure 7) and in the East (Figure 8), though with increased variability on steeper slopes.

Figure 7. Martial Eagle flight density and maximum slope, Choje West June 2019 - August 2020 (mean + 95% confidence limits).

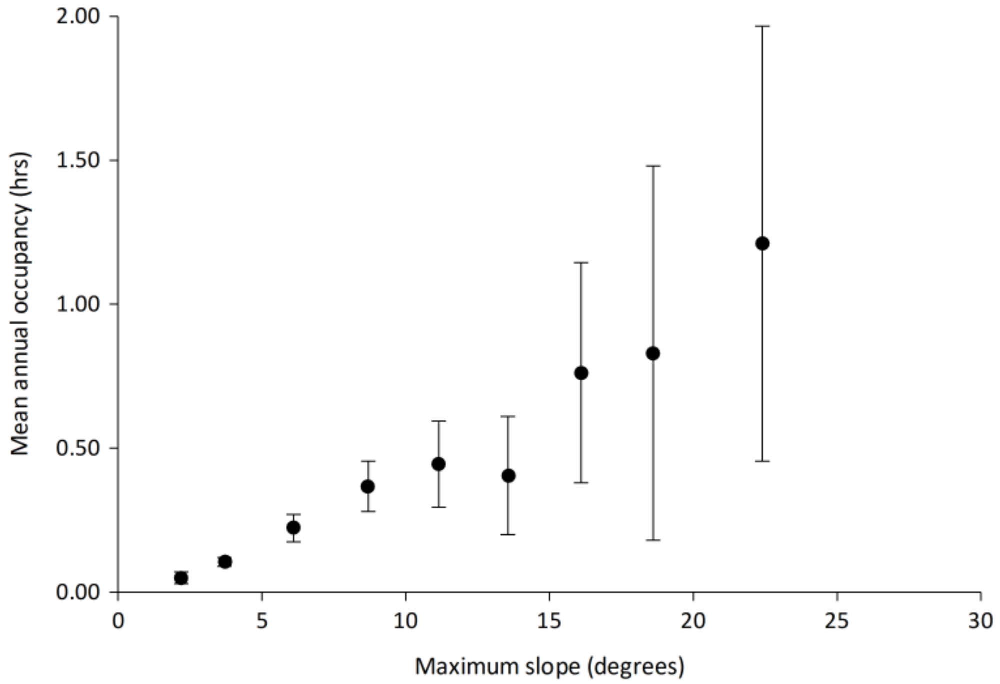
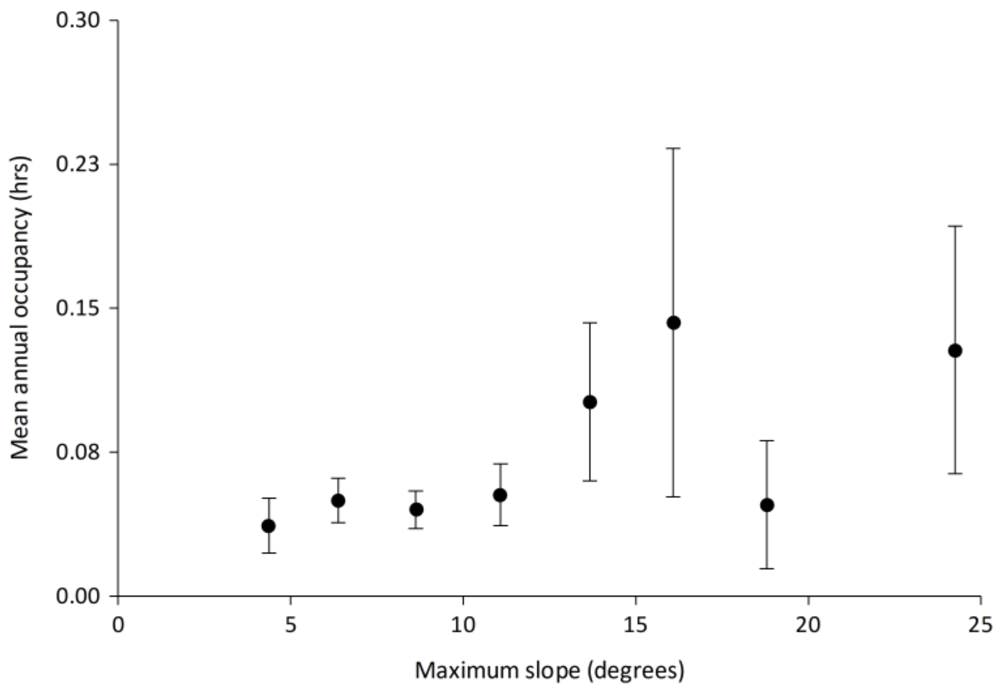


Figure 8. Martial Eagle flight density and maximum slope, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



There was variation in Martial Eagle flight density between habitats, with more activity over grassland and woodlands in the West (Figure 9), though also high variability (indicated by the large confidence interval bars). This may reflect the habitat types in proximity to the birds' nest sites, given the much higher flight densities around those sites. In the East there was little difference apparent in flight activity between habitats (Figure 10).

Figure 9. Martial Eagle flight density and habitat type (land cover 2018), Choje West June 2019 - August 2020 (mean + 95% confidence limits).

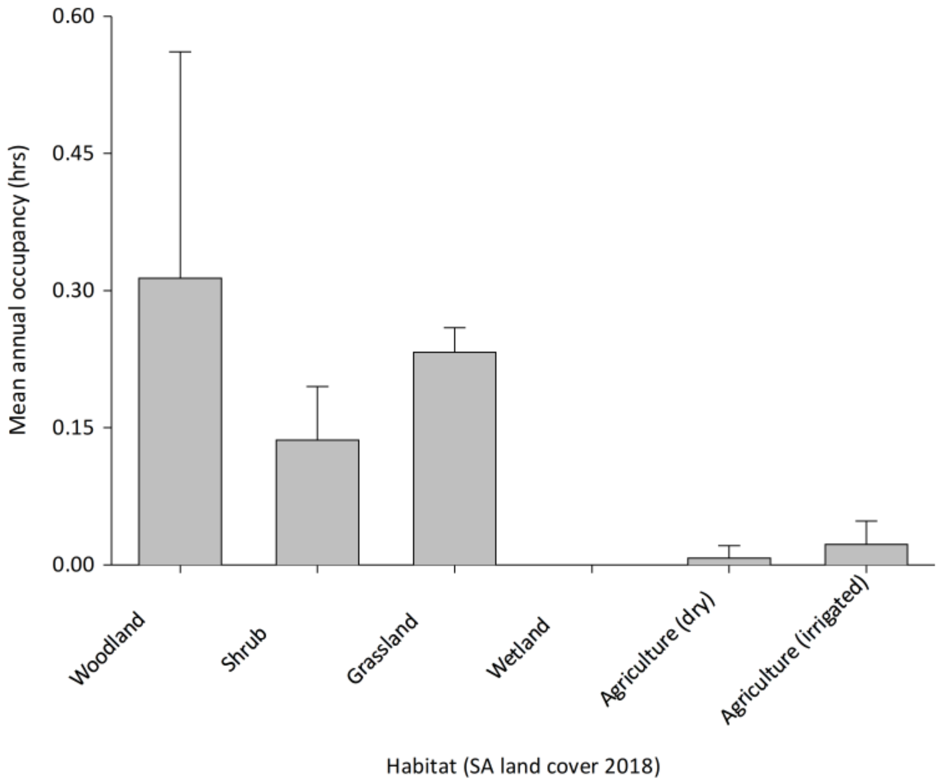
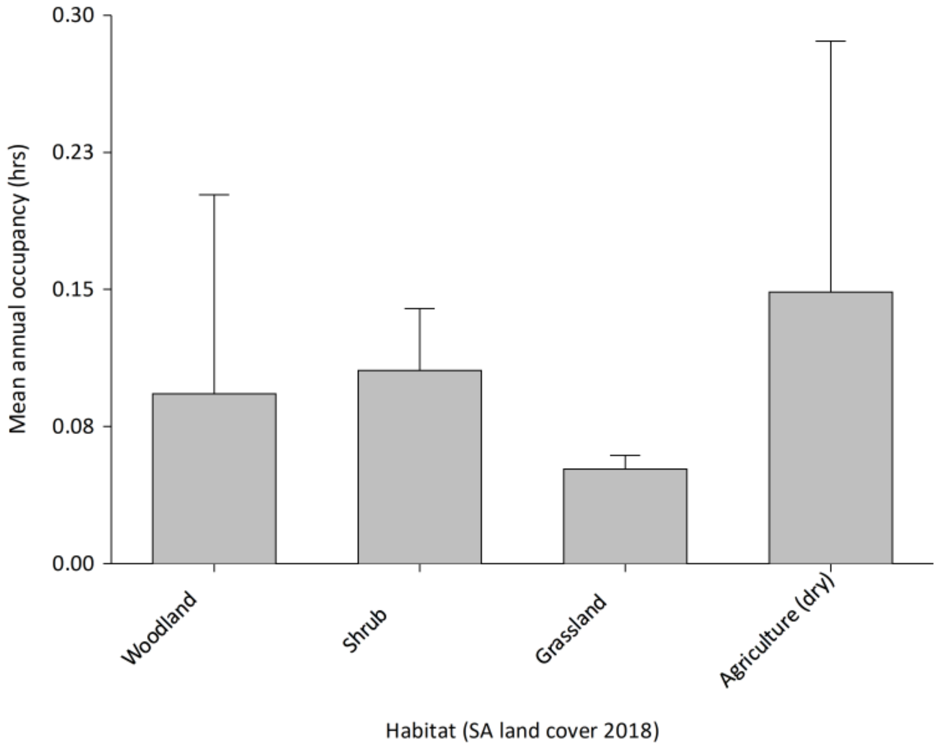


Figure 10. Martial Eagle flight density and habitat type (land cover 2018), Choje East June 2019 - August 2020 (mean + 95% confidence limits).



The results of the spatial modelling for Martial Eagle are summarised in Table 1. Distance from the nest (*ME_dist*) and altitude (*Alt_mean*) were the two variables most strongly related to flight density.

The spatial model was used to predict Martial Eagle flight activity across the whole of the study area, enabling estimates to be made of flight density in areas that fell outside the VP survey area, and hence complete coverage of the wind farm site and its surrounds, as shown in Figure 11 (West Block) and 12 (East Block). This could then be used to more fully quantify the benefits of applying buffer zones around nest sites (see following section on mitigation). This illustrates clearly the higher levels of use predicted around the nest sites, with the large majority of the higher use zones within the proposed turbine exclusion zone.

Figure 11. Predicted Martial Eagle distribution in the Choje Western Block. Darker shading indicates higher predicted use, with proposed turbine (small white dots) and turbine exclusion zones (larger black extended circles) also shown.

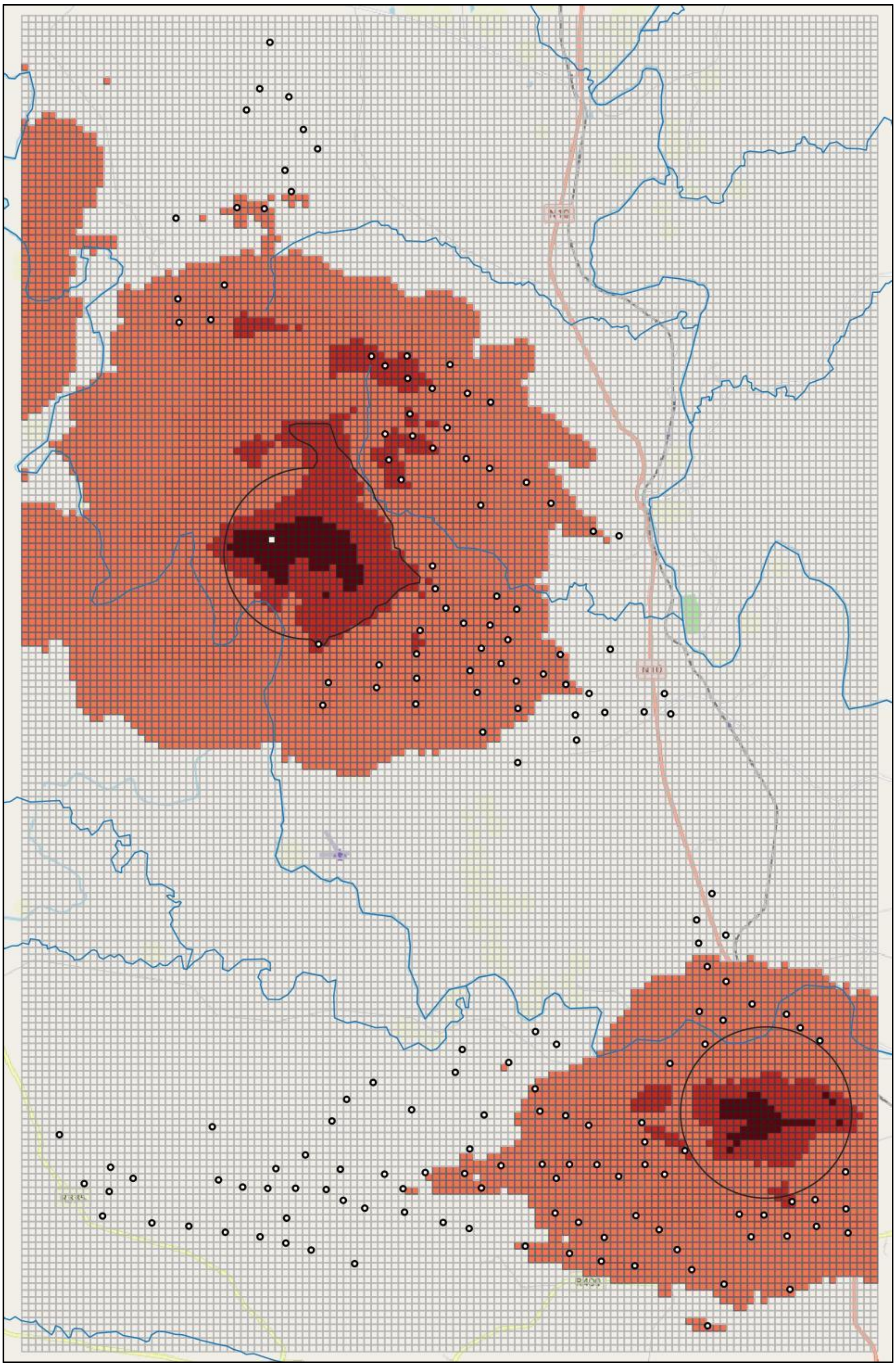


Figure 12. Predicted Martial Eagle distribution in the Choje Eastern Block. Darker shading indicates higher predicted use, with proposed turbine (small white dots) and turbine exclusion zones (larger black extended circles) also shown.

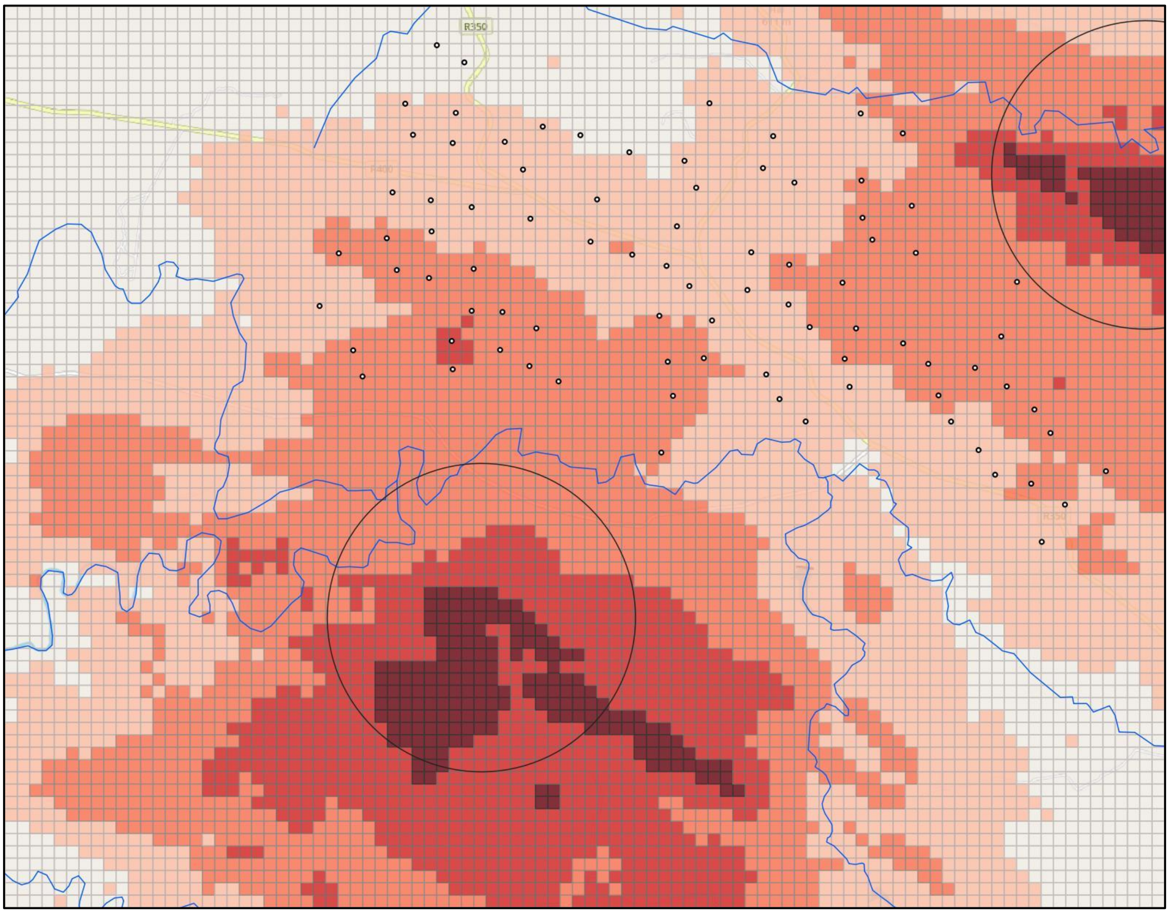


Table 1. Spatial autoregressive modelling results for Martial Eagle for Choje West June 2019 - August 2020

```
Spatial autoregressive model                    Number of obs     =      5,035
GS2SLS estimates                                Wald chi2(9)      =    1031.31
                                                Prob > chi2       =     0.0000
                                                Pseudo R2         =     0.1272
```

ME_LogOcc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ME_LogOcc						
ME_Dist	-.0127315	.0018686	-6.81	0.000	-.0163939	-.0090692
Alt_mean	.0002223	.0000364	6.11	0.000	.000151	.0002936
Slope_max	.0007377	.000698	1.06	0.291	-.0006303	.0021057
Ridge600_Dist	-.0052949	.0038001	-1.39	0.164	-.0127429	.0021532
_cons	.0078316	.0148548	0.53	0.598	-.0212832	.0369464
WestGrid200_contig						
ME_Dist	.0124109	.0019062	6.51	0.000	.0086747	.0161471
Alt_mean	-.0002484	.000035	-7.10	0.000	-.0003169	-.0001798
Slope_max	.00169	.0015168	1.11	0.265	-.0012827	.0046628
Ridge600_Dist	.0056109	.0039469	1.42	0.155	-.0021248	.0133466
ME_LogOcc	.9165076	.1065873	8.60	0.000	.7076003	1.125415
e.ME_LogOcc	.0722844	.1036631	0.70	0.486	-.1308915	.2754604

```
Wald test of spatial terms:          chi2(6) = 243.68     Prob > chi2 = 0.0000
```

***Note**: 'ME_LogOcc' = Martial Eagle grid square flight activity; 'Alt_mean' = Mean altitude; 'Slope_max' = Maximum slope; 'Ridge600_Dist' = Distance to nearest high (>600m asl) ridge line; 'ME_Dist' = Distance to nearest Martial Eagle nest site.*

Verreaux's Eagle

There were no Verreaux's Eagle nests within 1.5km of any proposed wind turbine locations (to comply with BLSA guidance, BLSA 2017), so there was less coverage of areas in proximity to nests during VP surveys (which were designed primarily to maximise coverage of the wind farm site). As a result, flight activity data within that zone are limited, and the usual increased flight activity in closer proximity to the nest site was not apparent (Figure 13). A similar pattern was observed in the Choje East Block (Figure 14).

Figure 13. Verreaux's Eagle flight density and distance from the nest, Choje West June 2019 - August 2020 (mean + 95% confidence limits).

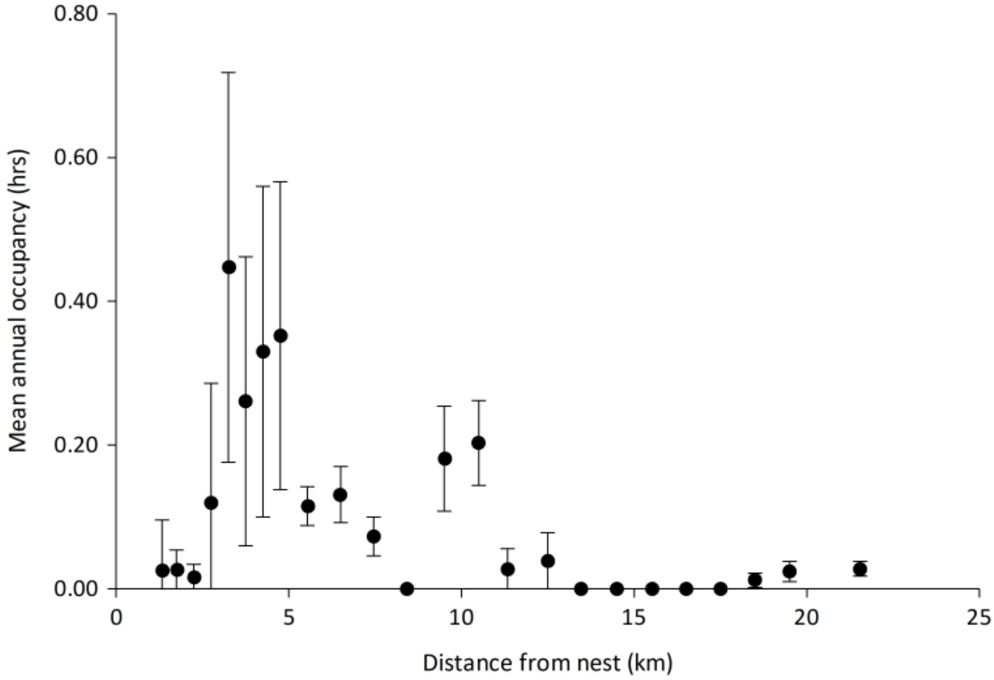
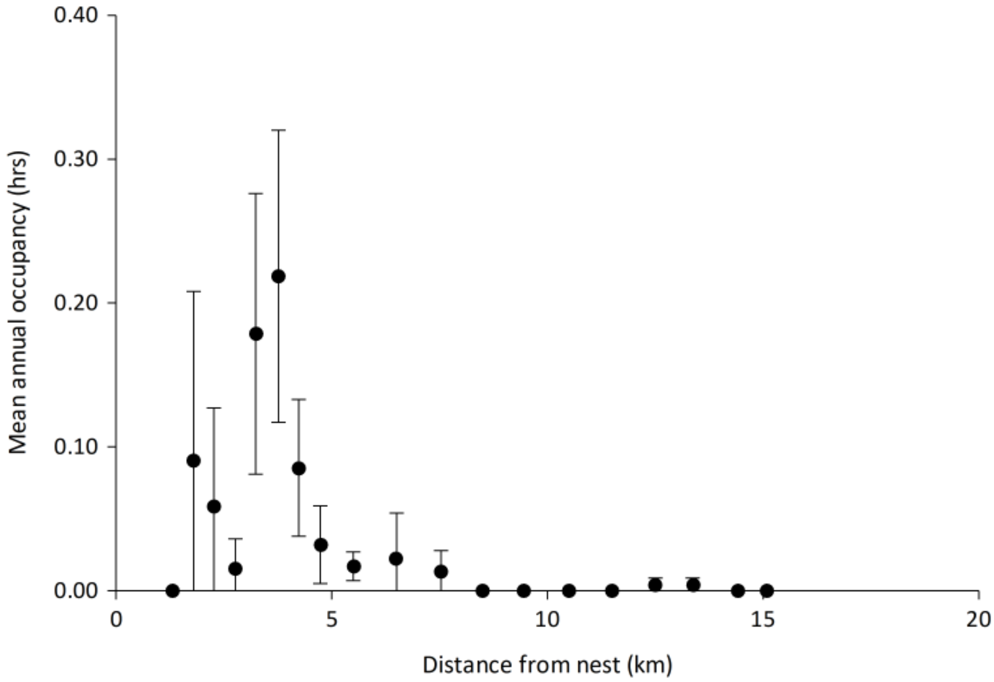


Figure 14. Verreaux's Eagle flight density and distance from the nest, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



Verreaux's Eagle flight density showed a strong positive relationship with altitude, with very little flight activity in areas below 700m, and higher activity above 800m above sea level in the West Block (Figure 15). In the East Block (Figure 16), flight density was highest in the 550-700m zone.

Figure 15. Verreaux's Eagle flight density and altitude (m above sea level), Choje West June 2019 - August 2020 (mean + 95% confidence limits).

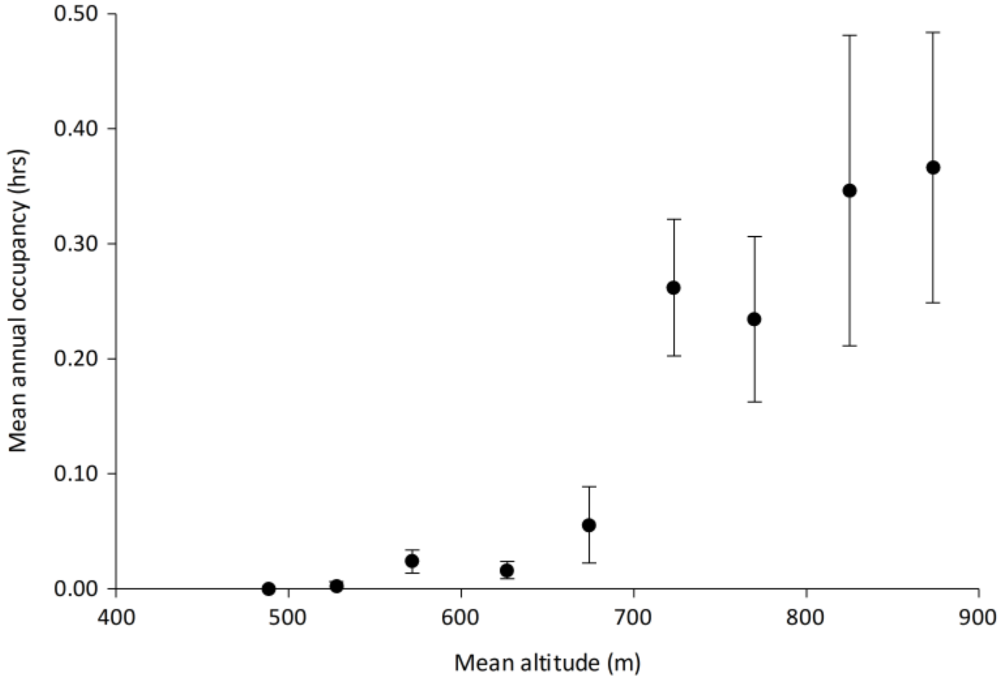
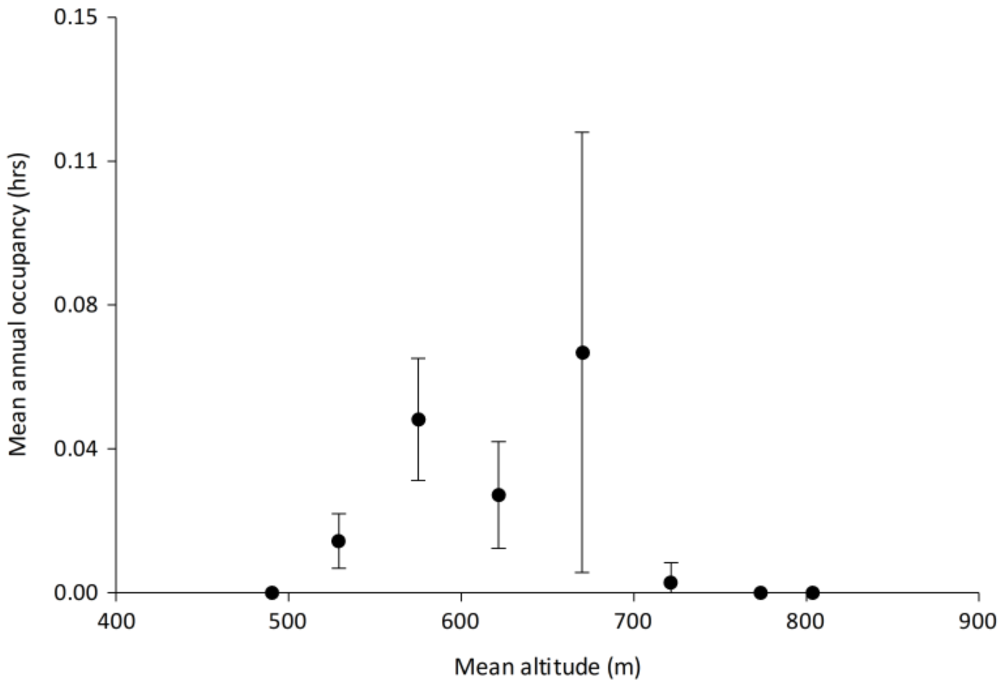


Figure 16. Verreaux's Eagle flight density and altitude (m above sea level), Choje East June 2019 - August 2020 (mean + 95% confidence limits).



Verreaux's Eagle also exhibited a strong preference for flying near higher ridge lines, with higher flight density within 1km of ridges in the West Block (Figure 17) and within 1.5km in the East (Figure 18).

Figure 17. Verreaux's Eagle flight density and distance from higher (>600m) ridge lines, Choje West June 2019 - August 2020 (mean + 95% confidence limits).

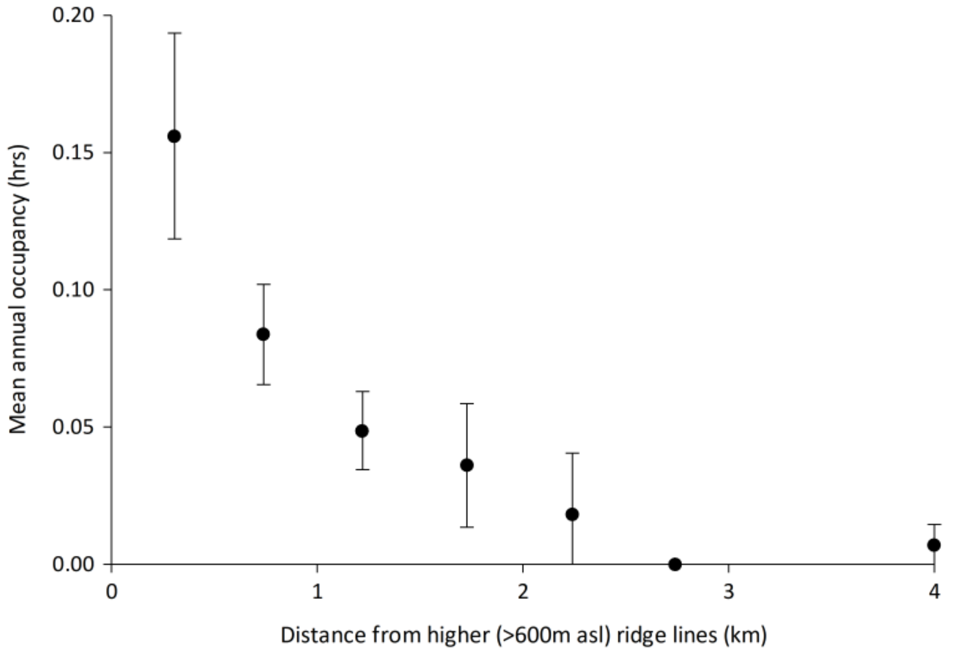
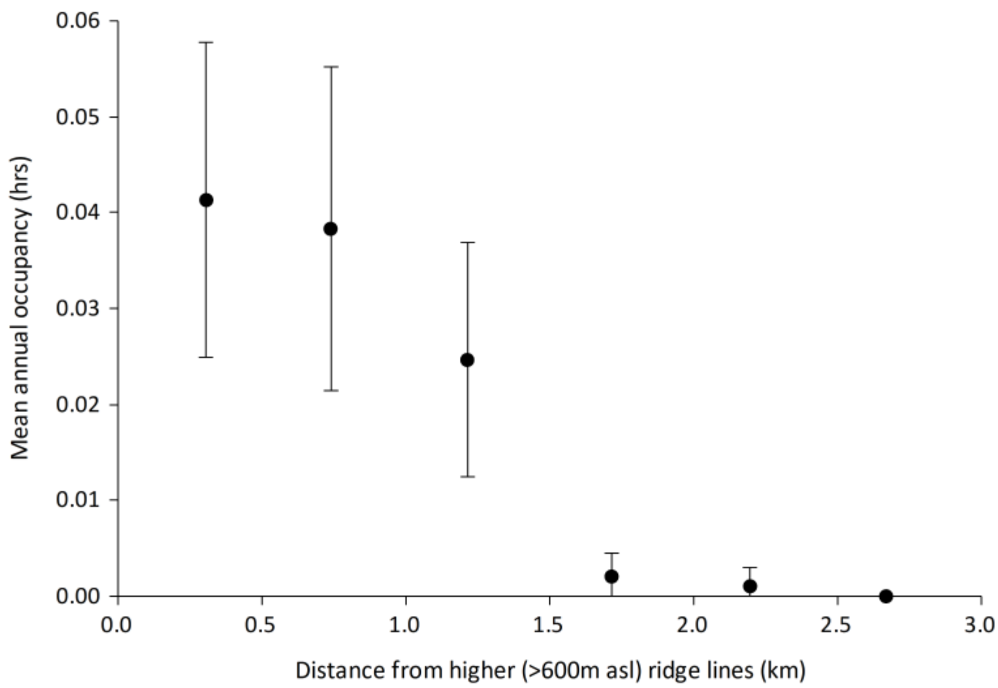


Figure 18. Verreaux's Eagle flight density and distance from higher (>600m) ridge lines, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



Verreaux's Eagle flight density was lower in flatter areas (lower maximum slope), with notably higher activity on slopes exceeding 15 degrees (Figures 19 and 20), and with higher variability on steeper slopes.

Figure 19. Verreaux's Eagle flight density and maximum slope, Choje West June 2019 - August 2020 (mean + 95% confidence limits).

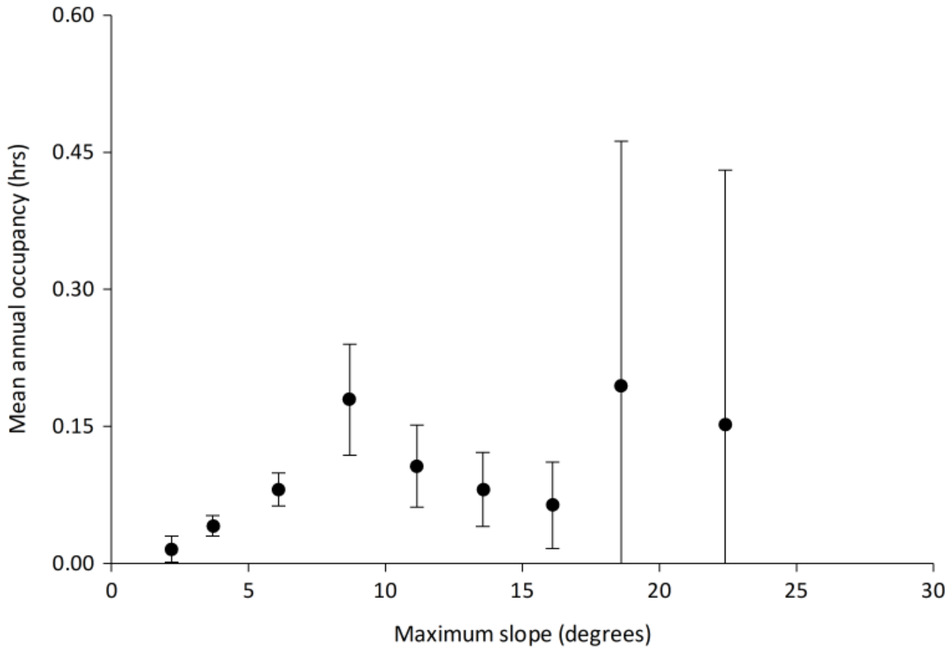
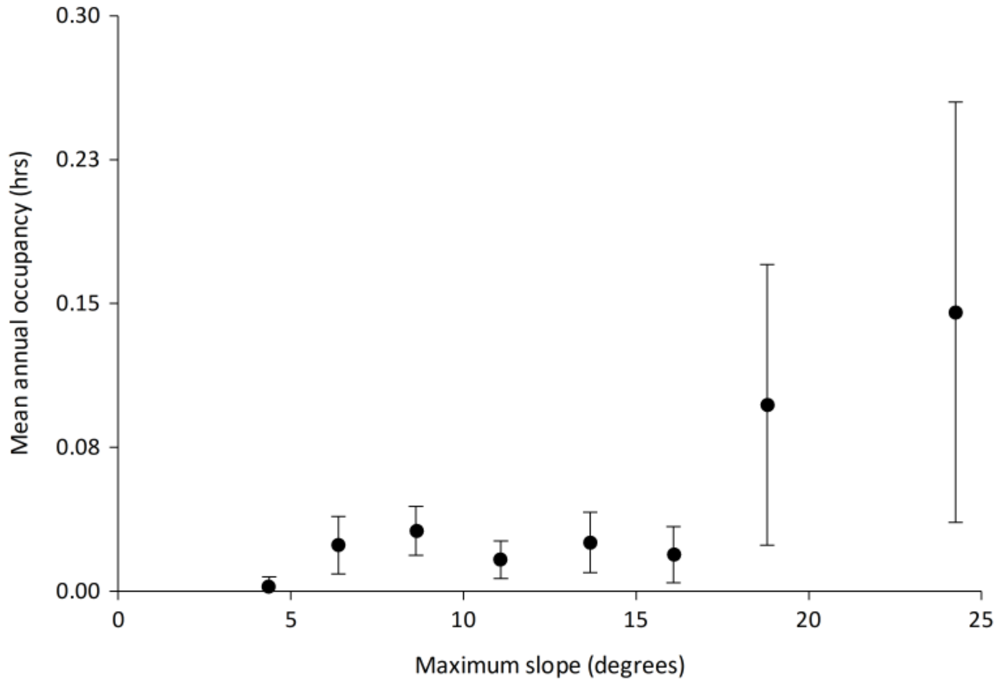


Figure 20. Verreaux's Eagle flight density and maximum slope, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



Verreaux's Eagle showed a strong preference for open grassland habitat, with the majority of records from this habitat class in both the West Block (Figure 21), more records were observed over woodlands in the East (Figure 22).

Figure 21. Verreaux's Eagle flight density and habitat type (land cover 2018), Choje West June 2019 - August 2020 (mean + 95% confidence limits).

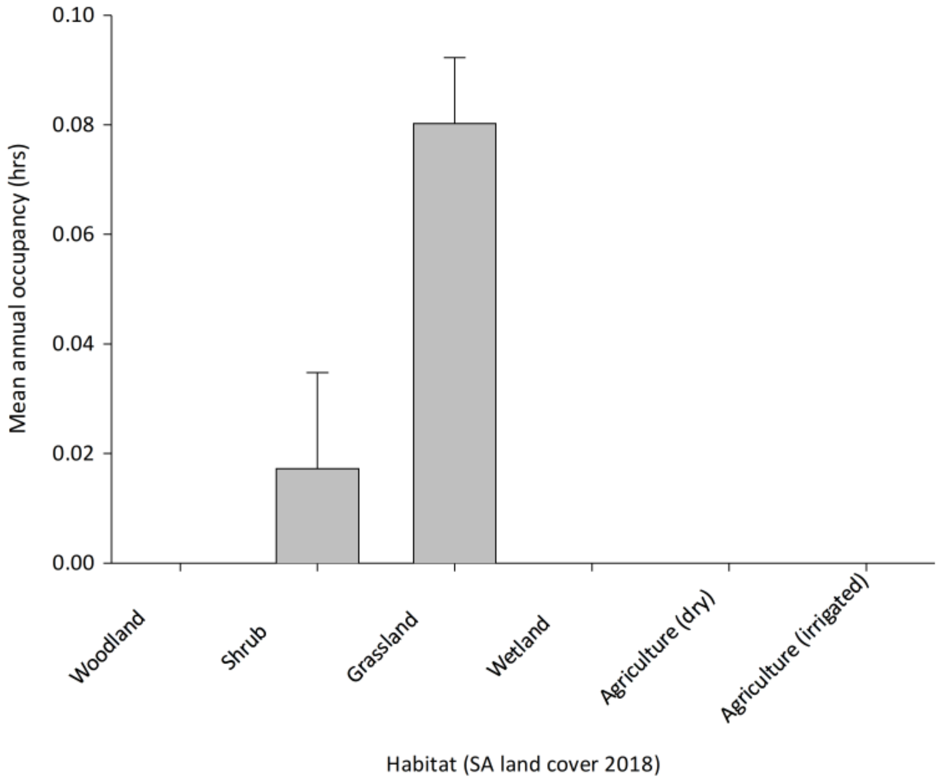
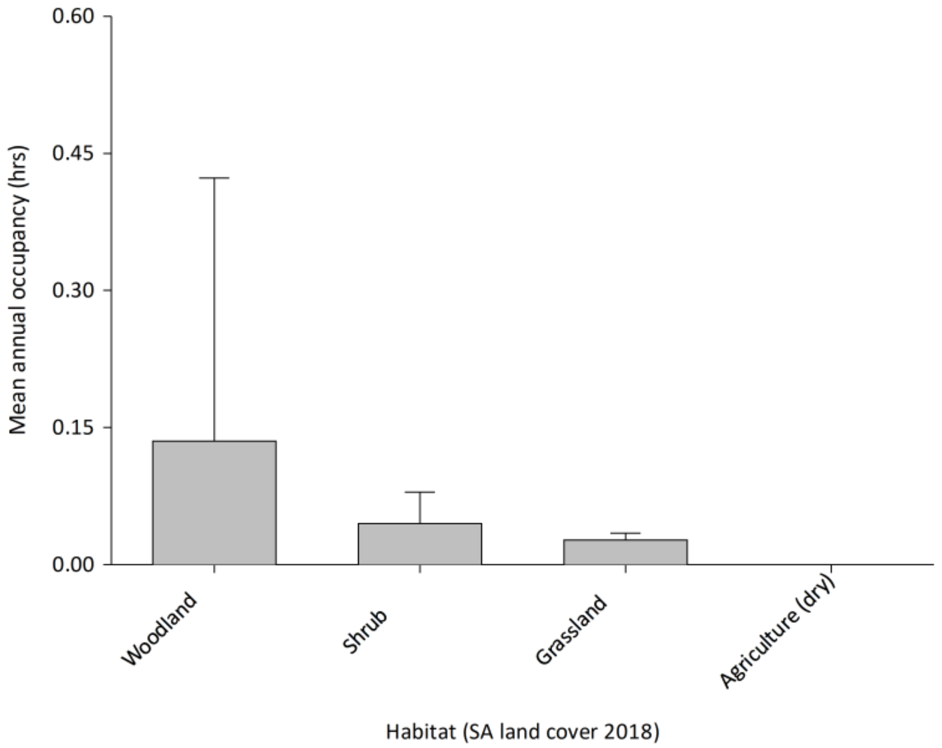


Figure 22. Verreaux's Eagle flight density and habitat type (land cover 2018), Choje East June 2019 - August 2020 (mean + 95% confidence limits).



The results of the spatial modelling for Verreaux's Eagle are summarised in Table 2. Distance from the nest (*VE_dist*) was less important for this species (as discussed above, few data were collected in closer proximity to Verreaux's Eagle nests, where flight activity would be expected to be higher), but altitude (*Alt_mean*) was strongly related to flight density.

The spatial model was used to predict Verreaux's Eagle flight activity across the whole of the study area, enabling estimates to be made of flight density in areas that fell outside the VP survey area, and hence complete coverage of the wind farm site, as shown in Figure 23. As for the equivalent modelling for Martial Eagle, this could then be used to more fully quantify the benefits of applying buffer zones around nest sites. It should be noted though that, as discussed above, there are few flight activity data available from within the buffer zones, so these do not show as clearly the benefits of applying these buffers.

Figure 23. Predicted Verreaux's Eagle distribution in the Choje Western Block. Darker shading indicates higher predicted use, with proposed turbine (small white dots) and proposed turbine exclusion zones (large black circles) also shown.

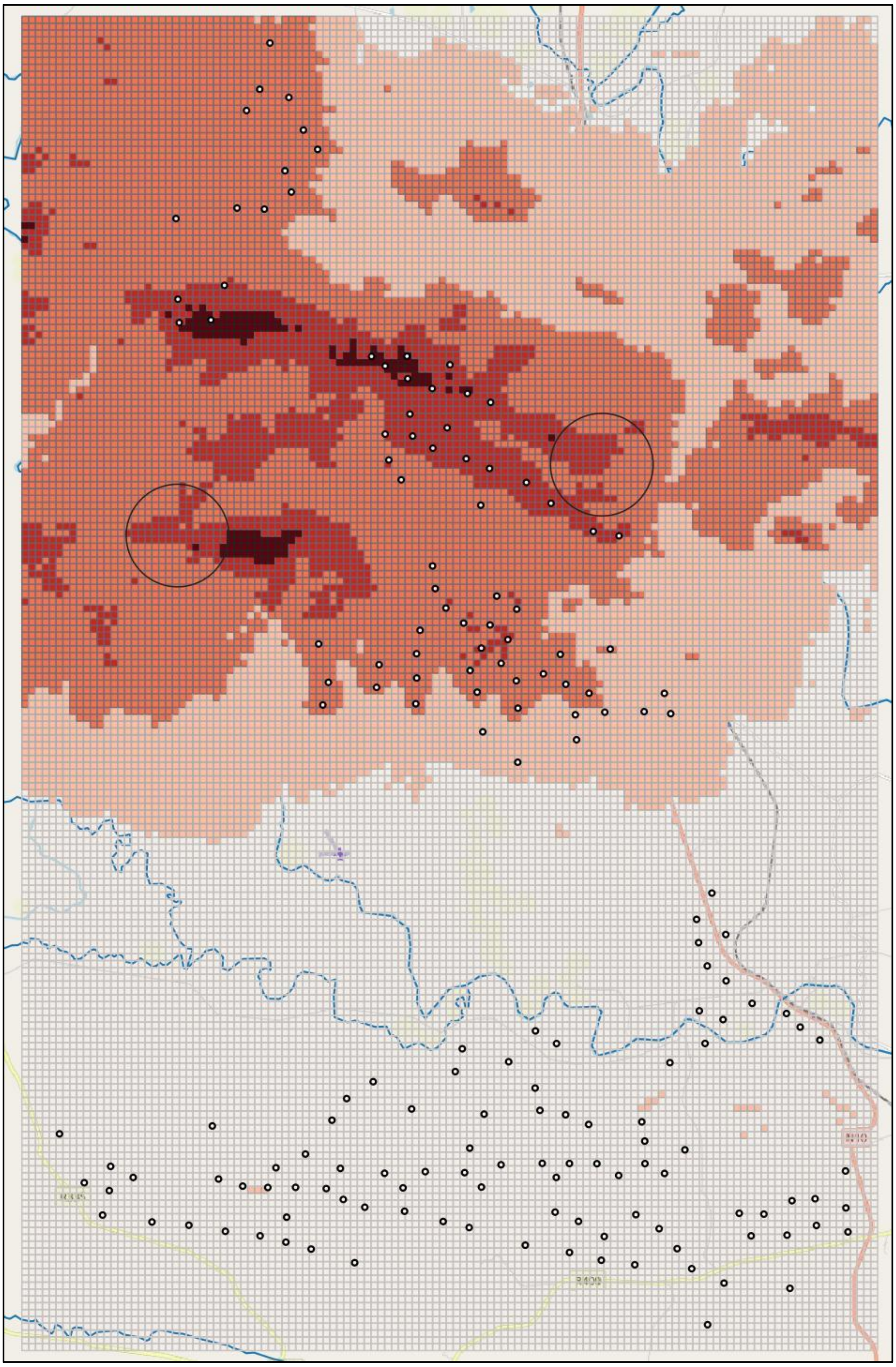


Figure 24. Predicted Verreaux's Eagle distribution in the Choje Eastern Block. Darker shading indicates higher predicted use, with proposed turbine (small white dots) and turbine exclusion zones (larger black extended circles) also shown.

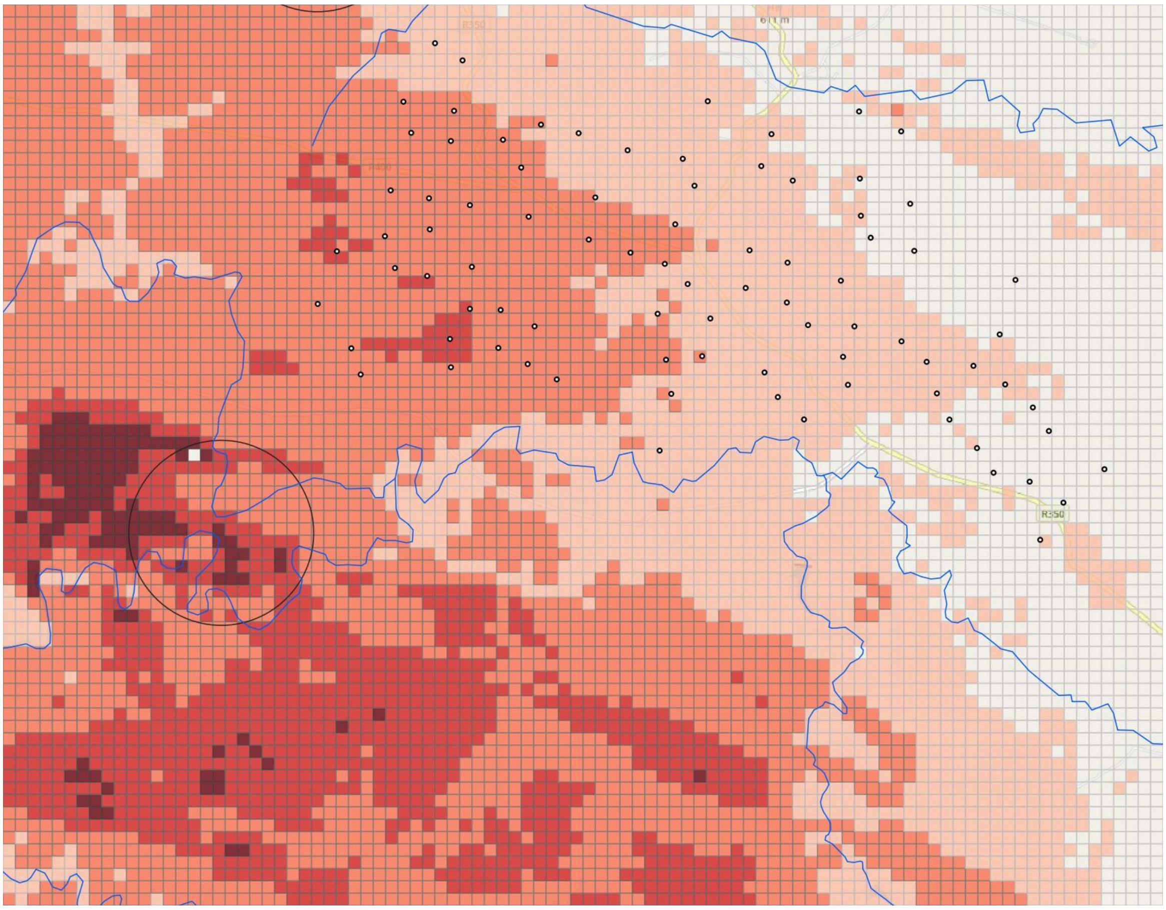


Table 2. Spatial autoregressive modelling results for Verreaux's Eagle for Choje West June 2019 - August 2020

```
Spatial autoregressive model                    Number of obs     =      5,035
GS2SLS estimates                                Wald chi2(9)      =    9637.73
                                                Prob > chi2       =     0.0000
                                                Pseudo R2         =     0.1562
```

VE_LogOcc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
VE_LogOcc						
VE_Dist	-.0033832	.0012547	-2.70	0.007	-.0058423	-.0009241
Alt_mean	.0001413	.0000423	3.34	0.001	.0000583	.0002242
Slope_max	.0007224	.000394	1.83	0.067	-.0000497	.0014946
Ridge600_Dist	-.0000994	.0020439	-0.05	0.961	-.0041054	.0039065
_cons	-.0269601	.0270847	-1.00	0.320	-.0800451	.0261249
WestGrid200_inv						
VE_Dist	.0102771	.0023614	4.35	0.000	.0056489	.0149053
Alt_mean	-.0002114	.000067	-3.16	0.002	-.0003427	-.0000801
Slope_max	-.0099589	.0024217	-4.11	0.000	-.0147054	-.0052124
Ridge600_Dist	-.0001898	.0069056	-0.03	0.978	-.0137244	.0133449
VE_LogOcc	2.840624	.133522	21.27	0.000	2.578925	3.102322
e.VE_LogOcc	9.824169	1.348158	7.29	0.000	7.181828	12.46651

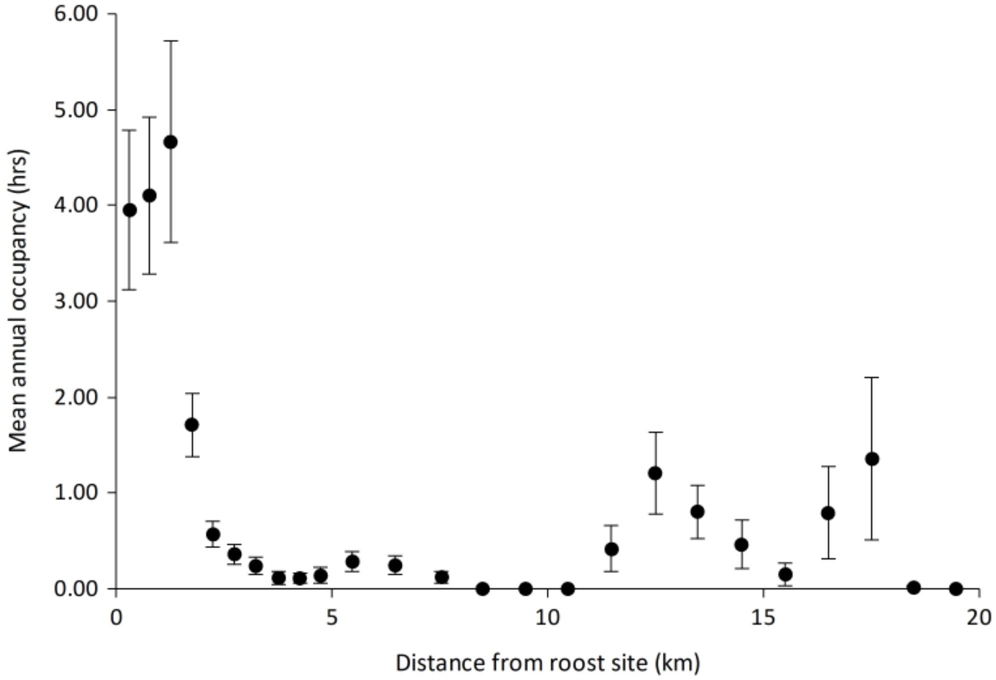
```
Wald test of spatial terms:          chi2(6) = 1267.32    Prob > chi2 = 0.0000
```

***Note**: 'VE_LogOcc' = Verreaux's Eagle grid square flight activity; 'Alt_mean' = Mean altitude; 'Slope_max' = Maximum slope; 'Ridge600_Dis't = Distance to nearest high (>600m asl) ridge line; 'VE_Dist' = Distance to nearest Verreaux's Eagle nest site.*

Cape Vulture

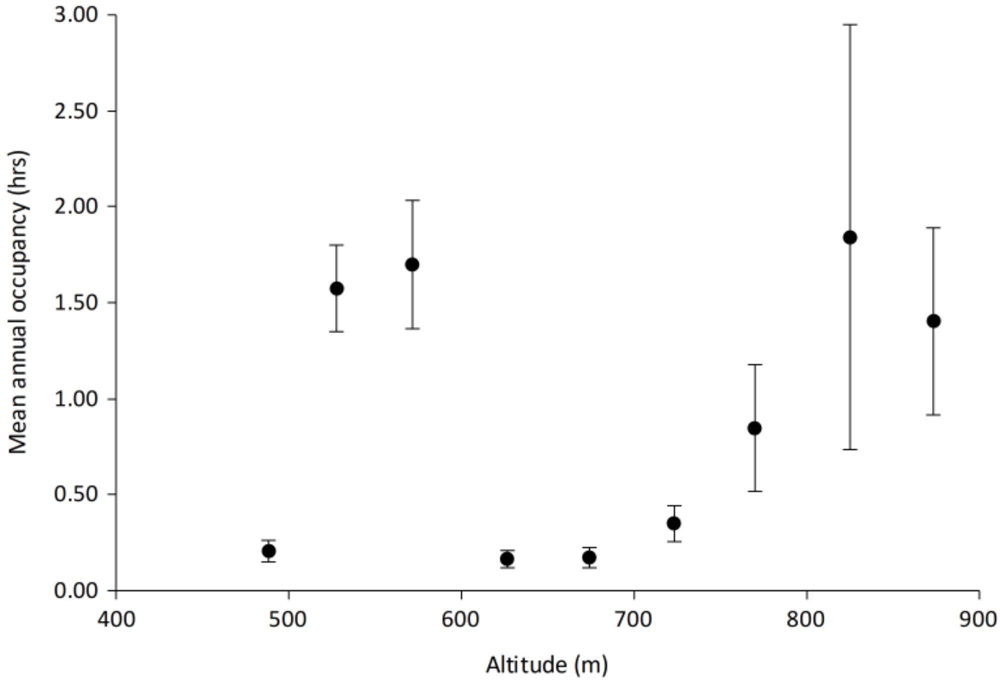
Cape Vultures did not breed within the survey area, so their flight distribution was not associated with any nest sites, but they were strongly associated with their night roost sites (with higher flight densities within 2km of the roosts, Figure 25).

Figure 25. Cape Vulture flight density and distance from the nearest roost, Choje West June 2019 - August 2020 (mean + 95% confidence limits).



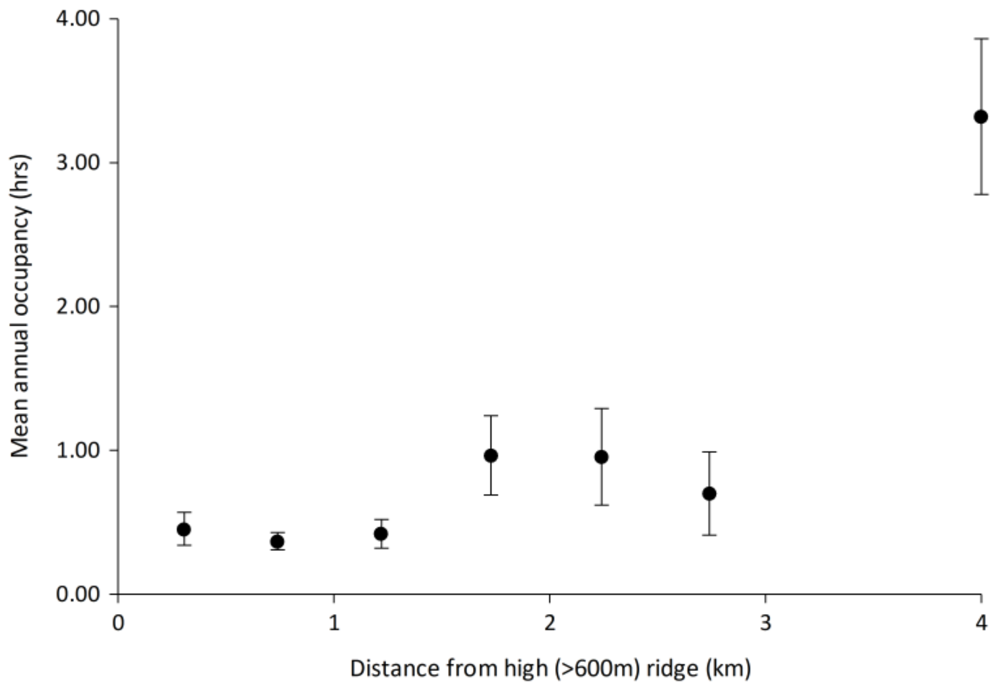
Cape Vulture flight density showed two peaks in relation to altitude, one around 500-600m (coincident with the altitude of their main roost sites) and a second above 800m above sea level (Figure 26).

Figure 26. Cape Vulture flight density and altitude (m above sea level), Choje West June 2019 - August 2020 (mean + 95% confidence limits).



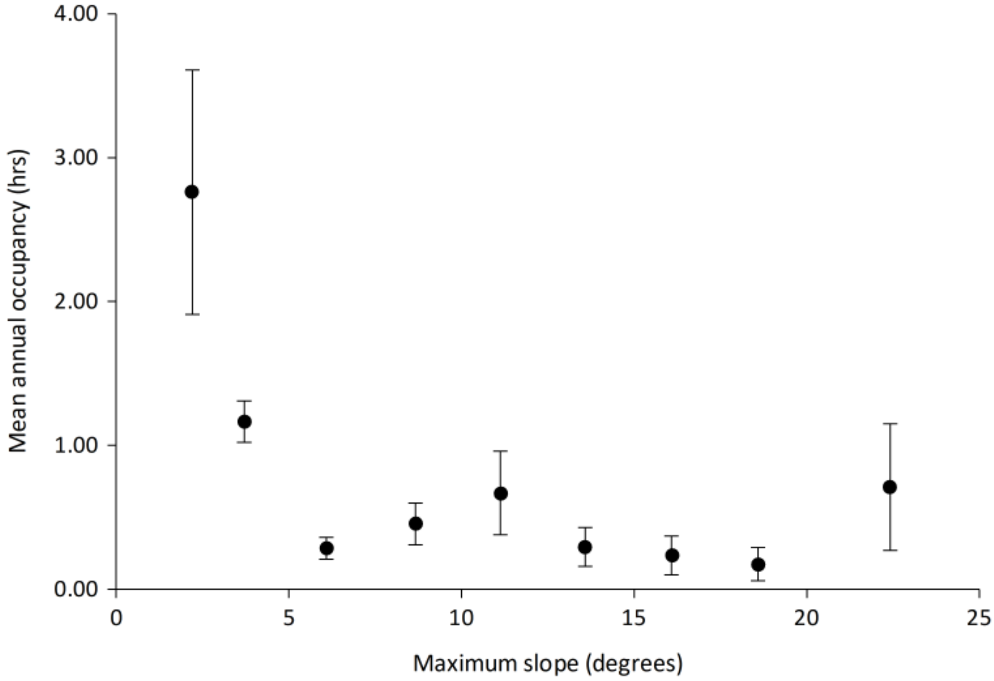
Cape Vulture flight density did not vary greatly in relation to distance from higher ridgelines, apart from a higher level at 4km (the distance coincident with the location of their main roost sites, Figure 27).

Figure 27. Cape Vulture flight density and distance from higher (>600m) ridge lines, Choje West June 2019 - August 2020 (mean + 95% confidence limits).



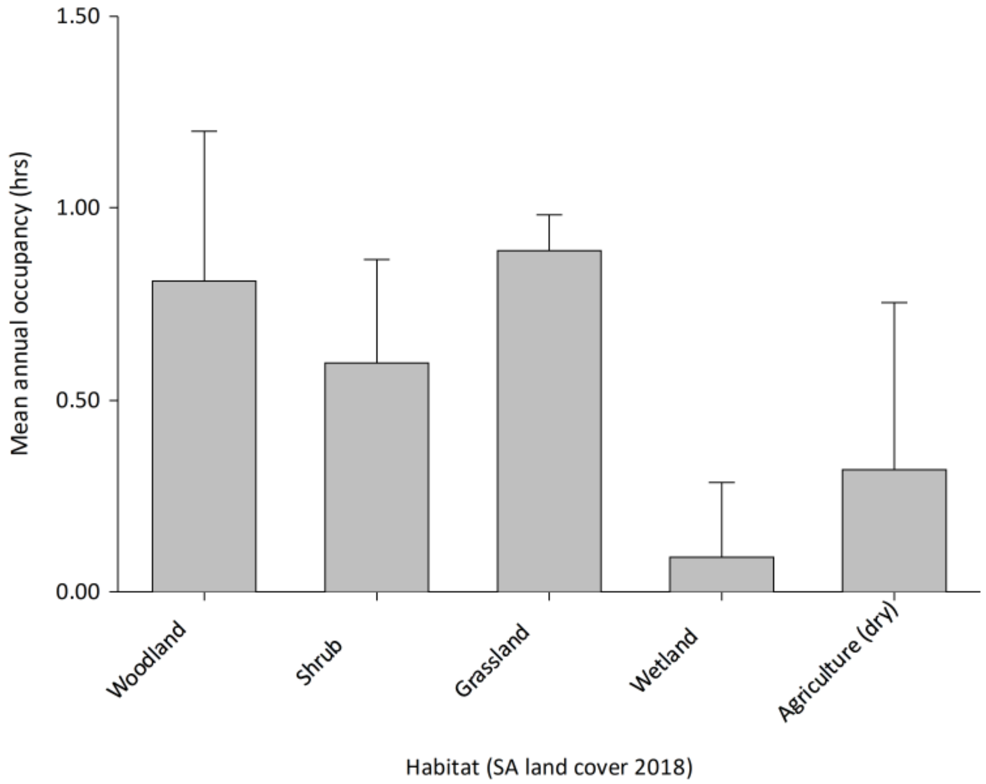
Cape Vulture flight density was highest in flatter areas (lower maximum slope), with lower activity on slopes exceeding 5 degrees slope (Figure 28).

Figure 28. Cape Vulture flight density and maximum slope, Choje West June 2019 - August 2020 (mean ± 95% confidence limits).



Cape Vultures used a range of habitat types, but higher flight densities were recorded over grasslands, scrub and woodland (Figure 29).

Figure 30. Cape Vulture flight density and habitat type (land cover 2018), Choje West June 2019 - August 2020 (mean + 95% confidence limits).



The results of the spatial modelling for Cape Vulture are summarised in Table 3. Distance from the roost (*CV_dist*) and altitude (*Alt_mean*) were the two variables most strongly related to flight density.

The spatial model was used to predict Cape Vulture flight activity across the whole of the study area, enabling estimates to be made of flight density in areas that fell outside the VP survey area, and hence complete coverage of the wind farm site, as shown in Figure 31. This could then be used to more fully quantify the benefits of applying buffer zones around roost sites.

Figure 31. Predicted Cape Vulture distribution. Darker shading indicates higher predicted use, with proposed turbine (small white dots) and 2km roost buffer zones (solid black lines) also shown.

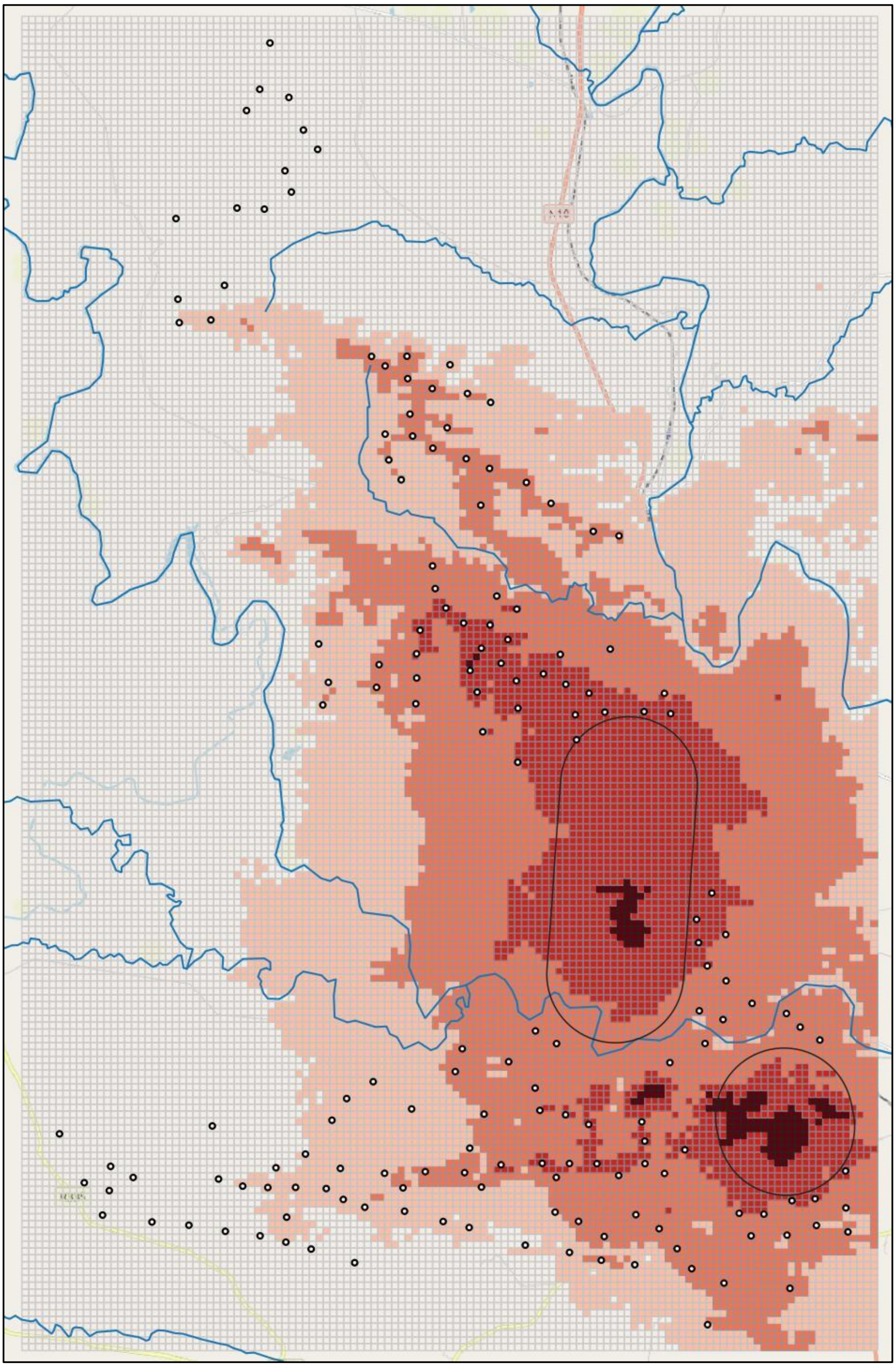


Table 3. Spatial autoregressive modelling results for Cape Vulture for Choje West June 2019 - August 2020

```
Spatial autoregressive model                    Number of obs     =      5,035
GS2SLS estimates                                Wald chi2(9)      =    6901.30
                                                Prob > chi2       =     0.0000
                                                Pseudo R2         =     0.2797
```

CV_LogOcc	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
CV_LogOcc						
CV_Dist	-.0105113	.0018755	-5.60	0.000	-.0141871	-.0068354
Alt_mean	.0003725	.0000612	6.08	0.000	.0002525	.0004926
Slope_max	-.0022023	.0009372	-2.35	0.019	-.0040391	-.0003655
Ridge600_Dist	.0048486	.0075932	0.64	0.523	-.0100338	.019731
_cons	-.0567729	.0270587	-2.10	0.036	-.1098069	-.0037388
WestGrid200_contig						
CV_Dist	.0096047	.0021747	4.42	0.000	.0053425	.013867
Alt_mean	-.0002712	.0000507	-5.35	0.000	-.0003705	-.0001719
Slope_max	.001819	.0013421	1.36	0.175	-.0008114	.0044495
Ridge600_Dist	-.0018321	.0084908	-0.22	0.829	-.0184738	.0148096
CV_LogOcc	.9885125	.022191	44.55	0.000	.945019	1.032006
e.CV_LogOcc	-.303651	.0722655	-4.20	0.000	-.4452888	-.1620133

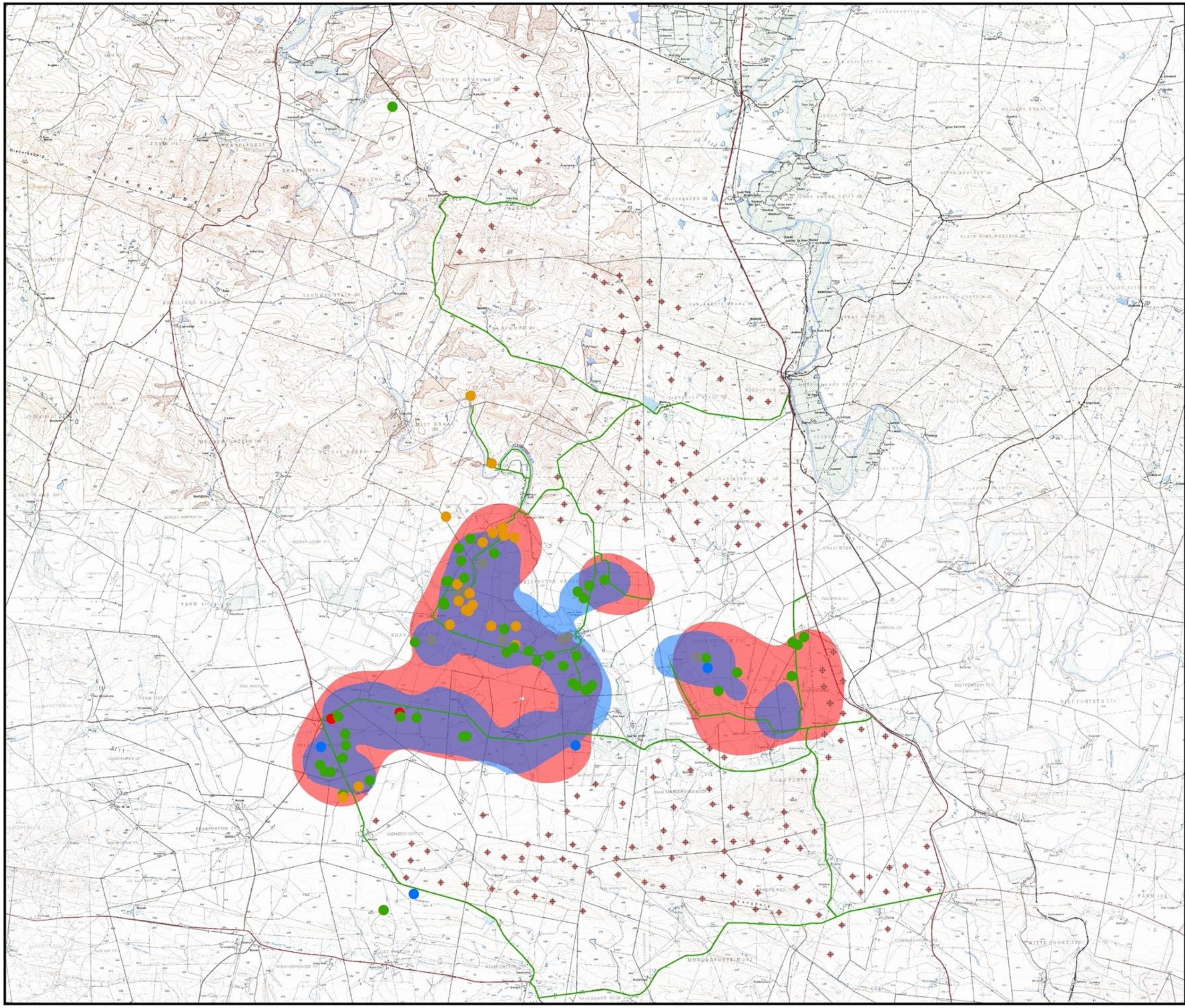
```
Wald test of spatial terms:          chi2(6) = 2612.03    Prob > chi2 = 0.0000
```

***Note**: 'CV_LogOcc' = Cape Vulture grid square flight activity; 'Alt_mean' = Mean altitude; 'Slope_max' = Maximum slope; 'Ridge600_Dis't = Distance to nearest high (>600m asl) ridge line; 'CV_Dist' = Distance to nearest Cape Vulture roost site.*

Cranes and Bustards

The areas of higher importance for cranes and bustards were identified in the previous February 2020 report primarily from the road transect data, and that same approach has been adopted here. This analysis focussed on the two more abundant larger species, Blue Crane and Ludwig's Bustard, as the two species most at risk from the wind farm, then considered how these areas included areas used by other less abundant species.

This 'area of higher importance' was determined firstly by calculating the 90% utilisation range of the each of these two species, using kernel density estimation (Worton 1989), then merging those two areas. The results are shown in Figure 32. A check was then made against the records from the other large crane and bustard species recorded, to see whether their distribution was included in this area. Very few records lay outside this merged range, so no further extension of that area was required.



WIND RELIC RENEWABLES

Choje Proposed Wind Farm: Western Block

FIGURE 32

Large Crane and Bustard Areas of Importance Jun 2019 - Aug 2020

KEY:

- Choje West turbines EIA
- Blue Crane 90% range
- Ludwig's Bustard 90% range
- Choje West Road Transects

Other Species Records

- Denham's bustard
- Grey crowned-crane
- Karoo bustard
- Kori bustard
- Secretarybird

Ecology Consulting

N

0 1 2 4 6 8 Kilometres

LAYOUT DWG N/A

T-LAYOUT NO. N/A

DRAWING NUMBER EC-2020-1

SCALE - 1:150,000 @ A3

ROAD TRANSECT SURVEY JUNE 2019 - AUGUST 2020

Appendix A - Savannah – Impact Assessment Methodology

Assessment of Impacts

Direct, indirect and cumulative impacts associated with the projects must be assessed in terms of the following criteria:

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

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

S=(E+D+M)P

S = Significance weighting

E = Extent

D = Duration

M = Magnitude

P = Probability

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

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

Appendix B - AVIFAUNAL MANAGEMENT PLAN

OBJECTIVE: to provide guidance to the Developer, the Environmental Control Officer and the construction contractor before the start of the construction work, especially concentrating on the findings of the AIA report and Sensitivity areas. This also include the "do's and don'ts"' of every aspect that will be underlined by the EAP and every other specialist.

The Developer need to employ an independent Environmental Control Officer (ECO) to oversee all construction work, which in turn needs to sign agreements with the Construction Contractors (CCs) (and sub-contractors) to obey to all environmental authorisation terms, etc.

The Avifaunal specialist need to train the ECO and CCs in understanding the needs and work in perform their duties to the minimum risk and impact on birds during construction of all aspects of their work.

POST-CONSTRUCTION BIRD MONITORING PROGRAMME

The work done to date on the Wind Garden wind farm site has established a baseline understanding of the distribution, abundance and movement of key bird species on and near the site. However this is purely the 'before' baseline and aside from providing input into turbine micro-siting, it is not very informative until compared to post-construction data. The following programme has therefore been developed to meet these needs. It is recommended that this programme be implemented by the Wind Garden Wind Farm if constructed.

During construction monitoring

It will be necessary to monitor the breeding status and productivity of the Martial Eagle and the Verreaux's eagle pairs during breeding seasons during construction. This can be done by a minimum of three visits to the nest site per breeding season, or close enough to observe the eagles without disturbing them.

Post-construction monitoring

The intention with post-construction bird monitoring is to repeat as closely as possible the methods and activities used to collect data pre-construction. This work will allow the assessment of the impacts of the proposed facility and the development of active and passive mitigation measures that can be implemented in the future where necessary.

One very important additional component needs to be added, namely mortality estimates through carcass searches under turbines. The following programme has therefore been developed to meet these needs, and should start as soon as possible after the operation of the first phase of turbines (not later than 3 months):

Note that this framework is an interim draft. The most up to date version of the best practice guidelines (Jenkins et al 2015) should inform the programme design at the time.

Live bird monitoring:

» The 6 Walking transects of 400m each that have been done during pre-construction monitoring should be continued.

» The Road transect survey should be continued and conducted twice on each site visit.

» The 11 Focal point surveys along the Road transect route. If any sensitive species are found breeding on site in future these nest sites should be defined as focal sites.

» The 6 Vantage Point surveys already established should be used to continue data collection post-construction. The exact positioning of these may need to be refined based on the presence of new turbines and roads. A total of 12 hours of observation should be conducted at each vantage point on each site visit, resulting in a total of 48 hours direct observation on site per site visit.

Bird Fatality estimates

This is now an accepted component of the post construction monitoring program and the newest guidelines (Jenkins et al, 2015) will be used to design the monitoring program. It is important that in addition to searching for carcasses under turbines, an estimate of the detection (the success rate that monitors achieve in finding carcasses) and scavenging rates (the rate at which carcasses are removed and hence not available for detection) is also obtained (Jenkins et al, 2015). Both of these aspects can be measured using a sample of carcasses of birds placed out in the field randomly. The rate at which these carcasses are detected and the rate at which they decay or are removed by scavengers should also be measured.

The area surrounding the base of turbines should be searched (up to a radius equal to 75% of the maximum height of turbine) for collision victims. The frequency at which these searches need to be conducted will be at least every 10 working days (or effective two weeks). Any suspected collision casualty should be comprehensively documented (for more detail see Jenkins et al, 2015). A team of carcass searchers will need to be employed and these carcass searchers will work on site every day searching the turbines for mortalities. It is also important that associated infrastructure such as power lines and wind masts be searched for collision victims according to similar methods.

A more detailed postconstruction monitoring programme can be designed once the full layout is finalised. The most up to date version of the best practice guidelines (Jenkins et al, 2015) should inform the programme design at the time.

Appendix C - The Specialist Declaration

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

Proposed Wind Garden wind farm development, west of Grahamstown, in the Makana Local Municipality, Eastern Cape

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	East Cape Diverse Consultants			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	1	Percentage Procurement recognition	20
Specialist name:	Adri Barkhuysen			
Specialist Qualifications:	MSc			
Professional affiliation/registration:	Pr.Nat.Sc. 400/350/13			
Physical address:	34 Scanlen Street, Mount Croix, Port Elizabeth			
Postal address:	As above			
Postal code:	6001	Cell:	082 630 2448	
Telephone:	041-373 2047	Fax:	n/a	
E-mail:	adriba@telkomsa.net			

2. DECLARATION BY THE SPECIALIST

I, __Adri Barkhuysen_____, 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 48 and is punishable in terms of section 24F of the Act.

[signature]

Signature of the Specialist

East Cape Diverse Consultants

Name of Company:

1 Dec 2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, Adri Barkhuysen swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

East Cape Diverse Consultants

Name of Company

1 Dec 2020

Date

71806522
CN n. Comphe

Signature of the Commissioner of Oaths

SOUTH AFRICAN POLICE SERVICE
COMMUNITY SERVICE CENTRE
GEMEENSKAPSDIENS SENTRUM
2020 -12- 0 1
STATION COMMANDER
MOUNT ROAD
SUID-AFRIKAANSE POLISIEDIENS

2020 /12/01.

Date

Appendix D – the Specialist's CV

Curriculum Vitae

Adri Barkhuysen

Date of Birth: 1 December 1959

Specialist Field: Avifauna

Consultant: Environmental Assessment Practitioner

Professional Natural Scientist: *Pr. Sci. Nat. (400350/13)*

Contact Details:

34 Scanlen Street, Mount Croix, Port Elizabeth 6001 Email: adriba@telkomsa.net

Tel: 041-373 2047 Fax: 041-991 0551 Cell: 082 630 2448

QUALIIFICATIONS

MSc (Zoology) – University of Port Elizabeth – 2000-2002

MSc thesis - evaluate and compare the prey/food availability of eagles and large terrestrial birds that are prone to power line interactions – electrocutions and collisions - between transformed and untransformed habitats in a Karoo landscape near Somerset-East.

BSc Honours in Zoology – Potchefstroom University – 1998-1999

BSc Zoology and Botany – Unisa (part-time) 1990-1996

RELEVANT WORK EXPERIENCE

- 1994-2002: Volunteer Raptor Conservation Group of the Endangered Wildlife Trust (EWT).
- 2002-2010: Field biologist with EWT in the Eastern Cape. Duties included: eagle/farmer conflict resolution, surveying and monitoring breeding success of Cape vulture for the Vulture Study Group and Black eagle for the Raptor Conservation Group.

Project Coordinator of the Birds of Prey Working Group and Oribi Working Group for EWT in the Eastern Cape, which included various Oribi translocation initiatives to reintroduce Oribi into areas where it disappeared from.

• Since August 2010 to present: Environmental Consultant and bird specialist for East Cape Diverse Consultants.

BUSINESS PROFILE:

I am the Director and owner of East Cape Diverse Consultants CC (ECDC) since August 2010. The business provides a professional environmental consulting service to a wide variety of clients while I conduct regular assessments and studies as an avifauna specialist.

The income of ECDC is mainly generated from the cellular industry, as environmental assessment practitioner to obtain environmental authorization from competent authorities for projects that require basic assessment and EIA reports. But we supply services in the agricultural, power line and wind farm sectors.

CLIENTS:

Industry:

- Eskom Distribution Division - power line
- Eskom Transmission Division - power line
- Cellular - Vodacom, MTN, CellC and Telkom 8Ta
- Cellular – American Tower Company, Atlas Tower, Eaten Towers, BJB Project Services, Senzile Infrastructure Consultants, Analytics Hive.
- Wind farm - Newcombe Wind Developments and Woodlands Trust

Consultants:

- Bohlweki Environmental
- Royal HaskoningDHV
- JAH Environmental Consulting
- SKR Consulting
- Environmental CEN
- Wild Skies Ecological Services
- Ecology Consulting in the UK
- Phila Environmental Services

Our cellular clients and work include Vodacom, MTN, CellC, American Tower Company (ATC) and Telkom/8-ta, with projects in the Eastern Cape (and in the former Transkei region), KwaZulu-Natal (Zululand and Midlands) and Western Cape (south Cape region). These include the public participation process and visual impact assessments.

The agricultural work include, impact assessments for environmental authorization for a variety of projects, including:

- Centre-pivot irrigation development – dairy farming;
- Extension to Feathers Egg laying plant - poultry farming;
- Road and fire break – timber plantation;
- Culvert river crossing and soil erosion/stabilizing – dairy farming;
- Bush clearing – citrus farming;
- Charcoal/Briquette plant/factory

A variety of works, acting as Environmental Control Officer were completed, mainly for the construction of cellular towers.

Section 24G applications for non-compliance of NEMA environmental regulations by farmers/landowners. This sector of work was based in the Eastern and Western Cape Provinces.
An application for Sand Mining permits in the former Transkei to the Department of Minerals Resources.
Water Use Licence Applications for landowners/clients to the Department Water and Sanitation in the Cacadu district region.
Secondly, my work as avifauna specialist, include conducting bird field studies and bird impact assessments for the wind farm industry, Eskom power lines, universities, environmental organisations and environmental consultants in the private sector.

Bird studies include:

- Bird Impact assessment desktop study for scoping report - for the proposed 400kV Eskom power line from Grassridge near Port Elizabeth to Poseidon substation near Bedford – for Bohlweki Environmental;
- Bird habitat assessment report for the existing 132kV Eskom power line to fit bird flight diverters from Grassridge to Humansdorp – for Royal HaskoningDHV;
- avifauna pre-construction monitoring for proposed wind farms;
    - Spitskop WEF near Riebeeck-East - for JAH Environmental Consulting.
    - Banna Ba Pifhu WEF near Humansdorp – for Woodlands Trust.
    - Roodeplaat WEF near Uitenhage – for Newcombe Wind Developments.

- Bird Impact Assessment report for proposed wind powered generation facilities

  - Spitskop near Riebeech-East with JAH Environmental Consulting
  - Banna Ba Pifhu WEF near Humansdorp – for Woodlands Trust.

- Black eagle nest surveys and monitoring between Uitenhage and Steytlerville during 2003 to 2007 for EWT;
- African Barred owl surveying project in the Albany district and in the former Transkei – 2007-2009 for EWT;
- Bird study - Jacobin cuckoo / Cape bulbul brood parasite field study at NMMU Reserve, Port Elizabeth - for Prof Oliver Kruger, Bielefeldt University, Germany;
- Monitoring of Cape vulture roosting and breeding colonies in the former Transkei 2006-2007 - for Dr Andre Boshoff of Nelson Mandela Metropolitan University;
- Bird Impact Assessment for the proposed Wing Park airstrip development EIA near Port Elizabeth - 2014;
- Large eagle nests and breeding success surveys and monitoring for Wild Skies Ecological services – 2013;
- Black eagle, African Crowned eagle and Martial eagle nest searching surveys and monitoring for the continuation of the EIA process of the proposed Roodeplaat WEF - 2015-2018;
- Avifauna baseline assessment and a year pre-construction monitoring: for Transnet Manganese Export Terminal in the Coega IDZ and Port of Ngqura – Phila Environmental Services 2015-2016.

Other bird related work:

Professional assistance to American, Bill Clark, an author of a book on African birds of prey – 2007

Consultant for Birding EcoTours Chris Lotz – African Barred owl research and exploring – 2007-2009

Professional assistance to Marie-Sophie Garcia-Heras and Dr Rob Simmons from UCT on Black harrier research for her PhD - 2014

Professional assistance to Gareth Tate from UCT on Black sparrowhawk research for his PhD - 2014

Consultant for the Wildlife film makers – Talking Picture Films - 2003-2005 and Home Brew Films - 2016- 2017

Professional assistance to Dr Guy Castley of the Griffith University, Australia with forest bird surveys and monitoring - 2017

Collaborations:

In the successful operation of our business, we employ the serves of many professional scientists to conduct specialist studies, e.g. wetland ecologist Dr Brian Colloty, ecologist Jesse Jegles, plant specialist Dr Marietjie Landman, Jamie Pote, archeological Dr Billy de Klerk, Dr Celeste Booth, paleontological Dr Johan Binneman, Dr Francois du Rand, historians Gerrie Horn, etc. which broadens our understanding of sensitive sites or issues under assessment.

Other Environmental work:

Consultations with a variety of clients in the industrial/commercial sector for potential and future developments such as a hydroponic establishment, coal-driven electric generators, charcoal/briquette plant, poultry farming, fruit juice extraction plant, bird pest control, waste water analysis for a house hold chemical manufacturer, etc.
I am still regularly consulted on eagle/farmer conflict resolutions.

East Cape
DIVERSE
CONSULTANTS

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Port Elizabeth
6001

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adriba@telkomsa.net
Fax: 041-991 0551
Cell: 082 630 2448

CC 2006 / 039496 / 23

Date: 23 February 2021

To who it may concerm

RE: Avifaunal Impact Assessment – Wind Garden Wind Farm

Adri Barkhuysen (East Cape Diverse Consultants) and Steve Percival (Ecology Consulting) was appointed by Savannah Environmental (Pty) Ltd to prepare an Avifaunal Impact Assessment report for the Wind Garden Wind Farm, in the Makana Local Municipality, Eastern Cape. The project site is located within the Cookhouse Renewable Energy Development Zone (REDZ). Due to the location of the project site within the REDZ, a Basic Assessment (BA) process is being pursued.

The pre-construction bird monitoring field work started in June 2019 and ended in August 2020 (14months) and followed the requirements of Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6 and also using the BirdLife South Africa (BLSA) guidance, and South African best practice (Jenkins et al. 2015) and international best practice (Scottish Natural Heritage 2017).

Consultations with Savannah started in January 2020 and in March 2020 we received the requirements prescribed by Government Gazette 43110 (Published in Government Notice No. 320) of 20 March 2020 "Protocol for The Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Avifaunal Species by Onshore Wind Energy Generation Facilities where the electricity output is 20 Megawatts or more".

Therefore, this Notice was not available to us during the design and planning stage before the bird study.

Sincerely

Adri Barkhuysen

082 630 2448