RIPPONN WIND FARM

Blue Crane Route Local Municipality, Eastern Cape Province

AVIFAUNA IMPACT ASSESSMENT REPORT

August 2021

Prepared for:

Savannah Environmental Jo-Anne Thomas joanne@savannahsa.com +27(0)11-656 3237

Prepared by:

Adri Barkhuysen (East Cape Diverse Consultants) and Dr Steve Percival (Ecology Consulting)

East Cape
DIVERSE
CONSULTANTS
34 Scanlen Street
Mt Croix
Port Elizabeth
6001
Tel: 041-373 2047
adriba@telkomsa.net
Fax: 041-991 0551
Cell: 082 630 2448
CC 2006 / 039496 / 23

Ecology Consulting

Ecology Consulting,
Swallow Ridge Barn,
Old Cassop, Durham DH6 4QB, UK
steve.percival@ecologyconsult.co.uk

TABLE OF CONTENTS

Executive Summary

The Ripponn wind farm is located in the Cookhouse Renewable Energy Development Zone (REDZ, assessed within the Strategic Environmental Assessment (SEA) report of the Department of Environmental Affairs (2015). It forms one of four wind farms that make up the western block of the Choje cluster of renewable energy developments. A total of 117 species were recorded during the pre-construction bird monitoring surveys. Eleven of these were classed as 'Species of Conservation Concern' on the basis of their conservation value, i.e. South African red-listed species and those on the IUCN red list (near-threatened status and higher concern). Of these, seven species were classed as 'Priority Species' for this assessment, i.e. those of conservation concern that were at risk of collision (i.e. flew through the wind farm site at rotor height) or could be at risk of disturbance and/or powerline impacts (i.e. occurred within the potential impact zone and were potentially vulnerable to these impacts).

The Ripponn site is mostly 'Albany Subtropical Thicket' (bushveld) vegetation, especially on the slopes and small kloofs, with Karoo shrubland (bossieveld) encroaching into the flatter areas The hill-tops and ridges are mainly 'Bedford dry grassland' vegetation.

Three Martial Eagle and three Verreaux's Eagle territories were confirmed in the whole of the Choje West block and its surrounds during the raptor surveys. Other breeding locations identified included Lanner Falcon, Grey-crowned Crane, two Jackal Buzzards, several Pale Chanting-goshawk nests and potentially an African Harrier-hawk.

The site lies on the fringe of the usual range of the main Cape Vulture roost in this region (which lies 51km north-east of the nearest proposed Ripponn wind turbine). However, unprecedented high numbers of Cape Vultures (peak count 72) visited the Choje West block during the summer season (November 2019 - March 2020) and roosted on the 400kV Eskom pylons in the flat Karoo bossieveld areas in the centre of the Choje West block, 5km south from the closest Ripponn turbine). These vultures only visited the area during the summer of 2019 and not during the other seasons. This area had not previously held such large numbers and it is thought that these exceptional numbers were a result of a combination of severe drought conditions and high food availability of dead small livestock in the area.

The large terrestrial birds were found in low numbers within the flat grassland areas. Large flocks of Blue Crane were recorded in the Choje West block about 5km south of the Ripponn site. The bushveld supported a high diversity of small bush birds.

The entire West block of the Choje complex is flanked by the Great and Little Fish rivers, which has permanent irrigation water. This allows landowners to create irrigated croplands, which are mainly centre-pivot systems. These are massive attractions to birds, especially water birds and large flocks of Blue Crane, however no pivots occur within the Ripponn wind farm area.

It is anticipated that the proposed Ripponn Wind Farm will have a variety of impacts on avifauna, which ranges from low to medium significance with the implementation of the proposed mitigation (up to high in the absence of mitigation).

The Table below summaries the assessments for the different potential impacts at Ripponn wind farm

Potential Impacts on Birds	before mitigation 36 turbines	after mitigation 23 turbines
	Construction Phase	
Habitat Loss	MEDIUM	LOW
Disturbance	MEDIUM	MEDIUM
	Operation Phase	
Collision with Turbines	MEDIUM	MEDIUM
Disturbance	MEDIUM	LOW
Collision with Powerline conductors/wires	HIGH	MEDIUM
Electrocution on Powerline structures	MEDIUM	LOW
Decommissioning	MEDIUM	LOW
Cumulative Effects over the Wider area	MEDIUM	MEDIUM

A range of ornithological mitigation measures will be required, and these are set out in detail in the Ornithological Mitigation Plan (Appendix F). This includes:

- Design Mitigation to avoid higher sensitivity areas including buffers around priority species' nest and roost sites.
- Collision risk reduction (Cape Vulture):
  - Reduce suitability of powerline roost sites;
  - Carcass removal programme (removal from wind farm properties to reduce vulture food availability).
- Collision risk reduction (eagles and large terrestrial birds):
  - Increase turbine blade visibility in more sensitive areas;
  - On- and off-site habitat management;
  - Shut-down-on demand, informed by adaptive management programme;
  - Reduce powerline collision risk.
- Comprehensive monitoring of the effectiveness of the mitigation to inform an adaptive management strategy, including post-construction bird surveys, carcass searches and nest/breeding monitoring.

The overall conclusion is that there are likely to be LOW to MEDIUM significant impacts on ornithology as a result of the proposed Ripponn wind farm, assuming that the mitigation measures specified in this report are implemented.

1. INTRODUCTION

Ripponn (Pty) Ltd is proposing the development of a commercial wind farm and associated infrastructure on a site located approximately 44km south-east of Somerset East and 41km south-west of Cookhouse (measured from the centre of the site) within the Blue Crane Route Local Municipality and the Sarah Baartman District Municipality in the Eastern Cape Province.

A preferred project site with an extent of 12,838ha has been identified by Ripponn (Pty) Ltd as a technically suitable area for the development of the Ripponn Wind Farm with a contracted capacity of up to 324MW that can accommodate up to 36 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 Choje 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), all located in the Makana and Blue Crane Route Local Municipalities. The Ripponn Wind Farm is in the West Block and the site is centred on -32.991825° S latitude and 25.764826°E longitude. The wind farm is neighboured by another proposed wind farm known as the Hamlett Wind Farm (37 turbines), which will be assessed in a separate Avifauna Impact Assessment (AIA) report. The Ripponn and Hamlett wind farms will connect to the national grid via a 400kV MTS with a 16km powerline.

East Cape Diverse Consultants (in collaboration with Ecology Consulting, a UK-based consultancy) 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 has been designed using the BirdLife South Africa (BLSA) guidance and international best practice (Jenkins *et al*. 2015, SNH 2017, BLSA 2017 Verreaux's eagle guidelines, BLSA 2018 Cape vulture guidelines) and the information in the Strategic Environmental Assessment (SEA) (Department of Environmental Affairs 2015) completed by CSIR for the Cookhouse REDZ Focus Area. The pre-construction bird monitoring data was collected as a combined programme for the entire Choje West block.

It is important to note that the proposed Ripponn wind farm forms part of the larger Choje energy complex, and the design of the bird study focused on the whole extent of the developments, not just the area in which the Ripponn wind farm would be located. This report assesses the avifaunal impacts of the Ripponn Wind Farm only, although cumulative impacts of all projects in the area are considered.

1.1. Project Description

The project site comprises the following eight farm portions:

- Remaining Extent of Farm No 381
- Remaining Extent of Farm Wilton No 409
- Portion 7 of Farm No 381
- Remaining Extent of Farm Hartebeest Kuil No 220
- Portion 1 of Farm Hartebeest Kuil No 220
- Portion 2 of Farm Haartebeestkuil No 220
- Portion 2 of Farm No 230
- Remaining Extent of Portion 4 (Pruim Plaas) of Farm Draai Hoek No 221

The Ripponn 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 324MW:

- Up to 36 wind turbines with a maximum hub height of up to 166m. The tip height of the turbines will be up to 246m;
- A 132/33kV on-site collector substation to be connected to a proposed 400kV Main Transmission Substation (MTS) located to the south of the site via a new 132kV overhead power line (twin turn dual circuit line). The development of the proposed 400kV Main Transmission Substation will be assessed as part of the separate BA process in order to obtain Environmental Authorisation;
- 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 5,400ha in extent and the much smaller development footprint of 30.8ha will be placed and sited within the development envelope.

1.2. Evolution of the Site Design

Two specific areas have been identified for the development of the Choje complex of wind farms, as shown in Figure 1, in an 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.

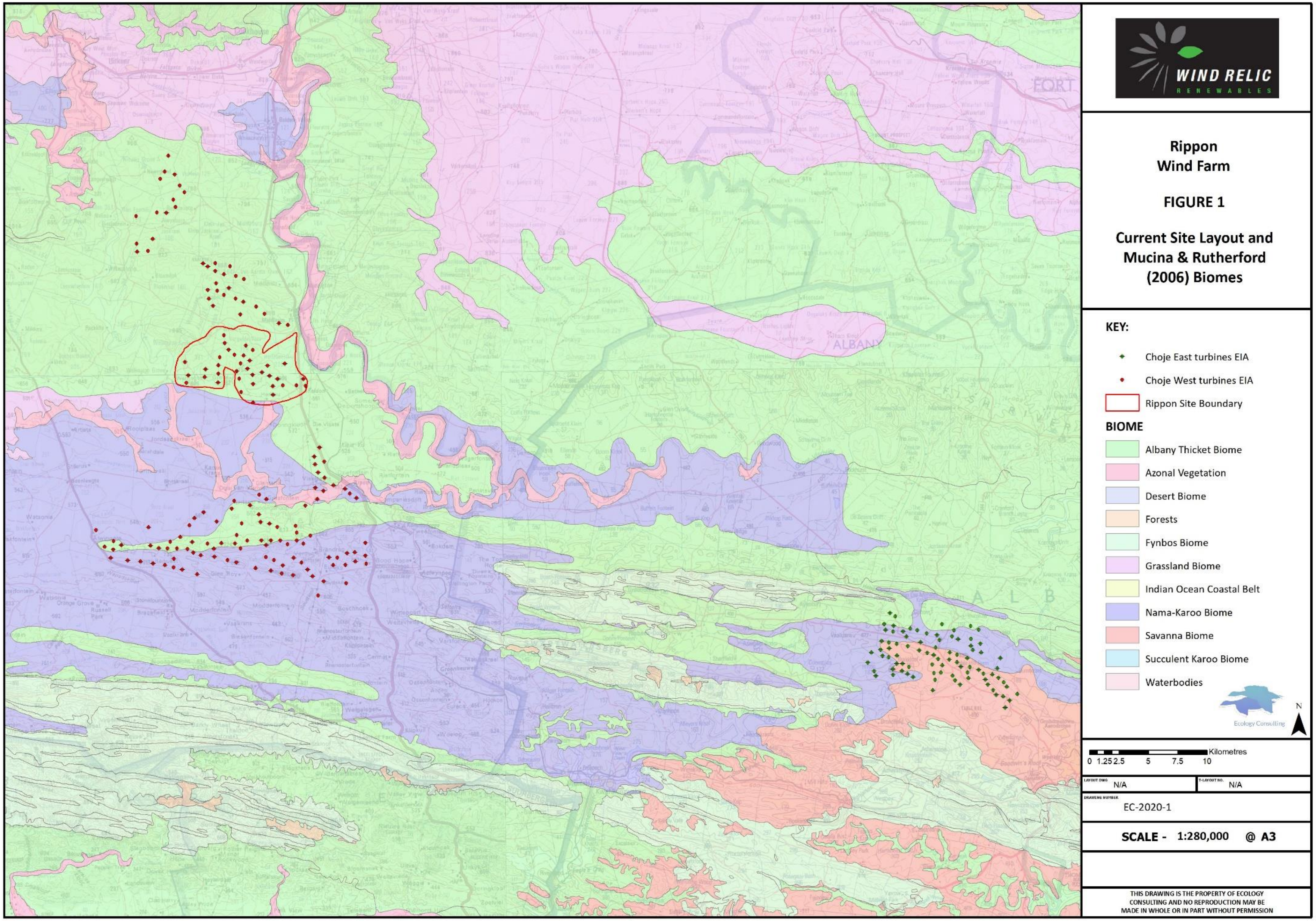
These two blocks have been further sub-divided into six specific zones that will each form the basis of the wind farm applications, two in the Eastern Block and four in the Western Block. The Ripponn proposal forms one of these six applications, located in the northern part of the Western Block.

These wind farm development areas were refined in an iterative design process for the wind turbine layouts. The timeline for these changes was as follows:

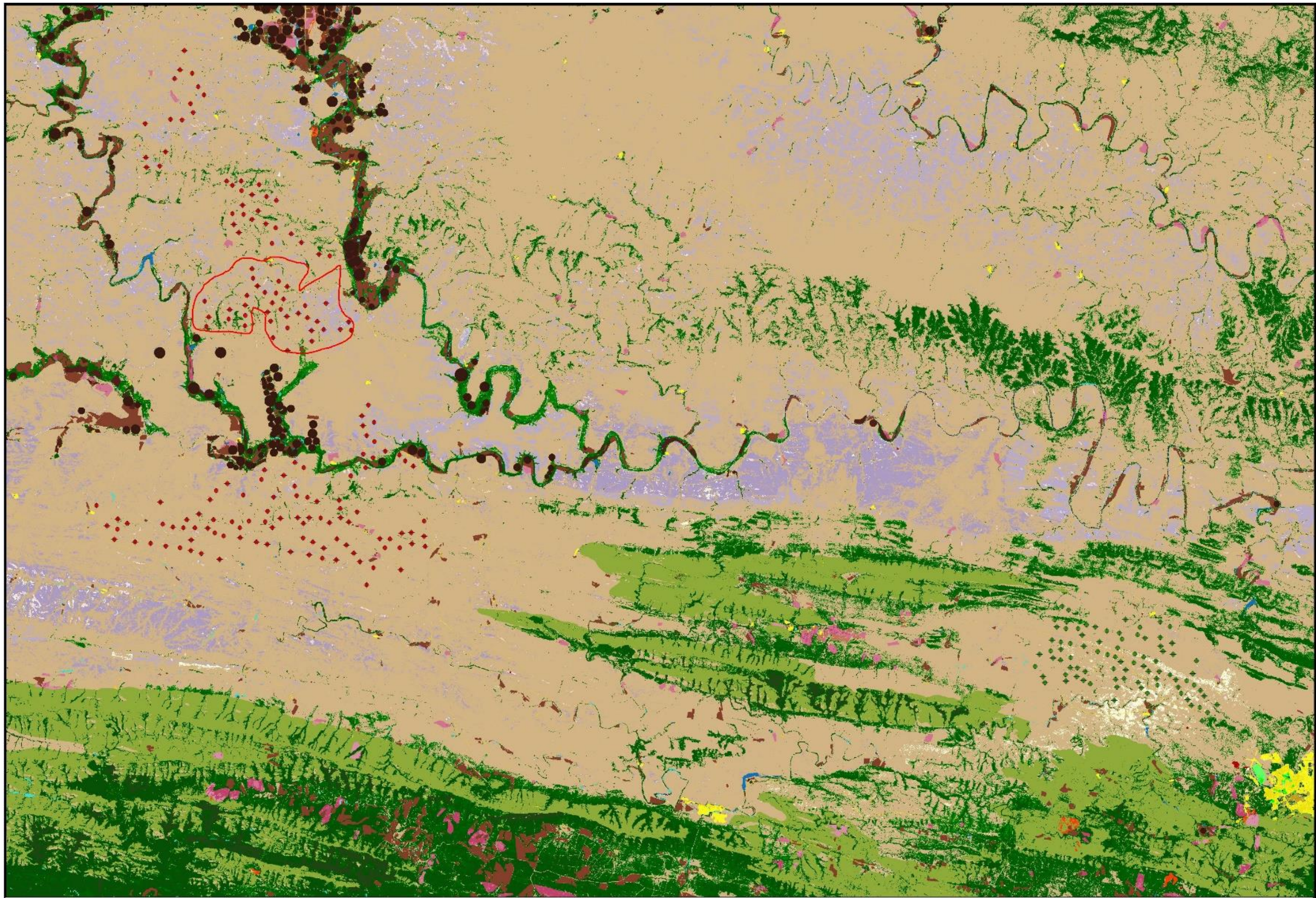
- February 2019 - initial layout (dated 21/2/19) comprising 494 turbines in the Western Block (plus 139 in the Eastern Block). The initial survey methodology was designed based on this layout.
- August 2019 - second layout iteration (dated 22/8/19). This layout was considerably reduced on the initial layout, and comprised 297 turbines in the Western Block (and 128 turbines in the Eastern Block).
- October 2020 - further refinement of the layout, finalising it for the EIA process. The number of turbines was further reduced to 175 turbines in the Western Block (and 85 turbines in the Eastern Block), removing turbines from more sensitive areas as identified through specialist studies. The proposed turbine locations are shown in Figures 1, 2 and 3.

The proposed Ripponn wind farm, assessed in this report, now comprises 36 turbines and is located in the Western Block.

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



WIND RELIC
RENEWABLES
Rippon
Wind Farm
FIGURE 1
Current Site Layout and
Mucina & Rutherford
(2006) Biomes
KEY:
Choje East turbines EIA
Choje West turbines EIA
Rippon 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
Ecology Consulting
N
Kilometres
0 1.25 2.5 5 7.5 10
N/A
N/A
EC-2020-1
SCALE - 1:280,000 @ A3
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION



Rippon Proposed Wind Farm

FIGURE 2

Current Site Layout and Land Cover (2018) Classes

KEY:

- Choje West turbines EIA
- Choje East turbines EIA
- Rippon 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)

N

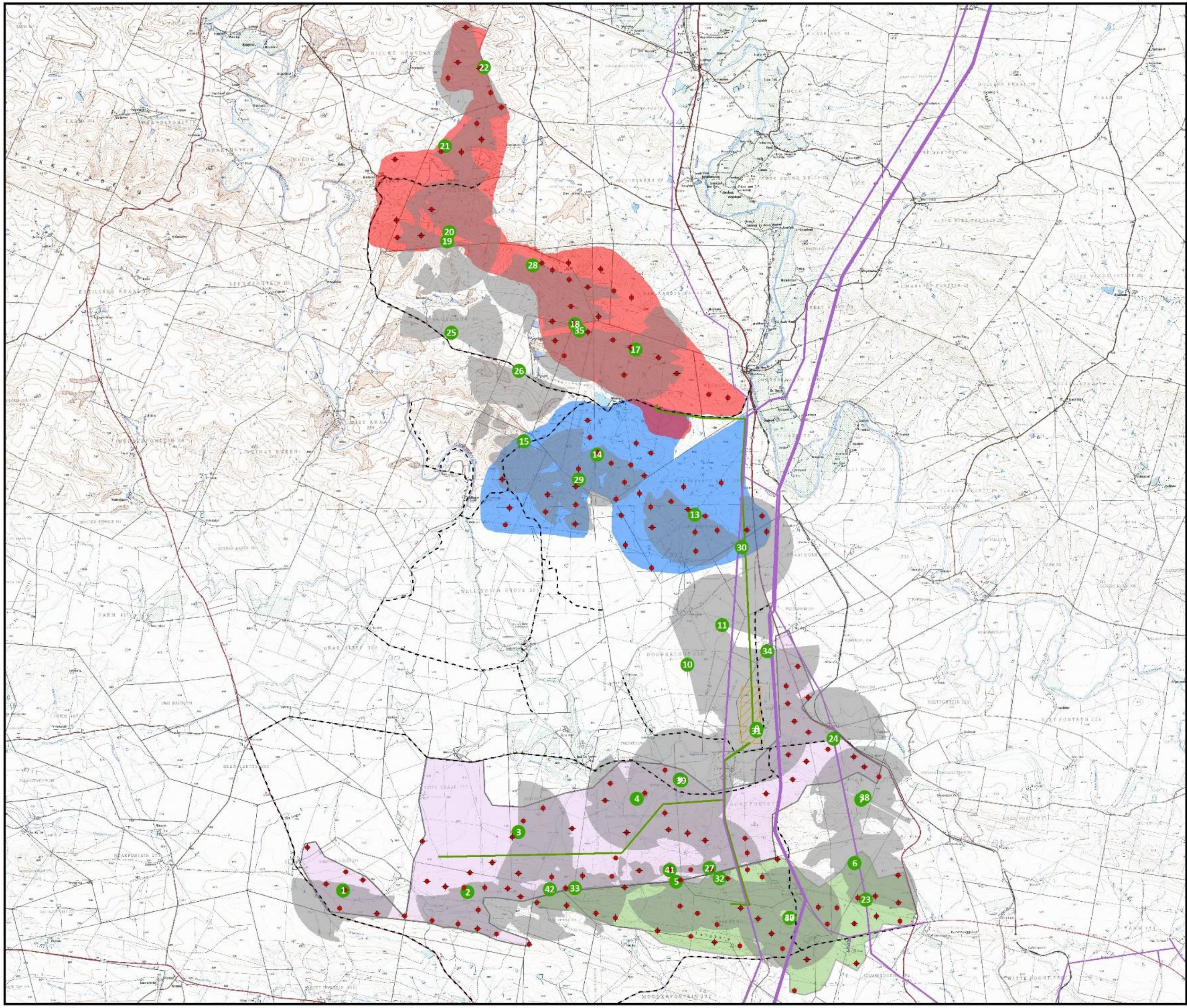
Ecology Consulting

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 RELIC RENEWABLES

Rippon Proposed Wind Farm

FIGURE 3

Western Block: proposed layout, VP locations and road transects

KEY:

- Choje West turbines EIA
- Choje West VP locations
- Choje West Road Transects
- Rippon Site Boundary
- Hamlett Site Boundary
- Redding Site Boundary
- Aeolus Site Boundary
- Choje West Viewsheds
- Greater area for 400MTS
- Existing powerlines
- Proposed new powerline

Ecology Consulting

N

Kilometres
0 0.75 1.5 3 4.5 6

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

SCALE - 1:140,000 @ A3

Viewshed: 2km cut-off, 1.7m viewing height to 40m above ground level

1.3. Power line and Associated Infrastructure Areas

The map in Figure 3 shows the Ripponn wind farm study area in the red area (in the south) with the turbine positions and all the 39 bird pre-construction vantage points with their viewsheds for Ripponn and the other proposed wind farms in the Choje West complex (Redding, Ripponn, Hamlett and Aeoulus).

Figures 3 and 3a shows the additional infrastructure to be constructed as part of the Ripponn wind farm, as described in the Project Description. This includes 16km of new overhead 132kV powerline. The only vegetation clearance required for the powerline will be at the new tower locations.

A new Collector substation (100x100m area) with its connection to a new 16km powerline that will connect to the new 400kV MTS (a separate application) 16km south, which then connects to an existing Eskom 132kV powerline. Ripponn and Hamlett wind farms will each have their own collector substations, but they will share the same proposed 16km powerline to the proposed 400kV MTS (Figure 3). Additionally, there will be working areas required for the construction site buildings, storage areas and concrete batching of about 12ha and camp site for staff accommodation of about 6ha., which will also require vegetation clearance and hence loss of bird habitat. Figure 3a shows a Google Earth image of the additional infrastructure to be constructed as part of the Ripponn wind farm.

Figure 3a. GoogleEarth images showing Ripponn BoP area shaded light green, 132kV collector sub (above) and the light blue line (below) is the 16km powerline connecting to the proposed 400kV sub where it will connect the existing Eskom 400kV powerline.

2. DESIGN AND METHODOLOGY OF THE BIRD STUDY

This section of the report sets out the preliminary information on the area's ornithological sensitives that were obtained from the Strategic Environmental Assessment (SEA) report of the Department of Environmental Affairs (2015), that were used to inform the pre-construction study, and how this was used to design the field studies (in conjunction with reference to the BirdLife South Africa (BLSA) guidance and international best practice (Jenkins *et al*. 2015, SNH 2017, BLSA 2017, BLSA 2018), and data from initial site surveys). The surveys and the wind farm site layout were designed following an iterative process, refining the design of each in light of bird data being collected and changes to the proposed site layout.

2.1. Strategic Environmental Assessment – Desk study

The site lies within the Cookhouse Focus Area, which the Strategic Environmental Assessment (SEA) (Department of Environmental Affairs 2015) 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 Focus Area SEA (source: Table 3 from the SEA (Appendix A5), updated for current IUCN status.

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-threatened	-	19	1.89	High	Moderate
Ludwig's Bustard	Endangered	Endangered	Near-endemic	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

Species	Threat status		SA Endemism	National sensitivity rating (wind only)	SABAP2 Rep Rate (%)	FA-specific predicted susceptibility to	
	Regional	Global				Wind	Solar
Cape Vulture	Endangered	Endangered	Near-endemic	1	0.94	Very high	Low
Black Harrier	Endangered	Endangered	Near-endemic	7	6.37	Moderate	Moderate
Jackal Buzzard	-	-	Near-endemic	42	26.18	High	Low
Verreaux's Eagle	Vulnerable	Least concern	-	3	3.30	Very high	Low
Booted Eagle	-	-	-	57	5.19	High	Low
Martial Eagle	Endangered	Endangered	-	5	4.72	Very high	Moderate
African Crowned Eagle	Vulnerable	Near-threatened	-	27	4.25	Very high	Low
Secretarybird	Vulnerable	Endangered	-	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 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

Ornithological feature	Information source	Sensitivity and buffer extent
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
Known Cape Vulture roost site at Agieskloof / Lichtenstein	EWT Knowledge Management Database, BLSA, Boshoff *et al*. 2009 a and 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 Table 2, 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 programme of site-based bird baseline surveys have, however, addressed this issue and provided a more accurate local picture of the ornithological sensitivities.

The proposed Ripponn site lies outside several of the key constraint areas identified in the Focus Area SEA. It is beyond the 40km buffer (which was used in the SEA to identify high sensitivity areas) from the important Cape Vulture roost. It also outside the BLSA-recommended 50km buffer to identified high sensitivity areas from main vulture roosts, being 51km south-west of the nearest regular roost at Aggieskloof.

The SEA considered the area within 1km of Lanner Falcon nests to be very high sensitivity, and within 3km to be high sensitivity. No nests were reported in the SEA within this distance of the Ripponn site.

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 further information available from the SEA 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. 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.

2.2. Guidance Documents on Baseline Bird Surveys

The design of the bird study drew primarily on BirdLife South Africa (BLSA) guideline, including general guidance on surveys methods and assessment (Jenkins et al. 2015), as well as being informed by international best practice (SNH 2017). As set out in the BLSA guideline, the baseline surveys used a range of methods to obtain quantitative data on the distribution and abundance of small birds (using walked transects), large terrestrial birds (using driven vehicle transects), focal point surveys of key ornithological features such as priority species nests and communal roosts and vantage point (VP) surveys to map priority species flight activity.

The surveys were carried out over the recommended 12 months between June 2019 and August 2020, with a 1-month gap in April 2020 due to Covid-19 restrictions. For the VP surveys the BLSA recommended minimum of 48 hours survey per VP was achieved for all VPs. Coverage of the proposed wind farm site by the VP view-sheds exceeded the BLSA-recommended 75% minimum.

The study area was defined to include areas outside the potential impact zone of the wind farm, in order to provide a reference area for post-construction monitoring (to compare priority species' numbers, distribution and flight activity in that area with that in the wind farm site) and enable a Before-After-Control-Impact analysis to be carried out.

Additional specific guidelines produced for particular species of importance was also taken into account, including:

- Verreaux's Eagle (BLSA 2017): dedicated surveys were carried to identify nest sites within and around the entire Choje West block (up to 5km from the boundaries). BLSA advise that baseline surveys should be extended to two years where this species is at significant risk. There are two seasons' nest surveys (2019 and 2020) which were undertaken. Survey effort in proximity to Verreaux's Eagle nests were not increased to 72 hours as, through early design mitigation, no nests were located within 1.5km of any proposed turbine locations.
- Cape Vulture (BLSA 2018): as part of the Choje West block is within 50km of a vulture roost, this guidance recommends 72h/VP per year. This was not fully achievable at the Ripponn site, primarily because of the fact that the birds were present in the Choje West block for only a relatively short period (November-March) and were unexpected given the previous lack of records in the area (from the SEA, local landowner consultation, and the surveyors' own experience in the area). However these vultures are unlikely to return to the Choje West block, unless high stock losses occur again. Additional focussed survey work was however undertaken on the vultures' temporary powerline roost in the Choje West block when they were present, including VP surveys and roost counts. Though only a single vulture season was covered in the baseline, the relatively high numbers present meant that a comprehensive picture of their use of the area could be established, including spatial modelling to investigate the factors affecting their flight activity (and hence collision risk).
- Black Harrier (Simmons et al 2020): areas potentially suitable for this species were surveyed during initial surveys in February-May 2019 but no breeding birds were found. The same result was recorded from the ongoing surveys through to August 2020, with no data to contradict these initial findings. Overall, there was no evidence that the Choje West block is important for this species.

In summary, the baseline surveys are consistent with BLSA guidance, apart from the following:

- The recommended increase in VP survey hours to 72 was undertaken at key locations where turbines were proposed and where collision risk to species of conservation concern was higher but not all 'high sensitivity' areas. The focus of the work was to obtain key data to inform site design and risk. There has been a very extensive VP survey effort that provides extensive data on all priority species.
- The surveys have not met the BLSA recommendation for two years' baseline in areas of higher sensitivity for Verreaux's Eagle and Cape Vulture, but have included two seasons for the Verreaux's Eagle breeding surveys.

Furthermore, the spatial modelling that has been undertaken has provided much more insight into the birds' behaviour and site use, than the basic baseline monitoring, which has provided an enhanced, more reliable, baseline for the assessment.

The application of these guideline documents in the context of the wind farm site design and mitigation are dealt with in the relevant sections below.

2.3. Terms of reference of the Bird Study

The scope of this report is to assess all expected impacts on birds of the proposed Ripponn wind farm and additional infrastructure, including:

- the effects of the habitat loss on birds;
- the disturbance and displacement of birds during the construction and the dismantling;
- the effect during the operation of the wind farm and other infrastructure, including 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, 1998, and also to satisfy the requirements of Appendix 6 of GN.R982 of NEMA, 1998 (as amended by GNR 326 2017).

SANBI's (2020) National Environmental Screening Reports were not available to inform the baseline survey protocol as they post-date the time that those surveys were designed. It is not considered that they would have materially affected the monitoring strategy had they been available. The survey design pre-dates the avifaunal protocol published under Government Notice No. 320 in The National Gazette, No. 43110 of 20 March, 2020: “National Environmental Management Act (107/1998) Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of sections 24 (5) (a) and (h) and 44 of the Act, when applying for Environmental Authorisation” the compilation of the report post-dates the publication of this legislation and has taken into account the terms of reference relevant to the reporting requirement.

2.4. Pre-construction Monitoring Methods

2.4.1. Development of the Survey Methods

The pre-construction bird monitoring methodology was designed at the first stage to address the fact that it was not practically possible to cover the whole of the initial proposed 494-turbine development area across the Choje West Block. Surveys were 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.

A site visit was undertaken in January 2019 to inform the initial survey methodology, which was followed up by four visits during February-May 2019 to ground truth the information from the desk study and confirm current eagle and other important raptor breeding locations (to feed into the wind farm site design). The main baseline surveys commenced in June 2019.

Following the revision of the wind farm layout in August 2019 (reducing the number of turbines in the West Block to 297), it was possible to achieve a fuller coverage of the potential impact zone, and the previous sampling methodology was refined to provide a level of coverage in line with BLSA’s recommended minimum 75%, through a combination of a reduction in the size of the overall wind farm and an increased number of Vantage Points in the West Block from 27 to 39. This survey protocol was continued through to August 2020 to give 12 months’ coverage from all VPs (with surveys suspended in April 2020 due to Covid-19 restrictions before restarting in May 2020).

The following principles were adopted for the survey design:

- 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 were identified as collision and disturbance. Key species at risk were identified, and updated as more baseline data became available. These species were the focus of the assessment;
- The surveys followed BLSA (Jenkins *et al*. 2015) recommended survey methodologies where possible. Initially a sampling regime was developed to inform modelling of ornithological risks. This specifically included spatial modelling of flight density, flight heights, flights at risk of collision with wind turbines and overhead lines, and bird populations at risk of disturbance (and availability of alternative habitat to better understand impacts of that disturbance). The work drew 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, and lastly Murgatroyd *et al.* 2021 when it became available). This same analytical approach was followed through the baseline data collection and assessment process, though with coverage meeting the BLSA guidance after the layout had been reduced in August 2019 and more VPs had been incorporated into the surveys.

2.4.2. Survey Area

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. It was updated in August 2019 to the area shown in Figure 3, to reflect the reduction in the extent of the proposed wind farm across the Western Block, and retained at that extent through the remainder of the surveys (to give 12 months' coverage of the Choje Western block).

2.4.3. Control site

An extensive reference area around the Choje Western Block wind farm sites (outside the potential impact zone of the wind farms) was surveyed and will be available for post-construction before/after comparison, for example, for before/after gradient analysis. This is shown in Figure 3 as the grey VP viewsheds that lie outside the wind farm sites. A minimum 48 hours' surveys were carried out at each of 5 VPs to the south-west of the Hamlett site (covering an area of about 24km^2), 7 VPs to the south of the Ripponn site (covering an area of about 37km^2), 3 VPs to the east of the Ripponn site (covering an area of about 12km^2). This will serve as a reference area for all four Choje Western Block wind farms.

The Choje West areas were also surveyed by vehicle transects and walking transects (located at each VP) each month for 12 months.

2.4.4. Vantage Point Surveys

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 was to collect data on key species flight activity to 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 was not required at any VP, a single observer was considered sufficient at each.

The following species were recorded as target species, defined to include all species that could be at risk of collision with the wind turbines:

- All birds of prey and owls;

- All cranes and bustards;
- Large flocks (>100 birds) of other species;
- Other species/sightings considered of note.

A total of 39 VPs were used for the Western Block, five of which covered the Ripponn 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 Ripponn wind farm and for the other Choje Western Block proposals. This covers 84% the proposed Western Block turbines (in line with the minimum BLSA-recommended 75% coverage). For the Ripponn wind farm on its own, coverage of the full risk volume was achieved for 24 of the 36 turbine locations (67%).

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. This target was met for all VPs. A total of 48-72 hours of surveys were obtained from each of the five VPs covering the Ripponn site (mean 55.2 hours).

All target birds were recorded, irrespective of their distance from the vantage point. Observations were carried out throughout daylight hours (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, 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 heights 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.

2.4.5. Raptor Surveys

Breeding raptor surveys were carried out between March 2019 and August 2020, checking all known and other possible raptor nest sites within a 5km buffer of the whole Choje Western Block. This included checks of all potential Black Harrier nesting habitat for the presence of this species across the survey area (Simmons *et al.* 2020). Breeding raptor surveys included mini-VP surveys (VP-type watches but for shorter time periods) and walkover surveys, focussing on likely habitat/nesting sites (which were 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 included surveys for all key raptors breeding in 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 2019 and another four in 2020, focusing on key species' breeding periods. Cape Vulture do not breed the region, so were not included in these surveys.

2.4.6. Vehicle Transect Surveys

Vehicle Transect Surveys were driven along all of the accessible roads within each area (83km in the Choje 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 enables 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, for a period of 12 months. The Western Block vehicle transect route is shown in Figure 3. There was a total length of 15km of road transect within the Ripponn site (plus a 500m buffer).

2.4.7. 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.

In addition to the wetland areas, it became apparent during the initial surveys that many of the irrigated agricultural areas ('pivots') also supported a range of larger terrestrial bird species, so these were also covered as part of these surveys. None of these areas were, though, within the Ripponn site.

2.4.8. Small Terrestrial Bird Surveys (Walking Transect Surveys)

Walking transects were undertaken at each VP location (i.e. five VPs for the Ripponn 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 2.0km of walking transect within the Ripponn site.

2.5. Screening for Assessment

A two-stage screening exercise was undertaken to determine the bird species to take forward for more detailed assessment. Firstly all '**Species of Conservation Concern'** using the study area were identified on the basis of their conservation value. This included all South African red-listed species and those on the IUCN red list (near-threatened status and higher concern).

The second stage identified the '**Priority Species'** for the Ripponn assessment, i.e. the 'Species of Conservation Concern' that were potentially vulnerable to impacts from the wind farm and its associated infrastructure. This include those species that were at risk of collision (i.e. those that were recorded flying through the wind farm site at rotor height) or could be at risk of disturbance and/or powerline impacts (i.e. those that occurred within the potential impact zone of the wind farm and were potentially vulnerable to these impacts).

3. IDENTIFYING THE IMPACTS

3.1. 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.

3.2. Direct effects: loss of habitat during construction

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.

3.3. 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 Ripponn 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 the highest numbers of reported 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 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 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 collisions (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 Ripponn, 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).

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).

3.4. Collision risk in South Africa

Ralston-Paton *et al.* (2017) reviewed the results of operational phase bird monitoring at eight wind farms in South Africa 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 and Darters 1%; Shorebirds, Lapwings and gulls 2%; Large terrestrial birds 2%; Gamebirds 4%; Flufftails and coots 2%; Songbirds 26%; Swifts, swallows and martins 12%; Pigeons and doves 2%; Barbets, mousebirds and cuckoo's 1%; Ravens and crows 1%; Owls 1%; and Diurnal raptors 36%. Reported collisions included a range of threatened species including three Blue Cranes, five Verreaux's Eagles, two Martial Eagles, and five Black Harriers.

Perold *et al.* (2020) published a further review in which they reported bird collision rates from 20 wind farms in South Africa. They estimated a mean fatality rate of 4.6 birds per turbine per year, similar to that reported previously by Ralston-Paton *et al*. (2017) and also within a similar range to those reported in the northern hemisphere. They showed a wide diversity of bird species collided, and a range of species of conservation concern including Cape Vulture (10), Black Harrier (6), Martial Eagle (4), Blue Crane (8), Southern Black Korhaan (5), Verreaux's Eagle (6) and Lanner falcon (6).

3.5. Collision risk mitigation: review

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 Ripponn 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 Smøla in 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.

3.6. Indirect effects: disturbance

Disturbance could potentially affect a 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 within 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 Ripponn 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.

3.7. 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.

3.8. Potential Effects of Power lines on Birds

In addition to the potential effects of the proposed Ripponn 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.

During the operational phase birds can be at risk of collision with power line conductors or get electrocuted on pole structures (Percival 2005, Drewitt and Langston 2006, Gove *et al.* 2013).

3.9. 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.

3.10. 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 vulnerable groups are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it more difficult to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). 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.

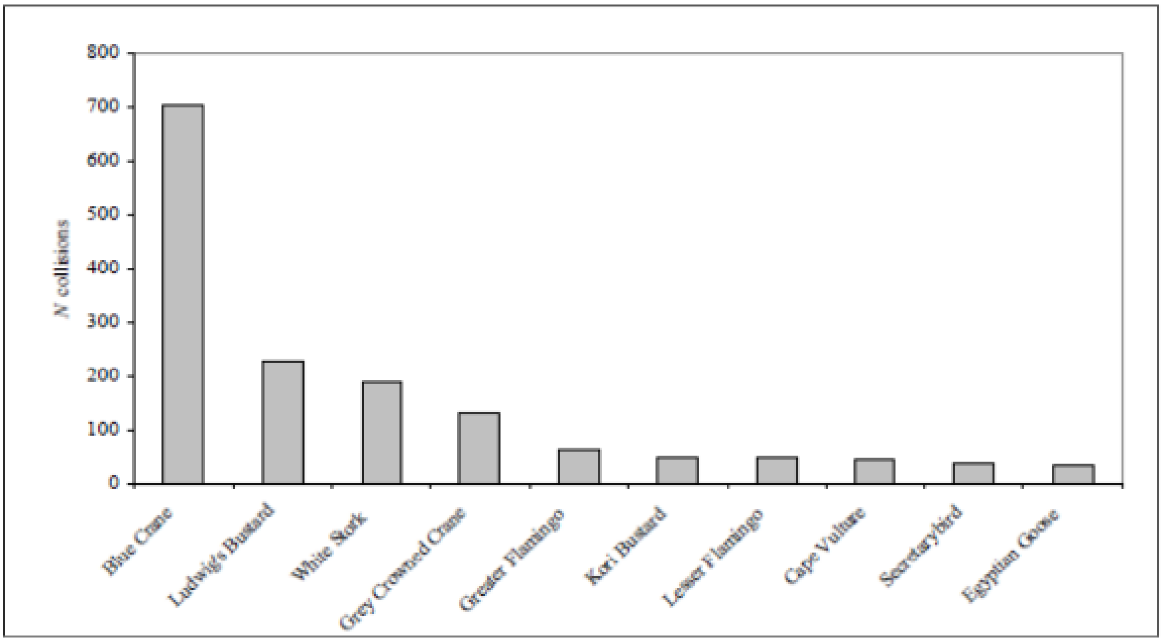


Figure i. The top ten power line collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins et al. 2010)

Electrocution can occur when a bird perches 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.

3.11. Potential Collisions and Electrocutions at Ripponn Wind Farm

Several of the bird species of Conservation Concern that occur in the Ripponn study area will be at risk from the power lines. This includes:

- collisions occur when birds collide with power line conductors or earth wires; Blue Crane, Ludwig's Bustard, Southern Black Korhaan and Secretarybird. These species are all 'walking-while-feeding' species, and mainly lack the ability to perch, therefore are more prone to collide with lines or wires (van Rooyen 2004).
- electrocutions occur when birds perch on powerline poles or structures, these include Martial Eagle, Cape Vulture, Verreaux's Eagle and Black Stork (van Rooyen 2004), these species regularly perch on powerline poles.

4. 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 wind farm development, an 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 at this time, such as the painting of turbine blades in different colours.

5. LIMITATIONS AND ASSUMPTIONS

The presence of the observers on site will have an effect on the birds. 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 others may be inquisitive and approach the observers. Likewise with the vantage point counts, observers sitting in position for four hours at a time will likely affect bird flight activity. 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 larger birds 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 will be detectable over a smaller distance. A particularly important challenge is that of estimating the height at which birds fly above the ground where there were no reference points against which to judge. For this reason, the flight height data were treated cautiously in this report, and collision modelling has been based on conservative estimates of the percentage of birds flying at rotor height.

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 team of observers was used for all the baseline surveys. Despite this subjectivity, and a number of assumptions that line transects rely on (for more details see Bibby *et a*l, 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.

Limitations in relation to BLSA guidance included use of a single year's baseline and less than the full recommended 72 hours' surveys in some of the more sensitive areas, as discussed in section 2.2 above. It is considered that the extensive nature of the data collection from a large number of VPs, in combination with spatial modelling of these data, has provided a robust baseline for the assessment.

There is still limited information available on the environmental effects of wind energy facilities in South Africa, though a review published by Ralston-Paton *et al.* in 2017 using data from 8 wind farms has been recently updated to use data from 20 wind farms (Perold *et al*. 2020), and overall collision rates appear similar to those in the northern hemisphere. Estimates of impacts are therefore also based on knowledge gained internationally, applied with caution to local species and conditions.

The collision risk assessment has also been limited by the lack of availability of quantitative comparisons of bird flight activity and collision rates on the priority species at other wind farm sites, but has adopted a precautionary approach, making reasonable worst-case assumptions but also drawing on empirical evidence from similar species elsewhere. As a result it is considered that the predicted collision risks are unlikely to be exceeded.

6. DESCRIPTION OF HABITAT

6.1. Biomes and Vegetation types

The climate of the Ripponn Wind Farm site is semi-arid and the site is predominantly two natural vegetation types (Mucina and Rutherford, 2006), see Figure 1:

- ‘Sub-escarpment Grassland’ bioregion (with ‘Bedford Dry Grassland’)
- ‘Albany Thicket’ (with AT11 Great Fish Thicket)
- ‘Nama-Karoo’ Lower Karoo NKl4 Albany broken veld, dominated by small shrubs (bossies), occur between the Thicket vegetation in flatter, open areas.

Thicket (bush) vegetation covers the majority of the study area, especially the southern slopes and the Karoo shrubland is very much intertwined with the bushveld. The ‘dry grass’ occurs mainly on the hill and ridge tops.

The bushveld mainly hosts small bird species (bush birds) while the ‘dry grasslands and open Karoo veld attract mainly large terrestrial bird species. The Ripponn site is relatively pristine and no large agricultural croplands occur on site but many can be seen outside the study area (where Great and Little Fish rivers bring the irrigation water in from the Gariep Dam).

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 overgrazing, the open areas get covered with Karoo bossies (see Figure 3b). In a phenomenon not clearly understood by local botanists (Becker et al. 2015), the Karoo shrub areas get overgrown by grass during periods/seasons of good rain, while during times of drought the grass disappears.

Figure 3b. Shows the contrast between Thicket bushveld and Karoo shrub vegetation (the open patches between the trees). Also a large extent of Karoo shrubland with a Blue crane showing the cover and height of the bossieveld.

6.2. Bird microhabitats

To determine which bird species are likely to occur on the proposed Ripponn 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 Ripponn Wind Farm, falls within the Albany Subtropical Thicket (Valley bushveld) biome (Mucina and 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 Great Fish thicket present within the Ripponn 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 more arid) the Thicket is less dense, having more a savanna pattern of cover. Small bush birds inhabit the Thicket.

Bedford dry grassland

This consist mainly of dry long-lived grasses with many bulbs and geophytes in pristine state while dry drainage lines have *Acacia karroo* masses. This low grassland vegetation is what attract Cape vultures down from the escarpment in their non-breeding and the summer seasons. These birds never enter any Thicket areas but foraging over these low grasslands from where they also enter Karoo bossieveld when scavenging carcasses are found.

Nama Karoo veld

Nama-Karoo biome (Mucina and Rutherford 2006) with Karoo shrubland (bossieveld) vegetation is a complex mix of dwarf shrub (30-40cm) and a grass dominated vegetation type. This is intertwined with Thicket vegetation especially in degraded areas. It is also attractive to Large Terrestrial birds that forage in this Bossieveld.

Croplands and Centre-pivots

The entire West block of the Choje complex is flanked by the Great and Little Fish rivers, which have permanent irrigation water. This allows landowners to create irrigated croplands, which are mainly centre-pivots but also a few old flood irrigation lands. These attract large numbers of birds, especially water birds, including mixed flocks of thousands of Sacred and Hadeda ibises, Spur-winged and Egyptian geese. A flock of almost 800 Blue cranes were recorded on one maize pivot after harvesting. Historically a flock of 260 White storks was recorded on a ploughed lucerne pivot. Ludwig's bustards forage on the edges of these pivots. Each 'pivot' cropland has a 6-8 week management cycle, of harvesting and growing and with irrigation in between. The Ripponn site has no pivots within its boundary.

Rivers and Drainage Lines

No permanent rivers occur in the Ripponn 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.

The Great and Little Fish rivers, surrounding the Ripponn site, have permanent water from the Gariep Water Scheme. The permanent water in these two rivers cause the *Acacia karroo* trees to grow exponentially, turning the water ways into almost a tunnel-shape. This limits the common wetland water birds to use the river, also the water is running quite fast.

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 were present in the Ripponn Wind Farm site but there were many small dams which attracted various waterfowl, herons and African Spoonbill. African Fish Eagle was often seen at these dams while Blue Cranes used small farm dams as night roost sites.

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 West block. The steep bush areas, surrounding cliffs can host tall trees, especially on south-facing slopes, these and cliffs 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 within the Ripponn site, some deep south draining kloofs in the Choje area have small patches with tall trees, especially clumps of Tree Euphorbias, Olive and Kiepersol trees. These three tree species are the nesting trees used by Martial eagles.

Ridge slopes and Thermal areas

Many raptors use the wind blowing over the slopes of ridges and hills (slope soaring) to gain lift and to hunt. Raptor abundance can be affected by wind direction and strength, for example Verreaux's Eagles may be seen more frequently in stronger winds.

Thermal conditions vary between habitats. On hotter days bare ground heats faster than more vegetated ground, causing the rising of hot air (thermal soaring), which can attract large raptors such as Martial eagles.

Power lines

Four large 400kV (steel pylon) power lines cross the proposed Ripponn Wind Farm site on the eastern edge running north to south. Raptors use these poles as hunting perches and roost sites.

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 a high diversity of small passerine birds. Spotted eagle-owl and Barn Owl often breed 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.

Fynbos vegetation

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

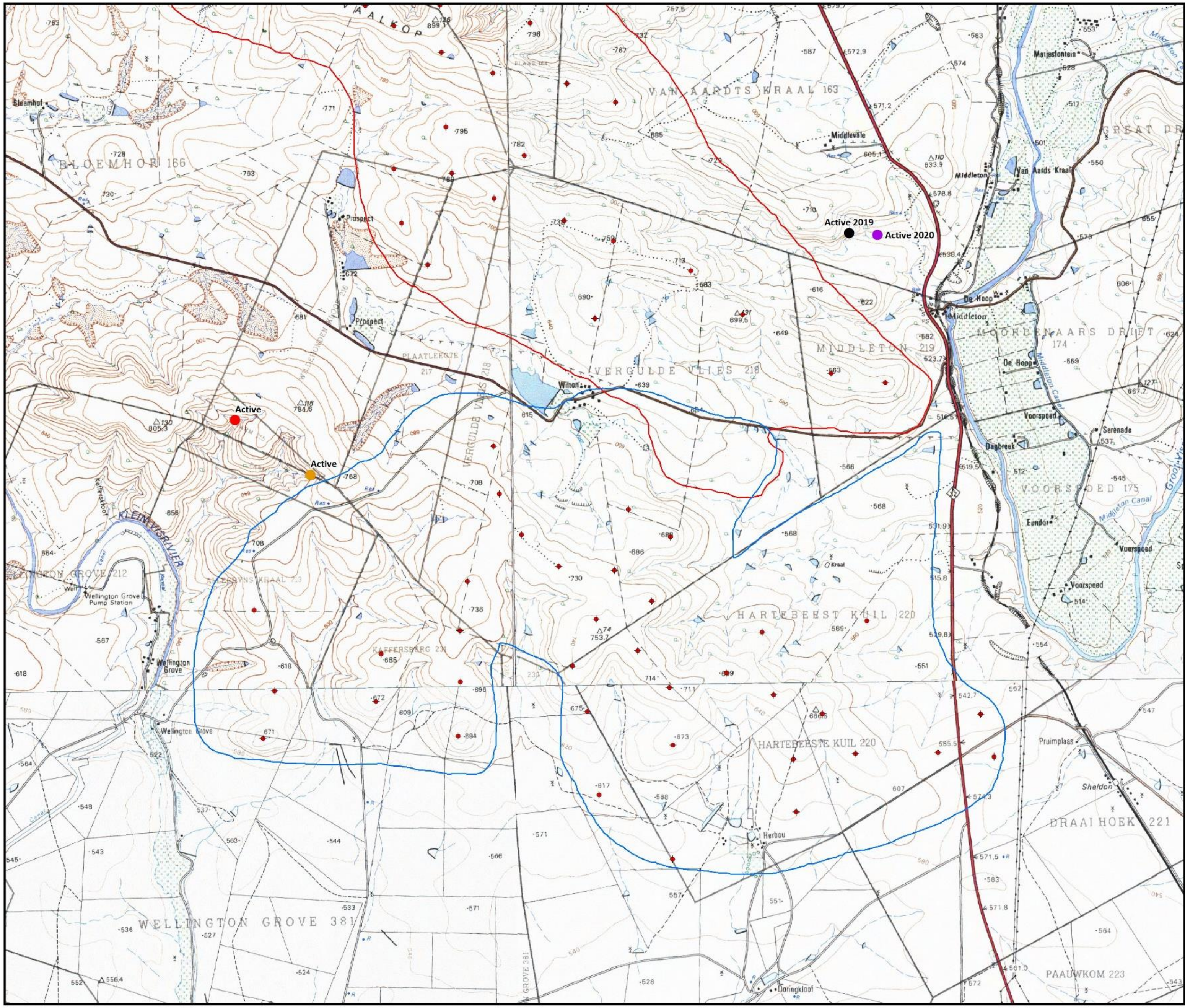
7. RESULTS OF THE PRE-CONSTRUCTION BIRD MONITORING (JUNE 2019 – AUGUST 2020)

7.1. Raptor Breeding Locations (Choje West block)

This section of the report provides information on the raptor breeding locations across the whole of the Choje west block (to provide a wider context), then focusses on the nest sites that are located in the areas that could be affected by the Ripponn wind farm.

Three Martial Eagle and three Verreaux's Eagle territories were confirmed in the Western Block and its surrounds during the raptor surveys. Breeding was confirmed in all three Martial Eagle ranges, with females seen incubating. Breeding was also confirmed and nest sites located at all three Verreaux's Eagle sites in 2019 (though only two of these sites were active in 2020, with the third occupied by a pair of Lanner Falcons). Other breeding locations identified included three Secretarybirds (two active and one potential site), a Grey Crowned-crane and two Jackal Buzzards.

The locations of all these breeding locations in proximity to the Ripponn site are shown in Figure 4 (showing nest sites of one Martial Eagle, one Verreaux's Eagle and one Lanner Falcon).



Rippon Proposed Wind Farm

FIGURE 4

Rapter and other key species breeding locations 2019-20

KEY:

- Choje West turbines EIA

Species

- Jackal Buzzard
- Lanner Falcon
- Martial Eagle
- Secretarybird
- Verreaux's Eagle
- Hamlett Site Boundary
- Rippon Site Boundary

Ecology Consulting

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Kilometres

0 0.325 0.65 1.3 1.95 2.6

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EC-2020-1

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Table 3. Flight rates (number of birds per hour) at rotor height and the total flights of target species through the proposed Ripponn wind farm, June 2019 - August 2020 and their conservation status (IUCN and South Africa Red Data Book Listings) ['-' = no records in that month].

Species	IUCN	SA	Jun 19	Jul	Aug	Sep	Oct	Nov	Dec 19	Jan 20	Feb	Mar	May	Jun	Jul	Aug 20	TOTAL FLIGHTS @ ROTOR HT	TOTAL FLIGHTS OBSERVED
Egyptian goose	LC		-	-	-	-	-	-	-	-	-	-	0.094	-	-	-	65	65
South African shelduck	LC		-	-	-	-	-	-	-	-	-	-	-	-	0.099	0.099	2	5
Spur-winged goose	LC		-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	3
Alpine swift	LC		-	-	-	-	-	-	1.500	-	-	-	-	-	-	-	30	30
Blue crane	VU	NT	-	-	-	-	-	-	0.100	-	-	0.917	-	0.200	-	-	28	28
Ludwig's bustard			-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	4
African sacred ibis	LC		-	-	-	-	2.000	0.200	-	-	-	-	-	0.100	-	-	49	49
Hadada ibis																	0	2
Hamerkop	LC		-	-	-	-	-	-	-	-	0.050	-	-	-	0.050	0.050	2	2
African darter	LC		-	-	-	-	-	-	-	-	-	-	0.188	-	-	-	6	6
Caspian tern	LC	VU	-	-	-	-	0.050	-	-	-	-	-	-	-	-	-	1	2
Secretarybird	VU	VU	-	-	-	-	-	-	-	0.050	-	-	-	-	-	-	1	1
African harrier-hawk	LC		-	-	0.083	-	-	-	-	-	-	-	0.063	0.050	0.050	0.050	5	10
Cape vulture	EN	VU	-	-	-	-	-	-	-	1.250	1.400	0.042	-	-	-	-	54	75
Martial eagle	VU	EN	0.167	-	0.333	-	-	0.500	-	0.300	0.250	0.250	0.063	0.050	0.099	0.099	39	46
Verreaux's eagle			-	-	-	-	-	-	-	-	-	-	-	-	0.099	-	2	2
Booted eagle	LC		-	-	-	-	-	-	0.050	0.050	0.100	-	-	-	-	-	4	4
Pale chanting-goshawk	LC		-	0.083	-	0.250	0.250	0.100	0.100	-	0.050	0.083	0.031	0.050	-	-	20	46
African marsh-harrier	LC	EN	-	0.083	-	-	-	-	-	-	-	-	-	-	-	-	1	1
African fish-eagle	LC		2.000	0.583	-	-	0.200	0.050	-	0.050	-	-	-	-	-	-	37	43

Species	IUCN	SA	Jun 19	Jul	Aug	Sep	Oct	Nov	Dec 19	Jan 20	Feb	Mar	May	Jun	Jul	Aug 20	TOTAL FLIGHTS @ ROTOR HT	TOTAL FLIGHTS OBSERVED
Jackal buzzard	LC		-	-	-	-	-	0.050	0.350	0.100	-	-	-	-	-	-	10	10
Eurasian buzzard	LC		-	-	-	-	-	0.550	0.100	0.600	0.150	0.042	-	-	-	-	29	32
Common kestrel	LC		-	0.083	-	0.200	0.050	0.300	0.450	0.200	0.100	0.125	0.188	0.250	0.149	0.149	53	95
Lanner falcon	LC	VU	-	-	-	-	-	-	-	-	-	-	0.031	-	-	-	1	4

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

7.2. Vantage Point Survey Results

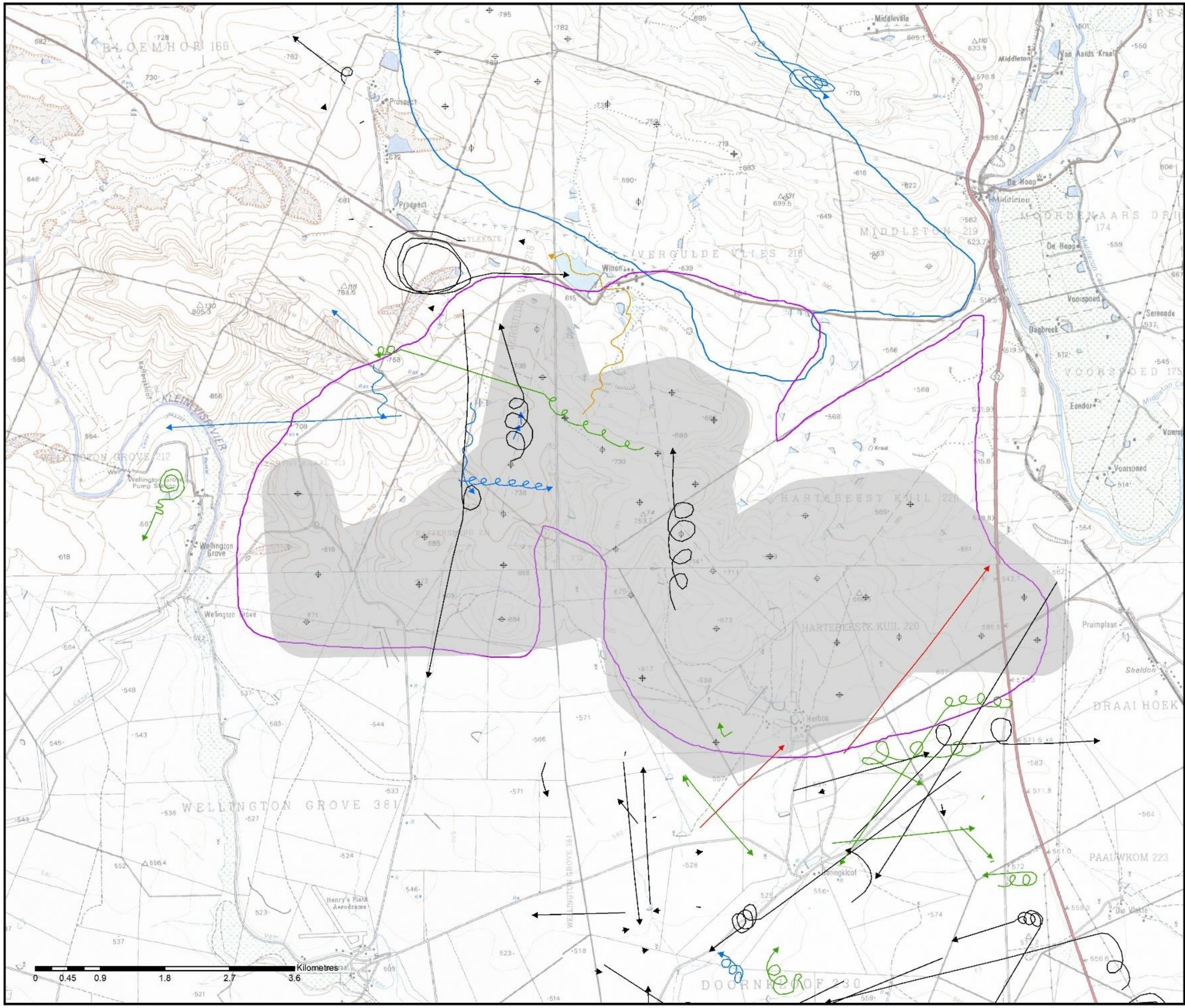
The flight rates at rotor height recorded during the VP surveys over the Ripponn site are summarised in Table 3. This Table gives the number of flights recorded per hour observation for each month from June 2019 through to August 2020. The Table also gives the conservation status of each species (its IUCN 2019 and South Africa Red Data Book Listings), the total number of flights observed, and the number of those flights that were recorded at rotor height (taken for the purposes of this assessment conservatively as 40-300m above ground, to allow for errors in flight height estimation (the actual rotor height would be between 60 and 86m for the lowest point of the rotor and 220-246m above ground level for the rotor tip, depending on the final choice of hub height).

The Ripponn VP surveys recorded seven key species of Conservation Concern: Blue Crane, Caspian Tern (a single flight at rotor height), Secretarybird (also only a single flight at rotor height), Cape Vulture, Martial Eagle, African Marsh-harrier (a single flight) and Lanner Falcon (single flight). Flight line maps these species at risk of collision (i.e. seen flying at rotor height within the Ripponn site) are presented in Figures 5-8. No notable concentrations of flight activity of any of these species was noted in this area.

Cape Vultures are unusual in this area (Boshoff *et al*. 2009a), with the nearest regularly-used roost identified in the SEA (DEA 2015) located 51km north-east from the site at its closest point. The birds recorded during the summer season were roosting overnight on the powerlines running north-south through the eastern part of the Choje Western Block and flying out to forage on the surrounding land. Their flight lines are shown in Figure 6. They were present in the area between November 2019 and March 2020. They do not breed in the region and their presence is expected to be as a result of severe droughts experienced in the larger area.

Martial Eagle flight activity (Figure 7) was widespread over the Western Block survey area, but with notable concentrations around the active nests, including the nest to the north-west of the Ripponn site.

Verreaux's Eagle flights were scattered over the Choje Western Block (Figure 8). There were no Verreaux's Eagle nests near the Ripponn site and were no Verreaux's Eagle flights observed through the Ripponn site at rotor height.



WIND RELIC RENEWABLES

Rippon Proposed Wind Farm

FIGURE 5

VP survey Flight Lines Jun 2019 - Aug 2020: Blue Crane and other key species

KEY:

- Choje West turbines EIA

Flight lines:

- African marsh-harrier
- Blue crane
- Caspian tern
- Lanner falcon
- Secretarybird
- Hamlett Site Boundary
- Rippon Site Boundary
- Rippon Collision Zone

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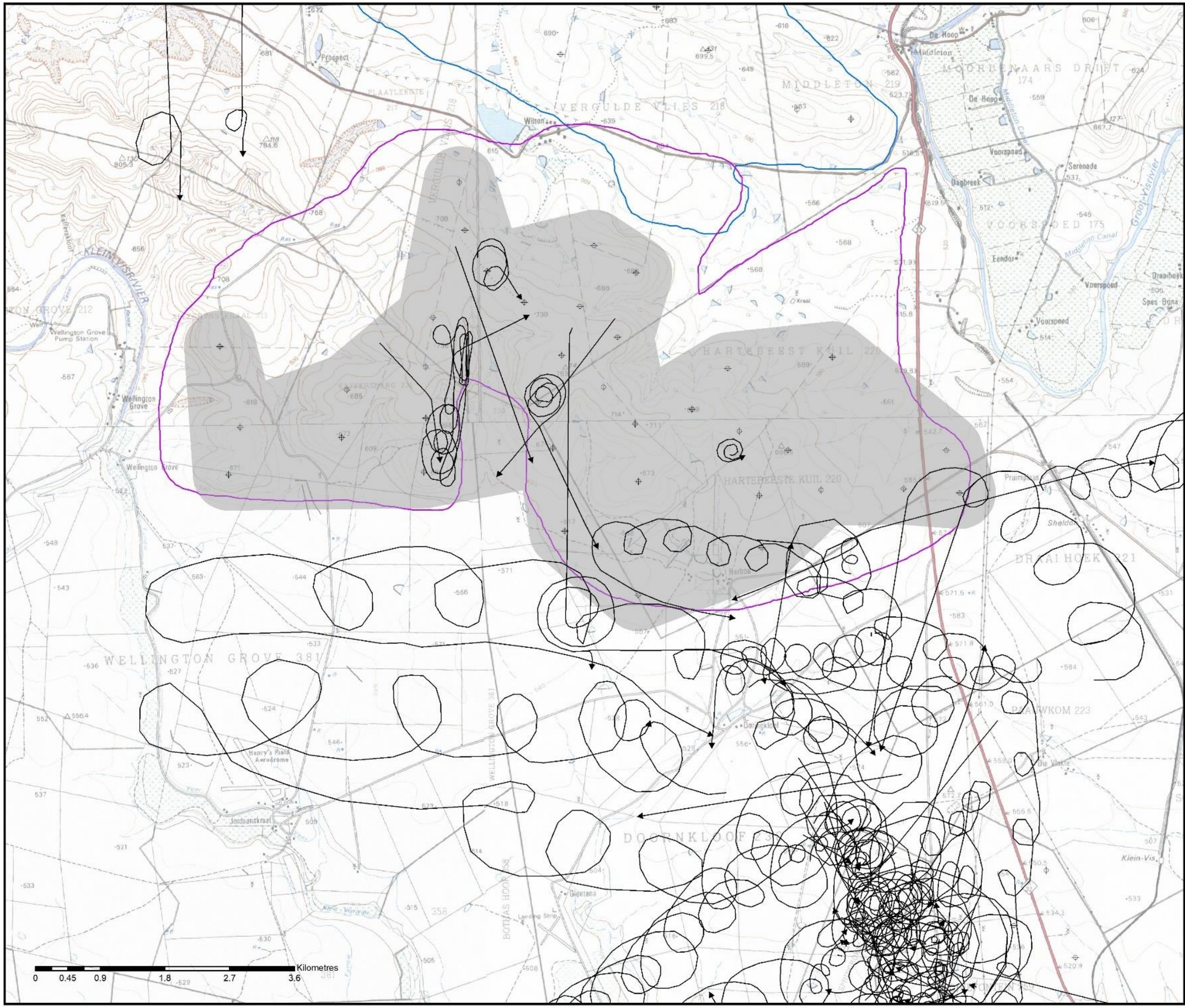

Rippon Proposed Wind Farm

FIGURE 6

VP survey Flight Lines Jun 2019 - Aug 2020: Cape Vulture

KEY:

- Choje West turbines EIA
- Flight lines Jun 2019-Aug 2020
- Hamlett Site Boundary
- Rippon Site Boundary
- Rippon Collision Risk Zone

Ecology Consulting

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DRAWING NUMBER EC-2020-1	
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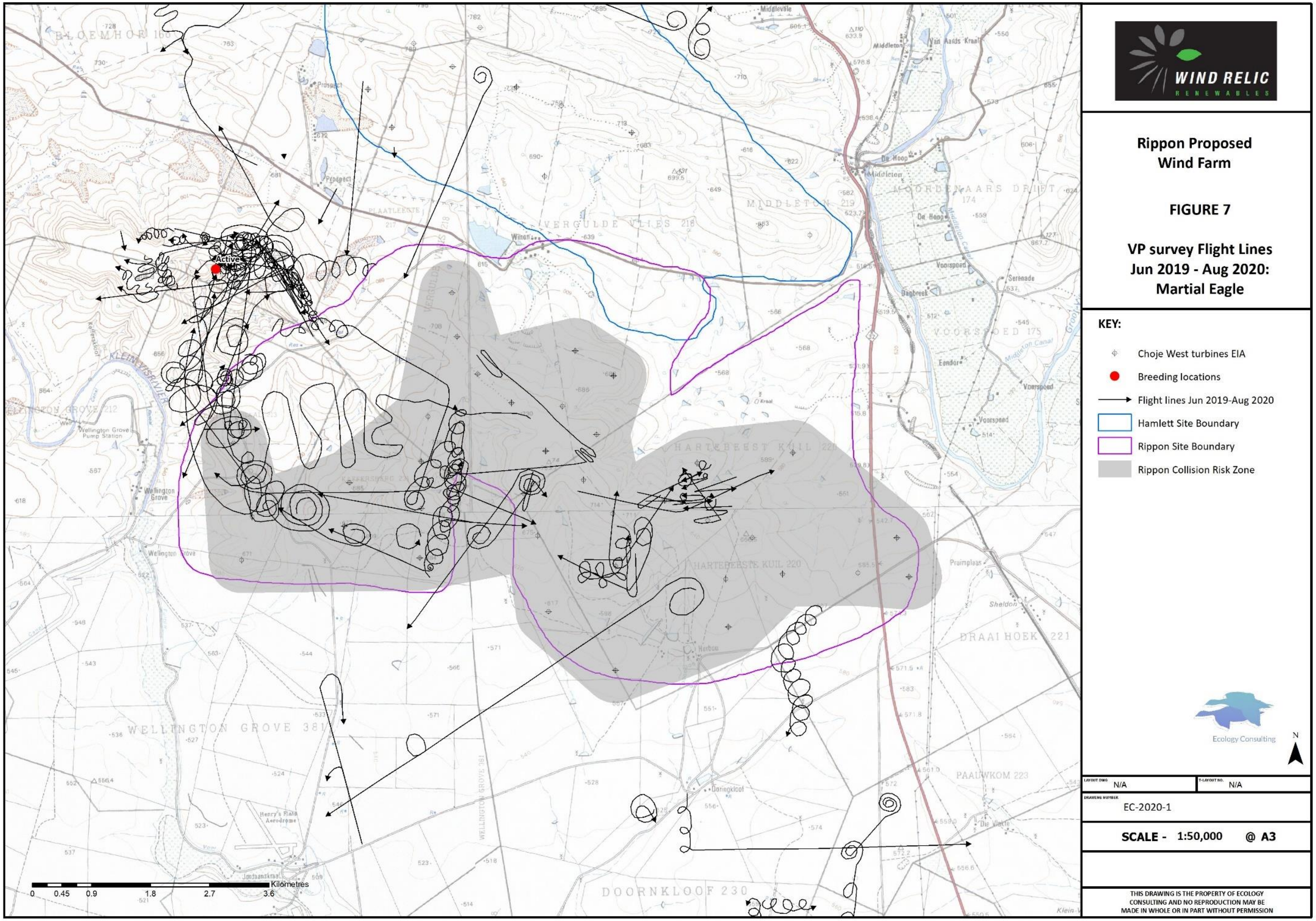
WIND RELIC
RENEWABLES
Rippon Proposed Wind Farm
FIGURE 7
VP survey Flight Lines Jun 2019 - Aug 2020: Martial Eagle
KEY:
Choje West turbines EIA
Breeding locations
Flight lines Jun 2019-Aug 2020
Hamlett Site Boundary
Rippon Site Boundary
Rippon Collision Risk Zone
Ecology Consulting
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DRAWING NUMBER EC-2020-1
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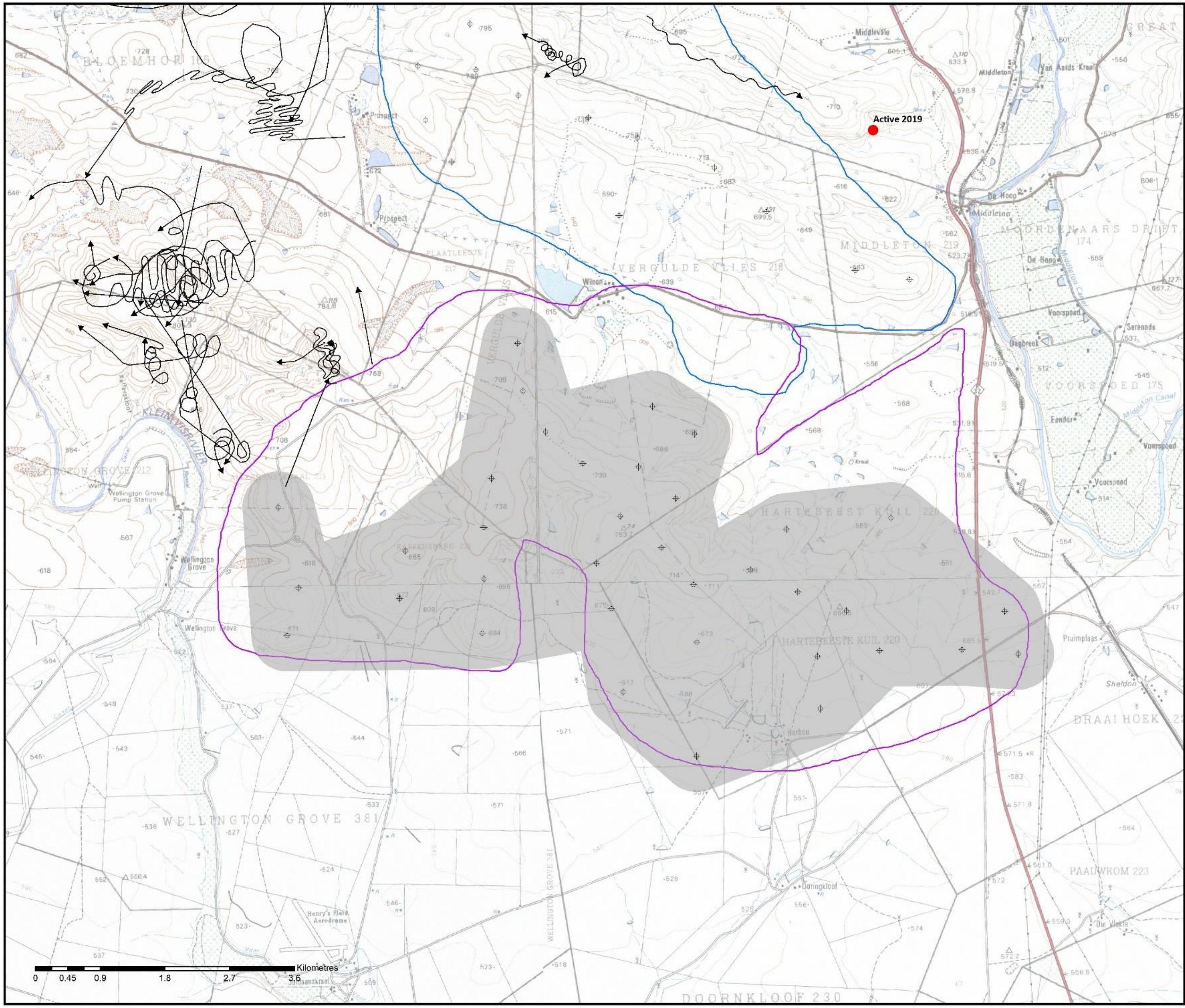
Active
Kilometres
0 0.45 0.9 1.8 2.7 3.6
VERGULDE VLIES 218
MIDDLETON 219
HARTEBEEST KUIL 220
HARTEBEESTE KUIL 220
WELLINGTON GROVE 381
DOORNKLOOF 230
DRAAI HOEK 221
PAAUWKOM 223
VOORSPOED 175
MOORDENAARS DRIFT 174
KLEIN VISRIVIER
Middleton
Prospect
Wilson
Harbou
Doringkloof
Prumplaas
Sheldon
Voorspoed
Eendor
Wellington Grove
Wellington Grove Pump Station
Henry's Field Aerodrome



WIND RELIC RENEWABLES

Rippon Proposed Wind Farm

FIGURE 8

VP survey Flight Lines Jun 2019 - Aug 2020: Verreaux's Eagle

KEY:

- Choje West turbines EIA
- Breeding locations
- Flight lines Jun 2019-Aug 2020
- Hamlett Site Boundary
- Rippon Site Boundary
- Rippon Collision Risk Zone

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7.3. Road Transect/Wetland Survey Results

The results of the road transect survey of the Choje Western Block during June 2019-August 2020 are summarised in Table 4. This gives the total number of each target species counted each month per km transect within the Ripponn wind farm site (plus a 500m buffer), along with their conservation status (IUCN/South Africa Red Data Book). Six species of Conservation Concern were noted: Greater Flamingo, Blue Crane, Ludwig’s Bustard, Cape Vulture, Martial Eagle and Verreaux’s Eagle.

The distribution of the most common wetland species, Egyptian Goose, is shown in Figure 9, to illustrate the main wetland areas. This included irrigated agricultural areas (pivot grasslands) as well as dams and river systems. Several important concentrations of wetland birds were recorded, but these lay outside the proposed Ripponn wind farm site (to the south, between the northern and southern sections of the Choje Western Block).

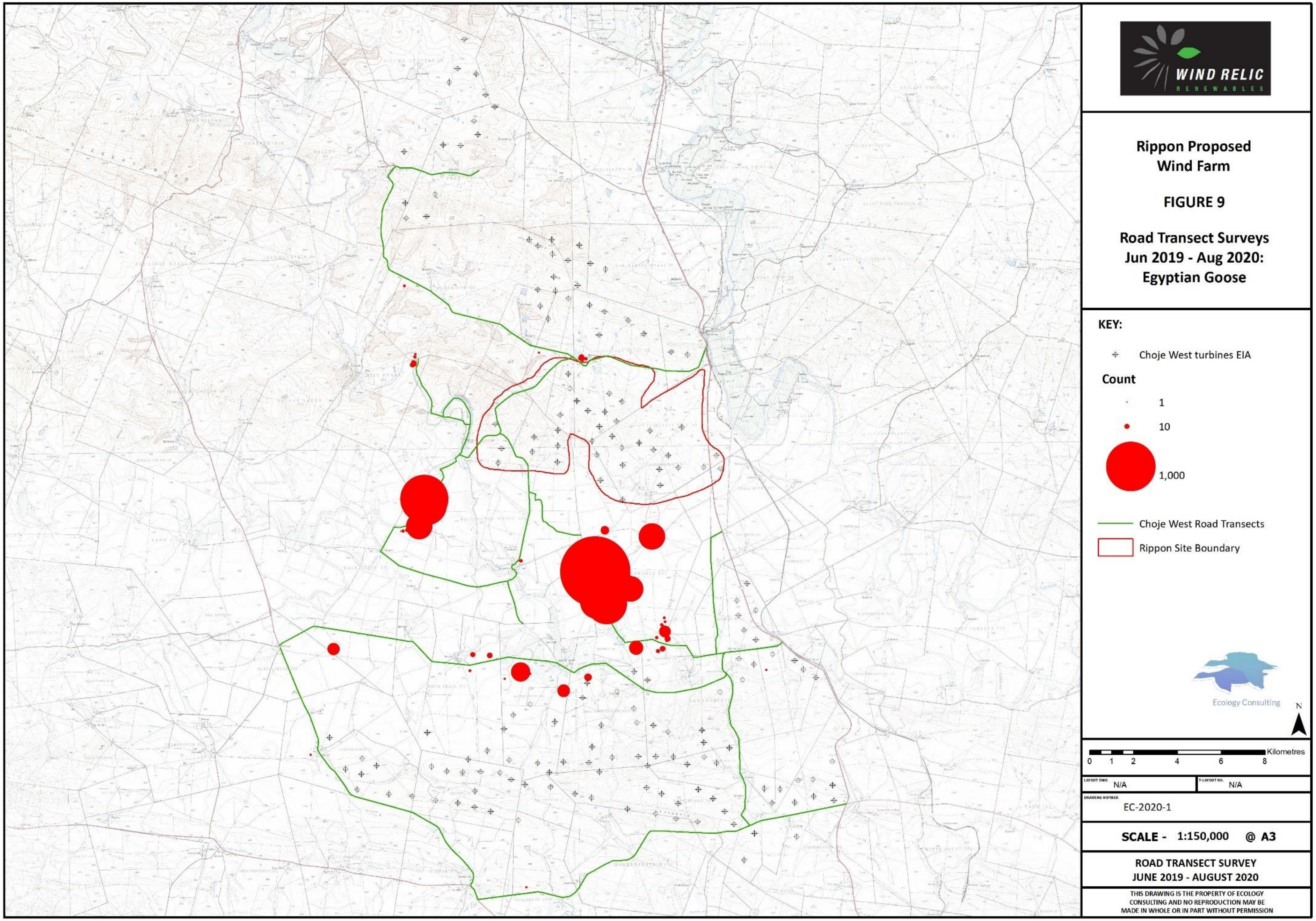
Blue Crane (Figure 10) were abundant, particularly during the September-December surveys, with largest numbers found in the same irrigated grassland areas that supported high numbers of wetland birds, outside the proposed Ripponn wind farm site (and the others in the Western Block). Ludwig’s Bustard (Figure 11) had a similar distribution and were also associated with the irrigated agricultural grassland, though were also found on the more open flatter karoo areas in the central part of the survey area, but with few records within the proposed Ripponn site.

The latter karoo areas held the highest numbers of Southern Black Korhaan (Figure 12). Records of the other less abundant cranes and bustards were mainly from the same area as the Blue Cranes, outside the proposed wind farm site (Figure 13). Cape Vulture records (Figure 14) were mainly from the area along the main powerlines in proximity to their roost sites, and in the flatter central karoo areas. Other key species (Figure 15) were widely scattered but with more records between the northern and southern sections of the Choje Western Block, outside the proposed wind farm sites.

Table 4. Vehicle transect survey counts (birds/km transect) by month in the proposed Ripponn wind farm site (plus 500m buffer), June 2019-August 2020.

Species	IUCN	SA RDB	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2020	Feb	Mar	May	Jun	Jul	Aug 2020
Egyptian goose	LC		-	-	0.27	0.27	0.27	0.75	0.75	1.36	1.36	0.68	0.75	0.41	0.34	0.14
South African shelduck	LC		-	0.14	0.54	0.27	1.36	1.29	0.88	0.27	0.61	0.61	1.36	0.34	0.20	0.61
Spur-winged goose	LC		-	-	-	-	-	-	0.61	-	-	-	-	-	0.07	-
Cape shoveler	LC		-	-	-	-	-	-	-	-	0.14	0.34	0.07	0.07	-	0.27
Yellow-billed duck	LC		-	-	-	-	-	-	0.88	0.68	0.27	1.02	0.68	1.22	0.82	1.09
Cape teal	LC		-	-	-	-	-	-	-	-	-	-	-	0.14	-	-
Red-billed teal	LC		-	-	-	-	0.07	-	-	1.43	0.82	0.54	0.07	0.20	0.41	0.20
Little grebe	LC		-	-	0.61	0.41	0.41	0.34	0.41	0.48	0.14	0.34	0.68	0.75	-	-
Greater flamingo	LC	NT	-	-	-	-	-	-	-	-	0.14	-	-	-	-	-
Blue crane	VU	NT	-	-	-	-	0.14	-	-	0.07	-	-	-	-	-	-
Ludwig's bustard	EN	EN	-	0.20	-	-	-	-	-	0.07	-	-	-	-	-	-
African spoonbill	LC		-	-	-	-	-	-	0.34	0.34	0.20	0.20	0.14	0.07	0.27	0.14
African sacred ibis	LC		-	0.14	-	-	-	-	-	-	-	0.07	-	-	-	-
Hadada ibis	LC		-	-	-	-	-	0.07	-	0.07	-	0.07	0.14	-	-	0.07
Grey heron	LC		0.07	-	0.07	0.07	0.48	-	0.07	0.07	-	0.07	0.07	0.07	0.07	-
Long-tailed cormorant	LC		-	-	0.07	0.07	0.07	-	-	0.07	-	-	-	-	-	-
Great cormorant	LC		-	-	0.07	-	-	-	-	0.20	-	0.07	0.20	0.07	-	0.20
Pied avocet	LC		-	-	0.14	0.14	-	-	-	0.07	-	-	-	-	0.41	0.68
Black-winged stilt	LC		-	-	0.68	1.09	1.29	1.84	2.72	1.09	0.61	0.41	0.48	0.95	0.75	0.68
Kittlitz's plover	LC		-	-	0.41	0.41	0.14	0.54	0.75	0.20	-	0.27	0.95	0.61	1.16	1.63
African three-banded plover	LC		-	-	0.07	0.20	0.14	0.68	1.22	0.34	-	0.07	0.82	0.68	0.95	1.29
Blacksmith lapwing	LC		-	-	0.14	0.14	0.14	-	0.20	0.41	0.14	0.20	0.41	0.41	0.54	0.14
Crowned lapwing	LC		-	-	-	-	-	-	0.14	-	-	-	-	-	-	-
Ruff	LC		-	-	-	-	-	-	0.07	-	-	0.07	-	-	-	-
Little stint	LC		-	-	-	-	0.07	0.07	0.07	-	-	-	-	-	-	-
African snipe	LC		-	-	-	-	-	-	-	-	-	-	-	-	0.07	-
Common greenshank	LC		-	-	-	0.07	-	0.20	0.34	0.34	0.07	-	-	-	-	0.20
Marsh sandpiper	LC		-	-	-	-	-	-	0.07	0.07	-	-	-	-	-	-

Species	IUCN	SA RDB	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2020	Feb	Mar	May	Jun	Jul	Aug 2020
Common barn-owl	LC		-	-	0.07	-	-	-	-	-	-	-	-	-	-	-
Spotted eagle-owl	LC		-	-	-	-	-	-	-	-	-	-	-	-	0.07	-
African harrier-hawk	LC		-	-	-	-	-	-	-	-	0.07	-	0.07	-	-	-
Cape vulture	EN	EN	-	-	-	-	-	-	-	-	1.02	-	-	-	-	-
Martial eagle	VU	EN	-	-	-	-	-	-	-	-	-	-	-	-	0.07	-
Verreaux's eagle	LC	VU	-	-	-	0.07	-	-	-	-	-	-	-	-	-	-
Pale chanting-goshawk	LC		0.20	0.14	-	0.07	0.20	0.14	0.34	0.14	0.20	0.14	0.27	0.14	0.34	0.27
Jackal buzzard	LC		-	-	-	-	0.07	-	-	-	-	-	0.07	-	0.07	-
Eurasian buzzard	LC		-	-	-	-	-	-	-	0.07	0.41	-	-	-	-	-
Rock kestrel	LC		-	-	0.14	0.14	0.07	0.07	-	-	-	-	0.07	-	-	-


WIND RELIC
RENEWABLES
Rippon Proposed
Wind Farm
FIGURE 9
Road Transect Surveys
Jun 2019 - Aug 2020:
Egyptian Goose
KEY:
Choje West turbines EIA
Count
1
10
1,000
Choje West Road Transects
Rippon Site Boundary
Ecology Consulting
N
Kilometres
0 1 2 4 6 8
N/A
N/A
EC-2020-1
SCALE - 1:150,000 @ A3
ROAD TRANSECT SURVEY
JUNE 2019 - AUGUST 2020
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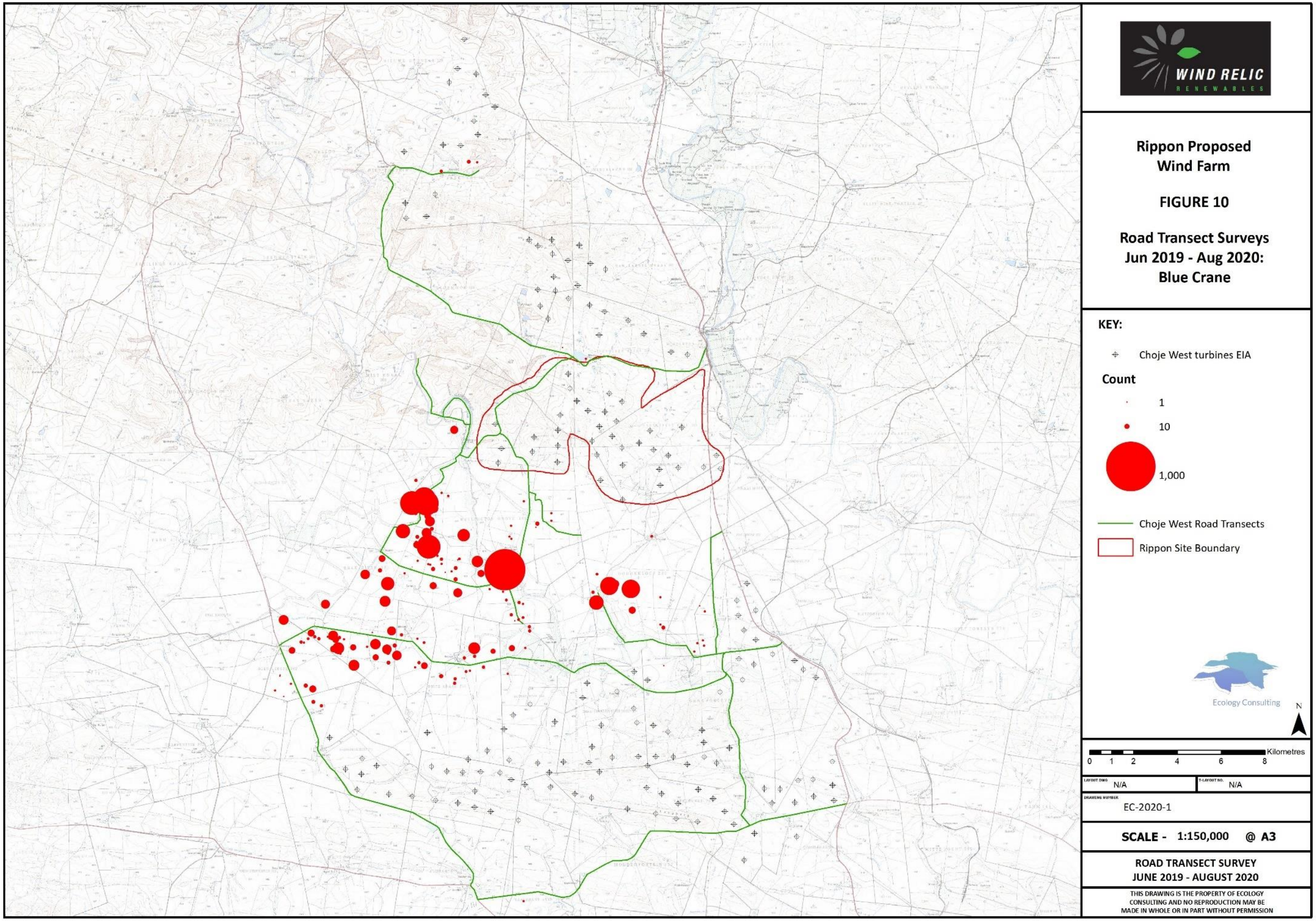
WIND RELIC
RENEWABLES
Rippon Proposed
Wind Farm
FIGURE 10
Road Transect Surveys
Jun 2019 - Aug 2020:
Blue Crane
KEY:
Choje West turbines EIA
Count
1
10
1,000
Choje West Road Transects
Rippon Site Boundary
Ecology Consulting
N
Kilometres
0 1 2 4 6 8
N/A
N/A
EC-2020-1
SCALE - 1:150,000 @ A3
ROAD TRANSECT SURVEY
JUNE 2019 - AUGUST 2020
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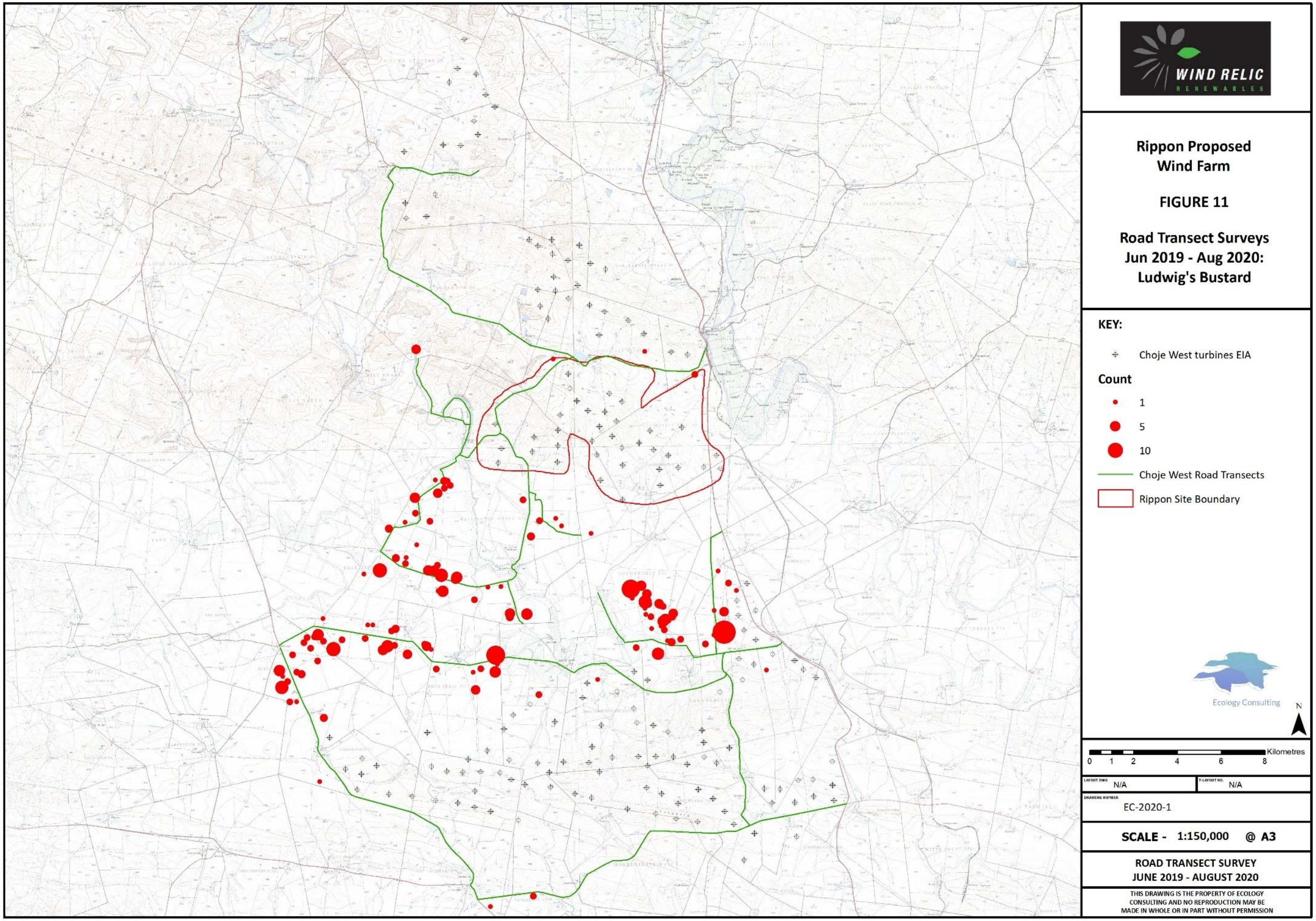
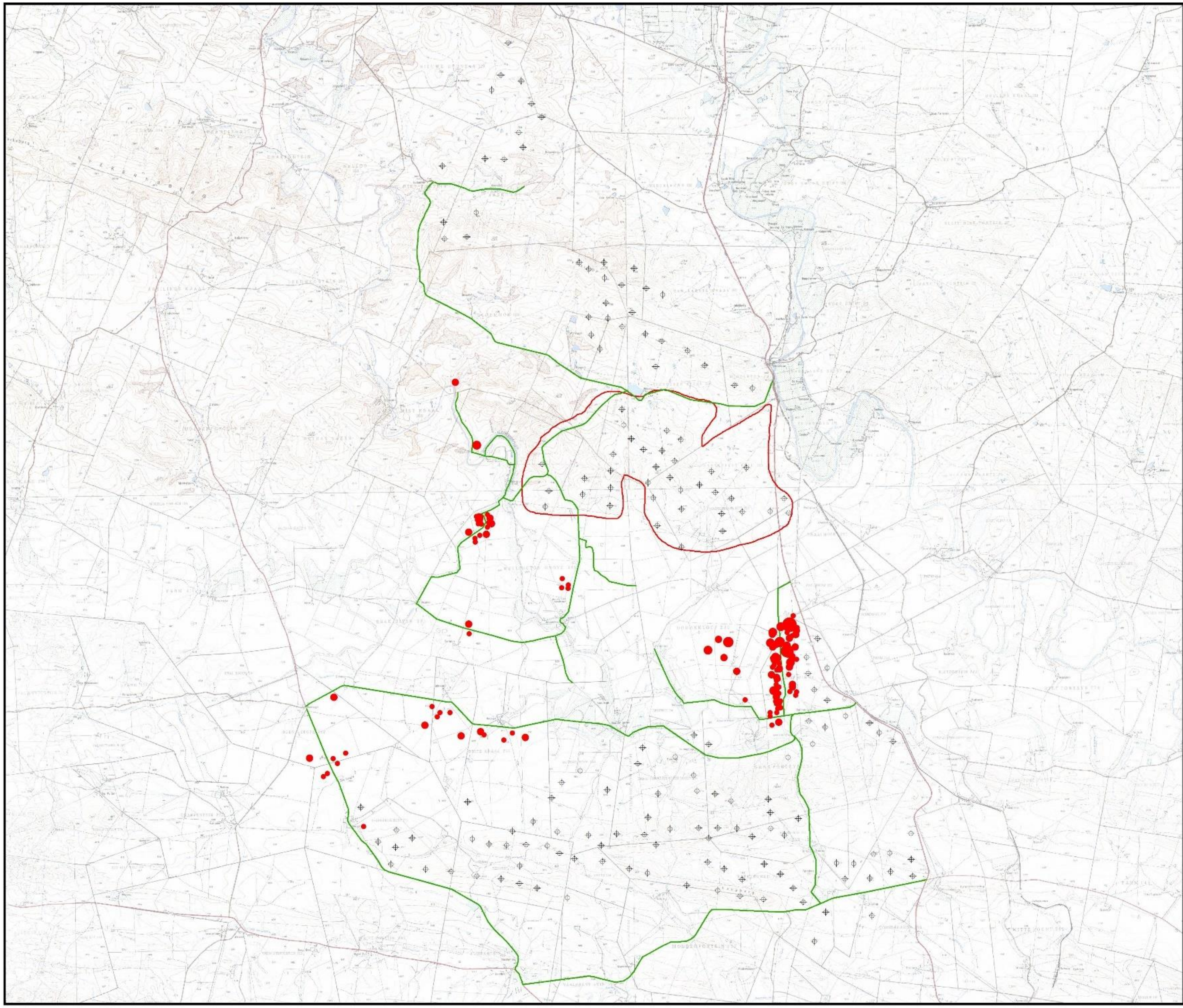


WIND RELIC
RENEWABLES
Rippon Proposed
Wind Farm
FIGURE 11
Road Transect Surveys
Jun 2019 - Aug 2020:
Ludwig's Bustard
KEY:
Choje West turbines EIA
Count
1
5
10
Choje West Road Transects
Rippon Site Boundary
Ecology Consulting
N
Kilometres
0 1 2 4 6 8
N/A
N/A
EC-2020-1
SCALE - 1:150,000 @ A3
ROAD TRANSECT SURVEY
JUNE 2019 - AUGUST 2020
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION



WIND RELIC RENEWABLES

Rippon Proposed Wind Farm

FIGURE 12

Road Transect Surveys Jun 2019 - Aug 2020: Southern Black Bustard

KEY:

Choje West turbines EIA

Count

1

5

10

Choje West Road Transects

Rippon Site Boundary

Ecology Consulting

N

Kilometres 0 1 2 4 6 8

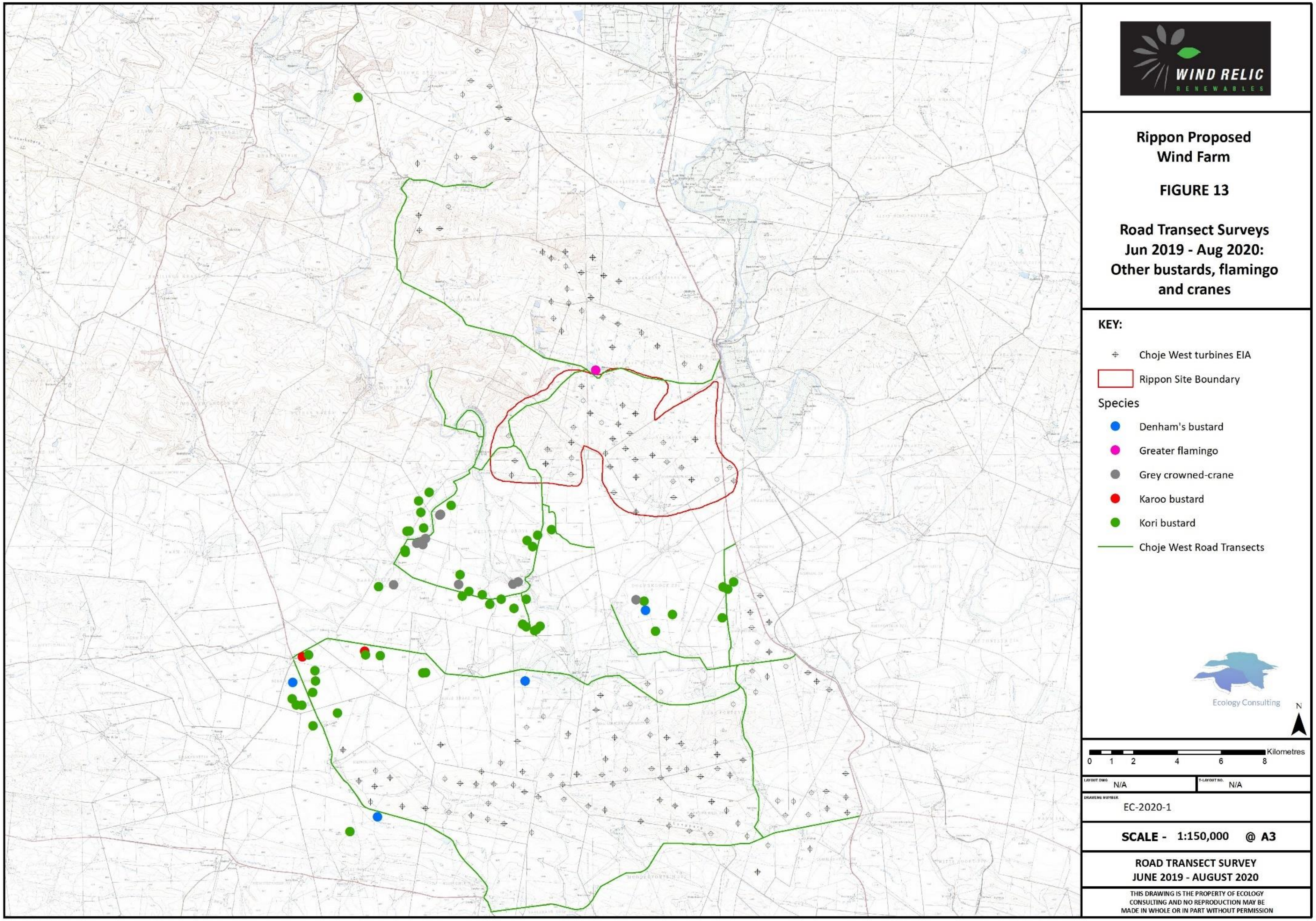
LAYOUT DWG N/A

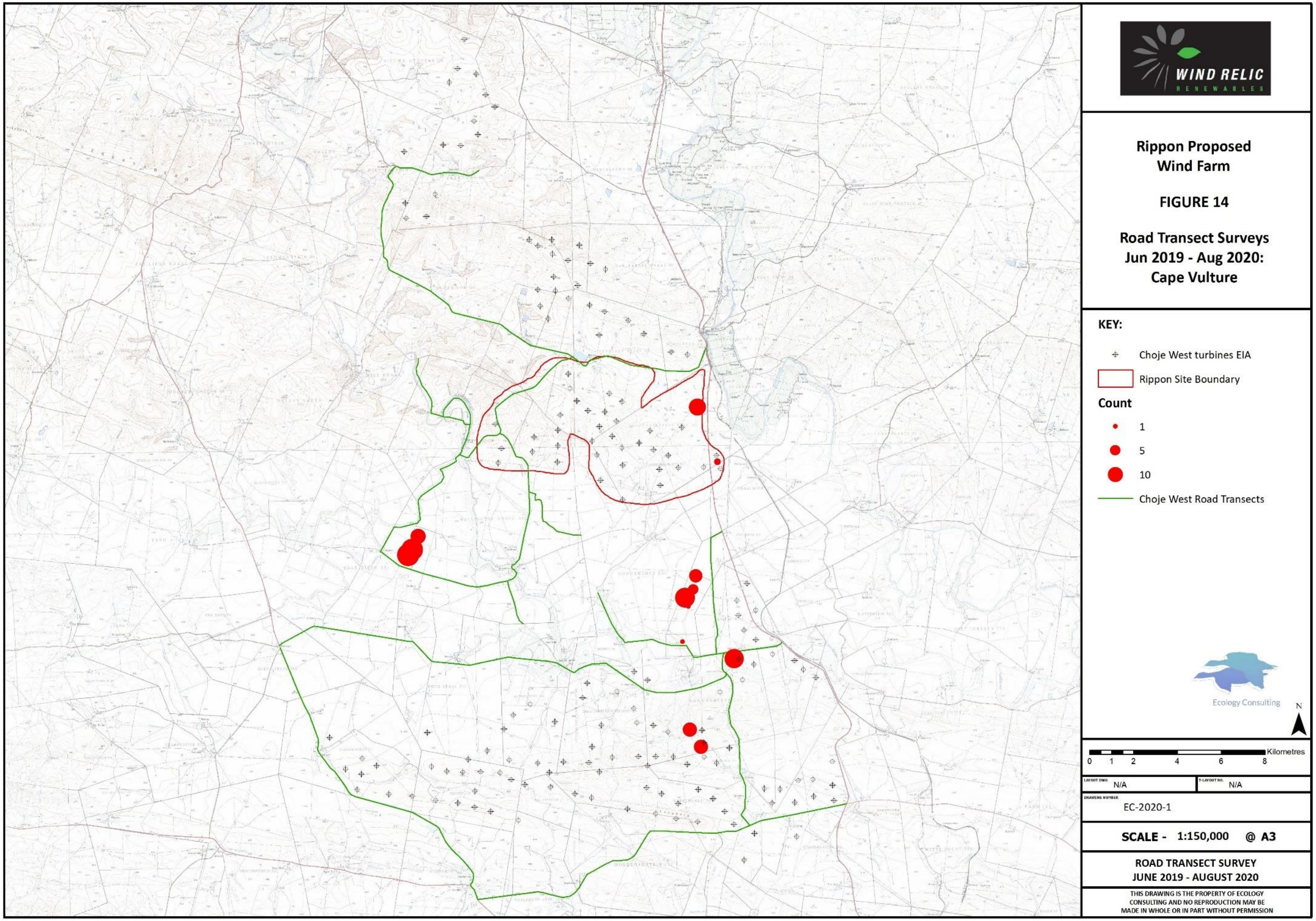
T-LAYOUT NO. N/A

DRAWING NUMBER EC-2020-1

SCALE - 1:150,000 @ A3

ROAD TRANSECT SURVEY JUNE 2019 - AUGUST 2020


WIND RELIC
RENEWABLES
Rippon Proposed Wind Farm
FIGURE 13
Road Transect Surveys Jun 2019 - Aug 2020: Other bustards, flamingo and cranes
KEY:
Choje West turbines EIA
Rippon Site Boundary
Species
Denham's bustard
Greater flamingo
Grey crowned-crane
Karoo bustard
Kori bustard
Choje West Road Transects
Ecology Consulting
N
Kilometres
0 1 2 4 6 8
N/A
N/A
EC-2020-1
SCALE - 1:150,000 @ A3
ROAD TRANSECT SURVEY
JUNE 2019 - AUGUST 2020
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION


WIND RELIC
RENEWABLES
Rippon Proposed
Wind Farm
FIGURE 14
Road Transect Surveys
Jun 2019 - Aug 2020:
Cape Vulture
KEY:
Choje West turbines EIA
Rippon Site Boundary
Count
1
5
10
Choje West Road Transects
Ecology Consulting
N
Kilometres
0 1 2 4 6 8
N/A
N/A
EC-2020-1
SCALE - 1:150,000 @ A3
ROAD TRANSECT SURVEY
JUNE 2019 - AUGUST 2020
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION

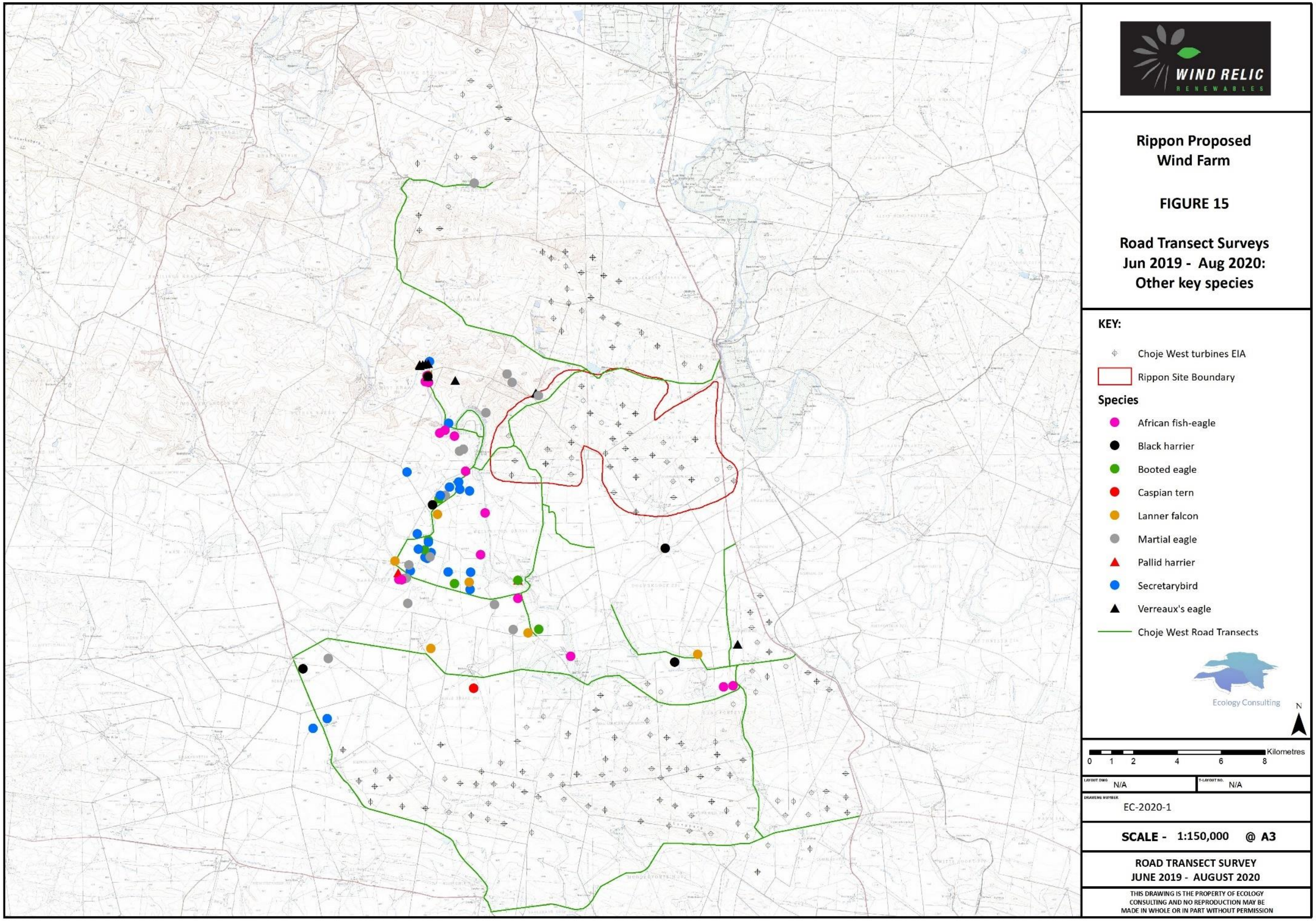

WIND RELIC
RENEWABLES
Rippon Proposed
Wind Farm
FIGURE 15
Road Transect Surveys
Jun 2019 - Aug 2020:
Other key species
KEY:
Choje West turbines EIA
Rippon Site Boundary
Species
African fish-eagle
Black harrier
Booted eagle
Caspian tern
Lanner falcon
Martial eagle
Pallid harrier
Secretarybird
Verreaux's eagle
Choje West Road Transects
Ecology Consulting
N
Kilometres
0 1 2 4 6 8
N/A
N/A
EC-2020-1
SCALE - 1:150,000 @ A3
ROAD TRANSECT SURVEY
JUNE 2019 - AUGUST 2020
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION

Table 5. Walking transect survey counts (birds per km transect) by month in the Ripponn proposed 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
Ring-necked dove	LC		1.50	1.00	2.00	1.00	3.50	1.00	0.50	1.00	0.50	1.00	3.00	2.00	1.00	1.50
Namaqua dove	LC		-	0.50	1.50	1.50	-	-	-	-	-	-	-	-	-	-
Diederik cuckoo	LC		-	-	-	-	-	0.50	-	-	-	-	-	-	-	-
Crowned lapwing	LC		-	1.00	1.00	-	-	-	1.00	-	1.50	-	1.50	-	-	-
Red-faced mousebird	LC		3.50	2.00	-	2.50	2.50	1.00	-	-	6.50	3.50	4.50	2.00	-	-
Common hoopoe	LC		-	-	-	-	0.50	-	-	-	-	-	-	0.50	-	-
Green woodhoopoe	LC		1.50	-	-	-	-	-	-	-	-	-	-	-	-	-
Brown-hooded kingfisher	LC		0.50	-	-	-	-	-	-	-	-	-	-	-	-	-
Acacia pied barbet	LC		0.50	-	-	-	0.50	-	-	0.50	1.00	0.50	-	0.50	-	0.50
Black-collared barbet	LC		1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
Cardinal woodpecker	LC		0.50	-	-	-	-	-	-	-	-	-	-	-	-	-
Common kestrel	LC		0.50	-	-	-	-	-	-	-	-	-	-	-	-	-
Chinspot batis	LC		-	-	1.00	-	1.50	0.50	1.00	1.00	0.50	-	1.00	-	-	-
Pririt batis	LC		2.00	-	-	-	-	-	-	-	-	-	-	-	-	-
Southern boubou	LC		-	-	-	-	-	-	-	-	0.50	-	-	-	-	-
Bokmakierie	LC		2.00	0.50	0.50	1.00	1.00	-	-	-	0.50	-	1.00	1.00	-	-
Common fiscal	LC		0.50	0.50	1.00	1.00	1.50	-	0.50	-	-	-	-	0.50	-	0.50
Cape crow	LC		-	-	0.50	-	-	-	-	-	-	-	0.50	-	-	-
Pied crow	LC		-	-	-	1.00	-	-	1.00	1.00	-	-	-	2.50	-	1.00
Southern black tit	LC		1.00	-	-	-	-	-	-	-	-	-	-	-	-	-
Grey tit	LC		-	0.50	-	-	-	-	-	-	-	-	-	-	-	1.00
Cape penduline-tit	LC		1.00	-	1.00	-	-	-	-	-	-	-	-	-	-	-

Species	IUCN	SA RDB	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec 2019	Jan 2020	Feb	Mar	May	Jun	Jul	Aug 2020
Spike-heeled lark	LC		1.00	1.00	-	1.00	2.50	3.50	2.00	3.50	5.00	2.00	1.50	3.00	4.00	-
Eastern long-billed lark	LC		0.50	-	-	-	-	-	-	-	-	-	-	-	-	-
Grey-backed sparrow-lark	LC		-	-	-	-	-	-	-	-	-	-	-	1.50	-	-
Eastern clapper lark	LC		0.50	-	-	2.50	3.00	1.00	1.00	-	2.50	2.00	-	1.50	0.50	0.50
Rufous-naped lark	LC		-	-	-	0.50	0.50	0.50	1.00	1.00	1.00	0.50	-	-	-	-
Red-capped lark	LC		-	-	-	-	-	-	-	-	4.00	-	-	-	-	-
Long-billed crombec	LC		-	-	-	-	-	-	0.50	-	-	-	-	-	-	-
Yellow-bellied eremomela	LC		-	-	-	-	-	-	0.50	-	-	-	-	-	-	-
Bar-throated apalis	LC		-	-	-	0.50	-	-	-	-	-	-	-	-	-	-
Rufous-eared warbler	LC		1.00	1.50	1.00	2.50	5.00	2.00	3.00	3.00	1.50	2.50	7.00	4.50	1.50	1.50
Grey-backed cisticola	LC		-	1.00	2.00	-	1.00	-	1.00	0.50	-	1.00	-	-	0.50	1.00
Neddicky	LC		0.50	1.00	-	-	1.50	3.00	2.50	1.50	3.00	1.00	-	-	0.50	-
Karoo prinia	LC		-	-	-	-	-	-	-	-	0.50	-	-	-	-	-
Greater striped swallow	LC		-	-	-	-	2.00	-	-	1.50	1.00	-	-	-	-	-
Barn swallow	LC		-	-	-	-	-	1.50	4.00	4.00	2.50	4.00	-	-	-	-
Large rock martin	LC		-	0.50	-	-	-	-	-	-	-	-	-	-	-	-
African plain martin	LC		-	-	-	-	1.50	-	-	-	-	-	-	-	-	-
Sombre greenbul	LC		-	-	-	0.50	-	-	-	-	-	-	-	-	-	-
Common bulbul	LC		1.50	-	-	-	-	0.50	-	0.50	-	-	0.50	-	-	1.00
Chestnut-vented warbler	LC		0.50	-	0.50	-	-	-	-	-	0.50	-	-	-	-	0.50
Cape white-eye	LC		-	-	-	-	-	1.00	-	-	1.00	1.00	-	-	-	-
Red-winged starling	LC		1.00	4.50	-	-	1.00	-	-	-	-	-	-	-	-	-
African pied starling	LC		1.50	-	-	-	-	-	-	-	-	-	-	3.50	-	-

Species	IUCN	SA RDB	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec 2019	Jan 2020	Feb	Mar	May	Jun	Jul	Aug 2020
Cape starling	LC		7.50	1.00	2.00	1.00	1.50	-	-	0.50	0.50	0.50	1.50	1.50	-	1.50
Karoo scrub-robin	LC		-	1.00	0.50	-	-	-	1.00	-	0.50	-	-	-	-	-
Fiscal flycatcher	LC		1.50	1.50	0.50	-	-	-	-	-	0.50	-	-	-	1.00	0.50
Sickle-winged chat	LC		-	1.00	0.50	-	1.50	2.00	3.00	-	-	1.50	1.00	-	-	1.00
Southern anteater-chat	LC		0.50	-	-	-	-	-	-	-	-	-	-	-	-	-
Familiar chat	LC		0.50	-	-	0.50	2.50	0.50	1.00	-	-	-	1.00	1.00	1.00	-
Amethyst sunbird	LC		-	-	-	0.50	1.50	-	-	1.00	-	-	-	-	-	-
Malachite sunbird	LC		-	-	-	-	-	0.50	-	-	-	-	0.50	1.00	-	0.50
Southern double-collared sunbird	LC		1.00	-	-	-	-	-	-	-	-	-	0.50	-	-	-
Greater double-collared sunbird	LC		1.00	-	-	0.50	-	-	-	-	-	-	-	-	-	-
Red-billed quelea	LC		-	-	-	-	3.00	-	-	-	-	10.50	-	-	-	-
Cape weaver	LC		-	2.00	-	-	2.00	-	-	-	-	-	-	-	-	-
Southern masked weaver	LC		-	-	-	-	-	-	-	0.50	-	-	-	-	-	-
Common waxbill	LC		-	-	-	-	-	-	-	-	-	0.50	-	-	-	-
African quailfinch	LC		1.50	-	-	-	-	-	-	-	-	-	0.50	-	-	-
Cape sparrow	LC		-	-	-	-	-	-	-	-	-	-	1.00	-	-	-
African pipit	LC		0.50	2.00	1.00	2.00	5.00	3.00	1.50	0.50	5.00	2.50	2.00	4.00	1.50	1.50
Long-billed pipit	LC		-	-	1.00	-	0.50	-	-	0.50	-	-	-	-	-	-
Cape wagtail	LC		-	-	-	-	-	-	-	-	-	-	0.50	-	-	0.50
Yellow-fronted canary	LC		-	-	-	2.50	-	-	-	-	-	-	-	-	-	-
Streaky-headed seedeater	LC		0.50	2.00	-	-	-	-	-	-	-	-	-	-	-	-
Golden-breasted bunting	LC		0.50	-	-	-	-	-	-	-	-	-	-	-	-	-
Cape bunting	LC		1.00	1.00	1.00	1.00	1.50	-	-	-	1.00	-	1.00	0.50	0.50	-

Species	IUCN	SA RDB	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec 2019	Jan 2020	Feb	Mar	May	Jun	Jul	Aug 2020
Lark-like bunting	LC		-	-	-	-	-	-	-	-	-	2.50	1.50	2.50	1.50	1.00
Cinnamon-breasted bunting	LC		-	3.00	2.00	-	-	0.50	-	-	-	3.00	1.00	0.50	-	3.00

7.4. Walking transect surveys

The results of the walking transect surveys within the Ripponn site are summarised in Table 5. This gives the number of birds counted each month, per km length of transect 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, though no species of higher conservation importance was observed within the site.

7.5. Survey Weather and Climate Conditions

It is important when considering the results of these baseline surveys to consider that the surveys coincided with a very dry period, with very little rainfall across the entire Karoo region. Weather patterns and conditions change annually and this will influence the ecological state of the area. Consideration therefore has been given to the longer-term conditions that will occur over the lifetime of the wind farm.

8. BIRD DATA ANALYSIS

Given the potential impacts identified above that could affect the birds on the Ripponn site, further analyses were undertaken to better understand the factors affecting the distributions of key species and the risks of collision and disturbance. This included spatial modelling, potential range loss calculations and collision risk modelling to quantify risk to the Priority species (i.e. those Species of Conservation Concern at risk of impact).

8.1. Avifaunal Sensitivities: Species of Conservation Concern

Key species have been identified as those of higher conservation value that would be at risk from the proposed wind energy development. Species of Conservation Concern identified during the June 2019 - August 2020 baseline bird surveys in the Western Block included:

- **Martial Eagle** - two territories were located in proximity to the Choje West Block (both of which were confirmed as active), with one of these 2.7km from the nearest proposed Ripponn wind turbine (the other was 12km to the south). A third (also active) was found further to the north-west (18km from the nearest proposed Ripponn wind turbine). A fourth potential range was identified in the western part of the Redding site, where a recently fledged juvenile was observed on one occasion, but no further evidence of occupation of a range in this area was found (so it was concluded that it was not active). VP surveys recorded higher flight activity in proximity to the two active nests. The proposed Ripponn wind turbines are located outside the higher flight activity around the active nest north-west of the Ripponn wind farm (Figure 7).
- **Verreaux's Eagle** - three active nests were confirmed in the Western Block, at distances of 4.9km, 5.2km and 16km from the nearest proposed Ripponn wind turbine location (all active in 2019 and the two more distant ones in 2020 - the closer north-eastern site was occupied by a pair of Lanner Falcons in that year). As all of these sites lay outside the proposed wind farm, they were not covered in detail by the VP surveys, but those surveys did indicate that the closest wind turbines did not support notably higher flight activity than the low level observed across the survey area (Figure 8).
- **Cape Vulture** - this species was found in the Western Block in nationally important numbers during November 2019 - March 2020, with a peak of 74 in February 2020. The nearest regularly-used cliff roost identified in the SEA (DEA 2015) is located 51km north-east from the site. There are no known breeding sites within 100km of the Choje Western Block. The Western Block was only used during the summer non-breeding period. A further check on historic use of the site using SABAP2 data revealed only a single record in this area prior to 2019-20, in 2009, and consultations with local landowners also indicated very low occurrence of this species in the area. Consultation with VulPro (K. Wolter, in litt.) did though show that they considered this area high priority for vultures (and noted that they have received '*quite a number of injured birds due to power line related incidents'* from this area). Overall, looking at all of the available information on the historic use of this area by this species, it would appear that the Choje Western Block (including the Ripponn wind farm site) lies outside the usual range of this species, but that under some circumstances, as occurred during 2019-20, they can extend their range into this area.

  Cape vulture flight densities were highest during 2019-20 in proximity to the birds' roost sites on the powerlines running north-south through the eastern part of the Western Block, with the birds dispersing widely to forage on the surrounding land. There was some flight activity within the Ripponn collision risk zone, but at lower intensity than closer to the roost sites (Figure 9).
- **Cranes, Bustards and Secretarybird** - Grey-crowned Crane, Blue Crane, Ludwig's Bustard, Denham's Bustard, Kori Bustard, Karoo Korhaan, Southern Black Korhaan and Secretarybird were all recorded during the baseline surveys. All are Species of Conservation Concern. They were all more abundant in the central part of the Choje West block. Many were associated with irrigated agricultural grassland, and the more open flatter karoo areas in the central part of the Western Block, with few records in proximity to the proposed Ripponn site and only low levels of flight activity.
- **Lanner Falcon** - no breeding sites were identified in the Choje Western Block during the 2019 surveys, but a pair was nesting in 2020, in the same location as the north-eastern Verreaux's Eagle pair had bred in

2019 (Figure 4), 4.9km from the nearest proposed Ripponn wind turbine. Only a single flight was observed flying through the Ripponn collision risk zone at rotor height (Table 3 and Figure 5).

- **Other Species of Conservation Concern** - Caspian Tern, African Marsh-harrier, Black Stork, Black Harrier, Pallid Harrier and African Rock Pipit - only a very low level of occurrence was recorded for all of these species and (with the exception of African Rock Pipit) no evidence of breeding within the Choje West Block**.**

8.2. Priority Species for Assessment

Of these Species of Conservation Concern, eight were taken forward for more detailed assessment as Priority Species for Assessment: Martial Eagle, Verreaux's Eagle, Cape Vulture, Blue Crane, Secretarybird, African Marsh Harrier, Caspian Tern and Lanner Falcon.

8.3. Spatial Modelling

Though the vantage point survey area did meet BLSA recommendations with regard to their coverage (exceeding 75% cover for the study area as a whole), that coverage was not complete (67% of the Ripponn wind turbines). Spatial modelling of the VP survey data was therefore undertaken, to provide additional information on three species of particular concern at higher risk of impact (Martial Eagle, Verreaux's Eagle and Cape Vulture). This enabled the VP data to be used, in conjunction with data on the factors affecting the birds' flight activity, to predict these species' use of the areas that were not covered by the surveys. This provided a more complete picture of their use of the area in general, and an improved estimate of flight activity in areas that were not covered by the surveys (including for use in the collision risk modelling). The modelling methodology and results are summarised here, with more details provided in Appendix 2.

8.3.1. 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);
- 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).

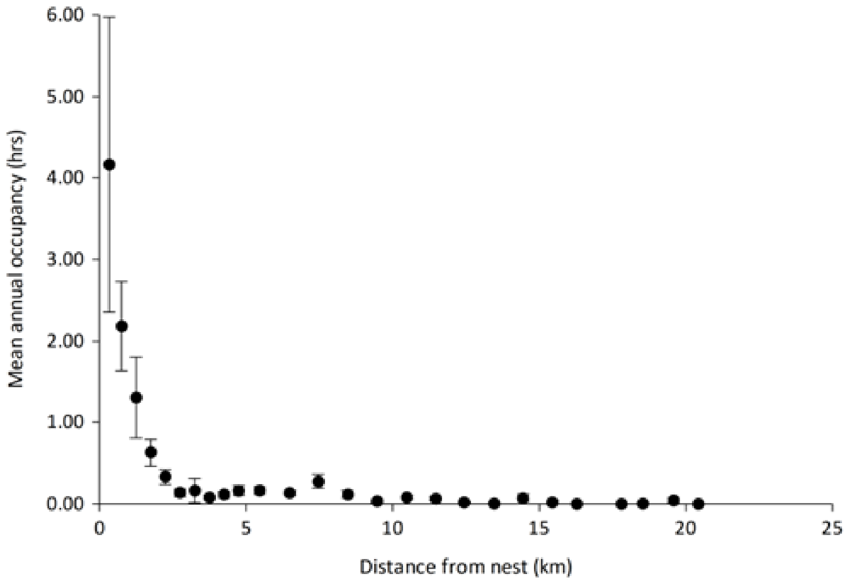
Other measures of local terrain variability were also investigated, including standard deviation of altitude with each grid square, terrain ruggedness index (Riley et al. 1999) and mean slope, but as they were strongly correlated with each other only one (maximum slope) was selected for inclusion in 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 account for spatial autocorrelation in the data.

8.3.2. Martial Eagle

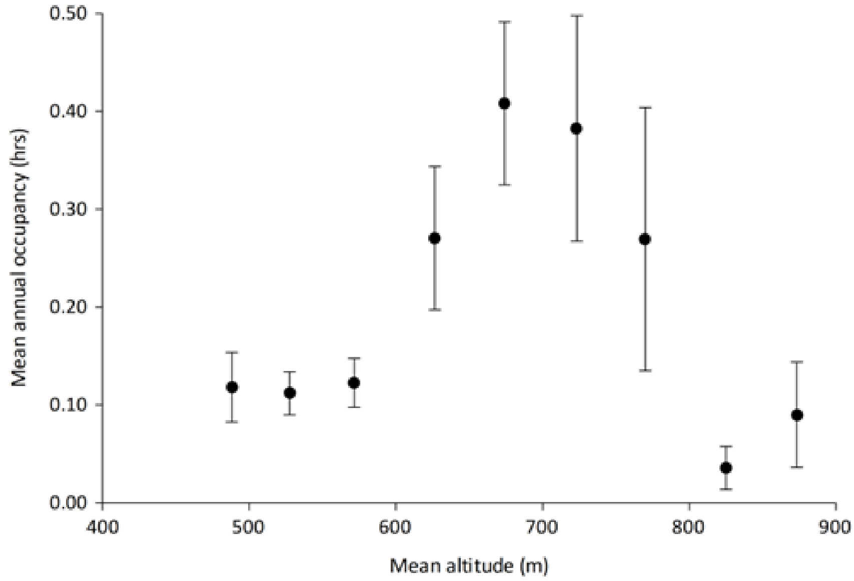
Martial Eagle flight density was strongly related to distance from the nest, but this relationship flattened out beyond 2.5km (Figure 16). The highest densities were recorded within 500m of nests and there was a steady decline in flight density with distance from the nest, but only up to a distance of 2.5km. Beyond 2.5km flight density was consistently lower.

Figure 16. Martial Eagle flight density and distance from the nest, Choje West June 2019 - August 2020 (mean + 95% confidence limits).



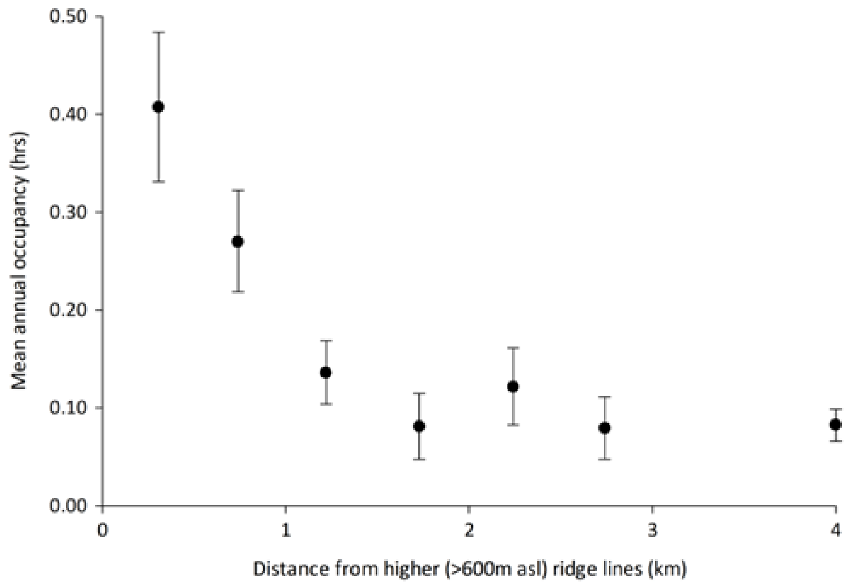
Martial Eagle flight density was lower at lower altitudes (below 600m asl) and at higher heights (above 800m), with higher flight activity in the 600-800m range (Figure 17), probably as a result of the altitudinal zones of the nest locations (and subsequent higher activity in proximity to nests).

Figure 17. Martial Eagle flight density and altitude (m above sea level), Choje West June 2019 - August 2020 (mean + 95% confidence limits



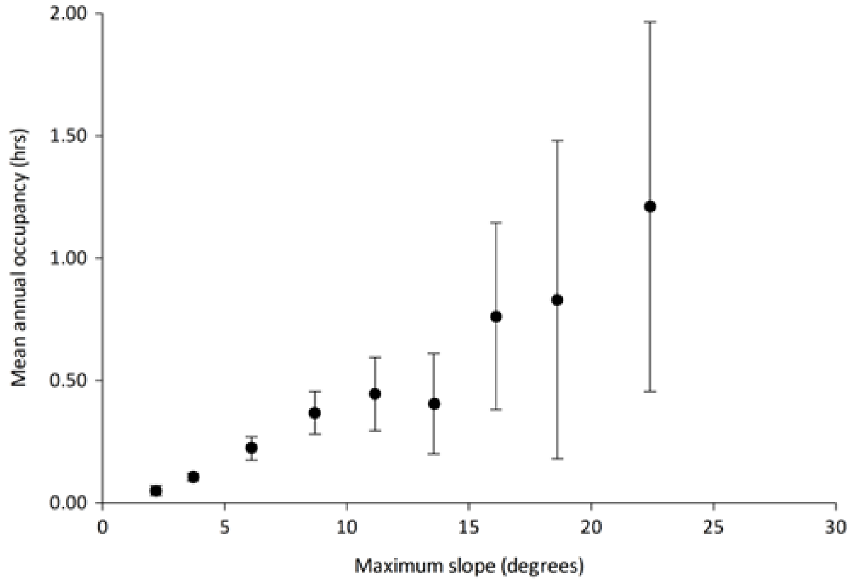
Martial Eagle flight density was also strongly influenced by proximity to higher ridge lines, with higher activity within 1km (Figure 18).

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



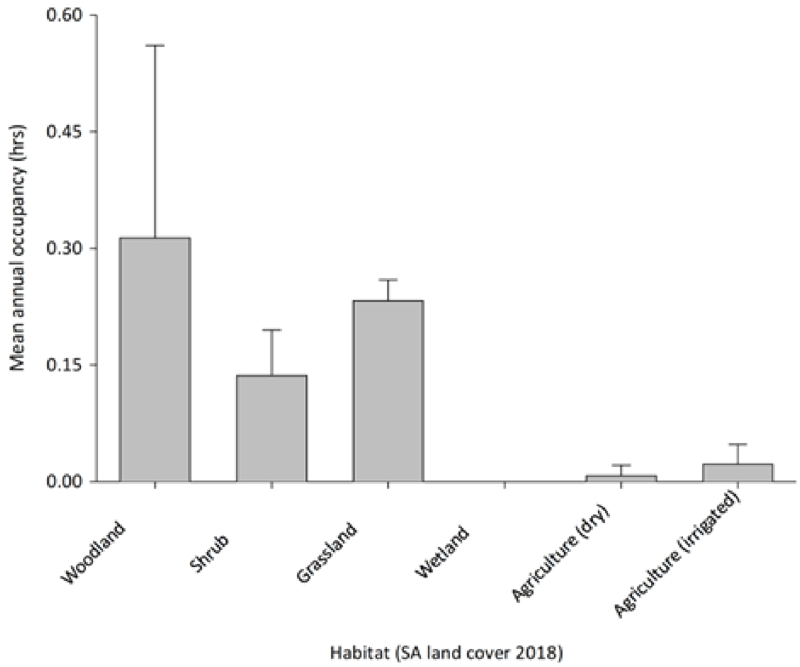
Martial Eagle flight density was lower in flatter areas (lower maximum slope), increasing steadily with increasing slope (Figure 19), though with increased variability on steeper slopes.

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



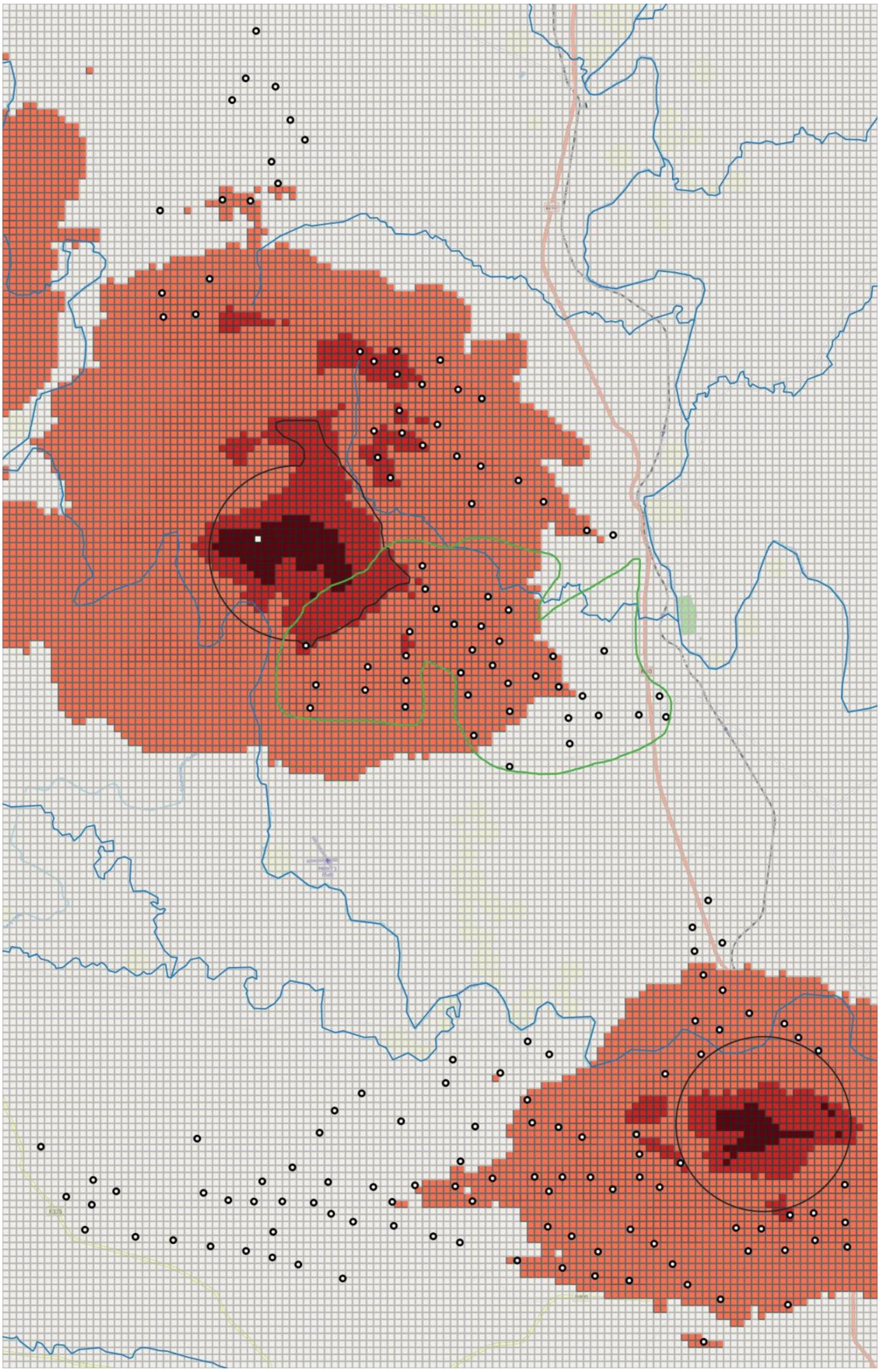
There was variation in Martial Eagle flight density between habitats, with more activity over grassland and woodlands (Figure 20), though also high variability (indicated by the large confidence interval bars). This may reflect the habitat types in proximity to the birds' nest sites, given the much higher flight densities around those sites.

Figure 20. Martial Eagle 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 Martial Eagle showed distance from the nest and altitude to be the two variables most strongly related to flight density. The predicted distribution from the spatial modelling is shown in Figure 21. The Figure also shows a recommended turbine exclusion zone around Martial Eagle nests where flight activity was predicted to be higher. Delineation of buffers zones around nest and roost sites of more vulnerable species, drawing on the results of the spatial modelling, are discussed further in the design mitigation section below.

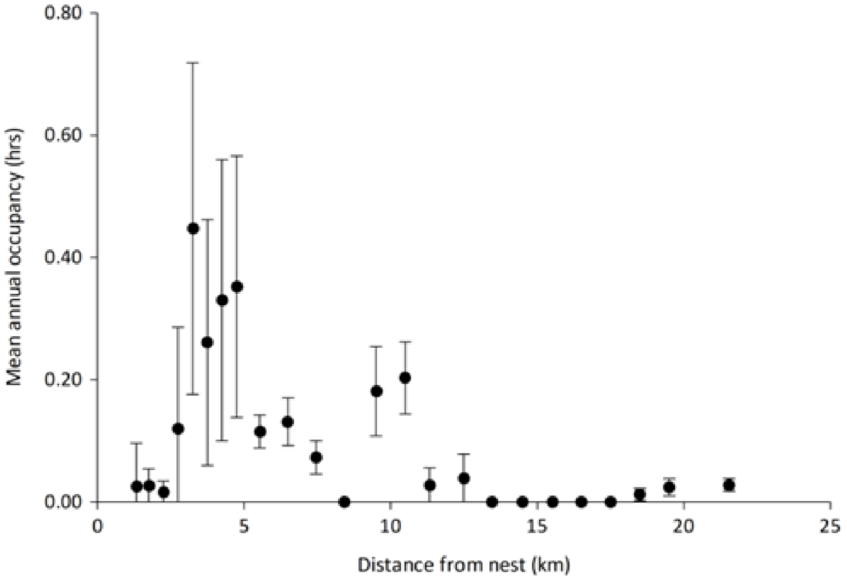
Figure 21. Predicted Martial Eagle distribution in the Choje Western Block. Darker shading indicates higher predicted use, with the Ripponn (green) site boundary, proposed turbines (small white dots) and turbine exclusion zones (larger black extended circles) also shown. Also see Appendix 2 for further information on the spatial modelling.



8.3.3. Verreaux's Eagle

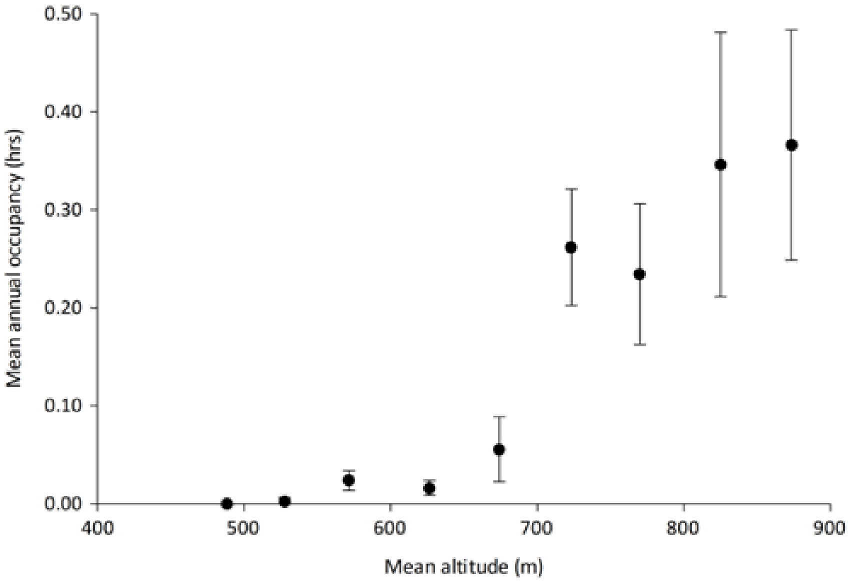
There were no Verreaux's Eagle nests within 1.5km of any proposed Choje West block wind turbine locations (to comply with BLSA guidance, BLSA 2017), so there was less coverage of areas in proximity to nests during VP surveys (which were designed primarily to maximise coverage of the Choje West wind farm 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 22).

Figure 22. Verreaux's Eagle flight density and distance from the nest, Choje West June 2019 - August 2020 (mean + 95% confidence limits).



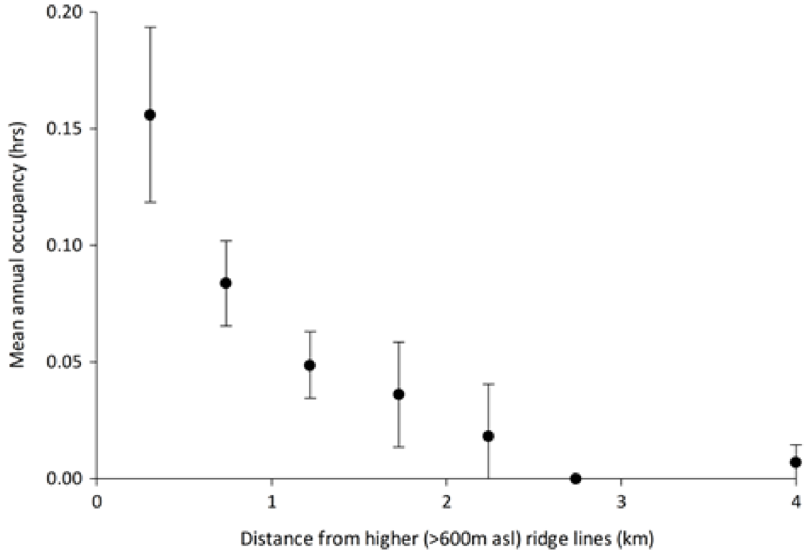
Verreaux's Eagle flight density showed a strong positive relationship with altitude, with very little flight activity in areas below 700m, and higher activity above 800m above sea level (Figure 23).

Figure 23. Verreaux's Eagle flight density and altitude (m above sea level), Choje West June 2019 - August 2020 (mean + 95% confidence limits).



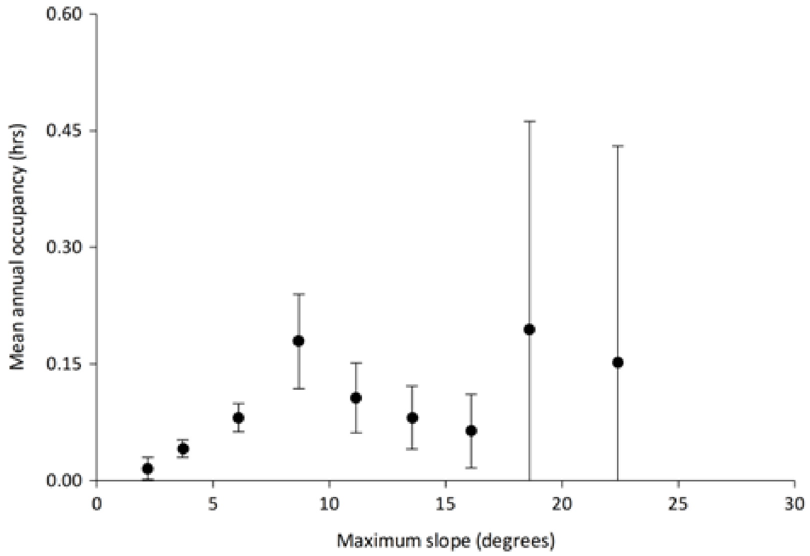
Verreaux's Eagle also exhibited a strong preference for flying near higher ridge lines, with higher flight density within 1km of ridges (Figure 24).

Figure 24. Verreaux's Eagle flight density and distance from higher (>600m) ridge lines, Choje West June 2019 - August 2020 (mean + 95% confidence limits).



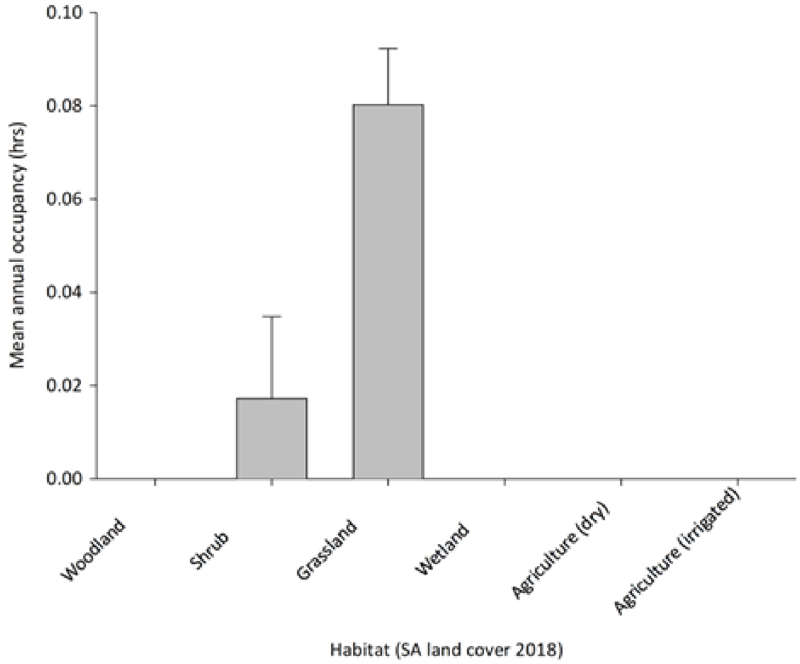
Verreaux's Eagle flight density was lower in flatter areas (lower maximum slope), with notably higher activity on slopes exceeding 15 degrees (Figures 25), and with higher variability on steeper slopes.

Figure 25. Verreaux's Eagle flight density and maximum slope, Choje West June 2019 - August 2020 (mean + 95% confidence limits).



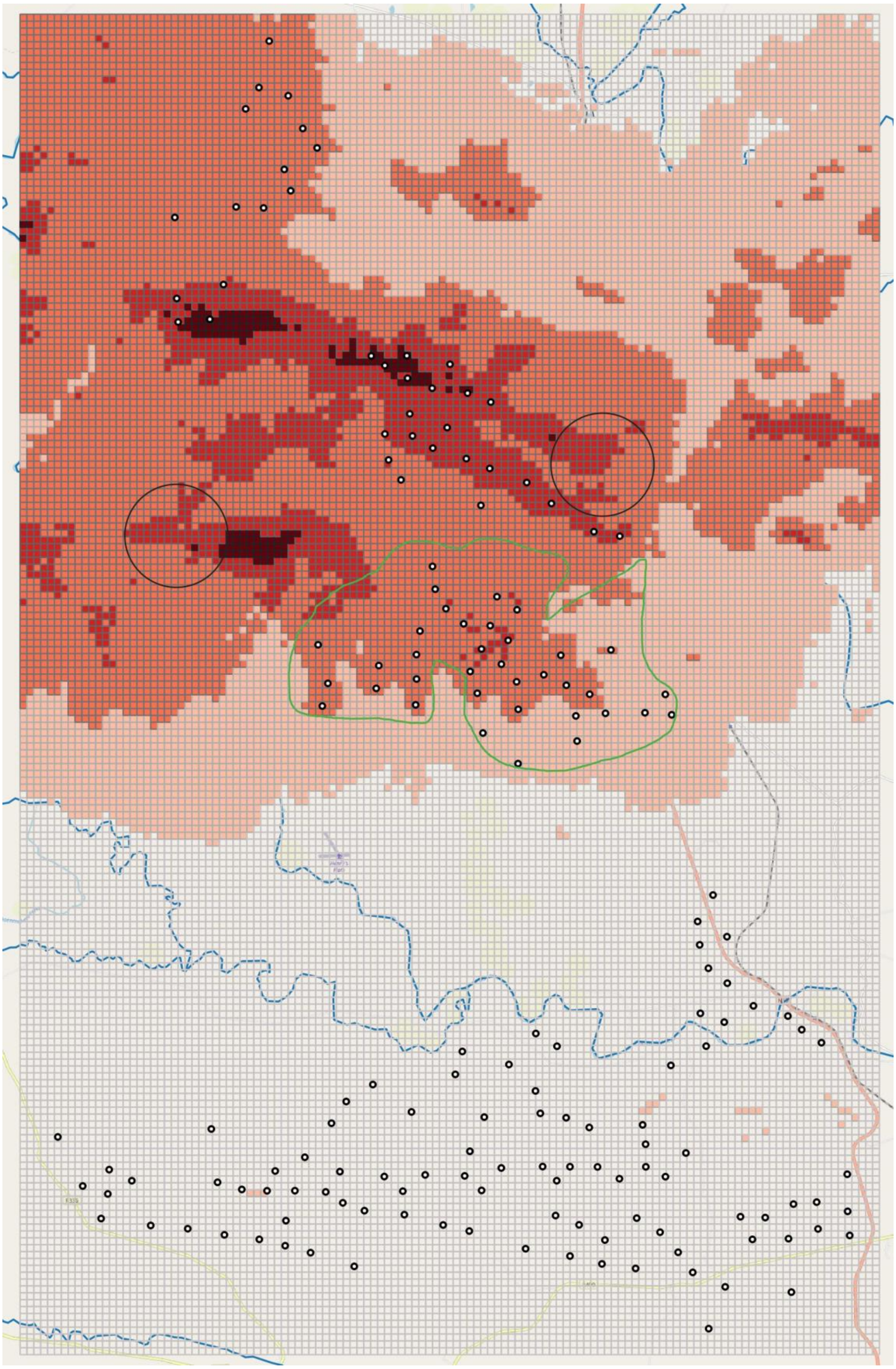
Verreaux's Eagle showed a strong preference for open grassland habitat, with the majority of records from this habitat class (Figure 26), more records were observed over woodlands in the East (Figure 22).

Figure 26. Verreaux's Eagle 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 Verreaux's Eagle showed distance from the nest to be 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 was strongly related to flight density. The predicted distribution from the spatial modelling is shown in Figure 27. The Figure also shows a recommended turbine exclusion zone around Verreaux's Eagle nests where flight activity was predicted to be higher (and in line with BLSA 2017 guidance). Delineation of buffers zones around nest and roost sites of more vulnerable species, drawing on the results of the spatial modelling, are discussed further in the design mitigation section below.

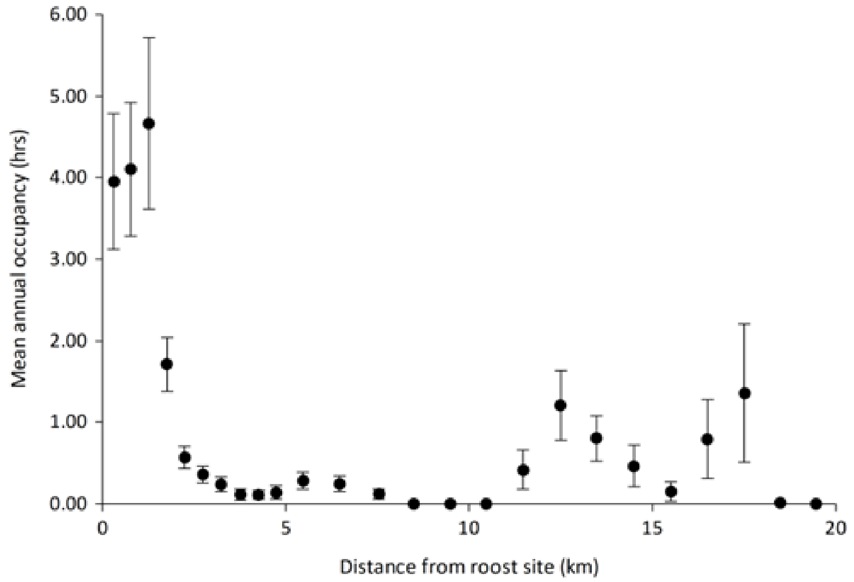
Figure 27. Predicted Verreaux's Eagle distribution in the Choje Western Block. Darker shading indicates higher predicted use, with the Ripponn (green) site boundary, proposed turbines (small white dots) and turbine exclusion zones (larger black extended circles) also shown. Also see Appendix 2 for further information on the spatial modelling.



8.3.4. Cape Vulture

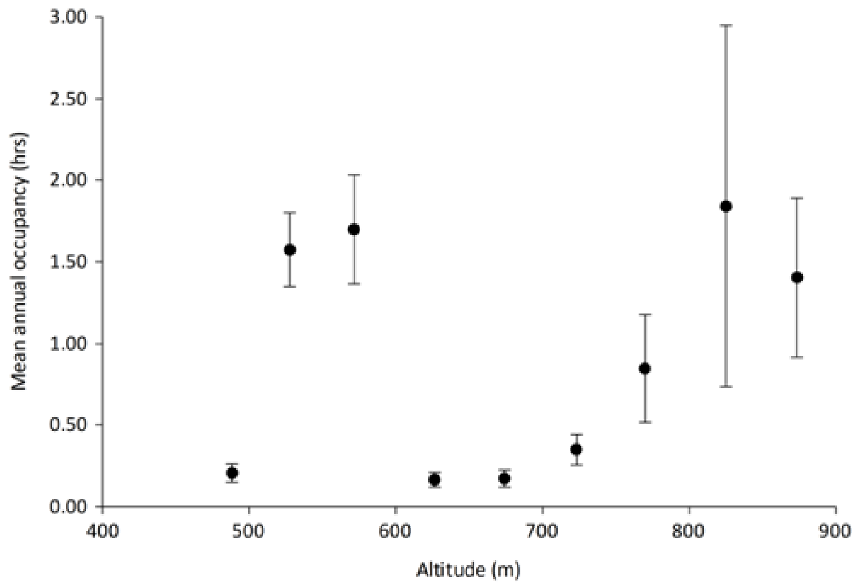
Cape Vultures do not breed in the region, so their flight distribution was not associated with any nest sites, but they were strongly associated with their night roost sites (with higher flight densities within 2km of the roosts, Figure 28).

Figure 28. Cape Vulture flight density and distance from the nearest roost, Choje West June 2019 - August 2020 (mean + 95% confidence limits).



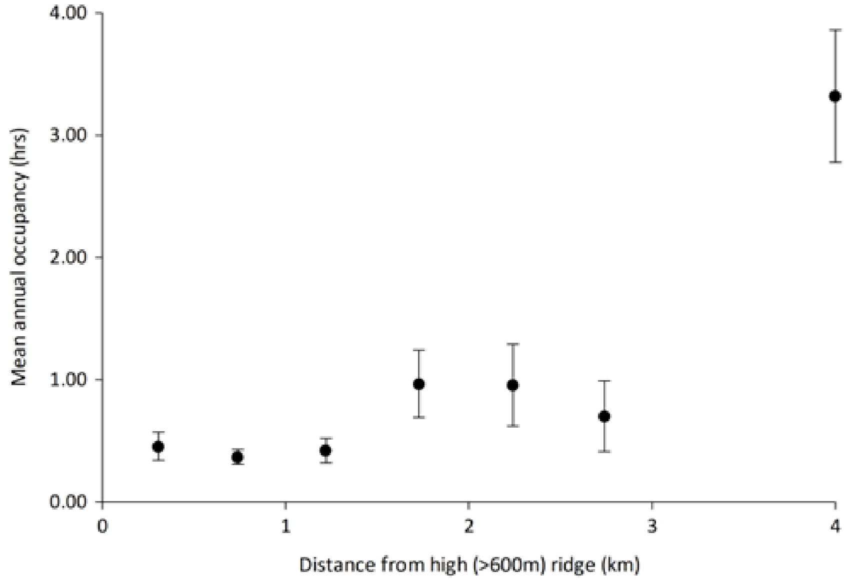
Cape Vulture flight density showed two peaks in relation to altitude, one around 500-600m (coincident with the altitude of their main roost sites) and a second above 800m above sea level (Figure 29).

Figure 29. Cape Vulture flight density and altitude (m above sea level), Choje West June 2019 - August 2020 (mean + 95% confidence limits).



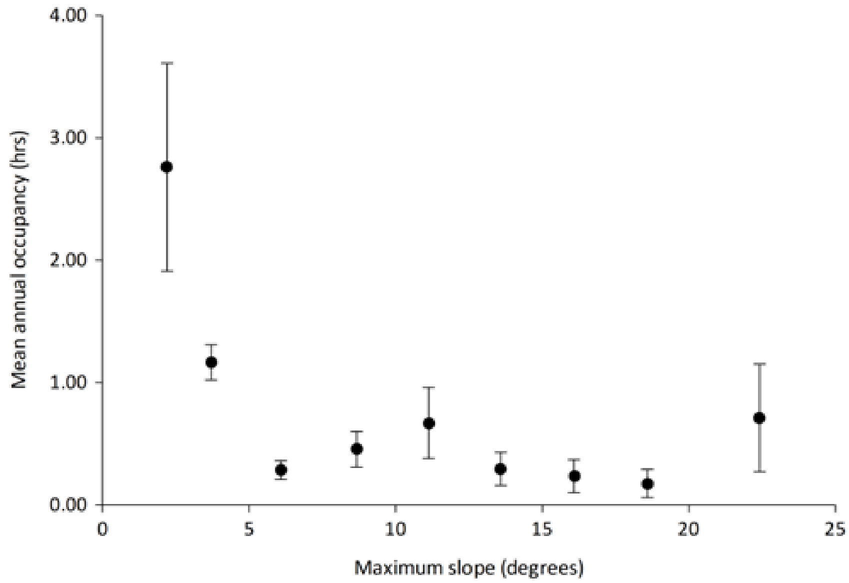
Cape Vulture flight density did not vary greatly in relation to distance from higher ridgelines, apart from a higher level at 4km (the distance coincident with the location of their main roost sites, Figure 30).

Figure 30. Cape Vulture flight density and distance from higher (>600m) ridge lines, Choje West June 2019 - August 2020 (mean + 95% confidence limits).



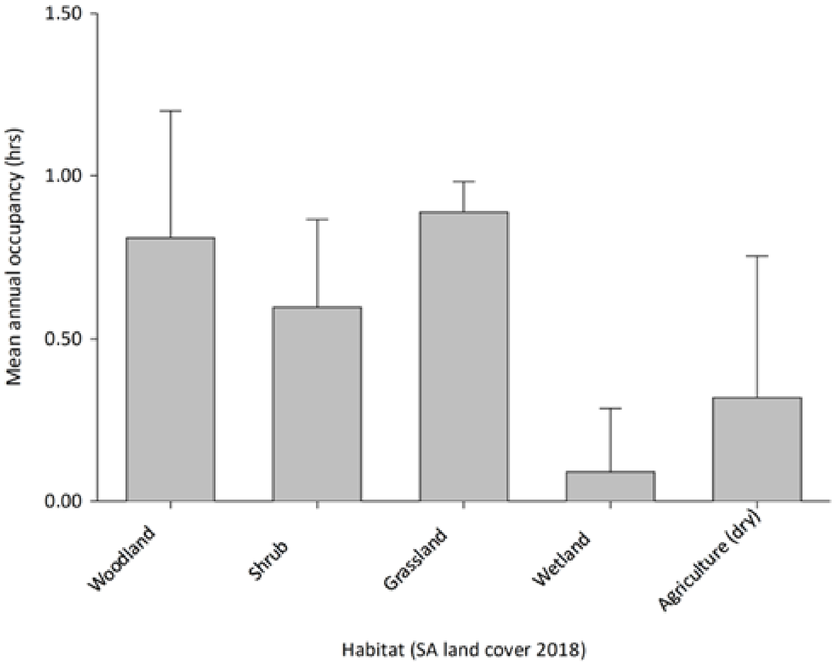
Cape Vulture flight density was highest in flatter areas (lower maximum slope), with lower activity on slopes exceeding 5 degrees slope (Figure 31).

Figure 31. Cape Vulture flight density and maximum slope, Choje West June 2019 - August 2020 (mean + 95% confidence limits)



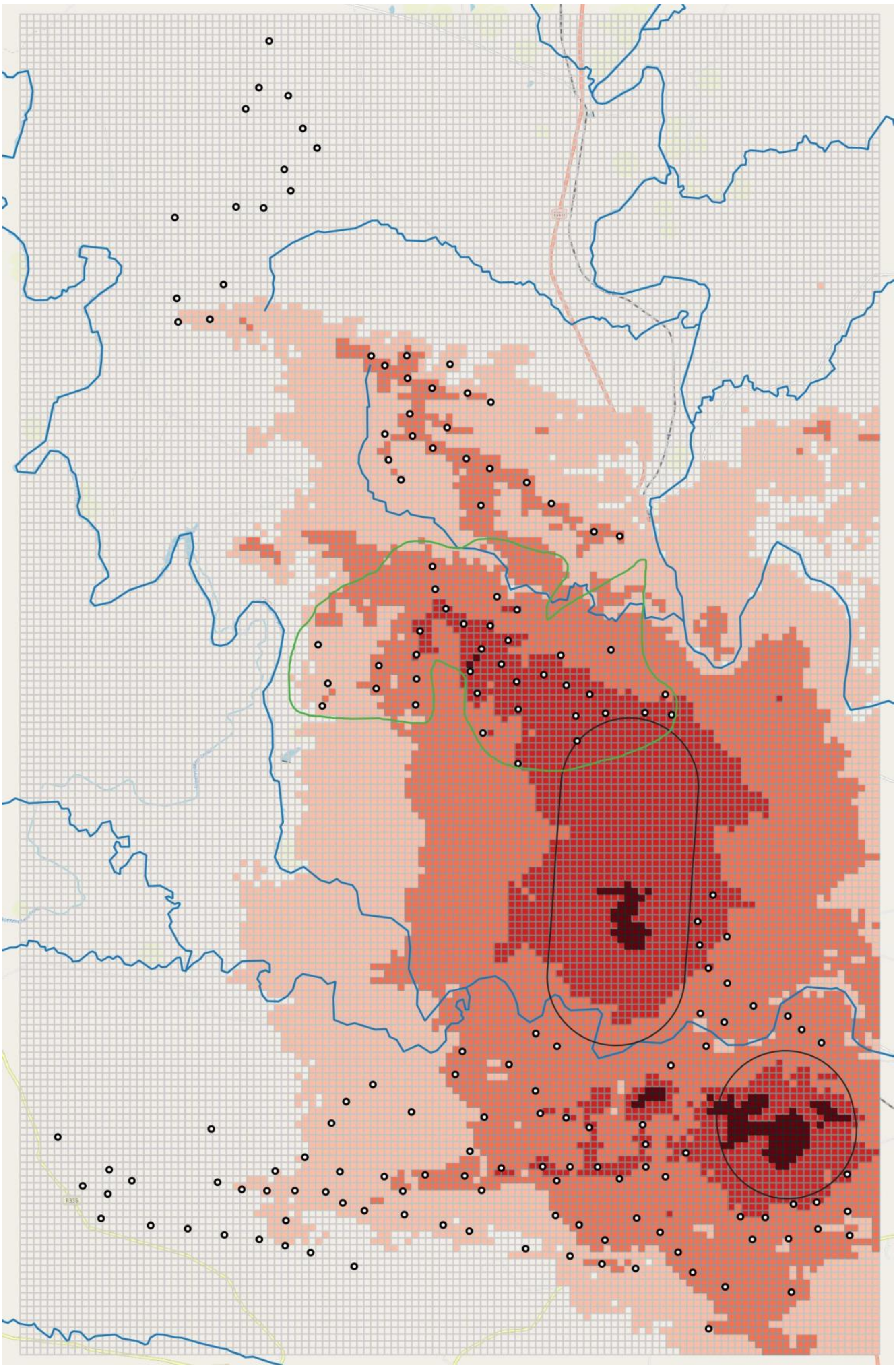
Cape Vultures used a range of habitat types, but higher flight densities were recorded over grasslands, scrub and woodland (Figure 32).

Figure 32. Cape Vulture flight density and habitat type (land cover 2018), Choje West June 2019 - August 2020 (mean + 95% confidence limits).



The spatial modelling for Cape Vulture found that distance from the roost and altitude were the two variables most strongly related to flight density. The predicted distribution from the spatial modelling is shown in Figure 33. The Figure also shows a recommended turbine exclusion zone around Cape Vultures where flight activity was predicted to be higher. Delineation of buffers zones around nest and roost sites of more vulnerable species, drawing on the results of the spatial modelling, are discussed further in the design mitigation section below.

Figure 33. Predicted Cape Vulture distribution in the Choje Western Block. Darker shading indicates higher predicted use, with the Ripponn (green) site boundary, proposed turbines (small white dots) and turbine exclusion zones (larger black extended circles) also shown. Also see Appendix 2 for further information on the spatial modelling.



8.4. Collision Risk Modelling

One of the main potential ornithological impacts of concern for the Ripponn 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, SNH 2017). Discussion as to the most appropriate avoidance rates to apply is included in the following section.

The CRM was carried out for all eight Species of Conservation Concern that were observed flying within the Ripponn collision risk zone at rotor height (Martial Eagle, Verreaux's Eagle, Cape Vulture, Blue Crane, Secretarybird, Ludwig's Bustard and Lanner Falcon).

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) and Kemp and Marks (2020). 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)**
Martial Eagle	0.81	2.15	10.4
Verreaux's Eagle	0.88	2.40	11.9
Cape Vulture	1.03	2.42	12.6
Blue Crane	1.15	1.90	15.0
Secretarybird	1.35	2.03	15.0
Lanner Falcon	0.44	1.01	12.1
Caspian Tern	0.51	1.34	12.1
African Marsh-harrier	0.47	1.15	10.6

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 36-turbine layout being assessed for the EIA.

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

Specification	Wind turbine input data
Number of turbines	36
Hub height *	140-166m
Rotor diameter	160m
Height to blade tip	220-246m
Minimum height of blade above ground	60m
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%

** Note: hub height modelled as worst case (lowest possible value) and may be higher (up to 166m) in final implementation - higher hub heights will generally reduce collision risks.*

Data from the VP surveys were used to determine the proportion of flights at rotor height, with all flights between 50m and 300m treated (conservatively to take into account the difficulty of accurately estimating flight heights and uncertainty as to final turbine specifications) as being at rotor height (actual rotor height would be 60-86m above ground level at the lowest point of the rotor sweep and 220-246m at its highest point).

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 24 of the 36 turbine locations, i.e. 67%).

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 farm 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 Conservation Concern at Ripponn. As collision avoidance rates are not yet known for the species of concern, suitable international species have been used as proxies, following the same assumptions as made for the previous CRM. The selection of appropriate rates followed 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).

8.4.1. Collision Modelling Results

The results of the collision risk modelling for the proposed 36-turbine layout for each of the eight 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. Harriers have similarly been shown to be less vulnerable to collision (SNH 2017) so a 99% avoidance rate has been used for them too. Vultures are a higher risk group, so a more precautionary 95% avoidance rate was applied for Cape Vulture. 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 Ripponn wind farm 36-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	5.78	2.31	**1.16**	0.58
Verreaux's Eagle	1.54	0.62	**0.31**	0.15
Cape Vulture	**5.66**	2.26	1.13	0.57
Blue Crane	3.36	**1.35**	0.67	0.34
Secretarybird	0.32	**0.13**	0.06	0.03
Lanner Falcon	0.07	**0.03**	0.01	0.01
Caspian Tern	0.07	**0.03**	0.01	0.01
African Marsh-harrier	0.0034	0.0014	**0.0007**	0.0003

Table 9. Collision risk modelling predictions based on 2019-20 data for the Ripponn wind farm 36-turbine layout: annual risk, year per collision and total collisions in 25 years.

Species	Martial Eagle	Verreaux's Eagle	Cape Vulture	Blue Crane	Secretary-bird	Lanner Falcon	Caspian Tern	African Marsh-harrier
Primary avoidance rate used for assessment	*99%*	*99%*	*95%*	*98%*	*98%*	*98%*	*98%*	*99%*
Collision prediction (annual)	**1.16**	**0.31**	**5.66**	**1.35**	**0.13**	**0.03**	**0.03**	**0.0007**
Years per collision	0.9	3.2	0.2	0.7	7.7	33.6	33.7	1467.3
Total collisions in 25 years *	28.9	7.7	141.4	33.6	3.2	0.7	0.7	0.0

** Note this is an extrapolation from baseline data in absence of mitigation, not a prediction of the actual number of collisions expected from the wind farm. Vulture totals, in particular, would be expected to be much lower given the exceptional numbers recorded in the survey area during the baseline surveys.*

The cumulative collision risk from the Choje wind farms in combination also needs to be considered. Table 10 gives the predicted collision risks for all four proposed wind farms in the Choje Western Block.

Table 10. Cumulative collision risk for the Choje wind farms in the Western Block (annual risk).

	Martial Eagle	Verreaux's Eagle	Cape Vulture	Blue Crane	Secretarybird	Lanner Falcon	Ludwig's Bustard	Black Stork	Caspian Tern	African Marsh-harrier
Avoidance rate:	*99%*	*99%*	*95%*	*98%*	*98%*	*98%*	*98%*	*98%*	*98%*	*99%*
Hamlett	0.33	0.61	4.83	0.59	0.02	0	0	0.20	0	0
Aeolus	0.35	0.02	1.43	0.09	0.09	0.01	0	0	0	0
Redding	0.51	0.06	5.66	5.68	0.41	0.08	0.11	0	0	0
Ripponn	1.16	0.31	5.66	1.35	0.13	0.03	0	0	0.03	0.0007
TOTAL	**2.35**	**1.00**	**17.58**	**7.70**	**0.66**	**0.12**	**0.11**	**0.20**	**0.03**	**0.0007**

8.4.2. 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 they 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, so this has instead been based on professional judgement (and mitigation will be implemented on a precautionary basis, requiring the implementation of collision risk reduction measures wherever any moderate/high risk to key species was identified by the collision modelling).

In the case of the predicted collision risks from the Ripponn wind farm, it is clear that the predicted levels of additional mortality for all species apart from Cape Vulture and Martial Eagle are 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, mitigation measures should still be implemented to minimise the risk of collision, so that the Ripponn site makes as small as possible a contribution to the overall cumulative risk from all the Choje wind farms as a whole.

The collision risk to Cape Vulture was higher, primarily as a result of applying a lower avoidance rate. Available information (Boshoff et al 2009, SABAP2 data) indicates that the high numbers of vultures present on the site in 2019-20 are probably unlikely to be a regular occurrence, and that numbers in most future years would be likely to be much lower. However, with only a year's baseline data, it cannot be ruled out that the numbers recorded in 2019-20 would not be repeated at some time through the lifetime of the wind farm (and more data over a further year would not have altered this conclusion). Therefore, a precautionary approach has been adopted, implementing a 2km turbine-free buffer around the roost sites used in 2019-20, and also a Vulture Management Plan to mitigate collision risk. This will include measures to reduce the attractiveness of the Choje West Block to vultures (by removing carcasses that could attract feeding birds, if vultures are present in the area), providing alternative feeding areas for vultures elsewhere away from the Choje West Block, reducing collision risk by increasing turbine blade visibility (painting single blades black in areas of higher vulture collision risk) and implementation of a shutdown-on-demand scheme.

For Martial Eagle, with a predicted collision risk of 1.16 birds per year, mitigation measures will be necessary to a level at which it can be concluded that there would not be any significant residual risk. These are discussed further below.

8.5. Disturbance Effects – determining 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; see Design Mitigation section below), 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 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 raptor Species of Conservation Concern 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), i.e. 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 2.9 km (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). Whilst these studies were undertaken in higher-density areas for both species than in the Choje region (and hence at Choje range sizes may be larger), this would just reduce the magnitude of the proportionate impact on the range.

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 11.

For Martial Eagle, there would be potential range loss from one breeding territory from the Ripponn wind farm, as it is the only nest site that lies within 5.8km of the Ripponn site. That nest site lies 2.7km from the nearest proposed wind turbine. There would be a 15.3% range loss from this Martial Eagle territory assuming complete displacement to 500m for the 36-turbine layout, and a 11.7% loss assuming complete displacement to 250m from the turbines.

There could also be a loss from this same Martial Eagle range from the adjacent proposed Hamlett wind farm. The in-combination effect of the two wind farms is also included in Table 11. This would be a 25.1% range loss with displacement to 500m and 19.6% loss for displacement to 250m.

For Verreaux's Eagle, there are no recorded nest sites within 2.9km of the Ripponn wind turbines, so no significant range loss would be expected to occur.

Table 11. Predicted Martial Eagle range loss for the proposed 36-turbine Ripponn *wind farm, assuming complete displacement to 250m or 500m from turbines.*

Species	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
Martial Eagle	12.4	11.7%	16.2	15.3%
Martial Eagle (in combination with Hamlett)	20.7	19.6%	26.5	25.1%

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).

Martial Eagles have large ranges, so would be predicted to be less vulnerable to range loss. The impact on the local breeding range from the Ripponn wind farm on its own would constitute a loss of up to 15% of the birds' range. Given the relatively low use that these birds make of the Ripponn site itself (from the vantage point survey results and from the range modelling), such a loss would not be considered significant. However, when the effect on this range from Ripponn in combination with the proposed Hamlett wind farm is considered, the potential for significant cumulative displacement cannot be ruled out, with a loss of as much as 25% possible.

In conclusion, potentially significant disturbance impacts have been identified, and mitigation measures will be needed, particularly when considering the cumulative effects of the whole Choje West scheme (and specifically here the Ripponn and Hamlett schemes together).

8.6. Disturbance Effect - Decommissioning phase (dismantling)

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.

9. 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 'do-nothing' alternative.

The proposal has been through a series of iterative layout designs, removing wind turbines from more sensitive areas. This has included implementation of the buffers discussed below and as shown in Figure 36. The original 297-turbine layout is shown in Figure 34, alongside the current proposed EIA layout for comparison. Further details of this process are given in Chapter 3 of the Basic Assessment Report.

The 'do-nothing' 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 'do-nothing' option on avifauna would therefore be None.

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.

9.1. Design Mitigation and Ornithological Buffers (Phase 1)

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 eight Priority Species that could be at risk from the wind farm, including Martial Eagle, Verreaux's Eagle, Cape Vulture, Blue Crane, Secretarybird, African Marsh-harrier, Caspian Tern and Lanner Falcon. Design mitigation has been implemented to avoid areas of higher risk to reduce the ornithological impacts of the wind farm for each of these species as set out below.

9.1.1. Verreaux's Eagle

Verreaux's Eagle nests have had two buffers implemented. Firstly a 1.5km red zone buffer (a wind turbine no-go area), in line with BLSA (2017) guidance for a minimum buffer of that size. Secondly an amber caution zone was identified for the zone 1.5-3km from the nests, in which turbines were reduced as much as possible in the design process, and where increased precautionary mitigation measures will be implemented (including shutdown on demand and increasing rotor blade visibility, e.g. by painting a single blade black - see below).

BLSA (2017) advises further than a 3km a precautionary buffer should be implemented but that this may be reduced (or increased) based on the results of baseline surveys. Nest buffers should, however, never be less than 1.5 km. The baseline VP flight activity data were used to explore the benefit of this wider buffer. These showed that Verreaux's Eagle flight density at the site was not significantly higher in the 1.5km - 3km zone than beyond 3km, so implementing a wider turbine-free buffer to 3km would not have reduced collision risk any further than the 1.5km buffer that has been put in place.

Where nests were not confirmed, the precautionary assumption was 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.

BLSA (2021) has recently produced a draft update to its 2017 guideline, based largely on recent research on Verreaux's Eagle published by Murgatroyd et al. (2021). This paper highlights that circular buffers do not optimise protection, and that consideration of the features such as distance to nest, distance to conspecific nest, slope, distance to slope and elevation can provide a more efficient way to reduce collision risk. The paper shows that even adopting very wide buffers, the collision risk to eagles is not removed and that a residual collision risk will remain, because (as the baseline surveys have shown at Ripponn) the eagles range widely from their nests.

The draft updated BLSA guideline recommends the adoption of a minimum 3.7km buffer from nests (unless the Murgatroyd et al spatial modelling has been undertaken to show that this includes lower risk areas), or 5.2km in the absence of any such modelling without detailed survey evidence. Murgatroyd et al however note that even with a 5.2km buffer this still would only capture 50% of collisions. There will, therefore, be a need for further mitigation measures to reduce collision risk to this species beyond design mitigation (as set out below and in the Ornithological Mitigation Plan in Appendix F).

9.1.2. Martial Eagle

BSLA has not published specific guidance on Martial Eagle, so the buffers implemented for this species are based on a combination of the results of the baseline surveys and published information on this species' ranging behaviour. 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.

The baseline data on flight activity from the study area showed Martial Eagle flight density to be higher within 2.5km of active nest sites, though not beyond that distance (see Figure 16 above). A minimum 2.5km red no-go buffer was therefore implemented for all Martial Eagle nest sites. The results of the spatial modelling were used to search for any further areas of higher eagle flight activity outside this 2.5km zone around each nest, and any such areas identified were added to the red turbine no-go buffer.

Additional to that, a 5km amber caution zone was identified in which turbines were reduced as much as possible in the design process, and where increased precautionary mitigation measures will be implemented (including shutdown on demand and a single black blade for each turbine to increase visibility - see below).

9.1.3. Cape Vulture

BLSA (2018) classified all areas within 50km of a Cape Vulture roost as high sensitivity (and 18km from a breeding colony). The guideline states that "*these buffers do not automatically represent a 'no go' for wind farm development, they should be used to guide site selection, as well as the scope of data collection for impact assessment. The buffers indicate potential sensitivity; there are some limitations to the use of standard, circular buffers, and there are also a number of other risk factors that must be considered in the impact assessment. The risks associated with developing wind turbines both within and outside of these buffers should therefore be subject to further interrogation throughout the process."*

Though Cape Vultures do not breed in the region, the site was used by non-breeding birds during November 2019 - March 2020, roosting on the power lines in the central part of the Choje Western Block at night and foraging widely over the surrounding land. The specific BLSA guideline has, therefore, been taken into account in the site design process. The Ripponn site lies further than 50km of the main vulture roost in the region at Aggieskloof (51km north-east), but local opportunistic roosts were located on powerlines within the Choje West block (including 2-3km from the Ripponn site).

Flight activity data showed Cape Vulture flight density to be significantly higher within 2km of the main roosts (see Figure 28 above), so no turbines have been located within this zone to reduce collision risk. This conclusion was also supported by the results of the spatial modelling that was undertaken for this species (see above).

9.1.4. Secretarybird

The nest sites of one other large raptor nest (Secretarybird) were also considered for buffering as a precautionary measure to reduce collision risk. This species' IUCN threat status has recently been updated from Vulnerable to Endangered. Flight activity around all confirmed and probable nest site locations identified during the surveys was assessed, to determine if there would be any benefit in removing turbines from a zone around the nest sites. There were no nest sites identified within the Ripponn site (see Figure 4), so no buffering for this species was needed. Areas of higher Secretarybird activity were, however, included within the larger terrestrial bird buffers discussed in section 9.1.5.

9.1.5. Bustards and Cranes

Areas of higher importance for cranes and bustards were identified using the road transect data. An analysis was undertaken focussing on the two more abundant larger terrestrial 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 35. 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.

This area of higher bustard and crane use was taken into account in the design mitigation process by locating as few turbines as possible within it. No Ripponn wind turbines are located within this zone.

9.1.6. Summary of Buffers Implemented

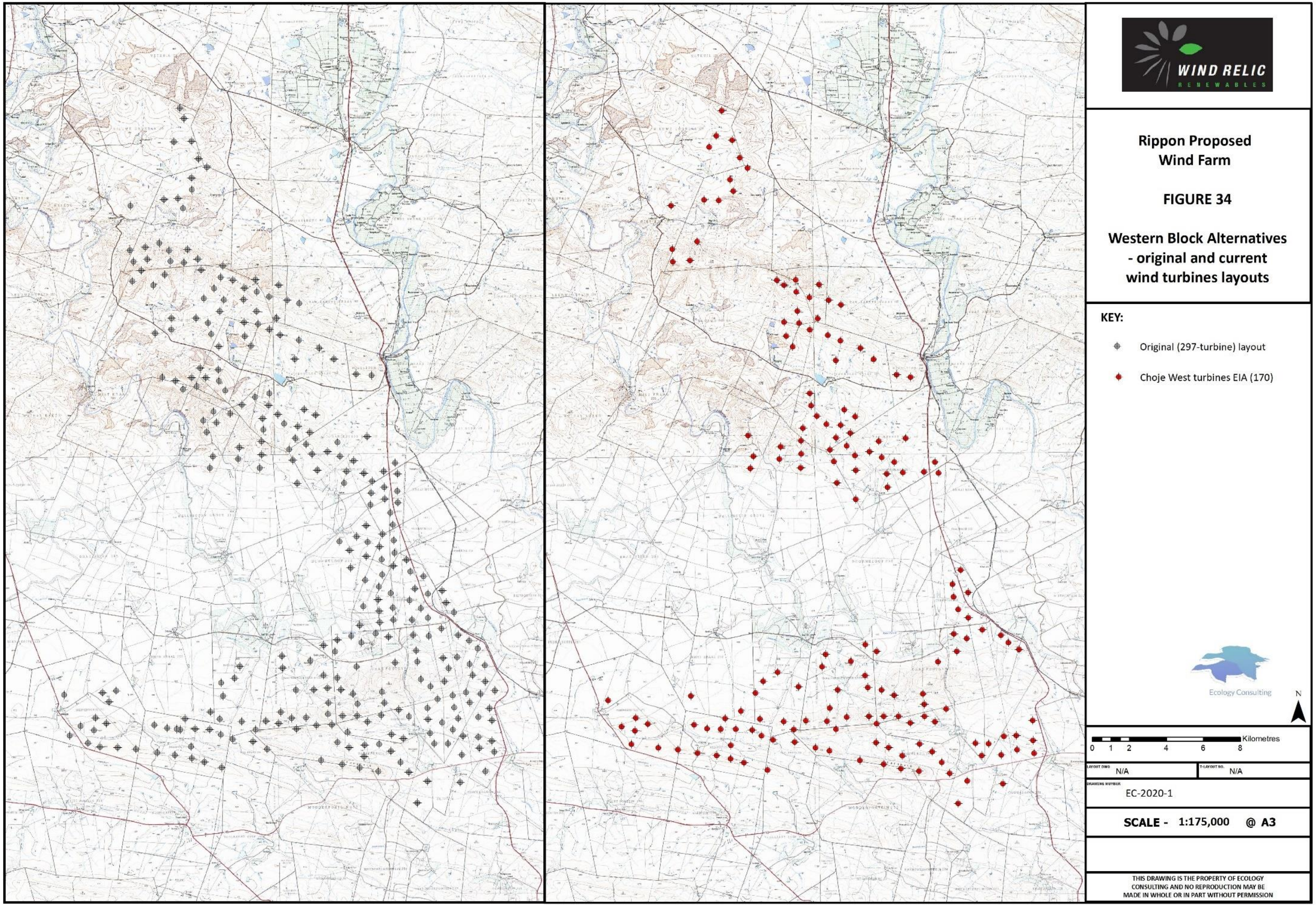
Two categories of buffers were identified in the assessment, red zones, from which wind turbines have been completely excluded, and amber zones, in which turbines were reduced as much as possible in the design process, and where increased precautionary mitigation measures will be implemented. The red zones comprised:

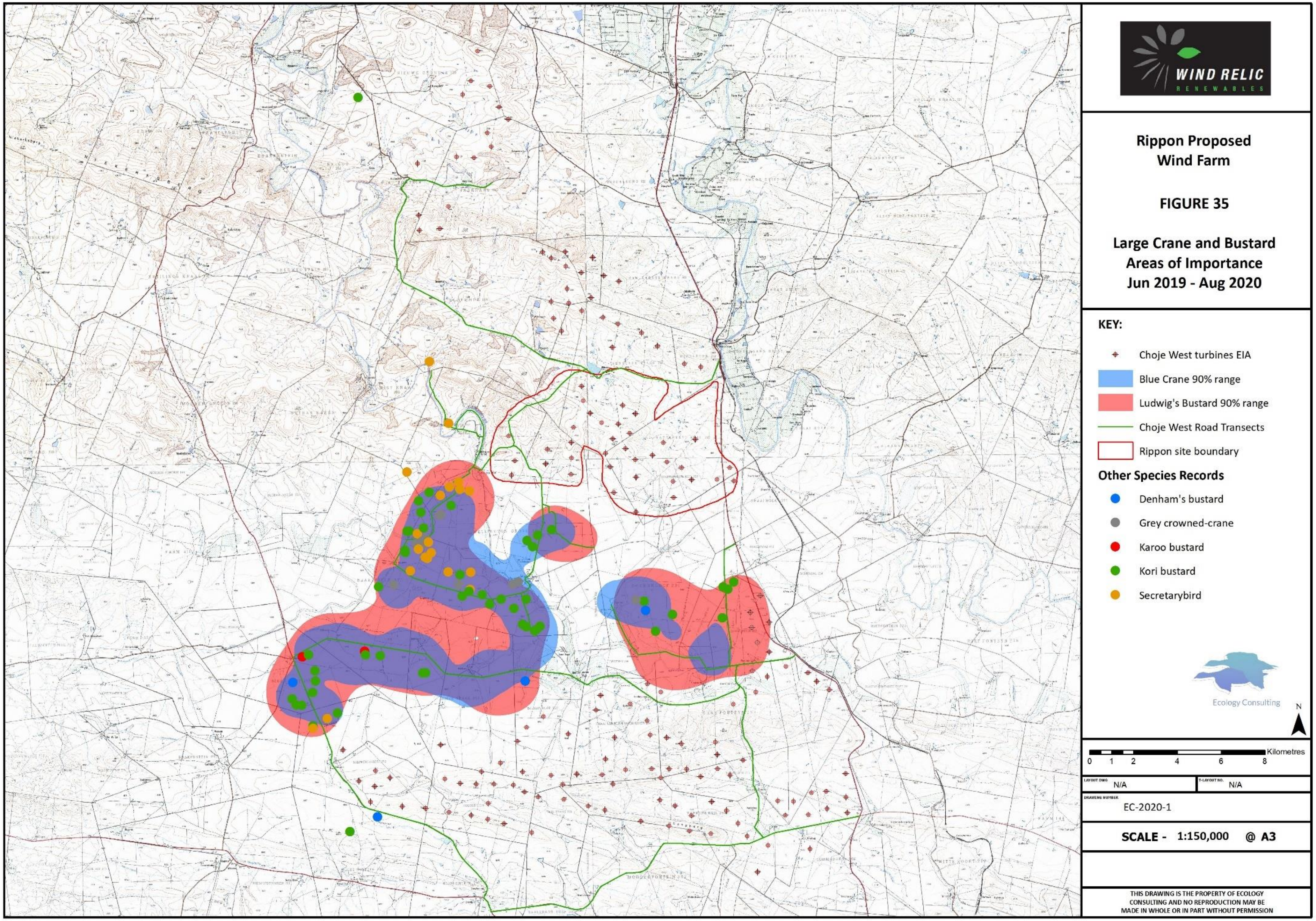
- Verreaux's Eagle nest sites - 1.5km
- Martial Eagle nests site - 2.5km plus any other areas of higher flight activity
- Cape Vulture roost sites - 2km

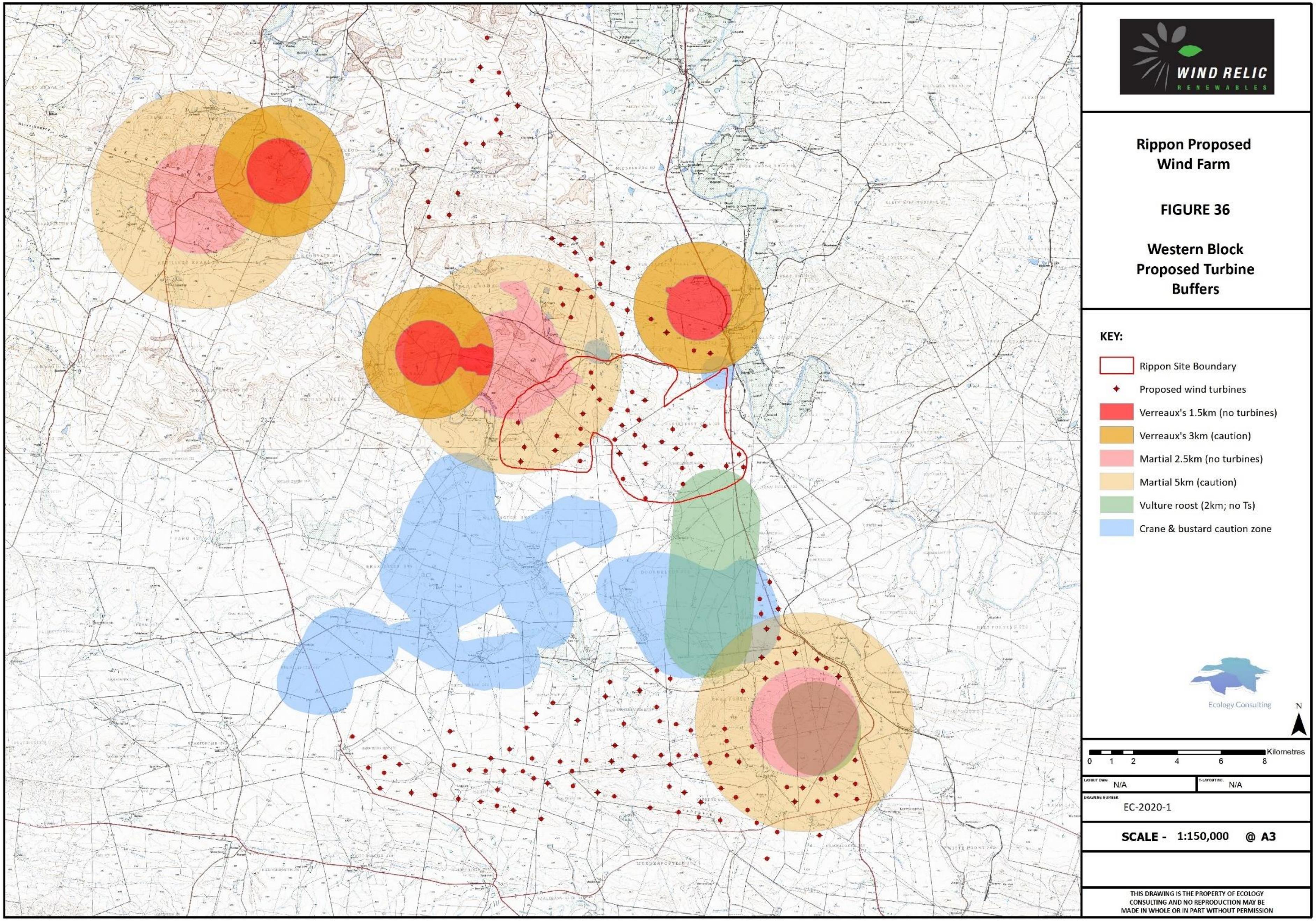
The amber zones comprised:

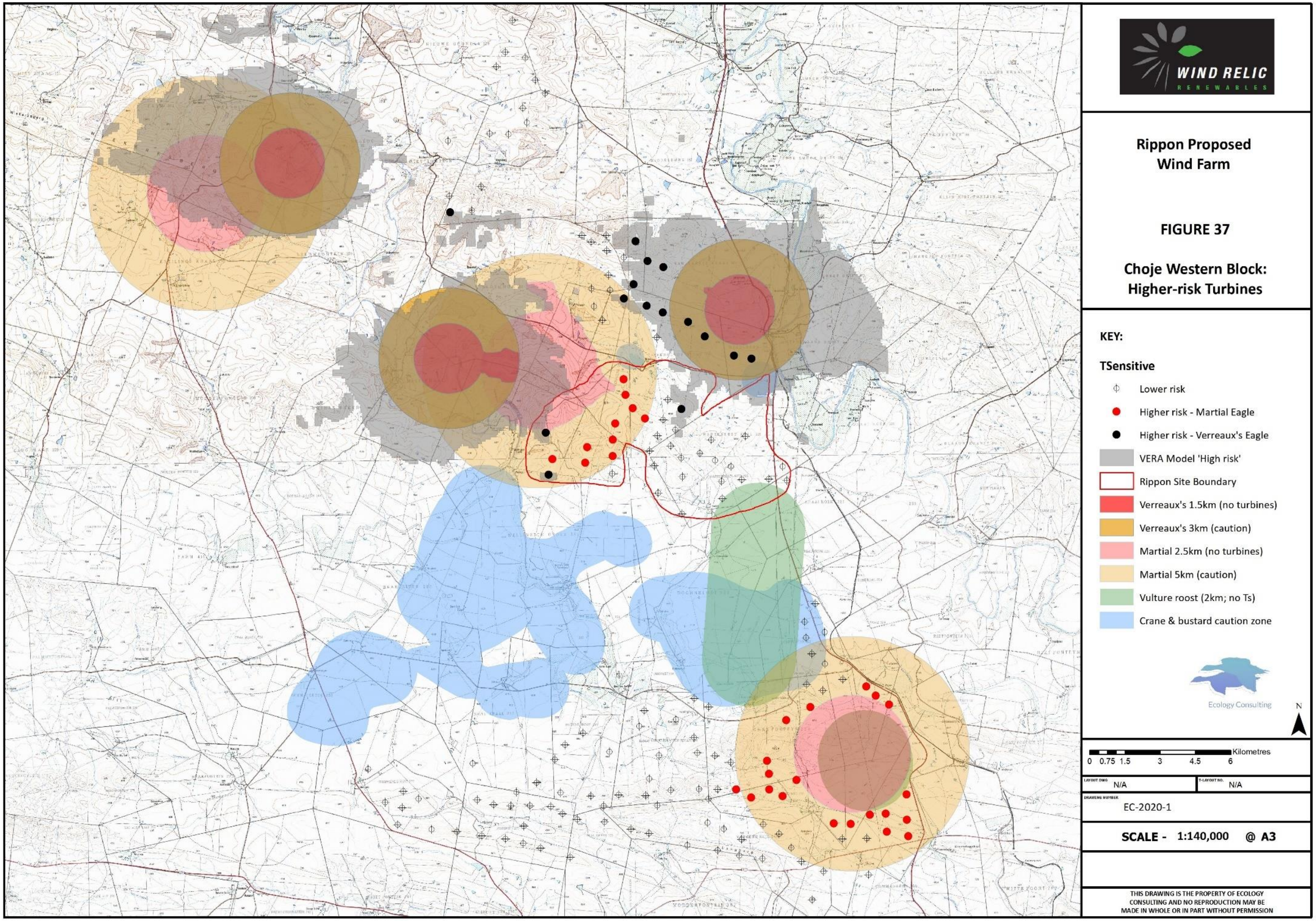
- Verreaux's Eagle nest sites - 1.5-3km
- Martial Eagle nests site - 2.5-5km plus any other areas of higher flight activity
- Bustard, Crane and Secretarybird higher activity areas - 90% utilisation range, as identified using kernel density estimation.

These zones across the Choje West Block (including the Ripponn site) are shown in Figure 36.


WIND RELIC
RENEWABLES
Rippon Proposed Wind Farm
FIGURE 34
Western Block Alternatives - original and current wind turbines layouts
KEY:
Original (297-turbine) layout
Choje West turbines EIA (170)
Ecology Consulting
N
Kilometres
0 1 2 4 6 8
N/A
N/A
EC-2020-1
SCALE - 1:175,000 @ A3
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION


WIND RELIC
RENEWABLES
Rippon Proposed
Wind Farm
FIGURE 35
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
Rippon site boundary
Other Species Records
Denham's bustard
Grey crowned-crane
Karoo bustard
Kori bustard
Secretarybird
Ecology Consulting
N
0 1 2 4 6 8
Kilometres
N/A
N/A
EC-2020-1
SCALE - 1:150,000 @ A3
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION


WIND RELIC
RENEWABLES
Rippon Proposed
Wind Farm
FIGURE 36
Western Block
Proposed Turbine
Buffers
KEY:
Rippon Site Boundary
Proposed wind turbines
Verreaux's 1.5km (no turbines)
Verreaux's 3km (caution)
Martial 2.5km (no turbines)
Martial 5km (caution)
Vulture roost (2km; no Ts)
Crane & bustard caution zone
Ecology Consulting
N
0 1 2 4 6 8 Kilometres
N/A
N/A
EC-2020-1
SCALE - 1:150,000 @ A3
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION


WIND RELIC
RENEWABLES
Rippon Proposed Wind Farm
FIGURE 37
Choje Western Block: Higher-risk Turbines
KEY:
TSensitive
Lower risk
Higher risk - Martial Eagle
Higher risk - Verreaux's Eagle
VERA Model 'High risk'
Rippon Site Boundary
Verreaux's 1.5km (no turbines)
Verreaux's 3km (caution)
Martial 2.5km (no turbines)
Martial 5km (caution)
Vulture roost (2km; no Ts)
Crane & bustard caution zone
Ecology Consulting
N
0 0.75 1.5 3 4.5 6
Kilometres
N/A
N/A
EC-2020-1
SCALE - 1:140,000 @ A3
THIS DRAWING IS THE PROPERTY OF ECOLOGY CONSULTING AND NO REPRODUCTION MAY BE MADE IN WHOLE OR IN PART WITHOUT PERMISSION

9.2. Design Mitigation and Ornithological Buffers (Phase 2)

9.2.1. Identification of Higher-Risk Turbines

Given the predicted impacts from collision with the wind turbines and from range loss to eagles (for the Ripponn site, Martial Eagle), a second phase of design mitigation was undertaken to identify the wind turbines that were contributing more to these risks and investigate how a reduced layout could reduce the impacts. This exercise was undertaken for all four proposed wind farms in the Choje Western Block (i.e. Aeoulus, Hamlett and Redding proposal as well as Ripponn).

For wind farms that were located within Verreaux's Eagle ranges, Hawkwatch International were contracted to produce a VERA model of the ranges (Murgatroyd et al. 2021). This was only relevant to the Hamlett and Ripponn sites (not Redding or Aeoulus), as these were the only ones within 6km of an active Verreaux's Eagle nest site. This modelling identified areas of high, medium and low sensitivity around each known nest site. Higher-risk zones for wind turbines were defined as all the high sensitivity areas predicted by the VERA model. This included three of the proposed Ripponn wind turbine locations (Figure 37). More details of the VERA modelling are given in Appendix 3.

A similar approach was used for Martial Eagle, but that modelling was based on local data from the baseline surveys (as described above). Higher-risk turbines are shown in Figure 37.

In order to reduce the impacts from collision risk and range loss on eagles, the higher-risk turbines should not be constructed in the initial phase of the development. Turbines in higher risk areas should only be consented once there is more baseline information on the eagles' use of these areas (following at least a further 12 months' baseline surveys) and where it can be demonstrated that the impacts would not be significant.

The Ripponn wind farm lies within an active Martial Eagle range, and ten turbines were identified that lie within the higher-risk zone. This, together with the 3 turbines referred to above, would reduce the number of turbines at the site in its initial phase from 36 reduced to 23. The adjacent Hamlett site lies within the same Martial Eagle range and it is proposed that the numbers of turbines at that site in the first phase should be reduced from 37 to 25. For the Aeoulus site 21 of 33 turbines would be consented in the initial phase, and for Redding, 56 of the 64 turbines.

9.2.2. Assessment of Reduced Layout

Collision Risk

The collision risks from the reduced 23-turbine Ripponn wind farm are summarised in Tables 12 and 13.

Table 12. Collision risk modelling predictions based on 2019-20 data for the reduced Ripponn wind farm 23-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	4.96	1.99	**0.99**	0.50
Verreaux's Eagle	0	0	**0**	0
Cape Vulture	**4.02**	1.61	0.80	0.40

Species	Precautionary predicted number of collisions per year			
Avoidance Rate	**95%**	**98%**	**99%**	**99.5%**
Blue Crane	0.36	**0.14**	0.07	0.04
Secretarybird	0.04	**0.02**	0.01	0.00
Lanner Falcon	0	**0**	0	0
Caspian Tern	0.05	**0.02**	0.01	0.00
African Marsh-harrier	0	0	**0**	0

Table 13. Collision risk modelling predictions based on 2019-20 data for the reduced Ripponn wind farm 23-turbine layout: annual risk, year per collision and total collisions in 25 years.

Species	Martial Eagle	Verreaux's Eagle	Cape Vulture	Blue Crane	Secretary-bird	Lanner Falcon	Caspian Tern	African Marsh-harrier
Primary avoidance rate used for assessment	*99%*	*99%*	*95%*	*98%*	*98%*	*98%*	*98%*	*99%*
Collision prediction for reduced layout (annual)	**0.99**	**0**	**4.02**	**0.14**	**0.02**	**0**	**0.02**	**0**
Years per collision	1.0	-	0.2	6.9	61.9	-	52.8	-
Total collisions in 25 years *	24.8	0	100.5	3.6	0.4	0	0.5	0
Previous total for full 36-turbine layout	*1.16*	*0.31*	*5.66*	*1.35*	*0.13*	*0.03*	*0.03*	*0.0007*

** Note this is an extrapolation from baseline data in absence of mitigation, not a prediction of the actual number of collisions expected from the wind farm. Vulture totals, in particular, would be expected to be much lower given the exceptional numbers recorded in the survey area during the baseline surveys.*

The cumulative collision risk from the reduced Choje wind farms in combination were also considered. Table 14 gives the predicted collision risks for all four proposed wind farms in the Choje Western Block, after the layout reduction had been applied for each.

Table 14. Cumulative collision risk for the Choje wind farms in the Western Block (annual risk) for reduced turbine layouts.

	Martial Eagle	Verreaux's Eagle	Cape Vulture	Blue Crane	Secretary bird	Lanner Falcon	Ludwig's Bustard	Black Stork	Caspian Tern	African Marsh-harrier
Avoidance rate:	*99%*	*99%*	*95%*	*98%*	*98%*	*98%*	*98%*	*98%*	*98%*	*99%*

Hamlett	0.11	0.38	4.34	0.40	0.02	0	0	0.12	0	0
Aeolus	0.08	0	0.04	0.04	0.02	0.01	0	0	0	0
Redding	0.41	0.05	4.42	3.32	0.13	0.07	0.09	0	0	0
Rippon	0.99	0	4.02	0.14	0.02	0.00	0	0	0.02	0
TOTAL	**1.59**	**0.44**	**12.82**	**3.90**	**0.18**	**0.08**	**0.09**	**0.12**	**0.02**	**0**

Eagle Range Loss

Martial Eagle range loss for the reduced Ripponn layout was predicted, as for the initial range loss analysis, 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 analysis for the reduced layout are summarised in Table 15.

The range loss would be substantially reduced from the reduced layout. There would be a 4.7% range loss from this Martial Eagle territory assuming complete displacement to 500m for the 23-turbine layout (compared with 15.3% for the full layout), and a 3.2% loss assuming complete displacement to 250m from the turbines (compared with 11.7% for the full layout).

There could also be a loss from this same Martial Eagle range from the adjacent proposed Hamlett wind farm (which it is proposed should also be reduced in its initial phase). The in-combination effect of the two wind farms for the reduced layouts is also included in Table 15. This would be a 13.7% range loss with displacement to 500m and 9.6% loss for displacement to 250m (reduced from 25.1% and 19.6% for the full layouts).

Table 15. Predicted Martial Eagle range loss for the reduced 23-turbine Ripponn wind farm, assuming complete displacement of both species to 250m or 500m from turbines (and in-combination with reduced 25-turbine Hamlett wind farm).

Species	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
Martial Eagle	3.4	3.2%	5.0	4.7%
Martial Eagle (in combination with Hamlett)	10.1	9.6%	14.5	13.7%
PREVIOUS FULL LAYOUTS:				
Martial Eagle	*12.4*	*11.7%*	*16.2*	*15.3%*
Martial Eagle (in combination with Hamlett)	*20.7*	*19.6%*	*26.5*	*25.1%*

10. IMPACT ASSESSMENT

Given the potential impacts identified in Section 4 that could affect the birds on the Ripponn site, the assessments below are all made on a qualitative basis and rated according to the criteria (supplied by Savannah shown in Appendix A), and is based on the professional judgement of the specialists, fieldwork from the data collected on site during the pre-construction bird monitoring programme (June 2019 to August 2020), reported on in Section 9 and supported by the various analysis and predictions made in Section 10 and specifically the results in Table 9 for the Collision Risk Model (CRM) and Table 11 for the Range Loss, and Table 10, for the Cumulative CRM for all the Choje West block wind farms.

Eleven Species of Conservation Concern were recorded as a result of their Conservation status and occurrence (from Table 3, 4 and 5) on or near the proposed Ripponn Wind Farm site (Martial Eagle, Verreaux's Eagle, Cape Vulture, Blue Crane, Secretarybird, Ludwig's Bustard, Lanner Falcon, Southern Black Korhaan, Lanner Falcon, African Marsh Harrier, Greater Flamingo and Caspian Tern).

Eight of these species were selected as Priority species (Martial Eagle, Verreaux's Eagle, Cape Vulture, Blue Crane, Secretarybird, Caspian Tern, Lanner Falcon and African Marsh-harrier) because of their higher potential to interact with the potential impacts at this site. Significant impacts on the other Species of Conservation Concern could be scoped out at this stage as a result of their lack of use of the wind farm impact zone and/or their low vulnerability to those impacts.

Before every Impact Table a list rates the Priority species with Low, Medium or High score for that specific impact to get a better understanding of how each species can be affected and which group of species are more at risk, i.e. raptors (wing-hunting species) or large terrestrial birds (walking-foraging species). The combined impact on these species assisted in the assessment decision-making in the different Impact Tables. These assessments have been made considering the populations of the Priority species on a national, a regional and a local scale. All these are assessed in the Tables below.

The proposed facility could pose risk to the eight Priority species in the following ways:

During Construction/Decommissioning

- habitat destruction risk (long-term habitat loss);
- risk of disturbance and displacement (indirect impact).

During Operation

- turbine collision risk (direct impact);
- risk due to disturbance by the wind farm (indirect impact);
- risk due to displacement (not enough habitat and barrier effect);
- risk of collision and electrocution on the powerlines.

During Decommissioning

- risk due to disturbance during the dismantling of the wind farm.

10.1. Description of the Eight Priority species

10.1.1. Martial eagle

The Martial Eagle is classified as globally Endangered and regionally Endangered (IUCN 2017, Taylor et al 2015). Martial Eagle has proven susceptible to collision with wind turbines (Ralston-Paton, Smallie, Pearson and Ramalho, 2017) particularly in close association with nests (MacEwan and Smallie, 2016; Simmons and Martins, 2016), therefore ranked 4th in the BLSA wind farm priority ranking (Ralston-Paton et al. 2017). This is a wide-ranging species, which can best be protected from wind turbine collision risk close to its breeding sites. By 2019, four mortalities of Martial Eagle had been recorded at wind farms in South Africa (BLSA 2019).

At the Ripponn site, three active breeding sites exist outside the development area. One was located 2.7km north-west from the closest turbine, one 12km south and the third 18km to the north-west, as described earlier (Figure 4). The closest nest has a 2.5km no turbine buffer and 5km limited turbine cautionary buffer (Figure 19). This species was recorded flying through the proposed Ripponn site 49 times at rotor height (and another 10 outside the rotor zone) in the 14-month survey period (Table 3). The main flight activity areas are around the nest site and the hilly area to the west and the flat area to the north (Figure 7). The area around the Ripponn site has preferred landscape and habitat for this species, a deep remote wooded east draining kloof for breeding, overlooking large flat open plains (Karoo bossieveld) to the north and open bushveld to the west for wing and perch hunting (van Eeden et al. 2017). There would be a 19.1% range loss from this Martial Eagle territory assuming complete displacement to 500m for the 64-turbine layout, and a 13.5% loss assuming complete displacement to 250m from the turbines (Table 11). Lastly, this eagle has many additional threats that restrict their existence, direct and indirect persecution (shooting, trapping, poisoning, etc.), electrocution on distribution powerlines, disturbance at breeding areas, etc. (Marnewick et al. 2015).

10.1.2. Verreaux's eagle

Verreaux's Eagle is Globally classified as Least Concern and Regionally as Vulnerable and is ranked third on the BLSA wind farm priority ranking (Ralston-Paton, Smallie, Pearson and Ramalho, 2017) 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.

In the Choje West block three active nests occur outside the Ripponn development area (Figure 4), at distances of 4.9km, 5.2km and 16km from the nearest proposed Ripponn wind turbine location. Flight activity within the site was very low, with only two flights at rotor height observed. With regard to the updated buffers suggested in the draft updated BLSA guidance (2021), there were no turbines within 3.7km of this nest and two within 5.2km for the full 36-turbine layout but none within 5.2km for the reduced 23-turbine layout.

This eagle has many additional threats that restrict their existence, direct and indirect persecution (shooting, trapping, poisoning), electrocution on distribution powerlines, and disturbance at breeding areas (Marnewick et al. 2015).

10.1.3. Cape Vulture

Cape Vulture is classified Globally as Endangered and Regionally as Endangered and is ranked number one on the BLSA wind farm priority ranking (Ralston-Paton, Smallie, Pearson and Ramalho, 2017) . This species does not breed in the Choje complex but breeds in the former Transkei region of the Eastern Cape during the winter. They start breeding in March/April and finish about October/November, then they leave their breeding cliffs in the summer. They move long distances, probably mostly north to the Drakensberg (eastern Free state, Lesotho highlands and western Natal) but some also move west (Boshoff et al 2009a), mainly on the Central Plateau (even west of Graaff-Reinet) but in some years they do come down from the Central Plateau and especially at Bedford, where similar habitat occurs, the 'Bedford dry grassland'.

During the summer of 2019/20, many vultures were recorded in the flat open habitats of the West block of the Choje complex and they roosted on large Eskom steel pylons at night, 2-3km from the Ripponn site at its closest point. The highest count was 72 on 23 January 2020. The vultures were mainly recorded flying north to south over the Ripponn site, using thermals to soar higher and then continuing south (Figure 6), (Table 3, in rotor zone 54 vs. outside 21). Their movements in the Choje West block were almost predictable, arriving with subtropical / thunderstorm weather (suitable thermal conditions) and they would disappear at the arrival of cold fronts. However, the West block area was in an extreme drought period and high stock losses occurred. Therefore, if the proposed Choje wind farms get approved, these stock losses need to be well-managed and controlled. Carcasses could be taken to a vulture restaurant on the high Plateau north of Somerset East. A potential site for this has been identified (34km north-west from the Ripponn site, in an area that would not increase flights through the Choje West or other nearby wind farm sites) and is shown in Figure 38.

10.1.4. Blue Crane

The Blue Crane is classed Globally as Vulnerable (IUCN, 2017) and Near-threatened regionally by Taylor et al (2015). It is ranked number 11 on the BLSA wind farm priority ranking (Ralston-Paton, Smallie, Pearson and Ramalho, 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 from 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 reasonably adept at avoiding turbine collisions. No known fatalities have been recorded at Eastern Cape Wind Farms. They normally roost in large flocks (sometimes in the water of small dams) during the winter and in the breeding season they split off in pairs to breed.

At Ripponn, this species was recorded in low abundance during the baseline surveys. Two main areas of activity were noted, to the west and the east of the Wilton homestead. No large night roost sites were recorded at the Ripponn site. However, they were recorded flying in low light conditions, making them more prone to powerline collisions.

10.1.5. Secretarybird

Secretarybird is classed Globally as Endangered and Regionally as Vulnerable and is ranked number 13 on the BLSA wind farm priority ranking (Ralston-Paton, Smallie, Pearson and Ramalho, 2017) . These birds occur in low abundance in the study area at low density, and spend most of their time walking and foraging on the ground and breeding in low trees or bushes. However, they do display in spectacular courtship flights that might make them vulnerable to turbine collisions. They do, though, seem to select isolated / quiet areas for these display flights during the midday period when there is high visibility.

At Ripponn (green flight lines, Figure 5), only one flight was recorded in the rotor zone, and only two flights in total (Table 3). Their main area of activity was on the grassland of the hills in the northeast area of Ripponn site, no nest was suspected.

10.1.6. Lanner Falcon

Lanner Falcon is classed Globally as Least Concern and Regionally as Vulnerable (IUCN 2017, Taylor et al 2015) and is ranked number 24 on the BLSA wind farm priority ranking (Ralston-Paton, Smallie, Pearson and Ramalho, 2017). This species has a low occurrence in South Africa. These birds occur in relative low abundance and feed in open areas and breed on isolated cliffs. No nests were found during the nest surveys, probably because there are no suitable breeding cliffs in the Ripponn site.

At Ripponn during the Vantage Point surveys only one flight was recorded through the site at rotor height, out of four total flights and this species was not recorded during any of the other surveys.

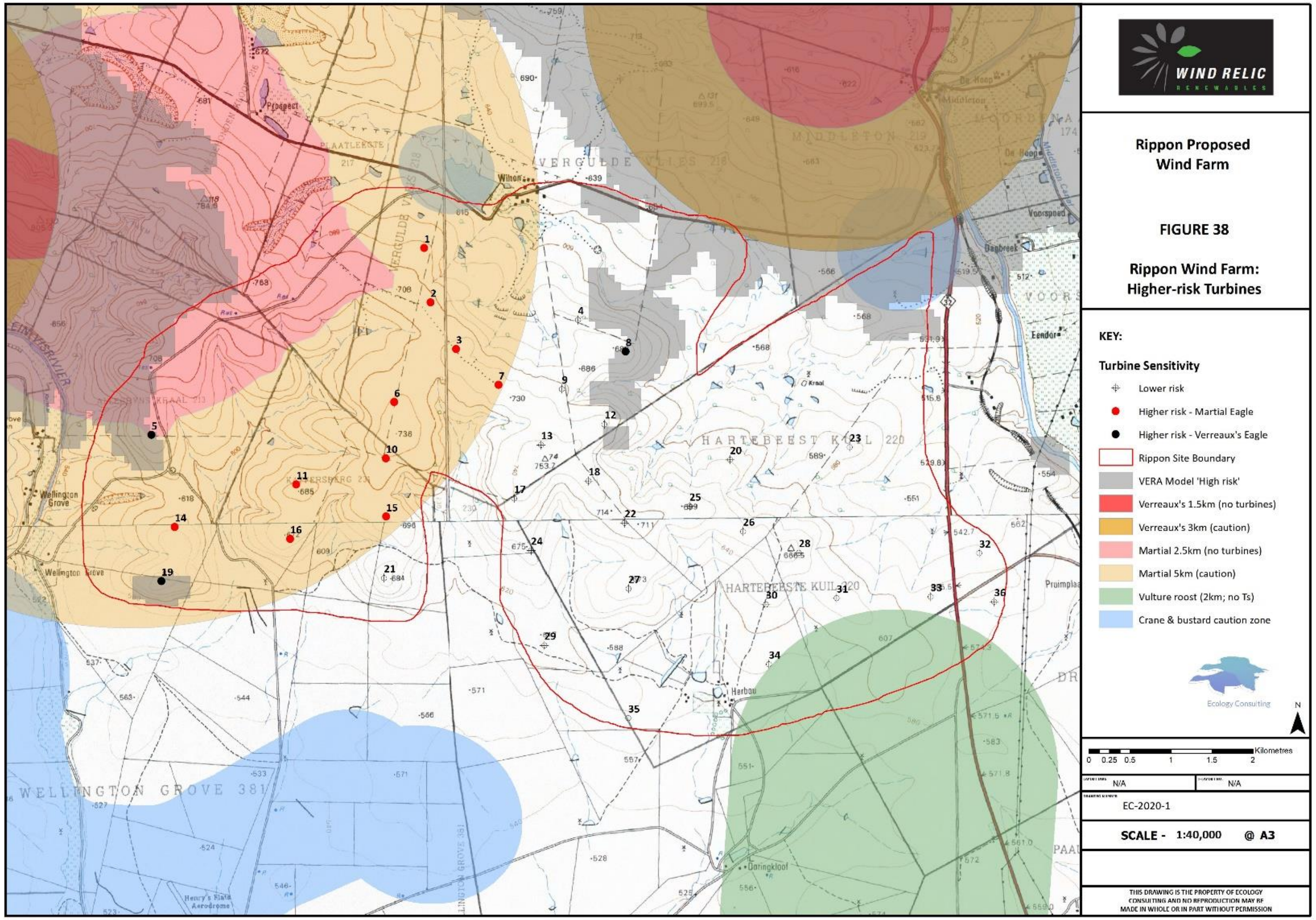
10.1.7. African Marsh Harrier

African Marsh Harrier is classified as globally Endangered and regionally Endangered (IUCN 2017, Taylor et al 2015). It is ranked number 25 on the BLSA wind farm priority ranking (Ralston-Paton, Smallie, Pearson and Ramalho, 2017). This species has a low occurrence in South Africa and in close association with wetlands. it was seen only occasionally, along the furrows and flooded areas where the irrigation water is used and where reedbeds are prevalent. It was recorded at Ripponn flying once in the rotor zone and once outside (Table 3).

10.1.8. Caspian Tern

Caspian Tern is classified as globally Endangered and regionally Endangered (IUCN 2017, Taylor et al 2015). It is ranked number 52 on the BLSA wind farm priority ranking (Ralston-Paton, Smallie, Pearson and Ramalho, 2017). This species forages over the Wilton dam on the northern edge of the Ripponn site. However, only one flight was of a bird flying through the site at rotor height and once outside.

Figure 37a The Higher-risk turbines at Ripponn WF, which were excluded from the after (final scenario) mitigation assessment



10.2. Assessment of the Potential Impacts

Considering the above, the assessments were initially completed for the full 36 turbine layout (before scenario) and then as a further mitigation as mentioned in Section 9.2, thirteen turbines (turbine numbers 1, 2, 3, 5, 6, 7, 8, 10, 11, 14, 15, 16 and 19 in Figure 37a) were positioned in the high-risk area and were excluded from the final assessment using the reduced 23 turbine layout (after scenario). The seven potential impacts were assessed for both scenarios for the proposed Ripponn Wind Farm site and rated according to the criteria (supplied by Savannah and shown in Appendix A), presented in Tables 10.1 to 10.7.

10.2.1. Habitat loss during Construction

Based on the average of 0.5 hectares per turbine of land that will be used and using the maximum of 36 turbines to be constructed, other construction areas and the powerlines on the Ripponn Wind Farm, it is estimated that approximately 30.8ha of land will be lost to the turbines, hard standings, roads, switching station, electrical cables and powerlines at the Ripponn site development envelope area of 5,400ha (and a total area of 12,838ha). Therefore 0.24% of the natural vegetation will be removed, which will consist mainly of 'Bedford dry grassland' and some 'Thicket' vegetation. However the removal of the thirteen turbines will decrease the amount of vegetation to be cleared, to approximately 24ha.

For Priority Species that prefer open habitat, the impact will also be LOW, especially for two large terrestrial birds - Blue Crane and Secretarybird. Martial Eagle has the potential to be affected by habitat loss because of the nest on the west side of the Ripponn site therefore the removal of turbines No. 1, 2, 3, 6, 7, 10, 11, 14, 15 and 16. While Verreaux's Eagle will can be affected by habitat loss therefore the removal of turbines, No. 5, 8 and 19.

The Recommendations in Section 11 sets out the further mitigation measures required during construction. The list below summarises the significance of construction phase habitat loss for each priority species, before and after mitigation, which has been used to inform the overall assessment of this impact set out in Table 10.1:

Species	Before mitigation 36 turbines	After mitigation 23 turbines
Martial Eagle	Medium	Low
Verreaux's Eagle	Low	Low
Cape Vulture	Low	Low
Blue Crane	Medium	Low
Secretarybird	Medium	Low
Lanner Falcon	Low	Low
A. Marsh Harrier	Low	Low
Caspian Tern	Low	Low

However, the loss of habitat can be reduced to all Priority Species to a LOW significance after the implementation of the mitigation including micro-positioning of the turbines (from Table 10.1).

Table 10.1 Impact Table for habitat loss of Priority Species during the construction.

Project phase: Construction (although it occurs during construction, it is permanent)				
Nature: Loss of habitat used by birds due the removal of natural vegetation during Construction phase				
	Without mitigation 36 turbines		**With mitigation 23 turbines**	
Extent	Local	2	Local	2

Duration	Permanent	5	Permanent	5
Magnitude	Moderate	5	Minor	2
Probability	highly 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: Mitigation exists and will considerably reduce the significance of impacts (see Recommendations below) however most important recommended mitigation will be the removal of Turbine numbers 1, 2, 3, 5, 6, 7, 8, 10, 11, 14, 15, 16 and 19.				
Residual Impacts: The effect of habitat loss will be LOW collectively for all species after the implementation of the required mitigation measures, the micro-positioning of turbines and powerline tower sites is necessary.				

10.2.2. Disturbance of birds during construction

The 5km buffers applied around the Martial Eagle nest (on the western edge of Ripponn) to reduce turbine collision risk should be adhered to during construction as well. This will also limit disturbance to these eagles near their nests. Verreaux's eagle occurred in low abundance and therefore will not be affected. Additionally, for Cape vulture a buffer of 5km from the roost area will be applied for all construction during November-March, limiting the potential for construction disturbance to this species too. The placement of infrastructure outside these buffer areas will reduce the significance of this impact. However, it is likely that all Priority Species will avoid areas under construction. The Recommendations in Section 11.2 sets out the further mitigation measures required during construction. The list below summarises the significance of construction phase disturbance for each priority species, before and after mitigation, which has been used to inform the overall assessment of this impact set out in Table 10.2:

Species	Before mitigation 36 turbines	After mitigation 23 turbines
Martial Eagle	Medium	Medium
Verreaux's Eagle	Medium	Low
Cape Vulture	Low	Low
Blue Crane	Medium	Low
Secretarybird	Medium	Low
Lanner Falcon	Medium	Low
A. Marsh Harrier	Low	Low
Caspian Tern	Low	Low

Based on the above, this impact will be LOW to MEDIUM after the implementation of mitigation at this proposed site during Construction period (from Table 10.2) though this will be a short-term impact.

Table 10.2 Impact Table for disturbance of Priority Species during construction.

Impact phase: Construction				
Nature: Disturbance and Displacement of Birds				
	Without mitigation (36 turbines)		**With mitigation (23 turbines)**	
Extent	Local	3	Local	3
Duration	Short-term	2	Short-term	2
Magnitude	Moderate	6	Low	5
Probability	Highly Probable	4	Probable	3
Significance	**Medium**	**44**	**Medium**	**30**
Status (positive or negative)	Negative		Negative	
Reversibility	PARTIALLY – 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 could impact on the population of a species.			
Can impacts be mitigated?	PARTIALLY– Some disturbance is inevitable with the activities associated with construction.			
Mitigation: Mitigation exists and will considerably reduce the significance of impacts (see Recommendations below) however most important recommended mitigation will be the removal of Turbine numbers 1, 2, 3, 5, 6, 7, 8, 10, 11, 14, 15, 16 and 19.				
Residual Impacts: It is highly likely that most priority species will be temporarily disturbed and displaced from the development area during the construction activities, due to the noise and activity. The significance will be a MEDIUM level collectively for all priority species after mitigation.				

10.2.3. 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 all eight Priority species at risk of collision (i.e. those observed flying through the collision risk zone at rotor height) for the reduced 23-turbine layout is given in Table 13. Cape Vulture predicted fatalities is 4.02, Blue Crane 0.14, Martial Eagle 0.99, Secretarybird 0.02, Caspian Tern 0.02, and zero for Verreaux's Eagle, African Marsh-harrier and Lanner Falcon collisions per year.

The Recommendations in Section 11.3 sets out the further mitigation measures required during operation of the wind farm. The list below summarises the significance of operation phase collision risk for each priority species, before and after mitigation, which has been used to inform the overall assessment of this impact set out in Table 10.3:

Species	Before mitigation (36 turbines)	After mitigation (23 turbines)

Martial Eagle	Medium	Medium
Verreaux's Eagle	Medium	Low
Cape Vulture	High	High
Blue Crane	Medium	Low
Secretarybird	Low	Low
Lanner Falcon	Low	Low
A. Marsh Harrier	Low	Low
Caspian Tern	Low	Low

The overall significance for all seven Priority species, would be LOW to MEDIUM after the implementation of mitigation (from Table 10.3).

Table 10.3 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				
	Without mitigation 36 turbines		**With mitigation 23 turbines**	
Extent	Local	2	Local	2
Duration	Permanent	5	Permanent	5
Magnitude	Moderate	6	Low	4
Probability	Highly Probable	4	Probable	3
Significance	**Medium**	52	**Medium**	**33**
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: Mitigation exists and will considerably reduce the significance of impacts (see Recommendations below) however most important recommended mitigation will be the removal of Turbine numbers 1, 2, 3, 5, 6, 7, 8, 10, 11, 14, 15, 16 and 19.				
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 MEDIUM.				

10.2.4. Disturbance and Displacement of birds during operations

The indications from operational wind farms in South Africa 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. Disruption of flight paths and local movement patterns of Priority Species during operation of the wind farm has also been considered. Birds might use more energy to get to their normal feeding grounds by flying around the wind farm.

Following implementation of the reduced 23-turbine layout for the initial phase of the development, the potential percentage range loss was calculated to be 4.7% and 3.2% for the affected Martial eagle nest, assuming complete displacement to 500m and 250m from turbines respectively (Table 15). In combination with the Hamlett WF site, the percentage range loss would be 13.7% and 9.6%.

This means, these eagles would need to fly further (therefore use more energy) to find enough foraging habitat because of the turbine disturbances if the proposed Ripponn wind farm gets approved and operational. This effect will likely only be evidence in the long-term, so it is important to continue nest monitoring for the lifespan of the wind farm, to compare the reproductive success eagle pairs in their respective territories (and use productivity and occupancy as measures of range health).

The Recommendations in Section 11.3 sets out the further mitigation measures required during operation of the wind farm. The list below summarises the significance of operation phase disturbance for each priority species, before and after mitigation, which has been used to inform the overall assessment of this impact set out in Table 10.4:

Species	Before mitigation (36 turbines)	After mitigation (23 turbines)
Martial Eagle	Medium	Low
Verreaux's Eagle	Low	Low
Cape Vulture	Low	Low
Blue Crane	Medium	Low
Secretarybird	Medium	Low
Lanner Falcon	Low	Low
A. Marsh Harrier	Low	Low
Caspian Tern	Low	Low

The overall significance of the impact will be LOW after the implementation of mitigation for all Priority species during Operation.

Table 10.4 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 36 turbines		**With mitigation 23 turbines**	
Extent	Local	2	Local	1
Duration	Permanent	5	Permanent	5
Magnitude	Moderate	6	Low	3
Probability	Probable	3	Probable	3
Significance	**Medium**	**39**	**Low**	**27**
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: Mitigation exists and will considerably reduce the significance of impacts (see Recommendations below) however most important recommended mitigation will be the removal of Turbine numbers 1, 2, 3, 5, 6, 7, 8, 10, 11, 14, 15, 16 and 19.	
Residual Impacts: Disturbance will remain an impact for the duration of the operational life-time of the facility. However, the overall impact is estimated to be of a LOW significance for the Priority species after the implementation of the mitigation measures.	

10.2.5. Power line impacts on birds (electrocution)

Birds can collide with power line conductors/wires or get electrocuted on overhead power line poles/structures (although unlikely because of the large pole size of 132kV powerlines) or on the substation and switching gear during the operation of the Ripponn Wind Farm. The stretch of new 132kV power line will be 16km with the collector substation and the switching station located on the wind farm site. Large terrestrial birds are more prone to colliding with power line conductors (assessed in Table 10.6) while large raptors and Cape Vultures are more likely to get electrocuted on powerline poles and structures.

The Recommendations in Section 11.6 sets out the further mitigation measures required for the powerlines. The list below summarises the significance of operation phase powerline electrocution risk for each priority species, before and after mitigation, which has been used to inform the overall assessment of this impact set out in Table 10.5:

Species	Before mitigation	After mitigation
Martial eagle	Medium	Low
Verreaux's eagle	Medium	Low
Cape vulture	Medium	Low
Blue crane	Low	Low
Secretarybird	Low	Low
Lanner Falcon	Low	Low
African Marsh-harrier	Low	Low
Caspian Tern	Low	Low

The new power line and pole structures will result in the Electrocution impact to be of LOW significance after the implementation of mitigation for all the perching Priority species (Verreaux's eagle, Martial Eagle, and Cape Vulture) during Operation.

Table 10.5 Assessment of Electrocution of Priority Species on power lines during operation.

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	3	Local	2
Duration	Permanent	5	Permanent	5
Magnitude	Moderate	3	Low	2
Probability	Probable	3	Probable	3
Significance	**Medium**	**33**	**Low**	**27**
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 (a walk-through by an avifaunal specialist); - 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 1.8m 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 potential for an electrocution risk will persist as long as the lines are operational, but it can be effectively eliminated at the onset, if bird-friendly hanging insulators and raptor-protectors pole structures are used. Electrocution of Priority species will be of LOW significance after the implementation of al the required mitigation measures.				

10.2.6. Power line collision impacts

As from above, the Collision of birds with the 16km of power line conductors can occur, and two of the Priority species are prone to collide with powerlines (Blue Crane and Secretarybird). Blue Crane is particularly susceptible to powerline collisions therefore rated as HIGH in score below.

The Recommendations in Section 11.6 sets out the further mitigation measures required for the powerlines. The list below summarises the significance of operation phase powerline collision risk for each priority species, before and after mitigation, which has been used to inform the overall assessment of this impact set out in Table 10.6:

Species	Before mitigation	After mitigation
Martial eagle	Low	Low
Verreaux's eagle	Low	Low
Cape vulture	Low	Low
Blue crane	High	Medium
Secretarybird	Medium	Low
Lanner Falcon	Low	Low
African Marsh-harrier	Medium	Low
Caspian Tern	Medium	Low

However, the Collision with powerlines will be of LOW to MEDIUM significance for all species during Operation after the implementation of mitigation (Table 10.6).

Table 10.6 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	3	Local	3
Duration	Permanent	5	Permanent	5
Magnitude	Moderate	5	Low	4
Probability	Probable	3	Probable	3
Significance	**Medium**	**39**	**Medium**	36
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	Yes		No	
Can impacts be mitigated?	Yes			
Mitigation: Mitigation exists and will considerably reduce the significance of impacts (see below)				
Residual Impacts: The application of BFDs should greatly reduce the collision impact but will not totally eliminate the risk. The collision risk will be MEDIUM after the implementation of all the required mitigation measure.				

10.2.7. The disturbance during the decommissioning phase

Disturbance and displacement of Priority Species during the decommissioning of the wind farm turbines and the power lines and other infrastructure will be short-term and it is likely to have a LOW significant impact on the birds after the implementation of mitigation.

The Recommendations in Section 11.4 sets out the further mitigation measures required during decommissioning of the wind farm. The list below summarises the significance of decommissioning phase disturbance for each priority species, before and after mitigation, which has been used to inform the overall assessment of this impact set out in Table 10.7:

Species	Before mitigation (36 turbines)	After mitigation (23 turbines)
Martial Eagle	Medium	Low
Verreaux's Eagle	Low	Low
Cape Vulture	Low	Low
Blue Crane	Medium	Low
Secretarybird	Medium	Low
Lanner Falcon	Low	Low
A. Marsh Harrier	Low	Low
Caspian Tern	Low	Low

Table 10.7 Disturbance of Priority Species due to Decommissioning of Turbines and power lines.

Impact phase: Decommissioning				
Nature: Disturbance and displacement of birds				
	Without mitigation 36 turbines		**With mitigation 23 turbines**	
Extent	Local	3	Local	3
Duration	Short-term	2	Short-term	1
Magnitude	Moderate	4	Low	3
Probability	Probable	4	Probable	3
Significance	**Medium**	**36**	**Low**	**21**
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: Mitigation exists and will considerably reduce the significance of impacts (see Recommendations below) however most important recommended mitigation will be the removal of Turbine numbers 1, 2, 3, 5, 6, 7, 8, 10, 11, 14, 15, 16 and 19.				
Residual Impacts: The dismantling activities associated with all wind farm infrastructure (turbines and powerlines) could result in the short-term disturbance of priority species. After the implementation of the proposed mitigation measures it will be of LOW significance for all Priority species.				

10.3. 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.

Ripponn will be the following distances away from the following operational and approved wind farms within 50km: Cookhouse 28km north-east, Nojoli 26km north-east, Nxuba 28km north-east, Golden Valley 6km north-east, Amakala Emoyeni 15km north-east, Msenge Izidiuli 32km north-east and from Highlands 36km north-west.

In relation to the other proposed wind farms in the Choje Western Block, the Hamlett wind farm is adjacent to the northern edge of the Ripponn site, Aeoulus lies 12km south from Ripponn and Redding 5km south. Figure 38 shows a map with all the known wind farms within a 30km radius of Ripponn.

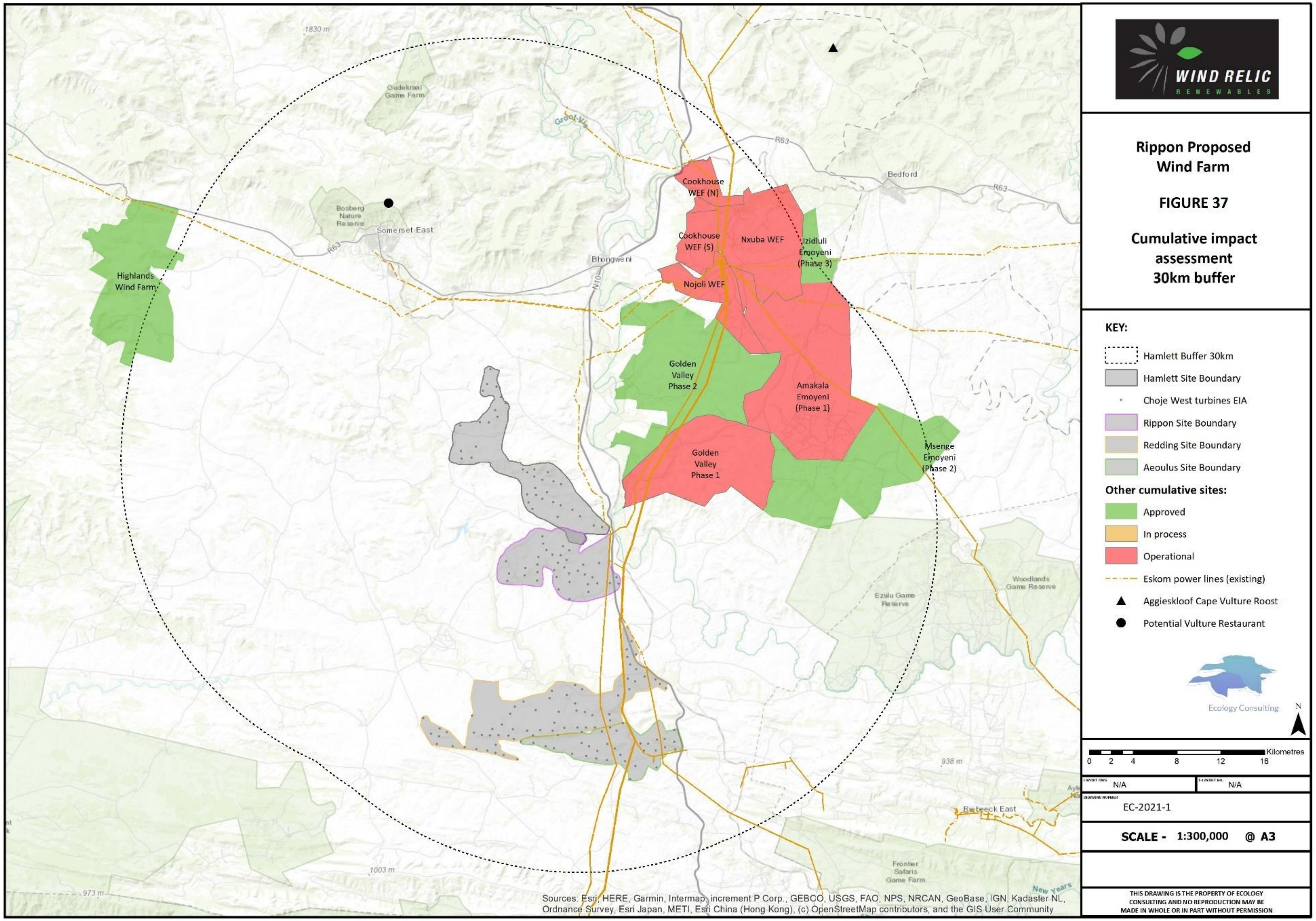
Available operational monitoring reports from these wind farms were obtained from BLSA and were reviewed:

- Cookhouse 1 – Smallie May 2016 post-construction;
- Nojoli wind farm – Smallie pre-construction 2021, April 2018, October 2019, December 2020 post-contruction;
- Amakhala Emoyeni – Smallie September 2017, December 2018, November 2019 – post-construction;
- Highlands – Pearson July 2018 pre-construction;
- Golden Valley 1 and 2 - pre-construction.

The fatalities of Species of Conservation Concern found under turbines and powerlines from the available post-construction data/reports at the wind farms to the north-east of Ripponn are summarised in Table 10.8 below. The results are variable, with no Species of Conservation Concern collisions recorded in one year of monitoring at the Cookhouse wind farm, but higher numbers at Amakhala-Emoyeni and Nojoli, with notable numbers of Cape Vulture collisions in particular. Both the Amakhala-Emoyeni and Nojoli wind farms are located closer to the main Cape Vulture roost at Aggieskloof, so the collision rate at Ripponn would be expected to be lower in the long-term. However, the potential for higher numbers of collisions at Ripponn in at least some years remains, and the overall population impact will be higher if collisions at these other sites continues at the rates reported here. This emphasises the importance of the Ornithological Mitigation Plan that is being proposed for the Ripponn site to ensure that it does not add significantly to this cumulative mortality, if the vultures did return to the site in future years. Numbers of collisions of other species of conservation concern at these operational wind farms were lower, so the cumulative impact would be likely to be of lesser concern.

Table 10.8. Numbers of Species of Conservation Concern collisions at operational wind farms considered in the Ripponn cumulative assessment.

Site	No of Turbines	No. years monitor-ing	Black Harrier	Blue Crane	Cape Vulture	Martial Eagle	Secretary -bird	Southern Black Korhaan
Amakhala Emoyeni	56	3	1	2	7	1	0	1
Nojoli	44	3	0	2	10	0	2	0
Cookhouse	66	1	0	0	0	0	0	0



Rippon Proposed Wind Farm
FIGURE 37
Cumulative impact assessment 30km buffer
KEY:
Hamlett Buffer 30km
Hamlett Site Boundary
Choje West turbines EIA
Rippon Site Boundary
Redding Site Boundary
Aeoulus Site Boundary
Other cumulative sites:
Approved
In process
Operational
Eskom power lines (existing)
Aggieskloof Cape Vulture Roost
Potential Vulture Restaurant
WIND RELIC RENEWABLES
Ecology Consulting
Highlands Wind Farm
Cookhouse WEF (N)
Cookhouse WEF (S)
Nxuba WEF
Izidluli Emoyeni (Phase 3)
Nojoli WEF
Golden Valley Phase 2
Amakala Emoyeni (Phase 1)
Golden Valley Phase 1
Msenge Emoyeni (Phase 2)
Somerset East
Bedford
Bhongweni
Bosberg Nature Reserve
Oudekraal Game Farm
Ezulu Game Reserve
Woodlands Game Reserve
Frontier Safaris Game Farm
Riebeeck East
R63
Kilometres
0 2 4 8 12 16
N/A
N/A
EC-2021-1
SCALE - 1:300,000 @ A3
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10.3.1. Cumulative Assessment

The cumulative effect of proposed Ripponn development along with the actual and predicted impacts of the operational wind farms mentioned above and future impacts of the proposed Choje wind farms and other proposed wind farms in the area, has the potential to affect various bird species at a higher significance than the impacts of the proposed Ripponn wind farm alone. Table 10 lists the annual Collision risks for the Key species that may be impacted cumulatively. Of these, Blue Crane, Cape Vulture, Martial Eagle and Verreaux's Eagle are of primary concern (from the cumulative collision risk).

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 Ripponn Wind Farm, in the absence of mitigation the possibility of significant numbers of collisions cannot be ruled out, particularly of Cape Vultures. Mitigation measures must be implemented to minimise the risk of collision to Cape vulture, Martial Eagle and Verreaux's Eagle in particular, so that, as well as avoiding potentially significant impacts from the wind farm on its own, the contribution of the Ripponn Wind Farm site to the overall cumulative risk will be reduced.

Table 10.10 summarises the assessment of the cumulative impacts of all these wind farms for the ten species in the CRM. This then also include, during Construction - Habitat loss and Disturbance, and during Operation – Disturbance/Range Loss, Collision with powerlines and Electrocution on powerline poles.

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 Ripponn development and the three other wind farms in the West block, the cumulative impact after mitigation (Table 10.9) is likely to have a MEDIUM significance.

Table 10.9 Cumulative Impact Table.

Nature: Cumulative impact on all avifauna at all the proposed, operational wind farms in the region.				
	Overall impact of the proposed project considered in isolation for reduced layout		***Cumulative impact of the project and other projects in the area for ALL the reduced layouts***	
Extent	Local	2	Regional	4
Duration	Permanent	5	Permanent	5
Magnitude	Low	3	Low	3
Probability	Probable	3	Probable	3
Significance	**Low**	**30**	**Medium**	**36**
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	Yes		Yes	
Can impacts be mitigated?	Yes		Yes	
Mitigation: Mitigation exists and will considerably reduce the significance of impacts (see Recommendations below) however most important recommended mitigation will be the removal of Turbine numbers 10, 12, 13, 15, 16, 53, 54 and 56.				
Residual Impacts:				

Although the assessed significance is of MEDIUM significance, if all the mitigation measures proposed for the various renewable projects are strictly implemented, the cumulative impacts of these developments, including the proposed wind farm, can be even more reduced.

Two more Species of Conservation Concern are discussed below as they are considered in the cumulative assessment because they were recorded at neighbouring wind farm sites during the monitoring surveys and they are all individually assessed with a before and after mitigation risk for the six potential impacts in Table 10.10.

Black Stork

This species is ranked number 10 on the South African Birds and Renewable Energy Specialist Group's priority list. It has a low occurrence in South Africa. These birds occur in low abundance in the Choje West block and feed in or near water and breed on isolated cliffs. It was not recorded at Ripponn but at Aeolus one bird was recorded flying through the site at rotor height (red flight line Figure 5) and was not recorded during the other surveys.

Ludwig's Bustard

The Ludwig's Bustard is classed Globally as Near-Threatened (IUCN 2017) and Regionally as Vulnerable by Taylor et al (2015) and its population and range has decreased over the last few decades due to habitat destruction and disturbance. It is ranked number 14 on the South African Birds and Renewable Energy Specialist Group's priority list. 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 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 West block of the Choje energy complex, this species is often seen near centre-pivot croplands but always on the edge of these sometimes-green areas.

This species was recorded at relative low flight rates at the Ripponn wind farm site, in the 14-month period but not once flying inside the rotor zone. The habitat (Karoo shrublands) at this proposed site is perfect at north and northwest edges, while the south has high coverage of Thicket bushveld vegetation in the area, which these birds avoid. These birds are susceptibility to collision with overhead power lines.

Conclusion on Cumulative Impacts

In conclusion, Table 10.10 shows the predicted Cumulative risk categories assigned to each of the Cumulative Priority species for the seven potential impacts if all four wind farms (Hamlett, Ripponn, Redding and Aeolus) are approved and operational, before and after all the recommended mitigation measures are implemented.

Table 10.10 Cumulative risks for all four wind farms assigned to the cumulative priority species from the seven impacts, before (full layouts) and after (reduced layouts) mitigation

Species	Construction phase				Operation phase				Operation phase							
	Habitat loss		Disturbance effect		Powerline Collision		Powerline Electrocution		Disturbance/Range Loss		Turbine Collision Risk			
	full layouts	reduced layouts	full layouts	reduced layouts					full layouts	reduced layouts	full layouts		reduced layouts	
	before	after	before	after	before	after	before	after	before	after	CRM	before	CRM	after
Martial Eagle	low	low	med	low	low	low	med	low	med	low	2.35	med	1.59	med
Verreaux's Eagle	med	low	med	med	low	low	med	low	med	low	0.69	low	0.44	low
Cape Vulture	low	low	low	low	low	low	med	low	low	low	17.58	high	12.82	high
Blue Crane	med	low	med	med	high	med	low	low	med	low	7.70	high	3.68	med
Secretarybird	med	low	med	med	med	low	low	low	med	low	0.66	low	0.59	low
Lanner Falcon	low	low	low	low	low	low	low	low	low	low	0.12	low	0.08	low
Ludwig's Bustard	low	low	low	low	med	low	low	low	med	low	0.11	low	0.09	low
Black Stork	low	low	low	low	low	low	med	low	low	low	0.20	low	0.12	low
Caspian Tern	low	low	low	low	low	low	low	low	low	low	0.03	low	0.02	low
African Marsh Harrier	low	low	low	low	low	low	low	low	low	low	0.0	low	0.0	low

11. RECOMMENDATIONS

The required and recommended measures to mitigate ornithological impacts of the Ripponn wind farm are set out below. These have been further developed into an Ornithological Mitigation Plan that is included in Appendix F.

11.1. 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. Additionally, an Ornithological Mitigation Plan is being developed through consultation with stakeholders to refine and implement the required mitigation measures set out in this assessment (see Appendix F).

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, Cape Vulture, Blue Crane, Lanner Falcon 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).

It is also possible that Cape Vultures could be disturbed whilst roosting on the power lines near to the site. BLSA (2018) recommends a 5km buffer between construction activity and vulture roosts to avoid the possibility of any disturbance. This buffer should therefore be implemented if the birds are present in the area during construction.

Where a disturbance impact on nesting birds is possible, site groundworks (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.

11.2. Mitigation of the Operation Phase

Mitigation will be implemented to ensure that significant bird collisions no not occur at this site. One option for such measures would be to set a threshold level of mortality (determined from a post-construction monitoring programme) that would trigger specific actions. 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).

An alternative, more precautionary approach, has been adopted in this assessment and agreed with the developer, applying a hierarchy of measures to reduce impact magnitude: design mitigation to avoid areas of higher flight activity, and mitigation measures to be applied on a precautionary basis at the outset of operation of the wind farm rather than waiting for collisions to occur. This will include increasing turbine blade visibility, e.g. through deploying single black blade (or similar measure to increase blade visibility) in amber zones closer to active eagle nests to increase visibility, implementation of a vulture management plan (including 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. As a further guarantee that significant bird collisions will not occur, a shutdown on demand system will also be implemented.

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 Ripponn Wind Farm, if required, to provide a back-up response should the number of collisions actually approach a level that could be significant. Given the low numbers of predicted collisions, the likelihood of such measures being required is considered to be low. Notwithstanding this, the developer has committed to implement a shutdown on demand system, in order to ensure that collision risk is minimised, that a significant number of collisions of any species does not occur and that the Ripponn site does not contribute to any significant cumulative collision risk. Further details of the proposed scheme are provided in Appendix F.

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 (following BLSA 2017 guidance). 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 there has been recent Cape vulture use of the site and these birds are exclusively carrion-feeders, a programme of carrion removal (including all dead stock animals) from the wind farm site will be implemented. This should form part of a specific Ornithological Mitigation Plan (see Appendix F for initial draft of this document, which is to be developed and finalised in consultation with stakeholders including BLSA).

Habitat Management (off-site): in order to enhance the mitigation measures proposed above, 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 and hence further reduce collision risk. 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. Vegetation management to open up areas for Verreaux's Eagle to hunt (such as removal of areas of Acacia karroo trees/thickets along the river bends/horseshoes) would make dassies more huntable, for example. A specific management plan for the whole Choje area must be drawn up by a suitably qualified ecologist employed by the wind farm developer and the scheme should be agreed with BLSA. Measures to enhance local crane and bustard populations must also be implemented. Further details are provided in the Ornithological Mitigation Plan in Appendix F.

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, 5km of Martial Eagle nests and 5km of Cape Vulture roosts) should deploy this mitigation measure, and paint a single blade black (or similar means to increase blade visibility) 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 with bird flight diverters to reduce collision risk.

11.3. 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 must be implemented as for the construction phase of the development.

11.4. Post-construction Monitoring

Ongoing monitoring during and after completion of construction must be undertaken as part of an ornithological management plan, and to inform ornithological mitigation measures 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. This must follow the BLSA Best Practice Guidelines (Jenkins *et al*. 2015 or any update thereto). A detailed post-construction monitoring programme will be an essential and integral part of the mitigation package, to ensure that it both delivers the required results and is managed in the optimal way. This will include:

- comprehensive collision checks (on at least a weekly basis for an agreed sample of at least 25% of turbines, including all those within amber zones);
- monitoring of key species flight activity in/around the wind farm;
- key species nest site and breeding success;
- large terrestrial bird vehicle transects;
- Cape Vulture roost counts;
- Monitoring of flight behaviour in relation to single black blade painting;
- Effectiveness of Shutdown-on-Demand, including recording of near-misses and 'false positive' shutdown events;
- Monitoring of effectiveness of habitat management measures;
- Detailed tracking of Martial Eagles, Verreaux's Eagles and Cape Vultures, with specific tracking programmes using appropriate technology (e.g. fitting of GPS tags) to better understand flight behaviour in proximity to wind turbines, and also to test and develop the spatial modelling undertaken as part of the baseline assessment work.

The operational phase bird collision monitoring should follow BLSA Best Practice Guidelines (Jenkins *et al*. 2015 or any updates thereto). A core area of a radius equal to at least 75% of the height to blade tip around each turbine should be carefully searched on foot. Sectors around the turbine should be slowly searched, taking particular care to search any taller clumps of vegetation, rocks and openings of animal burrows. The precise location of any dead birds found should be recorded and mapped (by reference to the distance and direction to the nearest wind turbine, and using a GPS). All carcasses should be photographed as found then placed in a plastic bag, labelled as to the location and date (turbine number, distance and direction from turbine base), and preserved (refrigerated or frozen) until identified. Feather spots (e.g., a group of feathers attached to skin) and body parts should also be collected. For all casualties found, data recorded should include species, sex, age, date and time collected, location, distance and direction (degrees) to nearest turbine, condition, and any comments regarding possible causes of death. The condition of each carcass found should be recorded using the following condition categories:

- Intact - carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger.
- Scavenged - entire carcass that shows signs of being fed upon by a predator or scavenger or a portion(s) of a carcass in one location (e.g., wings, skeletal remains, legs, pieces of skin, etc.).
- Feather Spot - 10 or more feathers at one location indicating predation or scavenging.

A sample of 50 dead birds (e.g. dark-feathered chickens) should be obtained in order to study the rate of carcass removal and to test observer search efficiency, repeated four times annually. These should be placed within the search area at intervals through the study by someone independent of the carcass searcher, at precise recorded locations (mapped in relation to distance and direction from the wind turbines), and marked appropriately (e.g. with coloured tape) to identify them as experimental birds. They should then be recorded by the observer on all subsequent visits, noting their precise location (distance and direction from nearest wind turbine) and condition, and left in place on site until they disappear. The amount of scavenger activity should inform the survey frequency, but an initial programme of weekly visits is recommended as a starting point.

11.5. Mitigation of Power line collision and electrocution

Mitigation of power line impacts will require design measures to ensure that the risk of electrocution is minimised (insulators hanging down from crossbars, rather than pointing upwards, i.e. smaller powerlines), and fitting of new overhead lines in higher risk areas with Bird Flight Diverters to increase visibility and reduce collision risk. This must include all lines within 5km of vulture roosts, 5km from eagle nests and all areas identified as important for blue crane and bustards. Existing power lines within these zones must also be retrofitted with bird flight diverters where possible.

Additionally, vulture roost deterrents (Eskom employ 'bird-guards' above the hanging insulators to restrict large birds/vultures perching in these areas on the cross-member, however a newer design of lattice pole-structure replace the cross-member with a hanging cable that restrict birds to perch there in total) must be fitted to all pylon towers within 5km of the main vulture roosts identified in the baseline surveys (as part of the Ornithological Mitigation Plan - see Appendix F).

Mitigation for habitat destruction must be implemented to micro-site turbines away from more sensitive habitats. Some habitat loss is unavoidable, but it should be minimised where possible.

12. CONCLUSION

In conclusion, a comprehensive range of ornithological baseline surveys have been carried out at the Ripponn site during June 2019 to August 2020. Eleven Species of Conservation Concern were identified using the site (Martial Eagle, Verreaux's Eagle, Cape Vulture, Blue Crane, Secretarybird, Ludwig's Bustard, Southern Black Korhaan, Lanner Falcon, Caspian Tern, Greater Flamingo and African Marsh Harrier), and the baseline data have provided information on their use of the site and its surrounds.

The pre-construction monitoring data were used to produce spatial models of key species distributions, calculate potential range loss and quantify collision risk, in order to inform the assessment process. This enabled evidence-based advice to be provided on nest and roost site buffers, so that the final turbine positions avoided areas of higher ornithological sensitivity. Seven potential impacts (during construction – habitat loss and disturbance/displacement; during operation – collisions with turbines, disturbance/displacement, powerline collisions and electrocutions, and the disturbance during the decommissioning phase) were identified and assessed for the seven Priority species taken forward for more detailed assessment in standard Impact Tables, together with the Cumulative impacts and requirements for mitigation.

12.1. DATA COLLECTED:

12.1.1. Raptor Breeding Locations

In the West block and close proximity to the Ripponn site, two Martial Eagle, two Verreaux's Eagle, one Lanner falcon nearby, two Jackal Buzzard, and various smaller raptor nest sites or nest territories were located.

12.1.2. Vantage Point Survey Results

Martial Eagle, Verreaux's Eagle, Cape Vulture, Blue Crane, Secretarybird, Lanner Falcon, African Marsh Harrier, and Caspian Tern are the eight Priority species that flew through the site at rotor height (Table 3).

12.1.3. Road Transect/Wetland Survey Results

Six Species of Conservation Concern were recorded on the road transect/focal point surveys (Table 4) across the Ripponn site: Blue Crane, Ludwig's Bustard, Greater Flamingo, Verreaux's Eagle, Cape Vulture and Martial Eagle, though the number of records of all of these were low. Twelve water bird species were recorded at the Focal Point (wetland) surveys, probably because of the semi-aridness of the site and the lack of large water bodies/dams.

12.1.4. Walking transect Results

Of the 70 species of bird species that were recorded during these surveys, no Species of Conservation Concern was recorded. Generally low numbers were recorded but included a high diversity of small terrestrial species, probably because of the high coverage of Thicket vegetation on site.

12.1.5. 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 and Secretarybird were recorded and likely breeding on site but no definite nests were found. Martial Eagle nest west of the Ripponn site. Cape Vulture visited the development area during the summer season (November-March).

12.2. DATA ANALYSED:

12.2.1. Spatial Modelling

The spatial model was used to predict flight densities of Martial Eagle, Verreaux's Eagle and Cape vulture across the whole West block study area, and to inform the optimal size of turbine-free buffers around eagle nest sites and vulture roost sites.

12.2.2. Collision Risk Modelling (CRM)

One of the main potential ornithological impacts of concern for the Ripponn Wind Farm is collision with the operational turbines. The CRM was carried out for all seven Priority species of conservation concern that were observed flying within the collision risk zone at rotor height. The following annual collision risks were predicted for the reduced 23-turbine layout: Cape Vulture 4.02, Blue Crane 0.14, Martial Eagle 0.99, Secretarybird 0.02, Caspian Tern 0.02, and zero Verreaux's Eagle, African Marsh-harrier and Lanner Falcon collisions per year.

12.2.3. Range loss

The percentage range loss for the closest eagle nest sites, for Martial is 4.7% and 3.2% for complete displacement to 500m and 250m respectively for the reduced 23--turbine layout at the Ripponn site. While Martial eagle in combination with Aeolus wind farm is 13.7% and 9.6% displacement for 500m and 250m respectively.

12.3. RISK TO PRIORITY SPECIES ASSESSED:

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

12.4. 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 Tables for each of the seven potential impacts on the six Priority species were assessed, these included, Habitat loss, disturbance during construction and during operation, turbine collision risk, disturbance/displacement, powerline collision risk and the electrocution risk on powerline poles. A range of mitigation measures are required and must be implemented to reduce the potential impacts of the proposed development. These are set out in detail in the Ornithological Mitigation Plan (Appendix F).

12.5. Cumulative Assessment

The cumulative effect of the proposed Ripponn Wind Farm development along with the predicted impacts of the future Choje Wind Farms and the neighbouring operational wind farms was assessed to be of MEDIUM significance. Key species that may possibly be impacted upon cumulatively include Blue Crane, Secretarybird, Cape Vulture, Martial Eagle and Verreaux's' Eagle.

12.6. Assessment of Residual Effects

The residual ornithological effects of the Development will be a LOW significant loss of a small amount of habitat to turbine bases and tracks/roads, and a MEDIUM significant risk of disturbance during construction. While during Operation the impact of turbine and powerline collisions will be MEDIUM.

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 after the implementation of all the required mitigation measures, including the reduced number of turbines for initial approval. The overall effect will be of MEDIUM significance.

However, it is essential to continue the nest monitoring to determine the long-term reproductive success of Martial and Verreaux's eagles (long-term disturbance effect), the post-construction monitoring of flight behaviour and the habitat use of these two eagles. While continuous carcass searches under turbines, to determine the long-term operational effect of this wind farm development on these birds. The regular driving under powerlines to monitor and search for carcasses, especially for Blue Crane. Removal of stock (sheep/goat) carcasses from the area to assure that Cape vultures do not return during the summer seasons must also be implemented.

Finally, we are confident in recommending that the Ripponn Wind Farm can be authorised subject to the implementation of all the required mitigation measures.

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APPENDICES

Appendix 1 Choje wind farms – 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 F Ornithological Mitigation Plan.

Appendix G. VERA model output for Verreaux's Eagle range modelling.

APPENDIX 1: CHOJE WIND FARMS (WEST)

SURVEY HOURS FOR VANTAGE POINT SURVEYS – WESTERN BLOCK (HAMLETT, RIPPONN, REDDING AND AEOLUS)

Wind Farm	VP	Jun 2019	Jul	Aug	Sep	Oct	Nov	Dec 2019	Jan 2020	Feb	Mar	Apr	May	Jun	Jul	Aug 2020	TOTAL HRS
Redding	1	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
Redding	2	4	4	4	4	4	4	4	4	4	4	0	4	4	8	8	**64**
Redding	3	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
Redding	4	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
Aeolus	5	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
None	6	4	4	4	4	4	4	4	4	4	8	0	9	4	8	8	**73**
None	7	4	5	4	3	4	4	4	4	4	4	0	8	8	8	8	**71**
Redding	8	4	4	4	4	4	4	4	4	4	7	0	5	4	0	0	**52**
Redding	9	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
None	10	4	4	4	4	4	4	4	4	4	4	0	8	4	0	0	**52**
None	11	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
None	12	4	4	4	4	4	0	0	0	0	4	0	0	0	0	0	**24**
Ripponn	13	4	4	4	4	4	4	4	4	4	0	0	8	4	0	0	**48**
Ripponn	14	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
Ripponn	15	4	4	4	4	4	4	4	4	4	8	0	8	4	8	8	**72**
Hamlett	17	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
Hamlett	18	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
Hamlett	19	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
Hamlett	20	4	4	4	4	3	5	4	4	4	4	0	4	4	0	1	**49**
Hamlett	21	4	4	4	4	4	4	4	4	4	4	0	4	0	4	0	**48**
Hamlett	22	4	4	4	4	4	4	4	4	4	4	0	4	0	4	0	**48**
Aeolus	23	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
Redding	24	4	4	4	4	4	4	4	4	4	8	0	9	4	8	8	**73**
None	25	3	4	4	4	4	4	4	4	4	4	0	4	4	0	1	**48**
None	26	4	4	4	4	4	4	4	4	4	8	0	8	4	8	8	**72**
Redding	27	4	4	4	4	4	4	4	4	4	4	0	4	4	0	0	**48**
Hamlett	28	0	0	0	4	4	4	4	4	4	4	0	4	4	8	8	**52**
Ripponn	29	0	0	0	4	4	4	4	4	4	8	0	8	4	8	8	**60**
Ripponn	30	0	0	0	4	4	4	4	4	4	4	0	4	4	4	8	**48**
None	31	0	0	0	4	4	4	4	4	4	8	0	9	4	8	9	**62**
Aeolus	32	0	0	0	4	4	4	4	4	4	4	0	4	4	8	8	**52**

Wind Farm	**VP**	**Jun 2019**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec 2019**	**Jan 2020**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug 2020**	**TOTAL HRS**
Aeolus, Redding	33	0	0	0	4	4	4	4	4	4	4	0	4	4	8	8	**52**
None	34	0	0	0	4	4	4	4	4	4	4	0	4	4	8	8	**52**
Hamlett	35	0	0	0	4	4	4	4	4	4	4	0	5	4	8	8	**53**
Aeolus	37	0	0	0	4	4	4	4	4	4	4	0	4	4	8	8	**52**
None	38	0	0	0	4	4	4	4	4	4	4	0	4	4	8	4	**48**
None	39	0	0	0	4	4	4	4	4	4	4	0	4	4	8	8	**52**
Aeolus	40	0	0	0	0	4	4	4	4	4	4	0	4	4	8	8	**48**
Redding	41	0	0	0	0	4	4	4	4	4	4	0	4	4	8	8	**48**
Aeolus, Redding	42	0	0	0	0	4	4	4	4	4	4	0	8	4	8	8	**52**
Hours/mo		*103*	*105*	*104*	*147*	*159*	*157*	*156*	*156*	*156*	*183*	*0*	*201*	*152*	*164*	*159*	*2102*
Aeolus total		*8*	*8*	*8*	*20*	*28*	*28*	*28*	*28*	*28*	*28*	*0*	*32*	*28*	*40*	*40*	*352*
Hamlett total		*24*	*24*	*24*	*32*	*31*	*33*	*32*	*32*	*32*	*32*	*0*	*33*	*24*	*24*	*17*	*394*
Redding total		*32*	*32*	*32*	*36*	*44*	*44*	*44*	*44*	*44*	*51*	*0*	*54*	*44*	*40*	*40*	*581*
Ripponn total		*12*	*12*	*12*	*20*	*20*	*20*	*20*	*20*	*20*	*24*	*0*	*32*	*20*	*20*	*24*	*276*

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 [2]);
- 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).

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

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

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).

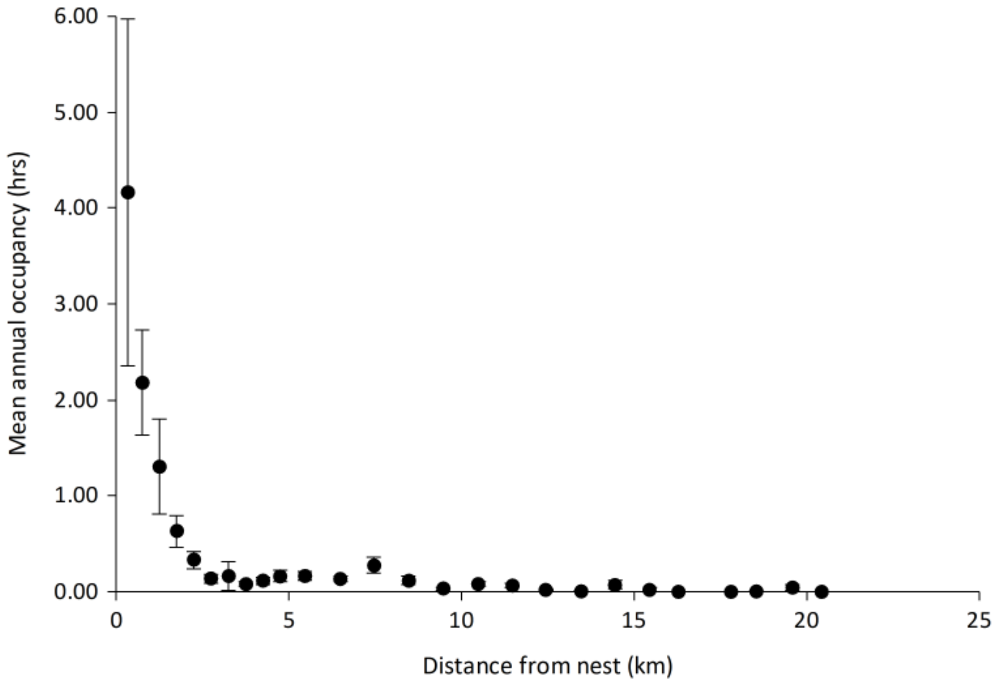
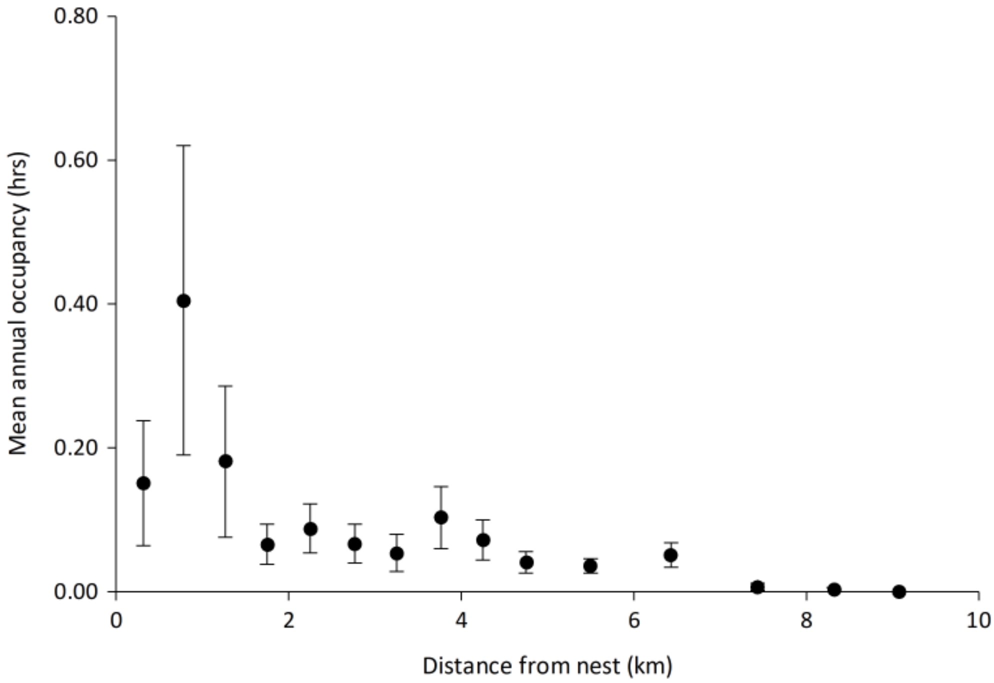


Figure 2. Martial Eagle flight density and distance from the nest, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



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).

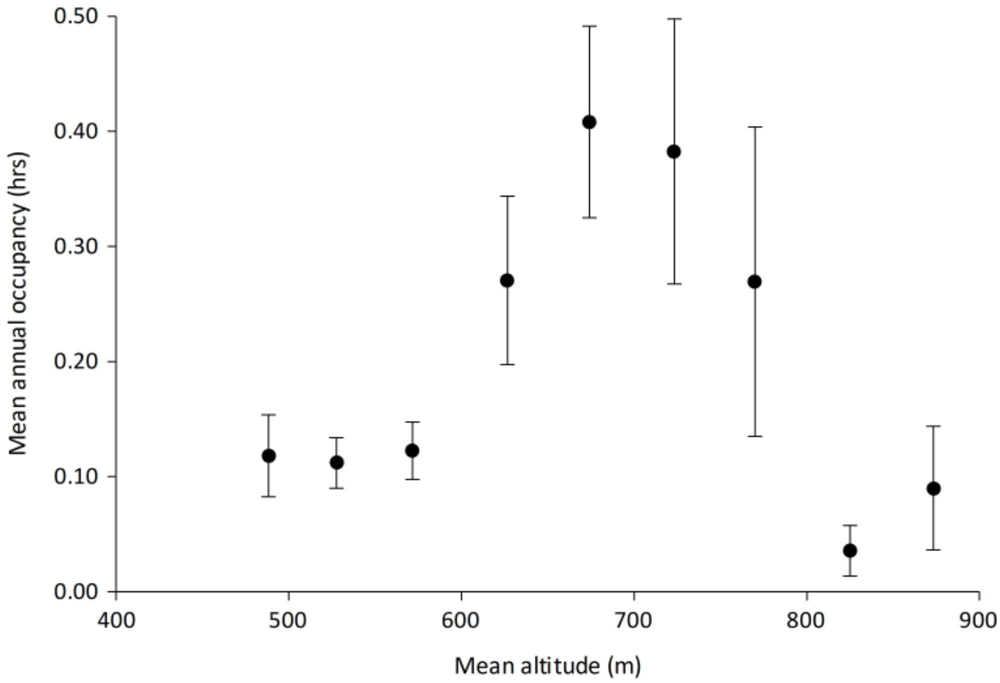
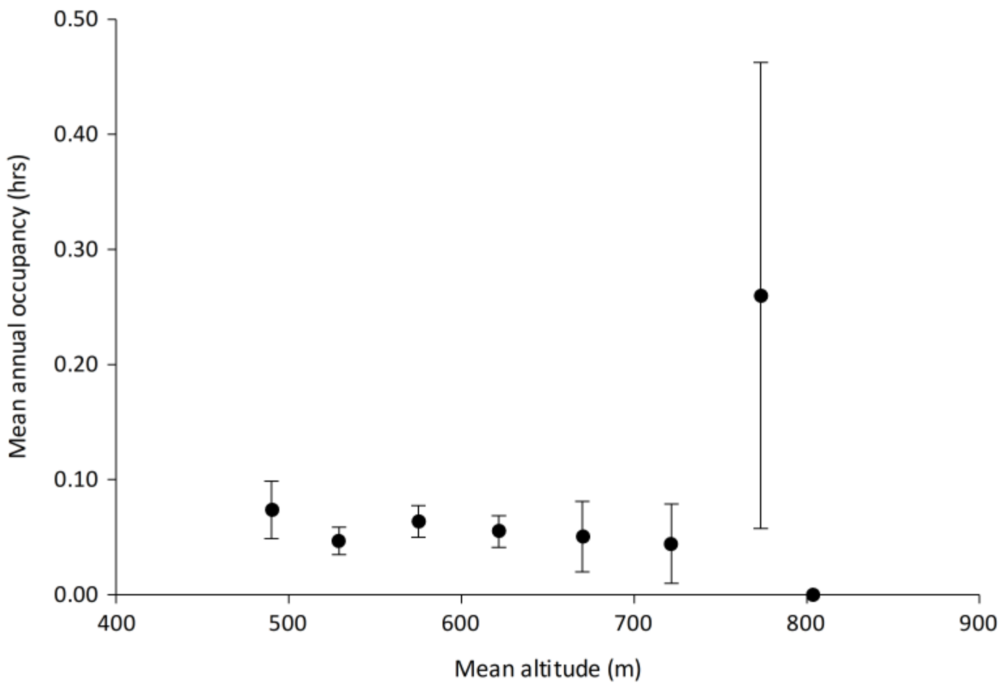


Figure 4. Martial Eagle flight density and altitude (m above sea level), Choje East June 2019 - August 2020 (mean ± 95% confidence limits).



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).

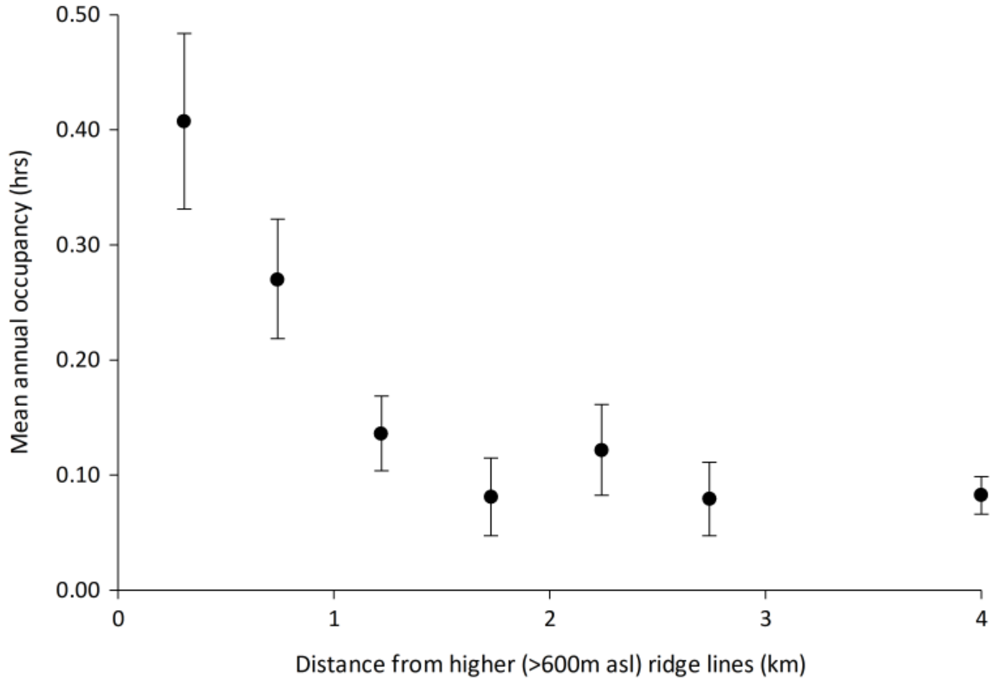
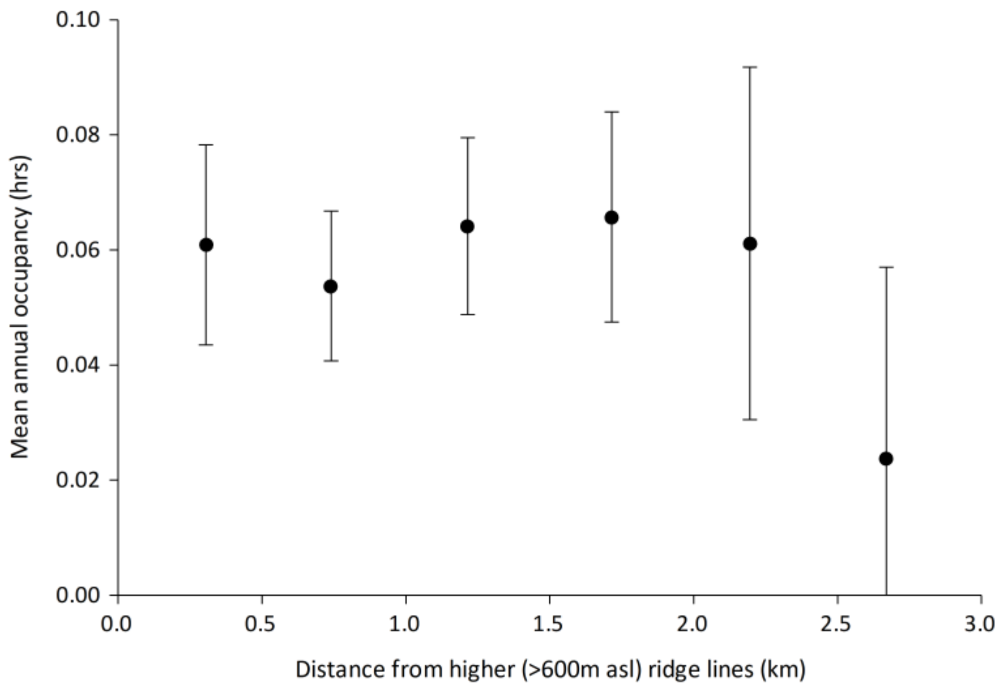


Figure 6. Martial Eagle flight density and distance from higher (>600m) ridge lines, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



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).

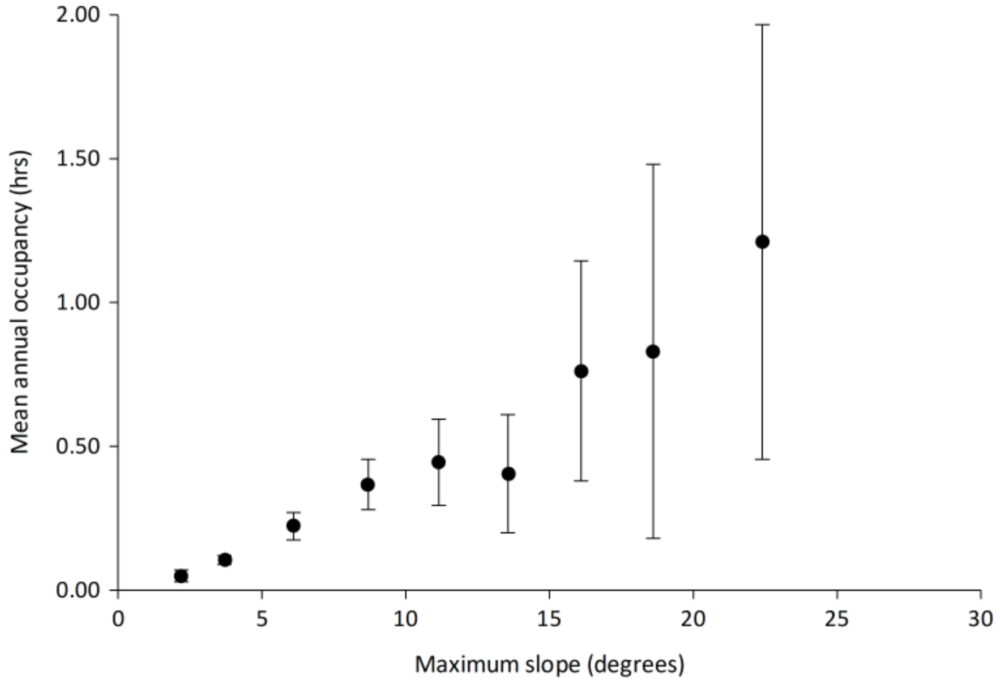
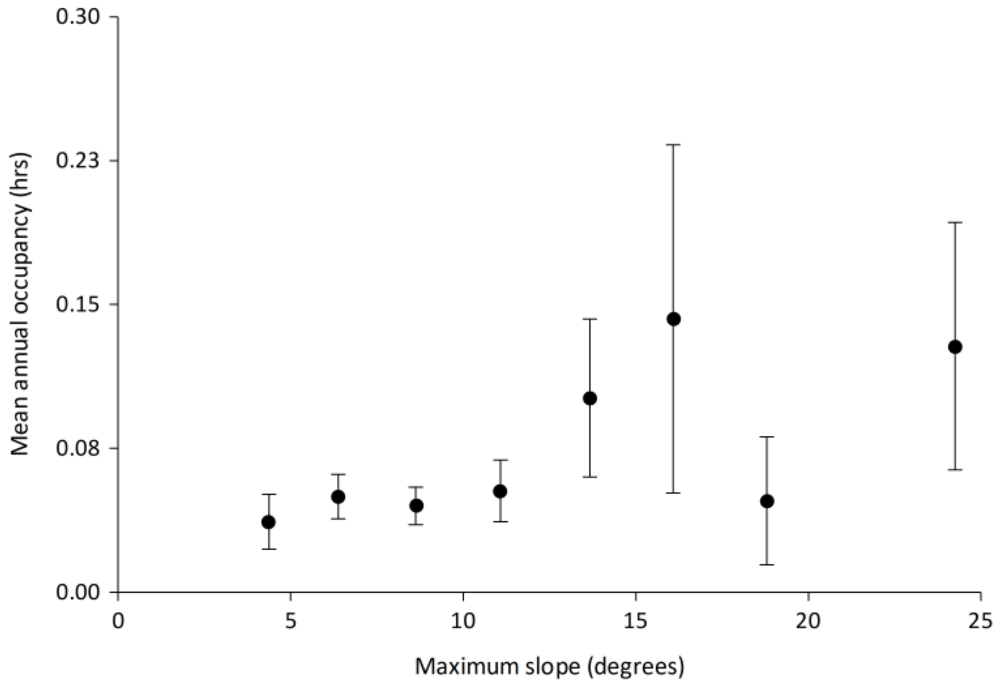


Figure 8. Martial Eagle flight density and maximum slope, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



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).

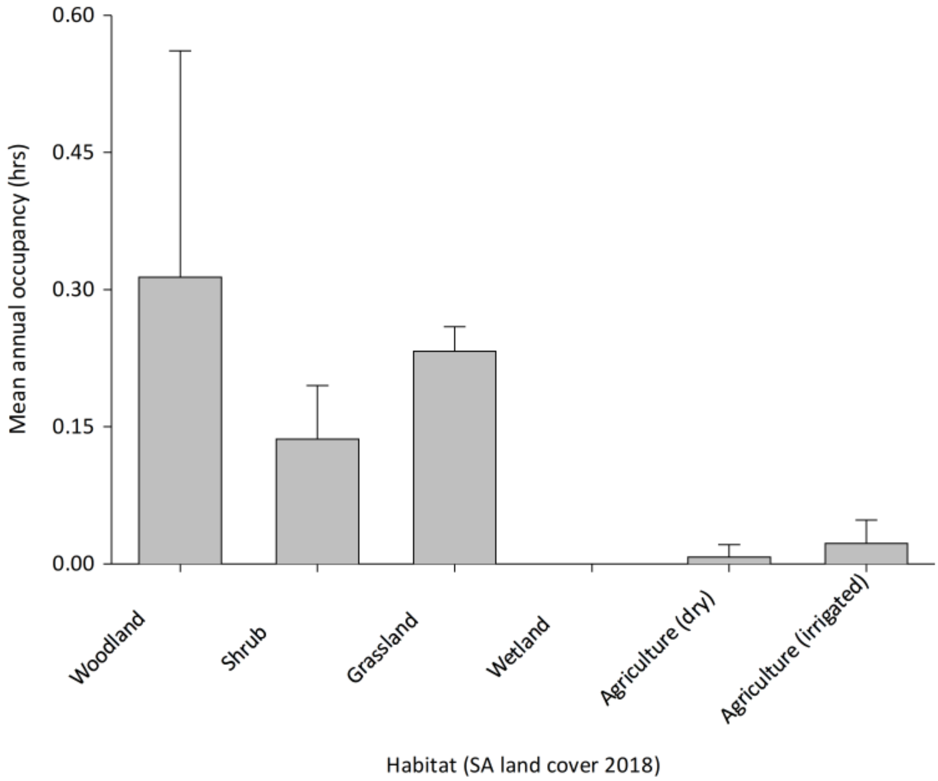
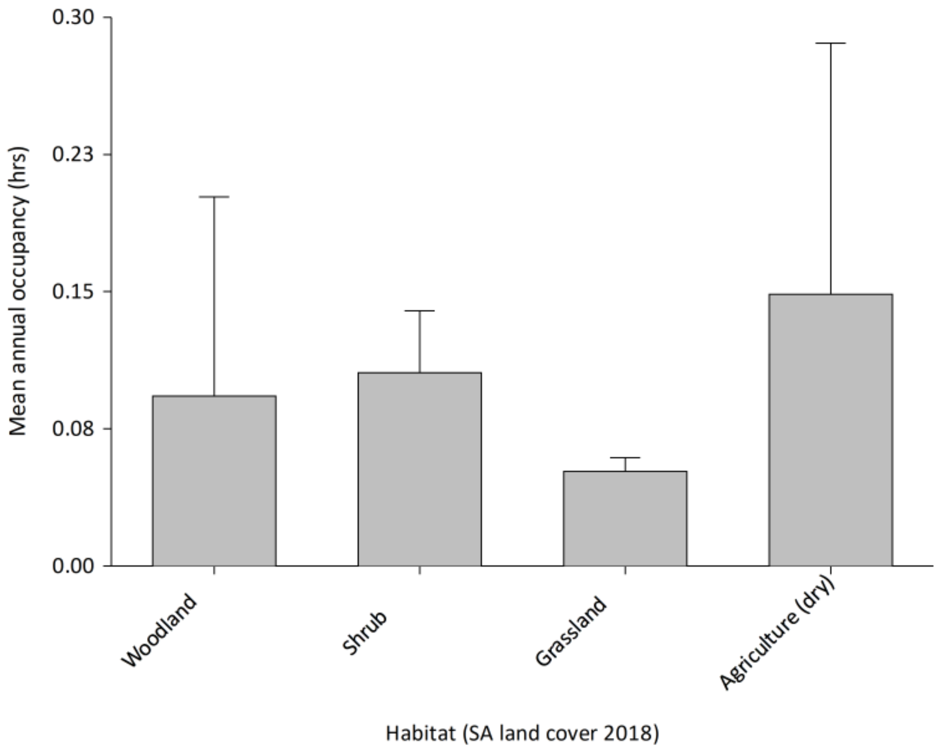


Figure 10. Martial Eagle flight density and habitat type (land cover 2018), Choje East June 2019 - August 2020 (mean + 95% confidence limits).



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.

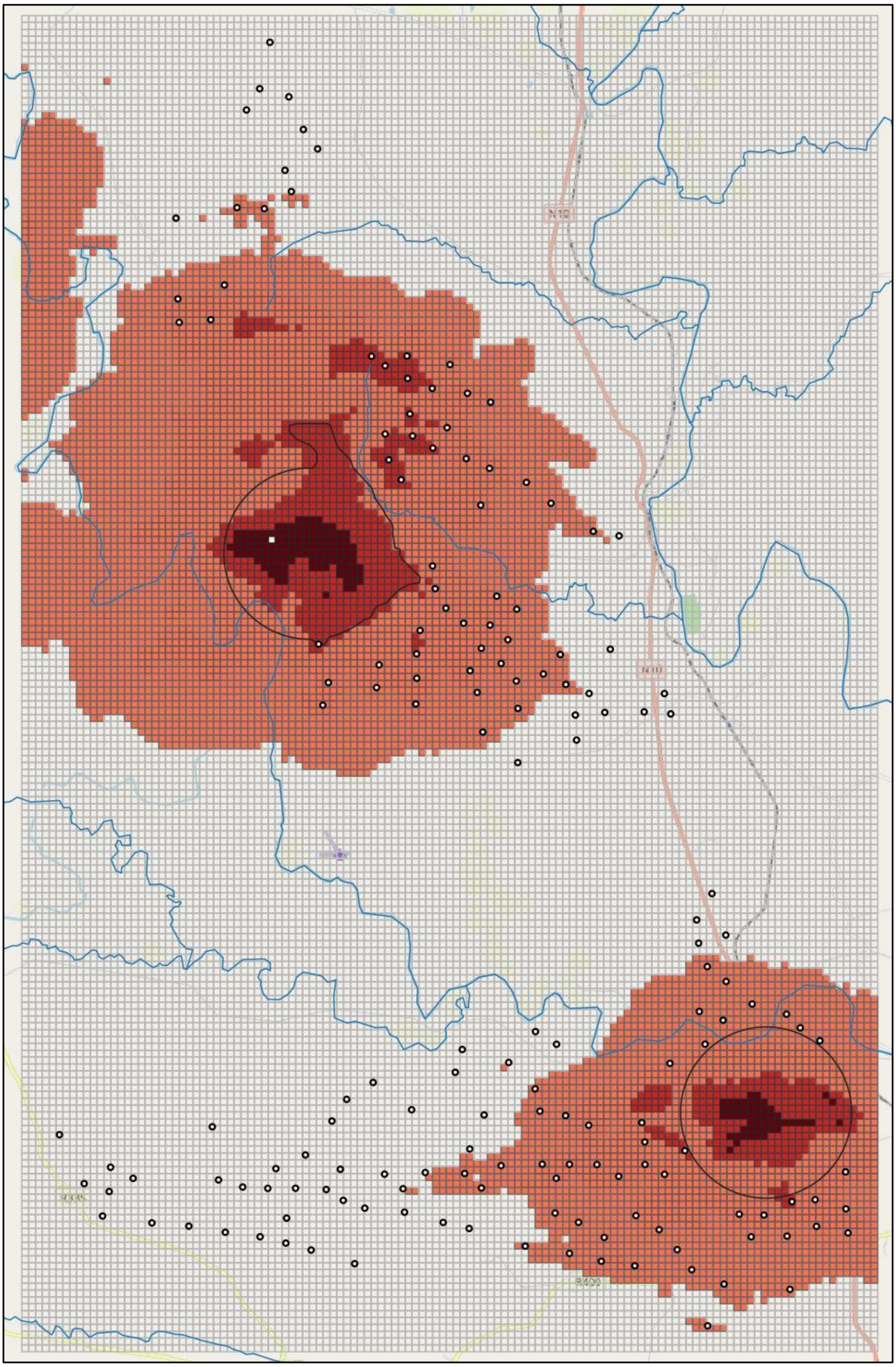


Figure 12. Predicted Martial Eagle distribution in the Choje Eastern Block. Darker shading indicates higher predicted use, with proposed turbine (small white dots) and turbine exclusion zones (larger black extended circles) also shown.

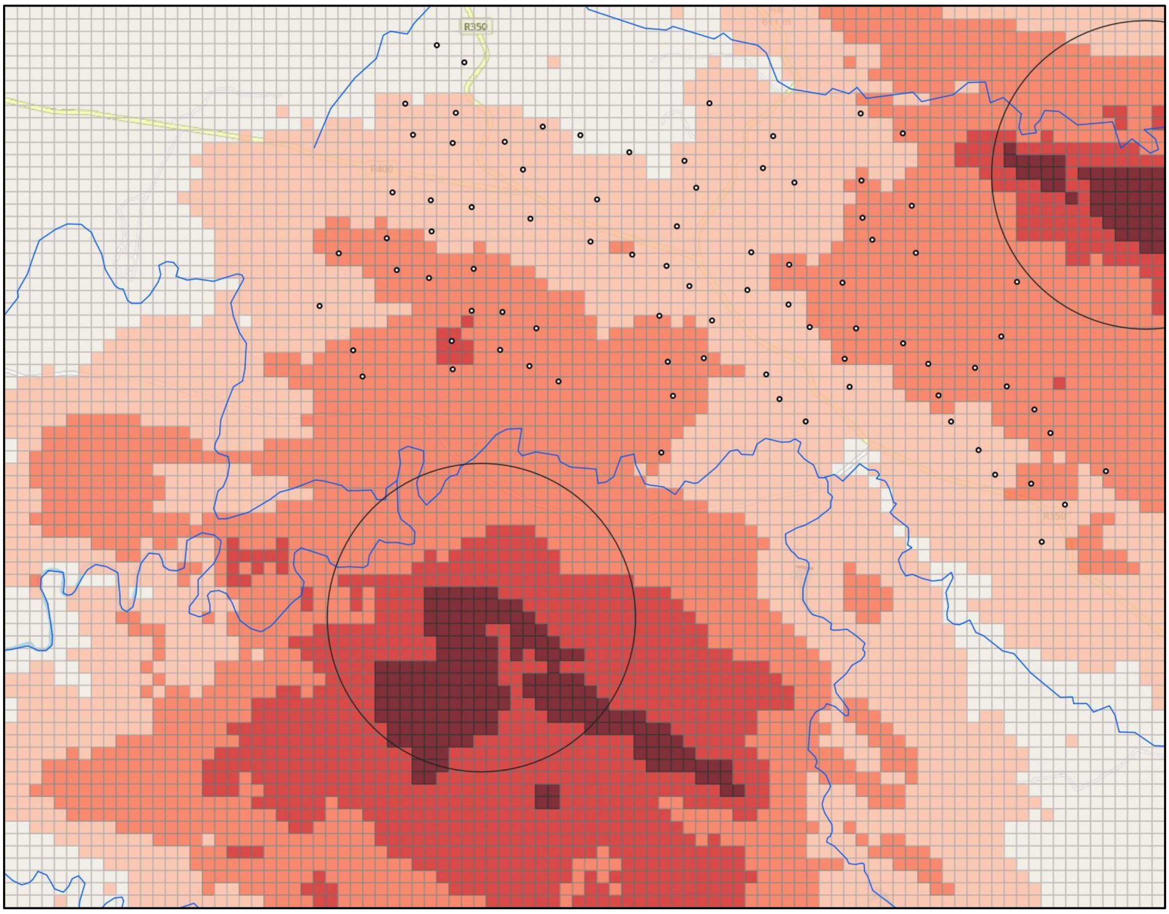


Table 1. Spatial autoregressive modelling results for Martial Eagle for Choje West June 2019 - August 2020

```
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).

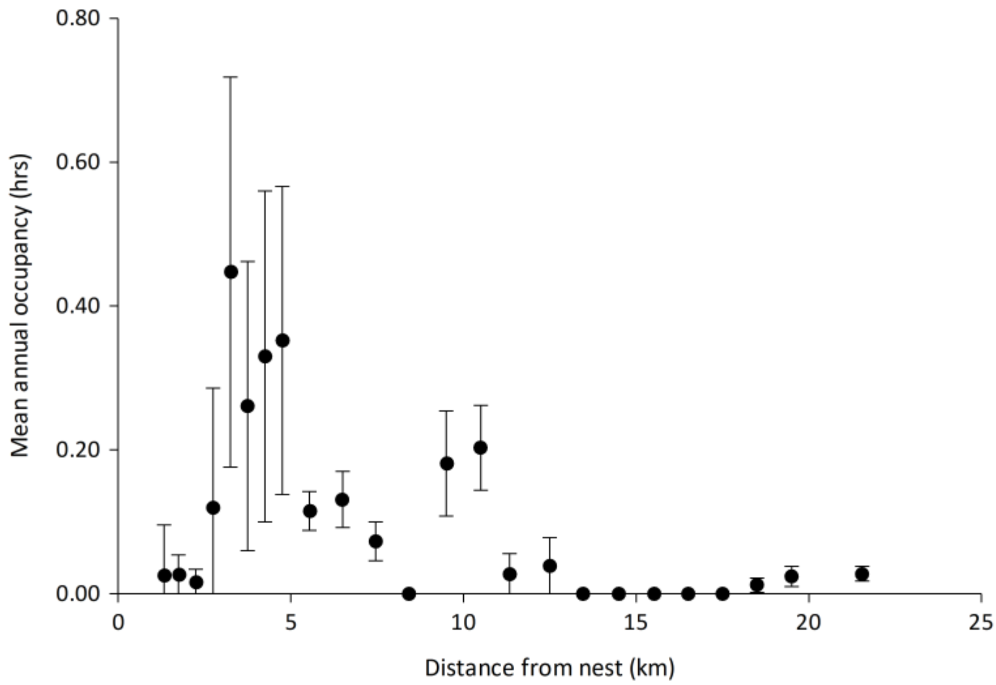
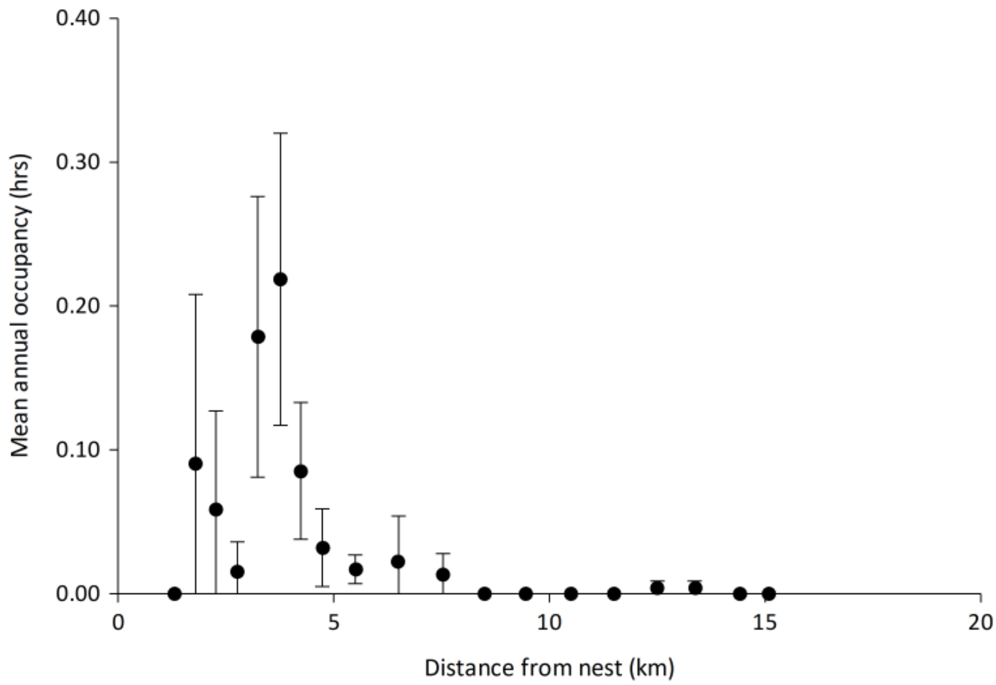


Figure 14. Verreaux's Eagle flight density and distance from the nest, Choje East June 2019 - August 2020 (mean ± 95% confidence limits).



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).

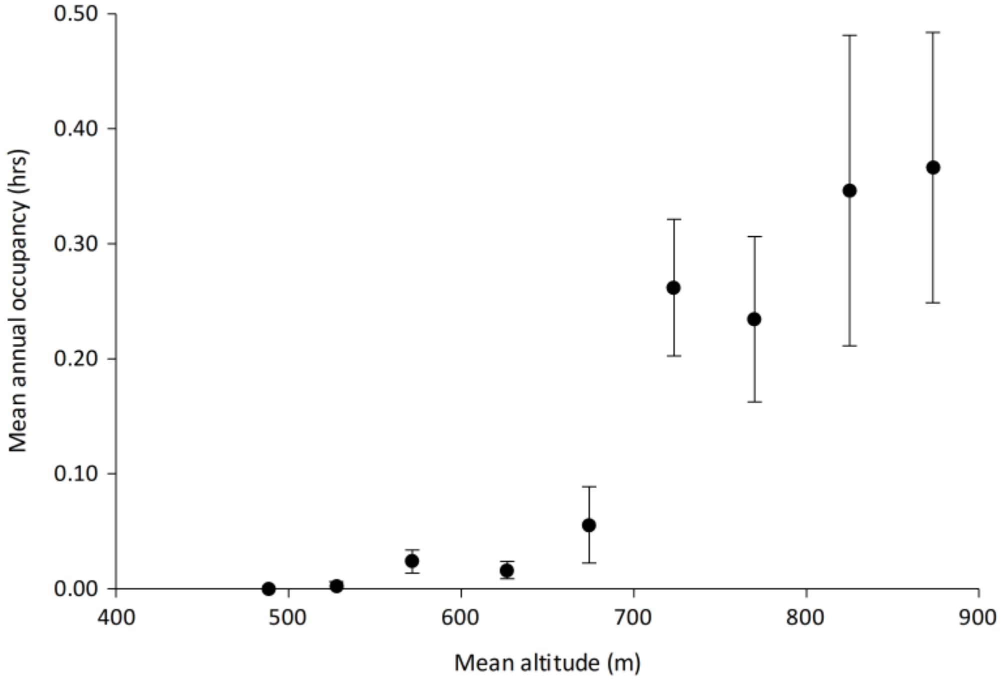
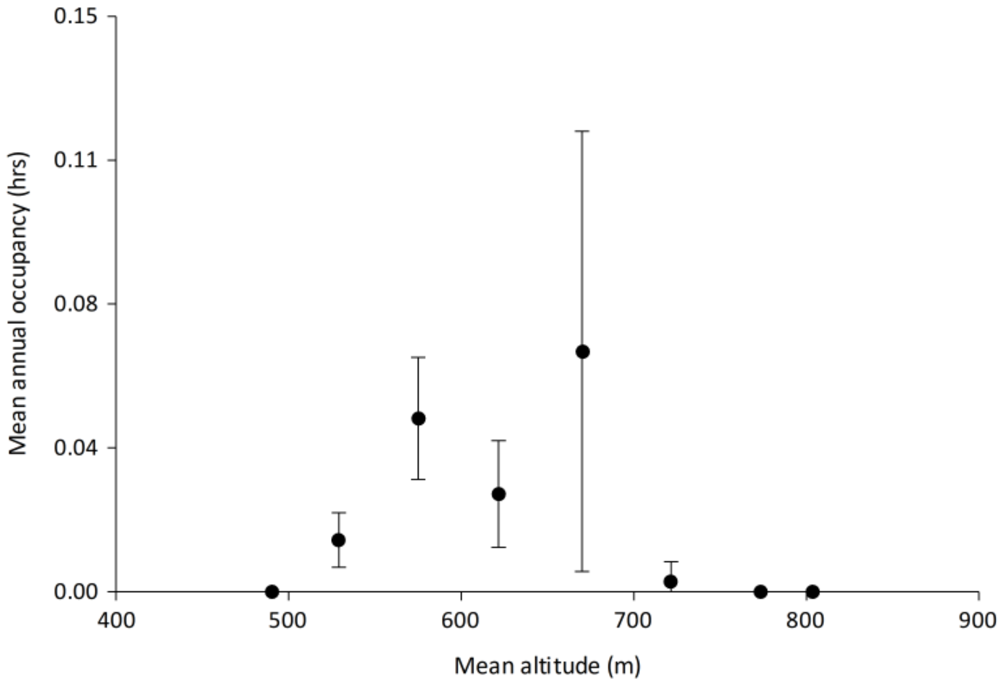


Figure 16. Verreaux's Eagle flight density and altitude (m above sea level), Choje East June 2019 - August 2020 (mean + 95% confidence limits).



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).

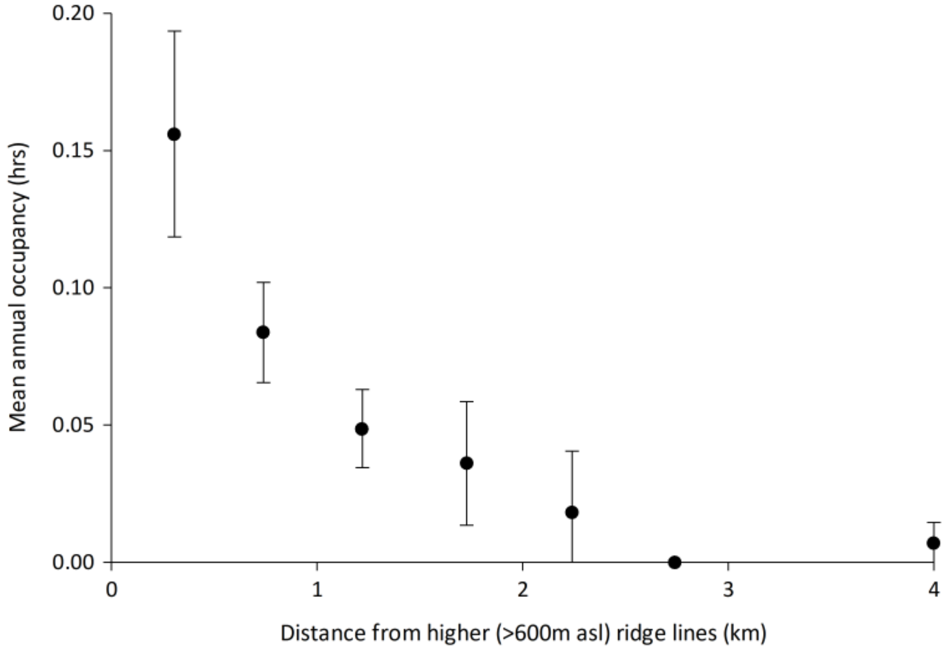
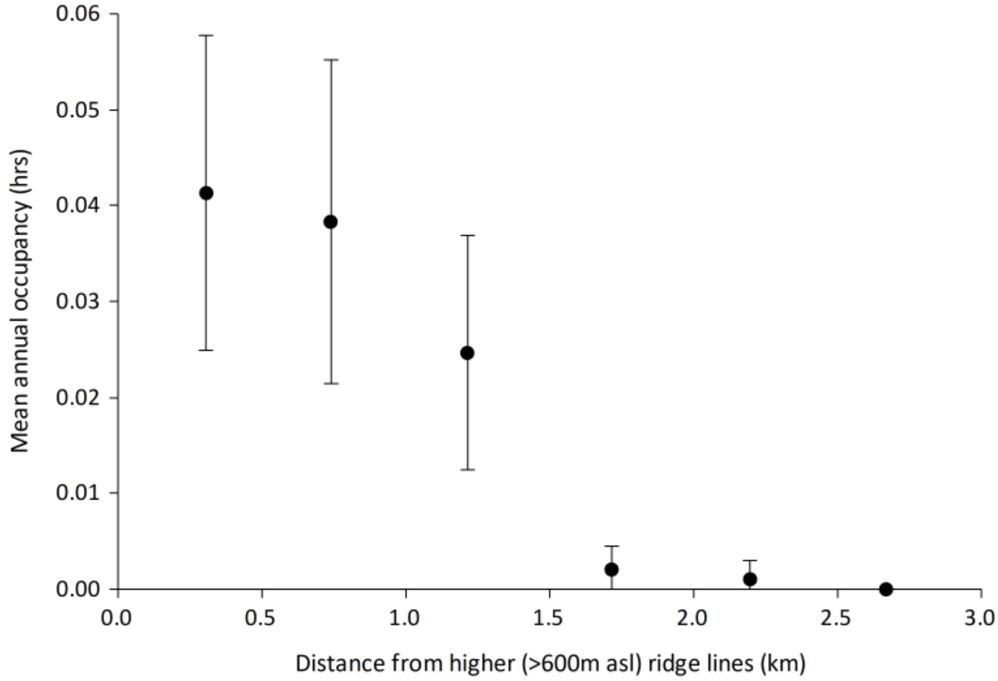


Figure 18. Verreaux's Eagle flight density and distance from higher (>600m) ridge lines, Choje East June 2019 - August 2020 (mean + 95% confidence limits).



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).

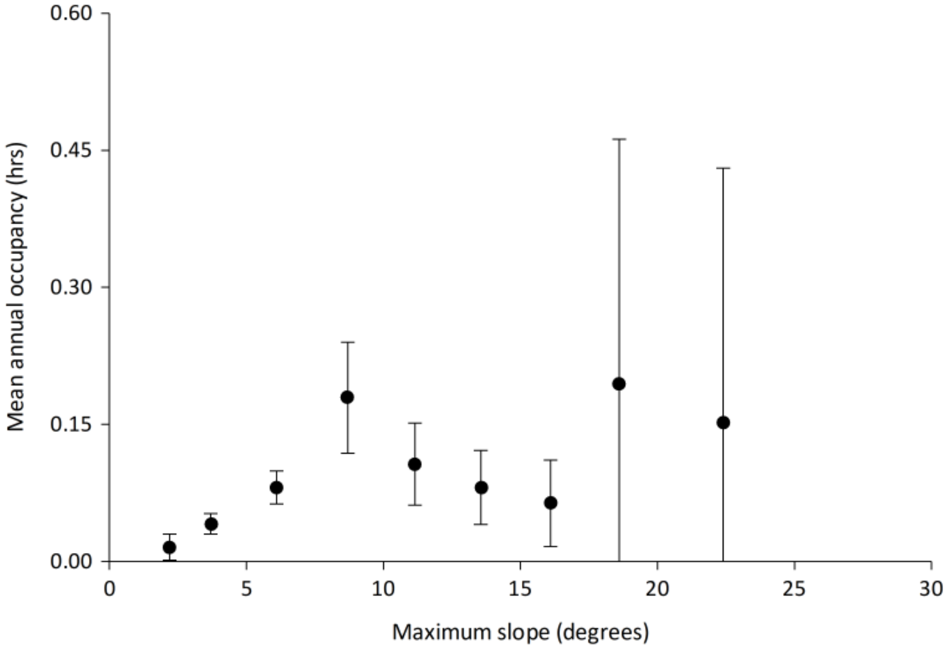
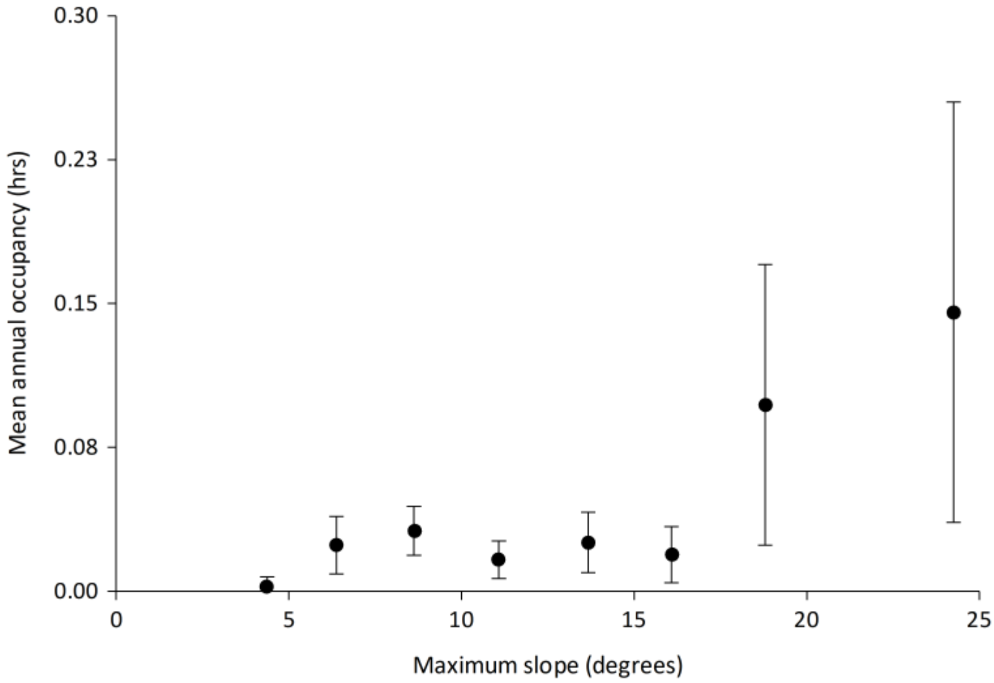


Figure 20. Verreaux's Eagle flight density and maximum slope, Choje East June 2019 - August 2020 (mean ± 95% confidence limits).



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).

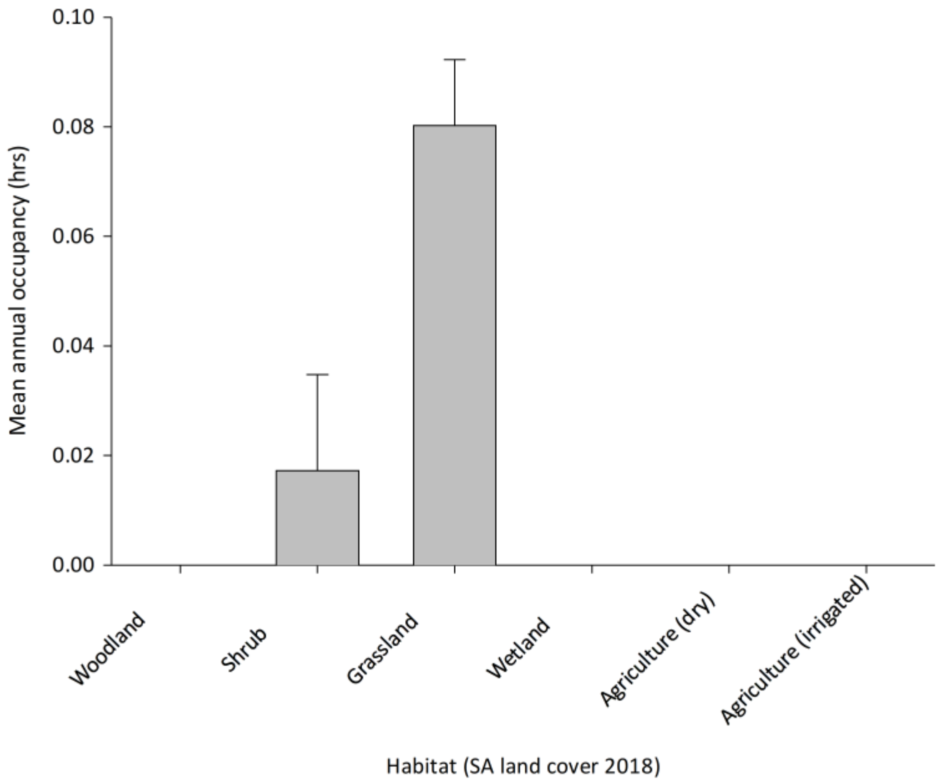
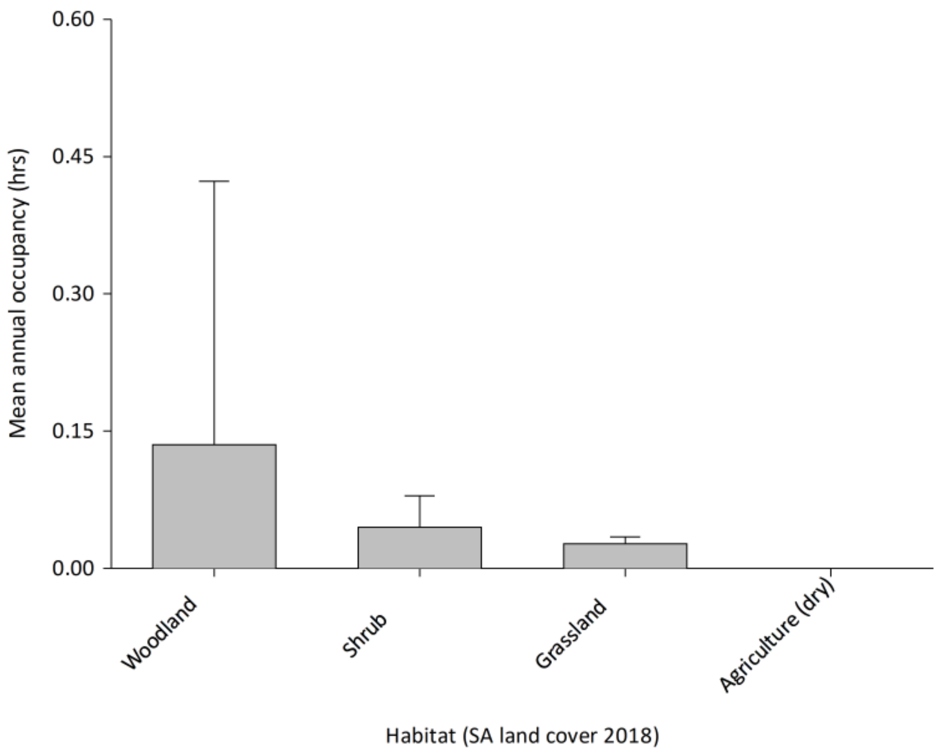


Figure 22. Verreaux's Eagle flight density and habitat type (land cover 2018), Choje East June 2019 - August 2020 (mean + 95% confidence limits).



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.

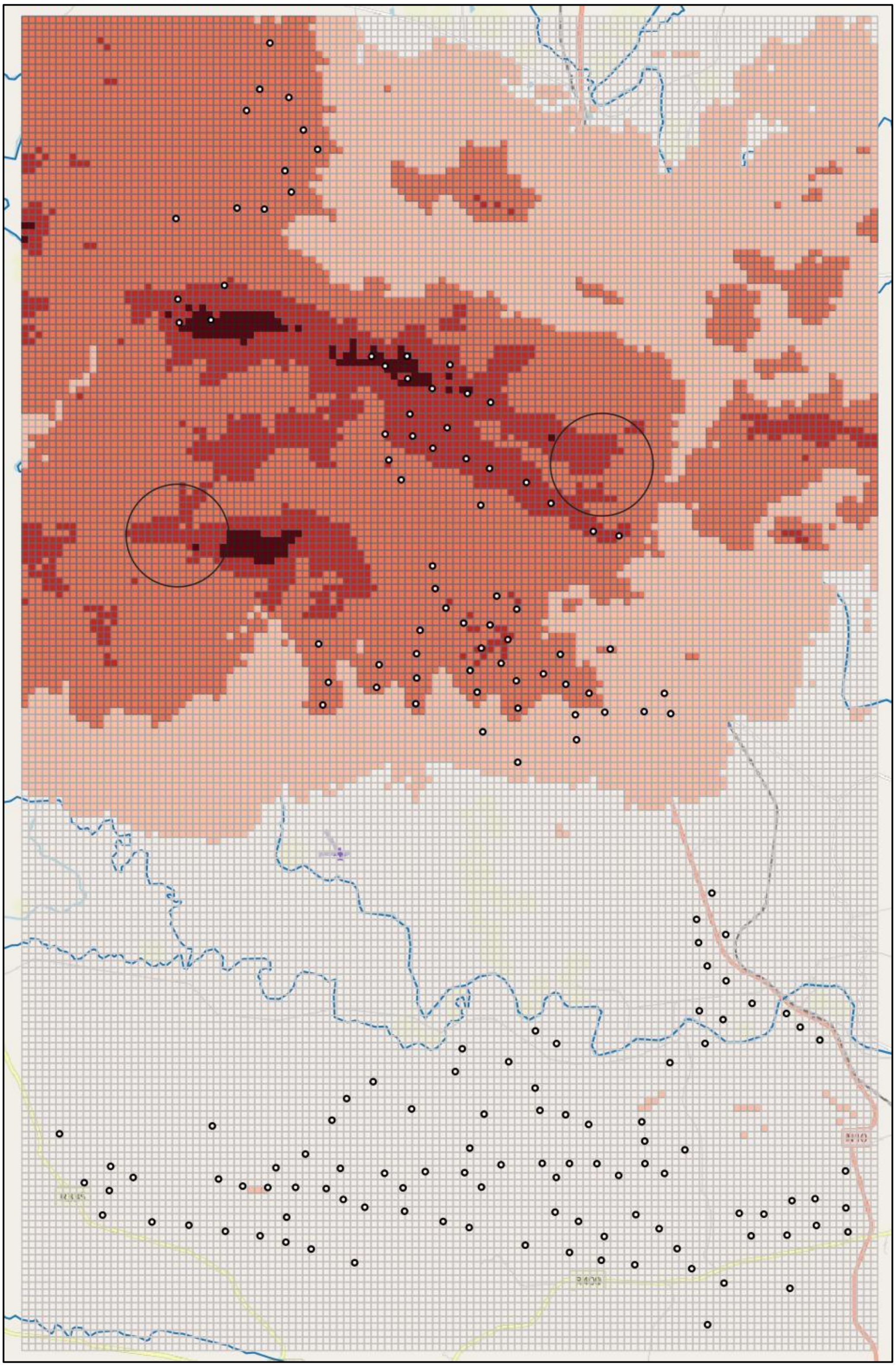


Figure 24. Predicted Verreaux's Eagle distribution in the Choje Eastern Block. Darker shading indicates higher predicted use, with proposed turbine (small white dots) and turbine exclusion zones (larger black extended circles) also shown.

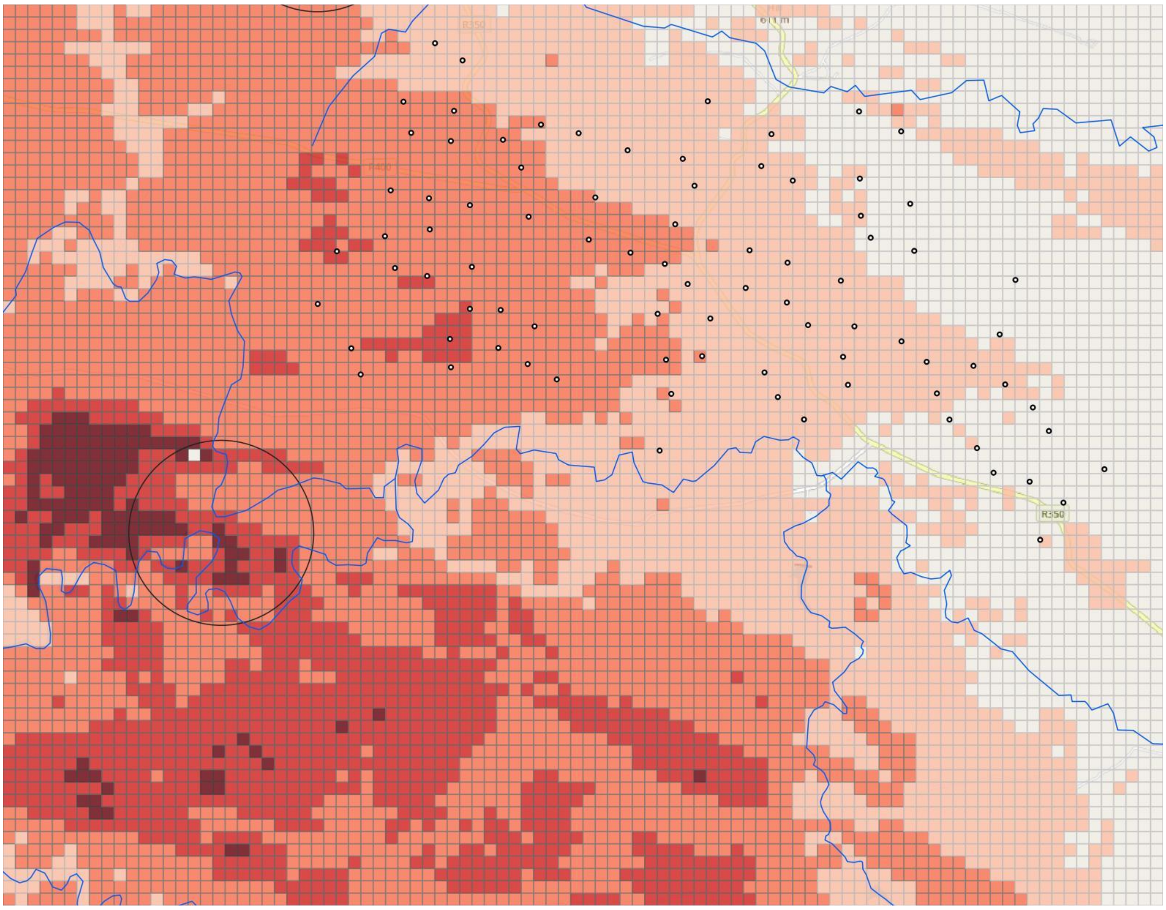


Table 2. Spatial autoregressive modelling results for Verreaux's Eagle for Choje West June 2019 - August 2020

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

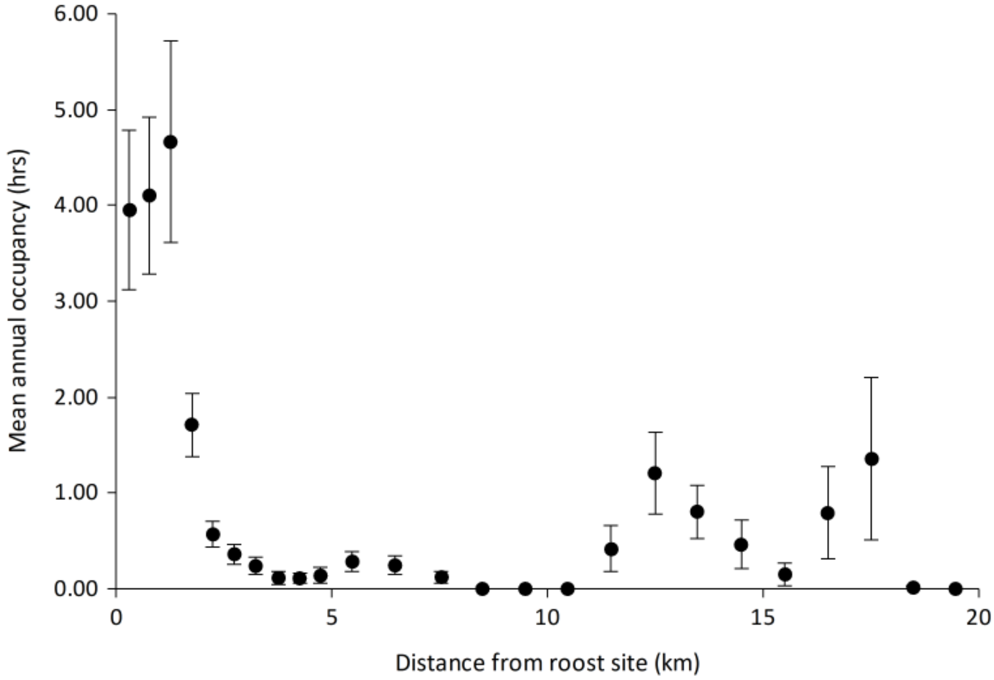
Wald test of spatial terms: chi2(6) = 1267.32 Prob > chi2 = 0.0000

***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

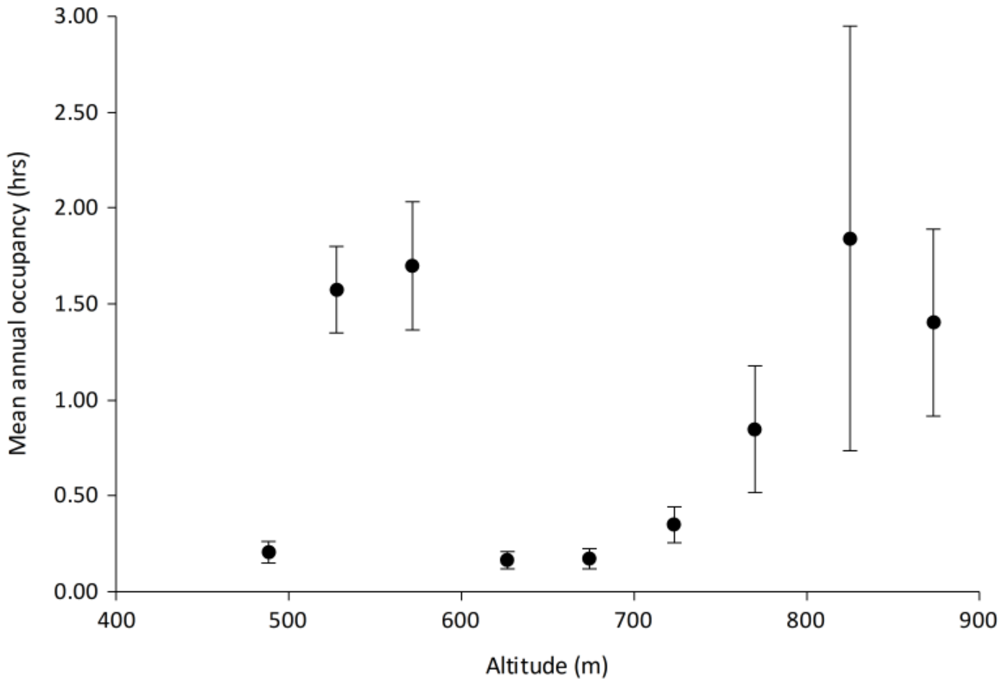
Cape Vultures did not breed within the survey area, so their flight distribution was not associated with any nest sites, but they were strongly associated with their night roost sites (with higher flight densities within 2km of the roosts, Figure 25).

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



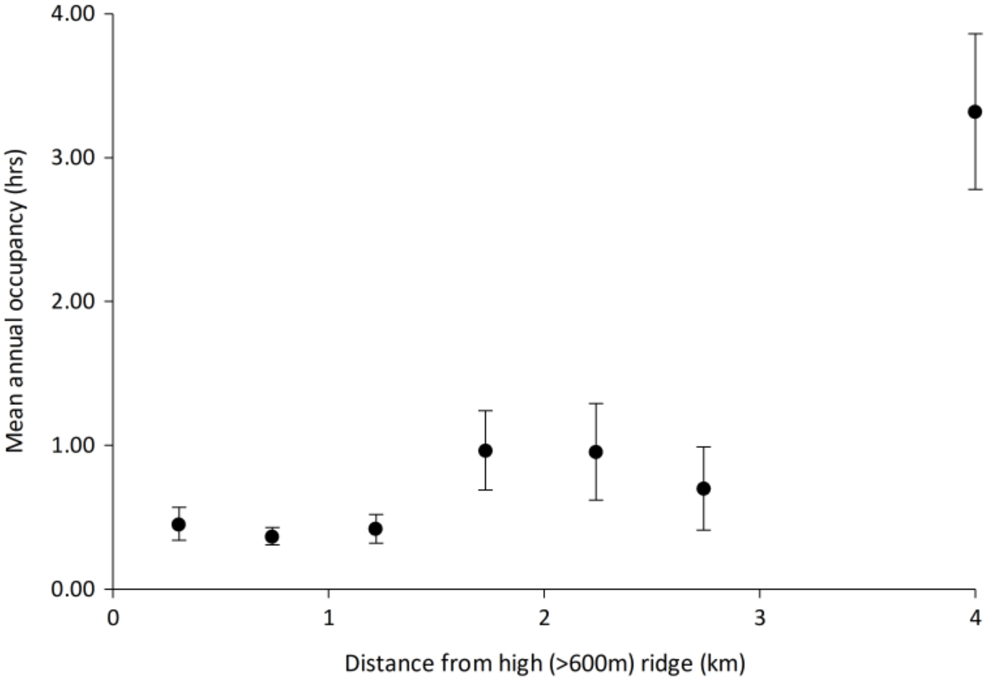
Cape Vulture flight density showed two peaks in relation to altitude, one around 500-600m (coincident with the altitude of their main roost sites) and a second above 800m above sea level (Figure 26).

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



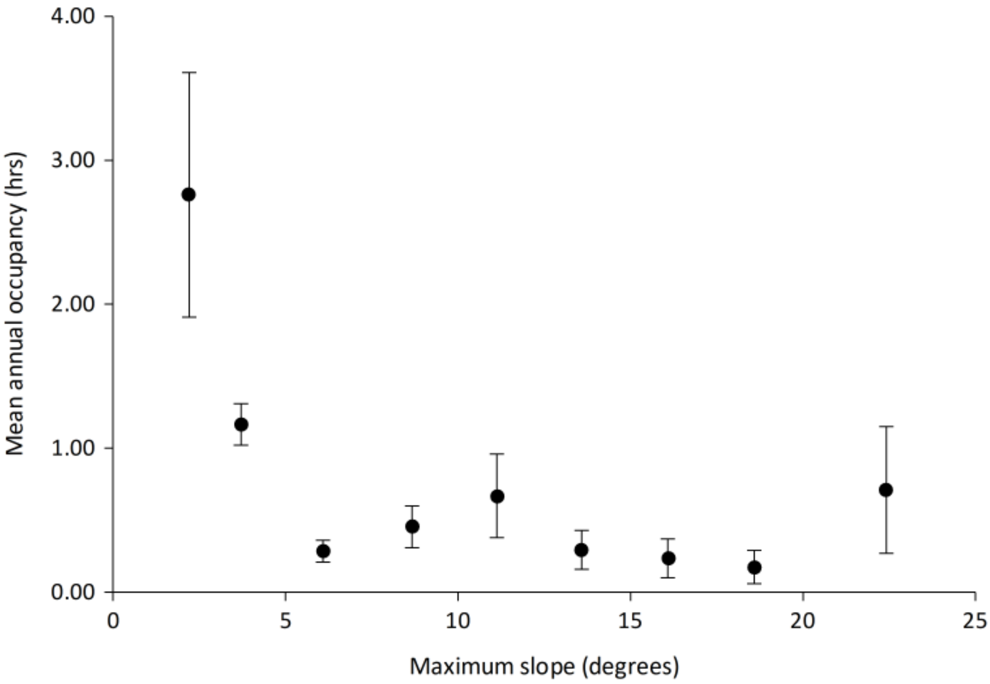
Cape Vulture flight density did not vary greatly in relation to distance from higher ridgelines, apart from a higher level at 4km (the distance coincident with the location of their main roost sites, Figure 27).

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



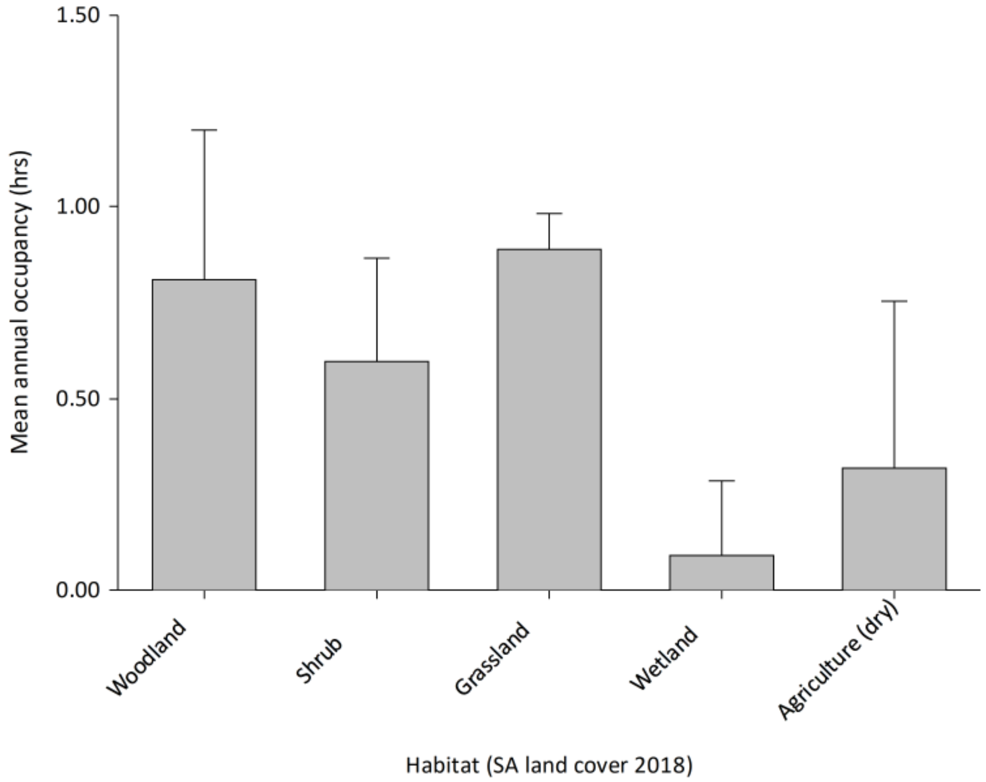
Cape Vulture flight density was highest in flatter areas (lower maximum slope), with lower activity on slopes exceeding 5 degrees slope (Figure 28).

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.

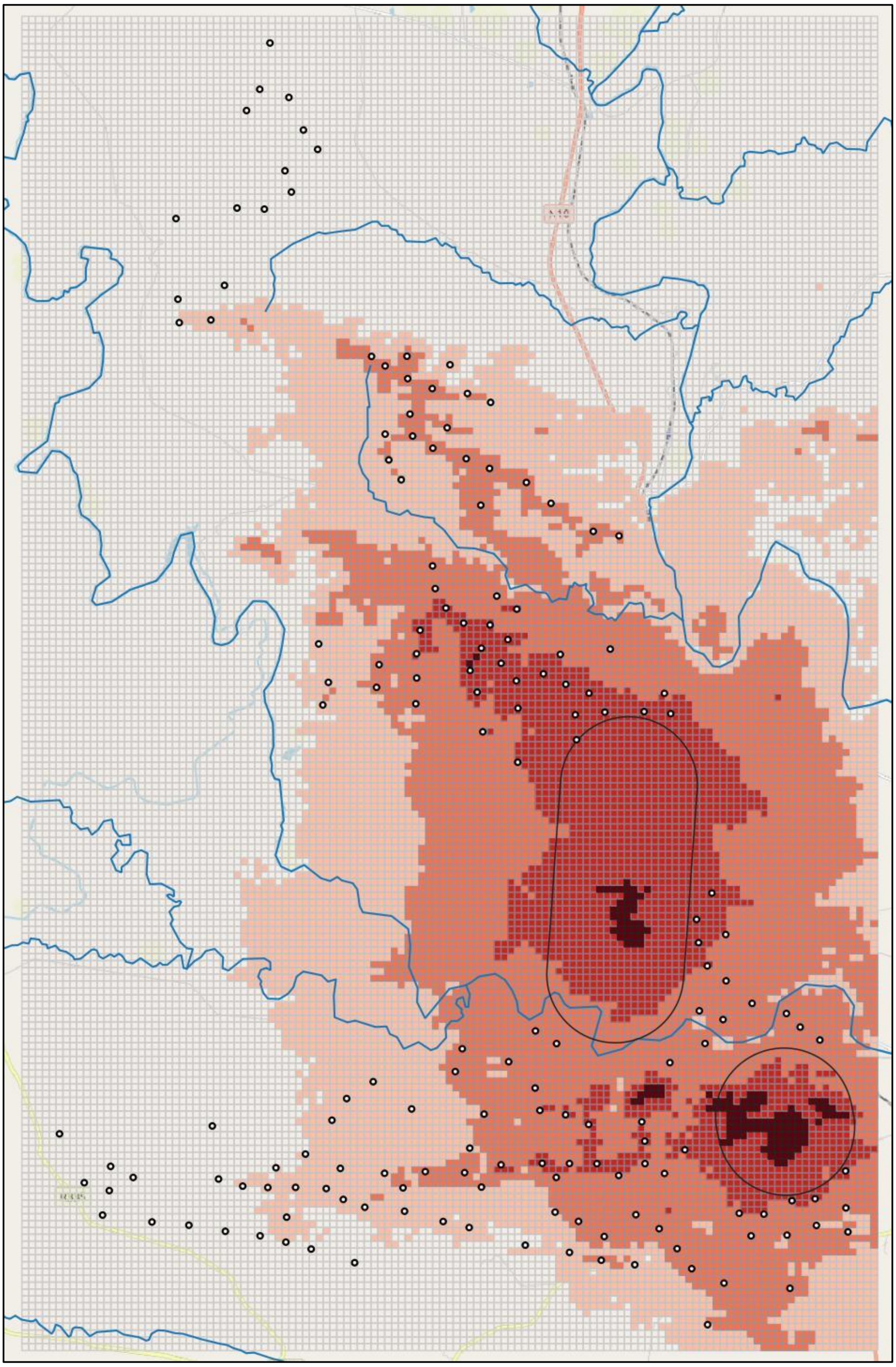


Table 3. Spatial autoregressive modelling results for Cape Vulture for Choje West June 2019 - August 2020

```
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

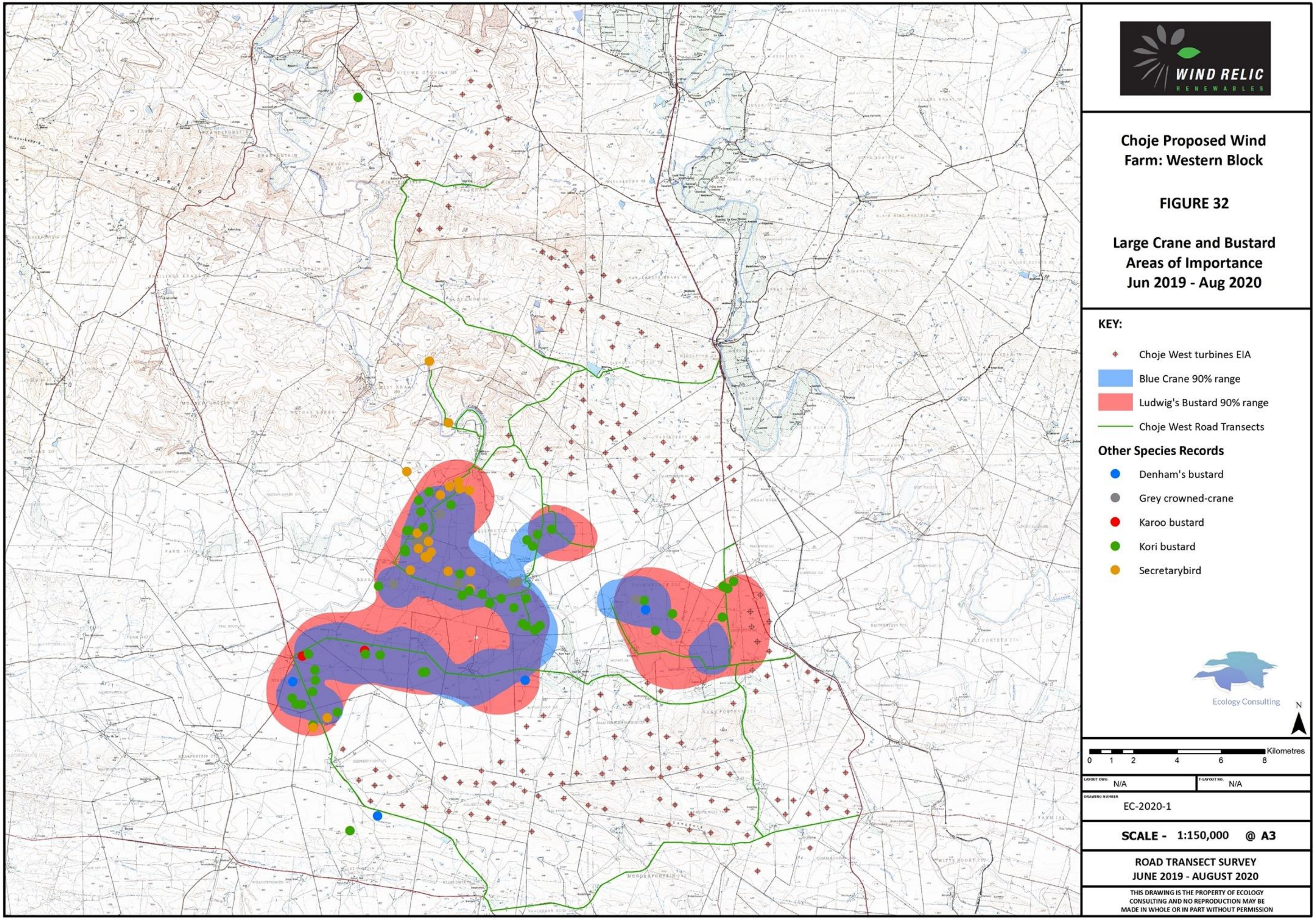
```
Wald test of spatial terms:          chi2(6) = 2612.03    Prob > chi2 = 0.0000
```

***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
Kilometres
0 1 2 4 6 8
N/A
N/A
EC-2020-1
SCALE - 1:150,000 @ A3
ROAD TRANSECT SURVEY
JUNE 2019 - AUGUST 2020
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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 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 needs to employ an independent Environmental Officer (EO) 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 EO 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 Ripponn 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 Ripponn Wind Farm if constructed.

<u>During construction monitoring</u>

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.

<u>Post-construction monitoring</u>

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 or updates thereto) 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 or any updates thereto) 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 or any updates thereto) should inform the programme design at the time.

Eagle Conservation Plan for the Choje energy complex

The future existence of the three large eagles, Martial, Verreaux's and African Crowned eagles will be under significant additional pressure from the proposed Choje wind and solar farms and their infrastructure. Because these eagles are presently already under pressure to survive mainly because of competition with farming activities and habitat loss.

This is a complex situation of biodiversity and natural food chains in competition with agriculture. More and more food is needed for humans in our cities. This creates a demand for landowners to produce such and with available water, this is possible even in the Karoo landscapes.

With this, more and more threats are put on the existence of these eagle species. The emphasis on only the three large eagles is because their behaviour and ability to kill larger prey (medium-sized mammals), which can include the young of domestic stock, make them different and put them regularly in conflict with farmers. Similarly their large territory sizes and habitat requirements are different to other raptors.

Below is a summary of the common threats currently facing these large eagles in the Karoo environment (Marnewick et al. 2015):

1. Habitat loss due to the ever expansion of the agricultural and food needs to plant more and more croplands, especially with the availability of water. Less habitat to support their prey base.
2. Permanent water along the Great and Little Fish rivers causes disproportionate growth of Acacia karroo thorn trees. These riparian overgrowths cover the rocky parts of the river (especially on bends), where Verreaux's eagle hunt, therefore limit them to large portions of their rocky habitat.
3. Overgrazing by domestic stock, sheep, goats and cattle. This results in a depletion of palatable plant species, soil erosion, and encroachment by Karoo shrubs, and include here is human encroachment. The result is loss of suitable habitat and a decrease in the availability of food (prey depletion) for these eagles.
4. Over-browsing by goats cause the degradation of bushveld thicket vegetation in the Eastern Cape, especially in remote southern slopes where Martial and African Crowned eagles nest/breed. The goats eat the undergrowth of bush clumps and this reduce the support of the large trees such as Euphorbia, Cussonia, Olive, and even Yellowwood. These trees often collapse when isolated.
5. Poisoning to control damage-causing predators, such as Blackbacked Jackal Canis mesomelas and Caracal Caracal caracas. The use of poison still continues, and the potential impacts on these eagle species has not been confirmed or quantified.
6. Roads are continuously getting more and busier. The areas next to busy motorways are commonly avoided by large eagles. Also because of eco-tourism and 4x4 trails, more and more hiking paths and 4x4-tracks are created in remote areas where large eagles breed.

7. Powerlines cause electrocutions and collisions. Small distribution power line poles in the Karoo are avoided by the three large eagles because these poles kill them> Although large pylons can be beneficial for these eagles as hunting perched and as nest structure in treeless environments. Currently no completely effective mitigation method to prevent collisions.
8. Persecution Direct persecution of eagles such as Verreaux's Eagle and Martial Eagle for stock predation is still taking place, using gin-traps or rifles to shoot them.
9. Climate change - Droughts are expected to become more severe, this will further aid more and more over-grazing by domestic stock and affect the depletion of prey.
10. Renewable energy developments. Five operating and six new wind farms and two solar developments are proposed within the Cookhouse RED zone. These have implications on the existence of these eagles in terms of collision mortality with turbines and displacement due to permanent habitat transformation.
11. Farm properties under study (bird and bat studies) where new WEFs are proposed, held the prospects of large financial benefits for landowners. These property owners will do anything to see this transpiring, therefore the existence of a historic/known eagle nest on such properties, might be a threat to such future WEF. Therefore it is possible and has likely happened that farmers attempt to destroy such nests.
12. In contrast, neighbouring farmers get no financial benefits if their neighbour gets turbines and they not because of recommended eagle buffers, this situation can also result in the destroying of eagle nests.

With all the above considerations, it is easy to see that these long-lived (60years), slow-breeding (one chick every two years), large prey (lower numbers than smaller prey) eating eagles will need serious assistance with an effectively managed conservation plan when such WEFs are authorized.

Below are recommendations:

1. The approval of wind and solar farms on private commercial farms can have many additional benefits for the environment and the farmer. Firstly the farmer will get substantial financial benefits, therefore before the authorization of such WEF by DEA, the farmer should sign agreements that will benefit and promote the natural biodiversity of his property and the wider environment.
2. More restrictions on authorizing EIA applications for bush clearing for croplands, therefore less habitat loss.
3. Working for Water projects should be implemented to clear Acacia karroo thickets along the Greater and Little Fish rivers, therefore opening of rocky areas.
4. Also, with the approval of these proposed WEFs and solar farms and the large financial benefits landowners will get, they can be less dependent on their agricultural activities for their existence. Therefore they can reduce their domestic stock numbers, which will benefit the environment largely in terms of soil conservation, water reduction, plant growth and the natural biodiversity, and this is likely to increase the prey base for the eagles.
5. Implement a 500x500m areas fenced area around known Martial eagle nests, to limit domestic stock of entering and ensure the growth and existence of thicket bush clumps. Such idea has been shared with farmers and with their positive agreements because they will do anything not to lose turbines, etc.
6. If possible, areas along major motorways and powerline corridors should be use for turbine and solar panel locations. Ensuring that not more natural habitats area changed.
7. Where possible, only existing powerline corridors should be used, therefore the opening of new powerlines to be constructed should be limited.
8. The benefit of restricting over-grazing, will increase the natural prey base of damage-causing predators and large eagles, therefore farmers must sign agreements that they will never use chemicals to poison any animal or never use gin-traps, never kill/shoot any eagle on his farm. Or he will lose his wind farm concession,
9. Points No. 11 and 12 in the previous section is a very controversial issue and difficult to proof, it is therefore recommended that neighbours also get some financial benefit by ensuring the successful existence of an eagle nest or breeding site.

CHOJE ORNITHOLOGICAL MITIGATION PLAN AND METHOD STATEMENT

The purpose of this document is to set out a framework to develop and agree mitigation measures and their implementation for the Choje wind farm cluster with stakeholders, including BirdLife South Africa, EWT and Vulpro. It is a working document that will be updated as the mitigation plan is developed. The mitigation package will be implemented to ensure that all of the Choje wind farms, alone and in-combination, do not result in any significant ornithological impacts. Implementation of these measures is considered to be a prerequisite for a positive Environmental Authorisation.

The ornithological assessments for these six wind farms have identified a range of key species of conservation concern that could be at risk from the developments, including:

- Martial Eagle
- Verreaux's Eagle
- Cape Vulture
- Secretarybird
- Blue Crane
- Ludwig's Bustard

The following potential impacts have been identified that could adversely affect these species:

- Collision with wind turbines
- Collision with overhead powerlines
- Electrocution on overhead powerlines
- Disturbance during operation
- Disturbance during construction/decommissioning
- Habitat loss through construction

The Mitigation Hierarchy is being followed during the development design process, sequentially reducing impacts through a process of avoidance, minimisation, mitigation, compensation and enhancement measures (CIEEM 2018).

Design Mitigation – Avoidance

Ornithological baseline data have been used to establish the optimal extent of turbine-free buffers around the most important centres of flight activity around key species' nest and roost sites, where flight activity was significantly higher than over the site as a whole.

- Verreaux's Eagle – 1.5km from nest sites (in line with BLSA recommended minimum buffer)
- Martial Eagle – 2.5km from nest sites
- Cape Vulture – 2km from main roost sites

These buffers were defined using the baseline survey data and spatial modelling of the key species' habitat preferences and flight densities in relation to distance from the nest (Verreaux's and Martial Eagle) and roost sites (Cape Vulture). 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 but beyond 2.5km flight density was consistently lower. This provided 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.

For Verreaux's Eagle, a buffer zone of 1.5km from nests was applied, in line with BLSA guidance, BLSA 2017). The baseline data showed flight activity within the 1.5-3km zone around nests was not higher than that at greater distance from the nest, so extending a turbine-free buffer to 3km would not be likely to deliver any significant reduction in collision risk.

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). This distance was therefore applied as a buffer zone.

Design Mitigation – Minimisation

Amber caution zones have been identified around locations where turbines have been minimised, and where mitigation measures would need specific focus:

- Verreaux's Eagle – 1.5-3km around nest sites
- Martial Eagle – 2.5-5km around nest sites
- Large terrestrial birds (blue crane and bustards) higher density areas[3]

PROPOSED ORNITHOLOGICAL MITIGATION PACKAGE

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 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 and Secretarybird. These should not be disturbed at the 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 were 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

[3] Areas of higher importance for cranes and bustards were identified from the 90% utilisation range of the blue crane and Ludwig's bustard, using kernel density estimation (Worton 1989), checked against the records from the other large crane and bustard species to ensure all important area were included.

encroaching onto adjacent habitat. It is important to protect habitats adjacent to the working area, since they might be used by nesting birds.

Operational Phase Mitigation

Cape Vulture Collision Risk Reduction

1. Removal of suitable roost sites

Currently a string of powerline towers provides attractive roost sites for the vultures within the Choje West area, enabling them to access areas that otherwise they may not use (in the absence of natural cliff roost sites). These measures will reduce the availability of those artificial roost sites, through the fitting of anti-vulture perching measures on pylons, measures that are a proven and well-established management measure in South Africa. It is proposed that these should be fitted to all pylon towers within 5km of the proposed wind turbine locations.

2. Removal of vulture food resources within wind farm properties

A detailed carrion search management plan will be implemented for all farms associated within the wind and solar developments. This will involve weekly checks of all properties for dead stock animals, and removal of any carcasses located.

General Collision Risk Reduction

A number of the measures below are required to be implemented during the construction phase and must be monitored and maintained during operation.

1. Increase turbine blade visibility

Recent trials of increasing blade visibility by painting one of the three turbine blades black have been successful in reducing collision risk to white-tailed eagles in Norway, a species that is known to be particularly vulnerable to collision (May *et al.* 2020). Collision risk to this species was reduced by 70%.

It is proposed that this mitigation measure will be initially trialled on turbines located in more sensitive areas, i.e. those within the amber zones defined above. Additionally, the trial will also include turbines within 5km of main vulture roosts. All these will have single black blades fitted (or similar mitigation to make the blade more visible) during construction.

As this is a trial deployment, it will be monitored in detail to determine effects on bird behaviour and efficacy as a mitigation measure at this site.

2. Reduce overhead line collision risk

Bird flight diverters will be fitted onto all new 132kV and 400kV overhead lines within the project development footprint during the construction phase, in line with the measures recommended in the Eskom/EWT Wildlife and Energy partnership. Opportunities will also be identified where the same measures can also be retrofitted to existing overhead lines in areas with higher densities of species at risk of collision.

3. On-site Habitat Management

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 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 will be removed prior to the commencement of operation of the turbines and through the operational phase of the wind farm. In addition, the proposed turbine bases should not serve as a refuge for small mammals, and thus the turbines themselves will not create attractive habitat for potential prey species such a hyrax.

4. Off-site Habitat Management

A management programme will 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 will be drawn up and implemented to integrate the ecological requirements of the local raptors into the management of this area. Range management plans will be developed for each Verreaux's Eagle and Martial Eagle range that could be affected by the developments, which will include measures to offset losses of existing range habitat through disturbance and direct loss to the developments. Measures to enhance local crane and bustard populations will also be implemented.

Collision Risk Management: Shutdown-on-Demand

As a further backup to ensure significant numbers of bird collisions do not occur at the site, a Shut-Down-On-Demand (SDOD) programme will be implemented for all six wind farms.

The initial focus of this work wil be the higher risk areas, i.e. the amber buffer zones for Verreaux's and Martial Eagles (1.5-3km and 2.5-5km respectively), 2-5km buffer around Cape Vulture roosts, and the large terrestrial bird (blue crane and bustard) higher sensitivity areas.

This would then be extended as necessary over the site in an adaptive management programme, informed by the results of a collision monitoring programme.

Shutdown-on-demand is a proven method to reduce collision risk (BirdLife 2015). SDOD is currently being implemented in South Africa, for example at the Excelsior wind farm.

The base case for a SDOD scheme at Choje would be one using field observers to manually shut down turbines when 'at risk' flights of key species were identified.

Technology-assisted systems would also be investigated to develop the system further. Radar-based and camera imaging systems have both been shown to be effective (BirdLife 2015). Some systems are now fully automated, and have been successfully deployed, reducing eagle collision risk by 82% (McClure et al. 2020).

A successful SDOD system will need clear shutdown criteria. An initial precautionary approach is proposed, such that whenever any key species was seen within 500m of a wind turbine, at risk height, that turbine would be shut down until the bird had passed out of the risk zone. This process would be refined as more knowledge from the site was built up of the risk factors. And how best to manage these. It will initially include all key species, i.e. all species listed above, though this will be reviewed in light of the results of the system in operation.

Security of Mitigation

It is critically important that the delivery of the required mitigation package is guaranteed. It is proposed that this should be achieved through condition of consent but also through legal commitment for delivery. The mitigation package will be set out in a legally binding method statement when the measures are finalised, with the aim to achieve net zero loss of priority species through these innovative solutions and collaboration with stakeholders (including BLSA, EWT, and University research departments/institutes).

Measures to avoid construction disturbance

The implementation of turbine-free buffers in the areas of highest ornithological sensitivity means that specific measures to protect these areas from disturbance during construction should not be necessary (as those areas are already sufficiently buffered from disturbance). However, a watching brief will be maintained in case there are any changes that could result in any construction disturbance to nesting bird or bustard leks.

Monitoring of Mitigation Effectiveness and Ornithological Impacts

A detailed post-construction monitoring programme will be an essential and integral part of the mitigation package, to ensure that it both delivers the required results and is managed in the optimal way. This will include:

- comprehensive collision checks (on at least a weekly basis for an agreed sample of at least 25% of turbines, including all those within amber zones);
- monitoring of key species flight activity in/around the wind farm;
- key species nest site and breeding success;
- large terrestrial bird vehicle transects;
- Cape vulture roost counts;
- Monitoring of flight behaviour in relation to single black blade painting;
- Effectiveness of SDOD, including recording of near-misses and 'false positive' shutdown events;
- Monitoring of effectiveness of habitat management measures;
- Detailed tracking of key species, with specific tracking programmes tusing appropriate technology (e.g. fitting of GPS tags) to better understand flight behaviour in proximity to wind turbines, and also to test and develop the spatial modelling undertaken as part of the baseline assessment work.

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CIEEM (2018) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater, Coastal and Marine. Chartered Institute of Ecology and Environmental Management, Winchester.

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McClure, C. J. W., B. W. Rolek, L. Dunn, J. D. McCabe, L. Martinson, and T. Katzner. 2021. Eagle fatalities are reduced by automated curtailment of wind turbines. Journal of Applied Ecology 58:446-452.

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Worton, B. 1989. Kernel methods for estimating the utilization distribution in home-range studies. Ecology 70:164–8.

Appendix C - the Specialist's 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 Redding wind farm development, south of Cookhouse, in the Blue Crane Route 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

Details of Specialist, Declaration and Undertaking Under Oath

Page 1 of 3

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 of the Specialist

East Cape Diverse Consultants

Name of Company:

1 Dec 2020

Date

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]

Signature of the Specialist

East Cape Diverse Consultants

Name of Company

1 Dec 2020

Date

[signature] 7180652 CM n. Compher

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.