FE Kudu Wind Energy Facility, Eastern Cape Province

Bat Monitoring & Basic Assessment Report

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FE Kudu Wind Energy Facility, Eastern Cape Province

Bat Monitoring & Basic Assessment Report

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Acronyms and Abbreviations

Name	Description
AOI	Area of Interest
BA	Basic Assessment
BESS	Battery Energy Storage System
DMRE	Department of Mineral Resource and Energy
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
ERM	Environmental Resources Management South Africa (Pty) Ltd
ha	Hectares
km	Kilometres
kV	Kilovolt
LED	Light-emitting Diode
m	Metres
MW	Megawatt
NEMA	National Environmental Management Act
O&M	Operations & Maintenance
PV	Photovoltaic
REIPPP	Renewable Energy Independent Power Producer Procurement
SABAA	South African Bat Assessment Association
WEF	Wind Energy Facility

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	Section of Report
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*.	Appendix B
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority.	Appendix B
(c) an indication of the scope of, and the purpose for which, the report was prepared.	Section 1
(cA) an indication of the quality and age of base data used for the specialist report.	Section 1, Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change.	Section 4
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment.	Section 1, Section 3
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used.	Section 2
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives.	Section 4, Appendix A - Figure 2
(g) an identification of any areas to be avoided, including buffers.	Section 4, Appendix A - Figure 2
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers.	Appendix A - Figure 2
(i) a description of any assumptions made and any uncertainties or gaps in knowledge.	Section 1.3
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities.	Section 3, Section 4
(k) any mitigation measures for inclusion in the EMPr.	Section 4, Section 5
(l) any conditions for inclusion in the environmental authorisation.	Section 4, Section 5
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation.	Section 4, Section 5
(n) a reasoned opinion— i. as to whether the proposed activity, activities or portions thereof should be authorised. iA. Regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan.	Section 4, Section 5, Section 6
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto.	None received as yet
(p) any other information requested by the competent authority.	None received
Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Government Notice No. 320 has been gazetted, and a verification report aligned with the requirements have been included.

1. INTRODUCTION

FE Kudu (Pty) Ltd ('FE Kudu') is considering the development of an up to 600 MW wind energy facility ('WEF') located approximately 40 km west of Aberdeen in the Eastern Cape Province. The proposed WEF will form part of a cluster of renewable energy projects, inclusive of the proposed FE Kudu WEF and FE Tango WEF. Environmental Resources Management Southern Africa (Pty) Ltd ('ERM') was appointed to conduct the pre-construction bat monitoring for the projects, the results of which have informed the final monitoring and specialist basic assessment process required for environmental authorisation in terms of the National Environmental Management Act, 1998 (Act 107 of 1998, as amended) (NEMA) and associated EIA regulations of 2014 as amended (EIA regulations). The final results and anticipated impacts for the FE Kudu WEF are assessed in this report[1]. All results are based on data obtained from a broader study area / area of interest ('AOI'), collectively known as the 'Aberdeen WEF Cluster Study Area'. This area is approximately ~19 440 hectares in extent, while the FE Kudu WEF makes up ~9 170 ha of this AOI (Figure 1).

The aim of the bat monitoring programme was to document bat activity in the AOI and, based on this activity, assess the proposed FE Kudu WEF (with results informed by the full WEF cluster) with regards to potential impacts to bats and the risk to development consent. The data obtained establishes a pre-construction baseline of bat species diversity and activity and are used to inform the required impact assessments. The monitoring data also assists in providing solutions to avoid and mitigate impacts by informing the final design and management strategies (construction and operation) of the WEF. The baseline will also be used to compare impacts to bats during the operational phase of the project, relative to that predicted during the pre-construction scenario.

This basic assessment report includes the results from the bat activity monitoring campaign undertaken between 30 March 2021 and 12 June 2023.

1.1 Description of the Proposed Development

The project is located within the Dr Beyers Naude Local Municipality and the greater Sarah Baartman District Municipality. The project site comprises a single affected property, Portion 2 of Farm Oorlogspoort 85. The project is planned as part of a cluster of renewable energy projects, which includes a second WEF with a capacity of up to 150 MW (FE Tango WEF), located approximately 20 km east of the FE Kudu WEF.

The entire extent of the site falls within the Beaufort West Renewable Energy Development Zones (i.e. REDZ Focus Area 11). The undertaking of a basic assessment process (currently underway by Savannah Environmental) for the project is in line with the requirements listed in GNR 114 of 16 February 2018.

The Kudu WEF will comprise wind turbines with a capacity of up to 7.5 MW each. The current infrastructure under consideration is an optimised layout, based on all environmental and social sensitivities that have been generated. Access to the site will be via an access road off the nearby R61. The FE Kudu WEF project site is proposed to accommodate the following infrastructure (Figure 2):

- Up to 80 Wind turbines
- Concrete turbine foundations and turbine hardstands
- An on-site substation hub incorporating:
  - A132/33 kV On-site substation
  - Switchyard with collector infrastructure
  - Battery Energy Storage System ('BESS')

[1] FE Kudu WEF assessed separately, as part of a separate Basic Assessment process.

  - Operation and Maintenance buildings
- A balance of plant area incorporating:
  - Temporary laydown areas
  - A construction camp laydown and temporary concrete batching plant
- Cabling between the turbines, to be laid underground where practical.
- Access roads to the site and between project components with a width up to 8m for primary access routes.

The project is intended to provide electricity to the national grid through the Department of Mineral Resource and Energy's (DMRE) Renewable Energy Independent Power Producer Procurement (REIPPP) Programme or other public or private off-taker programmes.

1.2 Assumptions and Limitations

The following assumptions and limitations relevant to this study are noted:

- The knowledge of certain aspects of South African bats including natural history, population sizes, demographics, local and regional distribution patterns, spatial and temporal movement patterns (including migration and flying heights) and how bats may be impacted by wind energy, including cumulatively, is very limited for many species.
- Bat echolocation calls (i.e. ultrasound) operate over ranges of metres therefore acoustic monitoring samples only a small amount of space (Adams *et al*. 2012). Recording a bat using sound is influenced by the type and intensity of the echolocation call produced, the species of bat, the bat detector system used, the orientation of the signal relative to the microphone and environmental conditions such as humidity. One must therefore adopt a precautionary approach when extrapolating data from echolocation surveys over large areas due to the limited sample size (i.e., only small areas are actually sampled).
- There can be considerable variation in bat calls between different species and within species. The accuracy of the species identification is dependent on the quality of the calls used for identification. Species call parameters can often overlap, making species identification difficult.
- Automatic bat classifiers in Kaleidoscope Pro Version 5.4.7 (Wildlife Acoustics, Inc) were used to identify bat species. Post-processing was used to manually verify the performance of the classifiers, but owing to the large number of files recorded, not all recordings could be verified manually. There may be instances where the software was unable to identify species or made incorrect identifications.
- Bat activity recorded by bat detectors cannot be used to directly estimate abundance or population sizes because detectors cannot distinguish between a single bat flying past a detector multiple times or between multiple bats of the same species passing a detector once each (Kunz *et al*. 2007a). This is interpreted using the specialists' knowledge and is presented as relative abundance.
- The potential impacts of wind energy on bats presented in this report represent the current knowledge in this field. New evidence from research and consultancy projects may become available in future, meaning that impacts and mitigation options presented and discussed in this report may need to be adjusted if the project is developed.
- While the data presented in this report provides a baseline of bat activity for the period sampled, it does not allow for an understanding of interannual variation in bat activity. It is therefore possible that during the lifespan of the facility, bat activity could be significantly different (lower or higher) compared to the baseline presented here.

- The FE Kudu Wind Energy Facility is a subset of a greater area of influence that forms the basis of the analysis conducted. Therefore, we assume that the overall analysis is a fair representation of conditions on the FE Kudu WEF site.

1.3 Applicable Legislation, Policies, Treaties, Guidelines and Standards

The following items provide a governance framework and guidelines for the consideration and management of impacts to biodiversity and are applicable to the development of infrastructure, including WEF's, that may result in such impacts:

- The Equator Principles (2013);
- International Finance Corporation Environmental, Health, and Safety Guidelines for Wind Energy (2015);
- Convention on the Conservation of Migratory Species of Wild Animals (1979);
- Convention on Biological Diversity (1993);
- Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996);
- National Environmental Management Act, 1998 (NEMA, Act No. 107 of 1998);
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004);
- National Biodiversity Strategy and Action Plan (2005);
- South African Best Practise Guidelines for Surveying Bats in Wind Energy Facility Developments – Pre-Construction (2020) & Post-Construction (2020);
- South African Bat Fatality Threshold Guidelines (MacEwan *et al*., 2018); and
- Species Environmental Assessment Guidelines (2022).

2. METHODOLOGY

2.1 Desktop Review

A desktop study of available bat locality data, literature and mapping resources was undertaken to determine the likelihood of bats being present at the proposed project site. Literature was also sought to understand the current state of knowledge of wind energy impacts on bats, globally. Very little published research in this regard is available for the South African context. Data sources included:

- Academic sources such as research papers and published texts;
- Information on bat activity at other nearby renewable energy developments such as from pre-construction and operational monitoring reports, EIA reports and EMPrs;
- Bat distribution records and maps; and
- A desktop review of the habitats on the site to identify, if possible, habitats, roosts and features which may be associated with bats.

2.2 Field Surveys

The pre-construction monitoring was designed to monitor bat activity across the proposed project site, but considered the full extent of the Aberdeen WEF Cluster Study Area[2]. The monitoring was undertaken in accordance with South African best practice (Sowler *et al*. 2020). Sampling of bat activity took place at seven locations (Figure 1) using Song Meter SM4 bat detectors (Wildlife Acoustics, Inc.). An ultrasonic microphone was mounted at 10 m ("ground level") at all these locations. Two of these

[2] The area of interest ('AOI'), collectively known as the 'Aberdeen WEF Cluster Study Area' is approximately ~19 440 hectares in extent. The FE Kudu WEF makes up ~9 170 ha of this AOI.

locations were meteorological masts on which microphones were placed at 10 m, 55 m, and 110 m, respectively (where 55 m and 110 m are considered to sample bat activity "at height"). All detectors were configured to record every night from 30 minutes before sunset until 30 minutes after sunrise.

The distribution of monitoring locations across the site (Figure 1) was determined based on vegetation types, land-use, and topography with the aim to sample bat activity in areas where bat activity was expected to be higher (e.g. near water and buildings, along riparian vegetation), but also in areas where bat activity was expected to be lower (e.g. away from water and buildings, on top of ridges, in open areas with low habitat complexity).

In addition to the acoustic monitoring, potential structures that bats could use as roosts were investigated during the day for the presence or evidence of roosting bats (e.g., guano and culled insect remains, etc.) when the ERM team was on site (3-4 March 2022). These included buildings, rocky outcrops, and trees. Potentially sensitive geographical features from GIS databases were also ground-truthed during the site visit, to further refine the bat sensitivity buffers.

2.3 Data Analysis

Bats emit ultrasonic echolocation calls for orientation, navigation and foraging. These calls can be recorded by bat detectors, enabling bat species to be identified from various features in their calls (e.g. the frequency of the call). A sequence of bat calls is termed a bat pass, defined as two or more echolocation calls separated from other calls by more than 500 milliseconds (Hayes 1997; Thomas 1988). Quantifying the number of bat passes recorded can be used to quantify the relative abundance of bat species.

Acoustic data from each bat detector was analysed using Kaleidoscope® Pro (Version 5.4.7, Wildlife Acoustics, Inc.). Bat species were automatically identified from their echolocation calls using the embedded echolocation call library in the software. The results were vetted by random or selective (for certain species) checks through manually identifying recordings to verify the results. The total number of files was used as a proxy for the number of bat passes, which is a standard approach to quantifying bat activity.

3. BASELINE ENVIRONMENT

3.1 Habitats

The Aberdeen WEF Cluster Study Area is situated entirely within the Nama Karoo ecoregion and encompasses four distinct vegetation types: Eastern Lower Karoo, Southern Karoo Riviere, Upper Karoo Hardveld, and Gamka Karoo. As for the FE Kudu WEF site, it can be divided into three parts based on vegetation types. The eastern and the western portion is characterised by the Eastern Lower Karoo vegetation type, while the middle portion is characterised by the Southern Karoo Riviere, and the Southern portion showcases the Gamka Karoo vegetation type. The Eastern Lower Karoo is characterised by plains interrupted by dolerite dykes, buttes, and mesas, supporting a middle-height microphyllous shrubland dominated by 'white' grasses as the prevailing plant community. The Southern Karoo Riviere displays a landscape dominated by narrow riverine flats with sandy drainage lines. This vegetation type hosts a complex of *Acacia karroo* or *Tamarix usneoides* thickets, tall Salsola-dominated shrubland, and Mesic thicket, which is more prevalent in the far eastern parts of this vegetation type. The Upper Karoo Hardeveld vegetation type has steep slopes characterised by rocky outcrops, buttes, and mesas. The Gamka Karoo vegetation type is characterised by hardy, drought-resistant shrubs and succulents.

Foraging bats face ecological challenges during flight due to clutter, such as vegetation, which presents perceptual and mechanical obstacles. Perceptually, the sensory capabilities of bats limit their ability to detect prey amidst clutter, as their echolocation system may be adapted differently for dense vegetation versus open spaces. Mechanically, bats' flight ability is constrained by wing adaptations suited for manoeuvring in dense vegetation or open areas. Habitats can be categorised based on clutter conditions, including uncluttered space (open areas, high above the ground), background cluttered space (near vegetation edges and gaps, and near the ground or water surfaces), and highly cluttered space (very close to surfaces like leaves or the ground). Diverse clutter conditions are more likely to support various bat species, and the structural complexity of a site is crucial for higher bat species diversity. While suitable habitats for roosting, foraging, and commuting exist in the mountainous areas, major bat roosts are lacking near the WEF boundaries.

The availability of roosting space is a critical factor for bats (Kunz and Lumsden 2003), determining their presence and species diversity in a landscape. Potential roosting features on site include buildings, trees (associated with farmsteads), and rocky outcrops. Certain bat species utilise rocky crevices (Monadjem *et al*. 2010), while others, like the Cape serotine and Egyptian free-tailed bats, use buildings as roosts (Monadjem *et al.* 2010). The absence of large caves in the study area suggests limited potential for large bat colonies, though the mountainous areas in the north have the potential to provide suitable roosting habitat and certain existing building infrastructures have the potential to also accommodate larger bat colonies.

Water sources are vital for bats, as drinking resources may not only be used to sustain bats directly, but are also attractors of insects and vegetation growth (e.g. riparian vegetation), making them suitable foraging and roosting sites (Greif and Siemers 2010; Sirami *et al*. 2013). For this reason, reservoirs and farm dams in the study area are likely to attract bats, along with rivers and drainage lines used for foraging and commuting. Some water resources are non-perennial, restricting availability to bats during specific periods, which may limit potential impacts to certain times of the year. Cultivated land is important for foraging, as some species hunt insect pests in agricultural fields (Noer *et al*. 2012; Taylor *et al*. 2011), though such areas are not that prevalent across the site.

Bats use linear landscape features, such as tree lines and edge habitat, as commuting routes between foraging and roost sites and water sources. These features offer protection from predators, shelter from wind, and provide orientation cues and foraging habitats (Verboom and Huitema 1997; Verboom 1998). The primary linear landscape features are drainage lines, often associated with riparian vegetation, providing bats with access to linear and edge habitat. Rivers, tree lines, and other edge habitats can also serve as commuting routes or navigation cues.

3.2 Bat Species

Approximately 13 bat species can potentially occur within the AOI (African Chiroptera Report 2018, IUCN 2017). However, due to limited knowledge of some bat species' distributions in South Africa, particularly rarer ones, it is possible that more or fewer species may be present.

Acoustic monitoring data analysis suggests that at least 10 bat species have been recorded on site (Table 1). The sensitivity of each species to the WEF depends on their conservation status and the likelihood of risk posed by the development. This risk assessment considers factors such as the foraging and flight ecology of bats, as well as their migratory behaviour.

Table 1: Potential and confirmed bat species within the AOI

Species	Species Code	# of Bat Passes	Conservation Status[3]		Likelihood of Risk
			National (2016)	Global	
Egyptian free-tailed bat *Tadarida aegyptiaca*	TADAEG	208 447	Least Concern	Least Concern	High
Long-tailed serotine *Eptesicus hottentotus*	EPTHOT	2 809	Least Concern	Least Concern	High
Cape serotine *Neoromicia capensis*	NEOCAP	38 071	Least Concern	Least Concern	High

[3] Child, M.F., Roxburgh, L., Do Linh San, E., Raimondo, D., Davies-Mostert, H.T. eds., 2016. The Red List of Mammals of South Africa, Swaziland and Lesotho. South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

Species	Species Code	# of Bat Passes	Conservation Status[3]		Likelihood of Risk
			National (2016)	Global	
Natal long-fingered bat *Miniopterus natalensis*	VES50/NLB	10 113	Least Concern	Least Concern	High
Lesueur's hairy bat *Cistugo lesueuri*			Near Threatened	Least Concern	Low
Temminks hairy bat *Myotis tricolor*			Near Threatened	Least Concern	Medium-High
Zulu Serotine *Neoromicia zuluensis*			Least Concern	Least Concern	High
Lesser Long-fingered Bat *Miniopterus fraterculus*	MINFRA	14	Least Concern	Least Concern	High
Egyptian slit-faced bat *Nycteris thebaica*	NYCTHE	-	Least Concern	Least Concern	Low
Cape horseshoe bat *Rhinolophus capensis*	RHICAP	116	Least Concern	Least Concern	Low
Geoffroy's horseshoe bat *Rhinolophus clivosus*	RHICLI	173	Least Concern	Least Concern	Low
African straw-coloured fruit bat *Eidolon helvum*	-	-	Near Threatened	Least Concern	High
Egyptian fruit bat *Rousettus aegyptiacus*	-	-	Least Concern	Least Concern	High
Subtotal # of Bat Passes		259 743			

3.3 Spatio-Temporal Bat Activity Patterns

Data obtained from the full monitoring campaign yielded a total of 259 743 bat passes recorded across all detectors within the AOI (Table 1). The Egyptian Free-tailed bat and Cape Serotine dominated the recorded activity, accounting for 80% and 15% of the total bat passes, respectively. All other species accounted for less than 5% of activity. The Egyptian Free-tailed bat was also the most abundant species recorded at rotor sweep height, accounting for 98% of passes at both 55 m and 110 m.

The percentage of nights with bat activity varied from moderate to high, with bats recorded between 57% and 97% of sample nights (Table 2).

Activity at height (55 m and 110 m) was moderate to high for the Nama Karoo ecoregion. Height-specific bat activity and fatality risk in the Nama Karoo ecoregion is defined by MacEwan *et al*. (2020) as:

Near Ground

- Low Risk: < 0.18 median bat passes per hour.
- Medium Risk: 0.18 – 1.01 median bat passes per hour.
- High Risk: > 1.01 median bat passes per hour.

Rotor Sweep

- Low Risk: < 0.03 median bat passes per hour.
- Medium Risk: 0.03 – 0.42 median bat passes per hour.
- High Risk: > 0.42 median bat passes per hour.

Table 2: Acoustic monitoring summary

Detector	Date Installed	# of Sample Nights	% of Sample Nights with Bat Activity	Mean Passes/Night; Median Bat Passes/hour	Total Bat Passes
A1	12/07/2021	677	97	247.25;10.45	166 895
A2	31/03/2021	519	83	15.13;0.54	7 851
A3_Met_10m	30/03/2021	658	86	31.95;0.80	21 026
A3_Met_55m	12/07/2021	552	80	21.09;0.57	11 641
A3_Met_110m	12/07/2021	475	57	11.56;0.08	5 479
A4	12/07/2021	485	77	26.39;0.80	12 827
Kudu 1	30/03/2021	688	80	20.05; 0.62	13 792
Kudu 2	12/07/2021	500	81	20.26; 0.68	10 110
Kudu3_Met_10m	06/09/2022	197	75	27.86; 0.61	5 489
Kudu3_Met_55m	06/09/2022	61	85	37.31; 1.02	2 276
Kudu3_Met_110m	06/09/2022	100	90	23.57; 0.98	2 357

Green = low risk, orange = moderate risk and red = high risk for the Nama Karoo ecoregion.

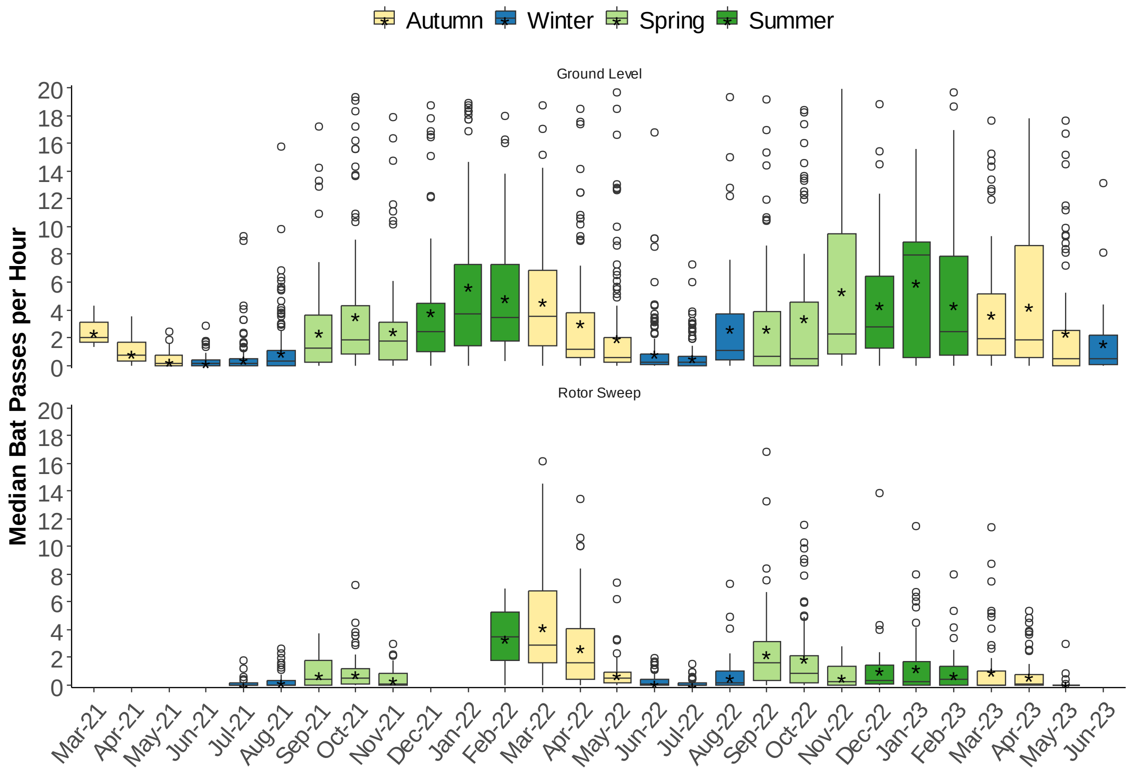
In terms of seasonal activity, activity was high at ground level and rotor sweep height in autumn (1.03 and 0.64 bp/h), summer (3.48 and 0.45 bp/h), and spring (1.64 and 0.7 bp/h, Table 3). Winter exhibited low activity levels at both ground level (0.14 bp/h) and medium levels at rotor sweep height (0.07 bp/h).

Table 3: Median bat passes per hour at ground level and rotor height per season

	autumn	winter	summer	spring
Ground Level	1.03	0.14	3.48	1.64
Rotor Sweep	0.64	0.07	0.45	0.70

Green = low risk, orange = moderate risk and red = high risk for the Nama Karoo ecoregion.

Specifically, activity at ground level was high from September to April, peaking in January of both 2022 (5.47 median bat passes per hour, bp/h) and 2023 (8.19 median bp/h, Table 4, Graph 1). However, activity at rotor sweep height slightly deviated from this pattern, peaking during the summer of 2021 (3.48 median bp/h in February), but not in the summer of 2022. Instead, activity increased to high levels in autumn 2022, before declining, and then increasing again to higher levels in spring, before declining again to moderate levels in December 2022 (Table 4).



Graph 1: Boxplot showing the temporal distribution of median bat passes per detector per hour per month

Analysis of activity distribution within the rotor sweep height band revealed notable differences between the two sampled heights (55 m and 110 m, Graph 2, Table 4). Activity levels were predominantly high at 55 m for most of the monitoring campaign, with the peak recorded in February 2021, reaching a median of 6.96 bp/h. However, at 110 m, the activity remained mostly low to moderate throughout the monitoring campaign, with high activity levels recorded only during autumn and spring of 2022, as well as in February 2023 (Table 4).

Overall, the results show a trend for activity (and subsequent risk of impacts) to be highest during spring, summer, and autumn seasons, while activity tends to be lower during winter.

Table 4: Median bat passes per hour per microphone per month

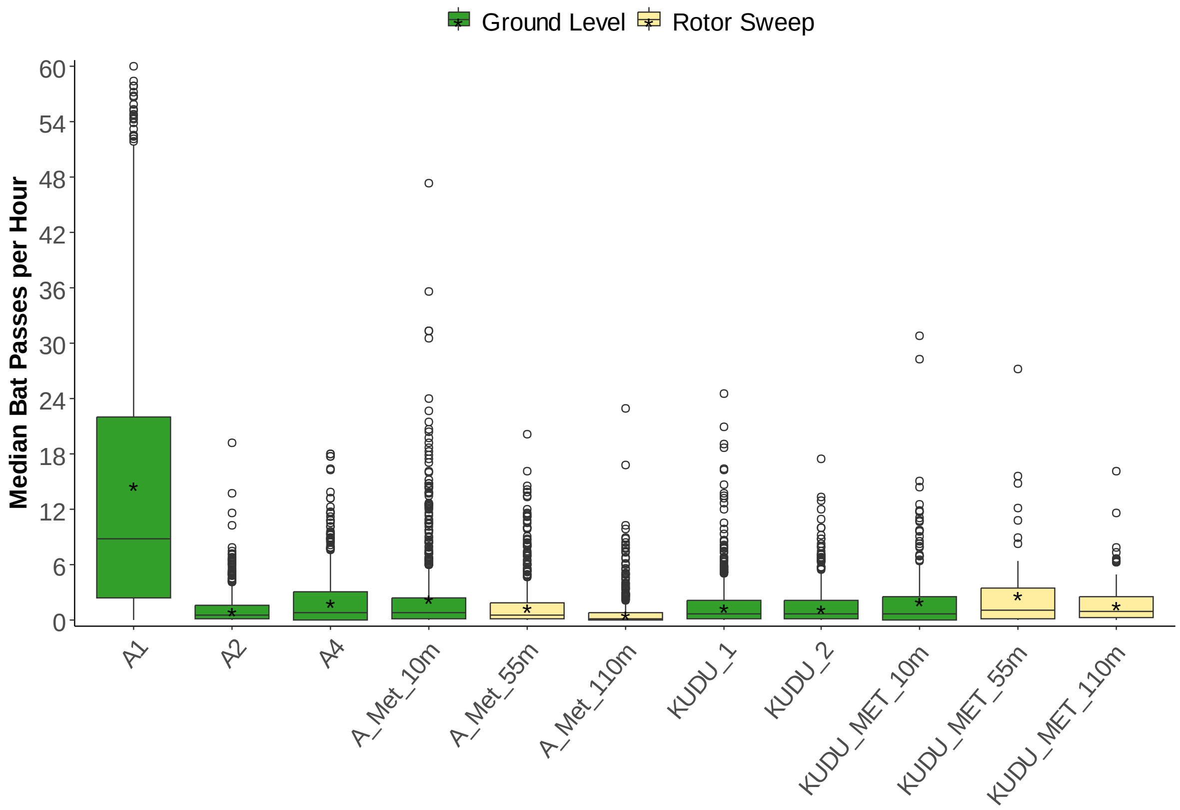
	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
2021												
Ground Level	2.05	0.61	0.14	0.07	0.07	0.21	1.05	1.35	1.42	2.79	5.47	4.29
Rotor Sweep	-	-	-	-	0	0.03	0.41	0.50	0.04	-	-	3.48
55m	-	-	-	-	0.07	0.07	0.41	0.67	0.18	-	-	6.96
110m	-	-	-	-	0	0	0.27	0.32	0	-	-	
2022												
Ground Level	3.27	1.30	0.54	0.20	0.20	0.84	1.88	2.35	2.37	2.78	8.19	2.43
Rotor Sweep	2.89	1.57	0.48	0.07	0	0.15	1.65	0.85	0.55	0.28	0.27	0.61
55m	5.33	2.13	0.79	0.07	0.07	0.36	3.46	0.71	0.39	0.37	1.10	1.36
110m	1.94	0.85	0.48	0.03	0	0.14	3.22	1.97	1.09	0	0.04	1.19
2023												
Ground Level	2.32	1.41	0.27	0.07								

	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb
Rotor Sweep	0.16	0.07	0	-								
55m	2.03	0.77	0.63	-								
110m	0	0	0	-								

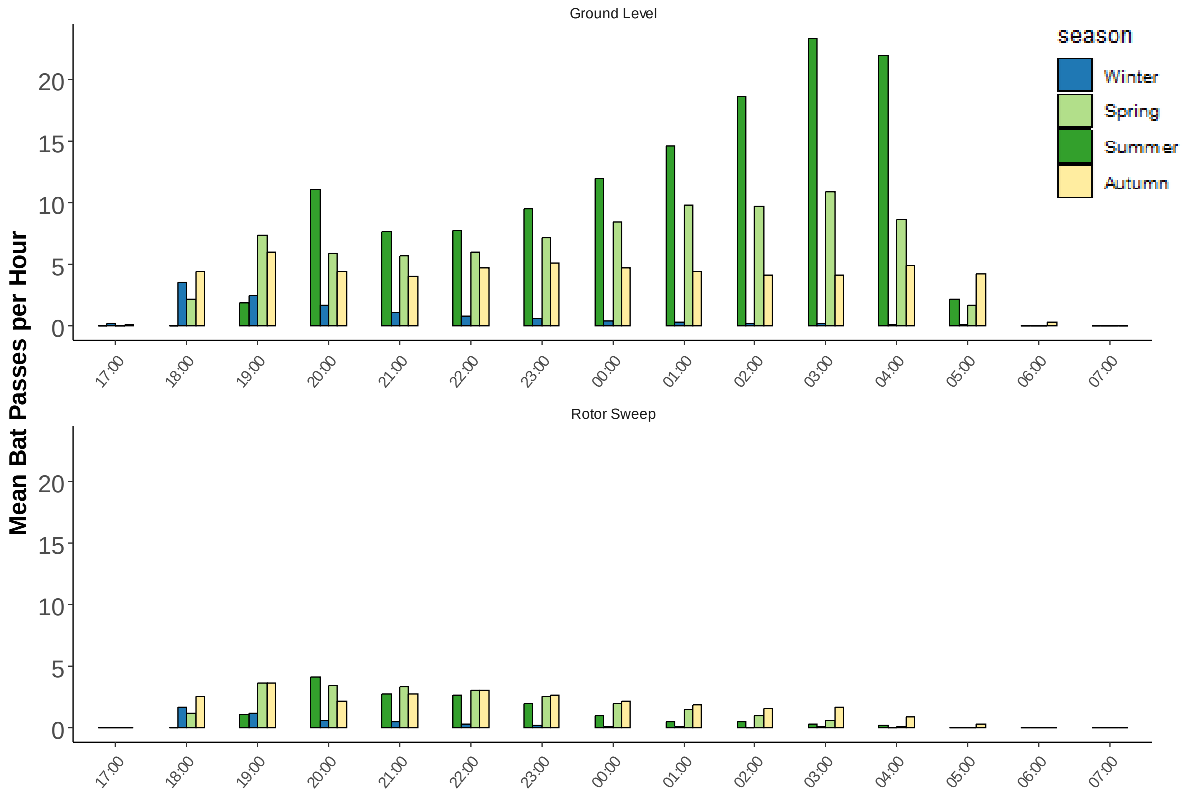
Green = low risk, orange = moderate risk and red = high risk for the Nama Karoo ecoregion.

Among the masts, short mast A1 stood out as recording the highest bat activity throughout the study period, with a median of 10.45 bp/h (Graph 2, Table 2). A1 also recorded the highest number of bat passes on a single night, with 1 687 passes occurring on the 31st of January 2022. The Egyptian Free-tailed bat was the most active species during this night, accounting for 1 498 passes, while the Cape Serotine and Long-tailed Serotine were only recorded to have 178 and 11 passes, respectively.

Bats were observed and recorded from sunset to sunrise (Graph 3), with the highest activity per hour occurring during the summer season. In summer, bat activity typically began between 19:00 and 20:00, with ground-level activity peaking at 03:00. At rotor sweep height, activity was lower overall and peaked earlier, between 20:00 and 21:00, after which it gradually decreased until sunrise. In spring, the pattern of bat activity closely resembled that of summer, with activity starting an hour earlier, between 18:00 and 19:00, ground-level activity peaking between 03:00 and 04:00, and rotor sweep height activity reaching its peak between 19:00 and 20:00. Similarly, in autumn, bat activity initiated between 18:00 and 19:00, with both ground level and rotor sweep height activities peaking between 19:00 and 20:00, followed by a gradual decline until sunrise. In winter, bat activity started and peaked in the initial two hours after sunset, occurring between 17:00 and 19:00, both at ground level and rotor sweep height.



Graph 2: Boxplot showing the median number of bat passes per detector per hour at ground level and rotor sweep height



Graph 3: Bar graph showing the mean number of bat passes per detector per hour. Each our represents one hour period (i.e. 18:00 = 18:00 – 19:00)

3.4 Discussion

The key findings from the full bat pre-construction monitoring campaign were that bat activity was generally moderate to high across the monitoring area, both at ground level and rotor sweep height. Activity at all heights was highest in spring, summer, and autumn seasons, while the lowest activity was recorded in winter. Activity peaked at ground level in January, while rotor sweep height activity yielded the highest activity levels in February. Thus, based on the data available, bats are at greatest risk to wind energy impacts during summer, followed by spring and autumn.

Bat activity also varied with the time of night. Overall, activity occurred throughout most of the night, across all four seasons. Summer and spring activity tended to peak early in the morning (around 03:00 to 04:00) before declining until sunrise. On the other hand, autumn and winter activity peaked very early (between 18:00 and 19:00) and at lower levels. This information is essential for developing suitable curtailment measures, if required, to mitigate any residual impacts.

Species diversity is typical for arid regions in South Africa (Cooper-Bohannon *et al*. 2016), with Egyptian Free-tailed and Cape Serotine being the most recorded species during the study period. Several other bat species susceptible to wind energy impacts were also present, with varying levels of risk. This includes six high risk species (Long-tailed serotine, Natal long-fingered bat, Zulu Serotine, and Lesser Long-fingered bat), one medium-high risk species (Temminks Hairy bat), and three low risk species (Lesueur’s Hairy bat, Cape Horseshoe bat, and Geoffroy’s Horseshoe bat). All of species detected have a Red List conservation status of “Least Concern”. Wind energy is however an emerging impact that may not be fully considered yet by the Red List of Mammals of South Africa and IUCN Red List. Fatality records of the Egyptian Free-tailed bat and Cape Serotine, specifically, are known from operating WEF’s across parts of South Africa (Doty and Martin 2021; Aronson *et al*. 2013; MacEwan 2016), and careful consideration should be made during the wind farm planning phase, to reduce the likelihood of impacts to such species, regardless of the conservation status.

The Egyptian Free-tailed bat accounted for the majority (80%) of the total bat activity during the sample period and 98% of rotor sweep height activity. This species is classified as high risk to wind energy developments due to its foraging ecology, which brings it in close proximity to wind turbine blades. Turbine design is a crucial factor in mitigating impacts to this species. For example, turbine hub height and rotor diameter should be carefully designed to reduce potential interactions between bats and turbine blades, as an increased lower blade tip is more likely to reduce impacts to clutter-edge foragers, while reducing the overall rotor diameter may decrease the total area in which potential direct impacts are likely to occur to certain bat species, inclusive of open-air foragers.

The bat detectors were strategically placed in the field, taking into account the expected variation in bat activity across different features within the study area (Figure 1). A1 was placed at the foot of a mountainous area close to a building, while A2 was positioned near a non-perennial river and riparian vegetation, where bat activity was anticipated to be high. A3_Met and A4 were positioned further away from these important features, within similar vegetation types and terrain, where activity was expected to be lower. The results revealed that A1 recorded the highest bat activity among all detectors, suggesting that the mountainous area to the north of FE Tango WEF demonstrated the most relevance for bats using the study area. A2, A4, Kudu 1, and Kudu 2, recorded marginally lower bat activity levels and were moderate for the Nama Karoo ecoregion. A2, specifically, associated with non-perennial drainage lines yielded the lowest median bat passes per hour (0.54), of any ground monitoring station – indicating that, although still relevant, such non-perennial features may not be as significant for bats as what was initially expected. Interestingly, A3_Met, which was expected to have lower activity levels due to its location further away from such sensitive features, showed high levels of bat activity at both 10 m and 55 m heights. Similarly, Kudu3_Met_55m and Kudu3_Met_110m also recorded high levels of bat activity. These findings suggest that bats utilise not only the areas close to the important features, but also regions further away, indicating a more widespread distribution of bat activity in the broader area. Nonetheless, a higher probability of impacts is likely to occur close to such sensitive features, due to their ecological importance to bats (navigation cues, roosting habitat and foraging & drinking sources).

Given the predominantly moderate and high activity levels recorded across the study area, it is evident that measures to avoid risks to bats are necessary. Effective mitigation options can be categorised into avoidance and minimisation techniques. Avoidance measures focus on spatially limiting potential interactions between bats and wind turbines by buffering key habitats. To achieve this, important habitats such as perennial watercourses, rivers, rocky outcrops, buildings, trees, water features, wetlands and cultivated lands have been buffered (200 m), while smaller non-perennial drainage lines have been buffered by 100 m (Figure 2), due to their marginally lower activity levels associated with them, and their inability to hold water for significant periods of the year. The buffer zones around these features should be entirely avoided from the placement of wind turbines, including the full blade length, to minimise potential impacts on the local bat population. Minimisation techniques, on the other hand, focus on mitigating residual impacts to bats primarily through curtailment[4] measures or the use of ultrasonic deterrents. These mitigation options may be considered during the operational phase of the project once real impacts are measured against fatality thresholds.

4. IMPACT ASSESSMENT

WEF's have the potential to directly impact bats through collisions and barotrauma, leading to mortality (Horn *et al*. 2008; Rollins *et al*. 2012). Indirect impacts can also occur due to habitat modification and disturbance/displacement effects (Kunz *et al*. 2007b) during the construction, operation and decommissioning of wind turbines and associated infrastructures. At the FE Kudu WEF, direct impacts pose the greatest risk to bats, with collisions being most relevant. However, habitat modification and disturbance/displacement also raise potential risks, especially if bats are disturbed during peak foraging or commuting hours or if potential roosting habitats are disturbed or destroyed. There is a possibility that bats may be reluctant to leave their roosts when subjected to disturbance, which may further exacerbate the impact.

During the monitoring campaign at the FE Kudu WEF site, no confirmed roosts have been identified based on evaluations of existing spatial data and specialist on-site observations. Nevertheless, it is essential to consider cumulative impacts, as similar effects on the local, regional, or national bat population could lead to irreparable losses for the affected bat community over time. Adequate mitigation measures are crucial to minimise the impact of the WEF on bats and their habitats.

4.1 Design Phase

Although impacts to bats can occur during the construction, operation, and decommissioning phases of the project, effective planning during the design phase can assist in reducing the probability of impacts, as well as the severity thereof. Mortality resulting from wind turbine collisions and barotrauma (during the operational phase) can be mitigated by incorporating measures defined during the design phase. Such impacts are likely to affect species that utilise the airspace within the rotor swept zone of the wind turbines for foraging, commuting, and/or migration activities. Furthermore, potential light pollution during operational activities may exacerbate these mortality impacts, as certain bat species are drawn to artificial lights due to the higher concentration of insects they attract. This can increase the risk of collision and barotrauma for these species near the operating turbines.

To mitigate these impacts, it is crucial to consider the proper placement of all turbines, ensuring that they do not overlap with high sensitivity (i.e. no-go) areas – inclusive of the full blade length. The placement of all turbines, as well as their full blade length, should avoid high sensitivity areas, to be considered from the outset of the design phase. Presently, no wind turbines (inclusive of the full blade length) overlap with such sensitive features, considering the most recent optimised layout provided (Figure 2). Additionally, it is recommended for the project's lighting to be minimised at all associated infrastructures, to avoid attracting bat prey items to areas where mortality events may occur. To achieve this, lighting should be reduced as far as possible and appropriate lighting options such as downward-

[4] Curtailment – the act restricting normal operation of a wind turbine by slowing or stopping blade rotation for a period of time.

facing low-pressure sodium and warm white LED lights should be utilised on all associated infrastructures.

4.2 Construction Phase

The construction phase of the project is anticipated to impact bats negatively. Likely impacts expected to occur include habitat modification (Table 5) and disturbance/displacement effects (Table 6). Habitat modification can occur through the removal or alteration of vegetation and other natural resources, potentially displacing bats from foraging areas. During this phase, the removal of vegetation may eliminate important cover and linear features that bats use for foraging and commuting. This could also create favourable conditions for insects (as the modification of habitat from a natural to a disturbed/fallow environment may provide suitable habitat for a variety of other habitat specialists), a primary food source for bats, attracting bats to the proposed WEF area. Indirect impacts, such as disturbance and displacement, may result from construction activities (for wind turbines and associated infrastructures) taking place during important bat foraging hours. Excessive noise and dust during construction could also prompt bats to abandon their roosts if construction activities are too close to these sites. While no roosts have been positively identified within the project area, suitable habitat may still be available to accommodate bats.

Before implementing mitigation measures, these indirect impacts are expected to have a moderate negative significance. However, with appropriate mitigation, this level of significance may be reduced to low (Table 5, Table 6).

Mitigation measures include limiting the removal or alteration of natural vegetation and man-made buildings in all high-sensitive areas as much as possible and reduced across the project site in all other areas. Construction activities (for wind turbines and associated infrastructures) should be restricted to daylight hours only, and no construction should take place within potential roosting habitats (i.e. avoid construction activities within no-go buffers, as far as possible). While no confirmed roosts have been identified on-site thus far, it is recommended that a final specialist site walk-through is conducted prior to construction – to search for roosts and provide subsequent roost management recommendations during the construction phase, if required (i.e. if roosts are found).

Regarding all other project-associated infrastructures, their small extent and temporary nature may allow them to be sited in sensitive areas, provided that all other mitigation measures are strictly followed. Ideally, such infrastructures should avoid sensitive areas, as far as possible.

Table 5: Habitat modification impacts associated with the construction phase

Nature:
Bats can be impacted indirectly through the modification or removal of habitats when erecting wind turbines and associated infrastructures. The removal of vegetation during the construction phase can impact bats by removing vegetation cover and linear features that some bats use for foraging and commuting. This modification could subsequently also create favourable conditions for insects upon which bats feed which could in turn attract bats to the proposed WEF area.

	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (36)**	**Low (21)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	

Mitigation:
The removal of vegetation and man-made buildings should be avoided in all high sensitive areas, as far as possible, and reduced across the project site in all other areas. Associated infrastructures are permissible in sensitive areas, but should aim to avoid them, as far as possible.

Residual Impacts:
Residual impacts (as a result of habitat modification) are possible to occur on site, after all recommended mitigation measures have been implemented. The significance thereof, however, is expected to be low for this particular impact, and is not likely to lead to an irreplaceable loss of resources.

Table 6: Disturbance/ displacement impacts associated with the construction phase

Nature:
WEF's have the potential to impact bats indirectly during the construction phase through the disturbance of roosts or when conducting activities during hours of important bat foraging activities. Relevant activities include the construction of roads, O&M buildings, sub-station(s), internal transmission lines and the installation of wind turbines. Excessive noise and dust during the construction phase could result in bats abandoning their roosts, depending on the proximity of construction activities to roosts.

	Without mitigation	With mitigation
Extent	Low (1)	Low (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (36)**	**Low (21)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- Limit all construction activities to daylight hours only, within 200m of any confirmed roosts.
- Avoid all construction activities within potential roosting habitats, if identified at the time when construction activities (for wind turbines and associated infrastructures) take place. No confirmed roosts have been identified on site to date, although it is recommended for a final specialist site walk-through to take place prior to construction to confirm this, and to provide further construction and roost management recommendations, if required (i.e. if roosts are found).

Residual Impacts:
Residual impacts (as a result of disturbance/displacement effects) are possible to occur on site, after all recommended mitigation measures have been implemented. The significance thereof, however, is expected to be low for this particular impact, and is not likely to lead to an irreplaceable loss of resources, and no confirmed roosts have been located on site throughout the duration of the monitoring campaign.

4.3 Operational Phase

During the operational phase of the project, impacts on bats can be direct (mortality due to turbine collisions or barotrauma) and indirect (disturbance/displacement effects). Direct impacts will mainly affect species that use the airspace within the rotor-swept zone of the wind turbines. Among the 13 potential species on site, 9 exhibit behaviour that may bring them into contact with wind turbine blades, making them susceptible to negative impacts if not properly mitigated. The Egyptian Free-tailed bat and Cape Serotine dominated the recorded activity, accounting for 80% and 15% of the total bat passes, respectively. All other species accounted for less than 5% of activity. The Egyptian Free-tailed bat was also the most abundant species recorded at rotor sweep height, accounting for 98% of passes at both 55 m and 110 m. Fatality records of both the Egyptian Free-tailed bat and Cape Serotine, specifically, are known from operating WEF's across parts of South Africa (Doty and Martin 2021; Aronson et al. 2013; MacEwan 2016), and careful consideration should be made during the wind farm planning phase, to reduce the likelihood of impacts to such species, regardless of the conservation status.

Indirect impacts to bats may occur during O&M activities, potentially disturbing bats during important foraging hours. Activities generating excessive noise and dust could also prompt bats to abandon their roosts, depending on their proximity to the activities. Although no confirmed roosts have been identified within the project area, suitable habitat is still available.

An initial mandatory step to monitor potential impacts involves implementing an operational phase bat monitoring campaign in line with the latest version of the South Africa Best Practice Guidelines for Monitoring Bats at Operational Wind Energy Facilities (Aronson *et al*., 2020). A qualified bat specialist should be appointed to conduct the operational monitoring campaign as soon as the turbines become operational (i.e. when blades begin spinning, regardless of grid connection), spanning at least two years with bat activity and fatality monitoring, and repeated again in Year 5, and then every five years thereafter for duration of the facility's lifespan.

To mitigate mortality impacts, blade feathering should be implemented, stopping all turbines at low wind speeds (up to the manufacturers cut-in speed) to prevent free-wheeling. This is important since bat fatality impacts are still possible at low wind speeds (below the relevant cut-in speeds). Additionally, lighting at the project should be minimised, using appropriate types like downward-facing low-pressure sodium and warm white LED lights to avoid attracting insects, and consequently, bats.

To further avoid impacts, key bat habitat features that provide potential roosting structures, foraging resources, and commuting resources have been buffered accordingly, and should be excluded from wind turbine placement (inclusive of any overlap with the full blade length) (Figure 2). While these impacts will be realised during the operational phase, considerations for these restrictions should already be made during the projects design phase. Presently, no turbines (including the full blade length [106 m]) are noted to overlap with such high sensitive (i.e. no-go) buffers, in accordance with the most recent optimised facility layout provided (Figure 2).

Buffers are effective in reducing interactions between clutter-edge bats and wind turbines. However, open-air foragers, such as the Egyptian free-tailed bat, are also active within the rotor swept zone. Wind turbine design (such as the use of taller towers with limiting rotor diameters) may help mitigate impacts on bats (Geiorgiakakis *et al*. 2012), as taller towers with smaller rotor diameters would allow for a raised lower blade tip – resulting in a reduced likelihood of impacts on clutter-edge foragers. Additionally, a smaller diameter may allow for a reduced area in which open air foragers may be subjected to direct impacts, as a result of spinning turbine blades. Certain South African bat species that are not adapted for flight at height have experienced mortality from wind turbines, particularly at the lower edge of the rotor swept zones (for example, the Cape Serotine). The data in this report suggests that moderate and high bat activity levels were observed at both ground level and at rotor height throughout most of the year (with the exception of winter). As such, the use of such a turbine design may be considered beneficial for both open air and clutter edge foragers and could reduce the risk of reaching fatality thresholds sooner.

In terms of fatality thresholds, it must be noted that the proposed FE Kudu WEF has a threshold limit of 45 ‘least concern’ microbat fatalities per year, determined in accordance with the Bat Monitoring Threshold Guidelines (MacEwan *et al*. 2018). The bat occupancy per 10 ha within the Nama Karoo ecoregion is estimated to be 9.94 bats. A 2 % value represents the threshold at which bat populations start to decline slowly, at approximately 0.1 % per annum. This translates to an annual threshold limit of 0.20 ‘least concern’ microbats (per species) per 10 ha, calculated as [2 % of bats per 10 ha] x [project boundary area/10 ha]. Thus, 0.20 x (2250/10) = 45 bat species fatalities (per species). If bat fatalities exceed this threshold limit, mitigation measures, such as turbine curtailment and acoustic deterrence mechanisms, will be required to be implemented. Threshold calculations should be done at least quarterly by a qualified bat specialist for prompt application of mitigation measures, which would be confined to specific periods and meteorological conditions if needed. The same mitigation would apply in the case of one or more observed fatalities of any frugivorous bats, conservation-important, or rare/range-restricted bats during a 12-month monitoring period.

In terms of mitigation measures for disturbance/ displacement effects, all O&M activities related to wind turbines and associated infrastructures should be limited to daylight hours, and none should occur within potential roosting habitats. No confirmed bat roosts have been identified on site to date, although a qualified bat specialist appointed for the operational phase bat monitoring should continually refine recommendations based on new roosting information.

As indicated in Table 7, bat mortality impacts due to collisions or barotrauma are anticipated to have a high negative significance before mitigation, but this significance is expected to decrease to a moderate level after mitigation. Similarly, disturbance/displacement impacts (Table 8) are anticipated to have a moderate negative significance before mitigation, which is expected to decrease to a low level after mitigation measures are implemented.

Table 7: Mortality due to wind turbine collision and/ or barotrauma during the operational phase

Nature:
Bats can be impacted during the operational phase by means of collision with wind turbines and/ or barotrauma. These impacts will be limited to species that make use of the airspace within the rotor swept zone of the wind turbines, during foraging, commuting and/ or migration activities. Such impacts would also be further exacerbated with potential light pollution that would be present during operational activities. Certain bat species actively forage around artificial lights due to the higher numbers of insects which are attracted to these lights. This would bring these species into the vicinity of the operating turbines and increase the risk of collision/barotrauma for these species.

	Without mitigation	With mitigation
Extent	High (4)	High (3)
Duration	Long-term (4)	Long-term (4)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Probable (3)
Significance	**High (80)**	**Medium (39)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Partially	

Mitigation:

- Implement an operational phase bat monitoring programme, in accordance with the most recent version of the operational phase bat monitoring guidelines.
- Implement blade feathering (up to the manufacturers cut-in speed) as soon as operation begins, to prevent free-wheeling.
- The placement of all turbines, as well as their full blade length, should remain outside of high sensitivity areas, to be considered from the outset of the design phase.
- If residual impacts reach the threshold limit (at any wind turbine), then appropriate minimisation measures should be implemented (turbine curtailment and/or acoustic deterrence mechanisms).
- Lighting at the project should be kept to a minimum at all associated infrastructures. Appropriate types of lighting are to be used to avoid attracting insects, and hence, bats. This includes downward facing low-pressure sodium and warm white LED lights. To be considered from the outset of the design phase.

Residual Impacts:
Impacts can be mitigated, although residual impacts are likely to occur. These can however be further minimised through appropriate minimisation techniques, in the event that fatality thresholds are reached. Careful consideration needs to be placed on proposed mitigation measures in order to reduce the magnitude of residual impacts, as far as possible.

Table 8: Disturbance/ displacement impacts associated with the operational phase

Nature:

WEF's have the potential to impact bats indirectly during the operational phase through the disturbance of roosts or when conducting O&M activities during hours of important bat foraging activities. Excessive noise and dust during the operational phase could also result in bats abandoning their roosts, depending on the proximity of operational activities to roosts.

	Without mitigation	With mitigation
Extent	Low (2)	Low (2)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (33)**	**Low (27)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- Limit O&M activities to daylight hours.
- Avoid all O&M activities for wind turbines and associated infrastructures within potential bat roosting habitats, as far as possible. No confirmed bat roosts have been identified on site to date, although it is recommended that a suitably qualified bat specialist (appointed to conduct the operational phase bat monitoring programme) is to further advise on refining recommendations pertaining to O&M activities as new roosting information becomes available, during the project's operational phase (if relevant).

Residual Impacts:
Residual impacts (as a result of disturbance/displacement effects) are possible to occur on site, after all recommended mitigation measures have been implemented. The significance thereof, however, is expected to be low for this particular impact, and is not likely to lead to an irreplaceable loss of resources, and no confirmed roosts have been located on site throughout the duration of the monitoring campaign.

4.4 Decommissioning Phase

During the decommissioning phase of the project, anticipated impacts include disturbance/displacement effects on bats. WEF's have the potential to indirectly impact bats through disturbances to roosts or decommissioning activities during bat foraging hours. Excessive noise and dust during decommissioning could also lead to bats abandoning their roosts, depending on the proximity of such activities to potential roosting sites. While no roosts have been confirmed within the project area, there might still be suitable habitat available for bats.

To address these impacts, specific mitigation measures have been identified. Decommissioning activities for wind turbines and associated infrastructure should be restricted to daylight hours only. Furthermore, if potential roosting habitats are identified during the project's operational phase monitoring campaign, no decommissioning activities should take place in these areas without consulting with an appropriate bat specialist regarding the suggested way forward for reducing impacts to the local roost(s) identified.

Disturbance/displacement effects are expected to have a moderate negative significance before mitigation, which is projected to decrease to a low negative significance after implementing appropriate mitigation measures (Table 9).

Table 9: Disturbance/ displacement impacts during the decommissioning phase

Nature:
WEF's have the potential to impact bats indirectly during the decommissioning phase through the disturbance of roosts or when conducting decommissioning activities during hours of important bat foraging activities. Excessive noise and dust during the decommissioning phase, as a result of decommissioning wind turbines

and associated infrastructures, could also result in bats abandoning their roosts, depending on the proximity of decommissioning activities to roosts.

	Without mitigation	With mitigation
Extent	Low (2)	Low (2)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (30)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	

Mitigation:

- Limit decommissioning activities to daylight hours only.
- Avoid all decommissioning activities within potential roosting habitats (without consulting with an appointed bat specialist), if identified during the projects' operational phase bat monitoring campaign, when decommissioning wind turbines and associated infrastructures. Consult with the appointed bat specialist on further management measures, should this be required.

Residual Impacts:
Residual impacts (as a result of disturbance/displacement effects) are possible to occur on site, after all recommended mitigation measures have been implemented. The significance thereof, however, is expected to be low for this particular impact, and is not likely to lead to an irreplaceable loss of resources, and no confirmed roosts have been located on site throughout the duration of the monitoring campaign.

4.5 Cumulative Impacts

According to the DFFE Renewable Energy database (REEA_OR_2023_Q1), the following facilities are being considered within a 50 km region of the FE Kudu WEF (Figure 3): FE Tango WEF, Eskom Aberdeen WEF, Aberdeen 1, 2 and 3 WEFs, and Kariega WEF Cluster.

Cumulative impacts on bats could potentially increase as new facilities are constructed (Kunz *et al*., 2007b). However, accurately predicting or assessing these impacts is challenging without baseline data on bat population size and demographics (Arnett *et al*., 2011; Kunz *et al*., 2007b), which is lacking for many South African bat species. Appropriate measures applied to WEF design and operation may help mitigate cumulative impacts. Even species currently listed as Least Concern could experience population declines if they are more susceptible to wind turbine mortality, especially high-flying open-air foragers like free-tailed and fruit bats, despite the application of mitigation measures. Further research into the populations and behaviour of South African bats, both in areas with and without wind turbines, is needed to better inform future assessments of the cumulative effects of WEFs on bats.

As indicated in Table 10, the cumulative impact on bats is likely to be high negative, while it is anticipated to be medium negative in isolation (with suitable mitigation measures). All mitigation measures relevant for operational phase bat mortality due to collisions and/or barotrauma should be applied to mitigate cumulative impacts. Furthermore, collaboration with other developments (current and proposed) in the broader project area is essential. Companies in the region should share lessons learned, align strategies, and agree on coordinated approaches when addressing environmental issues. Establishing a data sharing agreement with other wind farm projects in the region to share operational monitoring data is crucial. Sharing data with regulators and interested stakeholders will enable the documentation of cumulative impacts and inform adaptive management processes across projects.

Overall, it is anticipated that the proposed development could result in unacceptable loss to the regional bat population, considering all projects proposed in the area. However, should all mitigation measures be strictly adhered to (from design phase all the way through to decommissioning), it is anticipated that such losses may be reduced to acceptable levels.

Table 10: Bat fatality impacts on a cumulative scale

Nature:
Multiple WEF's impacting bats collectively, could have the potential to cause significant loss to affected species over a regional or national scale with an inability for the affected species to recover from such loss. This is likely to be most significant through bat mortality as a result of wind turbine collisions and/or barotrauma during the projects' operational phase, particularly during bat foraging/commuting activities. According to the DFFE Renewable Energy database (REEA_OR_2023_Q1), the following facilities are currently being considered within a 50 km region of the FE Kudu WEF: FE Tango WEF, Eskom Aberdeen WEF, Aberdeen 1, 2 and 3 WEFs, and Kariega WEF Cluster.

	Overall impact of the proposed project considered in isolation	Cumulative impact of the project and other projects in the area
Extent	High (3)	High (5)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	High (8)
Probability	Probable (3)	Definite (5)
Significance	**Medium (39)**	**High (85)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Low
Irreplaceable loss of resources?	No	Yes
Can impacts be mitigated?	Partially	
Confidence in findings: Medium		

Mitigation:

- All mitigation measures, as listed in Table 7, are highly recommended for WEF's in the greater (50 km^2) Project area, to reduce the probability of significant mortality impacts occurring at FE Tango WEF, and subsequently on a cumulative scale as well.
- The project should collaborate with other developments (current and proposed) in the broader project area. Companies in the area should share lessons learnt, align strategies, and agree to coordinated approaches when responding to environmental issues.
- A data sharing agreement should be setup with other wind farm projects in the region to share operational monitoring data. Data should be shared with regulators and interested stakeholders to allow cumulative impacts to be documented and to inform adaptive management processes across projects.

4.6 Site Alternatives

No site alternatives under consideration for further assessment.

4.7 No-go Alternative

The no-go alternative has been assessed for bats, considering the proposed development under consideration, together with its associated impacts. As reflected in Table 11, the impact on bats already existing in the area would be negligible, in the event that the facility is not constructed – as no change is anticipated to occur.

Table 11: No-go Alternative Impacts

Nature:
No impacts anticipated.

	Without mitigation	With mitigation
Extent	Low (1)	Low (1)
Duration	Very Short-term (1)	Very Short-term (1)
Magnitude	Small (0)	Small (0)
Probability	Very Improbable (1)	Very Improbable (1)
Significance	**Low (2)**	**Low (2)**
Status (positive or negative)	Positive	Positive
Reversibility	n/a	n/a
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	n/a	

Mitigation:
No mitigation required, in the event that the facility is not constructed.

5. MEASURES FOR INCLUSION IN THE ENVIRONMENTAL MANAGEMENT PROGRAMME

To comply with Chapter 6, Section 1 (k) and (m) of the NEMA EIA Regulations, 2014, as amended; any mitigation measures or monitoring requirements for inclusion in the Environmental Management Programme (EMPr), during the various phases of the project lifecycle, must be incorporated into the specialist assessment report. These inclusions are subsequently detailed in Tables 12 to 16, below.

Table 12: Construction phase measures for inclusion into the EMPr: habitat modification

Objective:
Avoid habitat modification.

Project Component/s	Wind Turbines and associated Infrastructures.	
Potential Impact	The removal of vegetation during the construction phase can impact bats by removing vegetation cover and linear features that some bats use for foraging and commuting. This modification could subsequently also create favourable conditions for insects (a primary food source for bats), as the modification of habitat from a natural to a disturbed/fallow environment may provide suitable habitat for a variety of other habitat specialists, which could in turn attract bats to the proposed WEF area.	
Activity/risk source	Modification or removal of habitats when erecting wind turbines and associated infrastructures.	
Mitigation: Target/Objective	Avoid habitat modification.	
Mitigation: Action/control	***Responsibility***	***Timeframe***
The removal of vegetation and man-made buildings should be avoided in all high sensitive areas, as far as possible, and reduced across the project site in all other areas. Associated infrastructures are permissible in sensitive areas, but should aim to avoid them, as far as possible.	Developer, on-site Environmental Control Officer (ECO) and construction teams.	Entire duration of the construction phase.
Performance Indicator	Degree of habitat removal, monitored by an on-site ECO.	
Monitoring	The project development team and construction team must adhere to all infrastructure layouts assessed in this report, while the on-site ECO must	

	confirm that all construction activities are only taking place within the areas assessed in this report, and that no vegetation and man-made buildings are being removed in all high sensitive areas, as far as possible (and reduced across the project site in all other areas). Any non-compliance should be reported immediately (by the ECO) to an appropriate authority (inclusive of the DFFE), with all associated construction activities being halted, until such time that the matter is resolved (with inputs from a suitably qualified bat specialist).

Table 13: Construction phase measures for inclusion into the EMPr: disturbance/displacement impacts

Objective:
Avoid disturbance/displacement impacts.

Project Component/s	Construction activities when installing all associated project components.	
Potential Impact	WEF's have the potential to impact bats indirectly during the construction phase through the disturbance of roosts or when conducting activities during hours of important bat foraging activities. Relevant activities include the construction of roads, O&M buildings, sub-station(s), internal transmission lines and the installation of wind turbines. Excessive noise and dust during the construction phase could result in bats abandoning their roosts, depending on the proximity of construction activities to roosts.	
Activity/risk source	Disturbance/displacement effects when conducting construction activities for all planned infrastructures.	
Mitigation: Target/Objective	Avoid disturbance/displacement impacts.	
Mitigation: Action/control	***Responsibility***	***Timeframe***
Limit all construction activities to daylight hours only. Avoid all construction activities within potential roosting habitats, if identified at the time when construction activities (for wind turbines and associated infrastructures) take place. No confirmed roosts have been identified on site to date, although it is recommended for a final specialist site walk-through to take place prior to construction to confirm this, and to provide further construction and roost management recommendations, if required (i.e. if roosts are found).	Construction team, on-site ECO and appropriate bat specialist.	Entire duration of construction phase. Bat roost specialist walk-through to be conducted within 6 months of anticipated construction date.
Performance Indicator	Hours and areas of work, monitored by an on-site ECO.	
Monitoring	The construction team must only work during daylight hours, which is to be monitored by the on-site ECO. A suitably qualified bat specialist should be appointed prior to construction to conduct a final specialist walk-through to search for roosts, and to provide further construction and roost management recommendations, if required (i.e. if roosts are found). The on-site ECO must confirm that all construction activities are not taking place within any potential roosting habitat – identified during the specialist site walk-through. Any non-compliance should be reported immediately (by the ECO) to an appropriate authority (inclusive of the DFFE), with all associated construction activities being halted, until such time that the matter is resolved (with inputs from a suitably qualified bat specialist).	

Table 14: Operational phase measures for inclusion into the EMPr: mortality impacts

Objective:
Avoid mortality impacts.

Project Component/s	Wind Turbines.	
Potential Impact	Bats can be impacted during the operational phase by means of collision with wind turbines and/ or barotrauma. These impacts will be limited to species that make use of the airspace within the rotor swept zone of the wind turbines, during foraging, commuting and/ or migration activities. Such impacts would also be further exacerbated with potential light pollution that would be present during operational activities. Certain bat species actively forage around artificial lights due to the higher numbers of insects which are attracted to these lights. This would bring these species into the vicinity of the operating turbines and increase the risk of collision/barotrauma for these species.	
Activity/risk source	Collision with spinning wind turbine blades, and/or barotrauma.	
Mitigation: Target/Objective	Avoid mortality impacts.	
Mitigation: Action/control	***Responsibility***	***Timeframe***
Implement an operational phase bat monitoring programme, in accordance with the most recent version of the operational phase bat monitoring guidelines. Implement blade feathering (up to the manufacturers cut-in speed) as soon as operation begins, to prevent free-wheeling. If residual impacts reach the threshold limit (at any wind turbine), then appropriate minimisation measures should be implemented (turbine curtailment and/or acoustic deterrence mechanisms). Lighting at the project should be kept to a minimum at all associated infrastructures. Appropriate types of lighting are to be used to avoid attracting insects, and hence, bats. This includes downward facing low-pressure sodium and warm white LED lights. To be considered from the outset of the design phase	Developer, on-site Environmental Control Officer (ECO), construction teams and an appropriate bat specialist.	Entire duration of the operational phase, with turbine placement and lighting types already considered from the outset of the design phase.
Performance Indicator	Real and estimated bat fatalities, assessed by a bat specialist.	
Monitoring	Although such impacts are expected to occur during the operational phase of the project, the project development team and construction team must adhere to all infrastructure layouts assessed in this report, from the outset of the design phase already, to avoid these impacts during the operational phase. The on-site ECO must confirm that all construction activities are only taking place within the areas assessed in	

	this report, and that no overlap of wind turbine infrastructure (inclusive of the full blade length) occurs within areas of high sensitivity for bats. A suitably qualified bat specialist should be appointed at the start of the operational phase (and in accordance with the latest version of the bat monitoring guidelines available at the time) and should monitor bat activity and fatalities in accordance with the timelines/scope as set out in the appropriate guidelines. Further inputs and additional mitigation measures recommended by a bat specialist at the time should be taken into account and implemented by the facility, should important bat fatalities be found. The wind farm operator must ensure that blade feathering is implemented (to prevent free-wheeling) during the entire duration of the projects' lifespan, and that appropriate lighting is used (and minimised). This should be audited by an appropriate ECO during annual audits. Any non-compliance should be reported immediately (by the ECO) to an appropriate authority (inclusive of the DFFE), with all associated operational activities being halted, until such time that the matter is resolved (with inputs from a suitably qualified bat specialist).

Table 15: Operational phase measures for inclusion into the EMPr: disturbance/displacement impacts

Objective:
Avoid disturbance/displacement impacts.

Project Component/s	Operational activities when operating the wind farm facility, and conducting maintenance activities.	
Potential Impact	WEF's have the potential to impact bats indirectly during the operational phase through the disturbance of roosts or when conducting Operational and Maintenance (O&M) activities during hours of important bat foraging activities. Excessive noise and dust during the operational phase could also result in bats abandoning their roosts, depending on the proximity of operational activities to roosts.	
Activity/risk source	Disturbance/displacement effects when conducting operational and maintenance activities for all infrastructures.	
Mitigation: Target/Objective	Avoid disturbance/displacement impacts.	
Mitigation: Action/control	***Responsibility***	***Timeframe***
Limit O&M activities to daylight hours. Avoid all O&M activities for wind turbines and associated infrastructures within potential bat roosting habitats, as far as possible. No confirmed bat roosts have been identified on site to date, although it is recommended that a suitably qualified bat specialist (appointed to conduct the operational phase bat monitoring programme) is to further advise on refining recommendations pertaining to O&M activities as new roosting information becomes available, during the project's operational phase (if relevant).	Wind farm operator / maintenance team, on-site ECO and appropriate bat specialist.	Entire duration of the operational phase.
Performance Indicator	Hours and areas of work, monitored by the wind farm operator and audited annually by an appropriate ECO.	
Monitoring	The operational / maintenance team must only work during daylight hours, which is to be monitored by the wind farm operator and audited annually by an appropriate ECO. A suitably qualified bat specialist (appointed for operational phase monitoring) must provide further inputs into O&M activities (wherever relevant) in the event that new roosts are found during the projects' operational phase bat monitoring campaign. Any non-compliance should be reported immediately (by the ECO) to an appropriate authority (inclusive of the DFFE), with all associated operational activities being halted, until such time that the matter is resolved (with inputs from a suitably qualified bat specialist).	

Table 16: Decommissioning phase measures for inclusion into the EMPr: disturbance/displacement impacts

Objective:
Avoid disturbance/displacement impacts.

Project Component/s	Decommissioning activities when decommissioning the wind farm facility.	
Potential Impact	WEF's have the potential to impact bats indirectly during the decommissioning phase through the disturbance of roosts or when conducting decommissioning activities during hours of important bat foraging activities. Excessive noise and dust during the decommissioning phase, as a result of decommissioning wind turbines and associated infrastructures, could also result in bats abandoning their roosts, depending on the proximity of decommissioning activities to roosts.	
Activity/risk source	Disturbance/displacement effects when conducting decommissioning activities for all infrastructures.	
Mitigation: Target/Objective	Avoid disturbance/displacement impacts.	
Mitigation: Action/control	***Responsibility***	***Timeframe***
Limit decommissioning activities to daylight hours. Avoid all decommissioning activities within potential roosting habitats, if identified during the projects' operational phase bat monitoring campaign, when decommissioning wind turbines and associated infrastructures. Consult with the appointed bat specialist on further management measures, should this be required.	Wind farm operator, on-site ECO and appropriate bat specialist.	Entire duration of the decommissioning phase.
Performance Indicator	Hours and areas of work, monitored by the wind farm operator and audited by an appropriate ECO, with inputs from a suitably qualified bat specialist – where required.	
Monitoring	The wind farm operator must ensure that the decommissioning team is to only work during daylight hours, and is not to disturb any roosts which may have potentially been identified during the projects' operational phase. This is to be monitored by an appropriate ECO at the start of decommissioning activities, with inputs from a suitably qualified bat specialist, wherever required (in the event that new roosts have been found). Any non-compliance should be reported immediately (by the ECO) to an appropriate authority (inclusive of the DFFE), with all associated decommissioning activities being halted, until such time that the matter is resolved.	

6. CONCLUSION

Overall, the bat monitoring campaign at the proposed FE Kudu WEF revealed mostly moderate to high bat activity throughout the study period. Notably, bat activity was particularly high and posed a high risk to bats during spring, summer, and autumn, with peaks observed in the summer season. The prevalence of Free-tailed bats suggests that they are likely to face the highest risk of impacts at the proposed site, making it crucial to implement sensitive design and mitigation measures to reduce risks to these and other bat species. Bat activity levels were also noted to be high within the rotor sweep area, particularly at 55 m, raising a level of concern for the local bat community on site. As such, careful consideration into project design must be undertaken with all mitigation measures being strictly adhered to.

The assessment of potential impacts relevant to bats at the proposed WEF indicated that impacts are likely to occur during all phases of the project - construction, operation, and decommissioning. Indirect impacts, such as habitat modification, disturbance, and displacement effects, were identified in most project phases, while more significant direct impacts, such as bat mortality due to collisions and/or barotrauma, were expected during the operational phase. Strict adherence to all defined mitigation measures is essential.

To minimise bat mortality, all mitigation measures, as defined in the impact assessment (Section 4) and inputs into the EMPr (Section 5), are to be strictly adhered to. All high sensitive (i.e. no-go) areas used by bats for foraging, roosting, and/or commuting, as identified in Figure 2, should be avoided from turbine placement (inclusive of the full blade length). Presently, no turbines (inclusive of the full blade length) have been identified to overlap with such sensitive areas, taking into consideration the most recent optimised facility layout assessed. The FE Kudu facility layout is considered to be acceptable. All associated infrastructures (i.e. laydown areas, construction camps, O&M buildings etc.) are recommended to avoid sensitive areas, as far as possible, but are permissible within these areas, provided that all construction, operational and decommissioning activities adhere to the mitigation measures defined in Sections 4 and 5.

Turbine design, including hub height and rotor diameter, should be carefully chosen to reduce potential interactions between bats and turbine blades, while maximising the hub height and raising the lowest possible blade tip above the ground to reduce the risk of reaching fatality thresholds sooner.

Implementing blade feathering up until the manufacturers cut-in speed (to prevent free-wheeling) is considered mandatory from the start of operation. Curtailment, acoustic deterrents or any other appropriate mitigation measures recommended by a suitably qualified bat specialist (during the projects' operational phase) must be implemented in the event that bat fatality threshold limits are reached. Any such mitigation/minimisation measures should be continuously refined and adapted based on incoming bat fatality data. A suitable curtailment plan with relevant parameters must be drawn up at the time that the requirement becomes necessary.

A mandatory operational phase bat monitoring program, conducted by a suitably qualified bat specialist, should be undertaken in accordance with the most recent operational bat monitoring guidelines available at the time. Such a bat monitoring campaign should be implemented (as a minimum) during the first two years of projects operation and repeated again in Year 5, and every five years thereafter – throughout the entire duration of the facility's lifespan, or more regularly – if motivated by a suitably qualified bat specialist.

Based on the data gathered from the full bat pre-construction monitoring, as well as the associated assessment of impacts, the proposed FE Kudu WEF and its associated infrastructures are not expected to cause significant irreplaceable loss to bat biodiversity on-site, although impacts are expected to occur. For the application of environmental authorisation, it will be mandatory for all mitigation measures and inputs into the EMPr to be strictly adhered to.

With the implementation of all recommended mitigation measures and inputs into the EMPr, the development of the proposed FE Kudu WEF can be submitted for authorisation.

7. REFERENCES

ACR, 2020. African Chiroptera Report 2020. AfricanBats NPC, Pretoria. i-xvi + 1-8028 pp.

Adams, A. M., M. K. Jantzen, R. M. Hamilton, and M. B. Fenton. 2012. Do you hear what I hear? Implications of detector selection for acoustic monitoring of bats. Methods in Ecology and Evolution 3:992-998.

Arnett, E.B., Hein, C.D., Schirmacher, M.R., Baker, M., Huso, M.M.P., Szewczak., J.M., 2011. Evaluating the effectiveness of an ultrasonic acoustic deterrent for reducing bat fatalities at wind turbines. A final report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Arnett, E. B. and R. F. May. 2016. Mitigating Wind Energy Impacts on Wildlife: Approaches for Multiple Taxa. Human–Wildlife Interactions: Vol. 10: Iss. 1, Article 5.

Aronson, J.B., Thomas, A.J., Jordaan, S.L., 2013. Bat fatality at a wind energy facility in the Western Cape, South Africa. African Bat Conservation News 31, 9-12.

Cooper-Bohannon, R., Rebelo, H., Jones, G., Cotterill, F., Monadjem, A., Schoeman, M.C., Taylor, P., Park, K., 2016. Predicting bat distributions and diversity hotspots in southern Africa. Hystrix 27, 47-57.

Doty, A.C., Martin, A.P., 2012. Assessment of bat and avian mortality at a pilot wind turbine at Coega, Port Elizabeth, Eastern Cape, South Africa. New Zealand Journal of Zoology, 1-6.

Hayes, J.P., 1997. Temporal Variation in Activity of Bats and the Design of Echolocation-Monitoring Studies. Journal of Mammalogy 78, 514-524.

Hayes, M., L. Hooton, K. Gilland, C. Grandgent, R. Smith, S. Lindsay, J. Collins, S. Schumacher, P. Rabie, J. Gruver, and J. Goodrich-Mahoney. 2019. A smart curtailment approach for reducing bat fatalities and curtailment time at wind energy facilities. Ecological Applications.

International Union for Conservation of Nature (IUCN). 2017. All bats (spatial data). The IUCN Red List of Threatened Species. Version 2022-2. https://www.iucnredlist.org.

Kunz, T.H., Arnett, E.B., Cooper, B.M., Erickson, W.P., Larkin, R.P., Mabee, T., Morrison, M.L., Strickland, M.D., Szewczak, J.M., 2007. Assessing impacts of wind-energy development on nocturnally active birds and bats: A guidance document. The Journal of Wildlife Management 71, 2449-2486.

MacEwan, K., 2016. Fruit bats and wind turbine fatalities in South Africa. African Bat Conservation News 42.

MacEwan, K., Aronson, J., Richardson, E., Taylor, P., Coverdale, B., Jacobs, D., Leeuwner, L., Marais, W., Richards, L. 2018. South African Bat Fatality Threshold Guidelines – ed 2. South African Bat Assessment Association.

MacEwan, K., Aronson, J., Richardson, E., Taylor, P., Coverdale, B., Jacobs, D., Leeuwner, L., Marais, W., Richards, L. 2020. South African Bat Fatality Threshold Guidelines: Edition 3. Published by the South African Bat Assessment Association.

Monadjem, A., Taylor, P.J., Cotterill, F.P.D., Schoeman, M.C., 2010. Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis. Wits University Press, Johannesburg.

Mucina, L. and M. C. Rutherford. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Romano, W. B., J. R. Skalski, R. L. Townsend, K. W. Kinzie, K. D. Coppinger, and M. F. Miller. 2019. Evaluation of an acoustic deterrent to reduce bat mortalities at an Illinois wind farm. Wildlife Society Bulletin 43:608-618.

Sowler, S., MacEwan, K., Aronson, J. and Lötter, C., 2020. South African best practice guidelines for pre-construction monitoring of bats at wind energy facilities.

Thomas, D.W., 1988. The distribution of bats in different ages of Douglas-Fir forests. The Journal of Wildlife Management 52, 619-626.

Weaver, S. P., C. D. Hein, T. R. Simpson, J. W. Evans, and I. Castro-Arellano. 2020. Ultrasonic acoustic deterrents significantly reduce bat fatalities at wind turbines. Global Ecology and Conservation: e01099.

APPENDIX A FIGURES

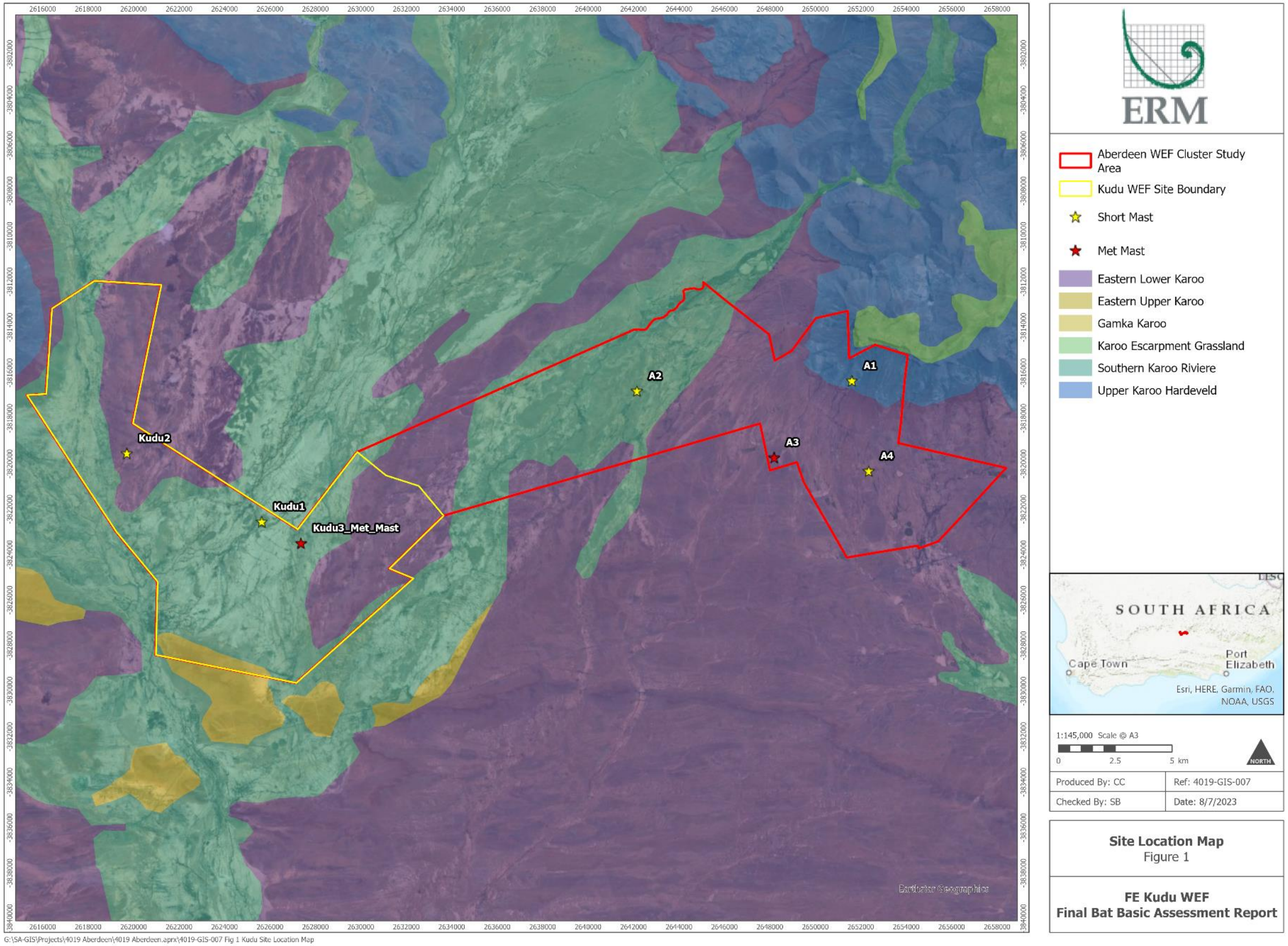


Figure 1: Site location map for the proposed FE Kudu Wind Energy Facility

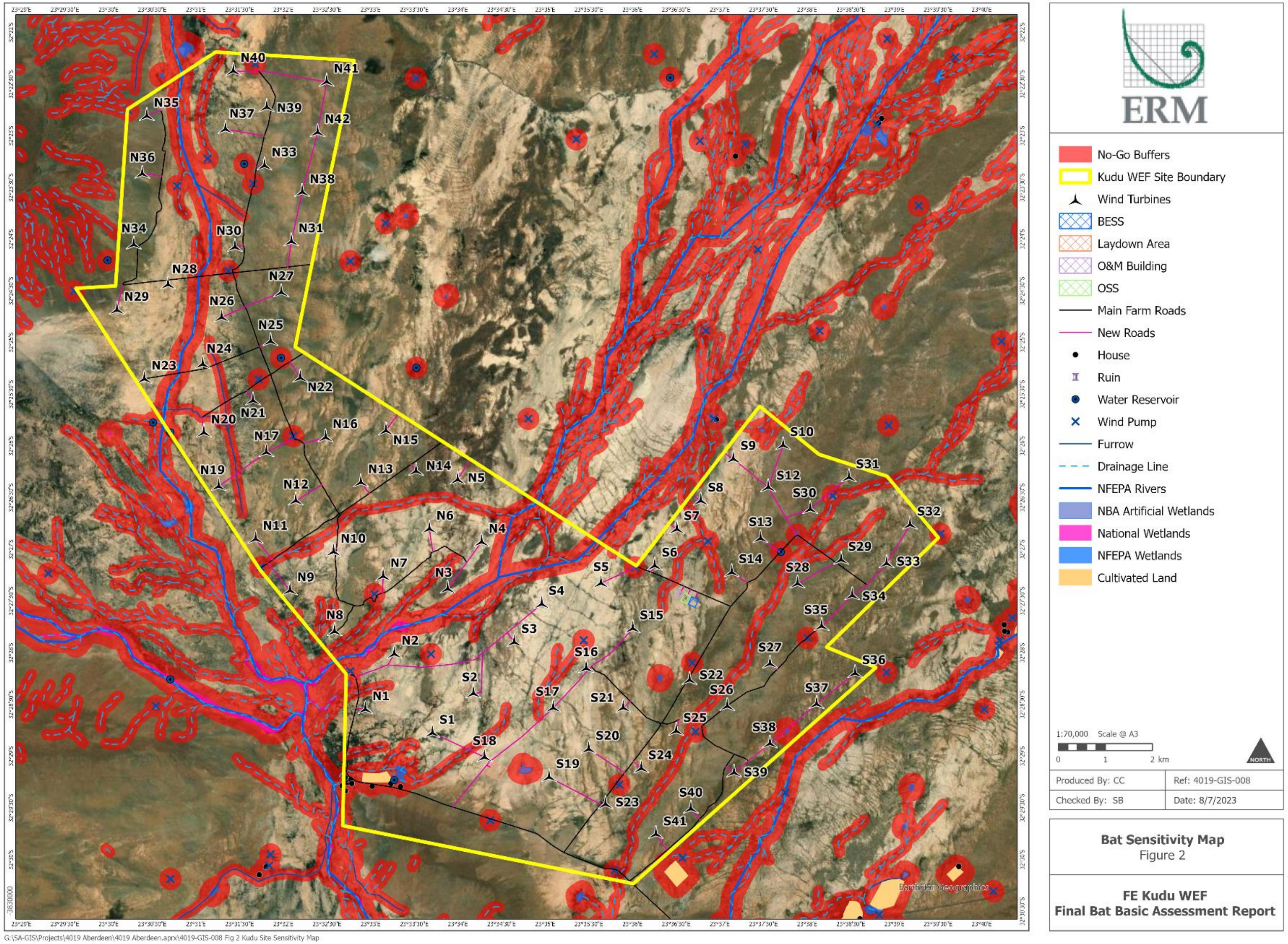


Figure 2: Site sensitivity map for the proposed FE Kudu Wind Energy Facility

APPENDIX B SPECIALIST DECLARATION AND CV

forestry, fisheries & the environment

Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for 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)

REPORT TITLE

FE Kudu Wind Energy Facility, Eastern Cape Province – Bat Monitoring & Basic Assessment Report

Kindly note the following:

1. This form must always be used for assessment that are in support of 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 August 2023. 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.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with '*the 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 - GN 320/2020)*', where applicable.

1. SPECIALIST INFORMATION

Title of Specialist Assessment	FE Kudu Wind Energy Facility, Eastern Cape Province – Bat Monitoring & Basic Assessment Report
Specialist Company Name	Environmental Resources Management Southern Africa (Pty) Ltd.
Specialist Name	Craig Campbell
Specialist Identity Number	8805295352086
Specialist Qualifications:	BSc (Conservation Ecology)
Professional affiliation/registration:	SACNASP Professional Natural Scientist (Ecological Sciences) - 119649
Physical address:	240 Main Road, 1st Floor Great Westerford, Rondebosch
Postal address:	240 Main Road, 1st Floor Great Westerford, Rondebosch
Postal address	7700
Telephone	082 420 6467
Cell phone	082 420 6467
E-mail	craig.campbell@erm.com

CC

2. DECLARATION BY THE SPECIALIST

I, Craig Campbell declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- 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 NEMA Act.

____

Signature of the Specialist

Environmental Resources Management Southern Africa (Pty) Ltd.

Name of Company:

2023-08-16

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

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

Signature of the Specialist

Environmental Resources Management Southern Africa (Pty) Ltd.

Name of Company

2023-08-16

Date

CST

B V/D WESTHUIZEN
72355956

Click or tap here to enter text.

Signature of the Commissioner of Oaths

Click or tap to enter a date.

Date

SOUTH AFRICAN POLICE SERVICE
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16 AUG 2023
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CC

Craig Campbell, Pr.Sci.Nat (Ecological Sciences)

Managing Technical Consultant

Craig Campbell is based in Cape Town, and holds the position of Managing Technical Consultant within ERM. He graduated with a Degree in Conservation Ecology from Stellenbosch University, South Africa. He is registered as a Professional Natural Scientist, in the field of Ecological Sciences (SACNASP).

Craig is an ecologist with fields of interest in fauna and avifauna. Since 2013, Craig has had extensive experience in ecological baseline studies, biodiversity monitoring surveys, environmental impact assessments, mitigation plans and IFC due diligence on several renewable energy and associated grid connection projects and scientific expeditions in South Africa, Mozambique, Tanzania, Portugal and Turkey. He has a sound background in management and ecology, having been the national manager of an environmental consultancy within South Africa for several years. Craig has been largely focussed on project management, project design & layout, GIS mapping, report compilation, business development and stakeholder engagement.

Experience: 10 years' experience in environmental and biodiversity consulting

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Education

- BSc (4-year). Conservation Ecology, Stellenbosch University, South Africa, 2013
- Certificate in Aquaculture Production Management, Stellenbosch University, South Africa, 2008

Professional Affiliations and Registrations

- SACNASP: Pr.Sci.Nat (Ecological Sciences)

Languages

- English, native speaker
- Afrikaans
- German

Fields of Competence

- Ecology (Fauna and Avifauna)
- Biodiversity Monitoring
- GIS
- Due Diligence
- Mitigation Plans

Key Industry Sectors

- Renewable Energy
- Linear Infrastructures (roads, powerlines)

APPENDIX C SITE SENSITIVITY VERIFICATION REPORT

1. INTRODUCTION

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 ('the Regulations'), when applying for Environmental Authorisation" includes the requirement that a Site Sensitivity Verification must be produced. The outcome of the Initial Site Sensitivity must be provided in a report format which:

a) Confirms or dispute the current use of the land and environmental sensitivity as identified by the national web based environmental screening tool;

b) Contains a motivation and evidence of either the verified or different use of the land and environmental sensitivity; and

c) Is submitted together with the relevant reports prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

This initial site sensitivity report is produced to consider only the bats theme and to address the requirements of a) to c) above.

2. INITIAL SITE VERIFICATION

Table 1 and Figure 1 below show the sensitivities for bats identified by the Department of Forestry, Fisheries and the Environments' (DFFE) Screening Tool for the Kudu WEF. There are some suitable habitats and waterbodies that can be used for drinking water, roosting, foraging, and commuting in the study area. Bats are known to use linear landscape features such as rivers and tree lines for commuting routes to get to and from foraging sites, roost sites, and to access water sources.

Table 1: DFFE Screening Tool output in the Bat (Wind) Theme (Tango Wind Energy Facility)

Theme	Very High Sensitivity	High Sensitivity	Medium Sensitivity	Low Sensitivity
Bats (Wind) Theme		X		
Sensitivity		**Feature(s)**		
High		Within 500 m of a river		
High		Wetland		
High		Within 500 m of a wetland		

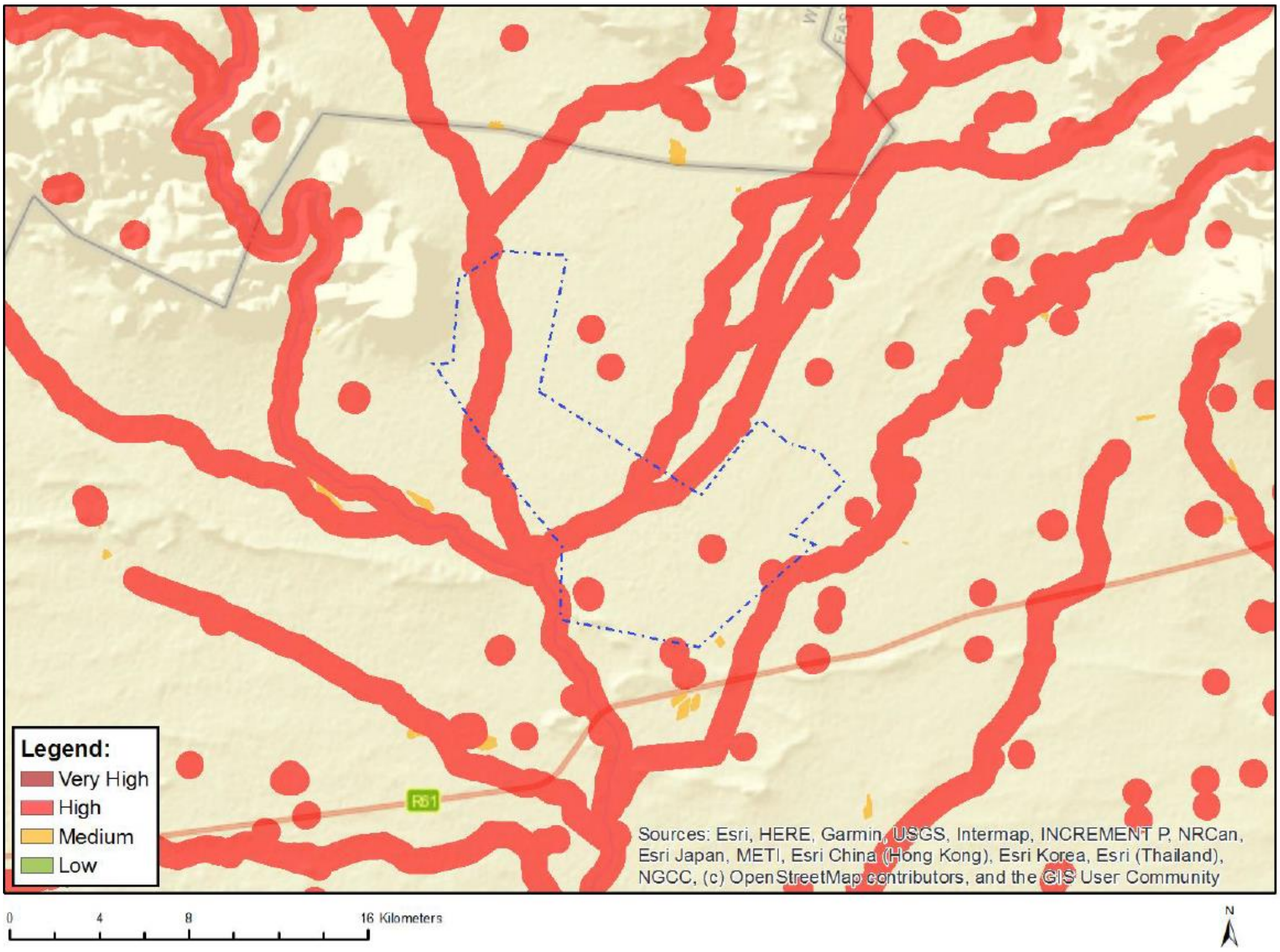

Figure 3: DFFE Screening Tool output for the Bats (Wind) Theme (FE Kudu Wind Energy Facility)

The baseline environment for bats at the proposed development sites were defined utilising a desktop study of available bat locality data, literature and mapping resources. This information was examined to determine the potential location and abundance of bats, including their potential habitats which may be sensitive to the Tango WEF development.

3. OUTCOME OF THE INITIAL SITE VERIFICATION

After the selected resources were mapped, they were aggregated to produce initial constraints maps for the respective developments, under the assumption that areas where resources are concentrated will be more important for bats (Figure 1).

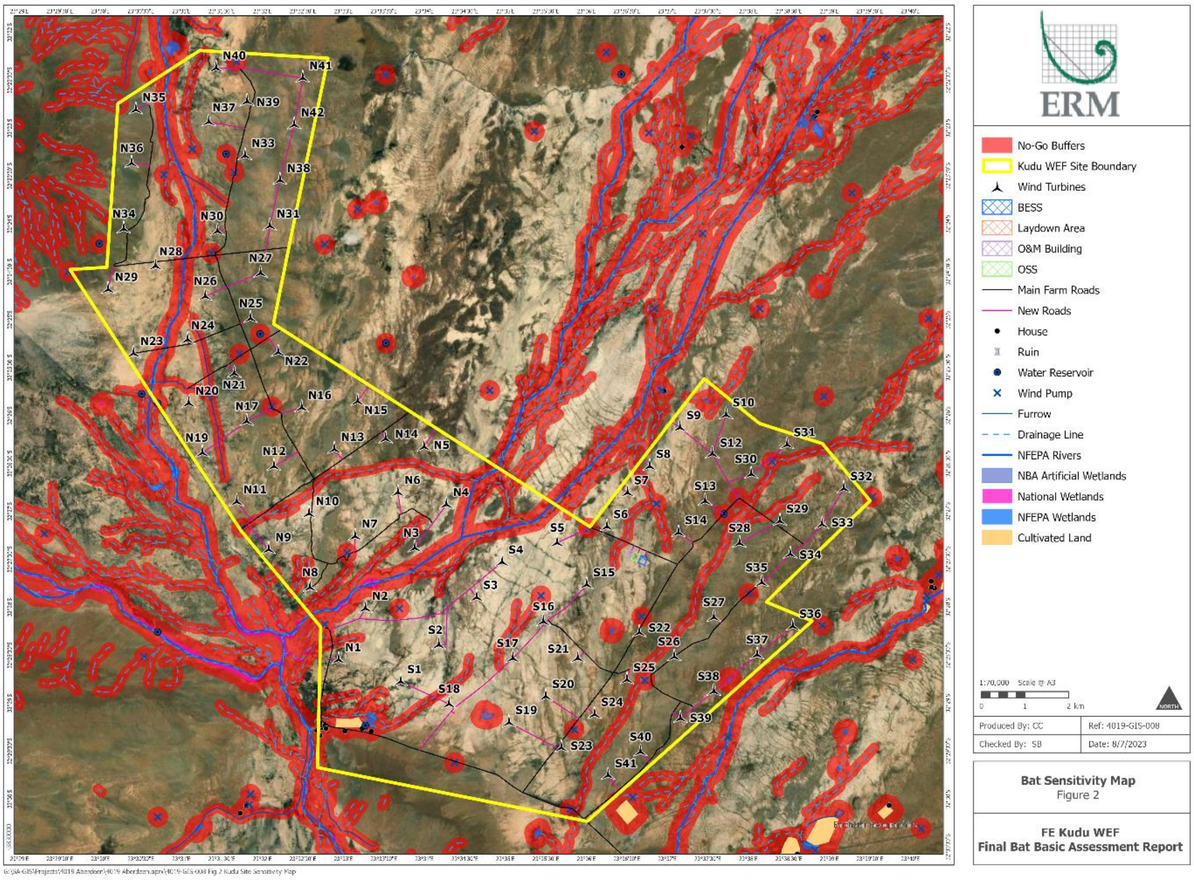

Figure 4: Initial constraints map for FE Kudu WEF

4. CONCLUSION

The DFFE Screening Tool identified two sensitivity ratings within the FE Kudu WEF development footprint, namely, high and medium. The constraints mapped by the specialist (Figure 2) were based on the full pre-construction monitoring campaign identified specific areas of high sensitivity and, in the specialist's opinion, confirms the current use of land and environmental sensitivity as identified by the national web based environmental screening tool. Additionally, evidence suggests additional high sensitivity areas for consideration, as demonstrated in figure 2, which should be considered No-Go areas with the remainder of the site potentially hosting medium to low sensitivity for bats.

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