

Appendix G.6

BATS ASSESSMENT



Environmental Impact Assessment Report: ABO Uvemvane Wind Energy Facility 1 in Mpumalanga and Gauteng, South Africa

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Expertise of Bat Specialists

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Disclaimer by Volant Environmental Director

I declare that the work presented in this report is my own and has not been influenced in any way by the developer. At no point has the developer asked me as specialist to manipulate the results to make it more favorable for the proposed development. I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP) and the EIA Regulations (2014, as amended). I have the necessary qualifications and expertise (*Pr. Sci. Nat. Zoological Science*) in conducting this specialist report.

Dr. Low de Vries



Specialist Summary

ABO Uvemvane Wind Energy Facility 1 (Pty) Ltd is proposing the development of the ABO Uvemvane Wind Energy Facility 1 located near Balfour in the Mpumalanga Province in the Dipaleseng Local Municipality within the Gert Sibande District Municipality and Heidelberg in the Gauteng Province in the Lesedi & Midvaal Local Municipalities within the Sedibeng District Municipality.

Since a project of this nature is likely to have an impact on bats, Volant Environmental (Pty) Ltd was appointed to conduct the specialist bat assessment. Based on the DFFE Screening tool report for the proposed WEF the overall area is rated a being of High sensitivity to bats due to the rivers and numerous wetlands present on site. Croplands have been given a Medium sensitivity rating, but no buffers are required. A Site Sensitivity Verification survey (26-29 August 2024) and the full twelve-month pre-construction bat monitoring was conducted on the proposed Wind Energy Facility development.

Concerning bats, our work on-site has produced the following findings thus far:

- A total of five species of bats were recorded on-site during our screening and pre-construction bat monitoring surveys which is on par for this region and habitat.
- Numerous active roosts were found
- No fatal flaws have been identified.

The current bat sensitivity based on the DFFE Screening Tool is classified as **High** and based on our desktop survey, ground truthing and data gathered to data we concur with this result.



Author Contributions

Author	Qualification	SACNASP	Role in project
Low de Vries	PhD Zoology	Pr. Sci. Nat. – 124178	Project management, field work, data analysis, GIS, report writing
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Acronyms & Glossary of Terms

PAOI: Project Area of Influence, the area that is affected by the proposed development.

Acoustic monitoring: Recording and analyses of echolocation calls to determine bat community species composition and abundance.

ACR: African Chiropteran Report.

AOI: Area of Influence, the area that is affected by potential impacts.

Bat call: An echolocation call emitted by a bat used to detect prey and navigate through its surroundings.

Bat detector: Electronic device for the detection and recording of bat echolocation calls. The terms Bat Detector and Song Meter are used interchangeably in this report.

Bat roost: A structure, natural or man-made, where bats roost during the day. This includes caves, trees, rocky outcrops, buildings, and culverts.

Blade tip sweep height: Height between ground level and the lowest point of the wind turbine rotor sweep zone.

bp/h: Bat passes per hour, calculated as a mean or median value from the nightly average bat passes per hour.

Buffer zone: A zone established around areas that are identified as sensitive for bats and includes flyways, foraging areas and bat roosts.

CITES: Convention on International Trade in Endangered Species of Wild Fauna and Flora.

Cumulative Impact: Impacts created due to past, present, and future activities and impacts associated with these activities.

Echolocation: A physiological process for locating distant or invisible objects (such as prey) by means of sound waves reflected to the emitter (such as a bat) by the objects.

EMPr: Environmental Management Programme: A legally binding working document, which stipulates environmental and socio-economic mitigation measures which must be implemented by several responsible parties throughout the duration of the proposed project.

Endemic: A species that is restricted to a particular area.

EIA (Environmental Impact Assessment): The process of identifying environmental impacts due to activities and assessing and reporting these impacts.

GPS: Global Positioning System device.

IUCN: International Union for Conservation of Nature.

MW: Megawatts.

NEMA: National Environmental Management Act.

Pre-construction phase: The period prior to the construction of a wind energy facility.



Pulse: A single emission of sound by a bat.

Red data species: Species included in the Critically Endangered, Endangered, Vulnerable or Rare categories as defined by the IUCN.

REDZ (Renewable Energy Development Zones): Areas where wind and solar photovoltaic power development can occur in concentrated zones.

Rotor blades: The air foil of a wind turbine that catches the wind and rotates.

Rotor swept area: The area through which rotor blades of a wind turbine rotate.

S&EIA: Social and Environmental Impact Assessment (EIA): The process of identifying social and environmental impacts due to activities and assessing and reporting these impacts.

SABAA: South African Bat Assessment Association.

SABPG: South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities

SACNASP: South African Council for Natural Scientific Professions.

SANBI: South African National Biodiversity Institute.

Scoping Report: A report contemplated in regulation 21 of the NEMA amended EIA regulations R326 dated 7 April 2017.

Song meters: A particular brand of Bat Detector developed by Wildlife Acoustics. The terms Song Meter and Bat Detector are used interchangeably in this report.

SD card: A storage device for song meter recordings.

ToPS: Threatened or Protected Species.

Turbine: A device that harnesses wind energy and turns it into kinetic energy used for the generation of electricity.

WEF: Wind Energy Facility.



1. Introduction

1.1 Project Details

Volant Environmental (Pty) Ltd was commissioned by ABO Energy South Africa (Pty) Ltd to conduct a survey to assess the potentially Sensitive Areas for bats at a proposed wind energy facility (WEF) which will be known as the ABO Uvemvane WEF 1. The following report outlines details for this WEF, which will be referred to as the ABO Uvemvane WEF 1 throughout the report. A preferred study area with a total combined extent of approximately 8 200 ha was identified as a technically suitable project site for the development of the WEF project. The ABO Uvemvane WEF 1 will have a capacity of up to 170 MW with up to 20 turbines which will be connected with underground cabling as far as possible. Each turbine will have a maximum hub height of up to 180 m and a maximum rotor diameter of up to 200 m (Table 1). The development footprint will be *ca* 67,2 ha, which is *ca* 1,05 % of the total area. There are plans for four temporary laydown areas and batching plants, and rehabilitation will be considered for all laydown areas. A maximum of one onsite substation will be constructed and one Battery Energy Storage System (BESS). Auxiliary buildings include, but are not limited to, Operation and Maintenance (O&M) building/s, admin building/s, workshop/s, gatehouse/s, security building/s, control centre/s, office/s, visitor centre/s, warehouse/s. The roads (up to 31 km in length) will measure up to 12 wide, but will be rehabilitated to 10 m, and a 33kV overhead/underground line will be used to connect the northern and southern portions of the facility. A communications tower will be installed (maximum height 32 m) and/or lighting mast (maximum height 25 m). Five (5) existing routes; four of these are off existing unnamed farm roads (originating from the D1220 and P243/1), and one is off Lagerspoort Road from Heidelberg - Balfour Road (R23). Four temporary laydown areas/ construction compounds (includes concrete batching), totalling up to 15 ha, would be fenced with access control.



Table 1. ABO Uvemvane Wind Energy Facility 1 technical details

Technical Details (ABO Uvemvane Wind Energy Facility 1)		
Component	Dimensions	
Site Extent	Overall site area:	8 200 ha
Installed Capacity	Maximum export capacity:	Up to 170 MW
Wind Turbines	Number of turbines:	Up to 20 turbines
	Hub height from ground:	Up to 180 m
	Blade Length	Up to 100 m
	Rotor diameter:	Up to 200 m
	Maximum tip height:	280 m
	Turbine capacity	Up to 10 MW
	Foundation	Concrete
Access roads	New vs existing	Existing farm roads will be utilised as far as reasonably possible and upgraded where necessary. New internal service roads will need to be established and these would either comprise farm (compacted dirt/gravel) roads or be paved.
	Width	Up to 12 m wide
	Length	Up to 31 km
Battery Energy Storage Systems	Battery technology type:	Based on available technology
	Approx. footprint (ha):	Up to 7 ha
	Capacity:	Not Provided
Temporary Laydown	Number	Up to 4
	Size	Up to 15 ha
Auxiliary buildings		Operation and Maintenance (O&M) building/s, admin building/s, workshop/s, gatehouse/s, security building/s, control centre/s, office/s, visitor centre/s, warehouse/s,



1.2 Project Location

The full Project Area of Influence (PAOI) that we were appointed to perform bat assessments on covers an area of *ca* 8 200ha, within this an affected area of approximately 6000 ha has been assessed at EIA Phase. The proposed WEF would be located approximately 9km west of the town of Balfour in the Mpumalanga Province in the Dipaleseng Local Municipality within the Gert Sibande District Municipality and approximately 14km southeast of the town Heidelberg in the Gauteng Province in the Lesedi Local Municipality within the Sedibeng District Municipality (Figure 1). The area can be accessed using the R23 that runs North of the proposed PAOI. Large areas are currently used as agricultural land with section of natural areas present across of the PAOI.

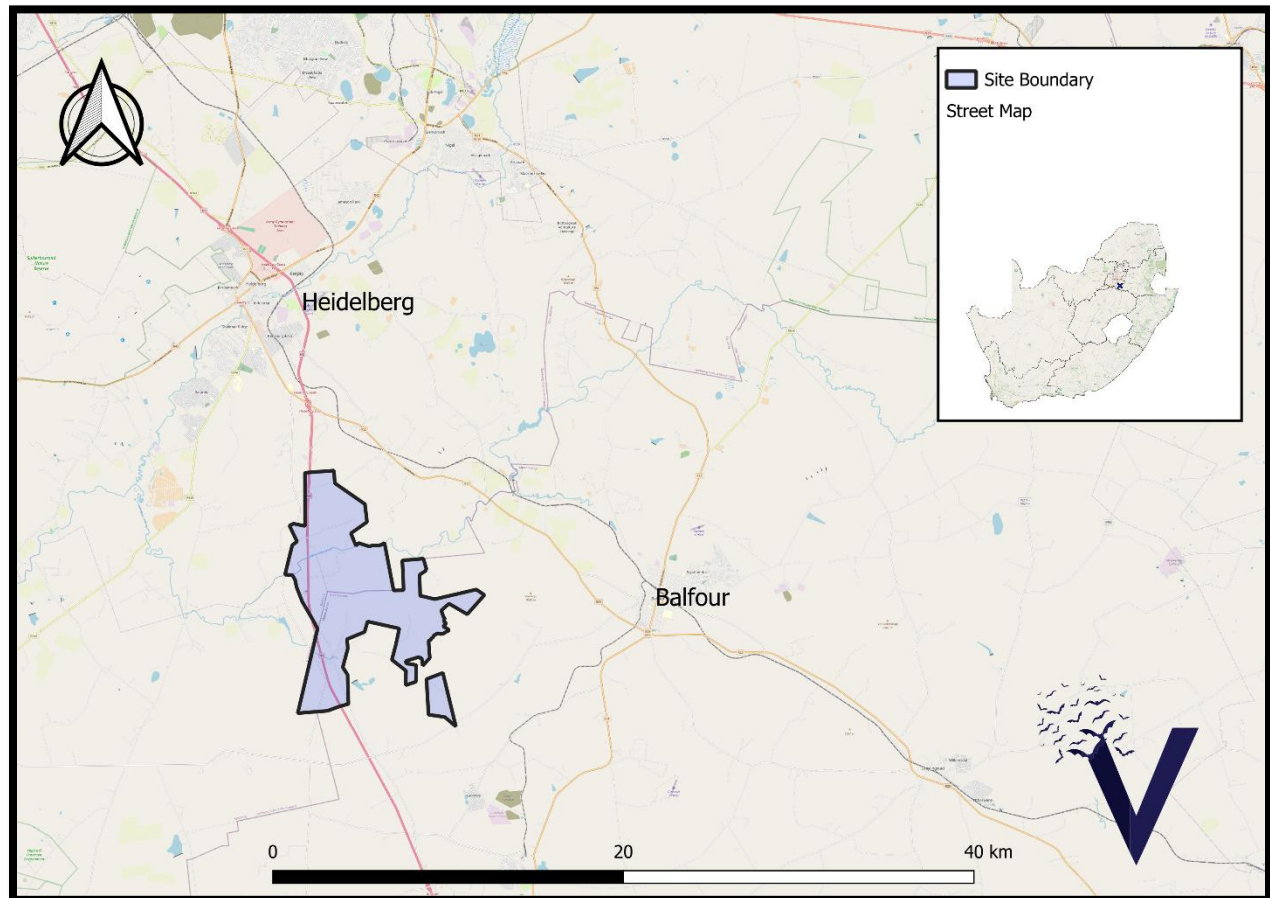


Figure 1. Location of the proposed ABO Uvemvane Wind Energy Facility 1.

1.3 Description of Ecoregion

The proposed PAOI falls across the Savanna Bioregion with Andesite Mountain Bushveld vegetation present on the majority of the proposed development site with smaller pockets of Gold Reef Mountain Bushveld, Tsakane Clay Grassland and Soweto Highveld Grassland (Figure 2 and 3, SANBI 2018). Based on the South African Best Practice Guidelines for Pre-Construction Monitoring of Bats at Wind Energy Facilities (SABPG, MacEwan et al. 2020) this is classified as the Drakensberg



Grasslands, Woodlands and Forest biome, and all future fatality risks during Pre-Construction monitoring will be assessed based on this ecoregion.

Andesite Mountain Bushveld is often characterised by dense, medium-tall thorny bushveld with a well-developed grass layer on hill slopes and some valleys with undulating landscape.

Mean maximum and minimum average temperatures in Heidelberg are 25.8°C and 13.5°C throughout the year with the area receiving 99 rainy days with an average annual rainfall of 59.09 mm.



Figure 2. Vegetation types found on the Proposed Area of Influence



Figure 3. Examples of habitat types found across the Project Area of Influence

1.4 Bats and Windfarms

All bat species form part of the Order Chiroptera which is classified as the second largest group of mammals only after rodents. Bats are also the only known mammal that has adapted to be capable of true flight which allows for the movement of bat species over vast distances, often crossing country boundaries as they migrate. They are the second most speciated mammal with a near worldwide distribution. More than 70% of bat species are insectivorous, while others are frugivorous, carnivorous or sanguivorous. Of more than 1 300 bat species documented globally at least 20% occur on the African continent, predominantly in the sub-Saharan regions, and a few on



the northern African coast (Simmons et al. 2008). Bat reproduction is similar to that of other mammals where gestation normally varies between 1.5 to 7 months, but averages around two months (Wilson, 2015). Bats distributed in areas with less seasonal variation and more persistent food availability reproduce biannually, compared with more temperate regions that only give birth once a year (monoestrous) (Bernard and Cumming, 1997). Most of the bat species found in southern Africa are insectivorous although some species have also been found to feed on amphibians, fruit, nectar as well as other invertebrates. As a result of their feeding behaviors, bats contribute to the control and suppression of insect numbers which include agricultural pests such as moths and vectors for diseases such as mosquitoes (Rautenbach 1982, Taylor 2000).

Urban development and agricultural practices have had a significant impact on bat population as deforestation and terrain manipulation often results in ideal habitat destruction and roost disturbances. This includes the increase in established wind farms that have negatively impacted bat populations (Aronson 2022). Although most bat species are equipped with advanced echolocation abilities, they are still at risk of physical impact with the blades of wind turbines. Although deaths due to direct impact with turbine blades has been established, the majority of bat fatalities are due to the barotrauma associated with the low air pressure found around the moving blades of wind turbines that causes the lungs of a bat to collapse resulting in fatal internal haemorrhaging (Kunz et al. 2007). It has been suggested that bats are often attracted to structures that include wind turbines. It is believed that insects get trapped within the low-pressure pockets that form near the rotor sweep zones which forces bats into the rotor sweep zone. Additional attractants such as lights installed on turbines as well as the clearance of vegetation around turbine structures are believed to also attract insects and subsequently bats (Johnson et al. 2003).

1.5 Bat Species most often Impacted by Windfarms

Southern Africa has multiple bat species with a few species that have very large distribution and abundance. Some of these species are of importance based on their likelihood of being impacted by the construction and operation of wind farms, due to high abundances and certain behavioural characteristics. Three species that have large distributions across South Africa and are present in



most habitat classification regions are the Egyptian free-tailed bat (*Tadarida aegyptiaca*), Cape serotine (*Laephotis capensis*) and The Natal long-fingered bat (*Miniopterus natalensis*). These three species are often fatalities of wind farms and will be discussed further below.

Tadarida aegyptiaca

The Egyptian free-tailed bat is an open-space forager that is known to fly and forage at great heights (altitudes as high as 100-3 000 m) (Davis, 1962; Williams et al., 1973). These bats have been found covering extensive distances and large areas during foraging and also during migration to different roosting systems. They typically have a body mass of approximately 16 grams and are known as the fastest flyers amongst the Molossidae family with a widespread distribution throughout the Southern Africa. They are known to roost in caves, cavities in trees, rock crevices and in the roofs of man-made structures such as buildings (Shortridge, 1934; Herselman and Norton, 1985; Skinner and Chimimba, 2000). They are classified as a species of Least Concern (SANBI Red List 2016) and are currently represented across large areas in South Africa where assessments have been conducted.

Tadarida aegyptiaca forages over a wide range of habitats, flying above the vegetation canopy. It appears that the vegetation has little influence on foraging behaviour as the species forages over desert regions, savannah, grassland and agricultural lands (large open spaces). As they are insectivorous bats, their presence is most commonly associated with insect abundance and thus having more insects present will correlate to an increase in their foraging presence (Monadjem et al. 2020). Their reproductive behavior leads to maternity colonies being established in November followed by birthing of a single pup, usually in November or December. The Egyptian free-tailed bat is considered to have a high risk of fatality from wind energy facilities due to turbine collisions (MacEwan et al. 2020). The wide spread abundance and distribution of these bats are linked to high mortality rates due to wind farms and thus are considered as one of the important species to focus on when assessing the impact a wind energy facility will have on bat populations.



Laephotis capensis

Laephotis capensis is commonly called the Cape serotine bat and was previously formally classified as *Neoromicia capensis*, and is classified as a species of Least Concern. They have a widespread distribution across southern Africa and as such are often fatally impacted by the presence of wind farms as they are found from arid and semi-arid areas to montane grasslands, forests, and savannas. They are most often found in roosts such as in under the bark of trees or in the roofs of houses with foraging occurring at the edge of vegetation due to them being clutter-edge foragers. Reproduction activities commence from end of March until the beginning of April with birthing occurring in October and November (van der Merwe 1994 and Lynch 1989). Due to their wide distribution and high abundance, they have a high fatality count at existing wind farms and assessments focusing on their presence should be prioritized (MacEwan et al. 2020).

Miniopterus natalensis

Miniopterus natalensis, commonly referred to as the Natal long-fingered bat, occurs widely across South Africa with distribution regions stretching into the neighboring countries with sparse recordings from East and West Africa. They are currently classified as a species of Least Concern. These bats are a cave dwelling species with roost numbers known to reach 260 000 bats (De Hoop Guano Cave) (Monadjem et al. 2020). Mine shafts and quarry diggings are used as roosting sites for small colonies of this species. They often have multiple roosting sites which are occupied at different times of the year dependent on the reproductive stage of these bats. Maternity colonies are occupied during the summer months when pups are birthed from October to December (Monadjem et al. 2020). Due to the migration of these bats between roosts, they are often fatalities of existing wind farms and thus assessment of potential cave roost on proposed wind energy facilities are vital when assessing impacts on this bat species (MacEwan et al. 2020). The species is currently displaying low to moderate numbers of mortalities at operational wind farms in South Africa but show a medium to high risk of collision (MacEwan et al. 2020).



1.6 Terms of Reference

The following terms of reference are deemed standard for bat studies conducted on proposed developments and meet the requirements of Appendix 6 of the EIA Regulations.

- The identification of species of conservation concern (SCC) for bats.
- The identification of sensitive habitats and No-Go areas for bats across and surrounding the development site and how these areas can be avoided.
- The identification of potential impacts on bats as a result of the proposed development and any associated infrastructure and the appropriate mitigation measures for each of these impacts across the construction, operational and decommissioning phases.
- Detailed impact assessments for each impact identified.
- Description of the relevant development and site-specific policies, guidelines, and legislation.
- Description of methodologies used to source information and data collection.
- Description of any site-specific assumptions and knowledge gaps.
- The recommendation of the best management processes to mitigate any identified risks on bats associated with the proposed development.
- To classify each impact according to the methods outlined and provided by the developer.

1.7 Content of Report

The EIA Regulations, 2014 (Government Notice (GN) R 982 of 2014, amended by GN R326 of 2017) Appendix 6 prescribe the required content in a specialist report. These requirements and the sections of this specialist report in which they are addressed, are summarised in Table 2.



Table 2. Content of report

GNR 982, Appendix 6 Ref.:	Item	Report Section:
(1) (a) (i)	Details of the specialist who prepared the report;	Appendix 2
(1) (a) (ii)	Expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 1
(1) (b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	P 3
(1) (c)	An indication of the scope of, and the purpose for which, the report was prepared;	Introduction
(1) (cA)	An indication of the quality and age of base data used for the specialist report;	Field surveys
(1) (cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Impact Assessment
(1) (d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Methods
(1) (e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Methods
(1) (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;	Impact Assessment
(1) (g)	An identification of any areas to be avoided, including buffers;	Bat buffers
(1) (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;	Opportunities and Constraints
(1) (i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Assumptions and Limitations
(1) (j)	A description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Impact Assessment
(1) (k)	Any mitigation measures for inclusion in the EMPr;	Environmental Management Plan



GNR 982, Appendix 6 Ref.:	Item	Report Section:
(1) (l)	Any conditions for inclusion in the environmental authorisation;	Environmental Management Plan
(1) (m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Environmental Management Plan
(1) (n) (i)	A reasoned opinion whether the proposed activity, activities or portions thereof should be authorised;	Conclusion
(1) (n) (iA)	A reasoned opinion regarding the acceptability of the proposed activity or activities;	Conclusion
(1) (n) (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, and where applicable, the closure plan;	NA
(1) (o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	NA
(1) (p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	NA
(1) (q)	Any other information requested by the competent authority.	NA
(2)	Where the government notice <i>gazetted</i> 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.	Regulatory Requirements

1.8 Bat Survey Validity Period

The current assessment is only representative for time spent assessing the proposed WEF and ultimate conclusions should not be drawn from this report (Table 2). Different bats are known to migrate before winter periods or annually (Jacobsen and du Plessis, 1976), and as such the species assemblages for the area could be vastly different during different periods of the year. The data reported in this report is solely based on data recorded, publicly available data and reports as well



as specialist experience and scientific opinions. This should, however, allow for preliminary conclusions to be made regarding the potential impact of bats of the proposed WEF.

1.9 Assumptions and Limitations

The assumption was made that all sources of information used during the completion of this report, are reliable and accurate.

Distribution records of bats in southern Africa are still poorly reported and limited for many species. In addition, migratory patterns of bats are largely unknown in South Africa. Studies have reported that bats do migrate, but the exact routes followed are not known (Pretorius *et al.*, 2020). The same is true for breeding behaviour and the formation of maternity colonies for many bat species.

Publicly available WEF reports for bats are reliant on in-depth site inspection and reporting echolocation calls (if no bat mortality data from adjacent facilities are available), but without echolocation call libraries, accurate identification of calls are not always possible. Published libraries created from release and handheld calls from captured bats are available for southern Africa but are geographically limited. The echolocation calls of a particular species from different regions in South Africa are known to vary to some degree (Monadjem *et al.*, 2020), and as such call libraries created in different regions are not always comparable.

Lack of public access to existing monitoring reports for WEFs and Solar Energy Facility (SEFs) is a recurring problem in the industry and one that severely hampers pre-construction monitoring studies and the recommendations therein, a problem to be addressed by relevant NGOs and the governmental institutions.

2. Site Sensitivity Verification

The Minister of Environment, Forestry and Fisheries, gave notice that the submission of a report generated from the national web-based environmental screening tool, as contemplated in Regulation 16(1)(b)(v) of the Environmental Impact Assessment Regulations, 2014, published



under Government Notice No. R982 in Government Gazette No. 38282 of 4 December 2014, as amended, will be compulsory from 4 October 2019 when submitting an application for environmental authorisation in terms of regulation 19 and regulation 21 of the Environmental Impact Assessment Regulations, 2014.

In addition, a set of protocols that an applicant needs to adhere to in the Environmental Authorisation (EA) process were developed and on 20 March 2020 the Minister of Forestry, Fisheries and the Environment gazetted the Protocols for national implementation purposes. The gazette *'Procedures to be followed for the Assessment and Minimum Criteria for Reporting of Identified Environmental Themes in terms of Section 24(5)(a) and (h) of the National Environmental Management Act (1998) when Applying for Environmental Authorisation'*, has protocols that have been developed for environmental themes which include agriculture, avifauna, bats, biodiversity (terrestrial and aquatic biodiversity), noise, defence and civil aviation.

The protocols set requirements for the assessment and reporting of environmental impacts of activities requiring environmental assessment. The higher the sensitivity rating of the features on the proposed site as identified by the screening tool report, the more rigorous the assessment and reporting requirements.

The SSV was carried out in the following manner:

1. The results from the Bat Theme of the DFFE Screening Tool were analysed.
2. The data collected on site during the screening visit and four seasons of pre-construction monitoring surveys was consulted.
3. Desktop analysis of the African Chiropteran Report (ARC 2021)
4. The on-site methodologies we utilised were consistent with the Best Practice Guidelines for Bats and wind Energy in South Africa" (MacEwan et al., 2020).
5. The dates of the site visits were as follows:

A site sensitivity verification and Screening visit took place in August 2024 during which time equipment was deployed. This visit was followed by a twelve-month pre-construction seasonal bat



monitoring survey of which the first seasonal survey was done during November 2024 and the last in September 2025.

Based on the screening reports generated in August 2024, the following summary of the development site environmental sensitivities were identified by the screening tool, as required by the 2014 EIA regulations and summarised below separately for each identified WEF cluster.

2.1 ABO Uvemvane Wind Energy Facility 1

The PAOI falls across a region with croplands, which is classified Medium Sensitive to bats. However, due to numerous water sources, wetlands and two rivers the area is classified as being of **High Sensitivity** (Figure 4). Based on the fly-ways, rivers, sources of open water and foraging areas we agree with the Screening tool that the area should be classified as a **High Sensitivity** area for bats.

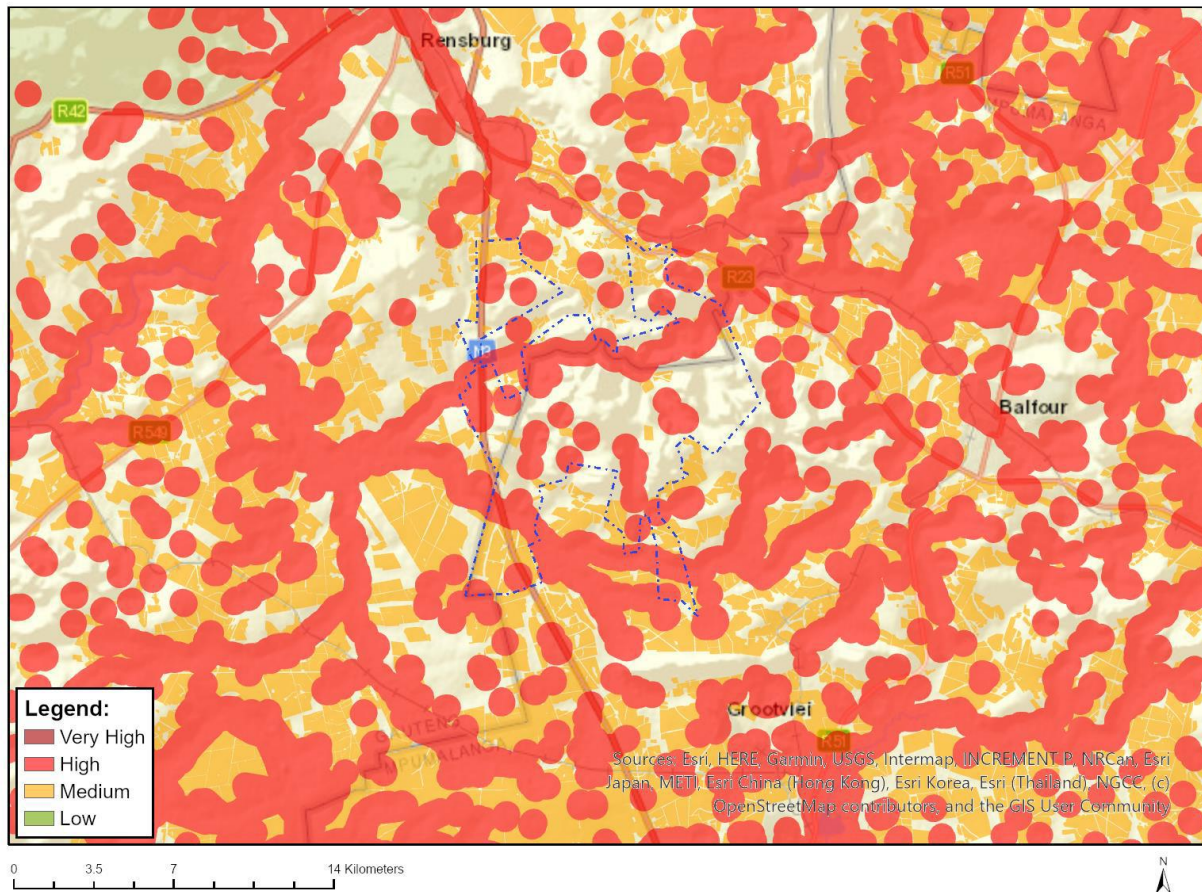


Figure 4. Bat Theme Screening tool output for the ABO Uvemvane Wind Energy Facility 1.



3. Methods

3.1 Guidelines and Requirements

3.1.1 Regulatory Requirements

Amendments were made to the NEMA: EIA Regulations of 2014: GNR 326 EIA Regulations; GNR 327 Listing Notice 1; GNR 325 Listing Notice 2; GNR 324 Listing Notice 3 which pertains to WEF and the activities surrounding their construction. Under Listing Notice 2 it is stated that a Scoping and Environmental Impact Assessment (EIA) is required for WEF with an electricity output 20 MW or more and which is not located in an urban area or on existing infrastructure. Only a Basic Assessment (BA) is, however, required in cases where the entire boundary of the proposed WEF is in a Renewable Energy Development Zone (REDZ) or when the output is below 20 MW. The proposed ABO Uvemvane WEF 1 is not located in a REDZ but will have an electrical output above 20 MW. Based on The South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities - ed 5 (SABPG, MacEwan *et al.*, 2020), a full 12-month survey is thus required. All methods used to inform desktop studies and conduct field surveys were implemented according to the SABPG (MacEwan *et al.*, 2020) and were undertaken to comply with Appendix 6 of the EIA Regulations.

3.1.2 Resources

Numerous resources are available to aid in the construction of a study of this nature and those consulted for the desktop study and during the pre-construction monitoring process are outlined below:

- The Bat Theme of the DFFE Screening Tool Report, which was generated in August 2024.
- Bats of Southern and Central Africa (Monadjem *et al.*, 2020)
- Volant Environmental specialist site visits, raw data and progress reports.
- African Chiropteran Report (2021)



- The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2018) was used to obtain the description of vegetation types occurring in the study area.

3.2 Desktop Study

A thorough desktop study was undertaken to estimate the likelihood of specific species of bats being present at the proposed WEF. This included investigations into available literature, including Bats of Southern and Central Africa (Monadjem *et al.*, 2020), the African Chiroptera Report (ACR, 2022) and any other bat surveys or monitoring reports for nearby WEF applications as determined from the REEA (2026 Q1) information. Lack of public access to existing monitoring reports for WEFs is a recurring problem in the industry and one that severely hampers pre-construction monitoring studies and the recommendations therein. A problem to be addressed by relevant NGOs and the governmental institutions.

A search was conducted to identify any protected areas present within 100 km of the proposed WEF project area using the South African Protected Area Data (SAPAD 2025 Q3).

3.3 Field Surveys

All methodologies used for the bat Screening Survey and subsequent Pre-Construction Monitoring were planned using the South Africa Best Practice guidelines for Pre-Construction monitoring of Bats at Wind Energy Facilities (MacEwan *et al.* 2020) as a guide and comply with all good practice guidelines. The first survey was conducted between the 26th and the 29th of August 2024 and was considered a Screening Survey where bat detectors were deployed. Four additional seasonal surveys were performed to conduct driven transects and roost inspections as required by the SABPG (2020) (Section 3.3.2, Table 3 and Figure 5). Transects were driven in such a way as to cover all habitat types.



Table 3. Summary of field work conducted.

Date	Season	Activity	Comments
26 – 29 August 2024	Autumn	Deployment and site inspection	Bat detectors were deployed, and preliminary roost inspections conducted
19 – 22 November 2024	Spring	Driven transects and preliminary roost inspections	All transects were driven and data collected
17 – 20 February 2025	Summer	Driven transects and preliminary roost inspections	All transects were driven and data collected. Summer roost inspections conducted
9 – 12 June 2025	Winter	Driven transects and preliminary roost inspections	All transects were driven and data collected
1 – 4 September 2025	Spring	Driven transects and removal of equipment	All transects were driven and data collected. Summer roost inspections conducted. All bat monitoring equipment removed

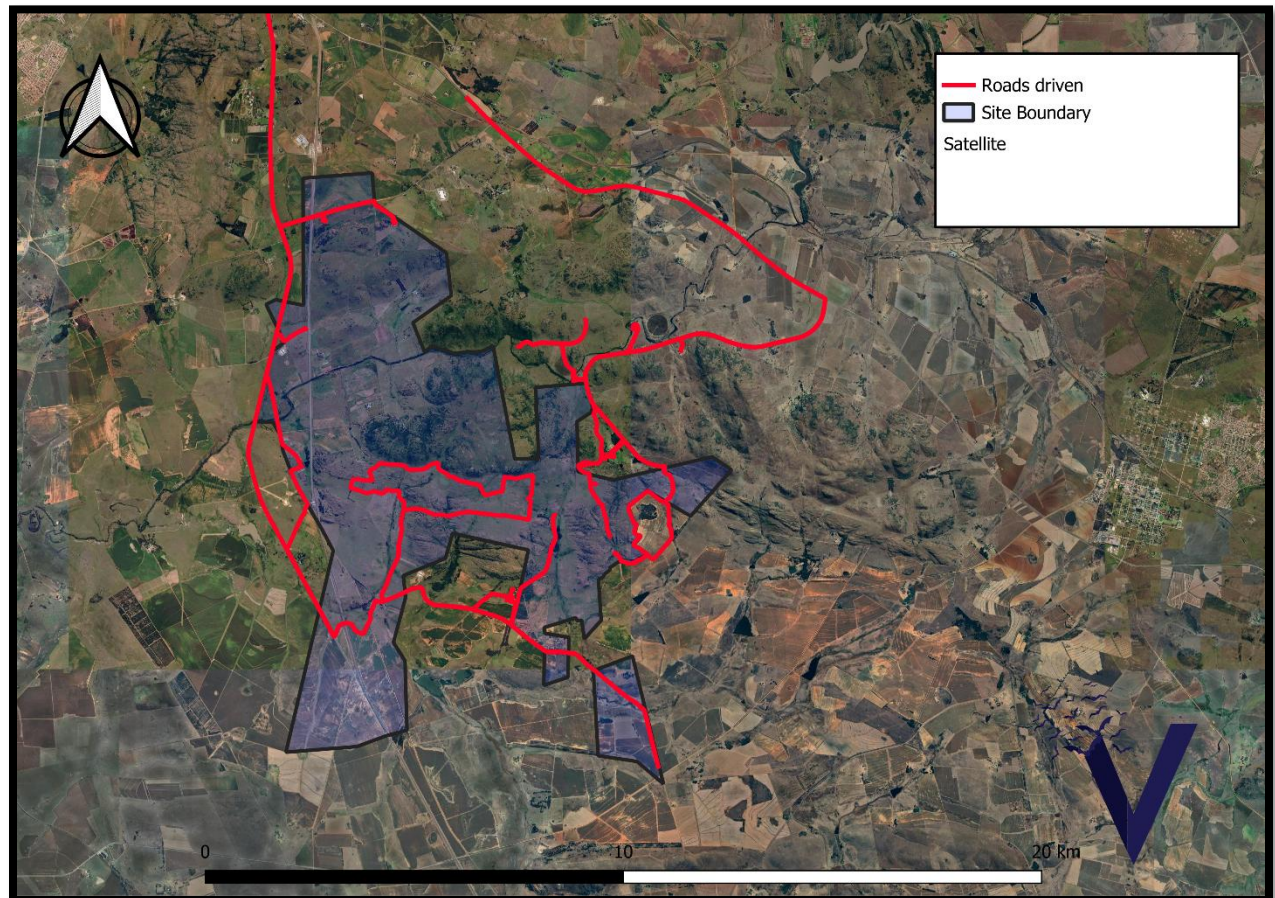


Figure 5. Roads driven during Site Sensitivity Verification

3.3.1 Passive Surveys

Nightly recordings of bats were captured using Wildlife Acoustics Bat detector SM4BAT FS Ultrasonic Recorders. Bat detectors were set to start recording 30 min before sunset until 30 min after sunrise to ensure that all active bats would be recorded. A total of five bat detectors were deployed across the PAOI (Figure 6). Locations where these detectors were placed were based on a thorough desktop investigation of the area and ground truthing conducted during the Screening Phase. Subsequently, bat detectors were placed to ensure that all habitat types were monitored



and any areas that were deemed to be important to bats (Figure 6 and 7) as stipulated in the SABPG (MacEwan et al. 2020)). This includes having at least one bat detector deployed at a height of 7 - 10 m per 5 000 ha of the PAOI, and one bat detector deployed at a height of 50 – 80 m per 10 000 ha for meteorological masts that are 80 m tall. If a mast is taller than 80 m an additional bat detector must be deployed as close to the top of the mast as possible. Bat detectors were deployed to cover the full POAI of 8 600 ha with three bat detectors deployed at 10 m above ground. A further two bat detectors were deployed at height on the met mast, one at 70 m and one at 120 m. During the recording time, the device is 'armed' and will begin a recording if a 'Trigger' is detected. A trigger is defined as a sound within the set frequency range (Default: >16 kHz) amplitude (Default: 12 dB) for a minimum duration (Default: 1.5 ms). The recording then continues for the duration of the Trigger Window (Default: 3 second) after the last Trigger, and then saves the recorded data. If there are constant Triggers, the recording will save and close after the maximum length of a recording file (Default: 00m:15s). All the detectors are powered by solar systems, and all data are copied from the SD cards and backed up during the seasonal site visits.

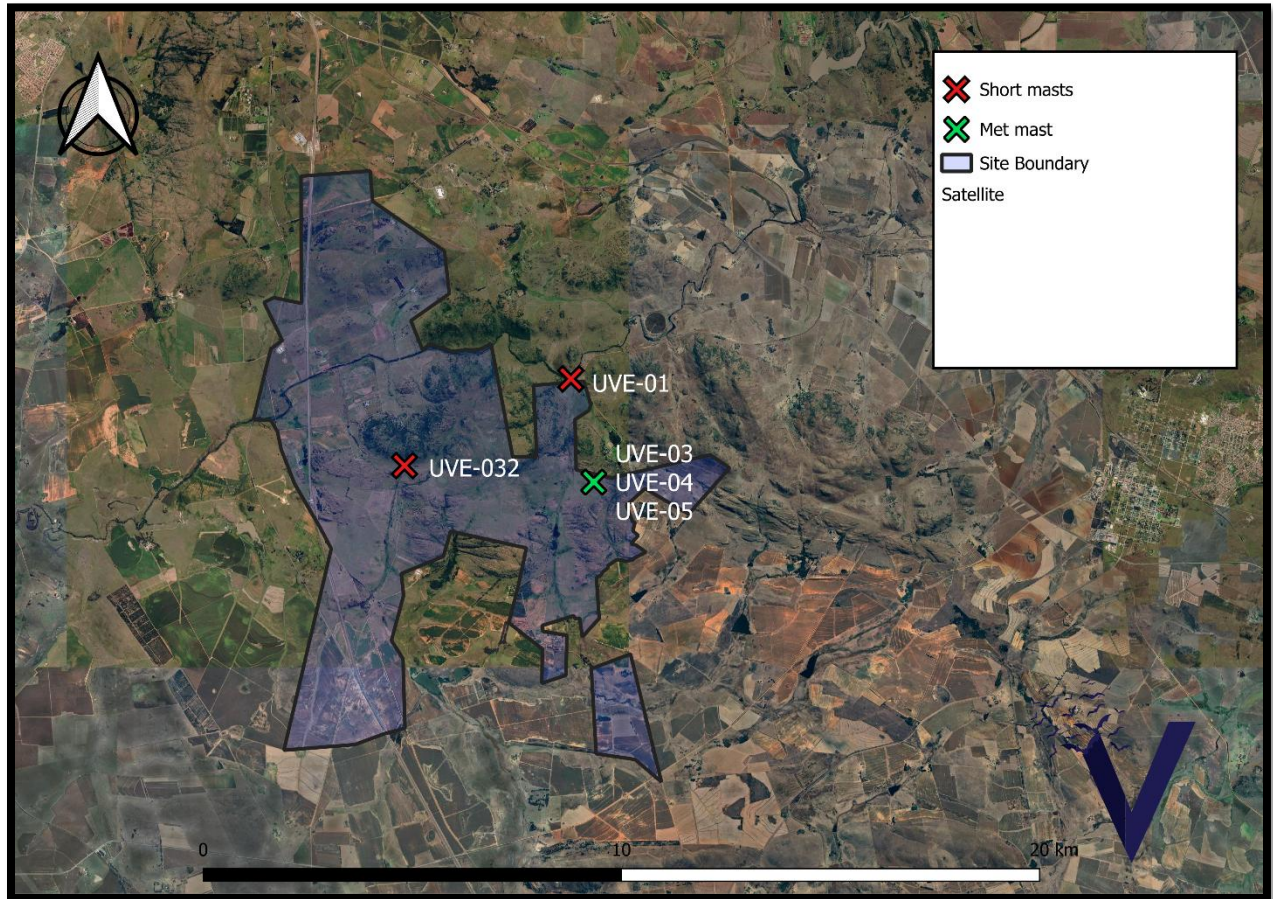


Figure 6. Locations of met masts and short mast used to deploy bat detectors.

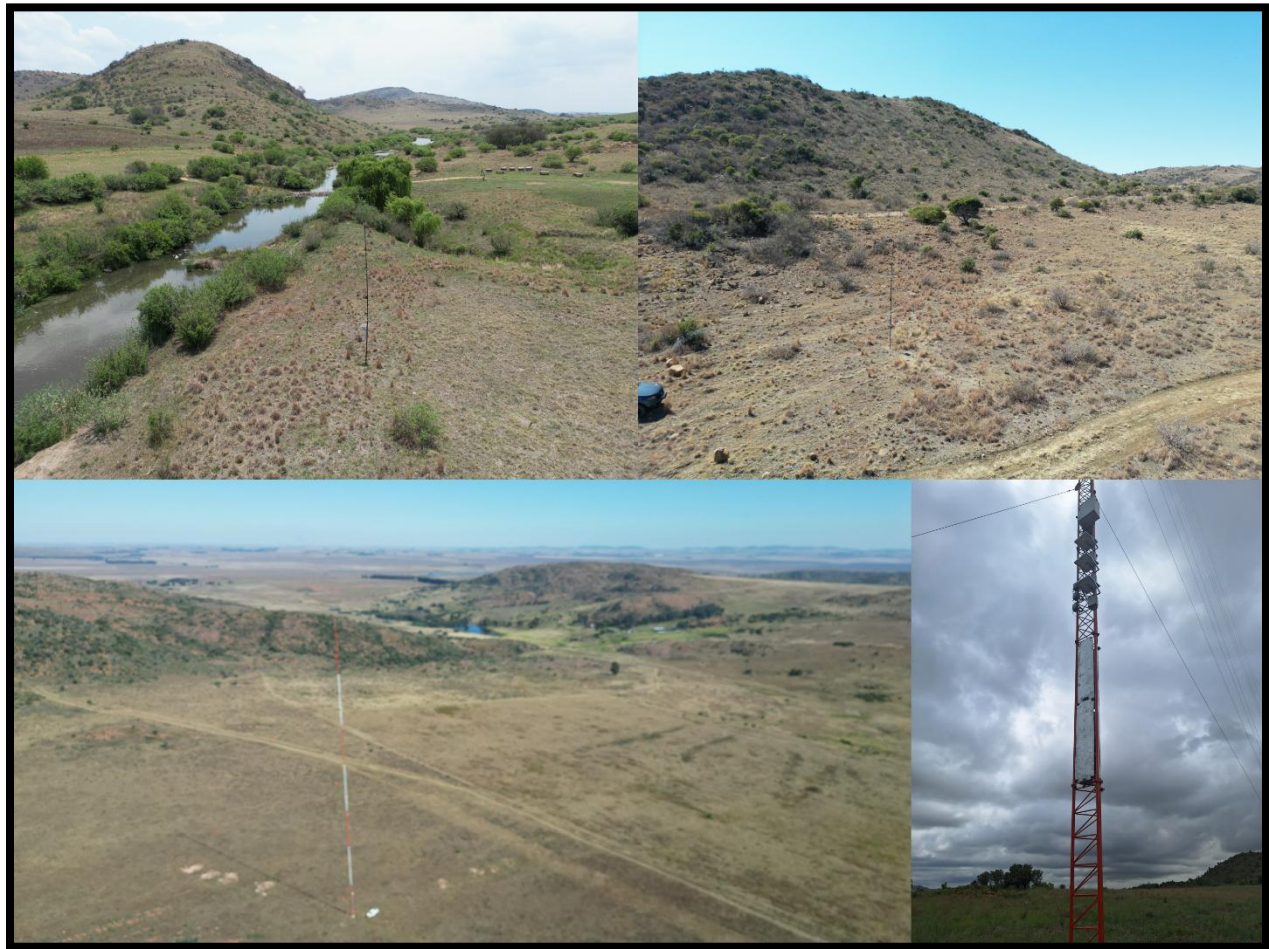


Figure 7. Short masts used to deploy bat detectors on the Project Area of Influence (top) and met mast with bat detectors deployed on the mast (bottom)

3.3.2 Active Surveys

Active surveys were conducted by driving transects around the area with a bat detector mounted on the roof of the vehicle at 30 km/h or slower (Table 4). Active surveys provide spatio-temporal representation of where different bat species may be found around the PAOI. When compared across seasons it will provide an idea of any specific trends present regarding the activity patterns



that may be unique to different species across the site. The routes and number of transects employed represented adequate coverage of the PAOI. Surveys began at twilight when conducted in the evening and lasted between 2.5 and 4 hours as required by the SABPG (2020). Two nights of transects were conducted per season on the proposed WEF.

Table 4. Times and duration of driven transects

Date	Start time	End time	Total
20 November 2024	18:05	20:42	02:37
21 November 2024	18:05	20:38	02:33
18 February 2025	18:14	20:48	02:34
19 February 2025	18:17	20:52	02:35
9 June 2025	16:44	19:15	02:31
10 June 2025	16:45	19:27	02:42
2 September 2025	17:26	20:07	02:41
3 September 2025	17:26	20:06	02:40
Total			20:53

3.3.3 Roost Surveys

Bats use a variety of roosts including caves, trees, crevices and buildings, and the choice of roost is species dependent (Miller-Butterworth et al., 2003; Pretorius et al., 2020). The locations of caves fairly well known, and historical records in conjunction with active searching can be used to uncover them. Detection of non-cave roosts sites are more difficult and can only be achieved through active searching. Transects were walked on all properties during the day, and potential roosting sites investigated with a bat detector. In addition, the search team was on the lookout for signs of bat activity such as traces of fecal material. Roost surveys were conducted during the summer and winter surveys as required by the SABPG.



3.4 Data Analyses

Kaleidoscope Pro v5.4.0 (www.wildlifeacoustics.com) was used to analyze all bat calls recorded *via* the auto-identification and cluster-analyses features. Due to the lack of release calls from bats in the southern Africa subregion and intra-species variation in bat calls the auto-identification feature is not always 100% accurate but does provide an indication of the potential bat species. As such all clusters created by the software was manually identified based on bat call parameters, including the peak frequency, call duration and bandwidth. Within each cluster one call was selected with a strong amplitude and minimal background noise to identify the species for that cluster.

3.5 Foraging Areas

The search team investigated areas with more complex vegetation structures which could potentially act as foraging areas, or areas that could be used as flythroughs. This included, but was not limited to, areas with trees or larger shrubs. It must be noted, however, that the absence of bats in these areas should not exclude these areas as potential foraging habitats.

3.6 Impact Assessment

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and



resources and receptors to provide a detailed discussion of impacts. The assessment considers direct (impacts that arise indirectly from activities not explicitly forming part of the Project), indirect (impacts that arise indirectly from activities not explicitly forming part of the Project), secondary (Secondary or induced impacts caused by a change in the Project environment) as well as cumulative impacts (impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future project).

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria presented in Table 5.



Table 5. Impact Assessment Criteria and Scoring System

Criteria	Score 1	Score 2	Score 3	Score 4	Score 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: No possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	4 to 15	16 to 30	31 to 60	61 to 80	81 to 100
Environmental Significance Rating (Negative (-))	Very low	Low	Moderate	High	Very High
Environmental Significance Rating (Positive (+))	Very low	Low	Moderate	High	Very High



3.7 Impact Mitigation

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

The mitigation sequence/hierarchy is shown in Figure 8 below.

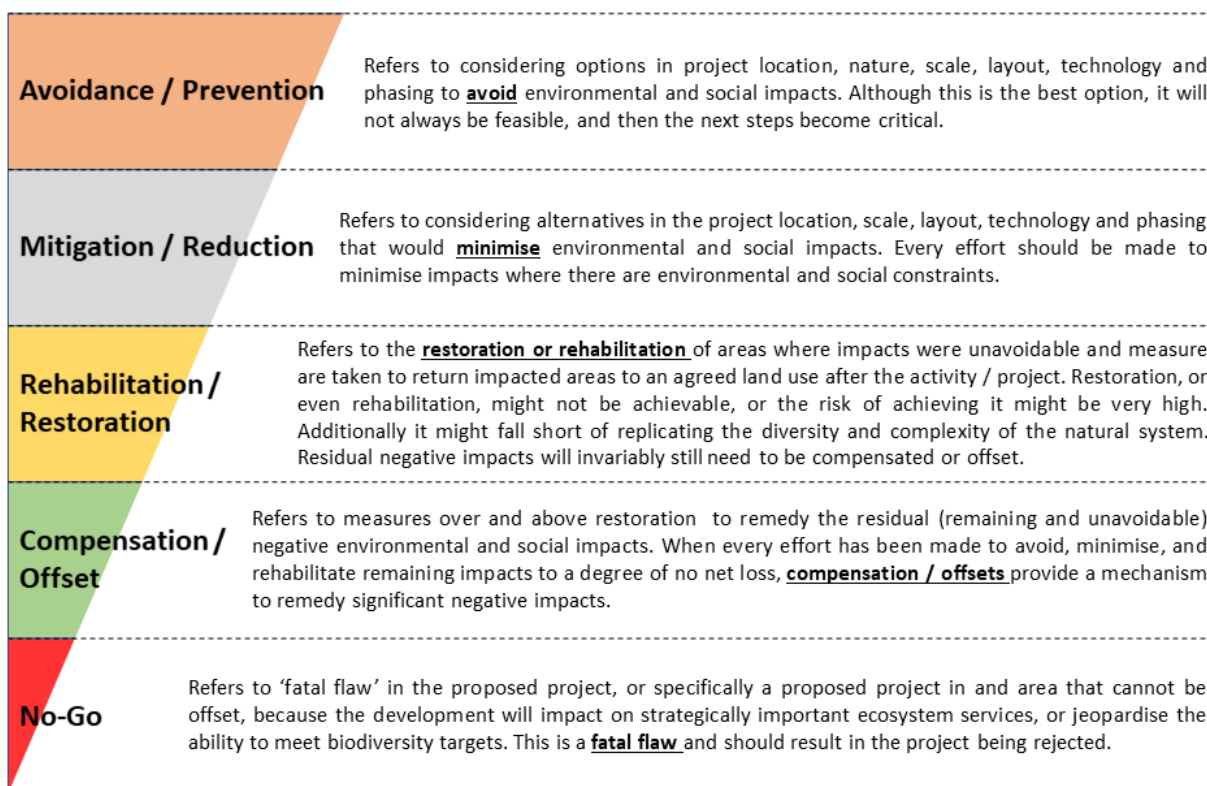


Figure 8. Mitigation Sequence/Hierarchy

4. Results

4.1 Desktop Survey

A thorough desktop study was undertaken to estimate the likelihood of specific species of bats being present at the proposed WEF. This included investigations into available literature, including Bats of Southern and Central Africa (Monadjem *et al.*, 2020), the African Chiroptera Report (ACR, 2022), and any other bat surveys or monitoring reports for nearby WEF as determined from the REEA (2026 Q1) information. Lack of public access to existing monitoring reports for WEFs and SEFs is a recurring problem in the industry and one that severely hampers pre-construction



monitoring studies and the recommendations therein. A problem to be addressed by relevant NGOs and the governmental institutions.

4.1.1 Bat surveys Conducted in the Area.

All nearby existing and proposed WEFs and SEF facilities were searched for online to find additional data regarding important bat findings that might be of importance to the proposed WEF. Investigations into available literature on other surveys or monitoring reports for nearby the proposed WEF application were undertaken (Figure 9, Table 6) as determined from the REEA (2026 Q1) information. In order to ensure that the data obtained was robust and our survey thorough, we included all renewable energy facilities within 50 km from the PAOI. These reports identified the potential impact of the proposed energy generating facilities on bat populations present and the mitigation strategies followed. Extensive lists of bats that could possibly be present on or near to the proposed WEF, was also compiled using the previous study data and publicly available information. This information can be seen in Table 6 and summarised below. When assessing the newest REEA data, 12 SEFs and one WEF are present within the search area, but as bat assessments are not required for SEFs based on the current guidelines, thorough assessments were not conducted, and no usable information regarding bats could be gathered from these facility reports. These facilities will, however, still be taken into consideration when assessing the cumulative impact of the proposed ABO Uvemvane Wind Energy Facility 1.

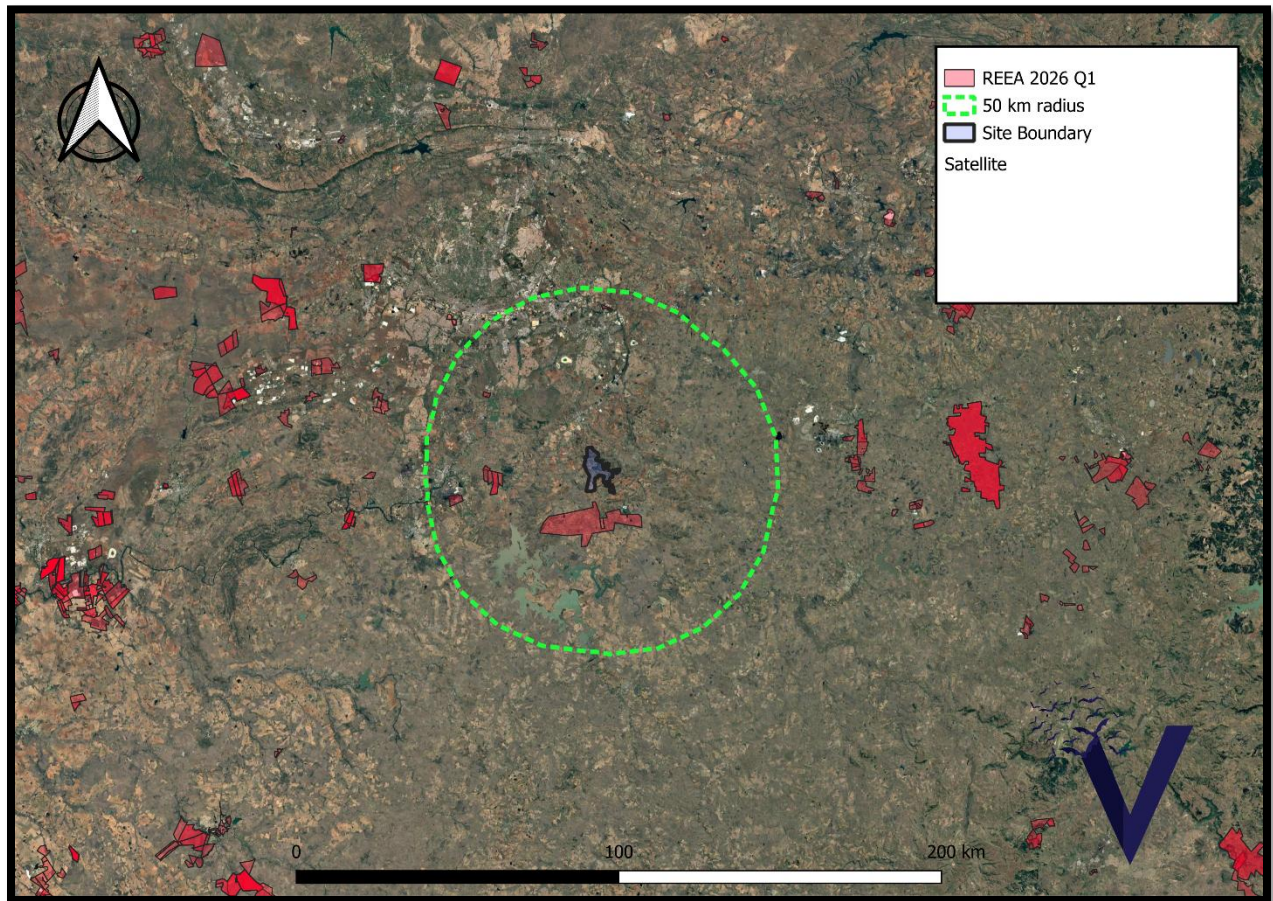


Figure 9. Renewable energy facilities located within 50 km of the proposed ABO Uvemvane WEF 1



Table 6. Environmental reports for Wind Energy Facilities (and other developments) in the region of the proposed WEF.

Report details	Consultant	Distance from site
The Proposed Impumelelo Wind Energy Facility and associated infrastructure near Secunda in Mpumalanga Province (Application Only)	Animalia Consultant (Pty) Ltd	20.7 Km East
The Proposed Suikerbos PV 1 and Associated Infrastructure in the Midvaal Local Municipality and the Sedibeng District Municipality, near Vereeniging, Gauteng Province.	Blue Crane Environmental (Pty) Ltd	26.07 Km West
Proposed construction of a 75 MW Solar (PV) electricity installation on various portions of the Farm Grootvlei No 453 IR Dipaleseng Local Municipality, Mpumalanga Province.	Mark Wood Consultants	3.38 Km South
The Proposed Suikerbos PV 2 and Associated Infrastructure in the Midvaal Local Municipality and the Sedibeng District Municipality, near Vereeniging, Gauteng Province.	Blue Crane Environmental (Pty) Ltd	27.69 Km West
The Proposed Villiers Solar Power Plant near Villiers, Free State Province	Blue Crane Environmental (Pty) Ltd	36.43 Km South
The Proposed Suikerbos PV 3 and Associated Infrastructure in the Midvaal Local Municipality and the Sedibeng District Municipality, near Vereeniging, Gauteng Province.	Blue Crane Environmental (Pty) Ltd	29.08 Km West
The proposed Suikerbos PV 4 Photovoltaic Solar Energy Facility and Associated Infrastructure near Vereeniging, Gauteng Province.	Blue Crane Environmental (Pty) Ltd	29.63 Km West
Proposed Kynoch Rooftop Energy Installation in Endicott Gauteng Province	Savannah Environmental (Pty) Ltd	47.43 Km Northwest
The proposed establishment of a 115MW solar photovoltaic (PV) facility in Springs, within the	WSP Group Africa (Pty) Ltd	42.53 Km North



Report details	Consultant	Distance from site
Ekurhuleni Metropolitan Municipality, Gauteng Province		
Proposed construction of a 3MW PV solar power facility on Farm Villa Liza No. 675IR in Mapelton	Phaki Phakanani Environmental Consultants (Pty) Ltd	30.9 Km Northwest
The Proposed Construction of A 75mw Solar Energy Generation Facility and Its Associated Infrastructure on Portion 1 of the Farm Putfontein 26 Ir, Ekurhuleni Metropolitan Municipality, Gauteng Province	Rock Environmental Consulting (Pty) Ltd	40.68 Km Northwest
Proposed 75 MW Solar PV facility at Lethabo Power Station, Free State Province	Savannah Environmental (Pty) Ltd	30.5 Km West
The 100 MW Waterval Solar Park including solar glass manufacturing, metallurgical silicone manufacturing plant and module manufacturing plant near Meyerton, Gauteng Province	EON Consulting	34.61 Km Northwest

Impumelelo Wind Energy Facility Final Environmental Impact Assessment Report

- A full twelve-month monitoring assessment was completed at the proposed development site.
- Areas of High and Medium sensitivity were mapped and appropriate no-go and buffer areas were supplied by the specialist.
- It was determined that construction will disturb feeding habitat, underground roosts as well as roost in tall trees. Mitigation measures were suggested by the specialist to limit the possible impact on bats.
- Mortality of bats during feeding and possible migration was highlighted by the specialist and mitigation measures suggested to lower the possible impact on bats.



4.1.2 Potential Species Present in the Area

Our desktop study, which included the above-mentioned reports, data from the African Chiropteran Report (ACR, 2022) and Bats of Southern and Central Africa (Monadjem et al., 2020) revealed that 20 species could potentially be found in the area (Table 7). The ACR database was used to plot species that have been captured or recorded near the POAI. We used a radius of 100 km as bats are known to travel vast distances and this provides a broader context to ensure that species that may migrate across the PAOI are included. Only four species have been captured or collected within 50 km from the proposed WEF, *Laephotis capensis*, *Tadarida aegyptiaca*, *Myotis welwitschii* and *Chaerephon pumilus* (Figure 10, ACR, 2021). More species have been captured within 100 km of the PAOI, including *Myotis tricolor*, *Rhinolophus simulator* and *Rhinolophus capensis*. Probability of occurrence is based on the distribution ranges of the species and habitat and roosting requirements along with specialist knowledge and experience. The distribution ranges of all species have been drawn from the ACR database (2022).

Table 7. List of species with possible occurrence around the proposed WEF site

Species name	Common name	Conservation Status IUCN/ SA Red List	Foraging habits	Roosts	Probability of occurrence	Risk of Impact
Cistugidae						
<i>Cistugo lesueur</i>	Lesueur's hairy bat	LC/NT	Clutter-edge forager	Rock crevices	Low	High
Emballonuridae						
<i>Taphozous mauritanus</i>	Mauritian tomb bat	LC/LC	Open-air forager	Open-air forager	High	High
Hipposideridae						
<i>Hipposideros caffer</i>	Sundevall's leaf-nosed bat	LC/LC	Clutter forager	Cave and hollow dependent	Low	Low
Miniopteridae						
<i>Miniopterus natalensis</i>	Natal long-fingered bat	LC/LC	Clutter-edge forager	Caves	High	High
Molossidae						
<i>Mops midas</i>	Angolan free-tailed bat	LC/LC	Open-air forager	Roosts in any suitable crevice and in the roofs of buildings and houses	High	High



Species name	Common name	Conservation Status IUCN/ SA Red List	Foraging habits	Roosts	Probability of occurrence	Risk of Impact
<i>Tadarida aegyptiaca</i>	Egyptian free tailed bat	LC/LC	Open-air forager	Caves, rock crevices, under exfoliating rocks, hollow trees, behind the bark of dead trees and buildings	High	High
Nycteridae						
<i>Nycteris thebaica</i>	Egyptian slit faced bat	LC/LC	Clutter forager	Caves, culverts, and trunks of large trees	Medium	Low
Pteropodidae						
<i>Epomophorus crypturus</i>	Peters's epauletted fruit bat	LC/LC	Clutter forager	In valleys and low-lying areas where large fruiting trees are present.	Medium	High
<i>Epomophorus wahlbergi</i>	Wahlberg's Epauletted Fruit bat	LC/LC	Clutter forager	Roosts in dense foliage of large, leafy trees	Medium	High
<i>Rousettus aegyptiacus</i>	Egyptian rousette	LC/LC	Clutter forager	Caves	Low	High
Rhinolophidae						
<i>Rhinolophus clivosus</i>	Geoffroy's horseshoe bat	LC/LC	Clutter forager	Caves and mines	Medium	Low
<i>Rhinolophus darlingi</i>	Darling's horseshoe bat	LC/LC	Clutter forager	Caves and mines	Medium	Low
<i>Rhinolophus denti</i>	Dent's horseshoe bat	LC/NT	Clutter forager	Caves and mines	Medium	Low
<i>Rhinolophus simulator</i>	Bushveld horseshoe bat	LC/LC	Clutter forager	Caves and mines	Medium	Low
Rhinonycteridae						
<i>Cloeotis percivali</i>	Percival's short-eared trident bat	LC/EN	Clutter forager	Cave and hollow dependent	Low	Low
Vespertilionidae						
<i>Eptesicus hottentotus</i>	Long-tailed serotine	LC/LC	Clutter-edge forager	Caves and rock crevices	High	Medium
<i>Laephotis capensis</i>	Cape serotine	LC/LC	Clutter-edge forager	Under the bark of trees, foliage, and buildings	High	High
<i>Myotis tricolor</i>	Temminck's myotis	LC/LC	Clutter-edge forager	Caves	Medium	Medium
<i>Pipistrellus hesperidus</i>	Dusky pipistrelle	LC/LC	Clutter-edge forager	Wooded areas in trees as well as cracks in rocks	High	Medium



Species name	Common name	Conservation Status IUCN/ SA Red List	Foraging habits	Roosts	Probability of occurrence	Risk of Impact
<i>Scotophilus dinganii</i>	Scotophilus dinganii	LC/LC	Clutter forager	Roosts mainly in holes in trees and roofs of houses	High	Medium

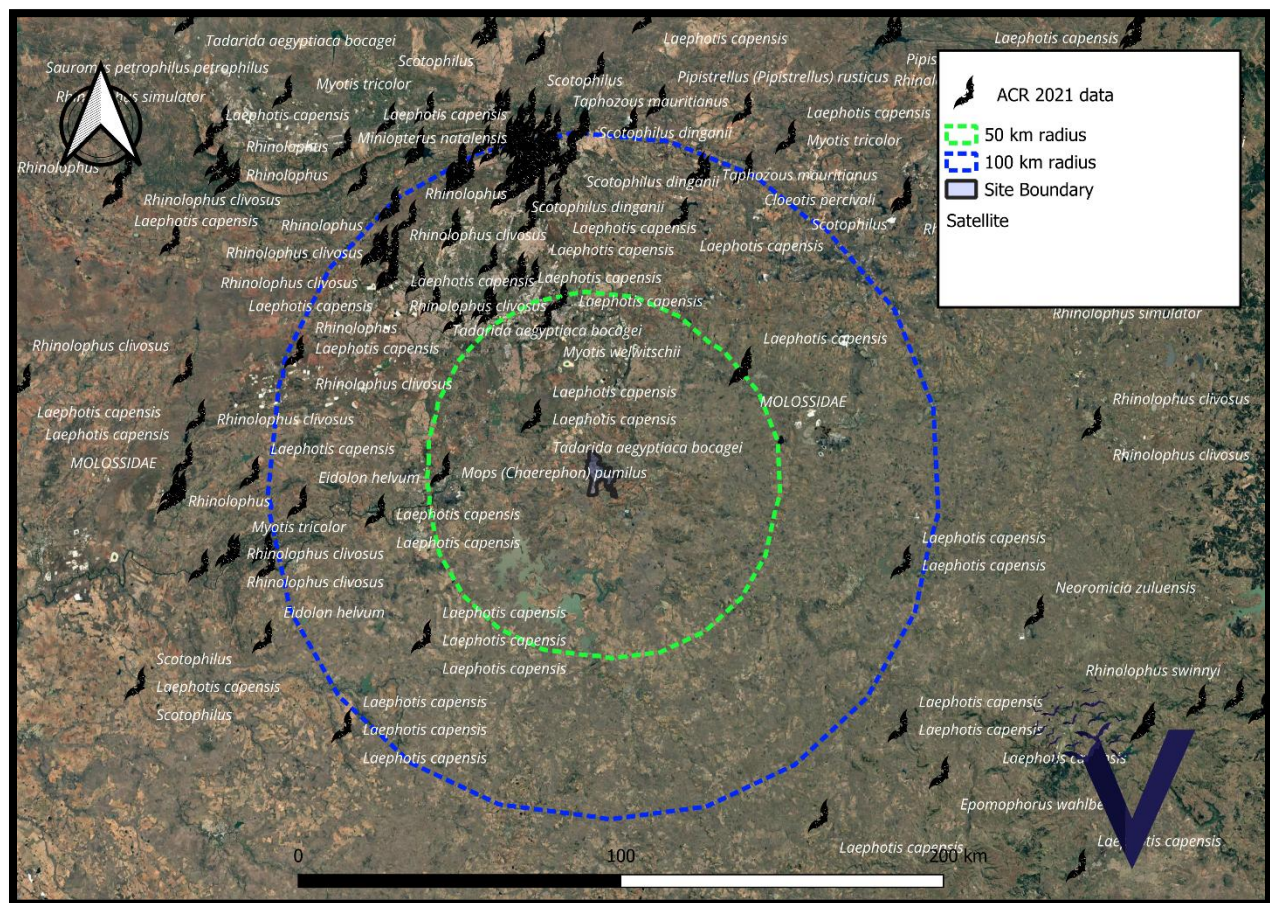


Figure 10. Bats captured or collected near the Project Area of Influence



4.1.3 Protected areas

A search was conducted to identify any protected areas present within 100 km of the proposed WEF project area using the South African Protected Area Data (SAPAD 2025 Q3). The identified public/private owned protected areas are listed in the table below (Figure 11, Table 8). The reserves consist of privately as well as publicly owned land used for wildlife conservation as well as specific livestock farming. These sites are all registered designated protected areas (SAPAD 2025 Q3).

In addition to protected areas present around the proposed WEF site, a search for cave roosts was conducted. Locations of historical caves are fairly well known, but as not all the records are publicly available, it does impose risks of these sites being missed. Both summer and winter roost inspections have been performed during the assessment. Due to the geological makeup of complex dolomite structures found in and around the Gauteng region, cave structures are easily formed. A few known caves found within the 50 Km and 100 Km radius are well known (e.g. Nash's Cave, Bat's Cave, Bakwena/Irene Cave, Skurweberg Caves, Gladysvale Mine, American Cave, Monument Cave, Fountains Cave, Scramblers, Sterkfontein, Gladysvale Mine, Kromdraai Mine, Minaar's Cave, Wondercave, Silwer Myn, Grobler's Cave, Porcupine Cave, Mamelodi Cave, Groenkloof, Swartkop cave). Most of the abovementioned caves are found North of the PAOI and should not affect the proposed development as the SABPG only require a 20 km search radius. Results obtained in this study will provide information on possible migration routes and roost presence.



Table 8. The identified public/private owned protected areas identified close to proposed WEF site

Name	Location From WEF
Marievale Nature Reserve	22.9 Km North
Daisy Private Nature Reserve	10.5 Km Northeast
Voortrekker Private Nature Reserve	20.5 Km Northeast
Nicolaas Private Nature Reserve	25 Km Northeast
Devon Protected Environment	21.5 Km Northeast
Vaaldam Nature Reserve And Parent Farms	18.8 Km South
Lourensa Game Farm	57.2 Km South
Rietgat Game Reserve	39.6 Km Southwest
Leeuwkuil Nature Reserve	74.3 Km West
Sasol Private Nature Reserve	54.4 Km Southwest
Leeuwspruit Private Nature Reserve	56.6 Km Southwest
Suikerbosrand Nature Reserve	11.7 Km West
TwEEfontein Private Nature Reserve	70.2 Km West
Avalon Private Nature Reserve	26.8 Km North
Andros Private Nature Reserve	28.5 Km North
Rondebult Nature Reserve	36.7 Km Northwest
Olifantsvlei Nature Reserve	51.7 Km Northwest
Magaliesberg Biosphere Reserve	72 Km Northwest
Melville Koppies Nature Reserve	60.3 Km Northwest
Alice Glöckner Nature Reserve	3.2 Km Northwest
Beaulieu Bird Sanctuary	74.9 Km Northwest
Austin Roberts Bird Sanctuary	92.3 Km North
Diepsloot Nature Reserve	79.7 Km Northwest
Van Riebeeck Nature Reserve	75.6 Km North
John Cairns Private Nature Reserve	97.2 Km Northeast
Colbyn Wetland Nature Reserve	95.3 Km North



Name	Location From WEF
Faerie Glen Nature Reserve	90.4 Km North
Frank Struben Bird Sanctuary	93.5 Km North
Gawie De Beer Nature Park	34.3 Km Southwest
Glen Austinpan Bird Sanctuary	71.7 Km Northwest
Groenkloof Nature Reserve	88.9 Km North
Koppies Dam Nature Reserve	81.1 Km Southwest
Leeuwfontein Private Nature Reserve	19.5 Km South
S. J. Van Der Merwe Private Nature Reserve	20.1 Km South
Sasolburg Private Nature Reserve	57.5 Km West
Blaauwbosch Bank Reserve	63.1 Km Southwest
Blomhoek Pleasure	88.4 Km South
Bronkhorstfontein Game Reserve	85.3 Km Southwest
Cloudy Creek Bird Sanctuary And Nature Reserve	63.9 Km West
Jagersrust Game	93.4 Km South
Klein Paradys Bird Sanctuary	85.5 Km West
Leeuwpoot Safaris	68.5 Km Southwest
Oppieplaas Game Reserve	79.2 Km Southwest
Savannah Game Ranch	84.2 Km West
J. N. Van Der Merwe Private Nature Reserve	16.2 Km South
Ian P. Coetzer Private Nature Reserve	32 Km North
Johanna Jacobs Private Nature Reserve	48.3 Km Northwest
Keyterskloof Private Nature Reserve	18.5 Km Northwest
Pamula Park Private Nature Reserve	53.2 Km North
Rietvlei Nature Reserve	73.4 Km North
Saronde Private Nature Reserve	83.5 Km Northwest
Carry Blaire Bird Sanctuary	85.7 Km West
Vechthoek Private Nature Reserve	85.2 Km West
Windheuvel Shooting Lodge	87.8 Km Southwest



Name	Location From WEF
Klipkraal Protected Environment	15.3 Km Southwest
Crocodile River Reserve Protected Environment	86.5 Km Northwest
Fossil Hominid Sites Of Sa	81.8 Km Northwest
Klapperkop Nature Reserve	89.6 Km North
Crocodile River Reserve Doornrandje Nature Reserve Cluster	86.1 Km Northwest
Voortrekker Monument Nature Reserve	92.1 Km North
Groenkloof National Park	93.4 Km North
Klipriviersberg Nature Reserve	48.3 Km Northwest
Crocodile River Reserve Central Nature Reserve Cluster	86.5 Km Northwest
Klipkraal Nature Reserve	18.7 Km Southwest

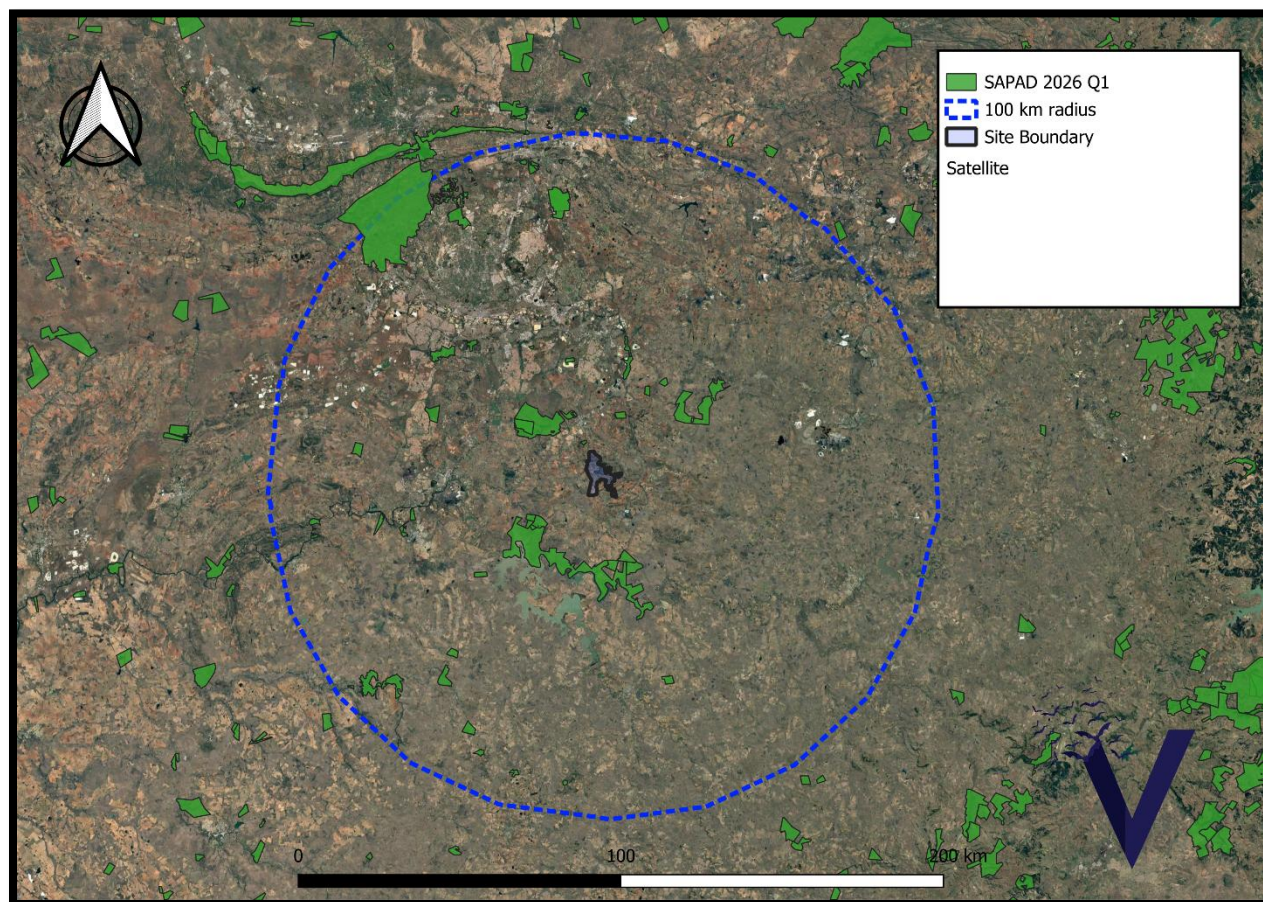


Figure 11. Location of protected areas near the Project Area of Influence

4.2 Passive Monitoring

We recorded five bat species across the monitoring period between 26 August 2024 and 3 September 2025 (Table 9). This included 264 691 bat calls recorded over a period of 20 572,57 hours at a median of 0,99 bat passes per hour. Of the species recorded *L. capensis* was the most abundant followed by *T. aegyptiaca*.



Table 9. Bat species detected across the Project Area of Influence with their Impact Risk and abundance (BP/H)

Species name	Common name	Conservation Status IUCN/ SA Red List	Foraging habits	Roosts	Risk of Impact	Median number of bat passes per hour
Molossidae						
<i>Tadarida aegyptiaca</i>	Egyptian free tailed bat	LC/LC	Open-air forager	Caves, rock crevices, under exfoliating rocks, hollow trees, behind the bark of dead trees and buildings	High	3,40
Miniopteridae						
<i>Miniopterus natalensis</i>	Natal long-fingered bat	LC/NT	Clutter-edge forager	Caves	High	0,00
Vespertilionidae						
<i>Laephotis capensis</i>	Cape serotine	LC/LC	Clutter-edge forager	Under the bark of trees, foliage, and buildings	High	16,76
<i>Pipistrellus hesperidus</i>	Dusky pipistrelle	LC/LC	Clutter-edge forager	Wooded areas in trees as well as cracks in rocks	Medium	0,07
<i>Scotophilus dinganii</i>	Yellow bellied house bat	LC/LC	Clutter-edge forager	Under the bark of trees, foliage, and buildings	Medium	1,34

4.2.1 Bat Passes per Species

Laephotis capensis showed peaks in activity between 18:00 and 20:00 during the survey period (Figure 12). This peak in activity is linked to bats emerging from their roosts to drink water and start feeding. This peak was similar for all species with slight variations. *Tadarida aegyptiaca* peaked an hour later at 19:00 along with *S. dinganii* while *P. hesperidus* only peaked at 21:00. After the initial peaks observed there was a decline in activity for all four species throughout the night with virtually no bats recorded after 05:00. There was a slight increase in activity for *L. capensis* at 04:00 which could be linked to bats returning to their roosts.

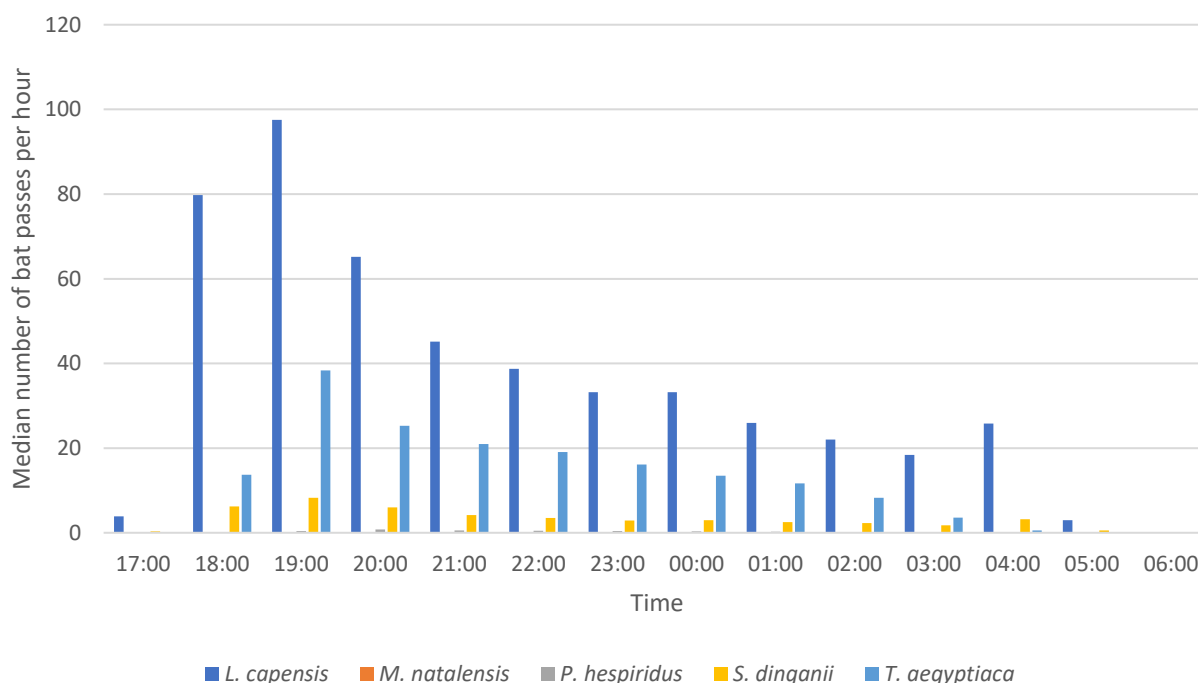


Figure 12. Hourly activity patterns of bats across the Project Area of Influence

Laephotis capensis was highly active during the initial part of the survey between September 2024 through to the end of January 2025, peaking during December 2024, after which there is a marked decrease in their activity levels (Figure 13). This would suggest that *L. capensis* move into the area during the summer period, but that few are around during the winter. *Tadarida aegyptiaca* showed a similar pattern in active, but started to decline towards the end of December 2024. In general, *L. capensis* give birth to their offspring between October and November while *T. aegyptiaca* give birth between November and December (Monadjem *et al* 2020). Given these parameters you would expect *T. aegyptiaca* to remain in the area longer after given birth, however, no data is given on the lactation period, and it is possible that *L. capensis* remains with their offspring for a longer period after giving birth. Activity starts to increase again during August 2025 as bats return to the area and become more active.



Numerous peaks in activity were observed, particularly during September and December 2024 for *L. capensis*, and December 2024 for *T. aegyptiaca*. Conversely, there were numerous days during the winter period when no bat activity was recorded. These peaks and troughs are most likely linked to climatic variables.

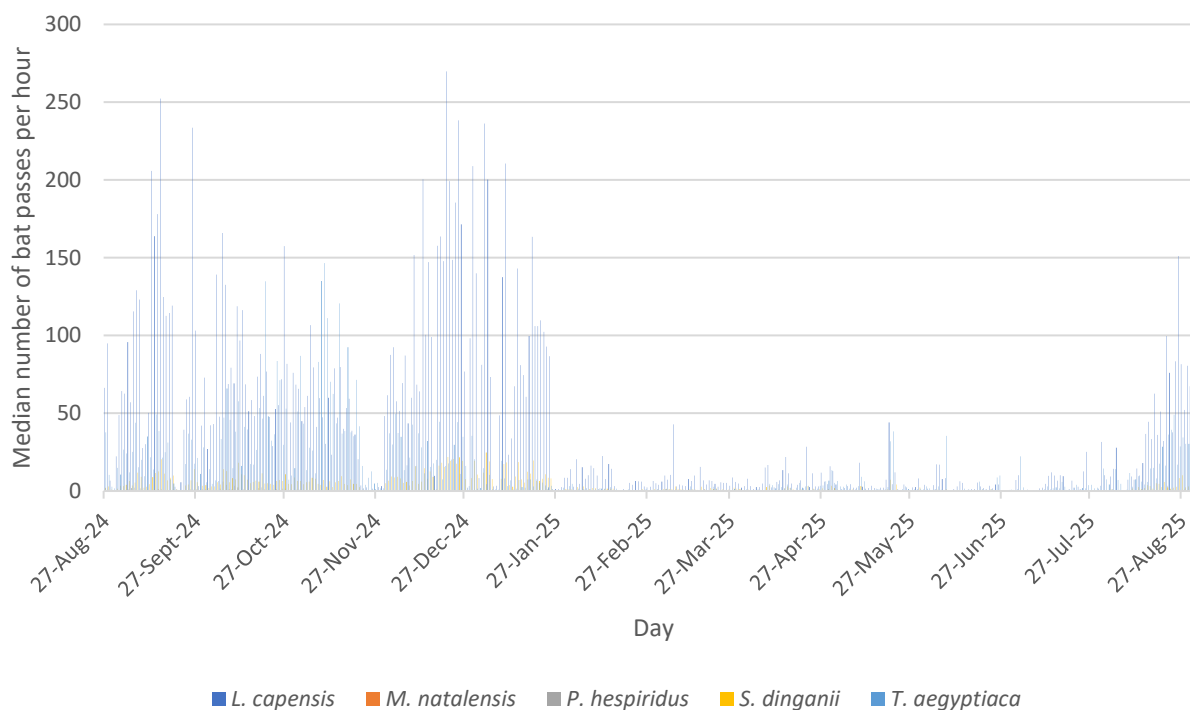


Figure 13. Daily activity of bats across the Project Area of Influence

Scotophilus dinganii, *M. natalensis* and *P. hesperidus* had low, but relatively constant activity across the current survey period (Figure 14). Activity for *M. natalensis* was, however, extremely low and we never had median of more than one bat pass per hour on any day. This suggests that they do not have a roost near the area, do not migrate across the POAI and only forage in the region on occasion. *Laephotis capensis* decreased in activity during November 2024, but increased again during December 2024 whereas *T. aegyptiaca* increased until November 2024 and decreased after December 2024.

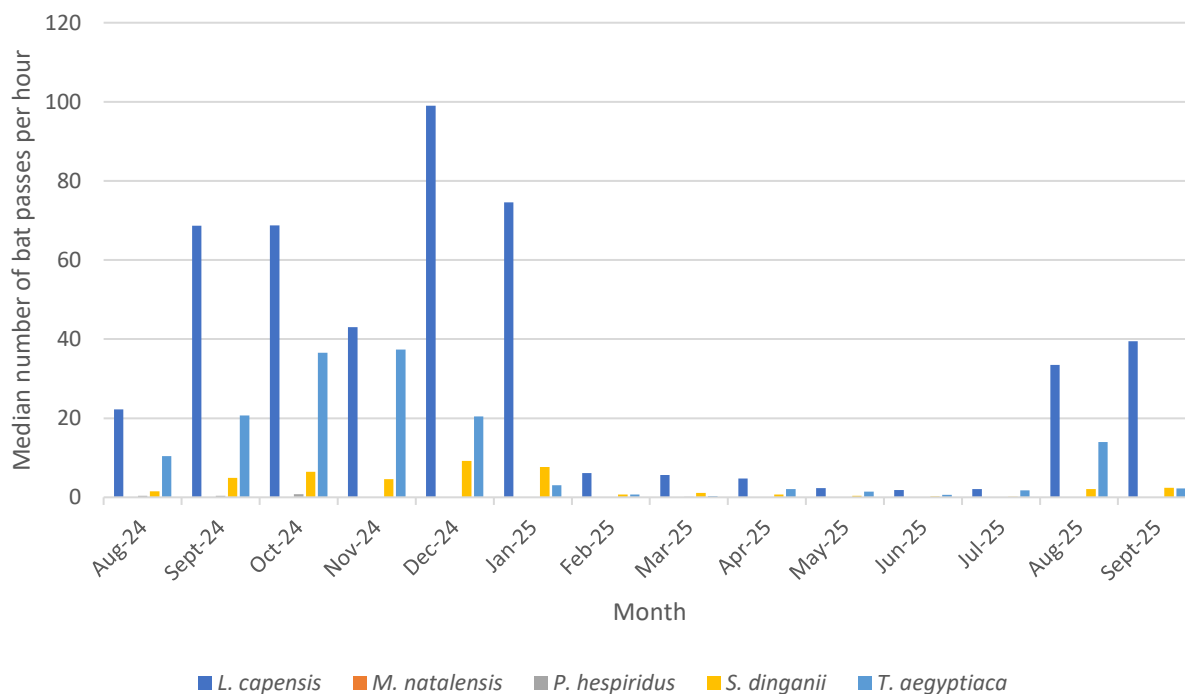


Figure 14. Bat species, and their relative abundance, detected during the current survey period.

4.2.2 Bat Passes per Bat Detector

The detectors that were deployed on the met mast was given to the team who installed the weather monitoring equipment to install. All detectors were already switched on ready to record, but unfortunately the met mast team switched them off when they deployed the detectors. Inspection of the equipment was done during October and the equipment was switched on, but unfortunately no data was recorded for the first two months. The microphone on UVE-02 failed on the 22nd October 2024 and was replaced on the 8th of January 2025, whereas the microphone on UVE-01 failed from the 26th of January 2025 and was replaced on the 5th of March 2025. The



equipment malfunctions are not expected to influence any data represented and more than 80 % of data was recorded during the monitoring period.

A total of 264 691 bat calls were recorded at a median of 2,48 calls per hour at ground level and 0,07 at height classifying fatality risk of the PAOI as **Medium**. Recorded bat activity was much higher at UVE-01, the detector deployed near the river, compared to all other detectors (Table 10) indicating the sensitivity of the rivers in the area.

Table 10. Bat detectors deployed across the Project Area of Influence with the relative abundance recorded at each

Detector	Height	Habitat	Number of bat calls recorded	Median bat passes per hour
UVE-01	10 m	River	228 225	16,76
UVE-02	10 m	Grassland near ridges	18 078	1,80
UVE-03	10 m	High grassland	10 862	0,95
UVE-04	70 m	High grassland	3 766	0,42
UVE-05	120 m	High grassland	3 760	0,00

Activity recorded per bat detector was similar to that observed for species, with high activity early in the evening (Figure 15). This was particularly noticeable for UVE-01 where the median number of bat passes per hour at 19:00 was above 100 BP/h. Activity declined steadily after 19:00, but activity at UVE-01 remained higher than other detectors. This detector was deployed next to the river which could attract bats, but is also situated near roosts for *L. capensis*.

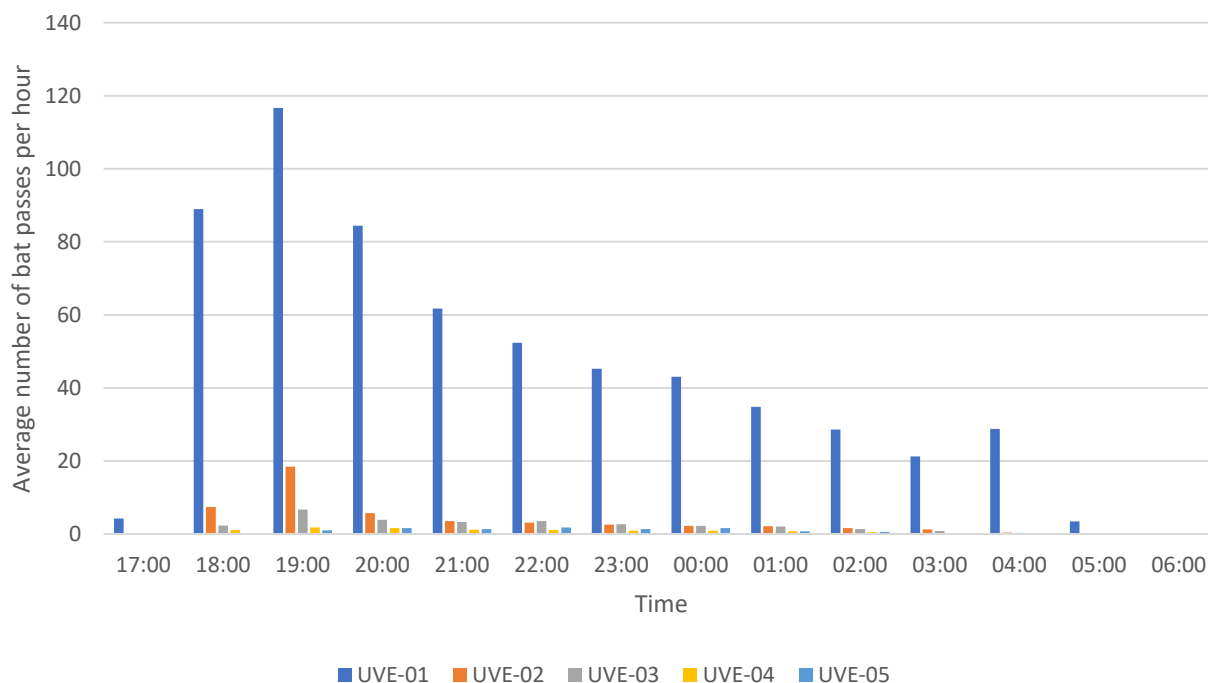


Figure 15. Hourly bat activity per bat detector across the Project Area of Influence

Activity per bat detector closely resembles the activity for the two most commonly recorded species, *L. capensis* and *T. aegyptiaca* (Figure 16 and 17). It is also clear that the peak for *L. capensis* was recorded at UVE-01. The river offers a source of open water and the denser vegetation is likely to attract insects which could lead to higher bat activity. With this high number of bats, however, it is expected that a rather large roost is located near the river.

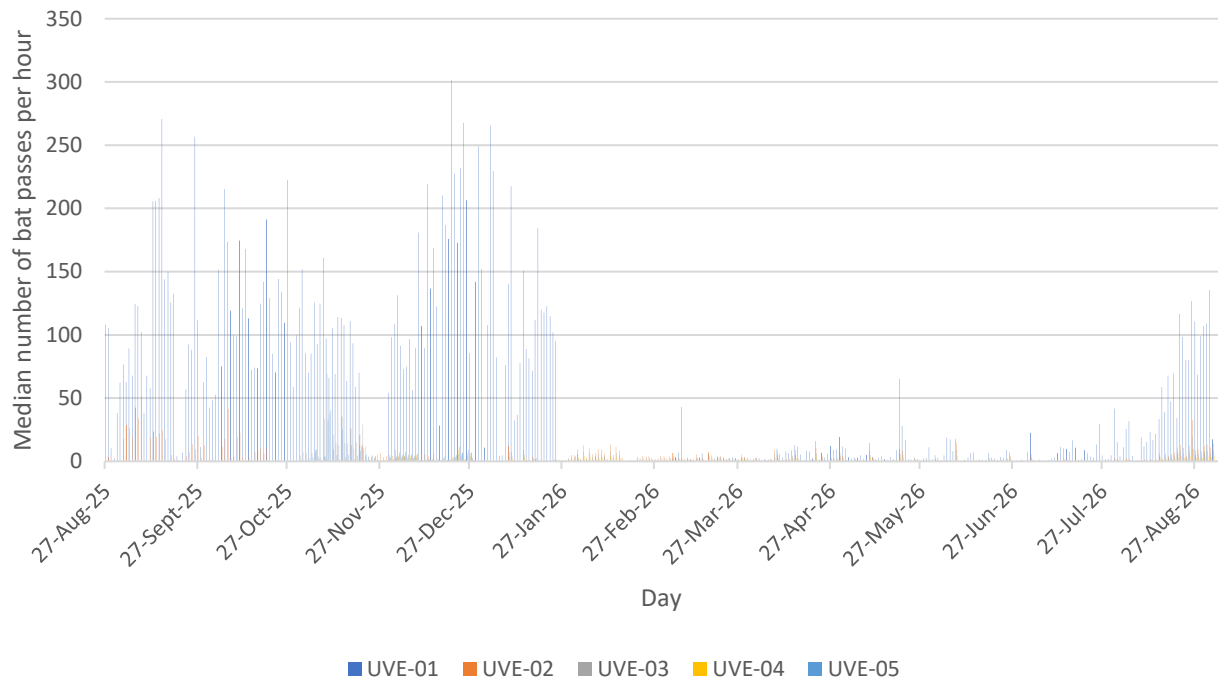


Figure 16. Number of bat passes recorded daily per bat detector

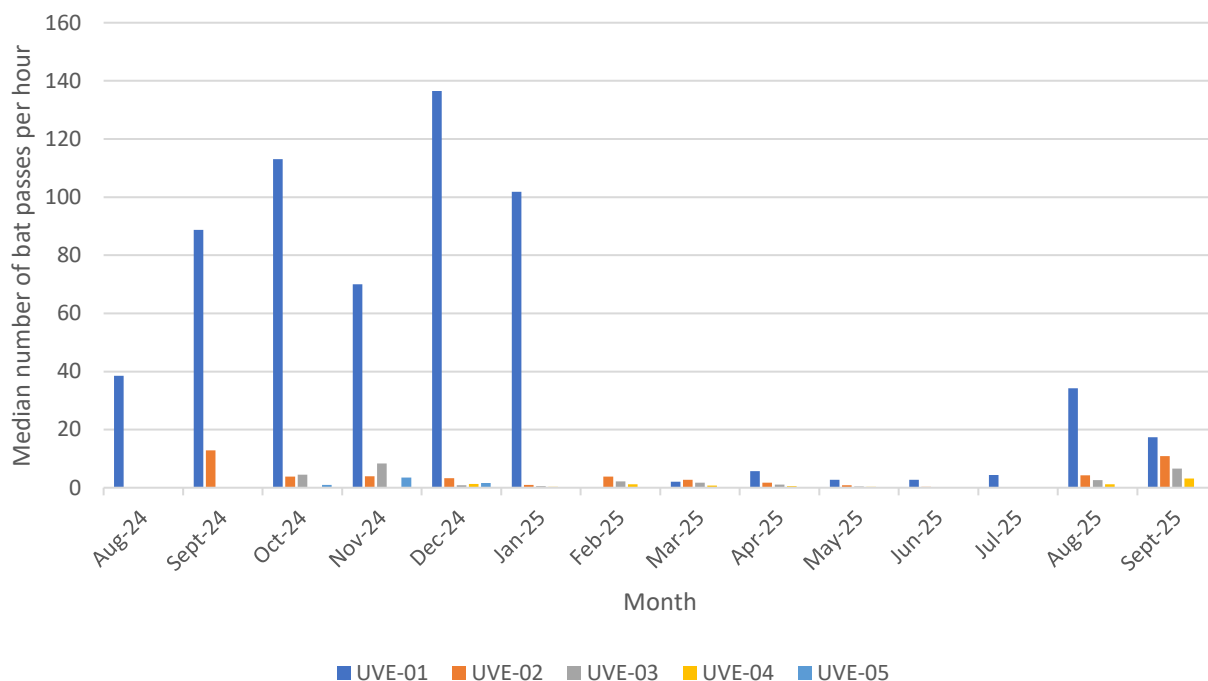


Figure 17. Bat activity per bat detector per month across the Project Area of Influence during the survey period

When activity per season is considered, it is clear that activity was centered around the spring and summer period and the most calls recorded per season per detector was at UVE-01 during summer (Figure 18). Interestingly, there were more calls recorded at the other four detectors during spring than summer, suggesting that species other than *L. capensis* were active in this area, most likely *T. aegyptiaca*.

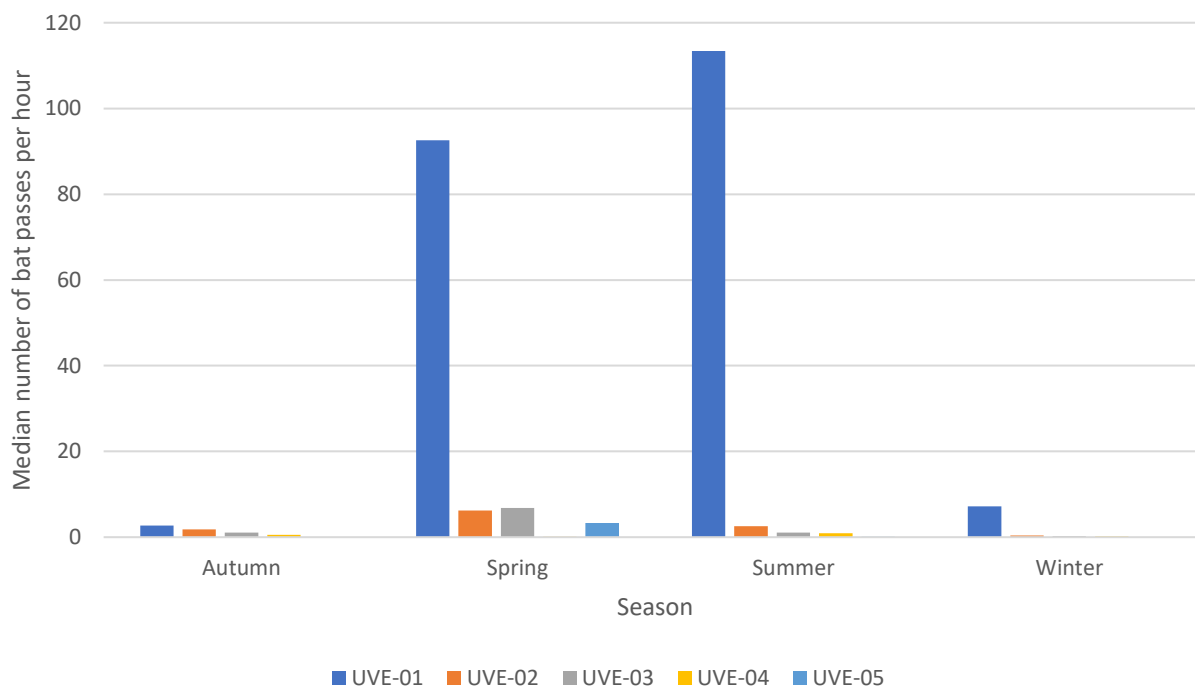


Figure 18. Bat activity per bat detector per season across the Project Area of Influence during the survey period

4.2.3 Bat Passes at Height

No data was recorded at height during August and September 2024, and as such only data from October 2024 can be considered for the microphones deployed at 70 and 120 m. Overall, activity was significantly higher at ground level than at height, indicating that bats travel and forage closer to ground level (Figure 19 and Figure 20). In fact, bats were only active at height in any significant number during November and December 2024, and again during August and September 2025, but only at 70 m.

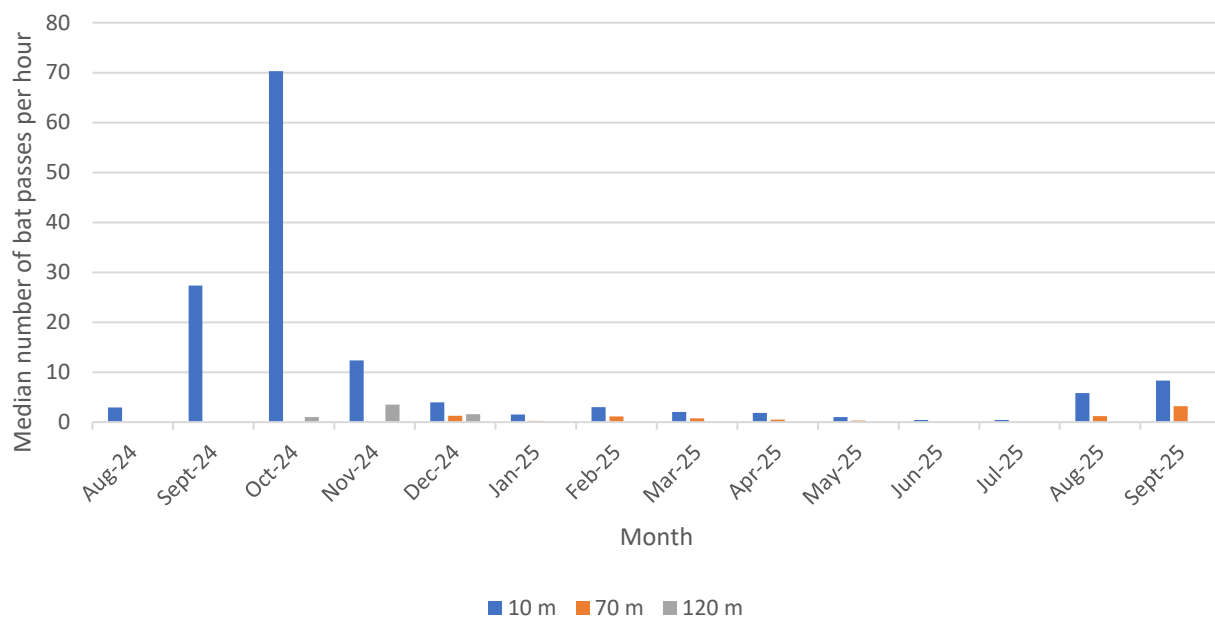


Figure 19. Comparison of bat activity at various heights across the Project Area of Influence

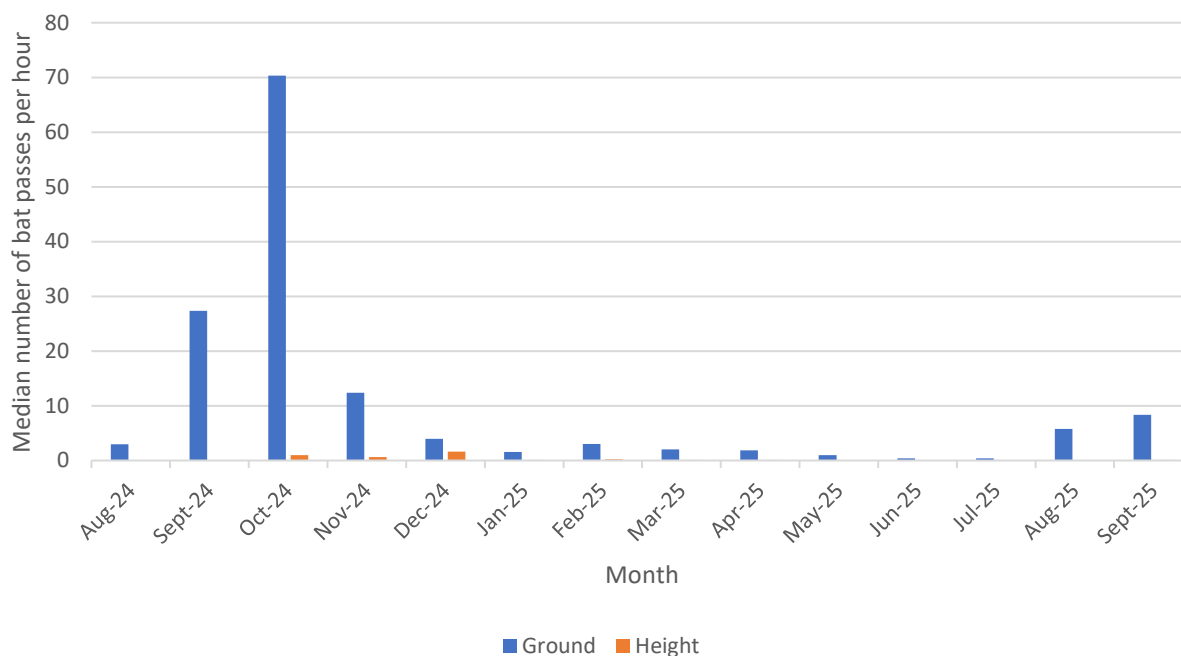


Figure 20. Comparison of bat activity at various heights across the Project Area of Influence when only bat detectors deployed on the met masts are considered

4.3 Active Surveys

As can be expected, the most bat calls were recorded during November 2024, and the majority of the calls were from *L. capensis* followed by *T. aegyptiaca*. Activity was centred around sources of water, both rivers and open water, and was extremely high around roosts. During February 2025 only *L. capensis* and *S. dinganii* were recorded, but activity was again higher around sources of water and roosts. The only calls that were recorded during June 2025 were from *L. capensis* and, comparatively, very few calls were recorded. The number of recorded calls increased during September 2025, and were recorded calls from both *L. capensis* and *T. aegyptiaca* and again we recorded a higher number of calls near sources of water. The active surveys strengthen the point made that water sources in the area should be seen as highly sensitive for bats.

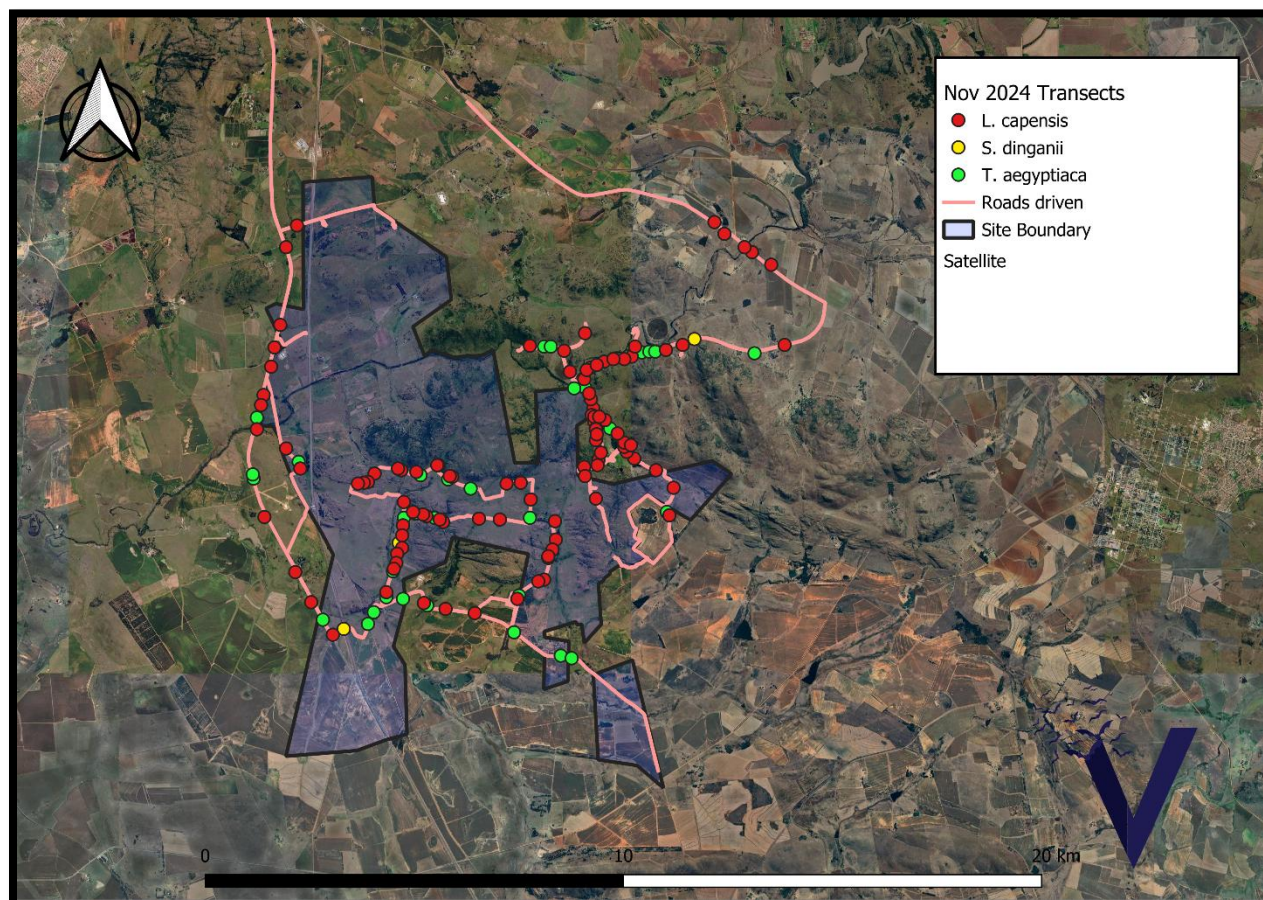


Figure 21. Bat species recorded during driven transects in November 2024

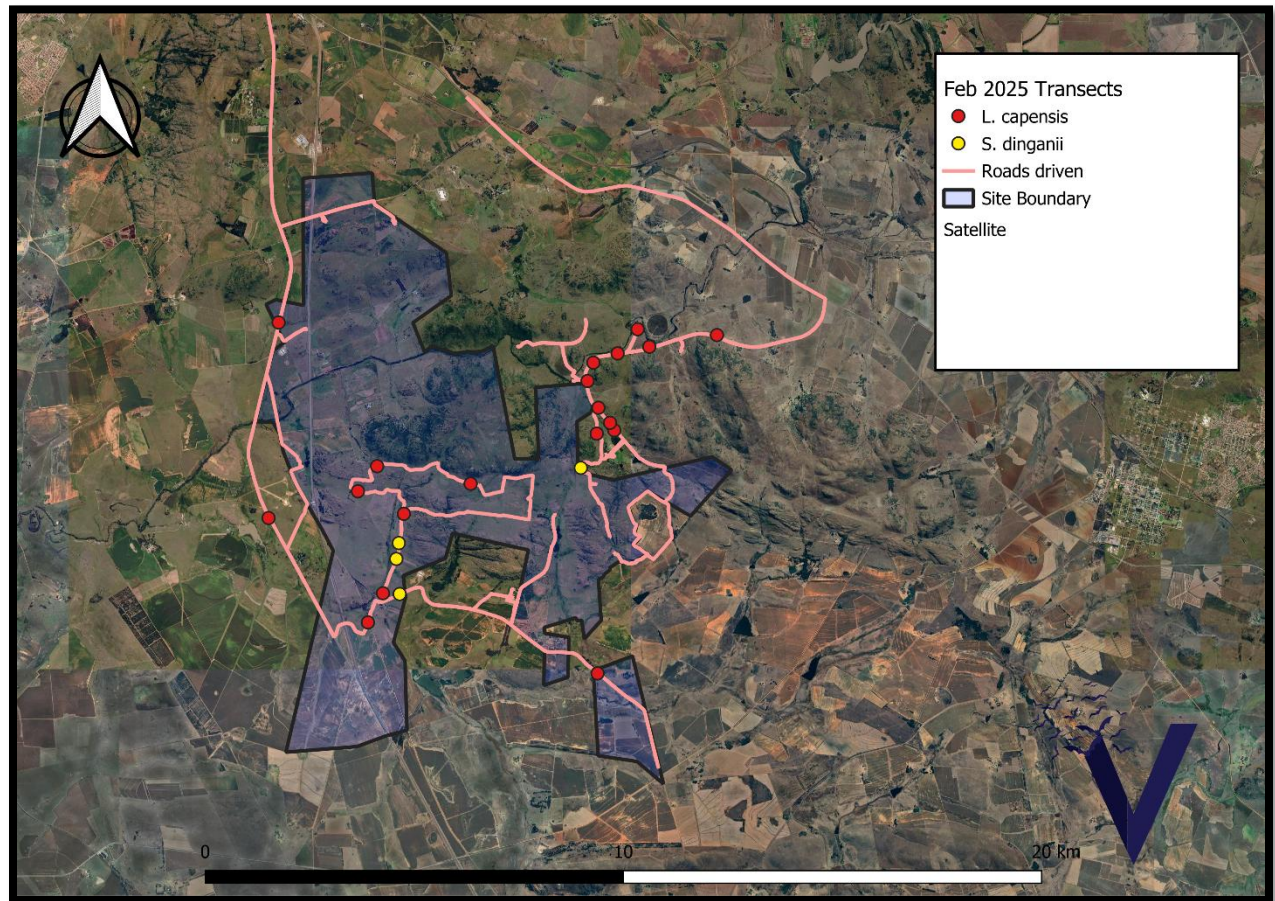


Figure 22. Bat species recorded during driven transects in February 2025

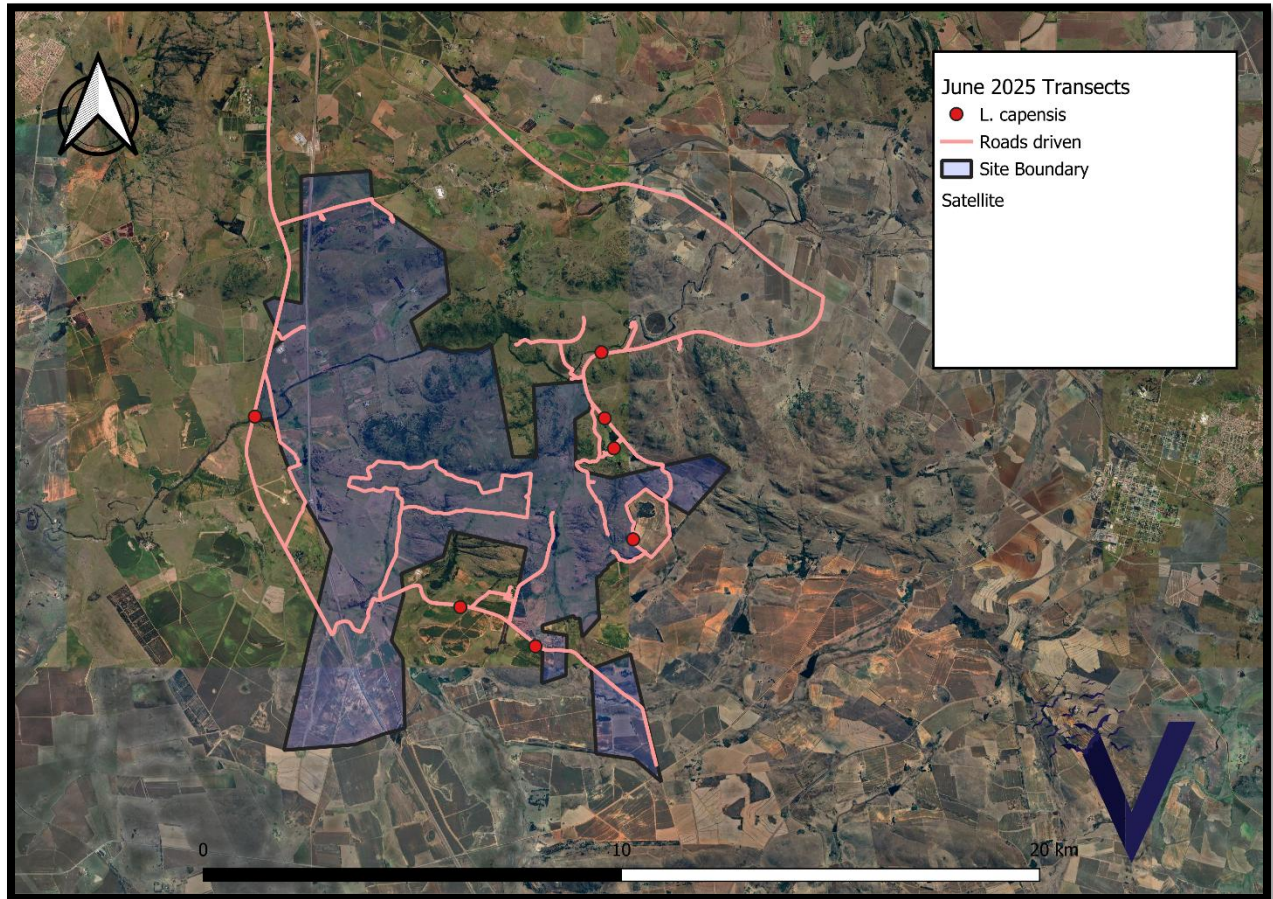


Figure 23. Bat species recorded during driven transects in June 2025

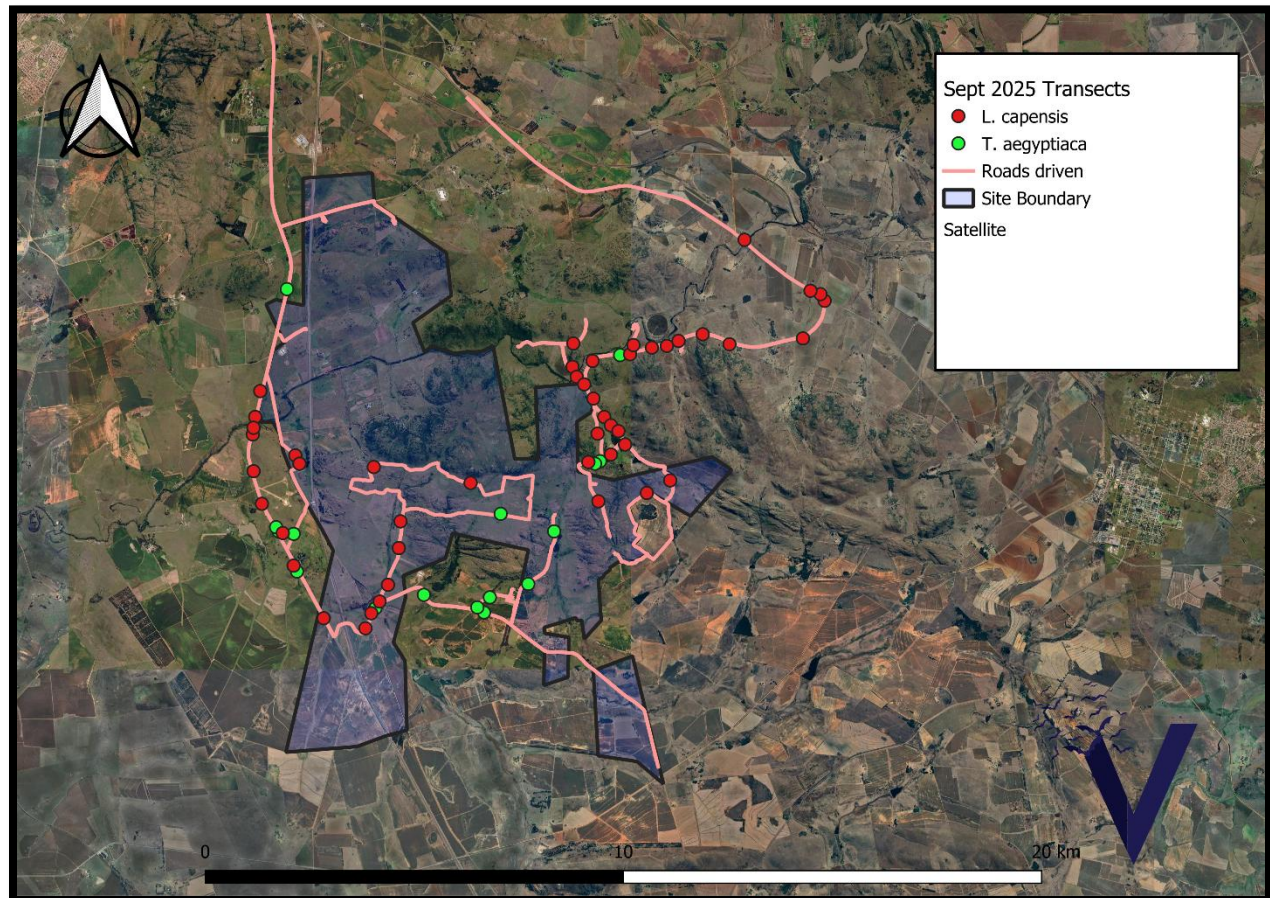


Figure 24. Bat species recorded during driven transects in September 2025

4.4 Roost inspections

The SABPG are very specific as to buffers that must be implemented around roosts, and these are as follows:

- A buffer of 500 m for a small roost of Least Concern (LC) bats and/or Low Fatality Risk bats.
- A buffer of 1 km for a medium roost of LC bats and/or Low Fatality Risk bats.
- A buffer of 2.5 km for a large roost of LC bats and/or Low Fatality Risk bats.



- A buffer of 1 km for a small roost of SCC bats and/or Medium, Medium-High and High Turbine Fatality Risk.
- A buffer of 2.5 km for a medium roost of SCC bats and/or Medium, Medium-High and High Turbine Fatality Risk.
- A buffer of 5 km for a large roost of SCC bats with a Low Fatality Risk.
- A buffer of 10 km for a large roost of SCC bats with a Medium, Medium-High and High Turbine Fatality Risk.
- A buffer of 20 km for an extra-large roost of bats with any conservation status and/or risk level.

When considering roost size, the following has been defined: small roost = 1 - 49 bats; medium roost = 50 – 499 bats; large roost = 500 – 1999 bats; extra-large roost = ≥ 2000 bats.

Five active bat roosts were identified near the PAOI, four of which were in buildings belonging to *L. capensis* (Figure 25 and 26). As *L. capensis* was previously classified as *Neoromicia capensis* it is considered as a species with High Turbine Fatality Risk even though it is a species of Least Concern. Three of the roosts in buildings were deemed as small and will require a 1 km buffer, whereas one was a large roost in a building and will require a 2.5 km buffer. The fifth roost was an old mine shaft and occupied by four individual *R. clivosus* (Figure 25 and 27). These bats are of least concern and at a low fatality risk and as such would only require a 500 m buffer. The mine shaft was inspected during each site visit to determine if other bats use the shaft, and no other bats were ever detected. During the summer site visit, however, the shaft was completely flooded and we could not gain access. This said, it will be vitally important that the shaft is continuously inspected during the construction and post-construction phase to ensure that it is not utilized by other bats in the future.

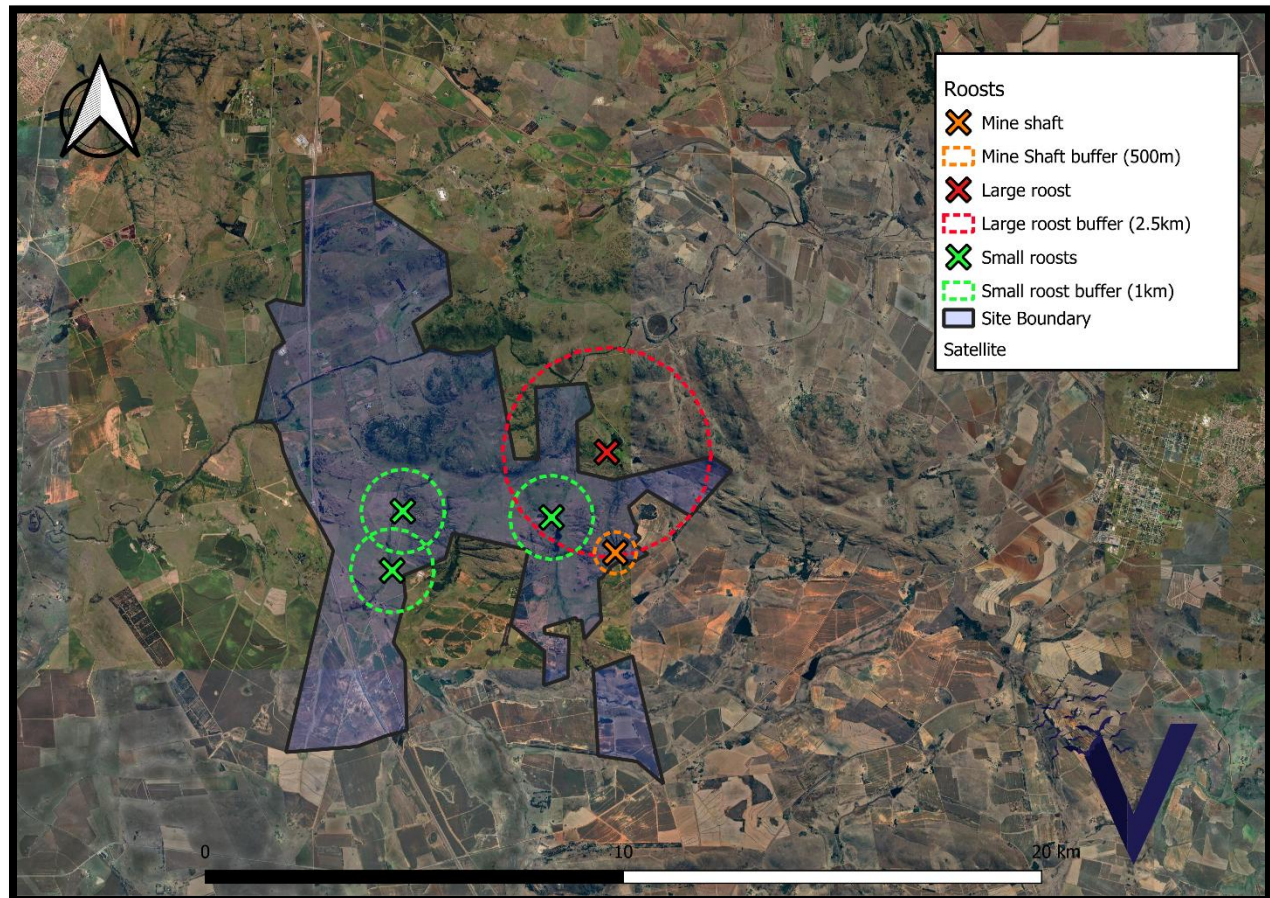


Figure 25. Locations of active bat roosts that have been detected during the current survey period with required buffers



Figure 26. Examples of roosts found on the Project Area of Interest



Figure 27. Abandoned mine shaft surveyed for signs of bats

4.5 Bat Sensitive Areas

Several potential bat sensitive areas, including water sources and potential foraging areas, are outlined below. Based on data obtained from bat detectors and during driven transects water sources, including rivers, open water and wetlands are highly sensitive. The ridges and vegetated areas will be used by bats for roosts and foraging and should be seen as highly sensitive. A 200 m



buffer was implemented around sites that are considered to be of High Sensitivity to bats as required by MacEwan (2022).

4.4.1 Water bodies

All bat species are dependent on sources of open water and will visit at least one of these sites once per night. This includes pools in streams, lakes, ponds, slow-flowing streams, rivers and artificial bodies of water with similar properties such as farm dams, cattle troughs, swimming pools (Korine et al, 2016). Some evidence also showed calm water sources tends to attract more bats as the water surface provides a less cluttered acoustic signal return being advantages to bats hunting behavior (Von Frenckell et al, 1978). Based on the South Africa Best Practice Guidelines for Bats at Wind Energy Facilities (SABPG, MacEwan et al 2020) a 200 m buffer is required around all areas that are seen as Medium Sensitivity areas for bats, and this includes all sources of open water (Figure 28).

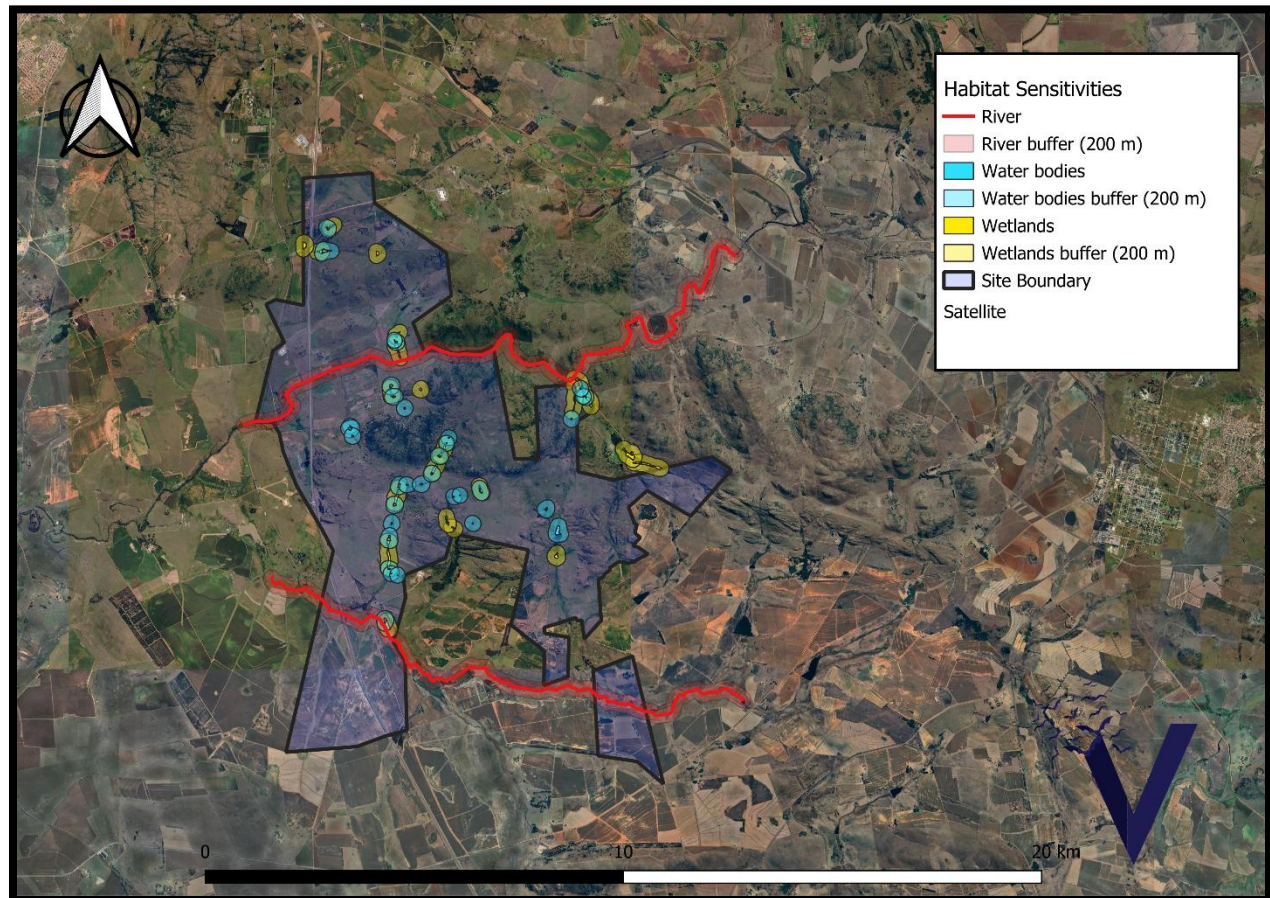


Figure 28. Locations of sources of water sources that are classified as sensitive to bats with required 200 m buffer applied.

4.4.2 Ridges

Some species of bats, including *T. aegyptiaca*, roost in rock crevices, and these areas may act as potential roosts. All ridges and rocky outcrops were visited during the spring survey (November) to determine if bats are roosting in the rock crevices. It appears as if bats do use ridges as flyways, classifying these as Medium Sensitive and a 200 m buffer will be needed (Figure 29).

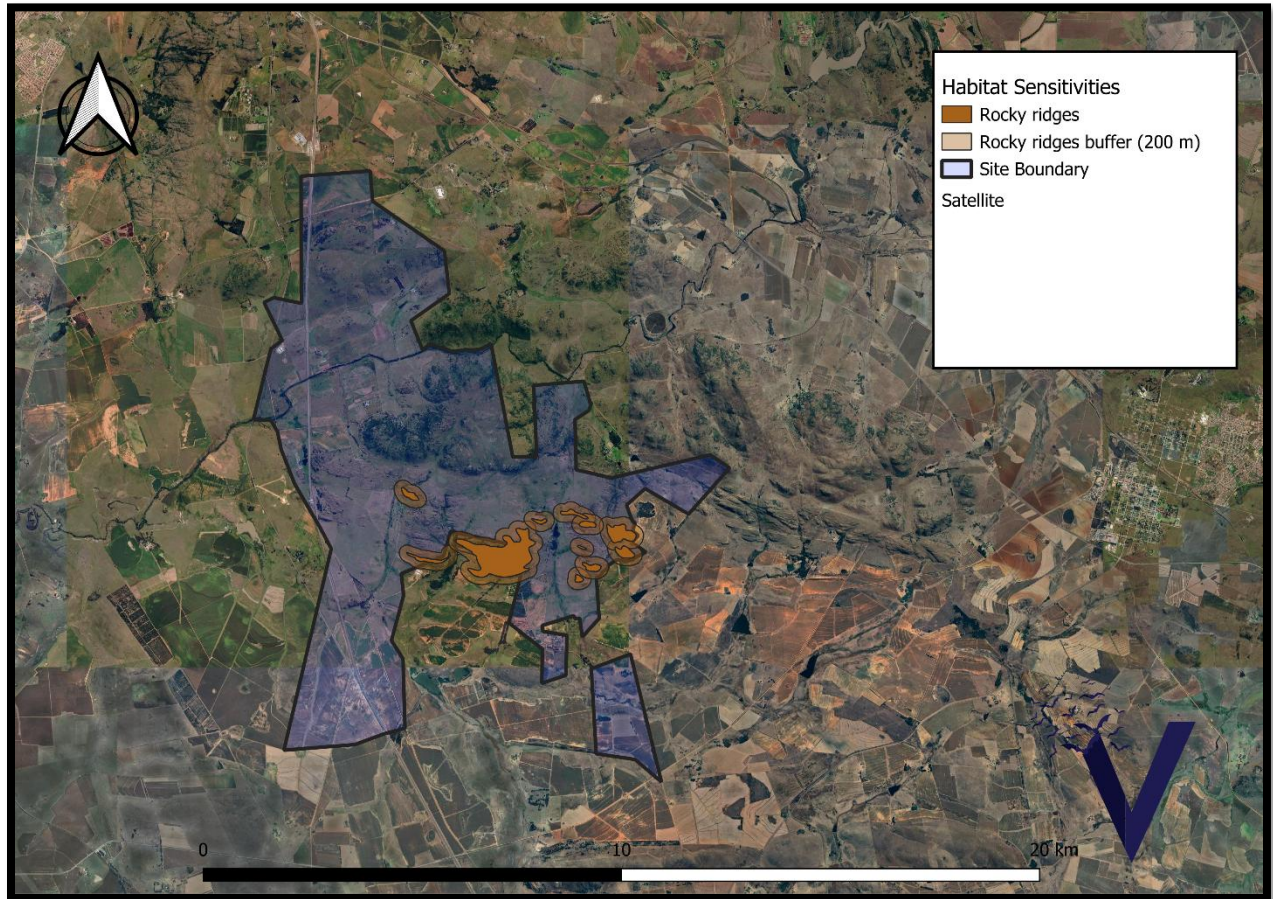


Figure 29. Ridges located across the Project Area of Influence including required buffers



4.4.3 Wooded Areas

Bats use dense patches of trees as both foraging and roosting locations, and has been deemed to be of Medium sensitivity to bats. As such a 200 m buffer will be required (Figure 30).

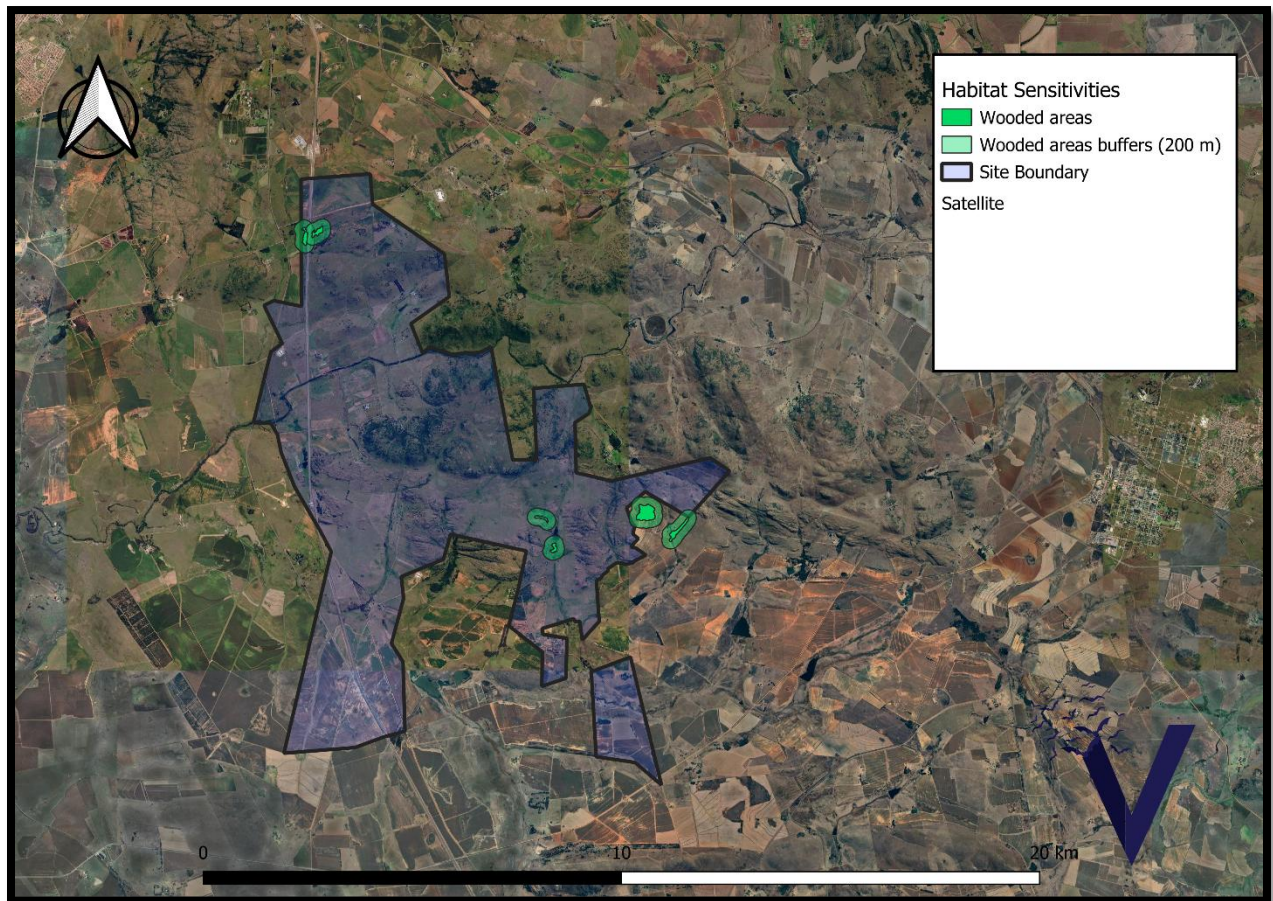


Figure 30. Wooded areas located on the Project Area of Influence including required buffers



4.6 Bat buffers

Water bodies, rivers, wetlands, ridges and wooded areas must be given 200 m buffers as they are seen as areas that are of Medium Sensitivity to bats, and No-Go buffers have been applied around all confirmed roosts which are considered as High sensitivity features (Figure 31). Roosts found have been classified as small and large roosts and will require a 1 km and 2.5 km buffer respectively. The mine shaft has been given a No-Go buffer of 500 m, but the shaft must be inspected continuously throughout the construction and pre-construction phase to ensure that it is not used by other species of bats in the future. As the guidelines regarding the buffer sizes and shapes are stringent and well defined, it is important that all applied buffers be respected and followed when considering final facility layout. No part of the wind turbine, including the blade tips must encroach into these buffer zones. The buffers zones can be measured on a map during the preparation of report sensitivity maps or on the ground. The applied buffer zones are measured from the ground all the way to the full length of the turbine sweep and it includes all parts of the turbine, tower and rotor sweep.

For other associated WEF developments, such as buildings, sub-stations, roads and powerlines, developers must:

- For roads: A 200 m minimum buffer applies to bat roosts, and disturbances to foraging areas by roads must be considered in the assessment.
- For power lines: A 500 m powerline buffer applies to bat roosts. Powerlines can cross bat important foraging areas area, as long as all the other water use license mitigation measures are in place in the case of wetlands and rivers.
- For buildings and sub-station infrastructure: A 500 m minimum buffer applies to bat roosts, and disturbances to foraging areas by roads must be considered in the assessment. Light pollution and noise from such buildings must also be considered in the assessment.

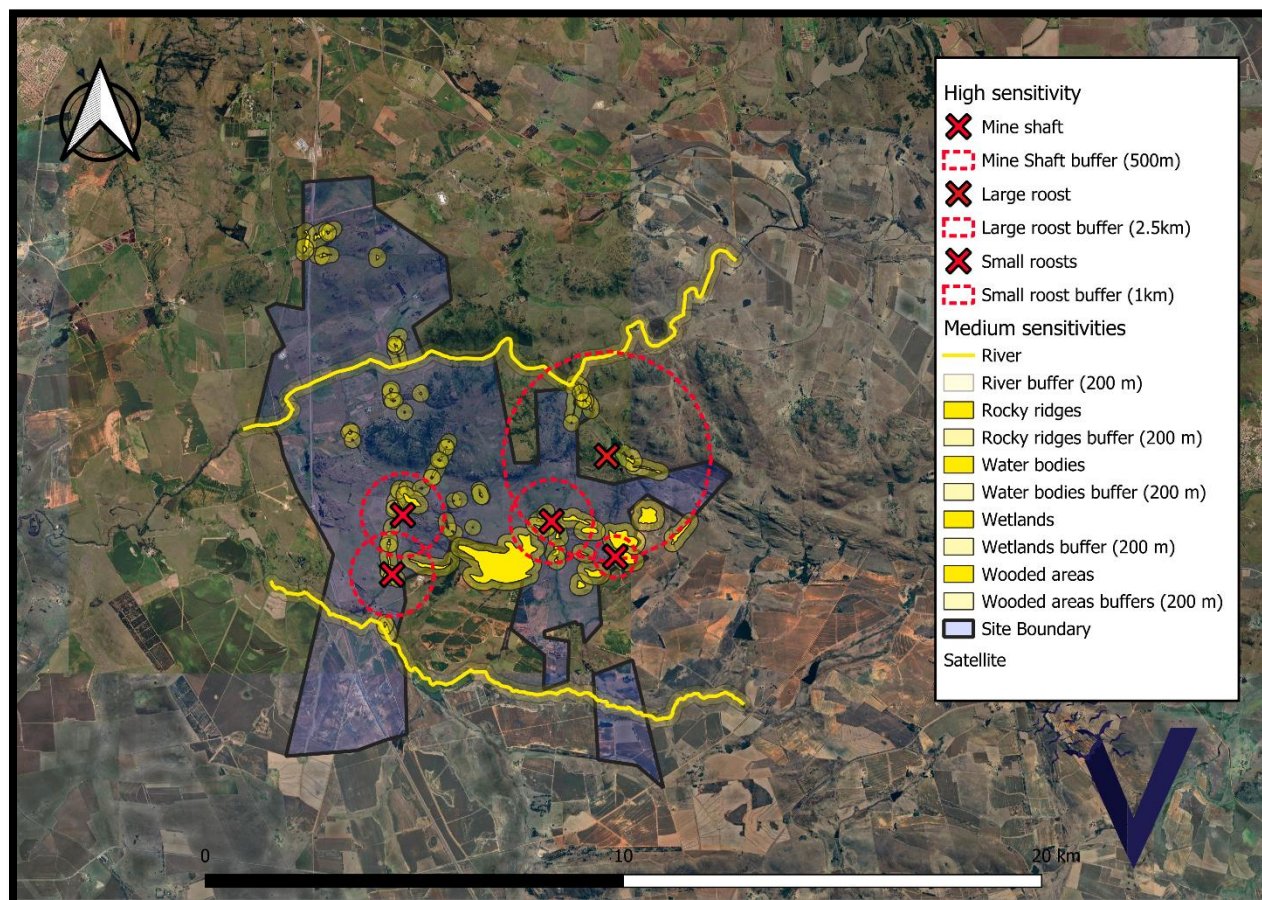


Figure 31. Buffers for bat sensitive areas

4.7 Climatic Variables

Several studies have been conducted describing how weather conditions influence the behaviour of bat species. These weather conditions include the wind speed during the evenings as well as the ambient temperature (O'Farrell et al. 1967; Arnett et al. 2010). When considering wind speed, increased wind speeds suppress flight activity whereas lower speeds are correlated to more bat activity (Arnett et al. 2010). Specific wind conditions can influence the time of bat emergence, duration of foraging and distance that bats will forage from their roost. Ambient temperature will



also play a role in bat behaviour as bat activity decreases at lower temperatures and increases with higher temperatures (Rachwald, 1992). The time of emergence and duration of bat flights are also related to temperature and during colder nights, bats will often delay emergence and have shorter peaks in activity. Both wind speed and temperature can have an effect on insect presence, leading to lower insect activity with higher wind speeds and lower temperatures (Peng et al. 1992; Gilbert and Raworth, 1996). The presence of stronger winds has an effect where insects might be present, with insects choosing to fly and forage close to wind breaks such as complex vegetation structure during higher wind speeds instead of more open spaces. This will in turn influence where bats will forage and can change movement behaviour. Insect presence will also be influenced by temperature as it has been shown that insects will prefer warmer temperatures (Abdullah, 1961; Peng et al. 1992). This will in turn also have an impact on bats as the presence of prey will drive bat movements. Climatic data collected during operational monitoring can be used to make informed decisions regarding mitigation measures when bat fatalities are found to be above the conservation thresholds.

Data from the met masts included wind speed (measured at 60.1 m, 80 m, 99.9 m, 114.9 m and 120 m), temperature (measured at 30 m and 122 m), humidity (measured at 122 m) and air pressure (measure at 122 m). We calculated an average for wind speed, temperature, humidity and air pressure from the instruments deployed at a lower level and compared these data to bat activity measured from bat detectors 10 m. Wind speed, temperature and humidity was recorded at height and these variables we compared to bat activity recorded at 120 m. As wind speed was also recorded at 60 m we compared this to bat activity recorded at 70 m. As all weather-related data is considered as sensitive and confidential, actual values are not displayed.

4.7.1 Wind speed

Wind can have an effect on bat activity, and bats tend to be more active at lower wind speeds (Erikson & West, 2002; Amorim *et al.*, 2012; de Jong et al., 2021). Regardless of the height at which wind speed was recorded, there appears to be a reduction on bat activity at wind speeds of 7.5 m/s and at all heights 80% of bat activity was recorded below this speed (Figure 32 – 36).



Employing blade feathering at wind speeds of 7.5 m/s or lower will have a significant impact on bat mortalities in the area as 80 % of activity occurs at wind speeds of below this threshold.

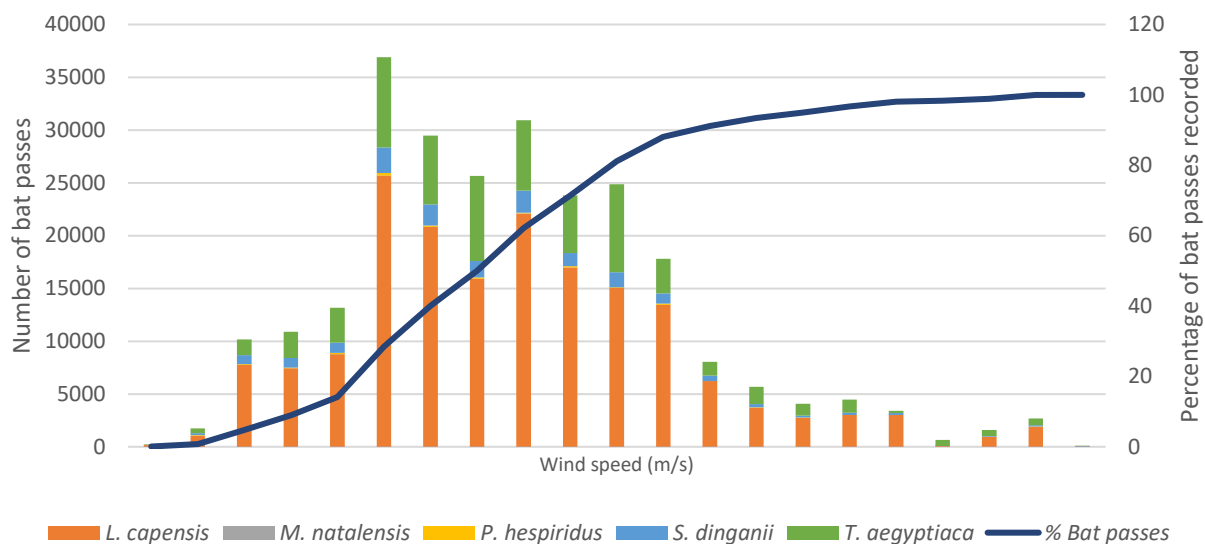


Figure 32. Number and percentage of bat calls recorded in comparison to wind speed (m/s) at 60.1 m

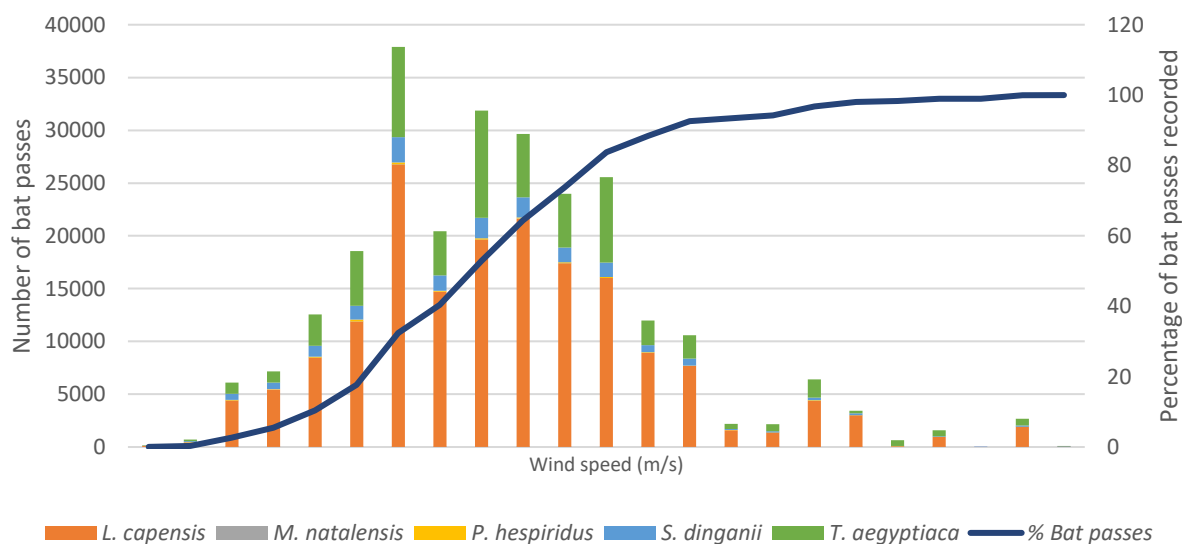


Figure 33. Number and percentage of bat calls recorded in comparison to wind speed (m/s) at 80 m

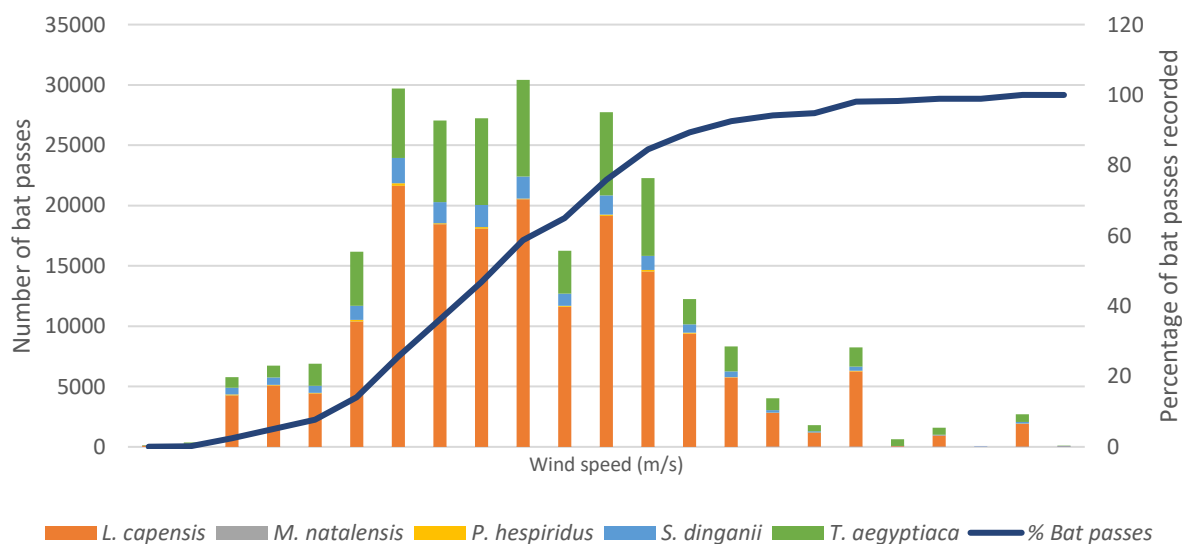


Figure 34. Number and percentage of bat calls recorded in comparison to wind speed (m/s) at 99.9 m

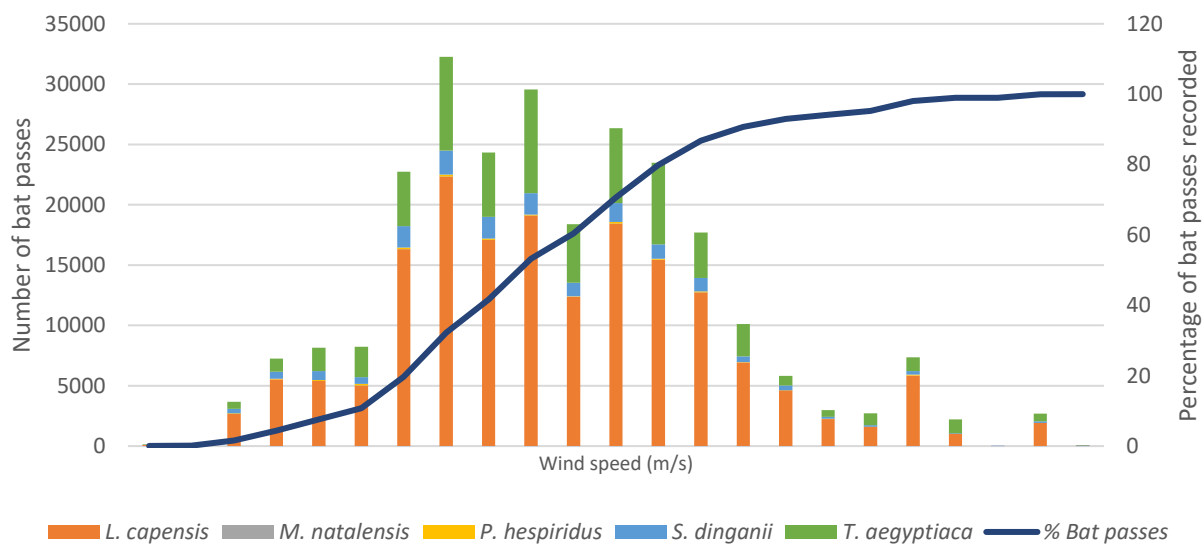


Figure 35. Number and percentage of bat calls recorded in comparison to wind speed (m/s) at 114.9 m

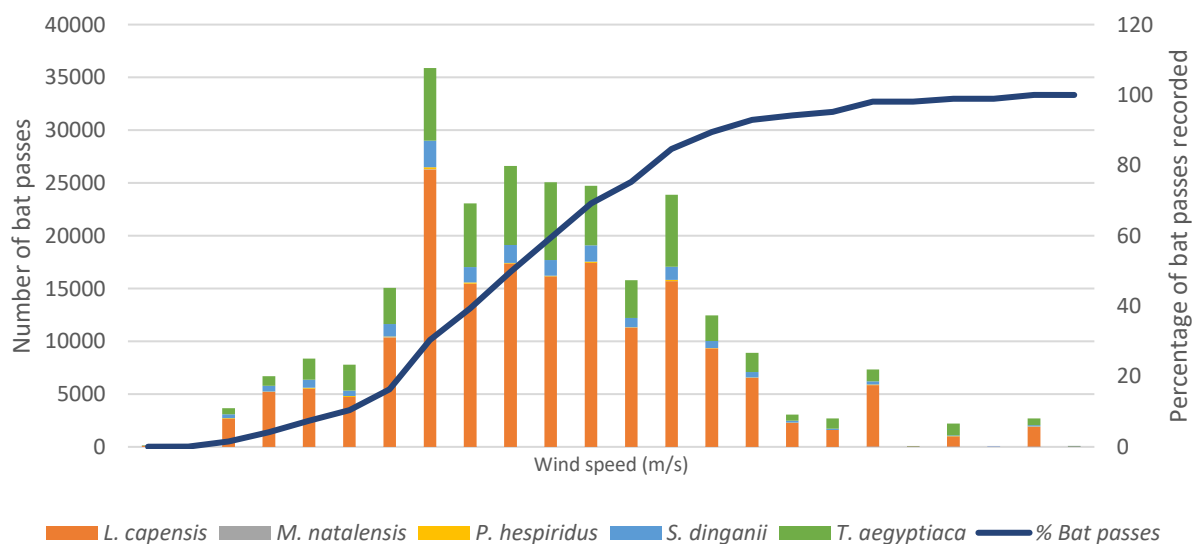


Figure 36. Number and percentage of bat calls recorded in comparison to wind speed (m/s) at 120 m



4.7.2 Temperature

Bats are less active at lower temperatures because the insects that they prey on tend to be inactive during these periods (Erikson & West, 2002; Amorim et al., 2012; de Jong et al., 2021). This seems to hold true for the ABO Uvemvane 1 WEF (Figure 37 and Figure 38). While we consider wind speed to be a more reliable variable to use as a mitigation measure there is a clear increase in bat activity above temperatures of 17 (°C) and a decrease in activity above temperatures of (°C) at 30 m and 21 (°C) at 122 m.

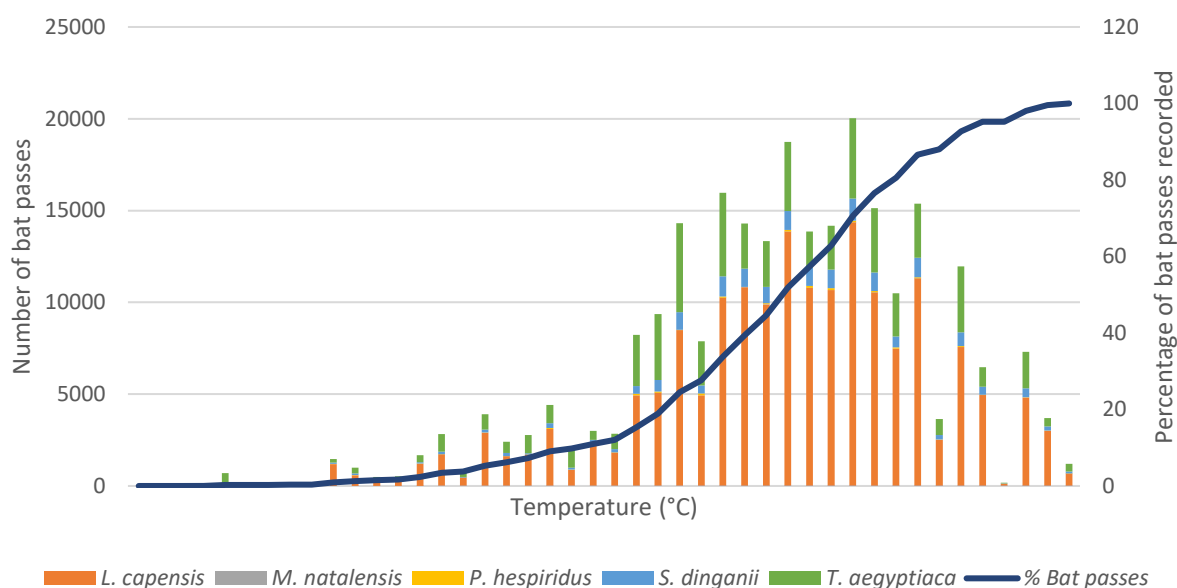


Figure 37. Number and percentage of bat calls recorded in comparison to temperature (°C) measure at 30 m

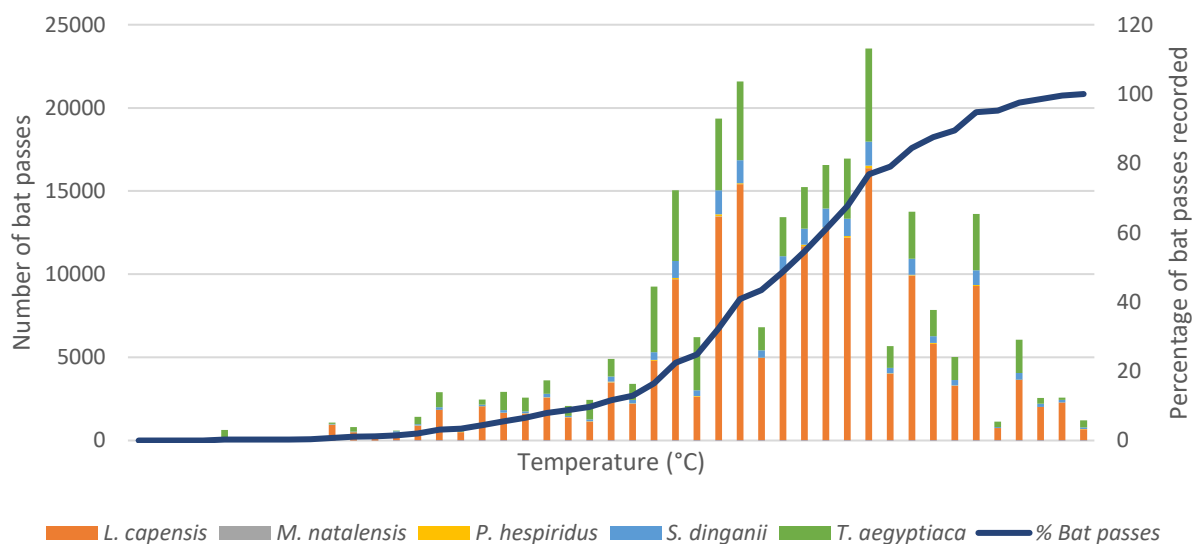


Figure 38. Number and percentage of bat calls recorded in comparison to temperature (°C) measure at 122 m

4.7.3 Barometric Pressure

Bats are less active when barometric pressure is higher, but the reasons for this is unclear (Squires *et al.*, 2021). This is quite likely more related to seasonal changes and the associated temperatures as barometric pressure tends to be higher during colder months. It is, however, clear that bats found on the PAOI follow this trend of less activity at higher barometric pressure (Figure 39), and 80 % of bat activity occurs when the barometric pressure is 828 hPa or lower.

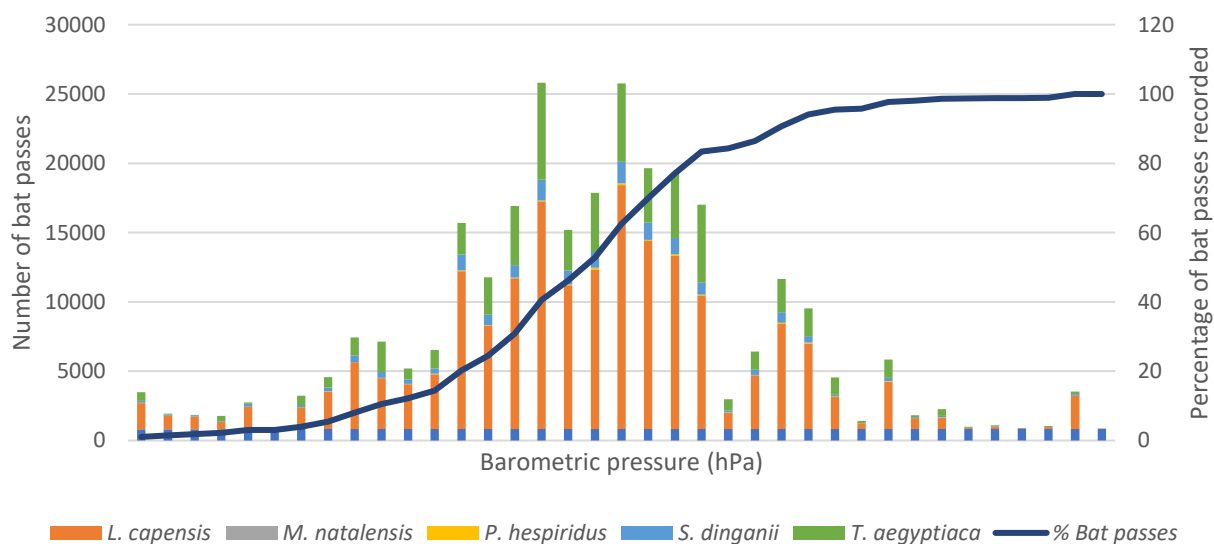
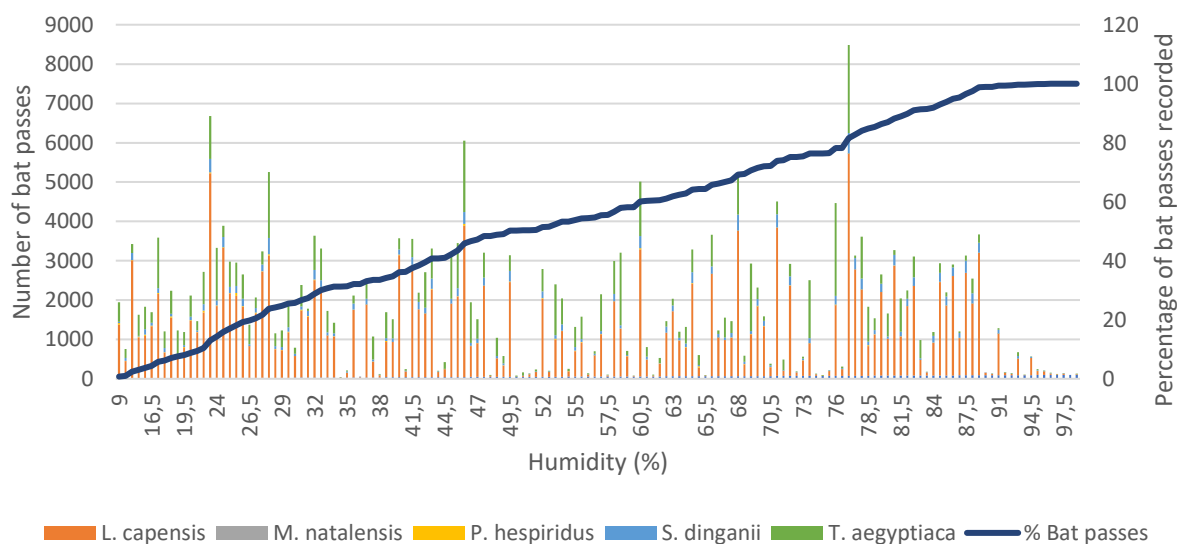


Figure 39. Number and percentage of bat calls recorded in comparison to barometric pressure (hPa) measure at 122 m

4.7.4 Relative Humidity

No rainfall data was available for the duration of this assessment, only data on relative humidity. Humidity can indirectly affect bat activity as larval development of insects is correlated to relative humidity (Amorim et al. 2012). There appears to be no relationship between relative humidity and bat activity (Figure 40).



5. Opportunities and Constraints

5.1 Turbine Layout

During our survey of bats in the region, we identified areas on the proposed site for the WEF that are currently designated as No-Go zones or Medium Sensitivity Zones due to the presence of active roosts and the availability of water (Figure 32). The construction of wind turbines and their associated infrastructure not only eliminate natural habitats but can also lead to light pollution. Certain bat species are known to be repelled by excessive lighting, while others may be drawn to it because of an increase in specific insect populations. Careful consideration should be given when deciding on the lighting for turbines and infrastructure (Korine et al, 2016).

All confirmed roosts and their associated buffers must be considered as **No-Go**, and thus No-Go areas for turbines and no part of the turbines may cross the buffers implemented around these locations. All water sources, including open water and streams are considered as **Medium Sensitivity** and a 200 m buffer has been placed around these areas which should be seen as No-



Go zones for turbines. No turbines are located in such a manner that their blade length, assuming it is 100 m, will infringe on buffered areas.

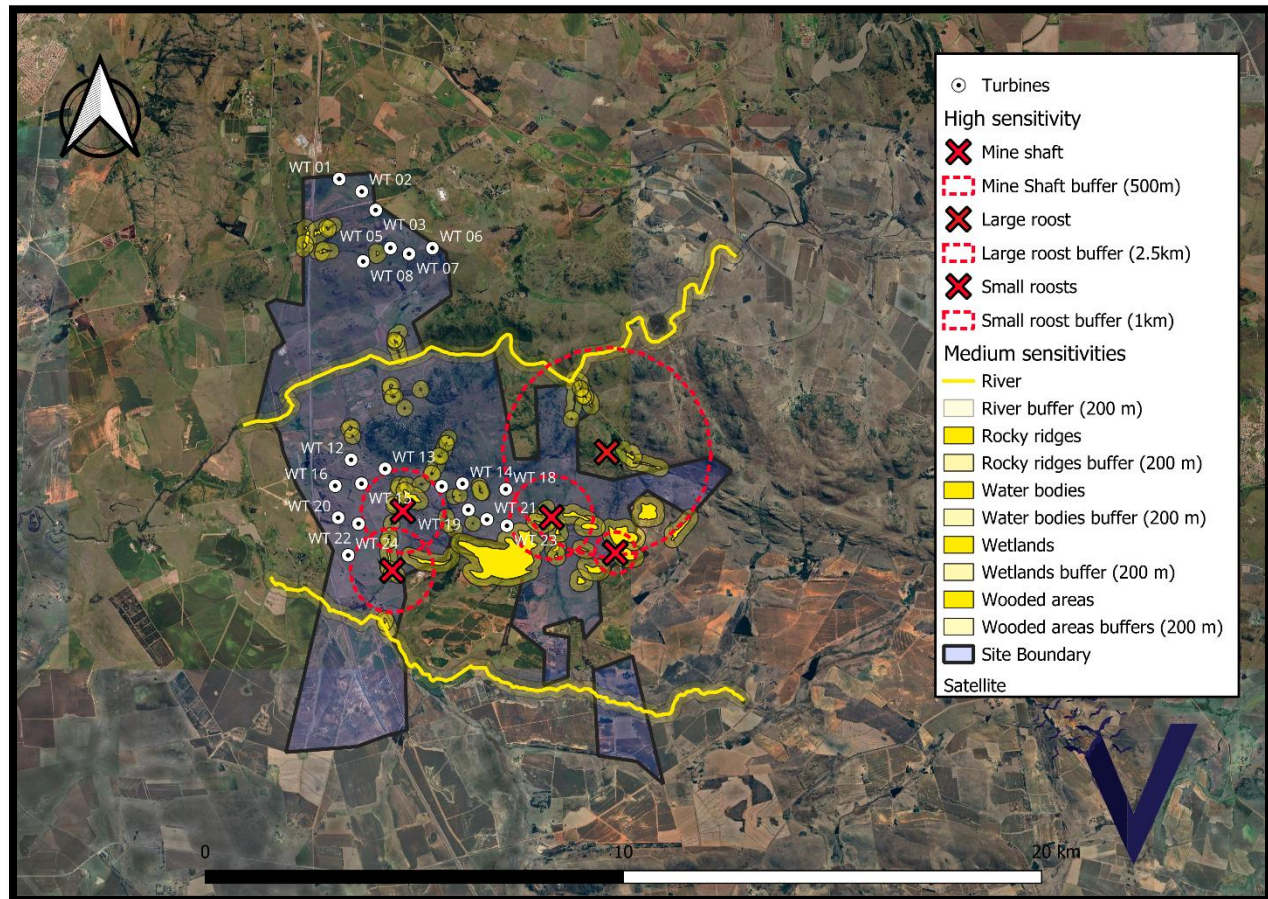


Figure 40. Proposed locations of the wind turbines in comparison to the required bat buffers

5.2 Roads

Research conducted to assess the influence of roads on bat populations has indicated that the effects are more significant than anticipated. The loss of habitat poses a major concern when evaluating the impact of infrastructure on bats. This encompasses the removal of trees, hedges,



shrubs, and water bodies. It was discovered that for every 10 km of road (7 m wide) constructed, 7 hectares of natural habitat are lost (Korine et al, 2016). Additionally, excessive roadways can create a barrier effect for bats. Roads can act as obstacles between roosting sites and foraging areas. Numerous bat species, particularly those that thrive in tree-dense environments, may be reluctant to traverse the sudden open spaces created by expansive roads. Consequently, this could limit the potential distribution of certain bat species (Korine et al, 2016). According to the SABPG (MacEwan et al., 2020), no roads should be built within 200 meters of any bat roost or foraging site, and powerlines should not be erected within 500 meters of any bat roost. Existing roads undergoing upgrades may intersect these buffered zones; however, it is essential to minimize disturbance during the upgrade of these specific roads, which should occur during the winter months (Figure 33). This process will be overseen by a specialist during the Construction Phase. There are new roads planned that cross over bat buffers in the north and central area and these roads will have to be moved. No powerlines are currently planned near any bat roosts.

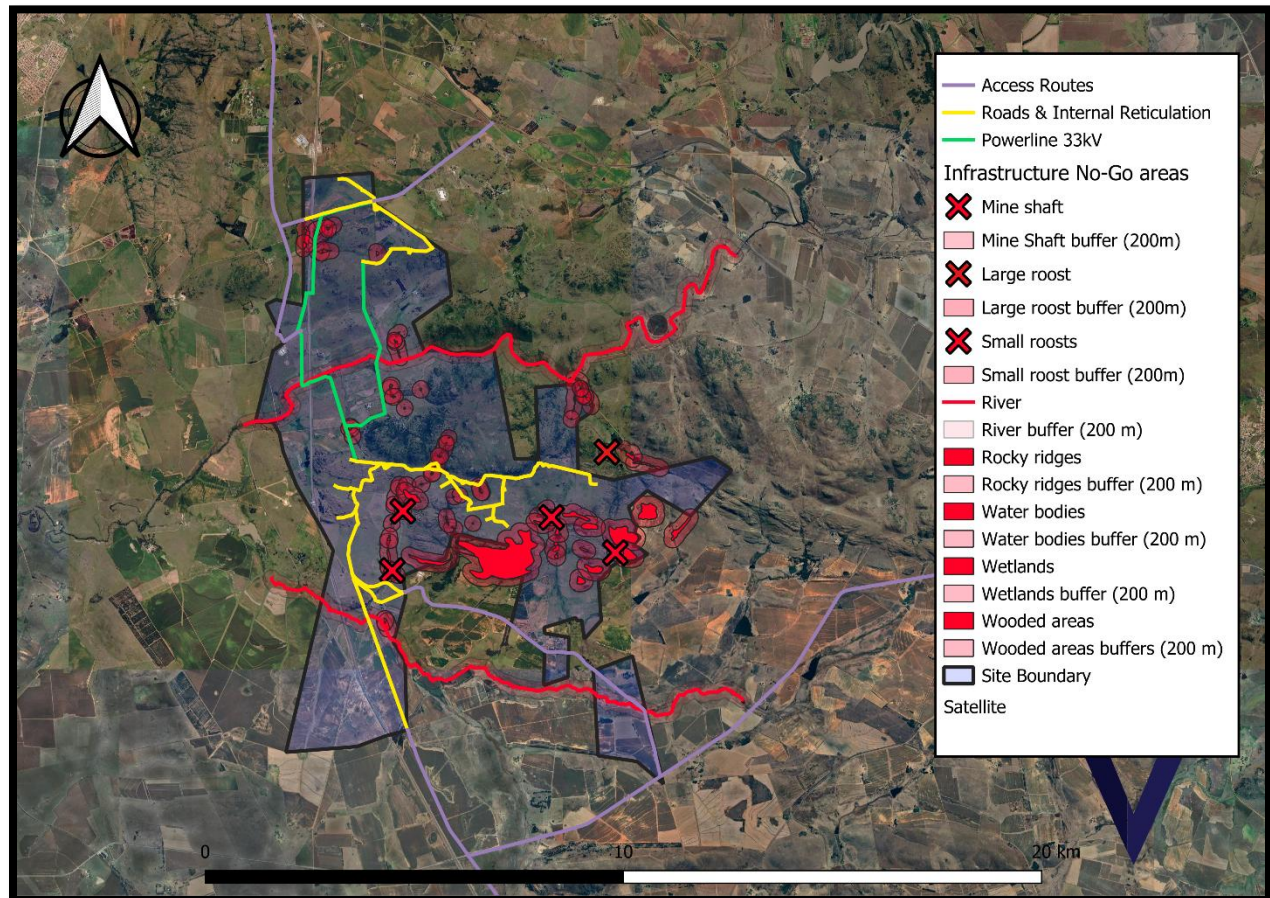


Figure 41. Road network and powerlines with required bat buffers

5.3 Infrastructure

Based on the SABPG (MacEwan et al., 2020) no buildings or any other infrastructure may be located within 500 m from any bat roost. The Temporary Laydown Area in the south currently cross over the 500 m of a small active bat roost (Figure 34).

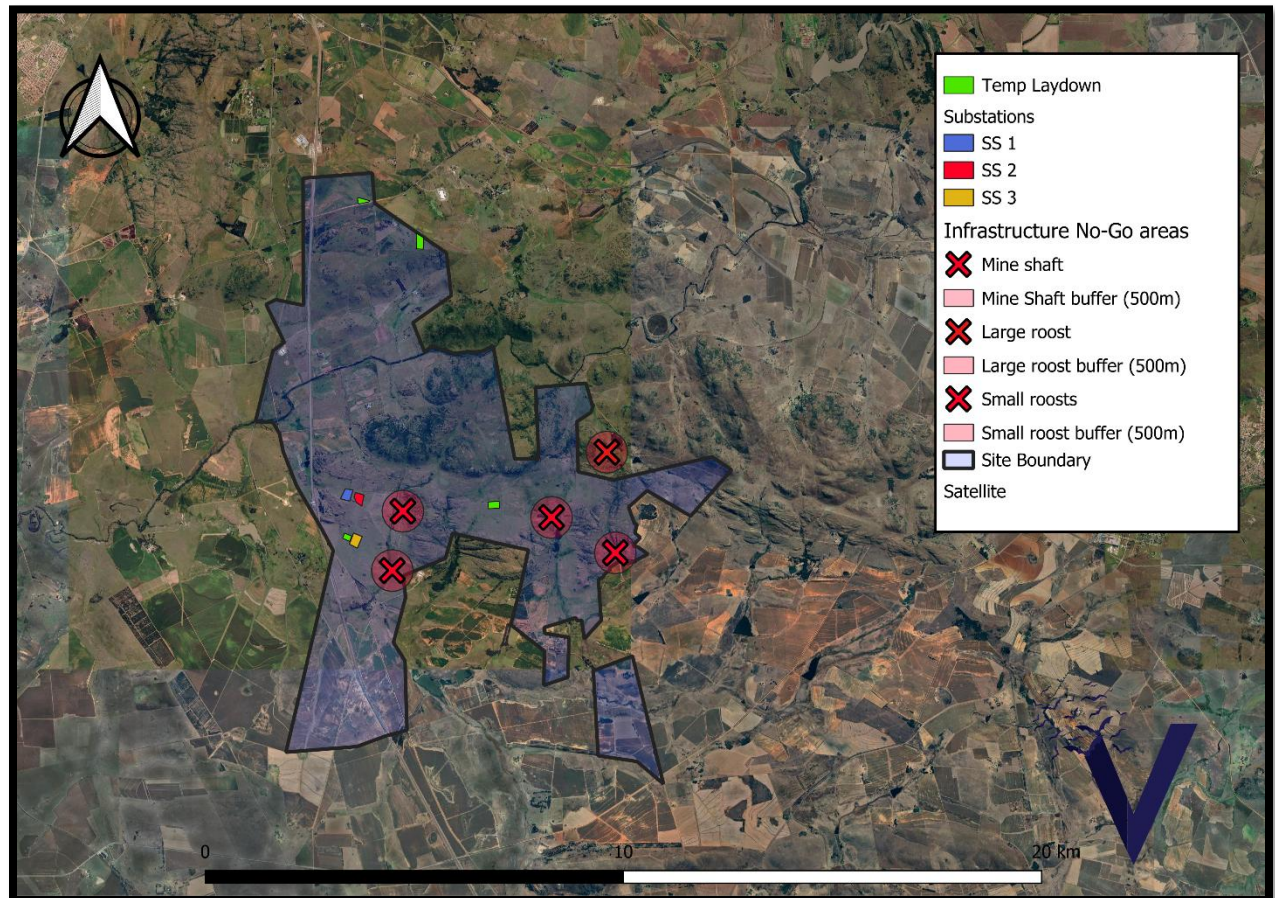


Figure 42. Planned infrastructure with required bat buffers



6. Preliminary Impact Assessment

6.1 Impacts Identified

Construction Phase:

- **Habitat destruction:** The construction of access roads, turbines or infrastructure may lead to foraging habitat and sensitive bat features being removed.
- **Destruction or disturbance of bat roosts:** The construction of access roads, turbines or infrastructure may lead to bat roosts being disturbed removed.

Operational Phase:

- **Bat mortality:** Bats killed due to barometric trauma or being struck by blades of the turbines during the operational phase.
- **Artificial lighting:** Artificial lights can have a negative effect on bat behaviour by affecting flight paths used or attracting them to lights due to higher insect abundance and elevating the likelihood of collision mortality.

Decommissioning Phase

- **Habitat destruction:** The decommissioning of access roads, turbines or infrastructure may lead to foraging habitat and sensitive bat features being removed.
- **Destruction or disturbance of bat roosts:** The decommissioning of access roads, turbines or infrastructure may lead to bat roosts being disturbed or removed.



6.2 Potential Impacts during the Construction Phase

6.2.1 Loss of Habitat and Roost Disturbance

Due to the construction of roads, turbines and infrastructure it is expected that a certain amount of habitat destruction will occur. The most sensitive habitat features for bats in the area appear to be sources of open water, and these must be avoided at all costs. In addition, the confirmed roosts must be avoided, and the 200 m buffers suggested above should be seen as **NO-GO** areas.

Currently there are no new roads planned for the construction within highly sensitive buffers and existing roads that will be upgraded in these areas and the impact without mitigation is expected to be **Moderate negative**. If these are moved outside of the buffered areas the impact is expected to be **Very Low negative** (Table 19).



Table 11. Significance of loss of bat habitat and roost disturbance during the Wind Energy Facility Construction Phase

Impact due to habitat loss or roost disturbance						
Due to the construction of roads, turbines and infrastructure it expected that a certain amount of habitat destruction will occur						
Pre-Mitigation						
Impact Magnitude (M)	Impact Extent (E)	Impact Reversibility (R)	Impact Duration (D)	Probability of Occurrence (P)	S	Rating
3	2	3	3	3	33	N3
N3 - Moderate						
Post-Mitigation						
Impact Magnitude (M)	Impact Extent (E)	Impact Reversibility (R)	Impact Duration (D)	Probability of Occurrence (P)	S	Rating
1	2	1	2	2	12	N1
N1 – Very Low						
Mitigation measures						
<ul style="list-style-type: none"> No construction of new roads in sensitive areas and avoid upgrading of existing roads in sensitive areas. If upgrading of existing roads is to go ahead a bat specialist must be present during the construction of these to ensure that the impact is kept to a minimum and construction must be done during the winter months. 						

6.3 Potential Impacts during the Operational Phase

6.3.1 Bat Mortality

The overall median number of bat passes per hour was 2,48 BP/H at ground level and 0,07 BP/H in the rotor sweep zone. The SABPG states that if the median bat passes per hour is between 0,23 and 1,76 at ground level and between 0,04 and 0,39 at height the area is seen as being of Medium Sensitivity to bats. This area is thus classified as Medium risk. While no specific migratory pathways were confirmed there is a large influx of bats during spring and summer, and the overall number



of bat passes per hour increases drastically. During these periods the Impact could be **Very High negative** and have a long-lasting effect on the *L. capensis* population in the area (Table 12).

Additional mitigation measures must be implemented following the post-construction monitoring results and be adjusted as necessary compared to preliminary measures (relaxed or tightened). The specific mitigation measures and changes thereof need to be prescribed by the post-construction monitoring bat specialist, and will be informed by the data collected during the pre- and post-construction monitoring as per the post-construction monitoring guidelines (Aronson *et al.*, 2020). Continuous recording of environmental variables, such as temperature, wind speed and rainfall will be required for operational bat activity data analysis and implementation of adaptive mitigations measures. These data should be collected by the WEF and made available for this purpose. The period over which these data should be collected must be informed by Post-Construction monitoring. Two main mitigation measures should be considered: automated peak curtailment or blanket peak curtailment.

6.3.1.1 Automated Peak Period Curtailment

Automated real-time bat monitoring and analysis systems have been shown to be successful in the USA, reducing bat fatalities by over 80% (Hayes et al., 2019). This option is available as the “Smart System” from Wildlife Acoustics (<https://www.wildlifeacoustics.com/smart-system>), and it is recommended as the primary method for automated and near-real-time bat fatality mitigation. The deployment of a single device near the center of the turbine area is suitable to control the curtailment of all turbines within a small area (< 5 000 ha), but additional devices would be required to cover a larger area. Furthermore, additional devices could be used to control specific turbines to allow for area specific curtailment measures based on the bat activity recorded. The microphones of these devices are attached to the turbines within the rotor sweep zone to monitor bat activity throughout the operational period, the system analyses the detections and the output can continuously feed back into the turbine control system to automatically initiate curtailment when the bat activity is high. The hardware for this option is expensive but is expected to perform more effectively than a blanket curtailment and thus reduce production losses. The recommended



placement for the Smart System microphones is within the lower portion of the rotor sweep area (62.5 - 237.5 m) as bat activity is expected to be greatest at this height and it is more likely that peak bat activity will be reliably detected. The recommended threshold value for bat activity to activate curtailment for Smart Systems should be calculated according to the threshold bat mortality figures (MacEwan *et al.*, 2020a), the estimated mortality from post-construction monitoring, and the bat activity recorded at (or corrected for) the height of the installed Smart System. The curtailment should be implemented in the form of a cut-in speed, such that during periods of high bat activity turbines will only begin rotating at wind speeds above the prescribed cut-in speed.

6.3.1.2 Blanket Peak Period Curtailment

Our results suggest that activity is very high during the spring and summer months and during this period the area should be seen as having a **Very High Risk** for bat fatalities. While activity is higher early in the evening, it remains very high during the remainder of the night and curtailment will have to occur across the full spring and summer periods.



Table 12. Impact due to bat mortality during the operational phase

Bat mortality						
Due to collisions with turbines or barotrauma bats may suffer fatalities at the proposed WEF						
Pre-Mitigation						
Impact Magnitude (M)	Impact Extent (E)	Impact Reversibility (R)	Impact Duration (D)	Probability of Occurrence (P)	S	Rating
5	3	5	5	5	90	N5
N5 – Very High						
Post-Mitigation						
Impact Magnitude (M)	Impact Extent (E)	Impact Reversibility (R)	Impact Duration (D)	Probability of Occurrence (P)	S	Rating
3	3	3	4	3	39	N3
N13– Moderate						
Mitigation Measures						
<ul style="list-style-type: none"> • Hub height at maximum as stated in the project description • Blade length at minimum as stated in the project description • Automated smart curtailment must be employed as mitigation measure, and the devices must be deployed in such a manner to provide maximum coverage across the WEF. These devices must be installed prior to the facility becoming operational. No devices are currently recommended, but should be based on the technology available at the time of installation • Post-construction monitoring in consultation with a bat specialist including carcass searching and acoustic monitoring. 						

6.3.2 Artificial Lights

Artificial lights can have a negative effect on bat behaviour by affecting foraging activity and flight paths used. Artificial lights can attract insects which will entice bats to feed in the area leading to a higher likelihood of bat fatalities due to collision with infrastructure or barotrauma (if lighting is present at the turbines). This impact could be high, but is easily reduced if low intensity, directional lights, and only minimal compulsory civil aviation lighting is used. Furthermore, non-UV emitting



lights must be used. This should be applicable to all areas, but especially bat sensitive features used for foraging, such as any waterbodies. In certain areas the use of artificial lights will be unavoidable, and these include areas where offices, substations or operational and maintenance buildings will be constructed. The impact is assessed to be of **Moderate** significance and with the implementation of mitigation is reduced to **Very Low** (Table 13).

Table 13. Impact due to artificial lights during the operational phase

Bat mortality						
Due to collisions with turbines or barotrauma bats may suffer fatalities at the proposed WEF						
Pre-Mitigation						
Impact Magnitude (M)	Impact Extent (E)	Impact Reversibility (R)	Impact Duration (D)	Probability of Occurrence (P)	S	Rating
4	2	3	3	3	36	N3
N3 - Moderate						
Post-Mitigation						
Impact Magnitude (M)	Impact Extent (E)	Impact Reversibility (R)	Impact Duration (D)	Probability of Occurrence (P)	S	Rating
2	2	3	3	1	10	N1
N1 – Very Low						
Mitigation Measures						
<ul style="list-style-type: none"> • Use only minimal compulsory civil aviation lighting • Use non-UV emitting lights 						



6.4 Operational Phase

6.4.1 Impact due to Habitat Loss or Roost Disturbance

If the decommissioning of all turbines and infrastructure is kept to the same footprint areas that were used during the Construction Phase it is expected the impact will be **Low** and no mitigation will be required.

6.5 Cumulative Impacts

The ABO Uvemvane 1 WEF is located close to a collection of prospective SEF and one WEF when considering the 30 Km radius prescribed by current guidelines (Figure 43). Unfortunately, no bat data is available for these SEFs as bat assessments are not a requirement for SEF and thorough assessments are rarely performed. Although bats will not be at risk for any fatalities due to collision with renewable energy infrastructure (as with the one wind energy facility present), the possible cumulative habitat destruction if all facilities are built will have an impact on bat foraging habitat. The destruction of habitat will cause a decrease in insects which is the primary food source for the bats found in this region. When assessing the REEA (2026, Q1) data, the total land usage for proposed renewable energy facilities located within a 30km radius of the proposed WEF accounts for approximately 21 081 ha (assuming the entire allocated portions are utilised). This equates to 5,02 % of the total habitat located in the 30 km radius around the proposed WEF. Considering this, it will have a negative effect on the bat populations to some degree, but without knowing the structure and assemblages of bat populations in the areas planned for SEFs it is near impossible to determine the magnitude of the impact. However, not all of these areas allocated to renewable energy facilities will be transformed and mitigation recommendations will ensure that the sensitive habitats are kept. It is thus believed that the negative impact on bats will only slightly increase due to the cumulative impact of facilities in the area and will not change the stated impact of the ABO Uvemvane 1 WEF.



All proposed buffers must be respected, and No-Go areas avoided. Construction of new roads and infrastructure may need to be reconsidered to avoid potential roosts and waterbodies where possible and artificial light should be kept to a minimum.



As it has been shown that higher cut in speeds reduces the number of bat fatalities (Amorim et al 2012), this will be required during times of peak activity. Only once bat carcass and acoustic data collected during operational monitoring indicates acceptable fatalities rates can these suggested mitigation measures be relaxed, if appropriate.

The annual threshold for bat fatalities in this the ecoregion is 0,20 bats per 10 ha (MacEwan et al., 2018), and therefore a total of 164 bat deaths per year would be acceptable based on the guidelines.



8. Conclusion

This report presents data obtained during the full 12-months of monitoring on the proposed ABO Uvemvane 1 WEF. Data was collected from three bat detectors that were deployed at 10 m above ground and a further two bat detectors that were deployed at height on the meteorological masts. A total of five bat species were detected on the PAOI during the monitoring period, and of these species *L. capensis* was the most active throughout the monitoring period. Overall bat activity was higher for all bat species during the summer period during December 2024, but activity was high throughout the spring and summer. Activity levels declined for all species after January 2025 and through the winter period and started increasing again in August 2025. Findings during the study indicate that many of the bat species do not overwinter in the area. Results obtained from the bat detectors showed a clear increase in bat activity early in the evenings (between 18:00 and 20:00), but declines after 04:00. Bat activity was also noted to be generally higher in areas close to water sources. Roost surveys conducted during the winter and months indicated that there are three small roosts, one large roost and a roost in an abandoned mine shaft, and the appropriate buffers have been implemented.

The SABPG states that, for the Grassland ecoregion, if the median bat passes per hour is less than 0,23 at ground level and less than 0,04 in the rotor sweep zone the area is considered as being of Low Sensitivity to bats. If the median bat passes per hour is between 0,23 and 1,76 at ground level and between 0,04 and 0,39 at height the area is seen as being of Medium Sensitivity to bats. Based on our monitoring results the median number of bat passes per hour at ground level is 2.48 and 0,07 within the rotor sweep zone indicating that the area is of **HIGH SENSITIVITY** to bats on ground level and of **MEDIUM SENSITIVITY** in the rotor sweep zone. It must, however, be stated that during the spring and summer periods the sensitivity is **HIGH** at ground level and at height.

An initial mitigation measure to avoid impacts is the choice of turbine design and it is advisable that hub height is set at the maximum and turbine blade length at the minimum as stated in the project description.



More active mitigation in the form of curtailment is required to manage the impact of bat mortality to an acceptable level. Automated smart curtailment must be employed and the devices must be deployed in such a manner to provide maximum coverage. These devices must be installed prior to the WEF being operational to ensure that bat mortality is kept at a minimum.

The mitigation strategy can and must be adapted based on post construction acoustic monitoring and carcass searching and in consultation with a bat specialist. Mitigation measures may thus be adjusted, if necessary, compared to preliminary measures (relaxed or tightened). The specific mitigation measures and changes thereof need to be prescribed by the post-construction monitoring bat specialist, and will be informed by the data collected during the pre- and post-construction monitoring as per the post-construction monitoring guidelines

In conclusion, the study did not identify any fatal flaws and with the strict implementation of mitigation and monitoring measures the project would be acceptable.



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WSP Group Africa (Pty) Ltd (2022). Camden II Wind Energy Facility Final Environmental Impact Assessment Report.





Appendix 1: Specialist Qualifications







Appendix 2: Curriculum Vitae of bat specialist

Personal details	
Full Name	John Low de Vries
DOB	07-Nov-84
Nationality	South African
Marital Status	Married
Email	low@volantenvironmental.com
Phone	+27 82 323 5475
ID number	8 411 075 188 087
Education	
Completed	Degree and Institution
2002	Matric, Hoërskool Jeugland, Kempton Park, South Africa
2006	B. Sc Zoology, University of Pretoria, Pretoria, South Africa
2007	B. Sc (Hons) Zoology, University of Pretoria, Pretoria, South Africa
2014	PhD Zoology, University of Pretoria, Pretoria, South Africa
Key areas of expertise	
· Bat Specialist	Conducting surveys on bat diversity and abundance and research on bat ecology.
· Environmental Assessment Practitioner	Writing and collating Basic Assessment (BA) for proposed Wind Energy Facilities
Memberships & Certificates	
· SACNASP Registered Professional Natural Scientist in the field of Zoological Science - Registration Number: 124178	
· Bat Assessment Specialist with South African Bat Assessment Association (SABAA)	
Other Training	
· Multivariate statistical modelling (Cape Town, South Africa)	
· Bat handling and identification course (AfricanBats)	



· Snake handling (Chameleon Village (South Africa)	
· ArcGis online course	
· First Aid level 2 (Johannesburg, South Africa)	
Publications	
Wood, M., de Vries, J.L. , Monadjem, A., Markotter, W. A critical review of factors influencing interspecific variation in home range size of bats. <i>Mammal Review</i> . <i>In submission</i>	
Markotter W, de Vries, J.L. , Paweska, J. 2022. Wing tattoos: A cost-effective and permanent method for marking bats. <i>In review</i>	
Geldenhuys, M., de Vries, J.L. , Dietrich, M., Mortlock, M., Epstein, J. H., Weyer, J., Paweska, J T., Markotter, W. Longitudinal surveillance of diverse coronaviruses within a <i>Rousettus aegyptiacus</i> maternal colony towards understanding viral maintenance and excretion dynamics. <i>In submission</i>	
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Kotze, R., Bennett, N., Cameron, E.Z., de Vries, J.L. , Marneweck, D.G., Pirk, C.W.W., Dalerum, F. 2012. Temporal patterns of den use suggest polygamous mating patterns in an obligate monogamous mammal. <i>Animal Behaviour</i> . 84. 1573-1578	
de Vries, J.L. , Pirk, C.W.W., Bateman, P.W., Cameron, E.Z., Dalerum, F. 2011. Extension of the diet of an extreme foraging specialist, the aardwolf (<i>Proteles cristata</i>). <i>African Zoology</i> . 6:1 194-196.	
de Vries, J. L. , Oosthuizen, M. K., Sichilima, A. M., Bennett, N. C. 2008. Circadian rhythms of locomotor activity in Ansell's mole-rat: are mole-rat's clocks ticking? <i>Journal of Zoology</i> . 276:4. 343-349	
Employment & work-related experiences	
2020 - present	Director and founder of Volant Environmental
2016 - present	Postdoctoral fellow, University of Pretoria
2015 - 2016	Postdoctoral fellow, NZG
2014 - 2015	Marion Island field assistant, University of Pretoria



2013	Documentary presenter, Oxford Scientific Films
2010 - 2011	Wildlife Education Trainer, Enviro- Insight
2010 - 2011	Game Raining Lecturer, Damelin Centurion
2009 - 2018	Lecturer and tutor, University of Pretoria
Conference Contributions	
Markotter W, de Vries, J.L. , Wood, M. 2022. Small scale movement of <i>Rousettus aegyptiacus</i> . International Bat Research Conference. Austin, Texas	
Infectious Diseases of Bats Symposium. Fort Collins, Colorado 2017. Body mass index of the Egyptian fruit bat, <i>Rousettus aegyptiacus</i> : An indicator of infection status. de Vries, J.L. , Dietrich, M., Paweska, J., Markotter, W.	
SASAS 2016. de Vries, J.L. , Jonker, M.L., Kriel, D., Kotze, A.K. The Tankwa goat: Phenotypically that different?	
De Beers Diamond Route Conference, 2010. de Vries, J.L. , Pirk, C.W.W., Bennett, N.C. Is the aardwolf a seasonally influenced optimal forager?	
Kimberley biodiversity research symposium, 2009. de Vries, J.L. , Bennett, N.C., Pirk, C.W.W., Dalerum, F., Cameron, E.Z. Den, and home range use of the aardwolf, <i>Proteles cristatus</i>	



Recent Project Experience

For further details please contact me directly at low@volantenvironmental.com

Time span	Nature of project	Capacity	Industry / Sector	Client / Developer	Country (Province)
2025-current	Maquassi ERA	Bat Specialist	Renewable Energy / Onshore Wind	AGV	South Africa (North West)
2025-current	Khangela WEF	Bat Specialist	Renewable Energy / Onshore Wind	ACED (Pty) Ltd	South Africa (Northern Cape)
2025-current	Ishwati WEF	Bat Specialist	Renewable Energy / Onshore Wind	ACED (Pty) Ltd	South Africa (Northern Cape)
2025-current	Umsinde WEF	Bat Specialist	Renewable Energy / Onshore Wind	ACED (Pty) Ltd	South Africa (Northern Cape)
2024-current	Uvemvane WEF	Bat Specialist	Renewable Energy / Onshore Wind	ABO Energy South Africa	South Africa (Mpumalanga)
2024-current	Mordant WEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	Cainmani	South Africa (Northern Cape)
2024	Castel WEF	Bat Specialist	Renewable Energy / Onshore Wind	Savannah (Pty) Ltd	South Africa (Northern Cape)
2024-current	Steeldrift WEF	Bat Specialist	Renewable Energy / Onshore Wind	EDF Renewables	South Africa (Mpumalanga)
2024	Deelkraal WEF	Bat Specialist	Renewable Energy / Onshore Wind	Cainmani	South Africa (Gauteng)
2024-current	Pretjiesberg WEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	Zutari	South Africa (Eastern Cape)
2024-2025	Mabele Emoyeni WEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	Sereti Green	South Africa (Free State)
2024-2025	Doringbaai South	Bat Specialist	Renewable Energy / Onshore Wind	WKN Windcurrent SA (Pty) Ltd	South Africa (Western Cape)
2023 - 2024	Unika WEF	Bat Specialist	Renewable Energy / Onshore Wind	Total Energies	Zambia (Eastern Province)
2023 - 2024	Pensulo WEF	Bat Specialist	Renewable Energy / Onshore Wind	Total Energies	Zambia (Central Zambia)



2023 - 2024	Rhenosterkop WEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	AGV	South Africa (Northern Cape)
2023 - 2024	Hotazel WE	Bat and Bird Specialist	Renewable Energy / Onshore Wind	AGV	South Africa (Northern Cape)
2023 - 2024	Buffelsfontein SEF	Bird Specialist	Renewable Energy / Onshore Wind	Cainmani	South Africa (Mpumalanga)
2023 - 2024	Stillfontein SEF	Bird Specialist	Renewable Energy / Onshore Wind	Cainmani	South Africa (Mpumalanga)
2023 - 2024	Roodepoort SEF	Bird Specialist	Renewable Energy / Onshore Wind	Cainmani	South Africa (Limpopo)
2023 - 2024	Kuske SEF	Bird Specialist	Renewable Energy / Onshore Wind	Cainmani	South Africa (Limpopo)
2023 - 2024	Komati WEF and SEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	WKN Windcurrent SA (Pty) Ltd	South Africa (Mpumalanga)
2023 - 2024	Three Provinces 1 SEF and WEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	Cainmani	South Africa (Mpumalanga)
2023 - 2024	Three Provinces 2 SEF and WEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	Cainmani	South Africa (Mpumalanga)
2023 - 2024	Brakdam WEF	Bat Specialist	Renewable Energy / Onshore Wind	Enertrag SA (Pty) Ltd	South Africa (Northern Cape)
2023 - 2024	Hartebees Skeur WEF	Bat Specialist	Renewable Energy / Onshore Wind	Enertrag SA (Pty) Ltd	South Africa (Northern Cape)
2023 - 2024	Brakputs WEF	Bat Specialist	Renewable Energy / Onshore Wind	Enertrag SA (Pty) Ltd	South Africa (Northern Cape)
2023 - 2024	Varsputs WEF	Bat Specialist	Renewable Energy / Onshore Wind	Enertrag SA (Pty) Ltd	South Africa (Northern Cape)
2023 - 2025	Daggakraal WEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	EDF Renewables	South Africa (Mpumalanga)
2023 - 2024	Imvubo SEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	Nextec	South Africa (KZN)



2023 - 2024	Ingagne SEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	Nextec	South Africa (KZN)
2023 - 2024	Camden WEF	Bird Specialist	Renewable Energy / Onshore Wind	EDF Renewables	South Africa (Mpumalanga)
2023 - 2023	Steelpoort SEF	Bird Specialist	Renewable Energy / Onshore Wind	Jones and Wagener	South Africa (Limpopo)
2023 - 2023	Tournee SEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	WKN Windcurrent SA (Pty) Ltd	South Africa (Mpumalanga)
2022 - 2023	Dubula SEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	CEN	South Africa (Eastern Cape)
2022	Dubula Greenfields SEF	Bat and Bird Specialist	Renewable Energy / Onshore Wind	CEN	South Africa (Eastern Cape)
2022	Tuinfontein Scoping survey	Bat and Bird Specialist	Renewable Energy / Onshore Wind	Akuo Energy	South Africa (Northern Cape)
2022	WEF Desktop surveys	Bat Specialist	Renewable Energy / Onshore Wind	Oryx Power	South Africa (Mpumalanga, Northern Cape, Eastern Cape)
2022	Langberg WEF Bat Scoping Survey	Bat Specialist	Renewable Energy / Onshore Wind	Akuo Energy	South Africa (Northern Cape)
2022	Thand Tau Bat Impact Assessment	Bat Specialist	Renewable Energy / Onshore Wind	Enertrag SA (Pty) Ltd	South Africa (Free State)
2022	Camden Bird Impact Assessment	Bird Specialist	Renewable Energy / Onshore Wind	EDF Renewables	South Africa (Mpumalanga)
2022	Hotazel WEF Scopin Survey	Bat Specialist	Renewable Energy / Onshore Wind	Jones and Wagener	South Africa (Northern Cape)
2022	Rhenosterkop WEF Scopin Survey	Bat Specialist	Renewable Energy / Onshore Wind	Jones and Wagener	South Africa (Western Cape)
2022-2023	Doringbaai WEF Bat Impact assessment	Bat Specialist	Renewable Energy / Onshore Wind	WKN Windcurrent SA (Pty) Ltd	South Africa (Western Cape)
2022	Castle WEF walkthrough	Bat Specialist	Renewable Energy / Onshore Wind	Savannah (Pty) Ltd	South Africa (Northern Cape)



2021	Fraserburg raptor nest survey	Bird specialist	Renewable Energy / Onshore Wind	WKN Windcurrent SA (Pty) Ltd	Renewable Energy / Onshore Wind
2021-2022	Dordrecht Bat Impact Assessment	Bat Specialist	Renewable Energy / Onshore Wind	ACED (Pty) Ltd	South Africa (Eastern Cape)
2021 - 2022	Indwe Bat Impact Assessment	Bat Specialist	Renewable Energy / Onshore Wind	Jones and Wagener	South Africa (Eastern Cape)
2021 - 2022	Waschbank Bat Impact Assessment	Bat Specialist	Renewable Energy / Onshore Wind	Jones and Wagener	South Africa (Eastern Cape)
2022 - 2023	Gorachouqua Bat Impact Assessment	Bat Specialist	Renewable Energy / Onshore Wind	Enertrag SA (Pty) Ltd	South Africa (Northern Cape)
2022 - 2023	Khoemana Bat Impact Assessment	Bat Specialist	Renewable Energy / Onshore Wind	Enertrag SA (Pty) Ltd	South Africa (Northern Cape)
2021 - 2022	Dalmanutha Bat Impact Assessment	Bat Specialist	Renewable Energy / Onshore Wind	Enertrag SA (Pty) Ltd	South Africa (Mpumalanga)
2020-2021	Bergvriervier Bat Impact Assessment	Bat Specialist	Renewable Energy / Onshore Wind	Genesis Eco-Energy Developments (Pty) Ltd	South Africa (Western Cape)
2020-2021	Botterblom Bat Impact Assessment	Bat Specialist Bird assistant	Renewable Energy / Onshore Wind	Genesis Eco-Energy Developments (Pty) Ltd	South Africa (Northern Cape)
2012	Dangerous snake removal	Herpetologist	Mining (Coal)	Anadarko	Mocimboa da Paia, Mozambique