Scoping phase assessment with regards to bat (Chiroptera) sensitivity

- For the proposed Aberdeen Wind Energy Facility in the Eastern Cape

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Terms of Reference

The scoping phase assessment aims to assess the sensitivity of the bat communities in the study area and undertake a desktop review of the site and surrounding area to identify bat species potentially present. A brief review of national and international literature on bat-wind farm interactions is also to be included, together with a desktop based Sensitivity Map indicating potential areas of bat sensitivity (to be reviewed in the detailed environmental impact assessment phase). The report also provides descriptions of the impacts and issues foreseen so far in relation to the proposed wind energy facility and its associating impacts. Further, a Terms of Reference for further work to assess/address the identified issues in the detailed EIA phase are proposed.

Appointment of Specialist

Animalia Zoological & Ecological Consultation CC was appointed by Savannah Environmental (Pty) Ltd to undertake a specialist scoping phase bat sensitivity study for the proposed Aberdeen Wind Energy Facility in Eastern Cape. The study was conducted by Werner Marais (CV available on request).

Independence:

Animalia Zoological & Ecological Consultation CC has no connection with the developer. Animalia Zoological & Ecological Consultation CC is not a subsidiary, legally or financially of the developer; remuneration for services by the developer in relation to this proposal is not linked to approval by decision-making authorities responsible for permitting this proposal and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project.

Applicable Legislation:

Legislation dealing with mammals applies to bats and includes the following:

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; Especially sections 2, 56 & 97)

The act calls for the management and conservation of all biological diversity within South Africa. Bats constitute an important component of South African biodiversity and therefore all species receive attention additional to those listed as Threatened or Protected.

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1. INTRODUCTION

1.1 Study Area

Eskom Holdings Limited is proposing to establish a commercial wind energy facility and associated infrastructure on a site located approximately 24 km west of Aberdeen in the Camdeboo Local Municipality falling within the Eastern Cape (**Figure 1**). The site is crossed several times by drainage lines and streams draining from north to south, with their origin in the Camdeboo Mountains that lies approximately 2.6 km to the north east of the site. The Southern Karoo Riviere vegetation unit consists primarily of larger river beds and hydrological features passing beyond the north western boundary of the site, also having their origin in the Camdeboo Mountains (**Figure 2 & 3**).

The site area (~8198 ha in extent) comprises the farms:

- Portion 3 of Sambokdoorns 92
- RE of Portion 4 of Sambokdoorns 92
- RE of Sambokdoorns 92
- Portion 1 of Klipdrift 73
- Portion 2 of Farm 94, and
- RE of Portion 2 of Farm 94

The proposed facility is proposed to accommodate up to 200 MW of generating capacity which would be accomplished by means of installing a cluster of between 100 and 150 wind turbines of nominal rated capacity of between 1.5MW and 2MW each. Other infrastructure associated with the facility will include:

- A cluster of between 100 and 150 wind turbines to be constructed over an area of ~ 8 198 ha in extent
- Concrete foundations to support the turbine towers
- Cabling between the turbines to be lain underground
- An on-site substation to facilitate the connection between the facility and the electricity grid
- An overhead power line (400kV) feeding into Eskom's electricity grid at the Droërivier Substation, approximately 140 km from the site1
- Main access road to site
- Internal access roads between wind turbines
- External roads to access the site may be required
- Borrow pits within the site for the construction of access roads

[1] Note that the power line is the subject of a separate EIA process.

- Office/Workshop area for operations, maintenance and storage
- Temporary water storage for construction and small storage for Operation
- Storage of fuel during construction
- Small Information centre and Operational & Maintenance building

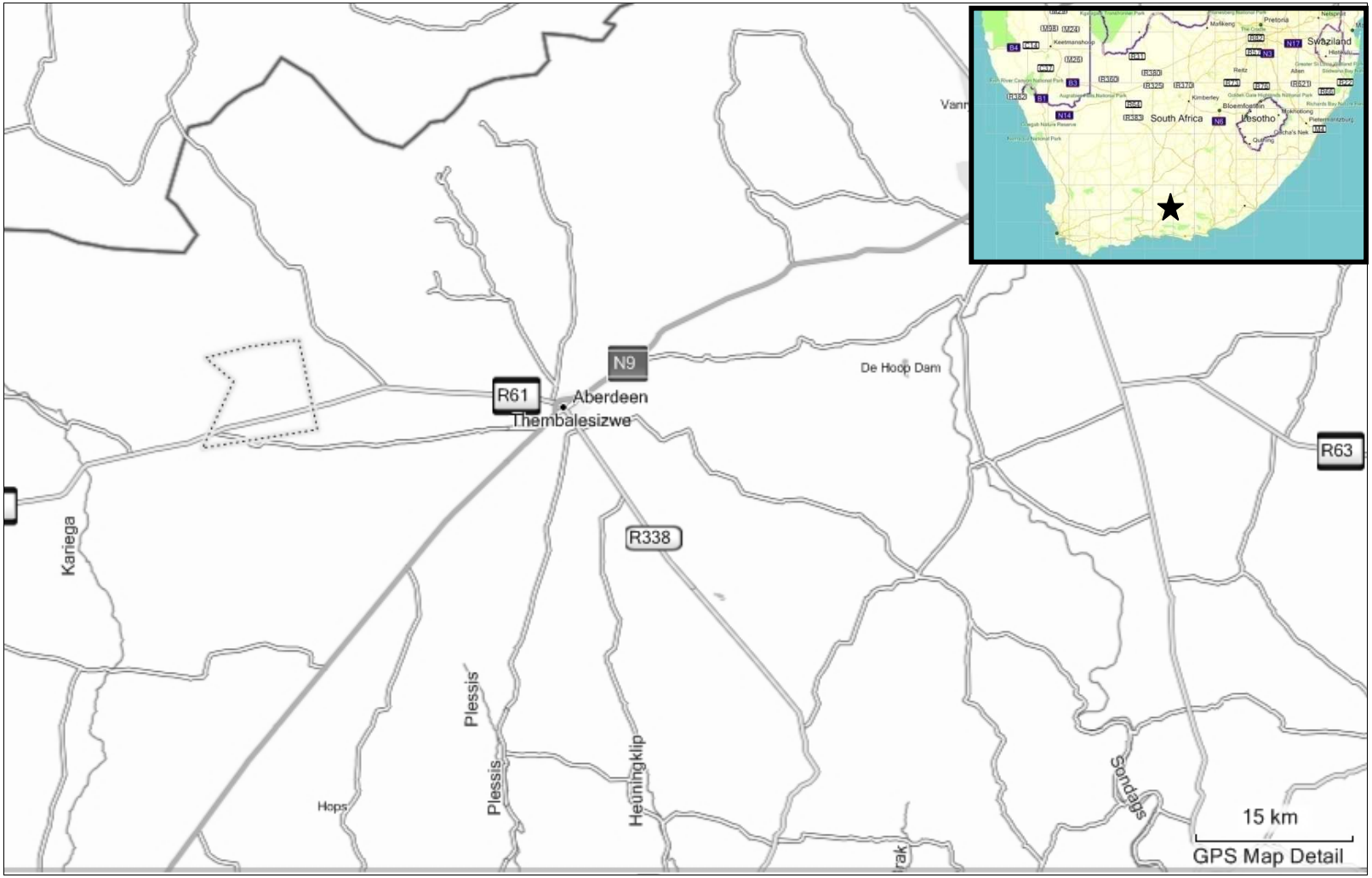


Figure 1: Map with an indication of the site (dotted outline), and an overview map with the site locality (black star).

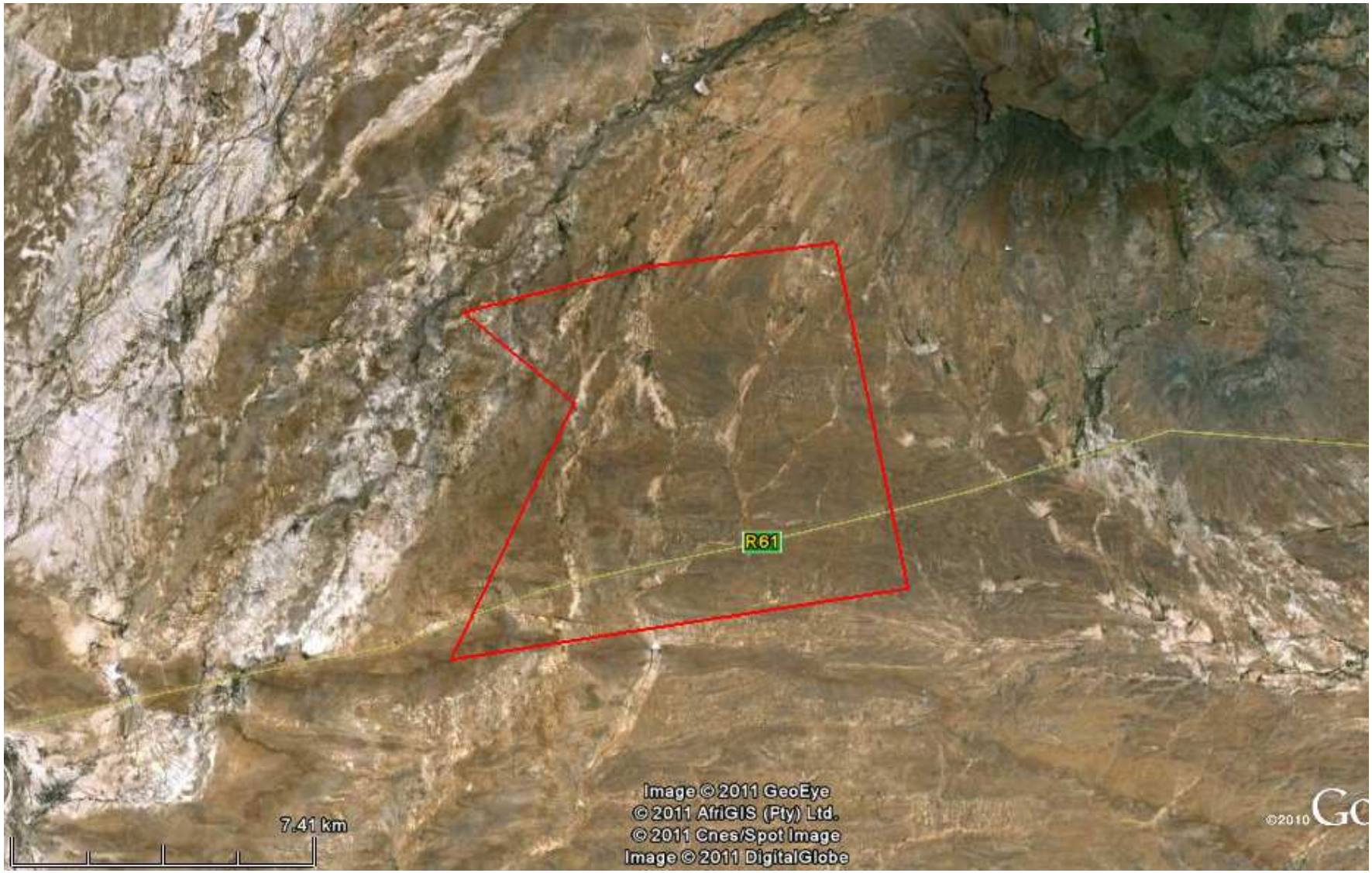


Figure 2: Satellite image of the site and surrounding area, the boundary is indicated in red. Note the site positioning close to the foot slope of the Camdeboo mountains to the north east. All satellite images retrieved from Google Earth™.

Figure 3: Close up satellite image of the site, indicating the deeper drainage valleys especially in the north western part.

1.2 Limitations, land use and existing impacts on the study area

The existing impacts on the study area are limited to some agricultural practices, primarily live stock grazing, with little major developmental modifications. The available literature on South African bat behaviour and ecology is limited, especially on behavioural acts pertaining to large geographical regions. Much of the knowledge of bat behaviour is therefore still relatively uncertain in comparison to more charismatic species of animals. Areas on the site to be designated as having a higher bat activity and/or diversity, is deemed as such based on the occurrences of certain environmental and terrain features that will be favourable to bats.

1.3 Vegetation units, geology and climate

Two different vegetation units are present in the study area (**figure 4**).

The Eastern Lower Karoo dominates the site and is characterized by plains interrupted by dolomite, and vegetation is low to middle height shrubland with drought resistant white grasses becoming abundant in places. Rainfall occurs mostly in late summer and early autumn with a main peak in March, and the MAP ranges from 150mm in west to 350mm in the east for the entire vegetation unit. The site is located in the west of this vegetation unit and would therefore have a Map closer to 150 mm, the mean maximum and minimum temperatures are approximately 38°C and 0°C respectively (Mucina & Rutherford, 2006).

The Southern Karoo Riviere vegetation unit is found to the north of the site, and extends slightly onto the site and also occurs on alluvia of the Buffels, Bloed, Dwyka, Gamka, Sout, Kariega and Sundays rivers and their tributaries and is embedded in the Albany Thicket biome south of Cradock extending onto the project area. This unit consists of narrow riverine flats supporting a complex of *Acacia karoo* or *Tamarix usneoides* thickets growing on recent sandy-clayey alluvial deposits rich in salt occurring on mudrocks and sandstones. There is a major rainfall peak in March and a minor peak in November with a MAP of only 243 mm, and temperatures are overall warm-temperate with a MAT of 16.3°C. Conservation status is Least Threatened (Mucina & Rutherford, 2006).

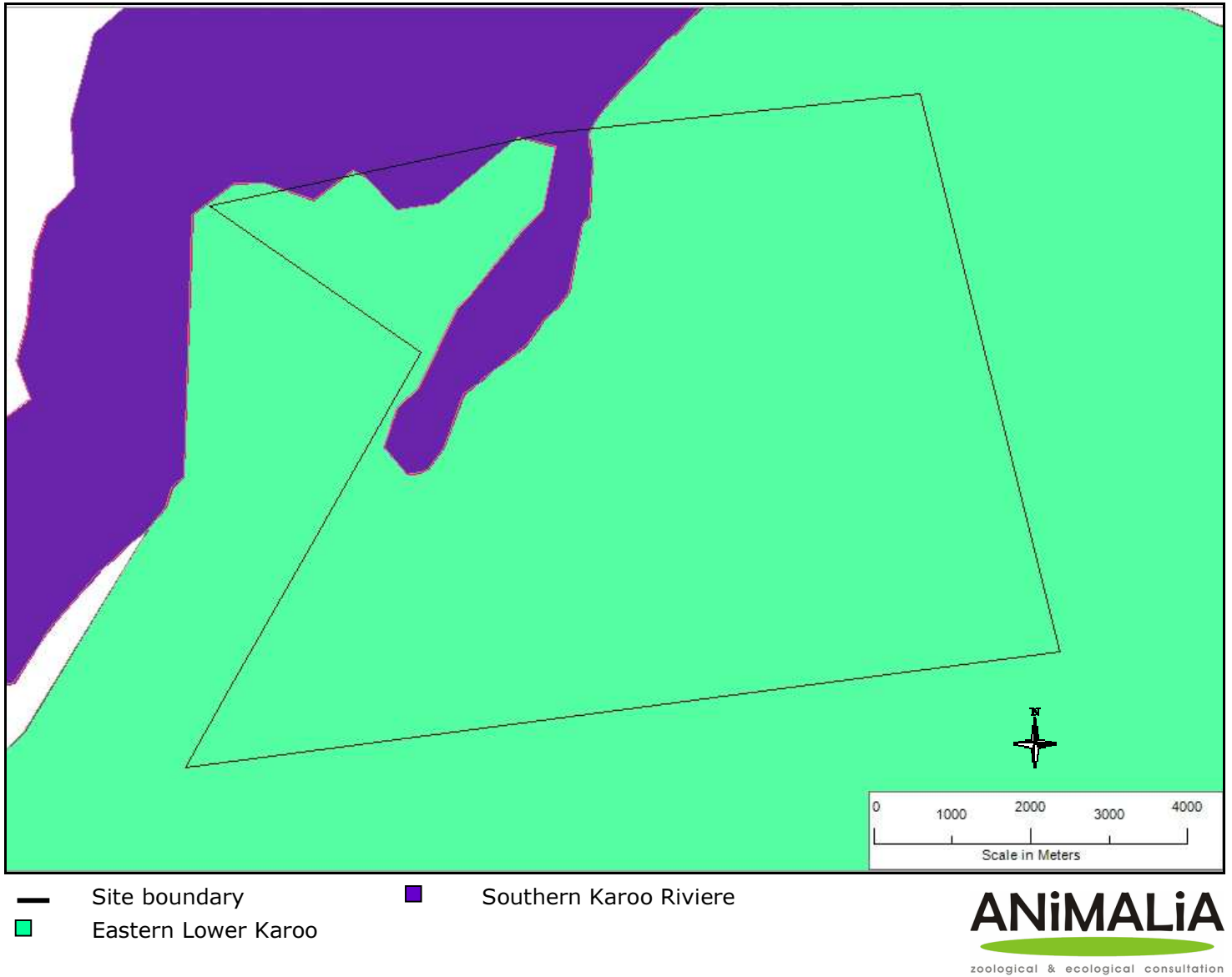


Figure 4: Vegetation units present in the study area (Mucina & Rutherford, 2006).

1.4 The bats of South Africa

Bats are mammals from the order Chiroptera, and are the second largest group of mammals after the rodents. There are approximately 117 species of bats in the Southern African sub-region, of which 5 species have a global Red list status of Vulnerable and 12 are classified as Near Threatened (Monadjem, et al. 2010). Out of the 117 species more than 50 species occur in South Africa (Taylor, 2000; Monadjem, et al. 2010).

Bats are the only mammals to have developed true powered flight and they have undergone various skeletal changes to accommodate this. The forelimbs are elongated, whereas the hind limbs are dramatically reduced and shortened to lessen the total body weight. This unique wing support frame allows bats to alter the camber of their wings in order to adapt the wing shape to different flight conditions while maximizing agility and maneuverability. This adaptability and versatility of the bat wing surpasses the more static design of the bird wings and enables bats to utilise a wide variety of food sources and diversity of insects (Neuweiler, 2000). The facial characteristics between species may differ considerably to suit the requirements of their life style especially with regard to their feeding and echolocation navigation strategies. The majority of South African bats are insectivorous, and can consume vast numbers of insects on a nightly basis (Taylor, 2000; Tuttle and Hensley, 2001), but may also consume other invertebrates, amphibians, fruit and nectar.

Insectivorous bats are therefore the only major predators of nocturnal flying insects in South Africa and contribute greatly in the control of their numbers. Their prey also includes agricultural insect pests, such as moths and vectors for diseases such as mosquitoes (Rautenbach, 1982; Taylor, 2000).

Urban development and agricultural practices have contributed to the decline in bat numbers globally. Public participation and funding of bat conservation are often hindered by the negative images of bats created by a lack of knowledge and certain misconceptions about bats. The fact that some species roost in domestic residences also contributes to the negative reputation of bats. Some species may occur in large numbers in buildings and besides being a nuisance, may become a health risk to the residents. Unfortunately, the negative association people have towards bats, obscures the fact that they are an essential component of the ecology and by en large beneficial to humans.

Many bat species roost in large aggregations and concentrate in small areas. Therefore, any major disturbance to that area can adversely impact many individuals of a population at the same time (Hester and Grenier, 2005). Secondly, the reproduction rates of bats are much lower than those of most other small mammals, because usually only one or two pups are born per female annually. According to O'Shea et al. (2003), bats may live for up to 30 years. Under natural circumstances, a population's numbers can build up over a long period of time, due to their longevity and the relatively low predation on bats, when compared to

other small mammals. Therefore, the rate of recovery of bat populations is slow after major die-offs and roost disturbances.

1.5 Bats and wind turbines

Since bats have highly sophisticated navigation by means of their echolocation, it is puzzling as to why they would get hit by rotating turbine blades. It may be theorized that under natural circumstances their echolocation is designed to track down and pursue smaller insect prey or avoid stationary objects, not primarily focused on unnatural objects moving sideways across the flight path. Apart from physical collisions, a major cause of bat mortality at wind turbines is barotrauma. This is a condition where the lungs of a bat collapse in the low air pressure around the moving blades, causing severe and fatal internal hemorrhage. One study done by Baerwald, et al. (2008) showed that 90% of bat fatalities around wind turbines involved internal hemorrhaging consistent with barotrauma. A study done by Arnett (2005) recorded a total of 398 and 262 bat fatalities were found during searches at Mountaineer Wind Energy Center in Tucker County, near Thomas, West Virginia, and at the Meyersdale Wind Energy Center in Somerset County near Meyersdale, Pennsylvania, respectively. This was during a 6-week study period from 31 July 2004 to 13 September 2004.

Some studies (Horn *et al.*, 2008) suggests that bats may be attracted to the large turbine structure as roosting space, and popular believe indicates that swarms of insects get trapped in low air pockets around the turbine and subsequently attract bats.

Whatever the reason for bat mortalities around wind turbines, the facts indicate this to be a very serious and concerning problem. During a study by Arnett, *et al*. (2009), 10 turbines monitored over a period of 3 months showed 124 bat fatalities in South-central Pennsylvania (America), which can cumulatively have a catastrophic long term effect on bat populations, if such a rate is persistent. Most bat species only reproduce once a year, bearing one young per female, meaning their numbers are slow to recover. Mitigation measures are being researched and experimented with globally, but are still only effective on a small scale. An exception to this is a mitigation measure called curtailment, where the turbine cut-in speed is raised to a higher wind speed. This relies on the principle that bats will be less active in strong winds due to the fact that their insect food can't fly in strong wind speeds, and the small insectivorous bat species need to use more energy to fly in strong winds. Therefore they are less likely to be impacted by a fast moving turbine blade than a slow moving blade, however this mitigation is not as effective yet to move this threat to a category of low concern.

2. METHODS

2. METHODOLOGY APPROACH OF THE STUDY

Three factors need to be present for most South African bats to be prevalent in an area:
1. availability of roosting space,
2. food (insects/arthropods or fruit), and
3. accessible open water.

However, the dependence of a bat on each of these factors depends on the species and its biology, and different species of bats make use of different types of roosting spaces. But nevertheless if all three of these factors are very common in an area the bat activity and abundance will also most likely be higher since these environmental factors have a synergistic effect on bat occurrence.

Concerning species of bats that may be impacted by wind turbines. the proposed site was evaluated by comparing the amount of:

- surface rock (possible roosting space),
- topography (influencing surface rock in most cases),
- vegetation (possible roosting spaces and food in the case of fruit bats),
- climate (can influence insect numbers and availability of fruit), and
- presence of surface water (influence insects and act as drinking water for bats).

Species probability of occurrence based on the above mentioned factors and distribution maps were also estimated for the site and the surrounding larger area.

These comparisons were done mainly by studying the geographic literature of the site and satellite imagery, as well as personal bat experience with some of the terrain types.

3. RESULTS

3.1 Species probability of occurrence

Table 1: Table of species that may be roosting or foraging on the study area, the possible area specific roosts, and their probability of occurrence. LC = Least Concern; NT = Near Threatened; V = Vulnerable (Monadjem *et al.*, 2010).

Species	Common name	Probability of occurrence	Conservation status	Possible roosting habitat to be utilised on study area
Rhinolophus capensis	Cape horseshoe bat	Medium	NT	Roosts gregariously in caves, no known caves close to the study site. But associated with Karoo succulents and suitable hollows which may be present.
Rhinolophus clivosus	Geoffroy's horseshoe bat	Medium	LC	Roosts gregariously in caves and rock hollows. Suitable hollows may be present. no known caves close to the study site.
Rhinolophus darlingi	Darling's Horseshoe bat	Low	LC	On border of distribution. Roosts gregariously in caves and rock hollows. Suitable hollows may be present. no known caves close to the study site.
Nycteris thebaica	Egyptian Slit-faced bat	High	LC	Roosts in any suitable hollows such as culverts, burrows and

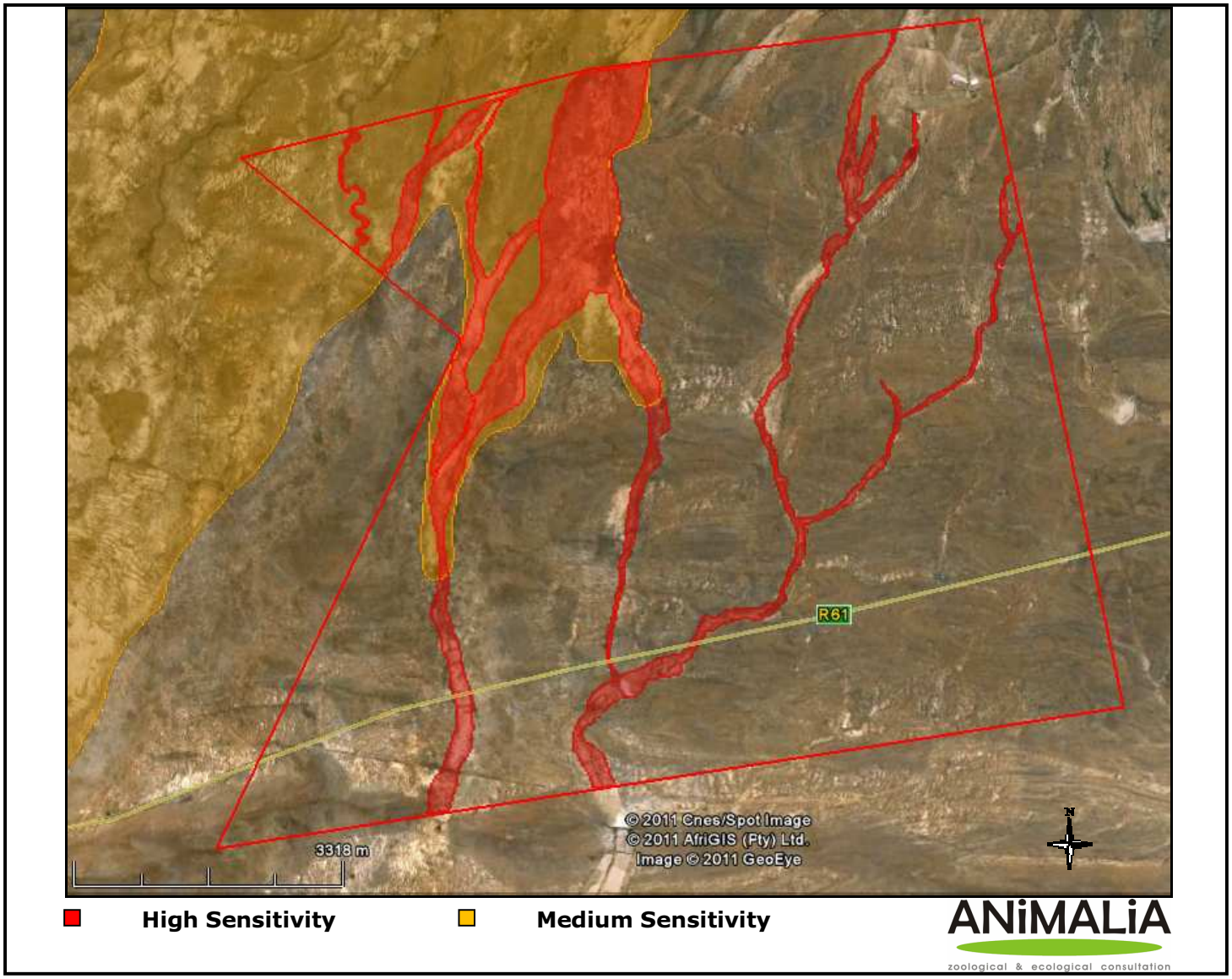
Species	Common name	Probability of occurrence	Conservation status	Possible roosting habitat to be utilised on study area
				manmade hollow structures.
Tadarida aegyptiaca	Egyptian free-tailed bat	High	LC	Crevices, buildings, rock crevices in mountainous area.
Miniopterus natalensis	Natal long-fingered bat	Medium	NT	Roosts gregariously in caves, no known caves close to the study site.
Eptesicus hottentotus	Long-tailed serotine	High	LC	Crevice dweller and in buildings and caves/rock hollows. no known caves close to the study site. Some farm buildings in north eastern corner of site, and at southern boundary.
Myotis tricolor	Temmink's Myotis	Medium	LC	Roost in small hollows and caves. no known caves close to the study site.
Neoromicia capensis	Cape Serotine bat	High	LC	Roofs of buildings, bark of large exotic trees at farm buildings in north eastern corner of site, very common species.

3.2 Surface rock, topography, climate, surface water and vegetation

The proposed Aberdeen site overall has a relatively low mean annual precipitation and therefore open surface water may not be available all year round. But yet numerous small streams are draining from the north towards the south of the site, originating in the Camdeboo Mountains. These waterways will have a higher insect diversity and numbers and therefore attract more insectivorous bats.

Additionally the Camdeboo Mountains to the north east of the site can offer a multitude of roosting space for bats that have a high probability of foraging down the valleys and drainage gulleys of the waterways draining from the mountains (**figure 5**). Therefore the water ways and area forming part of the Southern Karoo Riviere vegetation unit can act as important bat foraging corridors.

3.3 Desktop based sensitivity map – Figure 5



In figure 5 the areas where bats are most likely to forage have been marked as having a high sensitivity (red shading), and includes the streams and waterways draining from the Camdeboo Mountains. The Southern Karoo Riviere vegetation unit may also have more moisture and therefore insect activity than the rest of the site and is assigned a moderate sensitivity.

It is important to note that this Scoping phase sensitivity map is not intended to govern the ideal locations of wind turbines with regards to bat sensitivity, but rather to highlight areas that will require special attention during the detailed EIA phase, although the areas not marked with a high sensitivity should still be monitored.

4. FORESEEN IMPACTS OF THE PROPOSED DEVELOMENT and PROPOSED TERMS OF REFERENCE FOR ASSESSING/ADDRESSING THE ISSUES

4.1 Bat mortalities due to blade collisions and barotrauma during foraging

In section 1.5 the concern of bats and possible wind turbine blade collisions/barotrauma have been mentioned, but yet international research and experiments are unable to suggest sustainable large scale mitigation measures that can move this threat to a category of no concern. This is a negative regional direct impact that can have a cumulative effect, effective for the lifetime of the wind farm. The probability for this impact to occur on site is considered moderate.

Suggested Terms of Reference for assessing/addressing the issue

The correct placement of wind farms and of individual turbines can significantly lessen the impacts on bat fauna in an area (refer to the sensitivity map, Figure 5). Therefore it is proposed that areas of higher bat activity be identified in the EIA assessment and site visit with nocturnal monitoring, and these areas preferable be avoided in turbine placement. Affordable preconstruction long term monitoring data can be correlated with meteorological data and consequently provide more accurate data for implementation of mitigation measures, such as the ideal wind speed to use as a cut in speed. Last mentioned is more favourable than post construction monitoring, since some bat fatalities may already occur before the mitigation measures are perfected for the site. Additionally the areas identified in the desktop phase where implementation of mitigation measures are likely to be prioritized, must receive special attention in the EIA phase.

4.2 Bat mortalities due to blade collisions and barotrauma during migration

The migration paths of South African bats in the Cape Provinces are virtually unknown. Cave dwelling species like *Miniopterus natalensis* and *Myotis tricolor* undertake annual migrations, although no caves are known to be in close proximity to the study area. This is a negative, direct and potentially cumulative (especially if other proposed wind farms are also considered) national impact, that is effective for the lifetime of the wind farm. Due to a great lack in local knowledge of the South African bat migration routes, this impact needs to be conservatively anticipated to have a moderate probability of occurrence.

Suggested Terms of Reference for assessing/addressing the issue

Even though no known caves are in close proximity, it will be beneficial to collaborate with academic institutions to promote research on the subject. It is essential to establish that the site is not within any bat migration routes, and if so during what time and season of the year does migration take place. This can be achieved by doing affordable long term preconstruction monitoring and quantifying the risks more accurately. After which, if the site falls in line with a migration route, aggressive mitigation measures can be applied during the established times of bat migrations. An example of such a very aggressive mitigation measure would be to keep turbines static at night during periods of bat migrations, which can be several weeks at a time and occurring at least twice a year.

4.3 Destruction of foraging habitat

Some foraging habitat will be destroyed by the construction of the turbines and associated infrastructure. This impact is a negative and local impact that will be more significant during construction than during the operation of the wind farm. This impact has a definite probability of occurrence.

Suggested Terms of Reference for assessing/addressing the issue

Areas of higher bat foraging activity should be identified and these areas be treated with more caution and unnecessary habitat clearance avoided. Turbines should not be placed in the areas identified as having a high bat activity (and therefore foraging habitat) during the detailed EIA phase.

4.4 Destruction of roosts

During the construction phase of the project, possible bat roosts may be impacted by earthworks and large machinery. Diggings related to the placement of underground cables can also damage bat roosts. This is a negative local impact being applicable only during the construction phase. On the contrary this may be perceived as a neutral local impact after construction since the new turbines and associated structure will provide additional roosting space for some species of bats. But it is important to understand that this may be upsetting to the ecology since the new structures will benefit only a few species unnaturally.

Suggested Terms of Reference for assessing/addressing the issue

All diggings and earthworks must be kept to a minimum especially in rocky outcrop areas (should these exist on site), and blasting should be minimized.

5. CONCLUSION

The site displays a possibility of two of the three factors necessary for bat occurrence, namely the possibility of seasonal surface water and probability of insects due to surface water and streams, suggesting that it is likely to have a higher bat activity in the areas where the most moisture will be available. From **Table 1** it can be concluded that special attention needs to be given to the possible presence of *Rhinolophus capensis* and *Miniopterus natalensis* during the full detailed EIA phase site visit.

Additionally the Camdeboo Mountains to the north east of the site can offer a multitude of roosting space for bats that have a high probability of foraging down the valleys and drainage gulleys of the waterways draining from the mountains. Therefore the water ways and area forming part of the Southern Karoo Riviere vegetation unit can act as important bat foraging corridors.

The sensitivity map indicated in **Figure 5** should be treated as guidance for directing focus and special attention during future detailed assessments and preliminary decision making, it is not intended to govern final decision making with regards to sensitive bat habitat. The proposed Terms of Reference for further detailed studies described in Section 4 should be carried out in the detailed assessment phase.

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