Scoping phase assessment with regards to bat (Chiroptera) sensitivity

- **For the proposed Kleinzee Wind Energy Facility in the Northern Cape**

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PREPARED FOR:

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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 energy facility interactions is also to be included, together with a desktop based Fatal Flaws Map indicating potential areas of bat sensitivity (to be reviewed in the Environmental impact assessment (EIA) phase). Provide descriptions of the impacts and issues foreseen so far in relation to the proposed wind energy facility and its associating impacts. Draw up suggested terms of Reference for further work to assess/address the identified issues in the EIA phase (detailed phase).

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 Kleinzee Wind Energy Facility in Northern 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 6km south of Kleinzee in the Northern Cape Province, within the Nama Khoi Local Municipality (**figure 1**). It is proposed for a cluster of between 150 and 200 wind turbines to be constructed over an area of approximately 9300 ha in extent (Savannah Environmental, 2011). The site slightly undulating, but relatively flat with regards to bat roosting space relatively featureless. There is little major variations in environment and macro habitat types with regards to habitat variations usually associated with bat diversity and abundance, such as valleys, forests, waterways and hills (**figures 2 & 3**).

The area under consideration comprises of the farms:

- RE of Brazil 329,
- RE of Goraap 323,
- RE of Honde Vlei 325,
- RE of Kannabieduin 324,
- Portions 2 and 3 of Rooivlei 327.

The proposed facility is proposed to accommodate up to 300 MW of generating capacity with relatively large turbines that can generate 1.5 to 2 MW each and having a hub height of 140 m with a rotor diameter of up to 140 m (i.e. 70 meter blades). Other infrastructure associated with the facility will include:

» Concrete foundations to support the turbines
» Cabling between the turbines to be lain underground where practical
» 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 Gromis Substation, approximately 60 km from the site
» Internal access roads
» Borrow pits within the site for construction of access roads
» Office/Workshop area for maintenance and storage, and
» Visitors centre and accommodation during construction.

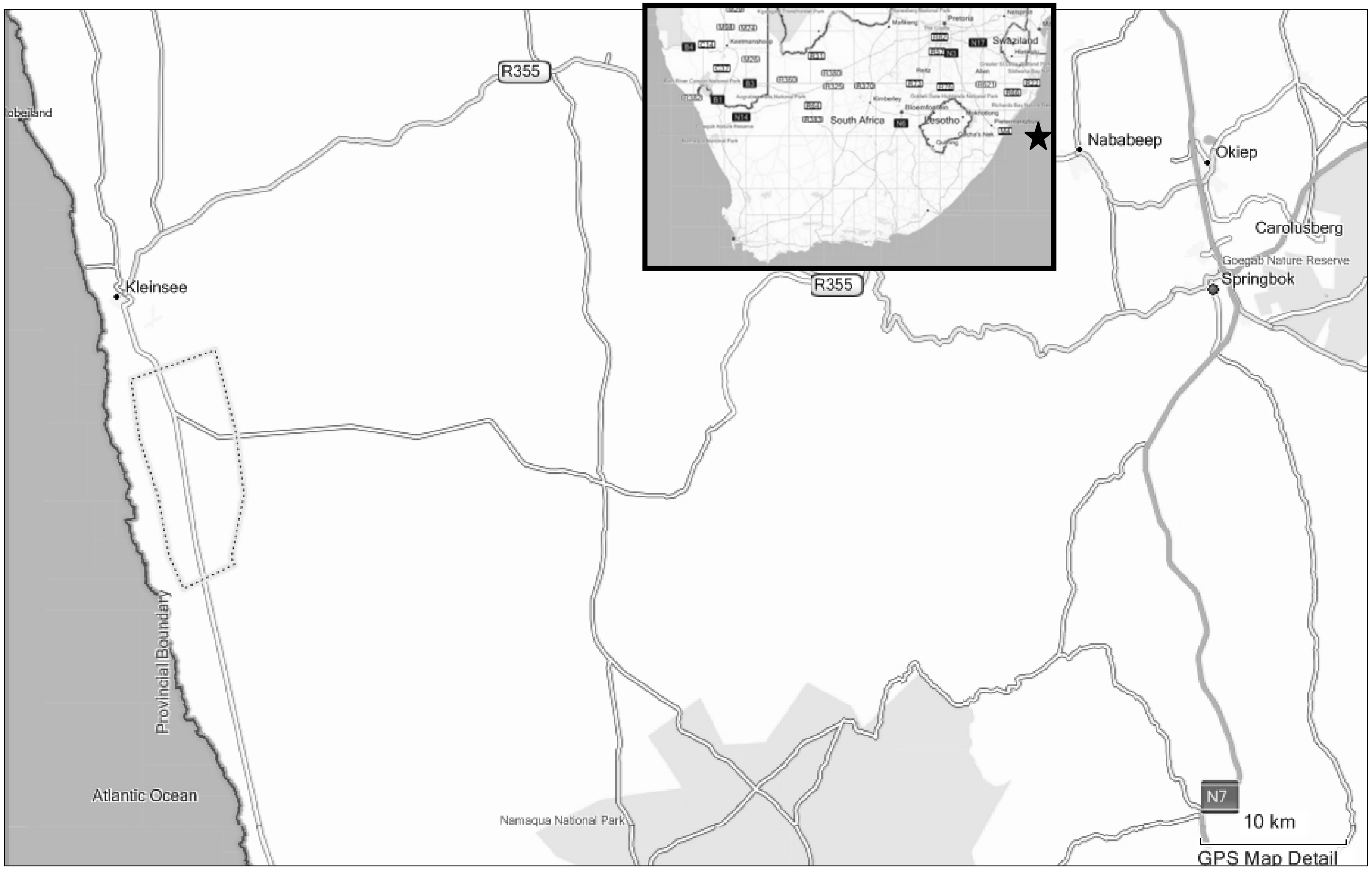


Figure 1: Map with an indication of the site (dotted outline), and an overview map with the site locality (black star).

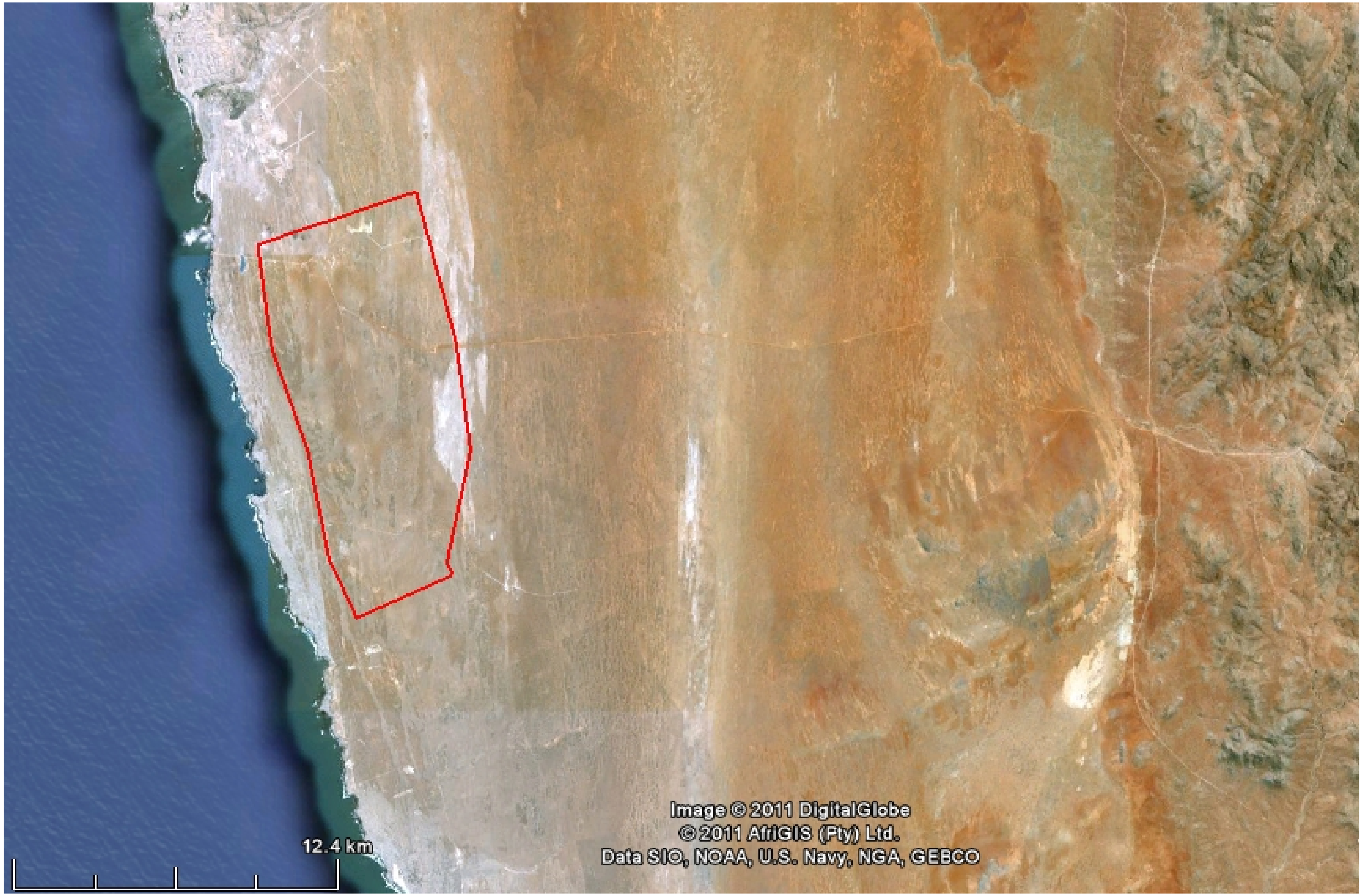


Figure 2: Satellite image of the site and surrounding area, the boundary is indicated in red. All satellite images retrieved from Google Earth™.

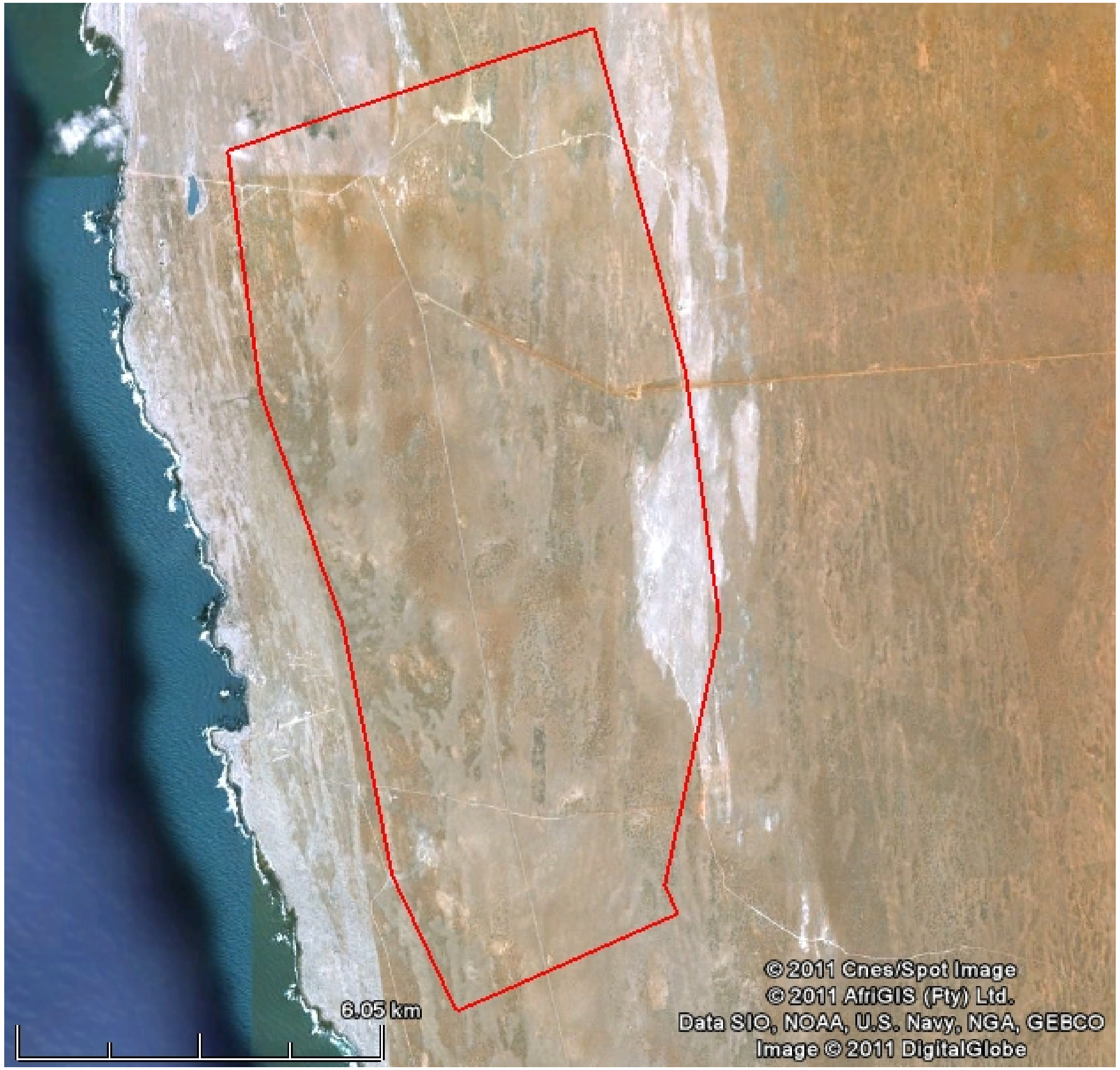


Figure 3: Close up satellite image of the site, showing the relatively featureless terrain.

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

The existing impacts on the study area are very limited and seems to inlcude some mining activities particularly in the northern parts. 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.

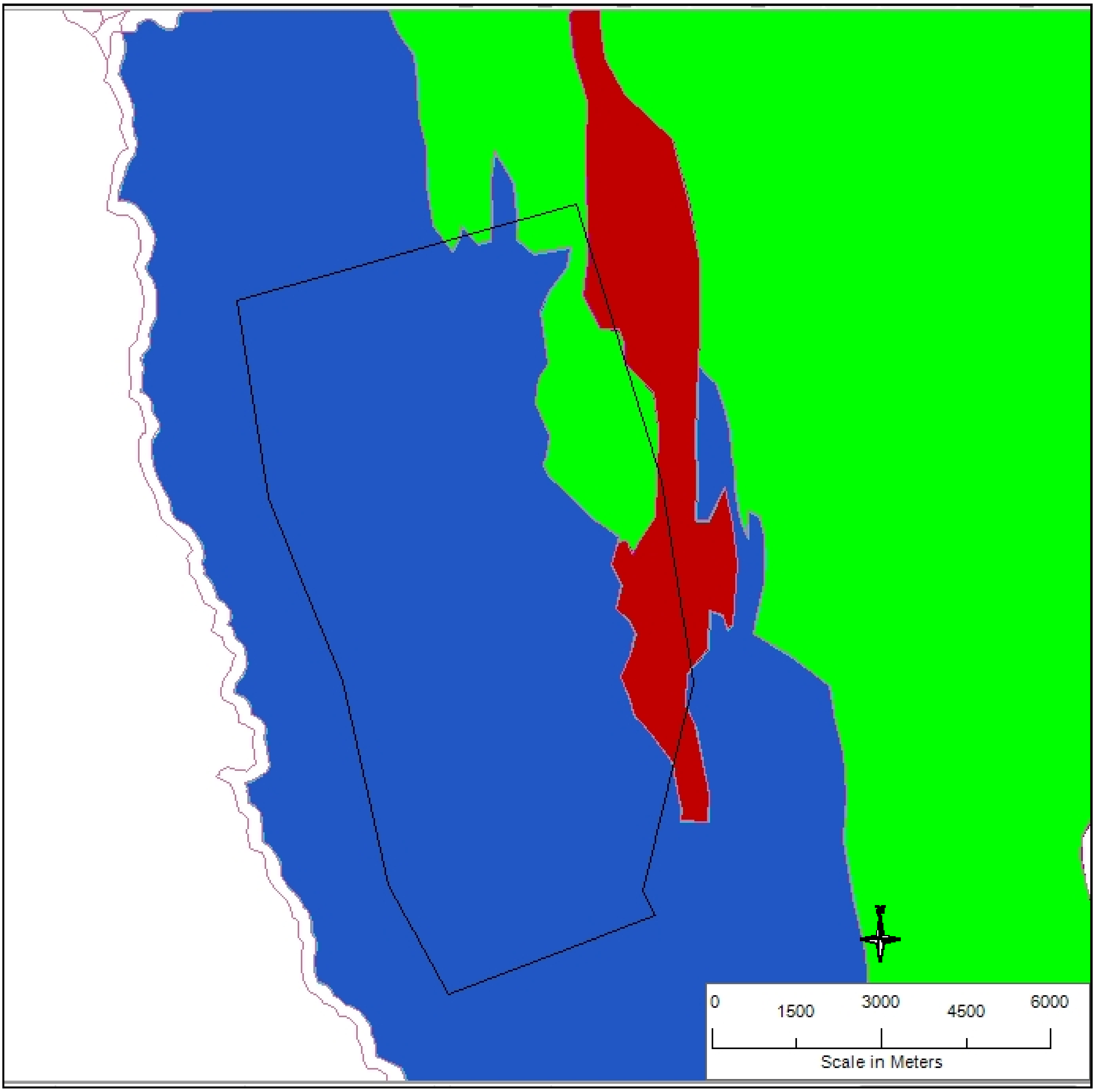
1.3 Vegetation units, geology and climate

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

The Namaqualand Coastal Duneveld is found in the Northern and Western Cape on an altitude range of 10-260m near the sea and covers most of the site. The general terrain has semi mobile sand plains to highly mobile sharp and angular dunes usually north of the estuaries. Vegetation consists of dwarf shrubland dominated by erect succulent shrubs, and spiny grasses are a common sight on semi mobile dunes. The geology of 1.5 meter deep fine sand is shared by Tertiary sediments of marine origin. This is an arid area with winter rainfall and a mean annual precipitation (MAP) of only 114mm almost entirely occurring from May to August, and the lowest temperatures in winter is approximately 10°C and highest in summer around 25°C (Mucina & Rutherford, 2006).

A small area in the north east of the site is classified as the Namaqualand Strandveld and is characterized by flat to slightly undulating plains, and short species rich shrubland dominated by erect and creeping succulents. Stable dunes and deep sand overlays marine sediments and granite gneisses. Some subtle scattered heuweltjies are found further away from the sea. Winter rainfall and precipitation is limited to only 112mm per year and only occurs from May to August (Mucina & Rutherford, 2006).

The Namaqualand Salt Pans are situated just beyond the eastern boundary of the site and extents onto the site in the south eastern parts. Landscape consists of flat surfaces and depressions mostly without any vegetation, but sometimes sparsely covered in highly salt tolerant succulent shrubs. These pans are nearly permanently dry, and only seldom intermittent pools may be found in the lowest depressions but are quickly buried under wind born sand. With regards to the site the climate and rainfall are similar to the other to vegetation units (Mucina & Rutherford, 2006).



Site boundary
Namaqualand Strandveld
Namaqualand Coastal Duneveld
Namaqualand Salt Pans

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. 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 in the proposed 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
Eidolon helvum	Straw coloured fruit bat	Very Low - None	LC	A non breeding migrant/accidental
Rousettus aegyptiaca	Egyptian rousette (fruit bat)	Very Low	LC	Roosts in caves and no known caves in area. Lack of fruiting trees for foraging. On border of literature distribution.
Rhinolophus capensis	Cape horseshoe bat	Medium	NT	Roosts gregariously in caves, lack of caves on site. But associated with Karoo succulents and suitable hollows may be present.
Rhinolophus clivosus	Geoffroy's horseshoe bat	Medium	LC	Roosts gregariously in caves and rock hollows. Suitable hollows may be present.
Nycteris thebaica	Egyptian Slit-faced bat	High	LC	Roosts in any suitable hollows such as culverts, burrows and manmade hollow structures.
Sauromys petrophilus	Robert's Flat headed bat	Low	LC	Crevices in rocks. Lacks of mountainous terrain.
Tadarida aegyptiaca	Egyptian free-tailed bat	High	LC	Crevices, buildings, rock crevices in mountainous

Species	Common name	Probability of occurrence	Conservation status	Possible roosting habitat to be utilised on study area
				area
Miniopterus natalensis	Natal long-fingered bat	Medium	NT	Roosts gregariously in caves, no known caves close to the study site.
Cistugo seabrae	Angolan wing gland bat	High	NT	Endemic to West Coast of Southern Africa and associated to low rainfall areas. May prefer to forage in stream beds or drainage canals.
Eptesicus hottentotus	Long-tailed serotine	Medium	LC	Crevice dweller and in buildings and caves/rock hollows
Neoromicia capensis	Cape serotine	High	LC	Roofs of buildings, very common species.

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

The proposed Kleinzee site is located at a low altitude and has a very low mean annual precipitation. Almost no visible open surface water, stream beds or drainage canals are visible on available maps.

Not much surface rock seems to be present and the site is relatively flat and sandy. From a habitat availability point of view the natural vegetation of the site does not offer much roosting space. The few buildings on the site can offer suitable roosting space to limited species. Bat roosting space and foraging resources are therefore predicted to be very low for this site.

3.3 Desktop based fatal flaws map / sensitivity map

Due to the featureless and homogenous nature of the site and the fact that no single terrain type or feature can be isolated and identified as having a higher possibility to support bat occurrence, no desktop sensitivity map could be drawn for this site. During the detailed specialist EIA study a sensitivity map may be drawn after a site visit has been conducted, and the terrain explored in more detail on foot to enable discovery of possible bat roosts.

However, the entire site can be assigned a **low bat sensitivity** with regards to the literature based scoping phase study.

It is important to note that this scoping phase sensitivity study is not intended to govern the ideal locations of wind turbines with regards to bat sensitivity, but rather to provide guidance for the EIA phase, although the site is deemed to have a low bat sensitivity, the entire site should still be critically investigated and bat activity monitored. The possible presence of *Cistugo seabrae*, *Rhinolophus capensis*, *and Miniopterus natalensis* must be investigated and special attention paid to the possible presence of caves in the surrounding area of the proposed site.

4. FORESEEN IMPACTS OF THE PROPOSED DEVELOPMENT 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, with a low probability of occurrence. True bat foraging activity needs to be determined in the EIA phase.

Suggested Terms of Reference for assessing/addressing the issue

Avoiding the placement of wind farms and individual turbines in areas of high bat acticity can significantly lessen the impact of wind farms on bat fauna. 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* undertakes annual migrations, although no caves are known to be in close proximity to the study area. Due to a great lack in local knowledge of the South African bat migration routes, this impact needs to be conservatively considered, but have a low probability of occurrence.

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.

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.

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.

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 entire site is predicted to have a low bat sensitivity and no specific feature or habitat type can be isolated or identified from available data that may indicate a higher presence of bats in such an area.

The site does not display the three factors of possible roosting space, surface water and probability of insects strongly, suggesting that it is unlikely to have a high bat activity. The possible presence of *Cistugo seabrae*, *Rhinolophus capensis*, *and Miniopterus natalensis* must be investigated and special attention paid to the possible presence of caves in the surrounding area of the site.

It is important to note that this scoping phase sensitivity study is not intended to govern the ideal locations of wind turbines with regards to bat sensitivity, but rather to provide guidance for the EIA phase, although the site is deemed to have a low bat sensitivity, the entire site should still be critically investigated and bat activity monitored.

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