EA Amendment Assessment Report for the 12-month preconstruction bat monitoring study

- For the Great Karoo Wind Energy Facility situated in the Western Cape Province

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March 2016

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Reference no.: R-1603-22

Appointment of Specialist (Animalia Zoological & Ecological Consultation CC)

Specialist Company:	Animalia Zoological & Ecological Consultation CC
Project overseen and reviewed by:	Werner Marias & Monika Moir
Appointed by:	Savannah Environmental (Pty) Ltd
For:	EA Amendment Assessment Report for the Great Karoo WEF, taking cognizance of the findings of the preconstruction bat monitoring study

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 authorization of this project.

Applicable Legislation:

Legislation dealing with biodiversity 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. TERMS OF REFERENCE

- To assess all impacts related to the proposed amendments
- Consider the advantages and disadvantages associated with the proposed amendments
- Describe measures to ensure management and mitigation of impacts associated with such proposed amendments

2. ASSUMPTIONS AND LIMITATIONS

The satellite imagery partly used to develop the sensitivity map, that was used in the amendment assessment, may be slightly imprecise due to land changes occurring since the imagery was taken.

Species identification with the use of bat detection and echolocation is less accurate when compared to morphological identification. Thus species identification from passive data used to assess the proposed EA changes is slightly tenuous.

Also, it is not possible to determine actual individual bat numbers from acoustic bat activity data, whether gathered with transects or the passive monitoring systems. However, bat passes per night are internationally used and recognized as a comparative unit for indicating levels of bat activity in an area.

There is no scientifically accredited study that can lend insight into the exact impacts the proposed amendments will have on the site specific species and specific turbine dimensions. Thus the impact assessment is based on best judgement and experience of the Specialist,

3. PROJECT OVERVIEW

The Great Karoo Wind Farm is located approximately 40km south from the town of Sutherland, and approximately 40km north from Laingsburg. The wind farm has Environmental Authorization for 56 turbines with a hub height and rotor diameter of 120m. Great Karoo Wind Farm (Pty) Ltd is proposing to amend the Environmental Authorization to 52 turbines with a rotor diameter of 140m and hub height of 120m.

Great Karoo Wind Farm (Pty) Ltd proposes to amend the Environmental Authorization as outlined in the table below (information provided by Savannah Environmental (Pty) Ltd).

Table 1: Proposed amendments to the Great Karoo Wind Farm

Component	Environmental Authorization	Proposed amendment
Number of turbines	56 Turbines	52 Turbines @ 3.6MW per turbine
Rotor / blade diameters	120m	140m
Hub height	120m	120m

The 12-month preconstruction bat monitoring study was carried out by Animalia Zoological and Ecological Consultation over July 2013 to April 2014. The final report was issued on 15 April 2014 with reference number **R-1403-19.** The closing statement of the report stated the proposed turbine positions of Great Karoo WEF were in areas of relatively low bat activity. The developer had worked alongside Animalia Ecological and Zoological Consultation through the course of the study and implemented mitigation measures (turbine movement) where suggested. The developer even elected to move turbines out of the buffer zones associated with Moderate bat sensitivity areas. There were no discoveries on site or in the passive monitoring data that indicated the need to withhold environmental authorization.
It was recommended that operational monitoring be carried out and be implemented as soon as the first turbine starts turning, whether it is connected to the gearbox and electricity grid or not, even if freewheeling is occurring during the construction phase.

Figure 1 below displays the previously authorised turbine layout. **Figure 2** displays the amended turbine layout around which this report is based. **Figures 3 and 4** display the locations of the bat monitoring systems from which passive data for the 12-month preconstruction bat monitoring study was gathered.

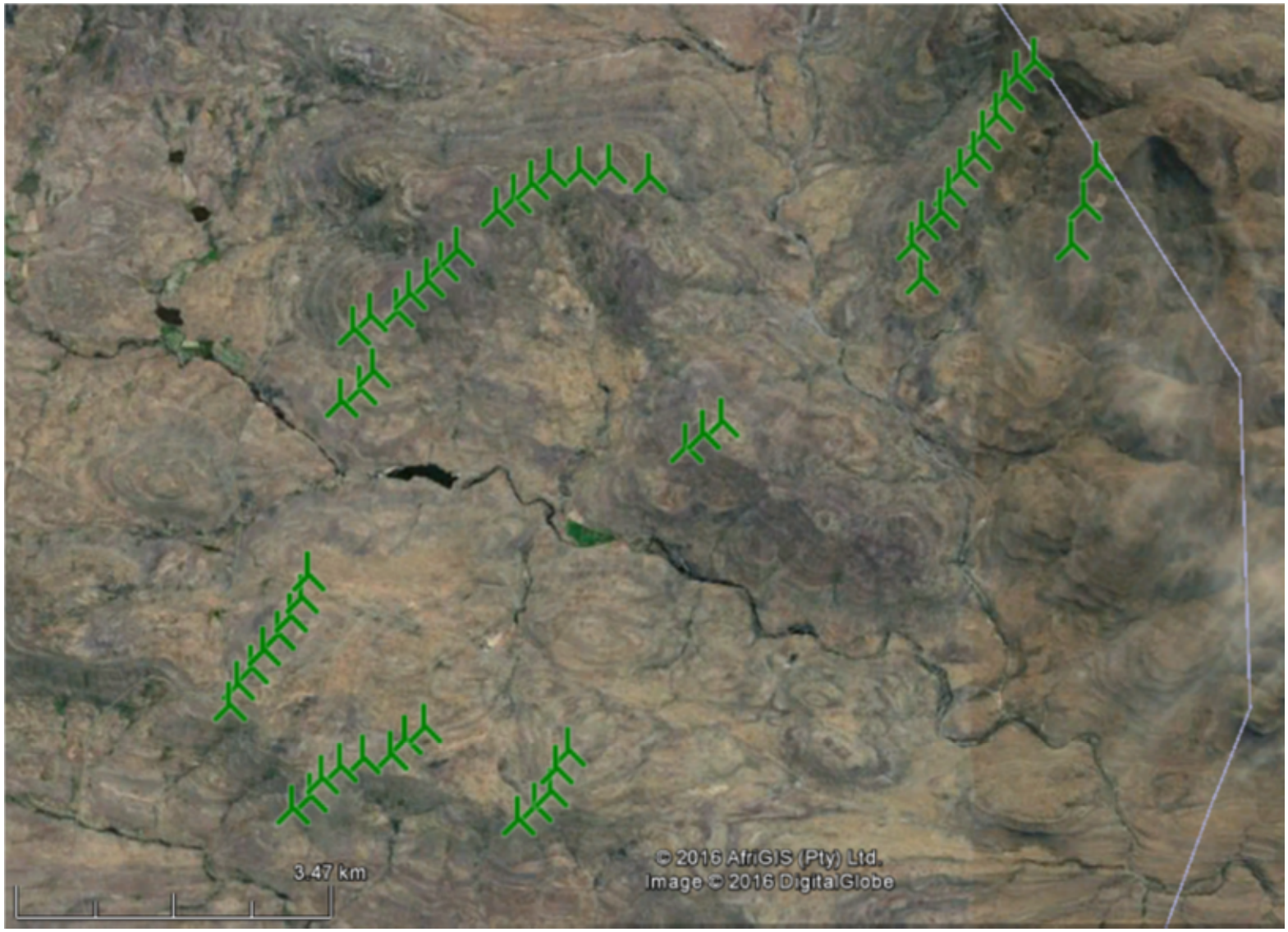


Figure 1: Great Karoo WEF previously authorized turbine layout

Figure 2: Great Karoo WEF amended 52 turbine layout

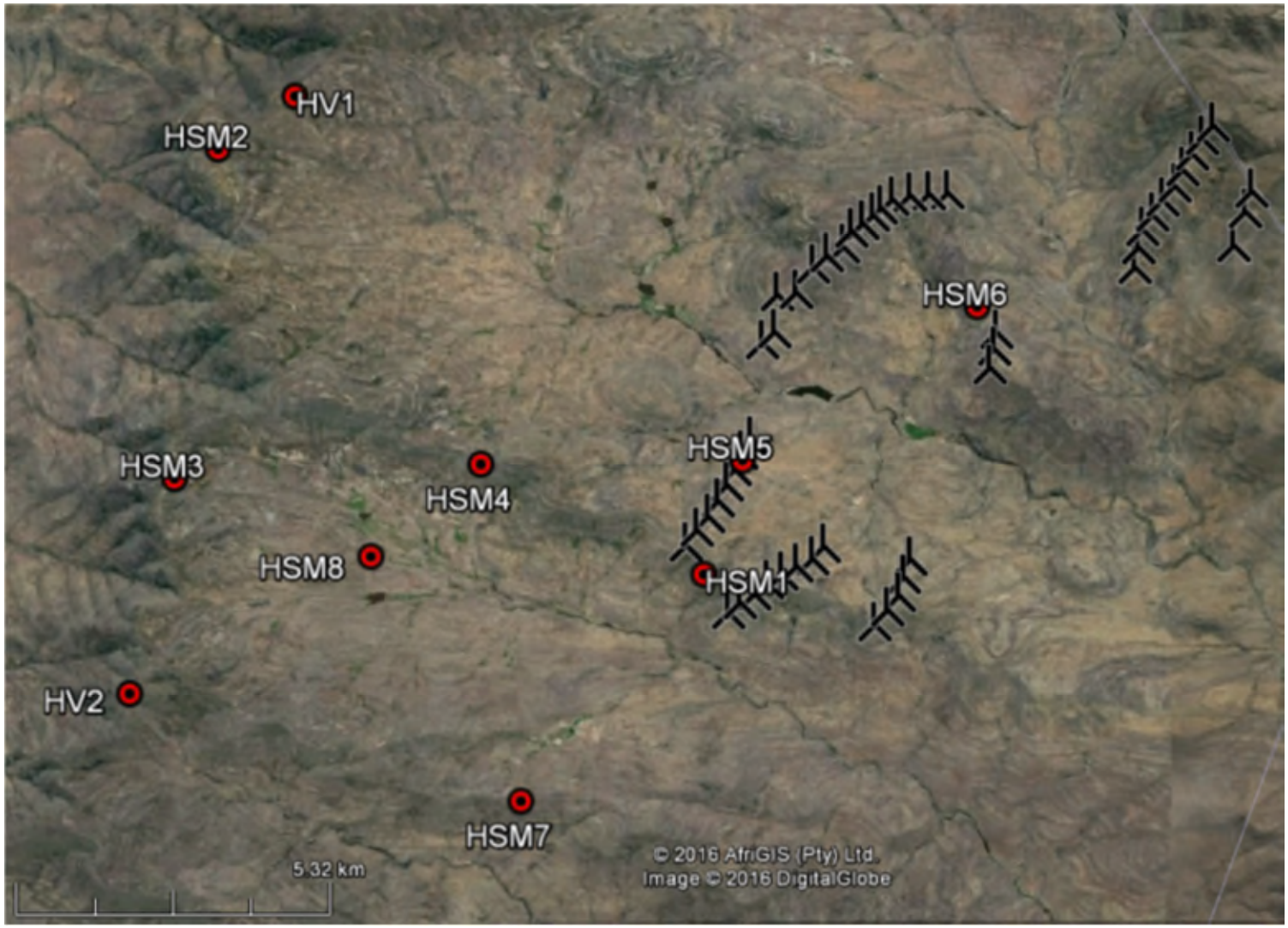


Figure 3: Locations of the bat monitoring systems utilized over the preconstruction study relative to the amended turbine layout (HSM1 – 8 denotes the 10m monitoring systems; HV1-2 denotes the 80 meteorological mast monitoring systems)

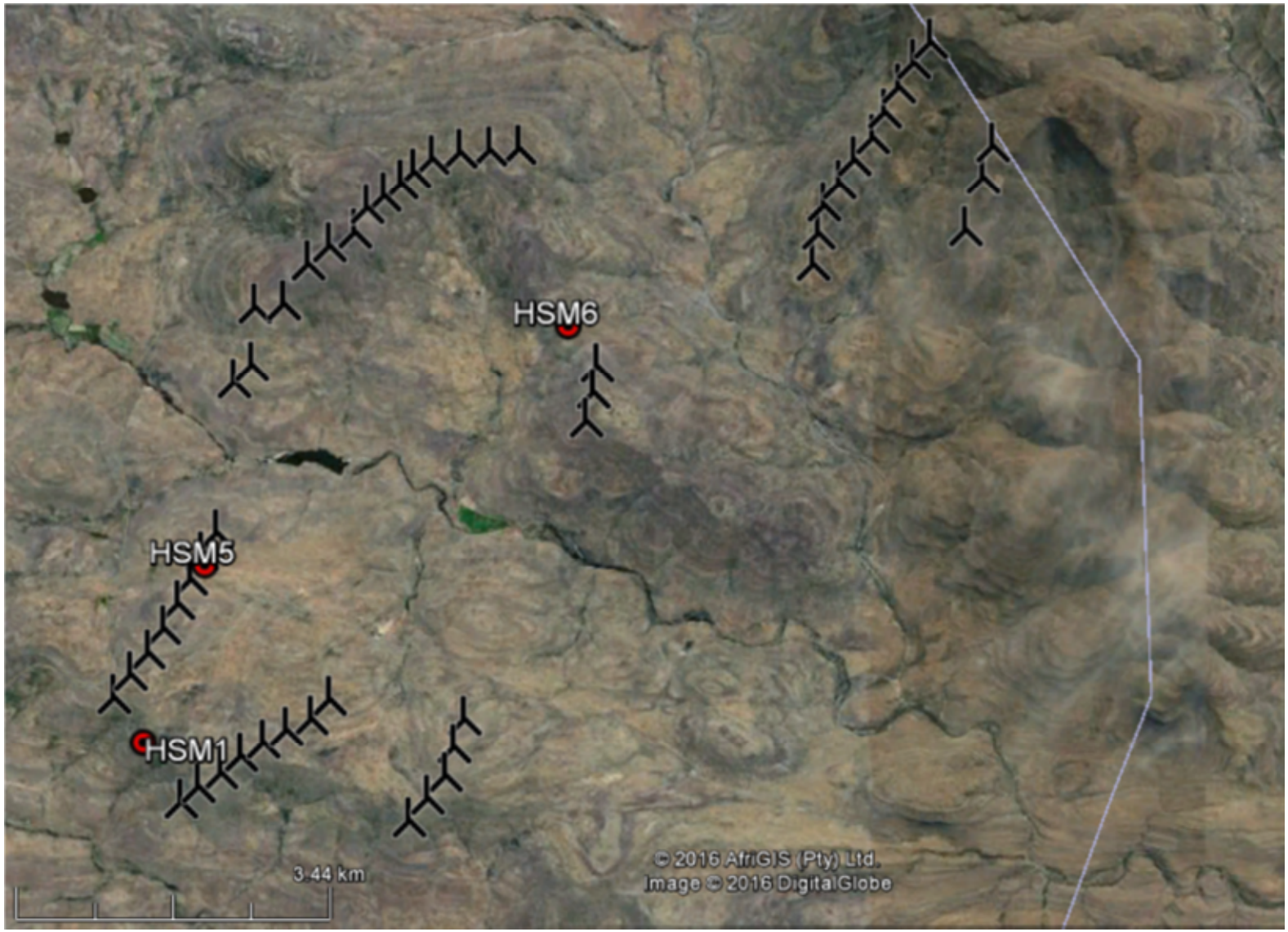


Figure 4: Locations of bat monitoring systems utilized during the preconstruction study that are in close proximity to the amended layout

4. BAT SENSITIVITY MAP

Figure 5 - 6 depicts the bat sensitive areas of the site, based on features identified to be important for foraging and roosting of the species that are confirmed and most probable to occur on site. The sensitivity map was generated during the course of the preconstruction bat monitoring study. The map was used by the developer as a pre-construction mitigation in terms of improving turbine placement with regards to bat preferred habitats on site.

Table 2: Buffer zones and features used to generate the bat sensitivity map

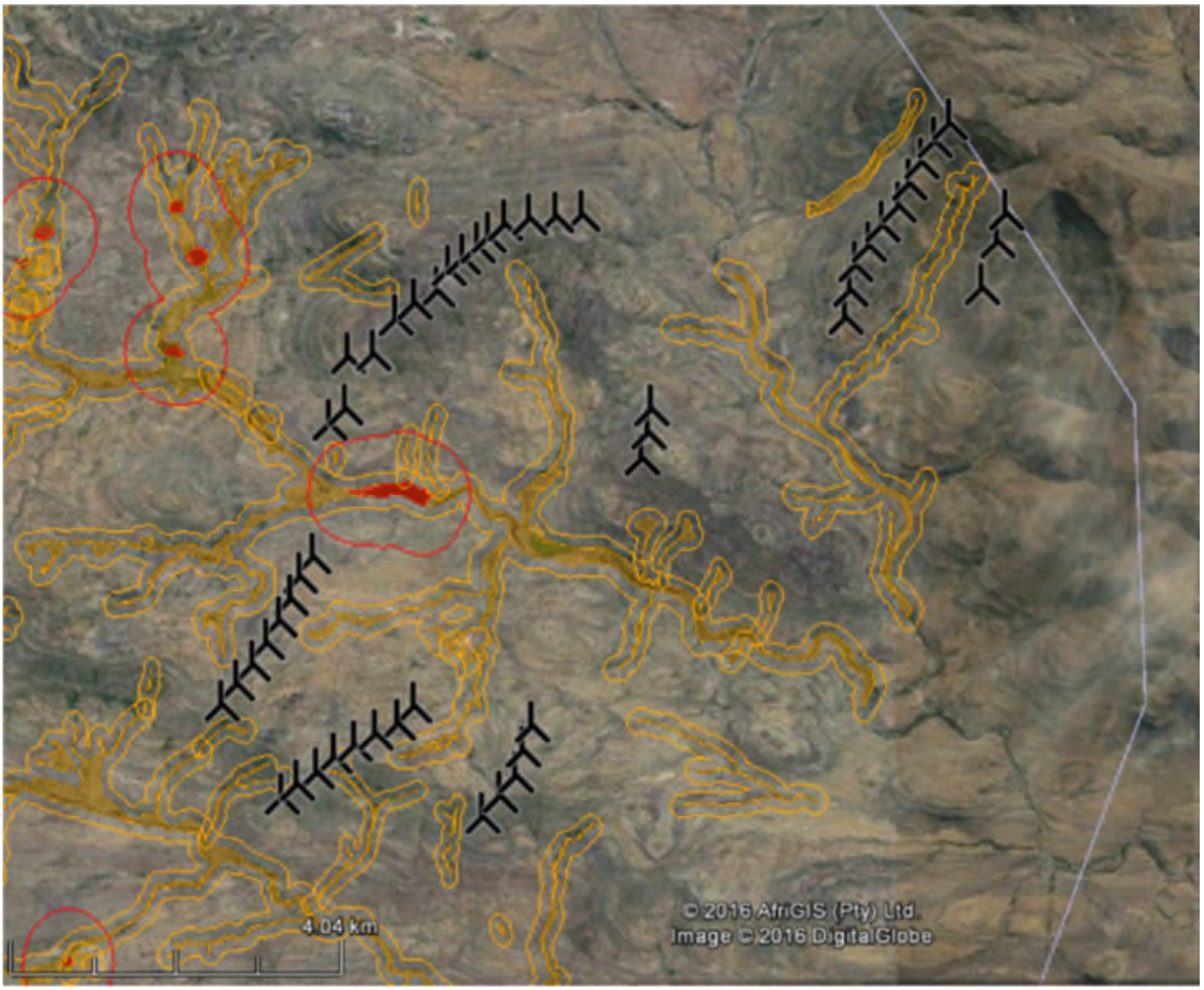
High and moderate sensitivity buffers	100m from blade tip to nearest feature of moderate sensitivity and 500m from blade tip to nearest feature of high sensitivity (based on 90m rotor diameter and72m hub height). On a flat surface the distance from the base of a turbine must be 125m from a moderate sensitivity to maintain 100m from the blade tip and 540m from a high sensitivity to maintain 500m from blade tip. Thus 125m and 540m buffer has been applied to all moderate and high sensitivity features, respectively. Formula used: b=$\sqrt{(\mathbf{100} + \boldsymbol{bl})^2 - (\boldsymbol{hh})^2}$, derived from Mitchell-Jones & Carlin (2009) Where: *b* = horizontal buffer distance to turbine base *bl* = blade length *hh*= hub height
Features used to develop the sensitivity map	Drainage lines closest to proposed turbine positions, especially when exposed rock that can be used as roosting space is visible in the drainage line
	Clumps of larger woody plants. These features provide natural roosting spaces and tend to attract insect prey. Mostly in drainage lines
	Farm dams with open surface water will be used for drinking spots and insect numbers can be higher in these areas.

Table 1: Description of sensitivity categories utilized in the sensitivity map

Sensitivity	Description
Moderate Sensitivity	Areas of foraging habitat or roosting sites considered to have significant roles for bat ecology, with an expected relative higher risk of impacting on local bats. Turbines within or close to these areas must acquire priority (not excluding all other turbines) during pre/post-construction studies and for the application of mitigation measures.
High Sensitivity and their buffers	Areas that are deemed critical for resident bat populations, capable of elevated levels of bat activity and support greater bat diversity than the rest of the site. These areas are 'no-go' areas and turbines must not be placed in these areas.

The amended layout of 52 turbines is respective of the Great Karoo WEF bat sensitivity map. No turbines are located within High or Moderate sensitivity areas and their respective buffer zones. Wind turbine GK11 is near to the boundary of a Moderate sensitivity buffer but is located out of the area (**Figure 6**).

There is no infringement of the amended layout on bat sensitive habitat thus, turbines do not need to be moved or removed from the layout.



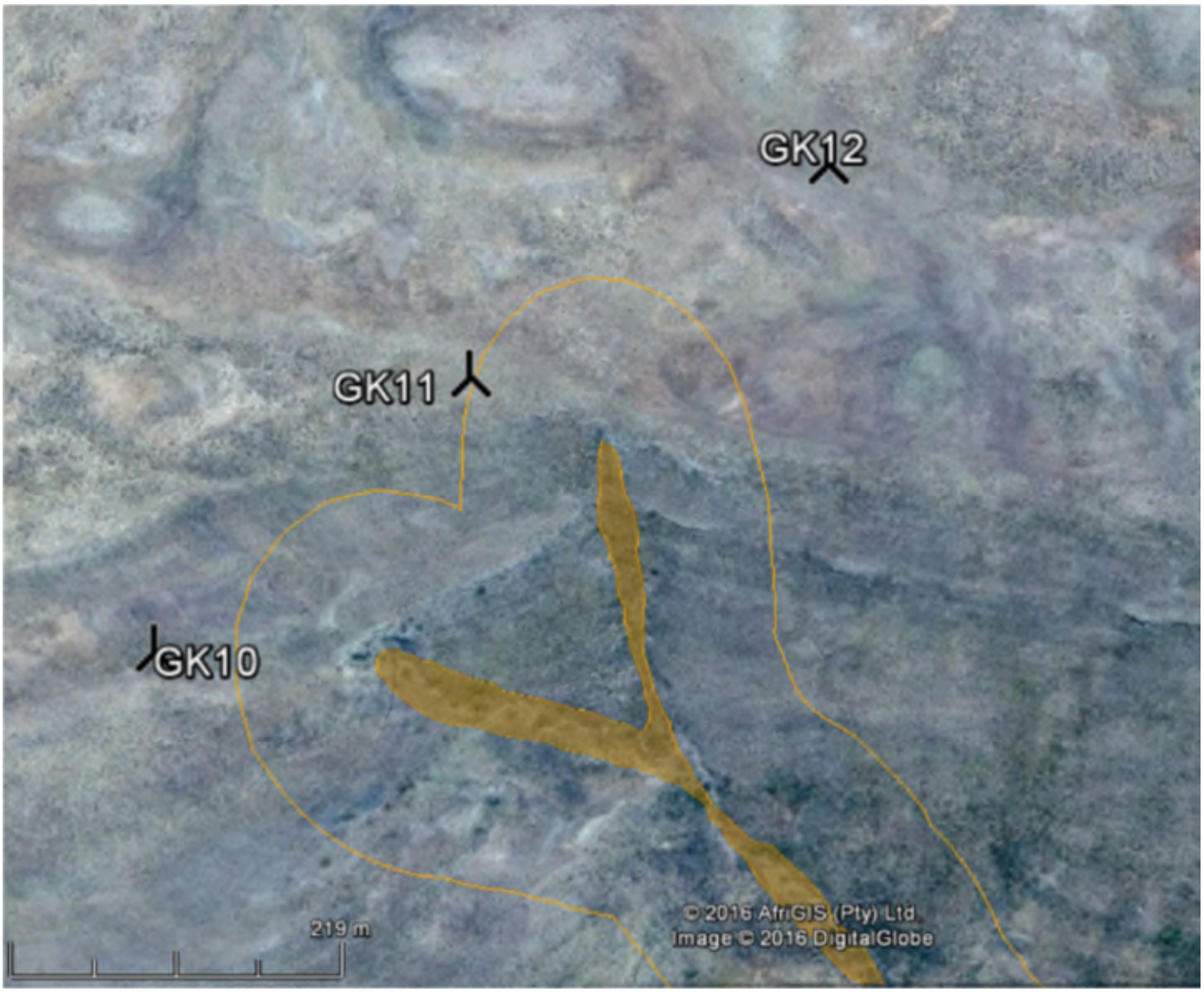
High sensitivity area

High sensitivity buffer

Moderate sensitivity area

Moderate sensitivity buffer

Figure 5: Sensitivity map of the amended Great Karoo Wind Farm turbine layout



High sensitivity area

High sensitivity buffer

Moderate sensitivity area

Moderate sensitivity buffer

Figure 6: Location of GK11 within the sensitivity map of the amended Great Karoo Wind Farm turbine layout

5. PROPOSED MITIGATION MEASURES AND DETAILS

The correct placement of wind farms and of individual turbines can significantly lessen the impacts on bat fauna in an area, and has been considered as the preferred option for mitigation. The amended layout is respective of the bat sensitive habitat and thus the mitigation of turbine placement has been adhered to.

Nevertheless, certain turbines may experience high bat activity only during certain times of the year and when a combination of certain climatic conditions occur simultaneously - in these cases, if such turbines are found during the post construction (operational) monitoring study, it will be recommended that mitigation be applied during the peak activity periods and times, and when the advised wind speed and temperature ranges are prevailing.

If found to be necessary during operational monitoring, mitigation options that may be utilized include curtailment, blade feathering, blade lock, acoustic deterrents or light lures. The following terminology applies:

Curtailment:

Curtailment is defined as the act of limiting the supply of electricity to the grid during conditions when it would normally be supplied. This is usually accomplished by locking or feathering the turbine blades.

Cut-in speed:

The cut-in speed is the wind speed at which the generator is connected to the grid and producing electricity. For some turbines, their blades will spin at full or partial RPMs below cut-in speed when no electricity is being produced.

Feathering or Feathered:

Adjusting the angle of the rotor blade parallel to the wind, or turning the whole unit out of the wind, to slow or stop blade rotation. Normally operating turbine blades are angled almost perpendicular to the wind at all times.

Free-wheeling:

Free-wheeling occurs when the blades are allowed to rotate below the cut-in speed or even when fully feathered and parallel to the wind. In contrast, blades can be “locked” and cannot rotate, which is a mandatory situation when turbines are being accessed by operations personnel.

Increasing cut-in speed:

The turbine's computer system (referred to as the Supervisory Control and Data Acquisitions or SCADA system) is programmed to a cut-in speed higher than the manufacturer's set speed, and turbines are programmed to stay locked or feathered at 90° until the increased cut-in speed is reached over some average number of minutes (usually 5 – 10 min), thus triggering the turbine blades to pitch back "into the wind" and begin to spin normally and producing power.

Blade locking or feathering that render blades motionless below the manufacturers cut in speed, and not allow free rotation without the gearbox engaged, is more desirable for the conservation of bats than allowing free rotation below the manufacturers cut in speed.

Acoustic deterrent:

Acoustic deterrents are a developing technology that has not yet proved successful on a large scale application, and will therefore need investigation closer to time of wind farm operation.

Light lures:

Light lures refer to the concept where strong lights are placed on the periphery (or only a few sides) of the wind farm or problem areas to lure insects and therefore bats away from the turbines. The long term effects on bat populations and local ecology of this method is unknown.

Habitat modification, with the aim of augmenting bat habitat around the wind farm in an effort to lure bats away from turbines, is not recommended. Such a method can be adversely intrusive on other fauna and flora and the ecology of the areas being modified. Additionally, it is unknown whether such a method may actually increase the bat numbers of the broader area, causing them to move into the wind farm site due to resource pressure.

Currently the most effective method of mitigation, after correct turbine placement, is alteration of blade speeds and cut-in speeds under environmental conditions favorable to bats.

A basic "4 levels of mitigation" (by blade manipulation or curtailment), from light to aggressive mitigation:

1. No curtailment (free-wheeling is unhindered below manufacturers cut in speed so all momentum is retained, thus normal operation).
2. 90 Degree feathering of blades below manufacturers cut-in speed so it is exactly parallel to the wind direction as to minimize free-wheeling blade rotation as much as possible without locking the blades.
3. 90 Degree feathering of blades below mitigation cut in conditions.
4. 90 Degree feathering throughout the entire night.

Preliminarily, it is recommended that curtailment mitigation initiates at Level 1 then depending on the results of the operational mortality monitoring, which must be initiated when the first turbine is turning, the mitigation can be intensified up to a maximum intensity of Level 4 should it be necessary. This is an adaptive mitigation management approach that will require changes in the mitigation plan to be implemented immediately and in real time during the operational monitoring.

6. IMPACT ASSESSMENT

The impact assessment tables below display the assessments for both the authorised 56 turbine layout and the proposed amended 52 turbine layout with the increased rotor diameter.

6.1 Construction phase

Nature: Destruction of bat roosts during construction Possible roosting space on site are mostly in the form of rock crevices where water erosion has exposed rock on hill slopes. Water drainage areas are demarcated in the sensitivity map and these are avoided				
	Authorized		**Proposed amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Low (1)	Low (1)	Low (1)	Low (1)
Duration	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)	Minor (2)	Minor (2)
Probability	Very improbable (1)	Very improbable (1)	Very improbable (1)	Very improbable (1)
Significance	8 (Low)	8 (Low)	8 (Low)	8 (Low)
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Very low	Very low	Very low	Very low
Irreplaceable loss of resources?	Yes	No	Yes	No
Can impacts be mitigated?	Yes		Yes	
Mitigation: Strictly adhere to the bat sensitivity map				

Nature of impact: Artificial lighting

During construction strong artificial lights used in the work environment during night time will attract insects and thereby also bats. However only certain species of bats will readily forage around strong lights, whereas others avoid such lights even if there is insect prey available. This can draw insect prey away from other natural areas and thereby artificially favour certain species, affecting bat diversity in the area.

	Authorized		**Proposed amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Low (1)	Low (1)	Low (1)	Low (1)
Duration	Very short (1)	Very short (1)	Very short (1)	Very short (1)
Magnitude	Minor (2)	Minor (2)	Minor (2)	Minor (2)
Probability	Highly probable (4)	Probable (3)	Highly probable (4)	Probable (3)
Significance	16 (Low)	12 (Low)	16 (Low)	12 (Low)
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	High	High	High	High
Irreplaceable loss of resources?	No	No	No	No
Can impacts be mitigated?	Yes		Yes	

Mitigation: Consciously switch off all lights at a construction area when not required anymore, do not let it burn throughout the night. If suitable for the purpose, utilize lighting temperatures (colours/wavelengths) that attract less insects.

Nature of impact: Foraging habitat loss

Some foraging habitat will be permanently lost by construction of turbines and access roads. Temporary foraging habitat loss will occur during construction due to storage areas and movement of heavy vehicles.

	Authorized		**Proposed amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Low (1)	Low (1)	Low (1)	Low (1)
Duration	Medium (3)	Short (2)	Medium (3)	Short (2)
Magnitude	Moderate (6)	Low (4)	Moderate (6)	Low (4)

Probability	Highly probable (4)	Probable (3)	Highly probable (4)	Probable (3)
Significance	40 (Medium)	21 (Low)	40 (Medium)	21 (Low)
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Moderate	High	Moderate	High
Irreplaceable loss of resources?	Yes	No	Yes	No
Can impacts be mitigated?	Yes		Yes	
Mitigation: Adhere to the bat sensitivity map. Keep to designated areas when storing building materials, resources, turbine components and/or construction vehicles and keep to designated roads with all construction vehicles. Damaged areas should be rehabilitated by an experienced vegetation succession specialist after construction.				

6.2 Operational phase

Nature of impact: Bat mortalities due to direct blade impact or barotrauma during foraging (not migration).				
	Authorized		**Proposed amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Low-medium (2)	Low-medium (2)	Low-medium (2)	Low-medium (2)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)	Moderate (7)	Low (5)
Probability	Probable (3)	Improbable (2)	Probable (3)	Improbable (2)
Significance	36 (Medium)	20 (Low)	39 (Medium)	22 (Low)
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Low	Low	Low	Low
Irreplaceable loss of resources?	Yes	No	Yes	No

Can impacts be mitigated?	Yes		Yes	
Mitigation: Adhere to the sensitivity map, and do not move any turbines into Moderate sensitivity areas.				

Nature: Bat mortalities due to direct blade impact or barotrauma during migration
Migratory routes in the region are completely unknown, and there is no knowledge of whether any such migrations exist. However, no caves capable of providing roosting space for migratory species are known in the area, and furthermore the migratory species *M. natalensis* have only been detected in low numbers.

	Authorized		**Proposed amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Medium (3)	Medium (3)	Medium (3)	Medium (3)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)	Moderate (7)	Low (5)
Probability	Probable (3)	Probable (3)	Probable (3)	Probable (3)
Significance	39 (Medium)	33 (Medium)	42 (Medium)	36 (Medium)
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Low	Low	Low	Low
Irreplaceable loss of resources?	Yes	No	Yes	No
Can impacts be mitigated?	Yes		Yes	
Mitigation: Monitor passive data and mortalities over the operational phase to determine if new migrations occur on site or not. If migrations occur affected turbines must be curtailed accordingly to avoid impact to migrating bats.				

7. CONCLUSION

No proposed turbines are located in areas of high bat sensitivity or their buffers in this phase, but rather on the higher surrounding hills. It was clear from the data gathered from the 12-month pre-construction bat monitoring study, that the lower lying valley type areas had higher bat activity than the elevated regions of the site where turbines are proposed. The turbine layout has been devised such that turbines do not encroach on high or moderate bat sensitive areas or their respective buffer zones. Thus the amended turbine layout is deemed acceptable.

Therefore, the impact on bats is expected to be relatively low. Due to the relatively low bat activity levels recorded by passive bat monitoring systems for the Great Karoo wind farm, confidence in the impact statement is high.

With regards to the amended turbine specifications, a change to rotor diameter can increase the risk of impact on bats due to the fact that an increased turbine size increases the airspace in which bat mortality may occur. The proposed increased rotor diameter of 140m, increases the blade length by 10m closer to the ground and 10m higher above the ground. Thus the amended turbine size may have an increased impact on high flying bat species, such as *Tadarida aegyptiaca*, as well as low flying species that are active near vegetation clutter, such as *Neoromicia capensis*. The very slight increased impact is reflected in the impact assessment tables although impact category ratings have not changed. However, the slightly reduced turbine layout from 56 turbines to 52 turbines is a positive amendment and simultaneously decreases the negative impacts on bats which is ultimately more favourable than the currently authorised layout.

The reduced number of turbines is a favourable amendment, however only a total of four turbines have been dropped from the layout whereas the rotor diameter has increased by 20m for the remaining 52 turbines. The overall impact of the proposed amendments has increased and this has been demonstrated in **Section 6** in the cases where the impact assessment rating has increased. However, these ratings have only increased slightly.

Signed off by:

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