Environmental Authorization Amendment Impact Assessment Report of the preconstruction bat monitoring study

- For the Springbok Wind Energy Facility situated near Springbok in the Northern Cape

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Appointment of Specialist

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Project overseen and reviewed by:	Werner Marias & Monika Moir
Appointed by:	Mulilo Springbok Wind Power (Pty) Ltd
For:	EA Amendment Assessment Report for the Springbok WEF, taking cognizance of the findings of the preconstruction bat monitoring study

Independence:

Animalia Zoological & Ecological Consultation (Pty) Ltd has no connection with the developer. Animalia Zoological & Ecological Consultation (Pty) Ltd 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 additional attention to those listed as Threatened or Protected.

Table of Contents

1. TERMS OF REFERENCE

To compile an addendum to the Springbok WEF final EIA report for the bat monitoring study which addresses the following:

- The implications of the proposed amendments and the assessment of the potential impacts on bat fauna due to the amendments to turbine layout and dimension
- An outline of the potential advantages and disadvantages of the proposed amendments
- An assessment of whether the proposed amendments require changes or additions to the mitigation measures recommended in the original specialist report

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.

The 12-month pre-construction bat monitoring study was carried out by Animalia Zoological and Ecological Consultation over the period of March 2015 to September 2016. There were three bat monitoring systems used for the preconstruction study (one met mast and two short mast systems). There were short comings with both short mast bat monitoring systems over the course of the 12-month study. This data loss was compensated for as much as possible in the final report for the preconstruction monitoring study however, the data remains unavailable and conclusions are drawn based on the Bat Specialist experience and knowledge.

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 and layout. Thus, the impact assessment is based on best judgement and experience of the Bat Specialist.

3. PROJECT OVERVIEW

The Springbok Wind Farm is located approximately 6km north east from Springbok in the Northern Cape Province of South Africa. The wind farm has Environmental Authorisation for 37 turbines with a generation capacity of 1.5MW each, a hub height of 80m, a rotor diameter of 88m and an overall tip height of 124m and a lowest tip height of 36m above the ground. Mulilo Springbok Wind Power (Pty) Ltd propose an amendment to the EA to increase the

turbine generation capacity while reducing the number of turbines at the WEF. The proposed amendments are outlined in **Table 1** below.

Table 1: Proposed amendments to the Springbok WEF

Component	Approved	Proposed amendment
Number of turbines	37	Maximum of 25 (i.e. potential range of 12 turbines @ 4.5MW to 25 turbines @ 2.0MW - 2.2MW)
Generation capacity per turbine	1.5MW	2.0MW – 4.5MW
Generation capacity of the WEF	55.5MW	Same as authorised (55.5MW)
Rotor diameter	88m	Maximum of 160m
Hub height	80m	Maximum of 140m
Temporary construction pad	40 x 20m	40 x 40m
Permanent affected area (foundation size)	16 x 16m and 2 m deep	16 x 16m and 3 m deep

The Application for amendment of the EA will assess the "worst case scenario" of 25 turbines with a generation capacity of 2.0MW - 2.2MW per turbine, with the understanding that should the Applicant use 4.5MW turbines (which would have the same maximum dimensions as the 2.0MW - 2.2MW turbines, outlined in **Table 1** above), then the Applicant would reduce the number of turbines to 12. It is furthermore noted that the generation capacity of the WEF would remain 55.5MW, as authorized by DEA).

The initial EIA bat sensitivity assessment (undertaken by David Jacobs in 2010) assessed the original turbine layout of 37 turbines. The subsequent Pre-Construction Bat Monitoring study (undertaken by Animalia over 2015 – 2016) assessed the most recent 25 turbine layout. The impact assessment presented in this report presents the impact assessment ratings of the amendments compared with the ratings of the Pre-Construction Bat Monitoring study rather than the initial EIA bat sensitivity assessment. Thus, the amendment change to 25 turbines does not change from the impact assessment provided in the Pre-Construction Bat Monitoring study report (dated 2016).

The factors of the proposed amendment that affect the original impact assessment are:

- An increase in the overall tip height from 124m to 220m
- An increase in the lowest tip height from 36m to 90m

Figure 1 and 2 below display the general Springbok WEF site location as well as the turbine layout that was assessed in the Final Pre-Construction Monitoring Report. **Figure 3** below displays the sensitivity map from the Final Pre-Construction Monitoring Report. The Springbok WEF turbine layout is respective of the bat sensitivity map and doesn't encroach on any sensitive areas and their respective buffers.

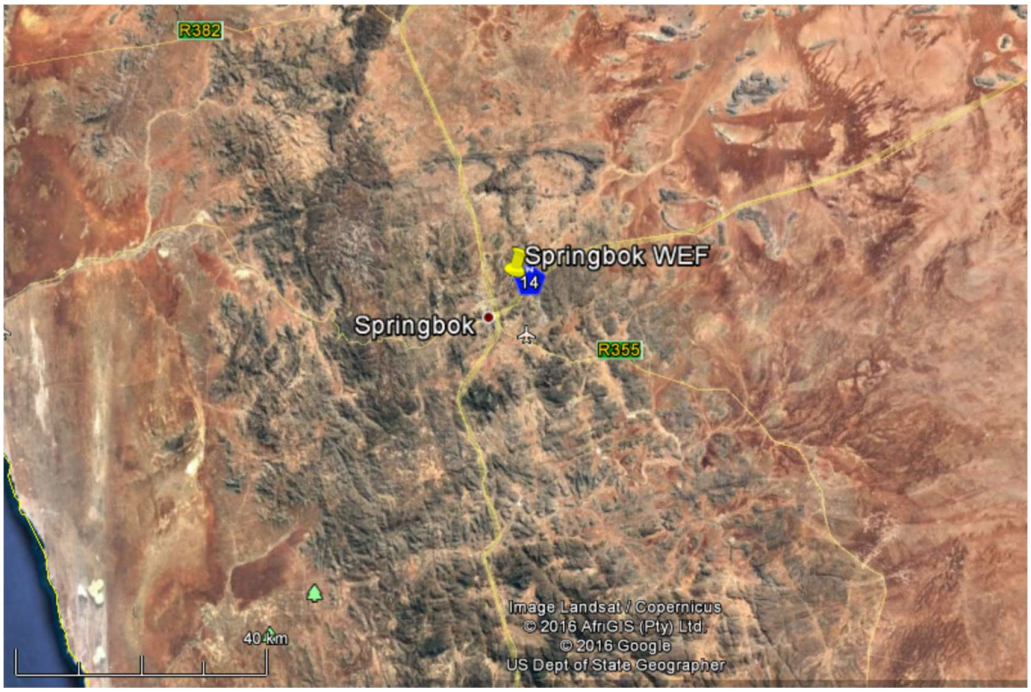

Figure 1: General location of the Springbok WEF and its proximity to the town of Springbok

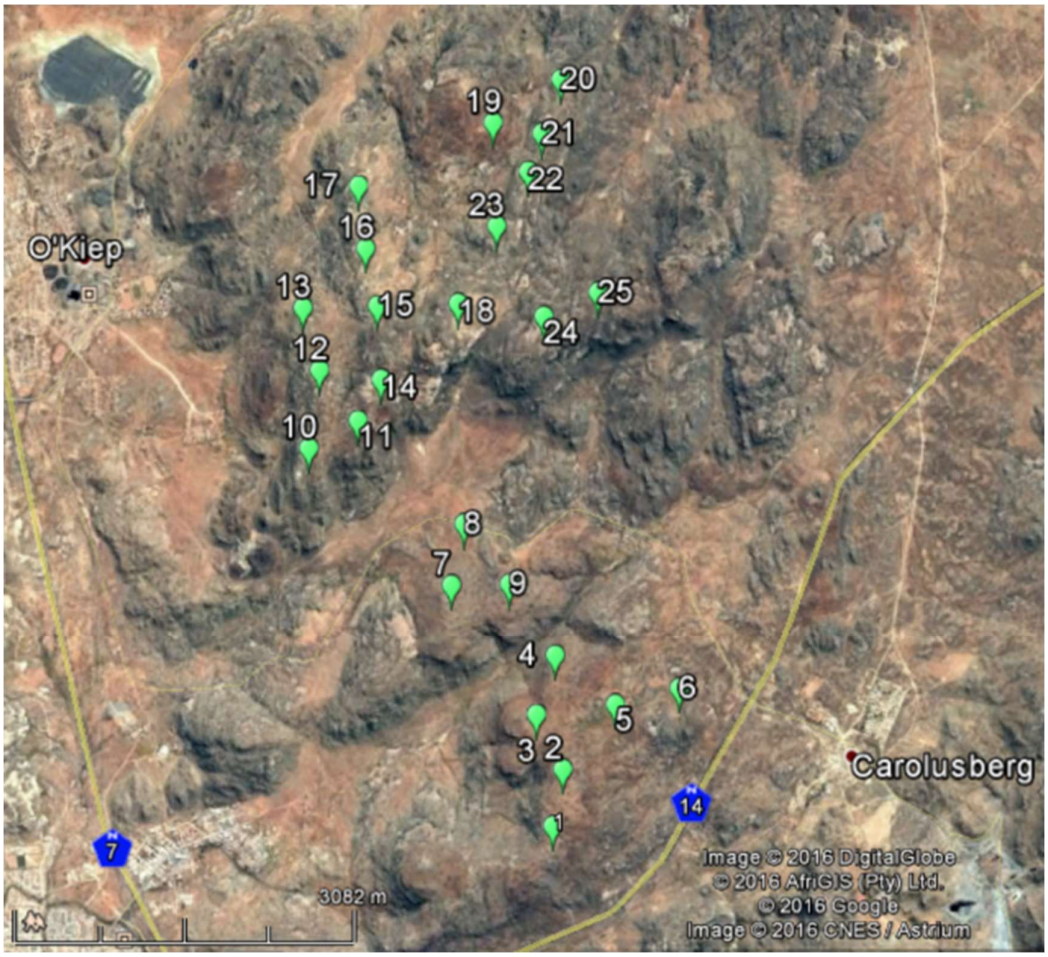

Figure 2: Turbine layout assessed in the Final Pre-Construction Monitoring Report

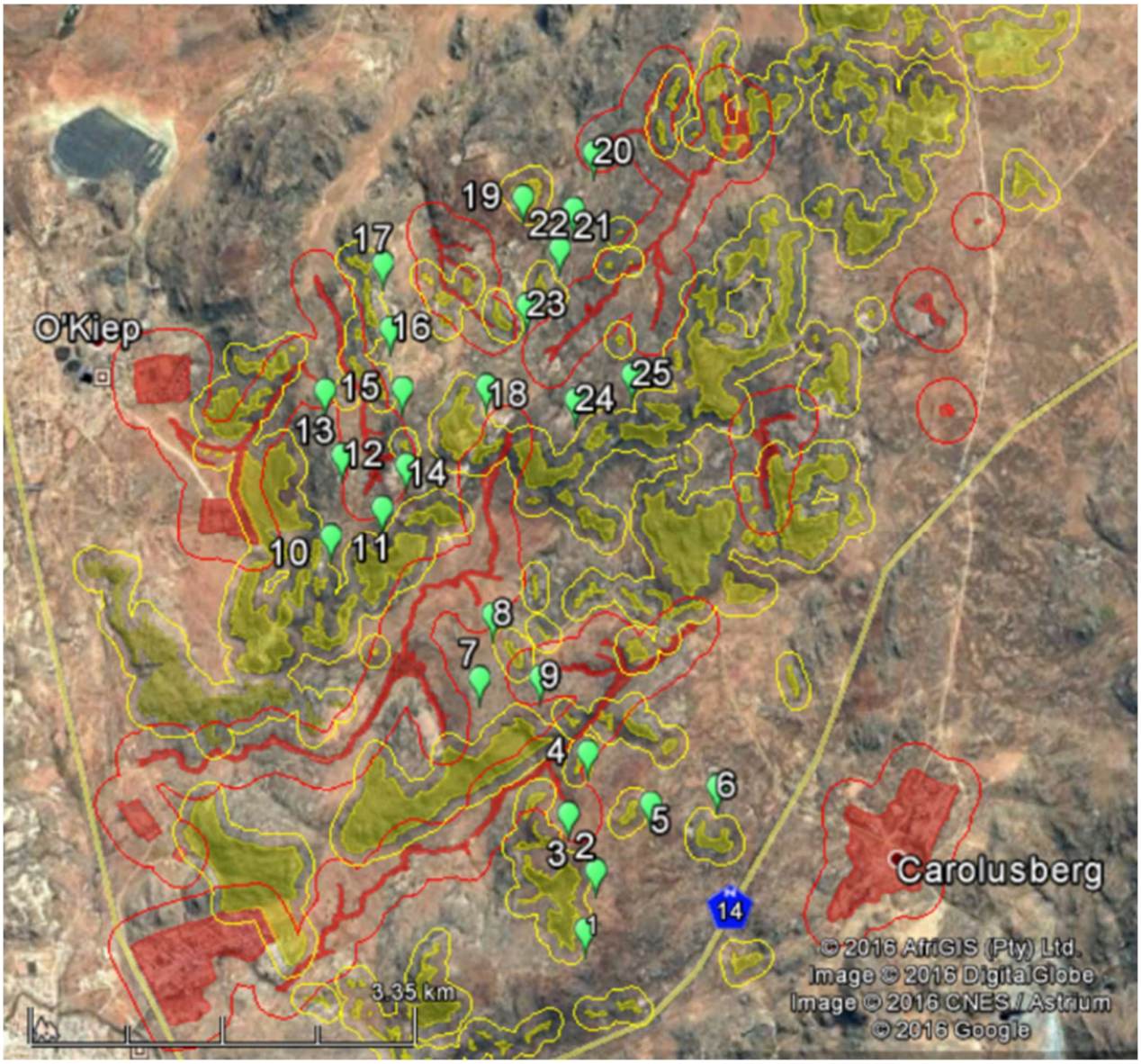

Figure 3: Bat sensitivity map of the Springbok WEF site as presented in the Final Preconstruction Monitoring Report

The 12-month preconstruction bat monitoring study was carried out over March 2015 to September 2016. The final report was issued in November 2016. The report presented a bat sensitivity map indicating bat sensitive roosting and foraging areas which were to be avoided for turbine placement. The final report also listed mitigation measures to be implemented from the onset of the operational phase.

3.1. Recommendations from the Final Preconstruction Bat Monitoring Report

3.1.1. Mitigations

The blades of all turbines of the Springbok WEF must be feathered below manufacturers cut in speed and not allow for free-wheeling. This must be implemented at the onset of operation. Bat activity is markedly higher over low wind speed periods. Preventing free-wheeling should not affect energy production significantly and will be a significant bat conservation mitigation measure.

To further minimize cumulative impacts from wind farms on bats, the mitigation table below is recommended to be applied to several high-risk turbines at the onset of turbine operation. The identified turbines are numbered 3, 4, 9, 12, 14, 15 and 23. The recommended mitigation schedule is defined below and is only applicable during peak activity periods and when environmental conditions are in line with the mitigation schedule outlined in the table below.

Table 2: The recommended mitigation schedule

Terms of mitigation implementation	
Peak activity (times to implement curtailment/ mitigation)	10 September – 25 October over the period of sunset to 06:00
Environmental conditions in which to implement curtailment/ mitigation	Wind speed below 4.0m/s and Temperature above 10°C
Autumn peak activity (times to implement curtailment/ mitigation)	15 January – 1 February over the period of sunset to 05:30
Environmental conditions in which to implement curtailment/ mitigation	Wind speed below 4.0m/s and Temperature above 16°C

Where mitigation by location is not possible, other 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 produce power.

Blade locking or feathering that renders blades motionless below the manufacturers cut in speed, and don't allow free rotation without the gearbox engaged, is more desirable for the conservation of bats than allowing free rotation below the manufacturer's cut in speed. This is because bats can still collide with rotating blades even when no electricity is being produced.

Acoustic deterrents:

Are a developing technology and will need further investigation closer to time of wind farm operation, opportunities to test such devices may be available during operation of the facility.

Light lures:

Refer to the concept where strong lights are placed on the periphery (or only a few sides) of the wind farm to lure insects and therefore bats away from the turbines. However, 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 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 favourable to bats.

A basic "6 levels of mitigation" (by blade manipulation or curtailment), from light to aggressive mitigation is structured as follows:

1. No curtailment (free-wheeling is unhindered below manufacturer's cut in speed so all momentum is retained, thus normal operation).
2. Partial feathering (45-degree angle) of blades below manufacturer's cut-in speed in order to allow the free-wheeling blades half the speed it would have had without feathering (some momentum is retained below the cut in speed).
3. Ninety degree feathering of blades below manufacturer's 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.
4. Ninety degree feathering of blades below manufacturer's cut-in speed, with partial feathering (45-degree angle) between the manufacturer's cut-in speed and mitigation cut-in conditions.
5. Ninety degree feathering of blades below mitigation cut in conditions.
6. Ninety degree feathering throughout the entire night.

It is recommended that curtailment be applied initially at the start of operation at Level 3 during the climatic conditions and time frames outlined in **Table 2**. However, actual impacts

on bats will be monitored during the operational phase monitoring, and the recommended mitigation measures and levels of curtailment will be adjusted (either getter lighter or more aggressive) according to the results of the operational monitoring. This is an adaptive management approach, and it is crucial that any suggested changes to the initial proposed mitigation schedule be implemented within maximum 2 weeks from the date of the recommendation, unless the recommendation refers to a time period later in the future (e.g. the following similar season/climatic condition).

3.1.2. Impact assessment recommendations

The Impact Assessment section of the Final Preconstruction Bat Monitoring Report listed mitigations to be adhered to for the reduction of impact significance. These mitigations remain relevant and must be implemented. The mitigation relevant to each impact is listed below.

Impact of destruction of bat roosts due to earthworks and blasting: Adhere to the sensitivity map during turbine placement. Blasting should be minimised and used only when necessary. Before blasting of rocky areas with notable cracks and crevices, the Bat Specialist must survey the specific blasting area for the presence of bat roosts. The mitigation measures will reduce the impact blasting and earthworks will have on the environmental parameter, through avoiding sensitive areas.

Impact of artificial lighting: Utilise lights with wavelengths that attract less insects (low thermal/infrared signature). If not required for safety or security purposes, lights should be switched off when not in use or equipped with passive motion sensors.

Impact of foraging habitat loss: Adhere to the 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 not required after construction should be rehabilitated by an experienced vegetation succession specialist. The mitigation measures will reduce the degree of habitat loss.

Bat mortalities due to direct blade impact or barotrauma during foraging activities (not migration: Adhere to the sensitivity maps, avoid areas of bat sensitivity and their buffers. Apply the initial mitigation measures outlined in Section 7 and 8 of the final report. Adhere to operational mitigation measures that may be deemed necessary during the operational monitoring assessment

Bat mortalities due to direct blade impact or barotrauma during foraging – cumulative impact: Drainage areas can serve as commuting corridors for bats in the larger area, potentially lowering the cumulative effects of several WEF's in an area if the drainage areas are avoided during turbine placement and are well buffered. Also, adhere to recommended

mitigation measures for this project during the operational phase study, and it is essential that project specific mitigations be applied and adhered to for each project. Adhere to the sensitivity map during any further turbine layout revisions, and avoid placement of turbines in bat sensitive areas and their buffers.

4. IMPACT ASSESSMENT

4.1 Impact Assessment Methodology

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

4.1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 3**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

4.1.2 Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- **planning**
- **construction**
- **operation**
- **decommissioning**

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 3: Description of terms

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by an action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures

2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact because of the proposed activity		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which may not be significant but may become		

significant if added to other existing or potential impacts emanating from other similar or diverse activities because of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

4.2 Impact Assessment

The impact assessment tables below display the assessments for both the authorised turbine dimensions and layout, with the proposed amendments.

4.2.1 Construction phase

Impact: Destruction of bat roosts due to earthworks and blasting

IMPACT TABLE FORMAT	
Environmental Parameter	Bat populations will be impacted upon through earthworks and blasting close to bat roosts.
Issue/Impact/Environmental Effect/Nature	Earthworks and blasting close to bat roosts will negatively affect bat populations through high mortality, which in effect will cause a decrease in bat population numbers.

IMPACT TABLE FORMAT				
Extent	If bat roosts are found to be within the site, blasting will have a negative effect on the bat populations in the local area.			
Probability	There is a probable chance of the impact occurring.			
Reversibility	Blasting occurring at bat roosts will cause damage to the bat population in the area. It is reversible over a longer time period.			
Irreplaceable loss of resources	If blasting and earthworks occurs close to a bat roost, it will be destroyed and lost.			
Duration	The impact of blasting will be of short duration, as blasting and earthworks will only occur during construction phase. However, the lasting effects of losing bat roosts is a long-term effect.			
Cumulative effect	Moderate effect, as the destruction of the bat roosts impact the population numbers within the area which in effect may impact the insect numbers.			
Intensity/magnitude	Blasting of bat roosts will cause mortality to the bats inhabiting the roosts, and will negatively impact the population and ecosystem.			
Significance Rating	The anticipated impact will have significant effects and will require mitigation measures to achieve an acceptable level of impact.			
	Authorised		**Proposed Amendment**	
	Pre-mitigation impact rating	Post mitigation impact rating	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1	2	1
Probability	3	1	3	1
Reversibility	4	2	4	2
Irreplaceable loss	4	2	4	2
Duration	1	1	1	1
Cumulative effect	3	1	3	1
Intensity/magnitude	4	2	4	2
Significance rating	**- 68 (high negative)**	**- 16 (low negative)**	**- 68 (high negative)**	**- 16 (low negative)**
Mitigation measures	Adhere to the sensitivity map during turbine placement. Blasting should be minimised and used only when necessary. Before blasting of rocky areas with notable cracks and crevices, the Bat Specialist must survey the specific blasting area for the presence of bat roosts. The mitigation measures will reduce the impact blasting and earthworks will have on the environmental parameter, through avoiding sensitive areas.			

Impact: Loss of foraging habitat

IMPACT TABLE FORMAT				
Environmental Parameter	Loss of foraging habitat within the site boundaries.			
Issue/Impact/Environmental Effect/Nature	Loss of foraging habitat. Some minimal 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.			
Extent	Loss of foraging habitat will be contained within the boundaries of the development site.			
Probability	There is a probable chance of the impact occurring.			
Reversibility	Depending on the degree of habitat loss, it will be partly reversed with some mitigation measures, especially in more sensitive areas. Minimal foraging habitat will be permanently lost.			
Irreplaceable loss of resources	In areas where vegetation is removed for roads and turbines, there will be a loss of habitat resources, but the scale is insignificant.			
Duration	The impact will be of a long duration, past the operation of the development.			
Cumulative effect	Low effect, as the removal of habitat will cause a slight decrease in the number of bat numbers within the site boundaries.			
Intensity/magnitude	Habitat removal will negatively impact the population and system.			
Significance Rating	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.			
	Authorised		**Proposed Amendment**	
	Pre-mitigation impact rating	Post mitigation impact rating	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1	1	1
Probability	3	1	3	1
Reversibility	3	1	3	1
Irreplaceable loss	3	2	3	2
Duration	3	2	3	2
Cumulative effect	2	1	2	1
Intensity/magnitude	2	1	2	1
Significance rating	**- 30 (medium negative)**	**- 8 (low negative)**	**- 30 (medium negative)**	**- 8 (low negative)**

IMPACT TABLE FORMAT	
Mitigation measures	Adhere to the 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 not required after construction should be rehabilitated by an experienced vegetation succession specialist. The mitigation measures will reduce the degree of habitat loss.

4.2.2 Operational phase

Impact: Bat mortalities due to direct blade impact or barotrauma during foraging activities (not migration)

IMPACT TABLE FORMAT	
Environmental Parameter	Impact on bat population numbers.
Issue/Impact/Environmental Effect/Nature	Bat mortalities due to direct blade impact or barotrauma during foraging activities (not migration). If the impact is too severe (e.g. in the case of no mitigation) local bat populations may not recover from mortalities.
Extent	The impact will be contained within the boundaries of the development site. However, the effects of the impact will affect the greater local area ecosystem.
Probability	There is a high chance of the impact occurring.
Reversibility	The impact will occur throughout the lifespan of the wind facility. Population numbers may take very long to recover. Population and diversity genetics may be permanently altered.
Irreplaceable loss of resources	Bat population numbers will decrease in the area.
Duration	The impact will be of long duration, past the operational phase of the development. It will take some time for the population to achieve its previous numbers after the impact.
Cumulative effect	High effect, as the decrease in bat numbers will in effect cause an increase in the number of insects in the area which changes the system of the area.
Intensity/magnitude	High impact on the bat population numbers in the area.
Significance Rating	The anticipated impact will have highly significant effects and it is very important that they be mitigated adequately.

IMPACT TABLE FORMAT				
	Authorised		**Proposed Amendment**	
	Pre-mitigation impact rating	Post mitigation impact rating	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1	1	1
Probability	4	2	5	3
Reversibility	4	2	4	2
Irreplaceable loss	3	2	3	2
Duration	3	3	3	3
Cumulative effect	4	3	4	3
Intensity/magnitude	4	2	4	2
Significance rating	**- 76 (very high negative)**	**- 26 (low negative)**	**- 80 (very high negative)**	**- 28 (low negative)**
Mitigation measures	Adhere to the sensitivity maps, avoid areas of bat sensitivity and their buffers. Apply the mitigation measures outlined in this report. Adhere to operational mitigation measures that may be deemed necessary during the operational monitoring assessment.			

Impact: Artificial lighting

IMPACT TABLE FORMAT	
Environmental Parameter	Impact on bat populations, foraging behaviour and diversity.
Issue/Impact/Environmental Effect/Nature	During operation, strong artificial lights that may be used at the turbine base or immediate surrounding infrastructure, the light will attract insects and thus bats. This will significantly increase the likelihood of blade collision and barotrauma to bats foraging around such lights. Additionally, only certain species of bats will readily forage around strong lights, whereas others avoid such lights even if there is insect prey available, which can draw insect prey away from other natural areas and thereby artificially favor only certain species.
Extent	Artificial lighting will be contained within the boundaries of the development site.
Probability	There is a probable chance of the impact occurring.
Reversibility	Yes, the impact is reversible.
Irreplaceable loss of resources	No
Duration	The impact will be of a long-term duration, the lifespan of the wind farm.

IMPACT TABLE FORMAT				
Cumulative effect	During operational phase, strong artificial lights used at 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.			
Intensity/magnitude	Artificial lighting in the area will change the diversity of the bat species in the area. This will negatively affect the system.			
Significance Rating	The anticipated impact will have moderate negative effects and will require mitigation measures.			
	Authorised		**Proposed Amendment**	
	Pre-mitigation impact rating	Post mitigation impact rating	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1	1	1
Probability	4	1	4	1
Reversibility	2	1	2	1
Irreplaceable loss	2	1	2	1
Duration	3	2	3	2
Cumulative effect	3	2	3	2
Intensity/magnitude	2	1	2	1
Significance rating	- 30 (medium negative)	- 8 (low negative)	- 30 (medium negative)	- 8 (low negative)
Mitigation measures	Utilise lights with wavelengths that attract less insects (low thermal/infrared signature). If not required for safety or security purposes, lights should be switched off when not in use or equipped with passive motion sensors.			

4.2.3 Decommissioning phase

Impact: Loss of foraging habitat

IMPACT TABLE FORMAT	
Environmental Parameter	Loss of foraging habitat within the site boundaries.
Issue/Impact/Environmental Effect/Nature	Loss of foraging habitat. Some minimal foraging habitat will be permanently lost by construction of turbines and access roads. Temporary foraging habitat loss will occur during

IMPACT TABLE FORMAT				
	construction due to storage areas and movement of heavy vehicles.			
Extent	Loss of foraging habitat will be contained within the boundaries of the development site.			
Probability	There is a probable chance of the impact occurring.			
Reversibility	Depending on the degree of habitat loss, it will be partly reversed with some mitigation measures, especially in more sensitive areas.			
Irreplaceable loss of resources	In areas where vegetation is removed for roads and turbines, there will be a loss of habitat resources.			
Duration	The impact will be of a long duration, past the operation of the development.			
Cumulative effect	Low effect, as the removal of habitat will cause a decrease in the number of bat numbers and insect numbers within the site boundaries.			
Intensity/magnitude	Removal of habitat will have a moderate magnitude impact on local bat fauna.			
Significance Rating	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.			
	Authorised		**Proposed Amendment**	
	Pre-mitigation impact rating	Post mitigation impact rating	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1	1	1
Probability	3	1	3	1
Reversibility	3	1	3	1
Irreplaceable loss	3	2	3	2
Duration	3	2	3	2
Cumulative effect	2	1	2	1
Intensity/magnitude	2	1	2	1
Significance rating	**- 30 (medium negative)**	**- 8 (low negative)**	**- 30 (medium negative)**	**- 8 (low negative)**
Mitigation measures	Adhere to the 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 not required after construction should be rehabilitated by an experienced vegetation succession specialist. The mitigation measures will reduce the degree of habitat loss.			

5. MITIGATIONS

The blades of all turbines of the Springbok WEF must be feathered below manufacturers cut in speed and not allow for free-wheeling. This must be implemented at the onset of operation. Bat activity is markedly higher over low wind speed periods. Preventing free-wheeling should not affect energy production significantly and will be a significant bat conservation mitigation measure.

To further minimize cumulative impacts from wind farms on bats, the mitigation table below is recommended to be applied to several high-risk turbines at the onset of turbine operation. The identified turbines are numbered 3, 4, 9, 12, 14, 15 and 23.

Table 4: The recommended mitigation schedule

Terms of mitigation implementation	
Peak activity (times to implement curtailment/ mitigation)	10 September – 25 October over the period of sunset to 06:00
Environmental conditions in which to implement curtailment/ mitigation	Wind speed below 4.0m/s and Temperature above 10°C
Autumn peak activity (times to implement curtailment/ mitigation)	15 January – 1 February over the period of sunset to 05:30
Environmental conditions in which to implement curtailment/ mitigation	Wind speed below 4.0m/s and Temperature above 16°C

The curtailment outlined above must be applied initially at the start of the wind farm operation during the climatic conditions and time frames outlined in **Table 4**. The impacts on bats will be monitored during the operational phase monitoring, and the recommended mitigation measures and levels of curtailment may be adjusted according to the results of the operational monitoring study. This is an adaptive management approach, and it is crucial that any suggested changes to the initial proposed mitigation schedule be implemented within maximum 2 weeks from the date of the recommendation, unless the recommendation refers to a time period later in the future (e.g. the following similar season/climatic condition).

6. CONCLUSION

A change to the rotor diameter and hub height of authorised turbines can increase the risk of impact on bats due to the fact that an increased blade size increases the airspace in which bat mortality may occur during wind turbine operation. It would not increase the impacts of construction or decommission, as seen in **Section 4** above. The increased construction pad and foundation size is minimal such that it did not cause a change in the impact assessment.

The proposed increased rotor diameter, and increased hub height, would result in increasing the bottom blade tip height from 36m to 90m above the ground, and increasing the overall blade tip height from 124m to 220m above the ground. The proposed amendment turbine size has a lowered impact on low flying species that are active near vegetation clutter, such as *Neoromicia capensis*.

The amended turbine size has an increased impact on high flying bat species, such as *Tadarida aegyptiaca*, based on increased airspace in which mortality is a risk. The increase in turbine dimensions are significant and thus it triggered an increased negative impact in bat mortalities due to direct blade impact or barotrauma during foraging activities. This has resulted in the need for strict application of mitigation measures described in **Section 5** above, in order for the proposed amendments to be acceptable from a bat sensitivity and impact perspective.

The curtailment outlined above must be applied initially at the start of the wind farm operation during the climatic conditions and time frames outlined in **Table 4**. The impacts on bats will be monitored during the operational phase monitoring, and the recommended mitigation measures and levels of curtailment may be adjusted according to the results of the operational monitoring study. This is an adaptive management approach, and it is crucial that any suggested changes to the initial proposed mitigation schedule be implemented within maximum 2 weeks from the date of the recommendation, unless the recommendation refers to a time period later in the future (e.g. the following similar season/climatic condition).

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