Addendum report to the EIA bat impact assessment and preconstruction monitoring report

- For the proposed Environmental Authorisation amendments of the Witberg Wind Energy Facility and associated infrastructure, Western Cape

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For:	The Witberg Wind Energy Facility and associated infrastructure Motivation Report, Western Cape Province

Independence:

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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 compile an addendum report to the most recent pre-construction bat monitoring study dated June 2015 for the Witberg Wind Energy Facility (WEF) and associated infrastructure Motivation Report which addresses the following:

- An assessment of all impacts related to the proposed changes;
- Advantages or disadvantages associated with the changes;
- Comparative assessment of the impacts before the changes and after the changes, if any significant differences are expected;
- Measures to ensure avoidance, management and mitigation of impacts associated with such proposed changes, and any changes to the EMPr, if any changes are required.

2. INTRODUCTION

Witberg Wind Power (Pty) Ltd is proposing to amend the turbine specifications (**Table 1**) and layout for the Witberg WEF. Additionally, the validity period of the environmental authorisation is proposed to be extended by an additional 2 years.

Table 1: The proposed amendments to the turbines.

Component	**Approved (as per appeal decision LSA 105-439) dated 13 August 2013**	**Proposed amendment**
Hub height	92	Up to 120m
Rotor diameter	116	Up to 136m
Output capacity per turbine	3MW	Up to 5MW
Measurement masts height	80m	120m
Number of turbines and layout	27	25 (shifted layout of turbines and associated infrastructure)

A number of other minor amendments are also being proposed including:

- Change in contact details of the holder of the EA;
- Correct minor spelling errors of approved listed activities;

- Amendment of Condition 40 as per additional conditions to be added to the EA in the amendment of the EA (Ref: LSA 105-439) to refer to Witberg Wind Power (Pty) Ltd instead of G7.

The minor amendments in the bullet points above being proposed, are not related to bat impacts and are therefore, not assessed herein accordingly. During the preconstruction study no cumulative impacts were assessed, therefore it is discussed and assessed in this report in Sections 4 and 5.2.

3. DISCUSSION OF PROPOSED AMENDMENTS AND RESULTS

3.1. Turbine dimensions amendment

The currently authorised turbine dimensions with a hub height of 92m and a rotor diameter of 116m, will result in a lowest rotor swept height above ground of 34m. Whereas, the proposed increased turbine dimensions of up to 120m hub height and up to 136m rotor diameter, will result in an increase of the lowest rotor swept height above ground to 52m. This will result in a total increase in lowest rotor swept height above ground level of 18m from the authorised wind turbine specifications in comparison to the proposed amended turbine specifications.

During the preconstruction study, the two stations with microphones at 60m recorded 1.8 and 6.5 times less bats, than at 10m height. This indicates a clear negative correlation between bat activity and height above ground, meaning the probability of impacts on bats is less at 52m than at 34m. However, the larger rotor diameter of the proposed dimensions will also result in a larger airspace that poses a risk to bats.

Thus, considering the decreased risk of 52m at the lowest rotor swept height, and the increased risk of the larger airspace occupied by a larger rotor diameter, **the proposed turbine dimension change will have a negligible effect on the significance of impacts identified in the most recent bat pre-construction monitoring report dated June 2015.**

3.2. Output capacity of turbines

The proposed increased output capacity of the turbines is related to the proposed increase in turbine dimensions, refer to Section 2.1 above on turbine dimensions. The actual wind turbine generation output capacity per turbine is not relevant to impacts on bats, and therefore is not assessed.

3.3. Extension of the Environmental Authorisation validity period by an additional 2 years

The pre-construction data was gathered from May 2011 to May 2012. Six bat monitoring stations were used to monitor bat activity levels, with two having microphones at height. During the study time frame, the South African Good Practice Guidelines for Surveying Bats in Wind Farm Developments 2nd edition (April 2011) was in use, and was undergoing refinement to the 3rd edition (Sowler and Stoffberg, 2012). The study was conducted in accordance with the guidelines that were current at that time. The study design differs from the 3rd edition guidelines (Sowler and Stoffberg, 2014) in that monitoring was carried out for

only 15-25% of the likely bat activity periods over the year. This limitation was factored in to the re-analysis of the study data in 2015, on which the EIA was based and authorisation granted.

The site environment has not changed significantly since the EIA assessment in 2015, **extension of the validity of the authorisation by an additional 2 years will have a negligible effect on the significance of impacts identified in the EIA report.**

3.4. Change in the turbine layout and associated infrastructure

Changes in the layout of the associated infrastructure will have a negligible effect on the significance of impacts identified in the original EIA bat report dated 2011. The proposed change in the turbine layout will decrease the significance of impacts originally identified in the EIA bat report dated 2011 for the operational phase. The currently authorised layout (Layout Revision 7 as per appeal decision LSA 105-439, dated 13 August 2013) has 1 turbine inside a high bat sensitivity buffer and 1 turbine in a moderate sensitivity buffer. The proposed layout has no turbines in high sensitivity buffers and 5 turbines inside moderate sensitivity buffers (**Table 2** and **Figures 1 - 4**). Due to the high significance and importance of high bat sensitivity areas and their buffers, they are prioritised over moderate sensitivity buffers.

Table 2: Turbines located within bat sensitive areas, authorised layout compared to the proposed layout.

Bat sensitivity area	**Authorised layout (as per appeal decision LSA 105-439) dated 13 August 2013**	**Proposed layout**
High	None	None
High buffer	Turbine 4	None
Moderate	None	None
Moderate buffer	Turbine 8	Turbines 11, 14, 21, 22 and 23

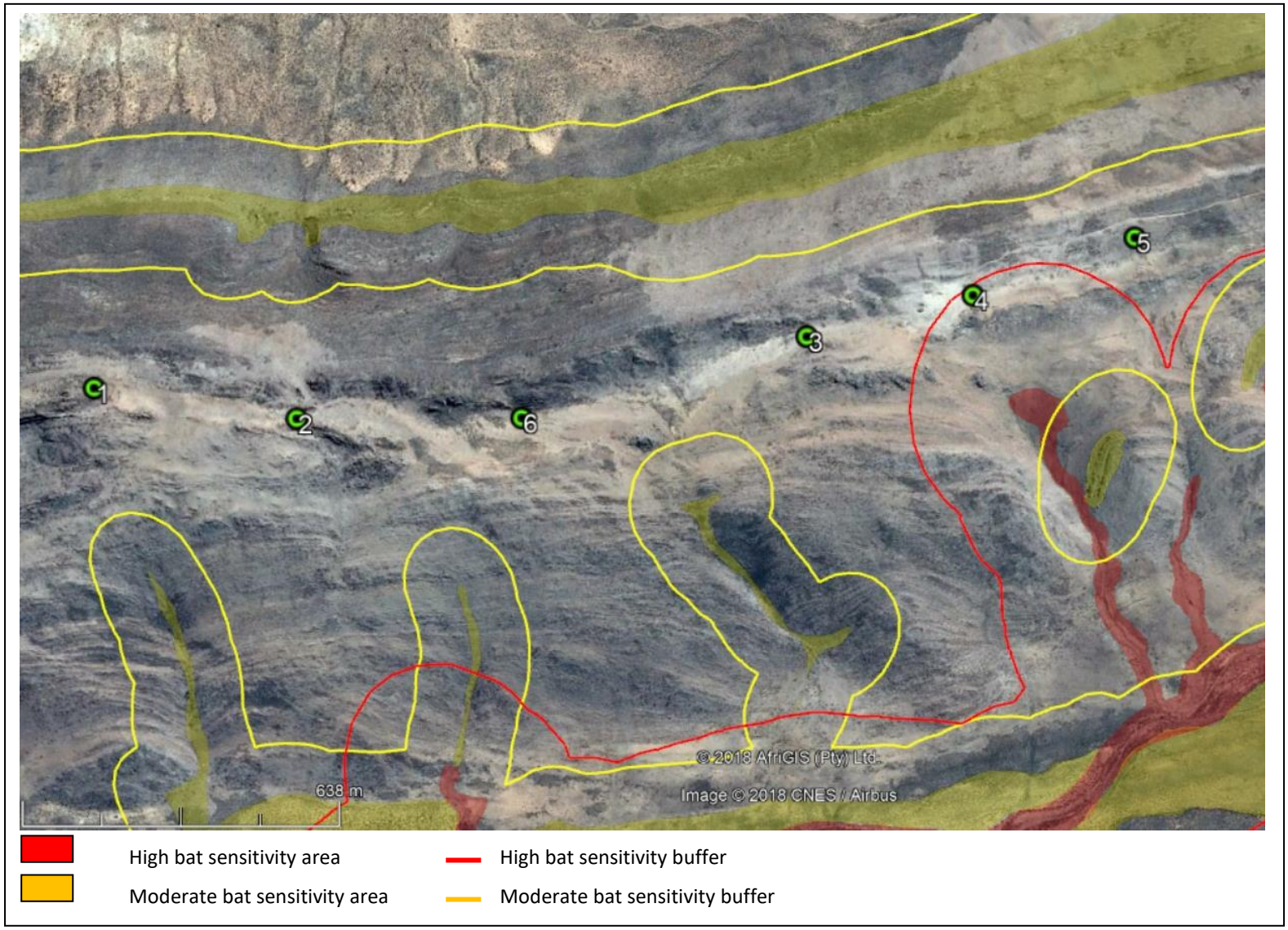

Figure 1: Bat sensitivity map in relation to the currently **authorised layout**, western cluster of turbines (turbine 4 in high sensitivity buffer).

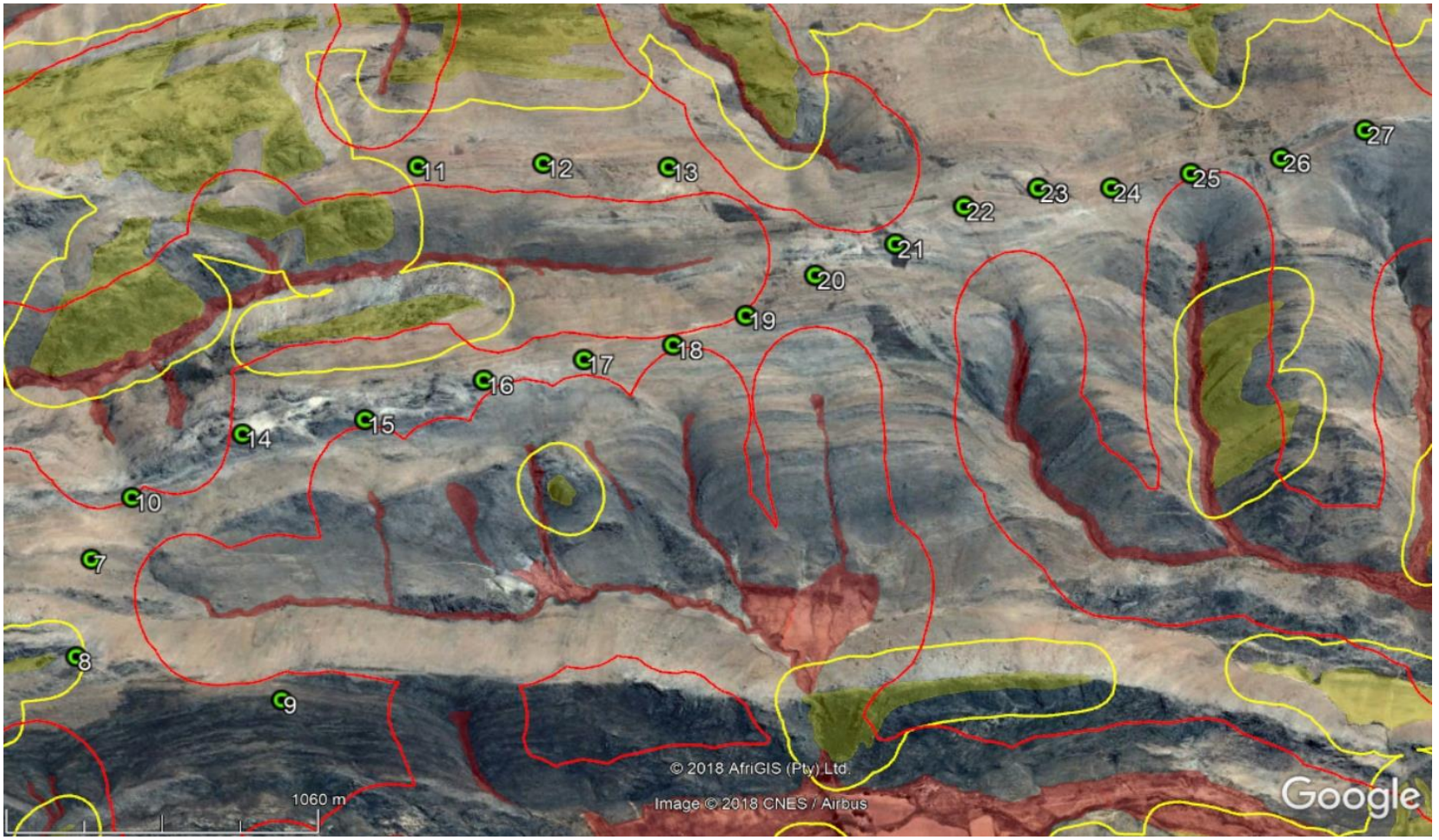

Figure 2: Bat sensitivity map in relation to the currently **authorised layout**, eastern part of site (turbine 8 in moderate senstivity buffer).

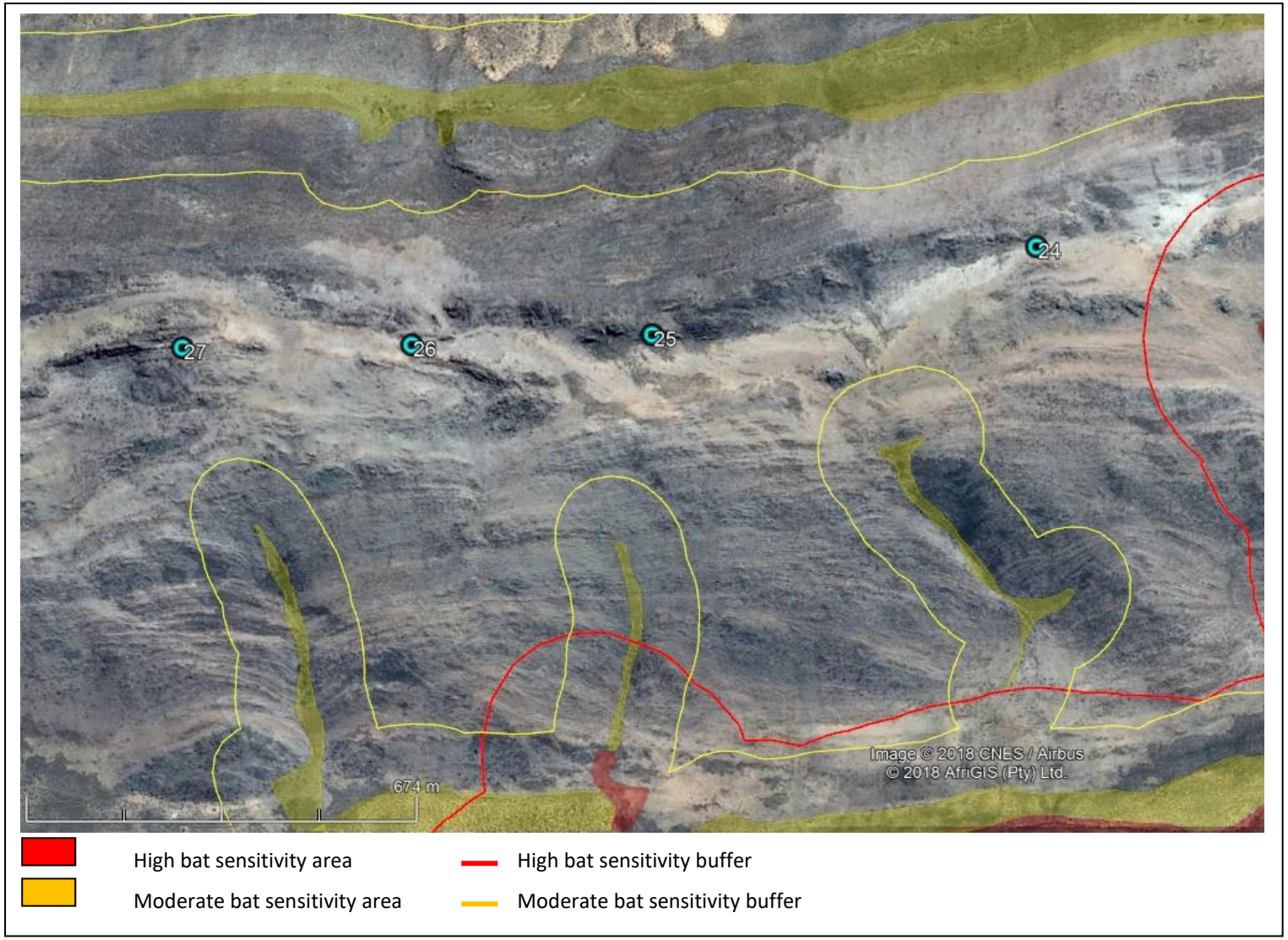

Figure 3: Bat sensitivity map in relation to the currently **proposed layout**, western cluster of turbines. No Turbines are in any sensitive areas or their buffers.

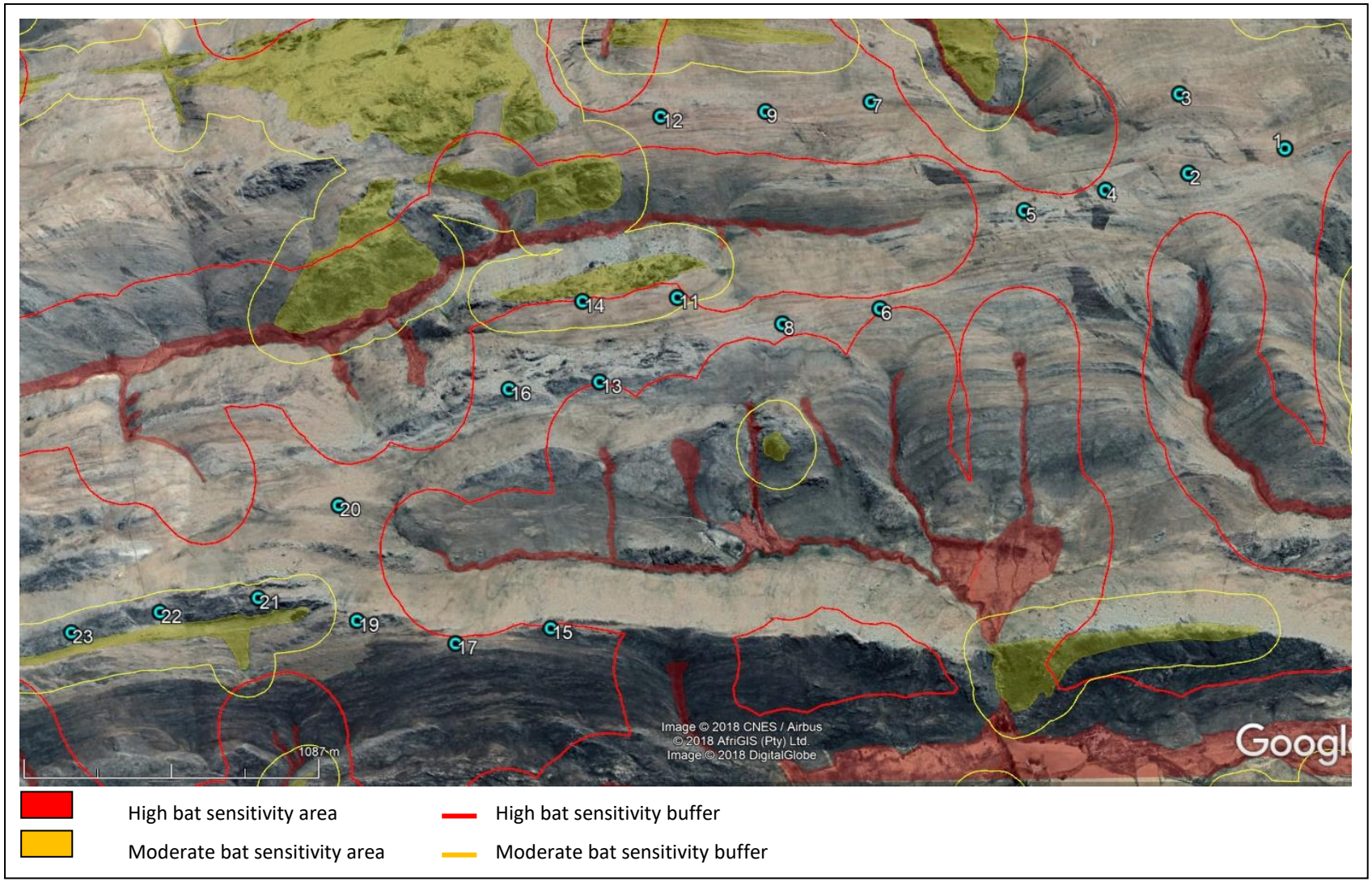

Figure 4: Bat sensitivity map in relation to the currently **proposed layout**, eastern part of site (no turbines in the high sensitivity buffer, and turbines 11, 14, 21, 22 and 23 in moderate senstivity buffer).

4. CUMULATIVE IMPACTS FROM NEARBY WIND FARMS

During the preconstruction study no cumulative impacts were assessed, therefore it is discussed in this section (also refer to Section 5.2). Other operating wind farms or proposed wind farms with valid environmental authorisations within a radius of 30km from the site are depicted in **Figure 5** below. All facilities shown have received environmental authorisation except for the proposed Rietkloof facility, to the best current knowledge of the specialist. All of the facilities indicated in **Figure 5** fall mostly within the Montane Fynbos and Renosterveld ecoregion. Only some facilities are bordered by the Succulent Karoo ecoregion (including Witberg, but not the turbine areas), and the Perdekraal East and West sites are within the Succulent Karoo ecoregion. Since watercourses and riparian habitats have been treated as bat sensitive habitats in the Witberg WEF, as well as nearby wind farms, they allow for continous natural bat foraging habitat and movement corridors through the facilities, even though Witberg have no directly adjacent facilities.

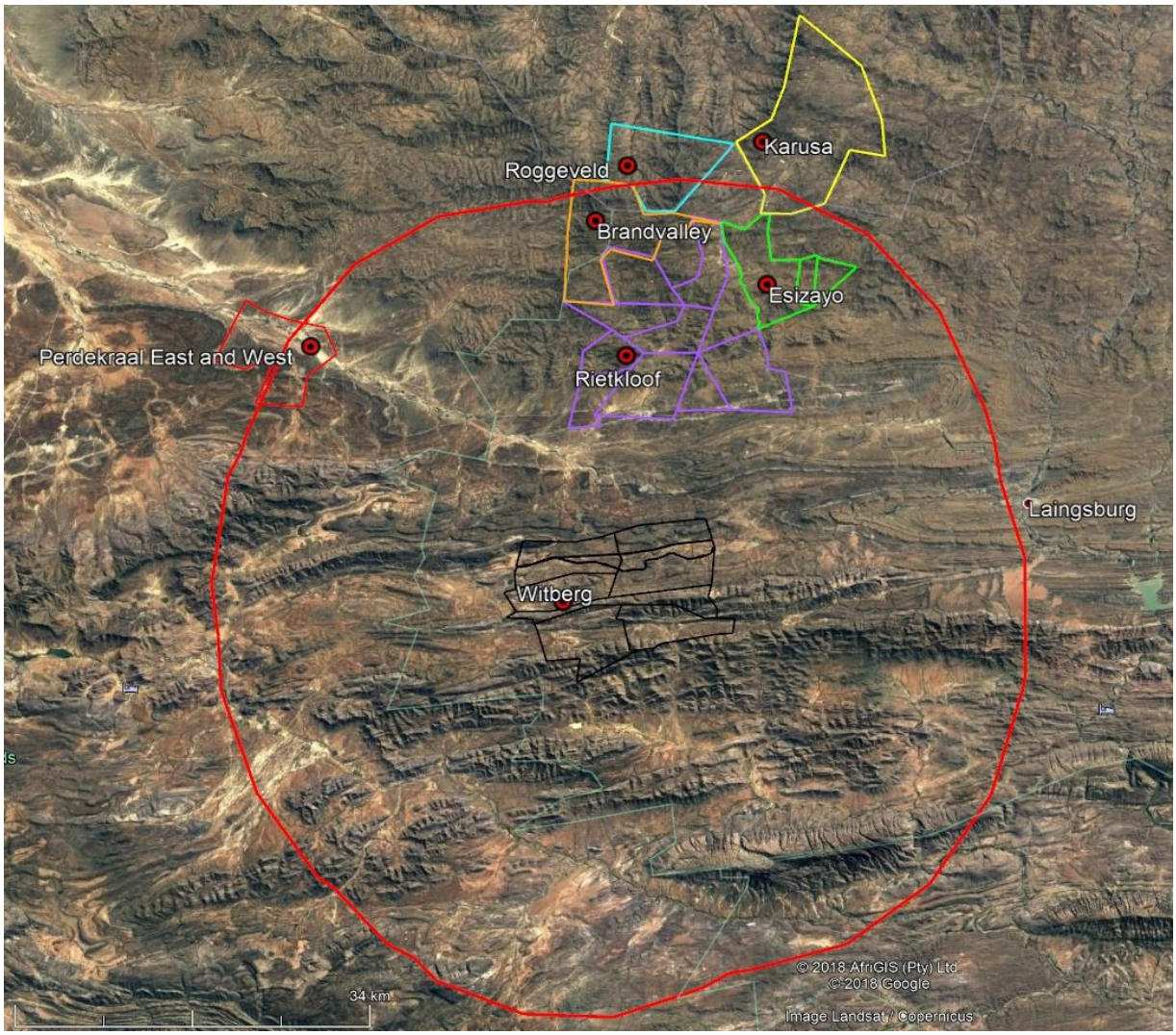

Figure 5: Nearby approved and proposed wind farms in relation to the Witberg wind farm site. The 30km radius is indicated by the red circle.

Table 3 below indicates the current bat impact risk for each site, which is related to the Montane Fynbos and Renosterveld ecoregion in which the listed sites are situated. And also indicates the overall averages without and with the proposed Rietkloof facility. This is according to the "Estimated turbine related bat fatality risk levels based on bat activity levels for different terrestrial ecoregions" as depicted in the "South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction: Edition 4.1" (Sowler *et al*., 2017). The data of bat activity was retrieved from the relevant specialist reports where available.

Table 3: Bat impact risks for the Witberg WEF and surrounding facilities.

Wind Farm	**Highest average bat passes/ hour/ year (>40m above ground)**	**Risk Level (Sowler *et al.*, 2017)**
Rietkloof	0.48	High
Brandvalley	0.33	High
Roggeveld	0.33	High
Esizayo	0.81*	High
Karusa	0.16	Low
Average of facilites without Witberg	**0.33**	**High**
Witberg	0.04	Low
Average of facilites with Witberg	**0.27**	**Medium**

*Where only 10m data could be used reliably, this value was omitted in the average calculations since the risk levels are assigned to activity at height >40m only.

It's important to note that several limitations and inconsistencies exist between sites on the overall total bat passes of each site. This includes specialist methodology and type of bat detectors used, recording conditions and locations of bat detectors. The actual mortality monitoring data from the area will be capable of informing the impacts more accurately.

It is logical to deduce that an increased number of facilities in an area will increase the risk levels of impacts on bats, even though the average risk with Witberg included was lower in **Table 3**. It should be noted that, in this table, the area in between facilities within the 30km has not been considered (this can only be done meaningfully with actual mortality numbers). These areas contribute towards the support of a much larger bat population. The nearby facilities are not neighbouring and will therefore allow for space in between them and the Witberg facility, thereby lowering the cumulative impact that may be determined when operational bat mortality data is available. Ultimately, it remains the responsibility of each wind farm to apply mitigations where needed and to lower their risk levels and estimated impacts below acceptable sustainability thresholds. This will lower the overall cumulative impact of all wind farms in the area.

The 12-month pre-construction 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.

5. IMPACT ASSESSMENT

Only the proposed change in turbine layout and cumulative impacts will be considered in this section, since these are the only factors that results in increased or additional impacts.

5.1. Considering proposed change in turbine layout, operational phase

Table 4: Impact statement of bat mortalities due to moving turbine blades, authorised and proposed layouts.

Nature of impact: Foraging and/or migrating bats can be killed by moving turbine blades, this happens either by direct impact or due to barotrauma.				
	Authorised		**Proposed amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (1)	Local (1)	Local (1)	Local (1)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	High (8)	Low (4)	High (8)	Low (4)
Probability	Highly probable (4)	Improbable (2)	Probable (3)	Improbable (2)
Significance	52 (Medium)	18 (Low)	39 (Medium)	18 (Low)
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Low	Medium	Low	Medium

Irreplaceable loss of resources?	No	No	No	No
Can impacts be mitigated?	Yes	N/A	Yes	N/A

Mitigation: Correct turbine placement out of high sensitivity buffers, and it's also preferable to avoid moderate sensitivity buffers where possible. Where needed curtailment or acoustic deterrents may also be implemented.

Specific mitigations are as follows:

The mitigations are based on the passive data collected over the 12-month pre-construction monitoring study (June 2015). They infer mitigation be applied during the peak activity periods and times, and when the advised wind speed and temperature ranges are prevailing (considering conditions in which 80% of bat activity occurred). Both the temperature and wind speed parameters indicated in **Table 6** must be present simultaneously to infer mitigation. This is due to the fact that they have synergistic or otherwise contradictory influences on bat activity and are never considered in isolation. In general, bat activity is negatively correlated to wind speed and positively correlated to temperature.

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

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

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 initially start off at Level 3 during the dates, times and environmental conditions set out in **Table 6**. Then depending on the results of the post construction mortality monitoring the curtailment can be either relaxed or intensified (moving down or up in the levels) up to a maximum intensity of Level 5. 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 post construction monitoring.

Table 6: The times and date periods when mitigations should be applied initially at the start of the facility operational life.

	Authorised layout: Applies to Turbines 4, 8, 10, 25	**Proposed layout: Applies to Turbines 11, 14, 15, 23**
Spring peak activity (times to implement curtailment/ mitigation)	Based on monitoring station W2 60m data: 15 September - 15 October Sunset – 00:00; and 5:00 – sunrise	Based on monitoring station W2 60m data: 15 September - 15 October Sunset – 00:00; and 5:00 – sunrise
Environmental conditions in which to implement curtailment/ mitigation	Below 5.5m/s measured at 60 height Above 15.5°C measured at 60m height	Below 5.5m/s measured at 60 height Above 15.5°C measured at 60m height
Autumn peak activity (times to implement curtailment/ mitigation)	Based on monitoring stations W3 10m and W4 60m data: 01 February to 15 May Sunset – 00:00; and 5:00 – sunrise	Based on monitoring stations W3 10m and W4 60m data: 01 February to 15 May Sunset – 00:00; and 5:00 – sunrise

Environmental conditions in which to implement curtailment/ mitigation	Below 8.5m/s measured at 60m Above 18.5°C measured at 60m	Below 8.5m/s measured at 60m Above 18.5°C measured at 60m
Residual Risks: Even with the correct turbine placement and curtailment implemented, the possibility remains for bats to be impacted by turbine blades.		

5.2. Considering cumulative impacts, operational phase

During the preconstruction study no cumulative impacts were assessed, therefore it is assessed in this section (also refer to Section 4).

Table 5: Impact statement of bat mortalities due to moving turbine blades, cumulative effect.

Nature:

Foraging and/or migrating bats can be killed by moving turbine blades, this happens either by direct impact or due to barotrauma. Mortalities of bats due to wind turbines during foraging and migration can have significant ecological consequences, as the bat species at risk are insectivorous and thereby contribute significantly to the control of flying insects at night. On a project specific level insect numbers in a certain habitat can increase if significant numbers of bats are killed off. But if such an impact is present on multiple projects in close vicinity of each other, insect numbers can increase regionally and possibly cause outbreaks of colonies of certain insect species.

Additionally, if migrating bats are killed off it can have detrimental effects on the cave ecology of the caves that a specific colony utilises. This is due to the fact that bat guano is the primary form of energy input into a cave ecology system, given that no sunshine that allows photosynthesis exists in cave ecosystems.

	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)

Probability	Probable (3)	Improbable (2)
Significance	39 (Medium)	22 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	N/A

Mitigation:

Adhere to the sensitivity maps by avoiding areas of High bat sensitivity and their buffers as well as preferably avoid areas of moderate bat sensitivity and their buffers.

The high sensitivity valley 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 all facilities adhere to their sensitivity maps. It is essential that project specific mitigations be applied and adhered to for each project, as overarching regional mitigation measures are more complex and less feasible due to habitat and ecological differences between project sites.

The project specific mitigations for this project is as follows:

The mitigations are based on the passive data collected over the 12-month pre-construction monitoring study (June 2015). They infer mitigation be applied during the peak activity periods and times, and when the advised wind speed and temperature ranges are prevailing (considering conditions in which 80% of bat activity occurred). Both the temperature and wind speed parameters indicated in **Table 6** must be present simultaneously to infer mitigation. This is due to the fact that they have synergistic or otherwise contradictory influences on bat activity and are never considered in isolation. In general, bat activity is negatively correlated to wind speed and positively correlated to temperature.

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

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

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 initially start off at Level 3 during the dates, times and environmental conditions set out in **Table 6**. Then depending on the results of the post construction mortality monitoring the curtailment can be either relaxed or intensified (moving down or up in the levels) up to a maximum intensity of Level 5. 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 post construction monitoring.

Table 6: The times and date periods when mitigations should be applied initially at the start of the facility operational life.

	Authorised layout: Applies to Turbines 4, 8, 10, 25	**Proposed layout: Applies to Turbines 11, 14, 15, 23**
Spring peak activity (times to implement curtailment/ mitigation)	Based on monitoring station W2 60m data: 15 September - 15 October Sunset – 00:00; and 5:00 – sunrise	Based on monitoring station W2 60m data: 15 September - 15 October Sunset – 00:00; and 5:00 – sunrise
Environmental conditions in which to implement	Below 5.5m/s measured at 60 height	Below 5.5m/s measured at 60 height

curtailment/ mitigation	Above 15.5°C measured at 60m height	Above 15.5°C measured at 60m height
Autumn peak activity (times to implement curtailment/ mitigation)	Based on monitoring stations W3 10m and W4 60m data: 01 February to 15 May Sunset – 00:00; and 5:00 – sunrise	Based on monitoring stations W3 10m and W4 60m data: 01 February to 15 May Sunset – 00:00; and 5:00 – sunrise
Environmental conditions in which to implement curtailment/ mitigation	Below 8.5m/s measured at 60m Above 18.5°C measured at 60m	Below 8.5m/s measured at 60m Above 18.5°C measured at 60m

Residual Risks:

Even with the correct turbine placement and curtailment implemented, the possibility remains for bats to be impacted by turbine blades.

6. ADVANTAGES AND DISADVANTAGES OF EACH PROPOSED RELEVANT AMENDMENT

Table 7: Summary of the advantages and disadvantages of each proposed relevant amendment. Refer to Section 3 for discussions and explanations.

Proposed amendment	**Advantages**	**Disadvantages**	**Conclusion**
Turbine dimension	Lowest rotor swept height increased from 32m to 52m	Larger rotor airspace occupied.	Negligible effect on impact identified in the most recent bat pre-construction monitoring report dated June 2015.
Output capacity of turbines	None	None	Not relevant to bats.
Extension of Environmental Authorisation	None	None	Data remains valid. Negligible effect on impact identified in the most recent bat pre-construction monitoring report dated June 2015.
Change in turbine layout	Decreased risk of impacts on bats	None	Decrease the significance of impacts originally identified in the EIA bat report dated 2011 for the operational phase. Since the proposed layout has no turbines in high sensitivity buffers

			(**Table 2** and **Figures 1 - 4**).

7. CONCLUSION

The currently authorised turbine dimensions with a hub height of 92m and a rotor diameter of 116m, will result in a lowest rotor swept height above ground of 34m. Whereas, the proposed increased turbine dimensions of up to 120m hub height and up to 136m rotor diameter, will result in an increase of the lowest rotor swept height above ground to 52m. This will result in a total increase in lowest rotor swept height above ground level of 18m from the authorised wind turbine specifications in comparison to the proposed amended turbine specifications.

During the preconstruction study, the two stations with microphones at 60m recorded 1.8 and 6.5 times less bats, than at 10m height. This indicates a clear negative correlation between bat activity and height above ground, meaning the probability of impacts on bats is less at 52m than at 34m. However, the larger rotor diameter of the proposed dimensions will also result in a larger airspace that poses a risk to bats.

Thus, considering the decreased risk of 52m at the lowest rotor swept height, and the increased risk of the larger airspace occupied by a larger rotor diameter, **the proposed turbine dimension change will have a negligible effect on the significance of impacts identified in the most recent bat pre-construction monitoring report dated June 2015.**

The proposed changes in output capacity per turbine is not applicable to impacts on bats. During the preconstruction study no cumulative impacts were assessed, therefore it is discussed and assessed in this report (Sections 4 and 5.2).

The site environment has not changed significantly since the EIA assessment in 2015, extension of the validity of the authorisation by an additional 2 years will have a negligible effect on the significance of impacts identified in the EIA report.

The proposed change in the turbine layout will decrease the significance of impacts originally identified in the EIA report for the operational phase. This is primarily since the proposed layout has no turbines located in high bat sensitivity buffers, and respects the sensitivity map better.

Therefore, the proposed turbine layout is preferable above the authorised layout, and the recommended mitigation measures need to be adhered to for both layout options. The specialist has no objection to the proposed changes of turbine dimensions, output capacity, and the extension of the validity period.

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