BAT IMPACT ASSESSMENT: AMENDMENT

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KORANA WIND ENERGY FACILITY, WESTERN CAPE

Contents

DECLARATION OF INDEPENDENCE

In terms of the National Environmental Management Act of 1998, I, Stephanie C Dippenaar, owner of Stephanie Dippenaar Consulting, operating as a sole proprietor, do hereby declare that I have no conflicts of interest related to the work of this Second Amendment of the Bat Impact Assessment Report: Korana Wind Energy Facility, Northern Cape. I have no personal or financial connections to the relevant property owners, developers, planners, financiers or consultants of the development.

Stephanie C Dippenaar

Signed at Stellenbosch on 3 September 2019

BAT IMPACT ASSESSMENT AMENDMENT: KORANA WEF

1. PROJECT DESCRIPTION

South Africa Mainstream Renewable Power Developments (Pty) Ltd (Mainstream) received Environmental Authorisation (EA) from the Department of Environmental Affairs (DEA) for development of the Korana Wind Farm, located near the town of Pofadder in the Northern Cape Province. Mainstream is currently submitting a Part II amendment application to the DEA to modify turbine specifications for turbines with a larger rotor diameter, hub height and power generation capacity. Stephanie Dippenaar Consulting has been contracted by Mainstream Renewable Power South Africa to undertake an assessment of the project amendments (Table 1) with regards to the potential impacts to bats.

Table 1: Aspects of the proposed amendment

Aspect to be amended	Previously assessed	Proposed amendment
Hub height	Up to 140 m	Up to 200 m
Rotor diameter	Up to 150 m	Up to 200 m
Individual turbine capacity	1.5MW - 4MW	2MW - 7MW

Korana WEF will have a total facility generating capacity of 140 MW, but the exact turbine specifications that will be deployed are not yet known. With the proposed larger turbine model associated with the amendment, less turbines will be constructed to reach the overall export capacity of 140 MW. A few turbines could therefore be removed from the layout during final design and micro-siting.

Table 2 and Figure 1 indicate the increase in the volume of the total sweep area of the proposed larger turbines, if turbine sweep is calculated as a sphere. The lowest point of the sweep of the turbine blades is also indicated, as this could have an impact on bat mortality, see Section 4.1.

Table 2: Changes in area of collision, with an example of 40 turbines with amended specifications.

Aspect to be amended	Previously assessed	Proposed amendment	Difference between previously assessed specifications and amendment	Percentage increase between previously assessed specifications and amendment
Total volume of the sweep of the turbine blades, if calculated as a sphere	0.123697 km^3	0.175924 km^3	0.052227 km^3 more airspace is occupied	42 %
Lowest point of the sweep of the turbine blades, from ground level	65 m	100 m	35 m higher from ground level	53.8 %

2. TERMS OF REFERENCE

The purpose and scope of this report is to assess whether the proposed amendments to the EA will alter the impacts identified in the original bat impact assessment performed by Arcus Consultancy Services[1] dated 9 December 2014. Amendments or additions to the mitigation measures in the existing Environmental Management Programme (EMP) will be identified in this report in order to prevent, manage and mitigate impacts of the proposed turbine changes (if found to be necessary). The cumulative impacts (of wind energy developments within a 20 km radius of the WEF) identified in the original bat impact assessment will be reviewed considering the current developments and updated if necessary.

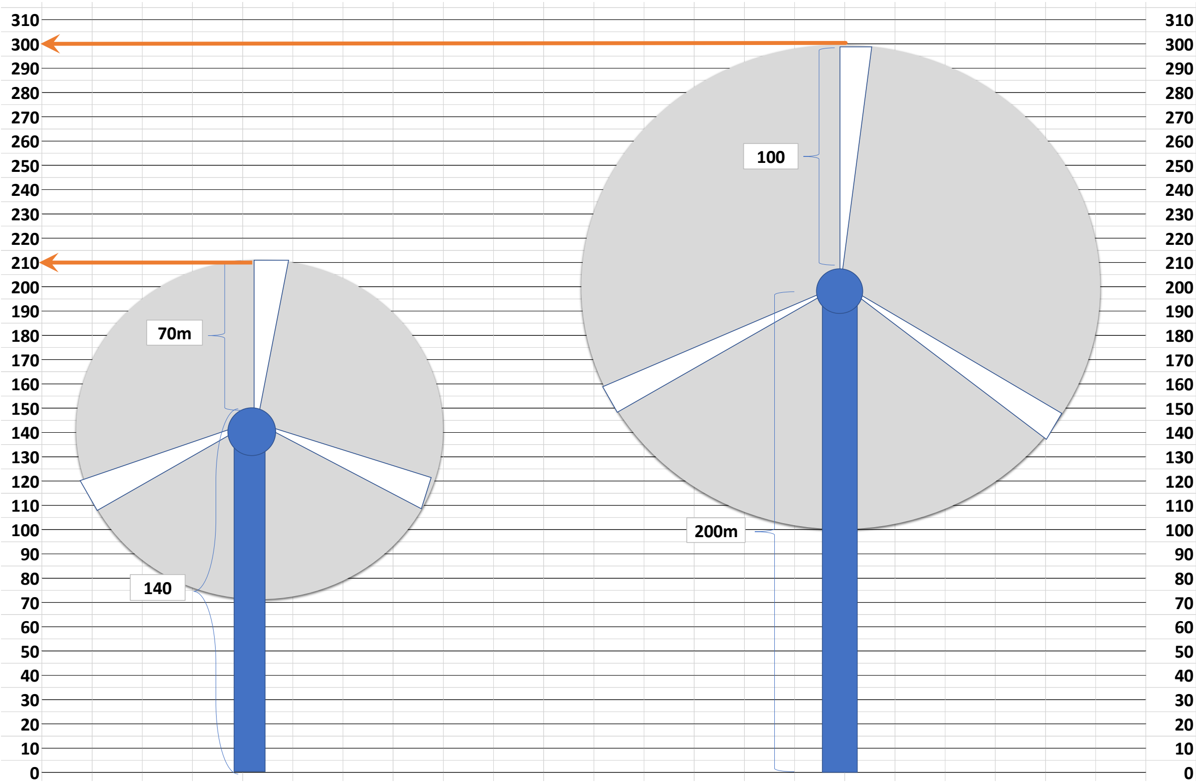

Figure 1: Changes in specifications of turbine dimension

3. METHODS

The current scientific literature was reviewed to gain insight into the relationship of turbine size on bat mortalities to aid in the assessment of the impacts of greater turbine hub height and rotor diameter. The literature was also reviewed for effective mitigation measures for the relevant impacts.

The original bat impact assessment report was reviewed with critical assessment of bat species richness and activity levels on site, the sensitivity map, impact assessment, cumulative impact assessment and recommended mitigation measures considering the proposed project amendments.

[1] Information source: Pre-construction bat monitoring and impact assessment, Pofadder wind energy facility, Northern Cape Final EIA Report (2014)

4. RESULTS

4.1 Literature review

The proposed increased turbine dimensions result in a larger rotor swept area and greater overall height per turbine. The impact relevant to this amendment is the change in risk of barotrauma and direct collision of bats in flight with moving turbine blades. Two studies by Barclay *et al.* (2007) and Georgiakakis *et al*. (2012) reported a positive exponential relationship of bat mortalities with turbine tower height, with no effect of the size of rotor sweep area (blade diameter). Whereas Rydell *et al*. (2010) found significant positive effects of tower height and rotor swept area with bat mortality. Studies by Johnson *et al*. (2003) and Fiedler *et al.* (2007) corroborated findings of increased mortalities with increased turbine dimensions. However, Thompson *et al*. (2017) performed a synthesis and review of mortality data from 218 North American studies representing 100 wind farms and did not find a significant relationship between increased turbine height and increased bat mortality. It is important to note that turbine specifications in the above-mentioned studies (hub height range of 44 m to 98 m and maximum rotor diameter of 180 m) are smaller than the maximum dimensions applied for in this amendment and, the wind farms consisted of much fewer turbines. Rydell *et al*. (2010) found the bat mortality rate to be independent of the size of the wind farm (number of turbines) however, the survey covered a maximum of 18 turbines which is substantially fewer than the authorised 70 turbines for the Korana WEF.

Thaxter and co-workers (2017) undertook the first global quantitative assessment from published literature of the effects of wind farms on bat and bird mortality. They detected a strong positive association between turbine capacity (MW) and collisions per turbine for both bats and birds. Per wind farm energy output, a large number of small turbines resulted in higher predicted mortality rates than fewer larger turbines. The modelled mortality rate was highest when 1000 0.01MW turbines were used, thereafter the mortality rate decreased exponentially up to 1.2 MW turbines. The mortality for bats then increased again from 14 bats with 1.2 MW turbines, to 24 bats with 2.5 MW turbines. Thus, increasing the turbine dimensions with a reduction in total number of turbines would reduce mortality up to a point (1.2 MW turbines), thereafter mortality would increase with an increase in turbine dimensions.

The other consideration is that a greater turbine hub height increases the height of the lower blade tip from the ground, and may shift the species-specific risks towards open air foraging and high-flying species, such as the Molossidae family (Free-tailed bats), while reducing the risk for species flying closer to ground level (Willig *et al.,* 2018). Willig and co-workers (2018) investigated the vertical distribution of bat activity within the European Alps. They demonstrated a clear trend of decreased activity with increased height, most activity was recorded below 50 m height. Mathews *et al.* (2016) found greater species richness and activity levels at ground level than at heights between 30 and 80 m. Wind farm fatalities of clutter-edge foraging species, that do not typically occupy open air spaces high above the ground, have been found in South Africa (Aronson *et al.,* 2013; MacEwan, 2016). Additionally, the Bat Specialist/Consultant (Monika Moir) has observed the trend of higher activity and species richness at lower monitoring systems, usually situated around 10 m, in most preconstruction bat monitoring studies conducted across South Africa. Therefore, it seems that the proportion of bat species at risk may decrease with increased hub height, but open-air high-flying species would have an increased mortality risk. As discussed in Section 4.2.1, an open-air high-flying species, *Tadarida aegyptiaca* (Egyptian free-tailed bat), with a high risk of turbine blade collision (Sowler *et al*., 2017) was detected on site and are thus of greater concern.

4.2 Review of the Final Progress Report of 12-month Long-Term Bat Monitoring Study

4.2.1 Species richness and activity trends

Acoustic monitoring was conducted on six short masts at 12 m height, and one meteorological (met) mast at 12 m and 65 m height for a period of 12 months (22 November 2013 – 25 November 2014). The study was conducted in compliance with the Third Edition of the South African Good Practice Guidelines for Surveying

Bats at Wind Energy Facilities of 2014. Since there have been no significant changes to the environment since the study was completed, and it satisfied the requirements of the guidelines of its time, the study is still considered valid according to the current guidelines (Edition 4.1) that permit a six year validity period.

The height at which monitoring took place is an important consideration for the proposed amendment to assess the relevance of the trends in species richness and activity levels detected at 65 m height, relative to the proposed amended turbine specifications, where the lower tip height is proposed at 100 m. The height at which monitoring took place is 35 m below the lowest reach of the proposed amendment turbine sweep area. Even in optimal conditions this could be lower than the recording range of the systems used during monitoring.

The mean number of bat passes per night detected by the 12 m microphone on the met mast was greater than recorded at 65 m height; however, the mean and median bat passes per night at 65 m height was higher than recorded by POF1, POF3, POF4, POF5 and POF6 systems (12 m masts). Species richness was the same for both recording heights with a total of four species detected on site, *Eptesicus hottentotus* (Long-tailed serotine), *Miniopterus natalensis* (Natal long-fingered bat), *Neoromicia capensis* (Cape Serotine) and *Tadarida aegyptiaca* (Egyptian free-tailed bat). *Tadarida aegyptiaca* (Eqyptian free-tailed bat) was the most abundant species across all monitoring systems and at the 65 m monitoring height. This is a high-flying species with a high risk of collision with turbine blades (Sowler *et al*., 2017). Lower bat activity was detected over the winter months with a steady increase from November 2013 to March 2014, peaking in January 2014. Bat activity was typically higher in the first portion of the night immediately after sunset, with a secondary peak in activity between 02:00 – 04:00am (Arcus Consultancy Services, 2014).

4.2.2 Sensitivity map

The sensitivity map identified potential roosts on site and designated buffers of **300 m and 500 m** around them, as identified and motivated for in the final bat monitoring report (Arcus Consultancy Services, 2014). Siting of turbines, and other construction activities, in these buffers should be avoided. **For this amendment, all components, including the turbine blade tips, must be excluded from entering the buffer areas**.

The Applicant must ensure that turbines are placed at an appropriate distance away from bat sensitivity areas, based on the finalized turbine dimensions. The turbine layout should be approved by a bat specialist upon finalisation of turbine specifications.

4.2.3 Impact assessment

Of the impacts identified in the EIA, the only impacts relevant to this amendment are bat mortalities due to direct blade impact or barotrauma during commuting and/or foraging (Section 4.1.2.1 of the EIA report) and bat mortality during migration (Section 4.1.2.2 of the EIA report). From the final EIA report, the impacts during commuting/foraging were identified as negative medium (score of 56) without mitigation, and reduced to a score of 33, but still rated as negative medium impact with mitigation implementation. From the final EIA report, the impact during migration was identified as negative medium (score of 42) without mitigation and reduced to negative low (score of 20) with mitigation. The recommended mitigation measures from the final EIA report were:

- **Adhere to the bat sensitivity map (avoid development in the demarcated sensitivity areas and their buffers) as indicated in Section 4.2.2.**
- **Implement an operational bat monitoring study immediately after construction of turbines and apply mitigation measures outlined by the Bat Specialist during the operational monitoring study. Mitigations that could be implemented (based on recommendations from the results of the operational monitoring study) include ultrasonic deterrents, raising the cut-in speeds of turbines, turbine blade feathering and targeted curtailment during specific periods for specific turbines.**

Considering the increased airspace that would be occupied by the larger turbines evaluated in this amendment, the higher mortality risk to the dominant species detected on site (*Tadarida aegyptiaca*) and the lack of data within the sweep of the amended turbine blades, the following mitigation measures should be **added to the above mitigation** to avoid a raise in the negative impact rating of the amendment turbine specifications:

- **All turbines must be feathered below cut in speed and not allow for freewheeling during construction and from the start of operation. Bat activity is markedly higher over low wind speed periods. Preventing freewheeling should not affect energy production significantly but will be a substantial bat conservation mitigation measure.**
- **A maximum amount of 42 turbines, with a hub height of 200 m and a rotor diameter of 200 m, is proposed within the provided total output of 140 MW. If more than 42 turbines with these specifications are installed, a curtailment programme will have to be drawn up by a bat specialist and will have to be implemented at the onset of operation of the wind farm. In the case of installation of smaller turbines, more turbines may be installed, subject to agreement of a Bat Specialist.**
- **An operational bat monitoring study should already be in place at the onset of wind farm operation and should be implemented immediately after construction of turbines. Mitigation measures outlined by the Bat Specialist during the operational monitoring study should be applied with due diligence.**
- **To refine mitigation measures and to account for the lack of data within the sweep of this amendment turbine specifications, the appropriate turbines, as indicated by the post-construction bat specialist, should be installed with bat monitoring equipment at height and bat monitoring should start at the onset of turbine operation.**

Considering the greater turbine dimensions proposed in the amendment application, the impact would remain the same as assessed in the final EIA report, on condition of implementation of the above listed mitigation measures, as well as the mitigation recommendations from the final EIA report (Arcus Consultancy Services, 2014), described in section 4.2.1 of this report, and sensitivity buffers recommended in section 4.2.2 of this report.

4.2.4 Cumulative impact assessment

The pertinent threat to bats, from the cumulative impact of several wind energy facilities operating within a single general area, is mortality from turbine blade collision and barotrauma. There is potential for significant loss of locally active bats and migratory bats that will essentially reduce the effective population size and may cause population crashes.

According to the DEA's Renewable Energy EIA Application Database for SA (First quarter 2019), there are currently three authorised wind farms within 20 km of the Korana WEF, namely:

- Khai-Ma WEF (Applicant - Mainstream Renewables)
- Poortjies WEF (Applicant - Mainstream Renewables)
- Proposed wind energy facility and associated infrastructure on Namies wind farm Pty Ltd (EAP – Savannah Environmental Consultants)

Additionally, there are several solar energy facilities authorised in the greater area:

- 75MW Enamandla PV5 projects and associated infrastructure on the farm Hartbeest Vlein No 86 (Applicant – BioTherm Energy)
- Bloemhoek 75MW Solar Energy Facility near aggeneys (Applicant – Solar Capital)

- 70MW Orlight SA Photovoltaic Solar Power Plant on Portion 1 of the Farm Aroams 57 RD (Applicant – Orlight SA)
- Sato Energy Holdings Photovoltaic Project (EAP – SRK Consulting)
- Boesmanland solar farm portion 6 (A portion of portion 2) Farm 62 Zuurwater (EAP – SRK Consulting)
- Sol Invictus 4 PV solar facility and its associated infrastructure (Applicant – Cyralex)

Although solar power installations do not typically contribute directly to bat mortalities, they do result in habitat destruction that may interrupt foraging behaviours.

Currently, there are no guidelines or recommendations of how to mitigate for the cumulative impact of wind farms within a greater area. Cumulative impacts on bats are difficult to accurately assess without baseline data on bat population size and demographics. These data are lacking for many South African bat species. Further research into the populations and behaviour of South African bats is required to inform future assessments of the cumulative effects of wind farms on bats.

This amendment assessment assumes all neighbouring facilities will implement appropriate mitigation measures informed by their preconstruction EIA studies, and that the mitigation measures proposed in this report are adhered to. Thus, there are no additional mitigations required for the proposed amendment with regards to the cumulative impact assessment and there is no change to assessment of the final EIA report.

5. CONCLUSION

After review of relevant scientific literature and the long-term preconstruction monitoring report, the requested amendments to the turbine dimensions proposed for the Korana wind energy facility would increase the negative impacts to bats as identified in the EIA. The mortality risk may be decreased for the lower flying species detected on site as the lower blade tip height increases with larger turbine dimensions. However, there is a higher risk of mortality for high flying species (that is also the most abundant species on site) as the rotor swept area and higher blade tip height are increased with larger turbine dimensions. To account for this higher risk, mitigation measures outlined in section 4.2.3 of this report must be implemented upon construction, and the sensitivity buffers must be revised and calculated with the amended turbine sizes (as described in section 4.2.2 of this report). The turbine layout must adhere to the sensitivity areas and buffers; and the layout should be approved by a bat specialist upon finalisation of turbine specifications. The impact assessment ratings will remain as in the EIA report on condition of implementation of the above-mentioned mitigations.

To reduce bat mortality risk, a three-pronged consideration must be used when selecting the appropriate turbine technology for the wind farm:

- Turbine dimensions with a greater hub height (to increase lower blade tip height and reduce collision risk with lower flying species);
- Turbine dimensions with the smallest rotor diameter (to decreased total tip height and reduce collision risk with high flying species);
- Least number of turbines required to generate the total megawatt output of the facility.

An operational monitoring study must be implemented immediately upon construction of the wind farm and be already in place when turbines are starting to operate. All applicable mitigation measures should be incorporated in the EMPr and mitigation measures recommended by the Bat Specialist during the operational monitoring study must be implemented immediately and in real time. If all above mentioned conditions are met, the amendment is supported from a bat sensitivity perspective.

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