BAT IMPACT ASSESSMENT FOR THE AMENDMENT OF TURBINE SPECIFICATIONS FOR THE SOETWATER WIND ENERGY FACILITY

On behalf of

Savannah Environmental (Pty) Ltd

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1 INTRODUCTION

Savannah Environmental (Pty) Ltd is submitting an application for amendment to the Environmental Authorisation (EA) received for the Soetwater Wind Energy Facility (WEF) to the Department of Environmental Affairs (DEA). The amendments are to change the specifications of the turbines, as assessed in the Environmental Impact Assessment (EIA).

The changes to be applied for are (Figure 1):

- Increase in the rotor diameter from 120 m to up to 150 m;
- Increase in the individual WTG rating from between 2 MW and 3.5 MW up to a maximum of 4.5 MW; and
- Slight adjustment in turbine footprint and road layout.

The above changes result in a reduction in the number of turbines from 56 up to a maximum of 43.

1.1 Terms of Reference

The report has been carried out under the following terms of reference and provides:

- An assessment of all impacts related to the proposed changes;
- Advantages and disadvantages associated with the changes;
- A comparative assessment of the impacts before the changes and after the changes; and
- Measures to ensure avoidance, management and mitigation of impacts associated with such proposed changes, and any changes to the EMPr.

The assessment, undertaken according to the methodology of Savannah Environmental, clarifies whether the proposed changes will:

- Increase the significance of impacts originally identified in the EIA report or lead to any additional impacts; or
- Have a zero or negligible effect on the significance of impacts identified in the EIA report; or
- Lead to a reduction in any of the identified impacts in the EIA report.

2 METHODOLOGY

In carrying out this assessment, Arcus conducted a literature review on bats and wind energy impacts with a focus on the relationship between turbine size and bat fatality. The literature review was carried out using the Web of Science® using the following search terms:

bat OR fatality OR wind energy OR turbine OR wind turbine OR fatalities OR mortality OR mortalities OR kill* OR tower height OR height OR rotor swept zone OR rotor zone OR blades OR turbine blades OR influence OR increas* OR trend OR positive OR decreas* OR relation* OR wind farm OR wind energy facility OR carcass* OR chiroptera OR rotor diameter OR correlat* OR size*

In addition to the outputs from the above search, the following project documentation were reviewed and used to provide context for the impact assessment:

- Animalia (2014). Long term bat monitoring study for the proposed Hidden valley Wind Energy Facility, Western Cape Province.
- Savannah Environmental (2016) Environmental Management Programme: Soetwater Wind Farm near Sutherland, Northern Cape Province
- The Soetwater WEF revised layout.

3 REVIEW

The core issue relevant to this assessment is the impact to bats of increasing the size of the candidate turbines at the Soetwater WEF. The proposed amendment to the turbines at the WEF would result in a greater rotor swept zone and hence a potentially greater likelihood bats would collide with turbine blades or experience barotrauma. The rotor swept zone will increase from 11,304 m^2 up to a maximum of 17,662.5 m^2.

Numerous studies support the hypothesis that taller wind turbines are associated with higher numbers of bat fatalities. Rydell et al. (2010) found a significant positive correlation between bat mortality with both turbine tower height and rotor diameter in Germany. However, there was no significant relationship between bat mortality and the minimum distance between the rotor and the ground. The maximum tower height in their study was 98 m and data on rotor diameter were not given. In Greece, Georgiakakis et al. (2012) found that fatalities were significantly positively correlated with tower height but not with rotor diameter. In their study, maximum tower height and rotor diameter were 60 m and 90 m respectively. In Minnesota and Tennessee, USA, both Johnson et al. (2003) and Fiedler et al. (2007) showed that taller turbines with a greater rotor swept area killed more bats. The maximum heights of turbines in these two studies were 50 m and 78 m respectively. In Alberta, Canada, bat fatality rates differed partly due to differences in tower height but the relationship was also influenced by bat activity (Baerwald and Barclay 2009). For example, sites with high activity but relatively short towers had low bat fatality and sites with low activity and tall towers also had low bat fatality. At sites with high bat activity, an increase in tower height increased the probability of fatality. Maximum turbine height and rotor diameter in this study was 84 m and 80 m respectively.

Turbine size has increased since the above studies were published and no recent data of the relationship between bat fatality and turbine size are available. The maximum size of the turbines in the literature reviewed for this assessment had towers of 98 m and blade diameters of 90 m. Some towers were as short as 44 m and had blade tips extending down to only 15 m above ground level. The towers and blades under consideration in this assessment are significantly taller than this. Currently, the approved turbine dimensions would mean the blade tips extend from 60 m above ground level to 180 m. The amendment would result in the blade tips extending from 45 m above ground level to 195 m, based on the maximum dimensions being applied for (Figure 1).

It is not known what the impact of turbines of this size would be to bats because of a lack of published data from wind energy facilities with turbines of a comparative size. Hein and Schirmacher (2016) suggest that bat fatality should continue to increase as turbines intrude into higher airspaces because bats are known to fly at high altitudes (McCracken et al. 2008; Peurach et al. 2009). However, McCracken et al. (2008), who recorded free-tailed bats in Texas from ground level up to a maximum height of 860 m, showed that bat activity was greatest between 0 m and 99 m. This height band accounted for 27 % of activity of free-tailed bats, whereas the 100 m to 199 m height band only accounted for 6 %. In South Africa, simultaneous acoustic monitoring at ground level and at height is a minimum standard for environmental assessments at proposed wind energy facilities. Based on unpublished data from 10 such sites Arcus has worked at, bat activity is generally greater at ground level (10 m) than at height (45 m to 100 m). Bat activity ranged from approximately double to 65 % higher at ground level compared to at height. Therefore, even though bats are recorded at heights that would put them at risk from taller turbines, the proportion of bats that would be at risk might be less. Furthermore, the number of species that might be impacted would decrease because not all bat species use the airspace congruent with the rotor swept zone of modern turbines owing to morphological adaptations related to flight and echolocation. Bats that are adapted to use open air space would be more at risk, and this risk is positively correlated with the amount of time spent at height (Roemer et al. 2017). In the United Kingdom, both Collins and Jones (2009) and Mathews et al. (2016) showed that fewer species were recorded at heights between 30 m and 80 m compared to ground level. In two regions in France, Sattler and Bontadina (2005) recorded bat activity at ground level, 30 m, 50 m, 90 m and 150 m and found more species and higher activity at lower altitudes.

The increase in the size of the turbines under consideration in this amendment will decrease the distance from the ground to the lowest sweep of the blade tip; from 60 m to 45 m. Bat activity tends to decrease with height, therefore this change could be negative as it could mean more bat species, and a greater number of individual bats, would be at risk. It is possible that some bats species, particularly those not adapted to use open air spaces, are being killed at the lower sweep of the turbine blades so increasing the blade length and having a shorter distance between the ground and the lowest rotor point would be negative. Although Rydell et al. (2010) did not find a significant relationship between bat mortality and the minimum distance between the rotor blades and the ground, data from Georgiakakis et al. (2012) suggest that as the distance between the blade tips and the ground increases, bat fatality decreases.

The disadvantage of the proposed amendments to the turbine dimensions is that the rotors will extend higher into the air and lower to the ground. This could potentially put a greater number of high risk bat species (i.e. those that make use of open air spaces in the middle to upper area of the rotor swept zone) at risk even though their activity levels may be higher at lower altitudes. However, if their activity is higher at lower altitudes, the new turbines dimensions will increase the chance of impacts to these species. The change could also put a greater number of medium-high and medium risk bat species (i.e. those that are active at lower altitudes) at risk. This increased risk is independent of the reduction in the number of turbines because it appears as if there may not be a relationship between the number of turbines at a wind energy facility and bat fatality (Rydell et al. 2010).

4 IMPACT ASSESSMENT

During the four seasons of pre-construction monitoring at the Soetwater WEF, four bat species were recorded; the Egyptian free-tailed bat (*Tadarida aegyptiaca*), Roberts's flat-headed bat (*Sauromys petrophilus*), the Natal long-fingered bat (*Miniopterus natalensis*) and the Cape serotine (*Neoromicia capensis*). The first three species have a high mortality risk from wind turbines while the Cape serotine has a medium-high risk. Except for Roberts's flat-headed bat, all these species have suffered mortality at wind energy facilities in South Africa (Doty and Martin 2012; MacEwan 2016). The pre-construction monitoring revealed that bat activity for these species is low and that the risk to bats posed by the Soetwater WEF is subsequently low. In addition, the pre-construction monitoring programme resulted in delineated exclusion zones for the avoidance of areas sensitive to bat impacts which involved the reduction in the number of turbines. These have been adhered to in the turbine layout and no turbines are located in high risk areas for bats. However, pre-construction activity data cannot accurately predict bat fatality during operation of a wind energy facility so a precautionary approach was adopted during this impact assessment (Hein et al. 2013).

Of the impacts identified in the EIA, only mortality of species due to collision with turbine blades or due to barotrauma is relevant to this amendment. This includes mortality during migration. However, only one migratory species was recorded during the pre-construction monitoring, the Natal long-fingered bat. This species was recorded very infrequently and it is anticipated that the changes to the turbine dimensions would not alter the current impact assessment for this species. The significance of non-migratory impacts after the proposed change would likely increase because of the greater rotor swept zone and because the rotor blades will extend closer to the ground. It would therefore be preferential if taller turbines were used for the given rotor dimensions as this would increase the minimum distance between the blade tips and the ground. If this is not possible, the blade length should be restricted to 140 m.

Animalia rated the significance of bat mortality as medium (33) before mitigation and low (18) after mitigation. Based on our review and knowledge of the area, this would increase to medium (48) before mitigation but remain low (20) after mitigation given that the turbine layout adheres to the recommended sensitivity exclusions zones and based on the mitigation measures proposed by Animalia (Table 1). The difference before mitigation is a higher magnitude and a higher probability of the impact associated with the increased turbine size and the decreased proximity of the blade tips to the ground. No additional impacts are anticipated based on the proposed amendments to the turbine dimensions.

Table 1: Impact Assessment for Increasing Turbine Size at the Soetwater WEF

Nature: Mortality of bats due to collision with turbine blades or barotrauma caused by turbine operation.				
	Authorised		**Proposed Amendment**	
	Without Mitigation	With Mitigation	Without Mitigation	With Mitigation
Extent	Low (1)	Low (1)	Low (1)	Low (1)
Duration	Long term (4)	Long term (4)	Long term (4)	Long term (4)
Magnitude	Moderate (6)	Low (4)	Moderate (7)	Low (4)
Probability	Probable (3)	Improbable (2)	Highly Probably (4)	Improbable (2)
Significance	**Medium (33)**	**Low (18)**	**Medium (48)**	**Low (18)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Low	Low	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	No	Yes	Yes
Can impacts be mitigated?	Yes	-	Yes	-
Mitigation: All currently proposed mitigation measures in Animalia (2014) and Savannah Environmental (2016) should be adhered to. An additional mitigation measure would be to limit the increase in blade length to 140 m.				
Cumulative Impact: The changes being applied for should not result in an increase in cumulative impacts as assessed by Animalia (2014).				
Residual Impacts: No change from Animalia (2014).				

5 CONCLUSION

It is possible that increasing the turbine dimensions at the Soetwater WEF would increase impacts to bats despite the facility having fewer turbines. However, based on bat activity levels as assessed from pre-construction monitoring data in the area, impacts to bats of the Soetwater WEF are likely to remain of a medium significance before mitigation and low after mitigation given the positions of the turbines adhering to the recommended sensitivity exclusions zones. Therefore the amendment to the rotor size and adjustments to turbine positions does not result in a change to the overall significance of the impacts to bats and the amendment can be supported. However, the weighting of the significance of the potential impact with the proposed amendment does increase overall, but the rating of medium significance remains, as previously assessed. A precautionary approach should be adopted and the degree to which the blade length is increased should be limited.

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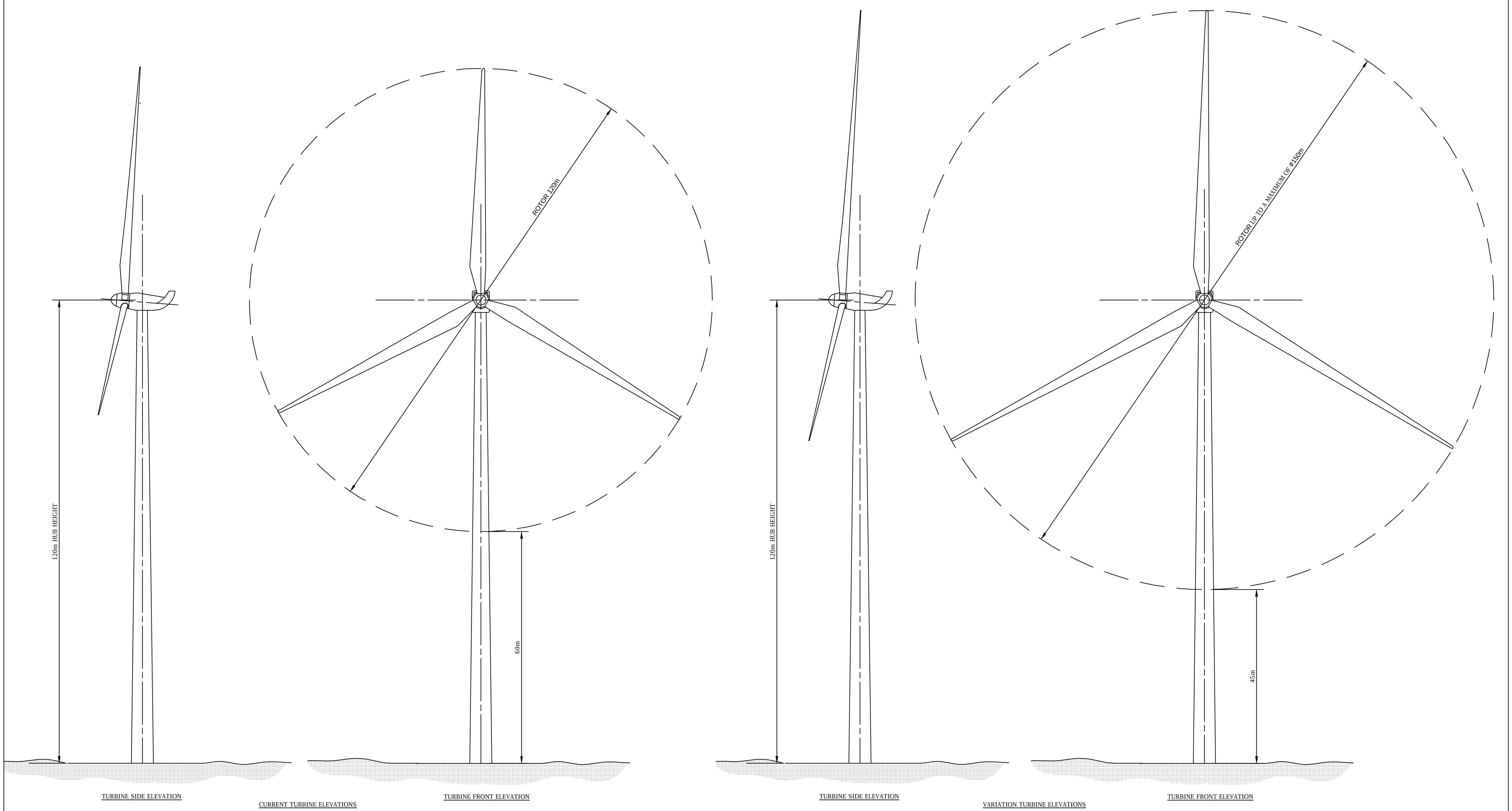

Project Title

IMPACT ASSESSMENT FOR THE AMENDMENT OF TURBINE SPECIFICATIONS SOETWATER ENERGY FACILITY

Client

SAVANNAH ENVIRONMENTAL (PTY) LTD

Drawing Title

FIGURE 1

TURBINE ELEVATIONS

Purpose of issue: PRELIMINARY

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