ZONNEQUA WIND FARM
AMENDMENT APPLICATION BAT IMPACT ASSESSMENT

On behalf of

Savannah Environmental (Pty) Ltd

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Prepared By:

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1 INTRODUCTION

Genesis Zonnequa Wind (Pty) Ltd received Environmental Authorisation on 18 February 2019, and is proposing to amend the turbine specifications and layout of the Zonnequa Wind Farm (DEA ref.: 14/12/16/3/3/1/1970). The intended amendments include:

- Reduction of the number of turbines from up to 56 turbines to up to 35 turbines
- Hub height from up to 130 m to up to 150 m
- Tip height from up to 205m to up to 240m
- Individual turbine capacity from up to 4.5 MW to up to 7 MW

This report presents a comparative assessment of the above amendments with respect to impacts on bats as identified during the Basic Assessment process for the wind farm.

1.1 Terms of Reference

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

- An assessment of all impacts related to the proposed changes;
- Advantages and disadvantages associated with the proposed 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.

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 BA report, or lead to any additional impacts; or
- Have a zero or negligible effect on the significance of impacts identified in the BA report; or
- Lead to a reduction in any of the identified impacts in the BA 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® and Google Scholar 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 rotor swept area 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 documentation were reviewed and used to provide context for this amendment assessment:

- Savannah Environmental (2018). Final Basic Assessment Report: Zonnequa Wind Farm, Northern Cape Province;
- Savannah Environmental (2018). Environmental Management Programme: Zonnequa Wind Farm, Northern Cape Province; and
- Animalia (2018). Bat Impact Assessment Report and Final Report of a 12-month Long-Term Preconstruction Bat Monitoring Study For the proposed Zonnequa Wind Farm, Northern Cape.

3 REVIEW

The core issue relevant to this amendment assessment is the impact to bats of increasing the size of the turbines at the Zonnequa Wind Farm. The proposed amendment to the turbine specifications at the wind farm would result in a greater rotor swept area per turbine and hence a potentially greater likelihood that bats would collide with turbine blades or experience barotrauma.

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 addition, there was no relationship between bat fatality and the number of turbines at a wind energy facility. However, the largest wind energy facility in this study only has 18 turbines (Rydell et al. 2010) which is significantly fewer than the Zonnequa Wind Farm which is currently approved for up to 56 turbines.

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. Despite the above support for the hypothesis that taller wind turbines kill more bats, in a review of 40 published and unpublished studies in North America, Thompson et al. (2017) found no evidence that turbine height or the number of turbines influences bat mortality. Berthinussen et al. (2014) also found no evidence of modifying turbine design to reduce bat fatalities. The relationship between bat mortality and turbine size, or number of turbines at a wind energy facility, is therefore equivocal.

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 (where indicated in each study) for this assessment had towers of 98 m and rotor 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.

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 may have a negative impact and potentially place a greater diversity of species at risk. In South Africa, evidence of fatality for species which typically do not forage in open spaces high above the ground, is available from several wind energy facilities (Aronson et al. 2013; Doty and Martin 2012; MacEwan 2016). Although Rydell et al. (2010) did not find a significant relationship between bat mortality and the minimum distance between the rotor 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.

It is not known what the impact of turbines of the size proposed for the Zonnequa Wind Farm 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; Roeleke et al. 2018). 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 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 18 such sites Arcus has worked at, bat activity and species diversity is greater at ground level than 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. Further, the number of species that might be impacted would decrease because not all bat species use the airspace congruent with the rotor swept area of modern turbines owing to morphological adaptations related to flight and echolocation. Bats that are adapted to use open air space, such as free-tailed and sheath-tailed bats, would be more at risk.

In the United Kingdom, both Collins and Jones (2009) and Mathews et al. (2016) showed that fewer species, and less activity, 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. Roemer et al. (2017) found that at 23 met masts distributed across France and Belgium, 87 % of bat activity recorded was near ground level. However, the authors also showed a significant positive correlation between a species preference for flying at height and their collision susceptibility, and between the number of bat passes recorded at height and raw (i.e. unadjusted) fatality counts. In a similar study in Switzerland, most bat activity was recorded at lower heights for most species but the European free-tailed bat had greater activity with increasing height (Wellig et al. 2018). These results suggest that on average, bat activity is greater at lower heights but that there are important differences across species – those species adapted to using open air spaces are at greater risk.

4 IMPACT ASSESSMENT

Of the impacts identified in the BA, only mortality of species due to collision with turbine blades or due to barotrauma, and cumulative impacts, are relevant to this amendment. The significance of all other identified impacts on bats associated with the development will remain the same as per the BA report.

The potential collision impact to bats is currently rated as medium before, and low after mitigation with avoiding sensitive areas for bats being the major mitigation measure proposed, along with blade feathering. The significance of the impact after the proposed amendment would be dependent on the size of the turbines chosen. Our assessment is based on the scenario where turbines of the maximum dimensions being applied for are used. This would result in turbines having a ground clearance to minimum blade tip of 60 m and maximum blade tip of 240 m. This would increase risk to high flying species such as free-tailed bats because the turbines blades would extend higher into the air. Risks to lower flying species may be reduced because the turbine blades would sweep down five meters higher above the ground. However, the overall project risk to bats would remain medium before mitigation, and low after mitigation because very low activity was recorded at 97 m, which is the only proxy for data at height. This assumes that activity does not increase above 97 m. As such, the impact assessment tables presented by Animalia 2018 have not been updated as they capture the risk to bats sufficiently considering the proposed amendments. All current mitigation measures must be adhered to. However, the mitigation measures related to buffers need to be updated to reflect the changes in turbine size.

The exact turbine dimensions being applied for are up to 150 m for the hub height, and up to 180 m for the rotor diameter. Within this range, the impacts to bats and associated buffer zones needed to limit impacts (as an initial mitigation) will vary depending on the size of the turbines used. Turbines with a lower ground clearance will need to be placed further away from buffers than turbines with a higher ground clearance. For example to determine the buffer distances required to ensure that no turbine blades enter the bat buffers, the following formula should be used (Mitchell-Jones and Carlin 2014):

$$b = \sqrt{(bd + bl)^2 - (hh - fh)^2}$$

Where: bd = buffer distance, bl = blade length, hh = hub height and fh = feature height (zero in this instance). "b" is the distance required between the base of the turbine and the edge of the buffer area, to ensure no blade overhang into the buffer area.

The exact turbine dimensions that will ultimately be used are not known so a worst case scenario was used to update the bat buffer areas. These buffers are the primary mitigation measure proposed by Animalia to avoid impacts. A turbine with a low hub height (110 m) and with the maximum blade length being applied for (90 m) was used. Such a turbine would have a ground clearance of 20 m. Based on this, each turbine base must be 155 m from the moderate sensitivity areas and 268 m from the high sensitivity bat areas (Figure 1). No turbines are located with the no-go high sensitivity areas but seven turbines of the amended layout are within moderate sensitivity areas, compared to nine turbines of the currently approved layout. All buffers proposed are to blade tip, i.e. no part of the blade tip must extend into the buffer areas proposed. The moderate sensitivity buffer is not strictly a no-go for turbine placement, but turbine placement should have a hierarchy approach to avoid these areas in the first instance.

5 CONCLUSION

Compared to the previous impact assessment undertaken by Animalia in 2018, it is likely that the amendments to the turbine dimensions proposed for the Zonnequa Wind Farm would not increase impacts to bats overall. Cumulative mortality impacts would also not increase beyond what was previously assessed and rated. However, there may be additional impacts to high flying species because the blade tips will extend higher into the air. Risks to lower flying species may be reduced as the blades will be higher above the ground.

The key initial mitigation measure that should be implemented at the Zonnequa Wind Farm would be adherence to the updated sensitivity map (Figure 1). The sizes of the bat buffers have been increased to reflect the changes in the turbine size. An additional mitigation measure recommended by Animalia (2018) is that curtailment via blade feathering must be applied to all turbines from sunset until sunrise every night during March, April, May, August and September. The requirements of curtailment and blade feathering and the application thereof, as contained in the EMPr and contained in Animalia 2018, still apply and no changes to this have been made based on this amendment assessment. Operational monitoring must also be carried out as per best practise (i.e. for a minimum of two years) and based on these results, adjustments to the curtailment may be needed or the use of acoustic deterrents investigated. If these mitigation measures are adhered to, the specialist accepts the proposed amendments.

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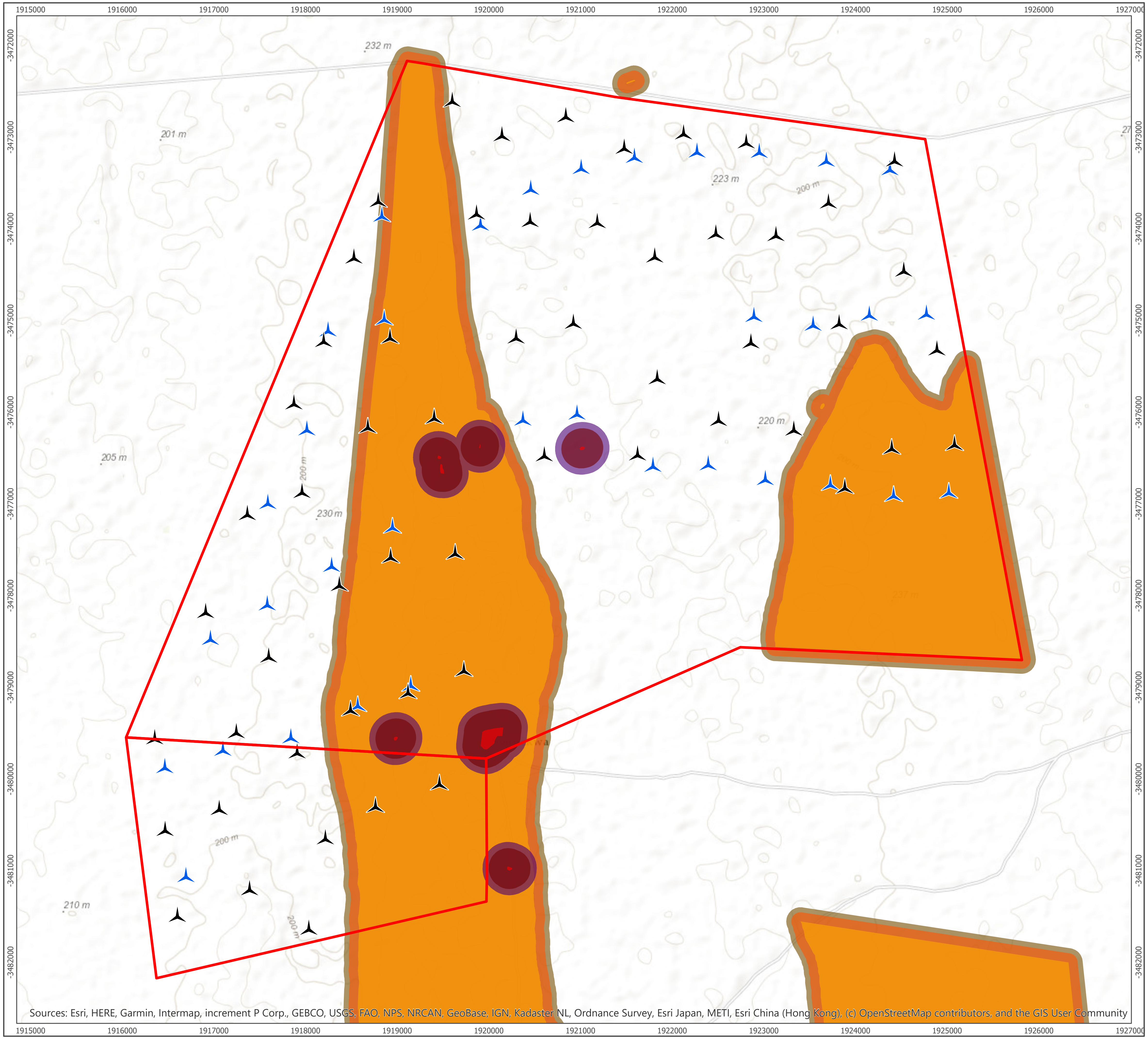

ARCUS

Zonnequa Site Boundary
Zonnequa Layout
Zonnequa Amended Layout
Moderate Sensitivity Area
Moderate Sensitivity 100 m Buffer (Current)
Moderate Sensitivity 155 m Buffer (Amended)
High Sensitivity Area
High Sensitivity 200 m Buffer (Current)
High Sensitivity 268 m Buffer (Amended)

1:40 000 Scale @ A3

0 1 2 km NORTH

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Bat Sensitivity Map
Figure 1

Zonnequa Wind Energy Facility Amendment Application Bat Impact Assessment

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