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PART 2 EA AMENDMENT FOR THE PROPOSED HAGA HAGA WIND ENERGY FACILITY EASTERN CAPE PROVINCE

On behalf of

Coastal and Environmental Services (Pty) Ltd

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1 INTRODUCTION

Coastal and Environmental Services (Pty) Ltd are submitting a Part 2 EA Amendment for the Haga Haga Wind Energy Facility (WEF), which was granted environmental authorisation in July 2019. The aim of this report is to consider how the proposed amendments may influence the previously assessed impacts to bats. The amendment will result in changes to the turbine dimensions and the number of turbines (Table 1).

Table 1: Proposed Amendment for the Haga Haga WEF

Turbine Aspect	Approved	Proposed Amendments
Hub height	Up to 134 m	Up to 180 m
Rotor diameter	Up to 150 m	Up to 200 m
Upper tip height	Up to 200 m	Up to 290 m
Lower tip height	Down to 59 m	Down to 80 m
Number of Turbines	42	36

In addition, internal WEF roads are proposed to increase by 2 m, and a Battery Energy Storage Facility will be included. Both of these proposed amendments will not pose a significant risk to bats and are therefore not assessed further in this report.

2 EFFECT ON CURRENT IMPACTS

Pre-construction bat monitoring was undertaken between May 2016 and May 2017. Several impacts to bats were identified and of these, mortality associated with wind turbines will pose the greatest risk to bats. Therefore, this report only focuses on this impact. The Final Environmental Impact Assessment Report (FEIAR) rated the overall impact of the Haga Haga WEF to bats as medium. However, the specific impact rating for bat mortality was rated as low before, and low after, mitigation.

Some evidence suggests that larger turbines kill more bats (Baerwald and Barclay 2009) or that as the distance between the blade tips and the ground increases, bat fatality decreases (Georgiakakis et al. 2012). However, other studies have found no evidence that turbine height or the number of turbines influences bat mortality (Berthinussen et al. 2014; Thompson et al. 2017). The relationship between bat mortality and turbine size, or number of turbines at a wind energy facility, is therefore equivocal. The reason for the equivocal relationship is very likely driven by the manner in which studies account for biases in the search protocols (i.e. searcher efficiency, carcass persistence, crippling bias, search radius bias) and because of large variation in search effort, particularly the search interval, across studies (Smallwood 2020, Smallwood and Bell 2020). It is therefore difficult to predict the scale of the impact to bats based on turbine size alone but it is likely that increased tower height increases collision risk, at least in the USA (Smallwood 2020). Thus, the proposed 46 m increase in **hub height** (Table 1) may theoretically increase impacts to bat species making use of the higher airspace.

Data from pre-construction and operational studies in South Africa (Arcus; unpublished data) have demonstrated that bat species diversity and bat activity tend to decrease with height at most sites. The pre-construction monitoring data for the Haga Haga WEF showed that between May and August, bat activity was greater at 90 m compared to 10 m. However, between September and April, activity was either greater at 10 m or there was little difference between the activity at 10 m and at 90 m. Since there are no data available for the site above 90 m, it is not possible to empirically determine if the increased hub height will increase risk to bats. The maximum height at which data are available is below both the approved and proposed amended hub heights, making it impossible to accurately assess risk. In order to do this, data from at least above 134 m at the site would need needed.

Elsewhere, bats are known to forage high in the air, with evidence of bat activity at 200 m in Thailand (Nguyen et al. 2019), 600 m in Zimbabwe (Fenton and Griffin 1997), and even up to 1000 m above ground level in Texas (McCracken et al. 2008). Nguyen et al. (2019) showed that bat activity at 100 m and 200 m was higher than at ground level for the Wrinkle-lipped free-tailed bat, while both Fenton and Griffin (1997) and McCracken et al. (2008) showed that the vertical activity profile of various free-tail bat species can have two peaks; one between the ground and 100 m, and the second between 200 m and 500 m.

Therefore, the increase in the hub height may increase impacts to high flying bat species by elevating the rotor swept area, particularly to free-tailed bats, fruit bats and tomb bats which are all present, and have fatally collided with turbines, in the Eastern Cape. While the increased hub height might be negative for high flying bat species, the proposed amendment might decrease potential impacts to lower flying species. These species would have a reduced likelihood of encountering turbine blades that are higher in the air, which is a positive aspect of the proposed changes (Table 2).

While there are limited data on the relationship between **rotor diameter** and bat fatality for turbines of the size being proposed for the Haga Haga WEF, it is logical to assume that increasing the rotor swept area would likely increase bat fatality, but this remains untested in South Africa. The approved rotor swept area is approximately up to 17,672 m^2, which would increase to up to 31,416 m^2. However, the increased rotor diameter is associated with an increased hub height and would be higher in the air. The increased rotor diameter may therefore also have a differential impact to bat species, with high flying species being impacted more (Table 2).

The increase in the **upper tip height** from 200 m to 290 m would only impact high flying species. It is unlikely that this additional 90 m would result in a significant difference in fatality for this group of bats (Table 2) and would not change the previous assessments findings.

Fatalities of bats in South Africa have occurred among species that typically do not use high, open air spaces, suggesting that these species are likely killed in the lower portion of the rotor swept area. Based on Arcus' experience, turbines with lower tip heights may result in greater fatality. The mean **lower tip height** of operating turbines in South Africa is 35 m, thus both the approved and proposed lower tip heights of no less than 59 m and 80 m respectively are significantly higher. The proposed amendment to increase the lower tip height is positive for lower flying species because they are less likely to encounter turbine blades. For high flying species, this change would be neutral because these bats would be active across most of the rotor swept area (Table 2).

Based on Arcus' experience in South Africa, the **number of turbines** does not appear to influence bat fatality and that various aspects of turbine dimensions, and turbine location are better predictors of risk. In addition, the proposed reduction is only for six turbines and it is likely that the fewer larger turbines might supersede any positive gains from having fewer turbines, unless the number of turbines was reduced even further. Therefore, this specific amendment is neutral (Table 2).

Table 2: Summary of the Impact Status of the Proposed Amendments

Proposed Amendment	Impact Status		
	Positive	Negative	Neutral
↑ Hub height	For low flying species	For high flying species	-
↑ Rotor diameter	For low flying species	For high flying species	-
↑ Upper tip height	For low flying species	For high flying species	-
↑ Lower tip height	For low flying species	-	For high flying species
↓ Number of Turbines	-	-	For all species

The proposed amendments will have a differential impact on bat species. Most of the changes will be positive for low flying species but negative for high flying species. The amendment will not alter the overall impact of the Haga Haga WEF which was rated as medium in the FEIAR. However, Arcus believes that the impact rating for bat mortality (rated as low before and after mitigation) was underestimated in the FEIAR and that this should increase to medium before and low after mitigation before the proposed amendments. The proposed amendments will not increase this rating further based on the data reviewed in the pre-construction monitoring report.

3 EFFECT ON MITIGATION MEASURES

Mitigation options for bats can be categorised into avoidance and minimisation techniques. Avoidance includes buffering key habitats and considering turbine design so that potential interactions between bats and wind turbines are spatially limited as much as possible. Minimisation relates to mitigating residual impacts to bats primarily through various forms of curtailment or by using ultrasonic acoustic deterrents.

Avoidance mitigation techniques have been incorporated by buffering key habitat features for bats. Buffers of either 100 m, 200 m or 500 m to blade tip were applied depending on the specific features. Determining the distance to the turbine base is dependent on the hub height and blade length of the proposed turbines used (Mitchell-Jones and Carlin 2014). Because the exact dimensions of the turbines are unknown and only a range was approved, and is proposed in this amendment, a worst-case scenario was developed based on a lower tip height of 40 m.

3.1 Approved Layout

The worst-case scenario results in buffers to the base of the approved turbines of 132 m, 250 m or 563 m. Eight turbines in the approved layout are within these buffers and must be relocated if the worst-case scenario turbine dimensions are utilised. Alternatively, a turbine with a taller hub height, and/or shorter blades (resulting in a minimum clearance distance of 40 m or more) must be used.

3.2 Proposed Amendment Layout

The worst-case scenario results in buffers to the base of the proposed turbines of 143 m, 265 m or 583 m. No turbines in the proposed layout are within these buffers (Figure 1).

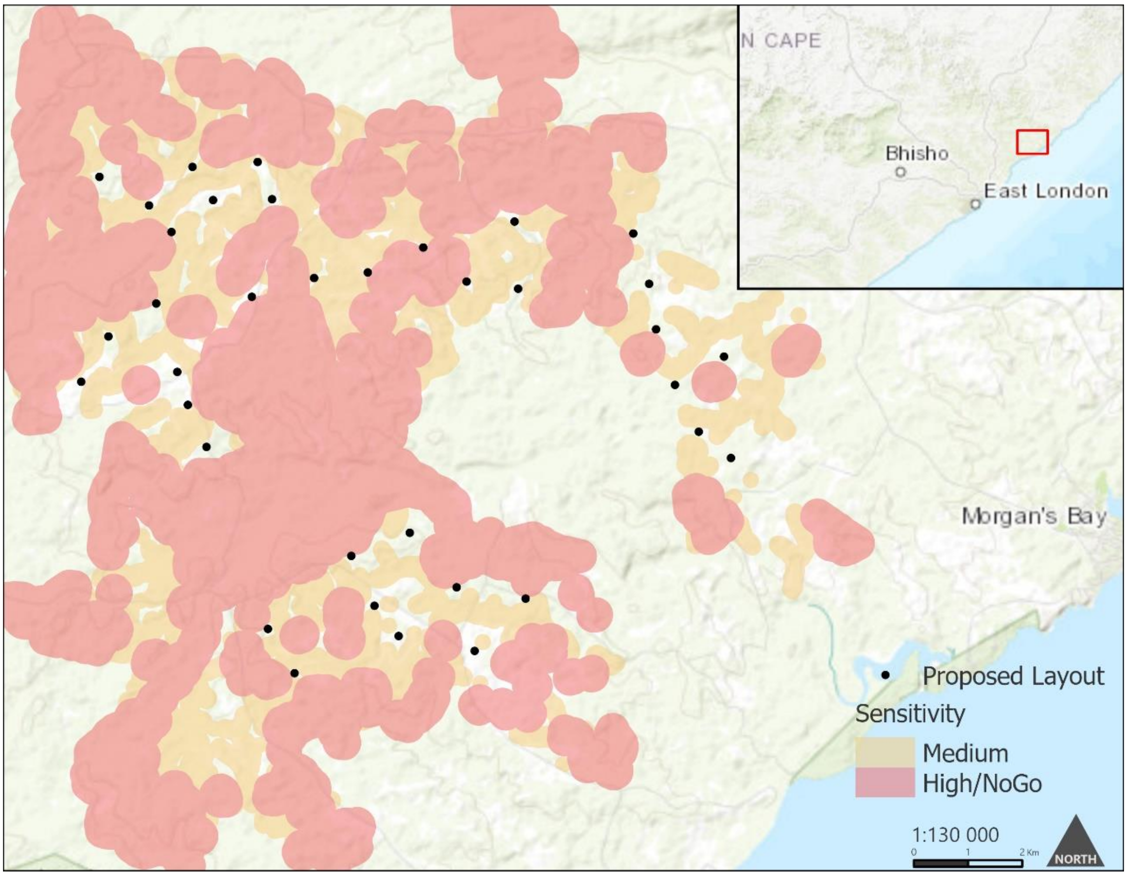

Figure 1: Bat Constraints Map for the Haga Haga WEF.

3.3 Residual Impacts

Because bat activity is more intense next to vegetation structures and water, and tends to be associated with fine scale vegetation structure patterns (Ober and Hayes 2008, Sirami et al. 2013, Heim et al. 2018), buffer zones to exclude wind turbines around these landscape features are hypothesized to reduce impacts. However, species differ in their degree of association with vegetation structures, including seasonally. Further, some bat species are attracted to and investigate turbines (Horn 2008, Cryan et al. 2014; Foo et al. 2017). Therefore, even though turbines are spatially distanced from key habitat features, bats may still collide with turbine blades resulting in residual impacts. To reduce these residual impacts, more active mitigation measures are needed.

Assuming the buffer zones and lower tip height of 40 m or greater will provide protection to some species of bat, and because the magnitude of bat activity was rated medium overall, residual impacts might be low. These impacts will need to be evaluated during operational monitoring and assessed relative to threshold guidelines applicable at the time (currently MacEwan et al. 2018). Should thresholds be exceeded, curtailment or deterrents must be used. Curtailment and deterrents are known to reduce bat fatality (Arnett and May 2016; Hayes et al. 2019, Weaver et al. 2020) and because curtailment is known to be more successful, it must be prioritised. The carcass search data must be assessed each month to determine the observed and estimated fatality rate.

4 EFFECT ON CUMULATIVE IMPACTS

According to the EMPr, cumulative impacts of the Haga Haga WEF will be "*low to medium negative*". The proposed amendments will not increase this rating further based on the data reviewed in the pre-construction monitoring report, provided all mitigation measures are adhered to including the potential need for curtailment or deterrents should fatality thresholds be exceeded.

5 EFFECT ON CURRENT EA CONDITIONS

- The EA must include a condition that the lower tip height must be 40 m or greater.
- The EA must include a condition that curtailment or deterrents must be used if bat fatality exceeds threshold levels as described in threshold guidelines applicable at the time (currently MacEwan et al. 2018).

6 CONCLUSION

The proposed amendments will have a differential impact on bat species. Most of the changes will be positive for low flying species but negative for high flying species. The amendment will not alter the overall impact of the Haga Haga WEF which was rated as medium in the FEIAR. The specific impact rating for bat mortality has been increased to medium before and low after mitigation before the proposed amendments because it was previously underrated in the FEIAR in Arcus' opinion. The proposed amendments will not increase this rating further based on the data reviewed in the pre-construction monitoring report.

Provided the mitigation measures are adhered to, including avoiding the placement of turbines in high sensitivity areas, maintaining a lower blade sweep of at least 40 m, and using curtailment or deterrents if bat fatality exceeds threshold levels, the proposed development can proceed without unacceptable impacts to bats.

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