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To: Donna Bolton
Ark Energy
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Ref #: NBAPPWF20221125
Date: 25 January 2023
CC: Anahita Jungalwalla - Anahita@eraplanning.com.au

Re: St Patricks Plains Eagle Utilisation - Avoidance Rate Determination

Dear Donna,

We understand that the Environment Protection Authority (EPA) Tasmania and the Department of Climate Change, Energy, the Environment and Water (DCCEEW) requested a clarification of the avoidance rates used in the Collision Risk Model (CRM) for St Patrick's Plains Wind Farm (SPPWF) Environmental Impact Statement (EIS).

Key definitions

A key module of CRMs (including the NA-BAND model we applied at SPPWF) is the adjustment of the number of flights at risk of collision with a turbine by the ability for the species to avoid the turbine (i.e. the 'avoidance rate').

Birds can avoid interaction and collision with turbines via alteration of behaviour on three scales:

1. **Macro-avoidance**: Avoidance of the subject site in its entirety.
2. **Meso-avoidance**: Avoidance of the turbine infrastructure through alterations in flight path through the subject site.
3. **Micro-avoidance**: The birds ability to fly through the risk zone of the turbine (i.e. the envelope of the tower and blade sweep) and avoid the turbine infrastructure. This includes flying 'through' the blade sweep or going over / under the blade swept area.

In the Nature Advisory Model (and the Biosis CRM) the 'CRM avoidance parameter' refers to the total avoidance at all three scales, compared to the site with no turbines present.

These scales are visualised in Figure 1.

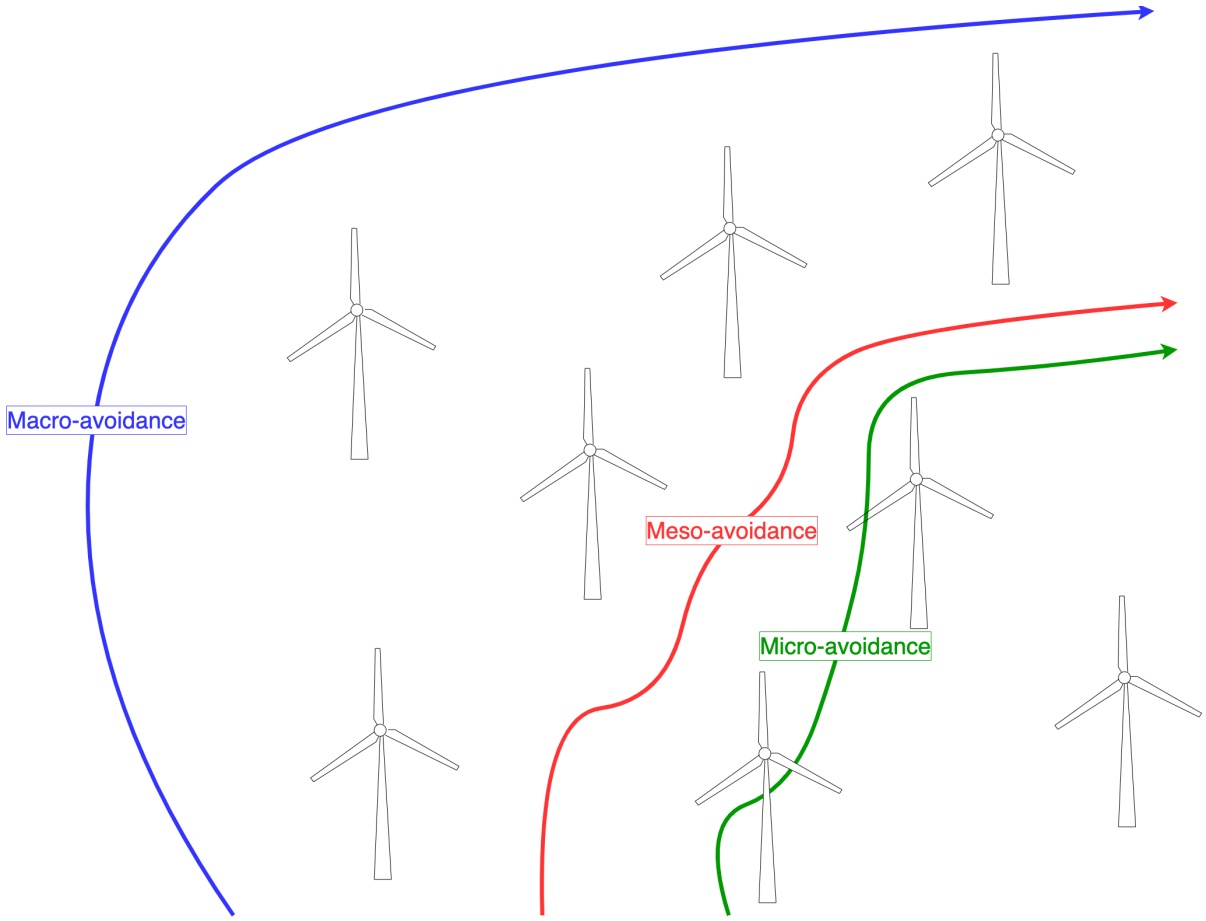


Figure 1: Levels of avoidance of wind farm turbines. Arrowed lines represent bird flights with macro- (blue line), meso- (red line) or micro-avoidance (green line).

To our knowledge, very few studies have been published on the avoidance behaviour of Australian birds. The Tasmanian Wedge-tailed Eagle (*Aquila audax fleayi*, TWTE) and the White-bellied Sea-eagle (*Haliaeetus leucogaster*, WBSE) , however, have been studied behaviourally through direct flight path observation (Hull and Muir 2013) as well as by comparison of predicted and actual collision rates (Smales et al. 2013).

To assist with clarifying the avoidance rates applied in the SPPWF CRM, I will outline the definitions used and the evidence we relied on. Our advice drew on the published works listed as references and Symbolix's significant involvement in each. Symbolix Director, Dr Stuart Muir, was co-author on Hull and Muir (2013) and Smales et al. (2013), and Symbolix staff were contributors to all the studies named in the attached reference list.

Clarification of definitions in Hull and Muir 2013

Hull and Muir (2013) analysed observational data of the TWTE and WBSE at three wind farm sites in northern Tasmania to quantify avoidance behaviour for these species. Hull and Muir (2013) aimed to understand meso-scale avoidance by a before-after comparison of the closest-approach distance to turbine locations.

Height data was unavailable for this study, so the paper did not model the path eagles took across the turbine envelope (for example, whether the bird flew under or over the blade sweep area). As such, any reference to 'avoidance' in that paper is specifically a reference to *meso*-avoidance (avoidance of an infinite-height cylinder around the turbine). There is no analysis of macro or micro-scale avoidance conducted in this paper.

The findings of this paper provided strong evidence for meso-avoidance, with eagles avoiding the cylinder of airspace around the turbine. They showed a preference for flying in the area 1.5–3 diameters from turbines - approximately half of the inter-turbine spacing of turbines on both sites. Hull and Muir (2013) measured the "Effective Avoidance Rate" (EAR). Specifically this was the ratio (flights before / after construction) integrated over a cylinder with its rotor diameter centred at the turbine tower.

The average meso-EAR of the TWTE was 81.3% (S.E. 1.4%) and 90.3% (S.E. 1.4%), at Studland Bay and Bluff Point, respectively. We expect the total meso+macro avoidance to be higher than these values, for the reasons outlined in the next sections.

Factors in determining total avoidance

In determining the total avoidance rate for collision risk modelling, we assume macro-avoidance to be negligible. There is clear, documented evidence of resident and non-resident TWTE using commissioned wind-farm sites, indicating a lack of site-wide *macro*-avoidance.

We also assume micro-avoidance is non zero. There is evidence from data on existing wind farm sites (including unpublished work we have carried out on GPS tracked birds) that TWTE can and do fly above and below the rotor swept area (i.e. they do not avoid the entire column of space). Hull and Muir (2013) supports anecdotal evidence of reasonably sophisticated avoidance behaviour, with different responses to stationary and moving turbines, and in different conditions. It is reasonable that this sophistication lends itself to a measure of micro-avoidance.

Evidence for total avoidance rate

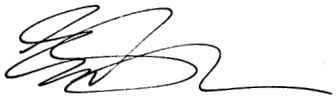
In the two commonly applied CRM's in Australian, the Biosis model (Smales et al. (2013)) and the Nature Advisory Band (NA-BAND model, used for SPPWF), the CRM avoidance parameter represents the total (macro+meso+micro) avoidance.

Smales et. al. (2013) tested the most appropriate rate for the CRM avoidance parameter, using TWTE mortality data from Bluff Point and Studland Bay wind farms. Models with 95% avoidance rates best predicted for the mean number of collisions actually documented at these farms per annum, with estimates from models with 90% and 95% avoidance rates also falling within the 95% confidence interval of measured mortality rates (Smales et al. (2013)). Similarly, collision numbers at Musselroe Wind farm "are consistent with the modelled estimates for a 90% avoidance rate" applied in their CRM (Musselroe Wind Farm Public Environmental Report 2019 – 2022, pg 56; Woolnorth Renewables (2022)).

Given this evidence we recommended 90% avoidance rate at SPPWF. We reported avoidance rates at from 90% to 99% in alignment with the range historically used in CRM's (e.g., 90%, 95%, 98%, and 99%; Smales (2006)).

We hope that this helps to clarify the evidence base for our recommendation of a 90% avoidance rate for TWTE at SPPWF.

Kind regards,



Dr Elizabeth Stark

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References

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Smales, Ian. 2006. "Wind Farm Collision Risk for Birds: Cumulative Risks for Threatened and Migratory Species." *Department of Environment and Heritage*.

Smales, Ian, Stuart Muir, Charles Meredith, and Robert Baird. 2013. "A Description of the Biosis Model to Assess Risk of Bird Collisions with Wind Turbines." *Wildlife Society Bulletin* 37 (1): 59–65.

Woolnorth Renewables. 2022. "Musselroe Wind Farm Public Environmental Report 2019 - 2022." Woolnorth Renewables.