Technical Assessment 4: Shadow Flicker Assessment

Volume 3

Rivestone Turbine Repowering

28/11/2023

Contents

1. INTRODUCTION

1.1. This Shadow Flicker Assessment has been produced to supplement the planning application to Aberdeenshire Council ("the Council") for the removal of the existing wind turbine and the erection of a single replacement wind turbine up to a maximum of 77m to blade tip height and revised hardstanding arrangements ("the Proposed Development") on the land to the north of Rivestone, Kinnoir, Huntly, Aberdeenshire AB54 7YX ("the Application Site").

1.2. The Proposed Development would consist of a single turbine, with an output capacity matched to the 300kW existing maximum grid capacity. The Applicant proposes to use a EWT DW54 with a 50m hub height as a candidate replacement turbine with the potential to alternatively replace with a similar model such as a Vestas V52, any alternative of which will not exceed the dimensions of the candidate – a maximum tip height of 77m or rotor diameter of 54m.

1.3. The Application Site is located in a rural setting on land approximately 6km north of Huntly (Volume 2, Figure 1: Location Plan). On the Application Site operates one Enercon E33 wind turbine at the approximate Grid Reference E355348, N846386. This has a hub height of 37m, a rotor diameter of 33m and overall tip height of 53.5m. The turbine on site outputs at a capacity of 300kW. The Proposed Development turbine will act as a replacement and will be located adjacent to the existing turbine. (Volume 2, Figure 2: Site Plan).

2. ANALYSIS CRITERIA

2.1. 'Shadow Flicker' is the strobe effect caused when a wind turbine's rotating blades intermittently cast shadows over enclosed apertures as they turn. This is most prevalent in dwellings with small windows, where the blades can cause a flicking light effect as their shadows momentarily disrupt the emergence of sunlight into an interior.

2.2. The duration, significance, and likelihood of shadow flicker is influenced by a number of factors:

- Sun height and position (and, correspondingly, time of year and day);
- Prevalence of clouds;
- Direction of turbine relative to receptor;
- Distance from turbine to receptor;
- Prevalence of objects between the turbine and receptor which may act as a screen;
- Turbine rotor diameter and height;
- Window size at the receptor;
- Wind speed;
- Wind direction;

2.3. Supplementary Planning Guidance, Part Two: Guidance for Assessing Wind Energy Developments[1] published by Aberdeenshire Council in 2005 sets out the methodology on page 20 for assessing the significance to shadow flicker and shadow throw. In summary, the methodology prescribes a high significance to where 'The effect of shadow flicker/throw from any number of wind turbines will occur a significant number of times in the year', and as the number of times in the year that the effect of shadow flicker occur, as does its significance.

2.4. There is no recommended quantitative measure for what amount of shadow flicker effect can be considered acceptable within Scotland. Guidance contained within 'Best Practice Guidance

[1] Use of Wind Energy in Aberdeenshire: Part Two (2005)

to Planning Policy Statement 18 'Renewable Energy' [2] published by Northern Ireland Department of the Environment in 2009, recommends that shadow flicker effects should not exceed '30 hours per year or 30 minutes per day', quoting a previous survey undertaken by Predac, an organisation sponsored by the European Union to promote best practice. This assessment will provide comments on mitigation with these measures as a guide for best practice.

[2] Best Practice Guidance to Planning Policy Statement 18 'Renewable Energy' (2009)

3. AREA CRITERIA

3.1. Scottish Government Planning Advice Note, 'Onshore Wind Turbines'[3] published in 2014, advises that, where separation is provided between wind turbines and nearby dwellings, as a general rule 10 rotor diameters, shadow flicker should not cause issue. In the same advice note, the Scottish Government advises that shadow flicker only occurs within buildings where the flicker appears through a narrow window opening.

3.2. Supplementary Planning Guidance issued by Aberdeenshire Council, Part One: Guidance for Developers[4], posits on page 17 that "PAN 45 states that in most cases a separation distance of 10 rotor diameters between the wind turbines and the nearest dwelling should be adequate, although the local topography and the position of the turbine in relation to the dwelling(s) should be taken into consideration".

3.3. However, the same guidance continues on page 28 in section 4.10, to state "'an assessment of potential shadow flicker and shadow throw throughout the year should be provided of all dwellings within a 1000 metre radius of the proposed location of each wind turbine".

3.4. The Scottish Government in the Scottish Government Planning Advice Note, 'Onshore Wind Turbines', 2014, advises that in the UK, only properties within 130 degrees either side of north of the wind turbine can be affected – due to the angle of the sun at any time at these latitudes.

3.5. The assessment area for this turbine will reach a 1000m radius around the turbine – encompassing all the dwellings provided in Table 1. Dwellings outside of 130 degrees either side of north have been included in the assessment to follow the exact guideline wording of Aberdeenshire Council. A priority weighting should, in line with documentation from both the Scottish Government and Aberdeenshire Council, be provided to those properties that do sit within 10 rotor diameters of the turbine in comparison to those outside of this parameter.

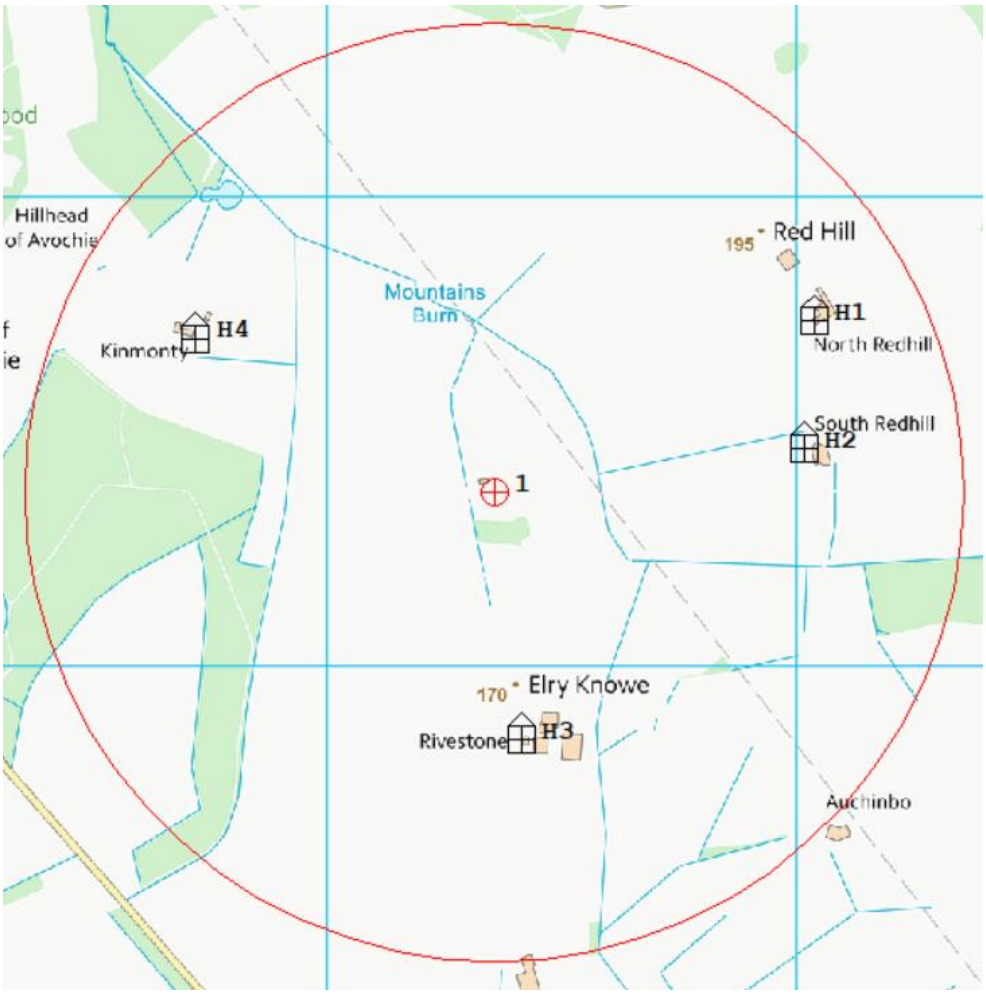
3.6. There are four dwellings, or receptors, within 1km of the Proposed Development. These are detailed in Table 1.1 and Figure 1.2 below.

[3] Onshore Wind Turbines: Planning Advice (2014)
[4] Use of Wind Energy in Aberdeenshire: Part One (2005)

Table 3.1: Receptors within 1km

ID	Receptor Name	Grid Easting	Grid Northing	Proximity to Turbine (m)	Bearing to Turbine (degrees)	Financially Involved (Y/N)
1	Redhill	356035	846738	770	62	No
2	South Redhill	356012	846466	660	82	No
3	Rivestone	355411	845846	530	173	Yes
4	Kinmonty	354718	846700	710	297	No

Figure 3.2: Map of 1km Area of Assessment and relevant receptors



4. ASSESSMENT

4.1. An assessment of the potential for shadow flicker effects has been carried out in accordance with the above. This assessment has taken a conservative approach, assuming cloudless skies at all times; turbine blades constantly rotating at their most impactful angle for each receptor, and open ground between turbine and receptor with no screening of the receptor by intermediary objects. A study area radius of 1000m has been examined, in exceedance of the 10 times rotor diameter (540m) area often recommended.

4.2. Windfarm 4.2.1.7 has been used as the software modelling the potential for shadow flicker. The assessment has been carried out utilising the model of an EWT DW54 with a 50m hub height and 54m rotor diameter. A view height from valid receptors is centred at 2m above ground level, with the dimensions of a 1x1m window angled to face the Proposed Development. The model considers bare terrain, the geometry of the turbine and receptor, and the path of the Sun across the sky throughout a single year. It is considered that the effects of shadow flicker only materialise when the Sun is 3 degrees above the horizon, as evidenced in German state guidance, due to vegetation, buildings, and most importantly the optical diffraction that takes place due to the layers of atmosphere that have to be penetrated on flat terrain.[5]

4.3. Table 4.1 provides the summary of modelled, worst case shadow flicker effects at each property, in decimalised time where in hours 0.50 = 30 minutes.

[5] Information on determining and assessing the optical emissions from wind turbines, Federal Working Group for Immission Control (LAI), a working committee of the Conference of Environment Ministers of Germany (2020)

Table 4.1: Shadow Flicker Assessment Results

ID	Receptor Name	Number of Days in a Year with Flicker Event (Days)	Longest time of any one Flicker Event in the Year (Hours)	Average Event Length on any one Day (Hours)	Sum of all Hours of Flicker Events in one Year (Hours)	Months in Year with Shadow Flicker Events
1	Redhill	0	0	0	0	n/a
2	South Redhill	0	0	0	0	n/a
3	Rivestone	0	0	0	0	n/a
4	Kinmonty	26	.33	.27	7	Feb, Mar, Oct

5. CONCLUSION

5.1. All four dwellings assessed sit outside of 10 times the rotor diameter of the turbine (540m) but within 1000m. Of these, one dwelling has the potential to receive shadow flicker effect effects. The others face no potential shadow flicker effects due to their bearing, altitude difference, and or distance from the turbine.

5.2. The affected property sits under the limits of nearby quantitative guidance of a maximum 30 minutes per day or 30 hours per year. Equally, the receptor faces potential effects only during a small part of the year.

5.3. Due to the low amount of potential shadow flicker times applicable at the one dwelling with the potential to receive shadow flicker effects in this worst case assessment, it is suggested that no mitigation measures need to be taken.