RENEWABLE
ENERGY SPECIALISTS

Loco2gen

Shadow Flicker Assessment

Land West of The Energy Coast Business Park Wind Turbine Repowering

Windlend (Cumbria) Ltd

Document Information		
Document title:	*Shadow Flicker: Land West of the Energy Coast Business Park*	
Date of issue:	*4th of December 2023*	
Status:	Approved	
Prepared by:	*Ian McLean*	*04/12/2023*
Checked by:	*Amy Crum*	*04/12/2023*
Approved by:	*Ian McLean*	*04/12/2023*

Version	Date	Purpose of amendment
V1.0	*24/11/2023*	Completed draft for Client review
V2.0	*04/12/2023*	*Final report for submission*

Summary

Locogen were commissioned by Windlend (Cumbria) Limited ('The Client') to produce a shadow flicker assessment to support a planning application for the repowering of a single Wind Turbine and associated infrastructure on Land West of the Energy Coast Business Park, Haile, Cumbria in Cumberland Council ('The Proposed Development).

The majority of the nearest properties were located out with the 10x rotor diameter area where shadow flicker is stated to occur. One property to the north was on the edge of this area of potential impact and Shadow flicker modelling was completed for the Project using ReSoft Windfarm software. The modelling demonstrated that no shadow flicker would occur at the properties due to the distance and relative position uphill of the turbine.

It is therefore concluded that shadow flicker is not an issue at this site and that no further modelling works will be necessary for this development.

Table of contents

1. Introduction

1.1. Background

Locogen have been commissioned by Windlend (Cumbria) Limited ('The Client') to produce a shadow flicker Assessment to support a planning application for the repowering of a single Wind Turbine and associated infrastructure on farmland at Land West of the Energy Coast Business Park in Cumberland Council ('The Proposed Development).

The Proposed Development is not considered to be an Environmental Impact Assessment (EIA) development as agreed through consultation with Cumberland Council.

The aim of the development of is to maximise the generation of renewably sourced electricity from the Site through re-powering the asset at the Site by installing a larger dimensioned replacement wind turbine.

The Proposed Development Site is located Ordnance Survey Grid Reference (NGR) NGR) NY 02329 08344 with the expectation being that any new turbine would be located within c.20m from the existing turbine to allow for construction to take place alongside operation of the existing turbine to minimise operational downtime. It is sited adjacent to a pre-existing industrial park associated with the West Cumbria Energy Coast.

The project will comprise the re-powering of an existing 46.5m high (blade to tip) Turbowind 400kW wind turbine which has been in operation since 2015. This will involve replacing it with a taller three bladed wind turbine measuring 77m high (base to tip) along with associated infrastructure for a further period of 30 years to reflect the operational life of the proposed repowered wind turbine.

1.2. Report structure

This report assesses whether the Project is likely to cause a shadow flicker disturbance to the nearest residential dwellings. The report initially provides an overview of relevant guidance and site context before assessing the extent of potential shadow flicker impacts on the sensitive residential receptors.

2. Baseline

2.1. Shadow flicker explanation

"Shadow flicker" refers to when rotating wind turbine blades periodically cast a temporary shadow over neighbouring properties (typically through constrained openings such as windows). The magnitude of the shadow flicker effect varies in relation to the relative location of the receptors and time of day/year, as well as also depending on several environmental conditions such as the position and height of the sun, wind speed and direction and cloudiness.

A further description of shadow flicker is provided within relevant English planning guidance as referred to in the following section.

2.2. Relevant policy & guidance

There is no extant English planning policy guidance in relation to shadow flicker. In the absence of that it is considered relevant to refer to the previous planning guidance in England (the Companion Guide to PPS22) which required developers to investigate the impact of shadow flicker but does not specify methodologies. There is no specific standard for the assessment of shadow flicker in the UK and no guidelines on acceptable levels of shadow flicker.

The Companion Guide to PPS22 makes the following statements:

- Shadow flicker only occurs inside buildings where the flicker appears through a narrow window opening;
- Only properties within 130 degrees either side of north of the turbines can be affected at UK latitudes;
- Shadow flicker has been proven to occur only within ten rotor diameters of a turbine position;
- Less than 5% of photo-sensitive epileptics are sensitive to the lowest frequencies of 2.5-3 Hz; the remainder being sensitive to higher frequencies; and
- A fast-moving three-bladed wind turbine will give rise to the highest levels of flicker frequency of well below 2 Hz. The new generation of wind turbines is known to operate at levels below 1 Hz.

Additional relevant text is as follows:

"It only occurs inside buildings where the flicker appears through a narrow window opening. The seasonal duration of this effect can be calculated from the geometry of the machine and the latitude of the site. Although problems caused by shadow flicker are rare, for sites where existing development may be subject to this problem, applicants for planning permission for wind turbine installations should provide an analysis to quantify the effect. A single window in a single building is likely to be affected for a few minutes at certain times of the day during short periods of the year.

The likelihood of this occurring and the duration of such an effect depends upon:

- the direction of the residence relative to the turbine(s);
- the distance from the turbine(s);
- the turbine hub-height and rotor diameter;
- the time of year;
- the proportion of day-light hours in which the turbines operate;

- the frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon); and,
- the prevailing wind direction."

Furthermore, the guidance also states that:

"The further the observer is from the turbine the less pronounced the effect will be. There are several reasons for this:

- there are fewer times when the sun is low enough to cast a long shadow;
- when the sun is low it is more likely to be obscured by either cloud on the horizon or intervening buildings and vegetation; and,
- the centre of the rotor's shadow passes more quickly over the land reducing the duration of the effect."

At further distances – "the blades do not cover the sun but only partly mask it, substantially weakening the shadow. This effect occurs first with the shadow from the blade tip, the tips being thinner in section than the rest of the blade. The shadows from the tips extend the furthest and so only a very weak effect is observed at distance from the turbines."

"Shadow flicker can be mitigated by siting wind turbines at sufficient distance from residences likely to be affected. Flicker effects have been proven to occur only within ten rotor diameters of a turbine. Therefore, if the turbine has 80 m diameter blades, the potential shadow flicker effect could be felt up to 800 m from a turbine."

3. Assessment

3.1. Proposed wind turbine

The location and relevant details (rotor diameter) for the Project are provided in Table 1 below.

Turbine type	Rotor diameter (m)	Location	
		Easting	Northing
EWT Directwind 61 (500kW)	61	302357	508321

Table 1: Yeorton Hall repowering wind turbine details

3.2. Receptors

Based on the guidance set out above, a shadow flicker impact assessment has been carried out on the nearest sensitive receptors to the Project. These are shown relative to the proposed turbine location in Figure 1 below, with further details provided in Table 2. It should be noted that these distances provided refer to the closest part of the dwelling including garden areas. As set out above shadow flicker is only expected to occur within buildings which are generally further away from the closest edge of the property.

Figure 1: Sensitive receptors surrounding the Project and area of potential impact

The closest three properties at Yeorton hall farm (who have a financial involvement in the project) are out with the area shown to be potentially impacted by shadow flicker.

Table 2: Residential properties considered in the assessment

Ref.	Name of location	Easting	Northing	Distance from proposed turbine (m)
R1	Yeorton Hall Farm (1)	302639	507858	542
R2	Yeorton Hall Farm (2)	302625	507836	545
R3	Yeorton Hall Farm (3)	302681	507836	583
R4	Winscales	302186	508959	660
R5	Winscales House	302335	508963	642
R6	Vicarage	303062	508713	806
R7	Woodlands	303224	508507	886
R8	Weston	301950	507817	647
R9	Oaklands	301777	507948	689
R10	Woodlea	302125	507648	711
R11	Former reservoir	302105	508853	588

Of all the identified properties only R11 to the north is shown to have their curtilage within 610m of the proposed turbine. For completeness an assessment has been undertaken to understand if shadow flicker may occur at any location within the property.

3.3. Shadow flicker assessment

The effect of shadow flicker can be assessed using specialist software. This software models the shadow flicker from the following geometric considerations:

- The position of the sun at a given date and time;
- The size and orientation of the windows that may be affected; and,
- The size of the proposed turbines that would cast the shadow.

If periods of shadow flicker were calculated, then the turbine may have to be shut down over all potential periods. This would mean that the availability of the turbine option would be reduced.

A shadow flicker assessment was undertaken using Resoft's Windfarm software to demonstrate the extent of shadow flicker in the area assuming the worst-case assumptions. This map is shown in Figure 2 below for the proposed development. The contours mark the number of hours

of potential impact to an individual window at 2m above ground level. Each contour represents 20 hours of worst-case shadow flicker events per annum.

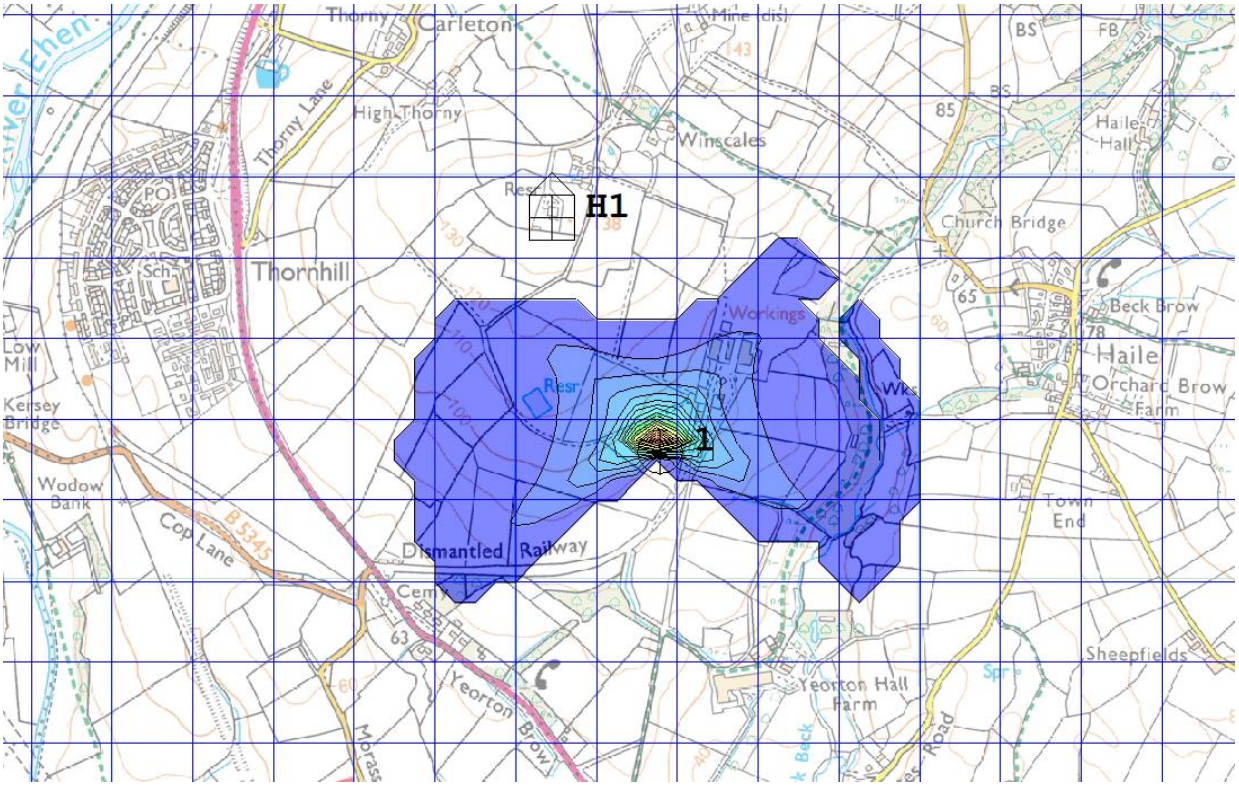

Figure 2: Theoretical shadow flicker zone surrounding the proposed wind turbine

The above model shows that potential shadow flicker events do not extend out to within close proximity of the edge of the assessed property. This limited extent of occurrence is due to the terrain height rising from the turbine to the north and the elevated position of the assessed property meaning no flicker impacts.

4. Conclusion

The planning guidance (referred to in Section 2.2) identifies that the principal means of avoiding a shadow flicker effect is through careful siting of the turbine, providing effective separation to residential occupiers.

This assessment demonstrates that there are no dwellings within 10 rotor diameters of the turbine within the areas where shadow flicker may potentially occur. Shadow flicker modelling has also demonstrated that the property where the landownership would be within the zone of potential shadow flicker impacts is not impacted.

Accordingly, the proposal would satisfy the relevant planning guidance and does not require further consideration.