



Environmental Appraisal Report

Woolfords Wind Farm - Tip Height Increase

Annex 5-1-3: Aviation Lighting Assessment

Woolfords Wind Energy Ltd

wind2

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Document Prepared For

Ewan Eley

Woolfords Wind Energy Ltd

Document Prepared By

Nigel Buchan

Landscape Consultant

planning@atmosconsulting.com

Document Approved By

Malcolm Sangster

Technical Director

planning@atmosconsulting.com

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1. Aviation Lighting Assessment

1.1 Introduction

Aviation safety lighting would be required due to the height of the proposed turbines. The proposed aviation lighting is as follows:

- Two medium intensity (2000 candela) red lights on the hubs of each of the turbines; and
- Three intermediate level 32 candela lights, positioned around the approximate mid height of the towers.

Visibility sensors would be installed to measure prevailing atmospheric conditions and the range of visibility. When atmospheric conditions, such as low cloud cover, rain, mist, haze, snow or fog, limit visibility to distances of less than 5km in any direction the lights would be illuminated at an intensity of 2000 candela. When conditions allow visibility of 5km or more, the lights would operate at a lower intensity of 200 candela.

1.2 Methodology

The assessment of lighting effects follows the same method as the LVA. It is important to note that this is not a technical lighting assessment based on quantitative measurement of light levels, but rather a qualitative judgement of the likely change to the baseline levels of artificial lighting. This is in line with best practice guidance, which notes that:

“Quantitative assessment of illumination levels, and incorporation into models relevant to visual effects assessment, will require input from lighting engineers, but the visual effects assessment will also need to include qualitative assessments of the effects of the predicted light levels on night-time visibility.” (Landscape Institute et al., 2013).

The assessment also takes account of the following factors, which are not possible to represent in visualisations:

- In some situations a flicker effect may be experienced by receptors as the turbine blades pass in front of the stationary lights;
- A reflected red glow on the adjacent surface of the turbine blades may also be evident from nearby locations under certain conditions;
- Aviation lighting would only be apparent during hours of darkness, which changes with the seasons. During the summer months aviation lighting would only be visible for a short period;
- The way in which aviation lighting would be experienced differs from most baseline sources of artificial light because the aviation lights would generally be seen as a series of red lights close to, or above the skyline; and
- The intensity of light detected reduces exponentially with distance, being proportional to the square of the distance between the emitter and receptor. Consequently a receptor at 2km from a light source would detect a quarter of the light that one at 1km would (CPRE, 2016).

The baseline conditions, against which the effects of the Proposed Development are assessed, include the nearby Longhill Burn wind farm, which is 200m to blade tip and includes aviation lighting. The visualisations show this development, with visible aviation lighting reflecting the worst case scenario of 2000 candela (see below for further details).

Turbines over 150m in height are assumed to be lit where no information is available.

1.2.1 Zone of Theoretical Visibility Mapping

Screened ZTVs have been prepared to illustrate the extent of theoretical visibility of turbine hubs within 15km, taking into account the screening effect of buildings, forest plantations and woodland blocks. Figure 5-4 shows the theoretical visibility of the Proposed Development alone and Figure 5-40 shows the Proposed Development and Longhill Burn. These provide an indication of where hub aviation lights would be visible.

1.2.2 Visualisations

Visualisations have been produced for three of the viewpoints (4, 5 and 7) where hub lighting would be visible (see Figures 5-6, 5-8 and 5-11). The visualisations have been carried out in accordance with best practice guidance, which states:

“The visualisation should use photographs taken in low light conditions, preferably when other artificial lighting (such as street lights and lights on buildings) are on, to show how the wind farm lighting will look compared to the existing baseline at night”... “We have found that approximately 30 minutes after sunset provides a reasonable balance between visibility of the landform and the apparent brightness of artificial lights, as both should be visible in the image.” (Scottish Natural Heritage, 2017).

Baseline photography was undertaken at dusk in clear weather conditions and sought to capture the presence of existing baseline sources of artificial lighting. Note that the night-time visualisations represent a worst case appearance of the aviation lighting at dusk during clear viewing conditions and at 2000 candela.

The hub aviation lights are angled upwards for aircraft, so the intensity of light perceived from the ground is likely to be less than the maximum of 2000 candela, due to the angle of viewing. This effect is more noticeable closer to the turbines.

The Proposed Development would be located on relatively high ground, further reducing the light levels likely to be experienced from surrounding lower-lying areas. This angle is not something that can be incorporated into the visualisations, which present the worst case in terms of anticipated lighting (2000 candela). In practice, the higher intensity lights would only be used in the lower visibility situations noted above, but low light photography has to be done during clear visibility in order to capture the scene, so this needs to be borne in mind when interpreting the visualisations.

1.2.3 Light Pollution Mapping

Light pollution mapping published by the Campaign to Protect Rural England (CPRE) also covers Scotland and Wales (CPRE, 2016). The mapping, derived from satellite data, classifies UK land according to nine colour bands, representing different levels of radiance shining up into the night sky. The 2016 study found that 77% of Scotland falls into the darkest band, colour band 1.

Within 15km of the Proposed Development the CPRE mapping indicates light pollution varies considerably. Light pollution is greatest to the north of this zone, including the A71 and M8 corridors, whilst the darkest skies are largely restricted to the uplands between the A70 and A702, more than 5km to the south-east of the Proposed Development. Even here, much of the area is in colour band 2, indicating the presence of some light pollution, from larger settlements such as Edinburgh, Livingston and Bathgate, which lie to the north.

1.3 Landscape Effects

Based on fieldwork and the CPRE mapping LCTs have been broadly grouped into the remoter, less settled upland areas which are likely to have darker skies; plateau landscapes with scattered settlement, which have moderately dark skies and the urbanised areas along the A71 and M8 corridors, where artificial lighting is more prevalent.

Upland Areas

Figure 5-4 indicates that there would be intermittent theoretical visibility of turbine hubs from areas of high ground to the south-east of the Proposed Development, mostly within 10km and including some summits and north-west facing slopes of the Pentland Hills within the South Lanarkshire (212 Moorland Hills - Glasgow and Clyde Valley) and West Lothian (268 Upland Hills – Lothians) LCTs.

Although there is more separation from artificial light sources and a greater chance of dark skies within upland areas, the CPRE mapping indicates the presence of some light pollution from artificial lighting within these upland LCTs. Their susceptibility is assessed as medium.

These upland areas include SLAs, but are not widely recognised for their dark skies. They are also relatively remote and less likely to be frequented at night, so limiting the potential for landscape change to be appreciated. The landscape value is assessed as medium.

From these areas, the proposed aviation lighting would appear brighter, due to the viewing angle, although this would be partly offset by the effects of distance noted above.

Figure 5-40 indicates that, wherever there is visibility of the hubs of the Proposed Development, these would almost always be seen in combination with the hubs of Longhill Burn. Consequently, the Proposed Development would appear to form an extension to Longhill Burn, so reducing the effect on the baseline conditions.

Taking into account the pattern of theoretical visibility of the turbine hubs and the presence of aviation lighting on the Longhill Burn turbines, the magnitude of effect is assessed as small, giving rise a moderate-minor degree of landscape effect.

Plateau Landscapes

Figure 5-4 indicates that there would be widespread theoretical visibility of the hubs from the 201 Plateau Farmland - Glasgow and Clyde Valley LCT and more intermittent theoretical visibility from the 213 Plateau Moorlands - Glasgow and Clyde Valley and 269 Upland Fringes - Lothians LCTs.

Although moderately dark skies may be experienced within these areas, especially to the south of the Site, scattered light sources within settlements, individual farms and dwellings and from the road and rail network affect these LCTs throughout. Overall susceptibility of these LCTs is judged to be low-medium.

These LCTs are not known for dark skies and the value is assessed as low-medium.

Figure 5-4 illustrates the screening effect of the extensive forest plantations within the plateau landscapes on the theoretical visibility of the turbine hubs. Where visible, the apparent brightness of the aviation lighting would generally be reduced from these areas, due to the viewing angle and the location of the Proposed Development on relatively higher ground.

The proposed aviation lighting would introduce further artificial lighting in the night-time landscape experience of these predominantly rural landscapes. Figure 5-40 shows how the hubs of the Proposed Development would almost always be seen in combination with those of Longhill Burn, although a small area to the north-west and south-west of viewpoint 2 will have no visibility of

Longhill Burn. From these LCTs the Proposed Development would generally appear to form an extension to Longhill Burn, so reducing the effect of aviation lighting on the baseline conditions.

Taking into account the pattern of theoretical visibility of the turbine hubs and the presence of aviation lighting on the Longhill Burn turbines, the magnitude of effect is assessed as small, giving rise a moderate-minor degree of landscape effect.

Urbanised Areas

Figure 5-4 indicates that there would be intermittent theoretical visibility of turbine hubs from more urbanised areas to the north of the Proposed Development and within 15km, including the 213 Plateau Moorlands - Glasgow and Clyde Valley, 269 Upland Fringes - Lothians, and 273 Lowland Plateaux – Lothians LCTs.

Within these LCTs the influence of light pollution from settlements and transport routes is more noticeable. Light spillage from larger towns such as Livingston, Bathgate and Whitburn, settlements along the A71 corridor and from the M8 transport corridor affects the night-time baseline, which is assessed as low.

These LCTs are not recognised for having dark skies, and the night-time landscape value is judged as low.

Visibility of the proposed aviation lighting would be sporadic, as forest plantations, large woodland blocks and extensive built development would provide substantial screening. Further from the Site, the apparent brightness of the proposed lighting would also be mitigated by distance.

Figure 5-40 shows how the hubs of the Proposed Development would always be seen in combination with those of Longhill Burn. The Proposed Development would generally appear to form an extension to Longhill Burn, so reducing the effect of the proposed aviation lighting on the baseline conditions.

The overall night-time magnitude of effect is judged to be small-negligible, giving rise to a minor degree of landscape effect.

1.4 Visual Effects

Representative Viewpoints

The following assessment focuses on three representative viewpoints agreed through consultation with SLC. These viewpoints were selected to represent views of the proposed aviation lighting from settlements within 10km, as these are more likely to be frequented during the hours of darkness by higher sensitivity receptors.

Night-time photomontage visualisations have been produced for the following three viewpoints:

- VP2: Minor Road near Haywood and Bugthknowes (Figures 5-6c-e);
- VP4: Minor road at Woolford's Cottages (Figures 5-8c-e); and
- VP7: Longridge (Figures 5-11c-e).

The photomontage visualisations illustrate the aviation lighting at the maximum worst case scenario of 2000 candela. Table 5-17 summarises the findings of the detailed viewpoint assessments.

1.5 Summary of Effects of Aviation Lighting

None of the broad groupings of LCTs are recognised for their dark sky qualities. The Proposed Development would generally appear as an extension to Longhill Burn and no substantial landscape effects are anticipated.

The proposed aviation lighting is not predicted to give rise to any substantial effects from the selected viewpoints (see Table 5-17). These represent some of the closest residential receptors and consequently it is considered unlikely that substantial visual effects would occur elsewhere.

Table 1: Summary of Night-time Viewpoint Assessments

VP	Location	Distance	Visual Receptors	Susceptibility	Value	Magnitude	Degree of Effect
2	Minor road near Haywood and Bughtknowes	2.19	residents	high	low-medium	small-medium	moderate
			road users	low	low	small-medium	moderate-minor
4	Minor road at Woolfords Cottages	1.70	residents	high	medium	medium	moderate-major
			road users	low	low-medium	medium	moderate
7	Longridge	5.80	residents	high	medium	small-negligible	minor
Comparative Assessment of Effects between the Consented Development and the Proposed Development:							
The difference in turbine size between those of the Proposed Development and the Consented Development would not be apparent from these viewpoints and the Proposed Development is not considered to cause a material change to the level of effect.							

Table 2: Night-time Viewpoint Assessments

Viewpoint: 2
Baseline Conditions
Viewpoint Location: Minor road near Haywood and Bughtknowes
Figure Number: Figures 5-6c-e
Current View: Views in all directions from this viewpoint are predominantly dark, containing limited artificial lighting. Lights of vehicles on the minor road are periodically apparent and lighting within nearby dwellings can also be seen.
Visual Receptors, Receptor Susceptibility to Change and Value of View Residents: Views from dwellings – high susceptibility Dark skies not widely promoted; small number of receptors – low-medium value Road users: Road users are unlikely to be focussing on the view – low susceptibility Dark skies not widely promoted; small number of receptors – low value
Assessment of predicted effects
Description of Changes: Figures 5-6c and 5-6e illustrate the view of the Proposed Development and Longhill Burn at night with 2000 candela aviation lighting. Turbine lighting on the hubs of three turbines and towers of two would be seen above the skyline. Turbine lighting on Longhill Burn is hidden from view by intervening woodland.
Visual Effects: The Proposed Development would occupy a relatively small part of the view but the lighting would be noticeable from the road and some dwellings. The magnitude of visual effect is predicted to be medium. Figure 5-6c also shows the consented Heathland resubmission and Pearie Law extension turbines. Hub lighting on both of these would be visible, either side of the Proposed Development. Should these developments be constructed, this would affect the baseline conditions and reduce the visual effect of the Proposed Development.
Degree of Visual Effects
Residents: Moderate Road Users: Moderate-minor

Viewpoint: 4
Baseline Conditions
Viewpoint Location: Woolfords
Figure Number: Figures 5-8c-e
Current View: Views in all directions from this viewpoint are predominantly dark, with limited artificial lighting. Lights of vehicles on the minor road and trains on the railway line are intermittently apparent and lights within the settlement of Woolfords can be seen to the north. These dwellings currently experience a dark outlook to the west but the construction of Longhill Burn will introduce aviation lighting into the view.
Visual Receptors, Receptor Susceptibility to Change and Value of View Residents: Views from dwellings – high susceptibility Dark skies not widely promoted; medium number of receptors – medium value Road users: Road users are unlikely to be focussing on the view – low susceptibility Dark skies not widely promoted; medium number of receptors – low-medium value
Assessment of predicted effects

Viewpoint: 4

Description of Changes:

Figures 5-8c and 5-8e illustrate the view of the Proposed Development and Longhill Burn at night with 2000 candela aviation lighting. Turbine lighting on the hubs and towers of three turbines would be seen above the skyline, amongst the lights of Longhill Burn. The Proposed Development would appear to form part of a larger wind farm, but it would increase the proportion of the view containing lighting, bringing the lighting closer to the observer and higher above the skyline.

Visual Effects:

The changes would be noticeable from the road and curtilage of dwellings but would not affect the principal view from the majority of dwellings, which is towards the east. The magnitude of visual effect is predicted to be small-medium.

Figure 5-8c also includes the consented Heathland resubmission turbines. Hub lighting on these would be visible behind the Proposed Development. Should this development be constructed, it would affect the baseline conditions and reduce the visual effect of the Proposed Development.

Degree of Visual Effects

Residents:

Moderate

Road Users:

Moderate-minor

Viewpoint: 7

Baseline Conditions

Viewpoint Location: Longridge

Figure Number: Figures 5-11c-e

Current View:

The night-time view to the south-east towards the Proposed Development is affected several sources of artificial lighting. These include intermittent lights from traffic on the A71 and A706 and trains on the rail line to the north of the A71 and lights within the settlement of Breich.

Visual Receptors, Receptor Susceptibility to Change and Value of View

Residents:

Views from dwellings – high susceptibility

Dark skies not widely promoted; medium number of receptors – medium value

Assessment of predicted effects

Description of Changes:

Figures 5-11c and 5-11e illustrate the view of the Proposed Development and Longhill Burn at night with 2000 candela aviation lighting. Turbine lighting on the hubs of two and tower of one of the turbines would be seen above the skyline, amongst the lights of Longhill Burn, which would be much more prominent. The Proposed Development would appear to form part of Longhill Burn, and would not increase the proportion of the view containing lighting or bring the lighting closer to the observer or higher above the skyline.

Visual Effects:

The changes would be barely discernible and the magnitude of visual effect is predicted to be small-negligible.

Figure 5-11c also shows the consented Pearie Law extension and Heathland resubmission turbines. Hub lighting on both of these would be visible, either side of the Proposed Development. Should these developments be constructed, this would affect the baseline conditions and further reduce the visual effect of the Proposed Development.

Degree of Visual Effects

Residents:

Minor