15 OTHER ISSUES

15.1 Introduction

15.1.1 This chapter considers the potential effects of the Proposed Development on telecommunications and shadow flicker.

15.1.2 The chapter includes a description of the assessment methodology that has been adopted, the consultations conducted, relevant policy and legislation, the overall baseline conditions, the impacts and associated mitigation measures. The chapter concludes with a summary of the residual effects.

15.1.3 Radio waves and microwaves are used in a variety of communications and any large structure has the potential to interfere with their reception. The magnitude of the impact on a structure is principally dependent upon the size, shape and materials of construction. Wind turbines are slender, and the rotor is substantially constructed from non-conducting materials (Glass Reinforced Plastic), both of which reduce their potential for causing interference. However, the tower is usually steel, and the rotor blades contain some conductive materials, for lightning conduction, and in some cases structural carbon fibre.

15.1.4 Shadow flicker may occur under certain combinations of geographical position and time of day when the sun passes behind the rotors of a wind turbine and casts a shadow over neighbouring properties. Rotating wind turbine blades can cause brightness levels to vary periodically at locations where they obstruct the sun's rays. As the blades rotate, the shadow flicks on and off, an effect known as shadow flicker. The effect can only occur inside buildings, where the flicker appears through a window opening. This can result in a nuisance when the shadow is cast over the windows of residential properties. Shadow flicker can be a cause of annoyance at residences near wind turbines if it occurs for a significant period during the year.

15.2 Scope and Methodology

Telecommunications

15.2.1 Information on Electromagnetic Interference (EMI) and telecommunications was obtained through consultation via the EIA scoping process and subsequent enquiries as identified in **Table 15.1** below.

Shadow Flicker

15.2.2 The magnitude of the shadow flicker effect varies both spatially and temporally and depends on several environmental conditions coinciding at any particular point in time, including, the position and height of the sun, wind speed and direction, cloudiness, and proximity of the turbine to a sensitive receptor. To undertake a shadow flicker assessment, information on the Proposed Development, the location of potential residential receptors and other parameters are included in a computer model in order to predict and quantify the impact shadow flicker may have on receptors within the vicinity of the Proposed Development.

15.2.3 It is common to use a multiplier of the equivalent of 10 rotor diameters as a maximum limit within which significant shadow flicker effects can occur. However, the scoping response provided to the Energy Consents Unit (ECU) by The Highland Council (THC) requested that shadow flicker be assessed for all residential properties within 11 rotor diameters of each turbine. Shadows are cast by the sun as it crosses the southern sky; therefore, shadow flicker can hypothetically take place 130º either side of north[168][169] (see **Figure 15.1**). Therefore, these parameters (11 rotor diameters and 130º either side of north) have been considered within the analysis in order to establish the potential for shadow flicker to be experienced at relevant properties.

15.2.4 The locations of residential receptors and the locations and maximum dimensions of turbines comprising the Proposed Development have been input into a model run on industry standard ReSoft WindFarm Release 5 software. To help inform an accurate shadow flicker assessment, a site visit at the identified visual receptors was conducted on 20th January 2022. Each window with an angle towards the proposed wind turbines (direct or oblique) was recorded along with height and length measurements. Subsequently, the number of windows, of each visual receptor, and their dimensions and angle towards proposed turbines were incorporated into the software which calculated the total shadow duration on each receptor from all turbines. A minimum sun elevation of 2 degrees has been considered.

15.2.5 Shadow flicker effects occur only on sunny days. In addition to consideration of the window position and dimensions, the following variables can reduce shadow flicker effects: wind direction; wind speed (as shadow flicker is not experienced if the blades are not turning); intervening obstacles and cloud cover. The results of the assessment therefore presented below in two forms: a conservative, worst-case scenario and a realistic scenario factoring in these additional variables.

15.2.6 There is no formal guidance on the amount of shadow flicker that is considered acceptable within the UK. Other European countries do have guidance on shadow flicker; however, these vary from one country to another. Guidance which has been utilised in Northern Ireland[170], Germany[171] and Belgium, suggests shadow flicker does not exceed 30 hours per year with a maximum of 30 minutes per day. For the purposes of this assessment, exceedance of 30 hours per year with a maximum of 30 minutes per day is considered to result in a significant effect which may require mitigation.

Limitations

15.2.7 The assessment of effects on telecommunications assets is limited by the availability of data. Information on the location and sensitivity of telecommunications assets is not publicly available; therefore, assessment is only possible if telecommunications asset

[168] Parsons Brinckerhoff, 2011 – Update of UK Shadow Flicker Evidence Base.

[169] Department for Communities & Local Government (July 2013): Planning practice guidance for renewable and low carbon energy.

[170] Best Practice Guidance to Planning Policy Statement 18 'Renewable Energy',

Northern Ireland Department of the Environment (2009), cited in Parsons Brinckerhoff 2011

[171] Notes on the Identification and Evaluation of the Optical Emissions of Wind Turbines, States Committee for Pollution Control – Nordrhein-Westfalen (2002), cited in Parsons Brinckerhoff 2011.

owners respond to requests for information. A summary of the consultations received is included in **Table 15.1** below.

15.2.8 For the shadow flicker assessment, the outputs of industry standard software such as ReSoft WindFarm adopt a "worst-case scenario" approach, as they do not factor in variables such as atmospheric conditions (wind speed, cloud cover) which reduce the duration of shadow flicker. Therefore, the shadow flicker assessment additionally interpolated weather conditions to the software results to identify an additional, "realistic scenario", based on additional variables. This was achieved by examining historic cloud coverage data and average sunlight hours for each month at the specified location, as provided by the Met Office.

15.2.9 Furthermore, the "worst-case scenario" approach to the assessment does not consider the effect of intervening elements (topography, screening) preventing or reducing the duration of shadow flicker impact, as a direct view between the turbine blade from the window is required for shadow flicker to be experienced. As part of the "realistic scenario" through a site visit at the identified visual receptors and with the help of Geographical Information Systems (GIS) technology and Global Positioning Systems (GPS) devices, the on-site field personnel were able to identify intervening objects that would limit or eliminate any visual capability between the identified receptors and Proposed Development.

15.3 Consultation Undertaken

15.3.1 Shadow flicker was identified by THC as requiring assessment in their response to the EIA scoping request.

15.3.2 Telecommunications operators were also consulted, and information requested for telecommunications links within close proximity of the turbine area. A summary of consultation undertaken is provided in **Table 15.1**.

Table 15.1 Shadow Flicker, Telecoms and EMI Consultee Responses

Consultee	Summary of Consultation	Comment/action taken
THC	EIA Scoping response: Given that the final layout for the turbines and the candidate turbine is yet to be selected, a shadow flicker assessment should be undertaken as part of the EIAR. That said, if there are no properties within 11 rotor diameters the matter of shadow flicker will not require detailed assessment but should still be addressed in the EIAR.	Assessment undertaken confirmed that two properties lie within 11 rotor diameters of proposed turbines (see **Section 15.5** below). Assessment undertaken in **Section 15.6**.

Consultee	Summary of Consultation	Comment/action taken
British Telecommunications (BT)	BT has studied this Windfarm proposal with respect to EMC and related problems to BT point-to-point microwave radio links. The conclusion is that, the Project indicated should not cause interference to BT's current and presently planned radio network.	No further action required.
Joint Radio Company	No response	N/A
WHP Telecoms Ltd	RSK identified a planning application for a proposed communications mast. WHP acted on behalf of EE regarding a proposed new emergency services network (ESN) mast at Dalchork Wood, Dalnessie, A386, Lairg, Highlands, IV27 4AA, (THC planning reference 20/00127/TPNO). After being contacted by RSK, WHP requested a copy of the EIA Scoping Report.	RSK provided a copy of the EIA Scoping Report to WHP.
	WHP confirmed that EE's radio planners had reviewed the plans in the Scoping Report and had no concerns with the Proposed Development as it will not affect their site.	No further action required.

15.4 Statutory and Planning Context

Telecommunications

15.4.1 Scottish Planning Policy (SPP) indicates that impacts on telecommunications and broadcasting installations should be taken into account by proposals for energy infrastructure.

15.4.2 Planning Advice Note (PAN) 62[172] considers disruption to radio systems caused by large structures due to the obstruction and reflection of signals. It advises that planning permission can be granted for such structures subject to a planning condition that, prior to development, the developer proposes measures to maintain the quality of reception by systems potentially affected by the proposal.

[172] Scottish Government. 2001. Planning Advice Note 62: Radio telecommunications. https://www.gov.scot/publications/pan-62-radio-telecommunications/ [accessed January 2022]

15.4.3 THC's Highland-wide Local Development Plan[173] (HwLDP) Policy 67 *Renewable Energy Developments* states that the Council will support proposals where it is satisfied that they are located, sited and designed such that they will not be significantly detrimental overall, either individually or cumulatively with other developments, having regard in particular to a variety of interests including other communications installations or the quality of radio or TV reception.

15.4.4 THC Supplementary Planning Guidance (SPG) in relation to renewable energy[174] states that the siting of wind turbines must have regard to radio, TV, telecoms and other communication systems (section 4.27). It goes on to state that, "*Planning conditions or legal agreements may require developers to correct any electromagnetic interference at their own expense. The Joint Radio Company should be contacted for joint screening for telemetry or microwave links in use by either electricity or gas utilities*."

Shadow Flicker

15.4.5 The HwLDP[175] Policy 67 *Renewable Energy Developments* states that the Council will support proposals where it is satisfied that they are located, sited and designed such that they will not be significantly detrimental overall, either individually or cumulatively with other developments, having regard in particular to a variety of interests including shadow flicker.

15.4.6 THC's SPG[176] states that proposals should seek to avoid significant adverse effects on the safety of any residential or regularly occupied property including shadow flicker. It goes on to state that "*Wind energy schemes should always be designed to avoid causing shadow flicker, blade glint, glare and light effects to any regularly occupied buildings not associated with the development. Where this cannot be achieved, the Council will expect wind energy developments to be located a minimum distance of 11 times the blade diameter of the turbine(s) from any regularly occupied buildings not associated with the development. Within a distance less than 11 times the blade diameter, a shadow flicker assessment will be required*."

[173] The Highland Council. 2012 Highland-wide Local Development Plan, April 2012. https://www.highland.gov.uk/info/178/local_and_statutory_development_plans/199/highland-wide_local_development_plan [accessed November 2021]

[174] The Highland Council. 2017. Onshore Wind Energy Supplementary Guidance, November 2016 (with addendum, December 2017). https://www.highland.gov.uk/directory_record/712079/onshore_wind_energy [accessed November 2021]

[175] https://www.highland.gov.uk/info/178/local_and_statutory_development_plans/199/highland-wide_local_development_plan [accessed November 2021]

[176] The Highland Council. 2017. Onshore Wind Energy Supplementary Guidance, November 2016 (with addendum, December 2017). https://www.highland.gov.uk/directory_record/712079/onshore_wind_energy [accessed November 2021]

15.5 Existing Environment

Telecommunications

15.5.1 A proposed new ESN mast was identified at Dalchork Wood, Dalnessie, A386, Lairg, Highlands, IV27 4AA (THC planning reference 20/00127/TPNO[177], subsequently re-submitted with amended site boundaries and referred to as 20/01919/TPNO[178]). No other telecommunications assets were identified within the vicinity of the Proposed Development.

Shadow Flicker

15.5.2 Within the 11-rotor diameter study area established for shadow flicker for the Proposed Development, two residential receptors were identified. These are the residence of the Dalnessie estate manager (Receptor 1) and the Dalnessie Lodge (Receptor 2), located 1.552 km and 1.475 km from the nearest turbine respectively. Both properties are in the ownership of the Dalnessie Estate.

15.5.3 The two properties are both located within a cluster of properties including other ancillary, non-residential buildings, storage/parking areas and garden.

15.6 Predicted Impacts

Telecommunications

15.6.1 From the consultation responses received, there is no indication that the Proposed Development would interfere with telecommunications links. No impacts on any identified telecommunications assets are predicted.

Shadow Flicker

15.6.2 In terms of shadow flicker, the geographic orientation of Receptors 1 and 2 in relation to the proposed turbine locations and sun's monthly path, indicate that only turbines T1 and T2 could result in shadow flicker effects. The shadow area coverage from both turbines is illustrated in **Figure 15.2** in hours per year.

15.6.3 According to the geographic orientation of Receptor 1, two sides of the building may experience shadow coverage from turbines T1 and T2 during the summer months, and subsequently experience shadow flicker effects. The wider side of the building with the most windows is facing north-west, and the narrower side of the building is facing north-east, meaning that the wider side would have an almost direct angle of view towards the proposed turbines, and the narrow side would have an oblique angle.

15.6.4 Receptor 2 has a narrow and a wide side facing towards north-west and north-east respectively. In this instance, the angle of view from the narrow side in relation with the

[177] The Highland Council E-planning portal. https://wam.highland.gov.uk/wam/applicationDetails.do?activeTab=summary&keyVal=Q4381IIHI4I00 (accessed November 2021).

[178]The Highland Council E-planning portal.. https://wam.highland.gov.uk/wam/applicationDetails.do?activeTab=summary&keyVal=QAQM04IHMIH00 (accessed January 2022).

proposed location of turbines T1 and T2 is almost direct. Accordingly, the wider side would have an oblique angle of view.

15.6.5 During a site visit conducted on 20th January 2022, the following physical intervening objects were identified between the visual receptors and Proposed Development:

- A barn used to store various equipment is located directly adjacent to Receptor 1, blocking views towards the proposed wind turbines. Due to the proximity of the two buildings and height of intervening structure, any shadow coverage on Receptor 1 from turbines T1 and T2 would be limited at any month of the year.
- Between Receptor 2 and proposed turbines T1 and T2, there is mixed planted habitat consisting of; three recently planted conifers (4-6 m in height), several deciduous trees, and part of hedgerow forming part of the garden. Although the dense conifers could provide some visual screening of the turbines, they would not obstruct views in their entirety.

Shadow Flicker Impact – Worst Case Scenario

15.6.6 The results of the shadow flicker assessment as a worst-case scenario are shown in **Table 15.2** below. This scenario does not take into consideration physical intervening objects nor environmental and weather elements that may prevent shadow flicker, such as cloud coverage.

Table 15.2 Shadow Flicker Effects – Worst-Case Scenario

Receptor	Days per year of Shadow Flicker	Maximum hours per day	Mean hours per day	Total hours per year
1	88	0.71	0.41	35.7
2	107	0.77	0.43	46.2

15.6.7 Therefore, prior to mitigation, and based on the conservative "worst-case" approach adopted by the model, both of these receptors would experience a **significant** shadow flicker impact (i.e., an exceedance of 30 hours per year with a maximum of 0.5 hours (30 minutes) per day). However, as stated in paragraphs **15.2.5** and **15.2.8**, this approach does not factor in wind direction, wind speed, cloud cover and the presence of obstacles; variables which have the potential to reduce the likelihood and duration of shadow flicker effects.

Shadow Flicker – Realistic Scenario

15.6.8 A realistic shadow flicker scenario incorporates data on weather patterns in the surrounding area of the Proposed Development. Met Office and CEDA[179] datasets were collated, analysed, and subsequently interpolated to the worst-case scenario results from **Table 15.2**.

15.6.9 The worst-case scenario model predicted shadow flicker effects could only occur between mid-April and late August (due to sun's monthly orientation), therefore historical

[179] Centre for Environmental Data Analysis

meteorological information[180] in the form of time series within this time frame were included in the analysis. Weather data from 1981 to 2020 indicated a lack of cloud coverage for 18.59% of the examined duration.

15.6.10 Following the application of the above climatic conditions and parameters, the assessment for a realistic scenario concluded to the following shadow flicker impacts.

Table 15.3: Shadow Flicker Effects – Realistic Scenario

Receptor	Days per year of Shadow Flicker	Maximum hours per day	Mean hours per day	Total hours per year
1	16.36	0.13	0.07	6.64
2	19.89	0.14	0.08	8.59

15.6.11 Therefore, prior to mitigation, and based on a "realistic scenario" approach taking into consideration climate conditions, Receptor 1 and Receptor 2 would experience minor shadow flicker impact (i.e., less than 30 hours per year with a maximum of 0.5 hours (30 minutes) per day), which is considered **not significant** under EIA terms.

15.6.12 The observations made during the site visit of 20th January 2022 confirmed that the storage barn adjacent to Receptor 1 blocked views of turbines T1 and T2 from the windows. Therefore, the predicted shadow flicker impacts from Receptor 1, would be limited even further due to the intervening building.

15.7 Mitigation

Telecommunications

15.7.1 No impacts on any identified telecommunications assets are predicted. Therefore, no mitigation is required.

Shadow Flicker

15.7.2 Based on the realistic case scenario, no significant negative impacts are expected on either of the identified shadow flicker receptors, therefore no mitigation is required in this scenario.

15.7.3 Based on the worst-case scenario, the following mitigation is proposed:

- Where existing screening is not present, the applicant will seek agreement with the landowner (Dalnessie Estate) to provide additional screening to reduce or eliminate significant impacts. These could take the form of either vegetation screening (such as planting and maintaining woodland shelterbelts) or blinds located at relevant windows within Receptors 1 and/or 2.
- In the event that after these measures have been explored, significant shadow flicker impacts are still experienced at Receptor 1 and/or 2, a turbine shut down protocol for Turbines T1 and T2 will be put in place, and the blades remain stationary until the conditions causing those shadow flicker effects have passed.

[180] https://catalogue.ceda.ac.uk/uuid/c26a65020a5e4b80b20018f148556681

15.8 Summary of Residual Effects

15.8.1 Based on the "realistic scenario" shadow flicker assessment and the impact assessment on telecommunications assets, **no significant** residual effects are predicted.

15.9 References

Department for Communities & Local Government. 2013 *Planning practice guidance for renewable and low carbon energy*

Nordrhein-Westfalen 2002. *Notes on the Identification and Evaluation of the Optical Emissions of Wind Turbines, States Committee for Pollution Control*, cited in Parsons Brinckerhoff 2011

Northern Ireland Department of the Environment 2009. *Best Practice Guidance to Planning Policy Statement 18 'Renewable Energy'*, cited in Parsons Brinckerhoff 2011

Parsons Brinckerhoff. 2011. *Update of UK Shadow Flicker Evidence Base*. Report prepared for Department of Energy and Climate Change

Scottish Government. 2001. Planning Advice Note 62: *Radio telecommunications*. https://www.gov.scot/publications/pan-62-radio-telecommunications/ [accessed January 2022]

The Highland Council. 2012 *Highland-wide Local Development Plan*, April 2012. https://www.highland.gov.uk/info/178/local_and_statutory_development_plans/199/highland-wide_local_development_plan [accessed November 2021] https://www.highland.gov.uk/info/178/local_and_statutory_development_plans/199/highland-wide_local_development_plan

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