14 Other Issues

Contents

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14. Other Issues

Executive Summary

This chapter covers the following:

- aviation & radar;
- telecommunications;
- climate change & carbon balance; and
- shadow flicker.

An aviation assessment has been conducted by Wind Power Aviation Consultants Ltd (WPAC) in accordance with the relevant policy and guidance as detailed below. The assessment has concluded that the Proposed Development will have no effect on aviation stakeholders and that no mitigation will be required.

14.1 Introduction

14.1.1 This chapter assesses the potential effects of the Proposed Development on the following issues:

- aviation & radar;
- telecommunications:
- climate change & carbon balance; and
- shadow flicker.

14.1.2 This chapter is supported by the following figures and technical appendices:

- Figure 14.2.1 – VFR 250 k Chart Extract
- Figure 14.2.2 – VFR 500 k Chart Extract
- Figure 14.3.1 – Telecommunication Link
- Figure 14.5.1 – Shadow Flicker Study Area
- Appendix 14.1 – Aviation & Telecoms Consultation

14.2 Aviation & Radar

14.2.1 Wind turbines have the potential to affect civil and military aviation. This section explains the methodology used to undertake the aviation safeguarding scoping assessment, lists the aviation references used and describes the aviation baseline condition, consultation requirements and mitigations to be applied if required.

14.2.2 The aviation and radar assessment has been written by Cdr John Taylor RN (Ret) of WPAC Ltd. He has over 35 years experience as an Air Traffic Controller, Fighter Controller and Aviation Regulator and was head of Air Traffic Control for the Royal Navy. His responsibilities included responding to wind farm consultations on and offshore. Since 2008 his company has provided advice on the interaction between wind turbines and aviation including assessing over 3,000 wind turbine proposals and giving evidence at over 20 inquiries and appeals in England and Scotland. He has also advised a number of Local Authorities on this issue. His team includes experts on radar propagation and modelling and low flying operations.

Legislation, Policy and Guidelines

14.2.3 There are a number of aviation publications relevant to the interaction of wind turbines and aviation containing guidance and legislation, which cover the complete spectrum of aviation activity in the UK as shown below;

- Civil Aviation Publication (CAP) 764 Civil Aviation Authority (CAA) Policy and Guidance on Wind Turbines Version 6, Feb 2016 (CAA, 2016);
- CAP 168 Licensing of Aerodromes, Version 11 March 2019 (CAA 2019);
- CAP 670 ATS Safety Requirements Version 3 June 2019 (CAA 2019);
- CAP 774 UK Flight Information Services, Ed 3 May 2017 (CAA 2017);
- CAP 738 Safeguarding of Aerodromes Version 2 Dec 2006 (CAA 2006);
- CAP 793 Safe Operating Practices at Unlicensed Aerodromes Ed 1 July 2010 (CAA 2010);
- CAP 493 Manual of Air Traffic Services Part 1 Ed 7.0 2017 (CAA 2017);
- CAP393 The Air Navigation Order 2016 and Regulations (CAA 2016);
- CAP 660 Parachuting Ed 5 March 2020 (CAA 2020);
- Military Aviation Authority Regulatory Article 2330 (Low Flying) (MOD MAA 2019);
- UK Aeronautical Information Publications (AIP) (NATS 2020);
- CAA 1:250,000 and 1:500,000 VFR Charts (NATS 2019,2020); and
- CAA Policy Statement: Lighting of En-Route Obstacles and Onshore Wind Turbines 01 April 2010 (CAA 2010).

Consultation

14.2.4 Consultation was carried out in accordance with the guidance laid down in paragraphs 14.2.5 to 14.2.9 below. As shown below, there is no requirement to consult with aviation stakeholders except for the MOD, who were consulted and confirmed (email 28/01/2021) that based on details provided they would have no concerns and requested individual turbines be lit with 25 candela or infra-red lighting (refer to Appendix 14.1).

Assessment Methods and Significance Criteria

Study Area

14.2.5 The assessment of effects of the Proposed Development is based upon the guidance laid down in CAA Publication CAP 764 'Policy and Guidelines on Wind Turbines' Version 6 Dated February 2016 with the consultation criteria for aviation stakeholders defined in Chapter 4 of that document. These distances inform the size of the study area and include:

- Airfield with a surveillance radar – within 30 km;
- Non radar licensed aerodrome with a runway of more than 1,100 m – within 17 km;
- Non radar licensed aerodrome with a runway of less than 1,100 m – within 5 km;
- Licensed aerodromes where the turbines would lie within airspace coincidental with any published Instrument Flight Procedure (IFP);
- Unlicensed aerodromes with runways of more than 800 m – within 4 km;

- Unlicensed aerodromes with runways of less than 800 m– within 3 km;
- Gliding sites – within 10 km; and
- Other aviation activity such as parachute sites and microlight sites within 3 km – in such instances developers are referred to appropriate organisations.

14.2.6 CAP 764 goes on to state that these distances are for guidance purposes only and do not represent ranges beyond which all wind turbine developments will be approved or within which they will always be objected to. These ranges are intended as a prompt for further consultation between developers and aviation stakeholders which results in the study area being modified as required based on specific airspace and operational considerations.

14.2.7 It is also necessary to take into account the aviation and air defence activities of the Ministry of Defence (MOD) as safeguarded by the Defence Infrastructure Organisation (DIO). The types of issues that are addressed in this chapter include:

- MOD Airfields, both radar and non-radar equipped;
- MOD Air Defence Radars;
- MOD (now UK Met Office) Meteorological Radars; and
- Military Low Flying.

14.2.8 It is necessary to take into account the possible effects of wind turbines upon the National Air Traffic Services En Route Ltd (NERL) communications, navigation and surveillance systems – a network of primary and secondary radars and navigation facilities around the country.

14.2.9 As well as examining the technical impact of wind turbines on Air Traffic Control (ATC) facilities, it is also necessary to consider the physical safeguarding of ATC operations using the criteria laid down in CAP 168 Licensing of Aerodromes to determine whether the Proposed Development will breach obstacle clearance criteria.

Desk Study

14.2.10 The radar calculation results shown in this assessment have been produced using specialist propagation prediction software (RView Version 5). Developed over a number of years, it has been designed and refined specifically for the task. RView uses a comprehensive systems database which incorporates the safeguarding criteria for a wide range of radar and radio navigation systems. RView models terrain using the Ordnance Survey (OS) Terrain 50 digital terrain model, which has a post spacing of 50 m and has a root mean square (RMS) error of 4 m. The results are verified using the Shuttle Radar Topography Mission (SRTM) dataset, a separate smoothed digital terrain model with data spacing of 3 arc seconds. By using two separate and independently generated digital terrain models, anomalies are identified and consistent results assured. RView models the refractive effects of the atmosphere on radio waves and the First Fresnel Zone. A feature of RView is that as well as performing calculations in the manner believed to be most appropriate it also allows comparison with results from simpler models. For example, RView can perform calculations using the true Earth Radius at the midpoint between the radar and the wind turbine or the simplified 4/3 Earth Radius model. If needed, RView is also capable of modelling a range of atmospheric refractive conditions. RView models the trajectory of radar signals at different elevations, enabling modelling of both volume surveillance and pencil beam radars as well as the effects of angular sterilisation as applied, for example, in Met Office radars.

Site Visit

14.2.11 No site visit has been undertaken for this assessment.

Assessment of Potential Effects

14.2.12 Assessment of potential effects has been undertaken by identifying whether impacts are anticipated upon aviation and radar infrastructure and therefore whether aviation stakeholders are anticipated to object to the Proposed Development.

14.2.13 The assessment does not determine significant or non-significant effects, but whether there is an effect or no effect.

Requirement for Mitigation

14.2.14 Should effects upon aviation and radar infrastructure from the Proposed Development be identified, mitigation measures will be identified and reported.

Assessment of Residual Effects

14.2.15 As per the assessment of potential effects the assessment will not determine significance but whether the Proposed Development will give rise to an effect or not.

Baseline Conditions

14.2.16 The Proposed Development is located in an area relatively remote from any aviation facilities. Figures 14.2.1 and 14.2.2 show that it is underneath Class G unregulated airspace which extends upwards from ground level to Flight Level 195 (approximately 19,500 feet). The closest regulated airspace at low level is Class E regulated airspace designated N560 which takes traffic from Inverness to Wick and beyond. The Proposed Development is 20 km to the north-west of the boundary of this airspace. The Proposed Development is located within airspace designated as R610A, also known as the Highlands Restricted Area (HRA). The boundary is marked by hashed purple lines as shown in Figures 14.2.1 and 14.2.2. The HRA covers most of Northern Scotland and is used by the MOD for tactical low flying training.

Licensed Aerodromes

14.2.17 There are no licensed radar equipped aerodromes within 30 km. The closest is Inverness Airport, 76 km to the south-east; a busy regional airport operated by Highlands and Islands Airports Ltd (HIAL). Due to the lack of other radar facilities in the area, HIAL will often be consulted about proposed wind farm developments well beyond the standard 30 km. For completeness radar line of sight calculations have been undertaken to assess if any of the turbines would be likely to affect the radar.

Unlicensed Aerodromes

14.2.18 There are no unlicensed aerodromes within consultation distance. The closest shown on aviation charts is the microlight site at Rovie Farm, over 32 km to the south-east. Consultation is not required. An online search for private airfields has also been conducted and none identified within consultation distance, however, not all private strips are listed in publications or marked on charts.

Ministry of Defence

14.2.19 The closest military ATC radar facility is at RAF Lossiemouth, 90 km to the south-east. Lossiemouth is a high intensity military base operating Eurofighter Typhoons and Poseidon anti-submarine patrol aircraft. The base facilities are currently being upgraded and this includes the installation of a new primary surveillance radar (PSR). Currently the MOD are safeguarding both the existing Watchman PSR and the planned Thales Star 2000 NG radar due to be installed within the next 12 months.

Air Defence Radar

14.2.20 The closest Air Defence Radar is located at Buchan, near Peterhead, well over 180 km to the south-east.

Military Low Flying

14.2.21 The Proposed Development is located within the HRA also known as Low Flying Area (LFA)14 (T). The area covers most of northern Scotland and it is utilised for tactical low flying, however, since the demise of the Tornado, low flying by fast jets has decreased. The entire area is designated as a 'Red' area on the MOD Low Flying Areas Consultation Chart, which is described as: 'a high priority military low flying area likely to raise considerable and significant concerns'.

NATS En Route Ltd (NERL)

14.2.22 An assessment has been conducted to determine any effect of the Proposed Development on NERL communications, navigation and surveillance infrastructure (CNS). The closest radars in the NERL network are at Alanshill and Perwinnes.

Met Office Radars

14.2.23 The Met Office safeguards its network of radars using a European methodology known as OPERA. In general, they will object to any turbine within 5 km in line of sight and will examine the impact of any turbines within 20 km. Where a site is within 20 km, the Met Office will undertake an operational assessment based on three main criteria, having determined if there is a technical effect on the radar. The factors they will consider include the following:

- proximity to airports;
- river catchment response times; and
- population density.

14.2.24 In this case the closest Met Office radar is at Hill of Dudwick, north of Aberdeen and well beyond 20 km. There will be no Met Office radar objection to the Proposed Development and consultation is not required.

Potential Effects

14.2.25 The following receptors have been brought forward for assessment of potential effects from the Proposed Development:

- Licensed aerodromes / Inverness Airport;
- Ministry of Defence / RAF Lossiemouth;
- Air defence Radar/ RRH Buchan;
- Military Low Flying; and
- NERL.

Licensed Aerodromes – Inverness Airport

14.2.26 Radar line of sight calculations have been undertaken from Inverness Airport to assess if any of the turbines would be likely to affect the radar. The results are shown in Table 14.14.1 below. As radar line of sight is far above the tip height of the Proposed Development (149.9 m) there is no possibility of the turbines being visible to the radar at Inverness Airport. Therefore, at a distance of 76 km there is no requirement to consult with HIAL in relation to the Proposed Development.

Table 14.14.1 – Radar Line of Sight Results for Inverness Airport Radar

Turbine	Radar Line of Sight (m above ground level (m AGL))	Turbine	Radar Line of Sight (m AGL)
T1	1,148.5	T6	1,179.5
T2	1,141.4	T7	1,192.2
T3	1,147.7	T8	1,218.1
T4	1,170.2	T9	1,237.5
T5	1,177.2		

Ministry of Defence

14.2.27 Radar modelling has been conducted for both the existing Watchman PSR and the planned Thales Star 2000 NG radars at RAF Lossiemouth with the results shown in Tables 14.2 and 14.3 below. The results show that whilst the new Star 2000 radar has much better coverage at low level, neither radar will be affected by the Proposed Development.

Table 14.14.2 – Radar Line of Sight Results for RAF Lossiemouth Watchman Radar

Turbine	Radar Line of Sight (mAGL)	Turbine	Radar Line of Sight (m AGL)
T1	981.4	T6	992.9
T2	976.8	T7	1,004.8
T3	982.9	T8	1,017.7
T4	999.0	T9	1,028.7
T5	997.1		

Table 14.14.3 – Radar Line of Sight Results for RAF Lossiemouth Thales Star 2000 NG

Turbine	Radar Line of Sight (m AGL)	Turbine	Radar Line of Sight (m AGL)
T1	229.7	T6	260.9
T2	231.2	T7	271.8
T3	246.6	T8	304.1
T4	270.5	T9	309.5
T5	261.1		

Air Defence Radar

14.2.28 Radar modelling shows that there is no radar line of sight below 1,400 m above ground level (AGL) and there will be no effect on the radar at Buchan. Therefore, there is expected to be no MOD Air Defence objection to the Proposed Development.

Military Low Flying

14.2.29 Detailed examination of low flying charts covering the immediate area show there are no low flying flow arrows or restrictions in the vicinity of the Proposed Development and a low flying objection is therefore unlikely. Whilst military aircraft conduct low flying along Loch Shin and Glen Cassley, the MOD response to the previous 22 turbine layout stated that provided the turbines were not located closer to Loch Shin, there would be no objection. The MOD have requested that most, if not all, nine turbines be illuminated with MOD specification Infra-Red lights which are not visible to the naked eye.

NATS En Route Ltd (NERL)

14.2.30 Radar modelling of the closest radars at Alanshill and Perwinnes has been undertaken which has established that radar line of sight is in excess of 1,500 m AGL. There is no possibility of any NATS systems being affected by the Proposed Development. It is expected that NERL will confirm this when consulted by the planning authority.

Mitigation

14.2.31 Aviation obstruction lighting requirements are laid down in the CAA Policy Document Lighting of En-Route Obstacles and Onshore Wind Turbines (2010). In this case as the turbines are less than 150 m to tip and the Proposed Development is not in the vicinity of a licensed aerodrome, there is no requirement for any visible aviation lighting.

14.2.32 However, there will be a requirement for Infra-Red lights to satisfy MOD requirements. These lights are not visible to the naked eye.

Residual Effects

14.2.33 There will be no residual effects on aviation and radar receptors or operation.

Cumulative Effects

14.2.34 As there are no aviation effects to consider, there are no cumulative effects to assess.

Summary

14.2.35 The aviation assessment has been conducted following the guidance and policy laid down in CAA CAP764. Radar modelling has also been undertaken which demonstrates that none of the turbines will be visible to any air traffic control, air defence or Met Office radars. The results are very clear and none are marginal. The assessment shows that the Proposed Development will have no effect on any aviation receptors or operations.

14.3 Telecommunications

14.3.1 This section considers the likely effects of the Proposed Development on telecommunication infrastructure.

14.3.2 Wind turbines can potentially cause interference to telecommunication links through reflection and shadowing to electromagnetically propagated signals including terrestrial fixed microwave links managed by telecommunication operators.

Legislation, Policy and Guidelines

14.3.3 The assessment has been informed by relevant legislation, policy and guidelines, details of which are provided below.

- Wireless Telegraphy Act (2006);
- Planning Advice Note: PAN 62 Radio Telecommunications (2001);
- Inner Moray Firth Local Development Plan (The Highland Council (THC), 2015);
- Onshore Wind Energy Supplementary Guidance 2016 (THC, 2016); and
- Tall structures and their impact on broadcast and other wireless services (Ofcom, 2009).

Consultation

14.3.4 Consultation was undertaken with relevant stakeholders to identify any fixed wireless links or scanning telemetry links in the area, and a summary of their responses are set out in Table 14.4 below. OfCom(via Spectrum Licensing) no longer responds to consultation requests on telecommunications. However, they provide an online database containing information of fixed links. This database was interrogated and telecommunication links with the potential to be impacted were identified. Operators were then directly consulted, as detailed below.

Table 14.4 – Consultation Responses

Consultee	Consultation Response	Applicant Action
Airwave Solution (report June 2020)	Ran an analysis report on an earlier iteration of the layout and identified link pathways to the north-east and north-west of the Proposed Development turbines. Noted that the positions supplied raised no objection.	Airwaves were reconsulted in December 2020 and at time of writing no response has yet been received. Subsequent iterations of the Proposed Development layout have moved the final turbine positions further from the identified links than those originally analysed. Therefore, the Proposed Development is not anticipated to cause any interference with Airwaves infrastructure.
Atkins (email 06/12/20)	No objections.	No further action is required.
Arqiva (email 04/12/20)	No objections.	No further action is required.
BT (email 09/12/20)	No objections.	No further action is required.
Joint Radio Company (JRC) (email 14/01/21)	JRC ran an analysis report on potential interference to existing Scottish and Southern Energy's (SSE) licensed radio systems. Their analysis identified that with 50 m micrositing, the Proposed Development exceeds recommended diffraction criteria. Advised to consult directly with SSE.	JRC's analysis report was passed to SSE, however at the time of writing no response has been received. Consultation will be undertaken directly with SSE to agree mitigation. It is anticipated that this will involve restriction of micrositing allowances of select turbines, limiting their movement towards the fixed link pathway unless otherwise agreed with SSE.

Consultee	Consultation Response	Applicant Action
Vodafone (email 20/01/21)	Vodafone identified a link pathway in proximity to the turbines and stated that turbines should not be located within 100 m from blade tip to fixed link path.	This buffer has been applied to the link path and turbines have been positioned outwith this. Should micro-siting be required, the turbine locations would not be moved to within this buffer unless otherwise agreed with Vodafone.

Assessment Methods and Significance Criteria

14.3.5 This section describes the methods by which the key baseline conditions were identified and how the potential effects of the Proposed Development on these have been assessed.

14.3.6 Interference with mobile phone networks and other wireless data networks can occur through the interference of microwave and UHF band fixed links. These networks are operated by or on behalf of the mobile service providers, the utility companies, the emergency services and occasionally by small private networks.

14.3.7 The impact assessment has been conducted through consultation with the operators of these networks to identify potential impacts and residual impacts, and then go on to determine appropriate mitigation measures. Ofcom (via Spectrum Licensing) manages the allocation of frequencies and holds a database of licensed links. The database is available online for interrogation to identify fixed links for any given area. Ofcom does not comment on impacts or consider mitigation, which must be conducted in direct discussions with the system operators if links are identified.

Baseline Conditions

14.3.8 As detailed above, the baseline was established through consultation with key stakeholders (Table 14.4 and through review of the Ofcom freely available database (Ofcom, 2020). This process identified two overlapping fixed link pathways running through the turbine development area operated by Vodafone and JRC (on behalf of SSE) (refer to Figure 14.3.1).

Potential Effects

14.3.9 The Proposed Development has been designed to avoid impacts to fixed links through the turbine iteration process (refer to Chapter 3). With the implementation of embedded mitigation in the form of a clearance buffer (100 m to blade tip) around the link pathway as advised through consultation with link operators (refer to Table 14.4), no impacts or effects upon fixed links are anticipated as a result of the Proposed Development.

Mitigation

14.3.10 Although no impacts or effects are anticipated on fixed links, the Proposed Development will have a micro-siting allowance of up to 50 m in all directions in respect of each turbine and its associated infrastructure in order to address any potential difficulties which may arise in the event that pre-construction surveys identify unsuitable ground conditions or environmental constraints that could be avoided.

14.3.11 Should micro-siting be required, the turbine locations would not be moved within the accepted clearance buffer (100 m to blade tip) unless otherwise agreed with key stakeholders.

Residual Effects

14.3.12 Through the implementation of the proposed mitigation measures no residual impacts or effects upon telecommunications services from the Proposed Development are anticipated and it is therefore deemed that there is no significant effect as a result of the Proposed Development.

Cumulative Effects

14.3.13 As no residual effects from the Proposed Development alone are anticipated, the Proposed Development will not have cumulative effects with other wind farm developments on telecommunications.

Summary

14.3.14 This section has considered the potential effects of the Proposed Development on existing and planned telecommunications infrastructure.

14.3.15 Consultations have been undertaken with relevant consultees including; Airwave Solution, Arqiva, Atkins, BT, JRC, Spectrum Licensing and Vodafone.

14.3.16 Through implemented design changes and embedded mitigation, the Proposed Development will have no residual effects on telecommunications.

14.4 Climate Change & Carbon Balance

14.4.1 This section details the calculations to work out carbon dioxide (CO_2) emissions from the Proposed Development.

Energy Generation & Carbon Emissions Savings

14.4.2 Increasing atmospheric concentrations of greenhouse gases (GHGs), including CO_2 are resulting in climate change. A major contributor to this increase in GHG emissions is the burning of fossil fuels. With concern growing over climate change, reducing its cause is of utmost importance. The replacement of traditional fossil fuel power generation with renewable energy sources provides high potential for the reduction of GHG emissions. This is reflected in UK and Scottish Government climate change and renewable energy policy and commitments.

14.4.3 In addition to generating electricity, the Scottish Government sees wind farms as an important mechanism for reducing the UK's CO_2 emissions.

14.4.4 Whilst the Proposed Development will reduce carbon emissions by replacing the need to burn fossil fuels for power, carbon emissions will result from the component manufacturing, transportation and installation processes associated with the Proposed Development. There is also the potential for carbon fixers and sinks to be lost through the clearing of vegetation during construction. There must, therefore, be a sufficient balance between the carbon reduction associated with renewable energy development and that which is produced through construction/ fabrication processes and lost through site preparation.

Carbon & Peatland

14.4.5 Wind farms in upland areas tend to be sites on peatlands which hold stocks of carbon and so have the potential to release carbon into the atmosphere in the form of CO_2 if the peat is disturbed.

14.4.6 In order to minimise the requirement for the extraction of peat, the site design process has avoided areas of deep peat where feasible. Where areas of deep peat cannot be avoided floating tracks are proposed rather than new excavated track construction. The site design process is described in Chapter 3. Specific details on the peat depths on the site are included within Chapter 12.

14.4.7 The loss of carbon from the carbon fixing potential from plants and vegetation on peatland is small but is calculated for the area from which peat is removed and the area affected by drainage. The carbon stored in the peat itself represents a much larger potential source of carbon loss.

Assessment

14.4.8 This section estimates the CO_2 emissions associated with the manufacture and construction of the Proposed Development as well as estimating the contribution the Proposed Development would make to reducing CO_2 emissions, to give an estimate of the whole life carbon balance of the Proposed Development. The carbon balance assessment uses the Scottish Government's web-based Carbon Calculator tool V1.6.1. This tool provides generic values for CO_2 emissions associated with some components (such as turbine manufacture) and requires site specific information for other components, such as habitat type, extent of peat disturbance and groundwater levels. The assessment is based on a detailed baseline description of the Proposed Development and its location. All calculations are based on site specific data, where available. Where site specific data is not available, approved national/regional information has been used.

Results

14.4.9 The calculations of total CO_2 emission savings and payback time for the Proposed Development indicates the overall payback period of a wind farm with 9 turbines with a maximum installed capacity of 49.9 MW would be approximately 2.2 years, when compared to the fossil fuel mix (the existing energy mix within the UK) of electricity generation.

14.4.10 The potential savings in CO_2 emissions due to the Proposed Development replacing other electricity sources over the 30 year lifetime of the Proposed Development are approximately:

- 106,000 tonnes of CO_2 per year over coal-fired electricity (3.18 million tonnes over a 30 year lifespan);
- 29,000 tonnes of CO_2 per year over grid-mix of electricity (0.87 million tonnes over a 30 year lifespan); or
- 52,000tonnes of CO_2 per year over a fossil fuel mix of electricity (1.56 million tonnes over a 30 year lifespan).

Summary

14.4.11 The Proposed Development is expected to take around 2.2 years to repay the carbon exchange to the atmosphere (the CO_2 debt) through construction of the wind farm.

14.5 Shadow Flicker

Introduction

14.5.1 This section assesses the potential for shadow flicker effects on residential receptors resulting from turbines of the Proposed Development.

14.5.2 Shadow flicker occurs when, *"[In] certain combinations of geographical position, time of day and time of year, the sun may pass behind the rotor and cast a shadow over neighbouring properties. When the blades rotate, the shadow flicks on and off; the effect is known as 'shadow flicker'. It occurs only within buildings where the flicker appears through a narrow window opening"* (Scottish Government, 2014, Onshore Wind Turbines).

14.5.3 The magnitude of shadow flicker effects varies both spatially and temporally, and depends on a number of environmental conditions coinciding at a particular point in time, which include:

- time of day and year;
- wind direction;
- height of wind turbine and blade length;
- position of the sun in the sky;
- weather conditions;
- proportion of daylight hours in which the turbines operate;
- distance and direction of the wind turbine from the receptor.

14.5.4 The flickering effect caused by shadow flicker also has the potential to induce epileptic seizures in patients with photosensitive epilepsy. The National Society for Epilepsy (NSE) advises that around 1 in 100 people in the UK have epilepsy and around 3 % of these have photosensitive epilepsy (NSE, 2019). The common rate or frequency at which photosensitive epilepsy might be triggered is between 3 and 30 hertz (Hz, flashes per second). Large commercial turbines rotate at low speeds resulting in less than 3 flashes per second are therefore unlikely to cause epileptic seizures (Harding et al., 2008: Smedley et al., 2010). Therefore, photo-sensitive epilepsy is scoped out and is not considered further in this assessment as there is no likelihood of any significant effect. This assessment therefore focuses solely on the effects of shadow flicker related to local amenity.

Legislation, Policy & Guidance

14.5.5 There is no applicable legislation setting out any relevant rules or requirements for the assessment or control of shadow flicker.

14.5.6 The Update of UK Shadow Flicker Evidence Base (DECC, 2011) reviews international legislation relating to the assessment of shadow flicker for wind turbine development and concludes that the area within 130 degrees either side of north from the turbine, and out to 10 rotor diameters, is considered acceptable for shadow flicker assessment. The DECC study also concluded that there have not been extensive issues with shadow flicker in the UK and in circumstances where the potential for significant shadow flicker effects have been identified, these have been resolved using standard mitigation.

14.5.7 The assessment has taken into consideration the Scottish Government's 'Onshore Wind Turbines: Planning Advice' (Scottish Government, 2014). This is consistent with the findings of the DECC study and stipulates that, in most cases '*where separation is provided between wind turbines and nearby dwellings (as a general rule, 10 rotor diameters), 'shadow flicker' should not be a problem*'.

14.5.8 THC Onshore Wind Energy Supplementary Guidance (THC, 2016) recommends that a shadow flicker assessment be undertaken where any turbines are within 11 rotor diameters of potential receptors. Their recommended increased study area from the widely accepted 10 rotor diameter is to account for the northern latitudes in the Highlands.

Consultation

14.5.9 Consultation with THC was undertaken to seek agreement that shadow flicker can be scoped out of the EIA Report for the Proposed Development due to the separation distance to potential receptors.

14.5.10 THC confirmed on the 11th of January 2021 that shadow flicker can be scoped out of the EIA Report (see Appendix 14.1).

Shadow Flicker Assessment

14.5.11 This section has assessed the Proposed Development as described in Chapter 4. For the purpose of this assessment, it has been assumed that the Proposed Development turbines will not exceed 149.9 m to blade tip and has been based on a candidate turbine with a rotor diameter of 133 m.

14.5.12 The initial study area within which receptors could potentially be affected by shadow flicker has therefore been set at a distance of 10 times the rotor diameter (133 m) from each turbine and 130 degrees either side of north (relative to each turbine), as noted within Update of UK Shadow Flicker Evidence Base report (DECC, 2011). The relevant study area for the Proposed Development therefore includes an area of 1,330 m from each turbine and 130 degrees either side of north.

14.5.13 Extending the study area to 11 rotor diameters in line with THC Supplementary Guidance includes an area of 1,463 m from each turbine.

14.5.14 The study areas and nearest sensitive receptors to the Proposed Development are shown on Figure 14.5.1.

14.5.15 As shown on Figure 14.5.1 there are no sensitive receptors within the study area, or any within 2 km of the turbines, and therefore no significant effects are anticipated, and no further assessment is required

Summary

14.5.16 The shadow flicker assessment has considered the potential for the Proposed Development to cause shadow flicker on sensitive receptors. Desk study and consultation identified that there are no potential receptors located within the shadow flicker study area and therefore no significant shadow flicker effects are anticipated, and no further assessment is required. This position was agreed through consultation with THC.

14.6 Summary

14.6.1 Table 14.5 below provides a summary of the residual effects presented within this chapter.

Table 14.5 - Summary Table – Other Issues

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Aviation & Radar					
Effects to aviation and radar receptors and operations	None	N/A	Infra-Red lights to satisfy MOD requirements	None	N/A
Telecommunications					
Effects on telecommunication	None	N/A	Embedded mitigation of a clearance buffer and micrositing restriction if required.	None	N/A
Shadow Flicker					
Shadow flicker nuisance	None	N/A	None required.	None	N/A

14.7 References

Civil Aviation Authority (2016) Civil Aviation Publication (CAP) 764 Civil Aviation Authority (CAA) Policy and Guidance on Wind Turbines Version 6.

CAA (2019) CAP 168 Licensing of Aerodromes, Version 11 March 2019.

CAA (2019) CAP 670 ATS Safety Requirements Version 3 June 2019.

CAA (2017) CAP 774 UK Flight Information Services, Ed 3 May 2017.

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