Contents

15.0 Shadow Flicker, Telecommunications and Other Issues

15.1 Introduction

This chapter assesses the potential effects of the proposed development in relation to:

- Shadow Flicker;
- Telecommunications;
- Major Accidents and Disasters;
- Population and Human Health; and
- Air Quality.

Elements relating to Major Accidents and Disasters have also been addressed in the individual technical discipline chapters where relevant.

Impacts on Population and Human Health have also been addressed in the individual EIA topic chapters where relevant.

This assessment has been undertaken by SLR Consulting.

The chapter is supported by Figures 15.1 – 15.2, and **Technical Appendix 15.1: Carbon Calculator** that are referenced in the text where appropriate.

15.2 Shadow Flicker

15.2.1 Introduction

This section of the chapter summarises the potential effect of shadow flicker associated with the proposed development.

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, as the blades rotate, the shadow may appear to flick on and off, when viewed through a narrow aperture such as a window. The phenomenon occurs only within buildings where shadows are cast across a window aperture, and the effects are considered to occur up to a maximum distance of 10 times the rotor diameter from each wind turbine[1]. This effect is known as shadow flicker.

The following policy documents have been referred to in undertaking the assessments:

- National Planning Framework 4; and
- Moray Council's Local Development Plan 2 in its Supplementary Guidance: Wind Energy

15.2.1.1 Guidance

The following guidance documents have been referred to in undertaking the assessments:

- Scottish Government - Onshore wind policy statement 2022 (and its predecessor Onshore wind turbines: planning advice); and
- Department of Energy & Climate Change (DECC) guidelines.

[1] IWEA Best Practice Guidelines for Wind Farms. Available at: https://windenergyireland.com/images/files/best-practice-guidelines-for-windfarm-electrical-operation1.pdf Date Accessed 23/6/2023

A report on shadow flicker from the Department of Energy & Climate Change (DECC) indicates a general rule of ten rotor diameters should be used for separation distance from a wind turbine position to a dwelling. Scottish Government guidance advocates that beyond this distance, shadow flicker should not be a problem.

15.2.2 Scope of Assessment

Neither National Planning Framework 4 (2023), the Scottish Governments Onshore Wind Policy Statement (2022) or Moray Council's Local Development Plan (2020) contain technical details regarding the assessment of shadow flicker.

Moray Council's Local Development Plan (2020) states that:

"In addition to the assessment of the impacts outlined in part a) above, the following considerations will apply:

…

Impact on local communities

the proposal addresses unacceptable significant adverse impact on communities and local amenity including the impacts of noise, shadow flicker, visual dominance and the potential for associated mitigation".

The older Onshore wind turbines: planning advice (2014) document states that:

"Under 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. The seasonal duration of this effect can be calculated from the geometry of the machine and the latitude of the potential site.

Where this could be a problem, developers should provide calculations to quantify the effect. In most cases however, where separation is provided between wind turbines and nearby dwellings (as a general rule, 10 rotor diameters), 'shadow flicker' should not be a problem. However, there is scope to vary layout/reduce the height of turbines in extreme cases".

The assessment was therefore carried out based on the 10-rotor diameter distance following the DECC and Onshore wind turbines: planning advice guidelines, however in the event of shadow flicker being reported beyond this radius, reports will be investigated and mitigatory measures will be put in place.

Shadow flicker effects are only considered during the operational phase of a wind farm development, and do not occur if the turbines are not rotating or if the sun is not shining.

15.2.3 Study Area

In line with the best practice guidance outlined above, a study area based on a distance of 10 rotor diameters from the proposed wind turbines has been employed to determine the zone of potential shadow flicker incidence of the proposed development. The turbines assessed for the proposed wind turbines have a maximum rotor diameter of 170m, which results in a study area of 1,700m from the turbines. In addition to this a further 100m area was added to the 10-rotor diameter distance in order to account for potential micrositing should the proposed development receive consent (total study area = 1,800m). 34 properties were identified within the initial 10-rotor diameter study area.

The maximum study area for the proposed development was mapped using GIS software. This was then refined to include only the areas within 130 degrees of north of proposed wind turbine locations. Properties within the study area identified from OS AddressBase data, aerial imagery and discussions with residents at public exhibitions. Of the original 34 properties identified within the 10-rotor diameter shadow flicker study area, 28 fall within the 130 degrees either side of north limitation. **Figure 15.1** shows the location of these properties, and for completeness all 34 are included in the figures and tables.

15.2.4 Methodology

The shadow flicker assessment comprises numerical modelling of the proposed turbines and receptors within the defined study area. It is noted that whilst there are a number of computer models available, the DECC study (2011) confirms that there are limited differences between outputs of the various packages. For Shadow Flicker assessments, SLR Consulting use one of the industry standard software packages, ReSoft Wind Farm software (version 5.1.2.1).

The calculations from this assessment process assume a worst-case scenario based on the sun shining during all daylight hours over the course of a year, no obscuring features (such as trees, hedges, other buildings) being present, the face of the rotor always being aligned towards the dwelling, and that the rotor is always turning (i.e. the wind is always blowing between 4m/s and 25m/s, and no account is taken of shut down periods for maintenance). This methodology yields a theoretical maximum indication of potential shadow flicker incidence, together with the times of day, and dates during the year when potential incidence may occur.

The levels of shadow flicker at each receptor have been calculated based on a ‘greenhouse’ modelling approach, where the full length of each façade of a building is modelled as a window (and is therefore sensitive to shadow flicker). Each modelled window is assumed to have a height of 2 m. This approach has been taken in order to present a worst case estimate of shadow flicker, in the absence of any detailed window location data. In reality, only the glazed area of each façade would be sensitive to shadow flicker effects, therefore modelling the full façade will result in higher predicted levels than will actually be possible.

The software performs calculations to determine the position of the sun throughout the year, and thus during what times of day it will theoretically cast a shadow across the windows of nearby houses within 10 rotor diameters (plus 50m micrositing). Data input into the model where shadow flicker assessment is required is as follows:

- The locations of all properties within ten times the rotor diameter (including an allowance of 50m for micrositing) and 130 degrees either side of north of any turbine;
- The dimensions and orientations of windows facing the proposed development;
- The surrounding topography (Ordnance Survey Digital Terrain Model); and
- The locations and dimensions of the turbines.

The following sources of information outlined in **Table 15-1** were used to inform this assessment.

Table 15-1: Sources of Information

Topic	Source of Information
Residential properties Location in relation to proposed development and identification of windows.	Ordnance Survey (OS) 1:25,000 Mapping Google Earth Street View Bing Maps Birds Eye View
Topography Height data	OS 5m DTM data

In practice it is likely that shadow flicker effects would occur for considerably less time than the worst-case predictions, for the following reasons:

- In the UK, sunshine typically occurs for approximately 30% of daylight hours. At other times, the wind turbines are unlikely to cast shadows sufficiently pronounced to cause shadow flicker effects to occur;
- At times when the wind turbine rotor is not oriented directly towards the property, the duration of shadow flicker effects would be reduced due to the elliptical shape of the shadow cast;
- The assessment has been undertaken assuming a worst-case scenario which does not take into consideration the screening effect of anything located between the wind turbines (e.g., intervening structures or vegetation) and the property.

Only those properties within 1,800m of the proposed turbines have been included in the calculations. The model has been run using OS terrain 5 DTM data which is the most accurate digital terrain data available for the Site.

15.2.5 Limitations to the Assessment

There are several additional factors that can influence the amount of shadow flicker actually experienced and these cannot be readily included in a computer-based assessment.

Climatic conditions dictate that the sun is not always shining. The closest Met Office location is Keith, located approximately 5km from the proposed development.

Historic Met Office data (over the period 1991–2020) gives actual sunshine hours for the Keith Met Station to be on average 30.8%[2] of total daylight hours. Cloud cover during other times may obscure the sun and prevent shadow flicker occurrence. While some shadows may be cast under slightly overcast conditions, no shadow at all would be cast when heavy cloud cover prevails.

During calm periods, or very high winds, the wind turbine blades would not rotate, and shadow flicker would not occur. Turbines would also be periodically shut down for maintenance or repair work.

Wind turbines automatically orientate themselves to face the prevailing wind direction. This means that the turbine rotors would not always face directly towards the occupied buildings. Under some wind conditions, the proposed turbines would face 'side-on' to properties, and in these conditions only a very small area of blade movement would be visible.

Any screening provided by vegetation or structures has not been incorporated as the analysis has been run on bare ground terrain data as a worst-case scenario. The inclusion of a 100m micrositing has also added to the worst-case nature of the assessment, as for some properties this means additional turbines are considered to cause shadow flicker if they moved 100m towards the property.

15.2.6 Assessment of Significance

Whilst the time and duration of shadow flicker events can be predicted accurately, the level of the effect is difficult to quantify as this would depend on the location of windows within a property, the use of the rooms affected, the level of shading surrounding the property and how susceptible the receptor is to light flicker.

As confirmed by the DECC study (2011), there is no standard Scottish or UK guidance relating to a limit for shadow flicker, and this remains the case. The only guidance providing additional recommendations is the Northern Irish PPS 18 (2009) guidance which recommends that for

[2] Average sunshine hours of 1,350.56 / total number of daylight hours 4,380 = 30.8%. Data from Met Office Climate Averages Site available at: https://www.metoffice.gov.uk/research/climate/maps-and-data/uk-climate-averages/gfjzkg7yh

properties within 500m of the turbines, shadow flicker should not exceed 30 hours per year or 30 minutes per day.

The assessment has therefore adopted a criterion of 30 hours of shadow flicker (under the likely-case assessment criteria) in one year as a significance threshold. Where less than 30 hours of shadow flicker is predicted to occur in one year at a particular property, this is considered to be a minor effect (not significant), with significance increasing in relation to the number of hours (over 30) of shadow flicker per year, in accordance with best practice guidance.

Whilst the distance between turbine and property does not affect the calculated shadow flicker exposure times, it does mean that the actual effect (i.e. the total exposure time and flicker intensity combined) of the proposed development would, in reality, be less than that calculated as a worst-case.

Mitigation is proposed to minimise or remove predicted effects, if levels of shadow flicker are deemed to be significant in practice in line with the Northern Irish PPS 18 (2009) guidance.

15.2.7 Baseline Conditions

A number of residential properties have been identified which fall within the 1,800m study area. These properties could theoretically be affected by shadow flicker from the proposed development (**Figure 15.1**). Details of these properties are identified in **Table 15-2**.

Table 15-2: Residential Properties within Study Area

Property ID.	Property Name	Notes (for information)	Easting	Northing	Distance from Nearest Proposed Turbine (m)
1	Muirton	Residential	346015	860748	1,569
2	Greenwells Croft	Residential	344886	860186	1,340
3	Hillhead Of Letterfourie	Residential	344475	860073	1,504
4	Inkerman (Derelict)	Currently derelict, has permission for rebuild.	344615	859769	1,197
5	Aultmore Lodge	Residential	349118	859525	1,702
6	Upper Allaloth	Residential	340732	858589	1,449
7	Langlanburn	Residential	349192	858506	1,523
8	Tarrymount	Possibly uninhabited.	340183	858107	1,389
9	Drodland	Residential	345312	857575	1,277
10	Marchbank (Derelict)	Derelict	348115	857435	924
11	Myreside	Residential	348538	857433	1,207
12	Hayfield	Residential	345255	857357	1,495
13	Raefin	Residential	339905	857295	1,357
14	Bossy Hillocks	Residential	348949	857295	1,618
15	Wester Windyhills	Residential	348604	857153	1,449
16	Balnamoon Hill Cottage	Residential	347757	856807	1,138
17	Goukstone Croft	Residential	347905	856690	1,324

Property ID.	Property Name	Notes (for information)	Easting	Northing	Distance from Nearest Proposed Turbine (m)
18	Beechtree Farm Caravan	Residential	347539	856591	1,598
19	Beechtree Farm	Residential	339827	856521	1,623
20	Ryeriggs Croft	Residential	339800	856519	1,214
21	Rowanbank	Residential	347922	856488	1,528
22	Sunnybrae Croft	Residential	340248	856472	1,268
23	The Bungalow Ryeriggs	Residential	346438	856354	1,394
24	Newtonbrae	Residential	343427	856289	1,221
25	Balnamoon Hill*	Residential	342830	856187	1,183
26	Redroofs Croft	Residential	340174	856092	1,485
27	Deerhill Croft*	Residential	342540	856004	1,383
28	Woodside Cottage*	Residential	342303	855385	1,529
29	Heads Of Auchinderran*	Residential	340828	855336	1,456
30	Heads Of Auchinderran Cottage*	Residential	340845	855327	1,457
31	Consented Property, not built	Consented but not built.	340664	856312	856
32	Redroofs Croft 2	Consented residential property, not completed at time of assessment.	346511	856342	1,536
33	Redroofs Croft 3	Consented residential property, not completed at time of assessment.	347994	856483	1,568
34	Deerhill Croft Consented*	Consented residential property, not completed at time of assessment.	348026	856468	1,368
* Property lies outwith the defined shadow flicker study area (130 degree either side of north) but is within 10 rotor diameters of a turbine.					

15.2.8 Assessment of Effects

Figure 15.2 shows the results of the shadow flicker modelling. Based on the predictive modelling technique outlined above, there is predicted to be shadow flicker effects of up to 110 hours per year at property 31, (shown in **Table 15-3**) assuming the worst-case scenario whereby it is assumed the sun is always shining during daylight hours, the turbines are always turning, and there is no screening from vegetation. The last two columns of **Table 15-3** provide an indication of the likely shadow flicker minutes per day and hours when the 30.8% average sunshine hours factor is included.

In addition, 22 other properties could also potentially receive shadow flicker effects but of fewer hours.

The results shown in **Table 15-3** are based on the 'worst-case scenario', which assumes that the sun is always shining during daylight hours, the wind is always blowing, makes no allowance for any screening by vegetation, and includes the potential for micrositing leading to turbines being moved 50m closer to these properties.

Table 15-3: Shadow Flicker Assessment Outputs

ID.	Property Name	Days per Year Where Shadow Flicker Potentially Experienced	Turbine(s) Causing Effect	Max Minutes per Day Where Shadow Flicker Potentially experienced	Total Hours per Year When Shadow Flicker Potentially experienced	Likely Minutes per Day Where Shadow Flicker Potentially experienced *	Likely Hours per Year When Shadow Flicker Potentially Experienced *
1	Muirton	69	6, 7, 8	27.6	22.8	5.4	7.0
2	Greenwells Croft	100	6, 7	36.6	46.8	11.3	14.4
3	Hillhead Of Letterfourie	36	6	31.2	12.7	9.6	3.9
4	Inkerman (Derelict)	58	6, 9	39	26.8	12.0	8.3
5	Aultmore Lodge	70	11, 13	26.4	23.4	8.1	7.2
6	Upper Allaloth	94	1, 2	33.6	42.3	10.3	13.0
7	Langlanburn	103	11, 13, 15	35.4	41.1	9.1	12.7
8	Tarrymount (Derelict)	46	1, 2	33	16.8	10.2	5.2
9	Drodland	143	12, 14, 16	33.6	60.3	10.3	18.6
10	Marchbank (Derelict)	116	14, 16	37.8	56.3	11.6	17.3
11	Myreside	87	14, 15, 16	28.2	25	8.7	7.7
12	Hayfield	82	12, 16	27	28.8	8.3	8.9
13	Raeffin	75	2, 5	33	30.2	10.2	9.3
14	Bossy Hillocks	54	15	29.4	20.5	9.1	6.3
15	Wester Windyhills	38	16	27	13.6	8.3	4.2
16	Balnamoon Hill Cottage	0	-	-	-	-	-
17	Goukstone Croft	0	-	-	-	-	-

ID.	Property Name	Days per Year Where Shadow Flicker Potentially Experienced	Turbine(s) Causing Effect	Max Minutes per Day Where Shadow Flicker Potentially experienced	Total Hours per Year When Shadow Flicker Potentially experienced	Likely Minutes per Day Where Shadow Flicker Potentially experienced *	Likely Hours per Year When Shadow Flicker Potentially Experienced *
18	Beechtree Farm Caravan	91	2, 5	30	34.9	9.2	10.7
19	Beechtree Farm	91	2, 5	29.4	33.6	9.1	10.3
20	Ryeriggs Croft	134	2, 4, 5	58.2	75.6	17.9	23.3
21	Rowanbank	54	4	27	18.8	8.3	5.8
22	Sunnybrae Croft	95	4, 5	31.8	37.9	9.8	11.7
23	The Bungalow Ryeriggs	70	5	34.2	30	10.5	9.2
24	Newtonbrae	87	2, 5	46.2	51.6	11.5	15.9
25	Balnamoon Hill	0	-	-	-	-	-
26	Redroofs Croft	0	-	-	-	-	-
27	Deerhill Croft	0	-	-	-	-	-
28	Woodside Cottage	0	-	-	-	-	-
29	Heads Of Auchinderran	0	-	-	-	-	-
30	Heads Of Auchinderran Cottage	0	-	-	-	-	-
31	Consented Property, not built	104	4, 5	76.8	110.1	23.7	33.9
32	Redroofs Croft 2	0	-	-	-	-	-
33	Redroofs Croft 3	0	-	-	-	-	-
34	Deerhill Croft Consented	0	-	-	-	-	-
* based on average sunshine hours being applied to the model as outlined in Section 15.2.5.							

15.2.9 Analysis of Results

The results confirm that 15 of the 34 properties assessed could potentially experience over 30 hours of shadow flicker effect per annum, based on the worst case assessment criteria. Based on the assessment criteria laid out in Section 15.2.6 the effects on these properties would therefore be significant without mitigation.

These figures are likely to comprise an over-estimate of actual effects. Given the conservative nature of this assessment as set out in the additional rationale in Section 15.2.5, it is likely in practice actual hours of shadow flicker would be considerably less than this due to the wind not always blowing and the sun not always shining, and other assumptions set out earlier.

Expected hours of shadow flicker are provided in the final column of **Table 15-3**, adjusted for likely sunshine hours, and under this assumption the annual hours of shadow flicker anticipated at all properties, with the exception of the as yet unbuilt property 31, is significantly under 30 hours. Details of when shadow flicker could be experienced at properties with a potentially significant effect are provided below.

15.2.9.1 House 31 – Unnamed property (consented but not built)

Shadow flicker at this property could be experienced for up to 110.1 hours per year (33.9 hours per year under the average sunshine hours adjustment) from turbines 4 and 5. Shadow flicker effects from turbine 4 would be likely to occur between the hours of 04:24 and 05:09 from mid-May to early August, whilst shadow flicker effects originating from turbine 5 would be likely to occur between the hours of 04:46 and 05:49 from early May February through to mid-August.

15.2.10 Mitigation

Based on the significance thresholds outlined in Section 15.3.5, significant shadow flicker effects are predicted to occur as a result of the proposed development, based on a worst-case scenario, at a single as yet unbuilt property.

Although shadow flicker levels are likely to fall to below the 30-hour per annum significance threshold based on the average sunshine hours expected at the Site (with the exception of a currently consented but unbuilt property), the applicant is nonetheless committed to promptly investigating any complaints of shadow flicker and taking appropriate action as required.

If a complaint is made regarding shadow flicker, an investigation would take place which considers the weather conditions at the time of the alleged shadow flicker, to determine which turbines were, or were not, creating the effect and the extent of the shadow flicker created. If the investigation confirms a loss of residential amenity at any location, the technical mitigation measures built into these turbines would be activated.

Shadow flicker control modules, consisting of light sensors and specialised software, will be installed on the turbines that can prevent operation during periods when shadow flicker can be experienced at nearby properties. The installation of a programmable shadow flicker module will allow the control of turbines in order to eliminate shadow flicker. The correct operation of the installed shadow flicker control measures will ensure that there will be no impact from shadow flicker. The operation and performance of the shadow flicker control measures will be monitored on an ongoing basis.

The shadow flicker control module consists of bespoke software, a clock, a timer, a switch, a wind direction sensor and a light sensor. The module can control a specific turbine (or turbines) which would be programmed to shut down on specific dates at specific times when the sun is bright enough, there is sufficient wind to rotate the blades and the wind direction is such that nuisance shadow flicker could occur. There is no specific UK guidance regarding what level of light is sufficient to cause a shadow flicker event. However, the actual light level that would trigger a turbine shut down can be manually configured onsite, following installation, to reflect local conditions.

A planning condition would provide an appropriate form of mitigation to ensure that any complaints would be investigated within a reasonable timescale and that the rectification of any substantiated shadow flicker issue would be implemented promptly and effectively. As noted in the DECC guidance (2011) states that "*Mitigation measures which have been employed to operational wind* *farms such as turbine shut down strategies, have proved very successful, to the extent that shadow flicker cannot be considered to be a major issue in the UK".*

15.2.11 Residual Effects

Following implementation of mitigation following a complaint, it is considered that there will be no significant effects in relation to shadow flicker as a result of the proposed development.

15.3 Telecommunications

15.3.1 Introduction

This chapter considers the likely significant effects on telecommunications associated with the construction, operation and decommissioning of the proposed development. The specific objectives of the chapter are to:

- describe the current baseline;
- describe the assessment methodology and significance criteria used in completing the impact assessment;
- describe the potential effects, including direct, indirect and cumulative effects;
- describe the mitigation measures proposed to address the likely significant effects; and
- assess the residual effects remaining following the implementation of mitigation measures.

The assessment has been carried out by Malcolm Spaven of Gladhouse Planning Ltd (trading as Aviatica). Aviatica is a specialist consultancy with over 20 years of experience assessing the impacts of wind energy developments on telecommunications. This has included the preparation of more than one hundred Environmental Impact Assessment (EIA) chapters for projects across the UK and assessment of six previous wind farm developments in Moray.

15.3.2 Legislation, Policy and Guidance

The following legislation, policy and guidance has informed the telecommunications assessment in this chapter.

- Wireless Telegraphy Act (UK Government, 2006);
- Planning Advice Note 62: Radio Telecommunications (Scottish Government, 2001); and
- Tall structures and their impact on broadcast and other wireless services (Ofcom, 2009).

15.3.3 Scope and Consultation

15.3.3.1 Consultation

Consultations with telecommunications stakeholders have been completed as shown in **Table 15-4.**

Table 15-4: Telecommunications consultations

Consultee	Response	Applicant's response
Joint Radio Company (JRC) (7 July 2021)	T12, T13, T14 and T15 breach the limits for the following links: 460MHz Telemetry and Telecontrol: JESHLS1 to JESHLO9 JESHLS1 to JESHLO1 JESHLS1 to JESHLO11 JESHLS1 to JESHLO13	The applicant has continued to work with JRC to define a layout that reduces impacts on their links and to identify appropriate mitigation. This is set out in section 15.3.9 of this chapter.

Consultee	Response	Applicant's response
	JESHLS1 to JESHLO2 JESHLS1 to JESHLO4 JESHLS1 to JESHLO5 JESHLS1 to JESHLO6 JESHLS1 to JESHLO7 >1GHz Microwave Point to Point: SCHY 0929268/1 SSE 0929268/1 SCHY 0929159/1 SCHY 0929160/1 SCHY 0929208/1 SCHY 0929270/1 SCHY 0929294/1 SCHY 0929332/1 SSE 1027602/2 SSE 0929332/1 SSE 0929270/2 Therefore JRC OBJECTS TO THE PROPOSED DEVELOPMENT.	
MBNL (8 July 2021)	I note these are revised coordinates from a previous application, unfortunately we still have an issue with T14. The clearance we require to the link is 100m from the blade tip. In this case the clearance is only 63m	Subsequent revisions to layout have moved all turbine blade tips further than 100m from all microwave links.
BT (14 July 2021)	We have 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 using the attached co-ordinates should not cause interference to BT's current and presently planned radio network.	No further action required.
Arqiva (15 July 2021)	We have considered whether this development is likely to have an adverse effect on our operations and have concluded that we have no objections to this development.	No further action required.
Vodafone (15 July 2021)	Vodafone require 100m clearance from tip of any turbine blade to fixed link radio path. In the event of any conflict, we advise performing Fresnel Zone calculations, adhering to the recommended Ofcom methodology. This may indicate that reduced clearance margins at location point are possible. Other means of mitigation such as re-siting of masts would be out of the question and non-negotiable.	Subsequent revisions to layout have moved all turbine blade tips further than 100m from all microwave links.
Telefonica (19 October 2023)	Acceptable	No further action required
Scot-Tel Gould Ltd (19 October 2023)	Acceptable	No further action required.
Atkins (19 October 2023)	The above application has now been examined in relation to UHF Radio Scanning Telemetry communications used by our Client in that region and we are happy to inform you that we have NO OBJECTION to your proposal.	No further action required.

15.3.4 Approach and Methodology

15.3.4.1 Scope of Assessment

The assessment of the effects of the proposed development on telecommunications covers potential adverse effects on:

- fixed point-to-point microwave radio telecommunications links;
- Ultra-High Frequency (UHF) scanning telemetry links used by the energy and water industries;
- terrestrial television reception.

The key issues identified through scoping and consultation are:

- effects on microwave links to/from telecommunications masts at Tor Sliasg, to the north of the western group of turbines in the proposed development;
- effects on power industry scanning telemetry links to/from Tor Sliasg; and
- reception of TV signals from the Knockmore transmitter.

15.3.4.2 Baseline Characterisation

Study Area

The study area for fixed telecommunications links is a 1.5km radius from the Site. The study area for television reception is an 85km radius from the Site in order to capture all television transmitters with the potential to provide terrestrial TV signals in the area surrounding the proposed development.

Information and Data Sources

Data on the telecommunications baseline has been obtained from the Ofcom Spectrum Information Portal and Wireless Telegraphy Register; from consultations with JRC, Atkins and Arqiva; and from television transmitter data published by Ofcom and the ukfree.tv website (https://ukfree.tv/).

Assessment Methods

The potential impacts of the proposed development on fixed microwave telecommunications links have been assessed by calculating the separation distances between turbine blade tips and link paths and comparing these to industry and Ofcom recommended minimum separation distances.

The potential impacts of the proposed development on power industry fixed microwave and UHF scanning telemetry links have been assessed by commissioning impact and mitigation studies from JRC.

The potential impacts of the proposed development on terrestrial television reception have been assessed by applying BBC/Ofcom criteria for potential interference zones and assessing the availability of signals from alternative transmitters.

15.3.5 Significance Criteria

The significance of an effect on fixed telecommunications links has been determined by assessing the proximity of turbines to the link, measured against Ofcom and industry standards, and by responses from telecommunications consultees.

The significance of effects on terrestrial television reception has been determined by reviewing the number of domestic properties in potentially affected areas and the availability of TV signals from other transmitters.

The criteria used in determining significance are set out in **Table 15-5.** Major and moderate effects are considered significant in relation to the EIA Regulations.

Table 15-5: Significance criteria

Significance of effect	Description
Major	Regular, frequent or permanent effects which require changes to existing operational and/or technical practice in order to mitigate adequately, or which are not capable of being mitigated adequately; and/or objection from telecommunications stakeholder.
Moderate	Periodic effects experienced which may require alterations to existing operational practice; and/or objection from telecommunications stakeholder..
Minor	Occasional effects experienced which do not require any alteration of existing operational and technical practice.
Negligible	Normally no measurable change from baseline conditions; occasional, fleeting or very short term effects experienced which do not require any alteration of existing operational and technical practice.
Nil	No measurable change from baseline conditions.

15.3.6 Telecommunications Baseline and Potential Sources of Impact

15.3.6.1 Current Baseline

The Ofcom Wireless Telegraphy Register lists 14 fixed microwave links operating to/from receiver/transmitter masts at Tor Sliasg, approximately 800m north of Turbine 3. These links are oriented between south-east, clockwise to north-west from Tor Sliasg. The details of these links are summarised in **Table 15-6**.

Table 15-6: Fixed microwave links baseline (Tor Sliasg mast)

Ofcom licence number	Operator	End point	Azimuth orientation from Tor Sliasg (° True)
0395535/1	BT plc	Garmouth	305
0398542/1	BT plc	Garmouth	305
0480654/1	BT plc	Elgin	281
0505930/3	Airwave Solutions Ltd	2.5 km south of Fochabers	248
0837850/2	Scot-Tel-Gould Ltd	2 km west of Elgin	281
0841381/3	Scot-Tel-Gould Ltd	6 km south-east of Forres	267
0845256/3	Scot-Tel-Gould Ltd	Hill of Foudland	143
0950516/1	Vodafone Ltd	6 km north of Rothes	258
1114435/1	Mobile Broadband Network Ltd (MBNL)	4 km south of Keith	166
1124737/1	Telefonica UK Ltd	Mosstodloch	281
1126517/1	Telefonica UK Ltd	3.5 km east of Keith	147
1225919/1	Aquila Air Traffic Management Services Ltd	7 km north-west of Oldmeldrum	126
1225885/1	Aquila Air Traffic Management Services Ltd	RAF Lossiemouth	298
1285571/1	Airwave Solutions Ltd	Burghead	289

JRC, which manages telecommunications links on behalf of the power industry, has advised that nine UHF scanning telemetry links and 11 microwave point-to-point links for which it has responsibility have the potential to be affected. All of these links emanate from the Tor Sliasg mast.

Terrestrial television signals in the Moray area are mainly received from the Knockmore mast, 11km south-west of the Site. In addition, the Rosemarkie transmitter provides coverage in the Fochabers-Buckie-Cullen area and the Rumster Forest transmitter provides coverage of areas of Moray and Aberdeenshire within approximately 10km of the Moray Firth coast.

15.3.6.2 Future Baseline

Planning consent is being sought[3] for a new telecommunications mast on Leomond Hill, located approximately 280m south-east of Turbine 13 of the proposed development. The mast is part of the Shared Rural Network, a government-supported programme to extend 4G mobile phone coverage to areas currently not covered. The operators of the new mast had planned to provide the data feed into the mobile phone network via a microwave link to Tor Sliasg.

The Tor Sliasg mast may also be subject to alterations in terms of the links it provides as the network continually evolves in line with usage and demands from consumers.

15.3.7 Potential Sources of Impact

The performance of fixed telecommunications links can be degraded by the scattering of the signal by rotating wind turbine blades; by 'multipath' effects when a physical structure is located close to the link path; and by reflection of the signal back to the receiver when physical structures are located close to the transmitter.

Television reception can also be affected by the same processes. However digital television signals, which replaced analogue transmissions in this part of Scotland in 2010, are significantly less prone to adverse reception effects from wind farms and other structures than analogue TV and are unlikely to occur except where receiver antennae are located in close proximity to wind turbines.

15.3.8 Assessment of Potential Effects

Wind and telecommunications industry experience has determined that adverse effects of wind turbines on fixed microwave point to point telecommunications links does not occur when the turbines are 500m or more from the link path and 500m or more from the transmitter and receiver masts. None of the proposed turbines are within 500m of the Tor Sliasg or any other transmitter/receiver masts. Only those links originating from Tor Sliasg on bearings between 140° and 275° True have the potential to pass within 500m of any of the turbines in the proposed development. Applying these criteria to the links listed in **Table 15.6**, the following links have been subject to detailed assessment: 0505930/3 (Airwave); 0841381/3 and 0845256/3 (Scot-Tel Gould); 0950516/1 (Vodafone); 1114435/1 (MBNL); and 1126517/1 (Telefonica). The potential effects of the proposed development on these links relate only to Turbines 1 to 5; the easterly group of turbines (Turbines 6 to 16) have no potential effects on current fixed microwave telecommunications links.

Initial consultation with JRC identified multiple point-to-point and UHF scanning telemetry links emanating from the Tor Sliasg mast that could be adversely affected by the proposed development. The applicant commissioned further analysis from JRC which identified the effects of each turbine on each link.

Although the turbine rotors will not, for the most part, be turning during the construction and decommissioning phases, the physical presence of turbine towers and blades close to microwave link paths has the potential to cause adverse effects. It is therefore assumed in this section that the

[3] Moray Council Planning Reference: 23/01375/APP

effects of the proposed development are the same in the construction, operational and decommissioning phases of the project.

The minimum separation distances between the blade tips of Turbines 1 to 5 and each of the microwave links listed above have been calculated and are set out in **Table 15-7**.

Table 15-7: Blade tip to microwave link separation distances

Ofcom licence number	Operator	Closest turbine	Minimum blade tip to link path distance (m)
0505930/3	Airwave Solutions Ltd	T1	233.4
0841381/3	Scot-Tel-Gould Ltd	T1	481.3
0845256/3	Scot-Tel-Gould Ltd	T3	557.6
0950516/1	Vodafone Ltd	T1	235.2
1114435/1	MBNL	T3	155.6
1126517/1	Telefonica UK Ltd	T3	407.6

All of the turbines are located such that the minimum distance between blade tips and any of the microwave links in the vicinity is in excess of 100m, which is the default industry standard for minimum separation distances from blade tips. It is concluded that any effects of the proposed development on fixed microwave links will be of ***nil*** or ***negligible*** significance and will therefore not be significant in EIA terms.

The conclusions of the JRC analysis of effects on power industry microwave and scanning telemetry links were as follows:

- effects on all power industry microwave links from/to Tor Sliasg would be within acceptable limits if the buffer zones to allow for (a) uncertainty of the location of the link ends and (b) the allowance for turbine micrositing were limited to 25m;
- one scanning telemetry link would be unacceptably affected by 11 of the 17 turbines;[4]
- one scanning telemetry link would be unacceptably affected by all five turbines in the western group; a further link would be unacceptably impacted by four of the five westerly turbines;
- a further ten scanning telemetry links would be unacceptably affected by one or two turbines in the western group.

It is concluded from the JRC assessment that:

- the effects on power industry microwave links will be of ***negligible*** significance;
- the effects on power industry scanning telemetry links will be of ***major*** significance.

The proposed microwave link from the new Leomond Hill mast to Tor Sliasg would have conflicted with Turbines 1, 2 and 3 of the consented Aultmore wind farm, with the link path running close to or through the rotor disc of those turbines. The effects of the consented Aultmore wind farm on this link are assessed as being of ***moderate*** to ***major*** significance, and therefore significant in EIA terms.

The proposed microwave link from the new Leomond Hill mast to Tor Sliasg would also conflict with Turbines 12 and 13 of the proposed development, with the link path running close to or through the rotor disc of those turbines. The effects of the proposed development on this link are assessed as being of ***moderate*** to ***major*** significance, and therefore significant in EIA terms.

[4] The JRC assessment was carried out on the Design Chill layout consisting of 17 turbines.

The coverage of the Knockmore television transmitter in the area to the north-east of the proposed development is already limited due to the effects of terrain. Assessment of the potential effects of the Consented Development on television reception, using a tool designed by the BBC, concluded that reception could be affected at up to six homes.[5] That assessment assumed analogue TV transmissions, which were much more vulnerable to adverse effects on reception than the current digital transmissions. However it was based on a wind farm with smaller turbines covering a smaller footprint than the proposed development. It is concluded that the potential for adverse effects of the proposed development on the reception of signals from the Knockmore television transmitter is of a similar order to that assessed in 2007.

The potentially affected area –approximately between Portknockie, Portsoy and the proposed development – has extensive TV signal coverage from the Rumster Forest transmitter. In addition, coverage from the Rosemarkie transmitter is available in the Portknockie-Cullen area. Review of current terrestrial TV antennae orientations from street images confirms that subscribers in this area are using all three transmitters - Knockmore, Rumster Forest and Rosemarkie. In view of the availability of alternative signals from the Rosemarkie and Rumster Forest transmitters, the significance of any effects of the proposed development on TV reception is assessed as **minor**, and therefore not significant in EIA terms.

15.3.9 Mitigation

The applicant has engaged with JRC from the pre-scoping stage on the means of mitigating the effects of the proposed development on the links for which they hold responsibility. These discussions have identified a number of methods of technical mitigation. The applicant is continuing to discuss the means of implementing those methods and is confident that an agreement can be reached that will permit the proposed development to proceed without significant adverse effects on any of the links for which JRC has responsibility.

In the event that TV reception from the Knockmore transmitter is found to be adversely affected by the proposed development – for example as a result of a complaint from a subscriber – mitigation can be readily implemented by changing the orientation of the subscriber's receiver antenna from Knockmore to either Rosemarkie or Rumster Forest. Alternatively, affected subscribers may be offered a switch to satellite TV, funded by the applicant.

The applicant proposes the following condition wording:

"Prior to first commissioning a scheme providing for a baseline survey and the investigation and alleviation of any electromagnetic interference to terrestrial television caused by the operation of any turbines shall be submitted to and approved in writing by the relevant planning authority. Where impairment is determined by the qualified television engineer to be attributable to the wind farm, mitigation works shall be carried out in accordance with the scheme which has been approved in writing by the relevant planning authority".

In order to mitigate the effects of the proposed development on the proposed microwave link from the proposed Leomond Hill mast to Tor Sliasg, the applicant has discussed alternative routings for the data feed from the mast into the mobile phone network. The operators of the mast have identified an alternative link routing from Leomond Hill to an existing mast at Hill of Foudland. This link path is oriented away from the proposed development and would remain well clear of all proposed turbines. With implementation of this mitigation, the residual effects of the proposed development on the operation of the Leomond Hill mast would be ***negligible*** and therefore not significant in EIA terms.

[5] Aultmore Wind Farm Environmental Statement, October 2007, Chapter 18, paragraph 20.

15.3.10 Telecommunications Summary

The residual effects of the proposed development are summarised in **Table 15-8**.

Table 15-8: Summary of Residual Effects

Likely Significant Effect	Mitigation Measures	Means of Implementation	Residual Effect
Degraded performance of power industry scanning telemetry links	technical mitigation measures under discussion with JRC.	Planning condition	Negligible
Degraded performance of microwave link from new mast at Leomond Hill to Tor Sliasg	Re-routing of link to Hill of Foudland	Agreement with mast operator	Negligible

15.4 Climate and Carbon Balance

15.4.1 Introduction

This section of the chapter details the calculations to work out CO_2 emissions from the proposed development. In addition to generating electricity, the Scottish Government sees wind farms as an important mechanism for reducing the UK's carbon dioxide (CO_2) emissions. 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 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.

An assessment on the vulnerability of the proposed development to climate change has not been included, as it is considered that none of the identified climate change trends would affect the proposed development, with the exception of increased windstorms. Mitigation with regards to extreme weather events, including windstorms, is detailed in Section 15.5. The effects of climate change on environmental receptors has been considered in each of the relevant environmental topic chapters of this EIA Report (Chapters 6 to 15).

Each unit of wind generated electricity would displace a unit of conventionally generated electricity, therefore, saving power station emissions. **Table 15-9** provides a breakdown of the estimated emissions displaced per annum and over the assumed lifespan of 35 years for the proposed development.

15.4.2 Carbon and Peatland

Renewable energy developments in upland areas may often be sited on peatlands which hold stocks of poorly protected carbon, and so have the potential to release carbon to the atmosphere in the form of CO_2 if disturbed. Scotland has the majority of peat soils in the UK and, therefore, has a responsibility to ensure stability of this carbon and to ensure that developments do not cause a significant loss of this carbon reservoir.

The proposed development is located in area where peaty soils and peat have been impacted by commercial land use management by establishment of commercial plantation forestry across the Site, which will have reduced the underlying 'peat resource' as a source of carbon. This peatland cannot be considered as pristine due to the disturbance from forestry planting and drainage activity resulting in release of CO_2 to the atmosphere and long-term degradation as a 'carbon sink'. The deeper peat, (below the water table) will still be a carbon sink as long as the water table is maintained and the peat is not artificially drained.

The carbon balance assessment considers the implications of any parts of the proposed development which could lead to the additional release of CO_2 resulting from the disturbance of peat.

In order to minimise the requirement for the extraction of peat, the layout design process has avoided areas of deeper peat where possible. The layout design process is described in **Chapter 3: Site Selection and Design Evolution**. Specific details on the peat depth and probing surveys undertaken are included in **Technical Appendix 10.1: Peat Landslide and Hazard Risk Assessment** and **Technical Appendix 10.2: Outline Peat Management Plan.**

15.4.3 Characteristics of Peatland

The loss of carbon from the carbon fixing potential from plants and vegetation on peat land 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.

When flooded, peat soils emit less carbon dioxide but more methane than when they are drained. In flooded soils, carbon emissions are usually exceeded by plant fixation, so the net exchange of carbon with the atmosphere is negative and soil stocks increase. When soils are aerated, carbon emissions usually exceed plant fixation, so the net exchange of carbon with the atmosphere is positive.

To calculate the carbon emissions attributable to the removal or drainage of the peat, emissions occurring if the soil had remained in situ and undrained are subtracted from the emissions occurring after removal or drainage.

The indirect loss of CO_2 uptake (fixation) by plants originally on the surface of the Site but eliminated by construction activity including the destruction of active bog plants on wet sites and felling, is calculated on Site specific data collected as part of the EIA process and based on blanket bog.

Emissions due to the indirect, long-term liberation of CO_2 from carbon stored in peat due to drying and oxidation processes caused by construction of the Site, can also be calculated from Site specific data for the proposed development. This figure is a worst-case scenario, as the peat would be reused onsite to minimise carbon losses.

15.4.4 Carbon Payback Methodology

The assessment of the carbon payback 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.

The methodology to calculate carbon emissions is based on 'Calculating carbon savings from windfarms on Scottish peat lands - A New Approach' (Nayak et al, 2008[6]), prepared for the Scottish Government Science, Policy and Co-ordination Division. This was superseded in 2011 by the document 'Calculating Carbon Savings from Wind Farms on Scottish Peatlands - A New Approach', (Nayak et al, 2008 and 2010[7]) and (Smith et al, 2007[8]). In terms of carbon footprint, the 'carbon calculator' is the Scottish Government's tool provided to support the process of determining the carbon impact of wind farm developments in Scotland. It is noted that this methodology is

[6] Nayak, D.R., Miller, D., Nolan, A., Smith, P. and Smith, J.U. (2008). Calculating Carbon Savings from Windfarms on Scottish Peat lands - Revision of Guidelines. October 2007 to January 2008. Final Report.

[7] Nayak D.R., Miller D., Nolan A., Smith P., Smith (2010) Mires and Peat (Article 09), 4, 1-23, http://www.mires-andpeat.net/, ISSN 1819-754X

[8] Smith, P., Smith, J.U., Flynn, H., Killham, K., Rangel-Castro, I., Foereid, B., Aitkenhead, M., Chapman, S., Towers, W., Bell, J., Lumsdon, D., Milne, R., Thomson, A., Simmons, I., Skiba, U., Reynolds, B., Evans, C., Frogbrook, Z., Bradley, I., Whitmore, A. and Falloon, P. (2007). ECOSSE: Estimating Carbon in Organic Soils - Sequestration and Emissions. Final Report. SEERAD Report. ISBN 978 0 7559 1498 2. 166pp.

specifically designed for wind farms and not renewable energy developments like the proposed development. Therefore, the assessment only considers the wind turbine element of the proposed development.

15.4.5 Effects of Carbon Emissions from Construction

Emissions arising from the fabrication of the wind turbines and the associated components are based on a full life analysis of a typical wind turbine and include CO_2 emissions resulting from transportation, erection, operation, dismantling and removal of wind turbines and foundations and transmission grid connection equipment from the existing electricity grid system.

With respect to wind turbines, emissions from material production are the dominant source of CO_2. Emissions arising from construction (including transportation of components, quarrying, building foundations, access tracks and hardstands) and commissioning are also included in the calculations. The assessment has used Nayak et al (2008) default values for 'turbine life' emissions, calculated with respect to installed capacity.

The proposed development is seeking consent without a limit to operational lifetime, however in order to ensure a meaningful result from the calculator, an illustrative operational lifespan of 35 years has been used.

15.4.6 Input Parameters

To undertake this assessment, the following parameters were considered, which encompass a full life cycle analysis of the proposed development. These parameters include:

- emissions arising from the fabrication of the wind turbines and all the associated components;
- emissions arising from construction, (including transportation of components; quarrying; building foundations, access tracks and hardstands; and commissioning);
- the indirect loss of CO_2 uptake (fixation) by plants originally on surface of the Site but eliminated by construction activity (including the destruction of active bog plants on wet sites);
- emissions due to the indirect, long-term liberation of CO_2 from carbon stored in peat due to drying and oxidation processes caused by construction; and
- loss of carbon due to drainage.

As part of their methodology, Nayak et al have provided a spreadsheet called 'Scottish Government Windfarm Carbon Assessment Tool' to calculate whole life carbon balance assessments for windfarms on peat lands. The calculation spreadsheet (online calculator version 1.7.0 and reference number (92GI-M8YX-0BR7 v1) allows a range of data to be input in order to address expected, minimum and maximum values. However, if several parameters are varied together, this can have the effect of 'cancelling out' a single parameter change. For this reason, the approach for this assessment has been to include 'maximum values' as those values which would result in the longest (maximum) payback period; and 'minimum values' as those values which would result in the shortest (minimum) payback period.

This spreadsheet tool provides generic values for CO_2 emissions associated with some components (such as wind turbine manufacture) and requires Site specific information for other components (such as habitat type, extent of peat disturbance and ground water levels).

This assessment draws on information detailed in the EIA Report, **Chapter 8: Ecology and Biodiversity** and **Chapter 10: Geology, Hydrology and Hydrogeology**. For the purpose of this assessment, it is assumed that all the embedded good practice measures outlined in **Chapter 8: Ecology and Biodiversity**, and **Chapter 10: Geology, Hydrology and Hydrogeology** would be employed.

The final wind turbine choice is not yet known but would likely be around 6.6MW and the greenhouse gas savings and carbon payback are based on the input parameters of the proposed 16 wind turbines. Figures are based on currently available wind turbines and assume a consistent supplier for all wind turbine locations (i.e. wind turbine types are chosen by manufacturer). Note that, within the calculation spreadsheet, the expected, maximum and minimum values have been adjusted to suit the input parameter.

The capacity factor used within the calculation spreadsheet is based on measured onsite wind data giving a capacity factor of 44.5%.

The input parameters for the Scottish Government calculation spreadsheet are detailed in **Technical Appendix 15.1: Carbon Calculator.** The choice of methodology for calculating the emission factors uses the 'Site Specific methodology' defined within the calculation spreadsheet.

15.4.7 Results

This section presents a summary of the carbon assessment which has been undertaken in respect of the proposed development. The purpose of the 'carbon calculator' is to assess, in a comprehensive and consistent way, the carbon impact of wind energy developments. This is undertaken by comparing the carbon costs of manufacture and construction with the carbon savings attributable to a development through operation. An assessment has been undertaken to calculate the carbon emissions which would be generated in the construction, operation and possible decommissioning of the proposed development after an illustrative 35 years.

The carbon calculations spreadsheet is provided in **Technical Appendix 15.1: Carbon Calculator**. A summary of the anticipated carbon emissions and carbon payback of the proposed development relative to the current Department for Business, Energy & Industrial Strategy published figures is provided in **Table 15-9.**

Table 15-9 CO_2 Emissions and Payback Time

Results	Exp.	Min.	Max.
Net emissions of carbon dioxide (t $CO_{2\ eq}$) (carbon losses minus carbon gains) per annum.	237,689	188,182	323,598
Carbon Payback Time			
…coal-fired electricity generation (years)	0.6	0.5	0.8
…grid-mix of electricity generation (years)	3.0	2.3	4.1
…fossil fuel – mix of electricity generation (years)	1.3	1.0	1.8
Ratio of CO_2 eq. emissions to power generation (g/kWh) (Target ratio by 2030 (electricity generation) <50 g/kWh)	16.50	12.92	22.72

15.4.8 Interpretation of results

The calculations of total carbon dioxide emission savings and payback time for the proposed development indicates the overall payback period of a development with 16 wind turbines with an average (expected) installed capacity of around 6.6MW each would be approximately 1.3 years (16 months), when compared to the fossil fuel mix of electricity generation.

This means that the proposed development is expected to take around 16 months to repay the carbon exchange to the atmosphere (the CO_2 debt) through construction of the wind turbines; the proposed development would in effect be in a net gain situation following this time period and would contribute to national CO_2 reduction targets.

The potential savings in CO_2 emissions due to the proposed development replacing other electricity sources over the lifetime of the wind turbines (assumed to be 35 years for the purpose of the carbon calculator) are approximately:

- 412,473 tonnes of CO_2 per year over coal-fired electricity (approximately 14.43 million tonnes assuming a 35-year lifetime for the purposes of the carbon calculator);
- 79,605 tonnes of CO_2 per year over grid-mix of electricity (approximately 2.79 million tonnes assuming a 35-year lifetime for the purposes of the carbon calculator); and
- 177,833 tonnes of CO_2 per year over a fossil fuel mix of electricity (6.22 million tonnes assuming a 35-year lifetime for the purposes of the carbon calculator).

15.5 Major Accidents and Disasters

The vulnerability of the proposed development to major accidents and natural disasters, such as flooding, sea level rise, or earthquakes, is considered to be low due to its geographical location and the fact that its purpose is to ameliorate some of these issues.

In addition, the nature of the proposals and location of the Site means there would be negligible risks on the factors identified by the EIA Regulations. For example:

- population and human health – the Site is away from major population centres with low population density and the required safety clearances around turbines has been a key consideration throughout the design process;
- biodiversity – receptors and resources would be unaffected as there would be little risk of polluting substances released or loss of habitat in a turbine failure scenario (highly unlikely);
- land, soil, water, air and climate – there would be little risk of polluting substances released or loss of habitat in a turbine failure scenario (highly unlikely); and
- material assets, cultural heritage and the landscape – there would be no adverse effects on these features in a turbine failure scenario (highly unlikely).

This section should set out the methods used to characterise existing and/or future baseline conditions at the Site and in the surrounding area. This might include Site visits, review of published information/maps, consultation, policy review etc.

15.5.1 Public Safety and Access

The Renewable UK Onshore Wind Health and Safety Guidelines (2015) note that wind farm development and operation can give rise to a range of risks to public safety including:

- traffic (especially lorries during construction, and abnormal loads for the transport of wind turbine components; including beyond the Site boundary);
- construction site hazards (particularly to any people entering the Site without the knowledge or consent of the Site management);
- effects of catastrophic wind turbine failures, which may on rare occasions result in blade throw, tower topple or fire; and
- ice throw, if the wind turbine is operated with ice build-up on the blades.

The RenewableUK guidance (2015) states that *"Developers should ensure that risks to public safety are considered and managed effectively over the project lifecycle, and should be prepared to share their plans for managing these risks with stakeholders and regulators; effective engagement can both build trust, and help to reduce the level of public safety risk by taking account of local knowledge"*.

Site security and access during the construction period would be governed under Health and Safety at Work Act 1974 and associated legislation. Public access along the existing forestry access road (such as Braes on Enzies) would remain in place as far as possible during construction (subject to temporary health and safety restrictions during certain construction activities) and would reopen to the public fully once construction of the wind farm is complete. No public access would be permitted along the new access track to the Site during construction. However, the Land Reform (Scotland) Act (2003) which came into effect in February 2005 establishes statutory rights of responsible access on and over most land. The legislation offers a general framework of responsible conduct for both those exercising rights of access and for landowners. Once the construction period and commissioning of the wind farm is complete, no special restrictions on access are proposed.

Informal recreational access would benefit from the presence of the turbines within the Site by providing improved signage and information boards for the walking routes across the Site. Appropriate warning signs would be installed concerning restricted areas such as the substation compound, switchgear and metering systems. All onsite electrical cables would be buried underground with relevant signage.

15.5.2 Traffic

Accident data for the roads local to the Site (B9017 from the Site access junction to the A98) has been reviewed and is presented in **Chapter 11: Traffic and Transport**. An assessment of the potential effects on road safety has been undertaken. In summary, the proposed development would create an increase to HGV traffic levels within the study area, but these levels would remain well within the design capacity of the local road network.

15.5.3 Construction

With regard to risks and accidents during the construction phase, the construction works for the proposed development would be undertaken in accordance with primary health and safety legislation, including the Health and Safety at Work Act 1974 and the Construction (Design and Management) (CDM) Regulations 2015 which will include a requirement to produce emergency procedures in a Construction Phase (Health & Safety) Plan in accordance with the Regulations.

Nonetheless, the risk of accidents and other disasters is covered where relevant in individual topic Chapters, for instance, the potential for environmental incidents and accidents such as spillages are considered in **Chapter 8: Ecology and Biodiversity**, **Chapter 9: Ornithology** and **Chapter 10: Geology, Hydrology and Hydrogeology**. Flood risk is also assessed with **Chapter 10**.

15.5.4 Extreme Weather

As far as the risk of turbine failure during high winds is concerned, the turbines would cut-out and automatically stop as a safety precaution in wind speeds over 25 m/s.

Wind turbines can be susceptible to lightning strike due to their height and appropriate measures are taken into account in the design of turbines to conduct lightning strikes down to earth and minimise the risk of damage to turbines. Occasionally however, lightning can strike and damage a wind turbine blade. Modern wind turbine blades are manufactured from a glass-fibre or wood-epoxy composite in a mould, such that the reinforcement runs predominantly along the length of the blade. This means that blades will usually stay attached to the turbine if damaged by lightning and in all cases turbines will automatically shut down if damaged by lightning.

Ice build-up on blade surfaces occurs in cold weather conditions. Wind turbines can continue to operate with a very thin accumulation of snow or ice, but will shut down automatically as soon as there is a sufficient build up to cause aerodynamic or physical imbalance of the rotor assembly. Potential icing conditions affecting turbines can be expected two to seven days per year (light icing) in Scotland (WECO, 1999). The potential for ice throw to occur after start-up following a turbine shut down during conditions suitable for ice formation is high. There are monitoring systems and protocols in place to ensure that turbines that have been stationary during icing conditions are restarted in a controlled manner to ensure public safety. The risk to public safety is considered to be very low due to the few likely occurrences of these conditions along with the particular circumstances that can cause ice throw.

15.5.5 Seismic Activity

No geological fault lines are present on or in the immediate vicinity of the Site, and there are no records of any earthquakes occurring in the vicinity of the Site within the last 49 years (Earthquake Track). Earthquakes in Scotland are typically no greater than 3 on the Richter Scale and, therefore, minor and unlikely to cause significant damage to buildings and infrastructure.

It is very unlikely that an earthquake would occur on the vicinity of the Site resulting in any damage to the proposed development. Should a wind turbine be damaged, the risk to public safety is considered to be negligible due to the remote location and careful design layout of the infrastructure.

15.6 Population And Human Health

Chapter 6: Landscape and Visual, **Chapter 10: Geology, Hydrology and Hydrogeology**, **Chapter 11: Traffic and Transport**, **Chapter 12: Noise** and **Chapter 13: Socio-economics, Tourism and Recreation** contain assessments which relate to the health and wellbeing of the local population. These chapters assess the effects of the proposed development, both positive and negative, provide an analysis of the significance of these effects and also put forward measures to mitigate against negative effects on people and their health.

Chapter 16: Schedule of Mitigation, provides an overview of the mitigation put forward as part of these assessments in order to reduce any negative effects of the proposed development to an acceptable level.

Further to the topics covered in Chapters 6 – 15, including this chapter, it is not expected that there will be any other effects from the proposed development which would have significant effects on population and human health.

15.7 Air Quality

Construction activities can result in temporary effects from dust if unmanaged. This can result in nuisance effects such as soiling of buildings and, if present over a long period of time, can affect human health. As the nearest property is over 500m away from any substantial construction works (substation compound), effects associated with dust or vehicle emissions are considered to be unlikely, therefore the effects of dust and vehicle emissions from the construction, operation and decommissioning of the proposed development was scoped out of this assessment.