Chapter 15

Other Issues

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15.1 Executive summary

1. This Chapter outlines the potential for effects on or from nearby infrastructure, telecommunications and TV, aviation, carbon emissions, shadow flicker from wind turbines, population and human health, risks of disasters and waste management. The findings of these studies are summarised here.

2. Infrastructure: This study identifies that there is limited existing infrastructure on the Site which includes existing forest roads, including roads that form parts of the Heads of the Valley logging route, a newly constructed 132 kV overhead power line and an 11 kV pole mounted power line.

3. Telecommunications and TV: There is no indication as presented by consultees that the proposed Development would interfere with telecommunication links or with television reception transmission which is now served by digital transmitters.

4. Shadow Flicker: Shadow flicker guidance indicates that shadow flicker can occur at properties within 10 rotor diameters of the wind turbines, located 130^{o} either side of north. No third party properties have been identified within the shadow flicker study area; therefore shadow flicker is not considered further.

5. Climate and Carbon: The calculations of total carbon dioxide emission savings and payback time for the proposed Development indicate the overall payback period of a development with 21 turbines with an average (expected) installed capacity of around 6 MW each would be approximately 1.5 years, when compared to the fossil fuel mix of electricity generation.

6. The proposed Development would offset 173,842 tonnes of CO_2 per year, when compared to fossil fuel grid mix electricity generation.

7. This means that the proposed Development is expected to take around 18 months (1.5 years) to repay the carbon exchange to the atmosphere (the CO_2 debt) through construction of the wind turbines; the Site would in effect be in a net gain situation following this time period and would to contribute to national objectives.

8. Air Quality: As the nearest property is within 50 m from the proposed Development boundary and along one of the proposed access routes, effects associated with dust or vehicle emissions are possible, but these potential effects would be managed through good practice construction measures which would form part of the Construction Environmental Management Plan (CEMP).

9. Aviation: Following further consultation and modelling, it was concluded that the proposed Development would not have an effect on aviation as a physical obstruction. Radar modelling shows that all 21 turbines are in Radar Line of Sight (RLoS) of NATS En-Route PLC (NERL)'s Lowther Hill and Great Dun Fell: if this RLoS has a negative impact on the air traffic service in the vicinity of the Site provided by NERL, SPR will engage with NERL to agree necessary mitigation (based on the use of a Cumbernauld PSR infill). In addition, 14 of the turbines are predicted to be in RLoS of GPA's Primary Surveillance Radars. Notwithstanding this, SPR does not consider that this will have any impact on GPA's air traffic service, due to the inherent processing capabilities of GPA's Terma Scanter PSR.

10. Population and human health: Further to the consideration of human health impacts throughout the Environmental Impact Assessment Report, it is not expected that there would be any impacts from the proposed Development which would have significant effects on population and human health.

11. Risks of accidents and other 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 proposal and remoteness of the Site means there would be negligible risks on the surrounding environment.

12. With respect to potential effects on road safety, 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 much of the local road network, including all the Class A (trunk) roads. The accident records for the study area overall are low to average, with only 75 accidents occurring over the two year study period. Therefore, the level of effect is considered to be minor adverse and not significant.

13. The traffic flows would increase significantly more than 10% on the C128n Blackaddie Road and U432 Euchan Water in worst and likely case scenarios if Access Route B is used (see **Chapter 12: Traffic and Transport for** details). There has only been one accident recorded on the C128n Blackaddie Road and U432n Euchan Water in the last five years and given HGVs will be subject to the 30 mph speed limit along the C128n, and 40 mph along the U432n the magnitude of effect is considered minor. However, as these roads are classed as having high sensitivity, this equates to a moderate adverse effect and is therefore significant, and mitigation is therefore required.

14. An outline Construction Traffic Management Plan (CTMP), found in **Technical Appendix 12.4: CTMP,** provides preliminary details of proposed traffic management measures and associated interventions that would be implemented during the construction phase of the proposed Development in order to minimise disruption and ensure safety along Blackaddie Road and the U432n Euchan Water.

15. Subject to implementation of the identified mitigation measures, there are not predicted to be any significant effect on safety of road users.

16. Waste and environmental management: The outline CEMP (**Technical Appendix 3.1: Outline CEMP**) provides a general overview on how waste and other environmental issues would be managed during the construction phase. The Peat Management Plan (PMP) (**Technical Appendix 10.2: PMP**) also details how excavated peat is controlled, stored, re-used and disposed of during the construction phase of the proposed Development.

17. It is expected that a site-specific waste management plan for the control and disposal of waste generated onsite would be required by condition, should the proposed Development receive consent.

15.2 Introduction

18. This Chapter assesses the potential effects of the construction and operation of the proposed Development on the following issues:

- infrastructure;
- telecommunications;
- television reception;
- shadow flicker;
- climate and carbon balance;
- air quality;
- aviation;
- population and human health; and
- waste and environmental management.

15.3 Infrastructure

19. Overhead 132 kV power lines operated by ScottishPower Energy Networks (SPEN) cross the Euchanhead forest block in the north of the Site from east to west. These power lines form part of the South West Scotland Connections Project, which has been built to support the expansion of renewable energy in the region. The Glenglass substation, forming part of this connections project, is located immediately adjacent to the application boundary near Euchan Water. These overhead power lines were given a buffer of 400 m during the design process, and as such no turbines are proposed to be built within 400 m of these overhead power lines. This position has been agreed with SPEN, following a wake assessment being prepared to show that operation of the lines will not be impacted by the proposed Development.

20. No effects on the SPEN power lines, as a result of the proposed Development, are anticipated and so they are not considered further.

15.4 Telecommunications

21. Wind turbines can potentially cause interference to telecommunication links through reflection and shadowing to electro-magnetically propagated signals including terrestrial fixed microwave links managed by telecommunications operators.

22. Telecommunications operators were consulted and information requested for telecommunications links within close proximity of the Site. A summary of consultation is provided in **Table 15.1**.

Table 15.1: Consultee responses

Consultee	Summary of consultation	Comment / action taken
Arqiva	Email dated 17/02/2020. Arqiva has no adverse comments to make.	No further action required.
Atkins	Consultation request emailed 14/02/2020. No response to date.	
British Telecommunications (BT)	Email dated 09/03/2020 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 should not cause interference to BT's current and presently planned radio network.	No further action required.
Joint Radio Company (JRC)	Email dated 17/02/2020 This proposal *cleared* with respect to radio link infrastructure operated by: The local electricity utility and Scotia Gas Networks	No further action required.
Ofcom	Email dated 27/02/2020. Advises that the Spectrum Information System (SIS) be consulted. It is confirmed that the SIS online engagement tool was consulted. This established that no microwave links cross the Site.	No further action required.
Dumfries and Galloway Council	Pre-application advice service requested from council. No response to date.	No further action required.

24. From the consultation responses received, there is no indication that the proposed Development would interfere with telecommunications links. The proposed turbine height has increased by 5m through the design process, but the increase has not resulted in any increase to the requested consultation radius of 1500 m from the turbine locations provided at the scoping consultation stage; therefore, this issue is not considered further.

15.5 Television reception

25. Wind turbines have the potential to adversely affect analogue television reception through either physical blocking of the transmitted signal or, more commonly, by introducing multi-path interference where some of the signal is reflected through different routes.

26. The proposed Development is located in an area which is now served by a digital transmitter and, therefore, television reception is unlikely to be affected by the proposed Development as digital signals are rarely affected. In the unlikely event that television signals are affected by the proposed Development, reasonable mitigation measures would be considered by the Applicant.

15.6 Shadow flicker

15.6.1 Introduction

27. 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. This effect is known as shadow flicker.

28. The likelihood and duration of the effect depends upon:

- direction and aspect of the property relative to the turbine(s): in the UK, only properties within 130 degrees either side of north, relative to the turbines, can be affected, as turbines do not cast long shadows on their southern side;
- distance from turbine(s): the further the building is from the turbine, the less potential there is for the effect to arise., given the shadow fades with distance due to light refraction. 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 (Scottish Government 2014);
- turbine height and rotor diameter;
- topography between the turbine and the receptor;
- time of year and day;
- wind direction and orientation of the turbine blades in relation to the receptor; and
- weather conditions (i.e. cloudy days reduce the likelihood of effects occurring).

29. If significant effects due to shadow flicker cannot be avoided through embedded mitigation, then technical mitigation solutions are available, such as shutting down those turbine(s) which cause the effect when certain conditions prevail.

30. Shadow flicker effects are only considered during the operational phase of a windfarm development.

15.6.2 Legislation, policy and guidance

Legislation

31. There is no legislation that deals directly with shadow flicker.

Policy

32. **Chapter 4**: **Climate Change, Renewable Energy and Planning Policy** of the EIA Report sets out the planning policy framework that is relevant to the EIA. The policies set out include those from the Dumfries and Galloway Council (DGC) Local Development Plan 2 (LDP2) and relevant supplementary guidance, relevant aspects of Scottish Planning Policy (SPP), Planning Advisory Notes (PANs) and other relevant guidance.

33. Of relevance to the shadow flicker assessment presented within this Chapter, regard has been had to the following policies:

- LDP Policy IN2 Wind Energy;
- Section E (E14 – E15) – Effects on Local Amenity and Communities from Wind Energy Development: Development Management Considerations SPG; and
- Paragraph 169 of SPP.

34. No residential properties within East Ayrshire would be affected by shadow flicker, therefore East Ayrshire policies are not considered.

Guidance

35. Planning guidance in the UK requires developers to investigate the impact of shadow flicker. This guidance does not specify how to assess the impact, or how to assess the significance of the impact. In Scotland current guidance is available in the "Onshore Wind Turbines: Planning Advice" document (last updated May 2014).

36. Onshore Wind Turbines (2014), 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".

37. In England, the National Planning Policy Framework (NPPF), Planning Practice Guidance identifies that: *"Only properties within 130 degrees either side of north, relative to the turbines can be affected at these latitudes in the UK – turbines do not cast long shadows on their southern side."*

38. The above criteria are widely accepted in shadow flicker analysis for wind turbines. Additionally, the 10 rotor diameter rule has been widely accepted across different European countries, and is deemed to be an appropriate assessment study area.

Scottish Government Onshore Wind Policy Statement

39. The Scottish Government published its Onshore Wind Policy Statement in December 2017.

40. A review of light and shadow effects from wind turbines was commissioned by ClimateXChange to review how light and shadow flicker effects are considered in the development planning process in Scotland.

41. This document includes a review of current UK guidance, along with a review of how the current guidance is applied through the selection and review of case studies. The review recommended that guidance, definitions and significance thresholds should be developed for the assessment of shadow flicker, shadow throw and light effects, including their presentation in public consultations.

42. It should be noted that since the publication of this review (2017), shadow flicker guidance in Scotland has not changed, and as such, the guidance in the Online Planning Guidance for Renewables and Low Carbon Energy remains extant.

15.6.3 Methodology

43. As noted in **Chapter 2: Site Description and Design Evolution**, the location of the proposed turbines has been carefully considered with respect to distance from residential properties.

44. An assessment has been carried out to identify whether shadow flicker would be likely to occur at properties neighbouring, and if so the predicted times of year, and the time and duration of these potential effects.

45. Shadow flicker is calculated based on the worst-case condition assuming the sun is always shining. It is further assumed that here are no screening features such as trees, no accounting for periods of turbine shut down and also the wind is always

blowing at sufficient velocity to spin the blades and in a direction which results in the blades being perpendicular to the property (maximum shadow flicker or worst-case).

15.6.4 Consultation

46. Consultation was undertaken with a range of consultees, as outlined in **Chapter 6: Scoping and Consultation**. No responses regarding shadow flicker were received.

15.6.5 Study area

47. In line with the best practice guidance, a study area based on a distance of 10 rotor diameters from the proposed candidate wind turbines is normally employed to determine the zone of potential shadow flicker incidence. The candidate wind turbines for the proposed Development would have a rotor diameter of around 150 m; this gives a study area of 1,500 m from the turbines. In addition to this a further 50 m area was added to the 10 rotor diameter distance in order to account for micrositing of the turbines should the proposed Development receive consent.

48. 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 10 rotor diameters (1,500 m) plus 50 m for the reasons outlined above (1,550 m) and the 130^{o} area were identified from OS 1:25k base mapping and AddressBase data.

49. One third party property was identified within 1,550 m of the proposed turbine locations, but it is outwith the 130 degrees of north area and therefore outside the shadow flicker study area. **Figure 15.1** shows the location of this property and the study area.

15.6.6 Predicted effects

50. As no properties fall within the study area, shadow flicker effects are unlikely to occur as a result of the proposed Development, and therefore are not considered further.

15.6.7 Mitigation

51. No mitigation is currently required for the operational phase of the proposed Development as no shadow flicker effects are predicted to occur.

15.7 Climate and carbon balance

15.7.1 Introduction

52. In addition to generating electricity, Scottish Government sees wind turbines and other renewable technologies as an important mechanism for reducing the UK's carbon dioxide (CO_2) emissions. However, such development projects can themselves create carbon emissions (e.g. use of concrete and vehicle emissions). Therefore, this section estimates the CO_2 emissions associated with the manufacture and construction of the proposed Development compared to the estimated contribution the proposed Development would make to reducing CO_2 emissions. This gives an estimate of the whole life carbon balance of the proposed Development. Once the CO_2 emissions have been offset or paid back by the renewable energy development, each subsequent unit of wind generated electricity transmitted would be likely to displace a unit of conventionally generated electricity, thereby replacing traditional fossil fuel based power station emissions and contributing to reduction of CO_2 emissions.

53. **Table 15.2** provides a breakdown of the estimated emissions displaced per annum and over the assumed lifespan for the proposed Development. The proposed Development is seeking consent without a limit to operational lifetime; however, in order to ensure a meaningful result from the calculator tool, an illustrative operational lifespan of 40 years has been used.

15.7.2 Carbon and peatland

54. 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.

55. The proposed Development is partly sited on peaty soils and peat which has been impacted by extensive commercial forestry planting, 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 planting and harvesting 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.

56. 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.

57. In order to minimise the requirement for the extraction of peat, the Site design process has avoided areas of deeper peat. The Site design process is described in **Chapter 2: Site Selection and Design Evolution**. Specific details on the peat depth are included in **Technical Appendix 10.1: Peat Landslide and Hazard Risk Assessment.**

Characteristics of peatland

58. 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.

59. 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.

60. 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.

61. 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 using a blanket bog assumption to capture a worst-case scenario.

62. 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 re-used onsite to minimise carbon losses, for restoration of the renewables project and for habitat restoration including ditch blocking.

15.7.3 Carbon payback methodology

63. 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.

64. 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), 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) and (Smith et al, 2011). 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 windfarm developments in Scotland. It is noted that this methodology is specifically designed for windfarms and not renewable energy developments like the proposed Development. Therefore, the assessment only considers the wind turbine element of the proposed Development.

15.7.4 Effects of carbon emissions from construction

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

66. With respect to 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 hard standings) 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.

67. 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 40 years has been used.

Input parameters

68. 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 turbines and all the associated components;
- emissions arising from construction, (including transportation of components; quarrying; building foundations, access tracks and hard standings; 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) and felling;
- 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 and from forestry clearance.

69. 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 1.6.1 and reference number ZDQB-U0UU-1UX2 V.5) 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.

70. This spreadsheet 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 ground water levels).

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

72. The final wind turbine choice is not yet known but would likely be around 6 MW and the greenhouse gas savings and carbon payback are based on the input parameters of the proposed 21 turbines. Figures are based on currently available turbines and assume a consistent supplier for all turbine locations (i.e. 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.

73. The recommended capacity factor within the calculation spreadsheet is based on 35% which is the average of the figures used in the carbon calculator assessment.

74. 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.

Results

75. 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 40 years.

76. 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 15.2**.

Table 15.2: Anticipated carbon emissions and payback

Results	Exp.	Min.	Max.
Net emissions of carbon dioxide (t CO_2 eq.)	268,089	187,045	300,752
Annual CO_2 emission saving over coal - fired electricity generation (t CO_2 / yr)	355,411	354,395	356,426
Annual CO_2 emission saving over grid mix electricity generation (t CO_2 / yr)	97,962	97,682	98,242
Annual CO_2 emission saving over fossil fuel mix electricity generation (t CO_2 / yr)	173,842	173,346	174,339
Carbon payback time			
Coal-fired electricity generation (years)	0.8	0.5	0.8
Grid-mix of electricity generation (years)	2.7	1.9	3.1
Fossil fuel - mix of electricity generation (years)	1.5	1.1	1.7
Ratio of CO_2 eq. emissions to power generation (g / kWh) (TARGET ratio by 2030 (electricity generation) < 50 g /kWh)	17.35	12.07	19.52

Interpretation of results

77. The calculations of total carbon dioxide emission savings and payback time for the proposed Development indicates the overall payback period of a development with 21 wind turbines with an average (expected) installed capacity of around 6 MW each would be approximately 1.5 years, when compared to the fossil fuel mix of electricity generation.

78. The proposed Development would offset 173,842 tonnes of CO_2 per year, when compared to fossil fuel grid mix electricity generation.

79. This means that the proposed Development is expected to take around 1.5 years or 18 months to repay the carbon exchange to the atmosphere (the CO_2 debt) through construction of the wind turbines; the Site would in effect be in a net gain situation following this time period and would contribute to national CO_2 reduction targets.

15.8 Air quality

80. Construction activities can result in short term temporary impacts 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 adjacent to the application boundary (Bank Cottage / Glenglass) and one of the proposed accesses to the Site (Access Route B), impacts associated with dust or vehicle emissions are considered to be likely.

81. Experience of construction on similar sites suggests that the standard mitigation approaches are sufficient to avoid any significant effects.

82. Some of the standard mitigation measures implemented on Site may include, but will not be limited to, the following:

- adherence to the speed limit on Site in order to reduce the dust generated from transport on site roads;
- water bowsers - spraying with water to dampen dust down;
- road sweepers – remove silt from the road surface to reduce the potential for dust on the public road, if required;
- materials with the potential to produce dust to be stored so as to prevent dust generation e.g. materials stored out of the wind and covered; and

- transport of dust generating material to be covered.

83. Mitigation measures as part of the CEMP (**Technical Appendix 3.1: Outline CEMP**) would be implemented based on good construction practice to reduce the potential for dust emissions.

15.9 Aviation and radar

15.9.1 Introduction

84. The potential impacts of wind turbines on aviation interests are outlined below:

- physical obstruction: turbines can present a physical obstruction at, or close to, an aerodrome or other aviation activity site; and
- radar / Air Traffic Services: turbines can produce spurious / false returns known as "clutter", particularly from primary surveillance radar (PSR). Turbine clutter appearing on a radar display can affect the safe and efficient provision of air traffic services as it can mask unidentified aircraft from the air traffic controller and / or prevent them from accurately identifying aircraft under their control and / or cause the track of the aircraft under control to be incorrectly reported. In some cases, radar reflections from the turbines can affect the performance of the radar itself.

85. This section provides an assessment of the potential impacts the proposed Development may have on aviation in the area. This study has included a review of the location, technical characteristics and operational activities of aviation interests and operations in the vicinity of the Site, along with an examination of how they may be affected by the proposed wind turbines.

15.9.2 Approach to assessment and methods

86. The effects of the proposed Development have been assessed by modelling whether any of the wind turbines would be in the line of sight of any aviation radar facilities, and whether the development site is in an area of operational importance to those radars. Evaluation of these effects also took into account the response of radar operators to pre-application consultation.

15.9.3 Legislation, policy and guidance

87. The following guidance and industry standards on the potential effects of wind turbines on aviation have been considered in this assessment:

- Scottish Government Onshore Wind Policy Statement, 2017;
- Civil Aviation Authority (CAA), CAP 168: Licensing of Aerodromes, March 2019;
- CAA, CAP 393: Air Navigation Order 2016 and Regulations, March 2019;
- CAA, CAP 670: Air Traffic Services Safety Requirements, Part B, Section 4, June 2019;
- CAA, CAP 738: Safeguarding of Aerodromes, 2006;
- CAA, CAP 764: CAA Policy and Guidelines on Wind Turbines, February 2016;
- CAA, Policy Statement: Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in excess of 150m Above Ground Level, 2017;
- NATS wind farm self-assessment maps available on the NATS website; and
- Planning Circular 2 2003: The Town and Country Planning (Safeguarded Aerodromes, Technical Sites and Military Explosives Storage Areas) (Scotland) Direction 2003.

88. This guidance established that: If the development is within potential line of sight of an air defence, military aerodrome or en-route radar, then an assessment of the effects is likely to be required.

89. Further consultation is also required if turbines are planned within:

- 30 kilometres (km) of an airfield with a surveillance radar;
- 17 km of a non-radar licensed aerodrome with a runway of more than 1,100 metres (m);
- 5 km of a non-radar licensed aerodrome with a runway of less than 1,100 m;
- 4 km of an unlicensed aerodrome with a runway of more than 800 m;
- 3 km of an unlicensed aerodrome with a runway of less than 800 m; and
- 3 km of any other unlicensed aviation land use.

90. The proposed turbine height, at up to 230 m to blade tip, requires aviation lighting to be installed under Article 222 of the Air Navigation Order (ANO), 2016. This requires medium intensity 'steady' red aviation lights, rated at 2,000 candela, to be fitted at nacelle level. In addition, the CAA requires low intensity lights to be fitted at the intermediate level on the turbine tower (CAA, 2017). The intermediate tower lights would be 32 candela.

91. CAA, Policy Statement: Lighting of Onshore Wind Turbine Generators in the United Kingdom with a maximum blade tip height at or in excess of 150 m Above Ground Level, 2017 states that "*If the horizontal meteorological visibility in all directions from every wind turbine generator in a group is more than 5 km, the intensity for the light positioned as close as practicable to the top of the fixed structure required to be fitted to any generator in the windfarm and displayed may be reduced to not less than 10% of the minimum peak intensity specified for a light of this type*" This allows minimum intensities to be dimmed to 10% of their values if meteorological conditions permit (i.e. the 2,000cd minimum intensity can be dimmed to 200 candela, if visibility is greater than 5 km, i.e. moderate or above visibility).

92. Aviation lighting is also discussed further in **Chapter 3: Description of the proposed Development, Chapter 7: Landscape and Visual Impact Assessment**, and **Technical Appendix 15.3: Indicative Aviation Lighting Landscape and Visual Impact Mitigation Plan (IALLVMP).**

15.9.4 Baseline

93. The Site is approximately 36 km (measured to the nearest area of turbines) southeast of Glasgow Prestwick Airport (GPA) Primary Surveillance Radars (PSRs), and 62 km south of Glasgow Airport, the two major airports in the west of Scotland. Initial assessments have established that the proposed Development is not within radar line of sight (RLoS) of the PSRs at Glasgow Airport, but is within RLoS of the PSRs at GPA. The Site is beyond Glasgow Airport's Controlled Airspace.

94. No other licensed or unlicensed aerodromes are within close proximity of the Site.

15.9.5 Consultation

95. The relevant aviation stakeholders were consulted regarding the potential effects of the proposed Development as part of the scoping process. A summary of consultation is provided in **Table 15.3.**

Table 15.3: Consultee responses

Consultee	Summary of consultation	Comment/Action taken
Defence Infrastructure Organisation (DIO)	Email dated 05/03/2020: Advises that the proposed Development will occupy Low Flying Area 14 within which military fixed wind aircraft are permitted to fly down to 250 feet (76.2 metres) above terrain features. Identifies that the proposed Development will therefore cause a potential obstruction hazard to these military low flying activities and that to address this impact, it will be necessary for the development to be fitted with Ministry of Defence (MOD) accredited aviation safety lighting in accordance with the CAA ANO 2016.	SPR would consult with MOD/DIO prior to the commencement of construction so that details of the scheme can be provided. It is noted that the proposed Development is in Low Flying Area 20T, not 14 as stated in DIO's scoping response. The need for any specific red lighting and infrared lighting would also be discussed and agreed prior to commencement
NATS Safeguarding	Email dated 20/02/2020: Identifies that the proposed Development has the potential for unacceptable interference for radar users at NATS Prestwick Centre.	Initial modelling of the NATS En-Route PLC (NERL) PSRs at Lowther Hill and Great Dun Fell shows that all 21 turbines are in RLoS of these radars. It can be assumed that these radars will detect all the Euchanhead turbines. If this RLoS has a negative impact on the air traffic service provided by NERL, a potential

Consultee	Summary of consultation	Comment/Action taken
		mitigation (Cumbernauld PSR infill) has been identified as being suitable, if required. Consultation is ongoing between SPR and NATS.
CAA	Email dated 14/02/2020: Acknowledgement of scoping request. No further response received.	N/A
GPA	Email dated 06/04/2020: We have examined this scoping proposal – and many of the turbines as proposed will be visible to our primary radar – and consequently generate unwanted turbine clutter on our Radar Displays in an area of airspace utilised by Glasgow Prestwick Airport Ltd (GPA) Consequently, Glasgow Prestwick Airport ltd will require to object to this proposed development in its current configuration when it is presented to us via a full planning application – until a radar mitigation scheme is agreed by both parties. We remain open to further discussions on this matter in an effort to find an acceptable way forward for both parties.	Initial modelling of the S511 and Terma PSRs at GPA shows that 14 of the 21 proposed turbines are in RLoS of these radars. Probability of Detection analysis indicates that of the 7 turbines that are not in RLoS of the S511 PSR, 6 are unlikely to be detected by the S511 radar. Of the same 7 turbines that are not in RLoS of the Terma PSR, PD analysis confirms that they are all unlikely to be detected by the GPA Terma PSR radar. Consultation is ongoing between SPR and GPA.
Glasgow Airport	Email dated 20/02/2020: This proposal is located outwith the consultation area for Glasgow Airport. As such we have no comment to make and need not be consulted further.	No further action required.

15.9.6 Assessment of effects

97. From the consultation undertaken, it is concluded that the proposed Development would not have an effect on aviation as a physical obstruction provided appropriate aviation safety lighting is fitted.

98. However, radar modelling shows that all 21 turbines are in RLoS of NERL's Lowther Hill and Great Dun Fell radars which may result in radar interference. 14 of the proposed turbines are in RLoS of the PSRs at GPA. Further details of the aviation impact assessment methodology and modelling is found in **Technical Appendix 15.2: Aviation Impact Assessment (AIA).**

Mitigation

Aviation and Radar

99. SPR will engage with GPA and NERL to establish the extent of any detrimental impact on their radar systems as a result of the proposed Development. Should a detrimental effect on radar performance be established, **Technical Appendix 15.2: AIA** indicates that GPA's Terma PSR should operate to automatically mitigate any RLoS turbine impacts, so no detrimental impact on GPA's air traffic service should occur. **Technical Appendix 15.2: AIA** also outlines a radar solution available to resolve any NERL issues, namely use of the Cumbernauld PSR infill. The Cumbernauld mitigation has been successfully deployed for nearby windfarms, including SPR's Hare Hill Extension. Should mitigation be required, SPR will work to agree a suitably worded planning condition and the underlying commercial arrangements to allow the mitigation to be implemented so as to assure certainty of generation and reasonable cost. Mitigation should only be required for so long as there remains no obligation on aviation stakeholders to ensure that their surveillance infrastructure is windfarm tolerant.

Aviation Lighting

100. It is proposed to explore the option of using an aircraft detection lighting system, whereby the lights would only be switched on when low altitude aircraft enter a defined volume of airspace around the Site (volume bounded by 4 km from periphery turbines, 150 m above group level of lowest turbine and 300 m above the maximum tip height of the tallest turbine). A transponder activated lighting system is the preferred detection system.

101. SPR has a number of windfarms in south west Scotland and is working with local aviation stakeholders and the CAA with a view to adopting a strategic approach to aircraft detection lighting systems, which will reduce the amount of time the proposed Development (and all other relevant developments) will have aviation lights visible while minimising the additional surveillance infrastructure required to implement such an approach. Similar systems are currently being deployed in Germany.

102. **Technical Appendix 15.3:** IALLVIMP provides an indicative plan to outline the available mitigation options to reduce potentially significant landscape and visual effects caused by the requirement for aviation lighting to be installed at the proposed Development.

103. All mitigation options proposed within the IALLVIMP utilise procedures or technologies that have previously been successfully deployed elsewhere to mitigate the effects of aviation lighting on landscape and visual environmental receptors.

104. It is proposed that should the proposed Development be consented, then the measures proposed in the IALLVIMP would be used as the basis for detailed consultation with the CAA and the Scottish Ministers, , in order to agree the specification of a site specific ALLVIMP.

105. It is proposed that the implementation of mitigation measures to control the potential Aviation Lighting Landscape and Visual Impact would be controlled through the imposition of a planning condition. The wording below is proposed as a suggestion for a suitable planning condition:

(1) No development shall commence unless and until an Aviation Lighting Landscape and Visual Impact Mitigation Plan (ALLV IMP) has been submitted to and approved in writing by the Scottish Ministers following consultation with the Civil Aviation Authority.

(2) The mitigation plan shall provide:

   a. for the use of an aircraft detection lighting system or a scheme which demonstrates minimisation of the visual impact of the proposed lighting including:

      i. the extent of reduction of lighting intensity during good meteorological visibility as allowed by CAA policy and guidelines on wind turbines; and

      ii. the extent of cardinal or strategic lighting of selected turbines; and

   b. the timescale of and parameters for the periodic review of the operation and effectiveness of the ALLVIMP following its approval over the lifetime of the Development, to allow for adaptation and modification (with the written approval of the Scottish Ministers in consultation with the Civil Aviation Authority) in light of monitoring, reviews and changes in technology and relevant policy.

(3) The approved ALLVIMP shall be fully implemented throughout the lifetime of the Development, unless otherwise approved in writing by the Scottish Ministers as a result of a periodic review.

15.10 Population and human health

106. **Chapter 7: Landscape and Visual Impact Assessment, Chapter 10: Hydrology, Hydrogeology, Geology and Soils**, **Chapter 12: Access, Traffic and Transport**, **Chapter 13: Noise** and **Chapter 14: Socio-Economics Recreation and Tourism** and sections 15.6: Shadow Flicker and 15.8: Air Quality of this Chapter 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.

107. **Chapter 16: Summary 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.

108. Further to the topics covered in **Chapters 7 to 15**, 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.

15.11 Risk of accidents and other disasters

15.11.1 Introduction

109. 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.

110. In addition, the nature of the proposals and remoteness 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 remote 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).

15.11.2 Public safety and access

111. The RenewableUK Onshore Wind Health and Safety Guidelines (2015) note that wind turbine 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 application 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.

112. 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.”

113. Site security and access during the construction period would be governed under Health and Safety at Work Act 1974 and associated legislation. The Land Reform (Scotland) Act (2003) which came into effect in February 2005 establishes statutory rights of responsible access on and over most land and provides a general framework of responsible conduct for both those exercising rights of access and for landowners. Public access would be managed, including temporary restrictions on access to certain areas.

114. During construction, some restrictions on use of the public paths running through the proposed Development may be required for public safety. A temporary diversionary route for the Southern Upland Way has been proposed to run along the western edge of the Site to divert users away from construction activities where required.

115. Once the construction period and commissioning of the proposed Development is complete, no special restriction on access is proposed. Appropriate warning signs would be installed concerning restricted areas such as the substation compound, transformers, switchgear and metering systems. All onsite turbine cabling would be buried underground with relevant signage.

15.11.3 Traffic

116. Accident data for the roads local to the Site (U432n Euchan Water and C128n Blackaddie Road to the A76, and the A76 onwards to the delivery ports of King George V Docks and Port of Ayr) have been reviewed and are presented in **Chapter 12: Access, 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 primary road network. The accident records for the 25 km study area are low - average, with only 75 accidents occurring over the two year study period.

117. The C128n Blackaddie Road and U432 Euchan Water are currently very lightly trafficked, and the traffic flows would increase significantly more than 10% on these roads in the worst and likely case access route scenarios for Access Route B. However there has only been one accident recorded on the C128n Blackaddie Road and U432n Euchan Water in the last five years, and non-motorised users are accustomed to sharing the carriageway with vehicular traffic. In addition, HGVs will be subject to the 30 mph speed limit along the C128n, and 40 mph along the U432n the magnitude of effect is considered minor. Given these roads are classed as having high sensitivity however, this equates to a moderate adverse effect and is therefore significant.

118. In order to ensure the safety of road users, a Construction Traffic Management Plan (CTMP) would be put in place prior to construction commencing to actively mitigate the impacts of construction traffic. An Outline CTMP has been prepared and is provided as **Technical Appendix 12.4: Outline CTMP.** The purpose of the Outline CTMP is to provide preliminary details of proposed traffic management measures and associated interventions that would be implemented during the construction phase of the proposed Development in order to minimise disruption and ensure safety. The Outline CTMP would be supplemented with additional information as appropriate by SPR's appointed contractor(s), prior to commencement of construction activities. Should consent be granted, the Outline CTMP would be updated to a CTMP, the content of which would be agreed with the relevant highways authorities through consultation and enforced via a planning condition. In addition, an Abnormal Load Assessment and Abnormal Load Traffic Management Plan (ALTMP) would be prepared to secure permissions for the movement of abnormal loads and would include details of any required temporary widening and other road improvement measures, together with detailed consideration of vehicle swept paths, loadings, structural assessments (where required) and temporary street furniture removal details. It would also provide details of potential passing places to assist in minimising the delay experienced by vehicles on the A76. The document would be prepared in consultation with the Roads Authority, Transport Scotland and the emergency services, including Police Scotland. Information, with regards to abnormal loads, would be provided to local residents and users of amenities to alleviate any potential stress and anxiety, and allow them to plan their journeys to avoid disruption.

119. Subject to implementation of the above mitigation measures, there is not predicted to be any significant effect on safety of road users.

15.11.4 Construction

120. 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.

121. 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**, **Chapter 9: Ornithology** and **Chapter 10: Hydrology, Hydrogeology, Geology and Soils**. Flood risk is also assessed with **Chapter 10**.

15.11.5 Extreme weather

122. As far as the risk of turbine failure during high winds is concerned, wind turbines typically stop generating automatically as a safety precaution in wind speeds over 25 m/s. The energy storage facility would also be designed to withstand high winds and adverse weather conditions. The energy storage facility would be fully bunded to prevent any spillage or leakage of battery fluids.

123. 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. However, occasionally 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.

124. 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), which is a low probability of occurrence.

125. Modern wind turbines, such as those being considered for the proposed Development, are typically equipped with an ice detection system which works on a power curve analysis method. Ice build-up negatively affects the aerodynamic properties of the blades and thus impacts energy production performance, which can be remotely detected. When certain criteria are fulfilled, the turbine can be automatically shut down, thus limiting the risk of ice throw.

126. 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 highest risk of ice throw occurs when the turbines are restarted.

127. In addition, the proposed turbines are not located close to any buildings or public roads. The public rights of way are the closest public accesses to the turbines. The risk to public safety is therefore considered to be very low due to the few likely occurrences of these conditions, along with the remote nature of the Site.

15.11.6 Seismic activity

128. No fault lines are present on or in the immediate vicinity of the Site (**Figure 10.4**), and there are no records of any earthquakes occurring in the vicinity of the Site within the last 130 years (BGS GeoIndex, viewed 11/08/2020). 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.

129. It is very unlikely that an earthquake would occur on the vicinity of the Site resulting in any damage to the proposed Development.

15.12 Waste and environmental management

130. **Chapters 7 to 14** put forward suggestions on how to mitigate any negative impacts from the proposed Development with regards to waste and environmental management. These are summarised in **Chapter 16: Summary of Mitigation**.

131. The outline CEMP (**Technical Appendix 3.1**) provides a general overview on how waste and other environmental issues would be managed during the construction phase. The Peat Management Plan **(Technical Appendix 10.2: Peat Management Plan)** also details how excavated peat is controlled, stored, re-used and disposed of during the construction phase of the proposed Development.

132. The Forest Design Plan (**Technical Appendix 3.2: Forestry)** also provides information relating to the reuse and disposal of forestry wastes associated with felling required for the proposed Development.

133. It is expected that a site-specific waste management plan for the control and disposal of waste generated onsite would be required by condition, should the proposed Development receive consent.

15.13 References

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