Chapter 14

Other Issues

SCOTTISHPOWER RENEWABLES

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14.1 Introduction

1. This chapter assesses the potential effects of the construction and operation of the proposed Development on the following matters:

- aviation;
- climate and carbon balance;
- glint and glare;
- land use; and
- telecommunications.

2. The following aspects were scoped out of further assessment:

- Shadow Flicker - Shadow flicker is an effect that can occur when the shadow of a blade passes over a small opening (such as a window), briefly reducing the intensity of light within the room, and causing a flickering to be perceived. The Scottish Government Online Guidance (Scottish Government, 2014) refers to 10 rotor diameters as the distance above which shadow flicker should not be a problem, any properties within this area are assumed to be most at risk of shadow flicker effects. The proposed Development turbine dimensions will have a rotor diameter of up to 150 m, 10 rotor diameters is therefore up to 1,500 m. There are no properties within 1,500 m of each of the proposed Development turbine locations therefore shadow flicker was scoped out of further assessment within the Environmental Impact Assessment Report (EIA Report).
- Turbine Blade Reflectivity - Reflectivity is the potential for the sun to 'glint' off structures which, in the case of wind turbines, can be an intermittent glint when the turbines are rotating. The effect is be minimised by selecting a matt coating for the wind turbines, designed to reduce the potential for reflection. On the basis that all modern turbine manufacturers use light grey semi-matt finishes to reduce this effect and the nearest residential properties are greater than 2 km from the proposed Development turbine locations, this aspect was scoped out of further assessment within the EIAR.
- Television – Since the introduction of digital television signals, effects on television reception have substantially reduced. Given the absence of residential properties in close proximity to the Site, effects on television reception are considered extremely unlikely, and were scoped out of further assessment within the EIA Report.
- Air Quality - The only appreciable emission to air caused by the proposed Development would be emissions from construction traffic and dust generation from borrow pit excavation. Due to the distance of construction works from residential receptors and the use of industry standard best practice measures to control potential effects on air quality during construction (e.g. dust mobilisation and construction vehicle emissions) through implementation of a Construction Environmental Management Plan (CEMP), these effects are not considered likely to be significant and were therefore scoped out of further assessment within the EIA Report.
- Human Health - Properly designed and maintained wind turbines, solar panels and associated infrastructure are safe technologies. The Site location, design and inbuilt buffers from sensitive receptors have minimised the risk to humans from the operation of the proposed Development. Risks associated with ice build-up, lightning strike and structural failure are removed or reduced through inbuilt turbine mechanisms in modern machines. The combination of best practice construction health and safety methods, the distance of residential receptors from the proposed Development as well as no significant direct effects on recreational receptors (one crossing point of the Southern Upland Way) means there is minimal potential for direct effects on human health and this topic was therefore scoped out of further assessment within the EIA Report.
- Interrelationship effects – The interrelationship of effects can be assessed in cases where a single receptor can experience effects from multiple impacts. In the case of a wind and solar development this could be as a result of noise, shadow flicker, visual intrusion and glint and glare. As there are no residential or human receptors located in close proximity to the proposed Development Site which have been assessed in any of the technical chapters (Chapters 6 to 14), it can be assumed that there are no individual effects as a result of the proposed Development on receptors. If there are no individual effects on any receptor noted no interrelationship of effects will be experienced and as such this has been scoped out of further assessment.

14.2 Aviation

3. The installation of wind turbines has the potential to cause a variety of adverse effects on aviation interests during turbine operation. These include but are not limited to:

- Physical obstructions;
- Generation of unwanted returns on Primary Surveillance Radar (PSR) and adverse effects on overall performance of Communications, Navigation and Surveillance (CNS) equipment, where such impacts can be shown to detrimentally impact the safe and efficient provision of air traffic services or the defence of the realm.

14.2.1 Legislation, Policy and Guidelines

4. The UK statutory requirements for the lighting of en-route obstacles (i.e. those away from the vicinity of a licensed aerodrome) are set out in Article 222 of the UK Air Navigation Order 2016. Article 222 requires, as a general rule, all obstacles over 150 m to be lit with medium intensity (2000 candela) steady red aviation warning lights at regular intervals (less than 52m) up the obstacle's full height. Article 222 reflects the provision of ICAO SARPS Annex 14 paragraph 4.2.3 which states "In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150m or more above ground elevation should be regarded as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes."

5. The Civil Aviation Authority (CAA) Policy Statement on *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* (CAA, June 2017) modifies the strict application of Article 222 to require only the hub to be lit by 2000 candela steady red lights, with a single set of intermediate steady red lights halfway down the tower at a reduced intensity of 32 candela. This CAA Policy also allows the nacelle lights to operate in a lower intensity mode *"if the horizontal meteorological visibility in all directions from every wind turbine generator in a group is more than 5 km*". In these circumstances the 2000 candela lights could be operated at "*not less than 10% of the minimum peak intensity specified for a light of this type*" (200 candela). It also remains open to a structure owner to make the case to the CAA for a further reduction in visible lighting based on special aeronautical study as envisaged by Annex 14 para 4.2.3.

6. The CAA is also in the process of preparing a new policy statement *on En-Route Aviation Detection Systems for Wind Turbine Obstruction Lighting Operation* for industry consultation. SPR as a member of RenewableUK's Aviation Working Group, has had the opportunity to review and comment on the CAA's draft proposals for en-route aviation detection systems for wind turbine obstruction lighting operation. The CAA's policy is still under development, drawing on similar policies in North America and continental Europe. It is anticipated that the guidance will be finalised and released during 2020. The draft guidance currently envisages allowing aviation lights only to be illuminated when an aircraft is within a volume bounded by 4 km (horizontal distance) from the perimeter group of turbines and between 150m AGL of the lowest turbine and 300 m above the highest turbine tip of the Site. The aircraft's presence in this volume would be detected by a surveillance (radar) system.

7. SPR calculations estimate that the upper boundary of the volume which would require aviation obstacle lighting to be activated for the proposed Development would be around 2,500 ft above ground level[1]. The aviation lighting

[1] In terms of the maximum height of the coverage volume, this is calculated as follows (300m above the highest part of the turbine or group of turbines). The highest height above sea level within the proposed Development is Turbine 7 located at 200 m (rounded up to the nearest 5 m contour). With 180 m turbines and 300 m above the highest part of the turbine, the maximum height of the radar coverage required would be 680 m or 2231 ft, rounded up to 2500 ft.

would not be activated when commercial airlines pass over the Site as such aircraft ordinarily operate in Controlled Airspace (CAS) and the Site does not sit under CAS.

14.2.2 Consultation

8. The relevant aviation stakeholders were consulted regarding the potential effects of the proposed Development as part of the EIA scoping process. A summary of consultation is provided in **Table 14.1.1**.

Consultee	Summary of Consultation	Applicant Response
NATS Safeguarding (04 April 2019)	NATS (En Route) Public Limited Company ("NERL") has no safeguarding objection to the proposal.	No further action required.
Defence Infrastructure Organisation (DIO) (Ministry of Defence (MoD)) (07 May 2019)	The DIO has no objection to the proposal. In the interests of air safety, the DIO requests that the development is fitted with aviation safety lighting in accordance with the CAA.	Appropriate aviation lighting in accordance with CAA requirements will be included as part of the proposed Development. If requested by the MoD, the periphery turbines can have “combi” infra-red / visible lights installed with the infra-red lights (which are not visible to the human eye) being illuminated during hours of darkness.
Glasgow Prestwick Airport (GPA) (14 May 2019)	The windfarm is within the operational range of the airport’s primary radar, and as such if any turbines are within line of sight of the radar, then they are likely to generate clutter on the radar displays, and as such will require to be mitigated. Glasgow Airport should be consulted to check for potential impacts.	A Radar Line of Sight assessment has been undertaken for the proposed Development which shows no visibility with GPA radar systems. Full details are included in **Appendix 14.1.1.** Glasgow Airport was consulted (refer to response below).
Glasgow Airport (02 May 2019)	This proposal is located outwith our consultation zone, as such we have no comment to make on the proposals.	No further action required.
Edinburgh Airport (06 May 2019)	The proposed application has been examined from an aerodrome safeguarding perspective and does not conflict with safeguarding criteria. We therefore have no objection to this proposal.	No further action required.
Highlands and Islands Airports Limited (HIAL) (04 June 2019)	This development would not infringe the safeguarding surfaces for Campbeltown Airport, therefore we have no objections to the proposal.	No further action required.

Table 14.1.1: Consultation Responses

14.2.3 Baseline

9. The closest NATS radar is located at Lowther Hill, approximately 76 km north east of the Site.

10. The nearest Ministry of Defence (MoD) facility is the range radar at the now disused West Freugh Airfield, approximately 20 km south west of the Site. While part of the Site is in radar line of sight of West Freugh radar (at 180 m, according to MoD safeguarding mapping), the Site lies outside the Luce Bay Danger Area complex for which the West Freugh Range Radar provides services. A further MoD facility is the Kirkcudbright Training Area, located approximately 53 km south east of the Site.

11. The proposed Development’s turbines are located within a MoD “blue” low flying area, namely a relatively low concern area.

12. The nearest licensed aerodrome is Glasgow Prestwick Airport located approximately 57 km north east of the Site.

14.2.4 Potential Effects

13. The NATS online self-assessment maps indicate that the Site is not visible to any NERL radar (e.g. Lowther Hill) and does not conflict with NERL safeguarding criteria. NERL’s scoping response confirmed this conclusion (refer to **Table 14.1.1** and **Appendix 14.1.1**).

14. The MoD was consulted during the scoping stage and no objection was raised (refer to **Table 14.1.1** and **Appendix 14.1.1**).

15. Following GPA’s concerns regarding the possibility of the proposed Development being in line of sight of their radar facilities a Radar Line of Sight Assessment was undertaken in July 2019, for the two PSR facilities at GPA.

16. The Radar Line of Sight Assessment concluded that there is no line of sight between the two GPA PSR facilities and the proposed Development Site. It is therefore highly unlikely that either PSR facility will detect the proposed Development turbines. The full Radar Line of Sight Assessment is shown in **Appendix 14.1.1**.

14.2.5 Mitigation

17. As the proposed Development turbines would be in excess of 150 m to blade tip, they are required to be lit pursuant to Article 222 of the UK Air Navigation Order (ANO) 2016, with medium intensity (2000 candela) steady red aviation warning lights as modified by the CAA Policy Statement on *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* (CAA, June 2017), subject always to any special aeronautical study being accepted by CAA so as to reduce the amount of visible aviation lights required. Aviation lighting will be installed as soon as practicable on erected turbines.

18. The visual effect of lighting the turbines with medium intensity (2000 and 32 candela) steady red aviation warning lights is assessed within **Chapter 6: Landscape and Visual**.

19. It is proposed that visibility sensors are installed on the proposed Development turbines in line with the *2017 CAA Policy Statement* so that where visibility is restricted to 5 km or less from all the turbines in the proposed Development, the lights would operate at 2000 candela. Where visibility is greater than 5 km from all the turbines, the nacelle obstruction lights would be dimmed to 200 candela.

20. In addition, SPR proposes to explore the possibility of installing an aircraft detection lighting system whereby the lights would only be switched on when aircraft enter the volume as described above around the turbines. Given the lights are only required for aircraft flying at night in the vicinity of the Site at altitudes of up to 2500 ft, it is anticipated that the lights will be rarely on in this quiet airspace. The widest transit across the proposed Development is circa 2.15 km (approx. west to east between Turbine 02 and Turbine 01), then the horizontal coverage volume would be 10.15 km (4+2.15+4). At 125-250 knots (250 kt is the maximum speed permitted below 10,000ft) the lights would be on for between approximately 1.5 and 3 minutes, provided the radar can track the aircraft across the windfarm.

21. If an aircraft detection lighting system is required, this would be subject to a separate planning application, radar licensing and relevant CAA approvals. Optimally, any such radar deployment could benefit multiple windfarms in the Dumfries and Galloway or South Ayrshire regions.

14.2.6 Conclusion

22. In summary, through both consultation and assessment, it is concluded that the proposed Development, will have **no effect** on aviation infrastructure, from either physical obstruction or radar interference.

14.3 Climate and Carbon Balance

14.3.1 Introduction

23. This section of this Chapter details the calculations to work out carbon dioxide (CO_2) emissions from the proposed Development. In addition to generating electricity, the Scottish Government sees windfarms as an important mechanism for reducing the UK's overall CO_2 emissions. This Chapter 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 by displacing conventional electricity production, 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.

24. Each unit of wind generated electricity would displace a unit of conventionally generated electricity, therefore, reducing traditional power station emissions. **Table 14.3.1** provides a breakdown of the estimated emissions displaced per annum and over the assumed lifespan for the proposed Development. The proposed Development is seeking in-perpetuity consent, however in order to ensure a meaningful result from the application of the carbon calculator, an operational lifespan of 40 years has been assumed. This is a timescale which can be well quantified within the assessment and effects for this timescale are well understood.

14.3.2 Carbon and Peatland

25. Windfarms in upland areas tend to be sited on peatlands which hold stocks of carbon and so have the potential to release carbon into the atmosphere, in the form of CO_2 if the peat is disturbed.

26. In order to minimise the requirement for the extraction of peat, the Site design process has avoided areas of deeper peat (> 1m) where possible. Where areas of deep peat cannot be avoided floating tracks are proposed rather than hard infrastructure. The Site design process is described in **Chapter 3: Site Selection and Design Evolution**. Specific details on the peat depths of the Site are included in the Peat Landslide and Hazard Risk Assessment, included as **Technical Appendix 7.2.**

14.3.3 Effects of Carbon Emission from Construction

27. Emissions arising from the fabrication and manufacture of the turbines and the associated components are based on a full life analysis of a typical turbine and include CO_2 emissions resulting from fabrication, transportation, erection, operation, dismantling and removal of turbines and foundations and transmission grid connection equipment from the existing electricity grid system. The assessment has used Nayak *et al* (2008) default values for 'turbine life' emissions, calculated with respect to the Site's installed capacity (62 MW).

14.3.4 Characteristics of Peatland

28. 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.

29. To calculate the carbon emissions attributable to the removal or drainage of peat from the Site as a result of the proposed Development, emissions occurring if the soil had remained in situ and undisturbed are subtracted from the carbon emissions occurring after removal or development-related drainage.

30. The indirect loss of CO_2 uptake (fixation) by plants originally on the surface of the Site but eliminated by construction activity, is calculated on Site specific data collected as part of the EIA process and for the purposes of the carbon calculator is based on blanket bog as identified as the key habitat on Site during the Phase 1 Habitat Survey (as included in **Technical Appendix 8.1**.

31. 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 proposed Development on the Site, can also be calculated from Site specific data (the habitat loss calculations are included in Technical Appendix 8.1) for the proposed Development. This figure is a worst-case scenario, as the peat would be re-used where possible onsite to minimise carbon losses.

14.3.5 Methodology

32. The purpose of the 'carbon calculator' is to assess, in a comprehensive and consistent way, the carbon impact of windfarm developments. This is undertaken by comparing the carbon costs of windfarm developments with the carbon savings attributable to the windfarm.

33. The methodology to calculate carbon emissions generated in the construction, operation and decommissioning of a windfarm 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 online tool provided to support the process of determining the carbon impact of windfarm developments in Scotland. The SEPA (2014) Guidance *'Assessment of peat volumes, reuse of excavated peat and minimisation of waste'* and *'Guidance on Developments on Peatland - Site Surveys'* (Scottish Natural Heritage, SEPA and The James Hutton Institute, 2017) were also considered during the preparation of the carbon calculator.

14.3.6 Input Parameters

34. To undertake the assessment of carbon balance 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 the surface of the Site but eliminated by construction activity (including the destruction of active bog plants) 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 of the site and from forestry clearance.

35. As part of their methodology, Nayak et al (2010) have provided a spreadsheet 'Scottish Government Windfarm Carbon Assessment Tool' to calculate whole life carbon balance assessments for windfarms on peatlands. The calculator has progressed to an online tool. Version 1.6.0 of the carbon calculator is the current model and was used in this assessment. The online calculation tool[2] (project reference J8AL-WNTQ-CUND) allows a range of data to be input in order to address the expected, minimum and maximum values as a result of the proposed Development. However, it should be noted that 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.

36. This tool provides generic values for CO_2 emissions associated with some components (such as turbine manufacture) and requires Site specific information for other components (such as habitat type, extent of peat disturbance and groundwater levels, these were collected or inferred during the Phase 1 Habitat and Peat surveys of the Site and can be found in **Technical Appendix 8.1** and **Technical Appendix 7.2** respectively.

37. This assessment draws on information detailed in the EIA Report, **Chapter 4: Development Description, Chapter 7: Hydrology, Hydrogeology, Geology and Soils** and **Chapter 8: Ecology.** For the purpose of the assessment, it is assumed that all embedded good practice measures outlined in **Chapter 7: Hydrology, Hydrogeology, Geology and Soils** and **Chapter 8: Ecology**, would be employed.

38. The final wind turbine choice is not yet known, but would likely be a 5.6 MW generating machine, and the proposed Development would consist of 11 turbines with a total installed capacity of 62MW. The greenhouse gas savings

[2] https://informatics.sepa.org.uk/CarbonCalculator/index.jsp

and carbon payback are based on these input parameters. Figures are based on currently available turbine specifications and assume a consistent supplier for all turbine locations (i.e. turbine types are chosen by manufacturer).

39. The recommended capacity factor, as noted from BEIS (the actual electrical energy output over a given period of time to the maximum possible electrical energy output over that period) within the online calculation tool is based on values of between 23.9 – 29.6%.

40. The input parameters for the Scottish Government online calculation tool are detailed in **Technical Appendix 14.3.1**. The choice of methodology for calculating the emission factors uses the 'Site Specific Methodology' defined within the online calculation tool.

14.3.7 Results

41. This section presents a summary of the carbon assessment which has been undertaken in respect of the proposed Development. An assessment has been undertaken to calculate the carbon emissions which would be generated during the construction, operation and decommissioning of the proposed Development as well as the carbon payback period resulting from the operation of the proposed Development.

42. The carbon calculations results are provided in **Technical Appendix 14.3.2** and can be viewed online (using the project reference code J8AL-WNTQ-CUND)**.** A summary of the anticipated carbon emissions and carbon payback period of the proposed Development are provided in **Table 14.3.1** below.

Results	Expected	Minimum	Maximum
Net emissions of carbon dioxide (t CO_2 eq.)	139,435	108,973	161,791
Carbon Payback Period of proposed Development Comparison			
Displacing Coal-fired electricity generation (years)	1.1	0.8	1.4
Displacing Grid-mix of electricity generation (years)	3.8	2.7	4.9
Displacing Fossil fuel - mix of electricity generation (years)	2.2	1.5	2.8

Table 14.3.1: Anticipated Carbon Emissions

14.3.8 Interpretation of Results

43. The calculations of total CO_2 emission savings and payback time for the proposed Development indicates the overall payback period of a windfarm with 11 turbines with an average (expected) installed capacity of 5.6 MW per turbine would be approximately 2.6 years, when compared to the fossil fuel mix (the existing energy mix within the UK) of electricity generation.

44. The potential savings in CO_2 emissions due to the proposed Development replacing other electricity sources over the lifetime of the proposed Development (assumed to be 40 years for the purposes of the carbon calculator) are approximately:

- 132,000 tonnes of CO_2 per year over coal-fired electricity (5.28 million tonnes assuming a 40 year lifetime for the purposes of the carbon calculator);
- 36,000 tonnes of CO_2 per year over grid-mix of electricity (1.44 million tonnes assuming a 40 year lifetime for the purposes of the carbon calculator); or
- 65,000 tonnes of CO_2 per year over a fossil fuel mix of electricity (2.6 million tonnes assuming a 40 year lifetime for the purpose of the calculator).

14.3.9 Carbon Savings from the Solar Array

45. A calculation to estimate the potential carbon benefits from the proposed solar array was undertaken utilising the EU Database Photo Voltaic Geographical Information System, to estimate the carbon benefits from the proposed 20 MW of installed solar array. The results of this assessment highlighted a potential 5,214 t CO_2 eq carbon benefit per annum, based on the current grid emission factors (2019) for electrical generation in the UK as published by BEIS. The full assessment is detailed in **Appendix 14.3.3**.

14.3.10 Conclusions

46. The proposed Development is expected to take around 26 months (2.2 years) to repay the carbon exchange to the atmosphere (the CO_2 debt) through construction of the windfarm. There are no current guidelines about what payback time constitutes a significant impact, however, this is a relatively small percentage (5.4%) of the 40 year lifespan of the proposed Development (based on the conservative lifespan used in the carbon calculator). Compared to fossil fuel electricity generation projects, which also produce embodied emissions during the construction phase and significant emissions during operation due to combustion of fossil fuels, the proposed Development has a very low carbon footprint and after 2.2 years, the electricity generated is estimated to be carbon neutral and will displace grid electricity generated from fossil fuel sources. The Site would in effect be in a net gain situation following this time period and will then be contributing to national objectives of reducing greenhouse gas emissions and meeting the 'net zero' carbon targets by 2050, therefore the Proposed Development is evaluated to have an overall **beneficial** effect on climate change mitigation.

47. Although the proposed solar array cannot be accounted for within the Scottish Government carbon calculator tool (as the construction of the solar infrastructure will not include the removal of carbon (peat) from the Site), the calculation highlighted in Section 14.3.9 and **Appendix 14.3.3** suggests that the array will contribute a potential 5,214 t CO_2 e.q carbon saving per annum. This shows that the proposed solar array will support potential savings in CO_2 emissions due to the decreased requirement for other electricity sources and will also support the 'net zero' carbon targets. As a whole, the proposed Development will contribute to the requirements of the Climate Act (2019) and the meeting of the UK's 'net zero' targets.

14.4 Glint and Glare

14.4.1 Introduction

48. This section of the chapter sets out the effects of glint and glare arising from the indicative solar array areas within the proposed Development Site. The assessment considers only the possible effects upon users of the Southern Upland Way as there are no other receptors near-by.

49. The solar search areas are shown on **Figure 4.1a** and details of the indicative solar arrays are provided in **Figure 4.7**.

50. The assessment was undertaken by PagerPower Urban and Renewables and is provided in full in **Technical Appendix 14.4.1**.

14.4.2 Legislation, Policy& Guidelines

51. UK National Planning Practice Guidance: '*Planning practice guidance for renewable and low carbon energy'* states that in some instances a glint and glare assessment may be required. However, there is no specific guidance with respect to the methodology for assessing the impacts of glint and glare upon a receptor.

14.4.3 Assessment Methodology

52. For the purposes of the assessment the following definitions have been used:

- Glint- a momentary flash of bright light typically received by moving receptors or from moving reflectors.
- Glare – a continuous source of bright light typically received by static receptors or from large reflective surfaces.

53. The term 'solar reflection' is used to refer to both reflection types, glint and glare.

54. The following methodology has been followed for the glint and glare assessment:

- Identification of receptors within the surrounding area of the proposed Development's indicative solar arrays, in this case the Southern Upland Way.

- Consideration of direct solar reflections from the proposed Development' indicative solar arrays towards the Southern Upland Way by use of geometric calculations to determine whether reflection can occur and if so, at what time of day and year this would occur.
- Consideration of the visibility of the reflectors from the Southern Upland Way, if reflectors are not visible from the Southern Upland Way then no reflection can occur and therefore there is no impact.

55. **Table 14.4.1** presents the definition of impact significance in glint and glare terms and the requirement for mitigation under each.

Impact Significance	Definition	Mitigation Required
No Impact	A solar reflection is not geometrically possible or will not be visible from the assessed receptor	None
Minor	A solar reflection is geometrically possible, however any impact is considered to be small such that mitigation is not required, for example. intervening screening will limit the view of the solar panels.	None
Moderate	A solar reflection is geometrically possible and visible however it occurs under conditions which do not represent worst case	Whilst the impact may be acceptable, consultation and further analysis should be undertaken to determine the requirement for mitigation
Major	A solar reflection is geometrically possible and visible under conditions that will produce a significant impact. Mitigation and consultation is recommended.	Mitigation is required.

Table 14.4.1: Glint and Glare Impact Significance

56. It should be noted that significance of solar reflection decreases with distance, as the observer's field of vision that is taken up by the reflection area diminishes as the separation distance increases. Terrain and vegetation also obstruct an observer's view at longer distances for ground-based reflectors.

14.4.4 Assessment

57. The assessment has considered 10 locations along the Southern Upland Way with a receptor height of 1.8m (assumed average height of eye level of user of the Southern Upland Way), receptor locations are shown in Chapter 4 of **Technical Appendix 14.4.1**.

58. A number of representative solar panel locations were selected from within the solar search areas to be assessed to ensure full coverage of the potential indicative solar arrays within the assessment. A 10 m resolution was used in the assessment, meaning that geometric calculations were undertaken for each receptor every 10 m from within the defined area. The full assessment is detailed in **Technical Appendix 14.4.1**.

59. The assessment concluded that solar reflection was geometrically possible towards the receptor locations. There were very limited times of day (less than 10 minutes per day, in the early morning period, before 7am) due to vegetation cover to the west of the Site, as seen on available aerial imagery (refer to **Technical Appendix 14.4.1**), when reflection was noted as a result of the indicative solar arrays. Therefore, there is **no effect** upon receptors as a result of the indicative solar arrays included within the proposed Development and as such, no mitigation is required.

60. If vegetation was to be removed, as noted within **Technical Appendix 14.4.1** the impact would be categorised as **low** due to the great distance between the observer and the reflecting area, and therefore not significant.

14.4.5 Conclusions

61. Solar reflection from the indicative solar arrays within the proposed Development towards the Southern Upland Way is geometrically possible for all receptor locations assessed.

62. Available areial imagery shows vegetation will screen all receptor locations from the proposed solar search areas, therefore **no effect** is expected and no mitigation is required.

14.5 Land Use and Forestry

14.5.1 Assessment methodology and significance criteria

63. The land use assessment is confined to the land within the proposed Development application boundary.

64. The desk study for the land use assessment was based on the relevant OS mapping, master map aerial mapping and the Macaulay Institute Land Capability for Agriculture (LCA) map.

65. Site surveys have confirmed the land within the application boundary is used mainly for livestock grazing, with a small area of commercial forestry plantation and existing access tracks for the Operational Kilgallioch Windfarm.

66. The areas of the Site comprising the existing access track that may require minor upgrades will involve minimal land take, and therefore for the purpose of the land use assessment, these areas have been scoped out of further assessment. The proposed new access tracks, which connect the main development area to the Operational Kilgallioch Windfarm tracks will be considered within this section as they include land take from the commercial forestry planation. The remaining area within the application boundary will hereafter be referred to as the 'Development Area'. **Figure 14.5.1** outlines the Development Area.

14.5.2 Significance Criteria

67. Professional judgement was used to determine whether the construction and operation of the proposed Development would impact the use of the Development Area for forestry and agricultural practices.

68. The significance of effect was categorised as follows:

- Major– a highly noticeable difference in use.
- Moderate – a noticeable difference in use.
- Minor – a slightly noticeable difference in use.
- Negligible – a barely noticeable difference in use.

14.5.3 Baseline

69. The land within Development Area is used primarily for livestock grazing, and commercial forestry plantation. **Table 14.5.1** provides a breakdown of the classification of the land under the Land Capability Classification for Agriculture. This breakdown detailed on **Figure 14.5.1**.

LCA Classes		Development Area (ha)	Development Area (%)
1	Land Capable of producing a very wide range of crops	0	0
2	Land capable of producing a wide range of crops	0	0
3.1	Land capable of producing a moderate range of crops, high yields	0	0
3.2	Land capable of producing a moderate range of crops, high yields	0	0
4.1	Land capable of producing a narrow range of crops, suited to rotations	0	0
4.2	Land capable of producing a narrow range of crops, primarily grassland	35.10	6.33
5.1	Land capable of use as improved grassland, few maintenance problems and high yield	1.18	0.21

LCA Classes		Development Area (ha)	Development Area (%)
5.2	Land capable of use as improved grassland, physical limitations can cause maintenance problems	16.77	3.02
5.3	Land capable of use as improved grassland, but deterioration can be rapid due to a range of factors	48.97	8.83
6.1	Land capable of only rough grazing, high value	0	0
6.2	Land capable of only rough grazing, moderate value	61.68	11.12
6.3	Land capable of only rough grazing, low value	391.09	70.49
7	Land is of very limited agricultural value and use is restricted to very poor rough grazing	0	0
Total		554.79	100

Table 14.5.1: Land Classifications

70. Approximately 5.8 ha of the Development Area outlined in **Table 14.5.2** is, or was recently, planted with commercial forestry covering the following LCA classes, while the rest is agricultural grazing:

- 4.2 – 0.69 ha;
- 5.1 – 0.005 ha;
- 5.3 – 2.39 ha;
- 6.2 – 0.39 ha; and
- 6.3 – 2.35 ha.

71. 3.4 ha of the forestry land was felled in 2019, with the remaining 2.4 ha due to be felled in 2030. Both areas are currently due to be replanted with commercial forestry following felling. Due to its current use as forestry plantation, this area of land is excluded from agricultural land loss.

72. The applicant will comply with the Scottish Government's 'Control of *Woodland Removal Policy'*, and off-site compensatory planting will be provided.

14.5.4 Potential Effects

14.5.4.1 Construction

73. During construction the Applicant will minimise land used for construction purposes to minimise damage to land and will ensure that working corridors are clearly identified so vehicles and personnel do not stray outwith them.

74. It is not anticipated that any excavated material would leave Site. Further detail on Site restoration will be provided within the CEMP, an outline of which is provided in (**Technical Appendix 4.1**).

75. Excavated peat material will wherever possible be restored to its final destination rather than in temporary stockpiles. However, there may, in some circumstances, be a time-delay between these actions. During the interim period, peat would be stored onsite. It is important both for the peat itself and for the surrounding environment that the peat is not allowed to substantially erode or become dry, while it is stored. Procedures to control the hydrology of stored peat would be covered by the CEMP and the outline Peat Management Plan (**Technical Appendix 7.1)**

Forestry

76. The proposed Development would require the early felling of the 2.4 ha of currently standing commercial plantation for the construction of the new access track connecting the main Development Area of the proposed Development with the existing access track within the Operational Kilgallioch Windfarm.

77. The early felling of 2.4 ha of forestry due to construction of the new section of access track will result in a barely noticeable difference in use, and therefore the effect of the proposed Development on forestry is considered **negligible**.

Agriculture

78. During construction, it is assumed that the area within the proposed Development Area will not be available for agricultural grazing so for the construction period all of the land within the Site is considered to be land take. **Table 14.5.2** below details the land take from each LCA class in comparison with the wider Dumfries and Galloway area.

LCA Classes	Development Area (ha)	Dumfries and Galloway (ha)	Dumfries and Galloway (%)	Proposed Development as a percentage of land class within Dumfries and Galloway (%)
4.2	34.41	54002.2	8.38	0.064
5.1	1.17	30650.3	4.76	0.004
5.2	16.77	84134.3	13.06	0.020
5.3	46.58	81812.4	12.70	0.057
6.2	61.29	40678.1	6.31	0.151
6.3	388.74	177334.1	27.52	0.219

Table 14.5.2: LCA Class and Dumfries and Galloway

79. Livestock currently grazing the land within the Development Area will be removed from the site and placed in an offsite fenced pasture during the construction of the proposed Development. Based on the degree of land take as a percentage of land class in Dumfries and Galloway, the loss of agricultural land due to the proposed Development during construction will have **No effect** on agricultural land in the wider Dumfries and Galloway area.

14.5.4.2 Operation

Forestry

80. Following construction, the 2.4 ha of forestry felled to construct the access track will not be re-planted. In addition, 3.4 ha of forestry that was felled in 2019 as a result of commercial forestry rotation will also not be re-planted as a result of the proposed Development, and therefore can be considered a loss as a result of the operation of the proposed Development. Therefore, there will be a permanent loss of 5.8 ha of commercial forestry due to the proposed Development. This area is shown in **Figure 14.5.3**. This loss of 5.8 ha of forestry will result in a barely noticeable difference in use, and therefore the effects of the proposed Development is considered **negligible.**

Agriculture

81. The agricultural land lost permanently during operation due to the presence of infrastructure is detailed below in **Table 14.5.3**.

Land Take	LCA 4.1 (ha)	LCA 4.2 (ha)	LCA 5.1 (ha)	LCA 5.2 (ha)	LCA 5.3 (ha)	LCA 6.2 (ha)	LCA 6.3 (ha)	Total (ha)
Hardstanding	0	0	0	0.01	1.65	0.37	3.24	5.27
Tracks	0	0.30	0.01	0.12	0.90	0.62	4.76	6.71
Operations Building	0	0	0	0	0.12	0	0	0.12
Solar Areas (fenced)	0	0.71	0	0.14	7.48	0.78	15.13	24.24

Land Take	LCA 4.1 (ha)	LCA 4.2 (ha)	LCA 5.1 (ha)	LCA 5.2 (ha)	LCA 5.3 (ha)	LCA 6.2 (ha)	LCA 6.3 (ha)	Total (ha)
Construction Compound	0	0	0	0	0.49	0	0.01	0.5
Borrow Pits	0	0	0	0	0.81	1.1	5.1	7.01
Total (ha)	0.00	1.01	0.01	0.27	11.45	2.87	28.24	
Percentage of Total Area (%)	0	2.30	0.02	0.62	26.11	6.55	64.4	

Table 14.5.3: Land Take During Operation

82. **Table 14.5.4** provides an indication of this land loss as a percentage of the Development Area and as a percentage of Dumfries and Galloway as a whole for each LCA classification.

LCA Classes	Proposed Development Site (ha)	Percentage of proposed Development site (%)	Dumfries and Galloway (ha)	Dumfries and Galloway (%)	Proposed Development as a percentage of land class within Dumfries and Galloway (%)
4.1	0.00	0	49609.0	7.70	0
4.2	1.01	2.30	54002.2	8.38	0.002
5.1	0.01	0.02	30650.3	4.76	0.00003
5.2	0.27	0.62	84134.3	13.06	0.0003
5.3	11.45	26.11	81812.4	12.70	0.014
6.2	2.87	6.55	40678.1	6.31	0.0071
6.3	28.24	64.4	177334.1	27.52	0.0159

Table 14.5.4: Operational Land Take and Dumfries and Galloway

83. The loss of agricultural land in the context of the Development Area is assessed as having **Negligible** effect. The loss of agricultural land will have **No effect** on agricultural land in the wider Dumfries and Galloway area.

14.5.5 Mitigation

Forestry

84. As a result of the construction and operation of the proposed Development, there would be a net loss of woodland area. The area of stocked woodland in the Development Area would decrease by up to 5.8 ha. In order to comply with the criteria of the Scottish Government's 'Control of *Woodland Removal Policy'*, off-site compensation planting will be required. The Applicant is committed to providing appropriate compensatory planting. The extent, location and composition of such planting would be agreed with Scottish Forestry, considering any revision to the felling and restocking plans prior to the commencement of operation of the proposed Development.

Agriculture

85. The Applicant will liaise with the landowner to ensure that livestock do not access the construction site. The land not required for siting of the infrastructure of the proposed Development will be reinstated as agricultural grazing.

14.5.6 Residual Effects

Forestry

86. The residual construction and operation effects for forestry land use are anticipated to be **negligible**. Compensatory planting will offset the net loss of forestry in the Development Area and, as a result of the compensatory planting **no effects** on forestry are anticipated from the proposed Development.

Agricultural

87. The residual effects for agricultural land use are anticipated to be **negligible**. The loss of temporary land during construction and permanent land during operation is not considered to have an effect on the agricultural capability of Dumfries and Galloway, and therefore **no effects** are anticipated.

14.5.7 Summary

88. Construction and operation of the proposed Development is anticipated to have a **negligible effect** on forestry. This is reduced to **no effect** with the implementation of compensatory planting to offset the permanent forestry loss during operation of the proposed Development.

89. Land take from six agricultural classes; 4.2, 5.1, 5.2, 5.3, 6.2 and 6.3 is anticipated for the construction and operation of the Development Area. However, this is anticipated to have **no effect** on agricultural land capacity within Dumfries and Galloway as a whole or the long-term land use of the Site.

90. Mitigation measures, including the correct storage of soils and reinstatement of agricultural land not required following construction, will ensure that the land not required can be returned to agricultural use. Compensatory planting will be undertaken to offset the area felled for the construction of a section of access track through commercial forestry plantation.

14.6 Telecommunications

91. 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.

92. Telecommunications operators were consulted, and information requested for telecommunications links within close proximity of the Site. A summary of consultation is provided in **Table 14.6.1** and copies of the correspondence are provided in **Technical Appendix 5.1**.

93. Ofcom's online Wireless Telegraphy Register was also consulted for any fixed link or business radios within 2 km of the proposed Development main development area (Ofcom, 2019). The portal showed no fixed telecommunication links within 2 km of the main development area and three business radio transmitters, operated by SPR, located within the Operational Kilgallioch Windfarm Site.

Consultee	Summary of Consultation	Applicant Response
Joint Radio Company (16 April 2019 & 27 August 2019)	No concerns. The proposed Development has been cleared with respect to radio link infrastructure operated by Scottish Power and Scotia Gas Networks.	No further action required.
BT (16 April 2019)	No concerns. The proposed Development is not anticipated to cause interference to BT's current and presently planned radio network.	No further action required.
Atkins (27 August 2019)	The application was examined in relation to UHF Radio Scanning Telemetry communications in the region and have no objection to the proposals.	No further action required
Arqiva (27 August 2019)	The proposals were reviewed and Arqiva confirmed that the nearest SHF link is approximately 28 km away	No further action required

Consultee	Summary of Consultation	Applicant Response
	and therefore have no concerns with regard the proposed Development.	

Table 14.6.1: Consultation Responses

94. In summary, through consultation, it is concluded that the proposed Development, will have **no effect** on any telecommunication interests.

14.7 Summary

95. **Table 14.7.1** below provides a summary of the residual effects presented within this chapter.

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial / Adverse		Significance	Beneficial / Adverse
During Construction					
Aviation – effects on aviation (obstruction)	Negligible	Neutral	None	Negligible	Neutral
Aviation – effects on aviation and radar interests (interference)	Negligible	Neutral	None	Negligible	Neutral
Glint and Glare	None	Neutral	None	None	Neutral
Telecommunication Interests	Negligible	Neutral	None	Negligible	Neutral
Land Use - Forestry	Negligible	Adverse	None	Negligible	Adverse
Land Use - Agriculture	None	Neutral	none	None	Neutral
During Operation					
Aviation – effects on aviation (obstruction)	Minor	Adverse	Aviation lighting will be installed as soon as practicable on erected turbines, in line with CAA requirements	None	Neutral
Aviation – effects on aviation and radar interests (interference)	Negligible	Neutral	None	Negligible	Neutral
Glint and Glare	None	Neutral	None	None	Neutral
Telecommunication Interests	None	Neutral	None	None	Neutral
Land Use - Forestry	Negligible	Adverse	Compensatory planting off site	None	Neutral
Land Use – Agriculture	None	Neutral	None	None	Neutral
Cumulative Effects					
Aviation Interests	Minor	Adverse	Aviation lighting will be installed as soon as practicable on erected turbines, in line with CAA requirements	None	Neutral
Telecommunication Interests	None	Neutral	None	None	Neutral
Land Use	None	Neutral	None	None	Neutral

Table 14.7.1 Summary Table

14.8 References

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