



# Chapter 13

## Noise





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Technical Appendix 13.1: Environmental Noise Assessment





# Chapter 13

## Noise

### 13.1 Executive summary

1. Hoare Lea (HL) has undertaken the noise assessment for the construction and operation of the proposed Development. Noise would be emitted by equipment and vehicles used during construction and operation of the proposed Development. The level of noise emitted by the proposed Development and the distance from noise sources are the main factors determining levels of noise at nearby properties.
2. Construction noise has been assessed by a desk-based study of a potential construction programme and by assuming the proposed Development is constructed using standard and common methods. Noise levels have been calculated for properties closest to the areas of work and compared with guideline and baseline values. Construction noise, by its very nature, tends to be temporary and highly variable and, therefore, much less likely to cause adverse effects. Various mitigation methods have been suggested to reduce the effects of construction noise, the most important of these being suggested restrictions of hours of working. It is concluded that noise generated through construction activities will have a minor effect.
3. The noise generated by the energy storage facility and the substation at the nearest residential locations was considered negligible and not significant given the separation distances involved.
4. Operational wind turbines emit noise from the rotating blades as they pass through the air. The amount of noise emitted tends to vary depending on the wind speed. When there is little wind, the turbine rotors will turn slowly and produce lower noise levels than during high winds when the turbine reaches its maximum output and maximum rotational speed. Background noise levels at nearby properties will also change with wind speed, increasing in level as wind speeds rise due to wind in trees and around buildings, etc.
5. Noise levels from operation of the proposed Development have been predicted for those locations around the Site most likely to be affected by noise. Existing surveys data for adjacent windfarms have been referenced to establish existing baseline noise levels at these properties. Noise limits / criteria have been derived from data about the existing noise environment following the method stipulated in national planning guidance.
6. Predicted noise levels take full account of the potential combined effect of the noise from the proposed Development along with the operational Afton Windfarm, the operational Hare Hill and Hare Hill Extension Windfarms, the consented but not yet built Lorg Windfarm, the operational Sanquhar Windfarm, the consented but not built Sanquhar 'Six' Windfarm, the proposed Sanquhar II Windfarm, the operational Whiteside Hill Windfarm, and Windy Rig Windfarm, which is currently under construction.
7. Other more distant windfarms were not considered, as they do not make an acoustically relevant contribution to cumulative noise levels. Predicted operational noise levels have been compared to the limit / criteria values to demonstrate that turbines of the type and size which would be installed can operate within the limits / criteria so derived. It is concluded, therefore, that operational noise levels from the proposed Development would be within levels deemed, by national guidance, to be acceptable for developments of this nature, on an individual and cumulative basis.

### 13.2 Introduction

8. This Chapter summarises the assessment of the potential noise effects of the proposed Development on the residents of nearby dwellings. The assessment has been undertaken by Hoare Lea Acoustics. This Chapter has been written by Mark Jiggins MSc, Associate Acoustic Consultant at Hoare Lea, who is a member of the Institute of Acoustic (MIOA). Full details of

the noise assessment can be found in the Hoare Lea Technical Report, included in the EIA Report as **Technical Appendix 13.1: Environmental Noise Assessment**. The assessment considers both the proposed Development's construction and its operation.

9. Assessment of the operational noise effects accounts for the cumulative effect of the proposed Development with other windfarms including the Afton Windfarm (built and operating, approximately 2.8 km west of the nearest Euchanhead turbine), Hare Hill and Hare Hill Extension Windfarms (built and operating, approximately 2 km north), Lorg Windfarm (consented but not yet built, adjacent to the south west), Sanquhar Windfarm (built and operating, approximately 1.1 km north east), Sanquhar 'Six' Windfarm (consented but not yet built, adjacent to the north), Sanquhar II Windfarm (proposed and adjacent to the north, east and west), Whiteside Hill Windfarm (built and operating, approximately 3 km east), and Windy Rig Windfarm (under construction, approximately 4.5 km west). Other, more distant windfarms were not considered as their potential noise contribution was considered negligible.
10. For the construction phase, details of relevant working practices, traffic routes, and proposed working hours are described in **Chapter 3: Description of the proposed Development**. In addition, the assessment of noise and vibration from traffic associated with the construction work is based on the assessment presented in **Chapter 12: Access, Traffic & Transport**.

## 13.3 Approach to assessment and methods

### 13.3.1 Legislation, policy and guidance

11. Whilst Scottish Planning Policy (SPP) suggests noise impacts are one of the aspects that will need to be considered in the context of an application for windfarm development, it provides no specific advice with regards to noise.
12. Planning Advice Note PAN1/2011 provides general advice on the role of the planning system in preventing and limiting the adverse effects of noise without prejudicing investment in enterprise, development and transport. PAN1/2011 provides general advice on a range of noise related planning matters, including references to noise associated with both construction activities and operational windfarms. In relation to operational noise from windfarms, Paragraph 29 states that:  
  
*"There are two sources of noise from wind turbines - the mechanical noise from the turbines and the aerodynamic noise from the blades. Mechanical noise is related to engineering design. Aerodynamic noise varies with rotor design and wind speed, and is generally greatest at low speeds. Good acoustical design and siting of turbines is essential to minimise the potential to generate noise. Web based planning advice on renewable technologies for Onshore wind turbines provides advice on 'The Assessment and Rating of Noise from Windfarms' (ETSU-R-97) published by the former Department of Trade and Industry [DTI] and the findings of the Salford University report into Aerodynamic Modulation of Wind Turbine Noise."*
13. The Scottish Government's Online Renewables Planning Advice on Onshore wind turbines provides further advice on noise and confirms that the recommendations of 'The Assessment and Rating of Noise from Windfarms' (ETSU-R-97) "should be followed by applicants and consultees and used by planning authorities to assess and rate noise from wind energy developments".
14. Guidance on good practice on the application of ETSU-R-97 has been provided by the Institute of Acoustics (IOA Good Practice Guide or GPG). This was subsequently endorsed by the Scottish Government which advised in the Online Renewables Planning Advice note that the GPG 'should be used by all IOA members and those undertaking assessments to ETSU-R-97'.
15. PAN1/2011 and the Technical Advice Note accompanying PAN1/2011 note that construction noise control can be achieved through planning conditions that limit noise from temporary construction sites, or by means of the Control of Pollution Act (CoPA).
16. The Control of Pollution Act (CoPA) 1974 provides two means of controlling construction noise and vibration. Section 60 provides the Local Authority with the power to impose at any time operating conditions on the development site. Section 61

allows the developer to negotiate a prior consent for a set of operating procedures with the Local Authority before commencement of site works.

### 13.3.2 Study area

17. The study area for the assessment of operational noise includes the noise-sensitive residential properties nearest to the proposed turbines. In addition, properties in the vicinity of the other windfarms considered in the cumulative noise analysis were also considered, to determine whether the contribution from the proposed Development in terms of operational noise was negligible. The locations considered are listed below in **Table 13.2** (also shown on **Figure B1 in Annex B of Technical Appendix 13.1: Environmental Noise Assessment**) and are located at approximate distances of up to 1 km to 4 km from the turbines of the proposed Development.

18. The assessment of construction noise has considered the same residential properties as the operational assessment, as well as dwellings located alongside the two proposed routes for the Site access tracks and associated construction traffic routes.

### 13.3.3 Effects assessed in full

19. The proposed Development includes the construction and operation of a Renewable Energy Development, including wind turbines, an energy storage facility and ancillary infrastructure.

20. Noise and vibration which arises from the construction of this infrastructure is a factor which should be taken into account when considering the total effect of the proposed Development. However, when assessing the effects of construction noise, the temporary nature of the associated works can be taken into account. The main work locations for construction of the proposed turbines would be distant from the nearest noise sensitive residences and would be unlikely to cause significant effects. The construction and use of access tracks and some of the required infrastructure may, however, occur at lesser separation distances. Assessment of the temporary effects of construction noise is primarily aimed at understanding the need for dedicated management measures and, if so, the types of measures that are required. If there are requirements to decommission elements of the proposed Development, the activities involved would be less intensive than the construction process and would therefore have no additional effects. This is therefore not considered further in this noise assessment.

21. Once constructed and operating, wind turbines may emit two types of noise. Firstly, aerodynamic noise is a 'broad band' noise, sometimes described as having a characteristic modulation, or 'swish', which is produced by the movement of the rotating blades through the air. Secondly, mechanical noise may emanate from components within the nacelle of a wind turbine. This is a less natural sounding noise which is generally characterised by its tonal content. Traditional sources of mechanical noise comprise gearboxes or generators. Due to the acknowledged lower acceptability of tonal noise in otherwise 'natural' noise settings such as rural areas, modern turbine designs have evolved to minimise mechanical noise radiation from wind turbines. Aerodynamic noise tends to be perceived when the wind speeds are low, although at very low wind speeds the blades do not rotate or rotate very slowly and so, at these wind speeds, negligible aerodynamic noise is generated. In higher winds, aerodynamic noise is generally masked by the normal sound of wind blowing through trees and around buildings. The level of this natural 'masking' noise relative to the level of wind turbine noise determines the subjective audibility of the development. The relationship between wind turbine noise and the naturally occurring masking noise at residential dwellings lying around the project area will therefore generally form the basis of the assessment of the levels of noise against accepted standards.

22. The following effects have been assessed in full:

- the potential effect of noise and vibration during construction of the proposed Development (including construction traffic and potential cumulative effects); and
- the potential effect of noise during operation of the proposed Development, including cumulative effects.

### 13.3.4 Effects scoped out

23. On the basis of the desk-based work undertaken, the professional judgement of the EIA team, experience from other relevant projects and policy guidance or standards, the following effects have been 'scoped out'.

24. The results of previous research (detailed in **Annex A of Technical Appendix 13.1: Environmental Noise Assessment**) has demonstrated that vibration resulting from the operation of wind turbines is imperceptible at typical separation distances. Therefore, vibration effects during operation do not warrant detailed assessment and have not been considered further as part of this Chapter.

25. The proposed Development would include a substation and ancillary services/energy storage facility which would emit some noise during operation (e.g. electrical plant and air conditioning systems). Given the separation distances between the substation and energy storage area to the nearest residential properties, experience of similar installations and professional judgement, the associated levels of operational noise would be negligible and not significant. Therefore, assessment of the associated effects does not warrant detailed assessment and have not been considered further as part of this Chapter.

### 13.3.5 Baseline determination

26. The study area for the assessment includes residential dwellings located in the vicinity of both the proposed Development and the two proposed construction routes. The proposed Development is located in an area of relatively low population density. The noise environment in the surrounding area is generally characterised by 'natural' sources, such as wind disturbed vegetation, flowing water, birds and farm animals. Other sources of noise include intermittent distant commercial aircraft, commercial forestry and operational wind turbines on those sites which have been constructed.

27. There are a number of other wind energy developments in the area around the proposed Development, some of which are operational, some consented but not yet operational and others which are proposed; for which planning applications have been submitted but not yet determined. Each of these other wind energy developments were required to consider baseline conditions in order to derive noise limits in accordance with ETSU-R-97 and undertake an appropriate noise assessment. A review of these adjacent sites has confirmed that suitable baseline background noise levels for all relevant noise sensitive receptors around the proposed Development have already been sufficiently defined for the purposes of an assessment in accordance with ETSU-R-97, accordingly additional baseline surveys were not undertaken for the proposed Development. The resulting data remain representative of the noise environment at these receptor locations. This approach also provides consistency when considering cumulative effects of the proposed Development and the appropriate noise limits / criteria which may apply to the proposed Development. This approach is consistent with technical guidance on current good practice in the application of ETSU-R-97, as described in the Institute of Acoustics (IOA) Good Practice Guide (GPG), as recommended in the Scottish Government's Online Renewables Planning Advice on Onshore wind turbines. On the basis of this baseline information, and in accordance with the guidance in ETSU-R-97, applicable noise limits / criteria were determined as detailed in **Technical Appendix 13.1: Environmental Noise Assessment**.

28. The methodology in ETSU-R-97 includes the following steps:

- identify the locations of the nearest, or most noise-sensitive, neighbours;
- determine the background noise levels as a function of site wind speed at the nearest neighbours, or at least at a representative sample of the nearest neighbours, either through direct measurement or by reference to data already obtained during previous surveys in the area; and
- determine the daytime and night-time noise limits from the measured background noise levels at the nearest neighbours.

29. There are a number of either residential or habitable dwellings in the vicinity of the Site. Preliminary studies were undertaken, based on the scoping layout and taking into account neighbouring schemes and their potential noise emission levels. It was determined that a detailed study of the cumulative noise effects of the proposed Development in combination with other windfarms would not be required at several of these receivers, because noise from the proposed Development would be relatively negligible compared to existing and/or consented sites (see **Technical Appendix 13.1: Environmental Noise Assessment** for details). For other noise sensitive receptors, a full assessment including cumulative effects is required. All noise sensitive receptors are listed below in **Table 13.2** and shown on **Figure B1 of Annex B in Technical Appendix 13.1: Environmental Noise Assessment**.

30. In considering baseline data to inform the assessment, it is necessary to consider ETSU-R-97 is clear that the noise limits at residential properties should be set on the basis of background noise levels without contributions from existing windfarm noise. It is therefore necessary to take into account existing windfarms operating in the area and their potential contribution to the background noise.

31. As set out in **Annex C of Technical Appendix 13.1: Environmental Noise Assessment**, background noise data has already been surveyed at a number of receptor locations near to the proposed Development. The results of monitoring previously undertaken and how these would be used for this assessment were referenced in the Scoping report. Accordingly, new measurements were not considered necessary. Furthermore, the underlying baseline noise environment (excluding the turbine noise) is expected to be relatively unchanged at these previous baseline survey locations, thereby meaning there would be limited utility in undertaking new measurements. As some of these previous measurements were referenced to



wind speeds measured at lower heights above the ground than height representative of turbines on the proposed Development, the derived noise limits / criteria have been corrected in line with current good practice guidance, on a conservative basis, as set out in detail in **Annex C of Technical Appendix 13.1: Environmental Noise Assessment**.

### 13.3.6 Data sources

32. The following data sources have informed the assessment:

- Ordnance Survey information concerning the locations of all noise sensitive receptors in the vicinity of the Site;
- British Standard (BS) reference material for the sound emission characteristics of various construction activities associated with the proposed Development;
- manufacturer data for the candidate and operating turbines considered, as set out in **Technical Appendix 13.1 Environmental Noise Assessment**; and
- Environmental Statements and consent conditions for the different windfarms considered in the cumulative assessment.

### 13.3.7 Consultation

33. **Table 13.1** summarises the relevant consultation responses received and how these are considered in this Chapter.

Table 13.1: Consultation responses

Consultee	Summary of Key Issues	How this is addressed in this Chapter
Dumfries & Galloway Council (DGC)	No response on the topic of noise	Assessment conducted as proposed in the scoping report.
East Ayrshire Council (EAC)	No response on the topic of noise	Assessment conducted as proposed in the scoping report.

### 13.3.8 Approach to assessment of effects

#### Construction noise and vibration

35. Detailed guidance on construction noise and its control is provided by British Standard BS 5228-1 'Code of practice for noise and vibration control on construction and open sites' (2009, amended 2014). Analysis of construction noise impacts has been undertaken in accordance with the methodologies outlined in this standard, which provides methods for predicting construction noise levels on the basis of reference data for the emissions of typical construction plant and activities. These methods include the calculation of construction traffic along access tracks and haul routes, and construction activities at fixed locations including the bases of turbines, temporary construction compounds, and the substation. The construction noise assessment has been based on indicative data for the types of plant likely to be used during the construction works, as presented in BS 5228-1.

36. BS 5228-1 provides guidance on a range of considerations relating to construction noise including the legislative framework, general control measures, example methods for estimating construction noise levels and example criteria which may be considered when assessing effect significance. Similarly, BS 5228-2 provides general guidance on legislation, prediction, control and assessment criteria for construction vibration. Changes in the predicted traffic noise level on existing roads can be calculated using the Calculation of Road Traffic Noise (CRTN) methodology.

37. Planning Advice Note PAN50 'Controlling the Environmental Effects of Surface Mineral Workings' gives guidance on the environmental effects of mineral working. The main document summarises the key issues with regard to various environmental impacts relating to surface mineral extraction and processing such as road traffic, blasting, noise, dust, visual intrusion etc. In addition, several annexes to the main document have been published which consider specific aspects in more detail: Annex A, 'The Control of Noise at Surface Mineral Workings' and Annex D 'The Control of Blasting at Surface Mineral Workings'. BS 5228-1 and BS 5228-2 also provide guidance relating to surface mineral extraction including the assessment of noise and vibration effects associated with quarry blasting.

38. The noise-sensitive locations considered for the construction noise and vibration assessment include those closest to the proposed turbines and those considered in the operational noise assessment: see **Table 13.2**. Additional residential dwellings located alongside the two proposed routes for the Site access track and associated construction traffic routes, were also considered.

39. The nature of works and distances involved in the construction of the proposed Development are such that the risk of significant effects relating to ground borne vibration are very low (excluding blasting). Occasional momentary vibration can arise when heavy vehicles pass dwellings at very short separation distances, but again this is not sufficient to constitute a risk of significant impacts in this instance. Accordingly, vibration effects (excluding blasting) do not warrant detailed assessment and are therefore not discussed further in this Chapter.
40. The transmission and magnitude of ground vibrations associated with blasting operations at borrow pits are subject to many complex influences including charge type and position, and importantly, the precise nature of the ground conditions (material composition, compaction, discontinuities) at the source, receiver, and at every point along all potential ground transmission paths. Clearly any estimation of such conditions is subject to considerable uncertainty, thus limiting the utility of predictive exercises. Mitigation of potential effects of these activities is best achieved through onsite testing processes carried out in consultation with DGC and EAC so as not to exceed relevant vibration levels at neighbouring properties. In accordance with the guidance in PAN50 Annex D, ground vibration caused by blasting operations will be considered acceptable if Peak Particle Velocity (PPV) levels, at the nearest sensitive locations, do not exceed 6 mm/s for 95% of all blasts measured over any six-month period, and no individual blast exceeds a PPV of 12 mm/s.
41. Because of the difficulties in predicting noise and air overpressure resulting from blasting operations at the proposed borrow pits, these activities are best controlled following the use of good practice during the setting and detonation of charges.

### Operational noise

42. The assessment of operational noise impacts has been carried out in accordance with the methodology set out in ETSU-R-97. ETSU-R-97 has become the accepted standard for such developments within the UK and is specified as the appropriate assessment and rating guidance for windfarms in current Scottish planning policy. It is described in more detail in **Technical Appendix 13.1: Environmental Noise Assessment**. Technical guidance on current good practice in the application of the ETSU-R-97 methodology, as described in the Institute of Acoustics (IOA) Good Practice Guide (GPG) has also been referenced, as is recommended in the Scottish Government's Online Renewables Planning Advice on Onshore wind turbines (Scottish Government, 2014).
43. The exact model of turbine to be used at the Site would be the result of a future tendering process and therefore an indicative candidate turbine model has been assumed for the operational noise assessment. This model was determined to both fit the proposed turbine dimension parameters and also provide a representation of the typical noise emission levels for the range of turbine models which may be installed at the Site. Similarly, assessment of the substation and ancillary services/energy storage has been made based on experience of similar installations.
44. To undertake the assessment of noise impact in accordance with the methodology in ETSU-R-97, the following steps are required:
- specify the number and locations of the wind turbines and other windfarms to be included in the assessment;
  - determine the daytime and night-time noise limits from the measured background noise levels at the nearest neighbours (see above);
  - specify the type and noise emission characteristics of the wind turbines;
  - calculate noise immission levels from the operation of the turbines associated with the proposed Development as well as the contribution to cumulative noise immission levels from other nearby windfarms as a function of Site wind speed at the nearest neighbours; and
  - compare the calculated wind turbine noise immission levels with the derived noise limits and assess in the light of planning requirements in consultation with the local planning authority.
45. Note the term 'noise emission' relates to the sound power level actually radiated from each wind turbine, whereas the term 'noise immission' relates to the sound pressure level (the perceived noise) at any receptor location due to the combined operation of all wind turbines.
46. The noise limits defined in ETSU-R-97 relate to the total noise occurring at a dwelling due to the combined noise of all operational wind turbines. The assessment therefore needs to consider the combined operational noise of the proposed Development with other windfarms in the area to be satisfied that the combined cumulative noise levels are within the relevant ETSU-R-97 criteria. Full details of the operational noise assessment, including details of the noise output of the

candidate turbine for the proposed Development and the calculation parameters on which predictions have been based, can be found in **Technical Appendix 13.1: Environmental Noise Assessment**.

47. The noise-sensitive locations considered in the operational noise assessment are set out in **Table 13.2**. Please note that this list of receptor locations is not intended to be exhaustive but sufficient to be representative of noise levels typical of those receptors closest to the Site.

Table 13.2: Table of noise sensitive receptor locations near to the proposed Development at which noise effects have been assessed. Those receptor locations marked with an asterisk(\*) were subject to a full ETSU-R-97 cumulative assessment, whilst at all other locations stringent criteria were applied to consider noise from the proposed Development in isolation

Property	Easting	Northing	Approximate Distance to Closest Turbine (m)	Closest Turbine (ID)	Source of assessment criteria (see Annex C of Technical Appendix 13.1)
Cairnhead	270133	597200	2026	EUC20	Lorg Windfarm
Corlae	265835	597727	3841	EUC19	Lorg Windfarm
Craig	263442	606454	3776	EUC05	Afton Windfarm & Sanquhar II Windfarm
Dalgonar *	270038	603129	1874	EUC13	Sanquhar II Windfarm
Euchanbank Cottage	270530	606420	2082	EUC01	Whiteside Hill Windfarm & Sanquhar II Windfarm
Hillend	268201	608890	2378	EUC01	Hare Hill Windfarm & Hare Hill Extension Windfarm
Lorg *	266850	600875	1041	EUC11	Lorg Windfarm
Polgown	271866	603844	3347	EUC13	Sanquhar II Windfarm
Shinnelhead *	272926	599169	1953	EUC21	Sanquhar II Windfarm
Upper Holm of Dalquhairn	265565	599279	3076	EUC11	Lorg Windfarm

*During construction and operation of the proposed Development, the receptor location of Polskeoch (268688, 602320) will be under the ownership and management of ScottishPower Renewables and will be removed from residential use for the life of the proposed Development, based upon current project programme and contracted grid connection dates, therefore this location has not been considered as a receptor for the purposes of this assessment.*

49. The ETSU-R-97 day-time noise limit is derived from background noise data measured during so called 'quiet periods of the day', comprising weekday evenings (18:00 to 23:00), Saturday afternoons and evenings (13:00 to 23:00) and all day and evening on Sundays (07:00 to 23:00). Multiple samples of ten-minute background noise levels using the  $L_{A90,10min}$  measurement index are measured contiguously over a wide range of wind speed conditions (a definition of the  $L_{A90,10min}$  index is given in **Annex A of Technical Appendix 13.1: Environmental Noise Assessment**). The measured noise levels are then plotted against the simultaneously measured wind speed data and a 'best fit' curve is fitted to the data to establish the background noise level as a function of wind speed. The ETSU-R-97 day-time noise limit is then set at a level 5 dB(A) above the best fit curve to the background noise data over a 0-12 m/s wind speed range.
50. For wind speeds where the best fit curve to the background noise data lies below a level of 30 dB(A) to 35 dB(A), the limit is set at a fixed lower level in the range 35 dB(A) to 40 dB(A). The precise choice of fixed limit within the range 35 dB(A) to 40 dB(A) depends on a number of factors: the number of noise affected properties, the likely duration and level of exposure and the consequences of the choice on the potential power generating capability of the wind turbines. These factors are discussed in **Technical Appendix 13.1: Environmental Noise Assessment** and concluded that; considering the population density of the area of the proposed Development and its immediate surroundings, the predicted noise levels for the proposed Development in relation to the measured background noise levels, the large generation capacity of the proposed Development alone and in combination with other adjacent windfarms, as well as consistency with permissions for adjacent windfarms, it is wholly appropriate to set the day-time noise limit at 40 dB(A), within the range of 35 dB(A) to 40 dB(A).

51. The night-time noise criterion curve is derived from background noise data measured during the night-time periods (23:00 to 07:00) with no differentiation being made between weekdays and weekends. The ten-minute  $L_{A90,10min}$  noise levels measured over these night-time periods are again plotted against the concurrent wind speed data and a 'best fit' correlation is established. As with the daytime limit, the night-time noise limit is also based on a level 5 dB(A) above the best fit curve over the 0-12 m/s wind speed range. Where the night-time noise limit is found to be below 43 dB(A) it is fixed at 43 dB(A).
52. Where a property occupier has a financial involvement in a wind turbine development, the lower fixed portion of the noise limit at that property may be increased to 45 dB(A) during both the daytime and the night-time periods.
53. ETSU-R-97 also offers an alternative simplified assessment methodology: if predicted noise levels do not exceed 35 dB(A) up to 10 m/s, then they are considered acceptable and background noise surveys are not considered necessary.

#### Low frequency noise, vibration and amplitude modulation

54. Low-frequency noise and vibration resulting from the operation of windfarms are all issues that have been discussed in detail over the past 20 years. Consequently, **Annex A of Technical Appendix 13.1: Environmental Noise Assessment** includes a detailed discussion of these topics. In summary of the information provided therein, the current recommendation is that ETSU-R-97 should continue to be used for the assessment and rating of operational noise from windfarms.
55. **Annex A of Technical Appendix 13.1: Environmental Noise Assessment** also discusses the most recently published research on the subject of wind turbine blade swish or Amplitude Modulation (or AM). The IOA has published an objective technique developed for quantifying AM noise. The UK Government also commissioned a review on subjective responses to AM noise which outlines considerations for the control of this feature based on the IOA methodology. The Scottish Government is currently reviewing this recommendation in the context of the Scottish planning system.

#### 13.3.9 Noise predictions

56. The predictions of construction noise were made using the methodology of BS 5228 and representative emission levels based on the types and number of equipment typically associated with key phases of constructing a wind energy development. The predictions used conservative assumptions, such as considering when each activity would be closest to the neighbouring properties, and assuming the plant would operate for between 75% and 100% of the working day, on a conservative basis. This would represent the upper sound emission level during the day and actual noise levels are likely to be lower. Furthermore, the calculation has assumed there were no screening effects and the ground cover was 50% hard.
57. The level of construction noise that occurs at the surrounding properties would be highly dependent on a number of factors such as the final Site programme, equipment types used for each process, and the operating conditions that prevail during construction. It is not practically feasible to specify each and every element of the factors that may affect noise levels, therefore it is necessary to make reasonable allowance for the level of noise emissions that may be associated with key phases of the construction. The types and number of equipment associated with the key phases of constructing this renewable energy development have been based on experience of similar sites. The conservative assumptions made would likely offset the uncertainty in the exact details of the construction activities.
58. For operational noise, the exact model of turbine to be used for the proposed Development would be the result of a future commercial tendering process and therefore an indicative candidate turbine model has been selected for the operational noise assessment. Specifically, the operational noise assessment is based upon the noise specification of the Vestas EnVentus V150-5.6 MW wind turbine. 21 turbines have been modelled using the layout as indicated on the map in **Annex B of Technical Appendix 13.1: Environmental Noise Assessment**.
59. Assessment of the operational noise effects accounts for the cumulative effect of the proposed Development with other existing windfarms nearby as set out above and in **Technical Appendix 13.1: Environmental Noise Assessment**. Other, more distant windfarms were not considered because their potential noise contribution was considered negligible and not significant.
60. **Technical Appendix 13.1: Environmental Noise Assessment** details the assumptions made for each of the cumulative sites considered. In each case, robust emission data was assumed, including an allowance for measurement uncertainty in line with IOA GPG requirements (see **Annex B of Technical Appendix 13.1: Environmental Noise Assessment**).

61. Operational noise predictions were made in accordance with the methodology recommended in the IOA GPG, which is based on the ISO 9631-2 standard, and assumes robust emission levels for the candidate turbine. The predictions are made assuming downwind propagation from every turbine, which will be over-stating noise levels in some cases, particularly in cases in which receptors are situated in between the proposed Development and a cumulative site and could not be downwind of both simultaneously.

**13.3.10 Significance of effect**

62. BS 5228-1 indicates that a number of factors are likely to affect the acceptability of construction noise including Site location, existing ambient noise levels, duration of Site operations, hours of work, attitude of the Site operator and the noise characteristics of the work being undertaken. Based on the range of guidance values set out in BS 5228 Annex E, other reference criteria provided by the World Health Organization (WHO), the significance criteria presented in **Table 1 of Technical Appendix 13.1: Environmental Noise Assessment** have been derived (replicated below as **Table 13.3**). The values have been chosen in recognition of the relatively low ambient noise typically observed in rural environments. The presented criteria relate to daytime hours from 07:00 to 19:00 on weekdays, and 07:00 to 13:00 on Saturdays. If noise-generating works occur outside of these hours, this may increase the significance of the impact in some cases

Table 13.3: Impact criteria for construction noise

Impact	Definition
Major	Construction noise is greater than 85 dB LAeq,T for any part of the construction works or exceeds 75 dB LAeq,T for more than 4 weeks in any 12 month period.
Moderate	Construction noise is less than or equal to 75 dB LAeq,T throughout the construction period, with periods of up to 75 dB LAeq,T lasting not more than 4 weeks in any 12 month period.
Minor	Construction noise is generally less than or equal to 65 dB LAeq,T, with periods of up to 70 dB LAeq,T lasting not more than 4 weeks in any 12 month period.
Negligible	Construction noise is generally less than or equal to 60 dB LAeq,T, with periods of up to 65 dB LAeq,T lasting not more than 4 weeks in any 12 month period.

64. When considering the impact of short-term changes in traffic, associated with the construction activities, on existing roads in the vicinity of the Site, reference can be made to the criteria set out in the Design Manual for Roads and Bridges (DMRB). A classification of magnitudes of changes in the predicted traffic noise level is set out: for short-term changes, such as those associated with construction activities, a difference of less than 1 dB(A) are considered negligible, 1 to 3 dB(A) is minor, 3 to 5 dB(A) moderate and changes of more than 5 dB(A) constitute a major impact. This classification can be considered in addition to the criteria of **Table 13.3**, which can be applied when considering absolute levels of noise from construction traffic alone, as can be calculated using the haul route method included in BS 5228-1.

65. Major or moderate construction impacts are considered 'significant' in the context of the EIA Regulations.

66. The acceptable limits for wind turbine operational noise are clearly defined in ETSUR97. Consequently, the test applied to operational noise is whether or not the calculated windfarm noise immission levels at nearby noise sensitive properties lie below the noise limits derived in accordance with ETSUR97. If predicted noise levels are within the ETSUR97 derived noise limits, operational noise is considered acceptable, and therefore not significant in EIA terms. If predicted noise levels are above the ETSUR97 noise limits, operational noise is considered unacceptable and significant in EIA terms.

**13.3.11 Limitations to the assessment**

67. For construction noise, the types and number of equipment usually associated with the key phases of constructing the proposed Development have been based on experience of similar sites and assumed to operate between 75% and 100% of the working day, on a conservative basis. This would represent the upper sound emission level during the day and actual noise levels are likely to be lower. Furthermore, the calculation has assumed there were no screening effects and the ground cover was 50% hard. These conservative assumptions would likely offset the uncertainty in the exact details of the construction activities.

68. For operational noise, the exact model of turbine to be used at the proposed Development would be the result of a future commercial tendering process and therefore an indicative candidate turbine model has been selected for the operational noise assessment. The turbine model assumed are considered representative of the range of noise emissions for turbines

which may be installed at the Site. For operational, proposed or consented sites, robust assumptions of the potential noise emissions which may be allowed for each of these sites under their consent was made in line with current good practice.

## 13.4 Baseline conditions

69. The study area for the assessment includes residential dwellings located in the vicinity of both the proposed Development and the two proposed construction route options. The proposed Development is located in an area of relatively low population density. The noise environment in the surrounding area is generally characterised by 'natural' sources, such as wind disturbed vegetation, flowing water, birds and farm animals. Other sources of noise include intermittent distant commercial aircraft, commercial forestry and operational wind turbines on those sites which have been constructed.
70. There are a number of other wind energy developments in the area around the proposed Development, some of which are operational, some consented but not yet operational and others which are proposed; for which planning applications have been submitted but not yet determined. Each of these other wind energy developments were required to consider baseline conditions in order to derive noise limits in accordance with ETSUR97 and undertake an appropriate noise assessment. A review of these adjacent sites has confirmed that suitable baseline background noise levels for all relevant noise sensitive receptors around the proposed Development have already been sufficiently defined for the purposes of an assessment in accordance with ETSUR97, accordingly additional baseline surveys were not undertaken for the proposed Development. The resulting data remain representative of the noise environment at these receptor locations. This approach also provides consistency when considering cumulative effects of the proposed Development and the appropriate noise limits / criteria which may apply to the proposed Development. This approach is consistent with technical guidance on current good practice in the application of ETSUR97, as described in the Institute of Acoustics (IOA) Good Practice Guide (GPG), as recommended in the Scottish Government's Online Renewables Planning Advice on Onshore wind turbines. On the basis of this baseline information, and in accordance with the guidance in ETSUR97, applicable noise limits / criteria were determined as detailed in **Technical Appendix 13.1: Environmental Noise Assessment**.

### 13.4.1 Noise limits / criteria

71. Ten noise sensitive receptor locations have been considered at which assessment of noise from the proposed Development has been completed, as listed in **Table 13.2** and shown on the plan in **Annex C of Technical Appendix 13.1: Environmental Noise Assessment**. This list is not intended to be exhaustive but sufficient to be representative of noise levels typical of those receptors closest to the proposed Development. Those receptors which are further from the proposed Development would be less exposed to noise from the proposed Development, with consequently reduced effects, and are not considered further. This approach is consistent with the guidance provided by ETSU-R-97 and current good practice as set out in the IOA GPG.
72. The IOA GPG suggests that where noise immission levels from adjacent developments differ by more than 10 dB(A) then in practice this represents negligible effects and that cumulative effects need not be considered. For seven of the noise sensitive receptor locations listed in **Table 13.2**, stringent criteria were derived by subtracting 10 dB(A) from the ETSUR97 noise limits which would apply at each location. These stringent criteria were used to determine whether noise from the proposed Development alone would be sufficiently low in level to be considered acoustically unimportant, requiring no further assessment (see **Section 5.7 of Technical Appendix 13.1: Environmental Noise Assessment**). For the remaining three locations: Dalgonar, Lorg and Shinnelhead, a full ETSUR97 cumulative assessment has been completed (see **Section 5.8 of Technical Appendix 13.1: Environmental Noise Assessment**).

## 13.5 Assessment of effects

### 13.5.1 Construction

#### Potential construction effects

73. Predicted noise levels at the closest noise sensitive receptors for each of the key activities during construction of the proposed Development are presented in **Table 7 of Technical Appendix 13.1: Environmental Noise Assessment**. The proposed construction activities would generally occur at large distances from the residential properties considered, such that

the resulting predicted noise levels would not exceed 60 dB  $L_{Aeq}$ . With reference to the derived criteria of **Table 13.3**, the noise impact from these activities would therefore be negligible.

74. For track upgrades and construction of the Site compounds using the proposed Access Route B, these activities are closest to Euchanbank Cottage, resulting in increased noise levels predicted on a worst-case basis (74 dB  $L_{Aeq}$  for the track upgrades and 68 dB  $L_{Aeq}$  for constructing the closest temporary compound). These noise levels are likely to represent those for a very short-term period of around one week. Noise levels will quickly diminish as track upgrading progresses, moving the activity further from the property. The construction working hours for the proposed Development would allow working on Saturday afternoons and on Sundays: these short term high noise level activities may potentially occur outside the working hours assumed in deriving the criteria of **Table 13.3**, therefore increasing their significance. However, specific restrictions are to be adopted (detailed below) which restrict these higher noise level activities during Saturday afternoons and Sundays if proposed Access Route B is used. Considering the short duration of the work, in conjunction with activities being restricted to weekdays or Saturday mornings, along with the likelihood of the levels being lower in practice and the criteria of **Table 13.3**, the associated effects are predicted to result in a temporary minor effect, which is not significant in EIA terms.
75. If blasting is employed to win stone from the proposed borrow pits, there is a potential for this to affect the nearest properties. These activities are best controlled through a monitoring programme and following the use of good practice during the setting and detonation of charges, as set out in this Chapter and in the proposed mitigation section.
76. In addition to onsite activities, construction-related traffic passing to and from the Site would also represent a potential source of noise to surrounding properties. Based on the prediction methodology in BS 5288, the worst-case predicted noise level, due to heavy vehicles moving on the Site access track, at the closest dwelling is 60 dB  $L_{Aeq}$ . This corresponds to a negligible impact. The effect of traffic on existing roads was assessed using the CRTN methodology, with a maximum predicted increase of 2.8 dB(A) in the day-time average noise level. Based on the criteria set out in the DMRB, this predicted short-term change in traffic noise levels corresponds to a minor impact. In conclusion, noise from construction activities has been assessed and is predicted to result in a temporary minor effect, which is not significant in EIA terms.

#### Embedded mitigation measures

77. An outline CEMP is provided in **Appendix 3.1**. The final CEMP would be secured through a planning condition. This would include measures to control construction noise including:
- as proposed in **Chapter 3**, construction works that may give rise to audible noise at the surrounding properties and heavy goods vehicle deliveries to the Site would be limited to the hours 07:00 to 19:00 Monday to Friday and 07:00 to 16:00 at weekends, unless otherwise approved in advance by DGC/EAC (except in case of an emergency);
  - should Access Route B be used, some construction activities will be further restricted due to close separation distances of potential weekend working. Specifically, no construction HGV traffic will use Access Route B during Saturday afternoons and Sundays and light vehicles will be phased to spread the intensity of use so there are no more than approximately 35 vehicle movements per hour. In addition, activities related to upgrading of the access track or construction of the temporary site compound within 500 m of the Euchanbank receptor would be restricted to weekdays (07:00 to 19:00) and Saturday mornings (07:00 to 13:00);
  - all construction activities shall adhere to good practice as set out in BS 5228;
  - all equipment would be maintained in good working order and any associated noise attenuation such as engine casing and exhaust silencers shall remain fitted at all times;
  - where flexibility exists, activities would be undertaken away from residential properties, set back by the maximum possible distances;
  - a Construction Traffic Management Plan (CTMP) would be developed to control the movement of vehicles to and from the Site, including the above described restrictions for Access Route B;
  - construction plant capable of generating high noise and vibration levels would be operated in a manner to restrict the duration of the higher magnitude levels; and
  - in particular, if noise-generating activities could occur outside of the stated working hours, this could potentially lead to increased effects of potentially minor significance, but it is considered unlikely that significant effects could arise due to construction due to the large distances involved for the proposed activities in the wide majority of cases.

#### Proposed mitigation

78. Unless otherwise agreed in consultation with DGC or EAC, for example due to large separation distances, if blasting is to be employed at some of the borrow pits, the potential noise and vibration effects of blasting operations would be reduced

(unless otherwise agreed with DGC or EAC due to important separation distances) according to the guidance set out in the relevant British Standards and PAN50 Annex D:

- blasting should take place under controlled conditions with the agreement of the relevant authorities, at regular times within the working week, that is, Mondays to Fridays, between the hours of 10:00 and 16:00. Blasting on Saturday mornings should be a matter for negotiation between the contractor and DGC/EAC;
- vibration levels at the nearest sensitive properties are best controlled through onsite testing processes carried out in consultation with DGC/EAC. This site testing-based process would include the use of progressively increased minor charges to gauge ground conditions both in terms of propagation characteristics and the level of charge needed to release the requisite material. If required, the use of onsite monitoring at neighbouring sensitive locations during the course of this preliminary testing can then be used to define upper final charge values that would ensure vibration levels remain within the criteria set out previously, as described in BS 5228-2 and BS 6472-2;
- blasting operations would adhere to good practice as set out in BS 5228-2, and in PAN50, Annex D, Paragraph 95 in order to control air overpressure; and
- a scheme would be submitted to DGC/EAC for approval of blasting details, which would outline the mitigation measures to be adopted.

### Residual construction effects

79. The adoption of the identified mitigation measures would reduce the potential noise and vibration effects during construction and restrict noisy activities occurring outside of the range of hours on which the construction criteria were based. Comparing the predicted noise levels to the typical background noise levels measured for other developments around the proposed Development suggests that the noisier construction activities could be audible at various times throughout the construction phase. However, based on the considerations presented above, the associated effects would be a negligible to minor temporary adverse impact and therefore not significant.

### 13.5.2 Operation

#### Potential operational effects

80. The predictions of operational noise for the proposed Development in isolation at the noise-sensitive locations of **Table 13.2** are detailed in **Table 10 of Technical Appendix 13.1: Environmental Noise Assessment**. These varied between 10-24 dB(A) at low wind speeds and 26-36 dB(A) at high wind speeds.
81. Stringent criteria were used to determine that noise from the proposed Development alone would be sufficiently low in level to be considered acoustically unimportant, requiring no further assessment (see **Section 5.7 of Technical Appendix 13.1: Environmental Noise Assessment**). Predicted levels of noise were below these stringent criteria by between 1 dB(A) to 7 dB(A) for each of the relevant seven receptor locations<sup>1</sup> (see **Table 13.1** above). In conclusion, the operational noise levels from the proposed Development alone are considered acoustically unimportant and therefore acceptable in line with relevant noise limits.

#### Embedded measures

82. The layout of the proposed Development has been iteratively developed so as to achieve an acceptable noise impact on local residential amenity, based on a representative candidate turbine model, whilst maintaining as far as possible the generation capacity of the development (in addition to other design considerations). This included consideration of including for the cumulative effects of neighbouring windfarms where relevant. Specifically, the process involved the calculation of noise emission levels for the original outline scheme configuration, and layout design advice was provided on this basis to the design team to demonstrate compliance with successive iterations.

#### Proposed mitigation

83. The selection of the final turbine to be installed at the Site would be made on the basis of enabling the ETSUR97 noise limits to be achieved at surrounding properties, including any relevant tonality corrections. As ETSUR97 noise limits apply to the cumulative noise from all windfarms in the area, this is considered below in further detail for those receptor locations where operational noise from the proposed Development may be acoustically important.

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<sup>1</sup> The smallest margin is given in each case, which are those when comparing predicted noise levels with the day-time criteria, rounded to whole decibels. Predicted noise levels for the proposed Development alone are the same day-time and night-time. However the night-time criteria are higher than day-time criteria for all but one of these receptors, giving rise to larger margins during the night-time than those provided, by approximately 3 dB(A).



### Residual operational effects

84. The basis of the ETSUR97 method is to define acceptable noise limits thought to offer reasonable protection to residents in areas around windfarm developments. At some locations under some wind conditions and for a certain proportion of the time, the proposed Development noise may be audible; however, operational noise immission levels are acceptable in terms of the guidance commended by planning policy for the assessment of windfarm noise, and therefore considered not significant in EIA terms.

## 13.6 Cumulative assessment

85. For the remaining three receptor locations (Dalgonar, Lorg and Shinnelhead) where a full ETSU-R-97 cumulative assessment is required, cumulative predicted noise levels are shown for Lorg and Shinnelhead in **Tables 13 & 14 of Technical Appendix 13.1: Environmental Noise Assessment**. The full ETSU-R-97 cumulative assessment accounted for operational noise of the proposed Development together with the adjacent proposed Sanquhar II Windfarm at the Lorg and Shinnelhead receptor locations. At the Dalgonar receptor, this location would not be occupied during the life of the Sanquhar II windfarm, accordingly the full assessment for this receptor compared predicted noise immission levels from the proposed Development alone with the full ETSU-R-97 noise limits. Other more distant windfarms (Afton, Hare Hill, Hare Hill Extension, Sanquhar, Sanquhar 'Six', Whiteside Hill and Windy Rig) were sufficiently distant from these receptor locations that their noise contribution was considered acoustically unimportant and were not included in the cumulative assessment. For the Lorg noise sensitive receptor location, this property would not be in use during construction and operation of the Lorg Windfarm, accordingly the cumulative assessment at this receptor location did not include a contribution from Lorg Windfarm.
86. Predicted cumulative operational noise levels varied between 19-28 dB(A) at low wind speeds and 29-38 dB(A) at high wind speeds at the Lorg and Shinnelhead receptors. These predictions are also overlaid on the ETSU-R-97 derived noise limits in the charts of **Annex D in Technical Appendix 13.1: Environmental Noise Assessment**. The assessment presented within **Tables 15 and 16 of Technical Appendix 13.1: Environmental Noise Assessment** demonstrates that the derived ETSU-R-97 noise limits (**Tables 5 and 6 of Technical Appendix 13.1: Environmental Noise Assessment**) are predicted to be achieved in the cumulative case at all wind speeds and all three cumulative assessment locations. Predicted cumulative levels of noise were below the ETSU-R-97 criteria by between 2 dB(A) to 7 dB(A) day-time and 5 dB(A) to 10 dB(A) night-time for each of the three receptor locations of Dalgonar, Lorg and Shinnelhead<sup>2</sup>. In conclusion, the cumulative operational noise levels from the proposed Development are considered acceptable in line with relevant noise limits.
87. Satisfactory control of cumulative noise immission levels would be achieved through enforcement of the individual consent limits for each of the individual windfarms. Specific noise limits for the proposed Development are set out in **Technical Appendix 13.1: Environmental Noise Assessment**, with relevant limit values assuming, on a precautionary basis, that the adjacent Sanquhar II Windfarm is consented. Relevant limits values were determined such that compliance of the proposed Development with these noise limits would maintain the conclusion of the cumulative assessment and result in cumulative levels which do not exceed the derived ETSUR97 noise criteria. Should the adjacent Sanquhar II Windfarm not be consented the apportioned limits could still be applied to the proposed Development. The selection of the final turbine to be installed at the proposed Development would be made on the basis of enabling these derived specific noise limits to be achieved at surrounding properties, including any relevant tonality corrections.
88. Conditions attached to the planning consent should include the requirement that, in the event of a noise complaint, noise levels resulting from the operation of the proposed Development are measured in order to demonstrate compliance with the noise limits. Such monitoring should be done in full accordance with ETSU-R-97 and current good practice and include penalties for characteristics of the noise (if present).

<sup>2</sup> The smallest margin is given in each case. Night-time ETSU-R-97 noise limits are higher during the night-time than during the day-time, generally giving rise to larger margins during the night-time.

## 13.7 Summary and statement of significance

- <sup>89.</sup> On the basis of the embedded measures and proposed mitigation set out, there are no residual significant noise or vibration effects predicted.

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## 13.8 References

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