

16 Noise

16.1 Introduction

- 16.1.1 Wind farms have the potential to create noise during the construction, operation and decommissioning phases. This chapter summarises the findings of the construction/decommissioning and operational noise assessments undertaken by TNEI Services Ltd (TNEI) for Beaw Field Wind Farm (the Consented Development). The construction/decommissioning noise assessment report is included in full in Technical Appendix 16.1 and the operational noise assessment report is included in full in Technical Appendix 16.2.
- 16.1.2 The noise assessments have been undertaken by appropriately qualified staff all of which are affiliated with the Institute of Acoustics (IOA).
- 16.1.3 A review has been undertaken in May 2020 to identify any noise sensitive receptors within the Study Area that have been granted planning permission since the original EIA and that would not be represented in the original assessment. No additional properties have been identified and so the findings of the original assessment (as reproduced below) remain valid.

16.2 Legislative framework

- 16.2.4 The methods of assessment used the following combination of guidance and assessment methodologies:
- Planning Advice Note PAN 1/2011: 'Planning and Noise';
 - Web Based Renewables Advice: 'Onshore Wind Turbines' (updated May 2014);
 - ETSU-R-97 'The Assessment and Rating of Noise from Wind Farms';
 - ISO9613: 1996 'Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation';
 - Institute of Acoustics 'A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise' (2013) (IOA GPG);
 - BS5228-1: 2009+A1:2014 'Code of practice for noise and vibration control on construction and open developments - Noise';
 - Good Practice During Wind Farm Construction, (Scottish Natural Heritage, Scottish Environmental Protection Agency, Scottish Renewables & Forestry Commission Scotland) 2010;
 - Land Use Planning System, SEPA Guidance Note 4, Scottish Environmental Protection Agency, 14 May 2014; and
 - The Control of Pollution Act 1974 (COPA).
- 16.2.5 The above documents are discussed in detail within Technical Appendix 16.1: Construction/Decommissioning Noise Assessment and Technical Appendix 16.2: Operational Noise Assessment and Chapter 4, where relevant.

16.3 Methodology

Construction and decommissioning noise

- 16.3.6 The construction and decommissioning noise assessment has been undertaken using guidance contained in BS5228: Part 1 2009+A1:2014. The prediction of construction noise levels was undertaken using the calculation methodology presented in ISO9613:1996, together with published noise data for appropriate construction plant.
- 16.3.7 At the present time BS5228: Part 1 2009+A1:2014 is an Approved Code of Practice under the Control of Pollution Act 1974 in England only, by virtue of The Control of Noise (Code of Practice for Construction and Open Sites) (England) Order 2015. In Scotland the earlier BS5228: 1997 Part 1 remains as the Approved Code of Practice, nevertheless the latest version of the standard has been used in preference, providing as it does extensive guidance on practical noise control. The guidance includes an update of noise measurements to inform noise data, the inclusion of octave band sound power data rather than broadband only data, and the provision of significance criteria, all of which the former lacked. Part 1 provides recommendations for basic methods of noise control including sections on community relations, training, occupational noise effects, neighbourhood nuisance and project supervision. The annexes provide information on noise sources, mitigation measures and their effectiveness.
- 16.3.8 The BS5228-1:2009+A1:2014 document also contains sound power level data for a variety of construction plant. The data tabulated in the guidance document was obtained from field measurements of actual plant operating on construction and open sites in the United Kingdom.
- 16.3.9 For much of the working day the noise associated with construction and decommissioning activities would be less than predicted, as the assessment has assumed all equipment is constantly operating at full power and is located at the closest point to each receptor, whereas in practice equipment load and precise location varies.
- 16.3.10 Machinery on sites such as wind farm developments will produce noise levels that are transient in nature and fluctuate both due to the mobility of the activities and the load on any individual machine. The works generally comprise both moving and static sources. The moving sources include mobile construction plant and HGVs, while static construction plant such as generators, lighting rigs and pumps are usually located at a fixed location for a period of time.
- 16.3.11 To undertake an assessment of the construction and decommissioning noise impact in accordance with the requirements of BS5228: Part 1 2009+A1:2014, the following steps have been undertaken:
- Identify the noise sensitive receptors and select representative Noise Assessment Locations (NAL);
 - Identify the applicable threshold of significant effects from BS5228:1 2009+A1:2014;
 - Predict the noise levels for various construction and decommissioning noise activities;
 - Compare predicted noise levels against the applicable threshold;
 - Where necessary, develop suitable mitigation measures to minimise any significant adverse effects during the construction phase; and, if required
 - Assess any residual adverse effects taking into account any identified mitigation measures.



16.3.12 The assessment locations (receptors) used in the construction assessment are detailed in Table 16.1 and shown on Figure 16.1. The assessment locations are the closest receptors to the construction activities that would occur as part of the Consented Development (for example new access tracks).

Table 16.1: Construction and decommissioning noise assessment locations (NAL)

| <i>Receptor</i> | <i>Easting</i> | <i>Northing</i> | <i>Elevation (m AOD)</i> |
|-----------------------|----------------|-----------------|--------------------------|
| NAL1-Lower Holligarth | 452188 | 1183917 | 34 |
| NAL2-Whirliegarth | 452739 | 1183016 | 30 |
| NAL3-Easterlee | 451773 | 1180569 | 56 |
| NAL4-Hamnavoe | 449726 | 1180866 | 33 |

- 16.3.13 The construction process would be undertaken in several successive phases. During each stage, the plant and equipment, and the associated traffic, would influence the noise generated. The selection of plant and equipment to be used would be determined by the main contractor and detailed arrangements for on site management would be decided at that time. This assessment has therefore been based upon a typical selection of plant for a wind farm project of this size. In view of this, the plant has been modelled operating at the closest point to each receptor for a given activity in each construction phase whereas in reality only certain plant would be working at the closest point.
- 16.3.14 The core hours for construction activity are anticipated to be 07:00 to 19:00 weekdays and Saturdays 07:00 to 13:00 for all phases. It should be noted that out of necessity some activity, e.g. abnormal load deliveries, may occur outside the specified hours stated above,
- 16.3.15 For the purposes of this assessment, the construction programme has been split into eight phases:
- Phase 1 - involves soil handling, and distribution of hardcore required for the construction of the site compound(s);
 - Phase 2 - construction of the temporary Site compound(s), borrow pit construction removal of soil and distribution of hardcore material (if required);
 - Phase 3 - construction of the Site tracks, borrow pit activity, installation of cables, soil handling, and distribution of hardcore material;
 - Phase 4 - construction of the crane hardstandings, borrow pit activity, soil handling and distribution of hardcore material;
 - Phase 5 - construction of the turbine foundations which involves borrow pit activity, soil handling, on-site concrete batching and distribution of hardcore material;
 - Phase 6 - delivery and erection of the wind turbines;
 - Phase 7 – construction of the substation and distribution of hardcore material; and
 - Phase 8 – wind farm decommissioning.
- 16.3.16 The noise-generating equipment assessed for each construction phase is detailed in Technical Appendix 16.1, which shows actual noise data measured at 10m from the noise source. Using the data contained in these tables the noise levels for Phases 1-8 have been calculated.
- 16.3.17 The assessment has assumed that gravity based foundations will be used onsite. To protect the amenity of local residents, the construction noise activities can be controlled under The Control of Pollution Act

1974 (COPA) which is specifically concerned with the control of noise pollution. In particular Section 60, Part III of the COPA refers to the control of noise on construction sites. It provides legislation by which a Local Authority can control noise from construction sites to prevent noise disturbance occurring. In addition, it recommends that guidance provided by BS5228 be implemented to ensure compliance with Section 60.

- 16.3.18 Cumulative construction noise has not been considered in this assessment as there is no information to suggest that there are any other nearby developments which are due to be constructed at the same time as the Consented Development.
- 16.3.19 Further details regarding the methodology used in the construction noise assessment is provided within the Construction and Decommissioning Noise Report (Technical Appendix 16.1).

Operational noise

- 16.3.20 The assessment has been undertaken in accordance with ETSU-R-97 and current good practice, as specified in the Legislative Guidance (see para 16.1), ETSU-R-97 provides a robust basis for determining acceptable noise limits for wind farm developments. Consequently, the test applied to operational noise is whether or not the calculated wind farm noise levels at nearby noise sensitive properties will be below the noise limits derived in accordance with ETSU-R-97.
- 16.3.21 Limits differ between quiet daytime and night-time periods. The quiet daytime criteria is based upon the 'quiet periods of the day' comprising:
- All evenings from 18:00 to 23:00; plus
 - Saturday afternoons from 13:00 to 18:00; and
 - All day Sunday 07:00 to 23:00.
- 16.3.22 Night-time periods are defined as 23:00 to 07:00 with no differentiation made between weekdays and weekends.
- 16.3.23 ETSU-R-97 recommends that wind farm noise for the quiet daytime periods should be limited to 5 dB(A) above the prevailing background or a fixed minimum level within the range 35 - 40 dB $L_{A90,10min}$, whichever is the higher. The precise choice of criterion level within the range 35 - 40 dB(A) depends on a number of factors, including the number of dwellings in the neighbourhood of the wind farm (relatively few dwellings suggest a figure towards the upper end), the effect of noise limits on the number of kWh generated (larger sites tend to suggest a higher figure) and the duration and level of exposure to any noise. The exception to the setting of both the quiet daytime and night time fixed minimum on the noise limits occurs where a property occupier has a financial involvement in the wind farm development where the fixed minimum limit can be increased to 45dB(A) or a higher permissible limit above background during the quiet daytime and night time periods.
- 16.3.24 Following a review of the guidance in ETSU-R-97, the daytime limit for noise associated with the Consented Development has been set at 40dB(A) or background plus 5dB, whichever is greater. More information on the reasons for the choice of fixed minimum limit is included within the Assessment of Impacts section below and within Section 6.4 of Technical Appendix 16.2.
- 16.3.25 For night-time periods the recommended limits are 5 dB(A) above prevailing background or a fixed minimum level of 43 dB $L_{A90,10min}$, whichever is higher.

16.3.26 In addition to ETSU-R-97, the recommendations included in the IOA GPG have been considered in the noise assessment.

Cumulative wind turbine noise assessment

16.3.27 The need for a cumulative noise assessment was considered in accordance with the guidance contained within the IOA GPG. At the time of the operational noise assessment, no turbine applications were identified, nor were any applications in planning that required to be accounted for within the scope of the operational noise assessment. However, a number of small operational wind turbine developments within the vicinity of the Consented Development were identified; as such, and where required, a cumulative noise assessment was undertaken. The noise assessment has been undertaken in three separate stages:

- Stage 1 – establish the Total ETSU-R-97 Noise Limits for each Noise Assessment Location (NAL) based on the measured background noise levels and fixed minimum limits.
- Stage 2 – undertake noise predictions to determine whether noise predictions from the Consented Development on its own are within 10 decibels (dB) of the total noise predictions from the other wind turbines within the area. Where turbine predictions are within 10dB then a likely cumulative noise assessment will be undertaken.
- Stage 3 – establish the Site Specific Noise Limits for the Consented Development (through apportioning the Total ETSU-R-97 Noise Limits) and compare the noise predictions from the Consented Development on its own against the Site Specific Noise Limits.

16.3.28 The aim of the operational noise assessment therefore is to establish the Total ETSU-R-97 Noise Limits, determine the likely impacts of the Consented Development at the nearest noise sensitive receptors, derive Site Specific Noise Limits and to demonstrate that the Consented Development can meet (i.e. noise levels will be below) the limits.

16.3.29 The exact model of turbine to be installed on the Site will be the result of a future tendering process should consent be granted. Achievement of the noise limits determined by this assessment will be a key determining factor in the final choice of turbine for the Consented Development. Predictions of wind turbine noise for the Consented Development were made based upon the sound power level data for two candidate wind turbines, the Senvion 3.4M 104 and the Nordex N100 3.3, as these are considered representative of the type of turbine that would be installed at the Site. All calculations within this chapter refer to the Senvion 3.4M 104 as it is the louder of the two candidate turbines. Predictions of the wind turbine noise immissions levels at the NALs when considering the Nordex N100, 3.3 are shown on Figures A1.5a-o of Annex 1, Technical Appendix 16.2.

16.3.30 All the turbines modelled, inclusive of those used in the cumulative noise assessment, are summarised in Annex 7 of Technical Appendix 16.2. Uncertainty in sound power data for the Consented Development has been accounted for using the guidance contained within Section 4.2 of the IOA GPG which is applicable to turbines above 50kW. The small wind turbines to the south of the Site are less than 50kW therefore in order to consider the noise immissions from those turbines the turbine source data has been analysed using the data provided by the manufacturers. The location and the numbering of the wind turbines for the Consented Development (Turbines 1 – 17) and the small operational wind turbines to the south (Turbines 18 – 25) are shown on Figure 16.2.

16.3.31 Noise predictions have been undertaken using the propagation model contained within Part 2 of International Standard ISO 9613-2, 'Acoustics – Attenuation of sound during propagation outdoors'.

The model calculates, on an octave band basis, attenuation due to geometric spreading, atmospheric absorption and ground effects. The noise model was set up to provide realistic noise predictions, including mixed ground attenuation ($G=0.5$) and atmospheric attenuation relating to 70% Relative Humidity and 10°C.

- 16.3.32 Typically wind farm noise assessments assume all properties are downwind of all turbines at all times (as this would result in the highest wind turbine noise levels). However, where properties are located in between groups of turbines they cannot be downwind of all turbines simultaneously so it is appropriate to consider the effect of wind direction on predicted noise levels.
- 16.3.33 In line with the IOA GPG, an assessment has been undertaken to determine whether a concave ground profile correction (+3dB) or barrier correction (-2dB), is required due to the topography between the turbines and the noise sensitive receptors. Propagation across a valley (concave ground) increases the number of reflection paths, and in turn, has the potential to increase sound levels at a given receptor. Terrain screening effects (barrier corrections) act as blocking points, subsequently reductions in sound levels at a given receptor can potentially be observed. A concave ground and barrier correction was found to be required for a number of turbines at a number of receptors (Table 2 of Annex 8, Technical Appendix 16.2).
- 16.3.34 Information relating to operational noise such as Amplitude Modulation (AM), a potential characteristic of wind turbine noise and Low Frequency Noise are also addressed in detail within Technical Appendix 16.2. In summary, at the present time, current good practice suggests that it is not possible to predict the occurrence of AM or to assign a planning condition to deal with the characteristic. In relation to low frequency noise, an article published in the IOA Bulletin (March/April 2009) concluded that there is no robust evidence that either low frequency noise (including 'infrasound') or ground-borne vibration from wind farms, has an adverse effect on wind farm neighbours.

Assessment criteria

Construction and decommissioning noise

- 16.3.35 BS5228-1:2009+A1:2014, Appendix E Part E.3.2 sets criteria for assessing the significance of construction noise effects and gives examples of acceptable threshold values for construction noise. For the purposes of this assessment, having due regard to the existing ambient noise levels measured during background noise monitoring for the operational noise survey around the Consented Development, the Category A noise threshold values are applicable for all properties. This category has been utilised to assess the significance of the construction and decommissioning effects during each of the key construction phases. The significance criteria adopted for this assessment are based on Appendix E part E.3.2 of BS5228-1:2009+A1:2014 as detailed in Section 2.3.9 of the Construction and Decommissioning Noise Report (Technical Appendix 16.1).
- 16.3.36 The criteria for determining the significance of construction noise effects are provided in Table 16.2.

Table 16.2: Construction and decommissioning noise significance criteria

| Assessment category and threshold value period | Significance level | |
|--|--------------------------------|--------------------------------|
| | Not significant | Significant |
| Category A Daytime (07:00 – 19:00) and Saturdays (07:00 to 13:00) | ≤65dB L _{Aeq} , 12 hr | >65dB L _{Aeq} , 12 hr |
| Category A Evenings and Weekends (19:00 – 23:00) | <55dB L _{Aeq} , 5hr | >55dB L _{Aeq} , 5hr |

16.3.37 The threshold values are limits for the construction L_{Aeq} noise level. The limits in each category are to be used where the existing noise level at each location, rounded to the nearest 5dB is below the level given for a time of day.

Operational noise

16.3.38 Planning Advice Note PAN 1/2011 Planning and Noise provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. PAN 1/2011 refers to the Web based planning advice on renewable technologies for Onshore Wind Turbines which states that ETSU-R-97 should be used to assess and rate noise from wind energy developments. ETSU-R-97 does not define significance criteria, but describes a framework for the measurement of wind farm noise and gives indicative noise levels considered to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable restrictions on wind farm development. Achievement of ETSU-R-97 derived noise limits ensures that wind turbine noise will meet current Government guidance.

16.3.39 In October 2014, IEMA published 'Guidelines for Environmental Noise Impact Assessment'. The guidance document provides a framework for noise impact assessment and makes suggestions for factors which may be considered within noise assessments.

16.3.40 In relation to wind farms, the guidance states (in Para 7.64):

16.3.41 *"In certain cases, there is government endorsed guidance which defines what are considered to be acceptable noise thresholds e.g. ETSU-R-97 for wind turbines, below which the government states that the situation is acceptable. This does not mean, however, that there would be no effect (consequences) and it is important to acknowledge any impact (change in noise level) that is identified even if the government limit or guideline value is not exceeded."*

16.3.42 At time of writing the IEMA guidance has not been endorsed by the Scottish Government or the Institute of Acoustics.

16.3.43 In terms of the EIA Regulations, the terminology of significance used in this chapter refers to compliance/non-compliance with the ETSU-R-97 derived noise limits. For situations where predicted wind turbine noise meets or is less than the noise limits defined in ETSU-R-97, then the noise effects are deemed not significant. Any breach of the ETSU-R-97 derived noise limits due to the Consented Development is deemed to result in a significant effect.

16.3.44 For the purposes of this assessment, residential properties are considered to be sensitive receptors.

16.4 Baseline

Study area

16.4.45 Prior to the commencement of the operational noise assessment, initial desktop noise modelling was undertaken using ReSoft WindFarm Release 4.2.1.7 (WindFarm) software in order to identify suitable locations at which to monitor background noise. A draft 20 wind turbine layout^a was input into the 'WindFarm' software and using noise data for a candidate turbine representative of the type that could be installed at the Consented Development, a noise contour plot was produced. The noise contour plot defined the extent of the assessment area for the operational noise assessment based upon a 35dB(A) contour. An additional assessment location outside of the 35dB contour was included in order to allow for any changes in design of the scheme. The background Noise Monitoring Locations (NML) are shown on Figure 16.2 and more information on the NML can be found in Section 5 of Technical Appendix 16.2.

Scoping and consultation responses

16.4.46 The Scoping Opinion issued by Local Energy and Consents contained a response from Shetland Islands Council on noise and states:

16.4.47 *'There is very little information regarding the construction phase including the construction of access roads and the extraction of materials from quarry or borrow pit operations. Clarification of borrow pit locations etc and much more information will be required.'*

16.4.48 The scoping opinion refers to guidance contained within ETSU-R-97 and PAN 1/2011.

16.4.49 Direct consultation was undertaken with the Environmental Health Officer (EHO) at Shetland Islands Council (SIC) to agree the approach to the noise assessment and the proposed noise monitoring locations. The EHO responded to the consultation by email and agreed with both the approach and the monitoring locations. The EHO attended Site on the day the noise monitoring equipment was installed, and witnessed the siting of the equipment at three of the six monitoring locations. Following the installation details of all six noise monitoring locations were sent to the EHO and no comments were received.

16.4.50 Details of each of the equipment installed at each of the noise monitoring locations are detailed in Technical Appendix 16.2.

16.4.51 Additional consultation was undertaken following completion of the background noise monitoring where initial results and the suggested noise limits were presented to the Council and discussed during a teleconference. TNEI also sought the Council's views regarding the choice of quiet day time fixed minimum limit and provided information explaining why TNEI considered a 40dB fixed minimum limit would be appropriate for the Site. Details of the consultation responses are provided in the Annex 2 of Technical Appendix 16.2.

Background noise survey

16.4.52 The Consented Development is located within a rural location where existing background noise levels are considered to be relatively low. The predominant noise sources in the area are wind induced noise

^a A 20 turbine layout was used as this was the draft layout being considered at the time of the consultation.

(wind passing through vegetation and around buildings), distant and local road traffic noise, agricultural noise and birdsong.

- 16.4.53 The noise survey to determine the existing background noise environment at noise sensitive receptors neighbouring the Consented Development was undertaken in accordance with the guidance contained within ETSU-R-97 and current good practice (IOA GPG).
- 16.4.54 Background noise monitoring was undertaken at six noise sensitive receptors selected, and agreed with the EHO at SIC, as being representative of the noise sensitive receptors located closest to the Consented Development. The batteries on the noise meter located at NML 6 Hamnavoe, failed after 1 week, as a result of which insufficient datapoints were recorded to provide a robust assessment at that location. It was subsequently agreed during a telephone conversation with the SIC, that noise data collected at another location (NML 1, Holligarth) was representative of the expected background noise environment and as such the noise data from NML1 was used as a proxy to derive noise limits at Noise Assessment Location (NAL) 6 Hamnavoe. NML1 was the quietest unfiltered noise monitoring location, so using it as a proxy provided conservative noise limits at NML6.
- 16.4.55 The measurement locations were selected on the basis of preliminary noise predictions, which indicated those properties that for a wind condition of 10ms^{-1} at 10 metres above ground level, would be exposed to turbine noise immissions at or above 35dB(A). A total of fifteen noise sensitive receptors were chosen as representative Noise Assessment Locations (NAL). The NALs chosen were the closest receptors to the Consented Development and the other wind turbine developments. NALs refer to the position on the curtilage of a property. Predictions of wind turbine noise have been made at each of the NALs as detailed in Table 16.3 and shown on Figure 16.2. This approach ensures that the report models the worst case (loudest) noise immission level expected at the noise sensitive receptor. Table 16.3 also details which NML has been used to set noise limits for each NAL.

Table 16.3: Operational noise assessment locations (NAL)

| <i>Receptor</i> | <i>Easting</i> | <i>Northing</i> | <i>Elevation (m AOD)</i> | <i>Approximate distance to nearest turbine* (m)</i> | <i>Background noise data used</i> |
|------------------------|----------------|-----------------|------------------------------|---|---|
| NAL1- Lower Holligarth | 452188 | 1183917 | 34 | 1353 | NML1 |
| NAL2- Whirliegarth | 452739 | 1183016 | 30 | 909 | NML2 |
| NAL3- Easterlee | 451773 | 1180569 | 56 | 879 | NML3 |
| NAL4 - Gentletown | 452415 | 1180263 | 51 | 992 | NML4 |
| NAL5 - Littlester | 451022 | 1180133 | 34 | 1426 | NML5 |
| NAL6 - Hamnavoe | 449726 | 1180866 | 33 | 1860 | NML1 |
| NAL7 - Helnaquhida | 452013 | 1180138 | 35 | 1168 | NML3 |
| NAL8 - Kettlester | 451861 | 1180049 | 29 | 1303 | NML3 |
| NAL9 - Islesview | 451819 | 1180372 | 47 | 1033 | NML3 |

Table 16.3: Operational noise assessment locations (NAL)

| Receptor | Easting | Northing | Elevation (m AOD) | Approximate distance to nearest turbine* (m) | Background noise data used |
|--------------------------|----------------|-----------------|------------------------------|---|---|
| NAL10 - Westerlee | 451775 | 1180241 | 32 | 1168 | NML3 |
| NAL11 - Kletterlea | 451404 | 1180170 | 30 | 1279 | NML5 |
| NAL12 - The School House | 451203 | 1179999 | 20 | 1490 | NML5 |
| NAL13 – Cluness Cottage | 451955 | 1179932 | 27 | 1382 | NML3 |
| NAL14 - Staneygarth | 451936 | 1179890 | 24 | 1427 | NML3 |
| NAL15 - Giggleswick | 452261 | 1179936 | 30 | 1319 | NML4 |

* Please note the distances to the nearest turbines quoted above may differ from those reported elsewhere. Distances for the noise assessment are taken from the nearest turbine to the closest edge of the amenity area (usually the garden).

- 16.4.56 Background noise monitoring was undertaken over the period 24th June 2015 to 30th July 2015.
- 16.4.57 The sound level meters were set to log the L_{A90} (as required by ETSU-R-97) and L_{Aeq} noise levels over the required ten minute intervals continuously over the deployment period.
- 16.4.58 Simultaneous wind speed/direction data were recorded at various heights using a SoDAR Unit, which was located within the Site. The wind speed data collected at 80m and 100m height was used to calculate hub height wind speed (95m) which in turn was standardised to 10m height. A candidate turbine with a hub height of 95m which would fall within the 145m turbine design envelope has been used for this assessment.
- 16.4.59 Wind speed/direction data and rainfall data were collected over the same time scale, and averaged over the same ten minute periods, as the noise data to allow analysis of the measured background noise as a function of wind speed and wind direction.
- 16.4.60 As detailed above, the model calculates, on an octave band basis, attenuation due to geometric spreading, atmospheric absorption and ground effects. The noise model was set up to provide realistic noise predictions, including mixed ground attenuation ($G=0.5$) and atmospheric attenuation relating to 70% Relative Humidity and 10°C.
- 16.4.61 In line with current good practice, an assessment has been undertaken to determine whether a concave ground profile correction (+3dB) or barrier correction (-2dB) is required due to the topography between the turbines and the noise sensitive receptors. Details of the analysis are contained in Technical Appendix 16.2.

- 16.4.62 In line with the recommendations included in Section 3.1.21 of the IOA GPG, the polynomial background curve for the low speed conditions has been flatlined (where applicable) at the lower wind speeds where the derived minimum occurs.
- 16.4.63 The IOA GPG recommends that no fewer than 200 valid data points should be recorded in each of the quiet daytime and night time periods, with no fewer than 5 valid data points in any 1 ms⁻¹ wind speed bin (each wind speed bin being centred on an integer wind speed with a width of 1 ms⁻¹, for example the 4 ms⁻¹ bin would include all data with wind speeds of 3.5 to 4.5 ms⁻¹). This can be reduced to 100 data points and 3 per 1ms⁻¹ bin for filtered datasets. The number of data points measured in each wind speed bin for each receptor are detailed on Figures A1.2a - A1.2e of the operational noise assessment report contained within Technical Appendix 16.2. If there were insufficient data points measured per wind speed bin during quiet daytime and night time periods these data points have been excluded from the assessment and as detailed in Table 5.3 of Technical Appendix 16.2.
- 16.4.64 In the interest of protecting residential amenity, the noise limits for higher wind speeds where data have not been collected have been set equal to those derived for lower wind speeds, as detailed in Section 5.8 of Technical Appendix 16.2.
- 16.4.65 Table 16.4 provides a summary of the range of background noise levels measured during the monitoring period. Background noise data recorded during periods of rainfall (including the preceding 10 minute period in line with IOA GPG) have been excluded from the dataset, as well as periods of birdsong and when noise levels were atypical (sea noise at NML2) (see Figure A1.2b in Technical Appendix 16.2).

Table 16.4: Summary of background noise levels (dB(A))

| Receptor | Quiet daytime | Night-time |
|-------------------------|--------------------------------|--------------------------------|
| | <i>L_{A90, 10 min}</i> | <i>L_{A90, 10 min}</i> |
| NML1 - Lower Holligarth | 15.9-44.2 | 15.8-43.1 |
| NML2 - Whirliegarth | 18.0-43.5 | 17.3-43.5 |
| NML3 - Easterlee | 18.0-46.9 | 17.7-46.5 |
| NML4 - Nessview | 17.3-52.0 | 17.3-47.0 |
| NML5 - Heatherlea | 16.6-52.7 | 16.2-51.7 |

16.5 Assessment of impacts

Construction and decommissioning noise

16.5.66 Table 16.5 details the results of the Construction Noise assessment. Full details of the modelling and assessment can be found in Technical Appendix 16.1.

Table 16.5: Predicted Construction Noise Effects (Phase 1-8)

| Location | Category A daytime threshold dB | Category A weekend threshold dB | Construction Phase - Predicted daytime noise levels LAeq 12h for each phases in (dB) | | | | | | | |
|-------------------------|---------------------------------|---------------------------------|--|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| | | | Phase 1 | Phase 2 | Phase 3 | Phase 4 | Phase 5 | Phase 6 | Phase 7 | Phase 8 |
| NAL1 - Lower Holligarth | 65 | 55 | 20dB - Not significant | 23dB - Not significant | 34dB - Not significant | 32dB - Not significant | 28dB - Not significant | 20dB - Not significant | 32dB - Not significant | 26dB - Not significant |
| NAL2 - Whirliegarth | 65 | 55 | 23dB - Not significant | 21dB - Not significant | 37dB - Not significant | 33dB - Not significant | 29dB - Not significant | 24dB - Not significant | 34dB - Not significant | 28dB - Not significant |
| NAL3- Easterlee | 65 | 55 | 36dB - Not significant | 34dB - Not significant | 40dB - Not significant | 39dB - Not significant | 39dB - Not significant | 29dB - Not significant | 35dB - Not significant | 32dB - Not significant |
| NAL4- Hamnavoe | 65 | 55 | 51dB - Not significant | 41dB - Not significant | 45dB - Not significant | 44dB - Not significant | 40dB - Not significant | 29dB - Not significant | 33dB - Not significant | 38dB - Not significant |

16.5.67 The predicted levels at all receptors are below the 65dB Category A Daytime Threshold of BS5228. The predicted levels at all receptors are also below the 55dB Category A Evening and Weekend Threshold of BS5228. The resulting effects are therefore deemed to be Not significant.

16.5.68 It should also be noted that the proposed construction phases are temporary and short-term and therefore will not give rise to any long-term effects during the construction period. In practice for much of the working day the noise associated with construction activities would be less than predicted as the assessment has assumed all equipment is constantly operating at full load at the closest point to each receptor. Additionally, background noise may be greater as measurements of background noise were taken on a calm, dry day. At these times the effect would therefore be less than indicated.

Operational noise

16.5.69 The quiet daytime noise limits are chosen to protect external amenity, the precise choice of level within the range 35dB(A) to 40dB(A) depends on a number of criterion. A detailed discussion on each of the determining factors is provided within Section 6.4 of Technical Appendix 16.2. Each of the three criterion included within ETSU-R-97 and the IOA GPG has been considered in detail. A summary of the key findings for each criterion is included below:

- The number of properties affected by the adoption of the upper quiet daytime fixed minimum limit will be eleven or less. TNEI would consider this to be a relatively small number given the scale of the Consented Development.
- The effect on the power generation - based on the Senvion 3.4M 104, 9 turbines would need to be operated in a low noise mode resulting in a 19% loss of power per turbine for a proportion of the time (key receptors are located downwind). Alternatively, if turbines were to simply be removed until the lower limit was met this would result in a 35% decrease in the rated capacity of the scheme. Either option would clearly have an impact on the power generation of the wind farm.
- The level and duration of exposure - at the quietest location, Whirliegarth, background noise levels are less than 30dB(A) for 10% of the time when the turbines would be operating and the upper quiet daytime fixed minimum noise limit would be required (between 5.5-8.5ms⁻¹). The predicted long term wind rose also suggests that the area will experience a wide range of wind directions which would limit the exposure. Based on TNEI's experience the level and duration of exposure is not considered to be a significant proportion of the time.

Total ETSU-R-97 noise limits (Stage 1)

- 16.5.70 Based on the prevailing background noise levels, the Total ETSU-R-97 Noise Limits have been established for each of the NALs as detailed in Table 16.6 and Table 16.7 below, based on an upper fixed minimum of 40 dB (Quiet daytime) or background plus 5 dB and 43 dB (Night-time) or background plus 5 dB.
- 16.5.71 There are a number of small wind turbine developments to the south of the Consented Development, some of which are located in close proximity to some of the NALs considered in this assessment. As such it has been assumed that the occupiers of NAL11, NAL13, and NAL15 are financially involved with the single wind turbine developments therefore, a higher limit of 45dB or higher permissible margin above background noise has been assumed for those receptors during the quiet daytime and night time periods. The prevailing background noise levels are shown on Figures A1.2a-A1.2e included in Annex 1 of Technical Appendix 16.2. To ensure a robust worst cases assessment, the noise limits included within the tables below assume that turbine (T20) at Cluness Cottage is operational. However TNEI understand that the turbine at Cluness Cottage may be removed before the Consented Development commences operations, therefore an alternative set of predictions and limits without T20 are included within Annex 9 of Technical Appendix 16.2 to reflect that possible scenario.
- 16.5.72 For NAL13 Cluness Cottage the limits have been set equal to 45dB or the background noise plus 10dB (whichever is the greater) in accordance with ETSU-R-97. The limits reflect the predicted wind turbine noise levels resulting from the existing wind turbines in the area and the fact that the Council must have been satisfied with those noise levels when the existing turbine development was consented. It should be noted that the Consented Development would make a negligible contribution to cumulative wind turbine noise levels at this location as detailed in Section 6.5 of Technical Appendix 16.2. At NAL11 and NAL15 the noise limits have been set at 45dB or the background noise level plus 5dB (whichever is the greater).

Table 16.6: Total ETSU-R-97 noise limits - quiet daytime

| Location | Wind speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | |
|--------------------------|--|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1- Lower Holligarth | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40.1 | 41.8 | 42.6 | 42.6 | 42.6 |
| NAL2- Whirliegarth | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40.5 | 42.9 | 42.9 | 42.9 |
| NAL3- Easterlee | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL4 - Gentletown | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 41.8 | 44.6 | 46.8 | 48 | 48 |
| NAL5 - Littlester | 40 | 40 | 40 | 40 | 40 | 40 | 41.3 | 44.4 | 47.2 | 49.6 | 51.3 | 51.3 |
| NAL6 - Hamnavoe | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40.1 | 41.8 | 42.6 | 42.6 | 42.6 |
| NAL7 - Helnaquhida | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL8 - Kettlester | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL9 - Islesview | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL10 - Westerlee | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL11 - Kletterlea | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 47.2 | 49.6 | 51.3 | 51.3 |
| NAL12 - The School House | 40 | 40 | 40 | 40 | 40 | 40 | 41.3 | 44.4 | 47.2 | 49.6 | 51.3 | 51.3 |
| NAL13 – Cluness Cottage | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 47.4 | 49.6 | 51.7 | 51.7 |
| NAL14 - Staneygarth | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL15 - Giggleswick | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 46.8 | 48 | 48 |

Table 16.7: Total ETSU-R-97 noise limits - night time

| Location | Wind speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | |
|--------------------------|--|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1- Lower Holligarth | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.1 |
| NAL2- Whirliegarth | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43.7 | 43.7 |
| NAL3- Easterlee | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| NAL4 - Gentletown | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44 | 46.1 | 46.1 |
| NAL5 - Littlester | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.5 | 47.3 | 49.8 | 51.8 |
| NAL6 - Hamnavoe | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.1 |
| NAL7 - Helnaquhida | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| NAL8 - Kettlester | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| NAL9 - Islesview | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| NAL10 - Westerlee | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| NAL11 - Kletterlea | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 47.3 | 49.8 | 51.8 |
| NAL12 - The School House | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.5 | 47.3 | 49.8 | 51.8 |
| NAL13 – Cluness Cottage | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45.6 | 48 | 50.1 | 50.1 |
| NAL14 - Staneygarth | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| NAL15 - Giggleswick | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 46.1 | 46.1 |

Predicting the likely effects and the requirement for a cumulative noise assessment (Stage 2)

- 16.5.73 A comparison has been undertaken of the predicted wind turbine noise immission levels from the Consented Development and all other schemes at each of the identified NALs in order to determine whether predictions are within 10dB of each other. As is detailed in Sections 5.1.4 and 5.1.5 of the IOA GPG where noise immission levels are greater than 10dB apart then a cumulative noise assessment is not required. This is because the addition of a new noise source which is at least 10dB quieter than the existing noise level will have a negligible impact on overall noise levels. Where predictions are found to be within 10dB of each other then a cumulative assessment is required. It was found that a likely cumulative noise assessment is required at 13 noise sensitive receptors. Further details can be found in Annex 8 of Technical Appendix 16.2.
- 16.5.74 The assessment (shown in Table 16.8 and Table 16.9) compares predicted cumulative wind turbine noise with the Total ETSU-R-97 Noise Limits at the 13 identified receptors. A negative exceedance

indicates compliance with the limits. The tables show that the predicted cumulative wind turbine noise immission levels meet the Total ETSU-R-97 Noise Limits under all conditions and at all locations for both quiet daytime and night-time periods.

16.5.75 Tables 16.8 and 16.9 detail the prevailing background noise levels, relevant criteria and predicted wind turbine noise levels for ETSU-R-97 quiet daytime hours and ETSU-R-97 night-time hours. The tables also show the exceedance level which is the difference between the predicted turbine noise level and noise criterion at a given wind speed. A negative exceedance level indicates satisfaction of the noise criteria.

Table 16.8 Compliance Table- Likely Cumulative Noise - Quiet Daytime

| Location | | Wind Speed (ms ⁻¹) as standardised to 10m height | | | | | | | | | | | |
|-------------------------|--|--|----|----|-------|-------|------|------|------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 - Lower Holligarth | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40.1 | 41.8 | 42.6 | 42.6 | 42.6 |
| | Predicted cumulative wind turbine noise L _{A90} | - | - | - | 27.6 | 31.2 | 35 | 36.4 | 36.5 | 36.5 | 36.5 | 36.5 | 36.5 |
| | Exceedance level L _{A90} | - | - | - | -12.4 | -8.8 | -5 | -3.6 | -3.6 | -5.3 | -6.1 | -6.1 | -6.1 |
| NAL2 - Whirliegarth | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40.5 | 42.9 | 42.9 | 42.9 |
| | Predicted cumulative wind turbine noise L _{A90} | - | - | - | 30.5 | 34.1 | 37.8 | 39.2 | 39.4 | 39.4 | 39.4 | 39.4 | 39.4 |
| | Exceedance level L _{A90} | - | - | - | -9.5 | -5.9 | -2.2 | -0.8 | -0.6 | -1.1 | -3.5 | -3.5 | -3.5 |
| NAL3 - Easterlee | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| | Predicted cumulative wind turbine noise L _{A90} | - | - | - | 30.6 | 34.1 | 37.8 | 39.2 | 39.5 | 39.7 | 40 | 40.5 | 40.5 |
| | Exceedance level L _{A90} | - | - | - | -9.4 | -5.9 | -2.2 | -0.8 | -0.5 | -2.7 | -4.6 | -6.2 | -6.2 |
| NAL4 - Gentletown | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 41.8 | 44.6 | 46.8 | 48 | 48 |
| | Predicted cumulative wind turbine noise L _{A90} | - | - | - | 28.1 | 31.5 | 35.1 | 36.6 | 37 | 37.4 | 37.9 | 38.8 | 38.8 |
| | Exceedance level L _{A90} | - | - | - | -11.9 | -8.5 | -4.9 | -3.4 | -4.8 | -7.2 | -8.9 | -9.2 | -9.2 |
| NAL5 - Littlester | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 41.3 | 44.4 | 47.2 | 49.6 | 51.3 | 51.3 |
| | Predicted cumulative wind turbine noise L _{A90} | - | - | - | 28.6 | 31.6 | 34.8 | 36.5 | 37.5 | 38.8 | 40.3 | 42 | 42 |
| | Exceedance level L _{A90} | - | - | - | -11.4 | -8.4 | -5.2 | -4.8 | -6.9 | -8.4 | -9.3 | -9.3 | -9.3 |
| NAL6 - Hammavoe | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40.1 | 41.8 | 42.6 | 42.6 | 42.6 |
| | Predicted cumulative wind turbine noise L _{A90} | - | - | - | 24.6 | 28.2 | 31.9 | 33.3 | 33.5 | 33.5 | 33.6 | 33.7 | 33.7 |
| | Exceedance level L _{A90} | - | - | - | -15.4 | -11.8 | -8.1 | -6.7 | -6.6 | -8.3 | -9 | -8.9 | -8.9 |
| NAL7 | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |

Table 16.8 Compliance Table- Likely Cumulative Noise - Quiet Daytime

| Location | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | | |
|--------------------------|--|----|----|----|-------|------|------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| NAL8 - Kettlester | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 28.4 | 31.6 | 35 | 36.6 | 37.3 | 38.2 | 39.4 | 40.9 | 40.9 |
| | Exceedance level L_{A90} | - | - | - | -11.6 | -8.4 | -5 | -3.4 | -2.7 | -4.2 | -5.2 | -5.8 | -5.8 |
| | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL9 - Isleview | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 28.6 | 31.7 | 35 | 36.6 | 37.4 | 38.4 | 39.7 | 41.2 | 41.2 |
| | Exceedance level L_{A90} | - | - | - | -11.4 | -8.3 | -5 | -3.4 | -2.6 | -4 | -4.9 | -5.5 | -5.5 |
| | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL10 - Westerlee | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 29.3 | 32.8 | 36.4 | 37.9 | 38.2 | 38.6 | 39.2 | 40.1 | 40.1 |
| | Exceedance level L_{A90} | - | - | - | -10.7 | -7.2 | -3.6 | -2.1 | -1.8 | -3.8 | -5.4 | -6.6 | -6.6 |
| | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL11 - Kletterlea | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 28.9 | 32.2 | 35.7 | 37.2 | 37.8 | 38.5 | 39.4 | 40.6 | 40.6 |
| | Exceedance level L_{A90} | - | - | - | -11.1 | -7.8 | -4.3 | -2.8 | -2.2 | -3.9 | -5.2 | -6.1 | -6.1 |
| | Total ETSU-R-97 noise limit | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 47.2 | 49.6 | 51.3 | 51.3 |
| NAL12 - The School House | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 32.6 | 35.3 | 38 | 40 | 41.6 | 43.4 | 45.4 | 47.5 | 47.5 |
| | Exceedance level L_{A90} | - | - | - | -12.4 | -9.7 | -7 | -5 | -3.4 | -3.8 | -4.2 | -3.8 | -3.8 |
| | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 41.3 | 44.4 | 47.2 | 49.6 | 51.3 | 51.3 |
| NAL13 - Cluness Cottage | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 27.7 | 30.5 | 33.6 | 35.4 | 36.7 | 38.2 | 39.9 | 41.8 | 41.8 |
| | Exceedance level L_{A90} | - | - | - | -12.3 | -9.5 | -6.4 | -5.9 | -7.7 | -9 | -9.7 | -9.5 | -9.5 |
| | Total ETSU-R-97 noise limit | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 47.4 | 49.6 | 51.7 | 51.7 |
| NAL14 - Staneygarth | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 34.7 | 37.1 | 39.6 | 41.6 | 43.4 | 45.4 | 47.4 | 49.5 | 49.5 |
| | Exceedance level L_{A90} | - | - | - | -10.3 | -7.9 | -5.4 | -3.4 | -1.6 | -2 | -2.2 | -2.2 | -2.2 |
| | Total ETSU-R-97 noise limit | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 42.4 | 44.6 | 46.7 | 46.7 |
| NAL15 - Giggleswick | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 29.6 | 32.4 | 35.3 | 37.1 | 38.4 | 39.9 | 41.6 | 43.5 | 43.5 |
| | Exceedance level L_{A90} | - | - | - | -10.4 | -7.6 | -4.7 | -2.9 | -1.6 | -2.5 | -3 | -3.2 | -3.2 |
| | Total ETSU-R-97 noise limit | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 46.8 | 48 | 48 |
| NAL15 - Giggleswick | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 31.2 | 33.9 | 36.7 | 38.6 | 40.2 | 42 | 44 | 46 | 46 |

Table 16.8 Compliance Table- Likely Cumulative Noise - Quiet Daytime

| Location | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | |
|----------------------------|--|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Exceedance level L_{A90} | - | - | - | -13.8 | -11.1 | -8.3 | -6.4 | -4.8 | -3 | -2.8 | -2 | -2 |

Table 16.9 Compliance table- likely cumulative noise - Night time

| Location | | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | |
|--------------------------|---|--|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 - Lower Hollingarth | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 27.6 | 31.2 | 35 | 36.4 | 36.5 | 36.5 | 36.5 | 36.5 | 36.5 |
| | Exceedance level L_{A90} | - | - | - | -15.4 | -11.8 | -8 | -6.6 | -6.5 | -6.5 | -6.5 | -6.5 | -7.6 |
| NAL2 - Whirliegarth | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43.7 | 43.7 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 30.5 | 34.1 | 37.8 | 39.2 | 39.4 | 39.4 | 39.4 | 39.4 | 39.4 |
| | Exceedance level L_{A90} | - | - | - | -12.5 | -8.9 | -5.2 | -3.8 | -3.6 | -3.6 | -3.6 | -4.3 | -4.3 |
| NAL3 - Easterlee | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 30.6 | 34.1 | 37.8 | 39.2 | 39.5 | 39.7 | 40 | 40.5 | 40.5 |
| | Exceedance level L_{A90} | - | - | - | -12.4 | -8.9 | -5.2 | -3.8 | -3.5 | -3.3 | -3 | -4.6 | -4.6 |
| NAL4 - Gentletown | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44 | 46.1 | 46.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 28.1 | 31.5 | 35.1 | 36.6 | 37 | 37.4 | 37.9 | 38.8 | 38.8 |
| | Exceedance level L_{A90} | - | - | - | -14.9 | -11.5 | -7.9 | -6.4 | -6 | -5.6 | -6.1 | -7.3 | -7.3 |
| NAL5 - Littlester | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.5 | 47.3 | 49.8 | 51.8 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 28.6 | 31.6 | 34.8 | 36.5 | 37.5 | 38.8 | 40.3 | 42 | 42 |
| | Exceedance level L_{A90} | - | - | - | -14.4 | -11.4 | -8.2 | -6.5 | -5.5 | -5.7 | -7 | -7.8 | -9.8 |
| NAL6 - Hamnavoe | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 24.6 | 28.2 | 31.9 | 33.3 | 33.5 | 33.5 | 33.6 | 33.7 | 33.7 |
| | Exceedance level L_{A90} | - | - | - | -18.4 | -14.8 | -11.1 | -9.7 | -9.5 | -9.5 | -9.4 | -9.3 | -10.4 |
| NAL7 - Helnaquhida | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 28.4 | 31.6 | 35 | 36.6 | 37.3 | 38.2 | 39.4 | 40.9 | 40.9 |
| | Exceedance level L_{A90} | - | - | - | -14.6 | -11.4 | -8 | -6.4 | -5.7 | -4.8 | -3.6 | -4.2 | -4.2 |
| NAL8 - Kettlester | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 28.6 | 31.7 | 35 | 36.6 | 37.4 | 38.4 | 39.7 | 41.2 | 41.2 |
| | Exceedance level L_{A90} | - | - | - | -14.4 | -11.3 | -8 | -6.4 | -5.6 | -4.6 | -3.3 | -3.9 | -3.9 |

Table 16.9 Compliance table- likely cumulative noise - Night time

| Location | | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | |
|--------------------------|---|--|----|----|-------|-------|------|------|------|------|------|------|------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL9 - Isview | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 29.3 | 32.8 | 36.4 | 37.9 | 38.2 | 38.6 | 39.2 | 40.1 | 40.1 |
| | Exceedance level L_{A90} | - | - | - | -13.7 | -10.2 | -6.6 | -5.1 | -4.8 | -4.4 | -3.8 | -5 | -5 |
| NAL10 - Westerlee | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 28.9 | 32.2 | 35.7 | 37.2 | 37.8 | 38.5 | 39.4 | 40.6 | 40.6 |
| | Exceedance level L_{A90} | - | - | - | -14.1 | -10.8 | -7.3 | -5.8 | -5.2 | -4.5 | -3.6 | -4.5 | -4.5 |
| NAL11 - Kletterlea | Total ETSU-R-97 noise limit | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 47.3 | 49.8 | 51.8 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 32.6 | 35.3 | 38 | 40 | 41.6 | 43.4 | 45.4 | 47.5 | 47.5 |
| | Exceedance level L_{A90} | - | - | - | -12.4 | -9.7 | -7 | -5 | -3.4 | -1.6 | -1.9 | -2.3 | -4.3 |
| NAL12 - The School House | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.5 | 47.3 | 49.8 | 51.8 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 27.7 | 30.5 | 33.6 | 35.4 | 36.7 | 38.2 | 39.9 | 41.8 | 41.8 |
| | Exceedance level L_{A90} | - | - | - | -15.3 | -12.5 | -9.4 | -7.6 | -6.3 | -6.3 | -7.4 | -8 | -10 |
| NAL13 - Cluness Cottage | Total ETSU-R-97 noise limit | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45.6 | 48 | 50.1 | 50.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 34.7 | 37.1 | 39.6 | 41.6 | 43.4 | 45.4 | 47.4 | 49.5 | 49.5 |
| | Exceedance level L_{A90} | - | - | - | -10.3 | -7.9 | -5.4 | -3.4 | -1.6 | -0.2 | -0.6 | -0.6 | -0.6 |
| NAL14 - Staneygarth | Total ETSU-R-97 noise limit | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 45.1 | 45.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 29.6 | 32.4 | 35.3 | 37.1 | 38.4 | 39.9 | 41.6 | 43.5 | 43.5 |
| | Exceedance level L_{A90} | - | - | - | -13.4 | -10.6 | -7.7 | -5.9 | -4.6 | -3.1 | -1.4 | -1.6 | -1.6 |
| NAL15 - Giggleswick | Total ETSU-R-97 noise limit | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 46.1 | 46.1 |
| | Predicted cumulative wind turbine noise L_{A90} | - | - | - | 31.2 | 33.9 | 36.7 | 38.6 | 40.2 | 42 | 44 | 46 | 46 |
| | Exceedance level L_{A90} | - | - | - | -13.8 | -11.1 | -8.3 | -6.4 | -4.8 | -3 | -1 | -0.1 | -0.1 |

Derivation of site specific noise limits for the development (Stage 3)

16.5.76 As summarised in Table 16.10 below, for some receptors surrounding the Consented Development, operational noise from the other schemes will be negligible and will be at least 10dB below the Total ETSU-R-97 Noise Limits established for the Consented Development (as detailed in Tables 16.6 and 16.7). At the receptors where cumulative turbine predictions are at least 10dB below it would be

appropriate to allocate the entire noise limit to the Consented Development as the other wind turbines will use a negligible proportion of the Total ETSU-R-97 Noise Limit.

- 16.5.77 For the other receptors limit apportionment was required. At these receptors the predicted noise levels (including the additional uncertainty detailed in Section 4.3.5 of Technical Appendix 16.2) were then subtracted from the Total ETSU-R-97 Noise Limit to determine the residual limit available for the Consented Development (the suggested 'site specific noise limits'). When considering the predictions from small single wind turbine developments it has been assumed that the turbines are operating in full mode, which in some cases appear to be above the noise limits set for the relevant wind turbine development. Further information on the approach taken to modelling the single turbine developments is included within Section 4.3.4 of Technical Appendix 16.2.

Table 16.10: Requirement for Limit Apportionment

| <i>Receptor</i> | <i>Are predicted wind turbine noise levels within 10dB of Total ETSU-R-97 Noise Limit?</i> | <i>Is it necessary to apportion Noise Limits?</i> |
|--------------------------|--|---|
| NAL1- Lower Hollingarh | NO | NO |
| NAL2- Whirliegarth | NO | NO |
| NAL3- Easterlee | YES | YES |
| NAL4 - Gentletown | YES | YES |
| NAL5 - Littlester | YES | YES |
| NAL6 - Hamnavoe | YES | YES |
| NAL7 - Helnaquhida | YES | YES |
| NAL8 - Kettlester | YES | YES |
| NAL9 - Islesview | YES | YES |
| NAL10 - Westerlee | YES | YES |
| NAL11 - Kletterlea | YES | YES |
| NAL12 - The School House | YES | YES |
| NAL13 – Cluness Cottage | YES | YES |
| NAL14 - Staneygarth | YES | YES |
| NAL15 - Giggleswick | YES | YES |

- 16.5.78 As summarised in Table 16.10 above, apportionment is required at 13 receptors in order to allow the Consented Development and the other small wind turbine developments co-exist to within the Total ETSU-R-97 Noise Limits.

16.5.79 The Consented Development specific Noise Limits are compared to the predictions of the Consented Development operating on its own and the results are summarised in Table 16.11 and 16.12 below.

16.5.80 Tables 16.11 and 16.12 detail the Site Specific Noise Limits and predicted wind turbine noise levels for ETSU-R-97 quiet daytime hours and ETSU-R-97 night-time hours. These have been updated for NAL-2 Whirliegarth to reflect the findings of the FEI (Appendix 1.2) having considered an additional single turbine at Gassabrough. The tables also show the exceedance level which is the difference between the predicted turbine noise level and noise criterion at a given wind speed. A negative exceedance level indicates satisfaction of the noise criteria. The Site Specific Noise Limits and predictions are also shown on Figures A1.5a-A1.5m.

Table 16.11: Compliance Table - Site specific noise limits - Quiet Daytime

| Location | | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | |
|--------------------------|--|--|------|------|-------|------|------|------|------|-------------|-------------|-------------|-------------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 - Lower Hollingarth | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40.1 | 41.8 | 42.6 | 42.6 | 42.6 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 27.3 | 30.9 | 34.7 | 36.1 | 36.2 | 36.2 | 36.2 | 36.2 | 36.2 |
| | Exceedance level L_{A90} | - | - | - | -12.7 | -9.1 | -5.3 | -3.9 | -3.9 | -5.6 | -6.4 | -6.4 | -6.4 |
| NAL2 - Whirliegarth | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | <u>40.4</u> | <u>42.7</u> | <u>42.7</u> | <u>42.7</u> |
| | Predicted wind turbine noise L_{A90} | - | - | - | 30.5 | 34.1 | 37.8 | 39.2 | 39.4 | 39.4 | 39.4 | 39.4 | 39.4 |
| | Exceedance level L_{A90} | - | - | - | -9.5 | -5.9 | -2.2 | -0.8 | -0.6 | <u>-1</u> | <u>-3.3</u> | <u>-3.3</u> | <u>-3.3</u> |
| NAL3 - Easterlee | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 39.9 | 39.9 | 39.8 | 39.7 | 42.1 | 44.3 | 46.4 | 46.4 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 30.3 | 33.9 | 37.6 | 39.1 | 39.2 | 39.2 | 39.2 | 39.2 | 39.2 |
| | Exceedance level L_{A90} | - | - | - | -9.7 | -6 | -2.3 | -0.7 | -0.5 | -2.9 | -5.1 | -7.2 | -7.2 |
| NAL4 - Gentletown | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 39.9 | 39.9 | 39.8 | 41.6 | 44.4 | 46.6 | 47.8 | 47.8 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 27.5 | 31.1 | 34.8 | 36.2 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 |
| | Exceedance level L_{A90} | - | - | - | -12.5 | -8.8 | -5.1 | -3.6 | -5.2 | -8 | -10.2 | -11.4 | -11.4 |
| NAL5 - Littlester | Site specific noise limit : ETSU-R-97 | 39.9 | 39.9 | 39.9 | 39.9 | 39.7 | 39.6 | 40.7 | 44 | 46.8 | 49.2 | 50.9 | 50.9 |

Table 16.11: Compliance Table - Site specific noise limits - Quiet Daytime

| Location | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | | |
|--------------------|--|------|------|------|-------|-------|------|------|------|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| | Predicted wind turbine noise L_{A90} | - | - | - | 25.8 | 29.5 | 33.2 | 34.6 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 |
| | Exceedance level L_{A90} | - | - | - | -14.1 | -10.2 | -6.4 | -6.1 | -9.3 | -12.1 | -14.5 | -16.2 | -16.2 |
| | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40.1 | 41.8 | 42.6 | 42.6 | 42.6 |
| NAL6 - Hamnavoe | Predicted wind turbine noise L_{A90} | - | - | - | 24.5 | 28.1 | 31.8 | 33.2 | 33.4 | 33.4 | 33.4 | 33.4 | 33.4 |
| | Exceedance level L_{A90} | - | - | - | -15.5 | -11.9 | -8.2 | -6.8 | -6.7 | -8.4 | -9.2 | -9.2 | -9.2 |
| | Site specific noise limit : ETSU-R-97 | 39.9 | 39.9 | 39.9 | 39.9 | 39.8 | 39.7 | 39.5 | 39.2 | 41.6 | 43.8 | 45.9 | 45.9 |
| NAL7 - Helnaquhida | Predicted wind turbine noise L_{A90} | - | - | - | 26.6 | 30.2 | 34 | 35.4 | 35.5 | 35.5 | 35.5 | 35.5 | 35.5 |
| | Exceedance level L_{A90} | - | - | - | -13.3 | -9.6 | -5.7 | -4.1 | -3.7 | -6.1 | -8.3 | -10.4 | -10.4 |
| | Site specific noise limit : ETSU-R-97 | 39.9 | 39.9 | 39.9 | 39.9 | 39.8 | 39.7 | 39.5 | 39.2 | 41.6 | 43.8 | 45.9 | 45.9 |
| NAL8 - Kettleston | Predicted wind turbine noise L_{A90} | - | - | - | 26.4 | 30 | 33.7 | 35.1 | 35.3 | 35.3 | 35.3 | 35.3 | 35.3 |
| | Exceedance level L_{A90} | - | - | - | -13.5 | -9.8 | -6 | -4.4 | -3.9 | -6.3 | -8.5 | -10.6 | -10.6 |
| | Site specific noise limit : ETSU-R-97 | 39.9 | 39.9 | 39.9 | 39.9 | 39.9 | 39.9 | 39.8 | 39.6 | 42 | 44.2 | 46.3 | 46.3 |
| NAL9 - Isleview | Predicted wind turbine noise L_{A90} | - | - | - | 28.7 | 32.3 | 36 | 37.4 | 37.6 | 37.6 | 37.6 | 37.6 | 37.6 |
| | Exceedance level L_{A90} | - | - | - | -11.2 | -7.6 | -3.9 | -2.4 | -2 | -4.4 | -6.6 | -8.7 | -8.7 |
| | Site specific noise limit : ETSU-R-97 | 39.9 | 39.9 | 39.9 | 39.9 | 39.9 | 39.8 | 39.6 | 39.3 | 41.8 | 44 | 46 | 46 |
| NAL10 - Westerlee | Predicted wind turbine noise L_{A90} | - | - | - | 27.7 | 31.3 | 35 | 36.4 | 36.6 | 36.6 | 36.6 | 36.6 | 36.6 |
| | Exceedance level L_{A90} | - | - | - | -12.2 | -8.6 | -4.8 | -3.2 | -2.7 | -5.2 | -7.4 | -9.4 | -9.4 |
| | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 40 | 40 | 41.3 | 43.2 | 45.3 | 47.8 | 49.2 | 49.2 |
| NAL11 - Kletterlea | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 40 | 40 | 41.3 | 43.2 | 45.3 | 47.8 | 49.2 | 49.2 |

Table 16.11: Compliance Table - Site specific noise limits - Quiet Daytime

| Location | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | | |
|--------------------------|--|------|------|------|-------|-------|------|------|-------|-------|-------|-------|-------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| | Predicted wind turbine noise L_{A90} | - | - | - | 26.5 | 30.2 | 33.9 | 35.3 | 35.4 | 35.4 | 35.4 | 35.4 | 35.4 |
| | Exceedance level L_{A90} | - | - | - | -13.5 | -9.8 | -6.1 | -6 | -7.8 | -9.9 | -12.4 | -13.8 | -13.8 |
| | Site specific noise limit : ETSU-R-97 | 39.8 | 39.8 | 39.8 | 39.8 | 39.7 | 39.5 | 40.7 | 43.9 | 46.8 | 49.2 | 50.8 | 50.8 |
| NAL12 – The School House | Predicted wind turbine noise L_{A90} | - | - | - | 23.7 | 27.3 | 31.1 | 32.5 | 32.6 | 32.6 | 32.6 | 32.6 | 32.6 |
| | Exceedance level L_{A90} | - | - | - | -16.1 | -12.4 | -8.4 | -8.2 | -11.3 | -14.2 | -16.6 | -18.2 | -18.2 |
| | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 35 | 35 | 36.7 | 36.7 |
| NAL13 - Cluness Cottage | Predicted wind turbine noise L_{A90} | - | - | - | 25.6 | 29.2 | 32.9 | 34.3 | 34.5 | 34.5 | 34.5 | 34.5 | 34.5 |
| | Exceedance level L_{A90} | - | - | - | -14.4 | -10.8 | -7.1 | -5.7 | -5.5 | -0.5 | -0.5 | -2.2 | -2.2 |
| | Site specific noise limit : ETSU-R-97 | 39.8 | 39.8 | 39.8 | 39.8 | 39.6 | 39.3 | 38.7 | 37.7 | 40.2 | 42.5 | 44.5 | 44.5 |
| NAL14 - Stoneygarth | Predicted wind turbine noise L_{A90} | - | - | - | 25.2 | 28.9 | 32.6 | 34 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 |
| | Exceedance level L_{A90} | - | - | - | -14.6 | -10.7 | -6.7 | -4.7 | -3.6 | -6.1 | -8.4 | -10.4 | -10.4 |
| | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 41.8 | 42.7 | 44.1 | 44.1 | 44.1 |
| NAL15 - Giggleswick | Predicted wind turbine noise L_{A90} | - | - | - | 25.4 | 29 | 32.7 | 34.2 | 34.3 | 34.3 | 34.3 | 34.3 | 34.3 |
| | Exceedance level L_{A90} | - | - | - | -14.6 | -11 | -7.3 | -5.8 | -7.5 | -8.4 | -9.8 | -9.8 | -9.8 |
| | Site specific noise limit : ETSU-R-97 | 40 | 40 | 40 | 40 | 40 | 40 | 40 | 41.8 | 42.7 | 44.1 | 44.1 | 44.1 |

Table 16.12: ETSU-R-97 Compliance Table - Site specific noise limits - Night time

| Location | | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | |
|--------------------------|--|--|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL1 - Lower Hollingarth | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.1 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 27.3 | 30.9 | 34.7 | 36.1 | 36.2 | 36.2 | 36.2 | 36.2 | 36.2 |
| | Exceedance level L_{A90} | - | - | - | -15.7 | -12.1 | -8.3 | -6.9 | -6.8 | -6.8 | -6.8 | -6.8 | -7.9 |
| NAL2 - Whirliegarth | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43.7 | 43.7 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 30.5 | 34.1 | 37.8 | 39.2 | 39.4 | 39.4 | 39.4 | 39.4 | 39.4 |
| | Exceedance level L_{A90} | - | - | - | -12.5 | -8.9 | -5.2 | -3.8 | -3.6 | -3.6 | -3.6 | -4.3 | -4.3 |
| NAL3 - Easterlee | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 43 | 43 | 42.9 | 42.9 | 42.8 | 42.6 | 44.7 | 44.7 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 30.3 | 33.9 | 37.6 | 39.1 | 39.2 | 39.2 | 39.2 | 39.2 | 39.2 |
| | Exceedance level L_{A90} | - | - | - | -12.7 | -9.1 | -5.4 | -3.8 | -3.7 | -3.6 | -3.4 | -5.5 | -5.5 |
| NAL4 - Gentletown | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 43 | 42.9 | 42.9 | 42.9 | 42.7 | 43.7 | 45.7 | 45.7 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 27.5 | 31.1 | 34.8 | 36.2 | 36.4 | 36.4 | 36.4 | 36.4 | 36.4 |
| | Exceedance level L_{A90} | - | - | - | -15.5 | -11.9 | -8.1 | -6.7 | -6.5 | -6.3 | -7.3 | -9.3 | -9.3 |
| NAL5 - Littlester | Site specific noise limit : ETSU-R-97 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.8 | 42.6 | 42.4 | 43.7 | 46.6 | 49.2 | 51.4 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 25.8 | 29.5 | 33.2 | 34.6 | 34.7 | 34.7 | 34.7 | 34.7 | 34.7 |
| | Exceedance level L_{A90} | - | - | - | -17.1 | -13.4 | -9.6 | -8 | -7.7 | -9 | -11.9 | -14.5 | -16.7 |
| NAL6 - Hamnavoe | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 44.1 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 24.5 | 28.1 | 31.8 | 33.2 | 33.4 | 33.4 | 33.4 | 33.4 | 33.4 |
| | Exceedance level L_{A90} | - | - | - | -18.5 | -14.9 | -11.2 | -9.8 | -9.6 | -9.6 | -9.6 | -9.6 | -10.7 |

Table 16.12: ETSU-R-97 Compliance Table - Site specific noise limits - Night time

| Location | | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | |
|---------------------|--|--|----------|----------|----------|----------|----------|----------|----------|----------|-----------|-----------|-----------|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| NAL7 - Helnaquinida | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 42.9 | 42.9 | 42.8 | 42.6 | 42.3 | 41.8 | 43.9 | 43.9 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 26.6 | 30.2 | 34 | 35.4 | 35.5 | 35.5 | 35.5 | 35.5 | 35.5 |
| | Exceedance level L_{A90} | - | - | - | -16.4 | -12.7 | -8.9 | -7.4 | -7.1 | -6.8 | -6.3 | -8.4 | -8.4 |
| NAL8 - Kettlester | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 42.9 | 42.9 | 42.8 | 42.6 | 42.3 | 41.8 | 43.9 | 43.9 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 26.4 | 30 | 33.7 | 35.1 | 35.3 | 35.3 | 35.3 | 35.3 | 35.3 |
| | Exceedance level L_{A90} | - | - | - | -16.6 | -12.9 | -9.2 | -7.7 | -7.3 | -7 | -6.5 | -8.6 | -8.6 |
| NAL9 - Isleview | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 43 | 42.9 | 42.9 | 42.8 | 42.6 | 42.4 | 44.5 | 44.5 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 28.7 | 32.3 | 36 | 37.4 | 37.6 | 37.6 | 37.6 | 37.6 | 37.6 |
| | Exceedance level L_{A90} | - | - | - | -14.3 | -10.7 | -6.9 | -5.5 | -5.2 | -5 | -4.8 | -6.9 | -6.9 |
| NAL10 - Westertee | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 42.9 | 42.9 | 42.8 | 42.7 | 42.5 | 42 | 44.1 | 44.1 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 27.7 | 31.3 | 35 | 36.4 | 36.6 | 36.6 | 36.6 | 36.6 | 36.6 |
| | Exceedance level L_{A90} | - | - | - | -15.3 | -11.6 | -7.9 | -6.4 | -6.1 | -5.9 | -5.4 | -7.5 | -7.5 |
| NAL11 - Klettertea | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 41.1 | 43.6 | 46.3 | 50 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 26.5 | 30.2 | 33.9 | 35.3 | 35.4 | 35.4 | 35.4 | 35.4 | 35.4 |
| | Exceedance level L_{A90} | - | - | - | -16.5 | -12.8 | -9.1 | -7.7 | -7.6 | -5.7 | -8.2 | -10.9 | -14.6 |
| NAL12 - The School | Site specific noise limit : ETSU-R-97 | 42.9 | 42.9 | 42.9 | 42.9 | 42.9 | 42.8 | 42.6 | 42.3 | 43.7 | 46.6 | 49.1 | 51.4 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 23.7 | 27.3 | 31.1 | 32.5 | 32.6 | 32.6 | 32.6 | 32.6 | 32.6 |
| | Exceedance level L_{A90} | - | - | - | -19.2 | -15.6 | -11.7 | -10.1 | -9.7 | -11.1 | -14 | -16.5 | -18.8 |

Table 16.12: ETSU-R-97 Compliance Table - Site specific noise limits - Night time

| Location | Wind Speed (ms^{-1}) as standardised to 10m height | | | | | | | | | | | | |
|-------------------------|--|------|------|------|-------|-------|-------|------|------|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
| NAL13 - Cluness Cottage | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 41 | 36.7 | 40.3 | 42.4 | 42.4 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 25.6 | 29.2 | 32.9 | 34.3 | 34.5 | 34.5 | 34.5 | 34.5 | 34.5 |
| | Exceedance level L_{A90} | - | - | - | -17.4 | -13.8 | -10.1 | -8.7 | -6.5 | -2.2 | -5.8 | -7.9 | -7.9 |
| NAL14 - Staneygarth | Site specific noise limit : ETSU-R-97 | 42.9 | 42.9 | 42.9 | 42.9 | 42.8 | 42.7 | 42.4 | 42 | 41.2 | 39.4 | 41.4 | 41.4 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 25.2 | 28.9 | 32.6 | 34 | 34.1 | 34.1 | 34.1 | 34.1 | 34.1 |
| | Exceedance level L_{A90} | - | - | - | -17.7 | -13.9 | -10.1 | -8.4 | -7.9 | -7.1 | -5.3 | -7.3 | -7.3 |
| NAL15 - Giggleswick | Site specific noise limit : ETSU-R-97 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 43 | 42.7 | 39.7 | 36.1 | 36.1 |
| | Predicted wind turbine noise L_{A90} | - | - | - | 25.4 | 29 | 32.7 | 34.2 | 34.3 | 34.3 | 34.3 | 34.3 | 34.3 |
| | Exceedance level L_{A90} | - | - | - | -17.6 | -14 | -10.3 | -8.8 | -8.7 | -8.4 | -5.4 | -1.8 | -1.8 |

16.6 Mitigation measures

Construction and decommissioning noise

16.6.81 Construction noise effects are not considered significant and as such no additional or bespoke construction noise mitigation is required to make the development acceptable. The assessment is based on a worst-case scenario, as a detailed construction programme is not available. In line with good construction practice, good site practices can be implemented to minimise the potential effects. Although not required, Section 8 of BS 5228-1: 2009+A1:2014 recommends a number of simple control measures as summarised below which will be implemented.

16.6.82 Generally, proposed construction activities would be confined to the periods 07:00 - 19:00 weekdays and Saturdays 07:00 - 18:00. However, there may be the requirement for extended operating hours to minimise traffic disruptions during the movement of abnormal loads and during large concrete pours and also during the lifting of the turbine rotors. The principal contractor would (see also Chapter 3 and Appendix 3.6):

- Keep local residents informed of the proposed working schedule, where appropriate, including the times and duration of any abnormally noisy activity that may cause concern;

- Ensure site work continuing throughout 24 hours of a day shall be programmed, when appropriate, so that haulage vehicles will not arrive at or leave the site between 19.00 and 07.00 hours, with the exception of abnormal loads that will be scheduled to avoid significant traffic flows;
- Ensure all vehicles and mechanical plant will be fitted with effective exhaust silencers and 'smart' reversing alarms and be subject to programmed maintenance;
- Select inherently quiet plant where appropriate and feasible - major compressors should be 'sound reduced' models fitted, where appropriate and feasible, with properly lined and sealed acoustic covers, which will be kept closed whenever the machines are in use;
- Review the options to utilise close temporary boarded fencing as acoustic screens whenever works are in close proximity to dwellings;
- Ensure all ancillary pneumatic percussive tools will be fitted with mufflers or silencers of the type recommended by the manufacturers;
- Instruct that machines will be shut down between work periods or throttled down to a minimum;
- Ensure regular maintenance of all equipment used on Site, including maintenance related to noise emissions;
- Ensure that vehicles are loaded carefully to ensure minimal drop heights so as to minimise noise during this operation; and
- Ensure all ancillary plant such as generators and pumps will be positioned so as to cause minimum noise disturbance and if necessary, temporary acoustic screens or enclosures should be provided.

Operational noise

- 16.6.83 As is discussed in detail in Chapter 5, throughout the Site design process the layout of the Consented Development was iteratively reviewed to optimise turbine numbers and locations, subject to a wide range of constraints identified during the design process, including noise, landscape and ecology. The Site design process therefore satisfactorily minimised any increase in ambient noise levels at two levels: firstly through several iterations of site specific design (embedded mitigation) and secondly, at a higher level, through the use of ETSU-R-97 itself.
- 16.6.84 It should be noted that the Consented Development will be required to comply with the Site Specific Noise Limits regardless of any micro-siting requirements.

Assessment of Impacts

- 16.6.85 As the operational noise effects from the Consented Development have been determined as not significant, no further mitigation is proposed.

16.7 Residual effects

- 16.7.86 Predicted wind farm construction noise levels are below the assessment criteria at all receptors, for all construction phases. Due to the low background noise levels construction noise is likely to be audible at the closest residential receptors for certain periods during the construction phase. However, with or without the construction mitigation measures outlined above in Construction and Decommissioning noise, there will be no significant residual effects.

- 16.7.87 Predicted wind farm operational noise levels at all the noise assessment locations lie below the site specific ETSU-R-97 quiet daytime and night-time criterion curves. In addition the cumulative noise predictions from the Consented Development and other operational single wind turbine developments lie below the Total ETSU-R-97 Noise Limits. There would be no significant residual effects.
- 16.7.88 At some locations, under some wind conditions and for a certain proportion of the time wind farm noise will be audible; however, it would be at an acceptable level in relation to the ETSU-R-97 guidelines. There would be no significant residual effects.

16.8 Monitoring

- 16.8.89 No routine monitoring is proposed. A set of suggested Planning Conditions has been included within Appendix 22.1 and these were then amended slightly through the FEI process (see Appendix 1.2) taking account of an additional individual turbine at Gossabrough. These provide a mechanism for the Council to request a compliance monitoring survey in the event of a complaint.

16.9 Summary and conclusions

- 16.9.90 This chapter contains an assessment of the likely significant noise effects from the construction, operational and decommissioning phases of the Consented Development.
- 16.9.91 Predicted construction and decommissioning noise levels compared with the criteria outlined in BS5228: Part 1 2009+A1:2014 indicate the predicted construction and decommissioning noise levels are below the assessment criteria at all receptors and would not result in a significant effect.
- 16.9.92 Predicted operational noise levels and measured background noise levels indicate that for noise sensitive receptors neighbouring the Consented Development, wind turbine noise would meet the noise criteria derived in accordance with ETSU-R-97 and would not result in a significant effect. At some locations, under some wind conditions and for a certain proportion of the time wind farm noise will be audible; however, it would be at an acceptable level in relation to the ETSU-R-97 guidelines.
- 16.9.93 TNEI understands that the small wind turbine located in close proximity to Cluness Cottage (T20) may be removed, therefore for the purposes of this assessment, modelling has been undertaken with and without that turbine. The calculations included within this chapter assume that the turbine at Cluness Cottage is operational, however an updated alternative set of noise limits and predictions have been presented within Annex 9 of Technical Appendix 16.2 which would apply if the turbine is removed. Regardless of which scenario ultimately occurs, operational noise from the Consented Development would itself not cause any significant effects.
- 16.9.94 As the construction, operational and decommissioning noise effects have been determined as not significant, no further mitigation is proposed.