8 Noise

Contents

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8 Noise and Vibration

8.1 Introduction

8.1.1 This chapter provides an assessment of the potential effects of the Proposed Development on receptors sensitive to noise and vibration.

Scope of Assessment

8.1.2 The scope of this assessment has comprised the following:

- consultation with Shetland Islands Council (SIC);
- characterisation of baseline noise environment;
- evaluation of noise effects associated with the Proposed Development (in isolation and cumulatively with other wind farm developments);
- specification of appropriate mitigation, where necessary; and
- evaluation of residual effects.

8.1.3 This chapter is complemented by **Appendix 8.1** which contains a glossary of terminology.

8.2 Legislation, Policy and Guidelines

Legislation

8.2.1 For a development of this nature, there is no specific all-encompassing legislation relating to the standards associated with noise emission/effects. Most noise legislation applicable in Scotland is either EU-derived and focussed on specific noise-emitting plant. There are also legislative provisions which relate to noise nuisance, such as those addressed by the provisions of the Environmental Protection Act 1990 (UK Government, 1990).

8.2.2 Assessment of the effects of noise emissions from the Proposed Development which may arise during the construction, operational and decommissioning phases is carried out using information derived from a variety of sources including statutory and industry-specific guidance. Therefore, this chapter of the EIA Report makes reference to a number of British Standards, official planning advice notes and national guidance which are relevant to assessment of and restrictions on noise emissions from the Proposed Development.

Planning Policy

National Planning Guidance

Planning Advice Note PAN1/2011: Planning and Noise

8.2.3 Published in March 2011, the Planning Advice Note PAN1/2011: Planning for Noise (Scottish Government, 2011a) document provides advice on the role of the planning system in helping to prevent and limit adverse effects of noise. Information and advice on noise assessment methods are provided in the accompanying Technical Advice Note (TAN) (Scottish Government, 2011b): Assessment of Noise. Included within the PAN1 document and the accompanying TAN are details of the legislation, technical standards and codes of practice for specific noise issues.

8.2.4 With regards to noise from wind turbines, paragraph 29 of PAN 1/2011 states the following:

"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 'ETSU-R-97 The Assessment and Rating of Noise from Wind Farms' (The Working Group on Noise from Wind Turbines, 1996) 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."

8.2.5 With regards to appropriate assessment methods, the 'web-based planning advice' referred to in PAN 1/2011 is contained in an online document entitled 'Onshore wind turbines', published by the Scottish Government (Scottish Government, 2014a). The document is summarised in the corresponding section below, and also refers to the use of ETSU-R-97 (The Working Group on Noise from Wind Turbines, 1996) assessment guidance (discussed in paragraphs 8.2.14 to 8.2.26).

8.2.6 The accompanying TAN to PAN 1/2011 also refers to ETSU-R-97, including a summary of the associated assessment approach. The TAN points out that the ETSU-R-97 report presents a consensus view of a group of experts, who between them have a breadth and depth of experience in assessing and controlling the environmental impact of noise from wind farms.

8.2.7 With regards to the assessment and control of noise and vibration from construction sites, the British Standard on Noise BS 5228: 2009 (Parts 1 and 2) is used in this chapter in relation to the assessment of noise and vibration during construction. Parts 1 and 2 of BS 5228 have been superseded by BS 5228-1:2009+A1:2014: Code of practice for noise and vibration control on construction and open sites - Noise (BSi, 2009/2014) and BS 5228-2:2009+A1:2014: Code of practice for noise and vibration control on construction and open sites – Vibration (BSi, 2009/2014). These standards are summarised in paragraphs 8.2.46 to 8.2.52.

8.2.8 Neither PAN 1/2011 nor the associated TAN provide specific guidance on the assessment of noise from fixed plant, but the TAN includes an example assessment scenario for 'New noisy development (incl. commercial and recreation) affecting a noise sensitive building', which is based on BS4142:1997: Method for rating industrial noise affecting mixed residential and industrial areas (BSi, 1997). This British Standard has been superseded by BS4142:2014: Methods for rating and assessing industrial and commercial sound (BSi, 2014).

Scottish Government Online Planning Advice: Onshore Wind Turbines

8.2.9 Published in May 2014 (Scottish Government, 2014a), this online resource supersedes the former Planning Advice Note PAN 45: Renewable Energy (Scottish Government, 2008) and states the following with respect to noise and vibration:

"The Report, "The Assessment and Rating of Noise from Wind Farms" (The Working Group on Noise from Wind Turbines, 1996) describes a framework for the measurement of wind farm noise, which should be followed by applicants and consultees, and used by planning authorities to assess and rate noise from wind energy developments, until such time as an update is available. This gives indicative noise levels thought to offer a reasonable degree of protection to wind farm neighbours, without placing unreasonable burdens on wind farm developers, and suggests appropriate noise conditions.

On April 6, 2011, a further report produced by Hayes McKenzie for DECC entitled "An Analysis of How Noise Impacts are Considered in the Determination of Wind Farm Planning Applications" (Hayes McKenzie, 2011) suggested that best practice guidance is required to confirm and, where necessary, clarify and add to the way ETSU-R-97 should be implemented in practice. (A previous report in 2006 by the same authors concluded that there is no evidence of health effects arising from infrasound or low frequency noise generated by the wind turbines that were tested).

The Salford University report into Aerodynamic Modulation of Wind Turbine Noise (University of Salford Manchester, 2007) summarised the conclusions of the Hayes McKenzie report and investigated further complaints caused by amplitude modulation of aerodynamic noise (AM). Report findings were constrained by the low incidence of AM and the low numbers of people adversely affected in the UK.

The Institute of Acoustics (IOA) has since published Good Practice Guide to the Application of ETSU-R-97 (IOA, 2013) for the Assessment and Rating of Wind Turbine Noise. The document provides significant support on technical issues to all users of the ETSU-R-97 method for rating and assessing wind turbine noise, and should be used by all IOA members and those undertaking assessments to

ETSU-R-97. The Scottish Government accepts that the guide represents current industry good practice.

Further research by AECOM entitled 'NANR 277 - Wind Farm Noise: Statutory Nuisance Complaints Methodology' (AECOM, 2011) is aimed at helping Local Authorities deal with wind farm noise complaints, using statutory nuisance powers.

PAN1/2011 on Planning and Noise (Scottish Government, 2011a) provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise. The associated Technical Advice Note provides guidance which may assist in the technical evaluation of noise assessment."

Regional Planning Guidance

8.2.10 There is no regional planning guidance relevant for noise and vibration.

Local Planning Guidance

8.2.11 The Shetland Local Development Plan (LDP) was adopted by Shetland Islands Council (the "**Council**") on 26th September 2014 (SIC, 2014) and is the applicable development plan for the area in which the Proposed Development is located.

8.2.12 The LDP notes that all applications for proposed wind energy applications must include a noise impact assessment.

Guidance

8.2.13 Recognisance has been taken of the following best practice guidelines/guidance.

ETSU-R-97: The Assessment and Rating of Noise from Windfarms

8.2.14 As referenced for use in PAN1/2011 (Scottish Government, 2011a) and the online planning advice for renewable technologies: Onshore wind turbines (Scottish Government, 2014a), this document was written by a Noise Working Group including developers, noise consultants and environmental health officers, set up in 1995 by the Department of Trade and Industry through ETSU (the Energy Technology Support Unit) (The Working Group on Noise from Wind Turbines, 1996).

8.2.15 ETSU presents a consensus view of the working group and the ETSU-R-97 guidance was prepared to present a common approach to the assessment of noise from wind turbines. The document states that noise from wind turbines or wind farms should be assessed against site specific noise limits.

8.2.16 Noise limits are derived based on a series of acceptable lower limits, and based on an allowable exceedance above the prevailing background noise level, including consideration of a variety of different prevailing wind speed conditions. The noise limits should be derived for external areas used for relaxation, or areas where a quiet noise environment is highly desirable. Separate limits are required for night-time and daytime periods. Night-time limits are derived drawing upon measured night-time background noise levels, whilst daytime limits are derived drawing upon the background noise levels arising during 'quiet daytime' periods.

8.2.17 Night-time is defined as the period between 23:00 and 07:00 hours, whilst quiet daytime periods are defined as 18:00 to 23:00 hours on all days, as well as 13:00 to 18:00 hours on Saturdays and Sundays, and 07:00 to 13:00 hours on Sundays.

8.2.18 For the daytime, the suggested limits applicable to wind turbine noise are 5 decibels (dB) above the prevailing background noise level determined during quiet daytime periods, or 35 to 40 dB(A), whichever is the higher. The absolute criterion between the 35 to 40 dB(A) range is selected taking account of the site environs (e.g. number of local receptors), the energy generation capacity (e.g. number of kWh that can be generated) of the proposed development, and the associated duration and level of exposure.

8.2.19 During the night-time period, the suggested limits are 5 dB above the prevailing night-time background noise level or 43 dB(A), whichever is the higher. The absolute criterion for the night-time is higher than that for the daytime, as the derivation of this limit is based on preventing sleep

disturbance within a building whereas for the daytime, limits are based on occupation of external spaces used for relaxation.

8.2.20 It is required that the prevailing background noise levels be determined in terms of the $L_{A90,10min}$ noise index for both quiet daytime and night-time periods, for wind conditions ranging from 2 ms^{-1} to 12 ms^{-1}.

8.2.21 The noise limits are calculated by undertaking a regression analysis of the $L_{A90,10min}$ noise levels and the prevailing average wind speed for the same 10 minute period, when measured or determined at 10m above ground at the location of the proposed turbines. The allowable limit is then defined at +5 dB above the average noise level at each wind speed (as defined by the regression analysis), or the absolute noise level lower limit, whichever is the higher (assuming no financial involvement within the scheme).

8.2.22 Where a property has a financial involvement in the scheme, the document allows a relaxation of the derived noise limits, stating that '*It is widely accepted that the level of disturbance or annoyance caused by a noise source is not only dependent upon the level and character of noise but also the receiver's attitude towards the noise source in general. If the residents at the noise-sensitive properties were financially involved in the project then higher noise limits will be appropriate*'. The guidance goes on to state that it is '*recommended that both the day and night-time lower fixed limits can be increased to 45 dB(A) and the consideration should be given to increasing the permissible margin above background where the occupier of the property has some financial involvement in the windfarm*'. The amount by which the permissible margin above background can be relaxed is not specified, but the allowable relaxation to 45 dB(A) of the lower limits is an increase of (at least) 5dB during the daytime and 2dB during the night-time, so similar levels of relaxation might also be applied to background related element of the noise level limits.

8.2.23 The ETSU R-97 guidance states that the derived limits should be applied to noise from the proposed wind farm or turbines in terms of the $L_{A90,T}$ index, and that the $L_{A90,T}$ of the wind farm noise is typically 1.5 to 2.5 dB less than the $L_{Aeq,T}$ measured over the same period.

8.2.24 The derived noise limits are applicable to both the aerodynamic (e.g. 'blade swish') and mechanical (e.g. generator related) components of wind farm noise.

8.2.25 Where noise from the wind farm, is tonal, a correction of between 2 and 5 dB is to be applied to the wind farm noise. Guidance is provided on how to determine the level of correction required, but typically, for proposed developments, the need for any applicable correction is confirmed by the turbine manufacturers.

8.2.26 It is stated within the ETSU R-97 guidance that '*The Noise Working Group is of the opinion that absolute noise limits and margins above background should relate to the cumulative effect of all wind turbines in the area which contribute to the noise received at the properties in question. It is clearly unreasonable to suggest that, because a windfarm was constructed in the vicinity in the past which resulted in increased noise levels at some properties, that residents of those properties are now able to tolerate still higher noise levels. The existing windfarm should not be considered as part of the prevailing background noise*'. Accordingly, where an existing wind farm contributes to the prevailing background noise levels, it is necessary to either include for the contribution of this wind farm when comparing against the allowable noise limit, or correct for this contribution when deriving a limit applicable to the Proposed Development acting alone.

Good Practice Guide to the Application of ETSU-R-97

8.2.27 The Institute of Acoustics Good Practice Guide (IOA GPG) (IOA, 2013) presents the report of a 'noise working group' (NWG) assembled in response to a request from the Department of Energy & Climate Change (DECC). The guide is intended to represent current good practice in applying the ETSU R-97 method to assessing the noise impact of wind turbine developments with a power rating of over 50kW.

8.2.28 In addition to detailed consideration of various issues and factors concerned with current 'state of the art' knowledge of UK wind turbine noise assessment, a series of 'summary boxes' (SBs) highlighting key guidance points are included.

8.2.29 The SBs provide clarification and updated guidance on a range of matters relating to ETSU R-97 noise assessments, including consultation with relevant stakeholders, background noise survey methodology, noise survey data analysis, derivation of noise limits, noise prediction model input data, algorithms and parameters, cumulative impact assessment procedures, assessment reporting, planning conditions and amplitude modulation. A set of supplementary guidance notes (SGNs) also form part of the publication and include further specific detail for different technical areas.

8.2.30 The detail of the IOA GPG has been considered in the preparation of this assessment. Some of the key considerations relevant to this assessment are summarised as follows:

- Background noise surveys should be carried out for sufficient duration to obtain a suitably-sized data set; as a guideline, it is suggested that no less than 200 data points be obtained within each of the night-time and amenity hour periods for a given survey location, with no less than five data points within each contiguous wind speed integer interval. Where the data have been filtered by wind direction the guideline values are reduced.
- Background noise survey data should be analysed and anomalous periods of noise removed from the dataset; anomalous noise might include rain-affected periods and increased noise from water courses following rainfall, seasonal effects such as early-morning birdsong ('dawn chorus'), atypical traffic movements and other unusual noise sources affecting measured levels.
- Due to the potential for non-standard site-specific wind shear (i.e. differences in wind speed at different heights above the ground – a 'standard' profile increases logarithmically with height) background noise levels should be correlated with 10m height wind speeds derived using a method that 'standardises' the wind speeds using the assumed shear profile. Since wind turbine sound power levels are determined using the same shear profile, this procedure ensures a link between the predicted sound levels at a given hub height wind speed and the background noise levels at receptors near the ground under the same wind speed conditions (obtained using the 'standardised' 10 m height wind speed).
- Derivation of the prevailing background noise levels should be carried out using polynomial regression analysis, of order one to four, depending on the nature of the noise environment. The regression curve used should reach minimum and maximum values at the lowest and highest wind speeds for which the dataset is valid, respectively.
- Calculations of predicted wind turbine noise may be carried out using ISO 9613-2: Acoustics – Attenuation of Sound during Propagation Outdoors (ISO, 1996) preferred receptor heights, meteorological and ground absorption input parameters for this calculation procedure are given.
- Turbine sound power level source data should include appropriate uncertainty corrections. Guidance is given for determining when such uncertainty corrections have been inherently included in turbine source emission data.
- 'Excess amplitude modulation' (i.e. where the wind turbine noise has higher variability with momentary time than the 2 – 3 dB(A) considered within ETSU-R-97) is still the subject of research; current practice (at the time of publishing of the IOA GPG) in relation to determining applications for wind turbine developments is to not impose a planning condition specific to this phenomenon.

8.2.31 In addition to the above, the IOA GPG confirms that the ETSU-R-97 noise level limits should be applied cumulatively, and provides guidance on appropriate assessment methods for a variety of different cumulative scenarios. These scenarios include 'concurrent applications', 'existing wind farm consented with less than total ETSU-R-97 limits', 'existing wind farm/s consented to the total ETSU-R-97 limits currently operating', and 'permitted wind farm consented to total ETSU-R-97 limits but not yet constructed'.

8.2.32 This guidance is of particular relevance in the assessment of noise from the Proposed Development because it is proposed in the vicinity of a number of other wind farm developments which are either operational or proposed.

8.2.33 In the section entitled 'existing windfarm/s, consented to the total ETSU-R-97 limits, currently operating' it is stated that "*In the first instance, the consented noise limits should be used within the cumulative noise impact calculations unless otherwise agreed with the local authority. Provided the sum of the noise limits derived for the proposed site when added to those already consented for the operational sites does not exceed the limits that would otherwise be within the requirements of ETSU-R-97 for the cumulative impact, then the noise limits derived for the proposed site can be applied directly*".

8.2.34 In practical terms this can be achieved by ensuring that the noise limit for the Proposed Development is set 10 dB or more below that permitted to be generated by the existing developments.

8.2.35 It is however then discussed that this may not always be necessary, e.g. where there is a 'controlling property', whereby compliance with the noise limit at that controlling property would result in noise levels never realising the noise level limit 'in full' at another property (e.g. because the second property is further removed from the existing development), thereby leaving a proportion of the limits available for use at the second property by the subsequently proposed development. Another reason that is discussed is where there is no realistic prospect of the existing wind farm producing noise levels up to the consented limit, again thereby leaving a proportion of the limit available for the subsequently proposed development.

8.2.36 In the section titled 'concurrent applications' it is stated that where there are no pre-existing wind farms, this scenario permits the apportionment of the ETSU-R-97 limits between the concurrent developments, i.e. each of the developments could be subject to noise limits below the full ETSU-R-97 guidance, such that even if the individual limits applied to each development were utilised 'in full', the combined effect would be that the ETSU-R-97 guidance would not be exceeded cumulatively.

BS4142:2014 – Methods for rating and assessing industrial and commercial sound

8.2.37 BS 4142:2014 (BSi, 2014) is applicable for use in the assessment of control building / substation and transformer noise. It sets out a method for rating and assessing sound of an industrial and/or commercial nature, including "sound from fixed installations which comprise mechanical and electrical plant and equipment".

8.2.38 The assessment procedure contained within BS4142:2014 requires that initially the 'rating level' ($L_{Ar,Tr}$) that is (or would be) generated by the source under assessment is determined, externally, at the assessment location. Where this source does not include any acoustic features, such as tonality, impulsivity or intermittency etc., then the rating level ($L_{Ar,Tr}$) equals the specific sound level (Ls), which is the sound pressure level produced by the source using the $L_{Aeq,T}$ noise index. Where the source under assessment does include acoustic characteristics, then a series of corrections are added to the specific sound level to determine the rating level. The degree of correction applied to determine the rating level depends upon the results of either subjective or objective appraisals.

8.2.39 The background sound level at the assessment location, measured using the $L_{A90,T}$ index, is then subtracted from the rating level. The result provides an indication of the magnitude of impact, where the greater the difference, the greater the magnitude of impact.

8.2.40 The following scale is presented:

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact.

- Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

8.2.41 It can be seen from the above that the degree of impact is also dependent upon the context in which the sound arises. Factors that are considered with respect to context include: the absolute level of sound, and the character and level of the residual sound (that in absence of the source under assessment) compared to the character and level of the specific sound.

8.2.42 With regards to the absolute level, it is stated, amongst other points, that "where background sound levels and rating levels are low, absolute levels might be as, or more relevant than the margin by which the rating level exceeds the background. This is especially true at night".

8.2.43 The 1997 version of BS4142 stated that rating levels below 35 dB and background noise levels below 30 dB(A) were considered to be "very low".

BS8233:2014 – Guidance on Sound Insulation and Noise Reduction for Buildings

8.2.44 BS 8233:2014 provides guidance on the control of noise in and around buildings. The Standard sets out acceptable noise levels for new and refurbished buildings and amenity areas according to their use.

8.2.45 The guidance provides a set of superposed noise rating (NR) curves, which vary according to frequency. The NR curves can be used to set limits on noise emissions of static plant, such as fans or transformers.

BS5228:2009+A1:2014 – Code of practice for noise and vibration control on construction and open sites – Part 1 (noise) and Part 2 (vibration)

8.2.46 Part 1 of the standard sets out techniques to predict the likely noise effects from construction works, based on detailed information on the type and number of plant being used, their location and the length of time they are in operation.

8.2.47 The noise prediction methods can be used to establish likely noise levels in terms of the LAeq,T over the core working day during construction. This standard also documents a database of information, including previously measured sound pressure level data for a variety of different construction plant undertaking various common activities.

8.2.48 Three example methods are presented for determining the significance of construction noise impacts. In summary, these methods adopt either a series of fixed noise level limits, are concerned with ambient noise level changes as a result of the construction operations or a combination of the two.

8.2.49 With respect to absolute fixed noise limits, those detailed within Advisory Leaflet 72: 1976: 'Noise control on building sites' are presented. These limits are presented according to the nature of the surrounding environment, for a 12-hour working day. The presented limits are:

- 70 dB(A) in rural, suburban and urban areas away from main road traffic and industrial noise; and
- 75 dB(A) in urban areas near main roads and heavy industrial areas.

8.2.50 The above noise level limits are applicable at the façade of the receptor in question (not free-field).

8.2.51 The standard goes on to provide methods for determining the significance of construction noise levels by considering the change in the ambient noise level that would arise as a result of the construction operations. Two example assessment methods are presented, these are the 'ABC method' as summarised within **Table 8.1** and the '5 dB(A) change' method as described below in Section 8.2.522.

Table 8.1 - Example threshold of potential significant effect at dwellings (construction noise) – ABC method

Assessment Category and Threshold Value Period	Threshold Value, in Decibels (dB) ($L_{Aeq,T}$)		
	Category (A)	Category (B)	Category (C)
Night-time (23:00 – 07:00)	45	50	55
Evenings and weekends (D)	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75
NOTE 1: A potential significant effect is indicated if the $L_{Aeq,T}$ noise level arising from the site exceeds the threshold level for the category appropriate to the ambient noise level. *NOTE 2: If the ambient noise level exceeds the Category C threshold values given in the table (i.e. the ambient noise level is higher than the above values), then a potential significant effect is indicated if the total $L_{Aeq,T}$ noise level for the period increases by more than 3 dB due to site noise.* *NOTE 3: Applied to residential receptors only*			
A) Category A: threshold values to use when ambient levels (when rounded to the nearest 5 dB) are less than these values. *B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are the same as Category A values.* *C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5 dB) are higher than Category A values.* *D) 19.00-23.00 weekdays, 13.00-23.00 Saturdays and 07.00-23.00 Sundays*			

8.2.52 With respect to the '5 dB(A) change' method, the guidance states:

"Noise levels generated by construction activities are deemed to be significant if the total noise (pre-construction ambient plus construction noise) exceeds the pre-construction ambient noise by 5 dB or more, subject to lower cut-off values of 65 dB, 55 dB and 45 dB L_{Aeq}, from construction noise alone, for the daytime, evening and night-time periods, respectively; and a duration of one month or more, unless works of a shorter duration are likely to result in significant impact."

Calculation of Road Traffic Noise (CRTN)

8.2.53 CRTN (Department of Transport, 1988) provides a method for the prediction of noise levels due to road traffic based on 18-hour traffic flows, road type and geometry. CRTN may be used for determining the entitlement of existing properties to noise insulation where new roads are proposed and provides criteria for this purpose.

Design Manual for Roads and Bridges (DMRB)

8.2.54 DMRB (Highways Agency, 1989) provides standards and advice regarding the assessment, design and operation of roads in the UK. DMRB provides screening criteria, by which percentage changes in traffic flow can be related to a predicted change in road traffic noise and vibration. The guidance also provides significance criteria, by which the percentage of people adversely affected by traffic noise can be related to the total noise or vibration level due to road traffic, or the increase over an existing level.

8.2.55 DMRB provides screening criteria whereby a change in noise level of 1 $dBL_{A10,18hr}$ is equivalent to a 25% increase or 20% decrease in traffic flow, and a change in noise level of 3 $dBL_{A10,18hr}$ is equivalent to a 100% increase or 50% decrease in traffic flow.

8.2.56 The threshold criteria used for traffic noise assessment during the daytime is a permanent change in magnitude of 1 dB $L_{A10,18hr}$ in the short term (i.e. on opening) or a 3 dB $L_{A10,18hr}$ change in the long term (typically 15 years after project opening). For night time noise impacts, the threshold criterion of a 3 dB $L_{night,outside}$ noise change in the long term should also apply but only where an $L_{night,outside}$ greater than 55 dB is predicted in any scenario.

8.3 Consultation

8.3.1 **Table 8.2** provides details of consultations undertaken with the Council, together with action undertaken by the Applicant in response to consultation feedback. Full records of consultation are provided in **Appendix 8.2**.

Table 8.2 - Summary of consultation

Consultee	Consultation Response	Applicant Action
Shetland Islands Council (SIC)	ITPE provided details of the proposed scope and approach of the assessment, including references to appropriate guidance. SIC agreed approach	ITPE has undertaken assessment in accordance with agreed guidance and approach.
Shetland Islands Council	ITPE provided initial 35 dBL_{A90}noise contour of Proposed Development to agree study area and proposed 3 baseline survey locations. SIC agreed to 3 proposed locations and requested an additional monitoring location.	ITPE accepted SIC's additional location.
Shetland Islands Council	ITPE provided the results of the baseline noise survey and derived operational wind turbine noise limits for review. ITPE reported issue with Sound Level Meter (SLM) at Cullivoe during baseline survey & EHO noted that this data should be reported as "unqualified". ITPE provided details of identified cumulative wind turbines in the study area and set out which would be included in the noise assessment and which would be excluded. Approach for dealing with cumulative effects associated with Garth Wind Farm proposed. Approach for dealing with potential noise contributions to measured baseline noise levels at Sellafirth from existing single turbines proposed. SIC agreed with proposed approach.	ITPE has undertaken assessment in accordance with agreed approach.

8.4 Assessment Methodology and Significance Criteria

Consultation

8.4.1 Consultation was undertaken with SIC's Environmental Health Officer (EHO) as presented in Section 8.3 and **Appendix 8.2**.

Study Area

8.4.2 The study area for this assessment has been informed by maps and aerial images of the Proposed Development and its surroundings. A sample of the closest, and therefore potentially most affected,

Noise Sensitive Receptors (NSRs) to the Proposed Development have been identified and adopted for the evaluation of noise impacts. These have been selected to represent a geographic spread across the local area, including those located between the Proposed Development and the considered cumulative developments. NSRs at which noise limits have been set for cumulative developments have been identified for the evaluation of potential cumulative effects. NSRs identified are either single dwellings or representative of a group or cluster of dwellings.

8.4.3 The 35 dBL_{A90} operational noise contour for the Proposed Development in isolation (i.e. without cumulative developments) at the wind speed at which the proposed turbines generate their maximum sound power level (6 m/s), is shown in **Figure 8.1**. Appropriate NSR locations have been selected to represent clusters of properties at the closest approach to the turbines of the Proposed Development. The adopted representative NSR locations are shown in **Figure 8.1** – Study Area and NSRs, and are listed in **Table 8.3.**

Table 8.3 - Identified NSRs in the study area

NSR ID	NSR Name	Distance from closest proposed turbine, m	Direction from closest proposed turbine
NSR1	Gloup	1,100	North
NSR2	Hill of Breckon	2,300	North-east
NSR3	Cullivoe (northern end)	1,700	East
NSR4	Cullivoe (southern end)	2,500	East
NSR5	Gutcher (Laurenlea)	3,100	East-south-east
NSR6	Sellafirth	1,650	South

Baseline Noise Survey

8.4.4 Baseline noise monitoring was undertaken in accordance with the requirements of ETSU-R-97, with simultaneous wind speed and rainfall measurements. The baseline survey was completed within the period 18th July to 15th August 2018. The Noise Monitoring Positions (NMPs) at which baseline measurements were completed are provided in **Table 8.4** and shown on **Figure 8.2** .

Table 8.4 - Baseline noise measurement positions

Monitoring position	Representative of NSR	Grid Reference (OS GB)	
		Easting	Northing
NMP1	NSR1 – Gloup	450749	120450
NMP2	NSR2 – Hill of Breckon	452973	120430
NMP3	NSR3 – Cullivoe	453348	1203914
NMP4	NSR6 – Sellafirth	451904	119780

8.4.5 No monitoring was undertaken at locations representative of NSR4 and NSR5; the baseline for these receptors was characterised in the noise assessment for Garth Wind Farm, and the previously-defined baseline has been adopted in this assessment.

8.4.6 The SLMs used were compliant with Class 1 specification, as described in BS EN 6172-1:2003 after each measurement and no significant drift in calibration was noted. The SLMs and the calibrator used were within their accredited laboratory calibration period of two years and one year, respectively.

8.4.7 The SLM at NMP3 in Cullivoe was water damaged and a field calibration at the end of the survey was not possible. It was agreed with the SIC EHO that data from NMP3 could be reported within the EIA Report and cross-checked against measured data other NMPs. The EHO also specified that the data should be marked as "unqualified" (refer to 8.3.1).

Construction Phase

Construction Noise

8.4.8 Construction noise predictions have been undertaken in accordance with the methodology presented in BS5228 (BSi, 2009/2014) for the following construction stages:

- establishment of southern compound;
- rock breaking and crushing at borrow pits;
- site roads;
- turbine hardstandings;
- foundations;
- peat and habitat restoration;
- internal collector system;
- wind turbine delivery;
- wind turbine installation; and
- substation construction.

8.4.9 Details of the plant associated with each of the above stages and the associated on-times (utilisation) of plant items are provided in Appendix 8.3. Items of plant were placed within the model at the assumed point of closest approach of the works to the closest NSRs. Where construction activities will occur at multiple locations (e.g. turbine hardstandings) these works have been modelled at the distance of closest approach to multiple NSRs, to represent worst-case noise levels.

8.4.10 Noise levels associated with construction activities have been evaluated in accordance with the guidance contained within BS5228. As summarised in Section 8.2, the standard provides three example methods for determining the significance of potential construction noise impacts.

8.4.11 Following the "ABC method", the most stringent assessment criterion (Category A) during the daytime period (defined as 07:00 to 19:00 weekdays and 07:00 to 13:00 Saturdays) where the prevailing ambient noise levels (rounded to the nearest 5 dB) are below 65 dB $L_{Aeq,T}$. Where Category A applies, the threshold level for construction noise, which should not be exceeded, is 65 dB(A).

8.4.12 Construction noise criteria have been derived using the ABC method, and these are provided in **Table 8.9** within the Impact Magnitude section.

Construction Vibration

8.4.13 No potential significant sources of construction vibration have been identified; it is possible that blasting may be used within borrow pits, however, the method of rock extraction has yet to be determined and no details of potential blasting parameters are currently available. If detailed

ground investigations suggest that blasting should be required for rock extraction, then a blasting assessment including a vibration assessment will be undertaken and submitted to Shetland Island Council prior to construction commencing. The Applicant proposes that the requirement for a blasting assessment is placed as a condition of the consent.

8.4.14 Ground-borne vibration associated with construction activities is typically localised, and significant vibration is not anticipated beyond the application boundary. Consideration of vibration has therefore been scoped out of this assessment.

Construction Traffic

8.4.15 Traffic flows have been provided for the A968 for the baseline, future baseline (opening year without the Proposed Development) and for the construction phase of the Proposed Development. Traffic flows connected with the Proposed Development during the operational phase are assumed to be negligible (refer to **Chapter 11** (Transport and Traffic)) and therefore associated noise impacts have not been assessed.

8.4.16 The traffic data has been used to model noise from road traffic in the study area in accordance with the CRTN method, using CadnaA® noise prediction software. The projected traffic flows for light vehicles, heavy vehicles (HGVs) and the assumed traffic speeds for the baseline, future baseline and construction phase scenarios are provided in Appendix 8.4.

8.4.17 Noise levels have been predicted at two representative NSRs, located at a height of 4 m above ground level and at distances of 40 m and 80 m from the roadside, respectively.

Decommissioning Phase

8.4.18 Noise effects during decommissioning are anticipated to be similar to, but lesser than, those arising during the construction phase, given the smaller numbers of heavy plant and fewer activities anticipated. Noise effects from construction and decommissioning have therefore been assessed as one.

Operational Noise

8.4.19 The following assessment methodology was adopted for the assessment of operational wind turbine noise:

- A desk review has been undertaken of existing and proposed wind farm developments within a 10 km radius of the site. This review has been completed to identify those developments which have the potential to give rise to a cumulative noise impact when operating simultaneously with the Proposed Development. The results of this desk review have been used to inform the assessment of operational turbine noise.
- A sample of the closest, and therefore potentially most affected, noise sensitive receptors to the Proposed Development have been identified and adopted for the evaluation of noise impacts. These include a sample of receptors selected to represent a geographic spread across the local area, including those located between the Proposed Development and the considered cumulative developments.
- Baseline noise levels have been characterised in accordance with the IoA GPG. Operational noise limits have been derived using measured baseline noise levels in accordance with ETSU-R-97 and the IoA GPG.
- A noise model has been prepared for the site of the Proposed Development and surrounding area, including the NSRs using noise prediction software. The model was set to use the ISO 9613 prediction method, which includes prescribed methods for accounting for the effects of geometric divergence, ground absorption, and atmospheric absorption.
- Consideration has been given to nearby wind turbines and wind farms with which potential cumulative noise effects have been identified.

- Noise levels arising from the Proposed Development and cumulative developments have been predicted at identified representative NSRs across the range of wind speeds for which operational noise levels have been provided; 4 m/s - 12 m/s.
- The impact magnitude and effect significance have been determined following the criteria described in the assessment of potential effect significance section.

General Method of Prediction

8.4.20 A detailed noise model has been prepared for the study area, including the identified representative NSRs. Predictions were undertaken using CadnaA® software. The model was set to use the ISO 9613 prediction method, which includes prescribed methods for accounting for the effects of geometric divergence, ground absorption, and atmospheric absorption, in accordance with the requirements of ETSU-R-97 and the IOA GPG.

8.4.21 Whilst the IOA GPG presents methods for the determination of additional corrections to account for propagation directivity, which could be used for example to account for the effects of wind direction where a receptor is located between two developments, such corrections have not been included within this assessment. The predicted operational noise levels can therefore be considered worst-case in this regard.

The noise model was configured to ensure noise level predictions in compliance with the IOA GPG, including the following:

- ground absorption: g=0.5;
- receptor height: 4 m;
- a correction from $L_{Aeq,T}$ to $L_{A90,T}$ of -2 dB was applied;
- no acoustic screening from buildings or topography was included in the calculated noise levels (worst-case);
- temperature: 10°C; and
- humidity: 70%.

8.4.22 Given the generally flat-lying or gently-undulating topography in the study area, no valley corrections have been applied to predicted noise levels.

Proposed Development

Wind Turbine

8.4.23 This assessment has been undertaken using Siemens Gamesa SG 4.5-145 which has a 4.5 MW rated power output and a hub height of 127.5 m as a representative candidate turbine model for the Proposed Development. The actual turbine model built may be different from the candidate turbine, but the sound power level of the chosen turbine model will not exceed what has been assessed. The source noise terms of the candidate turbine model have been provided by Siemens Gamesa, both as 1/3 octave band data, and as broad-band levels, quoted as sound power levels over a range of operational hub-height wind speeds.

8.4.24 The broad-band sound power levels have been standardised to 10 m height wind speeds and an uncertainty correction of +2 dB has been applied to the declared sound power levels, in accordance with the requirements of the IOA GPG. The resultant source noise terms for the candidate turbine model are provided in **Table 8.5**.

8.4.25 The spectral shape provided in the 1/3 octave noise levels has been used within the noise model and, normalised to the broadband levels corrected to 10 m wind speeds. The 1/3 octave band data are provided in **Appendix 8.5.**

Table 8.5 - Source noise terms of Proposed Development candidate turbines

Wind speed, m/s	Sound power level standardised to 10 m height wind speed, dB(A)
	Siemens Gamesa SG 4.5-145 (127.5m hub height)
2	97.1
3	97.1
4	101.7
5	106.7
6	109.8
7	109.8
8	109.8
9	109.8
10	109.8
11	109.8
12	109.8

8.4.26 The candidate turbine model reaches its maximum sound power level at a 10 m wind speed of 6 m/s.

Fixed (Non-turbine) Plant Noise

8.4.27 Drawing upon the results of the completed baseline noise survey, and the guidance contained within BS 4142:2014, a series of applicable fixed plant noise level limits have been determined for non-turbine plant, such as electrical transformers. This assessment considers that planning conditions may be set to limit noise from fixed (non-turbine) plant to ensure a commensurate level of protection against noise for local receptors. Noise from such plant will be controlled by specification of appropriate attenuation as required, or selection of quiet plant.

8.4.28 The impact magnitude and effect significance of noise from fixed plant has been determined following the criteria described in the assessment of potential effect significance section on the assumption that the installed plant will be appropriately specified or silenced.

Cumulative Noise

Identification of cumulative developments

8.4.29 A desk-based review has been undertaken of existing and proposed wind energy developments within 10 km of the Proposed Development site. This review has been completed to identify those developments which have the potential to give rise to a cumulative noise impact when operating simultaneously with the Proposed Development. The results of this desk-based review have been used to inform the assessment of operational turbine noise. The potentially-cumulative developments considered in this assessment are listed in **Table 8.6** and were agreed with the Environmental Health Officer.

Table 8.6 - Potentially cumulative developments identified

Development	Distance (m) & direction from Proposed Development	Status
Garth Wind Farm	1,900 – East	Operational
Tulac single turbine	2,700 – South-south-east	Operational
Uphouse single turbine	1,700 - South	Operational
SW Cullivoe Hall single turbine	3,000 – East	Currently decommissioned, planning consent granted for replacement turbine
Niaroo single turbine	1,050 – North	Consented development, not constructed at time of assessment
Dalsetter 3Ts – wind cluster	1,100 - South	Screening opinion submitted in 2014.
Innhouse single turbine	2,050 - South	Consented development, not constructed at time of assessment

Review of Cumulative Noise Limits

8.4.30 SIC has confirmed that there were no planning conditions for noise set for Garth Wind Farm, however, the noise assessment provided in the Environmental Statement (ES) predicted operational noise against the upper ETSU daytime noise limit of "40 dBL_{A90} or background +5 dB, whichever is the higher", with measured background levels at the closest NSRs to the development used to derive ETSU noise limits. The derived numerical noise limits are not tabulated in the ES, only presented graphically.

8.4.31 All of the identified single turbine developments have been consented using the "simplified ETSU" noise limit of 35 dBL_{A90} at all wind speeds.

8.4.32 No proposed noise limits had been reported for the Dalsetter 3Ts wind cluster development at the time of assessment. Cumulative noise levels for the Dalsetter 3Ts development have been predicted using reported information obtained from the SIC planning portal, and evaluated against cumulative limits derived from background noise levels measured by ITPE.

Adoption of Noise Limits at NSRs

8.4.33 It has been agreed with SIC that the Proposed Development will be evaluated against the upper ETSU daytime noise limit of 40 dBL_{A90} or background +5 dB, whichever is the higher, and the night-time noise limit of 43 dBL_{A90} or background +5 dB, whichever is the higher (refer **to Appendix 8.2**). This approach matches that adopted for similar scale developments in Shetland.

8.4.34 Potential cumulative noise effects in the study area are anticipated to predominantly arise due to single-turbine developments, which are consented to the "simplified ETSU" 35 dBL_{A90} criterion. The simplified criterion is a "flat" limit, and does not vary according to wind speed or measured baseline noise levels, and therefore is overly conservative for considering cumulative noise from the Proposed Development. Noise limits for the Proposed Development have therefore been derived for NSRs potentially affected by cumulative noise from single turbine developments using the background noise levels measured during the baseline survey.

8.4.35 For NSRs at Sellafirth, where noise from the Tulac and Uphouse single turbine developments may have contributed to measured background levels at NMP4, the contribution of these turbines has been determined at the measurement location by prediction. The predicted contribution has been subtracted from the measured background levels at NMP4 to derive the background level in the absence of turbine noise, and noise limits for NSRs at Sellafirth have been derived from this "true" background level. This approach has been agreed with SIC.

Table 8.7 - Cumulative noise limits applicable at identified NSRs

NSR	Identified cumulative developments	Consented noise limits of identified developments	Adopted/controlling noise limit at NSR
NSR1 - Gloup	Niaroo	35 dB simplified ETSU	Proposed Development
NSR2 - Hill of Breckon	-	N/A	Proposed Development
NSR3 - Cullivoe (northern end)	-	N/A	Proposed Development
NSR4 - Cullivoe (southern end)	Cullivoe Hall	35 dB simplified ETSU	Proposed Development
NSR5 - Gutcher (Smithfield)	Garth	Daytime: 40 dBL_{A90} or background+ 5dB, whichever is the higher Night-time: 43 dBL_{A90} or background +5dB, whichever is the higher	Garth
NSR6 - Sellafirth	Uphouse Tulac	35 dB simplified ETSU 35 dB simplified ETSU	Proposed Development

8.4.36 With the exception of NSR5, for which derived noise limits are reported in the Garth Wind Farm ES, cumulative noise limits at all NSRs have been set as those derived from baseline noise levels measured as part of this assessment.

8.4.37 Tabulated noise limits for the Garth Wind Farm are not reported in the ES; they are instead displayed on graphs in an appendix; it is therefore not possible to accurately determine the exact cumulative noise limits applicable to NSR5. The graphs for the receptor "Smithfield" provided in the Garth ES show that the wind-dependent noise limit for Garth exceeds 40 dBL_{A90} during the daytime period at 8 m/s and exceeds 43 dBL_{A90} at approximately 11 m/s.

8.4.38 In a conservative approach, this assessment seeks to demonstrate compliance with flat cumulative limits at NSR5, i.e. independent of wind speed dependent background noise levels, removing any uncertainty on the prevailing background levels

Assessment of Potential Effect Significance

Receptor Sensitivity

8.4.39 The guidance contained within Technical Advice Note (TAN) to PAN 1/2011 has been drawn upon in the generation of an appropriate set of significance criteria. The receptor sensitivity criteria for both the construction, operational and decommissioning phases of the Proposed Development are considered to be the same. These are presented within **Table 8.8** and are applicable to both noise and vibration effects.

Table 8.8 - Receptor sensitivity criteria

Receptor Sensitivity	Description	Examples
High	Receptors where people or operations are particularly susceptible to noise and/or vibration.	Residential, quiet outdoor recreational areas, schools and hospitals.
Medium	Receptors moderately sensitive to noise and/or vibration, where it may cause some distraction or disturbance.	Offices and restaurants.
Low	Receptors where distraction or disturbance from noise and/or vibration is minimal.	Buildings not occupied, factories and working environments with existing levels of noise.

Magnitude of Impact

Construction Noise

8.4.40 Construction noise impact magnitudes have been determined with reference to threshold levels derived in accordance with the ABC method provided in BS4142. The impact magnitudes are provided in **Table 8.9**.

Table 8.9 - Evaluation criteria for noise from construction activities

Difference (d) between construction noise level and threshold level (dB)	Impact magnitude
d ≥+5	High
0 ≤ d < +5	Medium
-10 ≤ d < 0	Low
<-10	Negligible

Construction Traffic Noise

8.4.41 The Design Manual for Roads and Bridges (DMRB) states that "In the period following a change in traffic flow, people may find benefits or disbenefits when the noise changes are as small as 1 dB(A) – equivalent to an increase in traffic flow of 25% or a decrease in flow of 20%. These effects last for a number of years", whilst PAN1/2011 advises that a change of 3 dB(A) is the minimum perceptible under normal conditions. Criteria have been derived on this basis, and are provided in **Table 8.10.**

Table 8.10 - Evaluation criteria for noise from construction traffic

Change in road traffic noise level, dBLA10,18hr	Impact magnitude
>5	High
>3, ≤5	Medium
>1, ≤3	Low
<1	Negligible

Operational Wind Turbine Noise

8.4.42 For operational noise from the wind turbines for the Proposed Development the impact magnitude scale has been derived based on the guidance contained with ETSU-R-97; the criteria are summarised in **Table 8.11.**

Table 8.11 - Impact magnitude scale – wind turbine noise

Difference (d) between cumulative turbine noise level and applicable limit (dB)	Impact magnitude
d ≥+5	High
0 ≤ d < +5	Medium
-10 ≤ d < 0	Low
<-10	Negligible

Operational Fixed (Non-turbine) Plant Noise

8.4.43 For noise from any fixed (non-turbine) plant such as any transformers, control buildings or substations, it is appropriate to determine significance criteria based on the guidance contained within BS4142, i.e. by consideration of the difference between the rating level from the plant noise and the prevailing background sound levels, but also with respect to context and the resulting sound levels in absolute terms.

8.4.44 The impact magnitudes associated with noise generated from fixed plant are presented in **Table** 8.12.

Table 8.12 - Impact magnitude for fixed (Non-turbine) plant noise

Difference between Rating Level ($L_{Ar,Tr}$) and Background Sound Level (L_{A90})	BS4142 Guidance	Impact Magnitude
≥+10	Indication of significant adverse impact	High
+5	Indication of adverse impact	Medium
0	Indication of low Impact	Low
-10	-	Negligible
Where the rating level ($L_{Ar.Tr}$) is below 35dB the impact magnitude is classified as 'Negligible' regardless of the relationship to the background noise level. *+ indicates rating level above background noise level* *- indicates rating level below background noise level*		

Significance of Effect

8.4.45 The effect significance has been determined by consideration to both the receptor sensitivity and the impact magnitude according to the matrix detailed in **Table 8.13**.

Table 8.13 - Significance of effect matrix

Impact Magnitude	Receptor Sensitivity		
	High	**Medium**	**Low**
High	Major	Moderate	Minor
Medium	Moderate	Minor	Neutral
Low	Minor	Neutral	Neutral
Negligible	Neutral	Neutral	Neutral

8.4.46 This assessment considers all identified NSRs to be of "high" sensitivity. Adverse effects of "moderate" or "major" significance are considered "significant" and require mitigation.

Requirements for Mitigation

8.4.47 Consideration has been given to available mitigation measures to reduce adverse effects and enhance beneficial effects. Where mitigation measures are detailed, these are committed to by the Applicant and have been determined through professional judgement and the implementation of best practice.

8.4.48 Where required, modern turbines allow the control/reduction in the noise levels generated by operation in various reduced noise operational modes. Whilst the use of such modes has an associated reduction in power generation, and so should be avoided where possible, they can be operated where necessary to ensure compliance with applicable noise level limits. A turbine

management scheme can be operated which monitors the prevailing meteorological conditions (e.g. wind speed and direction) and controls the applicable operational mode (e.g. standard setting or a reduced noise operational mode) accordingly.

Assessment of Residual Effect Significance

8.4.49 Residual effects have been assessed following the methodologies described above, and take into account any committed mitigation measures.

Limitations to Assessment

8.4.50 This assessment has been undertaken in accordance with the information available at the time, making appropriately conservative assumptions. Potential sources of uncertainty, and the measures taken within this assessment to mitigate these, are identified below:

- variation in background noise levels – mitigated by extended duration of baseline survey;
- source noise terms of turbines – uncertainty correction applied, in accordance with IoA GPG; and
- method of prediction – method provided in IoA GPG followed.

8.4.51 The assessment of operational impacts associated with the wind turbines has been undertaken adopting source noise levels for the candidate turbine models. Following completion of the tendering process, it is possible that the precise turbine make and model will change from that adopted within the assessment. The candidate turbine assessed has been identified (by the Applicant) as having the highest operational noise emissions of the potential turbine options under consideration, therefore noise effects associated with other turbine models will be lesser than those assessed.

8.5 Baseline Conditions

NMP1 - Gloup

8.5.1 Monitoring at NMP1 was undertaken between 18th July and 3rd August 2018. The SLM was located within the curtilage of a residential property close to the Fishermen's Memorial. The SLM was field calibrated before and after the measurement with no drift in calibration noted. Photographs of the SLM in position are provided in **Appendix 8.6**.

8.5.2 No anthropogenic noise was noted during installation or decommissioning of the monitoring equipment at NMP1 and the property was unoccupied. The dominant noise source was intermittent bleating of sheep in the nearby field, and occasional bird calls.

NMP2- Hill of Breckon

8.5.3 Monitoring at NMP2 was undertaken between 18th July and 15th August 2018. The SLM was located within a small paddock to the west of a farmhouse. The SLM was field calibrated before and after the measurement with no drift in calibration noted. A rain gauge was also installed at this monitoring location. Photographs of the SLM in position are provided in **Appendix 8.6**.

8.5.4 No anthropogenic noise was noted during installation or decommissioning of the monitoring equipment at NMP1. The dominant noise source was intermittent bleating of sheep in nearby fields, and occasional bird calls.

NMP3- Cullivoe

8.5.5 Monitoring at NMP3 was undertaken between 18th July and 30th July 2018. The SLM was located adjacent to a field, on the opposite side of a single-track road, approximately 50 m from the nearest dwelling. The SLM was field calibrated before the measurement. During the course of the survey the SLM body suffered from water ingress and had ceased to operate on completion of the survey, the data is therefore presented as "unqualified". No obvious anomalies have been identified and it

is assumed that the SLM operated correctly until recordings ceased. Photographs of the SLM in position are provided in **Appendix 8.6**.

8.5.6 No anthropogenic noise was noted during installation or decommissioning of the monitoring equipment at NMP1. The dominant noise source was intermittent bleating of sheep in nearby fields, and occasional bird calls.

NMP4- Sellafirth

8.5.7 Monitoring at NMP4 was undertaken between 18th July and 15th August 2018. The SLM was located within a field overlooking the sea, approximately 100 m to the west of the nearest house. The SLM was field calibrated before and after the measurement with no drift in calibration noted. Photographs of the SLM in position are provided in **Appendix 8.6**.

8.5.8 The dominant noise source noted during installation and decommissioning of the monitoring equipment was intermittent bird calls. Noise from road traffic was also occasionally audible, and fishing boats on the nearby inlet were infrequently audible. Anecdotal evidence provided by the residents indicates that the single turbines to the north (Tulac) and south (Uphouse) are occasionally audible in the vicinity of the NMP, depending on the wind speed and direction.

Time-varying trends – all NMPs

8.5.9 Time-history graphs of the measured ambient (L_{Aeq}) and background (L_{A90}) noise levels for each monitoring location are provided in Appendix 8.7. Measured levels show a pattern of diurnal variation, with typically higher noise levels during the daytime period than the night-time period, attributed to noise from wildlife and human activities. The dominant control on noise levels, however, is the prevailing weather conditions; during extended periods of high winds the measured noise levels are substantially elevated, and do not vary significantly between daytime and night-time periods.

Data Analysis and Derivation of Noise Limits – Operational Phase

8.5.10 The measured background noise levels at each NMP have been correlated with measured wind speeds in accordance with the method described in ETSU and the IoA GPG. Data affected by rainfall events has been appropriately screened out.

8.5.11 Graphs showing the measured background noise levels correlated with wind speed, and divided into Quiet Daytime and Night-time periods, in accordance with ETSU are provided in Appendix 8.8 for each NMP. The graphs show the wind-dependent background noise level, the "background +5 dB" criterion and the derived noise limit.

8.5.12 For NMP4, predictions of the noise level due to operation of the Tulac and Uphouse single turbines have been made, using data provided in support of their respective planning applications. The predicted noise level across the range of wind speeds has been subtracted from the measured background level to determine the "true" background in the absence of wind turbine noise. The measured and corrected background noise levels are both shown on the graphs.

8.5.13 The derived operational phase noise limits for each NMP during the daytime and night-time periods are provided in **Table 8.14**.

Table 8.14 – Derived noise limit by monitoring position

Wind speed (m/s)	Noise level, dBL_{A90}										
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
NMP1 - Gloup											
Measured daytime background	18.5	22.4	25.1	26.9	28.0	28.9	29.8	31.2	33.2	36.3	40.8
Daytime noise limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.3	45.8
Measured night-time background	22.1	22.4	22.8	23.4	24.2	25.0	26.0	26.9	28.0	29.0	30.0
Night-time noise limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NMP2 – Hill of Breckon											
Measured daytime background	21.1	20.2	20.7	22.2	24.5	27.4	30.6	33.9	37.0	39.7	41.7
Daytime noise limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	42.0	44.7	46.7
Measured night-time background	19.1	19.8	20.8	22.0	23.4	24.9	26.6	28.4	30.2	32.1	33.9
Night-time noise limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NMP3 – Cullivoe											
Measured daytime background	18.3	20.9	23.3	25.4	27.4	29.4	31.5	33.8	36.3	39.3	42.7
Daytime noise limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.3	44.3	47.7
Measured night-time background	21.6	20.1	19.7	20.3	21.7	23.6	26.0	28.7	31.5	34.2	36.7

Wind speed (m/s)	Noise level, dBL_{A90}										
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Night-time noise limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
NMP4 – Sellafirth											
Measured daytime background[1]	23.4	25.2	26.9	29.1	31.2	33.2	34.9	36.3	37.2	37.3	36.8
Daytime noise limit	40.0	40.0	40.0	40.0	40.0	40.0	40.0	41.3	42.2	42.3	42.3
Measured night-time background[1]	17.7	18.0	19.8	22.4	25.6	29.1	32.3	35.2	37.4	38.8	39.3
Night-time noise limit	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.8	44.3

Note[1] – background level corrected to remove noise from existing single turbines.

8.5.14 The daytime noise limit derived using measured baseline noise levels from NMP2 – Hill of Breckon is lower (more conservative) than that derived using NMP3 – Cullivoe. Given the "unqualified" nature of the NMP3 data, the baseline levels at NMP2 have been adopted for the derivation of noise limits at NSR3 - Cullivoe.

8.6 Potential Effects

Construction & Decommissioning Phases

Construction/Decommissioning Noise

8.6.1 The proposed construction hours are 07:00 – 19:00 Mondays to Fridays, and 08:00 – 18:00 Saturdays and Sundays. These hours fall within the "daytime and Saturdays" and "evenings and weekends" threshold value periods provided in BS5228. No night-time working is proposed, however, turbine installation will be undertaken during appropriate wind conditions and this quiet activity, in locations remote from NSRs, may therefore occur during the evening, weekend or night-time period, as necessary. Threshold noise levels have been derived from measured baseline noise levels in accordance with the BS5228 "ABC method", and are provided in **Table 8.15** for the two threshold value periods during which construction works are proposed.

Table 8.15 – Derived construction and decommissioning noise criteria

NMP	Representative NSRs	Measured daytime ambient noise level below Category A values?	Applicable daytime and Saturdays threshold level at NSR using BS5228 ABC method, dBL_{Aeq}	Applicable evenings & weekends threshold level at NSR using BS5228 ABC method, dBL_{Aeq}
NMP1	NSR1	Yes	65	55
NMP2	NSR2	Yes	65	55
NMP3	NSR3	Yes	65	55
NMP4	NSR6	Yes	65	55

8.6.2 No threshold levels have been derived for NSR5, as this receptor is considered to be sufficiently remote from construction works that demonstration of compliance with threshold levels at NSRs in closer proximity to the Proposed Development will entail compliance with the thresholds at NSR5.

8.6.3 Of the two threshold level periods, the "evenings and weekends" threshold is lower; meeting this threshold therefore entails compliance with the "daytimes and Saturdays" threshold. Predicted noise levels for each of the construction stages identified are provided in **Table 8.16** and evaluated against the "evenings and weekends" threshold level.

8.6.4 Compliance with the threshold level is evaluated against the adopted impact magnitude criteria in **Table 8.9** and effect significance criteria for NSRs of "high" sensitivity provided in **Table 8.13**.

Table 8.16 – Evaluation of construction and decommissioning noise levels

NSR ID	Predicted worst-case daytime noise level, dB	Margin of compliance with criterion (criterion minus predicted level)	Resultant impact magnitude	Resultant effect significance
Site establishment				
NSR1	40	15	Negligible	Neutral
NSR2	36	19	Negligible	Neutral
NSR3	35	20	Negligible	Neutral
NSR4	34	21	Negligible	Neutral
NSR5	34	22	Negligible	Neutral
NSR6	51	4	Low	Minor

NSR ID	Predicted worst-case daytime noise level, dB	Margin of compliance with criterion (criterion minus predicted level)	Resultant impact magnitude	Resultant effect significance
Site roads				
NSR1	41	15	Negligible	Neutral
NSR2	36	19	Negligible	Neutral
NSR3	35	20	Negligible	Neutral
NSR4	34	21	Negligible	Neutral
NSR5	34	21	Negligible	Neutral
NSR6	51	4	Low	Minor
Borrow pits – rock breaking and crushing				
NSR1	19	36	Negligible	Neutral
NSR2	21	34	Negligible	Neutral
NSR3	20	35	Negligible	Neutral
NSR4	19	36	Negligible	Neutral
NSR5	25	30	Negligible	Neutral
NSR6	48	7	Low	Minor
Turbine hardstandings				
NSR1	42	13	Negligible	Neutral
NSR2	36	19	Negligible	Neutral
NSR3	35	20	Negligible	Neutral
NSR4	34	21	Negligible	Neutral
NSR5	33	22	Negligible	Neutral
NSR6	38	17	Negligible	Neutral
Foundations				
NSR1	43	12	Negligible	Neutral

NSR ID	Predicted worst-case daytime noise level, dB	Margin of compliance with criterion (criterion minus predicted level)	Resultant impact magnitude	Resultant effect significance
NSR2	37	18	Negligible	Neutral
NSR3	37	18	Negligible	Neutral
NSR4	36	19	Negligible	Neutral
NSR5	35	20	Negligible	Neutral
NSR6	40	15	Negligible	Neutral
Peat restoration				
NSR1	45	10	Negligible	Neutral
NSR2	40	16	Negligible	Neutral
NSR3	39	16	Negligible	Neutral
NSR4	38	17	Negligible	Neutral
NSR5	37	18	Negligible	Neutral
NSR6	43	13	Negligible	Neutral
Internal collector system				
NSR1	45	10	Negligible	Neutral
NSR2	40	16	Negligible	Neutral
NSR3	39	16	Negligible	Neutral
NSR4	38	17	Negligible	Neutral
NSR5	37	18	Negligible	Neutral
NSR6	43	13	Negligible	Neutral
Wind turbine delivery				
NSR1	33	22	Negligible	Neutral
NSR2	27	28	Negligible	Neutral
NSR3	27	28	Negligible	Neutral

NSR ID	Predicted worst-case daytime noise level, dB	Margin of compliance with criterion (criterion minus predicted level)	Resultant impact magnitude	Resultant effect significance
NSR4	25	30	Negligible	Neutral
NSR5	25	30	Negligible	Neutral
NSR6	43	12	Negligible	Neutral
Wind turbine installation				
NSR1	31	24	Negligible	Neutral
NSR2	25	30	Negligible	Neutral
NSR3	25	30	Negligible	Neutral
NSR4	24	31	Negligible	Neutral
NSR5	25	31	Negligible	Neutral
NSR6	43	12	Negligible	Neutral
Substation construction				
NSR1	31	24	Negligible	Neutral
NSR2	30	25	Negligible	Neutral
NSR3	31	25	Negligible	Neutral
NSR4	32	23	Negligible	Neutral
NSR5	33	22	Negligible	Neutral
NSR6	40	15	Negligible	Neutral

8.6.5 Predicted construction noise levels meet the evenings and weekends threshold level at all NSRs, by a minimum margin of 3 dB. The impact magnitude for construction activities on Saturday afternoons and on Sundays therefore ranges from negligible to low and the resultant effect significance ranges from neutral to minor and is therefore “not significant”.

8.6.6 The “evenings and weekends” threshold level is 10 dB lower than the “daytimes and Saturdays” threshold, therefore predicted construction noise levels meet this threshold by a minimum margin of 13 dB. The impact magnitude for construction activities on weekdays and Saturday mornings is therefore negligible and the resultant effect significance is neutral.

8.6.7 Noise effects associated with construction and decommissioning activities are not significant.

Construction Traffic

8.6.8 Predicted road traffic noise levels at representative NSRs located at 40 m and 80 m from the road, representative of a typical separation distance for dwellings along the A968, and are evaluated in **Table 8.17** against the impact magnitude criteria (as provided in **Table 8.10**) and effect significance criteria.

Table 8.17 – Evaluation of predicted construction traffic noise levels

NSR	Predicted future baseline noise level, $dBL_{A10,18hr}$	Predicted construction phase noise level, $dBL_{A10,18hr}$	Increase due to construction traffic, dB	Resultant impact magnitude	Effect significance
40 m from roadside	60.9	61.8	0.9	Negligible	Neutral
80 m from roadside	57.4	58.3	0.9	Negligible	Neutral

8.6.9 The predicted increase in road traffic noise due to construction traffic is below 1 dB at both NSRs, and the resultant impact significance is neutral. Noise from construction traffic is therefore not significant.

Operation

Wind Turbine Noise – Proposed Development Only

8.6.10 The predicted operational noise levels for the Proposed Development operating in isolation (i.e. excluding cumulative turbines from other wind farms) are evaluated against the derived noise limits in **Table 8.18**.

Table 8.18 – Evaluation of predicted operational noise levels – Proposed Development only

Wind speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Impact magnitude	Effect significance
NSR1 – Gloup													
Predicted noise level, dBL$_{A90}$	*24.9*	*24.9*	*29.7*	*34.6*	*38.0*	*37.7*	*37.7*	*37.7*	*37.7*	*37.7*	*37.7*	-	-
Margin of compliance with daytime noise limit, dB	15.1	15.1	10.1	5.4	2.0	2.3	2.3	2.3	2.3	3.6	8.1	Low	Minor
Margin of compliance with night-time noise limit, dB	18.1	18.1	13.3	8.4	5.0	5.3	5.3	5.3	5.3	5.3	5.3	Low	Minor
NSR2 – Hill of Breckon													
Predicted noise level, dBL$_{A90}$	*19.9*	*19.9*	*24.5*	*29.5*	*32.6*	*32.6*	*32.6*	*32.6*	*32.6*	*32.6*	*32.6*	-	
Margin of compliance with daytime noise limit, dB	20.1	20.1	15.5	10.5	7.4	7.4	7.4	7.4	9.4	12.1	14.1	Low	Minor
Margin of compliance with night-time noise limit, dB	23.1	23.1	18.5	13.5	10.4	10.4	10.4	10.4	10.4	10.4	10.4	Negligible	Neutral

Wind speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Impact magnitude	Effect significance
NSR3 – Cullivoe north													
Predicted noise level, dBL$_{A90}$	*19.7*	*19.7*	*24.3*	*29.3*	*32.4*	*32.4*	*32.4*	*32.4*	*32.4*	*32.4*	*32.4*	-	-
Margin of compliance with daytime noise limit, dB	20.3	20.3	15.7	10.7	7.6	7.6	7.6	7.6	9.6	12.3	14.3	Low	Minor
Margin of compliance with night-time noise limit, dB	23.3	23.3	18.7	13.7	10.6	10.6	10.6	10.6	10.6	10.6	10.6	Negligible	Neutral
NSR4 – Cullivoe south													
Predicted noise level, dBL$_{A90}$	*19.2*	*19.2*	*23.8*	*28.8*	*31.9*	*31.9*	*31.9*	*31.9*	*31.9*	*31.9*	*31.9*	-	-
Margin of compliance with daytime noise limit, dB	20.8	20.8	16.2	11.2	8.1	8.1	8.1	8.1	10.1	12.8	14.8	Low	Minor
Margin of compliance with night-time noise limit, dB	23.8	23.8	19.2	14.2	11.1	11.1	11.1	11.1	11.1	11.1	11.1	Negligible	Neutral
NSR5 – Gutcher													
Predicted noise level, dBL$_{A90}$	*16.9*	*16.9*	*21.5*	*26.5*	*29.6*	*29.6*	*29.6*	*29.6*	*29.6*	*29.6*	*29.6*	-	-
Margin of compliance with daytime noise limit, dB	23.1	23.1	18.5	13.5	10.4	10.4	10.4	10.4	10.4	10.4	10.4	Negligible	Neutral
Margin of compliance with night-time noise limit, dB	26.1	26.1	21.5	16.5	13.4	13.4	13.4	13.4	13.4	13.4	13.4	Negligible	Neutral

Wind speed (m/s)	2	3	4	5	6	7	8	9	10	11	12	Impact magnitude	Effect significance
NSR6 – Sellafirth													
Predicted noise level, dBL_{A90}	*22.6*	*22.6*	*27.3*	*32.2*	*35.3*	*35.3*	*35.3*	*35.3*	*35.3*	*35.3*	*35.3*	-	-
Margin of compliance with daytime noise limit, dB	17.4	17.4	12.7	7.8	4.7	4.7	4.7	6.0	6.9	7.0	7.0	Low	Minor
Margin of compliance with night-time noise limit, dB	20.4	20.4	15.7	10.8	7.7	7.7	7.7	7.7	7.7	8.5	9.0	Low	Minor

8.6.11 Predicted noise levels arising due to operation of the Proposed Development in isolation meet the noise limits set out in the relevant guidance at all identified representative NSRs. The smallest identified margins of compliance are predicted at NSR1 – Gloup, at 9 m/s wind speed; with a margin of 2.0 dB during the daytime period and 5.0 dB during the night-time period.

8.6.12 The effect significance at representative NSRs ranges from neutral to minor and noise effects are therefore not significant.

Wind Turbine Noise – Cumulative Operation

8.6.13 The predicted cumulative operational noise levels (i.e. all turbines within the study area) are evaluated against the derived noise limits in **Table 8.19**. Insufficient data was available for cumulative turbine noise at wind speeds below 4 m/s, therefore cumulative noise has been assessed only at wind speeds of 4 m/s and above.

Table 8.19 – Evaluation of predicted operational noise levels – cumulative operation

Wind speed (m/s)	4	5	6	7	8	9	10	11	12	Impact magnitude	Effect significance
NSR1 – Gloup											
Predicted noise level, dBL$_{A90}$	*29.9*	*34.7*	*38.1*	*37.8*	*37.9*	*37.9*	*38.1*	*38.2*	*38.2*	-	-
Margin of compliance with daytime noise limit, dB	10.1	5.3	1.9	2.2	2.1	2.1	1.9	3.1	7.6	Low	Minor
Margin of compliance with night-time noise limit, dB	13.1	8.3	4.9	5.2	5.1	5.1	4.9	4.8	4.8	Low	Minor
NSR2 – Hill of Breckon											
Predicted noise level, dBL$_{A90}$	*25.6*	*29.9*	*32.9*	*32.8*	*32.9*	*33.0*	*33.0*	*33.1*	*33.1*	-	-
Margin of compliance with daytime noise limit, dB	15.5	10.5	7.4	7.5	7.4	7.4	9.4	12.1	14.1	Low	Minor
Margin of compliance with night-time noise limit, dB	17.4	13.1	10.1	10.2	10.1	10.0	10.0	9.9	9.9	Low	Minor

Wind speed (m/s)	4	5	6	7	8	9	10	11	12	Impact magnitude	Effect significance
NSR3 – Cullivoe north											
Predicted noise level, dBL$_{A90}$	*25.9*	*29.9*	*32.8*	*32.7*	*32.9*	*33.0*	*33.1*	*33.2*	*33.2*	-	-
Margin of compliance with daytime noise limit, dB	14.1	10.1	7.2	7.3	7.1	7.0	8.9	11.5	13.5	Low	Minor
Margin of compliance with night-time noise limit, dB	17.1	13.1	10.2	10.3	10.1	10.0	9.9	9.8	9.8	Low	Minor
NSR4 – Cullivoe south											
Predicted noise level, dBL$_{A90}$	*29.1*	*31.3*	*33.3*	*29.7*	*33.3*	*34.1*	*34.2*	*34.4*	*34.4*	-	-
Margin of compliance with daytime noise limit, dB	10.9	8.7	6.7	10.3	6.7	5.9	7.8	10.3	12.3	Low	Minor
Margin of compliance with night-time noise limit, dB	13.9	11.7	9.7	13.3	9.2	9.4	8.8	8.6	8.6	Low	Minor
NSR5 – Gutcher											
Predicted noise level, dBL$_{A90}$	*32.7*	*33.4*	*34.2*	*34.2*	*35.2*	*35.8*	*35.9*	*35.9*	*35.9*	-	-
Margin of compliance with daytime noise limit, dB	7.3	6.6	5.8	5.8	4.8	4.2	4.1	4.1	4.1	Low	Minor
Margin of compliance with night-time noise limit, dB	10.3	9.6	8.8	8.8	7.8	7.2	7.1	7.1	7.1	Low	Minor

Wind speed (m/s)	4	5	6	7	8	9	10	11	12	Impact magnitude	Effect significance
NSR6 – Sellafirth											
Predicted noise level, dBL_{A90}	*29.2*	*33.1*	*35.9*	*36.0*	*36.3*	*36.6*	*36.9*	*37.5*	*37.5*	-	-
Margin of compliance with daytime noise limit, dB	10.8	6.9	4.1	8.8	3.7	4.7	5.3	4.8	4.8	Low	Minor
Margin of compliance with night-time noise limit, dB	13.8	9.9	7.1	11.8	6.7	6.4	6.1	6.3	6.8	Low	Minor

8.6.14 Predicted noise levels arising due to operation of the Proposed Development cumulatively with other identified wind energy developments meet the noise limits at all identified representative NSRs, by a margin of less than 10 dB. The derived effect significance at all representative NSRs is minor. Cumulative noise effects are therefore not significant.

Fixed (Non-turbine) Plant Noise

8.6.15 The Proposed Development includes one transformer at the base of each turbine, either external or within the tower, and a control building/substation which would have associated plant items and the potential to generate noise once operational.

8.6.16 At this stage, the technical specification of the transformer/plant has not yet been selected but these facilities are proposed to be located at considerable distances (more than 1 km) from the nearest noise sensitive receptors.

8.6.17 From a review of the measured background noise levels at each of the NMPs (refer to **Appendix 8.7**) it is evident that at wind speeds of up to 5 m/s the background noise levels are typically in the region of 20 dB, both during the daytime period and the night-time period. It is not possible to measure noise levels below approximately 20 dB accurately with typical environmental SLMs. Noise levels of this magnitude would be considered 'very low'.

8.6.18 In light of this context, the guidance contained within BS4142 and the impact magnitude scale adopted for this assessment (see **Table 8.12**), it is considered that the rating level for noise from transformers and the control building/substation should be limited such that noise levels within the closest receptors meet appropriate noise criteria such as NR35, as described in BS8233 (BSi, 2014b).

8.6.19 This limit will be applied to noise from all plant associated with the Proposed Development in order to avoid a cumulative noise impact from individual plant items. Where applicable, appropriate acoustic character corrections should be applied, in accordance with BS4142, in determining the plant rating level, prior to comparison against this rating level limit.

8.6.20 With reference to **Table 8.12**, compliance with this limit would ensure an impact magnitude of low. For receptors of high sensitivity, this impact magnitude corresponds to an effect significance of minor and is therefore not significant.

8.7 Mitigation

Construction & Decommissioning Phases

Construction/Decommissioning Noise

8.7.1 The nature of construction noise is inherently temporary. Human receptors will generally tolerate higher impacts where it is known that they will only be present for a limited time period. Several safeguards exist to minimise the effects of construction noise which will be adhered to during the construction of the turbines. These safeguards include:

- the various EC Directives and UK Statutory Instruments that limit noise emissions of a variety of construction plant;
- guidance set out in BS 5228-1:2009+A1:2014 which covers noise control on construction sites; and
- the powers that exist for local authorities under Section 60 of the Control of Pollution Act 1974 to control environmental noise on construction sites.

8.7.2 In addition, the adoption of Best Practicable Means (as defined in Section 72 of the Control of Pollution Act 1974) is an effective means of controlling noise from construction sites. Such measures will include the following:

- any compressors brought on to site to be silenced or sound reduced models fitted with acoustic enclosures;

- all pneumatic tools to be fitted with silencers or mufflers;
- the majority of deliveries to be programmed to arrive during normal working hours only;
- care to be taken when unloading vehicles to minimised noise. Delivery vehicles to be routed so as to minimise disturbance to local residents;
- delivery vehicles to be prohibited from waiting within or in the vicinity of the site with their engines running;
- all plant items to be properly maintained and operated according to manufacturers' recommendations in such a manner as to avoid causing excessive noise;
- all plant to be sited so that the noise impact at nearby noise-sensitive receptors is minimised;
- local hoarding, screens or barriers to be erected as necessary to shield particularly noisy activities;
- normal working hours will be between 07:00 and 19:00 Monday – Friday, and 08:00 – 18:00 Saturday and Sunday, with the exception of turbine installation, which will take advantage of appropriate wind conditions when they occur; and
- night-time deliveries will be minimal and will only be undertaken with special consideration. Care will be taken to minimise noise when unloading vehicles.

8.7.3 As part of the construction contract, the contractor will be required to comply with the above mitigation measures, as well as ensuring effective liaison with the local community. These requirements will be included in a Construction Environmental Management Plan (CEMP).

Construction Traffic

8.7.4 Noise effects associated with construction have been evaluated as "not significant", therefore it is considered that no mitigation is warranted. General "good practice" measures will, however, be enacted to minimise unnecessary disturbance. For general construction traffic, arrivals and departures will be timed such that they would be during the working daytime and not at night. Construction traffic will be prohibited from unnecessary idling within the site boundary or at the site access points. Due to the logistics in getting to the Island of Yell, there is potential for night time deliveries of turbine components, however, appropriate controls will be put in place to minimise unnecessary noise from these operations at noise-sensitive properties. These mitigation measures will be committed by inclusion within the CEMP.

Operation

Wind Turbine Noise

8.7.5 Predicted operational noise from wind turbines has been demonstrated to meet appropriate noise limits, both for the Proposed Development operating in isolation and cumulatively. No mitigation is therefore required.

Fixed (Non-turbine) Plant Noise

8.7.6 Any fixed plant will, where necessary, include a noise mitigation scheme to ensure that the derived plant noise limits will be achieved. This scheme will include measures such as appropriate plant selection, building fabrication, plant enclosures and appropriate plant orientations etc.

8.7.7 If necessary, the derived noise level limits could be incorporated into an appropriately worded conditional planning approval to ensure a commensurate level of protection against fixed plant noise for existing local residents.

8.8 Residual Effects

Construction & Decommissioning Phases

Construction/Decommissioning Noise

8.8.1 Noise from construction activities on site will be controlled in accordance with the CDEMP. Residual effects will therefore be similar to, or lesser than, potential noise effects. Residual noise effects associated with on-site construction activities are therefore neutral at all NSRs, and are not significant.

Operation

Wind Turbine Noise

8.8.2 No mitigation is required for operational wind turbine noise, therefore residual effects remain unchanged, and are not significant.

Fixed (Non-turbine) Plant Noise

8.8.3 Compliance with the derived noise level limits would ensure that noise from the operation of the proposed fixed plant would give rise to an impact magnitude of negligible.

8.8.4 With reference to **Table 8.13**, for receptors of high sensitivity, this impact magnitude corresponds to an effect significance of neutral and is therefore not significant.

8.9 Cumulative Assessment

8.9.1 As required by ETSU-R-97, the completed assessment of operational turbine noise includes potential cumulative impacts from other local wind farm developments which are operational, approved, and subject to valid planning applications. It has been demonstrated that the ETSU-R-97 noise level limits, which are applicable to cumulative noise can be complied with.

8.9.2 For construction noise, construction vibration and noise from fixed (non-turbine) plant, the considered cumulative developments are sufficiently removed, that no change in the identified effect significances are anticipated to arise should construction works or operation arise simultaneously.

8.10 Summary

8.10.1 This chapter has considered potential noise effects associated with construction and operation of the Proposed Development. No potential vibration effects have been identified and consideration of vibration has therefore been scoped out.

8.10.2 The assessment of noise comprised consultation with SIC, characterisation of the baseline noise environment, prediction of noise levels associated with construction activities, construction traffic, operational wind turbines and operation of other non-turbine fixed plant, and evaluation of predicted levels against derived criteria.

8.10.3 Baseline noise levels in the study area are typically dominated by wildlife and livestock, and show a strong correlation with wind speed. Noise from anthropogenic sources, such as road traffic, is a minor contributor to total noise levels.

8.10.4 Predicted noise levels associated with construction activities meet threshold noise levels set out in the relevant guidance at all identified representative NSRs, both during weekday and weekend daytime periods. Noise effects from construction activities are therefore "not significant".

8.10.5 The predicted change in road traffic noise levels associated with construction traffic is less than 1 dB, and has therefore been assessed as being of neutral significance. Noise effects from construction activities are therefore "not significant".

8.10.6 Predicted wind turbine noise levels associated with operation of the Proposed Development meet derived noise limits at all identified representative NSRs, both in isolation and cumulatively. Noise effects due to operation are therefore “not significant”.

8.10.7 Noise limits have been derived for non-turbine fixed plant associated with operation of the Proposed Development. Items of fixed plant will be specified such that they meet the derived noise limits at all representative NSRs. Noise effects from fixed plant are therefore “not significant”.

Table 8.20 – Summary of Effects

Description of Effect	Significance of Potential Effect		Mitigation Measure	Significance of Residual Effect	
	Significance	Beneficial/ Adverse		Significance	Beneficial/ Adverse
Construction					
Noise from on-site construction activities	Neutral	Adverse	Implementation of CDEMP.	Neutral	Adverse
Change in road traffic noise due construction traffic	Neutral	Adverse	Appropriate scheduling of site deliveries and controls on idling vehicles.	Neutral	Adverse
Operation					
Noise from operational wind turbines	Neutral	Adverse	None proposed.	Neutral	Adverse
Noise from non-turbine fixed plant	Neutral	Adverse	None proposed.	Neutral	Adverse
Decommissioning					
Noise from on-site construction activities	Neutral	Adverse	Implementation of CDEMP.	Neutral	Adverse

Summary of Cumulative Effects

8.10.8 As required by ETSU-R-97, the completed assessment of operational turbine noise includes potential cumulative impacts from other local wind farm developments which are operational, approved, and subject to valid planning applications. It has been demonstrated that the ETSU-R-97 noise level limits, which are applicable to cumulative noise can be complied with.

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