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Chapter 11

Noise

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Glossary

Term	Definition
Environmental Impact Assessment	Environmental Impact Assessment (EIA) is a means of drawing together by the developer, in a systematic way, a description of the development and information relating to the likely significant environmental effects arising from a Proposed Development
Environmental Impact Assessment Report	A document reporting the findings of the EIA and produced in accordance with the Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017 Regulation 5
Proposed Development	The proposed Scawd Law Wind Farm development
The Proposed Development Area	The development area within the red line site boundary (application area) as shown in Volume 3a Figure 1.2: Site Layout.
perA-weighting	A frequency weighting designed to correlate measured sound levels with subjective human response. The human ear is frequency selective and our ears are most sensitive between 500 Hz to 6 kHz, particularly when compared with lower and higher frequencies. The A-weighting applies a frequency correction which reduces the effect of these low and high frequencies on the overall measured level in order to account for the subjective human response at these frequencies.
L_{Aeq}	The A-weighted (see above) equivalent energy average noise level over a given time period.
L_{A90}	The A-weighted noise level exceeded for 90% of the time, often used to describe background or wind turbine noise as it excludes transient noises that affect the L_{Aeq}.

List of Abbreviations

Abbreviation	Description
AL	Advisory Leaflet
AM	Amplitude/Aerodynamic Modulation
ANC	Association of Noise Consultants
BS 5228	BS:5228:2009 +A1:2014, Code of practice for noise and vibration control on construction and open sites (February 2014)
CRTN	The Calculation of Road Traffic Noise (CRTN) (Department of Transport, Welsh Office, 1988)
dB	Decibel
DECC	Department of Energy and Climate Change
DTI	Department of Trade and Industry
EIA	Environmental Impact Assessment
ETSU-R-97	ETSU-R-97 The Assessment and Rating of Noise from Wind Farms, Department of Trade and Industry Working Group (September 1996)
GPG	The IOA document, A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Noise from Wind Turbines (May 2013).
IOA	Institute of Acoustics
M	Metres
MIOA	Member of the Institute of Acoustics
m/s	Metres per second
PAN1/2011	Planning Advice Note PAN1/2011, Planning and Noise, Scottish Government (March 2011)

11.1 STATEMENT OF COMPETENCE

11.1.1 The noise assessment was undertaken by the Hayes McKenzie Partnership Ltd. The lead author is Rob Shepherd (MEng), an associate at Hayes McKenzie, who is a Member of the Institute of Acoustics (MIOA) and has worked in the field of acoustical engineering for over 15 years. In that time, Rob has specialised in the field of noise from onshore wind farms and has been involved in work on over 300 wind farm projects, also appearing as an expert witness (relating to wind farm noise) in the UK (including Scotland) and Ireland. Hayes McKenzie Partnership Ltd are sponsor members of the Institute of Acoustics (IOA) and members of the Association of Noise Consultants (ANC).

11.2 INTRODUCTION

11.2.1 This chapter considers the potential noise effects of the Proposed Development on residential receptors in terms of the expected noise levels arising from its construction, operation, and decommissioning.

11.2.2 Construction and decommissioning noise resulting from the Proposed Development is discussed with reference to BS:5228:2009 +A1:2014, Code of practice for noise and vibration control on construction and open sites[1].

11.2.3 An operational noise assessment has been performed in accordance with ETSU-R-97, The Assessment and Rating of Noise from Wind Farms[2], with reference to the guidance contained within the Institute of Acoustics document, A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise[3] which is endorsed by Scottish Government. The operational noise assessment includes an assessment of cumulative noise impacts with neighbouring wind farm developments.

11.2.4 This chapter refers to the following chapter (Volume 2) and appendix (Volume 4):

- Chapter 12: Traffic and Transport; and
- Appendix 11.1: Noise Prediction Methodology.

11.3 LEGISLATION, POLICY AND GUIDANCE

Operational Noise

Planning Advice Note PAN1/2011, Planning and Noise

11.3.1 PAN1/2011[4] identifies two sources of noise from wind turbines: mechanical noise and aerodynamic noise. It states that "*good acoustical design and siting of turbines is essential to minimise the potential to generate noise*". It refers to the 'web-based planning advice' on renewables technologies for onshore wind turbines.

Scottish Government 2014, Web Based Planning Advice, Onshore Wind Turbines

11.3.2 The Web Based Planning Advice[5] (The Scottish Government, 2014) on onshore wind turbines re-iterates the sources of noise as "*the mechanical noise produced by the gearbox, generator and other parts of the drive train and the aerodynamic noise produced by the passage of the blades through the air*" and that "*there has been significant reduction in the mechanical noise generated by wind turbines through improved turbine design". It states that "the Report, "The Assessment and Rating of Noise from Wind Farms" (Final Report, Sept 1996, DTI), (ETSU-R-97), 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*". It notes that "*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*".

11.3.3 It introduces the IOA A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise (GPG), and states that "*The Scottish Government accepts that the guide represents current industry good practice*".

11.3.4 The accompanying Technical Advice Note[6] to PAN1/2011, Assessment of Noise, lists BS 5228, Noise and Vibration Control on Construction and Open Sites as being applicable for Environmental Impact Assessment (EIA) and planning purposes.

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

11.3.5 ETSU-R-97, The Assessment and Rating of Noise from Wind Farms, presents the recommendations of the Working Group on Noise from Wind Turbines, set up in 1993 by the Department of Trade and Industry (DTI) as a result of difficulties experienced in applying the noise guidelines existing at the time to wind farm noise assessments. The group comprised independent experts on wind turbine noise, wind farm developers, DTI personnel and local authority Environmental Health Officers. In September 1996, the Working Group published its findings by way of report ETSU-R-97. This document describes a framework for the measurement of wind farm noise and contains suggested noise limits, which were derived with reference to existing standards and guidance relating to noise emission from various sources.

11.3.6 ETSU-R-97 recommends that, although noise limits should be set relative to existing background and should reflect the variation of both turbine and background noise with wind speed; this can imply very low noise limits in particularly quiet areas, in which case, "*it is not necessary to use a margin above background in such low-noise environments. This would be unduly restrictive on developments which are recognised as having wider global benefits. Such low limits are, in any event, not necessary in order to offer a reasonable degree of protection to the wind farm neighbour.*"

11.3.7 For day-time periods, the noise limit is 35-40 dB L_{A90} or 5 dB(A) above the 'quiet day-time hours' prevailing background noise, whichever is the greater. The actual value within the 35-40 dB(A) range depends on the number of dwellings in the vicinity; the impact of the limit on the number of kWh generated; and the duration of the level of exposure.

11.3.8 For night-time periods, the noise limit is 43 dB L_{A90} or 5 dB(A) above the prevailing night-time hours background noise, whichever is the greater. The 43 dB(A) lower limit is based on an internal sleep disturbance criterion of 35 dB(A) with an allowance of 10 dB(A) for attenuation through an open window and 2 dB(A) subtracted to account for the use of L_{A90} rather the L_{Aeq}.

11.3.9 Residential properties where the occupier has financial involvement with the wind farm are allowed higher 'financially involved' noise limits where the lower fixed limits (for both the daytime and night-time) are increased to 45 dB L_{A90}.

11.3.10 Where predicted noise levels are low at the nearest residential properties a simplified noise limit can be applied, such that noise is restricted to the minimum ETSU-R-97 level of 35 dB L_{A90} for wind speeds up to 10 m/s when measured at 10 m height. This removes the need for extensive background noise measurements for smaller or more remote schemes.

[1] British Standards Institute (2009 + 2014). BS 5228 + A1, Code of Practice for Noise and Vibration Control on Construction and Open Sites. BSI

[2] Department of Trade and Industry (1996). ETSU-R-97, The Assessment and Rating of Noise from Wind Farms. ETSU/DTI Available at: https://webarchive.nationalarchives.gov.uk/+/http:/www.berr.gov.uk/files/file20433.pdf

[3] Institute of Acoustics (May 2013). A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise. IOA. Available at: https://www.ioa.org.uk/publications/wind-turbine-noise

[4] Scottish Government (March 2011). PAN1/2011. Planning and Noise. Available at: https://www.gov.scot/publications/planning-advice-note-1-2011-planning-noise/

[5] Scottish Government (May 2014). Onshore Wind Turbines. Available at: https://www.gov.scot/publications/onshore-wind-turbines-planning-advice/

[6] Assessment of noise: technical advice note, https://www.gov.scot/publications/technical-advice-note-assessment-noise/

11.3.11 It is stated that the $L_{A90,10min}$ noise descriptor should be adopted for both background and wind farm noise levels and that, for the wind farm noise, this is likely to be between 1.5 and 2.5 dB less than the L_{Aeq} measured over the same period. The $L_{Aeq,t}$ is the equivalent continuous 'A' weighted sound pressure level occurring over the measurement period 't'. It is often used as a description of the average ambient noise level. Use of the L_{A90} descriptor for wind farm noise allows reliable measurements to be made without corruption from relatively loud, transitory noise events from other sources.

11.3.12 ETSU-R-97 also specifies that a penalty should be added to the predicted noise levels, where any tonal component is present. The level of this penalty is described and is related to the level by which any tonal components exceed the threshold of audibility.

11.3.13 With regard to multiple wind farms in a given area, ETSU-R-97 specifies that the absolute noise limits and margins above background should relate to the cumulative impact of all wind turbines in the area contributing to the noise received at the properties in question. Existing wind farms should therefore be included in cumulative predictions of noise level for proposed wind turbines and not considered as part of the prevailing background noise.

A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise

11.3.14 In May 2013, the IOA published A GPG to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, as referred to in the Web Based Planning Advice. This was subsequently endorsed by the Secretary of State for Energy and Climate Change and by the Scottish Ministers. The publication of the GPG followed a review of current practice carried out for the Department of Energy and Climate Change (DECC) and an IOA discussion document which preceded the GPG.

11.3.15 The GPG includes sections on Context; Background Noise Data Collection; Data Analysis and Noise Limit Derivation; Noise Predictions; Cumulative Issues; Reporting; and Other Matters including Planning Conditions, Amplitude Modulation, Post Completion Measurements and Supplementary Guidance Notes. The Context section states that the guide "*presents current good practice in the application of the ETSU-R-97 assessment methodology for all wind turbine development above 50 kW, reflecting the original principles within ETSU-R-97, and the results of research carried out and experience gained since ETSU-R-97 was published*". It adds that "*the noise limits in ETSU-R-97 have not been examined as these are a matter for Government*".

11.3.16 As well as expanding on and, in some areas, clarifying issues which are already referred to in ETSU-R-97, additional guidance is provided on noise prediction and a preferred methodology for dealing with wind shear. The guidance within the GPG has been considered and followed for this assessment.

Other Issues Arising

Tonal Noise

11.3.17 As discussed at Paragraph 11.3.12, ETSU-R-97 specifies that, in line with other noise guidance, a penalty should be added to measured or predicted wind turbine noise levels if there is tonal noise above a certain level which is audible at residential properties. In this assessment, it has been assumed that there would be no tonal noise associated with the operation of the wind farm which would give rise to such a penalty as most modern turbines operate without significant tonal noise. A penalty is usually included with the planning conditions for wind farms requiring a tonal penalty to be added to measured noise levels, where required, before comparing them with the noise limits. Warranty agreements with turbine suppliers ensure that any such penalties will not occur in practice.

Low Frequency and Infrasound

11.3.18 Low frequency sound is typically defined as sound in the audible hearing frequency range of 20 Hz up to about 200 Hz. Infra-sound is noise occurring at frequencies below that at which sound is normally audible, i.e. at less than about 20 Hz, due to the significantly reduced sensitivity of the ear at such frequencies. In this frequency range, for sound to be perceptible, it has to be at very high amplitude, which is not the case for wind turbine noise.

11.3.19 Noise from wind turbines is not inherently low-frequency and it is typically broad-band in nature, and close to a wind turbine the dominant frequencies are usually in the 250 to 2000 Hz range. As the distance from a wind farm site increases the noise level decreases as a result of the spreading out of the sound energy and also due to air absorption which increases with increasing frequency. This means that, although the energy across the whole frequency range is reduced, higher frequencies are reduced more than lower frequencies with the effect that as distance from the site increases the ratio of low to high frequencies also increases. This effect may be observed with road traffic noise or natural sources, such as the sea, where higher frequency components are diminished relative to lower frequency components at long distances. At such distances, however, the overall noise level is so low, such that any bias in the frequency spectrum is insignificant.

11.3.20 Work carried out in 2006[7] by Hayes McKenzie for the UK Department of Trade and Industry to investigate the extent of low frequency and infrasonic noise from three UK wind farms concluded that "*the common cause of complaints associated with noise at all three wind farms is not associated with low frequency noise, but is the audible modulation of the aerodynamic noise, especially at night*". It is therefore considered that low frequency noise can be scoped out of the assessment.

11.3.21 In November 2016, a study into low frequency and infrasound was published by the State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Wuerttemberg[8] that contained a comprehensive review of low frequency and infrasound from wind turbines, and evaluated such noise in relation to other sources. The results state that "*the infrasound level in the vicinity of wind turbines is – at distances between 120 m and 300 m – well below the threshold of what humans perceive*" and that "*at a distance of 700 m from the wind turbines, it was observed by means of measurements that when the turbine is switched on, the measured infrasound level did not increase or only increased to a limited extent. The infrasound was generated mainly by the wind and not by the turbines*".

11.3.22 The report concludes that "*Infrasound is caused by a large number of different natural and technical sources. It is an everyday part of our environment that can be found everywhere. Wind turbines make no considerable contribution to it. The infrasound level generated by them lie clearly below the limits of human perception. There is no scientifically proven evidence of adverse effects in this level range*". It is therefore considered that infrasound can be scoped out of the assessment

Amplitude Modulation

11.3.23 The variation in noise level associated with wind turbine operation, at the rate at which turbine blades pass any fixed point of their rotation (the blade passing frequency), is often referred to as blade swish or Amplitude/ Aerodynamic Modulation (AM). This effect is identified within ETSU-R-97 where it is envisaged that *"… modulation of blade noise may result in variation of the overall A-Weighted noise level by as much as 3 dB(A) (peak to trough) when measured close to a wind turbine...* " and that at distances further from the turbine where there are *"… more than two hard, reflective surfaces, then the increase in modulation depth may be as much as 6 dB(A) (peak to trough)*". There have been instances where level of AM rates are higher than this, which results in the noise being perceived as more intrusive (in the same way as tonal content makes the noise more intrusive).

[7] Department of Trade and Industry (2006). ETSU W/45/00656/00/00, The Measurement of Low Frequency Noise at 3 UK Windfarms. Hayes McKenzie Partnership Ltd. for ETSU/DTI

[8] State Office for the Environment, Measurement and Nature Conservation of the Federal State of Baden-Wuerttemberg (September 2016, updated November 2016), Low-frequency noise incl. infrasound from wind turbines and other sources

11.3.24 The DECC commissioned a Wind Turbine AM Review report[9] that was published in two phases: Phase 1 in September 2015 and Phase 2 in October 2016 (although the Phase 2 report is dated August 2016). Phase 1 of the report sets out the approach and methodology to the review and research, and the Phase 2 report includes a literature review, research into human response to AM, and recommends how excessive AM might be controlled through the use of a planning condition. The report includes recommendations on how AM should be addressed when quantified according to the recommendations of a separate IOA working group document, A Method for Rating Amplitude Modulation in Wind Turbine Noise[10] (August 2016).

11.3.25 The AM Review reports recommend a two-tier approach whereby the first tier seeks a reduction in the depth and/or occurrence of AM with a rating level (according to the IOA Amplitude Modulation Working Group method) ≥3 dB. Whether remedial action is required depends on the prevalence of any complaints, and how often AM rating levels ≥3 dB occur. The second tier is that if AM is deemed to be a significant issue, and if nothing can be done to reduce the level of AM, then a penalty scheme has been proposed whereby a penalty ranging from 3 dB (for a rating level of 3 dB) up to a maximum of 5 dB (for a rating level of 10 dB and above) could be added to the measured level before measured levels are compared with the relevant noise limits.

11.3.26 It should be noted that most wind farms operate without significant AM, and that it is not possible to predict the likely occurrence of AM. At the time of writing there has been no official response to those recommendations from the IOA Noise Working group or endorsement from any Scottish Government Minister or Department. The IOA GPG, states that '*the evidence in relation to "Excess" or "other" Amplitude Modulation (AM) is still developing. At the time of writing, current practice is not to assign a planning condition to deal with AM'*, although it is possible to control such noise with an appropriately worded planning condition if necessary.

Construction Noise

11.3.27 The Scottish Government's Technical Advice Note, Assessment of Noise, states that, for planning purposes, construction noise should be assessed according to BS 5228:2009+A1:2014, Noise and Vibration Control on Construction and Open Sites. The standard provides example criteria for the assessment of the significance of construction noise effects and a method for the prediction of noise levels from construction activities. Two example methods are provided for assessing significance.

11.3.28 The first is based on the use of criteria defined in Department of the Environment Advisory Leaflet (AL) 72, Noise Control On Building Sites[11] (1976) which sets a fixed limit of 70 dB(A) in rural suburban and urban areas away from main roads and traffic. Noise levels are generally taken as façade L_{Aeq} values with free-field levels taken to be 3 dB lower, giving an equivalent noise criterion of 67 dB L_{Aeq}.

11.3.29 The second is based on noise change, with a 5 dB increase in overall noise considered to be significant. However, when existing noise levels are low, such as at this site, and construction activities continue for more than one month, minimum criteria are applicable. These are 45, 55 and 65 dB L_{Aeq}, for night-time (2300-0700), evening and weekends, and daytime (0700-1900) including Saturdays (0700-1300) respectively. This is referred to as the ABC method in BS 5228-1 and is described at paragraph E.3.2 and Table E.1 of the standard.

11.3.30 Road traffic noise from construction vehicles accessing the site has been assessed by calculating the increase in road traffic noise caused by construction vehicles above that caused by the existing traffic flow. Predictions were undertaken using The Calculation of Road Traffic Noise[12] (CRTN) (Department of Transport, Welsh Office, 1988).

11.3.31 In terms of increases in noise levels for similar sounds, a 10 dB increase is perceived as a doubling of loudness, a 3 dB increase is typically the minimum perceptible for environmental sounds outdoors, and 1 dB is the minimum change in noise level perceptible under laboratory test conditions.

11.4 METHOD OF ASSESSMENT

Operational Noise

11.4.1 Operational noise has been assessed by comparing predicted noise levels at noise sensitive residential receptors that are not financially involved with the Proposed Development with the ETSU-R-97 simplified noise limit of 35 dB L_{A90} as the scheme is relatively remote from residential properties. At noise sensitive residential properties where the occupants are financially involved with the Proposed Development, a noise limit of 45 dB L_{A90} has been applied as the lowest noise limit applying to such properties under ESU-R-97.

11.4.2 The ETSU-R-97 noise limits apply to cumulative noise from all wind farm developments in the vicinity and not from the Proposed Development acting alone. Consideration therefore needs to be made as to whether cumulative operational wind farm noise levels could exceed the noise limits described above. In this case, the nearest wind farms are sufficiently distant such that noise from other wind farms is more than 10 dB below the ETSU-R-97 simplified noise limit and therefore does not add significantly to noise from the Proposed Development. Cumulative operational noise levels would not exceed the relevant noise limits and therefore a cumulative noise assessment is not required.

11.4.3 Operational noise is assessed against the relevant noise limits described above. Where the relevant noise limits are met, operational noise levels are determined to be acceptable and therefore not significant.

Construction Noise

11.4.4 Daytime construction activities with a duration of one month or longer are assessed against the 65 dB L_{Aeq} noise limit, and if noise levels from predicted construction activities are below this then no significant noise impacts are predicted. Where construction activities have a duration of less than one month, noise levels above 65 dB L_{Aeq} are considered to be acceptable as long as mitigation is implemented to reduce the impact as much as reasonably practicable.

11.4.5 In respect of road traffic noise, a doubling of road traffic would, see a 3 dB increase in noise level at receptor locations above existing road traffic noise levels. It is considered that if road traffic noise increases (predicted using CRTN) during the construction phase are below 3 dB then no significant impacts are predicted, and if the predicted increase is less than 1 dB then no impact is predicted. There will be no impact from road traffic noise during the operational phase of the wind farm as the daily increase in road traffic noise during the operational phase would be less than 1 dB. Where road traffic noise level increases are above 3 dB the absolute noise levels can be compared with the relevant construction noise limits described at paragraph 11.4.4 above.

11.5 CONSULTATION

11.5.1 The Scoping Report (dated 28 July 2020) described the relevant legislation and guidance for operational and construction noise, which is still applicable. It was proposed to scope out operational and construction noise due to the large separation distances between the closest proposed turbines and noise sensitive residential receptor locations that are not financially involved with the Proposed Development.

[9] Department of Energy and Climate Change (2016). Wind Turbine AM Review: Phase 1 & Phase 2 Reports. DECC. Available at: https://www.gov.uk/government/publications/review-of-the-evidence-on-the-response-to-amplitude-modulation-from-wind-turbines

[10] Institute of Acoustics (2016). A Method for Rating Amplitude Modulation in Wind Turbine Noise - Version 1. IOA. Available at: https://www.ioa.org.uk/sites/default/files/AMWG%20Final%20Report-09-08-2016_1.pdf

[11] Department of Environment (1976). Advisory Leaflet 72, Noise control on building sites, DoE

[12] Department of Transport Welsh Office (1988). Calculation of Road Traffic Noise. London: HMSO

11.5.2 The Scoping Opinion (dated 21 October 2020) received from the Scottish Government stated that '*The noise assessment should be carried out in line with relevant legislation and standards as detailed on page 80 of the scoping report. The noise assessment report should be formatted as per Table 6.1 of the IOA "A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise'*.

11.5.3 The response from the Environmental Health department of Scottish Borders Council (dated 27 August 2020) stated that '*A noise impact assessment which considers the result of the proposal on nearby residential receptors should also be undertaken*'.

11.5.4 Although it was proposed to scope out operational and construction noise from the assessment, neither the Scoping Opinion from the Scottish Government, or the response form the Environmental Health department of Scottish Borders Council specifically agreed to this. Operational and construction noise have therefore been considered here despite the large separation distances between the turbine locations and non-involved residential receptors.

11.5.5 The noise assessment has been undertaken in accordance with the legislation and standards described in the Scoping Report, which includes the IOA GPG, and including an assessment of the potential noise impact on nearby residential receptors.

11.6 BASELINE NOISE

11.6.1 Baseline noise measurements have not been undertaken as construction and operational noise levels are predicted to meet the relevant noise limits that apply irrespective of existing baseline noise levels. If baseline noise measurements were undertaken, the resultant derived noise limits would be set at the greater of the daytime or night time lower limiting value or plus 5 dB above background and would therefore be the same or higher than the fixed limits assumed for this assessment.

11.7 ASSESSMENT OF POTENTIAL EFFECTS

Operational Noise

11.7.1 Operational noise predictions have been carried out according to the methodology described in the IOA GPG, with the full methodology set out in Appendix 11.1: Noise Methodology. Predictions were carried out for the layout shown at Table 13.1 below.

Table 13.1 Wind turbine coordinates (British National Grid)

Turbine ID	Easting	Northing	Hub Height (m)
1	336020	640609	113
2	335901	640940	113
3	335793	641399	113
4	336495	641194	113
5	336756	640856	113
6	336191	641911	113
7	336633	642429	113
8	337184	643040	113

11.7.2 Predictions were made at the residential noise sensitive receptors shown at Table 13.2 below.

Table 13.2 Receptor coordinates (British National Grid)

Receptor Name	Easting	Northing
Seathope Cottage*	337726	640868
Caberstongrains*	337638	640872
Caddonhead	340034	641049
Seethope Cottage, Hogg's Knowe	339153	637783
Old Caberston	336920	637744
Walkerburn Nearest	336540	637412
The Bothy, The Common	333483	639540
Colquhar	333266	641552
Glentress	333916	643085
Blackhopebyres	334403	644030
Blackhopebyres Steading	334413	644051

* These properties are inhabited by residents that are financially involved with the Proposed Development.

11.7.3 Whilst a candidate turbine will not be decided upon until pre-construction procurement processes have been finalised, for the purposed of this assessment, the candidate turbine assumed for the operational noise predictions is the Vestas V150 6.0 MW which is considered to be representative for turbines of this scale and class. Sound power levels supplied by the manufacturer with 2 dB added to account for uncertainty are shown at Table 13.3 below. The maximum sound power level is reached at a hub height wind speed of 11 m/s and does not increase above this, i.e. at higher wind speeds the sound power level remains constant.

Table 13.3 Candidate wind turbine sound power levels (dB L_{WA})

Wind Farm and Turbine Type	Hub Height Wind Speed (m/s)								
	3	4	5	6	7	8	9	10	>11
Vestas V150 6.0 MW	96.8	97.0	98.8	101.7	104.7	107.5	109.4	109.6	109.7

11.7.4 The octave band noise spectra used for the predictions have been taken from the technical specifications for a Vestas V150 5.6 MW turbine which has the same maximum sound power level as the Vestas V150 6.0 MW candidate turbine, with the results shown in Table 13.4, also including 2 dB added for uncertainty.

Table 13.4 Candidate wind turbine octave band levels (dB L_{WA})

Turbine Type	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Vestas V150 5.6 MW	88.1	96.8	102.4	104.8	104.2	100.4	93.6	83.5

Concave Ground Profile

11.7.5 The propagation paths between each turbine and each receptor location have been reviewed according to the methodology described in Appendix 11.1 to determine whether any concave ground profile corrections are required. In this case, the concave ground profile corrections were identified at two receptor locations as shown at Table 13.5 below. No concave ground profiles were identified for any other turbine to receptor location.

Table 13.5 Concave ground profile corrections (dB)

Location	Turbine ID								Overall Correction (dB)
	1	2	3	4	5	6	7	8	
Seathope Cottage	0	0	0	0	0	3	3	0	0.6
Caberstongrains	0	0	0	0	0	0	3	0	0.3

Topographical Shielding

11.7.6 Due to the topography of the site, the tips of a number of the turbines are not visible at the noise sensitive receptor locations resulting in a reduction in predicted noise level. The topographical shielding identified for each turbine to receptor path is shown at Table 13.6 below.

Table 13.6 Topographical shielding corrections (dB)

Location	Overall Correction (dB)								
	1	2	3	4	5	6	7	8	
Seathope Cottage	-2	-2	0	0	0	0	0	-2	-0.3
Caberstongrains	-2	-2	0	0	0	0	0	0	-0.3
Caddonhead	-2	-2	-2	-2	-2	-2	-2	-2	-2.0
Seethope Cottage, Hogg's Knowe	0	0	0	-2	-2	-2	-2	-2	-1.0
Old Caberston	-2	-2	-2	-2	-2	-2	-2	-2	-2.0
Walkerburn Nearest	-2	-2	-2	-2	-2	-2	-2	-2	-2.0
The Bothy, The Common	-2	-2	0	-2	-2	-2	-2	-2	-1.5
Colquhar	-2	-2	0	-2	-2	0	0	0	-0.9
Glentress	-2	-2	-2	-2	-2	0	0	0	-1.0
Blackhopebyres	-2	-2	-2	-2	-2	-2	-2	-2	-2.0
Blackhopebyres Steading	-2	-2	-2	-2	-2	-2	-2	-2	-2.0

Prediction Results

11.7.7 The results of the operational noise predictions are shown at Table 13.7 below, including the relative heights of the turbines and receptors, and concave ground profile and topographical shielding corrections identified at Table 13.5 and Table 13.6. The two financially involved receptor locations are identified in the table with an asterisk '*'.

Table 13.7 Predicted noise levels at receptor coordinates

Receptor Name	Predicted Noise Level (dB L_{A90})
Seathope Cottage*	39
Caberstongrains*	40
Caddonhead	26
Seethope Cottage, Hogg's Knowe	24
Old Caberston	26
Walkerburn Nearest	25
The Bothy, The Common	28
Colquhar	30
Glentress	30
Blackhopebyres	28
Blackhopebyres Steading	28

** Financially involved property*

Construction Noise

11.7.8 Detailed construction noise predictions have not been carried out here due to the large separation distances between on-site construction activities and sensitive residential receptors. It is highly likely that on-site track construction that is further than 200 m from residential properties would be below the 65 dB L_{Aeq} criterion. There is no on-site track construction proposed within 200 m of residential properties. All other on-site construction activities are likely to be less noisy.

11.7.9 It is possible that blasting will be required at the proposed borrow pit location to extract rock. It is not possible to carry out meaningful predictions as the frequency, duration and noise levels from blasting all depend very much on the type of rock, depth of charge and surrounding ground conditions onsite, together with the amount of rock that is required.

11.7.10 Where highways and cabling works are required along the route to the grid connection point, noise may be generated at times that is above the 65 dB L_{Aeq} adopted criterion, although the duration of the works is likely to be relatively short (i.e. less than one month). Specific predictions of likely noise levels have not been carried out as the likely noise levels are dependent on the specifics of the works required which are not known at this stage.

11.7.11 The predicted increase in road traffic noise levels along the construction route have been calculated using *The Calculation of Road Traffic Noise* for the worst case month of construction, month 7 as described within the Traffic and Transport Chapter. The prediction assumptions and results and shown at Table 13.8 below.

Table 13.8 Predicted road traffic noise level increases

Road	Existing Baseline Traffic Flow		Baseline + Construction Traffic Flow		Predicted Relative Change in Traffic Noise Level (dB)
	Total Traffic Flow	Total HGV (% HGV)	Total Traffic Flow	Total HGV (% HGV)	
A72 West	8393	250 (3%)	8427	262 (3%)	0.0 dB(A)
A72 East	4849	206 (4%)	4864	207 (4%)	0.0 dB(A)
B7007/B709 (north)	398	70 (18%)	427	95 (22%)	0.8 dB(A)
B709 (south)	398	70 (18%)	447	83 (19%)	0.6 dB(A)

11.7.12 Noise predictions have not been undertaken for decommissioning activities, but the large separation distances between breaking up of the concreate foundations (likely to be the noisiest activity) and residential properties

would result in noise levels at residential properties that are likely to be significantly below the adopted construction noise limit.

11.8 ASSESSMENT OF IMPACTS

Operational Noise Assessment

11.8.1 Predicted noise levels are below the ETSU-R-97 simplified noise limit of 35 dB L_{A90} at all noise sensitive receptor locations not financially involved with the Proposed Development. At the two residential properties that are financially involved with the Proposed Development (marked with an asterisk '*') predicted noise levels are below the financially involved noise limit of 45 dB L_{A90}.

Table 13.9 Noise assessment results

Receptor Name	Predicted Noise Level (dB L_{A90})	Noise Limit (dB L_{A90})	Margin to Limit (dB)
Seathope Cottage*	39	45	6
Caberstongrains*	40	45	5
Caddonhead	26	35	9
Seethope Cottage, Hogg's Knowe	24	35	11
Old Caberston	26	35	9
Walkerburn Nearest	25	35	10
The Bothy, The Common	28	35	7
Colquhar	30	35	5
Glentress	30	35	5
Blackhopebyres	28	35	7
Blackhopebyres Steading	28	35	7

Construction Noise Assessment

11.8.2 Detailed construction predictions have not been undertaken due to the large separation distances between construction activities and residential properties.

11.8.3 Noise from on-site construction activities are likely to be significantly below the 65 dB L_{Aeq} criterion, and it can therefore be concluded that noise impact from on-site construction activities will be not significant.

11.8.4 An additional construction noise impact would be blasting associated with the proposed borrow pit in order to obtain materials for the construction of turbine bases and the onsite access road. This type of noise does not typically fall within the assessment of normal construction noise because of the extremely high amplitude and impulsive nature of the waveform. It is very likely that blasting noise could be heard at nearby residential locations but a construction noise assessment would average noise levels across the day and is therefore not applicable to use for the assessment of blasting noise impacts. Mitigation to reduce the noise impact from blasting activities is set out in section 11.10.6, and with the mitigation implemented, noise from blasting activities is considered to be not significant.

11.8.5 Where highways upgrades (for example to facilitate AIL access) and cabling between the site and grid connection is carried out close to residential properties, there may be temporary short-term noise impacts, with the level of impact dependant on the specific work required. It is likely, however, that noisy activities near residential properties will generally continue for a duration of much less than one month, and therefore this short-term noise impact can be considered to be not significant.

Road Traffic Noise

11.8.6 As shown at Table 13.8, increases in road traffic are predicted to be small in relation to existing traffic flows. At receptor locations along the A72 the increase in road traffic noise level is 0.8 dB, which is the maximum increase predicted, and therefore the noise impact is determined to be negligible and therefore not significant. It should be noted that the construction road traffic noise assessment is based on the noisiest month of construction and that for other months the overall impact is predicted to be lower.

11.9 CUMULATIVE IMPACTS

Cumulative Operational Noise

11.9.1 There are no nearby wind farms where receptor locations could be downwind of the Proposed Development and other wind farms simultaneously and exposed to predicted operational noise levels from other developments above 25 dB L_{A90} such that there could be potential cumulative noise impacts. There are therefore no significant cumulative operational noise impacts predicted.

Cumulative Construction Noise

11.9.2 The construction of the Proposed Development is suitably remote such that no cumulative construction projects would be likely to cause any significant impacts.

11.10 MITIGATION

Operational Mitigation

11.10.1 No specific operational mitigation is required as the relevant noise limits are met (see Table 13.7). It should be noted that noise-reduced modes of operation are generally available for wind turbines of the scale proposed here that allow noise levels to be reduced by restricting the rotational speed of the machines. This mitigation could be employed in the unlikely event of any noise issues arising that would require mitigation to be implemented to enable the relevant limits to be met.

11.10.2 Noise from the operation of the wind farm is usually controlled through the implementation of planning conditions on noise that contain permissible limits. In this way if any operational noise issues arise then measurements can be undertaken to ascertain whether the site is operating within the appropriate noise limits.

Construction Noise Mitigation

11.10.3 Noise during construction works would be controlled by generally restricting works to standard working hours and exclude Sundays, unless specifically agreed otherwise.

11.10.4 BS 5228 states that the 'attitude of the contractor' is important in minimising the likelihood of complaints and therefore consultation with the local authority would be required along with providing information to residents on intended activity.

11.10.5 The construction and decommissioning works on-site would be carried out in accordance with:

- relevant EU Directives and UK Statutory Instruments that limit noise emissions from a variety of construction plant;
- the guidance set out in PAN1/2011 and BS5228: 2009; and
- Section 61 of the Control of Pollution Act 1974 and Section 80 of the Environmental Protection Act.

11.10.6 Where construction activities relating to highways improvements or cabling for the grid connection are within 200 m of a residential property, contractors would be required to assess noise impacts during the construction phase and a noise control plan would be produced that includes:

- procedures for ensuring compliance with statutory or other identified noise control limits;
- procedures for minimising noise from construction related traffic on the existing road network;
- procedures for ensuring that all works are carried out in accordance with the principle of “Best Practicable Means” as defined in the Control of Pollution Act 1974; and
- general induction training for site operatives, and specific training for staff having responsibility for particular aspects of controlling noise from the site.

11.10.7 The most appropriate way to address blasting noise is through a condition requiring a pre-blasting noise management programme to be submitted and agreed in writing prior to any blasting operations taking place. This would identify the most sensitive receptors that could be potentially affected by blasting noise. The plan would contain details of the proposed frequency of blasting, and proposed monitoring procedures. The operator would inform the nearest residents of the proposed times of blasting and of any deviation from this programme in advance of the operations. The plan would also contain contact details which would be provided to local residents should concerns arise regarding construction and blasting activities. In addition, each blast will be designed carefully to maximise its efficiency and to reduce the transmission of noise.

Decommissioning

11.10.8 Noise during decommissioning will be controlled through the relevant standards and best practice available at the time. Noise generation during decommissioning is likely to be similar to during construction and similar measures proposed for noise mitigation, essentially management controls to ensure excessive noise is not generated, would be employed.

11.11 CONCLUSIONS

11.11.1 A noise assessment has been carried out for the Proposed Development by comparing predicted operational noise levels, with the ETSU-R-97 simplified noise limit of 35 dB L_{A90}, at residential receptor locations that are not involved with the development. At residential receptor locations that are financially involved, operational noise levels have been assessed against the financially involved limit of 45 dB L_{A90}. In addition, no significant cumulative operational noise impacts are predicted.

11.11.2 A construction noise assessment has been undertaken with reference to BS5288:2009, Noise and Vibration Control on Construction and Open Sites, which indicates that noise from construction activities will be significantly below the adopted daytime noise limit of 65 dB L_{Aeq}, and therefore no significant construction noise impacts are predicted. Noise associated with off-site highways improvements and cabling requirements to the grid connections is not significant due to the relatively short-term impacts. Mitigation will be implemented such that, although blasting activities may be detected at residential properties, the impact is not significant.

11.11.3 No significant impacts are predicted for road traffic noise generated by construction traffic accessing the site during the construction phase of the development as the predicted noise increase is negligible.

11.12 PLANNING CONDITION ON NOISE

11.12.1 Predicted operational noise levels are below the ETSU-R-97 simplified noise limit or financially involved limits as appropriate. The operation noise planning condition proposed is therefore relatively straightforward and is set out below.

At wind speeds not exceeding 10 m/s, the wind turbine noise level at any dwelling shall not exceed 35 dB $L_{A90, 10min}$, for standardised 10 metre height wind speeds of up to 10 m/s. At any dwelling which is financially involved with the wind farm the noise limit is increased to 45 dB L_{A90}.

For the purposes of this condition:

"wind turbine noise level" means the rated noise level due to the cumulative effect of the Scawd Law wind turbines, excluding existing background noise level but including any tonal penalty incurred under the methodology described in ETSU-R-97 and A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise, May 2013.

“Standardised 10 metre height wind speed” means the hub height wind speed corrected to a reference height of 10 m assuming a logarithmic wind shear profile and a ground roughness length of 0.05 m.

Reason: to protect the amenity of residential properties in the locality.