



Dalfad Wind Farm

Environmental Impact Assessment Report

Technical Appendix 9.1: Assessment Methodology

APPENDIX 9.1 – ASSESSMENT METHODOLOGY

1. INTRODUCTION

- 1.1 This Technical Appendix sets out the assessment methodology and consultation basis for the noise assessment of the Proposed Development. It supports **Chapter 9: Noise** of the EIA Report and should be read, where applicable, alongside **Chapter 9** and its other technical appendices.
- 1.2 **Technical Appendix 9.2: Baseline Noise Survey** presents details of the baseline noise survey, the measurement results, and derived background noise relationships. **Technical Appendix 9.3: Noise Calculations, Predictions and Assessment** presents the acoustic source data, calculation inputs and detailed prediction results for each assessment element. **Technical Appendix 9.4: Noise Curtailment Strategy** presents the indicative noise curtailment strategy for the operational wind turbine noise assessment.
- 1.3 This appendix sets out the technical standards and consultation that informed the noise assessment methods and criteria. It describes the approach used to assess construction noise, construction traffic noise, operational wind turbine noise, cumulative operational wind turbine noise, ancillary electrical plant noise, and decommissioning noise. It also sets out how consultation with East Ayrshire Council has informed the assessment approach.

2. STANDARDS AND GUIDANCE

Overview

- 2.1 The noise and vibration assessment has been undertaken using topic-specific standards and guidance appropriate to the different sources associated with the Proposed Development. Operational wind turbine noise has been assessed principally in accordance with *Assessment and Rating of Wind Turbine Noise*. Construction and decommissioning noise have been assessed using BS 5228 (BSI, 2014), construction traffic noise using CRTN (Department of Transport and Welsh Office, 1988) and DMRB LA 111 (Highways England; Transport Scotland; Welsh Government; Department for Infrastructure, 2020), and noise from the BESS, substation and associated fixed plant using BS 4142 (BSI, 2019).
- 2.2 The Scottish Government's planning advice on noise provides the overarching planning and assessment context. Project-specific consultation with East Ayrshire Council (EAC) and its acoustic adviser, ACCON UK Ltd, has also informed the scope, baseline survey and assessment methodology.

Scottish Planning Guidance

Planning Advice Note 1/2011: Planning and Noise

- 2.3 Planning Advice Note 1/2011: *Planning and Noise* provides (Scottish Government, 2011) Scottish Government advice on the role of the planning system in preventing and limiting adverse effects from noise. It promotes good acoustic design, appropriate separation between noise sources and noise-sensitive development, early consultation and proportionate noise assessment.

Technical Advice Note: Assessment of Noise

- 2.4 The associated Technical Advice Note: *Assessment of Noise* (Scottish Government, 2011) provides non-prescriptive technical guidance for preparing and evaluating noise impact assessments in Scotland. It recognises that assessment should include both quantitative and qualitative considerations and that noise impact and significance cannot necessarily be determined from a numerical difference alone.
- 2.5 This has informed the contextual evaluation of effects, including consideration of the character, duration and timing of noise; the existing acoustic environment; receptor use; and the effectiveness of mitigation.

Construction and Decommissioning Noise and Vibration

- 2.6 BS 5228-1:2009+A1:2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1: Noise* is the principal standard used for predicting and assessing construction and decommissioning noise, applying the 'ABC method' set out in Annex E and identifying good-practice controls. BS 5228-2:2009+A1:2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 2: Vibration* (BSI, 2014) has informed the consideration of construction vibration and appropriate precautionary controls, although detailed vibration assessment has been scoped out based on the proposed activities and separation from sensitive receptors.

Construction Traffic Noise

Calculation of Road Traffic Noise

- 2.7 Calculation of Road Traffic Noise provides the calculation method used to determine road traffic basic noise levels from traffic flow, vehicle composition and speed.
- 2.8 CRTN has been applied to public-road construction traffic. Movements on private access tracks have instead been treated as construction activity and assessed using BS 5228-1.

DMRB LA 111

- 2.9 *Design Manual for Roads and Bridges LA 111: Noise and Vibration, Revision 2* provides the framework used to classify changes in road traffic noise and inform the evaluation of effect magnitude and significance.
- 2.10 The Proposed Development is not a highway scheme and LA 111 therefore does not have direct mandatory status. Its change bands and assessment principles have been applied indicatively as established technical guidance for interpreting temporary changes in road traffic noise.

Operational Wind Turbine Noise

Assessment and Rating of Wind Turbine Noise

- 2.11 *Assessment and Rating of Wind Turbine Noise* (DESNZ, 2026) (ARWTN) is the principal guidance used to assess operational wind turbine noise. It has been applied to selection of the day and night lower limiting values (LLVs), derivation of the total noise assessment criteria (TNAC) and site-specific noise limits (SSNLs), individual and cumulative assessment, treatment of financially involved receptors, consideration of noise-reduced operation and formulation of operational noise controls.

ETSU-R-97

- 2.12 ETSU-R-97: *The Assessment and Rating of Noise from Wind Farms* (ETSU, 1996) has been superseded by ARWTN and has not been applied as the controlling assessment framework. It remains relevant because earlier consultation and assessments of cumulative developments were undertaken under ETSU-R-97, and because several established technical procedures incorporated into later Institute of Acoustics (IOA) guidance originated from it. Where the two documents differ, ARWTN has been applied.

IOA Good Practice Guide

- 2.13 The *IOA Good Practice Guide to the Application of ETSU-R-97* (IOA, 2013) (IOA GPG) and its supplementary guidance notes provide detailed technical guidance on baseline data collection, data screening and processing, derivation of background noise relationships, turbine sound power data, wind shear, noise prediction and cumulative assessment. These documents have been applied where their recommendations remain compatible with ARWTN, with detailed survey application presented in **Technical Appendix 9.2** and calculation inputs and assumptions presented in **Technical Appendix 9.3**.

Wind Turbine Acoustic Emission and Propagation Standards

- 2.14 IEC 61400-11:2012+A1:2018 *Wind Turbines – Part 11: Acoustic Noise Measurement Techniques* (IEC, 2018) provides the technical basis for measuring and reporting wind turbine acoustic emissions and has informed interpretation of candidate turbine source data and standardised wind-speed conventions. Operational turbine noise propagation has been calculated using ISO 9613-2:2024 *Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation* (ISO, 2024), applied with the project-specific assumptions recommended by the IOA GPG; detailed source data and calculation settings are presented in **Technical Appendix 9.3**.

Operational Noise from BESS, Substation or Other Fixed-Plant

BS 4142

- 2.15 BS 4142:2014+A1:2019, *Methods for rating and assessing industrial and commercial sound* is the principal standard used to assess operational noise from the BESS, substation and associated fixed plant. It has informed the comparison of rating levels with representative background sound levels, application of corrections for distinctive acoustic characteristics and consideration of context, including low absolute sound levels.

Indoor Sound-Level Context

- 2.16 NANR116: *Open/Closed Window Research – Sound Insulation Through Ventilated Domestic Windows* (Waters-Fuller, Lurcock, Mackenzie, & MacKenzie, 2007) has been used as supporting evidence for the night-time contextual assessment of fixed-plant noise. An indicative 13 dB reduction through a partially open window has been used to consider likely indoor exposure, but does not replace the external BS 4142 assessment or form a separate compliance criterion.

Project-Specific Consultation

- 2.17 The assessment has taken account of EAC's Scoping Opinion response and subsequent methodology consultation with its acoustic adviser, ACCON UK Ltd. These project-specific responses have informed the scope of assessment, baseline survey, treatment of construction and fixed-plant noise, cumulative developments and reporting requirements.
- 2.18 Where consultation preceded publication of ARWTN, the methodology has been updated accordingly. Any material departure from the approach previously discussed has been identified and explained.

3. ASSESSMENT SCOPE AND STUDY AREAS

Scoped-In Topics

- 3.1 The assessment considers construction and decommissioning noise, construction traffic noise, operational wind turbine noise, operational noise from fixed-plant associated with the BESS and substation, and cumulative noise effects from other relevant developments and with respect to multiple different noise sources types.
- 3.2 The assessment focuses on residential properties as the principal noise-sensitive receptors.

Construction and Decommissioning Noise

- 3.3 Construction noise includes the formation of access tracks and hardstandings, turbine foundations and erection, temporary compounds, the BESS and substation, underground electrical connections, overhead line works and reinstatement. Decommissioning is assumed to involve similar, but generally less intensive, activities.
- 3.4 A 300 m Study Area has been applied to the principal construction works. No residential receptors lie within this area. Screening assessment has therefore been undertaken at the nearest receptors, including R2 Dalvene Cottage in relation to the northern access works and R8 Glenview Cottage (see Table 9-3 of **Chapter 9 Noise**) in relation to the southern infrastructure.
- 3.5 The final overhead line route has not yet been fixed. Its construction has therefore been considered separately using a corridor-based and reference-distance approach, taking account of residential receptors that could lie close to the eventual work fronts, which are set out in **Table 1** and can be seen in **Figure 9-1** (Volume 3).

Table 1 – OHL Corridor Construction Noise Receptors

Receptor ID	Receptor Name	Easting	Northing	Location with respect to OHL Corridor
OHL1	Low Garleffan	262461	619497	Within OHL Corridor
OHL2	Avisyard	260953	618902	<300 m from OHL Corridor
OHL3	High Polquheys	262293	616482	Within OHL Corridor
OHL4	Polquheys	262078	615110	<300 m from OHL Corridor
OHL5	Roughside	262905	615484	<300 m from OHL Corridor
OHL6	Mounthope	263696	615180	<300 m from OHL Corridor
OHL7	Meikle Garclaugh	264901	614399	<300 m from OHL Corridor
OHL8	Little Garclaugh	265613	614406	Within OHL Corridor
OHL9	Glen	265734	614808	Within OHL Corridor
OHL10	Merkland	265919	613993	Within OHL Corridor

Receptor ID	Receptor Name	Easting	Northing	Location with respect to OHL Corridor
OHL11	Corsencon	266775	613885	<300 m from OHL Corridor
OHL12	Overcairn & The Cairn Cottage	266715	613037	<300 m from OHL Corridor
OHL13	March Cottage	267004	613106	<300 m from OHL Corridor
OHL14	Marchburn	267268	613066	<300 m from OHL Corridor
OHL15	Knowehead	267565	613698	Within OHL Corridor
OHL16	Lideburn	267881	613447	Within OHL Corridor
OHL17	Hillhead	268197	614060	Within OHL Corridor
OHL18	Glen Hall	268483	613430	<300 m from OHL Corridor
OHL19	Niviston	269076	613529	<300 m from OHL Corridor
OHL20	Samsiston	269247	613885	<300 m from OHL Corridor
OHL21	Nether Glenmuckloch	270317	613261	<300 m from OHL Corridor
OHL22	Lagrae Cleuch	270666	613709	<300 m from OHL Corridor
OHL23	Lagrae	270821	614104	<300 m from OHL Corridor

Construction Traffic Noise

- 3.6 Construction traffic noise considers changes in road traffic noise on public roads used by construction vehicles. The Study Area comprises the sections of the local road network over which construction traffic could materially alter existing traffic flows.
- 3.7 Residential properties adjoining the affected routes (within 50 m) are represented through the traffic noise calculations. The identified affected routes comprise sections of the A70 and A76.
- 3.8 Vehicle movements on private access tracks are assessed as construction activity using BS 5228 rather than as public-road traffic noise.

Operational Wind Turbine Noise

- 3.9 Operational wind turbine noise includes the contribution from the Proposed Development alone and in combination with other acoustically relevant wind farms. The Study Area includes residential receptors at which the Proposed Development could make a material contribution to operational wind turbine noise.
- 3.10 Representative receptors have been selected to cover the nearest properties and wider groups of dwellings around the Site. Receptors predicted to experience noise from the Proposed Development at least 10 dB below the applicable TNAC are considered unlikely to be materially affected, although sufficient locations have been retained to demonstrate the geographical extent of effects.

- 3.11 The receptor schedule, financial-involvement status and assigned background noise datasets are presented in **Chapter 9** and **Technical Appendix 9.2**, and can be seen in **Figure 9.1** (Volume 3a).

Operational BESS and Substation Noise

- 3.12 The fixed-plant assessment includes the combined operation of the BESS, substation, transformers, inverters, cooling systems, ventilation equipment and associated electrical plant.
- 3.13 No arbitrary distance cut-off has been applied. The Study Area has been defined by the location of the infrastructure, surrounding topography, receptor distribution and the potential for fixed-plant noise to remain relevant at residential properties.
- 3.14 R8 Glenview Cottage is the closest residential receptor and is expected to control the acoustic design requirements. The adopted rating-level limit nevertheless applies at all noise-sensitive receptors.

Cumulative Assessment

Cumulative Construction Noise

- 3.15 Cumulative construction and construction traffic effects have been considered where the construction programme or access routes of another development could overlap with those of the Proposed Development. This includes combined effects from the Proposed Development and Glen Water for construction and construction traffic.

Cumulative Operational Wind Turbine Noise

- 3.16 Cumulative operational wind turbine noise includes relevant operational and consented wind farms and live planning applications capable of making a material contribution at the assessed receptors. Available layouts, predictions, consented limits and application information have been used as appropriate.

Cumulative Developments Considered

- 3.17 Other wind energy developments within 10 km have been reviewed but not carried forward where predicted contributions at receptors within the operational noise study area are below the ARWTN cumulative screening thresholds, or were otherwise considered to be not applicable. The cumulative developments considered are set out in **Table 2**.

- 3.18 Where an in-planning development is included in the main cumulative assessment, its inclusion provides a conservative assessment of cumulative operational wind turbine noise effects that could arise if it is consented and constructed. If such a development is refused, withdrawn, materially amended, or subject to materially different noise limits or curtailment requirements before operation of the Proposed Development, the cumulative assessment and associated SSNLs may need to be reviewed.

Table 2 – Cumulative Wind Energy Developments

Development	Distance	Status	Included	Reason
The Drum	0.3 km	Refused	Successful appeal included as an additional potential scenario.	Development application refused (appeal submitted).
Glen Water	1.3 km	Application	Yes	Material contribution to cumulative noise levels at R7-R13 and R19-R23
Lethans	5.6 km	Consented	No	Negligible noise contribution at all relevant receptors
Lethans Extension	8.0 km	Consented	No	Negligible noise contribution at all relevant receptors
Greenburn	8.6 km	Under Construction	No	Negligible noise contribution at all relevant receptors
Hare Hill	9.9 km	Operational	No	Negligible noise contribution at all relevant receptors

Cumulative Fixed-plant Noise

- 3.19 Cumulative fixed-plant noise has been considered qualitatively where other substations, BESS facilities or associated electrical infrastructure could contribute at shared receptors. This includes the Glen Water substation.
- 3.20 Consideration of the combined cumulative noise effects of wind turbine noise and noise from BESS and substation has been considered qualitatively.

Topics Scoped Out

- 3.21 Construction vibration has been scoped out because of the nature of the proposed works and the separation from residential receptors. Operational vibration from the turbines, BESS, substation and electrical infrastructure is not expected to propagate to residential receptors at levels capable of causing adverse effects.

- 3.22 Operational noise from the overhead line and routine operational traffic for the Proposed Development have been scoped out because the anticipated noise levels and frequency of activity would be low.
- 3.23 ARWTN identifies a number of potential wind turbine effects that do not require separate assessment at the planning stage, as they are considered negligible or suitably controlled by the ARWTN criteria. These comprise infrasound, ground-borne vibration and low-frequency sound, except where a specific low-frequency tonal component is present.
- 3.24 Accordingly, no separate assessment of operational wind turbine infrasound, ground-borne vibration or low-frequency sound has been undertaken. Any specific tonal component would be addressed through the operational noise compliance procedure.

4. CONSTRUCTION AND DECOMMISSIONING NOISE METHODOLOGY

Main Construction Works

Assessment Method & Criteria

- 4.1 Construction and decommissioning noise is assessed using the 'ABC method' set out in BS 5228-1 Annex E Table E.1, which sets a series of noise thresholds depending on the existing ambient sound levels and the applicable time-period. The details of Table E.1 are reproduced as **Table 3**.

Table 3 – BS 5228-1 Threshold of Potential Significant Effect at Dwellings

Assessment category and threshold value period	Threshold value, in decibels (dB) ($L_{Aeq,T}$)		
	Category A ^{A)}	Category B ^{B)}	Category C ^{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
^{A)} Category A: threshold values to use when ambient noise 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			

- 4.2 The lowest baseline noise categories are assumed, result in the most conservative construction noise criteria of 65 dB for the day, 55 dB for the evenings and 45 dB at night. However, at present, no requirement for evening or night-time works has been identified.
- 4.3 Where predicted construction noise levels do not exceed the applicable threshold, the resulting effect is considered to be not significant. In accordance with BS 5228 1, an

exceedance of the applicable threshold for an equivalent period of one month or more is considered to represent a potentially significant effect.

- 4.4 Where an exceedance would occur for less than one month, significance is determined with reference to the margin and duration of the exceedance, the time of day, the existing acoustic environment, the nature of the activity and the availability of practicable mitigation. Particularly high or repeated short-term exceedances may therefore still be considered significant.
- 4.5 The same criteria are applied to decommissioning activities. As decommissioning activities would generally be similar to, or less intensive than, the corresponding construction activities, the construction assessment is considered representative of reasonable worst-case decommissioning effects.

Prediction Method

- 4.6 Construction noise predictions are undertaken in accordance with the procedures in BS 5228-1. Representative plant schedules are developed for each assessed activity, identifying the source level, number of items of plant, percentage on-time and distance between the activity and receptor. The plant associated with each activity was assumed to operate concurrently during a reasonable worst-case assessment period.
- 4.7 Source data are taken from BS 5228-1 or other suitable acoustic information and comprised octave-band or A-weighted sound power levels, or sound pressure levels measured as measured at 10 m, $L_{pA,10m}$. Where octave-band data are available, an equivalent overall A-weighted level is calculated by logarithmically summing the octave band data. Sound power data are converted to sound pressure levels at 10 m by subtracting 28 dB, as a simplified correction. The following ground correction factors are calculated, respectively:

$$K_h = 20\log_{10}(d/10)$$

and $K_s = 25\log_{10}(d/10) - 2$

where:

K_h is the hard-ground correction factor;

K_s is the soft-ground correction factor; and

d is the distance of receiving position from the construction plant, in metres (m).

4.8 Accordingly, the ground correction factor, K_G , is given as:

$$K_G = K_h - G_s \times (K_h - K_s)$$

where:

G_s is the proportion of soft ground, as a decimal or percentage value.

4.9 Other correction factors for on-time, K_T , and number of plant, K_n , are defined by:

$$K_T = 10\log_{10}(T)$$

and $K_n = 10\log_{10}(n)$

where:

T is the on-time as a percentage or decimal value; and

n is the number of identical plant items represented by a given calculation.

4.10 The total contribution from each set of identical plant items is given by:

$$L_{Aeq} = L_{pA,10m} - K_G + K_T + K_n$$

4.11 Where construction traffic movements occur along access tracks, indicative absolute noise level calculations are conducted for receptors using the method set out in BS 5228 Annex F *Estimating noise from sites*, sub-clause F.2.5 *Method for mobile plant using regular well-defined route (e.g. haul roads)*, using the formula:

$$L_{Aeq,T} = L_{WA} - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d$$

where:

L_{WA} is the sound power level of the vehicle, in decibels (dB);

Q is the number of vehicles per hour;

V is the average vehicle speed, in kilometres per hour (km/h);

d is the distance of receiving position from the centre of haul road, in metres (m).

4.12 The resulting contribution from all items are logarithmically combined, where the activities could reasonably occur during the same assessment period.

4.13 A final +3 dB façade correction is also applied, with the resulting façade levels compared with the applicable construction noise criteria as set out in **Table 3**.

Construction Traffic Noise

4.14 Construction traffic noise was calculated using the Basic Noise Level method in Calculation of Road Traffic Noise (CRTN). Calculations were undertaken separately for the baseline

traffic flows and for the baseline plus construction traffic scenario on each assessed road link. The assessment used the $LA_{10,18h}$ index for the period 06:00–24:00.

- 4.15 For each scenario, the Basic Noise Level (BNL) at the CRTN reference position is calculated from the total 18-hour traffic flow, plus a correction factor to account for the mean traffic speed and proportion of heavy vehicles. The calculation is given by:

$$BNL = [29.1 + 10\log_{10}Q] + [33\log_{10}(V + 40 + 500/V) + 10\log_{10}(1 + 5p/V) - 68.8]$$

where:

Q is the number of vehicles in a given 18-hour period;

V is the mean traffic speed; and

p is the percentage of heavy vehicles, as a number 0 to 100.

- 4.16 It is noted that compared with the available traffic data within the time-period 07:00-19:00 set out in **Chapter 10**, the 18-hour traffic flow will be lower, as a result of not accounting for traffic in the hours of 06:00-07:00 and 19:00-24:00. This will subsequently result in an over-estimate of the noise-change effect from introducing construction vehicles.
- 4.17 No correction is applied for road gradient, with all road gradients assumed to be flat, or to have a neutral effect between two-way traffic flows. No correction is applied for road surface, which is assumed to be the same in the baseline and with-construction-traffic scenarios and therefore does not affect the noise-change.
- 4.18 The above calculation is undertaken for baseline traffic flow information, and then a worst-case month scenario, with the total number of heavy and light vehicles added to the traffic flows. The difference in BNL between these two scenarios is evaluated against criteria specified with reference to DMRB, which is set out in Table 4.

Table 4 – Construction Traffic Noise Criteria

Short-Term Change in Noise Level	Magnitude of Impact	Level and Significance of Effect
Less than 1 dB $LA_{10,18h}$	Negligible	Negligible adverse (not significant)
1 dB to less than 3 dB $LA_{10,18h}$	Low	Minor adverse (not significant)
3 dB to less than 5 dB $LA_{10,18h}$	Medium	Moderate adverse (significant)
5 dB $LA_{10,18h}$ or greater	High	Major adverse (significant)

- 4.19 A short-term increase of 3 dB $LA_{10,18h}$ or greater is normally considered significant. Where traffic flows are below the range for which CRTN calculations provide a reliable indication of noise change, effects would normally be considered not significant, although wider context is considered, such as the absolute number and timing of vehicle movements,

receptor proximity, existing traffic conditions, duration of the works and the temporary nature of the effect.

5. OPERATIONAL NOISE ASSESSMENT METHODOLOGY

Operational Wind Turbine Noise

Overview

- 5.1 The noise prediction methodology is based on guidance in ARWTN and the IOA GPG. These documents detail the assessment and calculation approach for wind farm noise, and advocate for the use of ISO 9613 *Acoustics – Attenuation of sound during propagation outdoors* as the basis for the noise predictions, with some specific assumptions and adjustments.

Wind Shear Correction

- 5.2 Wind turbine source sound power levels can be specified either in terms of ‘standardised’ 10 m height wind speeds, accounting for the specific hub-height to which the sound power levels relate, or with reference to the turbine hub height wind speed.
- 5.3 In order to allow like-for-like comparisons and appropriate usage in noise calculations, sound power levels are corrected, where applicable, to reflect the sound power level based on standardised 10 m height wind speeds, with reference to the specific hub height proposed or installed, in accordance with the IOA GPG *Supplementary Guidance Note 4: Wind Shear* (IOA, 2014).
- 5.4 The following equation is used for the purpose of this correction:

$$V_{10} = \left(\frac{\ln\left(\frac{10}{Z_0}\right)}{\ln\left(\frac{h}{Z_0}\right)} \right)$$

where:

h is the hub height;

V_{10} is the 10 m wind speed;

V_h is the wind speed at hub height; and

Z_0 is the ground roughness length, standardised to 0.05 m.

- 5.5 As the correction is based on the specific hub height of turbines, this accounts for the fact that different hub height turbines would experience different wind speeds at their hub

heights for the same 10 m wind speed conditions. Each turbine model and hub height configuration therefore has a unique derived sound power level specification.

Uncertainty

- 5.6 The IOA GPG recommends that, where predictions use a ground factor of $G = 0.5$, the turbine sound power levels should incorporate an appropriate allowance for uncertainty. *Supplementary Guidance Note 3* (IOA, 2014) identifies potential uncertainty arising from acoustic measurement, production tolerances and differences between the tested and proposed turbine configuration. The source data and uncertainty allowance should therefore be reviewed together rather than applying a standard correction without regard to the status of the data.
- 5.7 Where manufacturer sound power levels are expressly warranted or guaranteed and the documentation confirms that the stated values already incorporate measurement uncertainty and relevant production tolerances, no additional uncertainty correction is required. Where the manufacturer specifies a separate allowance to be used for prediction, that stated allowance should be added.
- 5.8 Where manufacturer specification or warranted values do not clearly include uncertainty, an allowance of +2 dB is normally applied to the stated sound power levels. This represents an upper estimate appropriate to planning-stage prediction.
- 5.9 An uncertainty allowance of +2 dB has therefore been applied at each assessed wind speed. The resulting levels form the sound power inputs used in the predictions presented in **Technical Appendix 9.3**.
- 5.10 Where octave-band spectra are required, the adopted uncertainty correction is applied consistently to each octave band, thereby retaining the spectral shape while increasing the overall A-weighted sound power level by the applicable amount. No separate additional allowance has been added for propagation-model uncertainty, as the IOA GPG prediction parameters, including the source uncertainty allowance and conservative propagation assumptions, are intended to provide robust planning-stage predictions.

ISO 9613-2 Noise Prediction Methodology

- 5.11 The ISO 9613 standard is used for predicting sound pressure level for downwind propagation by taking the source sound power level for each turbine in separate octave bands and subtracting a number of attenuation factors. These are set out in ISO 9613-2 *General method of calculation*, according to the following relevant parameters:

$$\text{Predicted Octave Band Noise Level} = L_w + D - A_{\text{geo}} - A_{\text{atm}} - A_{\text{gr}} - A_{\text{bar}} - A_{\text{misc}}$$

- 5.12 These factors are discussed in detail below, together with an additional term for taking wind direction into account where required. The predicted octave band levels from each turbine are summed together to give the overall 'A' weighted predicted sound level.

L_w – Source Sound Power Level

- 5.13 The sound power level of a noise source is normally expressed in dB re: 1 pW. Noise predictions are based on sound power levels detailed in the noise chapter.
- 5.14 The octave band noise spectra used for the predictions have been taken from the technical specifications of the turbine with the results shown in the noise chapter.

D – Directivity Factor

- 5.15 The directivity factor allows for an adjustment to be made where the sound radiated in the direction of interest is higher than that for which the sound power level is specified. In this case the sound power level is measured in a down wind direction, corresponding to the worst-case propagation conditions considered here and needs no further adjustment.

A_{geo} – Geometrical Divergence

- 5.16 The geometrical divergence accounts for spherical spreading in the free-field from a point sound source resulting in an attenuation depending on distance according to:

$$A_{\text{geo}} = 20\log_{10}(d) + 11$$

where d = distance from the turbine.

- 5.17 The wind turbine may be considered as a point source beyond distances corresponding to one rotor diameter.

A_{atm} – Atmospheric Absorption

- 5.18 Sound propagation through the atmosphere is attenuated by the conversion of the sound energy into heat. This attenuation depends on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with greater attenuation at higher frequencies. The attenuation depends on distance according to:

$$A_{\text{atm}} = d \times \alpha$$

where d = distance from the turbine, and

α = atmospheric absorption coefficient in dB/m.

- 5.19 Values of ' α ' from ISO 9613 Part 1 *Calculation of the absorption of sound by the atmosphere* (ISO, 1993), as given in Table 23, correspond to a temperature of 10 °C and a relative humidity of 70 %, the values specified in the IOA GPG. These values give relatively low levels of atmospheric attenuation and correspondingly worst-case noise predictions.

Table 5 – Frequency-dependent atmospheric absorption coefficients

	Octave band centre frequency, Hz							
	63	125	250	500	1000	2000	4000	8000
Coefficient (α , dB/m)	0.000122	0.000411	0.00104	0.00193	0.0037	0.00966	0.0328	0.117

Agr – Ground Effect

- 5.20 Ground effect is the interference of sound reflected by the ground with the sound propagating directly from source to receiver. The prediction of ground effects is inherently complex and depends on the source height, receiver height, propagation height between the source and receiver and the ground conditions. The ground conditions are described according to a variable G which varies between 0.0 for 'hard' ground (includes paving, water, ice, concrete & any sites with low porosity) and 1.0 for 'soft' ground (includes ground covered by grass, trees or other vegetation). The IOA GPG states that where wind turbine source noise data includes a suitable allowance for uncertainty, a ground factor of $G = 0.5$ and a receptor height of 4 m should be used.

Abar – Barrier Attenuation

- 5.21 The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise. The barrier attenuations predicted by the ISO 9613 model have, however, been shown to be significantly greater than that measured in practice under down wind conditions. The results of a study of propagation of noise from wind farm sites carried out for ETSU-R-97 concludes that an attenuation of just 2 dB(A) should be allowed where the direct line of sight between the source and receiver is just interrupted and that 10 dB(A) should be allowed where a barrier lies within 5 m of a receiver and provides a significant interruption to the line of sight. In this case a correction of 2 dB has been applied where there is no line of sight between the source and the receiver.

Amisc – Miscellaneous Other Effects

- 5.22 ISO 9613 includes effects of propagation through foliage, industrial plants and housing as additional attenuation effects. These have not been included here, and any such effects are unlikely to significantly reduce noise levels below those predicted.

Corrections for Ground Profile and Barriers

- 5.23 Sound propagation across a concave ground profile, for example valleys or where the ground falls away significantly between the turbine and the receptor, incurs an additional correction of +3 dB(A) to the overall A-weighted noise levels. This correction is calculated in order to take account of the reduced ground absorption effects and the potential for multiple reflection paths caused by the concave profile.
- 5.24 A computer programme is used to generate the ground profiles beneath each source-to-receptor path. From these plots it is possible to determine where a correction is appropriate, based upon guidance set out in the IOA GPG.
- 5.25 A mathematical condition is recommended in the IOA GPG for indicating where this correction should be applied:

$$h_m \geq \left(\frac{\text{abs}(h_s - h_r)}{2} \right)$$

where:

h_m is the mean height above ground along the direct path between the source and the receptor

h_s is the absolute source height above ground level, and

h_r is the absolute receptor height above ground level.

- 5.26 Whilst this condition is useful at highlighting where the ground profile beneath a source-to-receptor path may be concave, it can produce false positives. It should therefore be used in conjunction with a visual assessment of the ground profile when determining whether a correction should be applied.
- 5.27 Such effects have been limited to 2000 m distances, beyond which it is not anticipated that concave ground effects would occur.

Derivation of Criteria

- 5.28 Operational wind turbine noise is assessed in accordance with *Assessment and Rating of Wind Turbine Noise*. ARWTN provides technical guidance for the assessment and control of operational noise from wind turbines in the planning context and is presented as a targeted update and replacement for ETSU-R-97.
- 5.29 Noise assessment criteria and predicted operational wind turbine noise levels are correlated to standardised 10 m height wind speeds within the range 3 m/s to 10 m/s, as derived from

hub-height wind speeds for the Proposed Development. Alternatively, if background noise data are unsuitable or unavailable, fixed noise criteria can be adopted across the applicable wind speed range.

5.30 ARWTN defines operational wind turbine Total Noise Assessment Criteria (TNAC) for noise-sensitive receptors as the greater of:

- a Lower Limiting Value (LLV); or
- 5 dB above typical background sound levels determined in accordance with the guidance.

5.31 The TNAC are derived separately for the day and night from measured or otherwise agreed representative background sound level, subject to the applicable LLV.

5.32 For receptors that are not financially involved (FI) with the Proposed Development, the daytime LLV is selected within the ARWTN range of 35 dB to 40 dB $L_{A90,10min}$, and is selected on a project-level basis. ARWTN identifies the following matters as relevant to selecting the appropriate daytime LLV:

- generating capacity and the effect of the LLV on renewable energy generation;
- the number of dwellings and the magnitude of their exposure; and
- the duration and level of exposure.

5.33 As these factors and noise levels are inter-related, the assessment cannot readily be conducted on the basis of defining noise limit criteria and then assessing whether the criteria are met by the Proposed Development. Instead, the assessment for the daytime sets out the potential implications of adopting different LLVs within the specified range and evaluates the relevant merits or justifications for each as part of the assessment.

5.34 For night-time periods, ARWTN specifies an LLV of 43 dB $L_{A90,10min}$ for non-FI receptors. The night-time TNAC are therefore derived as the greater of:

- 43 dB $L_{A90,10min}$; or
- 5 dB above the typical night-time background sound level.

5.35 For FI receptors, ARWTN allows the TNAC to be increased to the greater of:

- 45 dB $L_{A90,10min}$; or
- 5 dB above typical background sound levels.

5.36 Full TNAC derivations and comparisons are provided in **Technical Appendix 9.3**.

Individual Assessment of the Proposed Development

- 5.37 For the Proposed Development acting alone, predicted noise levels are calculated using the Proposed Development layout and candidate turbine model to undertake an assessment of the Proposed Development noise effects in principle, before consideration for other existing, consented, or in-planning cumulative wind energy developments. Predictions assume downwind propagation from the Proposed Development to each receptor.
- 5.38 Where Proposed Development noise levels can be shown to comply with the identified TNAC at all noise-sensitive receptors, noise from the Proposed Development is considered to be acceptable in principle, subject to cumulative noise considerations.
- 5.39 The assessment evaluates whether:
- The Proposed Development is predicted to meet the TNAC derived on the basis of a 35 dB LLV for the daytime period;
 - The Proposed Development is predicted to meet an increased TNAC derived on the basis of an LLV up to 40 dB, where the contextual factors suitably justify the LLV;
 - The Proposed Development is predicted to exceed the TNAC derived on the basis of the highest justifiable LLV, and therefore mitigation would be required in order for the Proposed Development operational noise to be acceptable.

Site-Specific Noise Limits for the Proposed Development

- 5.40 The site-specific noise limits (SSNLs) are derived to set controls on the noise contributed by the Proposed Development, so as to ensure that noise from the Proposed Development, when combined with other relevant wind turbine developments, would not cause the applicable TNAC to be exceeded.
- 5.41 The SSNLs also provide a recommendation for the noise limits to be adopted through planning conditions.
- 5.42 Where there are no relevant cumulative wind turbine contributions, the SSNLs may be derived with direct reference to the TNAC and the predicted noise levels from the Proposed Development. Where there are relevant cumulative wind turbine contributions, the SSNLs are derived having regard to the remaining noise budget available to the Proposed Development after accounting for those contributions.

5.43 The final SSNLs should:

- apply only to noise from the Proposed Development;
- not exceed the applicable TNAC;
- be sufficient to ensure cumulative compliance with the TNAC;
- provide an appropriate operational allowance above predicted levels where justified;
- not make the Proposed Development responsible for noise from another operator; and
- be suitable for incorporation into a planning condition.

5.44 The SSNL is calculated by logarithmically subtracting the identified or calculated contribution from other relevant wind energy developments from the applicable TNAC.

5.45 The contribution from other developments is based on consented limits, predicted noise levels, planning status and consultation-informed assumptions, as appropriate.

5.46 Where the TNAC is already approached or exceeded by other developments, the Proposed Development contribution is required to be sufficiently low that it would not make a material contribution to the exceedance. The primary basis for negligible contribution is that the Proposed Development contribution is 10 dB or more below the relevant TNAC.

5.47 The resulting SSNLs for the Proposed Development are presented in **Chapter 9**, with detailed derivation and comparison tables provided in **Technical Appendix 9.3**.

Cumulative Operational Wind Turbine Noise Methodology

5.48 The cumulative operational wind turbine noise assessment considers the Proposed Development in combination with other relevant wind energy developments where those developments have the potential to contribute materially to noise levels at the same receptors.

5.49 Operational wind turbine noise from existing developments is not treated as part of the baseline background sound level used to derive the TNAC. Existing, consented and relevant in-planning wind energy developments are instead considered within the cumulative assessment.

5.50 In accordance with ARWTN, a cumulative operational noise assessment is not necessary at a receptor where noise from the Proposed Development is lower than 25 dB $L_{A90,10min}$ or 10 dB or more below both the daytime and night-time TNAC. All other wind farm

developments should be considered where their individual contribution is within 10 dB of the TNAC, subject to the small-turbine exclusions in ARWTN.

- 5.51 For the purposes of this assessment, the cumulative assessment includes operational, consented and live planning application wind energy developments where they have the potential to contribute materially to noise levels at the assessed receptors. Schemes at scoping stage are not included in the main cumulative assessment unless they progress to live application status before the assessment is finalised, but relevant nearby scoping schemes are kept under review.
- 5.52 The predicted contributions from the Proposed Development and other relevant wind energy developments are combined logarithmically. Unless otherwise stated, the cumulative assessment assumes that receptors are simultaneously downwind of all relevant wind turbine developments. ARWTN identifies this as a suitable means of implicitly accounting for the increased duration of exposure that may arise where receptors are affected by wind farms in different directions.

Treatment of Financial Involvement

- 5.53 For a receptor to be treated as financially involved, the financial involvement should relate to the occupier of the property and should represent a profitable benefit rather than merely compensation for an effect. The status of financially involved receptors has therefore been considered on a receptor-specific basis.
- 5.54 Where a receptor is financially involved with another wind farm development but not with the Proposed Development, the financial involvement is specific to that other development. In such cases, ARWTN requires two cumulative tests:
- Total cumulative noise from all relevant developments, including the development with which the receptor is financially involved, must not exceed the financially involved TNAC; and
 - Total cumulative noise from all relevant developments excluding the development(s) with which the receptor is financially involved must not exceed the non-financially involved TNAC.
- 5.55 Where applicable, potential future financial involvement arrangements are discussed as possible mitigation routes but are not relied upon for the primary assessment.
- 5.56 If financial involvement arrangements change before operation of the Proposed Development, the relevant TNAC, SSNLs, cumulative assessment and mitigation requirements should be reviewed.

Operational Noise Character

- 5.57 ARWTN provides guidance on correcting measured operational wind turbine noise for specific audible characteristics, including tonality and elevated amplitude modulation. These matters are principally addressed through the operational noise compliance procedure and planning condition.
- 5.58 At the assessment stage, no correction for tonality or elevated amplitude modulation has been added to predicted turbine noise levels as there is no specific evidence that the candidate turbine or proposed operating mode would exhibit such characteristics at the relevant receptors.
- 5.59 The eventual planning condition should include a suitable procedure for assessing and, where necessary, correcting measured operational wind turbine noise for tonality and elevated amplitude modulation in accordance with ARWTN.

Fixed-plant Noise Methodology

- 5.60 Operational noise from fixed-plant associated with the BESS and substation is assessed separately from operational wind turbine noise, as these sources have different acoustic characteristics and are outside the scope of ARWTN.
- 5.61 The assessment follows the principles of BS 4142:2014+A1:2019. BS 4142 provides a method for assessing sound of an industrial or commercial nature at nearby noise-sensitive receptors. The method compares the rating level of the specific sound with the representative background sound level at the receptor. The initial numerical comparison is considered alongside the acoustic and operational context.
- 5.62 The rating level, $L_{A,r,T,r}$, is defined by applying any applicable acoustic character corrections to the specific sound level. The specific sound level is the equivalent continuous sound level, $L_{Aeq,T,r}$, produced by the source being assessed over the relevant reference time period. BS 4142 defines the reference time period as one hour during the daytime and 15 minutes during the night-time.
- 5.63 Acoustic character corrections are applied where the specific sound contains features that make it more noticeable or intrusive at the receptor. These include tonality, impulsivity, intermittency, or other sound characteristics that are readily distinctive against the existing acoustic environment.
- 5.64 BS 4142 indicates that a rating level around 10 dB or more above the background sound level is likely to be an indication of a significant adverse effect. A rating level around 5 dB

above the background sound level is likely to be an indication of an adverse effect. A rating level below the background sound level is indicative of a low impact. These comparisons are initial indications only. The final assessment outcome is determined following consideration of context.

- 5.65 As detailed plant specifications are not yet available, the assessment defines a maximum combined rating level that the final BESS, substation and associated fixed-plant design must achieve for significant noise effects to be avoided, rather than predicting noise from a particular equipment selection. The limit applies to the combined operation of all relevant plant at each noise-sensitive receptor under the assessed operating conditions.
- 5.66 Because the limit is expressed as a rating level, any applicable corrections for acoustic character must be contained within it. Where a correction applies, the permissible specific sound level would therefore be correspondingly lower. Compliance may be achieved through plant selection, layout, equipment orientation, enclosures, silencers, barriers, operational controls or other appropriate acoustic design measures.
- 5.67 For this assessment, an external rating level below 35 dB $L_{A,r,Tr}$ is considered low in absolute terms as a matter of professional judgement, taking account of the rural receptor context, the low resulting sound level and the distinction between outdoor daytime exposure and predominantly indoor night-time exposure. Absolute sound level does not replace the BS 4142 comparison with background sound level, but forms an important part of the contextual evaluation and the selection of an appropriate fixed design limit.
- 5.68 The final design would be required to demonstrate compliance through an acoustic design report based on the selected plant, layout, operating conditions and mitigation measures. The report would include appropriate source data and propagation calculations and would demonstrate that the combined rating level, inclusive of any applicable acoustic character corrections, complies with the specified limit at all relevant receptors.

6. LIMITATIONS AND UNCERTAINTY

- 6.1 The assessment has been undertaken using the best available information at the time of writing, including the current Proposed Development layout, candidate turbine sound power data, baseline survey results, consultation responses and available information for relevant cumulative wind energy developments.
- 6.2 Construction noise predictions are based on representative plant schedules, assumed numbers of plant, activity durations, percentage on-times and distances to receptors. Actual construction activities would vary spatially and temporally, and not all plant would necessarily operate simultaneously at the closest assumed location. The calculations

therefore represent indicative reasonable worst-case assessment periods rather than continuous noise levels throughout construction. Ground absorption has been represented using the proportion of soft and hard ground along each propagation path, with no additional allowance for local screening unless specifically included.

- 6.3 Construction traffic calculations are based on forecast baseline and construction vehicle flows, vehicle classifications and assumed traffic speeds. The CRTN assessment predicts changes in the Basic Noise Level on each road link and does not model the detailed distribution of traffic past individual properties. Actual effects would depend on the final construction programme, routing, daily distribution of movements and prevailing traffic conditions.
- 6.4 Operational wind turbine noise predictions are based on candidate turbine sound power data, the assessed turbine layout and the propagation assumptions recommended by the IOA GPG. The final turbine model has not yet been selected. The selected turbine would therefore need to have sound emissions no greater than those assessed, including any applicable uncertainty allowance, or otherwise demonstrate compliance with the applicable SSNLs.
- 6.5 The ISO 9613-2 calculations assume favourable propagation from every turbine to each receptor, including cumulative development turbines. These conditions would not ordinarily occur at all receptors or from developments in different directions at the same time and in some cases may not be possible to occur. However, these assumptions provide a conservative basis for assessing potential operational noise effects.
- 6.6 Turbine source-level uncertainty has been addressed in accordance with the IOA GPG and its supplementary guidance. The source data and corrections adopted for the assessment are presented in **Technical Appendix 9.3**.
- 6.7 The operational wind turbine assessment does not predict corrections for tonality or elevated amplitude modulation. These characteristics cannot be reliably quantified at receptor locations before the final turbine is installed and operating. They are therefore addressed through the operational compliance procedure and any associated planning controls in accordance with ARWTN.
- 6.8 The BESS, substation and associated fixed plant have been assessed using a limits-led methodology because detailed plant specifications are not yet available. The assessment therefore does not predict noise from a particular equipment selection. The final acoustic design would need to demonstrate compliance with the specified combined rating-level limit, taking account of the selected plant, layout, duty, mitigation and any applicable acoustic character corrections.

- 6.9 The cumulative assessment relies on information available for other developments, including their layouts, turbine models, predicted levels, consented limits and planning status. This information may change before construction or operation of the Proposed Development. Where detailed or directly comparable information is unavailable, conservative assumptions have been adopted and the basis of the cumulative contribution is identified in **Technical Appendix 9.3**.
- 6.10 Where live planning application schemes are included in the main cumulative scenario, the assessment and associated SSNLs may need to be reviewed if those schemes are refused, withdrawn, materially amended, or subject to materially different noise limits or curtailment requirements.
- 6.11 Background sound levels are derived from measurements undertaken over finite survey periods and are subject to natural variation. Data have been processed and screened in accordance with ARWTN and the IOA GPG to derive relationships considered representative of the assessed receptors and periods. The survey methodology, data exclusions, regression analysis and representativeness assumptions are set out in **Technical Appendix 9.2**.
- 6.12 Predicted levels and assessment criteria are reported to one decimal place where required for comparison and limit-setting. This degree of numerical precision does not imply equivalent absolute accuracy in the underlying measurements or predictions. Small calculated differences should therefore be interpreted in the context of the adopted conservative assumptions, methodological uncertainty and the applicable assessment guidance.
- 6.13 The limitations set out herein do not prevent a robust assessment of the likely significant noise effects. Where uncertainty remains, the assessment identifies controls required to ensure that residual effects would be not significant.

7. PROPOSED PLANNING CONDITIONS

Wind Turbine Noise

- 7.1 ARWTN provides example planning condition wording for controlling operational wind turbine noise, together with Planning Condition Technical Guidance Notes setting out the detailed procedures for compliance measurements and assessment. The guidance is intended to allow the planning condition to reference those Technical Guidance Notes rather than reproducing the detailed procedures within the condition itself.
- 7.2 For the Proposed Development, the condition should secure both implementation of the noise curtailment required by the EIA and continuing compliance with the applicable Site-Specific Noise Limits (SSNLs). The proposed wording below is therefore based on the ARWTN example condition, with an additional requirement for approval and implementation of a final Operational Wind Turbine Noise Management and Curtailment Strategy prior to commercial operation.
- 7.3 The SSNL tables attached to the condition should reproduce the final applicable daytime and night-time SSNLs derived in Chapter 9 and Technical Appendix 9.3. The final schedules should reflect the planning status of The Drum Wind Farm at the time of determination. If its appeal remains unresolved at that time, separate schedules may be included for the principal and The Drum consented scenarios, with the circumstances in which each schedule applies defined explicitly.
- 7.4 Any qualifying financial-involvement status relied upon in the conditioned limits should similarly be established at the time the condition is imposed. No reliance should be placed on presently uncommitted future financial-involvement arrangements; any subsequent alteration to the conditioned limits would require approval through the appropriate planning mechanism.
- 7.5 Table 1 and Table 2 should be updated following any relevant updates to the financial involvement status of relevant receptors or material changes to the planning status of cumulative developments, for example a confirmed refusal or withdrawal of the Glen Water application, or a successful appeal by The Drum.

Proposed Wind Turbine Noise Planning Condition

The rating level of noise from the combined effects of the wind turbines hereby permitted (including the application of any tonal and/or amplitude modulation (AM) character correction), when determined at any residential properties lawfully existing or with planning permission at the time of the consent in accordance with the Assessment and Rating of

Wind Turbine Noise 2026 Planning Condition Technical Guidance Notes (“ARWTN Technical Guidance Notes”) or any relevant guidance notes which might replace these in due course, shall not exceed the values for the relevant integer wind speed set out in or derived from the Tables attached to this condition. In the event that a complaint is made, the following steps shall be carried out:

- A. Within 28 days from receipt of a written request of the Local Planning Authority, following a justified complaint¹ to it alleging noise disturbance at a specified residential property [or specified non-residential receptor], the wind farm operator shall, at its own expense, employ an appropriately qualified and experienced acoustician and provide a written protocol (“the Protocol”) to be approved in writing by the Local Planning Authority. The Protocol shall confirm the applicable noise limit, describe the procedure to assess the level and character of noise from the wind farm at the specified property in accordance with the procedures described in the ARWTN Technical Guidance Notes and set out a timescale within which the assessment described in the Protocol will be completed. The written request from the Local Planning Authority shall set out as far as possible the time or meteorological conditions to which the complaint relates and whether the character of the noise is likely to include tonal noise or AM components if applicable. Measurements to assess compliance with the noise limits shall be undertaken in accordance with the agreed Protocol. If the Local Planning Authority or acoustician determine the character of noise is likely to include tonal or AM components, the Protocol needs to consider the assessment of these characteristics.
- B. The wind farm operator shall provide to the Local Planning Authority the acoustician's assessment of the rating level of noise at the specified property. The assessment shall include, if requested by the Local Planning Authority, all data collected for the purposes of undertaking the compliance measurements and analysis, such data to be provided in a format to be agreed with the Local Planning Authority. Certificates of calibration of the equipment shall be submitted to the Local Planning Authority with the acoustician's assessment report.
- C. Where a further assessment of the rating level of noise from the wind farm at the specified property is required to correct for other noise sources pursuant to the ARWTN Technical Guidance Notes, the wind farm operator shall submit a copy

¹ A justified complaint would typically relate to a noise that, on their review, the relevant Planning Authority considers likely to be sufficiently audible or significant, and attributable to the specific wind farm under consideration.

of the further assessment within 21 days of submission of the acoustician's initial assessment unless otherwise agreed by the Local Planning Authority. The wind farm operator shall facilitate wind turbine shut-downs as suitably justified by the acoustician to allow the contribution from other sources to be determined, if suitable data is not already available.

- D. Wind farm operational and wind data logged by the operator, as defined in the ARWTN Technical Guidance Notes, shall be supplied to the relevant Local Planning Authority on its request, within 14 days of receipt in writing of such a request.

Table 5: Operational noise limits at properties (dB L_{A90}) – day (07:00-23:00)

Receptor Location (easting, northing)	Standardised Wind Speed (m/s)									
	1	2	3	4	5	6	7	8	9	10
R1 Boghead (263554, 624717)	39.0	39.0	39.2	39.8	40.3	40.9	41.5	42.1	39.0	39.0
R2 Dalvene Cottage (263434, 624658)	39.0	39.0	39.2	39.8	40.3	40.9	41.5	42.1	39.0	39.0
R3 Stonebiggs (262423, 623927)	39.2	40.3	40.6	40.5	40.1	39.7	39.5	39.9	39.2	40.3
R4 Carbello (261166, 622875)	39.0	39.0	39.2	39.8	40.3	40.9	41.5	42.1	39.0	39.0
R5 Sharif House (261014, 622559)	39.0	39.0	39.2	39.8	40.3	40.9	41.5	42.1	39.0	39.0
R6 Sunnyside (261023, 621973)	39.0	39.0	39.0	38.9	38.9	38.9	38.9	38.9	39.0	39.0
R7 Laigh Glenmuir (261709, 620412)	39.0	39.0	38.9	38.7	38.7	39.1	40.3	40.9	39.0	39.0
R8 Glenview Cottage (262364, 620072)	39.0	38.9	38.8	38.5	38.4	38.8	40.1	40.7	39.0	38.9
R9 Whiteholm (262481, 619944)	45.0	45.0	44.9	44.9	44.8	44.8	44.8	44.8	45.0	45.0
R10 Low Garleffan (262461, 619497)	38.9	38.9	38.6	37.8	37.5	38.1	39.5	40.2	38.9	38.9
R11 Dornal (263343, 619522)	45.0	45.0	44.9	44.7	44.6	44.6	44.6	44.9	45.0	45.0
R12 Nether Guelt (263611, 619278)	38.9	38.8	38.3	36.8	36.2	36.2	40.7	44.8	38.9	38.8
R13 Springhill Farm (264178, 619985)	39.0	38.9	38.8	38.4	38.3	38.3	38.3	38.3	39.0	38.9
R14 Darmalloch (260998, 620282)	39.0	39.0	38.9	38.8	38.8	38.8	38.8	38.8	39.0	39.0
R15 Riverside Gardens (260427, 622669)	39.0	39.0	39.0	39.0	38.9	38.9	38.9	38.9	39.0	39.0
R16 Braehead (259925, 621786)	39.0	39.0	39.0	38.9	38.9	38.9	38.9	38.9	39.0	39.0
R17 Wallaceton (260303, 621550)	39.0	39.0	39.0	38.9	38.9	38.9	38.9	38.9	39.0	39.0
R18 Knocknaib (259778, 621073)	39.0	39.0	39.0	38.9	38.9	38.9	38.9	38.9	39.0	39.0
R19 Crosslar (260201, 619878)	39.0	39.0	38.9	38.8	38.8	38.8	38.8	38.8	39.0	39.0
R20 Avisyard (260953, 618902)	39.0	38.9	38.8	38.5	38.3	38.3	38.3	38.3	39.0	38.9
R21 Guelt Cottage (264022, 618945)	38.8	38.7	38.0	35.5	34.3	34.3	34.3	34.3	38.8	38.7
R22 Dalbalair (264445, 619273)	38.9	38.9	38.6	37.8	37.6	37.6	41.2	45.0	38.9	38.9
R23 Kyle (265102, 619177)	38.9	38.9	38.8	38.3	38.1	38.1	41.5	45.1	38.9	38.9

Table 6: Operational noise limits at properties (dB L_{A90}) – night (23:00-07:00)

Receptor Location (easting, northing)	Standardised Wind Speed (m/s)									
	1	2	3	4	5	6	7	8	9	10
R1 Boghead (263554, 624717)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
R2 Dalvene Cottage (263434, 624658)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
R3 Stonebiggs (262423, 623927)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
R4 Carbello (261166, 622875)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
R5 Sharif House (261014, 622559)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
R6 Sunnyside (261023, 621973)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	43.0	43.0
R7 Laigh Glenmuir (261709, 620412)	43.0	43.0	43.0	42.9	42.9	42.9	42.9	46.2	43.0	43.0
R8 Glenview Cottage (262364, 620072)	43.0	43.0	42.9	42.8	42.8	42.8	42.8	46.2	43.0	43.0
R9 Whiteholm (262481, 619944)	45.0	45.0	44.9	44.9	44.8	44.8	44.8	46.2	45.0	45.0
R10 Low Garleffan (262461, 619497)	43.0	42.9	42.8	42.6	42.5	42.5	42.5	46.1	43.0	42.9
R11 Dornal (263343, 619522)	45.0	45.0	44.9	44.7	44.6	44.6	44.6	47.4	45.0	45.0
R12 Nether Guelt (263611, 619278)	42.9	42.9	42.7	42.3	42.1	42.1	43.8	47.3	42.9	42.9
R13 Springhill Farm (264178, 619985)	43.0	43.0	42.9	42.8	42.7	42.7	42.7	44.7	43.0	43.0
R14 Darmalloch (260998, 620282)	43.0	43.0	43.0	42.9	42.9	42.9	42.9	44.8	43.0	43.0
R15 Riverside Gardens (260427, 622669)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	43.0	43.0
R16 Braehead (259925, 621786)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	43.0	43.0
R17 Wallaceton (260303, 621550)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	43.0	43.0
R18 Knocknaib (259778, 621073)	43.0	43.0	43.0	43.0	43.0	43.0	43.0	44.9	43.0	43.0
R19 Crosslar (260201, 619878)	43.0	43.0	43.0	42.9	42.9	42.9	42.9	44.9	43.0	43.0
R20 Avisyard (260953, 618902)	43.0	43.0	42.9	42.8	42.7	42.7	42.7	44.7	43.0	43.0
R21 Guelt Cottage (264022, 618945)	42.9	42.9	42.6	41.9	41.7	41.7	41.7	44.1	42.9	42.9
R22 Dalbalair (264445, 619273)	43.0	43.0	42.9	42.6	42.5	42.5	44.0	47.4	43.0	43.0
R23 Kyle (265102, 619177)	43.0	43.0	42.9	42.7	42.7	42.7	44.2	47.5	43.0	43.0

BESS, Substation and Associated Electrical Infrastructure

- 7.6 The final BESS, substation and associated electrical plant design has not yet been confirmed. The assessment has therefore been undertaken on a limits-led basis, identifying the maximum combined rating level that the final design would be required to achieve at nearby noise-sensitive receptors.
- 7.7 The final plant selection, layout and detailed acoustic mitigation, where required, would be developed at the post-consent design stage. Compliance with the assessed design envelope can therefore be secured through a planning condition requiring submission and approval of a Fixed-Plant Acoustic Design Report prior to installation.

7.8 A suitable form of condition is set out below.

Proposed Electrical Infrastructure Noise Planning Condition

Prior to the installation of the BESS, substation or other associated fixed electrical plant, a Fixed-Plant Acoustic Design Report shall be submitted to and approved in writing by the Planning Authority.

The report shall demonstrate, using the final plant specifications and layout, that the combined rating level of sound from the BESS, substation and all other associated fixed electrical plant will not exceed **35 dB L_{Ar,Tr}** at any noise-sensitive receptor. The rating level shall be determined in accordance with **BS 4142:2014+A1:2019**, or any subsequent revision agreed with the Planning Authority, using the applicable one-hour daytime and 15-minute night-time reference periods and including any applicable corrections for acoustic character.

The report shall include, as appropriate:

- the location, type and operating duty of the proposed plant;
- sound power level data representative of the proposed equipment and operating conditions;
- consideration of simultaneous operation of all relevant plant;
- details of any acoustic enclosures, silencers, attenuated ventilation, equipment orientation, screening or other noise-control measures;
- noise propagation calculations to the nearest or otherwise representative noise-sensitive receptors; and
- confirmation that the specified rating-level limit will be achieved under the assessed operating conditions.

The development shall thereafter be installed and operated in accordance with the approved acoustic design report and any noise-control measures identified therein, unless otherwise agreed in writing by the Planning Authority.

8. REFERENCES

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