

Environmental Health
Wind Turbine Development: Submission Guidance Note

Wind Turbine Development: Submission Guidance Note on the Information required for an Assessment of the Noise Impact of Proposed Wind Turbine Developments to be undertaken in Connection with a Planning Application

This note is intended to provide guidance to applicants who intend to submit a planning application for (either small or large) wind turbine developments. This note details the minimum information that is required by Environmental Health to be submitted with any such full planning application. Failure to do so will mean that Environmental Health will make a recommendation for refusal due to insufficient information being provided to adequately assess the impact of noise, or on grounds of insufficient noise information to satisfy the local planning authority that the proposal would not adversely affect the amenity of nearby residents or other noise sensitive receptors.

South Ayrshire Council has determined that noise from all large wind turbine developments shall be restricted to the following limits at all relevant noise sensitive receptors:-

- 35dB $LA_{90, 10 \text{ min}}$ for all wind speeds up to 10 m/s for single turbines (where appropriate) or wind farms with very large separation distances between the development and the nearest noise sensitive receptors
- 35dB $LA_{90, 10 \text{ min}}$ day time hours and 38dB $LA_{90, 10 \text{ min}}$ night time hours or ETSU derived limits of background noise level plus 5dB (whichever is greater)
- 40dB $LA_{90, 10 \text{ min}}$ or ETSU derived limits of background noise level plus 5dB (whichever is greater), at properties with valid financial interest
- 45dB $LA_{90, 10 \text{ min}}$ or ETSU derived limits of background noise level plus 5dB (whichever is greater), at properties with valid financial interest where there are also cumulative noise impacts.

In the case of small turbines, (i.e., a wind turbine of 50kW or less with a rotor swept area 200m² or less, which equates to a rotor diameter of 16m) where the noise immissions are calculated having regard to BWEA/Renewable UK guidelines, it will be permissible to compare the $LA_{eq1 \text{ min}}$ noise levels with the Typical Background Noise Levels* detailed on page 5 of this document. Where a financial involvement exists the lower fixed limit will be 40dB $LA_{eq1 \text{ min}}$ or where there is a cumulative impact 45dB $LA_{eq1 \text{ min}}$.

The above restrictions must take account of all wind turbines consented and/or proposed (in the planning process) within the study area. Where there are already a number of turbines consented and/or proposed in the area, this is likely to result in a noise limit for an individual wind turbine development of less than 35dB LA_{90} on the planning consent.

***Adopted from Typical Background Noise Levels from Rural Aberdeenshire, which are believed to represent typical background noise levels in South Ayrshire.**

Definitions:

Small turbine

The definition provided by Renewable UK as stated in British Wind Energy Association Small Wind Turbine Performance and Safety Standard (29 Feb 2008) has been adopted by South Ayrshire Council, i.e., a wind turbine with a rotor swept area 200m² or less, which equates to a rotor diameter of 16m

Large turbine

any turbine outwith the scope of the definition for small turbine.

Note: the descriptions “Small turbine” and “Large turbine” in these contexts are relevant for the purposes of assessing noise impact only – not visual nor any other impacts.

Noise sensitive receptor

in general, any residential use (including nursing homes and accommodation blocks), although applicants should note that there will be instances where non-residential uses should be considered depending on how/when the buildings are used and the nature of the impact. (For example, caravan and camp sites and holiday lets in separate ownership would comprise noise sensitive receptors. This is mentioned again, below.) For the avoidance of doubt, “noise sensitive receptor” includes those developments, not yet constructed, with live planning permissions; and live planning permissions include those applications which have been refused but which may be open to appeal.

Financial interest

either, owning the land on which the turbines are to be sited, **or**, leasing the land on a long (greater than 20 year) lease, **or**, being a shareholder or owner of the development company. Where property is owned by someone with a financial interest in the development, but is leased to a third party, the occupiers of the property do not have any legal interest in the site and may be protected against amenity intrusions.

Curtilage

A domestic garden boundary.

Note – a nominal distance of 15m from the façade will normally be assumed; however, in certain circumstances the amenity area may extend beyond this.

The applicant must be aware that specific definitions in regard to noise sensitive receptors, curtilage, financial interest etc., will ultimately be determined by the Planning Case Officer or Planning Committee. Applicants are therefore advised to direct any queries regarding these issues to the relevant Planning Case Officer.

Noise Impact Assessment

All planning applications for wind turbine development must be accompanied by a site specific noise impact assessment. It is expected that the noise impact assessment will be undertaken in accordance with ETSU-R-97, the IoA Good Practice Guide to the Application of ETSU (May 2013) and the IoA Supplementary Guidance Notes that accompany these documents.

The Good Practice Guide and Supplementary Guidance Notes can be found within the “Publications” section of the Institute of Acoustics (IoA) website: <http://www.ioa.org.uk/publications/good-practice-guide>

A desktop site specific noise impact assessment is acceptable in circumstances where it is expected that the fixed limit of 35dB_{LA90, 10 min} for all wind speeds up to 10 m/s can be met by the proposed turbine(s), including any cumulative impacts. Where this fixed limit cannot be met, a background noise survey will be required to be undertaken and a detailed site specific noise impact assessment submitted.

A detailed site specific noise impact assessment will be required, at all times, where limits are to be set having regard to the measured background noise level.

The site specific noise impact assessment must provide predicted noise levels at the curtilage of identified noise sensitive premises and, where appropriate, financially involved properties in the vicinity of the proposed location of the turbine.

In the case of small turbines it will be permissible to carry out a desktop noise assessment with Typical Background Noise Levels* detailed on page 5 of this document.

Printouts from modelling software used in noise predictions or to produce noise contour maps are not sufficient by themselves and must be accompanied by a site specific noise impact assessment.

South Ayrshire Council requires predictions to be based on the sound power level of the turbine having regard to paragraph 4.3.6 and Supplementary Guidance Note 3 of the Institute of Acoustics Good Practice Guide to the Application of ETSU (May 2013) including penalties for any identified tonality in accordance with ETSU-R-97. Octave band data should be used as input to the predictions. The appropriate prediction methodology should be applied as follows:

- Small turbines – please refer to Equation A.2 in the British Wind Energy Association Small Wind Turbine Performance and Safety Standard (29 Feb 2008) (i.e. basic hemispherical sound propagation). The equation should be based upon the declared apparent sound power level at 8 m/s at hub height.
- Large turbines – predictions will be accepted using ISO 9613–2 following the IoA Good Practice Guide on input parameters. The noise assessment must be undertaken by a competent person, and all the data inputs, justification for use of these values, assumptions made, and margins of error must also be included in the assessment.

Cumulative Impacts

As a rough guide, the presence of any other proposed, consented or existing turbine development within a search area of 5km radius from the proposed wind turbine development should be established. Once this other turbine development has been identified, cumulative noise impacts must be considered where the proposed turbine produces noise levels within 10dB of the noise levels of any turbines existing, consented or in the planning process at the same receptor locations.

South Ayrshire Council expects that existing and consented wind turbine developments will be operating to full capacity of their consented noise limits. Predicted noise levels may only be used where adjacent wind turbine development has not yet been consented. Measured noise levels (i.e., levels measured during a sample period from existing wind turbine development) will not be accepted, as there is no guarantee those measured levels will be sustained over the lifetime of the consented development.

However, it is accepted, there may be some circumstances where an alternative approach is more appropriate. **If you wish to use an alternative approach then please contact Environmental Health to discuss.**

Extensions to Wind Energy Developments

Where a Planning Consultation relates to an application for an extension to an existing development, it will be assumed that the existing development will be operating such that noise immissions from the development will equate to its consented noise limits. Measured noise levels will not be countenanced. This may mean, that in order to permit the development to proceed, the existing planning consent may need to be revisited by further planning application process.

Other Considerations:

Candidate Turbines

In the event that an alternative turbine to that contained in the submitted noise assessment is chosen for installation, then a new desktop site specific noise assessment of the proposed turbine will be required to be submitted to and approved in writing by the Local Planning Authority.

Noise Sensitive Receptors

Please note that caravan and camp sites and holiday lets in separate ownership are classed as noise sensitive receptors and any noise assessment must provide predicted turbine noise levels at these locations.

Background Noise Monitoring

For applications that require background noise monitoring, the monitoring locations must be agreed in writing with Environmental Health in advance. Two weeks' notice must be given of the intended start date to provide the opportunity for an Officer from Environmental Health to attend, where appropriate, during the installation of the equipment. The noise assessment should state the name of the Officer with whom the locations were agreed.

Care should be taken to choose appropriate monitoring locations for background noise monitoring, and avoid taking measurements during unrepresentative noisy periods such as local events, peak holiday times near main roads, or following unusually heavy rainfall events near streams etc. Refer to the IoA Good Practice Guide for further information.

Specific Considerations for Small Wind

Assuming the information contained in the noise label/consumer label has been obtained in accordance with the BWEA/Renewable UK Standard, then the apparent declared sound power level given in respect of the turbine(s) can be used to calculate the sound pressure level due to the operation of the turbine(s) at surrounding noise sensitive receptors, at wind speeds from 3m/s to 10m/s. The calculation assumes hemispherical propagation. The expected noise immissions due to the operation of the turbine are then compared with notional background noise levels, detailed in the table below. These background noise levels are considered representative of rural Aberdeenshire:

*Typical Background Noise Levels in rural Aberdeenshire

Wind Speed (m/s)	3	4	5	6	7	8	9	10
Daytime Background Noise Level (dBA)	28.7	29.2	30.2	31.6	33.4	35.7	38.3	41.5
Night Time Background Noise Level (dBA)	22.3	23.4	25.0	27.0	29.6	32.7	36.2	40.3

Reporting Results of the Noise Impact Assessment

It is expected that the noise report will contain the appropriate key elements stated in Chapter 6, Table 1, of the IoA Good Practice Guide, reproduced here for reference:

Consultations	Consultation with Local Planning Authority EHO input into selection of Background Noise Measurement Equipment
Background Measurements	Number of Monitoring Locations Map Showing Monitoring Locations; Description of Monitoring Locations Description of Noise Environment; Photos of Monitoring Locations Monitoring Period; Description of Noise Measurement Equipment Wind Shield; Certification/Calibration of all Equipment Used and any Calibration Drift; Wind (speed and direction) & Rainfall Measurement Data Sources Clear Representation of Excluded Data in Time Histories or Scatter Plots; Chart Showing Distribution of Wind Speeds & Direction; Cumulative Issues in Background Measurements

*Adopted from Typical Background Noise Levels from Rural Aberdeenshire, which are believed to represent typical background noise levels in South Ayrshire.

Noise Predictions	Prediction Methodology; Candidate Turbine Model Turbine Source Noise Data (including noise-reduced modes if used) Turbine Source Octave Band Noise Levels Description of Noise Propagation/Attenuation Factors Atmospheric Attenuation – Assumed Temperature and Relative Humidity Ground Effects – Assumed Ground Factor Assumed Receiver Height; Barrier/Screening Attenuation Wind Direction Filtering (if considered); Noise Contours
Assessment	Wind Shear Assessment Method, Derivation of Prevailing Background Noise Type, Order and Coefficients of Regression Line Scatter Data Shown on Plots; Derivation of Noise Limits & Numerical Values Amenity Noise Limit; Justification for Amenity Noise Limit if Chosen Night-Time Noise Limit; Financially Involved Noise Limit Capping of Noise Limits at Highest Wind Speed Measured Comparison of Predicted Noise Level with Derived Noise Limits Correction from L_{Aeq} to L_{A90} ; Potential Tonal Content Properties Covered by Assessment Incorporated Mitigation (Turbines Running in Low Noise Mode) (if relevant) Cumulative Issues

Table 1: Suggested key points for inclusion in a wind turbine noise assessment report

Please note, **in addition to the appropriate key elements listed above**, South Ayrshire Council requires the following information to be included in the noise report:

- (a) Accurate twelve digit grid references for the turbine(s);
- (b) Accurate twelve digit grid references for the noise sensitive receptors;
- (c) Elevations of turbines and receptors;
- (d) Details of any financial involvement at noise sensitive receptors;
- (e) Sound power level details for the turbine(s). Broadband and A-weighted octave band data is required, together with uncertainty figures and any tonal penalty;
- (f) Information regarding any valley effect. It will be necessary to demonstrate whether or not, a 3dB correction is required in respect of the valley/significantly sloping ground effect.

Planning Conditions

Due to the increasing number of wind turbines in the South Ayrshire Council area, please note that site specific noise limits will be set that are based on predicted turbine noise levels rather than the application of the whole fixed or ETSU derived limits at each noise sensitive receptor. Detailed below are examples of noise conditions and informative comments normally recommended by South Ayrshire Council Environmental Health Service following Planning Consultations.

Large Wind

1. The turbine shall be designed to permit individually controlled operation, or cut-out, at specified wind speeds in order to enable, and ensure, compliance with the noise level criteria stated in these conditions.
2. Details from the turbine supplier and/or manufacturer regarding the tonality assessment carried out on the turbine require to be provided. A copy of the standard detailing the assessment method shall be submitted for approval by the Planning Authority. Where the tone level above audibility is 2dB or greater then a tonal penalty shall be applied to the permitted noise levels in accordance with figure 16 in the document “The Assessment and Rating of Noise from Wind Farms” (ETSU-R-97).
3. The rating level of noise immissions from the combined effects of the wind turbines (including the application of any tonal penalty) when determined in accordance with the accompanying Guidance Notes (to this condition), shall not exceed the values for the relevant integer wind speed set out in, or derived from, the table(s) below at any dwelling which is lawfully existing or has planning permission at the date of this permission.

Table 1

Location		Standardised Wind Speed at 10m height in m/s averaged over 10 minute periods, Sound Pressure Levels in dB, LA90 10min									
Property Name	Map Ref	4	5	6	7	8	9	10	11	12	
H1											
H2											
H3											
H4											
H5											
H6											
Note: for all properties not specified above the predicted noise from the turbine will be calculated using the propagation model in ISO 9613-Part 2 incorporating the recommendations contained in the Institute of Acoustics Good Practice Guide dated May 2013.											

Note – In certain circumstances separate tables will be required for daytime and night time

- 4 The wind farm operator shall continuously log power production, wind speed and wind direction, all in accordance with Guidance Note 1(d). These data shall be retained for a period of not less than 24 months. The wind farm

operator shall provide this information in the format set out in Guidance Note 1(e) to the Local Planning Authority on its request, within 14 days of receipt in writing of such a request.

5. No electricity shall be exported until the wind farm operator has submitted to the Local Planning Authority for written approval a list of proposed independent consultants who may undertake compliance measurements in accordance with this condition. Amendments to the list of approved consultants shall be made only with the prior written approval of the Local Planning Authority.
6. Within 21 days from receipt of a written request from the Local Planning Authority following a complaint to it from an occupant of a dwelling alleging noise disturbance at that dwelling, the wind farm operator shall, at its expense, employ a consultant approved by the Local Planning Authority to assess the level of noise immissions from the wind farm at the complainant's property in accordance with the procedures described in the attached Guidance Notes. The written request from the Local Planning Authority shall set out at least the date, time and location that the complaint relates to and any identified atmospheric conditions, including wind direction, and include a statement as to whether, in the opinion of the Local Planning Authority, the noise giving rise to the complaint contains or is likely to contain a tonal component.
7. The assessment of the rating level of noise immissions shall be undertaken in accordance with an assessment protocol that shall previously have been submitted to and approved in writing by the Local Planning Authority. The protocol shall include the proposed measurement location identified in accordance with the Guidance Notes where measurements for compliance checking purposes shall be undertaken, whether noise giving rise to the complaint contains or is likely to contain a tonal component, and also the range of meteorological and operational conditions (which shall include the range of wind speeds, wind directions, power generation and times of day) to determine the assessment of rating level of noise immissions. The proposed range of conditions shall be those which prevailed during times when the complainant alleges there was disturbance due to noise, having regard to the written request of the Local Planning Authority under paragraph (c), and such others as the independent consultant considers likely to result in a breach of the noise limits.
8. An assessment of amplitude modulation of noise from the turbines may also be required. This assessment will require to be carried out in accordance with the terms specified by the Planning Authority and shall also be carried out at the expense of the Wind Turbine Operator.
9. Where a dwelling to which a complaint is related is not listed in the tables attached to these conditions, the wind farm operator shall submit to the Local Planning Authority for written approval proposed noise limits selected from those listed in the Tables to be adopted at the complainant's dwelling for compliance checking purposes. The proposed noise limits are to be

those limits selected from the Tables specified for a listed location which the independent consultant considers as being likely to experience the most similar background noise environment to that experienced at the complainant's dwelling. The rating level of noise immissions resulting from the combined effects of the wind turbines when determined in accordance with the attached Guidance Notes shall not exceed the noise limits approved in writing by the Local Planning Authority for the complainant's dwelling.

10. The wind farm operator shall provide to the Local Planning Authority the independent consultant's assessment of the rating level of noise immissions undertaken in accordance with the Guidance Notes within 2 months of the date of the written request of the Local Planning Authority for compliance measurements to be made under paragraph 6, unless the time limit is extended in writing by the Local Planning Authority. The assessment shall include all data collected for the purposes of undertaking the compliance measurements, such data to be provided in the format set out in Guidance Note 1(e) of the Guidance Notes. The instrumentation used to undertake the measurements shall be calibrated in accordance with Guidance Note 1(a) and certificates of calibration shall be submitted to the Local Planning Authority with the independent consultant's assessment of the rating level of noise immissions.
11. Where a further assessment of the rating level of noise immissions from the wind farm is required pursuant to Guidance Note 4(c), the wind farm operator shall submit a copy of the further assessment within 21 days of submission of the independent consultant's assessment pursuant to paragraph (d) above unless the time limit has been extended in writing by the Local Planning Authority.

Guidance Notes for Noise Conditions

These notes are to be read with and form part of the noise condition. They further explain the condition and specify the methods to be employed in the assessment of complaints about noise immissions from the wind farm. The rating level at each integer wind speed is the arithmetic sum of the wind farm noise level as determined from the best-fit curve described in Guidance Note 2 of these Guidance Notes and any tonal penalty applied in accordance with Guidance Note 3. Reference to ETSU-R-97 refers to the publication entitled "The Assessment and Rating of Noise from Wind Farms" (1997) published by the Energy Technology Support Unit (ETSU) for the Department of Trade and Industry (DTI).

Guidance Note 1

- (a) Values of the LA90,10 minute noise statistic should be measured at the complainant's property, using a sound level meter of EN 60651/BS EN 60804 Type 1, or BS EN 61672 Class 1 quality (or the equivalent UK adopted standard

in force at the time of the measurements) set to measure using the fast time weighted response as specified in BS EN 60651/BS EN 60804 or BS EN 61672-1 (or the equivalent UK adopted standard in force at the time of the measurements). This should be calibrated in accordance with the procedure specified in BS 4142: 1997 (or the equivalent UK adopted standard in force at the time of the measurements). Measurements shall be undertaken in such a manner to enable a tonal penalty to be applied in accordance with Guidance Note 3.

- (b) The microphone should be mounted at 1.2 – 1.5 metres above ground level, fitted with a two-layer windshield or suitable equivalent approved in writing by the Local Planning Authority, and placed outside the complainant's dwelling. Measurements should be made in "free field" conditions. To achieve this, the microphone should be placed at least 3.5 metres away from the building facade or any reflecting surface except the ground at the approved measurement location. In the event that the consent of the complainant for access to his or her property to undertake compliance measurements is withheld, the wind farm operator shall submit for the written approval of the Local Planning Authority details of the proposed alternative representative measurement location prior to the commencement of measurements and the measurements shall be undertaken at the approved alternative representative measurement location.
- (c) The LA90, 10 minute measurements should be synchronised with measurements of the 10-minute arithmetic mean wind and operational data logged in accordance with Guidance Note 1(d), including the power generation data from the turbine control systems of the wind farm.
- (d) To enable compliance with the conditions to be evaluated, the wind farm operator shall continuously log arithmetic mean wind speed in metres per second and wind direction in degrees from north at hub height for each turbine and arithmetic mean power generated by each turbine, all in successive 10-minute periods. Unless an alternative procedure is previously agreed in writing with the Planning Authority, this hub height wind speed, averaged across all operating wind turbines, shall be used as the basis for the analysis. All 10 minute arithmetic average mean wind speed data measured at hub height shall be 'standardised' to a reference height of 10 metres as described in ETSU-R-97 at page 120 using a reference roughness length of 0.05 metres . It is this standardised 10 metre height wind speed data, which is correlated with the noise measurements determined as valid in accordance with Guidance Note 2, such correlation to be undertaken in the manner described in Guidance Note 2. All 10-minute periods shall commence on the hour and in 10- minute increments thereafter.
- (e) Data provided to the Local Planning Authority in accordance with the noise condition shall be provided in comma separated values in electronic format.
- (f) A data logging rain gauge shall be installed in the course of the assessment of the levels of noise immissions. The gauge shall record over successive 10-minute periods synchronised with the periods of data recorded in accordance with Note 1(d).

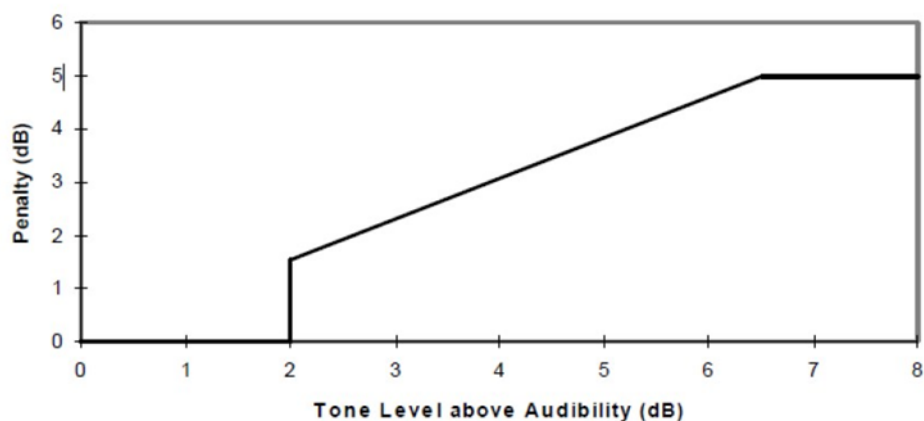
Guidance Note 2

- (a) The noise measurements shall be made so as to provide not less than 20 valid data points as defined in Guidance Note 2 (b)
- (b) Valid data points are those measured in the conditions specified in the agreed written protocol under noise condition 7, but excluding any periods of rainfall measured in the vicinity of the sound level meter. Rainfall shall be assessed by use of a rain gauge that shall log the occurrence of rainfall in each 10 minute period concurrent with the measurement periods set out in Guidance Note 1. In specifying such conditions the Local Planning Authority shall have regard to those conditions which prevailed during times when the complainant alleges there was disturbance due to noise or which are considered likely to result in a breach of the limits.
- (c) For those data points considered valid in accordance with Guidance Note 2(b), values of the LA90, 10 minute noise measurements and corresponding values of the 10-minute wind speed, as derived from the standardised ten metre height wind speed averaged across all operating wind turbines using the procedure specified in Guidance Note 1(d), shall be plotted on an XY chart with noise level on the Y-axis and the standardised mean wind speed on the X-axis. A least squares, "best fit" curve of an order deemed appropriate by the independent consultant (but which may not be higher than a fourth order) should be fitted to the data points and define the wind farm noise level at each integer speed.

Guidance Note 3

- (a) Where, in accordance with the approved assessment protocol under noise condition 7, noise immissions at the location or locations where compliance measurements are being undertaken contain or are likely to contain a tonal component, a tonal penalty is to be calculated and applied using the following rating procedure.
- (b) For each 10 minute interval for which LA90, 10 minute data have been determined as valid in accordance with Guidance Note 2 a tonal assessment shall be performed on noise immissions during 2 minutes of each 10 minute period. The 2 minute periods should be spaced at 10 minute intervals provided that uninterrupted uncorrupted data are available ("the standard procedure"). Where uncorrupted data are not available, the first available uninterrupted clean 2 minute period out of the affected overall 10 minute period shall be selected. Any such deviations from the standard procedure, as described in Section 2.1 on pages 104-109 of ETSU-R-97, shall be reported.
- (c) For each of the 2 minute samples the tone level above or below audibility shall be calculated by comparison with the audibility criterion given in Section 2.1 on pages 104-109 of ETSU-R-97.

- (d) The tone level above audibility shall be plotted against wind speed for each of the 2 minute samples. Samples for which the tones were below the audibility criterion or no tone was identified, a value of zero audibility shall be used.
- (e) A least squares “best fit” linear regression line shall then be performed to establish the average tone level above audibility for each integer wind speed derived from the value of the “best fit” line at each integer wind speed. If there is no apparent trend with wind speed then a simple arithmetic mean shall be used. This process shall be repeated for each integer wind speed for which there is an assessment of overall levels in Guidance Note 2.
- (f) The tonal penalty is derived from the margin above audibility of the tone according to the figure below.



Guidance Note 4

- (a) If a tonal penalty is to be applied in accordance with Guidance Note 3 the rating level of the turbine noise at each wind speed is the arithmetic sum of the measured noise level as determined from the best fit curve described in Guidance Note 2 and the penalty for tonal noise as derived in accordance with Guidance Note 3 at each integer wind speed within the range specified by the Local Planning Authority in its written protocol under paragraph (d) of the noise condition.
- (b) If no tonal penalty is to be applied then the rating level of the turbine noise at each wind speed is equal to the measured noise level as determined from the best fit curve described in Guidance Note 2.
- (c) In the event that the rating level is above the limit(s) set out in the Tables attached to the noise conditions or the noise limits for a complainant’s dwelling approved in accordance with paragraph (e) of the noise condition, the independent consultant shall undertake a further assessment of the rating level to correct for background noise so that the rating level relates to wind turbine noise immission only.

- (d) The wind farm operator shall ensure that all the wind turbines in the development are turned off for such period as the independent consultant requires to undertake the further assessment. The further assessment shall be undertaken in accordance with the following steps:
- (e) Repeating the steps in Guidance Note 2, with the wind farm switched off, and determining the background noise (L3) at each integer wind speed within the range requested by the Local Planning Authority in its written request under paragraph (c) and the approved protocol under paragraph (d) of the noise condition.
- (f) The wind farm noise (L1) at this speed shall then be calculated as follows where L2 is the measured level with turbines running but without the addition of any tonal penalty:

$$L_1 = 10 \log \left[10^{L_2/10} - 10^{L_3/10} \right]$$

- (g) The rating level shall be re-calculated by adding arithmetically the tonal penalty (if any is applied in accordance with Note 3) to the derived wind farm noise L1 at that integer wind speed.
- (h) If the rating level after adjustment for background noise contribution and adjustment for tonal penalty (if required in accordance with note 3 above) at any integer wind speed lies at or below the values set out in the Tables attached to the conditions or at or below the noise limits approved by the Local Planning Authority for a complainant's dwelling in accordance with paragraph (e) of the noise condition then no further action is necessary. If the rating level at any integer wind speed exceeds the values set out in the Tables attached to the conditions or the noise limits approved by the Local Planning Authority for a complainant's dwelling in accordance with paragraph (e) of the noise condition then the development fails to comply with the conditions.

Guidance Note 5

The level of amplitude modulation will require to be measured having regard to the methodology detailed in the RenewableUK document "Template Planning Condition on Amplitude Modulation Noise Guidance Notes dated December 2013".

Small Wind

1. At wind speeds not exceeding 10m/s at rotor centre height, the wind turbine noise level at each noise sensitive property shall not exceed the levels in Table 1 below.

Table 1

Location		Wind speed at rotor height in m/s averaged over 1 minute periods. Sound Pressure Levels in dB LA eq (1 min)						
Property Name	Map Ref	4	5	6	7	8	9	10
H1								
H2								
Note: For all properties not specified above the predicted noise from the turbine will be calculated using hemispherical propagation with no reduction for air attenuation or ground effect.								

2. At the request of the Planning Authority, following a complaint to South Ayrshire Council relating to noise emissions from the wind turbine(s), the wind turbine operator shall shut down the turbine not later than 24 hours after the receipt of the request and at his own expense, employ an independent consultant, approved by the Planning Authority, to assess the level of noise emissions from the wind turbine(s) (inclusive of existing background noise). The background noise level shall also be measured without the wind turbine(s) operating. The noise from the turbine alone can then be calculated by logarithmic subtraction. If requested by the Planning Authority the assessment of noise emissions shall include an investigation of amplitude modulation in a manner agreed with the Authority.
3. Should the wind turbine sound pressure level exceed the level specified in the above conditions the turbine shall cease operation until such times as it has been demonstrated to the Planning Authority that the sound pressure level, referred to in the condition, can be achieved.

Informative:

1. Determination of L_{A90}

Determination of L_{A90} index shall be used with integrating periods of at least 1 minute duration. At least 10 periods of measurement are required for each integer wind speed bin from the cut-in wind speed to a wind speed of 11m/s.

The L_{Aeq} Wind Turbine Noise Level shall be correlated with wind speed and derived using a Best Fit Line, using linear regression analysis.

The LA90 Background Noise Level shall also be correlated with wind speed and derived using a Best Fit Line, using linear regression analysis.

The assessment of compliance with the above conditions will be determined on the basis of the levels determined from the best fit lines.

The locations of monitoring shall be determined by, or agreed with, the Planning Authority.

2. Rotor height wind speed

Rotor height wind speeds can be determined by direct measurement at hub height or calculated from the measured wind speed at 10m height, using a roughness value, $Z_0 = 0.05m$, from the following equation:

$$V_1 = V_2 \times \{ \text{LN} (H_1/Z_0) / \text{LN} (H_2/Z_0) \}$$

Where V_1 = Hub Height wind speed
 V_2 = Measured 10m height speed
 H_1 = Hub Height, metres
 H_2 = 10 metres
LN is the natural logarithm to the base e

3. Noise Measurement Procedure and Interpretation

“Wind Turbine Sound Pressure Level” means the downwind sound pressure level due to the combined effect of all contributing Wind Turbines, excluding the contribution from background noise. The applicant shall be aware that due to the numerical similarity of the background noise level and the wind turbine noise level at some preferred monitoring locations it may be necessary to agree alternative monitoring locations, with the Planning Authority. The agreed location will be closer to the turbine. The turbine noise level can then be calculated for the preferred monitoring location using the formula.

$$SPL_1 = SPL_2 + 20 \log (R_2/R_1) - 0.01(R_1 - R_2)$$

Where:

SPL_1 is the calculated sound pressure level, dB L_{Aeq} at the preferred location.

SPL_2 is the measured sound pressure level, dB L_{Aeq} at the agreed alternative measurement location.

R_1 is the horizontal distance, in metres, from the preferred location at a height of 1.2m, to the turbine hub.

R_2 is the slant distance, in metres, from the turbine hub to the agreed alternative microphone position, (at a height of 1.2m).

“Background Noise Level” means the noise level in the absence of noise generated by the wind turbines as measured and correlated with Wind Speeds using linear regression analysis determined as a result of the monitoring exercise required by these conditions.

“The integer wind speed bin wind speeds” are the wind speeds between 0.5 m/s below and 0.5 m/s above each integer wind speed.

“Night Hours” means 23:00 – 07:00 hours on all days.

“Quiet Daytime Hours” means 18:00 – 23:00 hours Monday to Friday, 13:00 – 23:00 hours on Saturday and 07:00 – 23:00 hours on Sunday.

“Daytime Hours” means 07:00 – 18:00 hours Monday to Friday and 07:00 – 13:00 on Saturday.

Measurements shall be made using a measurement system of Type 1, (as defined in BS EN 61672-1:2013), using a fast time weighted response incorporating a windshield using a ½ inch diameter microphone, at a height of between 1.2m and 1.5m above ground level and at least 10m from any wall hedge or reflective surface.

Measurements shall be made using a sound level meter of EN 60651/BS EN 60804 Type 1, or BS EN 61672 Class 1 quality (or the equivalent UK adopted standard in force at the time of the measurements) set to measure using the fast time weighted response as specified in BS EN 60651/BS EN 60804 or BS EN 61672-1 (or the equivalent UK adopted standard in force at the time of the measurements), with the microphone mounted at 1.2 – 1.5 metres above ground level in “free field” conditions, and fitted with a two-layer windshield, or suitable equivalent approved in writing by the Local Planning Authority. To achieve “free field” conditions, the microphone should be placed at least 3.5 metres away from the building facade or any reflecting surface except the ground at the approved measurement location.