Seren Energy Ltd

Background Noise Assessment

Client:	**Myreton Renewable Energy**
Date:	**8th April 2009**
Assessor:	**Oliver Penney**
Approved:	**GT**
Ref Number:	**SE 04/09-1**

Executive Summary

A background noise survey was undertaken as part of the planning application for two additional wind turbines at Lurg Hill, Myreton, Moray. A single wind turbine has already been consented at the site. The survey comprised of a number of noise measurements over a range of wind speeds.

Predicted noise levels from the three wind turbines were compared with the measured noise levels. The survey found that current background noise levels were sufficiently high enough for the predicted noise levels from the turbines to comply with the relevant legislation at all wind speeds. Noise impact will not therefore be an issue for the proposed scheme.

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Contents

1. Objective

To carry out a background noise survey to assess the impact of installing two additional Enercon E48 800kW wind turbines on the Myreton site, Cross Roads, Keith, Moray.

2. Background

On the 22nd February 2008 Myreton Renewable Energy Ltd was granted planning consent for an Enercon E44 900kW wind turbine at grid reference 350118, 856999. A background noise survey was not undertaken for this application as the predicted noise from the turbine at the nearest residential property was below the 35dB(A) lower limit recommended in the relevant noise legislation, ETSU-R-97.

In January 2009 the developer submitted an application for two additional wind turbines on the site, at grid references 349956, 856849 and 350169, 856775. The additional wind turbines will result in predicted noise levels from the turbines of up to 40.41dB(A) at the nearest properties.

The limits set out by ETSU-R-97 require the noise levels from the turbine to be no greater than 5dB(A) above existing background noise levels at a range of wind speeds.

An initial survey was undertaken in October 2008 at a number of properties in the vicinity. The results of these were used in discussion with Douglas Caldwell, the Environmental Health Officer (EHO) at Moray Council when reviewing locations for a more comprehensive set of noise measurements.

3 Results Summary

3.1 Predicted Noise Levels

A noise prediction calculation using manufacturers information was run on Windfarm© software, developed by ReSoft Ltd (www.resoft.co.uk). Details of the calculation used are provided in Appendix B. Figure 1 shows the noise from the turbines over the whole area, and identifies the nearest 7 noise sensitive properties.

No tonal penalty has been included within the calculations as specified by the manufacturer. Enercon have in fact stated in an email sent on 6th January 2009 that "our turbines have no tonalities". A safety factor of 1dB(A) has been included with all calculations in line with manufacturers recommendations.

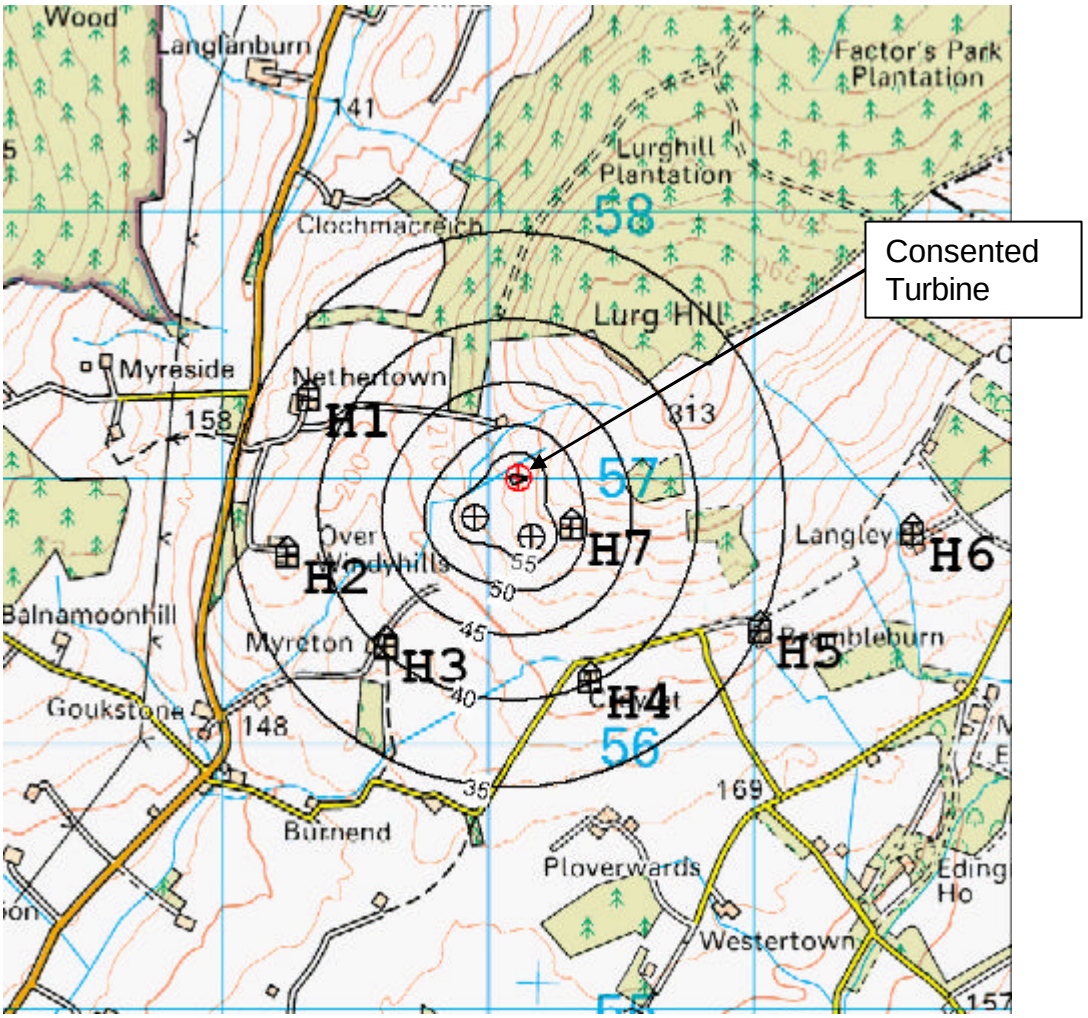

Figure 1: Predicted Noise Impact, dB(A), of the Proposed Wind Turbines, at a wind speed of 10m/s at 10m height (E48 turbines black, E44 turbine red).

The consented wind turbine is an Enercon E44 wind turbine, and the current planning application is for two additional Enercon E48 wind turbines. Noise prediction calculations have therefore been made for two Enercon E48 wind turbines and one Enercon E44 wind turbine.

E44 wind turbines and E48 wind turbines have optimal performance in different wind regimes. Following a full set of anemometry results, the planning permission is likely to be amended to either three E48s or three E44s to maximise the productivity of the scheme.

If three E44s are installed, noise levels at the houses will increase by between 0.33 and 0.39 dB(A). If three E48s are used, noise levels are reduced by between 0.11 and 0.18 dB(A). The requirements outlined in ETSU-R-97 will therefore be met whichever combination of wind turbines is used.

Table 1 gives the noise levels at each property.

House ID	House Name	Noise dB(A)	Comment
H1	Nethertown	37.62	Occupied
H2	Over Windyhills	37.75	Occupied
H3	Myreton	40.41	Owned and Occupied by Developer
H4	Croylet	40.06	Occupied
H5	Brambleburn	34.90	Occupied
H6	Langley	29.23	Occupied
H7	Loanhead	52.10	Derelict

Table 1: Noise Levels at Houses

The predicted noise levels at Brambleburn and Langley (H5 and H6) are below the lower fixed limit of 35dB(A) recommended in ETSU-R-97.

Myreton (H3) is owned and occupied by the developer, and is therefore considered to be 'financially involved'. ETSU-R-97 recommends that the lower fixed limit is raised to 45dB(A) when this is the case, so background noise measurements are not required at this property.

Loanhead is currently derelict. Planning permission has been granted to restore this building for residential purposes, but if the planning application for the additional turbines is successful, the building will remain in its current state. A letter was sent to the LPA by the land owner on 30th January 2009, confirming that if planning permission is granted for the further two wind turbines, no additional work will be undertaken on this property.

The noise level at the nearest house not financially involved is at Croylet (H4), with predicted noise level of approximately 40.1dB(A), which is above the daytime limit recommended in ETSU-R-97. Croylet was therefore selected through as one of the two locations where additional detailed background noise monitoring should take place.

The next two nearest houses have very similar noise levels; Over Windyhills and Nethertown have predicted noise levels of 37.75dB(A) and 37.62dB(A) respectively. Following discussion with Douglas Caldwell it was agreed that

additional detailed noise monitoring should also be undertaken at Nethertown. This location was chosen predominately because the initial survey found that at higher wind speeds Nethertown had lower background noise levels than Over Windyhills, and was considered to be a 'sheltered location' by Douglas Caldwell.

The noise levels described in this report are put into context in Table 2.

Source/Activity	Indicative Noise Level dB(A)
Threshold of hearing	0
Rural night time background	20-40
Quiet bedroom	35
Windfarm at 350m	35-45
Car at 40mph at 100m	55
Busy general office	60
Truck at 30mph at 100m	65
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

Table 2: Comparative Noise Levels (Information taken from Planning Advice Note PAN 45)

3.2 Survey Results Overview

The study found that at all wind speeds the predicted noise levels from the turbine at potentially noise sensitive properties were below the prevailing background noise level and therefore within the ETSU-R-97 limits, which allows a 5dB(A) increase above background noise levels. Detailed results are given in section 5.

4 Conclusions and Recommendations

The limits set out by ETSU-R-97 require the noise levels from the turbine to be less than 5dB(A) above existing background noise levels. The measurements taken during the survey show this to be the case. The recommendations in ETSU-R-97 are met, and noise impact is not therefore expected to be an issue for the proposed scheme.

The prevailing background noise level is currently above the predicted noise from the wind turbine for both locations at quiet waking hours and night hours. If an amendment to the consented application is made, and either three E48s or three E44s are used, there will be no significant increase in noise impact.

5 Noise Assessment

5.1 Measurement Locations

The measurement locations of Nethertown (H1) and Croylet (H4) are shown in Figure 2.

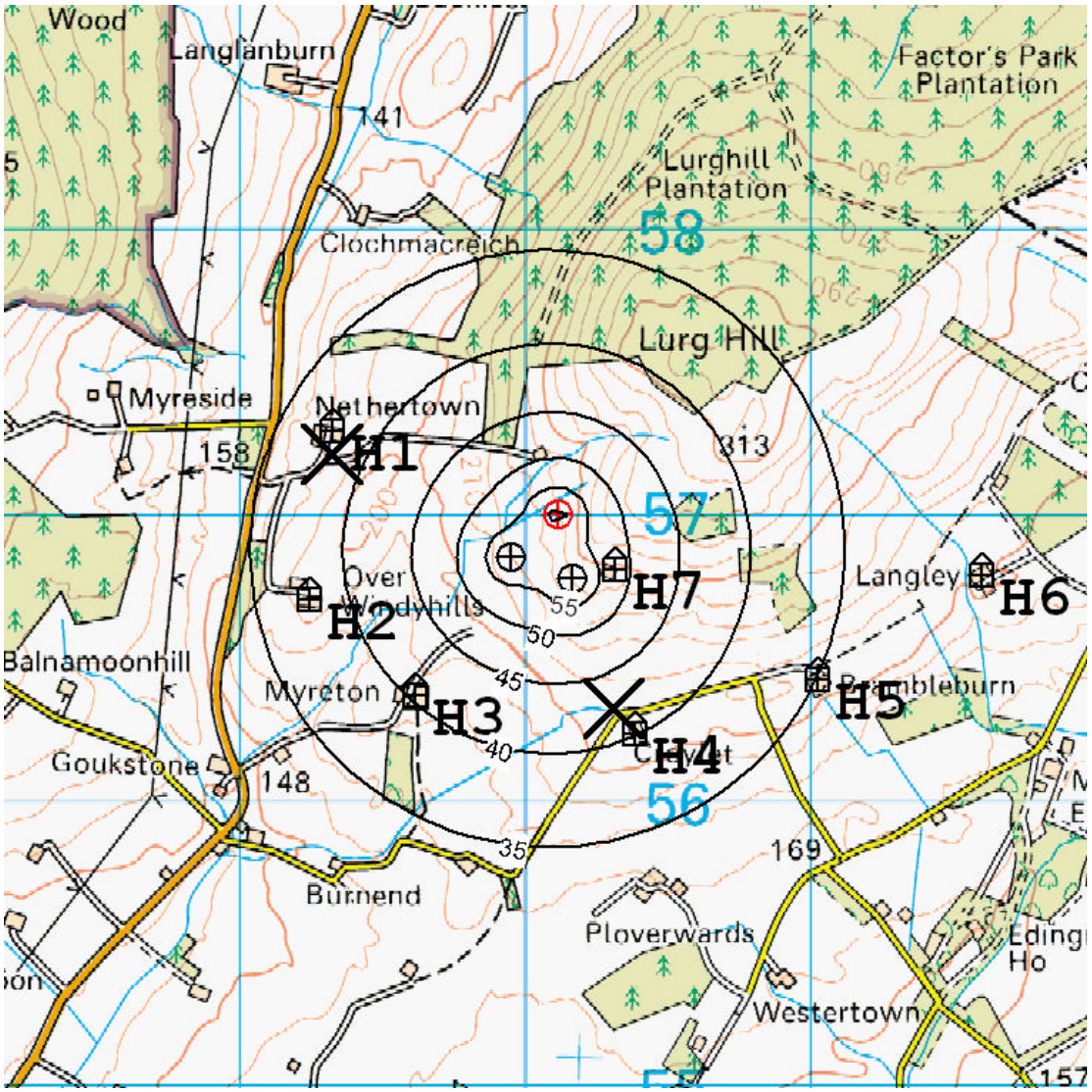

Figure 2 – Measurement Locations and Predicted Noise Levels at 10m/s at 10m height

5.2 Methodology

1. Background noise measurements were taken at potentially noise sensitive sites, following procedures specified in ETSU-R-97, 'The Assessment and Rating of Noise from Wind Farms'. The readings for Nethertown were taken between the 30th January 2009 and 2nd February 2009, and on the 10th and 11th February 2009. Readings were taken at Croylet between the 22nd and 30th March 2009. A February set of readings for Croylet had to be discounted as heavy snowfall partially covered the equipment.

2. $L_{A90,\ 10\ min}$ levels were taken. The $L_{A90,\ 10min}$ descriptor is the dB (A) level exceeded 90% of the 10 minute measurement time.

3. The measurements were taken using a Cirrus CR:831C sound level meter. Further details of equipment are provided in Appendix A and Appendix C

4. The instrumentation was mounted on a tripod of 1.3 metres height. The microphone itself was fitted with a wind shield, and was 0.2m above the top of the tripod, giving a total height above ground level of 1.5m.

5. The measurements were taken at two locations, which were agreed with the Environmental Health Dept of the Local Planning Authority prior to the survey.

6. An anemometer mast using equipment supplied by Enercon (the wind turbine manufacturer) at grid ref 544007 320521 recorded wind speed data at 10m height. Ten minute averages were used for the survey.

7. The acoustic data was split into two sub-sets; quiet waking hours (18:00-23:00 every day, 13:00-18:00 Saturday and 07:00 – 18:00 Sunday) and night hours (23:00 – 07:00 every day).

8. Data recorded during rainfall was discarded. Data recorded after the rainfall, for a time period equal to the duration of the rainfall, was also discarded. A total of 7 hrs 20 minutes of data was discarded.

9. A best fit curve was plotted for each data set using a second order polynomial model.

5.3 Results

H1- Nethertown

House Grid Reference: 349328, 857289
Measurement Grid Reference: 349320, 857210
Predicted Turbine Noise Levels at house (10m/s 10m height): 37.62dB(A)
Distance of house from Wind Turbine: 780m
Measurement Location Description: Near junction of proposed access track and Nethertown driveway

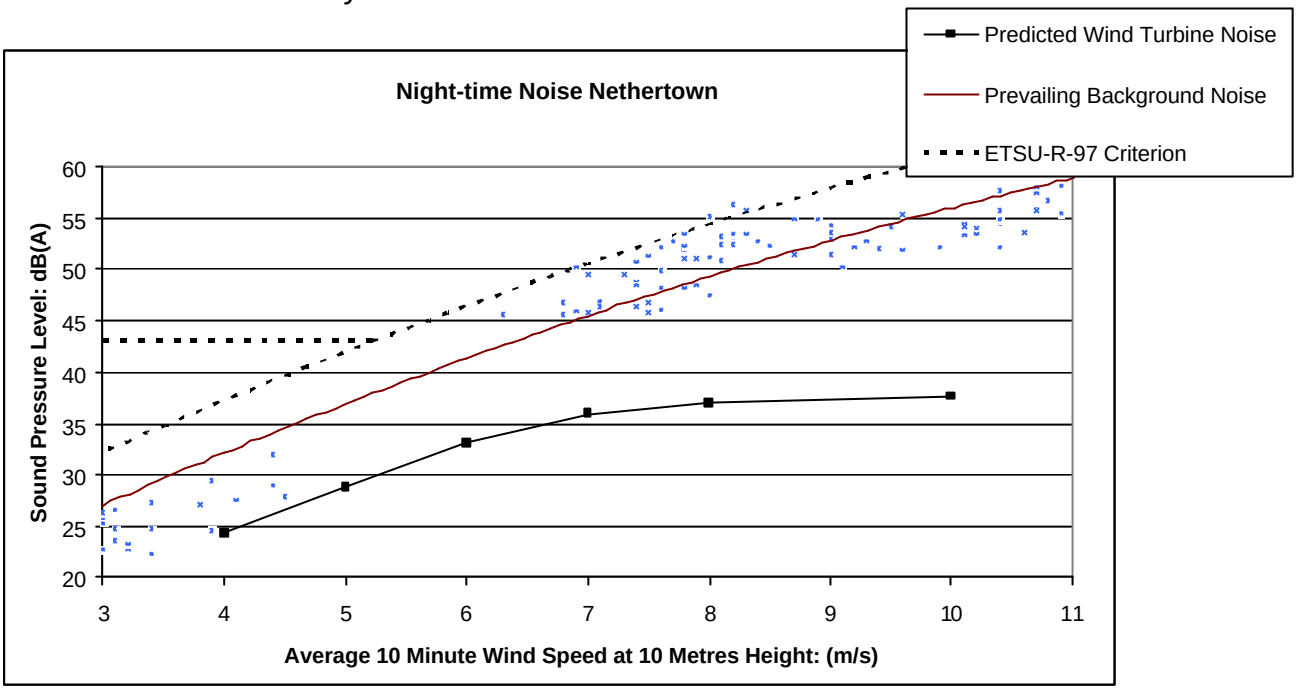

Figure 3: Night-time Noise at Nethertown

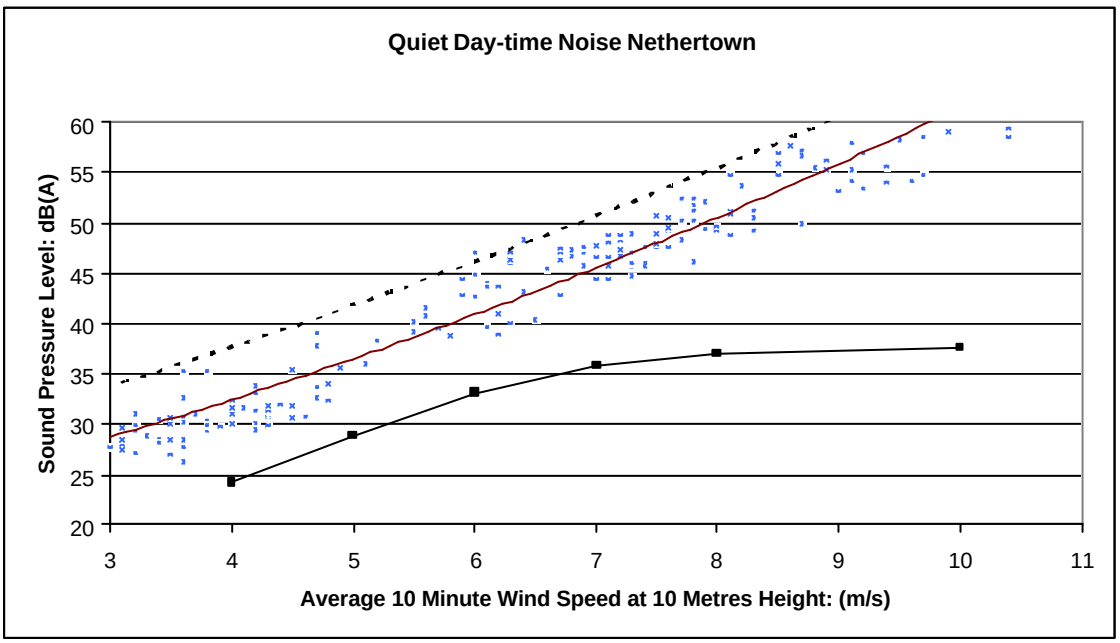

Figure 4: Quiet Day-time Noise at Nethertown

H4 - Croylet
House Grid Reference: 350387, 856230
Measurement Grid Reference: 350340,856320
Predicted Turbine Noise Levels: 40.06(A)
Distance to turbine: 560m
Measurement Location: Near beginning of forest track

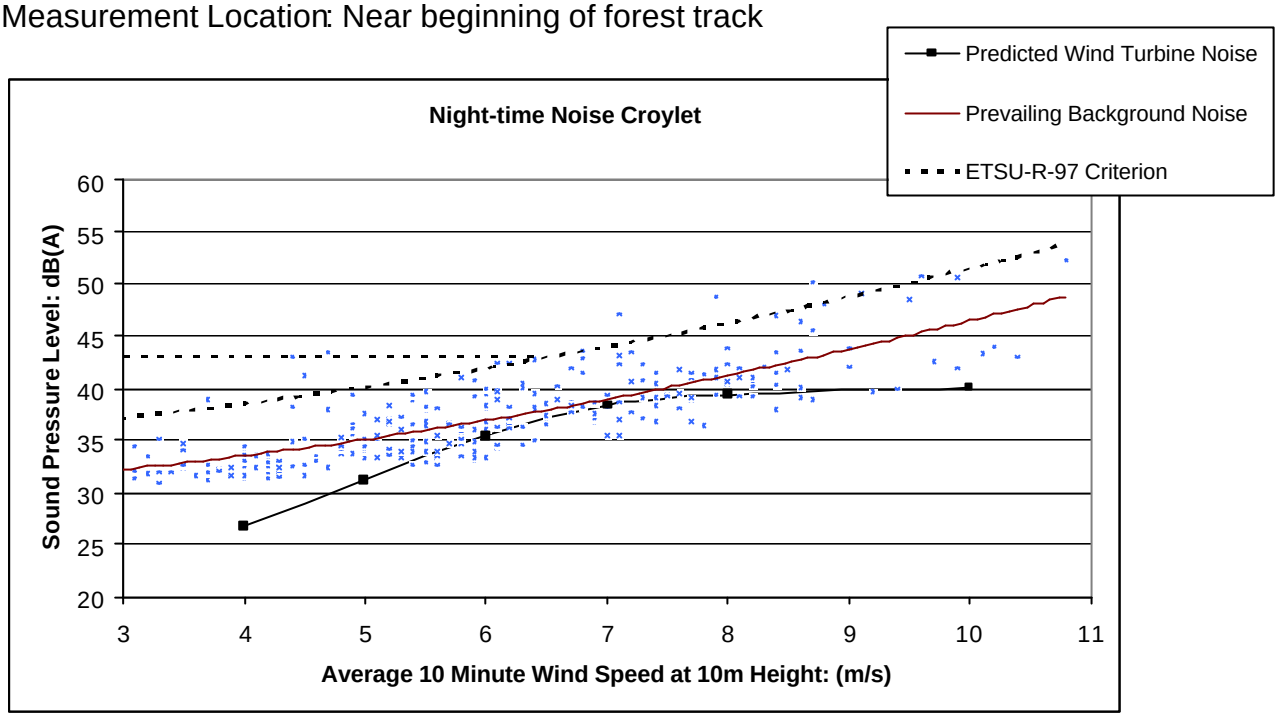

Figure 5: Night-time Noise at Croylet

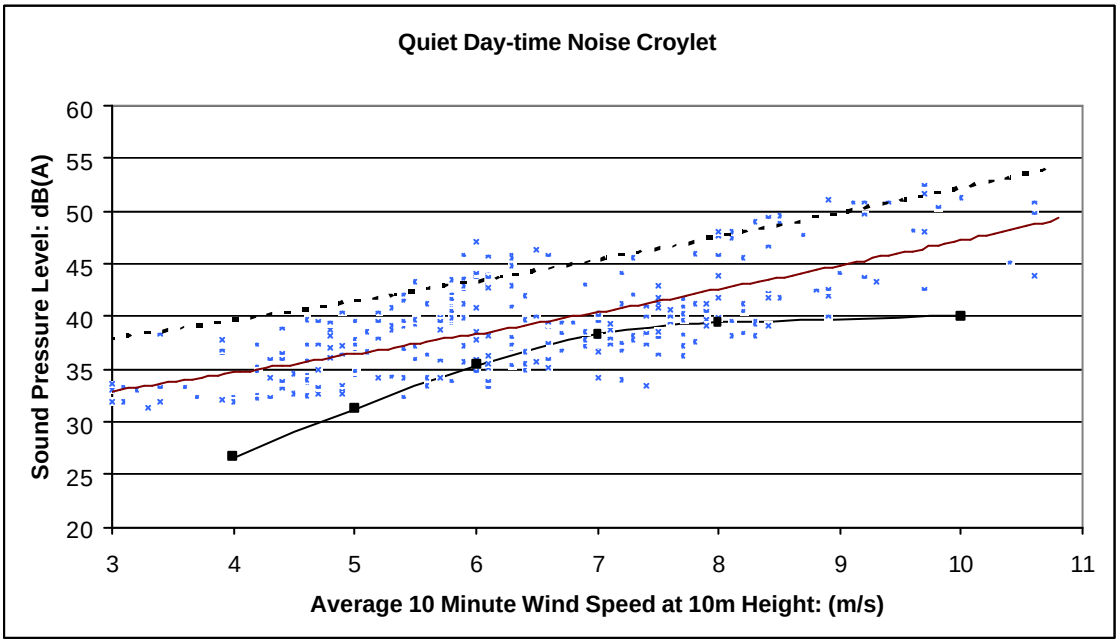

Figure 6: Quiet Day-time Noise at Croylet

Appendix A – Instrumentation Used

Cirrus CR:831C sound level meter – Class 1/Type 1 , with ½" diameter microphone

The noise meter was calibrated between each measurement set with a Cirrus CR:515 calibrator

Microphone Windshield

1.3m Tripod

Appendix B - Noise Calculation

Danish Noise Model

The noise model included in the noise calculation module is based on "Description of Noise Propagation Model Specified by Danish Statutory Order on Noise from Windmills (Nr. 304, Dated 14 May 1991)" as produced by The Danish Ministry of the Environment National Agency for Environmental Protection. Further details regarding the background, assumptions and use of this model have been provided in a separate letter to Douglas Caldwell.

Assessment of a Single Turbine

The noise level at a receiver **R** (house) at 1.5m above ground level is obtained using the following equation:

$$L_P = L_{wa} - 10 \cdot \log_{10}\left\{2 \cdot p \cdot r^2\right\} - a \cdot r \qquad [1]$$

Where:

The source (a wind turbine) is broadcasting noise at $\mathbf{L_{wa}}$ dB(A) re 1 pW;

$\mathbf{L_p}$ is the sound pressure level at **R** in dB (A) re 20 (iPascal);

r is the line of sight distance between source and receiver in metres; terrain height is not included in the calculation;

a is the attenuation coefficient in dB/m.

If L_{wa} exists as a single broadband sound power level, a = 0.005dB/m.

The Noise Directive also includes a 5dB penalty for the presence of tones in the noise emission of a turbine. By ‘presence’ the Directive means ‘clearly audible’ which, in the more recent nomenclature of the new IEA or IEC noise standards, translates to ‘prominent’. Enercon have confirmed that 'our turbines have no tonality', so no tonal penalty is included in calculations.

Results Assessment of Multiple Turbines

Determine $L_p(j)$ for each turbine, where j = 1...m, using equation [1]. The total sound pressure level resulting from all 'm' turbines is then:

$$L_P = 10 \cdot \log_{10}\left\{\sum_{j-1}^{j-m} 10^{L_P(j)/10}\right\}$$

Manufactures Information

The calculations were based on Enercons Guaranteed broadband noise levels for the E48 and E44 wind turbines. A safety factor of 1dB(A) has been added to these levels, in-line with the manufacturers recommendations. The Enercon E44 is aimed at high wind speed sites, and does not have guaranteed noise levels for low wind speeds. When assessing the noise at low wind speeds, data for the E48 wind turbine was therefore used for all three turbines.

Appendix C – Calibration Certificates

Certificate of Calibration

Cirrus Research plc

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Sound Level Meter
Model Number	CR:831C
Serial Number	D20437FF

Calibration Procedure

The instrument detailed above has been calibrated to the published test and calibration data as detailed in the instrument handbook, using the techniques recommended in the latest revisions of the International Standards IEC 61672-1:2002, IEC 60651:1979, IEC 60804:2001, IEC 61260:1995, IEC 60942:1997, IEC 61252:1993, ANSI S1.4-1983 and ANSI S1.43-1997 where applicable.

Sound Level Meters: All Calibration procedures were carried out by substituting the microphone capsule with a suitable electrical signal, apart from the final acoustic calibration.

Calibration Traceability

The equipment detailed above was calibrated against the calibration laboratory standards held by Cirrus Research plc. Which are traceable to the appropriate International Standards.

The Cirrus Research plc calibration laboratory standards are:

Microphone Type	B&K4180	Serial Number	1893453	Calibration Ref.	S 5505
Pistonphone Type	B&K4220	Serial Number	613843	Calibration Ref.	S 5423

Calibrated by	[redacted]
Calibration Date	29 August 2008
Calibration Certificate Number	162826

This Calibration Certificate is valid for 12 months from the date above.

Cirrus Research plc, Acoustic House, Bridlington Road, Hunmanby, North Yorkshire, YO14 0PH
Telephone: +44 (0) 1723 891655 Fax: +44 (0) 1723 891742
Email: sales@cirrusresearch.co.uk

Certificate of Calibration

Cirrus Research plc

Equipment Details

Instrument Manufacturer	Cirrus Research plc
Instrument Type	Acoustic Calibrator
Model Number	CR:515
Serial Number	48434

Calibration Procedure

The acoustic calibrator detailed above has been calibrated to the published data as described in the operating manual. The procedures and techniques used to follow the recommendations of the IEC standard Electroacoustics – Sound Calibrators IEC 60942:2003, IEC 60942:1997, BS EN 60942:1998 and BS EN 60942:2003 where applicable.. The calibrator's main output is 94.00 dB (1 Pa) and this was set within the 0.01 dB resolution of the test system, i.e. one hundredth of a decibel. Numbers in {parenthesis} refer to the paragraph in IEC 60942.

Calibration Traceability

The calibrator above was calibrated against the calibration laboratory standards held by Cirrus Research plc. These are traceable to International Standards {A.0.6}. The standards are:

Microphone Type	B&K4180	Serial Number	1893453	Calibration Ref. S 5505
Pistonphone Type	B&K4220	Serial Number	613843	Calibration Ref. S 5423

Calibration Climate Conditions

The climatic test conditions were all maintained within the permitted limits of IEC 60942:1997.

Temperature	{B.3.2}	Permitted band 15°C to 25°C
Humidity	{B.3.2}	Permitted band 30% to 90% RH
Static Pressure	{B.3.2}	Permitted band 85 kPa to 105 kPa
Ambient Noise Level	{B.3.3.6}	Max permitted level 64 dB(Z)

Measurement Results

The figures below are the Calibration Laboratory test limits for this model calibrator and have a smaller tolerance than those permitted in IEC 60942.

94 dB Output	94.00	dB	Permitted band 93.95 to 94.05 dB
Frequency	1000	Hz	Permitted band 990 to 1010 Hz

Uncertainty

With an uncertainty coefficient of k=2, i.e. a 95% confidence level, the uncertainty of each measure is

94 dB Output	± 0.13 dB	104 dB Output	± 0.14 dB
Frequency	± 0.1 Hz	Level Stability	± 0.04 dB

Calibrated by [redacted]

Calibration Date 29 August 2008

Calibration Certificate Number 162827

This Calibration Certificate is valid for 12 months from the date above.

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