Environmental Impact Assessment Report

Swarclett Wind Farm

Technical Appendix 9-1 Baseline Noise Measurements

Swarclett Wind Energy Limited

June 2024

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1 Introduction

The Proposed Development is located 11km south east of Thurso, Scotland and approximately 4km north of Loch Watten, near Hoy. This report describes the baseline noise measurements that have been undertaken, and the derivation of appropriate noise limits.

Baseline noise measurements were carried out at three locations agreed with The Highland Council (THC) in line with ETSU-R-97, *The Assessment and Rating of Noise from Wind Farms*, and the Institute of Acoustics document, *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Noise from Wind Turbines*. Measured noise levels have been correlated with hub height wind speeds (standardised to 10 m) calculated from the two closest heights measured using a SoDAR wind measurement unit situated within the Proposed Development Site.

Noise limits have been derived according to ETSU-R-97, *The Assessment and Rating of Noise from Wind Farms*.

The baseline measurements have been re-analysed for low wind speed conditions (less than 5m/s) to determine representative background sound levels suitable for a BS4142 assessment. This has been compared with worst-case predicted noise levels from the proposed Battery Energy Storage System(BESS) facility at the nearest residential properties.

2 Policy and Guidance

Baseline noise measurements were carried out in accordance with the methodology prescribed by ETSU-R-97 *The Assessment and Rating of Noise from Wind Turbines*, and the accompanying guidance produced by the Institute of Acoustics (IOA) in their document, *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Noise from Wind Turbines*.

Additionally, assessment of the proposed BESS facility requires baseline measurements to be analysed in an alternative way according to methodology set out in BS 4142:2014 + A1:2019. These guidance documents are discussed below.

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

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

ETSU-R-97 recommends that, although noise limits should be set relative to existing background and should reflect the variation of both turbine and background noise with wind speed; this can imply very low noise limits in particularly quiet areas, in which case;

> *"it is not necessary to use a margin above background in such low-noise environments. This would be unduly restrictive on developments which are recognised as having wider global benefits. Such low limits are, in any event, not necessary in order to offer a reasonable degree of protection to the wind farm neighbour."*

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

For night-time periods the noise limit is 43 dB L_{A90} or 5 dB(A) above the prevailing night-time hours background noise, whichever is the greater. The 43 dB(A) lower limit is based on an internal sleep disturbance criteria of 35 dB(A) with an allowance of 10 dB(A) for attenuation through an open window and 2 dB(A) subtracted to account for the use of the L_{A90} rather the L_{Aeq} noise measurement index ((see Paragraph 0 (below)).

At properties that are occupied by residents with a direct financial benefit from the wind farm, the daytime and night-time lower limiting values are increased to 45 dB L_{A90}.

It is stated that the $L_{A90,10min}$ noise descriptor should be adopted for both background and wind farm noise levels and that, for the wind farm noise, this is likely to be between

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

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

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

In May 2013, the IOA published *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise*. This was subsequently endorsed by the Scottish Government and is referenced in *Web Based Planning Advice*, *Onshore Wind Turbines*. The publication of the Good Practice Guide (GPG) followed a review of current practice carried out for the Department of Energy and Climate Change (DECC) and an IOA discussion document which preceded the GPC.

The GPG includes sections on the following:

- Context;
- Background Data Collection;
- Data Analysis and Noise Limit Derivation;
- Noise Predictions;
- Cumulative Issues;
- Reporting; and
- Other Matters (including Planning Conditions, Amplitude Modulation, Post Completion Measurements and Supplementary Guidance Notes).

The Context section states that the guide;

> "*presents current good practice in the application of the ETSU-R-97 assessment methodology for all wind turbine development above 50 kW, reflecting the original principles within ETSU-R-97, and the results of research carried out and experience gained since ETSU-R-97 was published*".

It adds that "*the noise limits in ETSU-R-97 have not been examined as these are a matter for Government*".

2.3 BS4142:2014 + A1 2019, Methods for Rating and Assessing Industrial and Commercial Sound

BS 4142:2014 + A1:2019 provides an assessment methodology for rating noise immission levels from industrial and commercial sources at residential properties. The standard describes a method for determining the noise impact based on the difference between the existing background sound level (without the noise source), measured using the L_{A90} measurement index, and the noise immission level of the source at a

receiver location (known as the specific sound level), measured or predicted using the L_{Aeq} index. If the specific sound level exhibits an identifiable character such as tonality or impulsiveness, then a variable penalty of up to 6 dB or 9 dB respectively is added to give the 'rating level'.

The difference between the background sound level and the rating level (rating minus background) is then used to assess the noise impact, according to Table 1 below. BS 4142:2014 + A1:2019 states that;

> '*the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact*'.

Table 9-1-1: BS 4142 Guidance on Noise Impact

Difference	Assessment
Around +10 dB or more	Indication of a significant adverse impact
Around +5 dB	Indication of an adverse impact
<0 dB	Indication of a low impact

Whilst BS 4142:2014 + A1:2019 gives an indicative assessment of the impact on residential amenity, there are no specific guidelines on what may be acceptable in a given situation and, in this respect, the standard is left open to interpretation.

Section 7 of the standard provides guidance on determination of the specific sound level. It is noted that, where measurement of the specific noise level is not possible, then this can be determined by calculation. It also describes how the specific noise level is quantified as an L_{Aeq} over the 'reference time interval' which means that, where it is not continuous, it is necessary to correct the measured noise level, taken during periods when the source is operating, for the percentage 'on-time' within the relevant reference time interval. The standard details different reference time intervals for the day-time and night-time of 1 hour and 15 minutes respectively.

Section 8 provides guidance on determination of the background sound level. It is noted that there is no 'single' background sound level as this is a fluctuating parameter. As a result, it is recommended that a series of sequential or disaggregated measurements, of duration not normally less than 15 minutes, are carried out to determine a 'representative' level which is then used as the basis of the assessment. It is noted that the data should suitably represent the particular circumstances and periods of relevance to the assessment, and that weekday and weekend periods may need to be considered separately. Levels are to be reported as integer values to reflect the variability of such measurements.

3 Consultation

THC were consulted regarding baseline monitoring locations and appropriate noise limits for the proposed wind turbines. In March 2023 a letter (HMPL ref. *3569_L01_EXT1),* was sent to THC environmental health department to suggest initial noise monitoring locations and to confirm adoption of methodology set out in their scoping response.

The correspondence summarised above is included at Appendix A. It should be noted that, as part of the scoping response, THC confirmed their policy to adopt lower night-time noise limits than recommended in ETSU-R-97 derived according to the greater of 38 dB L_{A90} or 5 dB above background.

4 Baseline Noise Measurements

Baseline noise measurements have been carried out to characterise the existing noise environment and to allow for appropriate noise limits to be derived for the Proposed Development in line with the agreements with THC.

4.1 Noise Survey Methodology and Instrumentation

Rion NL-52 sound level meters corresponding to the Class 1 standard in BS EN 61672, were used for the noise measurements. The calibration certificates for the sound level meters and the Brüel and Kjær 4231 Class 1 sound level calibrators used for the survey are given in Appendix 9-1-2.

The microphones were fitted with double skin windshields based on the recommended design in ETSU W/13/00386/REP and mounted on a tripod at a height of approximately 1.5 m. Wind speeds and noise measurements were collected for successive 10-minute measurement intervals.

Wind speeds were measured at a number of heights between 40 and 200 m using a Triton SoDAR wind measurement device sited within the wind farm proposed development boundary (located at OS grid reference: ND 21060 63220). To monitor rainfall over the duration of the noise measurements, an acoustic rain gauge was installed at the Lower Bowertower baseline measurement location.

The noise survey covered a three-week period from 10th May to 31st May 2023.

4.2 Noise Survey Measurement Locations

The measurement locations were selected based on noise predictions for a preliminary turbine layout. The locations of these dwellings suggested these properties would be the nearest and therefore subjected to the highest noise levels. The measurement locations are shown at Figure 9-1 which also shows the location of the proposed wind turbines (in yellow, numbered).

The measurement positions and equipment used at each location are described at Table 9-1-2.

Table 9-1-2: Baseline noise measurement details

Location Name 1	Easting	Northing	Meter serial number	Date of last calibration (Valid for 2 years)
Hoy	321138	964002	00921232	28/07/2022
Lower Bowertower	322124	962801	00821102	23/03/2023
Oakwood	322090	962435	01032423	20/01/2022

The sound level meters were calibrated at installation and collection, and at an interim visit when the batteries were changed, and data was downloaded. The GPG states that a calibration drift of no greater than 0.5 dB during the survey period is within an acceptable tolerance. A drift of no greater than 0.1 dB was measured at any of the locations on collection of the equipment which is within the allowable tolerance.

A description of the noise environment at each measurement location is provided at Appendix 9-1-3.

4.3 Baseline Measurement Results

The measured acoustic data has been correlated with the standardised 10 m height wind speed derived from the data measured using the on-site SoDAR in order to determine the prevailing background noise level during the night and quiet daytime periods.

The hub height wind speed was calculated from the measured 100 m and 80 m height wind speeds based on the wind shear exponent between the two measurement heights using the formula;

$$V_h = V_1 \left[\frac{H_h}{H_u}\right]^m$$

where: V_h is the hub height wind speed at height H_h, and V_1 is the upper measured wind speed at height H_U

and: m is the shear exponent according to:

$$m = \left(\log\frac{U_1}{U_2}\right) \Big/ \left(\log\frac{H_1}{H_2}\right)$$

where: U_1 is the wind speed at height H_1 and U_2 is the wind speed at height H_2.

The standardised 10 m height wind speed was calculated by correcting the calculated hub height wind speed at 82.9 m, assuming a logarithmic wind shear profile as described by the following formula;

$$V_{10} = V_h \left(\frac{\ln\left(\frac{10}{z_0}\right)}{\ln\left(\frac{h}{z_0}\right)}\right),$$

where: V_{10} is the 10 m wind speed

V_h is the wind speed at hub height h

z_0 is the reference ground roughness length of 0.05 m

Appendix 9-1-4 shows the wind speed and direction data measured throughout the night and quiet daytime periods of the background noise.

4.4 Data Filtering

The measured noise data was filtered into the relevant time periods for night-time and quiet daytime hours, and any period where rainfall was measured at any of the rain

gauges was excluded from the derivation of the average baseline noise levels at all locations.

Manual exclusions were carried out to exclude periods at the beginning and the end of the survey (at all locations) which may have been affected by activity associated with installing and collecting the equipment.

4.5 Baseline Results – ETSU-R-97

Appendix 9-1-5 shows the measured background noise level over a range of wind speeds for each measurement location during the quiet daytime hours and night-time periods, with respect to the standardised 10 m height wind speed. A 3rd order polynomial regression line has been plotted through the measured noise data to derive the prevailing background noise levels.

The resulting derived prevailing background noise levels at each location are summarised in Table 9-1-3.

Table 9-1-3: Prevailing background noise levels at each measurement location (dB L_{A90})

Location Name	Time Period	Standardised 10m height wind speeds										
		2	3	4	5	6	7	8	9	10	11	12
Hoy	Night-time	23	24	26	28	31	33	36	40	42	45	47
	Quiet Day	29	29	30	32	34	38	41	45	49	52	55
Oakwood	Night-time	21	22	23	25	27	29	31	33	35	38	40
	Quiet Day	24	25	26	27	29	32	34	37	41	44	48
Lower Bowertower	Night-time	22	23	24	26	29	31	34	37	40	43	45
	Quiet Day	25	26	27	30	32	36	39	43	46	50	52

4.6 Baseline Results – BS 4142

The baseline measurements described above have been reanalysed to determine representative background sound levels for the purposes of a BS 4142 assessment. It should be noted that using a 10-minute measurement period is likely to give generally similar results to using a 15-minute measurement period (recommended minimum period duration in BS 4142) but it provides a greater number of samples over the same survey period allowing statistical analysis of more data.

Any 10-minute period where rainfall was recorded has been removed from the derivation of the representative background sound levels. Similarly, and in accordance with recommendations in BS4142, any periods where average wind speeds (standardised 10m height) exceed 5 m/s have also been removed from the analysis. It should be noted that typically, for the purposes of BS4142 assessments, wind speed measurements are made at a similar height to the height of the measurement microphone or higher (in the region of 1.5 – 2 m above ground). Using the standardised 10m height wind speeds measurements collected for the purposes of the ETSU-R-97 assessment ensures a conservative assessment since vertical wind shear dictates that these wind speeds would be greater than wind speeds measured at 1.5 – 2 m above the ground.

Statistical analyses of the daytime and night-time background sound level results, at Hoy, are shown at Appendix 9-1-6. A representative value for the background sound level to be used in the BS4142 assessment must be derived by taking into account these frequency distribution plots of the background sound measurements. Review of the distribution plots indicates that the most commonly occurring background sound levels during the day and night) are **30** and **18 dB L_{A90}** at Hoy for daytime and night respectively.

5 Derivation of ETSU-R-97 Noise Limits

The night and daytime noise limits have been derived from the prevailing background noise levels in line with ETSU-R-97 whereby the limits are set at the greater of the lower limiting value or 5 dB above the prevailing background noise level. THC stipulated in their scoping response that the appropriate lower limiting value at night should be 38 dB L_{A90}, whilst during the daytime the lower limiting value is 35 dB L_{A90} for non-financially involved properties. For financially involved properties the lower limiting value is 45 dB L_{A90}. The resultant noise limits are shown in Appendix 9-1-5 along with the background noise levels. The resultant night and daytime derived noise limits are shown below in Table 9-1-4.

Table 9-1-4: Derived noise limits at each location (dB L_{A90})

Location Name	Limit Period	Standardised 10m height wind speeds (m/s)										
		2	3	4	5	6	7	8	9	10	11	12
Hoy (financially involved)	Night-time	45	45	45	45	45	45	45	45	47	50	52
	Quiet Day	45	45	45	45	45	45	46	50	54	57	60
Oakwood	Night-time	38	38	38	38	38	38	38	38	40	43	45
	Quiet Day	35	35	35	35	35	37	39	42	46	49	53
Lower Bowertower	Night-time	38	38	38	38	38	38	39	42	45	48	50
	Quiet Day	35	35	35	35	37	41	44	48	51	55	57

6 Conclusions

Baseline noise measurements were undertaken at 3 residential receptor locations in the vicinity of the Proposed Development.

The results of the baseline noise measurements were used to derive appropriate noise limits in line with ETSU-R-97, *The Assessment and Rating of Noise from Wind Farms*, the Institute of Acoustics document, *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Noise from Wind Turbines* and the methodology agreed with The Highland Council.

Baseline noise measurements were reanalysed for 1 location (Hoy) according to BS4142:2014 + A1 2019 methodology in order to determine representative background sound levels during the day and night periods under low wind speed conditions.

7 References

British Standards Institution, 1994. *Specification for sound level meters*. BS EN 60651:1994.

Department of Energy and Climate Change, 2011. *Report on DECC Research Contract 01.08.09.01/492A (Analysis), Analysis of How Noise Impacts are Considered in the Determination of Wind Farm Planning Applications*.

Department of Trade and Industry, 1996. *Noise Measurements in Windy Conditions*. ETSU W/13/00386/REP.

ETSU-R-97, 1996. *The Assessment and Rating of Noise from Wind Farms*.AA

Institute of Acoustics, July 2012. *Discussion Document on A Good Practice Guide to the Application of ETSU-R-97 for Wind Turbine Noise Assessment*.

Institute of Acoustics, May 2013. *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise.*

Aberdeenshire Council, 2021. *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*.

Annex 9-1-1 Correspondence with The Highland Council

Hayes McKenzie
Consultants in Acoustics

09 March 2023

Planning Reference: 22/00790/SCOP

Our Reference: 3569_L01_EXT1

Robin Fraser
Environmental Health Officer
The Highland Council

By email to: robin.fraser@highland.gov.uk

Dear Robin,

I am writing to you regarding the proposed Swarclett wind farm for which I have seen your scoping response under its previous name of Corsback wind farm. We have been appointed by the developers to carry out the environmental noise impact assessment for the site and you should note that only two turbines are now proposed.

The operational noise assessment will be carried out in line with ETSU-R-97 and the UK Institute of Acoustics Good Practice Guide on its use.

We are aware of a single turbine development at Red Moss which is currently in Scoping which will be accounted for in our assessment as necessary.

Operational noise impacts from the proposed development will be considered to be acceptable and meet the relevant noise limits if the relevant noise limits for cumulative noise from all wind turbines in the vicinity of plus 5 dB above background, subject to lower limiting values of 35 dB L_{A90} during the daytime and 38 dB L_{A90} at night as per The Highland Council's Requirements identified in your Scoping Response.

We have identified three residential properties in the vicinity of the proposed development (i.e. where predicted operational noise levels from the proposed development are above 35 dB L_{A90}) where we intend to carry out baseline noise measurements to derive appropriate noise limits. These are indicated on the attached figure as listed below:

Hoy
Lower Bowertower
Oakwood

DRAFT

T +44 (0)1722 710 091
F +44 (0)1722 711 671
E salisbury@hayesmckenzie.co.uk
W hayesmckenzie.co.uk

Unit 3, Oakridge Office Park
Whaddon, Salisbury
SP5 3HT
United Kingdom

ANC ACOUSTICS & NOISE CONSULTANTS
Institute of Acoustics sponsoring organisation
UKAS TESTING 9452

Registered in England and Wales at Lintrathen House, West Dean, Salisbury SP5 1JL. Registration No. 5211418

Hayes McKenzie
Consultants in Acoustics

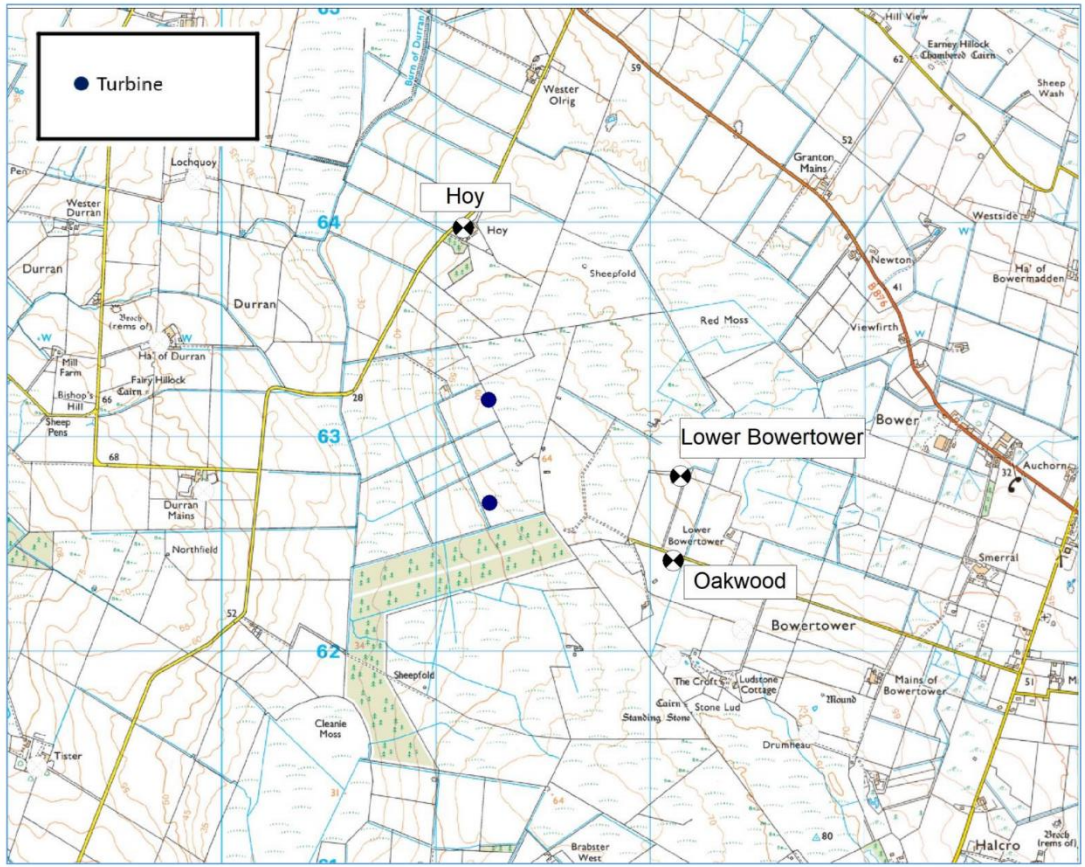
Measured background noise levels will be correlated with wind speed data measured on the proposed wind farm allowing for the hub height wind speeds to be determined. Periods of rainfall will be excluded from the derivation of the noise limits.

I am writing to you to seek agreement over our selected noise measurement locations, and to invite you to the installation of the equipment to ensure that it is installed at an agreed position. We do not have a confirmed date for installation of the measurement equipment yet but can email you when this is confirmed. I would therefore be grateful if you could indicate whether you are happy with the selected measurement locations, and whether you would like to attend the installation of the equipment, or to visit the equipment whilst it is in situ.

Yours sincerely

Dr Andy McKenzie
Director

Figure 1 – Baseline noise measurement locations



Annex 9-1-2 Calibration Certificates

CERTIFICATE OF CALIBRATION

Date of Issue: 20 January 2022 **Certificate Number: TCRT22/1053**

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

K. Mistry

Customer	Hayes McKenzie Partnership Ltd Unit 3 Oakridge Office Park Whaddon Salisbury SP5 3HT			
Order No.	1001/243			
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator			
Identification	*Manufacturer*	*Instrument*	*Type*	*Serial No. / Version*
	Rion	Sound Level Meter	NL-52	01032423 [HMP 53]
	Rion	Firmware		2.0
	Rion	Pre Amplifier	NH-25	32451
	Rion	Microphone	UC-59	05798
	Rion	Calibrator	NC-74	34536109
		Calibrator adaptor type if applicable		NC-74-002
Performance Class	1			
Test Procedure	TP 2.SLM 61672-3 TPS-49 *Procedures from IEC 61672-3:2006 were used to perform the periodic tests.*			
Type Approved to IEC 61672-1:2002	YES	Approval Number	21.21 / 13.02	
	If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003			
Date Received	19 January 2022	ANV Job No.	TRAC22/01027	
Date Calibrated	20 January 2022			

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	23 January 2020	TCRT20/1046	ANV Measurement Systems

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION

Certificate Number TCRT22/1053

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52		
SLM instruction manual ref / issue		11-03		
SLM instruction manual source		Manufacturer		
Internet download date if applicable		N/A		
Case corrections available		Yes		
Uncertainties of case corrections		Yes		
Source of case data		Manufacturer		
Wind screen corrections available		Yes		
Uncertainties of wind screen corrections		Yes		
Source of wind screen data		Manufacturer		
Mic pressure to free field corrections		Yes		
Uncertainties of Mic to F.F. corrections		Yes		
Source of Mic to F.F. corrections		Manufacturer		
Total expanded uncertainties within the requirements of IEC 61672-1:2002		Yes		
Specified or equivalent Calibrator		Specified		
Customer or Lab Calibrator		Lab Calibrator		
Calibrator adaptor type if applicable		NC-74-002		
Calibrator cal. date		17 January 2022		
Calibrator cert. number		UCRT22/1064		
Calibrator cal cert issued by		ANV Measurement Systems		
Calibrator SPL @ STP		93.98	dB	Calibration reference sound pressure level
Calibrator frequency		1002.02	Hz	Calibration check frequency
Reference level range		25 - 130	dB	

Accessories used or corrected for during calibration - Extension Cable (No Wind Shield)
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End		
Temperature	22.66	22.52	± 0.30	°C
Humidity	37.3	38.6	± 3.00	%RH
Ambient Pressure	102.66	102.69	± 0.03	kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.3	dB	Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±				0.10	dB

Self Generated Noise — This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A			C			Z		
	11.1	dB	UR	14.6	dB	UR	19.9	dB	UR
Uncertainty of the electrical self generated noise ±							0.12	dB	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with the Guide to the Expression of Uncertainty in Measurement published by ISO.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END .....

Calibrated by: C. Hirlav R 3

Additional Comments
None

CERTIFICATE OF CALIBRATION

ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Date of Issue: 28 July 2022

Certificate Number: TCRT22/1474

Issued by:

Approved Signatory

K. Mistry

Customer	Hayes McKenzie Partnership Ltd Unit 3 Oakridge Office Park Whaddon Salisbury Wiltshire SP5 3HT
Order No.	1001/259
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification

Manufacturer	*Instrument*	*Type*	*Serial No. / Version*
Rion	Sound Level Meter	NL-52	00921232
Rion	Firmware		2.0
Rion	Pre Amplifier	NH-25	21274
Rion	Microphone	UC-59	04267
Rion	Calibrator	NC-74	34536109
	Calibrator adaptor type if applicable		NC-74-002

Performance Class	1			
Test Procedure	TP 2.SLM 61672-3 TPS-49			
	Procedures from IEC 61672-3:2006 were used to perform the periodic tests.			
Type Approved to IEC 61672-1:2002	YES	Approval Number	21.21 / 13.02	
	If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003			
Date Received	27 July 2022	ANV Job No.	TRAC22/07269	
Date Calibrated	28 July 2022			

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	24 August 2020	TCRT20/1478	ANV Measurement Systems

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION

Certificate Number TCRT22/1474

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52	
SLM instruction manual ref / issue		11-03	
SLM instruction manual source		Manufacturer	
Internet download date if applicable		N/A	
Case corrections available		Yes	
Uncertainties of case corrections		Yes	
Source of case data		Manufacturer	
Wind screen corrections available		Yes	
Uncertainties of wind screen corrections		Yes	
Source of wind screen data		Manufacturer	
Mic pressure to free field corrections		Yes	
Uncertainties of Mic to F.F. corrections		Yes	
Source of Mic to F.F. corrections		Manufacturer	
Total expanded uncertainties within the requirements of IEC 61672-1:2002		Yes	
Specified or equivalent Calibrator		Specified	
Customer or Lab Calibrator		Lab Calibrator	
Calibrator adaptor type if applicable		NC-74-002	
Calibrator cal. date		01 July 2022	
Calibrator cert. number		UCRT22/1832	
Calibrator cal cert issued by		ANV Measurement Systems	
Calibrator SPL @ STP	94.00	dB	Calibration reference sound pressure level
Calibrator frequency	1001.94	Hz	Calibration check frequency
Reference level range	25 - 130	dB	

Accessories used or corrected for during calibration - Extension Cable (No Wind Shield)
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	23.39	23.54	± 0.30 °C
Humidity	43.0	42.9	± 3.00 %RH
Ambient Pressure	100.64	100.65	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.7	dB	Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±				0.10	dB

Self Generated Noise — This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A			C			Z		
	12.9	dB	UR	17.2	dB	UR	23.8	dB	UR
Uncertainty of the electrical self generated noise ±							0.12	dB	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with the Guide to the Expression of Uncertainty in Measurement published by ISO.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END .....

Calibrated by: B. Bogdan R 2

Additional Comments
None

CERTIFICATE OF CALIBRATION

Date of Issue: 24 March 2023 **Certificate Number: TCRT23/1265**

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

K. Mistry

Customer	Hayes McKenzie Partnership Ltd Unit 3 Oakridge Office Park Whaddon Salisbury SP5 3HT
Order No.	1001/276
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification

Manufacturer	*Instrument*	*Type*	*Serial No. / Version*
Rion	Sound Level Meter	NL-52	00821102 - REN4
Rion	Firmware		2.0
Rion	Pre Amplifier	NH-25	21143
Rion	Microphone	UC-59	04081
Rion	Calibrator	NC-74	34536109
	Calibrator adaptor type if applicable		NC-74-002

Performance Class 1

Test Procedure TP 2.SLM 61672-3 TPS-49

Procedures from IEC 61672-3:2006 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003

Date Received 24 March 2023 ANV Job No. TRAC23/03152

Date Calibrated 24 March 2023

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	22 March 2021	TCRT21/1202	ANV Measurement Systems

This certificate provides traceability of measurement to recognised national standards, and to units of measurement realised at the National Physical Laboratory or other recognised national standards laboratories. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION

Certificate Number TCRT23/1265

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52	
SLM instruction manual ref / issue		11-03	
SLM instruction manual source		Manufacturer	
Internet download date if applicable		N/A	
Case corrections available		Yes	
Uncertainties of case corrections		Yes	
Source of case data		Manufacturer	
Wind screen corrections available		Yes	
Uncertainties of wind screen corrections		Yes	
Source of wind screen data		Manufacturer	
Mic pressure to free field corrections		Yes	
Uncertainties of Mic to F.F. corrections		Yes	
Source of Mic to F.F. corrections		Manufacturer	
Total expanded uncertainties within the requirements of IEC 61672-1:2002		Yes	
Specified or equivalent Calibrator		Specified	
Customer or Lab Calibrator		Lab Calibrator	
Calibrator adaptor type if applicable		NC-74-002	
Calibrator cal. date		23 March 2023	
Calibrator cert. number		UCRT23/1384	
Calibrator cal cert issued by		ANV Measurement Systems	
Calibrator SPL @ STP	94.04	dB	Calibration reference sound pressure level
Calibrator frequency	1001.98	Hz	Calibration check frequency
Reference level range	25 - 130	dB	

Accessories used or corrected for during calibration - Extension Cable (No Wind Shield)
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End		
Temperature	23.26	23.37	± 0.30	°C
Humidity	42.8	40.4	± 3.00	%RH
Ambient Pressure	98.59	98.55	± 0.03	kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.1	dB	Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±				0.10	dB

Self Generated Noise This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A			C			Z		
	10.4	dB	UR	14.3	dB	UR	18.5	dB	UR
Uncertainty of the electrical self generated noise ±							0.12	dB	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with the Guide to the Expression of Uncertainty in Measurement published by ISO.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END .....

Calibrated by: C. Hirlav R 3

Additional Comments
None

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 17 August 2023 **Certificate Number: UCRT23/2082**

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Page 1 of 2 Pages

Approved Signatory

K. Mistry

Customer	Hayes McKenzie Partnership Ltd Unit 3 Oakridge Office Park Whaddon Salisbury SP5 3HT
Order No.	1001/286
Test Procedure	Procedure TP 1 Calibration of Sound Calibrators
Description	Acoustic Calibrator

Identification

Manufacturer	*Instrument*	*Model*	*Serial No.*
Brüel & Kjær	Calibrator	4231	3025352

The calibrator has been tested as specified in Annex B of IEC 60942:2003. As public evidence was available from a testing organisation (PTB) responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2003.

ANV Job No.	UKAS23/08574
Date Received	16 August 2023
Date Calibrated	17 August 2023

Previous Certificate

Dated	15 August 2022
Certificate No.	UCRT22/2005
Laboratory	0653

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Measurements

The sound pressure level generated by the calibrator in its WS2 configuration was measured five times by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below. It is corrected to the standard atmospheric pressure of 101.3 kPa (1013 mBar) using original manufacturers information.

Test Microphone	*Manufacturer*	*Type*
	Brüel & Kjær	4134

Results

The level of the calibrator output under the conditions outlined above was

94.06 ± 0.10 dB rel 20 µPa

Functional Tests and Observations

The frequency of the sound produced was	1000.02	±	0.12 Hz
The total distortion was	0.17	±	0.03 % Distortion

During the measurements environmental conditions were

Temperature	24	to	25	°C
Relative Humidity	41	to	48	%
Barometric Pressure	100.9	to	101.0	kPa

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

..... END .....

Note:

Calibrator adjusted prior to calibration?	NO	
Initial Level	N/A	dB
Initial Frequency	N/A	Hz

Additional Comments The results on this certificate only relate to the items calibrated as identified above.
None

Calibrated by: K. Zablocki R 1

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 24 July 2023

Certificate Number: UCRT23/1978

Calibrated at & Certificate issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

B. Bogdan

Customer	Hayes McKenzie Partnership Ltd Unit 3 Oakridge Office Park Whaddon Salisbury SP5 3HT
Order No.	1001/283
Test Procedure	Procedure TP 1 Calibration of Sound Calibrators
Description	Acoustic Calibrator

Identification	*Manufacturer*	*Instrument*	*Model*	*Serial No.*
	Brüel & Kjær	Calibrator	4231	2499193

The calibrator has been tested as specified in Annex B of IEC 60942:2003. As public evidence was available from a testing organisation (PTB) responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2003.

ANV Job No.	UKAS23/07506
Date Received	21 July 2023
Date Calibrated	24 July 2023

Previous Certificate		
	Dated	26 July 2022
	Certificate No.	UCRT22/1937
	Laboratory	0653

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory.

CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 0653

Certificate Number UCRT23/1978

Measurements

The sound pressure level generated by the calibrator in its WS2 configuration was measured five times by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below. It is corrected to the standard atmospheric pressure of 101.3 kPa (1013 mBar) using original manufacturers information.

Test Microphone	*Manufacturer*	*Type*
	Brüel & Kjær	4134

Results

The level of the calibrator output under the conditions outlined above was

94.11 ± 0.10 dB rel 20 µPa

Functional Tests and Observations

The frequency of the sound produced was	999.96	±	0.12 Hz
The total distortion was	0.47	±	0.04 % Distortion

During the measurements environmental conditions were

Temperature	22	to	23	°C
Relative Humidity	37	to	43	%
Barometric Pressure	99.5	to	99.6	kPa

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

..... END .....

Note:

Calibrator adjusted prior to calibration?	NO	
Initial Level	N/A	dB
Initial Frequency	N/A	Hz

Additional Comments: The results on this certificate only relate to the items calibrated as identified above.

None

Calibrated by: K. Zablocki

R 1

Annex 9-1-3 Baseline Measurement Location Details

Hoy

Description of Measurement Position

Hoy is a farm located to the north of the Proposed Development and there are two houses at this location, both of which are considered to be financially involved. The noise monitoring equipment was located on a grass paddock between the 2 houses away from any trees and at least 2.5m from a low garden wall.

Description of Local Noise Environment

The site visits the predominant noise sources affecting the local environment included distant road traffic noise, birdsong, farm vehicles and wind in the trees.

Plate 9-1-1: Hoy noise monitoring photos

Source: Hayes McKenzie

Lower Bowertower

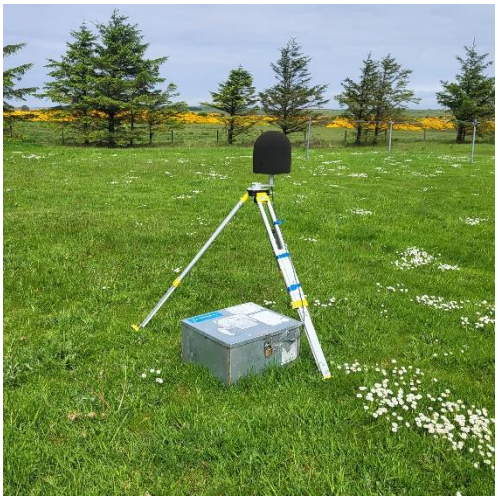
Description of Measurement Position

Lower Bowertower is to the east of the Proposed Development. The noise monitoring equipment was installed in a free-field location approximately 23 m to the southwest of the main house in the middle of the garden at least 20 m away from any of the trees at boundary edge. The rain gauge was installed on a fencepost.

Description of Local Noise Environment

At the site visits the predominant noise sources affecting the local environment included birdsong, wind in the foliage and very distant road traffic and machinery noise.

Plate 9-1-2: Lower Bowertower noise monitoring photos



Source: Hayes McKenzie

Oakwood

Description of Measurement Position

Oakwood is located to the east of the Proposed Development. The noise monitoring equipment was installed at the edge of sheltered garden area off of the main lawn as requested by the resident.

Description of Local Noise Environment

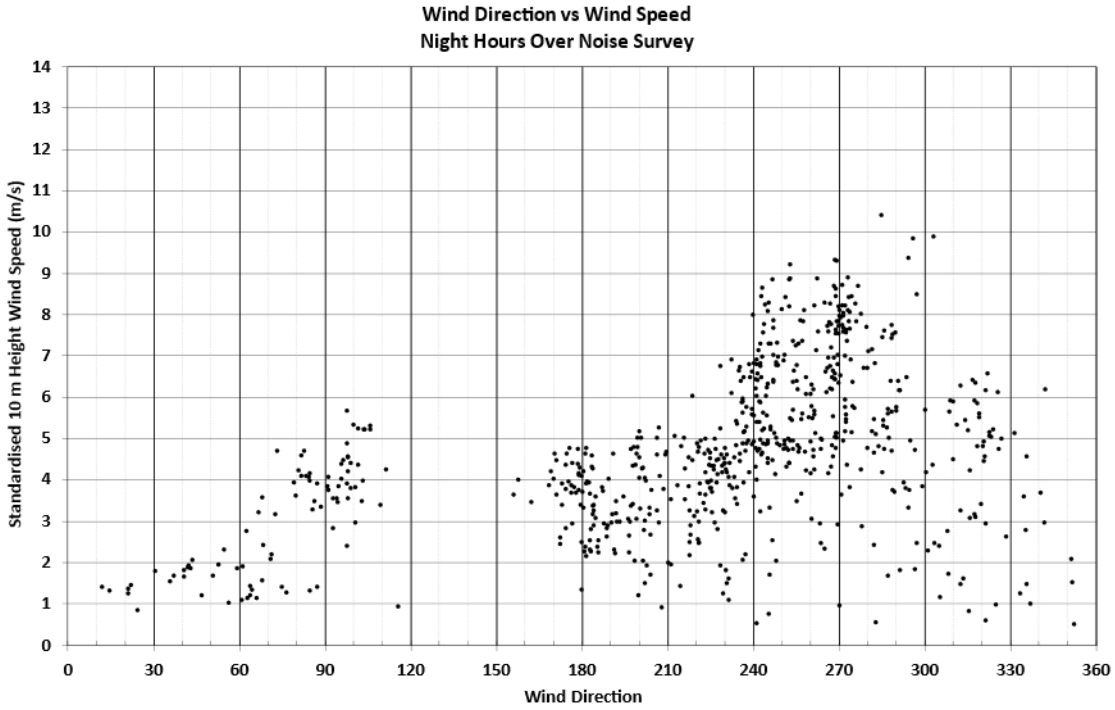
At the site visits the predominant noise sources affecting the local environment included wind in the trees, road traffic noise from local roads and birdsong.

Plate 9-1-3: Oakwood noise monitoring photos

Source: Hayes McKenzie

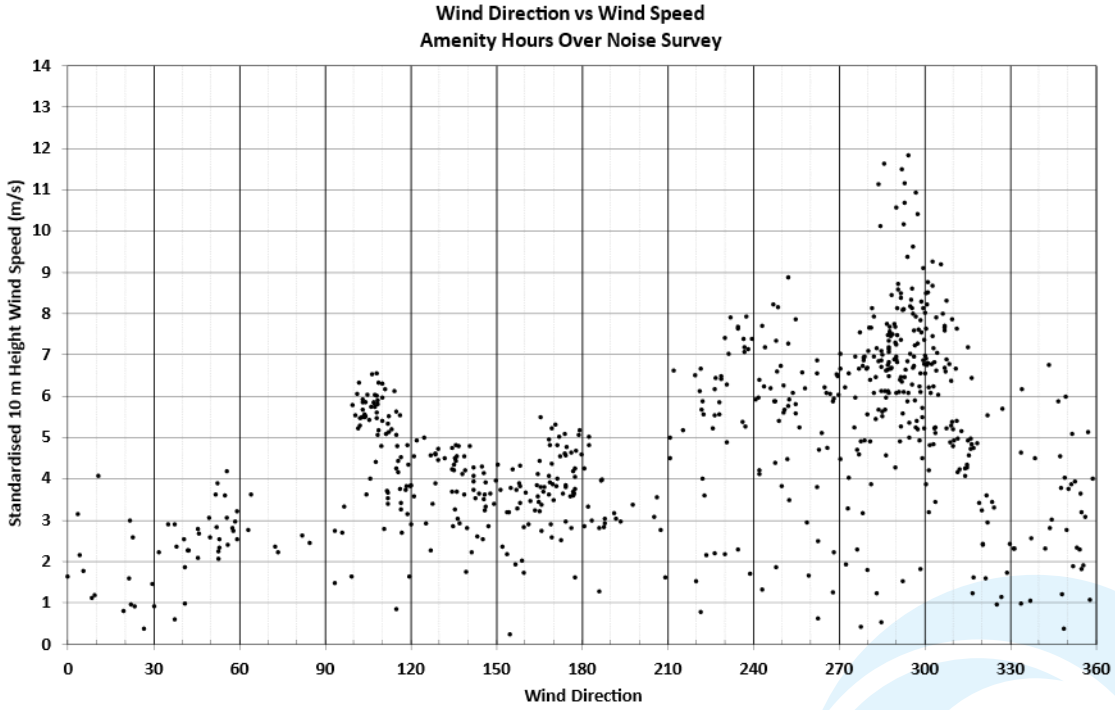
Annex 9-1-4 Wind Conditions During Survey

Plate 9-1-4: Variation of wind speed and direction during night hours



Source: Hayes McKenzie

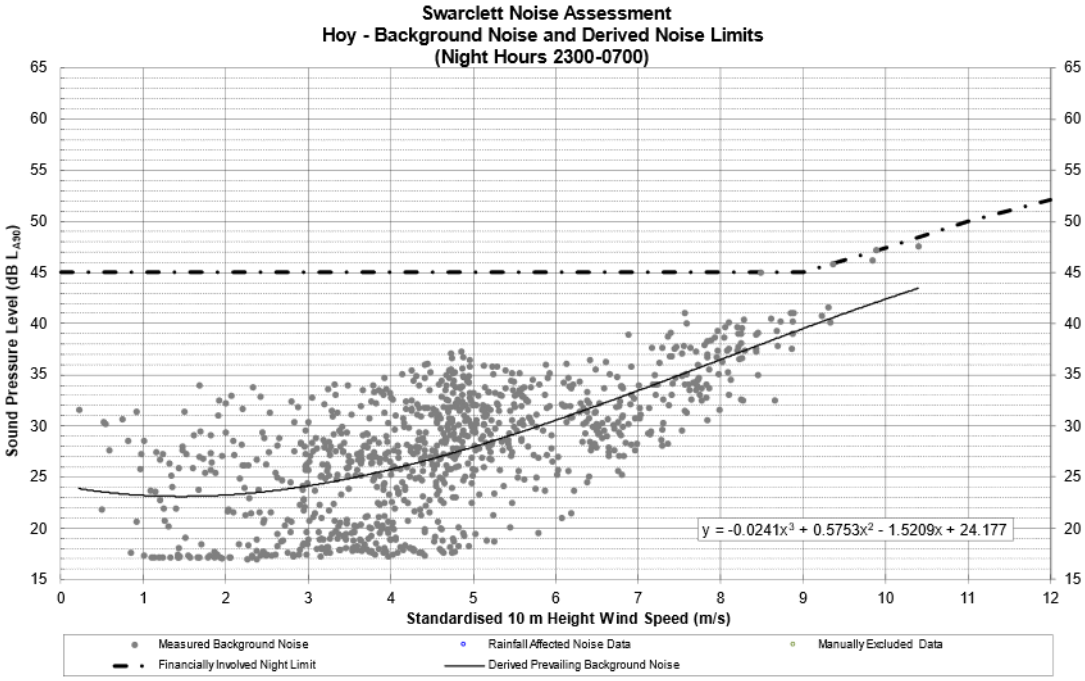
Plate 9-1-5: Variation of wind speed and direction during quiet daytime hours



Source: Hayes McKenzie

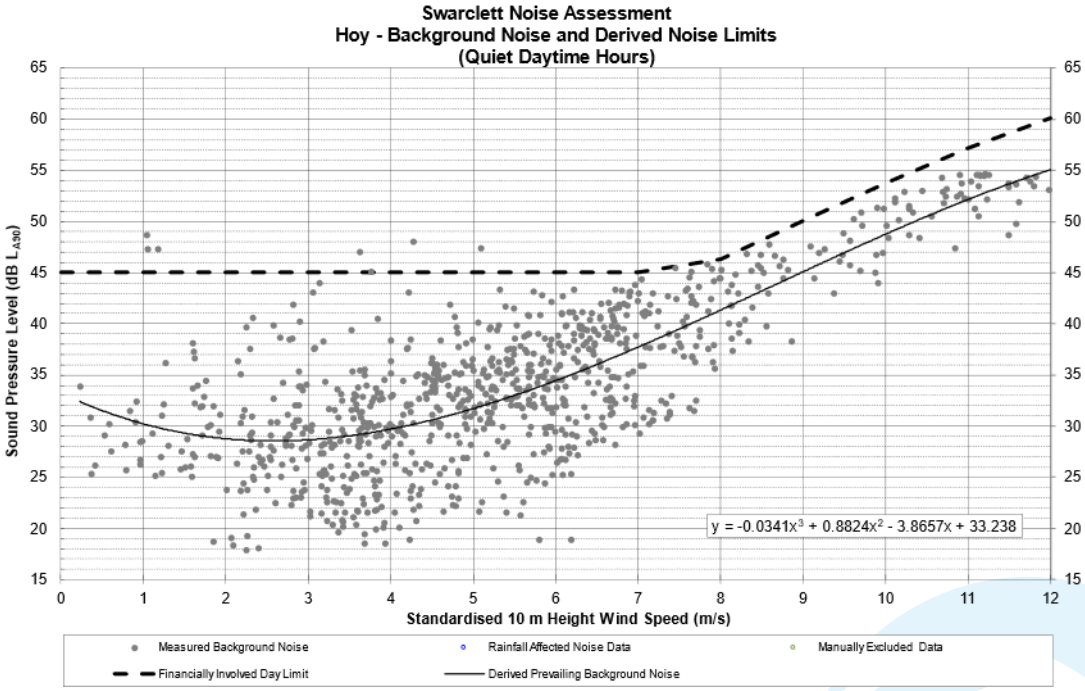
Annex 9-1-5 Baseline Measurement Results and Derived Limits

Plate 9-1-6: Baseline measurement results at Hoy; night



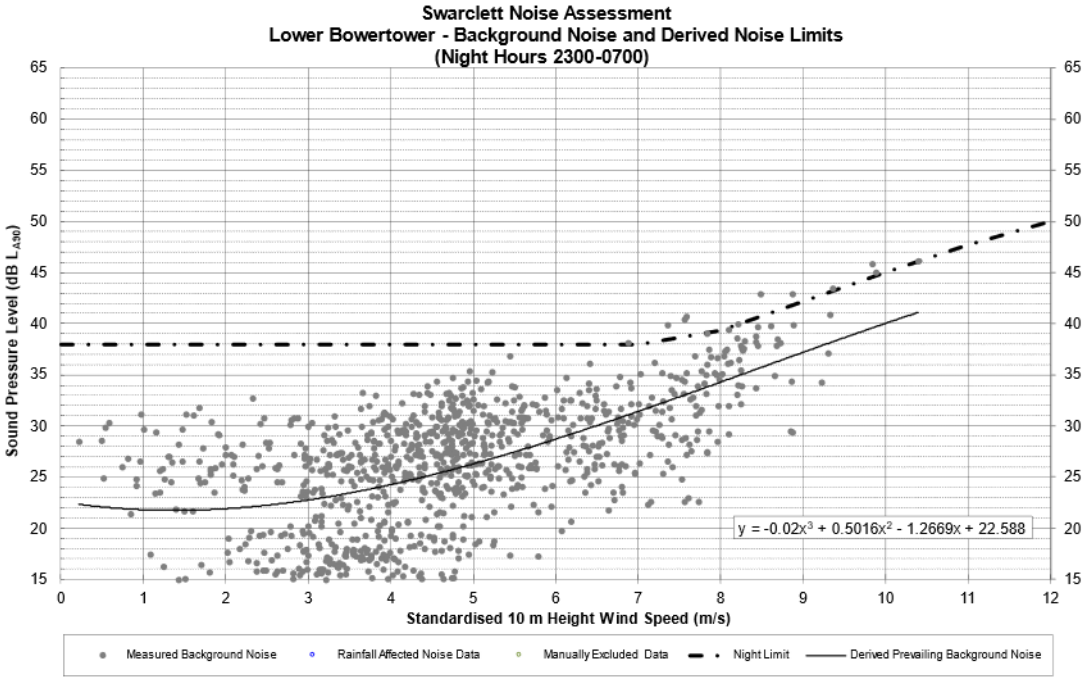
Source: Hayes McKenzie

Plate 9-1-7: Baseline measurement results at Hoy; quiet daytime



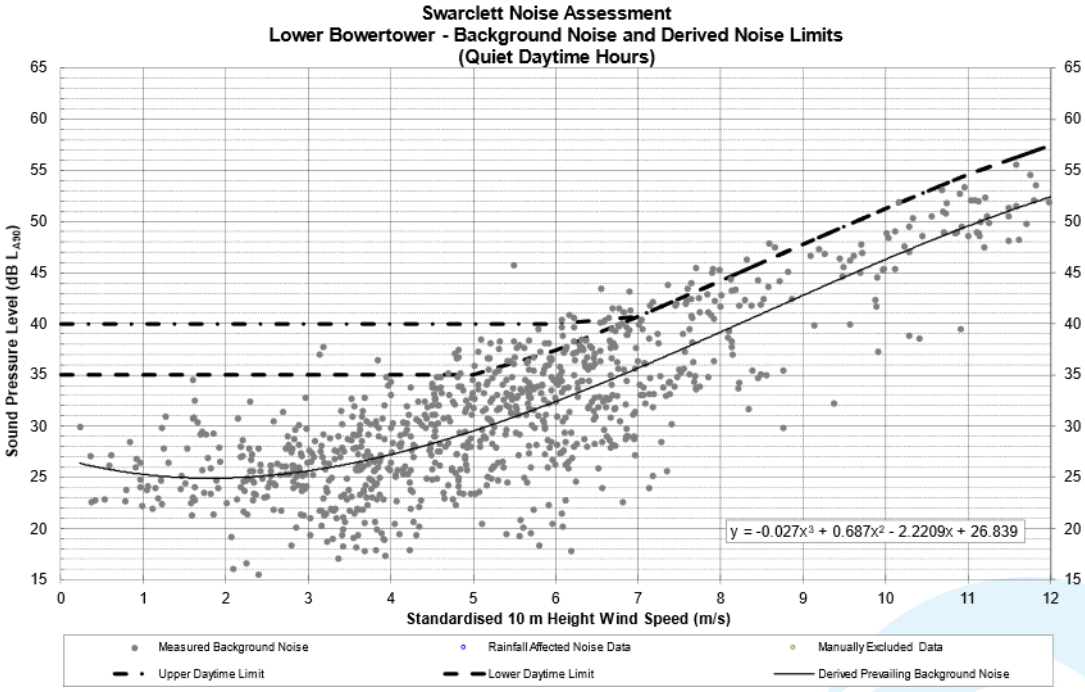
Source: Hayes McKenzie

Plate 9-1-8: Baseline measurement results at Lower Bowertower; night



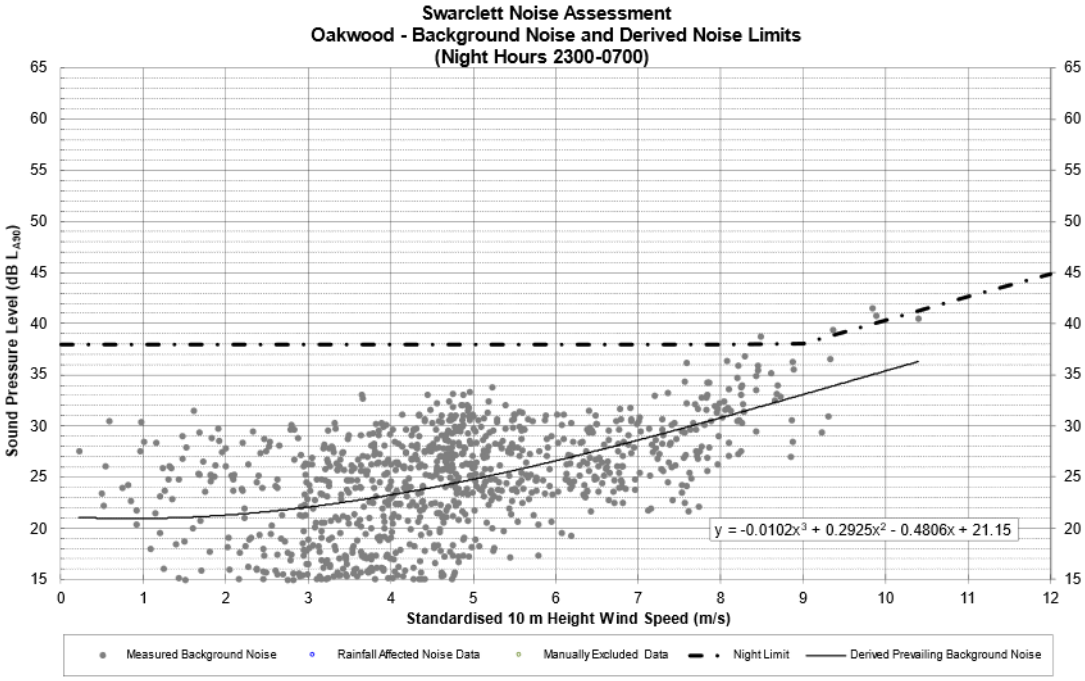
Source: Hayes McKenzie

Plate 9-1-9: Baseline measurement results at Lower Bowertower; quiet daytime



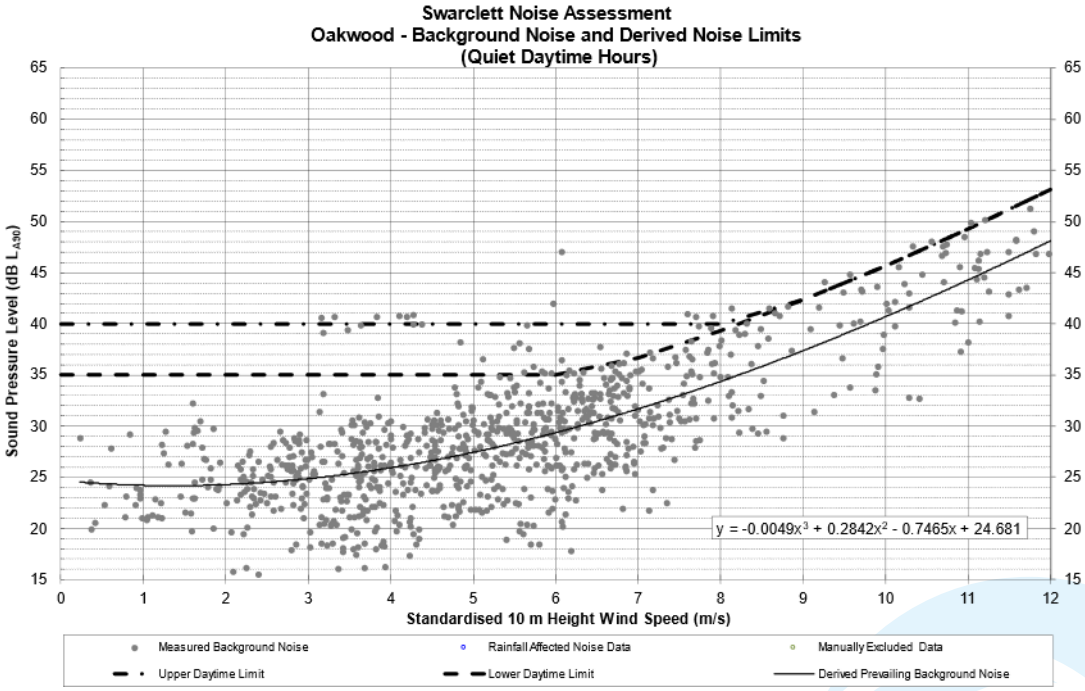
Source: Hayes McKenzie

Plate 9-1-10: Baseline measurement results at Oakwood; night



Source: Hayes McKenzie

Plate 9-1-11: Baseline measurement results at Oakwood; quiet daytime



Annex 9-1-6 Baseline Frequency Distribution Plots

Plate 9-1-12: Background Sound Level Frequency Distribution, Hoy, Day

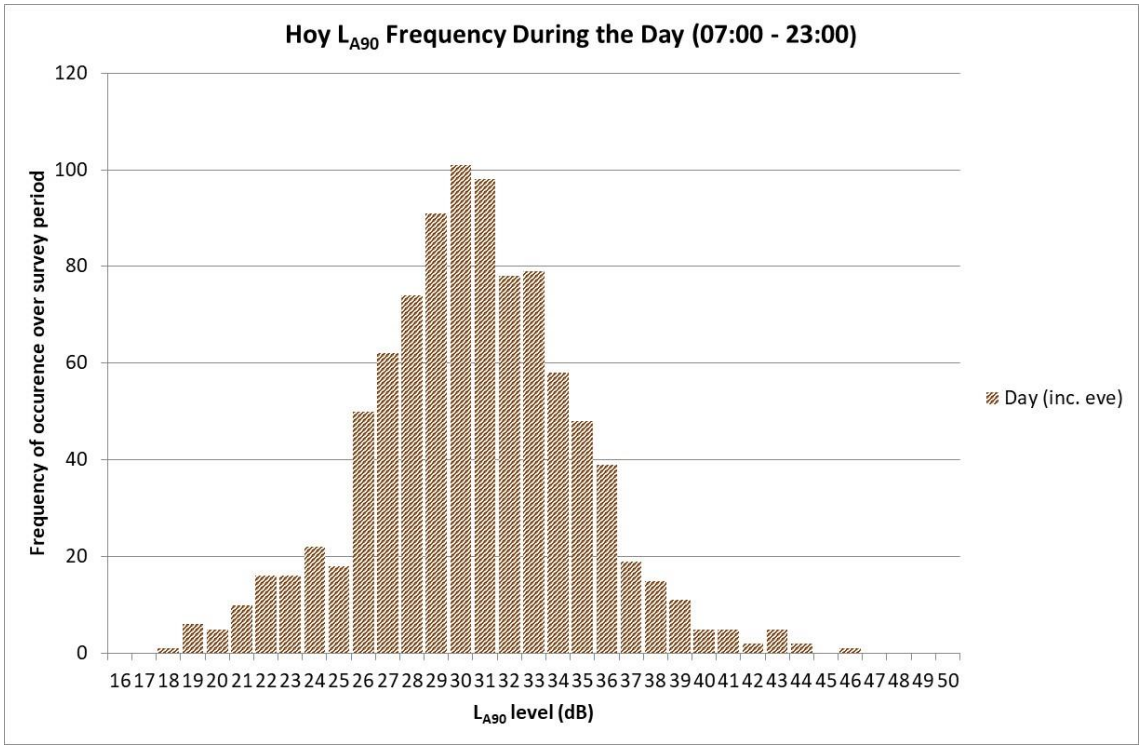


Plate 9-1-13: Background Sound Level Frequency Distribution, Hoy, Night