Assessment of Acoustic Impact for the Proposed Holmston Farm Energy Storage Project

Author: Jeremy Bass **Date:** 19 October 2022 **Ref:** 04874-4516616

Revision History

Issue	Date	Author	Nature & Location of Change
01	5 September 2022	Andrew Birchby	First created
02	19 October 2022	Jeremy Bass	New layout

CONTENTS

1.0 INTRODUCTION & SCOPE

This report contains an assessment of the acoustic impact of a proposed Holmston Farm energy storage project. Two Members of the Institute of Acoustics have been involved in its production. Details of their experience and qualifications can be found in Appendix A.

The scope includes determining the baseline and predicting sound levels due to the proposed development in order to assess the level of impact in accordance with relevant planning guidance.

2.0 PLANNING GUIDANCE

Within Scotland, the treatment of noise is defined in the planning context by 'Planning Advice Note (PAN) 1/2011: Planning and Noise'[1], which details the Government's planning policies and how these are expected to be applied. The PAN provides advice on the role of the planning system in helping to prevent and limit the adverse effects of noise, stating that planning policies and decisions should aim to avoid noise giving rise to significant adverse impacts, whilst at the same time mitigating and reducing to a minimum other adverse impacts on health and quality of life. The Technical Advice Note (TAN)[2] provides guidance to assist in the technical evaluation of noise assessment and aims to assist in assessing the significance of noise impact.

3.0 METHODOLOGY

3.1 Overview

An assessment in accordance with BS 4142: 2014[3] has been undertaken in order to determine the acoustic impact of the proposed development.

3.2 Baseline Conditions

In order to complete a BS 4142: 2014 assessment of the proposal, the background sound level at the times when the new sound source is intended to be operational should be measured. The background sound level is defined as the A-weighted sound pressure level that is exceeded for 90 % of the measurement time interval, or $L_{A90,\,T}$.

Measurements should be made at a location that is representative of the assessment locations, the time interval should be sufficient to obtain a representative value, and the duration should be long enough to reflect the range of background sound levels over the period of interest.

Precautions should be taken to minimise the influence on the results from sources of interference. Weather conditions that may affect the measurements should be recorded and an effective wind shield used to minimise turbulence at the microphone.

A statistical analysis, following the example given by BS 4142: 2014, shall be used to determine an appropriate background sound level for the analysis from the range of results obtained.

3.3 Propagation

The ISO 9613-2[4] propagation model shall be used to predict the specific sound levels due to the proposed development at nearby residential properties. The propagation model takes account

[1] "Planning Advice Notice 1/2011: Planning and Noise", Scottish Government policy, March 2011
[2] "Technical Advice Note: Assessment of Noise", Scottish Government policy, March 2011
[3] "Methods for rating and assessing industrial and commercial sound", The British Standards Institution 2014
[4] "Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation", International Organisation for Standardisation 1996

of sound attenuation due to geometric spreading and atmospheric absorption. The assumed temperature and relative humidity are 10 ˚C and 70 % respectively.

Ground effects are also taken into account by the propagation model, with a ground factor of 0.5 adopted to reflect a mix of hard and porous ground between the site and the assessment locations. A 4 m receiver height shall be used. Terrain shall be considered but the effect of surface features such as buildings and trees shall not be included in the model. There is a degree of conservatism built into the model as a result of the adoption of these settings.

ISO 9613-2 is a downwind propagation model. Where conditions less favourable to sound propagation occur, such as when the assessment locations are crosswind or upwind of the proposed development, the sound levels would be expected to be less and the downwind predictions presented here would be regarded as conservative i.e. greater than those experienced in practice.

3.4 Assessment

Once the specific sound levels due to the proposed new sound source have been predicted the rating sound level can be calculated, it is this which is compared to the existing background sound level to determine the level of impact. The rating level is obtained by adding any penalties due to character that may be applicable to the predicted specific sound level.

Table 1 details how the difference between the rating sound level and background sound level is used to come to a judgement about the level of impact under BS 4142: 2014, although it is noted that any assessment is context specific.

Table 1 - BS 4142: 2014 Assessment Criteria

Rating Level	BS 4142 Assessment
Below background	Indicates low impact
5 dB above background	Indicates adverse impact
10 dB above background	Indicates significant adverse impact

Depending upon the diurnal variation in the background sound level, and the times when the proposed new sound source is scheduled to operate, it may be appropriate to undertake separate assessments for certain times of day e.g., day, evening and night.

4.0 BASELINE DATA

Background sound measurements were undertaken at Holmston Farm from 12:15 on Friday 26th August 2022 until 09:45 on Monday 29th August 2022. The survey position is shown on the map in Figures 1 & 2 (Appendix B).

A Rion NL-31 sound level meter was used which is certified as meeting IEC 61672-1[5] Class 1 precision standards. The microphone was approximately 1.2 m above ground level and an outdoor wind shield supplied by the manufacturer was deployed.

The sound level meter was placed away from reflective surfaces and vegetation as shown in the photos in Appendix C. The equipment was calibrated at the start and end of the campaign and no drift was detected. All instrumentation had been subject to laboratory calibration traceable to national standards within the previous 24 months with the calibration dates and references provided in Table 2.

[5] "Electroacoustics – Sound level meters – Part 1: Specifications", International Electrotechnical Commission 2013

Table 2 - Instrumentation Records

	Meter	Calibrator
Type	Rion NL-31	Rion NC-74
Serial No.	952274	34851904
Calibration Certificate No.	UCRT21/1190	UCRT22/1192
Date of Issue	10/02/21	08/02/22
Microphone Serial No.	321532	-
Preamp Serial No.	17126	-

The background sound environment was dominated by traffic on the nearby A70 and A77 but also included contributions from the wind in the trees and birds. There was no noticeable contribution from the substation to the east or the river to the north. Weekend data was recorded to capture the reduced noise levels that would be expected with less traffic on the roads.

Weather conditions during the survey were such that interference with the results would not be expected. Wind speed measured at microphone height at the start and end of the survey did not exceed 5 m/s and no high wind speeds were forecast in between. Rain had fallen prior to setup but no further rain was forecast over the survey period. In any case the use of the statistical analysis method recommended by BS 4142: 2014 serves to filter out any periods where the background sound levels were atypically high.

Temperature during the survey period varied between 12 and 17 °C, comfortably within the operating range of the meter. Cloud cover at the start and end of the survey was judged to be 8 and 4 oktas respectively. The wind direction varied throughout the survey but any differences with the long-term rose are not expected to be significant as the wind speed was low throughout.

The data recorded during the measurement period is detailed in Figures 3-5 (Appendix B). Figure 3 shows the variation in the background sound level and residual sound level with time. Figure 4 shows the frequency at which a given level of background sound occurred and Figure 5 shows the frequency at which a given level of residual sound occurred.

The diurnal variation in the background sound level is such that a clear distinction can be drawn between day, evening and night-time periods. When split into day and night-time periods, the most frequently occurring background sound level was 49 dB $L_{A90,\ 15min}$ during the day, 47 dB $L_{A90,\ 15min}$ during the evening and 35 dB $L_{A90,\ 15min}$ at night. The most frequently occurring residual sound level was 52 dB $L_{Aeq,\ 15min}$ during the day, 51 dB $L_{Aeq,\ 15min}$ during the evening and 47 dB $L_{Aeq,\ 15min}$ at night.

5.0 ASSESSMENT

Details of the nearest properties to the proposed development are provided in Table 3.

Table 3 - Locations of Nearby Properties

House ID	X	Y
H1	236428	621005
H2	236512	620917
H3	236620	620862
H4	235879	620942
H5	235906	621083
H6	235988	621223
H7	236035	621324
H8	236102	621394

House ID	X	Y
H9	236286	621609
H10	236512	621472
H11	236480	621609

The main sources of sound within the proposed development are the cooling fans for the two inverters housed within the nine Power Conversion System (PCS) units, air conditioning for the Energy Storage Systems (ESS) and the transformers. The 36 ESS units are expected to be continuously charging and discharging. If there are any rest periods for the PCS units these are likely to be infrequent and the Heating Ventilation and Air Conditioning systems (HVAC) will still be functioning. There are four HVAC units per ESS unit, two at each end.

Acoustic emission data for the proposed equipment is detailed in Table 4. The data corresponds to the maximum acoustic emission for each device as advised by the manufacturer. Predictions based on this data therefore represent the worst case and the sound levels would be expected to be less when the site isn't operating at maximum capacity.

Table 4 - Acoustic Emission Data

Equipment	Sound Pressure Level at 1m, dB L_{Aeq}
Inverter within PCS unit	79
ESS HVAC unit (>=35˚C)	75
ESS HVAC unit with silent kit (>=35˚C)	70
ESS HVAC unit (20˚C)	70
ESS HVAC unit with silent kit (20˚C)	65
Auxiliary transformer	63

Potential mitigation options include the installation of a 3 m acoustic fence around the site or the fitting of silent kits, in the form of baffles, to the ESS HVAC units. Both of these mitigation measures would result in rated sound levels of less than or equal to the background sound level plus 5 dB, so it is proposed that the choice between one or the other is left open at this stage. For the purposes of this report, it is assumed that a 3 m acoustic fence is installed around the site.

Predicted specific sound levels at nearby properties with this mitigation measure in place are detailed in Table 5 for daytime periods, Table 6 during the evening and Table 7 at night. Modelling the scheme at its maximum acoustic emission during the night is overly conservative as the need for cooling would be less due to the lower ambient temperature. Separate day and night predicted noise levels are therefore shown corresponding to ambient temperatures of >=35˚C during the day and 20˚C at night. The predicted evening sound levels are assumed to be the same as those for daytime periods, reflecting the lighter summer evenings, which is likely to be conservative in winter. Illustrative sound footprints for the proposed development showing the predicted specific sound level for day and night-time periods are provided in Figures 1 & 2 (Appendix B).

The sound emitted by the inverter cooling fans and HVAC units can have distinctive character. Under the subjective method described in BS 4142: 2014, a correction of 2 dB has been applied in the event that tones are just perceptible at the assessment locations. The resulting rating sound levels for day and night-time periods are shown in Tables 5-7. The rating levels are then compared to the background sound level in these same tables to assess the impact at each location for each time period.

Table 5 - BS 4142: 2014 Assessment Results - Day

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Aeq}	Rating vs Background, dB	Impact
H1	36	38	-12	Low
H2	32	34	-15	Low
H3	30	32	-17	Low
H4	30	32	-17	Low
H5	32	34	-15	Low
H6	34	36	-13	Low
H7	34	36	-13	Low
H8	36	38	-12	Low
H9	31	33	-16	Low
H10	28	30	-19	Low
H11	30	32	-17	Low

Table 6 - BS 4142: 2014 Assessment Results - Evening

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Aeq}	Rating vs Background, dB	Impact
H1	36	38	-10	Low
H2	32	34	-13	Low
H3	30	32	-15	Low
H4	30	32	-15	Low
H5	32	34	-13	Low
H6	34	36	-11	Low
H7	34	36	-11	Low
H8	36	38	-10	Low
H9	31	33	-14	Low
H10	28	30	-17	Low
H11	30	32	-15	Low

Table 7 - BS 4142: 2014 Assessment Results - Night

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Aeq}	Rating vs Background, dB	Impact
H1	33	35	0	Low
H2	30	32	-3	Low
H3	28	30	-5	Low
H4	28	30	-5	Low
H5	30	32	-4	Low
H6	31	33	-2	Low
H7	31	33	-2	Low
H8	33	35	0	Low
H9	28	30	-5	Low
H10	25	27	-8	Low
H11	27	29	-6	Low

The impact of the proposed development is low where the rating sound level does not exceed the existing background sound level. This is the case at all properties during daytime, evening and night periods. No observed effect on health or quality of life would be expected where the impact is low.

A comparison of the predicted ambient sound level with the proposed development in operation to the measured residual sound level is shown in Table 8. The proposed site is predicted to result in no change in the ambient sound level during the day, evening or night-time periods which is consistent with the site having a low impact.

Table 8 - Predicted Change in Ambient Sound Level

House ID	Day Ambient Level, dB L_{Aeq}	Evening Ambient Level, dB L_{Aeq}	Night Ambient Level, dB L_{Aeq}	Day Change, dB L_{Aeq}	Evening Change, dB L_{Aeq}	Night Change, dB L_{Aeq}
H1	52	51	47	0	0	0
H2	52	51	47	0	0	0
H3	52	51	47	0	0	0
H4	52	51	47	0	0	0
H5	52	51	47	0	0	0
H6	52	51	47	0	0	0
H7	52	51	47	0	0	0
H8	52	51	47	0	0	0
H9	52	51	47	0	0	0
H10	52	51	47	0	0	0
H11	52	51	47	0	0	0

A level of conservatism has been built into the assessment to compensate for the potential impact of uncertainty. The predicted specific sound levels presented in this assessment, and the sound footprints shown in Figures 1 and 2, reflect this. The amenity of nearby residents can be further protected by the imposition of a planning condition relating to sound. A suggested appropriate form of wording for such a condition is provided in Appendix D. The margin by which the background sound level can be exceeded has been discussed and agreed with the Environmental Health Department of South Ayrshire Council.

6.0 CONCLUSIONS

The acoustic impact of the proposed Holmston Farm energy storage project has been assessed in accordance with BS 4142: 2014. The results show that, with the implementation of appropriate mitigation measures, a low impact during daytime, evening and night periods would be anticipated.

APPENDIX A - EXPERIENCE & QUALIFICATIONS

Author:

Name	Andrew Birchby
Experience	Acoustic Specialist, Renewable Energy Systems, 2017-Present Senior Acoustic Analyst, Renewable Energy Systems, 2014-2016 Acoustic Analyst, Renewable Energy Systems, 2012-2014 Technical Analyst, Renewable Energy Systems, 2006-2012
Qualifications	MIOA, Member of the Institute of Acoustics MSc Environmental Governance, Manchester University IOA Postgraduate Diploma in Acoustics and Noise Control MEng Systems Engineering, Loughborough University

Checker/Approver:

Name	Dr Jeremy Bass
Experience	Head of Specialist Services/Senior Technical Manager, Renewable Energy Systems, 2000-Present Technical Analyst/Senior Technical Analyst, Renewable Energy Systems, 1990-2000 Foreign Exchange Researcher, Mechanical Engineering Laboratory, Tsukuba, Japan, 1989-1990 Research Associate, Energy Research Unit, Rutherford Appleton Laboratory, 1986-1989
Qualifications	MIOA, Member of the Institute of Acoustics MInstP, Member of the Institute of Physics PhD, The Potential of Combined Heat & Power, Wind Power & Load Management for Cost Reduction in Small Electricity Supply Systems, Department of Applied Physics, University of Strathclyde BSc Physics, University of Durham

APPENDIX B – FIGURES

Figure 1 – Predicted Sound Footprint - Day

The L_{Aeq} descriptor has been used
Red receiver icon indicates survey location

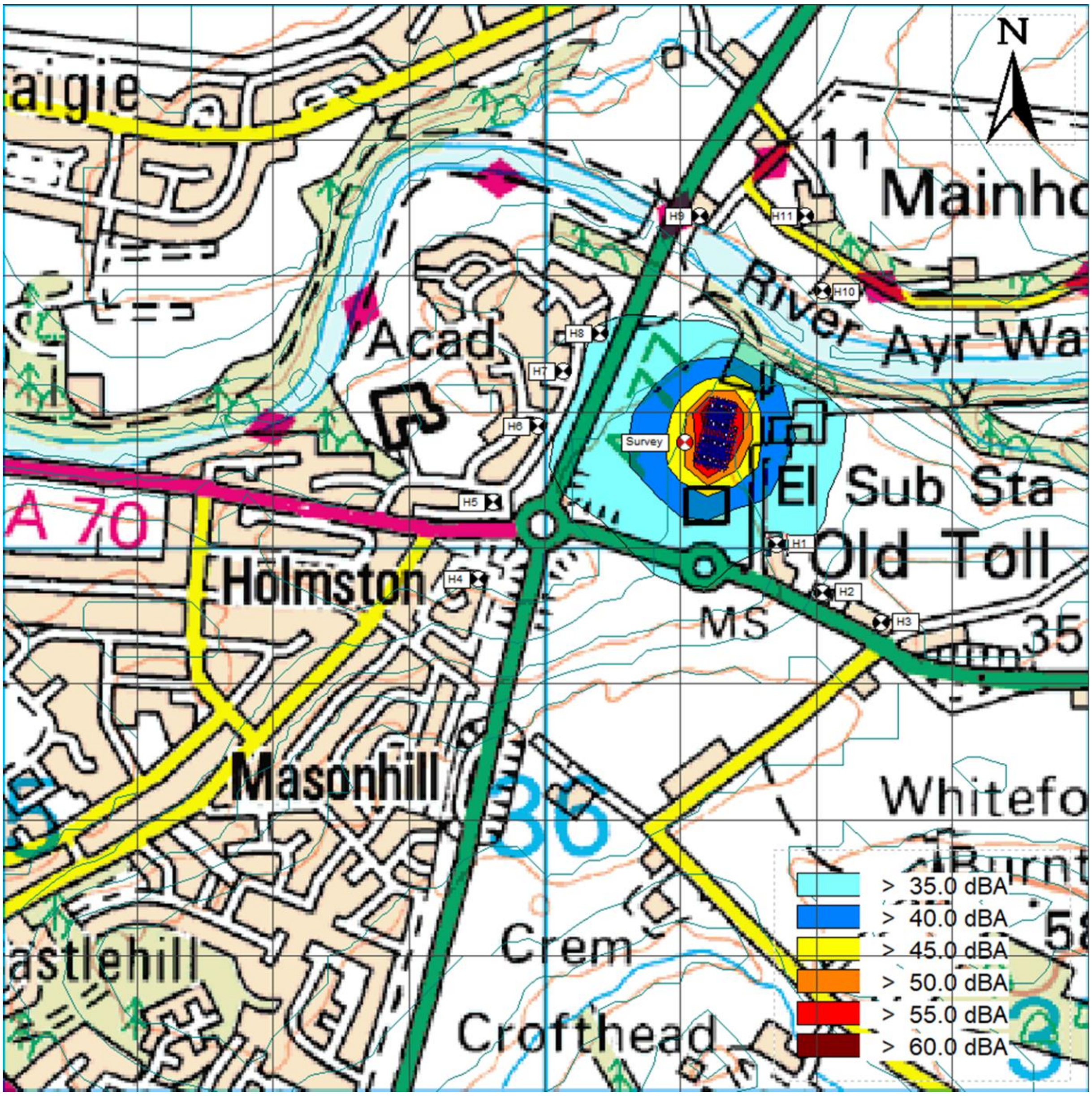


Figure 2 – Predicted Sound Footprint - Night

The L_{Aeq} descriptor has been used
Red receiver icon indicates survey location

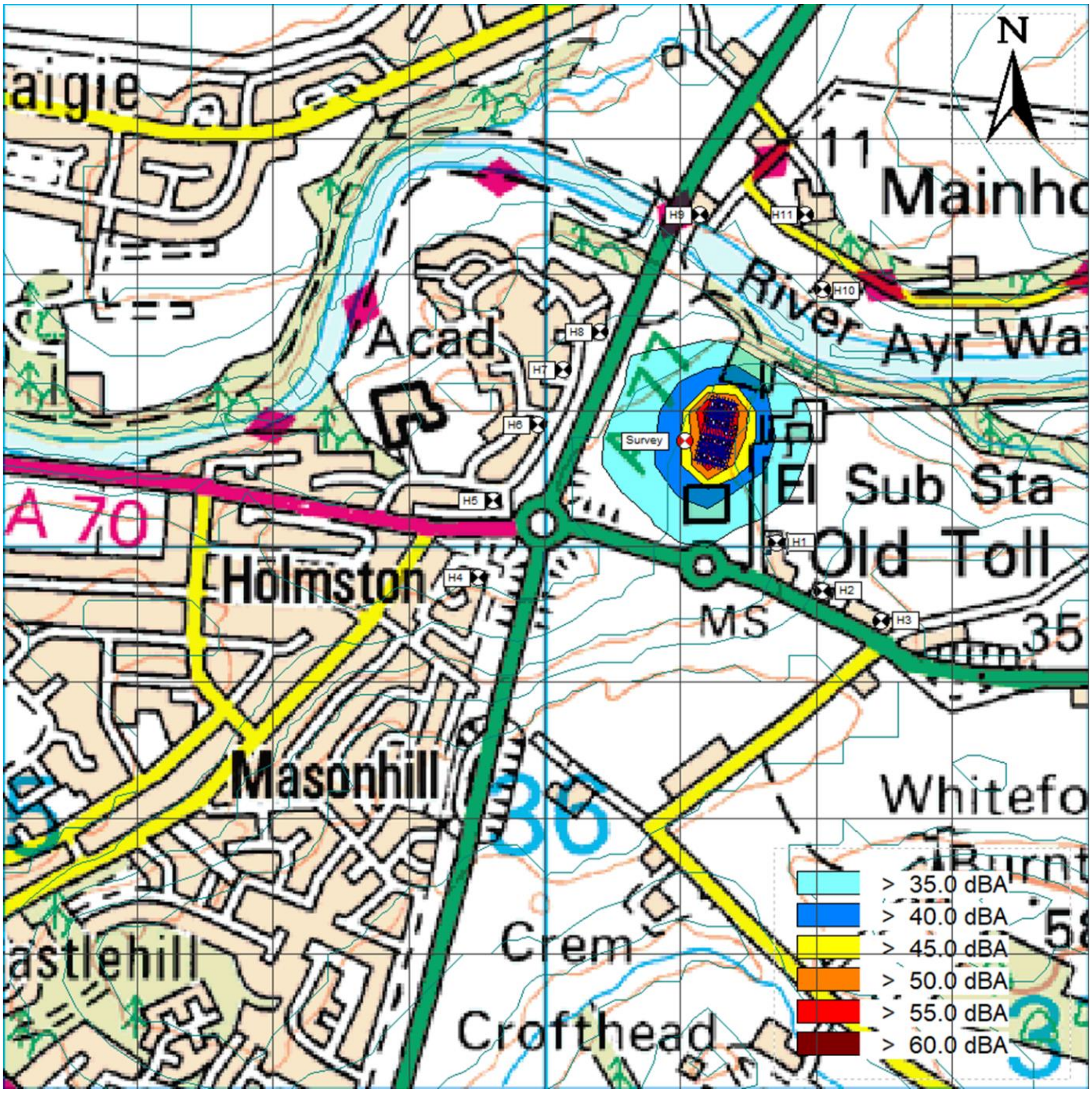


Figure 3 - Timeline of Background Sound Data

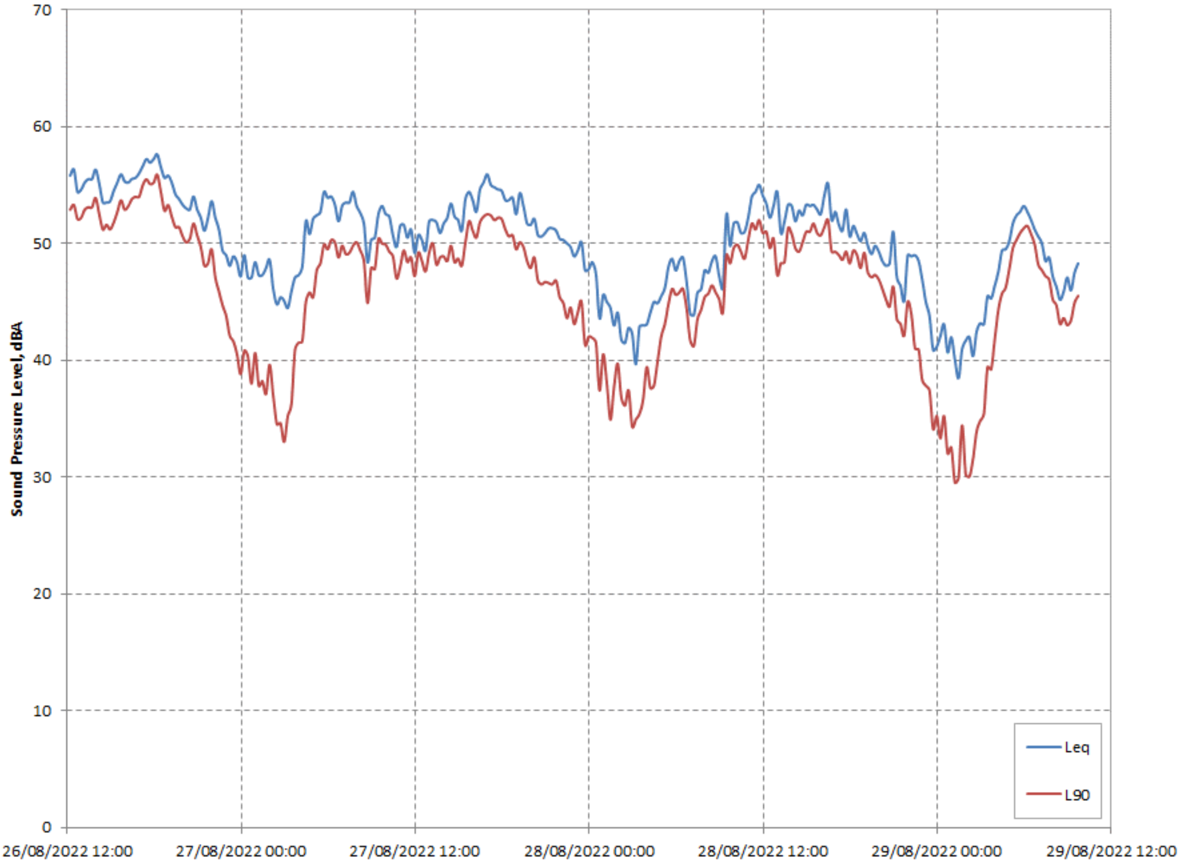


Figure 4 - Histogram of Background Sound Data

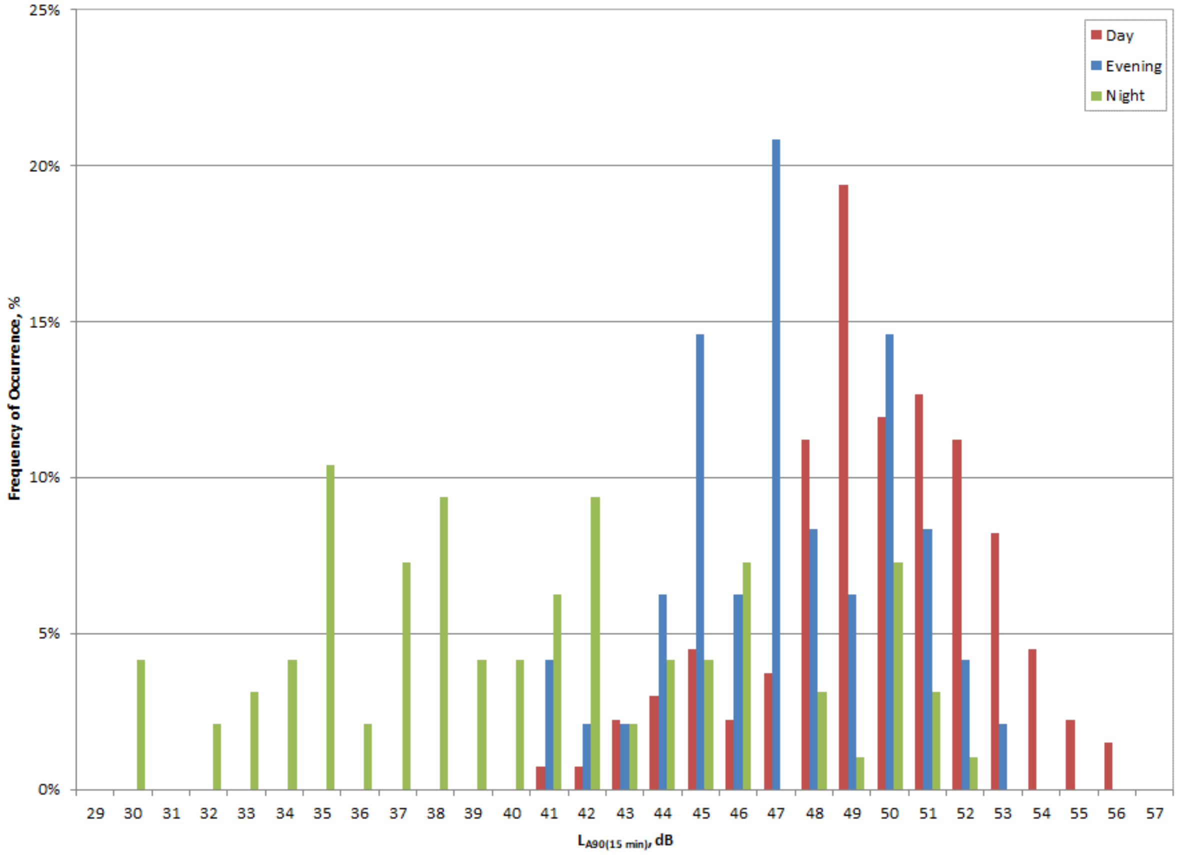
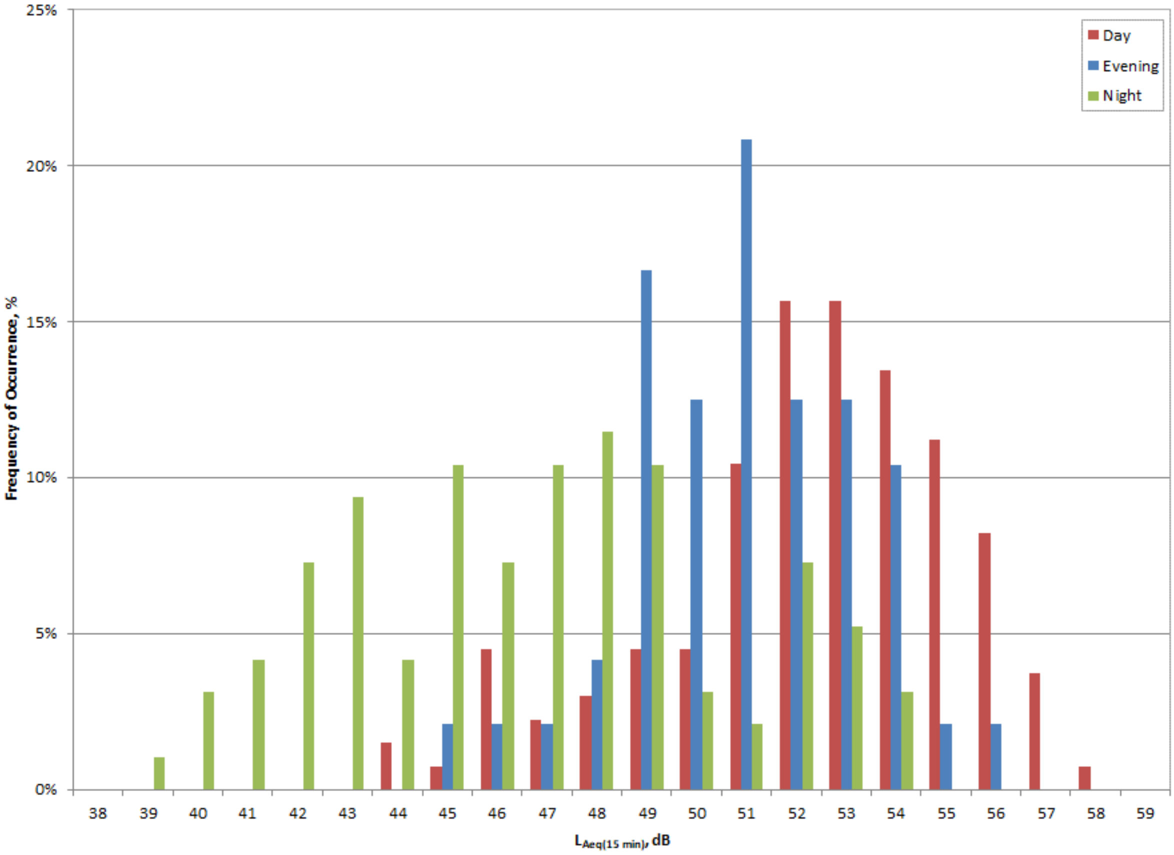


Figure 5 - Histogram of Residual Sound Data



APPENDIX C - PHOTOGRAPHS OF SURVEY LOCATION

View north

View east

View south

View west

APPENDIX D – SUGGESTED PLANNING CONDITION WORDING

The energy storage facility shall be designed and operated to ensure that the rating sound level, determined using the BS4142: 2014 methodology, shall not exceed the background sound level plus 5 dB(A) during day, evening and night-time periods at the nearest residential properties (as identified in RES report 04874-4516616-01). The background sound levels shall be as detailed in RES Report 04874-4516616-01, or those obtained in an updated survey, whichever are greater.