Assessment of Acoustic Impact for the Proposed Varley Solar Farm

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Revision History

Issue	Date	Author	Nature & Location of Change
01	10 Oct 2022	Andrew Birchby	First created

CONTENTS

1.0 INTRODUCTION & SCOPE

This report contains an assessment of the acoustic impact of the proposed Varley Solar Farm. 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

2.1 National Planning Policy Framework

Within England, the treatment of noise is defined in the planning context by the National Planning Policy Framework (NPPF)[1] which details the Government's planning policies and how these are expected to be applied. The NPPF 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. At this point the NPPF refers to the Noise Policy Statement for England (NPSE)[2] which provides guidance on the categorisation of impact levels.

2.2 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) sets out the long-term vision of Government noise policy: to promote good health and quality of life through effective noise management within the context of sustainable development. In order to weigh noise impacts against the economic and social benefits of the activity under consideration, NPSE defines three categories of effect level:

- No Observed Effect Level (NOEL): noise levels below this have no detectable effect on health and quality of life;
- Lowest Observed Adverse Effect Level (LOAEL): the level above which adverse effects on health and quality of life can be detected; and
- Significant Observed Adverse Effect Level (SOAEL): the level above which effects on health and quality of life become significant.

2.3 National Planning Practice Guidance

National Planning Practice Guidance (NPPG)[3] puts the effect levels defined by NPSE into greater context by explaining how such noise levels might be perceived, providing examples of outcomes based on likely average response, and advising on appropriate actions. These are reproduced in Table 1 below.

[1] "National Planning Policy Framework", Department for Communities and Local Government, March 2012
[2] "Noise Policy Statement for England (NPSE)", Department for Environment, Food and Rural Affairs, March 2010
[3] "National Planning Practice Guidance", Department for Communities and Local Government, March 2014

Table 1 - Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
No Observed Effect Level (NOEL)			
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

2.4 National Policy Statements

In addition to the aforementioned guidance which is applicable to all forms of environmental noise, specific guidance relating to nationally significant energy infrastructure has been published by the Department of Energy and Climate Change (DECC). Whilst the proposed development is not of a scale that would be deemed nationally significant, the relevant National Policy Statements are informative in that they suggest an assessment methodology that would be considered appropriate for the type of development being proposed.

The Overarching National Policy Statement for Energy (EN-1)[4] outlines the need for new electricity capacity from renewable sources as the country transitions to a low carbon electricity

[4] "Overarching National Policy Statement for Energy (EN-1)", Department of Energy and Climate Change, July 2011

system. However, referring back to the NPSE, EN-1 recognises the potential for energy infrastructure to impact on health and quality of life if it results in excessive noise. It goes on to say that where noise impacts are likely to arise, they should be assessed according to the principles of the relevant British Standards.

Of the examples provided, BS 4142[5] and BS 8233[6] relate to operational sound. BS 4142 describes methods for rating and assessing sound of an industrial or commercial nature. Outdoor sound levels are used to assess the likely effects on people who might be inside or outside a residential property. BS 8233 provides guidance on the control of noise for new buildings or those undergoing refurbishment. It does not provide guidance on assessing the effect of changes in external noise levels on occupants of existing buildings.

The National Policy Statement for Electricity Networks Infrastructure (EN-5)[7], relevant to the transmission and distribution parts of the electricity network along with any associated infrastructure, such as substations and converter stations, again points to the appropriateness of BS 4142 in assessing the acoustic impact of such projects. The inverters and transformers deployed as part of the proposed project are examples of infrastructure of this kind.

3.0 METHODOLOGY

3.1 Overview

An assessment in accordance with BS 4142: 2014 has been undertaken in order to determine the acoustic impact of the proposed development. This approach is consistent with the guidance provided in the National Policy Statements published by DECC for this type of development. BS 4142 lends itself well to an assessment in accordance with NPPF, NPSE and NPPG as it allows the level of impact to be ascertained. The assessment methodology has been agreed with the Environmental Health Department of South Gloucestershire Council.

3.2 Baseline Conditions

In order to complete a BS 4142 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, should be used to determine an appropriate background sound level for the analysis from the range of results obtained.

[5] "Methods for rating and assessing industrial and commercial sound", BS 4142: 2014+A1: 2019, The British Standards Institution 2014 (Amended 2019)
[6] "Guidance on sound insulation and noise reduction for buildings", BS 8233: 2014, The British Standards Institution 2014
[7] "National Policy Statement for Electricity Networks Infrastructure (EN-5)", Department of Energy and Climate Change, July 2011

3.3 Propagation

The ISO 9613-2[8] 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 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. The effect of surface features such as buildings and trees shall not be included in the model although the effect of the solar panels is considered. There is a level 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.

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 2 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, although is noted that any assessment is context specific. These criteria relate well with the categories defined by NPSE: with the background sound level representing the NOEL, 5 dB above background representing the LOAEL and 10 dB above background the SOAEL.

Table 2 – BS 4142 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

Baseline noise levels were determined in a survey undertaken by Hayes McKenzie Partnership Ltd between Tuesday 13th September and Tuesday 27th September 2022. Full details of the survey including the methodology, results, equipment used, photos and charts are provided in Hayes McKenzie's report (Appendix B)[9].

The measured background sound levels during day, evening and night-time periods are shown in Table 3. The two survey positions, H2 (Varley Farm) and H5 (Heathend Farm), are shown in red on the map in Figures 1 and 2 (Appendix C). Based on proximity the data recorded at survey

[8] "Acoustics - Attenuation of Sound During Propagation Outdoors, Part 2: General Method of Calculation", International Organisation for Standardisation 1996
[9] Varley Farm Solar, Background Noise Survey. Report HM: 3630_R01_EXT2. Hayes McKenzie, 19 October 2022

location H2 is assumed to be representative of houses H1-H3 and H10-H12. Data from survey location H5 is assumed to represent houses H4-H9.

Table 3 - Baseline Data

House ID	X, m	Y, m	Day Background, dB L_{A90}	Evening Background, dB L_{A90}	Night Background, dB L_{A90}
H1	370201	190418	36	34	32
H2	370061	190538	36	34	32
H3	369682	190340	36	34	32
H4	369784	189974	37	33	30
H5	369936	189813	37	33	30
H6	369731	189362	37	33	30
H7	369810	189124	37	33	30
H8	370457	188745	37	33	30
H9	371682	188635	37	33	30
H10	372123	190406	36	34	32
H11	371914	190962	36	34	32
H12	370885	191119	36	34	32

5.0 ASSESSMENT

The main sources of sound within the proposed development are the 10 inverters and transformers located at the solar inverter substations along with the grid transformer at the grid substation. The inverters are only assumed to be operating during daytime and evening periods when the solar farm could be generating power. This assumption is conservative in the winter months when there will be no generation in the evenings. The transformers are assumed to be operating at all times.

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 noise 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}
Solar substation (inverter plus transformer)	79
Solar transformer alone	71
Grid transformer	82

The sound emitted by the inverter cooling fans and transformers can have distinctive character. Under the subjective method described in BS 4142, a correction of 2 dB has been applied in the event that tones are just perceptible at the assessment locations.

Predicted specific sound levels and the resulting rating level at nearby properties are detailed in Tables 5-7 for daytime, evening and night-time periods. The rating level is then compared to the background sound levels of Table 3 to assess the impact at each location. An illustrative sound footprint for the proposed development showing the predicted specific sound level during daytime periods is provided in Figure 1 (Appendix C). An illustrative sound footprint for night-time periods is shown in Figure 2.

Table 5 - BS 4142 Assessment Results - Day

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Aeq}	Rating vs Background, dB	Potential Impact
H1	32	34	-2	Low
H2	25	27	-9	Low
H3	22	24	-12	Low
H4	26	28	-9	Low
H5	28	30	-7	Low
H6	21	23	-14	Low
H7	18	20	-17	Low
H8	16	18	-19	Low
H9	12	14	-23	Low
H10	12	14	-22	Low
H11	12	14	-22	Low
H12	16	18	-18	Low

Table 6 - BS 4142 Assessment Results - Evening

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Aeq}	Rating vs Background, dB	Potential Impact
H1	32	34	0	Low
H2	25	27	-7	Low
H3	22	24	-10	Low
H4	26	28	-5	Low
H5	28	30	-3	Low
H6	21	23	-10	Low
H7	18	20	-13	Low
H8	16	18	-15	Low
H9	12	14	-19	Low
H10	12	14	-20	Low
H11	12	14	-20	Low
H12	16	18	-16	Low

Table 7 - BS 4142 Assessment Results - Night

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Aeq}	Rating vs Background, dB	Potential Impact
H1	26	28	-4	Low
H2	21	23	-9	Low
H3	18	20	-12	Low
H4	21	23	-7	Low
H5	22	24	-6	Low
H6	16	18	-12	Low
H7	13	15	-15	Low
H8	12	14	-16	Low
H9	8	10	-20	Low
H10	9	11	-21	Low
H11	9	11	-21	Low
H12	14	16	-16	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-time 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 Tables 8-10 for daytime, evening and night-time periods. No change in the ambient sound level during day or night-time periods is predicted due to the operation of the proposed development. The proposed development is predicted to result in a 1 dB change in the ambient sound level during the evenings although this would be

restricted to the times of year when the site is generating during this period i.e. summer. These findings are consistent with the site having a low impact (3 dB representing the smallest perceptible change in the level of a given sound and 10 dB a doubling in loudness).

Table 8 - Predicted Change in Ambient Sound Level - Day

House ID	Day Residual, dB L_{Aeq}	Day Ambient, dB L_{Aeq}	Day Change, dB L_{Aeq}
H1	42	42	0
H2	42	42	0
H3	42	42	0
H4	43	43	0
H5	43	43	0
H6	43	43	0
H7	43	43	0
H8	43	43	0
H9	43	43	0
H10	42	42	0
H11	42	42	0
H12	42	42	0

Table 9 - Predicted Change in Ambient Sound Level - Evening

House ID	Evening Residual, dB L_{Aeq}	Evening Ambient, dB L_{Aeq}	Evening Change, dB L_{Aeq}
H1	38	39	1
H2	38	38	0
H3	38	38	0
H4	38	38	0
H5	38	38	0
H6	38	38	0
H7	38	38	0
H8	38	38	0
H9	38	38	0
H10	38	38	0
H11	38	38	0
H12	38	38	0

Table 10 - Predicted Change in Ambient Sound Level - Night

House ID	Night Residual, dB L_{Aeq}	Night Ambient, dB L_{Aeq}	Night Change, dB L_{Aeq}
H1	37	37	0
H2	37	37	0
H3	37	37	0
H4	38	38	0
H5	38	38	0
H6	38	38	0
H7	38	38	0
H8	38	38	0
H9	38	38	0
H10	37	37	0
H11	37	37	0
H12	37	37	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 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.

6.0 CONCLUSIONS

An assessment of the acoustic impact of the proposed Varley Solar Farm has been undertaken in accordance with BS 4142: 2014. The proposed development is predicted to have a low impact such that no observed effect on health or quality of life would be expected.

APPENDIX A – EXPERIENCE AND 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 – BASELINE NOISE ASSESSMENT REPORT

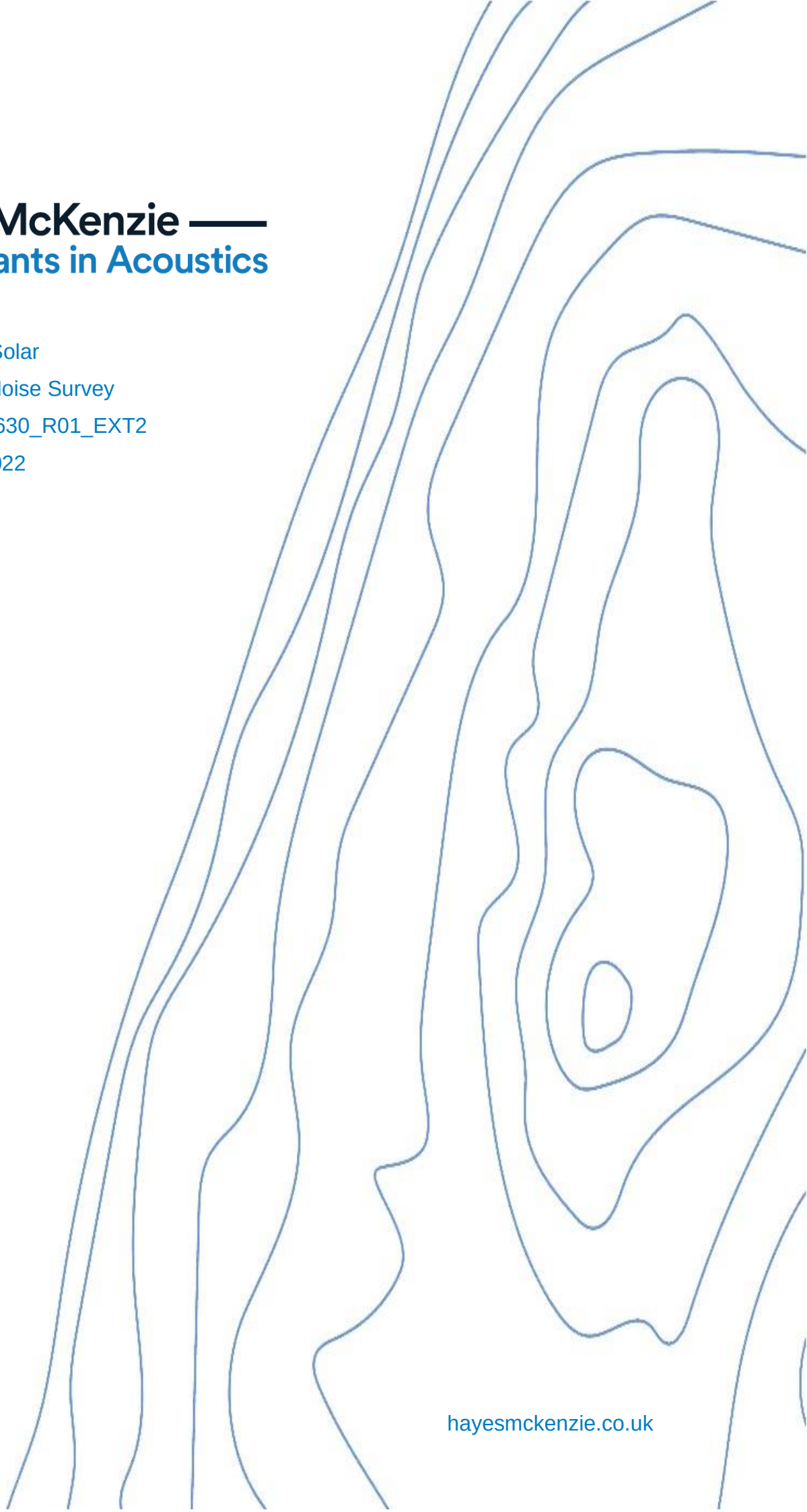
Hayes McKenzie
Consultants in Acoustics

Varley Farm Solar

Background Noise Survey

Report HM: 3630_R01_EXT2

19 October 2022



hayesmckenzie.co.uk

Varley Farm Solar
Background Noise Survey
Report HM: 3630_R01_EXT2
19 October 2022

Prepared for:	Renewable Energy Systems Ltd
Report prepared by:	Ed Guy, BSc, AMIOA Junior Acoustic Consultant
Checked by:	Andy McKenzie PhD, BSc, FIOA Director
Approved by:	Andy McKenzie PhD, BSc, FIOA Director

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1. INTRODUCTION

1.1 Hayes McKenzie Partnership Ltd have been commissioned by Renewable Energy Systems Ltd to undertake background noise measurements in connection with a proposed solar farm, located between Cromhall and Wickwar to the north-east of Bristol.

1.2 This report presents the results of these measurements.

2. RELEVANT GUIDANCE

BS 4142, Method for Rating & Assessing Industrial & Commercial Sound

2.1 BS 4142:2014, *Method for rating and assessing industrial and commercial sound*, provides an assessment methodology for determining the likely impact of noise experienced by people at neighbouring residential properties from industrial and commercial sources. The standard describes a method for rating noise levels based on the difference between the level of existing background noise (in the absence of the industrial or commercial source) and the noise immission level of the source at a particular receiver location (known as the specific noise level). In instances where the specific noise level exhibits an identifiable or perceived character (such as tonality, impulsiveness, or other identifiable character) then a penalty is added to the same noise level to give the 'rating level'. The maximum penalty for tonal content is +6 dB. The difference between the background noise level and the rating level is then used to determine the potential impact.

2.2 The background noise is expressed in terms of the L_{A90} noise level which is the level exceeded for 90% of the time interval over which measurements are taken. It is stated in BS4142 that a series of measurements are undertaken in intervals of normally not less than 15 minutes which are subsequently used to derive a 'representative' value for assessment purposes.

3. BACKROUND NOISE SURVEY

3.1 The measurements were carried out to determine the background noise levels at two locations representative of the nearest properties to the proposed development which lie to the north and west in Talbot's End and Heath End respectively as shown on Figure 1.

3.2 Continuous unattended measurements were conducted at Varley Farm and Heathend Farm between Tuesday the 13th of September 2022 and Tuesday the 27th of September 2022 at these locations.

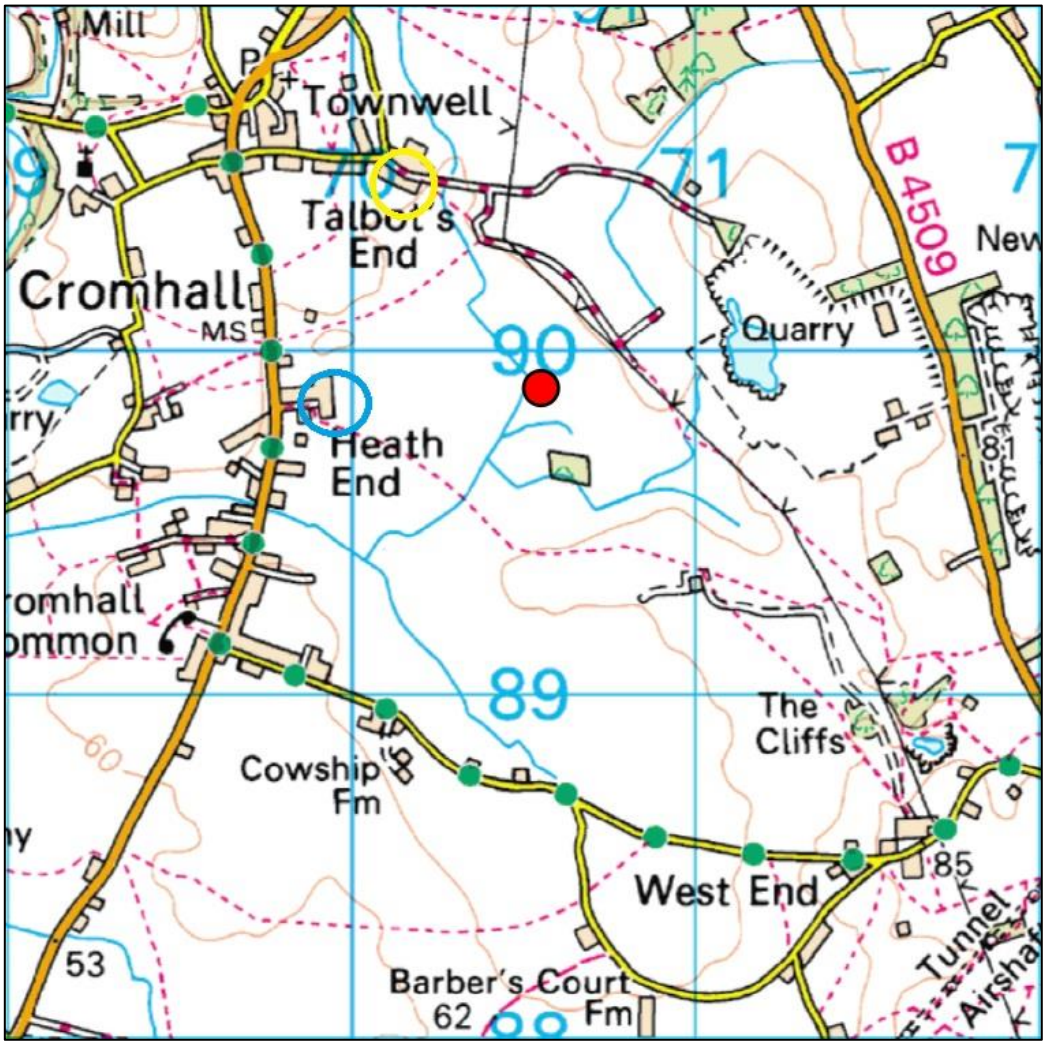


Figure 1 - Map Showing Approx. Centre of Site Location (Red Circle) with Measurement Locations Circled - Varley Farm in Yellow and Heathend Farm in Blue

3.3 A Rion NL52 Sound Level Meter (SLM) was installed at each of the two monitoring locations. Each meter was fitted with a 1/2" microphone complying with the Class 1 standard in IEC 61672-1. In each case, the microphone was fitted with a 45 mm radius foam ball windshield surrounded by a 125 mm radius secondary windshield of 40 mm thickness and mounted on a tripod at a height of 1.4 m.

3.4 The SLM was programmed to measure a number of statistical noise indices, including the L_{A90} and the L_{Aeq} over consecutive 15-minute intervals as specified in BS4142 as the minimum duration measurement interval.

3.5 Calibration was carried out using a B&K Type 4231 Acoustic Calibrator (s/n 3025352) set at a level of 94.00 dB at the start of the survey and checked at the end, with a drift of no more than 0.1 dB being observed, which is within normal tolerances. All equipment was within its relevant calibration period.

3.6 During the noise survey, a weather station[1] was installed at each monitoring location. This was mounted on a survey tripod positioning the anemometer and wind vane at an approximate height of 1.5 m above the ground. The weather station was connected to a data logger recording average wind speed and direction, and rainfall in 15-minute intervals synchronised with the noise measurements.

Varley Farm

3.7 The microphone was installed at the back of the property approximately 2.5m from a garden wall to the North, and more than 3m from outbuildings to the east and west. The weather station was positioned slightly to the west of the microphone.

3.8 Ambient noise noted during the installation and collection of the equipment included cows, birds, distant traffic noise, a milk container lorry being loaded/unloaded as well as other farm work activities.

[1] Vantage Vue Weather Station Davis Instruments: www.davisinstruments.com/products/vantage-vue-wireless-weather-station

Figure 2 – Varley Farm Equipment Looking North

Figure 3 – Varley Farm Equipment Looking North-West

Heathend Farm

3.9 The microphone was installed to the North of the property in a small paddock, with a fence and hedge combination to the North and open fences to the East and South. The weather station was installed to the West of the microphone.

3.10 Ambient noise noted during the installation and collection of the equipment included distant road and farm work noise, as well as bees and birds. Roof works were being undertaken on a nearby building during the installation. A quarry blasting alarm was noted during the installation at this property, which would presumably be audible at Varley Farm as well.

Figure 4 – Heathend Farm Equipment Looking East

Figure 5 – Heathend Farm Microphone Looking South

Results

3.11 BS4142 splits the 24-hour period into daytime (0700-2300) and night-time (2300-0700). In this report the results for the daytime have also been presented split into daytime (0700-1900) and evening (1900-2300), as the solar farm will not necessarily be running during the evening hours year-round. The 16-hour BS4142 daytime period (0700-2300) will be referred to as the "full day period".

3.12 This section presents the results of the measurements including average L_{A90} values over each of these periods or each day, as well as 16 hour, 8 hour, 12 hour and 4 hour L_{Aeq} values respectively, essentially the energy average noise levels, which are included for information only.

Varley Farm

3.13 The results of the measurements have been plotted as time history charts covering the entire 14-day survey period and are shown in Figure 6 and Figure 7. Periods of rainfall have been excluded from both the charts, the averages and the overall L_{Aeq} values, as this can artificially raise the background noise level.

3.14 Wind speeds exceeding around 5 m/s can affect sound levels due to the wind generating sound across the microphone or increasing the impact of wind noise in trees or similar. No (15-minute averaged) wind speeds exceeding 5 m/s were noted during the survey meaning no data had to be excluded due to high wind speeds.

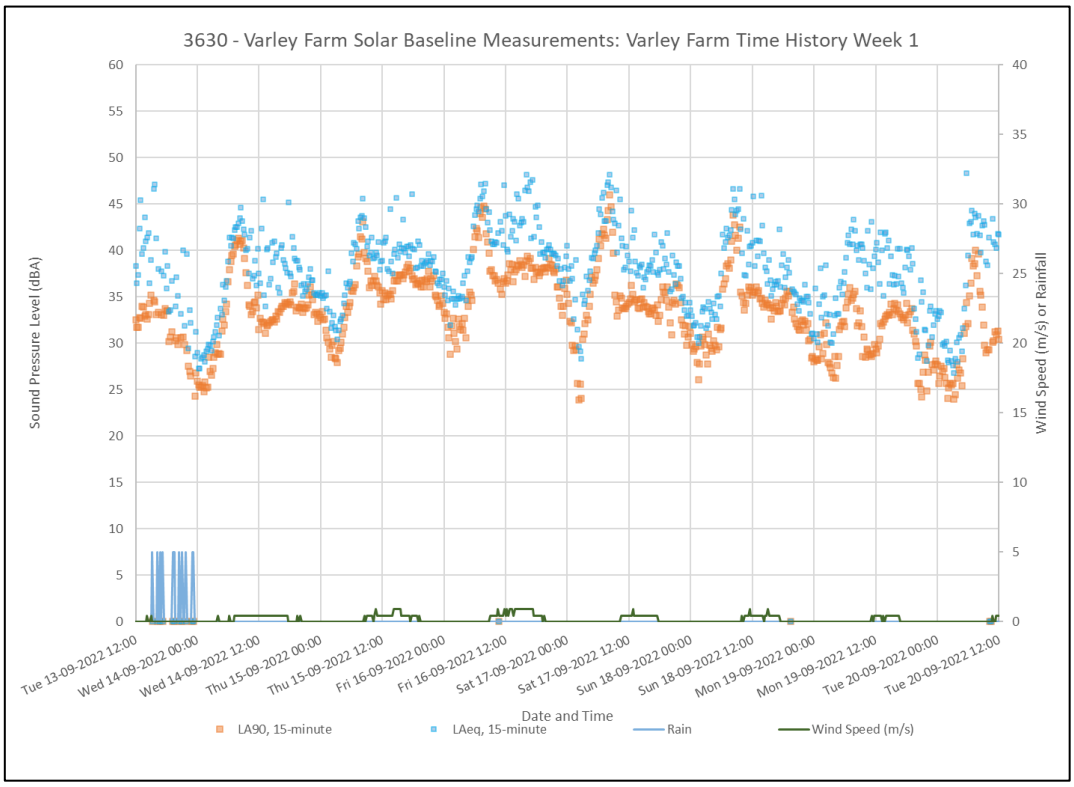


Figure 6 – Varley Farm Time History Week 1

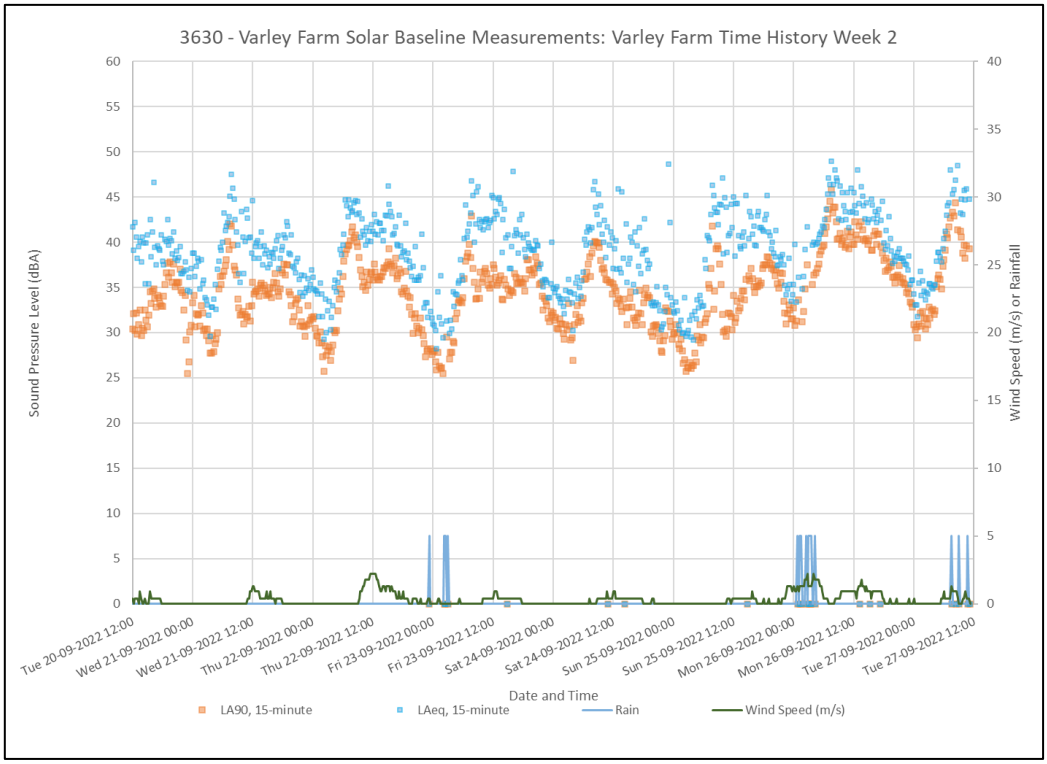


Figure 7 – Varley Farm Time History Week 2

3.15 Table 1 shows the full day, daytime, evening and night-time L_{Aeq} and average L_{A90} for all the days over the survey period.

Table 1 – Varley Farm Full Day, Daytime, Evening and Night L_{Aeq} and L_{A90}

Period (24hrs from 0700 to 0700)	Full Day (0700-2300) Average noise level dB $L_{Aeq\ 16\ hour}$	Full Day (0700-2300) Average noise level dB L_{A90} (Avg.)	Daytime (0700-1900) Average noise level dB $L_{Aeq\ 12\ hour}$	Daytime (0700-1900) Average noise level dB L_{A90} (Avg.)	Evening (1900-2300) Average noise level dB $L_{Aeq\ 4\ hour}$	Evening (1900-2300) Average noise level dB L_{A90} (Avg.)	Night (2300-0700) Average noise level dB $L_{Aeq\ 8\ hour}$	Night (2300-0700) Average noise level dB L_{A90} (Avg.)
Tue 13th – Wed 14th Sep					36	29	35	29
Wed 14th – Thurs 15th Sep	40	35	41	35	37	34	36	32
Thurs 15th – Fri 16th Sep	41	37	41	37	39	36	39	34
Fri 16th – Sat 17th Sep	43	38	44	39	40	37	39	33
Sat 17th – Sun 18th Sep	41	35	42	36	38	34	35	30
Sun 18th – Mon 19th Sep	41	35	42	36	36	33	36	30
Mon 19th – Tues 20th Sep	39	31	40	32	35	28	37	28
Tues 20th – Wed 21st Sep	41	34	41	33	39	35	37	32
Wed 21st – Thurs 22nd Sep	41	34	41	35	38	32	37	31
Thurs 22nd – Fri 23rd Sep	41	36	42	37	37	31	36	30
Fri 23rd – Sat 24th Sep	42	36	43	36	38	36	36	32
Sat 24th – Sun 25th Sep	40	34	41	35	34	31	37	29
Sun 25th – Mon 26th Sep	42	35	43	35	39	36	40	36
Mon 26th – Tues 27th Sep	44	39	45	41	39	36	38	34
Total	**41**	**35**	**42**	**36**	**38**	**34**	**37**	**31**

3.16 The noise levels measured over the 14 days and 14 nights indicate that L_{Aeq} noise levels for the full day period range between 39 and 44 dB $L_{Aeq,\ 16hr.}$ The L_{A90} levels range between 31 and 39 dB L_{A90}.

3.17 The daytime L_{Aeq} noise levels range between 40 and 45 $L_{Aeq,\ 12hr.}$ The L_{A90} levels range between 32 and 41 dB L_{A90}.

3.18 The evening L_{Aeq} noise levels range between 34 and 40 dB $L_{Aeq,\ 4\ hr}$. The L_{A90} levels range between 28 and 37 dB L_{A90}.

3.19 The night-time L_{Aeq} noise levels range between 35 and 40 dB $L_{Aeq,\ 8hr.}$ The L_{A90} levels range between 28 and 36 dB $L_{A90.}$

3.20 Figure 8 to Figure 11 shows the frequency of occurrence of each L_{A90} decibel level over the

duration of the survey for the full day, daytime, evening and night periods.

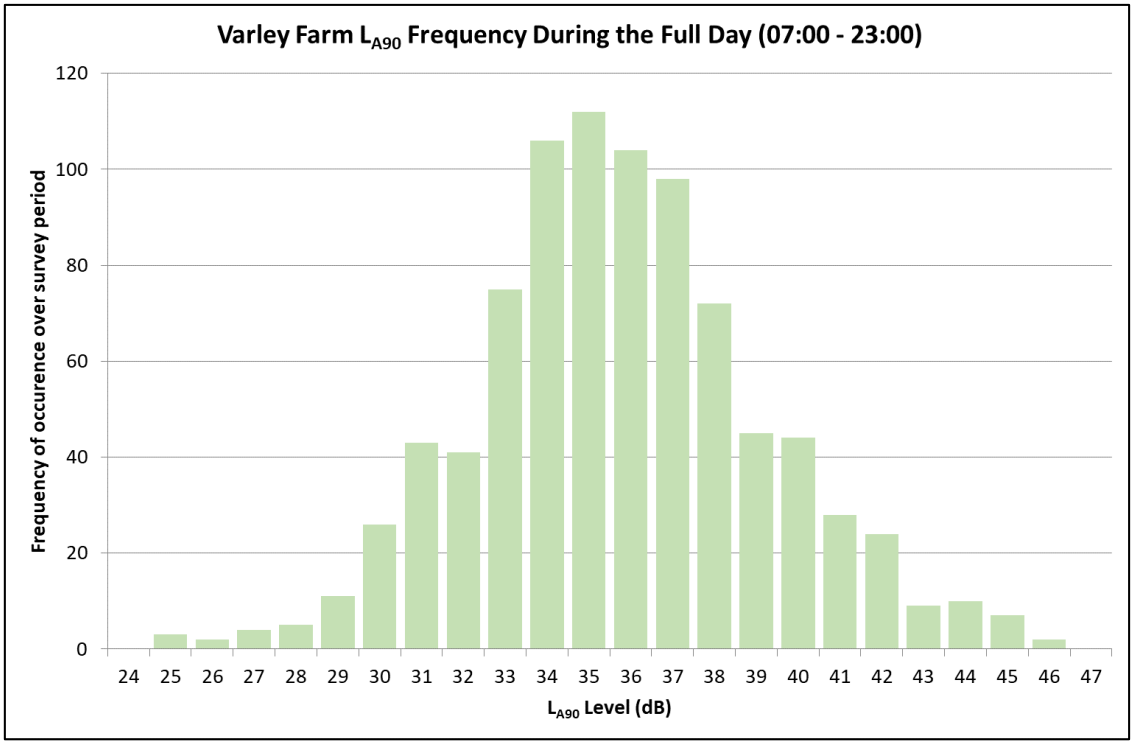


Figure 8 - Varley Farm Full Day Frequency

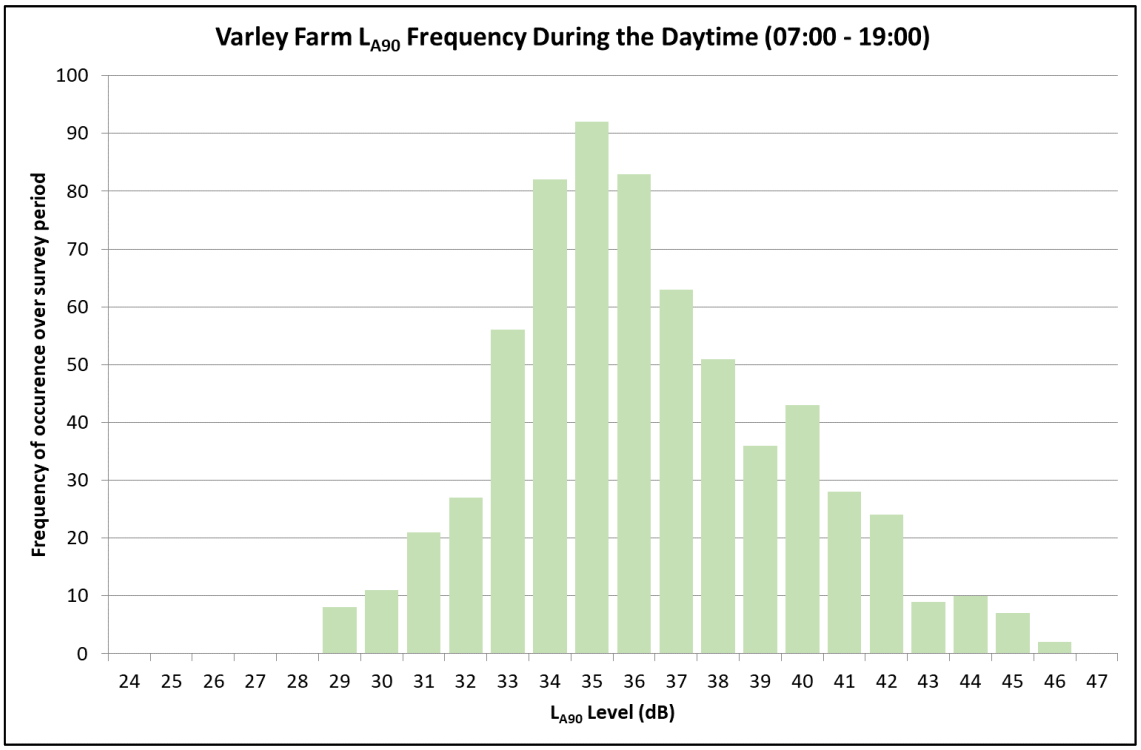


Figure 9 - Varley Farm Daytime Frequency

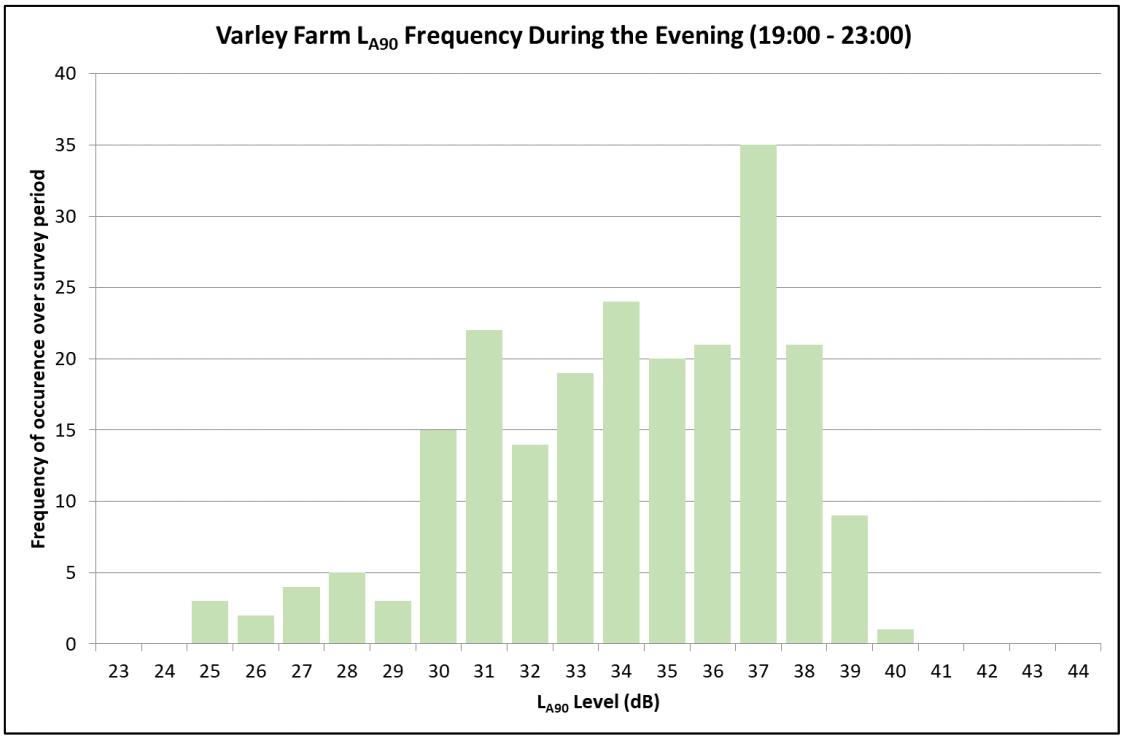


Figure 10 - Varley Farm Evening Frequency

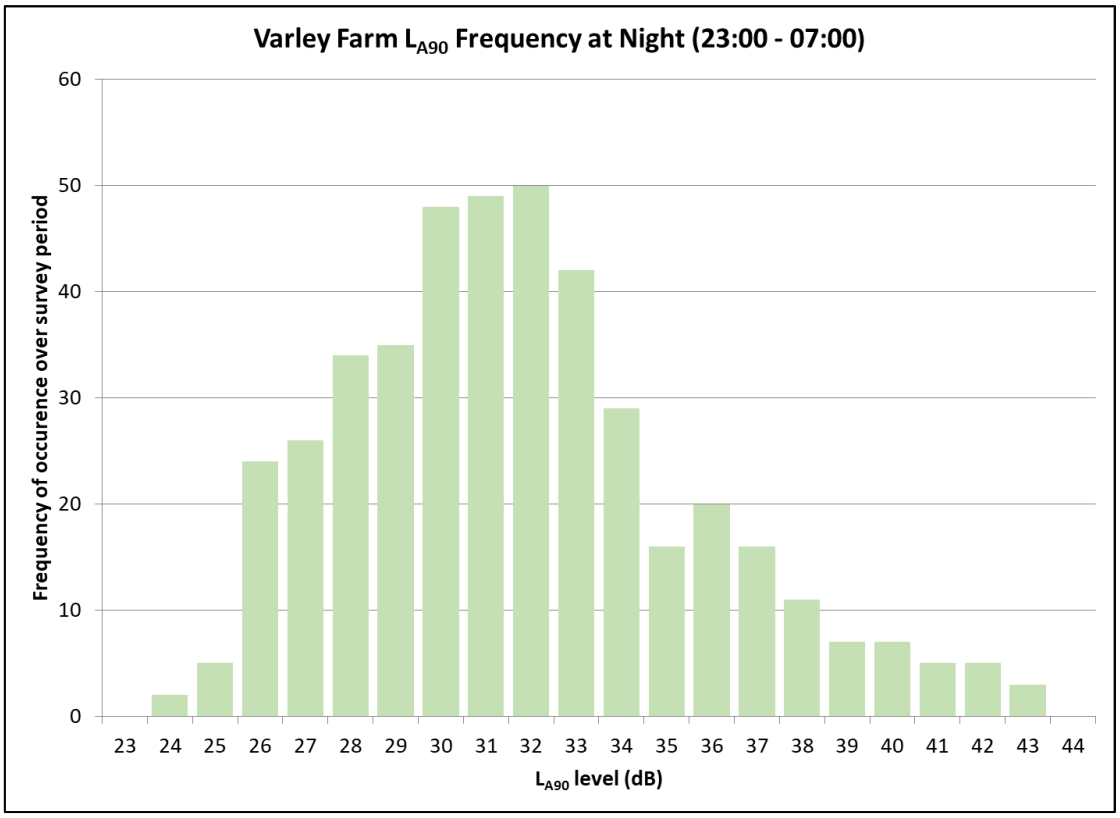


Figure 11 - Varley Farm Night Frequency

3.21 The most frequently occurring background sound level for the full day period is 35 dB L_{A90}. This corresponds to the average L_{A90} for the full day period across the survey meaning 35 dB L_{A90} is a good representative background sound level for Varley Farm during the full day period.

3.22 The most frequently occurring day-time background sound level is 35 dB L_{A90}. However, the average L_{A90} is 36 dB L_{A90} and it can be seen from Figure 9 that the majority of occurrences are above 35 dB L_{A90}. Therefore, 36 dB L_{A90} is a better representative background sound level for Varley Farm during the daytime.

3.23 The most frequently occurring evening background sound level is 37 dB L_{A90}. However, the average L_{A90} is 34 dB L_{A90} and it can be seen from Figure 10 that the majority of occurrences are below 37 dB L_{A90}. Therefore, 34 dB L_{A90} is a better representative background sound level for Varley Farm in the evening.

3.24 The most frequently occurring night-time background sound level is 32 dB L_{A90}. This is slightly higher than the average L_{A90} of 31 dB L_{A90}, but from looking at the distribution in Figure 11 32 dB L_{A90} is a better representative background sound level for Varley Farm during the night.

Heathend Farm

3.25 The results of the measurements, in terms of the L_{Aeq} and L_{A90} for each 15-minute interval, have been plotted in time history charts covering the entire 14-day survey period and are shown in Figure 12 and Figure 13. As for Varley Farm, periods of rainfall have been excluded and no (15-minute averaged) wind speeds exceeding 5 m/s were noted during the survey.

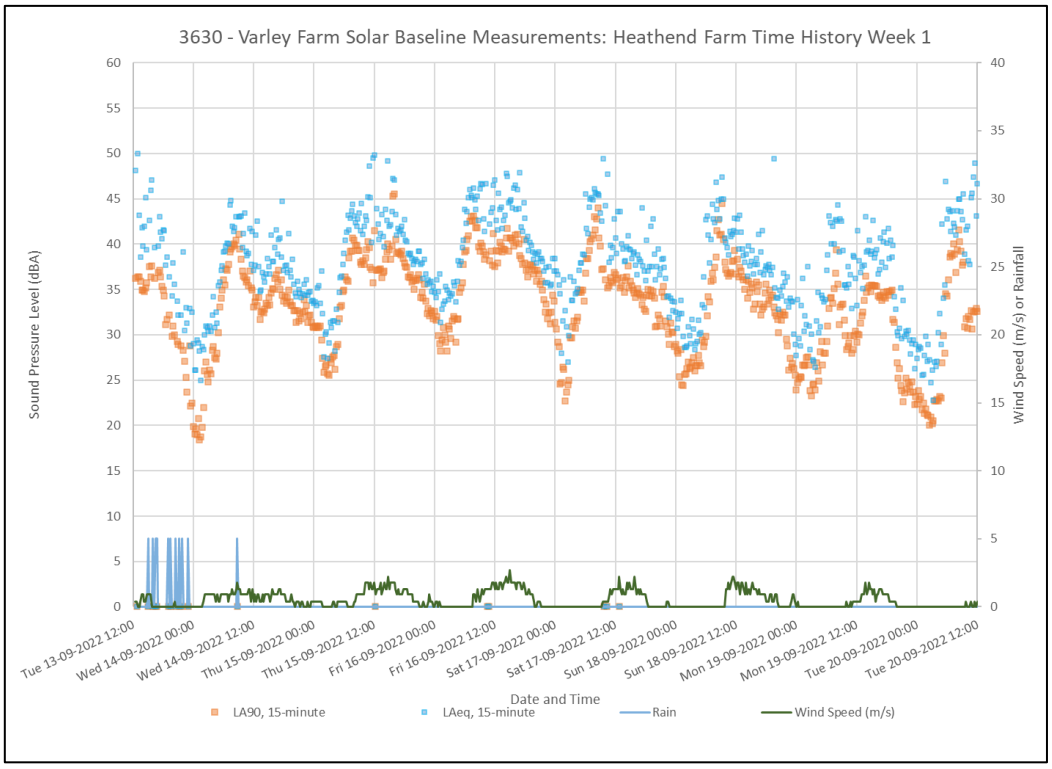


Figure 12 - Heathend Farm Time History Week 1

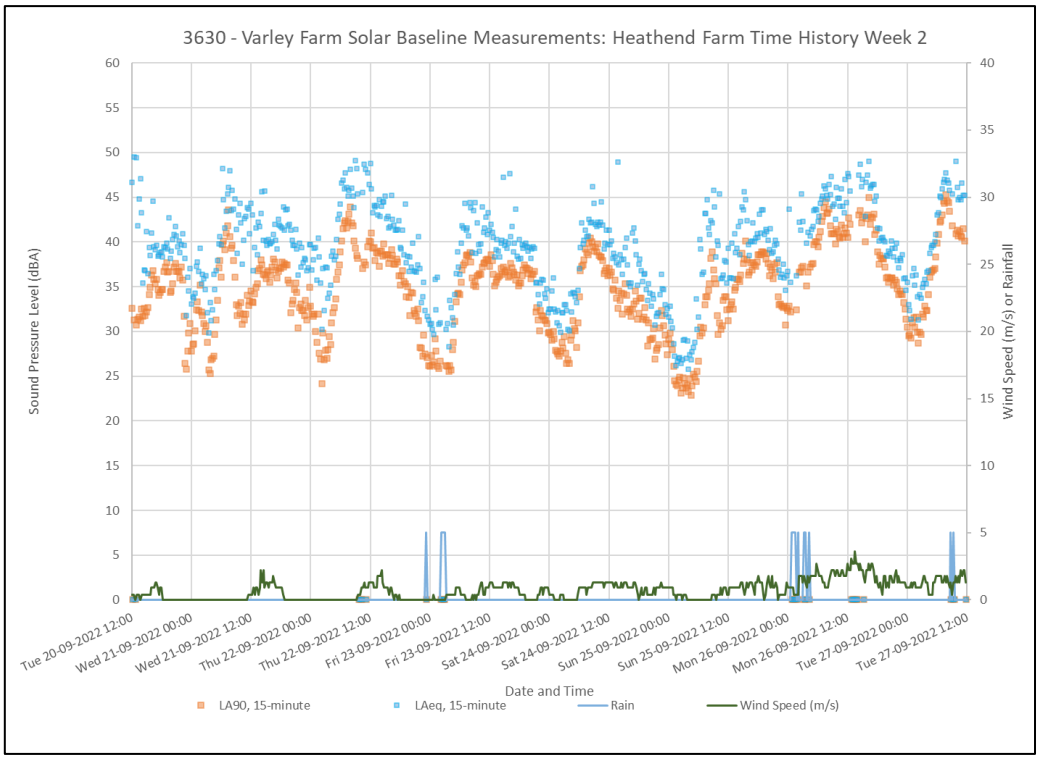


Figure 13 - Heathend Farm Time History Week 2

3.26 Table 2 shows the full day, daytime, evening and night-time LAeq and LA90 for all the days over the survey period.

Table 2 - Heathend Farm Full Day, Daytime, Evening and Night L_{Aeq} and L_{A90}

Period (24hrs from 0700 to 0700)	Full Day (0700-2300) Average noise level dB $L_{Aeq\ 16\ hour}$	Full Day (0700-2300) Average noise level dB L_{A90} (Avg.)	Daytime (0700-1900) Average noise level dB $L_{Aeq\ 12\ hour}$	Daytime (0700-1900) Average noise level dB L_{A90} (Avg.)	Evening (1900-2300) Average noise level dB $L_{Aeq\ 4\ hour}$	Evening (1900-2300) Average noise level dB L_{A90} (Avg.)	Night (2300-0700) Average noise level dB $L_{Aeq\ 8\ hour}$	Night (2300-0700) Average noise level dB L_{A90} (Avg.)
Tue 13th – Wed 14th Sep					35	29	34	27
Wed 14th – Thurs 15th Sep	40	35	40	36	36	33	36	30
Thurs 15th – Fri 16th Sep	43	38	44	39	38	35	38	33
Fri 16th – Sat 17th Sep	44	39	45	40	38	35	38	31
Sat 17th – Sun 18th Sep	42	36	42	37	38	33	35	28
Sun 18th – Mon 19th Sep	41	35	41	37	39	31	35	27
Mon 19th – Tues 20th Sep	39	31	40	33	34	26	37	25
Tues 20th – Wed 21st Sep	43	35	43	34	40	35	39	31
Wed 21st – Thurs 22nd Sep	42	35	43	36	41	34	40	32
Thurs 22nd – Fri 23rd Sep	44	37	45	39	38	32	35	29
Fri 23rd – Sat 24th Sep	41	36	42	37	38	35	35	30
Sat 24th – Sun 25th Sep	40	34	41	36	34	30	32	26
Sun 25th – Mon 26th Sep	41	36	41	35	40	36	42	36
Mon 26th – Tues 27th Sep	45	40	46	42	39	36	39	34
Total	**42**	**36**	**43**	**37**	**38**	**33**	**38**	**30**

3.27 The noise levels measured over the 14 days and 14 nights indicate that L_{Aeq} noise levels for the full day period range between 39 and 45 dB $L_{Aeq,\ 16hr.}$ The L_{A90} levels range between 31 and 40 dB L_{A90}.

3.28 The daytime L_{Aeq} noise levels range between 40 and 46 dB $L_{Aeq,\ 12hr.}$ The L_{A90} levels range between 33 and 42 dB L_{A90}.

3.29 The evening L_{Aeq} noise levels range between 34 and 41 dB $L_{Aeq, 4\ hr}$. The L_{A90} levels range between 26 and 36 dB L_{A90}.

3.30 The night-time L_{Aeq} noise levels range between 34 and 42 dB $L_{Aeq, 4\ hr}$. The L_{A90} levels range between 27 and 36 dB L_{A90}.

3.31 Figures to show the frequency of occurrence of each L_{A90} decibel level over the duration of the survey for the full day, daytime, evening and night periods.

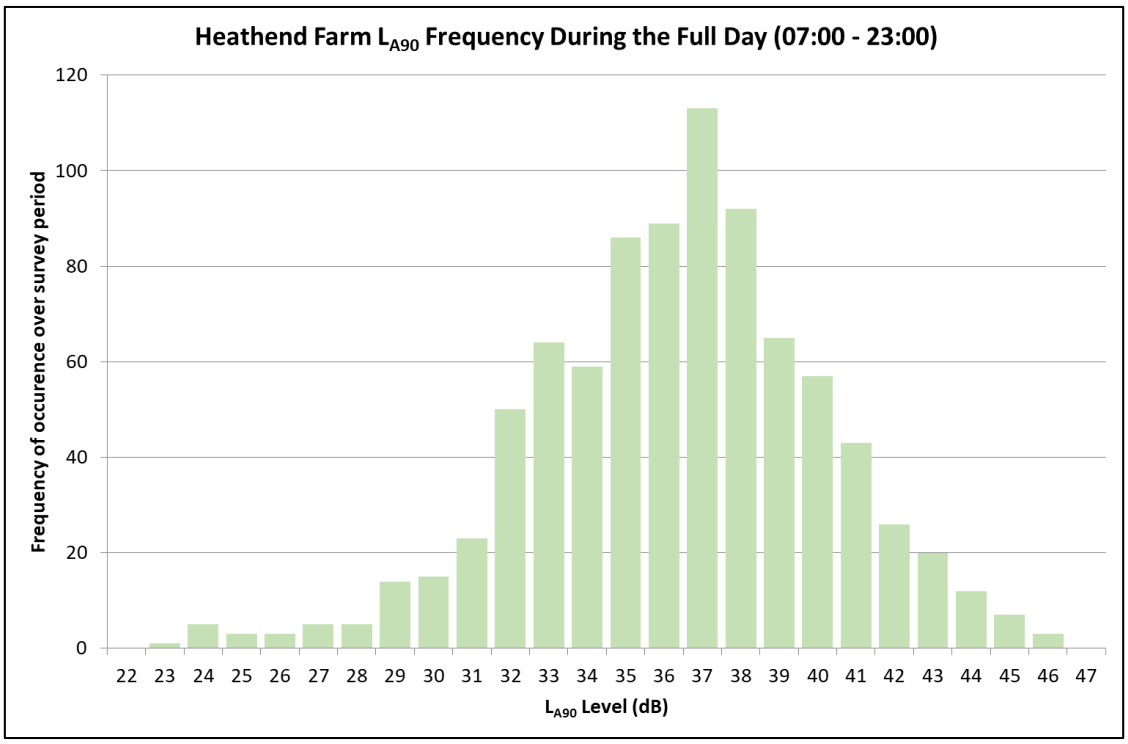


Figure 14 - Heathend Farm Full Day Frequency

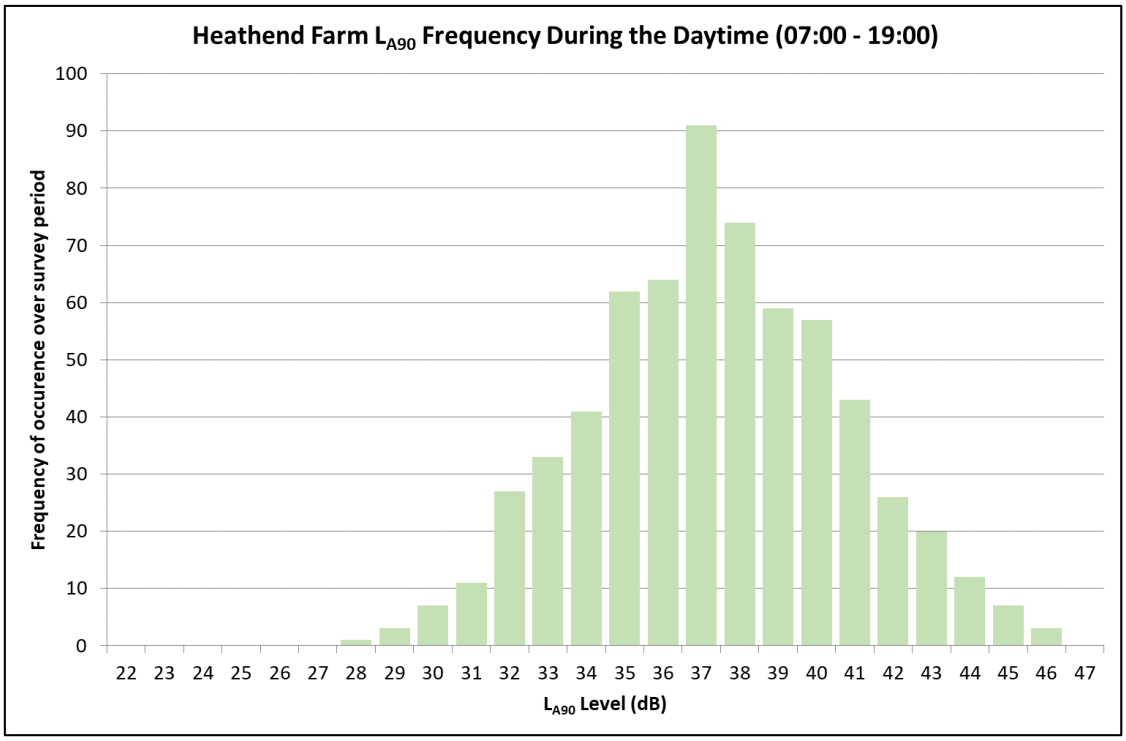


Figure 15 - Heathend Farm Daytime Frequency

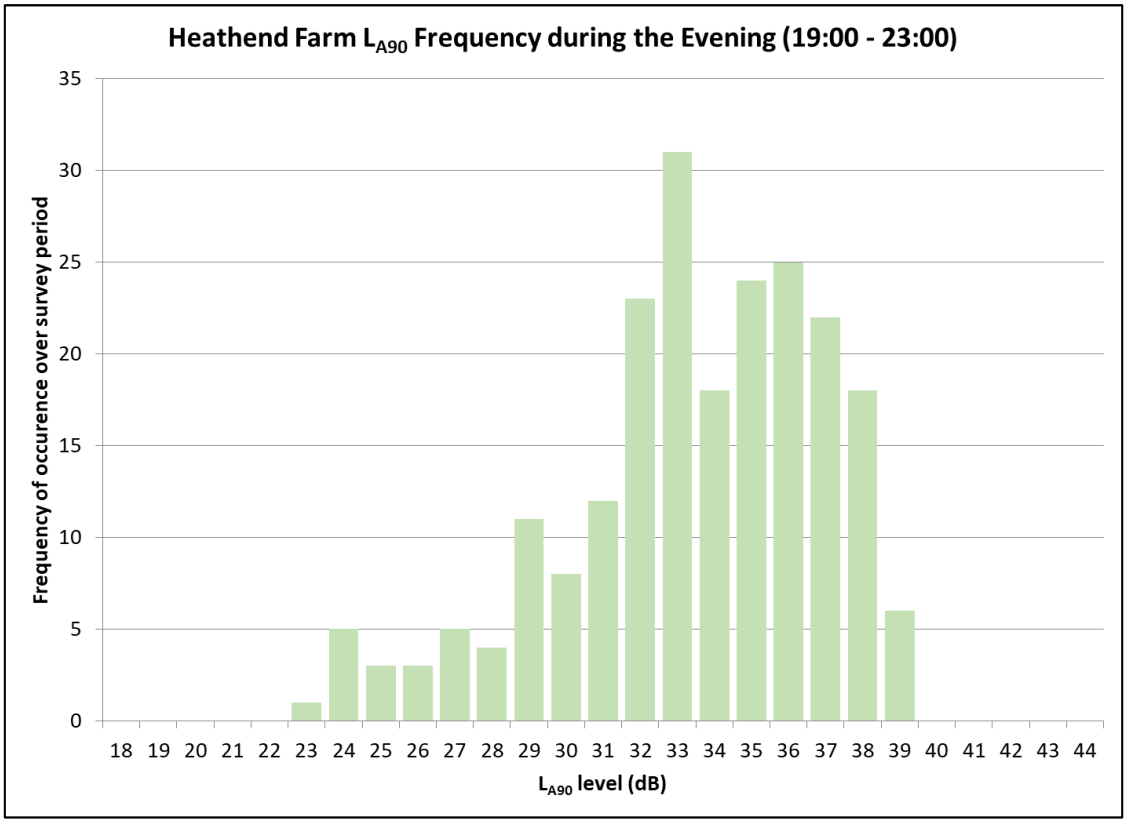


Figure 16 - Heathend Farm Evening Frequency

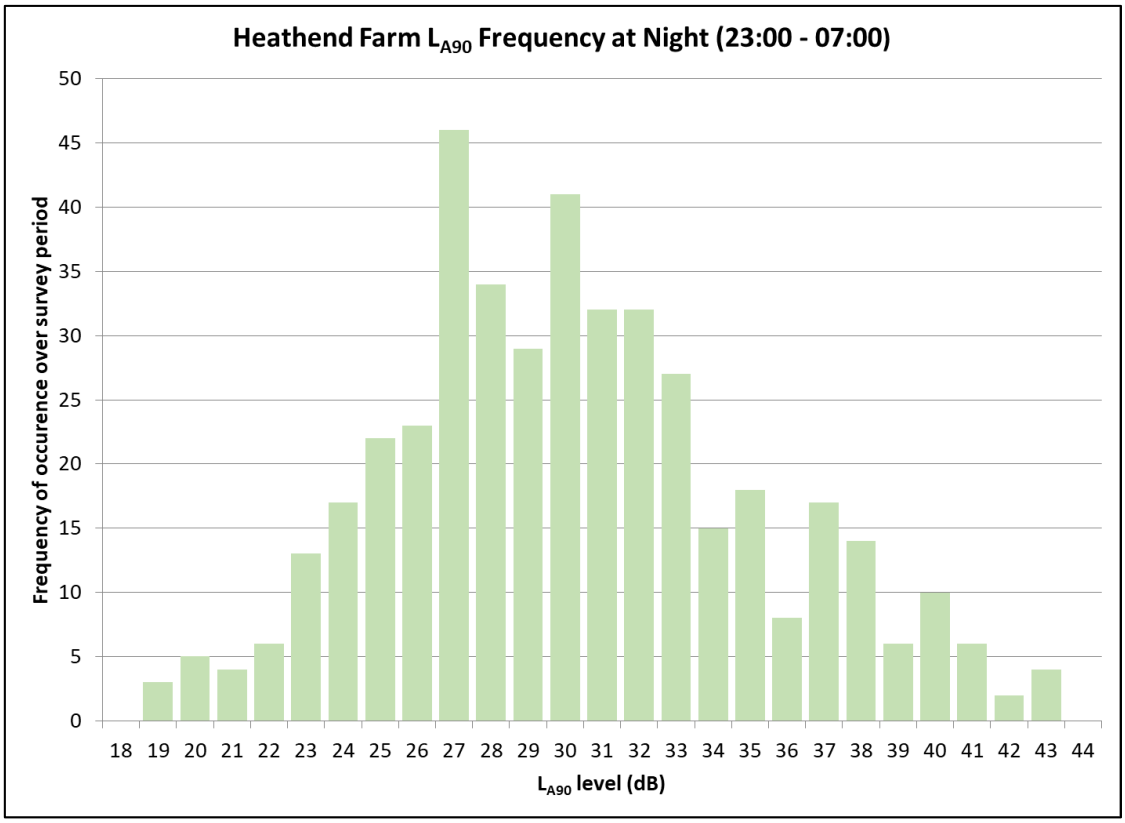


Figure 17 - Heathend Farm Night Frequency

3.32 The most frequently occurring background sound level during the full day period is 37 dB L_{A90}. This is slightly higher than the average L_{A90} of 36 dB L_{A90}, but from looking at the distribution in Figure 14 37 dB L_{A90} is a better representative background sound level for Heathend Farm during the full day period.

3.33 The most frequently occurring day-time background sound level was 37 dB L_{A90}. This corresponds to the average L_{A90} of 37 dB L_{A90}. Therefore, 37 dB L_{A90} is a good representative background sound level for Heathend Farm in the daytime.

3.34 The most frequently occurring evening background sound level was 33 dB L_{A90}. This corresponds to the average L_{A90} of 33 dB L_{A90}. Therefore, 33 dB L_{A90} is a good representative background sound level for Heathend Farm in the evening.

3.35 The most frequently occurring night-time background sound level is 27 dB L_{A90}. However, the average L_{A90} is 30 dB L_{A90} which corresponds to the second most frequently occurring background sound level in Figure 17. Furthermore, the majority of occurrences are above 27 dB L_{A90}, therefore, 30 dB L_{A90} is a better representative background sound level for Heathend Farm during the night.

4. CONCLUSION

4.1 A noise survey has been conducted at two residential locations around the proposed site in order to quantify representative background sound levels in accordance with BS4142.

4.2 The representative background sound levels in dB L_{A90} for the two properties during the full day period (0700-2300), daytime (0700-1900), evening (1900-2300) and night (2300-0700) are presented in Table 3.

Table 3 - Representative Background Sound Levels in dB L_{A90}

Property	Full day period (0700-2300)	Daytime (0700-1900)	Evening (1900-2300)	Night (2300-0700)
Varley Farm	35	36	34	32
Heathend Farm	37	37	33	30

APPENDIX C – FIGURES

Figure 1 – Predicted Specific Sound Footprint - Day
The L_{Aeq} descriptor has been used
Grid intervals at 1km
Red receiver icons indicate survey locations

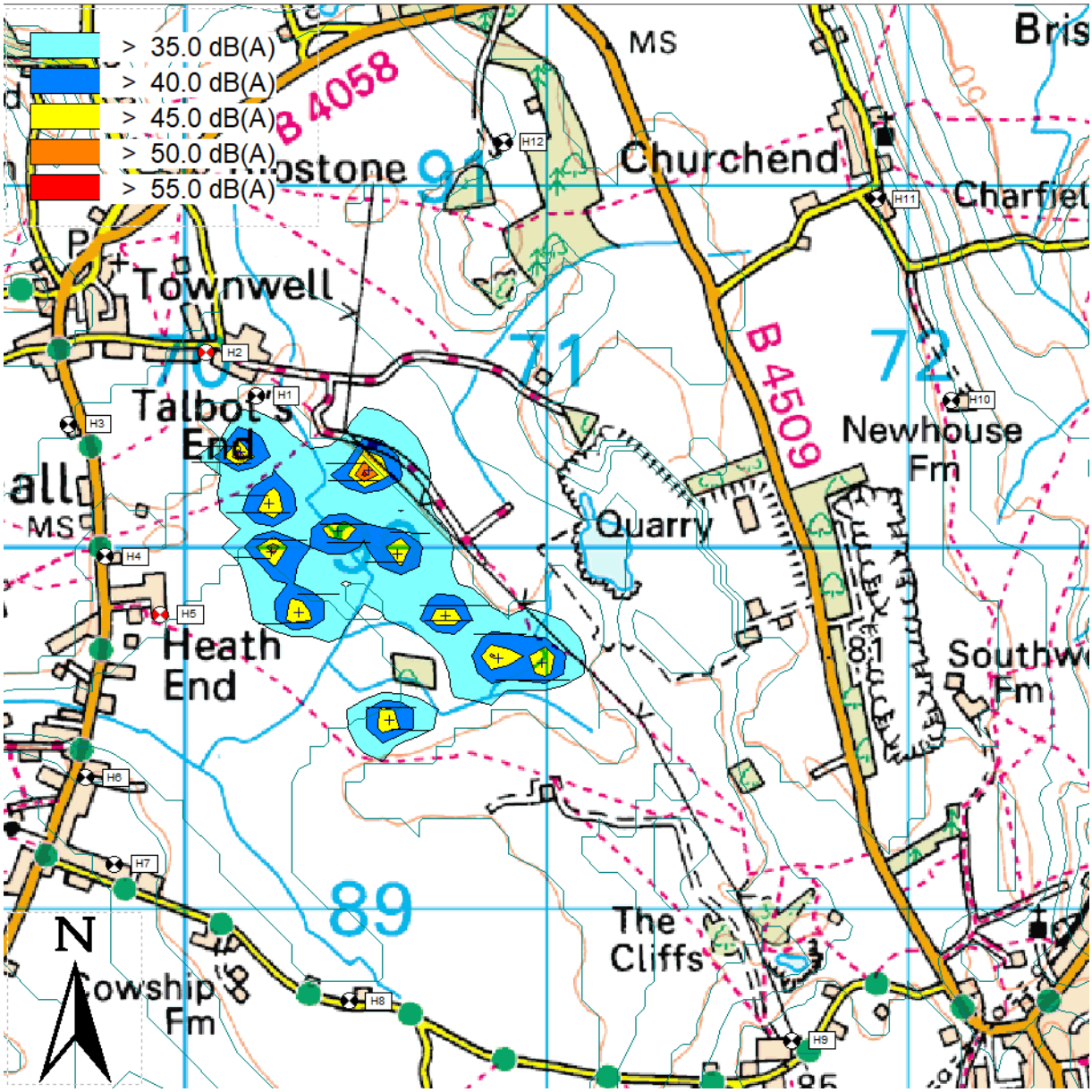
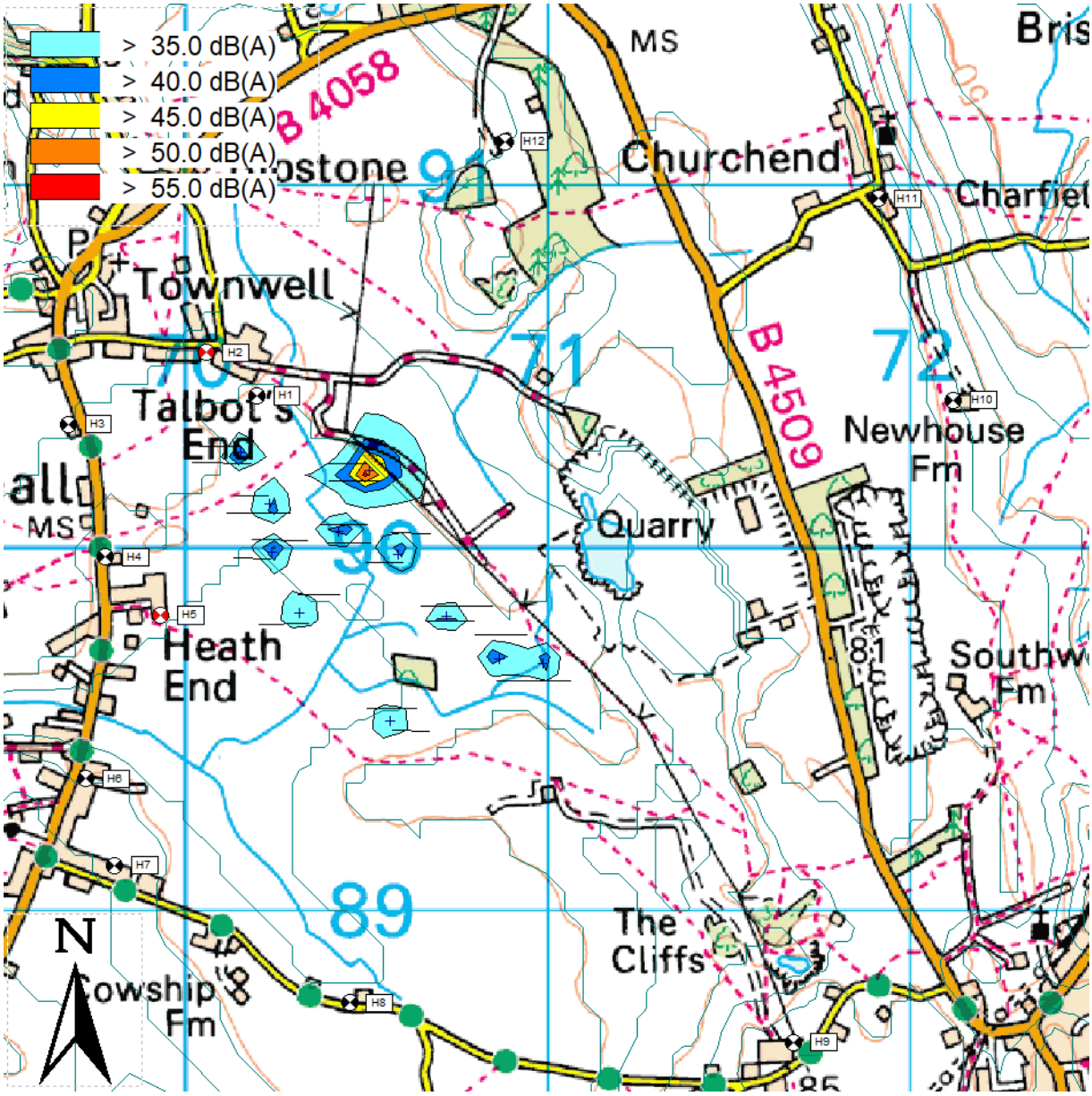


Figure 2 - Predicted Specific Sound Footprint - Night

The L_{Aeq} descriptor has been used
Grid intervals at 1km
Red receiver icons indicate survey locations



APPENDIX D – SUGGESTED PLANNING CONDITION WORDING

The 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 daytime, evening and night-time periods at the nearest residential properties (as identified in RES report 04886-4726443-01). The background sound levels shall be as detailed in RES Report 04886-4726443-01, or those obtained in an updated survey, whichever are greater.