Leaford Solar Farm

Acoustic Assessment

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Revision History

Issue	Date	Name	Latest Changes	File References
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Contents

1 Introduction

This report provides an acoustic assessment of the proposed Leaford Solar Farm and associated battery storage facilities, referred to as 'the Proposed Development' herein, in terms of operational sound. Three Members of the Institute of Acoustics (MIOA) have been involved in its production and details of their experience and qualifications can be found in **Appendix A**.

An assessment of the sound generated by the equipment installed as ancillary to the solar panels has been undertaken in accordance with BS 4142:2014 + A1:2019 'Methods for Rating and Assessing Industrial & Commercial Sound' with reference to documentation provided by the World Health Organisation (WHO) where necessary.

A survey of the existing background and ambient sound levels experienced at two properties neighbouring the development have been undertaken to inform the assessment and the results have been used as representative of other locations surrounding the site.

2 Planning Policy, Guidance & Standards

2.1 National Planning Policy Framework (NPPF)

The treatment of sound is defined in the context of planning 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 potential adverse effects of sound, stating that planning policies and decisions should aim to avoid sound giving rise to significant adverse impacts, whilst at the same time mitigating and reducing other adverse impacts on health and quality of life to a minimum. The NPPF refers to the Noise Policy Statement for England (NPSE) which provides guidance on the categorisation of impact levels.

2.2 Noise Policy Statement for England (NPSE)

The Noise Policy Statement for England (NPSE) [2] sets out the long-term vision of Government noise policy which is 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, the NPSE defines three categories of effect levels:

- 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 (NPPG): Noise

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

Table 1 - Noise Exposure Hierarchy

Response	Examples of Outcomes	Increasing Effect Level	Action
Not present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level (NOAEL)			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level (LOAEL)			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, 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 small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, 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
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

In addition to this guidance, which is applicable to all forms of environmental sound, specific guidance relating to nationally significant energy infrastructure has been published by the Department for Energy Security & Net Zero (DESNZ). Whilst the proposed development is not of a scale that would be deemed nationally significant, the relevant National Policy Statements (NPS) are informative in that they suggest an assessment methodology that would be considered appropriate for the type of development being proposed.

2.4 The Overarching National Policy Statement for Energy (EN-1)

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 system. However, when referring to the NPSE, EN-1 recognises the potential for energy infrastructure to impact on health and quality of life if it results in excessive sound and goes on to state that where impacts are likely to arise, they should be assessed according to the principles of the relevant British Standards. Of the examples provided, the standards BS 4142 and BS 8233 (discussed below) relate to operational sound/noise.

2.5 National Policy Statement for Renewable Energy Infrastructure (EN-3)

The National Policy Statement for Renewable Energy Infrastructure (EN-3) [5] refers back to EN-1 for the purposes of addressing sound impacts from renewable energy development on sensitive residential locations and provides additional general advice as to potential mitigation measures for additional specific instances.

2.6 The National Policy Statement for Electricity Networks Infrastructure (EN-5)

The National Policy Statement for Electricity Networks Infrastructure (EN-5) [6], 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 (discussed at **Section 2.8**) in assessing the operational acoustic impact of such projects.

2.7 National Policy Statements for Energy - Appraisal of Sustainability - Main Report

Appendix C of the National Policy Statements for Energy - Appraisal of Sustainability - Main Report [7] provides an overview of relevant planning policy, guidance and documentation applicable to the UK in general and provides an interpretation of the NPSE stating that the *"… NPSE considers that the noise levels above the SOAEL would be seen to have, by definition, significant adverse effects and would be considered unacceptable. Where the assessed levels fall between the LOAEL and the SOAEL the policy statement requires that: all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur but that efforts should be focused on minimising such effects. Where levels are below the LOAEL it is considered there will be no adverse effect. Once the levels are below the NOEL there will be no observable change. For the present guidance a numerical definition of*

LOAEL is given by the WHO Guidelines for Community Noise and BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings". This indicates that, where proposals can meet the requirements of BS 8233 and the WHO, adverse impacts would be avoided.

2.8 BS 4142 Methods for Rating and Assessing Industrial & Commercial Sound

BS 4142 [8] 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 via the comparison of the pre-existing background levels with the predicted/modelled sound levels associated with the introduction of a particular development, known as the 'rating' level, which also accounts for any distinguishing characteristics of the emitted sound.

To determine a value for the background sound level at a specific assessment point, a series of measurements are made at a location at, or representative of, a dwelling or receptor of interest. The standard requires that that the background sound measurements (dB $L_{A90,\,T}$ – the sound level exceeded for 90% of the time, or the lowest 10 % of sound, for the reference time period, T) should be measured during times when the sound source in question could or will be operating and that the individual measurement intervals should not normally be less than 15-minuites in length. The objective is then to determine a justifiable representative background sound level for time periods of interest via statistical analysis and/or observations of the data set collected. The standard states that the representative background sound level *"… should not automatically be assumed to be either the minimum or modal value".*

The 'rating' level is defined as the 'specific' sound level (dB L_{Aeq} – the average sound level) plus any corrections for the presence tones (i.e. whines, whistles or hums) or other impulsive character (i.e. banging, crashing or tapping) in the sound generated by the source in question. In instances where the source is unlikely to have a specific character at the assessment location then the 'rating' level can be assumed to equal to the 'specific' sound level. Where tones are present a correction of 2 to 6 dB can be added to the 'specific' sound level to determine the 'rating' level and a further addition of up to 9 dB maybe added where the source is highly impulsive.

The defined representative background sound level(s) and rating level(s) are then compared to determine the possible impact but with consideration of the context in which the industrial or commercial sound source to be introduced presents itself in respect of other sound sources and the existing character of the area. **Table 2** provides a summary of expected impacts when comparing background and rating levels.

Table 2 – BS 4142 Assessment Criteria

Rating Level	BS 4142 Assessment Criteria
Equal to or below background	*"…an indication of the specific sound source having a low impact, depending on the context".*
Approximately +5 dB greater than the background noise level	*"…an indication of an adverse impact, depending on the context".*
Approximately +10 dB or more greater than the background noise level	*"…an indication of a significant adverse impact, depending on the context".*

Further to the above, it may not be appropriate or proportionate to undertake a full assessment in accordance with the BS 4142 standard, particularly when the sound level associated with the new source is particularly low at neighbouring receptors and/or is expected to be much lower than the existing background levels. The previous version of BS 4142 [9] stated that this version of the standard is not appropriate for use in instances where background and rating sound levels are very low and that background sound levels *"…below about 30 dB and rating levels below about 35 dB are considered to be very low"*.

2.9 World Health Organisation (WHO)

The WHO document Guidelines for Community Noise [10] provides guideline values on overall desirable internal and external sound levels for a variety of situations which are intended to minimise health impacts for certain environments. The guidance informs much of the standards and guidance relating to the protection of external and internal amenity in relation to the impacts of sound on residences such as BS 8233 (as discussed at **Section 2.10**).

The guidelines state that overall internal night-time sound levels should not be above 30 dB L_{Aeq} within bedrooms such that people may sleep with minimal disturbance while the windows are open and it is stated that this corresponds to an external night-time level of 45 dB L_{Aeq}, when assuming a 15 dB attenuation in levels externally to internally. Furthermore, the guidance recommends that daytime external sound levels should not exceed 50 dB L_{Aeq} to protect the majority of people from being moderately annoyed.

The Night Noise Guidelines for Europe [11] are described as complementary to the Guidelines for Community Noise and recommend a limit of 40 dB L_{night}, outside. This is a yearly average night-time sound level which could potentially be exceeded on some nights of the year such that it is not necessarily inconsistent with the Guidelines for Community Noise if the sound levels do not exceed 45 dB L_{Aeq} on those nights.

The WHO Environmental Noise Guidelines for the European Region [12] was published in 2018 and provides *"… recommendations for protecting human health from exposure to environmental noise originating from various sources: transportation (road traffic, railway and aircraft) noise, wind turbine noise and leisure noise"* and make a series of strong or conditional exposure recommendations for each based on the weight of evidence available at the time the report was being drafted. The document does not consider sound from industrial sources as the specific features of these sources are usually very localised and vary between different kinds of development.

2.10 BS 8233 Guidance on Sound Insulation and Noise Reduction for Buildings

BS 8233 [13] provides guidance on the control of sound for new buildings or those undergoing refurbishment rather than providing guidance on assessing the effect of changes in external sound levels on occupants of existing buildings. The document provides a range of desirable internal average levels for dwellings which may be achieved via appropriate design where necessary. The levels are provided at Table 3 for reference and include additional detail as provided within the ProPG: Professional Practice Guidance on Planning & Noise document discussed below.

2.11 ProPG: Professional Practice Guidance on Planning & Noise

The ProPG: Professional Practice Guidance on Planning & Noise document [14], similarly to BS 8233, is intended to provide guidance in terms of assessment and design of new or newly refurbished housing development in terms of pre-existing airborne sound sources impacting on them (typically from transportation) and the requirements to achieve a suitable internal sound environment for potential inhabitants. **Table 3** shows the desirable internal sound levels referenced within BS 8233 for reference and with the additional detail and notes the ProPG provides.

Table 3 - Internal Noise Criteria

Activity	Location	Daytime	Night-time
		07:00 - 23:00 hrs	23:00 - 07:00 hrs
Resting	Living room	35 dB $L_{Aeq,\ 16\ hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,\ 16\ hr}$	-
Sleeping	Bedroom	35 dB $L_{Aeq,\ 16\ hr}$	30 dB $L_{Aeq,\ 8\ hr}$ 45 dB $L_{Amax,F}$ (Note 4)

NOTE 4: Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values. In most circumstances in noise sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45 dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events (see Appendix A).

These guideline internal sound values specified are based on values specified within the Guidelines for Community Noise, published by the World Health Organisation (WHO) [10].

2.12 Local Guidance & Consultation

Staffordshire Borough Council (SBC) published 'Planning Application Validation Guidance and Local Validation Criteria' [15] in September 2021. The document provides general guidance as to information that should support planning applications in general terms. In respect of sound, reference is made to policy in place at the time the document was drafted and various applicable standards relating to the assessment of sound generating development. Those relevant to the assessment provided herein are discussed above.

SBC Environmental Health Department were consulted as to the potential to supply an assessment on a simplified basis (i.e. against fixed limits with reference to WHO/BS 8233 guidelines). This was on the basis the existing environment would be dominated by sound associated with traffic flowing along the nearby A50 at many residences nearest the site and that certain dwellings, most sensitive to sound associated with the Proposed Development, would have a direct financial involvement with the proposals. However, on balance, it was considered that, whilst the suggested approach might be applicable to daytime periods, existing night-time ambient and background sound levels may be low enough to warrant a survey. As a result, a full BS 4142 assessment has been supplied herein but with further reference to WHO guidance and BS 8233 to provide further context where necessary.

There was no objection to the general principle of potentially relaxing criteria/requirements in instances where certain properties would benefit directly from the operation of the Proposed Development.

3 Baseline Environment

3.1 Sensitive Receptors

There a several conurbations surrounding the Proposed Development with some scattered dwellings located in closer proximity to the site. A list of locations considered representative of that located closest the Proposed Development is provided in **Table 4** below with some of these representing small groups of dwellings. These locations are also shown in **Figure 1, Section 5**.

Table 4 - Assessment Locations

House Name / Description	ID	Co-ordinates (OSGB)	
		Easting	Northing
Little Leacroft Farm (FI)	H1	395582	339612
Residences	H2	395556	339907
Leacroft Hall	H3	396031	339027
Fulford Hall Farm (FI)	H4	395371	338410
Residence	H5	396315	338429
Residences	H6	395375	340007
Residence	H7	396100	339020

3.2 Existing Sources of Sound

The current environment at properties surrounding the site consists of sound associated with vehicle movements along local roads and the A50, with variations in existing ambient and background sound levels that depend on the time of day and relative proximity of dwellings in relation to the A50. Other sources of existing sound, which are considered typical of a rural environment, include farm stock, farm works and activities, localised human and animal activities, birdsong and occasional aircraft passing overhead.

The survey information described below shows a diurnal variation in sound levels that is consistent with sources noted here.

3.3 Existing Sound Levels

A survey of the existing background and ambient sound levels was undertaken at two locations neighbouring the Proposed Development, with the result being intended to inform the baseline/background and ambient sound levels at other locations.

The measurements were made at Little Leacroft and Fulford Hall farms, with the measurements from the former being intended to represent other dwellings located to the north of this residence and the latter being representative of dwellings located to the south of Little Leacroft Farm. In both instances this approach is considered to represent a conservative basis of assessment as all other properties are in closer proximity to the A50, which is generally the dominant source of existing background and ambient/residual sound in the area.

Sound level meters (SLMs) were installed at the properties between the 12th and 19th October 2023 with the equipment setup to collect average ambient (dB L_{Aeq}) and background (dB L_{A90}) levels in 15-minute intervals, including various other statistical parameters, throughout the week-long survey period. The equipment was housed with appropriate outdoor protections and uprated microphone wind shields. The microphones were placed at a height approximately 1.3 m above the ground.

The sound level meter (SLM) at Little Leacroft Farm was placed on the side of the house facing the Proposed Development, approximately 3.5 meters from the nearest building façade and where sound associated with plant located on the farm buildings on the other side of the residence were not audible.

The Fulford Hall Farm SLM was placed to the rear of the farm, at least 10 m from the nearest building façade and in a sheltered location considered to be least affected by farm works such that the collected data could be considered representative of other properties in the area.

The measurement setup at each survey locations are shown in **Appendix B** of this report.

A meteorological station was positioned beside the Little Leacroft Farm measurement location which obtained wind speed and precipitation information throughout the survey period for the same time intervals such that the data collected at both locations may be readily filtered to remove any data considered to be affected by adverse weather conditions and/or sound associated with the pattering of rain on the measurement equipment and its surroundings.

The sound level meters used for the measurement campaign, corresponding serial numbers and calibration records are shown in **Table 5**.

Table 5 - Instrumentation Records

Location	Little Leacroft Farm	Fulford Hall Farm
Type	Rion NL-52	Rion NL-52
Serial No.	00732101	00231668
Calibration Certificate No.	UCRT23/1688	UCRT23/1113
Date of Issue	22/05/2023	24/01/2023
Microphone Serial No.	05286	04713
Preamp Serial No.	32129	21612
Calibrator Type	Rion NC-75	
Calibrator Serial No.	34235944	
Calibrator Cert. No.	UCRT23/1022	

The sound level meters were field calibrated at the start of the measurement period and checked at the end, with no substantive drift in the calibration level found at either location.

The internal clocks of all measurement equipment were set to local time (British Summer Time, BST) and no significant drift in time was found at the end of the survey period when the equipment was removed.

The data sets were filtered to remove periods where measured wind speeds were above 5 $m.s^{-1}$ and where any precipitation was detected during any 15-minute measurement period.

During the survey the wind turned from the typical prevailing south-westerly direction to an easterly direction, significantly increasing levels associated with traffic movements along the A50 due to the change in propagation conditions. As a result, all data collected from 16th October, where the easterly wind directions occurred, have been filtered out of the data sets collected at both measurement locations.

The data collected form Fulford Hall Farm has been further filtered to remove any data obviously affected by noisy farm works undertaken at the farm during the survey. This typically occurred during normal working hours.

The adopted background sound levels (dB L_{A90}) have been determined from modal analysis and observations of the remaining data sets collected during daytime (07:00 – 23:00) and night-time (23:00 – 07:00) periods respectively at both measurement locations. The ambient/residual sound levels (dB L_{Aeq}) have been determined by calculating the median daytime and night-time values from the filtered data set.

Figures showing the collected data sets and background and ambient/residual sound analysis are provided within **Appendix C** of this report. The results are summarised in **Table 6**.

Table 6 – Derived Existing Background & Ambient Sound Levels

Name	ID	Background Sound Level, dB L_{A90}		Ambient Sound Level, dB L_{Aeq}	
		Daytime	Night-time	Daytime	Night-time
Little Leacroft Farm	H1	40	32	44	34
Fulford Hall Farm	H4	35	30	41	35

4 Predictions

A model of the proposed solar farm, battery storage facilities and the surroundings has been developed using CadnaA[1] software. The ISO 9613-2 [16] propagation/prediction methodology has been employed to predict the sound levels resulting from the development at nearby residential properties, incorporating various assumptions and factors which are considered appropriate for use here:

- The various plant to be installed as part of the development has been modelled as point sources with a height of 1.5 m and these sources are assumed to be operating at their near maximum potential output for all time periods as a conservative basis of assessment;
- Soft ground conditions have been assumed (i.e. G=1) as representative of the farmland surrounding the Proposed Development. The ISO 9613-2 standard allows for a range of ground conditions to be applied, from porous ground conditions (G=1), which includes surfaces suitable for the growth of vegetation (i.e. farmland), to hard ground (G=0), such as paving, water and concrete;
- The receptors have been assigned a height of 1.5 m;

[1] https://www.datakustik.com/

- Atmospheric attenuation corresponding to a temperature and relative humidity of 10 ˚C and 70 % respectively, as defined within ISO 9613-1 [17], which represents relatively low levels of sound absorption in the atmosphere;
- The topography of the site and surroundings has been included; and,
- The photovoltaic panels to be introduced as part of the development have also been included within the model. This provides some shielding of sound generated by the equipment to be installed at the Proposed Development where certain panels are located directly between residences and the respective plant.

Furthermore, ISO 9613-2 is a downwind propagation model. Where conditions less favourable to sound propagation occur, such as when the assessment locations are upwind of the Proposed Development, the sound levels would be expected to be less and the downwind predictions presented as part of this report would be regarded as conservative, i.e. greater than those likely to be experienced in practice.

The predominant sources of sound to be introduced as part of the Proposed Development are the ancillary inverters (PCS units), transformers and dual DC battery storage containers attached to the photovoltaic panels, as located at several positions across the developable area.

The site has been designed on an iterative basis with a view to minimising, as far as practicably possible, the projected operational sound levels with due regard to the relative sensitivity of neighbouring premises and all other site constraints.

The assumed sound power data for the equipment to be installed as part of the Proposed Development are provided in **Table 7**. The overall levels correspond to the near maximum expected sound output for each of the respective plant, as advised by a candidate manufacturer. The propagation modelling therefore represents a relatively conservative scenario and actual sound levels would be expected to be less when the site is not operating at this capacity.

Table 7 - Overall Sound Power Levels, dB L_{WA}

Equipment & ID	Sound Power Level, dB L_{WA}
Battery Energy Storage System (BESS)	83
Power Conversion System (PCS)	93
Transformer (TRA)	79
Substation (SUB)	90

The source data is further supplemented by the level of sound in octave bands, as provided in **Table 8**. This information is based on a combination of manufacturers data and RES experience of similar plant.

Table 8 - Octave Band Sound Power Levels, dB L_{WA}

ID	Overall, dB L_{WA}	Centre of Octave Band (A-Weighted), Hz							
		63	125	250	500	1k	2k	4k	8k
BESS	83	71	75	76	76	78	73	63	56
PCS	93	67	77	88	85	86	84	81	75
TRA	79	56	68	70	76	73	69	64	55
SUB	90	67	79	81	87	84	80	75	66

The combination of assumptions detailed above are considered to provide a conservative prediction/modelling basis overall. The various equipment has been located at the associated hard standings relating to each inverter/transformer/battery combination. The results of the predictions at the various residences surrounding the Proposed Development are shown at **Section 5**.

The sound emitted by the various equipment to be introduced as part of the Proposed Development can have distinctive tonal character (i.e. a whine, whistle or hum). Under the subjective method described in BS 4142, a correction of 2 dB has been applied to account for this feature. However, the assessed specific and rating sound levels detailed in **Section 5** are particularly low and potential tonal character in the sound emitted from the various plant may well be masked by existing sources of sound in the area.

5 Assessment

The predicted specific sound and corresponding rating levels (i.e. including for a 2 dB penalty for tonal character) at the most sensitive properties located nearest to the Proposed Development are shown in **Table 9** for daytime and night-time periods respectively. The rating level is compared to the background sound levels detailed in **Section 3.3** to provide the associated impact at each location.

The background and ambient sound levels determined from survey data collected at Little Leacroft Farm has been used to represent this location and properties to the north, where existing background/ambient sound levels are likely to be higher due to the closer proximity of the surrounding road network. The remaining locations are represented by the values determined for Fulford Hall Farm, which is also likely to have lower background/ambient sound level than that experienced at the other properties, again due to the relative proximity of the wider road network.

The resultant impact is described as ‘low’ if the rating level is less than or equal to the background sound level; ‘minor’ if not more than 5 dB above; ‘moderate’ if not more than 10 dB above and major if more than 10 dB above. These criteria compare to the categories defined by the NPSE, with rating levels less than or equal to background sound level representing the NOAEL, 5 dB above background representing the LOAEL and 10 dB above background the SOAEL.

Table 9 - BS 4142 Assessment

House ID	Specific Level, dB L_{Aeq}	Rating Level, dB L_{Ar}	Background Level, dB L_{A90}	L_{Ar} - L_{A90}, dB	Potential Impact
			Daytime		
H1	31	33	40	-7	Low
H2	28	30	40	-10	Low
H3	30	32	35	-3	Low
H4	25	27	35	-8	Low
H5	24	26	35	-9	Low
H6	24	26	40	-14	Low
H7	29	31	35	-4	Low
			Night-time		
H1	31	33	32	1	Minor
H2	28	30	32	-2	Low
H3	30	32	30	2	Minor
H4	25	27	30	-3	Low
H5	24	26	30	-4	Low
H6	24	26	32	-6	Low
H7	29	31	30	1	Minor

The assessment indicates that the predicted impact from the Proposed Development at the nearest neighbouring residences is low for daytime periods and low-to-minor for night-time periods.

In all instances the predicted specific and rating sound levels are low, to the point at which the 1997 version of BS 4142 considered the standard was not appropriate for use (see **Section 2.8**). As a result, a further assessment has been undertaken by comparing the overall expected overall external and internal ambient sound levels with guidance provided by the WHO (see **Section 2.9**) and criteria supplied within BS 8233 (see **Section 2.10**) to provide further context and basis of assessment.

The predicted specific sound levels due to the Proposed Development shown in **Table 9** are added to the adopted ambient/residual sound levels for daytime and night-time periods to determine the total external ambient sound level during daytime periods at each residence. The projected internal levels for daytime and night-time periods are determined by assuming a 15 dB reduction externally to internally, as assumed within the guidance provided by the World Health Organisation (WHO).

The resultant levels, as shown in **Table 10**, indicate that overall daytime and night-time sound levels do not exceed the WHO/BS 8233 external and internal criteria (i.e. 50 & 45 dB L_{Aeq} externally and 35 & 30 dB L_{Aeq} internally for daytime and night-time periods respectively).

An illustrative sound footprint for the proposed development showing the predicted rated sound level (dB L_{Ar}) is provided in **Figure 1**.

Figure 1 - Rating Sound Level Contour Plot, dB L_{Ar}

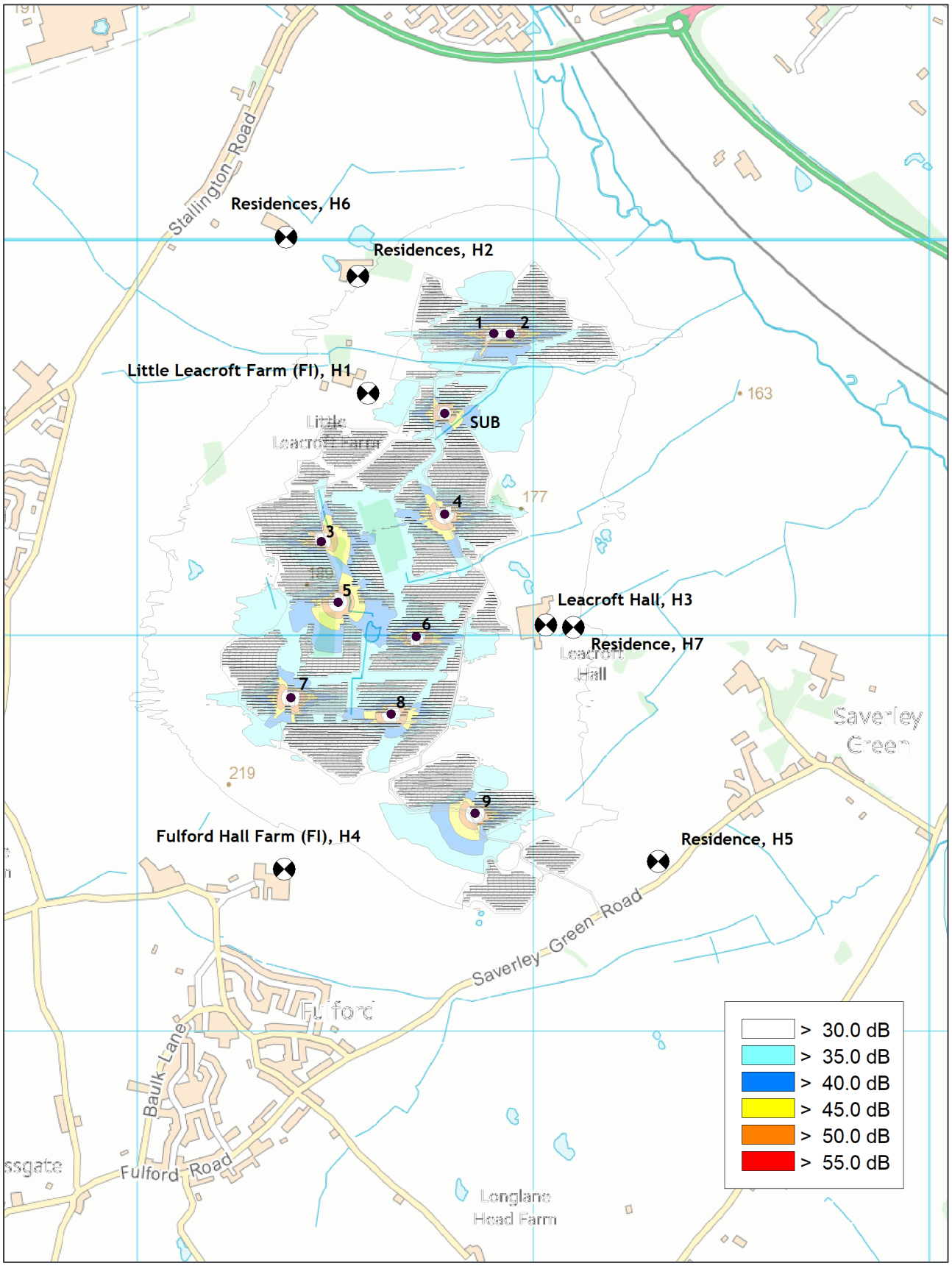


Table 10 - WHO & BS 8233 Assessment

House ID	Specific Level, dB L_{Aeq}	Existing Ambient Sound Level, dB L_{Aeq}	Total External Ambient Sound Level, dB L_{Aeq}	Total Overall Internal Sound Level, dB L_{Aeq}
Daytime				
H1	31	44	44	29
H2	28	44	44	29
H3	30	41	41	26
H4	25	41	41	26
H5	24	41	41	26
H6	24	44	44	29
H7	29	41	41	26
Night-time				
H1	31	34	36	21
H2	28	34	35	20
H3	30	35	36	21
H4	25	35	35	20
H5	24	35	35	20
H6	24	34	34	19
H7	29	35	36	21

Overall, in this context and based on the modelling assumptions and assessment results presented, the sound emitted by the Proposed Development can be considered 'present and not intrusive' in terms of government policy and guidance provided within the NPSE & NPPG (see **Sections 2.2 & 2.3** respectively). This corresponds to the 'No Adverse Observed Effect Level' (NOAEL) and no further specific action, over and above that already considered, is required to further mitigate operational sound associated with the introduction of the Proposed Development.

The wording for a suggested planning condition that would restrict noise/sound associated with the introduction of the Proposed Development, should the site gain planning consent, is provided in **Appendix D**.

6 Conclusions

An acoustic assessment of the proposed Leaford Solar Farm and associated battery storage facilities has been undertaken. The results show that sound levels resulting from the operation of the site will be low in the context of relevant assessment criteria (i.e. BS 4142, BS 8233 and that provided by the World Health Organisation), can be considered 'present and not intrusive' in terms of government policy and guidance provided within the NPSE & NPPG and no significant effects are anticipated as a result.

7 References

[1] Department for Levelling Up, Housing and Communities (September 2023) National Planning Policy Framework

[2] Department for Environment, Food and Rural Affairs (March 2010) Noise Policy Statement for England

[3] Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government (July 2019) National Planning Practice Guidance: Noise

[4] Department for Energy Security & Net Zero (November 2023) Overarching National Policy Statement for Energy (EN-1)

[5] Department for Energy Security & Net Zero (November 2023) National Policy Statement for Renewable Energy Infrastructure (EN-3)

[6] Department for Energy Security & Net Zero (November 2023) National Policy Statement for Electricity Networks Infrastructure (EN-5)

[7] Department for Energy Security & Net Zero (November 2023) National Policy Statements for Energy Appraisal of Sustainability - Main Report

[8] British Standards Institution (2019) BS 4142:2014 + A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound

[9] British Standards Institution (1997) BS 4142:1997 Rating Industrial Noise Affecting Mixed Residential and Industrial Areas

[10] World Health Organisation (2000) Guidelines for Community Noise

[11] World Health Organisation (2009) Night Noise Guidelines for Europe

[12] World Health Organisation (2018) Environmental Noise Guidelines for the European Region

[13] British Standards Institution (2014) BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

[14] Association of Noise Consultants, Institute of Acoustics & Chartered Institute of Environmental Health (2017) 'ProPG: Planning & Noise: Professional Practice Guidance on Planning & Noise: New Residential Development'

[15] Staffordshire Borough Council (September 2021) Planning Application Validation Guidance and Local Validation Criteria

[16] International Organisation for Standardisation (December 1996) ISO 9613-2:1996 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation

[17] International Organisation for Standardisation (June 1993) ISO 9613-1:1993 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 1: Calculation of the Absorption of Sound by the Atmosphere

Appendix A – Experience & Qualifications

Table A.1 - Author

Name	Mike Craven
Experience	Senior Acoustic Specialist, Renewable Energy Systems (RES), 2023-Present Principal Acoustic Consultant, Hayes McKenzie Partnership Limited (HMPL), 2019-2022 Senior Acoustic Consultant, HMPL, 2013-2019 Acoustic Consultant, HMPL, 2011-2013 Acoustic Consultant, URS/Scott Wilson, 2008-2011 Acoustic Consultant, HMPL, 2004-2008
Qualifications	MIOA, Member of the Institute of Acoustics BSc Audio Technology, University of Salford

Table A.2 - Checker

Name	Peter Brooks
Experience	Acoustics Team Lead, Renewable Energy Systems, 2023-Present Senior Acoustic Analyst, Renewable Energy Systems, 2022-2023 Acoustic Consultant, Arcus Consultancy Services, 2021-2022 Director, 343 Acoustics, 2019-2021 Lead Acoustic Engineer, Tymphany, 2017-2019 Research and Development Engineer, SEAS Fabrikker, 2014-2017 Acoustic Engineer, Premium Sound Solutions, 2011-2013
Qualifications	MIOA, Member of the Institute of Acoustics PGCert Environmental Acoustics, University of Salford BSc (Hons) Audio Technology, University of Salford

Table A.3 - Approver

Name	Dr Jeremy Bass
Experience	Head of Specialist Services/Senior Technical Manager, RES, 2000-Present Technical Analyst/Senior Technical Analyst, RES, 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 – Measurement Locations

Figure B.1 - Little Leacroft Farm Measurement Location

Figure B.2 - Fulford Hall Farm Measurement Location

Appendix C – Survey Data & Analysis

Figure C.1 - Little Leacroft Farm Time Series

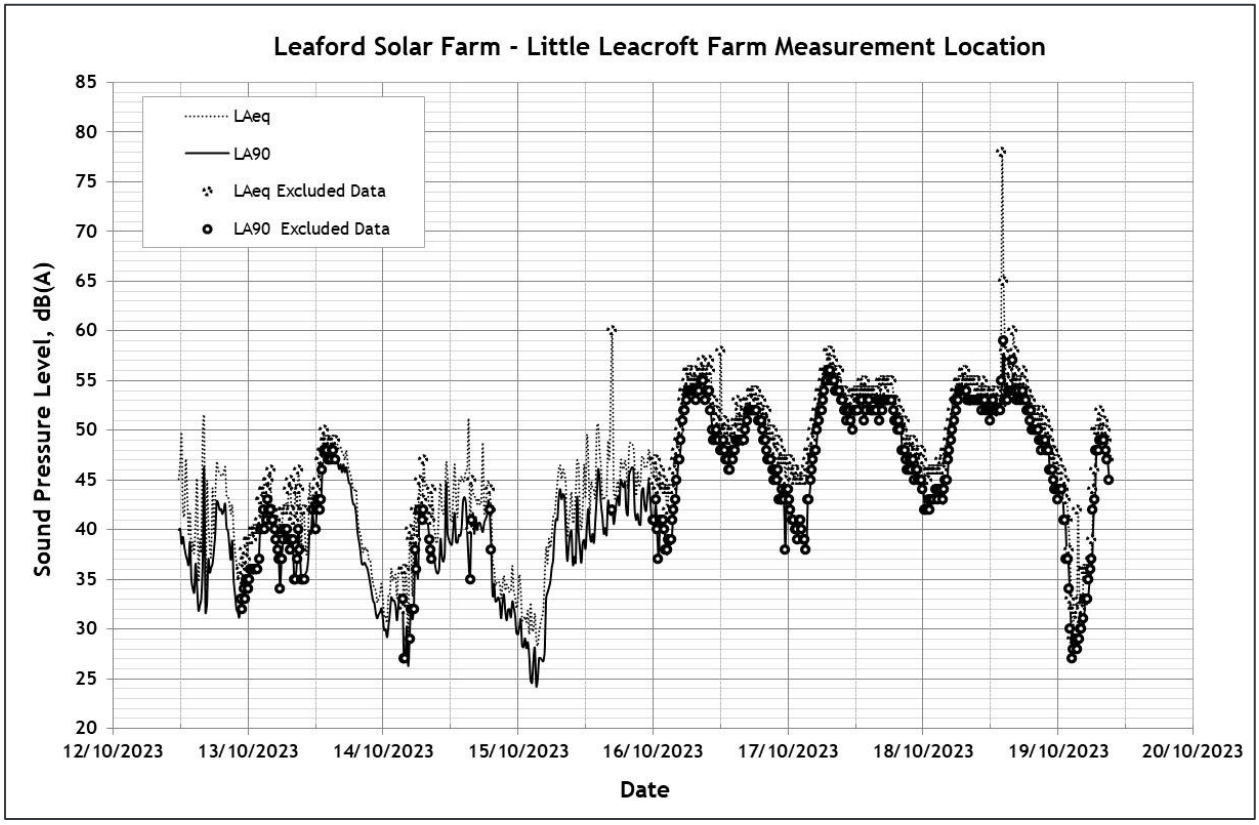


Figure C.2 - Little Leacroft Farm Data Analysis - All Data

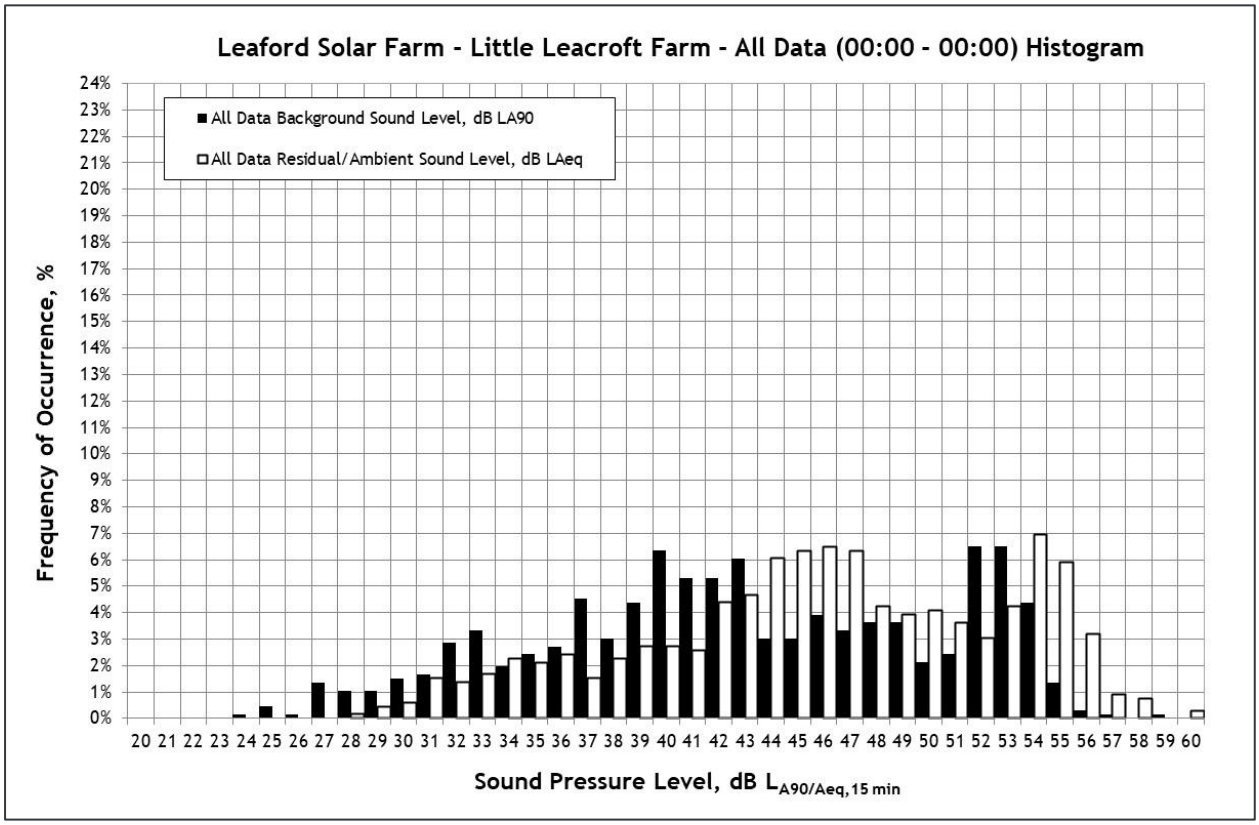


Figure C.3 - Little Leacroft Farm Data Analysis - Daytime

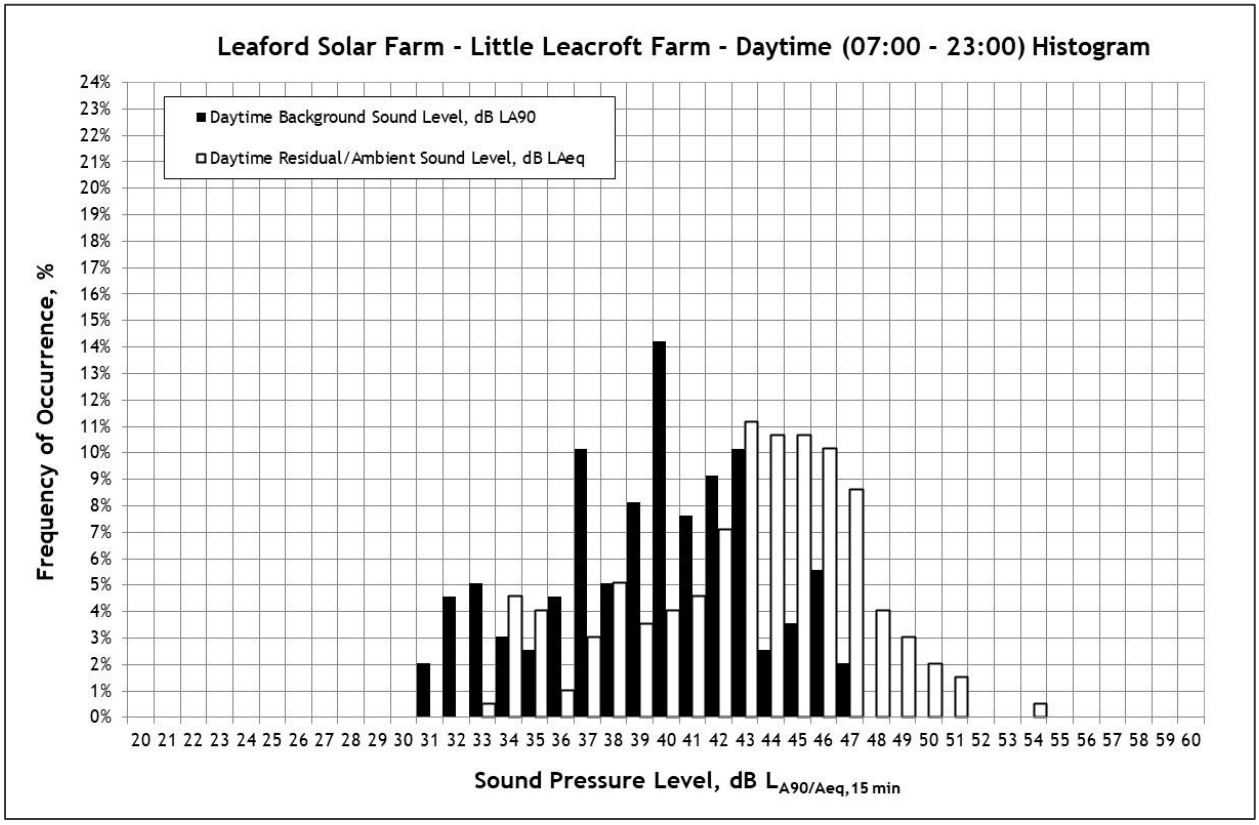


Figure C.4 - Little Leacroft Farm Data Analysis - Night-time

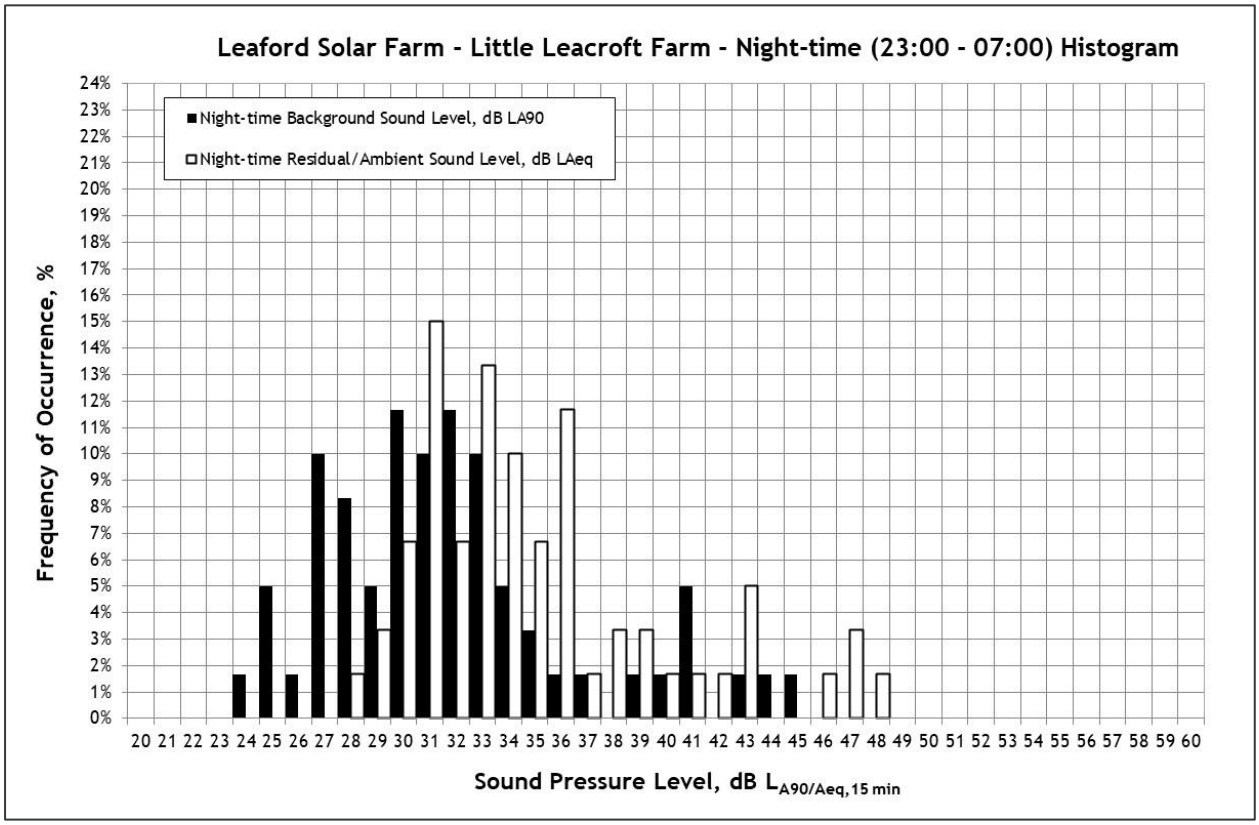


Figure C.5 - Fulford Hall Farm Time Series

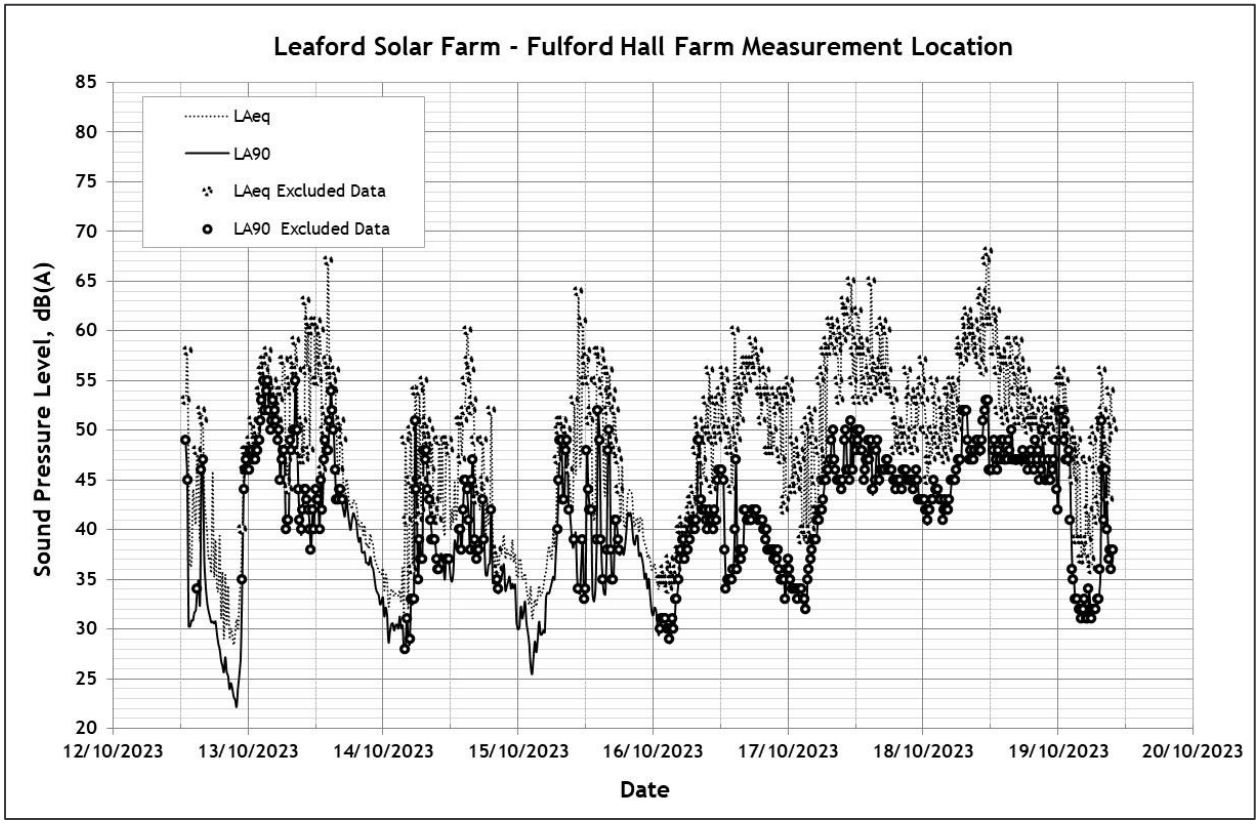


Figure C.6 - Fulford Hall Farm Data Analysis - All Data

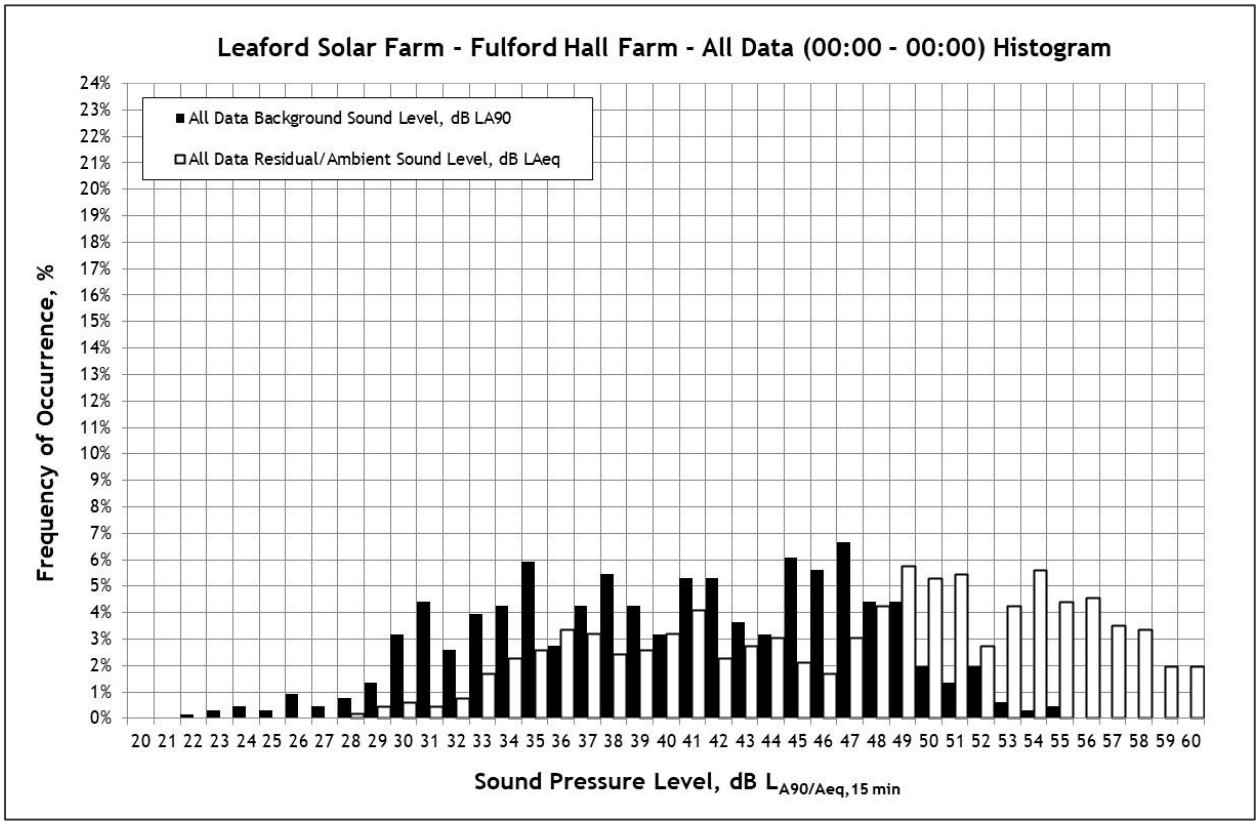


Figure C.7 - Fulford Hall Farm Data Analysis - Daytime

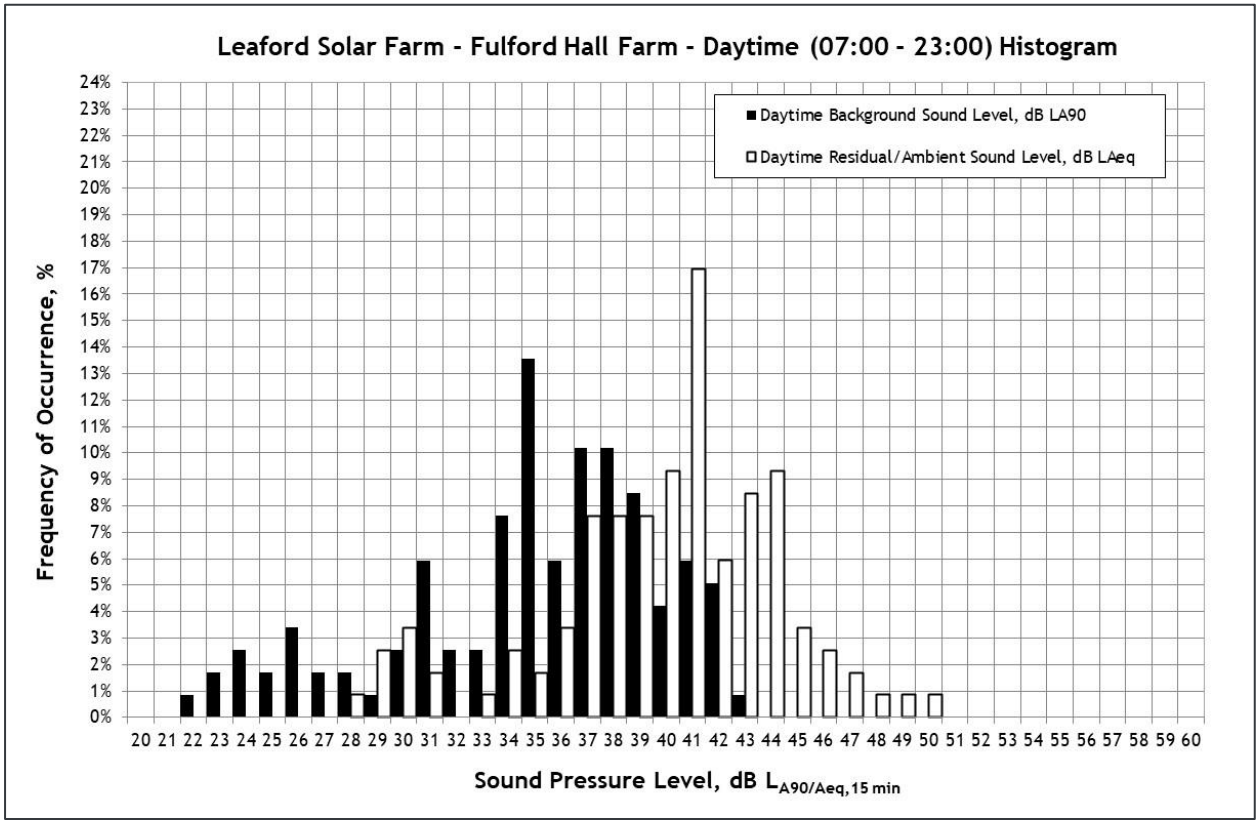
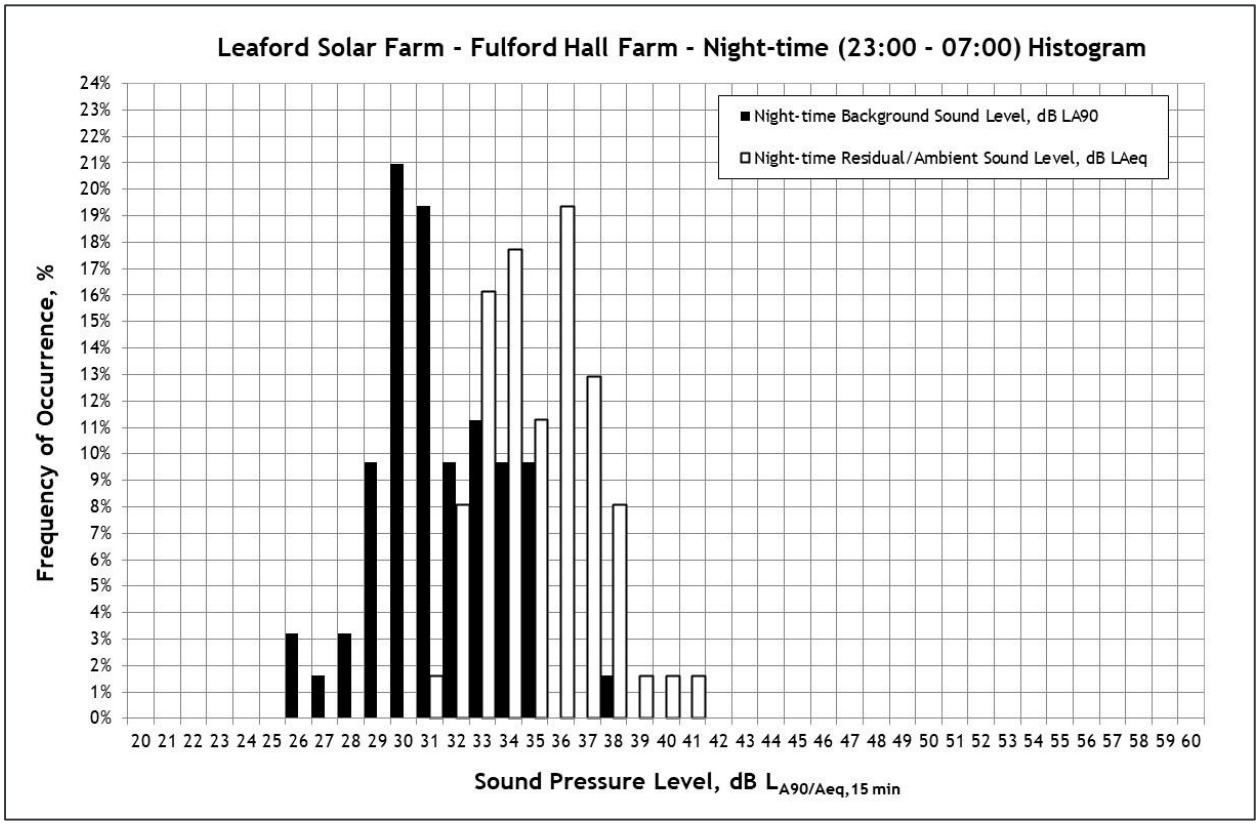


Figure C.8 - Fulford Hall Farm Data Analysis - Night-time



Appendix D – Suggested Planning Condition Wording

The solar farm shall be designed and operated to ensure that the rating sound level, determined using the BS 4142:2014 methodology external to a property, shall not exceed 40 dB L_{Ar} or the background sound level plus 5 dB, whichever is the greater, for both daytime and night-time periods.