Dean Moor
Solar Farm

Environmental Statement: Appendix 2.6 – Noise and Vibration Impact Assessment

on behalf of **FVS Dean Moor Limited**

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DEAN MOOR SOLAR FARM

ENVIRONMENTAL STATEMENT

APPENDIX 2.6 – NOISE AND VIBRATION IMPACT ASSESSMENT

PLANNING INSPECTORATE REFERENCE EN010155

PREPARED ON BEHALF OF FVS DEAN MOOR LIMITED

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009, Regulation 5(2)(a)

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1 Introduction

1.1 Background

1.1.1 This Noise and Vibration Impact Assessment (hereafter referred to as 'NIA') has been prepared to support the DCO application in relation to Dean Moor Solar Farm (the Proposed Development).

1.1.2 A significance-based assessment of operational noise and vibration has been scoped out of the EIA and there is no dedicated ES chapter because likely significant effects are not anticipated. This assessment which forms Appendix 2.6 of the ES provides evidence to support this approach. This approach has been agreed with the Planning Inspectorate on the basis that the detailed description of the Proposed Development within the ES demonstrates that the location of operational plant and equipment is unlikely to result in significant noise and vibration impacts on sensitive receptors (see section 2.2 of this report for more information).

1.1.3 This assessment is informed by an environmental sound survey. This has been undertaken to establish the existing environmental sound levels at positions considered representative of the nearest noise sensitive receptors ('NSR'). The assessment is based on this and the Parameter Plan (ES Figure 3.4) **[REF: 6.2]**, which is secured through the Work Plans in the DCO **[REF: 2.3]**.

1.1.4 An explanation of the acoustic terminology used in this report is included in Appendix A.

1.2 Scope of Report

1.2.1 The scope of this NIA is to:

- Establish, by means of a detailed daytime and night-time environmental sound survey, the existing environmental sound levels at selected locations representative of the nearest noise sensitive receptors;
- Determine relevant noise emission criteria based on guidance and the results of the environmental sound survey; and

- Undertake an assessment of the likely airborne noise propagation to nearby noise sensitive receptors based on the Parameter Plan (ES Figure 3.4).

1.3 Site Description and Location

1.3.1 The Site (ES Figure 1.1) **[REF: 6.2]** extends to approximately 276.5ha and is located approximately 1.1km east of the Lillyhall Industrial Estate, 600m east of the small village of Gilgarran, approximately 900m west of Branthwaite, and approximately 5km southeast of Workington town centre on the west Cumbrian coast. The hamlet of Branthwaite Edge is directly adjacent to the east of the Site.

1.3.2 The most northern Site boundary adjoins an unclassified road, hereafter referred to as 'Branthwaite Road'. The most southern Site boundary abuts Dean Cross Road. The unnamed north/south road between Branthwaite Road and Dean Cross Road, forming the eastern boundary of much of the Site, is the Branthwaite Edge Road. The Site is bisected by an unclassified road between Gilgarran and Branthwaite Edge, hereafter referred to as the 'Gilgarran Road'. ES Chapter 3 – Site and Proposed Development Description **[REF 6.2]** provides a further description of the Site.

1.3.3 Noise and vibration impacts have been assessed for the Parameter Plan of the Proposed Development, which is provided in ES Figure 3.4 and the parameters in the Design Parameters Document **[REF 5.7]**.

2 Assessment Criteria

2.1 National Policy

National Policy Statement for Energy

2.1.1 The National Policy Statement ('NPS') for Energy ('EN-1')[1] sets out national policy for the energy infrastructure described therein. It has effect for the decisions by the Secretary of State on applications for energy developments that are nationally significant under the Planning Act 2008.

2.1.2 In relation to noise, Section 5.12 outlines that the Government's policy on noise is set out in the Noise Policy Statement for England[2] ('NPSE').

2.1.3 Paragraph 5.12.5 outlines factors that will determine the likely noise impact, which include:

'The inherent operational noise from the Proposed Development, and its characteristics

The proximity of the Proposed Development to noise sensitive premises (including residential properties, schools and hospitals) and noise sensitive areas (including certain parks and open spaces)

The proximity of the Proposed Development to quiet places and other areas that are particularly valued for their soundscape or landscape quality

The proximity of the Proposed Development to sites where noise may have an adverse impact on protected species or other wildlife, including migratory species.'

2.1.4 EN-1 provides information required for assessment within paragraphs 5.12.6 - 5.12.12, the type of mitigation measures which could be included at 5.12.13 - 5.12.16, and how decisions should be made by the Secretary of State at 5.12.17 - 5.12.18.

National Policy Statement for Renewable Energy Infrastructure

2.1.5 The NPS for Renewable Energy Infrastructure ('EN-3')[3] together with the EN-1 provide the primary policy for decisions by the Secretary of State on NSIP applications for renewable energy infrastructure.

2.1.6 In relation to noise, EN-3 paragraph 2.5.2 states:

[1] HM Government (2024). Department for Energy Security & Net Zero (DESNZ) Overarching National Policy Statement for Energy (EN-1).

[2] HM Government (2010). Department for Environment and Food and Rural Affairs (DEFRA) Noise Policy Statement for England.

[3] HM Government (2024). DESNZ. National Policy Statement for Renewable Energy Infrastructure (EN-3).

'Proposals for renewable energy infrastructure should demonstrate good design, particularly in respect of landscape and visual amenity, opportunities for co-existence/co-location with other marine uses, and in the design of the project to mitigate impacts such as noise and effects on ecology and heritage.'

2.1.7 On noise and vibration impacts, paragraphs 2.7.39 and 2.7.40 state:

'2.7.39 Sources of noise and vibration may include:

- *The delivery and movement of fuel and materials;*
- *The processing of waste for fuel at efw generating stations;*
- *The gas and steam turbines that operate continuously during normal operation; and*
- *The external noise sources such as externally-sited air-cooled condensers that operate continuously during normal operation.*

2.7.40 Applicants should include in the ES a noise assessment of the impacts on amenity in case of excessive noise from the project in line with guidance set out in Section 5.12 in EN-1.'

2.1.8 For noise and vibration, paragraphs 2.7.98 - 2.7.100 set out example impacts (which are not exhaustive) and state:

'2.7.98 The Secretary of State should consider the noise and vibration impacts according to Section 5.12 in EN-1.and be satisfied that noise and vibration will be adequately mitigated through requirements attached to the consent.

2.7.99 The Secretary of State will need to take into consideration the extent to which operational noise will be separately controlled by the EA or NRW.

2.7.100 The Secretary of State should not grant development consent unless it is satisfied that the proposals will meet the aims set out in 5.12 of EN-1.'

Noise Policy Statement for England

2.1.9 The NPSE was published in March 2010 and clarifies the underlying principles and aims of existing policy documents that relate to noise. It also sets out the long-term vision of Government noise policy which is to *'promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development'.*

2.1.10 The NPSE states that noise should not be considered in isolation of the wider benefits of a scheme or development, and that the intention is to minimise noise and its effects as far as is reasonably practicable having regard to the underlying principles of sustainable development.

2.1.11 Paragraphs 2.20 and 2.21 define 'significant adverse' and 'adverse' impacts as applied to noise as follows:

'2.20 There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

2.21 Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.'

2.1.12 It is necessary to define the LOAEL and SOAEL for the potential source of noise so that the potential impact can be related to the aims and requirements of the NPSE.

2.2 Planning Practice Guidance – Noise

2.2.1 The Planning Practice Guide (PPG)[4] was launched in 2014 (with the latest update to noise aspects being in 2019) and provides additional guidance and interpretation to the Government's strategic policies in the NPPF.

2.2.2 The Noise PPG provides advice on how noise impacts should be determined. paragraph 3 states the plan-making and decision makes processes should consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.*

2.2.3 Paragraph 3 of the PPG also refers to the NPSE in stating that the overall effect of the noise exposure (including the impact during the construction phase where applicable) should be identified against the significant observed adverse effect level (SOAEL) and the lowest observed adverse effect level (LOAEL) for the given situation.

2.2.4 It provides more descriptive detail for the definitions of noise effect levels such as the NOEL, LOAEL and SOAEL but refrains from using numerical values. A summary of the descriptions is provided within the Noise Exposure Hierarchy

[4] Ministry of Housing, Communities and Local Government (2014) Noise Planning Guidance. Available at: https://www.gov.uk/guidance/noise--2 Accessed October 2025

Table[5]. The table also introduces the concept of the No Observed Adverse Effect Level (NOAEL). The hierarchy table is reproduced in Table 2.1.

Table 2.1: Noise Exposure Hierarchy Table

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level (NOEL)			
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

2.3 Local Planning Authority Policy

2.3.1 The Council inherited the local development plan documents of each of the former local authorities forming the new unitary authority. These documents

[5] Ministry of Housing, Communities and Local Government (2016) Noise Exposure Hierarchy Table. Available at: https://assets.publishing.service.gov.uk/media/5d39a87ce5274a4010e33fef/noise_exposure_hierarchy.pdf Accessed October 2025

will continue to be used, in the relevant former authority areas, to decide planning applications until they are replaced by new Cumberland Local Plan documents. As the Site used to fall within Allerdale Borough Council ('ABC'), the Allerdale Local Plan has been referenced herein.

2.3.2 The Allerdale Local Plan (Part 1)[6] published in 2014 contains the ABC's planning policies for the use and development of land up to 2029.

2.3.3 In relation to noise, Policy S19 Renewable Energy and Low Carbon Technologies states:

'The Council will seek to promote and encourage the development of renewable and low carbon energy resources given the significant wider environmental, community and economic benefits. Proposals where impacts (either in isolation or cumulatively) are, or can be made acceptable will be permitted.

The Council will take a positive view where;

a) Proposals (either in isolation or cumulatively);

i) Do not have an unacceptably adverse impact on the amenity of local residents (such as air quality/emissions, noise, odour, water pollution, shadow flicker); …

Renewable energy proposals are expected to provide supporting evidence including landscape, visual and environmental assessments and to demonstrate that any negative impacts have been made acceptable….'

Local Planning Authority Statutory Consultation Response

2.3.4 Statutory responses to the PEIR were received in Spring 2024. In relation to noise, the following table sets out statutory consultation responses to the PEIR, and how they have been addressed in the ES.

Table 2.2: Summary of Statutory Consultation Responses

Response From	Planning Inspectorate EIA Scoping Opinion Comment	Applicant's Response
Dean & Distington Parish Councils	*'Noise. The HVAC units built into the BESS units are potentially noisy, especially when the systems are working at high power either charging or discharging. Such noise will be proportionate to the number of units installed, which is not specified in the consultation documents. In addition to visual screening of the installation consideration needs to be given to installing acoustic screens to mitigate any noise nuisance to nearby properties'*	The BESS element no longer forms part of the Proposed Development and therefore this comment is no longer applicable. Due to the BESS element no longer being proposed, the operational noise risks associated with the Proposed Development are considered to be lower. As such, this NIA provides an updated review of the Proposed Development based on the assessment which was presented within the PEIR.

[6] Allerdale Borough Council (2014). Allerdale Local Plan (Part 1) Strategic and Development Management Policies.

Response From	Planning Inspectorate EIA Scoping Opinion Comment	Applicant's Response
Cumberland Council	*'A construction management plan should also be included as part of the application ensuring that this covers noise and dust management.'*	A Construction Environmental Management Plan ('CEMP') will be implemented prior to construction. The Outline CEMP ('OCEMP') that will be the basis of a CEMP to be provided as a DCO Requirement is included with the ES (Appendix 5.1) **[REF: 6.3].**
Cumberland Council	*'A Noise Impact Assessment ('NIA') informs the PEIR. This considers the impact from construction and operational noise. During operation, the main sources of noise would be from the Heating, Ventilation and Air Conditioning ('HVAC') systems associated with the BESS and solar inverters. The Concept Layout which is assessed within the PEIR has been informed by the NIA work which identified the areas within the Site where noise emitting elements can be sited to avoid any observable adverse effects from noise.* *It is noted that a full NIA will be provided to supplement the ES, which will consider a refined iteration of the layout. This NIA will advocate for a DCO Requirement for further evidence or assessment to demonstrate that the final design and procured technology will also meet the standard of having no observable adverse effects.'*	This NIA provides an updated assessment of noise based on a parameter-based approach. Due to the BESS element no longer being proposed, the operational noise risks associated with the Proposed Development are considered to be lower. As such, this report provides an updated review of the proposals based on the assessment which was presented within the PEIR. As outlined in Table 4.1 of the Outline Operational Management Plan ('OOMP') (ES Appendix 3.1) **[REF: 6.3]**, Work No. 1 (solar PV infrastructure) will not be operational until further noise modelling demonstrates that noise levels will not exceed the SOAEL for this part of the Proposed Development. This is secured by a DCO Requirement. An Operational Management Plan ('OMP') will be implemented for the operational phase and will be substantially in accordance with the OOMP.

Local Planning Authority Scoping Opinion

2.3.5 A statutory consultee response to the Scoping Report (ES Appendix 2.1) **[REF: 6.3]** by the Council was received on 11 September 2023.

2.3.6 In relation to noise and vibration, the following table sets out topics in response to the Planning Inspectorate Scoping Opinion dated September 2023 (ES Appendix 2.2) **[REF: 6.3]**.

Table 2.3: Summary of Scoping Opinion

Topic	Planning Inspectorate EIA Scoping Opinion Comment	Applicant's Response
Traffic Noise and Vibration	*'The Inspectorate agrees that on the basis of the information provided, the increase traffic movements associated with the Proposed Development at all phases are unlikely to result in significant effects relating to noise and*	Noted, scoped out.

Topic	Planning Inspectorate EIA Scoping Opinion Comment	Applicant's Response
	vibration and therefore this matter can be scoped out.'	
Construction Noise and Vibration	*'The Inspectorate agrees that on the basis of the information provided, vibration associated with the construction of the Proposed Development is unlikely to result in significant effects and therefore agrees that this matter can be scoped out from further assessment.* *However, the Inspectorate is not content that the Scoping Report has provided the information required to justify that noise associated with the construction of the Proposed Development infrastructure in the solar array area is unlikely to give rise to significant effects. Whilst appropriate working methods and construction hours may reduce impacts, the Inspectorate would expect to see further information provided on construction techniques, locations, routes, machinery and duration to rule out the likelihood for significant effects to occur.'*	Noted, construction vibration is scoped out of the ES. In relation to construction noise, further information on construction techniques, locations, routes, machinery, and duration is provided in ES Chapter 5 – Construction and Decommissioning Methodology and Phasing **[REF: 6.1]**, as well as the OCEMP (Appendix 5.1), and the OCTMP (Appendix 5.2) **[REF: 6.3]**.
Operational Noise and Vibration	*'The Scoping Report states that operational infrastructure could be appropriately mitigated and located away from receptors at a suitable distance so that significant effects are not anticipated.* *Based on the nature and characteristics of the Proposed Development and given that the Applicant intends to submit a separate Noise and Vibration Impact Assessment with the DCO as an appendix to the ES, the Inspectorate agrees that operational noise and vibration may be scoped out of further assessment. However, the detailed description of the Proposed Development within the ES should demonstrate that the location of operational plant and equipment is unlikely to result in significant noise and vibration impacts on sensitive receptors.'*	This NIA provides an assessment of operational noise and vibration based on the Parameter Plan (ES Figure 3.4). As outlined in Table 4.1 of the OOMP (ES Appendix 3.1), Work No. 1 (solar PV infrastructure) will not be operational until further noise modelling demonstrates that noise levels will not exceed the SOAEL for this part of the Proposed Development. This is secured by a DCO Requirement. An OMP will be implemented for the operational phase and will be substantially in accordance with the OOMP.

2.4 Standards

BS 4142:2014 + A1 2019 'Methods for Rating and Assessing Industrial and Commercial Sound'

2.4.1 BS 4142:2014 + A1 2019 *'Methods for rating and assessing industrial and commercial sound'*[7] (BS4142) describes methods for rating and assessing sound of an industrial and/or commercial nature. The prescribed methods use

[7] The British Standards Institution (2019) British Standard 4142:2014 +A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound.

outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.

2.4.2 The standard is used to determine the rating levels for sources of sound of an industrial and/or commercial nature; and the ambient, background and residual sound levels at outdoor locations. These levels could be used for the purposes of investigating complaints; assessing sound from proposed, new, modified, or additional source(s) of sound of an industrial nature at premises used for residential purposes. It is noted that the determination of noise amounting to a nuisance is beyond the scope of the standard.

2.4.3 The standard should not be used to assess sound from the passage of vehicles on public roads and railway systems; recreational activities; people among other sources; and other sources falling within the scopes of other standards or guidance. The standard cannot be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels.

2.4.4 The procedure contained in BS 4142 assesses the significance of sound which depends upon the margin by which the rating level of the specific sound sources exceeds the background sound level and the context in which the sound occurs/will occur.

2.4.5 An initial estimate of the impact of the specific sound is obtained by subtracting the measured background sound level from the rating level and considering the following:

'a) Typically, the greater this difference, the greater the magnitude of the impact;

b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

c) A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.

d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.'

2.4.6 Where the initial estimate of the impact needs to be modified due to the context, the following factors should be considered:

'1) The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse.

2) The character and level of the residual sound compared to the character and level of the specific sound. Consider whether it would be beneficial to compare the frequency spectrum and temporal variation of the specific sound with that of the ambient or residual sound to assess the degree to which the specific sound source is likely to be distinguishable and will represent an incongruous sound by comparison to the acoustic environment that would occur in the absence of the specific sound. Any sound parameters, sampling periods and averaging time periods used to undertake character comparisons should reflect the way in which sound of an industrial and/ or commercial nature is likely to be perceived and how people react to it.

3) The sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions such as:

i) façade insulation treatment;

ii) ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and

iii) acoustic screening.'

BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

2.4.7 BS 8233:2014[8] sets out guideline values in habitable rooms, such as living rooms and bedrooms which should not be exceeded.

2.4.8 The guideline values relate to steady external noise without a specific character. According to the standard, 'noise has a specific character if it contains features such as a distinguishable, discrete, and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.' Examples of noise with a character may include tonal/intermittent plant noise emissions, music playback, and workshop noise. Examples of external steady noise sources may include environmental noise sources such as busy road traffic.

[8] The British Standards Institution (2014) British Standard 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings.

2.4.9 The guideline internal ambient noise levels for dwellings are presented in Table 2.4.

Table 2.4: BS 8233 Guideline Internal Ambient Noise Levels for Dwellings

Activity	Location	Internal Ambient Noise Level	
		07:00 to 23:00 hours	23:00 to 07:00 hours
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

2.4.10 Table 4 of BS 8233:2014[9] provides the following relevant additional notes:

'…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 LAmax,f, depending on the character and number of events per night. Sporadic noise events could require separate values.

Note 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative source of ventilation that does not compromise the façade insulation or the resulting noise levels. …

Note 7 Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.…'

2.4.11 The standard also provides advice in relation to sound levels for external noise. It states in paragraph 7.7.3.2 that:

'7.7.3.2 For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable.

In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate.

Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general

[9] The British Standards Institution (2014) British Standard 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings.

guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation.

In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space.'

2.4.12 With respect to industrial noise, paragraph 6.5.2 states:

'6.5.2 Where industrial noise affects residential or mixed residential areas, the methods for rating the noise in BS 4142 should be applied. BS 4142 describes methods for determining, at the outside of a building:

a) noise levels from factories, industrial premises or fixed installations, or sources of an industrial nature in commercial premises; and

b) background noise level.'

2.5 Guidance

BS 4142:2014+A1:2019 Technical Note

2.5.1 The BS 4142:2014+A1:2019 Technical Note[10], prepared by members of the Association of Noise Consultants Working Group is a discussion document *'intended to assist with the evolution and development of subsequent guidance'.*

2.5.2 The note provides clarification on low background sound levels in Subclause 11(1), page 42, stating:

'BS 4142 does not define 'low' in the context of background sound levels nor rating levels. The note to the Scope of the 1997 version of BS 4142 defined very low background sound levels as being less than about 30 dB L_{A90}, and low rating levels as being less than about 35 dB $L_{Ar,Tr}$.

The [Working Group] suggest that similar values would not be unreasonable in the context of BS 4142, but that the assessor should make a judgement and justify it where appropriate'.

[10] Association of Noise Consultants (2020). BS 4142:2014+A1:2019 Technical Note

3 Environmental Sound Survey

3.1.1 Baseline sound surveys were conducted between the following dates:

- Thursday 23 and Monday 27 March 2023; and
- Thursday 4 and Thursday 11 May 2023.

3.1.2 Measurements were made over 15-minute periods of the L_{Aeq}, L_{A90} and L_{AFMax} sound levels.

3.1.3 The sound level meters were located in environmental cases. The microphones were connected to the meters via an extension cable and fitted with the manufacturer's windshield. The microphone was approximately 1.5m above ground level at all measurement locations.

3.1.4 The instrumentation used in the survey (including calibration information) is listed in Appendix B.

3.1.5 Field calibrations were performed before and after the measurements with no significant fluctuations recorded (< 0.5 dB). Calibration certificates are available upon request.

Measurement Locations

3.1.6 Measurements were taken at six unattended locations (LT1-6), and one attended location (ST1). The locations of the measurements are indicated in Figure 3.1 of this NIA and described in Table 3.1. Consultation with the Council for the survey methodology was sought on 6 March 2023, although no response was received. The measurement methodology is considered to align with best practice and is as outlined within BS 4142.

Figure 3.1: Sound Survey Locations

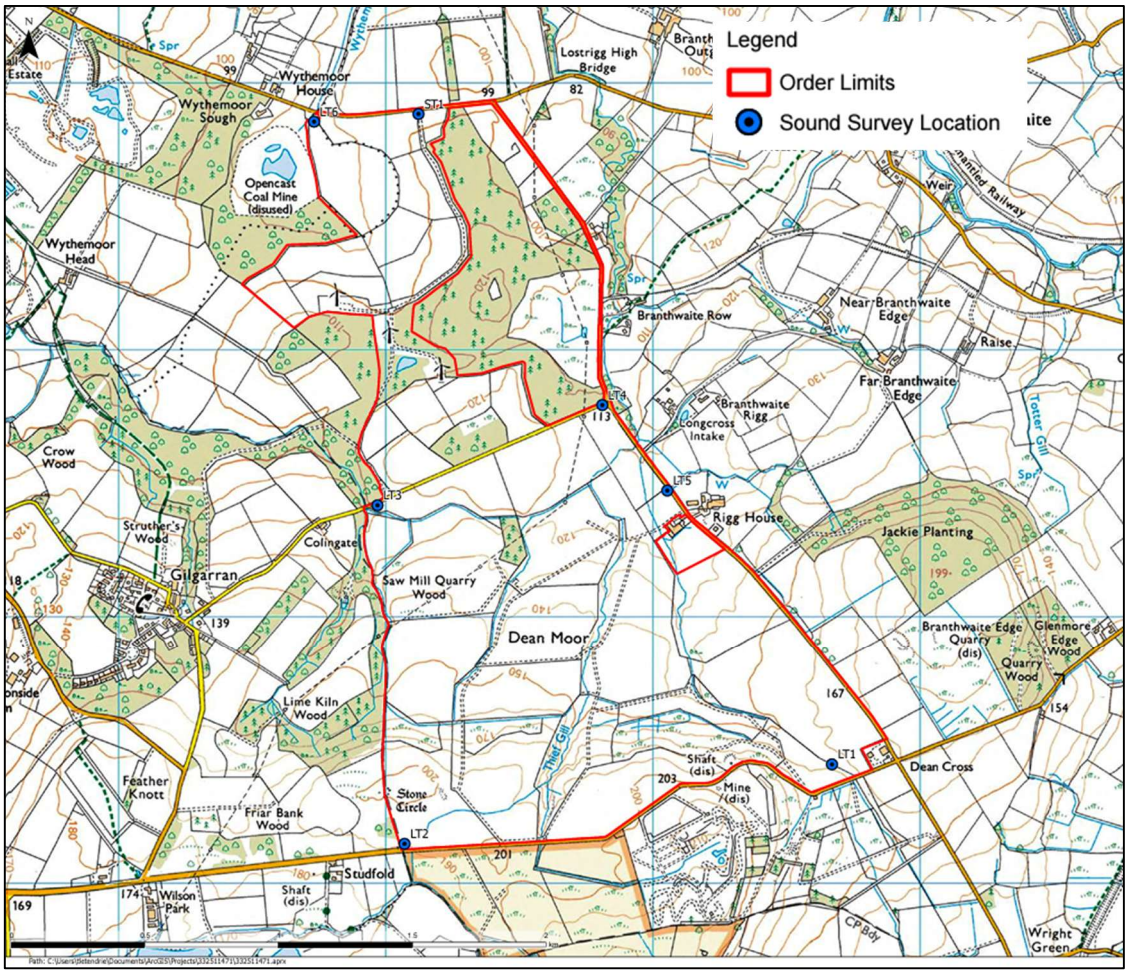


Table 3.1: Description of Sound Survey Locations

Position	Description
LT1	The microphone was located in a free field position approximately 65m from south-eastern boundary of the Site and approximately 56m from Dean Cross.
LT2	The microphone was located in a free field position at the south-western boundary of the Site and approximately 25m from the road.
LT3	The microphone was located in a free field position on the western boundary of the Site and approximately 5m from the road.
LT4	The microphone was located in a free field position on the eastern boundary of the Site and approximately 5m from the road.
LT5	The microphone was located in a free field position on the eastern boundary of the Site and approximately 15m from the road.
LT6	The microphone was located in a free field position approximately 41m from the north boundary of the Site and approximately 41m from the road.
ST1	The microphone was located in a free field position on the north-eastern boundary of the Site and approximately 25m from the road.

3.2 Meteorological Conditions

3.2.1 Due to the nature of the survey (i.e., predominantly unattended), it is not possible to accurately comment on the meteorological conditions throughout the entire survey period. However, based on a review of publicly available weather data[11] and observations at the beginning and end of the survey period, the weather conditions are detailed in Table 3.2.

Table 3.2: Meteorological Conditions

Date	Temperature	Precipitation (mm)	Wind Speed (m/s)	Wind Direction
23/03/2023	4 to 9	4	2 to 6	2 to 6
24/03/2023	5 to 8	5	3 to 6	3 to 6
25/03/2023	3 to 9	3	0 to 5	0 to 5
26/03/2023	0 to 7	0	0 to 3	0 to 3
27/03/2023	-1 to 8	0	0 to 2	0 to 2
04/05/2023	3 to 15	0	0 to 7	0 to 7
05/05/2023	9 to 16	0	1 to 6	1 to 6
06/05/2023	9 to 17	0.3	0 to 3	0 to 3
07/05/2023	8 to 13	0	0 to 5	0 to 5
08/05/2023	9 to 12	1.8	2 to 6	2 to 6
09/05/2023	6 to 15	0.6	0 to 3	0 to 3
10/05/2023	6 to 12	0.3	0 to 4	0 to 4
11/05/2023	7 to 16	0.9	0 to 4	WSW

3.2.2 Based on a review of publicly available data, weather conditions over the period 23 to 25 March 2023 were unlikely to be suitable for environmental sound measurements, due to rainfall and windspeeds greater than 5 m/s. This period has therefore been omitted from the analysed dataset. However, the baseline sound survey measurements recorded between 25 and 27 March 2023 and between 4 and 11 May 2023 are considered to comprise a robust dataset for the baseline assessment.

[11] Publicly available data on Wunderground https://www.wunderground.com/dashboard/pws/IWHITE97 Accessed December 2024

3.3 Assumptions and Limitations

3.3.1 The engineer noticed nothing unusual in terms of the sound climate at the time of the survey. This NIA refers, within the limitations stated, to the environment of the Site in the context of the surrounding area at the time of the inspections. Environmental conditions can vary. No warranty is given as to the possibility of changes in the environment of the Site and surrounding area at differing times.

3.4 Environmental Sound Climate

3.4.1 Due to the nature of the survey (i.e., unattended), it is not possible to accurately comment on the dominant noise sources or specific noise events during the entire survey period. However, at the beginning and end of the survey period, the noise sources experienced at each survey location are described in Table 3.3.

Table 3.3: Description of Noise Climate at Sound Survey Locations

Position	Description
LT1	The dominating noise source was vehicular movements on the surrounding road network. Construction works were noted on Branthwaite Edge Road to the east.
LT2	The dominating noise source was vehicular movements on Dean Cross Road.
LT3	The dominating continuous noise source was sound from the nearby Potato Pot wind farm to the north. Other noise sources included sheep.
LT4	The dominating noise source was vehicular movements on Branthwaite Edge Road.
LT5	The dominating noise source was vehicular movements on Branthwaite Edge Road.
LT6	The dominating noise source was vehicular movements on Branthwaite Road.
ST1	The dominating noise source was vehicular movements on Branthwaite Road. Wind turbine noise was audible at the measurement location.

4 Environmental Sound Survey Results

4.1.1 A full summary of the results is provided in Appendix D of this NIA. Histograms of the background sound levels at each measurement location are provided in Appendix E of this NIA. The histograms only present the background sound levels which were considered suitable for use within the assessment (i.e., exclude data obtained during adverse weather conditions).

Table 4.1: Sound Levels at Measurement Locations LT1-LT6

Measurement Location	Time Period	Ambient Sound Level $L_{Aeq,T}$ (dB)	Range of Typical Background Sound Levels $L_{A90,15minutes}$ (dB)
LT1	Daytime 07:00 – 23:00	43	27-36
	Night-time 23:00 – 07:00	38	18-35
LT2	Daytime 07:00 – 23:00	45	22-28
	Night-time 23:00 – 07:00	40	19-24
LT3	Daytime 07:00 – 23:00	52	34-41
	Night-time 23:00 – 07:00	47	26-41
LT4	Daytime 07:00 – 23:00	52	34-35
	Night-time 23:00 – 07:00	44	32
LT5	Daytime 07:00 – 23:00	54	30-43
	Night-time 23:00 – 07:00	47	21-40
LT6	Daytime 07:00 – 23:00	53	31-35
	Night-time 23:00 – 07:00	48	26-29

4.1.2 The measured average sound level at ST1 was 56 dB $L_{Aeq,30minutes}$ between 12:15 and 13:45 hours on 4 May 2023.

4.1.3 The background sound levels during daylight hours have been reviewed (which are understood as being up to between approximately 04:30 and 22:00 hours for the Site during the peak of summer). The background sound levels measured during the daytime hours (between 07:00 and 23:00 hours) were noted to be the same as those during daylight hours (04:30 and 22:00 hours).

5 Preliminary Plant Noise Assessment

5.1 Overview

5.1.1 The key consideration in noise during operation is the noise generated by elements of the Proposed Development that represent noise emitting sources. This excludes fixed solar arrays but includes the grid connection infrastructure (substation transformers) and PCS Units (inverter-transformer units) for the solar technology.

5.2 Proposed Equipment

5.2.1 Sound levels used within this assessment are based on typical worst-case manufacturer's data for items of plant included in preliminary design. The exact location, number of items of equipment and associated sound levels are subject to change. For the purposes of this assessment, the calculations are based on the equipment and associated noise levels described in Table 5.1.

Table 5.1: Plant Details

Plant	Sound Level	Sound Level Including Mitigation	Location & Indicative Number of Units
Grid Transformers	91 dBA L_w per unit	86 dBA L_w per unit (5 dB due to acoustic barrier)	1no. transformer unit within a single compound
PCS Units (Central Inverter-Transformer)	91 dBA L_w per unit	86 dBA L_w per unit (5 dB due to manufacturer's mitigation)	19no. units across the Site

5.3 Acoustic Attenuation (Mitigation)

5.3.1 For the noise emitting equipment associated with the Grid Connection Infrastructure (which may be located anywhere within Work No. 2 it has been assumed that an acoustic barrier would be included within the design, if required, providing a minimum insertion loss of approximately 5 dB. This can be achieved by an appropriately specified acoustic barrier which provides line-of-sight screening between the noise source and the NSR.

5.3.2 Alternatively, it may be provided by additional attenuation affixed to the equipment itself such as noise dampening plates added to a grid transformer.

While noise attenuating equipment is typical in substation design, specification of options for this aspect of the Proposed Development must remain flexible as measures to be included will be led by specifications from Electricity North West Limited (ENW) as the Distribution Network Operator (DNO) (electricity undertaker) for whom the works will be constructed to DNO standards.

5.3.3 For the PCS units which may be located anywhere within Work No. 1, multiple manufacturers have advised that a noise reduction system can be incorporated which would reduce noise emissions by 5 dB. This would reduce the sound power level produced by the system to 86 dBA L_w, which is what has been used within this assessment. This level of attenuation is standard and is also available for standalone transformer units should the Proposed Development utilise string inverters, rather than combined central inverter-transformer units.

5.3.4 For the purpose of this NIA, the paragraphs above set out the attenuation assumption relied on for this assessment, and then sets out different types of noise mitigation available including the sensitive siting of equipment, the inclusion of additional attenuation measures added to the equipment itself, and the provision of off-unit acoustic barriers.

5.3.5 This NIA will also be relied on for baseline data to inform the detailed design of the Proposed Development and the discharge of DCO Requirement 12 and to support the commitments of the Outline Operational Management Plan (OOMP) and OMP for Requirement 11 (see NIA sections 5.9 and 5.12). When utilised for these purposes the noise mitigation hierarchy that should be applied within the design process to enable compliance with these commitments is as follows (in this order):

- Avoid noise effects through the selection of equipment which has a standard (non-attenuated) sound level that is quieter than the worst-case levels utilised in this NIA;
- Avoid noise effects through the sensitive siting of equipment so that no additional attenuation measures are required;
- Mitigate through the provision of additional attenuation applied to the unit itself, prioritising options that do not rely on regular calibration or maintenance, before considering options that have point of failure risks; and

- Mitigate through the provision of additional attenuation that is independent of the unit itself such as acoustic barriers, prioritising low-maintenance and durable options.

5.4 Description of Plant Operation

5.4.1 The PCS units within Work No 1 are inverters and transformers which operate by converting the direct current (DC) power produced by the photovoltaic process in the solar PV arrays to alternating current (AC) electricity, and transforming the voltage before transmission to the Work No 2 infrastructure. This means the PCS units will only operate when electricity is being produced, which would be during daylight hours (i.e., up to between 04:30 and 22:00 during the peak of summer). When there is no daylight, the PCS would cease to operate and therefore not generate noise. PCS unit noise is associated with the operation of the units' HVAC system which means noise levels can vary if the HVAC is not required or depending on conditions which influence PCS load factors and HVAC operations such as weather and external temperature.

5.5 Noise Sensitive Receptors

5.5.1 The locations of the nearest NSRs are indicated in Figure 5.1 and described in Table 5.2.

Figure 5.1: Noise Sensitive Receptors

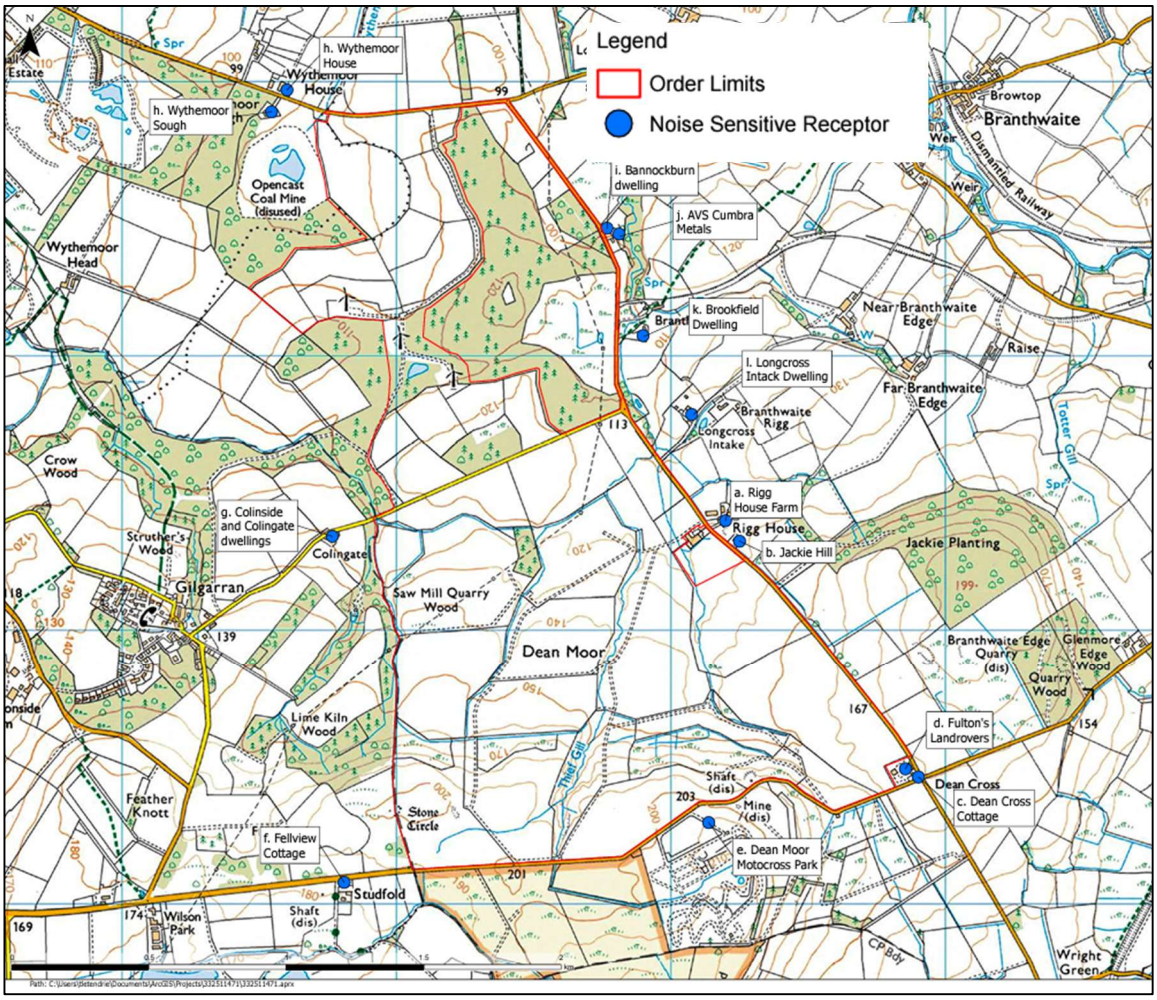


Table 5.2: Noise Sensitive Receptors

NSR ID	Description
a	Dwelling - Rigg House Farm
b	Dwelling - Jackie Hill
c	Dwelling - Dean Cross Cottage
d	Commercial Building - Fulton's Landrovers
e	Commercial Site - Dean Moor Motocross Park
f	Dwelling - Fellview Cottage
g	Dwellings - Colinside and Colingate
h	Dwellings - Wythemoor Sough and Wythemoor House
i	Dwelling - Bannockburn
j	Commercial Site - AVS Cumbria Metals
k	Dwelling - Brookfield
l	Dwelling - Longcross Intack

5.6 Assessment Criteria

5.6.1 Based on the measured background sound levels shown in Table 4.1 and guidance provided within BS 4142:2014+A1:2019, the criteria in Table 5.3 have been developed as LOAELs and SOAELs at dwellings. It should be noted that context should be taken into account when assessing noise sources based on guidance within BS 4142:2014+A1:2019. LOAEL and SOAEL values could therefore vary depending on the overall final context of the assessment. Whether or not a noise impact is considered to be significant would depend on the context of the assessment and the sensitivity of the receptor.

5.6.2 The commercial receptors identified (d, e, and j) are anticipated to be less sensitive to noise from the Proposed Development than the residential receptors, although their operations still have the potential to be affected. Based on guidance provided within BS 8233:2014 on external sound levels, it is considered that adopting a LOAEL of 45 dB $L_{Ar,Tr}$ and a SOAEL of 55 dB $L_{Ar,Tr}$ is suitable and protect existing commercial uses. It is noted that the LOAEL at commercial receptors is likely to be achieved by default due to more stringent noise requirements at dwellings.

Table 5.3: LOAELs and SOAELs Used Within Assessment

NSR	Location	Period	Range of Typical Background Sound Levels $L_{A90,15minutes}$ (dB)	LOAEL* (Noise Rating Level $L_{Ar,Tr}$ dB)	SOAEL* (Noise Rating Level $L_{Ar,Tr}$ dB)
a and b (dwellings)	LT5	Daytime 07:00-23:00	30-43	31	35
		Night-time 23:00-07:00	21-40	27	30
c (dwelling)	LT1	Daytime 07:00-23:00	27-36	28	30
		Night-time 23:00-07:00	18-35	22	25
d and e (commercial)	LT1	Daytime 07:00-23:00	27-36	45	55
f (dwelling)	LT2	Daytime 07:00-23:00	22-28	28	30

NSR	Location	Period	Range of Typical Background Sound Levels $L_{A90,15minutes}$ (dB)	LOAEL* (Noise Rating Level $L_{Ar,Tr}$ dB)	SOAEL* (Noise Rating Level $L_{Ar,Tr}$ dB)
		Night-time 23:00-07:00	19-24	22	25
g (dwelling)	LT3	Daytime 07:00-23:00	34-41	31	35
		Night-time 23:00-07:00	26-41	30	30
h (dwelling)	LT6	Daytime 07:00-23:00	31-35	31	35
		Night-time 23:00-07:00	26-29	27	30
i, k and l (dwellings)	LT4	Daytime 07:00-23:00	34-35	35	35
		Night-time 23:00-07:00	32	32	32
j (commercial)	LT4	Daytime 07:00-23:00	34-35	45	55
*The LOAEL and SOAEL have the potential to vary depending on the overall final context of the assessment.					

5.7 Calculation Methodology

5.7.1 To account for ground absorption and atmospheric attenuation over distances of 250m the calculations include a 2dB loss. The loss from ground absorption and atmospheric attenuation is expected to increase at greater distances, although this has not been considered within the assessment as a worst-case assumption.

5.7.2 The topography of the Site has not been taken into account, and it is assumed that there is no acoustic screening provided by the landscape.

5.7.3 The calculations are based on hemispherical point source propagation, which means the sound power for each piece of plant radiates from a single point, and spreads over a hemisphere.

5.8 Assessment Results

5.8.1 The equipment data provided in Table 5.1 and assumed mitigation outlined in section 5.4 has been used to determine the minimum distances required between the various items of plant and noise sensitive receptors, based on the SOAELs and LOAELs outlined in Table 5.3. The minimum distances for the PCS units and Grid Connection Infrastructure (also referred to as Point of Connection (POC) equipment) are set out in Table 5.4 and presented in Figures 1 and 2 in Appendix F respectively.

5.8.2 The red areas in Figures 1 and 2 in Appendix F indicate that if the respective PCS or POC equipment is sited in these locations, then sound levels at the receptors could exceed the SOAEL, and therefore result in a significant effect.

5.8.3 The yellow areas in Figures 1 and 2 in Appendix F indicate that if the respective PCS or POC equipment is sited in these locations, then sound levels at the receptors could exceed the LOAEL, and therefore result in an adverse effect where additional mitigation could be required to minimise effects as much as possible.

5.8.4 The green areas in Figures 1 and 2 in Appendix F indicate that if the respective PCS or POC equipment is sited in these locations, then sound levels at the receptors could be below the LOAEL, and therefore result in effects at either the NOAEL or No observable effects level (NOEL) where no additional mitigation is required.

5.8.5 It should be acknowledged that the SOAEL and LOAEL (and therefore the minimum distance) has the potential to vary based on the contextual factors of the final assessment. The minimum distances also have the potential to vary based on the actual noise emissions from the selected equipment and the final locations of the equipment. The minimum distances are therefore indicative of those which are expected to be required based on the criteria applied in this NIA as set out in sections 5.2-5.7 above), but further assessment may demonstrate that these are not necessary for the rating level to be below the SOAEL or LOAEL following the application of the mitigation hierarchy as set out in section 5.3.

5.8.6 To ensure a worst-case assessment, the minimum distances also include allowance for a battery energy storage system (BESS) facility which previously formed part of the Proposed Development (before submission of the DCO application) in Area C adjoining and overlapping with Work No.2. Without inclusion of the BESS, the minimum distances are expected to be reduced as there will be less noise generating equipment contributing to the rating level at the NSRs.

5.8.7 The underlying assumptions of this NIA reflect the noise model prepared for the PEIR before the BESS facility was removed as part of the Proposed Development. Whilst individual units within a BESS facility, including battery containers and battery PCS units in battery stations, have noise levels similar to Work No 1 PCS units, the large number of these units (assumed up to 40 battery containers and 10 PCS units in the PEIR NIA) in a single area leads to a concentration of noise emitting equipment that compounds the potential for noise effects of other equipment which is fixed in a given area (like Work No.2) and especially for un-fixed elements like PCS units which may be located anywhere within Work No 1.

5.8.8 This means the NIA outcomes as to sound levels at the SOAEL/LOAEL assume the POC and PCS equipment is operating on a site that also has a BESS facility adding-to the noise levels from the generating station and making the potential for noise to be experienced from the POC and PCS equipment more likely.

5.8.9 The decision was made for this NIA to maintain this as part of the baseline despite the negative ramifications of this for the determination of SOAEL and LOAEL effect distances (that is, this has the potential to show that the distance where effects occur are less than what they would be without the inclusion of BESS in the baseline, particularly for Area C proximate NSR).

5.8.10 However, this was also considered to help reinforce the conclusion of this NIA which demonstrates that even with this compounding factor, the Work No. 2 infrastructure is located in an area where effects will not exceed the LOAEL, and there is significant area within Work No 1 where PCS units can be sited which are also below the LOAEL, as per Figures 1 and 2 of Appendix F. This

is intended to support this NIA as a worst-case assessment and provide confidence that the Proposed Development can mitigate adverse noise effects on NSR.

Table 5.4: Indicative Minimum Distances Between Equipment and Receptors to Not Exceed SOAELs and LOAELs

NSR ID	Plant	SOAEL Minimum Distance (m)	LOAEL Minimum Distance (m)
a and b (dwellings)	Grid Connection Infrastructure (Work No. 2) PCS Units (Work No. 1)	251 283	398 448
c (dwelling)	Grid Connection Infrastructure PCS Units	447 502	562 632
d and e (commercial)	Grid Connection Infrastructure PCS Units	25 28	79 89
f (dwelling)	Grid Connection Infrastructure PCS Units	447 502	562 632
g (dwelling)	Grid Connection Infrastructure PCS Units	200 224	398 448
h (dwelling)	Grid Connection Infrastructure PCS Units	251 283	398 448
i, k and l (dwellings)	Grid Connection Infrastructure PCS Units	251 283	251 283
j (commercial)	Grid Connection Infrastructure PCS Units	25 28	79 89

5.8.11 Based on the mitigation assumed (i.e. 5 dB to the grid transformers and 5 dB to the PCS units) the results indicate that:

- With the level of mitigation currently provided to the Grid Connection Infrastructure (Work No 2), the SOAEL and LOAEL are not expected to be exceeded by noise generated by this equipment at any NSR, as it is further from receptors than the indicative minimum distance; and
- Noise emissions from PCS units could exceed the LOAEL and SOAEL, if they are sited at distances of less than the minimum distances from receptors and quieter equipment is not specified and/or additional mitigation is not incorporated.

5.8.12 Based on the equipment being appropriately mitigated and located in compliance with the minimum distances in Table 5.4, the proposed SOAELs are not anticipated to be exceeded. This table and a similar table at 5.6

include minimum distances, but these do not specify the minimum distance between Work No. 1 and 2 and the NSR; in many cases the minimum is secured by the Work Plans, without the need for additional mitigation.

5.8.13 As also noted, subject to the outcome of the proposed additional modelling to inform the detailed design, the rating level may still be below the SOAEL or LOAEL at distances less than those noted in Table 5.4. This could occur either if the contextual assessment modifies the SOAEL/LOAEL using either topography or final layout to influence the rating level at NSR, or if noise emissions from equipment is lower than the worst case assumed within this assessment. It is also noted that removing the compounding BESS facility which currently forms part of the NIA will also provide a reduction, particularly for NSR proximate to Area C. Further detail on this future NIA is set out in section 5.11 below.

5.9 Consideration of Further Mitigation

5.9.1 To understand the potential levels of mitigation required for the PCS units to be below the LOAEL and SOAEL at all NSRs, further calculations have been undertaken assuming additional mitigation.

5.9.2 For PCS units it is possible to provide more mitigation than 5 dB if required as additional attenuation can be designed-in to the units, including to all units as well as specific units, to meet higher sound reduction performances. The further mitigation could be achieved by measures such as incorporating cowls or louvres to the PCS ventilation (HVAC) system, increasing the extent of enclosures to the PCS units, or through particular calibration options for the equipment within the units. Additional off-unit attenuation can also be provided through the provision of acoustic barriers between a specific unit and an NSR.

5.9.3 This is demonstrated by further assessment set out below whereby a level of additional mitigation is applied based on a library of data from the project's acoustic consultant's experience with NIA for other solar farm developments.

5.9.4 In undertaking these further calculations, the NIA has not excluded the compounding effects of BESS, to maintain a consistent approach with the robust worst-case assumed in the initial NIA calculations. These calculations

have been made to support the consideration of additional attenuation that may be applied to PCS units within Work No. 1.

5.9.5 The sound levels assumed to be generated by plant, following consideration of further mitigation, are presented in Table 5.5, with additional attenuation only for the PCS Units and not the Grid Connection Infrastructure.

Table 5.5: Example Mitigated Plant Noise Levels

Plant	Original Sound Level	Standard Mitigation Sound Level	Further Attenuation Sound Level
Grid Connection Infrastructure (Work No. 2)	91 dBA L_w per unit	86 dBA L_w per unit *(-5 dB due to acoustic barrier)*	86 dBA L_w per unit *(-5 dB due to acoustic barrier)*
PCS Units (Work No. 1)	91 dBA L_w per unit	86 dBA L_w per unit *(-5 dB due to manufacturer's mitigation)*	75 dBA L_w per unit *(-16 dB due to full enclosure or attenuation applied to cooling fans)*

5.9.6 The sound levels have been used to calculate the LOAEL and SOAEL distances for the PCS units, should the further mitigation be incorporated. As no further mitigation for the grid connection infrastructure is identified as being required, there are no changes to the distances described for this equipment identified in Table 5.4.

5.9.7 The minimum distances between PCS units and NSR with further mitigation are presented in Table 5.5. The minimum distances between PCS units and NSR with further mitigation are presented in Table 5.5. The SOAEL and LOAEL minimum distances for PCS units are also presented graphically in Figure 3 in Appendix F.

Table 5.6: Indicative Minimum Distances Between Equipment and Receptors to Not Exceed SOAELs and LOAELs with Further Mitigation

NSR ID	Plant	SOAEL Minimum Distance (m)	LOAEL Minimum Distance (m)
a and b (dwellings)	PCS Units	80	126
c (dwelling)	PCS Units	142	179
d and e (commercial)	PCS Units	8	25

NSR ID	Plant	SOAEL Minimum Distance (m)	LOAEL Minimum Distance (m)
f (dwelling)	PCS Units	142	179
g (dwelling)	PCS Units	63	126
h (dwelling)	PCS Units	80	126
i, k and l (dwellings)	PCS Units	80	80
j commercial	PCS Units	8	25

5.9.8 As the level of attenuation for the PCS units can be varied as necessary, it is considered that the LOAEL would be achievable at all receptors based on the worst-case scenario for mitigation requirements.

5.9.9 Due to the scale of the Site, and the opportunities for mitigation to be provided by placing noise emitting sources further from receptors and applying additional attenuation mitigation to equipment as required, the Applicant has sufficient flexibility within the Site to ensure that SOAEL is not exceeded and adverse impacts on health and quality of life are mitigated to a minimum in accordance with both the NPSE and EN-1.

5.9.10 Furthermore, it is worth noting that when considering the Noise PPG the majority of noise emitting plant sited beyond the areas discussed to achieve the LOAEL threshold may also achieve the NOAEL or NOEL thresholds. The flexibility for distance attenuation within the Site (i.e. avoiding placing noisier equipment close to NSRs) is demonstrated by the figures in Appendix F.

5.9.11 Therein Figures 1-2 which correspond to the outcomes of NIA section 5.8 have been prepared on a worst-case basis and demonstrate the limited geographical areas which would experience effects if PCS units or grid infrastructure were sited in these areas without further mitigation beyond that identified within this document. Appendix F Figure 3 then provides this same model for the PCS units factoring in the additional -16 dB attenuation as described in this section.

5.9.12 The NIA demonstrates that significant effects can be avoided at all NSRs. In addition, through appropriate equipment selection, layout, and attenuation measures previously discussed, adverse effects can be mitigated and reduced. As can be seen in Table 5.4 and Table 5.5, the LOAEL and SOAEL level for each receptor has been established, and these will guide the siting and specification of noise emitting equipment as part of the pre-construction detailed design.

5.10 BS 4142 Noise Rating Corrections

5.10.1 Acoustic feature corrections, as defined in BS 4142:2014+A1:2019, have not been applied at this stage of the assessment. The minimum distances within the preliminary assessment are therefore based on the specific sound level being in-line with the criteria in Table 5.3.

5.11 Future Noise Impact Assessment

5.11.1 This NIA presents the results of the operational noise assessment for the Proposed Development based on worst case assumptions as to the sound levels and potential equipment locations as defined by the Work Plans. Further noise modelling which considers the final layout of plant, topography, and relevant contextual factors provided in BS 4142:2014+A1:2019 will be undertaken to inform the detailed design of the Proposed Development and the discharge of Requirement 12

5.11.2 Requirement 12 of the DCO requires a further NIA to be prepared and provided to the Council for approval before the Work No. 1 equipment is operational.

5.11.3 This NIA will be based on the detailed design of the Proposed Development and will demonstrate that the sound levels associated with the specified equipment and layout prevent significant effects which exceed the SOAEL. Details of any additional mitigation for effects within the LOAEL to mitigate and minimise as much as possible in accordance with the Noise PPG will be set out in the OMP as per OOMP Table 4.1 (A). The Requirement 12 NIA to be approved by the Council will thereby establish the sound level parameters which the Council deem to be acceptable for the proximate NSR.

5.12 Other Operational Noise Management Measures

5.12.1 While DCO Requirement 12 requires an updated model in advance of the operation of noise emitting Work No 1 equipment, further commitments relating to operational noise are secured by the OOMP at Table 4.1 (A).

5.12.2 The OOMP forms the basis of the OMP. Requirement 11 of the DCO requires an OMP, which must be substantially in accordance with the OOMP, to be approved by the Council, thereby securing the commitments made by the OOMP. The final OMP will set out all necessary information relating to the operational noise mitigation strategy which will be in accordance with the details provided in the OOMP at Table 4.1 (A). This establishes the following:

- General approach to operational phase noise mitigation including both operational equipment and operational activity.
- Details relating to any attenuation measures that are relied on for Requirement 12 noise level parameters for the prevention of significant effects and the mitigation of effects below the SOAEL, including the details of any maintenance or monitoring required for attenuation equipment.
- The provision of a Noise Verification Report (NVR) to be submitted to the Council within 12 months of the date of final commissioning when the generating station becomes operational. This will verify that that the equipment is operating in accordance with the parameters established by the Requirement 12 NIA. An up to 12-month period is proposed given the uncertainty around the commissioning date and to ensure that the NVR can be undertaken in the summer as this is when the PCS will be operating longer and with HVAC in full-load conditions.
- A procedure to be followed in the event of a non-conformity or noise complaint being received once the generating station is operational despite the outcomes of the Requirement 12 NIA and NVR

Noise Verification Reporting

5.12.3 Following the commencement of commercial operations, the OOMP provides a commitment for a Noise Verification Report (NVR) to be produced. This will validate that equipment is operating within the approved noise parameters established by the pre-operational Requirement 12 NIA modelling and any additional attenuation specified in the OMP.

5.12.4 The resultant sound levels at NSR (which are off-Site) may be above, in-line with or below background sound levels. Where sound levels are not significantly above background sound levels, it can be practically impossible to determine the level of sound attributable to specific equipment. As such, it is not proposed to undertake measurements at locations of receptors. Measurements will be taken at the equipment to ensure it is operating at the expected levels based on the manufacturer noise test results for the equipment and any additional attenuation.

5.12.5 The general methodology to be adopted to validate noise emissions will be as follows:

- Short-term attended measurements will be taken near to noise generating equipment. The measurement distance, duration and operation of the equipment will be noted during the survey.
- The noise model will be updated based on the results of the attended measurements. Resultant sound levels at NSRs will be presented within the NVR and compared with those presented in the Requirement 12 NIA.

5.12.6 The NVR can be undertaken in the first summer following the date of final commissioning when the generating station is operational. All NVR recordings will be made from specified locations within a period of the warmest weather conditions (typically 12:00-16:000) unless otherwise agreed with the Council.

5.12.7 The NVR produced will not be produced for the Council's approval but will demonstrate to the Council that the Proposed Development is operating in accordance with the parameters established by the Requirement 12 NIA. Should the NVR indicate any non-conformities, matters will proceed in accordance with the corrective action procedure set out in OOMP Table 4.1 (A.4).

6 Conclusions

6.1.1 This NIA provides the evidence to support scoping operational noise and vibration out of the EIA.

6.1.2 An environmental sound survey has been undertaken to establish the existing environmental sound levels at positions considered representative of the nearest NSRs. The results of the environmental sound survey have been used to establish background sound levels.

6.1.3 The Work Areas s which are identified on the Work Plans have been defined and informed by preliminary noise modelling undertaken during the EIA scoping stage, in support of the PEIR (ES Appendix 2.1), which indicates that no significant effects would occur should Work No 2 equipment be sited in the areas defined as Work No 2.

6.1.4 Based on the Grid Connection Infrastructure (Work No. 2) being appropriately mitigated through sensitive siting, as set out in section 5.3, significant effects (noise levels above the SOAEL at receptors) from operational noise associated with Work No 2 are not anticipated to occur. Effects from Work No 2 would also be below the LOAEL for all sensitive receptors.

6.1.5 This assessment has also found that there are locations where the PCS Units as-assessed herein (at the levels specified in Table 5.1) would have significant effects exceeding the SOAEL, and locations where effects would not be significant but would exceed the LOAEL. In doing so, corresponding Appendix F Figures 1 and 2 also demonstrate that there is sufficient area within the Site for PCS units to be located across Work No 1 while avoiding locations that this NIA finds could give rise to significant effects based on the assessment in section 5.8.

6.1.6 Section 5.9 goes on to provide further insight into the potential for noise effects from the PCS units. This part of the assessment considers opportunities for how additional mitigation can be incorporated to demonstrate means by which significant effects can be avoided, and adverse effects can be mitigated and reduced, based only on adaptations to attenuate the effects of the equipment, as opposed to restricting equipment locations. This is

visualised in Appendix F, Figure 3, which can be contrasted with Figure 1, to show the change in SOAEL and LOAEL locations, which reflects the differences in the minimum distances in Table 5.4 (initial NIA outcomes) and Table 5.6 (with additional attenuation for PCS).

6.1.7 The assessment indicates that through appropriate equipment siting of PCS units, the effects below the SOAEL and within or below the LOAEL can be achieved at all receptors. This will be reinforced by DCO Requirement 12 which establishes that Work No. 1 (solar PV infrastructure) will not be operational until further noise modelling secured by DCO Requirement 12 demonstrates that noise levels will not exceed the SOAEL for this part of the Proposed Development. The assessment also demonstrates that there is potential for effects to be below the LOAEL such that no additional mitigation would be required, but otherwise there are a range of mechanisms following the noise mitigation hierarchy which will enable any effects which are below the SOAEL but exceeding the LOAEL to be mitigated and minimised as much as possible in accordance with the Noise PPG.

Appendix A Acoustic Terminology

Parameter	Description
Ambient Sound Level (La = LAeq,T)	Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T.
A-Weighted Decibel (dBA)	A decibel level that has been corrected for the A-Weighting curve.
A-Weighting	Octave band and 1/3 octave band filters that correlate to the response of the human hearing system to sound pressure levels at different frequencies.
Background Sound Level (LA90,T)	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using a fast time-weighting and quoted to the nearest whole number of decibels.
Decibel (dB)	A logarithmic unit used to describe the ratio between the measured level and a reference level of 0 dB. The ratio can be sound pressure, intensity or power. The reference value for sound pressure is 20 µPa and for sound power is 1 ρW.
Equivalent Continuous A-Weighted Sound Pressure Level (LAeq,T)	Value of the time-averaged A-weighted sound pressure level, in decibels (dB), of a continuous steady sound for the duration of the specified time interval, T.
Façade Level	The sound pressure level at a distance of 1 metre from the façade
Fast Time Weighted	The speed at which the instrument responds to changes in amplitude of the measured signal. The response time of a fats time-weighted instrument is 0.125 seconds.
Free-Field Level	The sound pressure level measured away from any reflective surfaces.
Frequency (f)	The number of cycles of pressure fluctuations within a given period of time. Measured in Hertz.
Hertz (Hz)	The unit of frequency or pitch of a sound. One hertz is equal to one cycle per second.
Octave Band	Band of frequencies where the upper limit of the band is twice the frequency of the lower limit. E.g., the 1000 Hz band contains noise energy at all frequencies from 707 to 1414 Hz.
Percentile Level (LAN,T)	The A-Weighted Sound Pressure Level which is exceeded for N% of the specified time interval. E.g., the LA90,1hour is the A-weighted sound level exceeded for 90% of 1 hour/
Reference Time Interval (T)	Specified interval over which the specific sound level is determined.
Sound Pressure Level (Lp)	The logarithm of the ratio of a given sound pressure (p) to the reference sound pressure (p0). The reference value for sound pressure is 20 µPa. Defined as: $L_p = 20log\left(\frac{p}{p_0}\right)$

Appendix B Equipment Calibration Information

Description	Manufacturer	Type	Serial Number	Laboratory Calibration Date
Sound Level Meter	RION	NL-52	542903	12/01/2023
½" Pre-polarised microphone		UC-59	06480	12/01/2023
Pre-amplifier		NH-25	42931	12/01/2023
Sound Level Meter	RION	NL-52	1043458	10/09/2021
½" Pre-polarised microphone		UC-59	07233	10/09/2021
Pre-amplifier		NH-25	43487	10/09/2021
Sound Level Meter	Brüel & Kjær	2250	2626233	25/03/2022
½" Pre-polarised microphone		4189	2621212	25/03/2022
Pre-amplifier		ZC0032	11992	25/03/2022
Sound Level Meter	RION	NL-62	930517	10/01/2022
½" Pre-polarised microphone		UC-59L	00701	10/01/2022
Pre-amplifier		NH-26	00559	10/01/2022
Sound Level Meter	RION	NL-52	1043457	12/01/2023
½" Pre-polarised microphone		UC-59	07232	12/01/2023
Pre-amplifier		NH-25	43486	12/01/2023
Sound Level Meter	Brüel & Kjær	2250	3012156	04/11/2022
½" Pre-polarised microphone		4189	3349717	04/11/2022
Pre-amplifier		ZC0032	27836	04/11/2022
Sound Calibrator	Brüel & Kjær	4231	2619375	03/01/2023
Sound Calibrator		4231	2619373	03/01/2023

Appendix C Summary of Survey Measurements

ID	Date	Period	Period Average L_{Aeq} dB	Range $L_{A90,15minutes}$ dB	Mean $L_{A90,15minutes}$ dB	Median $L_{A90,15minutes}$ dB
LT1	Thursday 04/05/2023	Daytime (07:00 – 23:00 hours)	43	27-42	33	33
		Night-time (23:00 – 07:00 hours)	41	27-42	34	33
	Friday 05/05/2023	Daytime (07:00 – 23:00 hours)	44	17-40	31	31
		Night-time (23:00 – 07:00 hours)	35	16-36	21	18
	Saturday 06/05/2023	Daytime (07:00 – 23:00 hours)	39	20-31	27	27
		Night-time (23:00 – 07:00 hours)	36	16-34	22	19
	Sunday 07/05/2023	Daytime (07:00 – 23:00 hours)	41	26-40	31	31
		Night-time (23:00 – 07:00 hours)	41	29-39	35	35
	Monday 08/05/2023	Daytime (07:00 – 23:00 hours)	45	29-40	36	36
		Night-time (23:00 – 07:00 hours)	38	21-34	27	27
	Tuesday 09/05/2023	Daytime (07:00 – 23:00 hours)	42	21-39	30	30
		Night-time (23:00 – 07:00 hours)	36	22-35	27	25
	Wednesday 10/05/2023	Daytime (07:00 – 23:00 hours)	43	21-35	32	32
		Night-time (23:00 – 07:00 hours)	37	21-36	26	23
	Thursday 11/05/2023	Daytime (07:00 – 23:00 hours)	39	30-34	32	32
LT2	Saturday 25/03/2023	Daytime (07:00 – 23:00 hours)	47	22-34	28	28
		Night-time (23:00 – 07:00 hours)	38	20-34	25	24
	Sunday 26/03/2023	Daytime (07:00 – 23:00 hours)	43	19-38	28	28
		Night-time (23:00 – 07:00 hours)	42	18-29	21	19

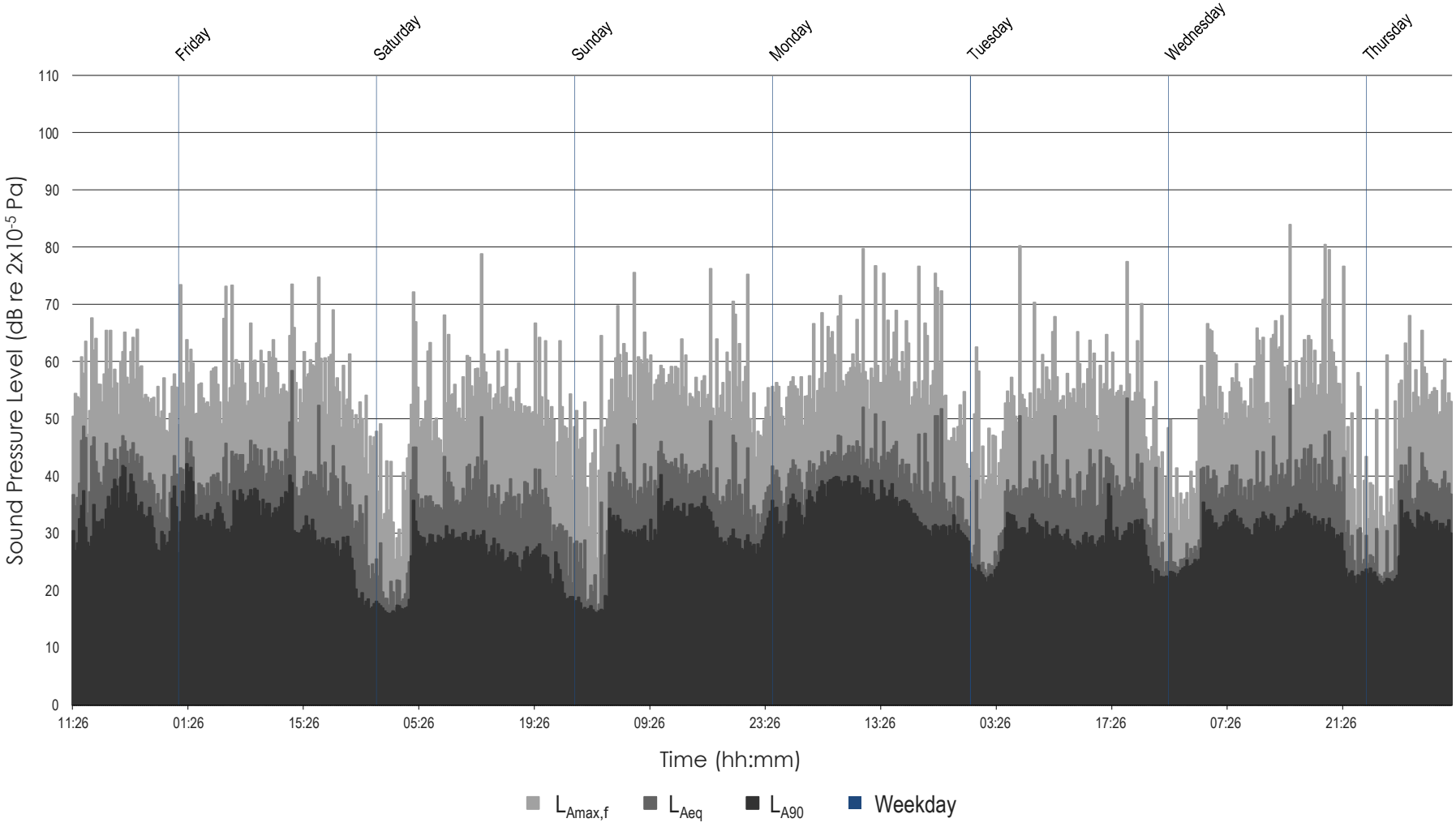
ID	Date	Period	Period Average L_{Aeq} dB	Range $L_{A90,15minutes}$ dB	Mean $L_{A90,15minutes}$ dB	Median $L_{A90,15minutes}$ dB
	Monday 27/03/2023	Daytime (07:00 – 23:00 hours)	45	19-29	22	22
LT3	Thursday 04/05/2023	Daytime (07:00 – 23:00 hours)	55	34-51	41	41
		Night-time (23:00 – 07:00 hours)	49	39-49	40	41
	Friday 05/05/2023	Daytime (07:00 – 23:00 hours)	51	25-44	35	35
		Night-time (23:00 – 07:00 hours)	46	25-40	29	26
	Saturday 06/05/2023	Daytime (07:00 – 23:00 hours)	51	26-41	31	31
		Night-time (23:00 – 07:00 hours)	46	25-38	29	27
	Sunday 07/05/2023	Daytime (07:00 – 23:00 hours)	50	29-40	35	34
		Night-time (23:00 – 07:00 hours)	50	36-50	42	41
	Monday 08/05/2023	Daytime (07:00 – 23:00 hours)	52	37-50	42	41
		Night-time (23:00 – 07:00 hours)	45	33-40	35	35
	Tuesday 09/05/2023	Daytime (07:00 – 23:00 hours)	53	30-37	34	34
		Night-time (23:00 – 07:00 hours)	46	30-41	33	32
	Wednesday 10/05/2023	Daytime (07:00 – 23:00 hours)	52	30-38	35	35
		Night-time (23:00 – 07:00 hours)	46	28-39	32	30
	Thursday 11/05/2023	Daytime (07:00 – 23:00 hours)	54	31-37	34	34
LT4	Saturday 25/03/2023	Daytime (07:00 – 23:00 hours)	53	32-39	35	34
		Night-time (23:00 – 07:00 hours)	44	31-37	33	32
	Sunday 26/03/2023	Daytime (07:00 – 23:00 hours)	52	30-38	34	35

ID	Date	Period	Period Average L_{Aeq} dB	Range $L_{A90,15minutes}$ dB	Mean $L_{A90,15minutes}$ dB	Median $L_{A90,15minutes}$ dB
LT5	Thursday 04/05/2023	Daytime (07:00 – 23:00 hours)	51	33-43	37	36
		Night-time (23:00 – 07:00 hours)	42	27-40	32	32
	Friday 05/05/2023	Daytime (07:00 – 23:00 hours)	52	20-43	34	35
		Night-time (23:00 – 07:00 hours)	43	21-36	25	22
	Saturday 06/05/2023	Daytime (07:00 – 23:00 hours)	51	23-40	30	30
		Night-time (23:00 – 07:00 hours)	43	19-31	23	21
	Sunday 07/05/2023	Daytime (07:00 – 23:00 hours)	52	26-44	36	35
		Night-time (23:00 – 07:00 hours)	48	35-48	41	40
	Monday 08/05/2023	Daytime (07:00 – 23:00 hours)	56	38-48	43	43
		Night-time (23:00 – 07:00 hours)	48	31-40	34	33
	Tuesday 09/05/2023	Daytime (07:00 – 23:00 hours)	54	26-40	32	32
		Night-time (23:00 – 07:00 hours)	48	37-36	31	31
	Wednesday 10/05/2023	Daytime (07:00 – 23:00 hours)	54	27-43	35	35
		Night-time (23:00 – 07:00 hours)	49	26-39	30	29
	Thursday 11/05/2023	Daytime (07:00 – 23:00 hours)	58	30-41	34	33
LT6	Thursday 11/05/2023	Daytime (07:00 – 23:00 hours)	53	29-43	34	33
		Night-time (23:00 – 07:00 hours)	46	26-39	30	29
	Sunday 26/03/2023	Daytime (07:00 – 23:00 hours)	53	25-40	33	35
		Night-time (23:00 – 07:00 hours)	50	25-41	29	26

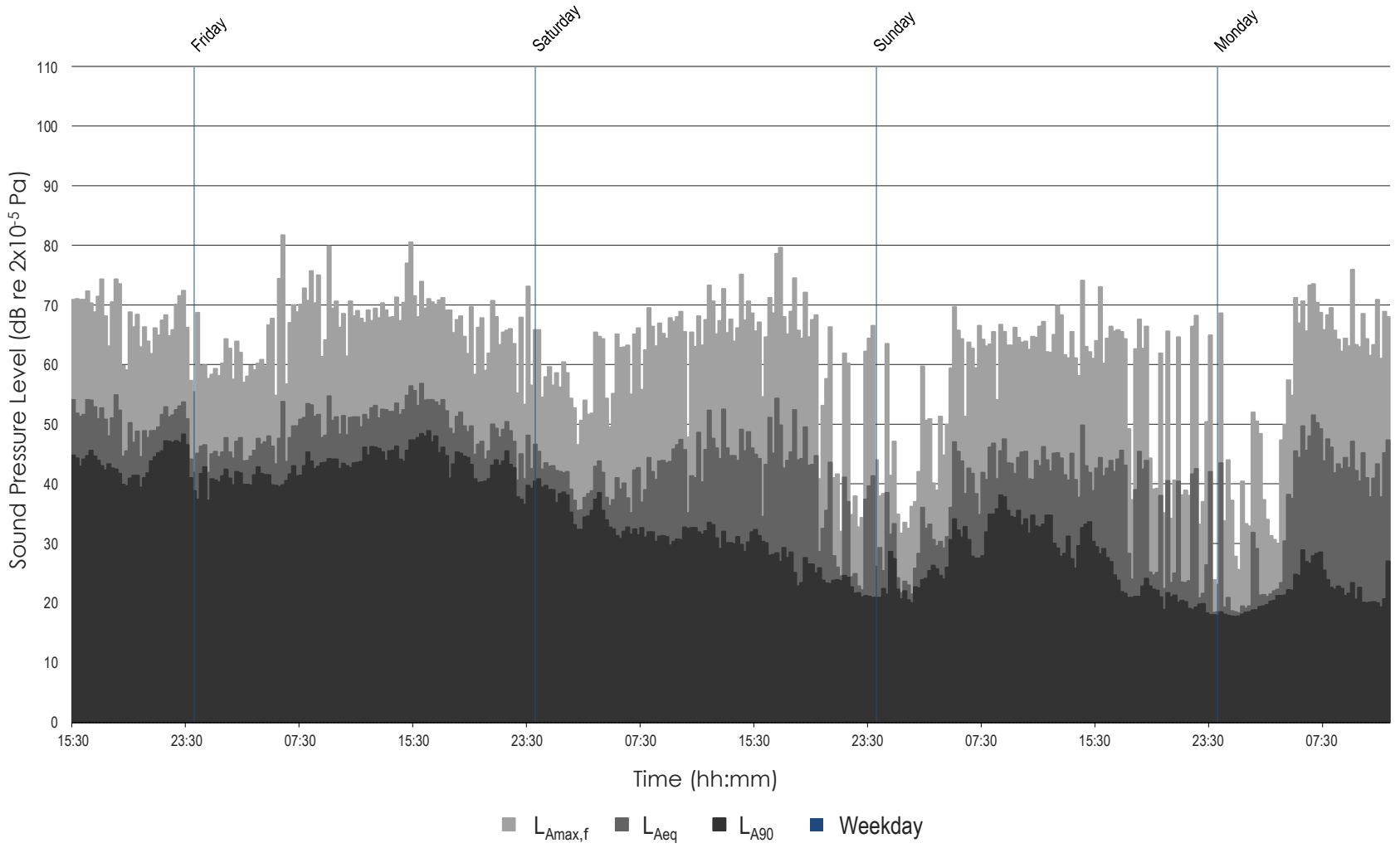
ID	Date	Period	Period Average L_{Aeq} dB	Range $L_{A90,15minutes}$ dB	Mean $L_{A90,15minutes}$ dB	Median $L_{A90,15minutes}$ dB
	Monday 27/03/2023	Daytime (07:00 – 23:00 hours)	54	28-41	32	31

Appendix D Time History Graphs

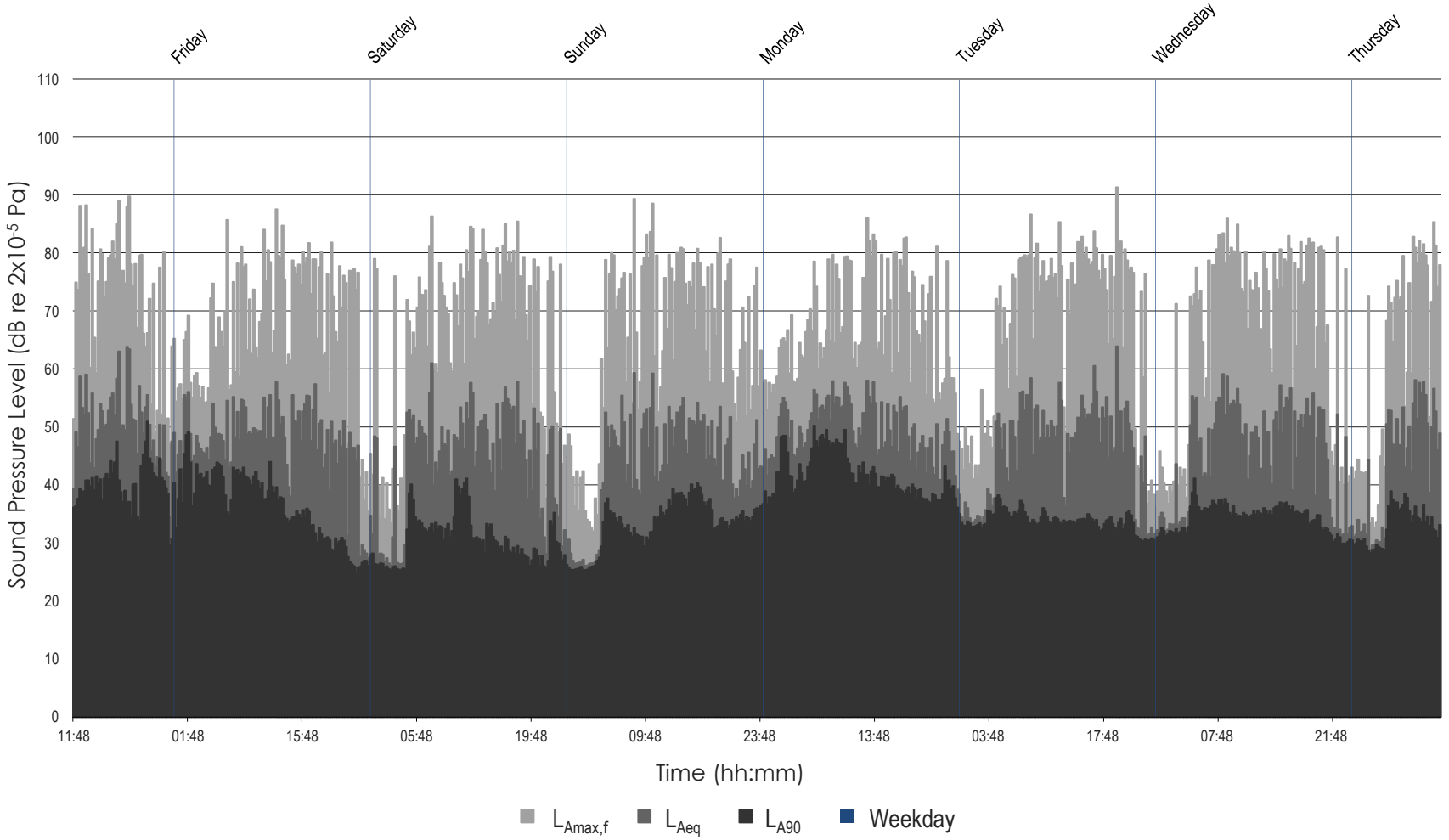
Dean Moor Solar Farm
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
LT1 - Thursday 4 May to Thursday 11 May 2023



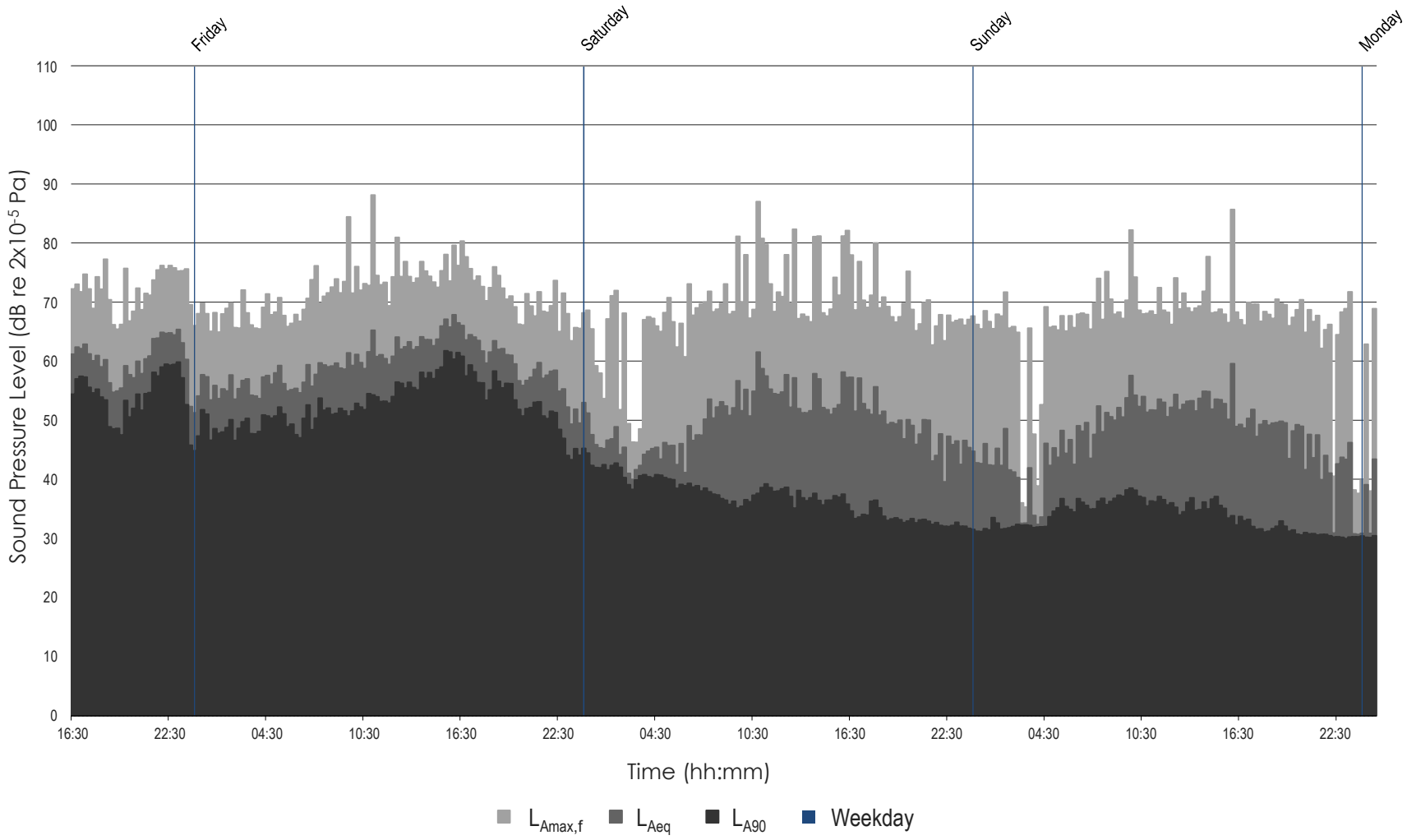
Dean Moor Solar Farm
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
LT2 - Thursday 23 March to Monday 27 March 2023



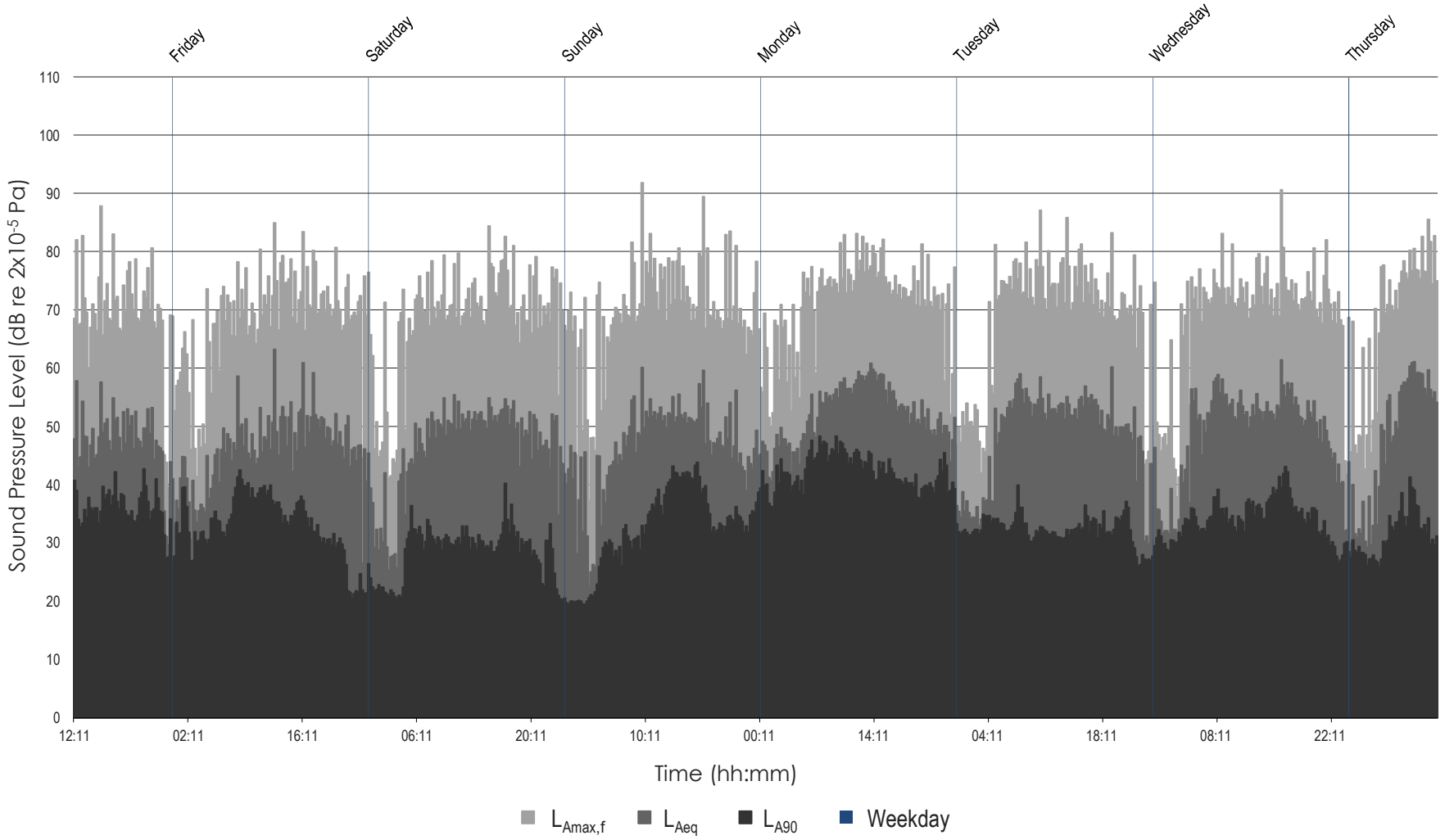
Dean Moor Solar Farm
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
LT3 - Thursday 4 May to Thursday 11 May 2023



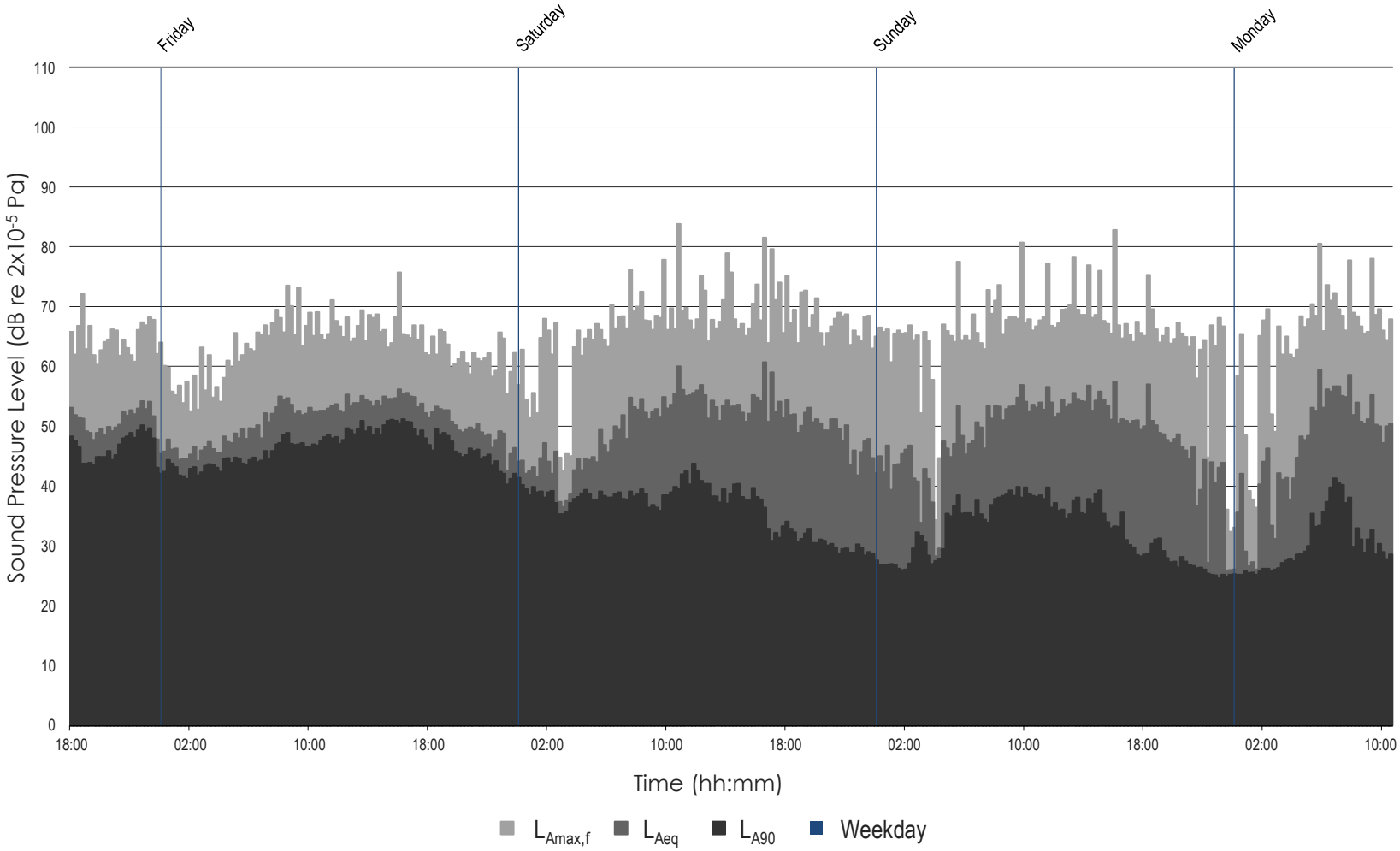
Dean Moor Solar Farm
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
LT4 - Thursday 23 March to Monday 27 March 2023



Dean Moor Solar Farm
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
LT5 - Thursday 4 May to Thursday 11 May 2023

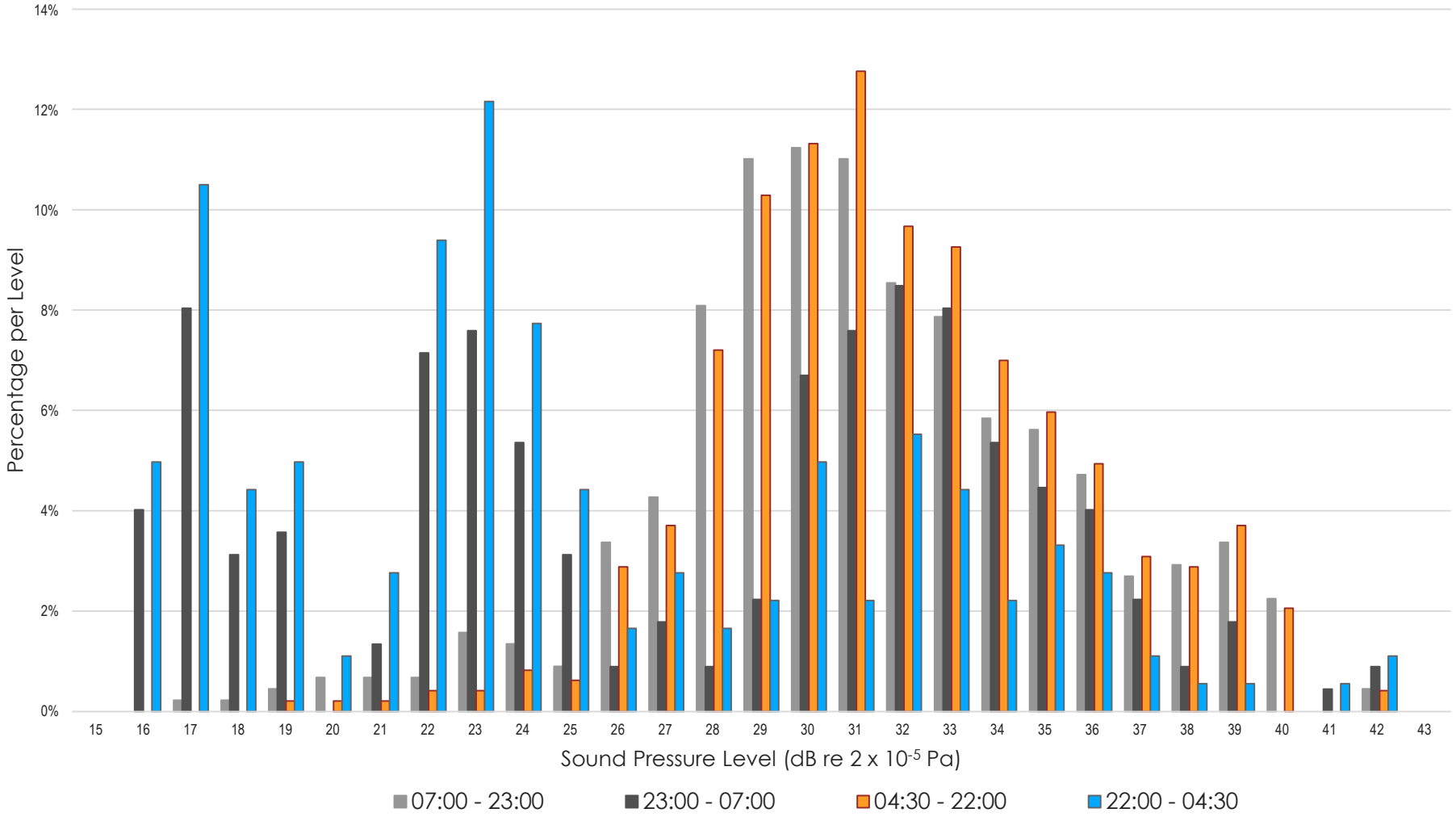


Dean Moor Solar Farm
L_{Aeq}, $L_{Amax,f}$ and L_{A90} Time History
LT6 - Thursday 23 March to Monday 27 March 2023

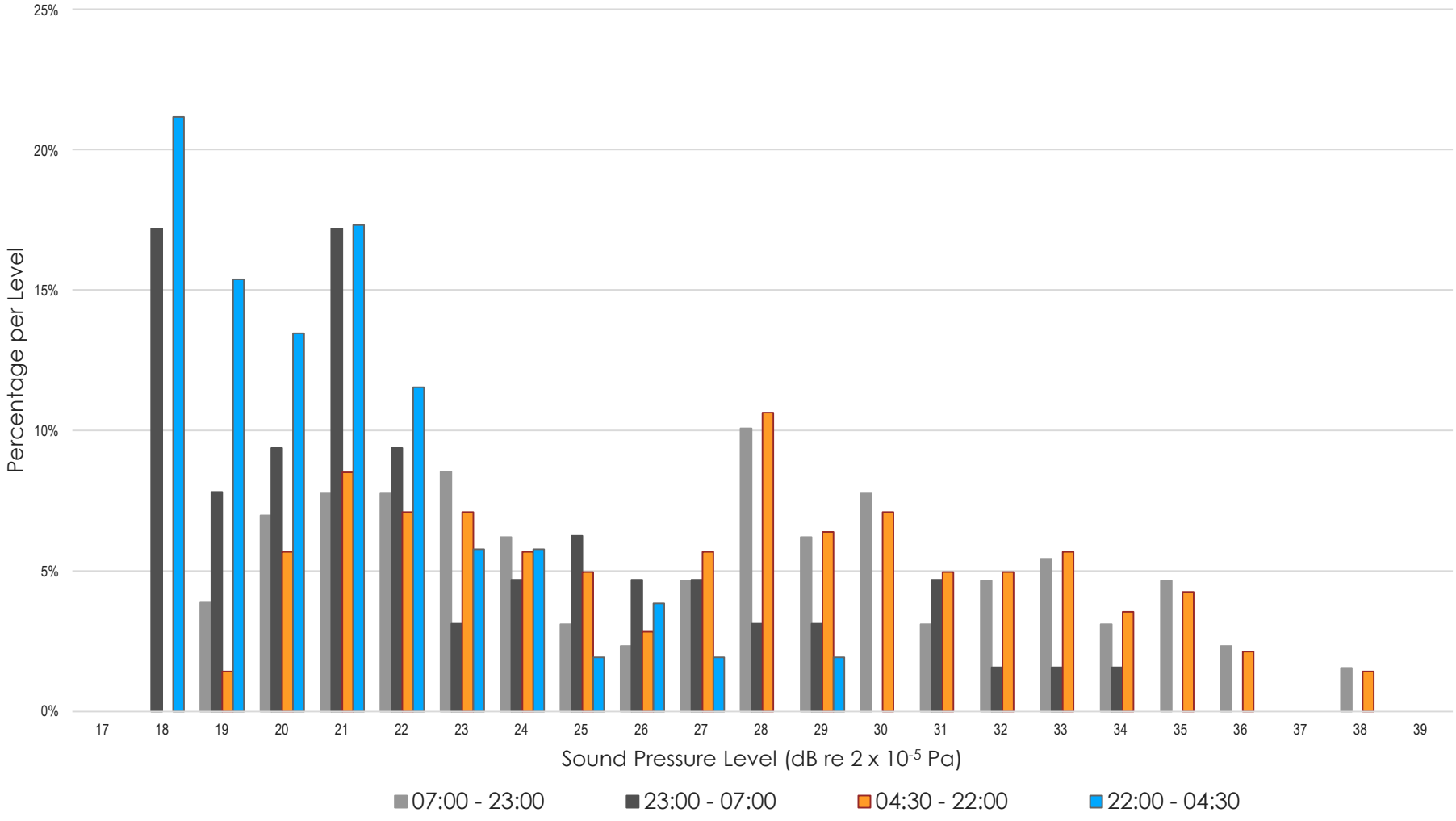


Appendix E Background Sound Level Histograms

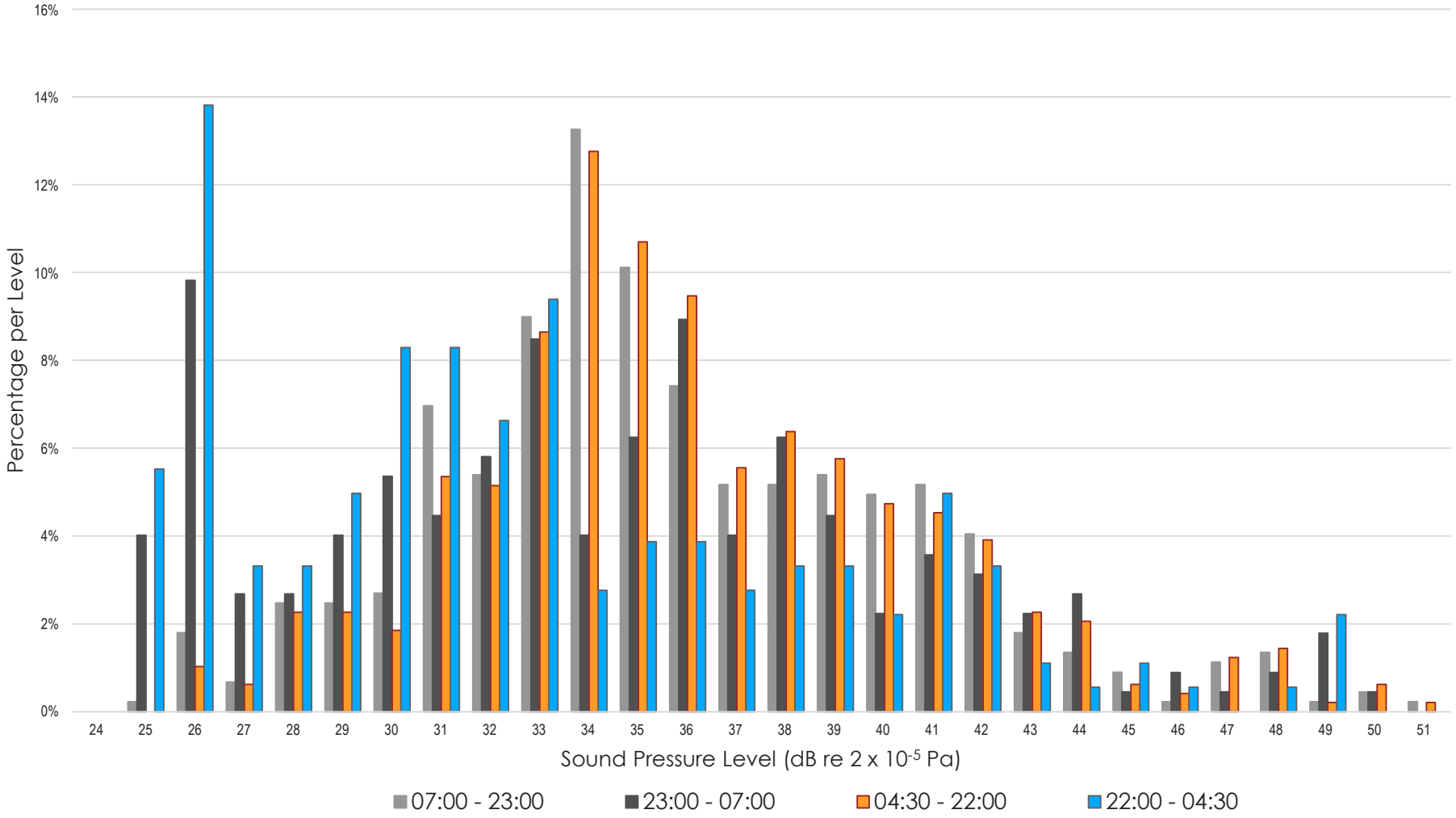
Dean Moor Solar Farm
$L_{A90,15\ minutes}$ Histogram
LT1 - Thursday 4 May to Thursday 11 May 2023



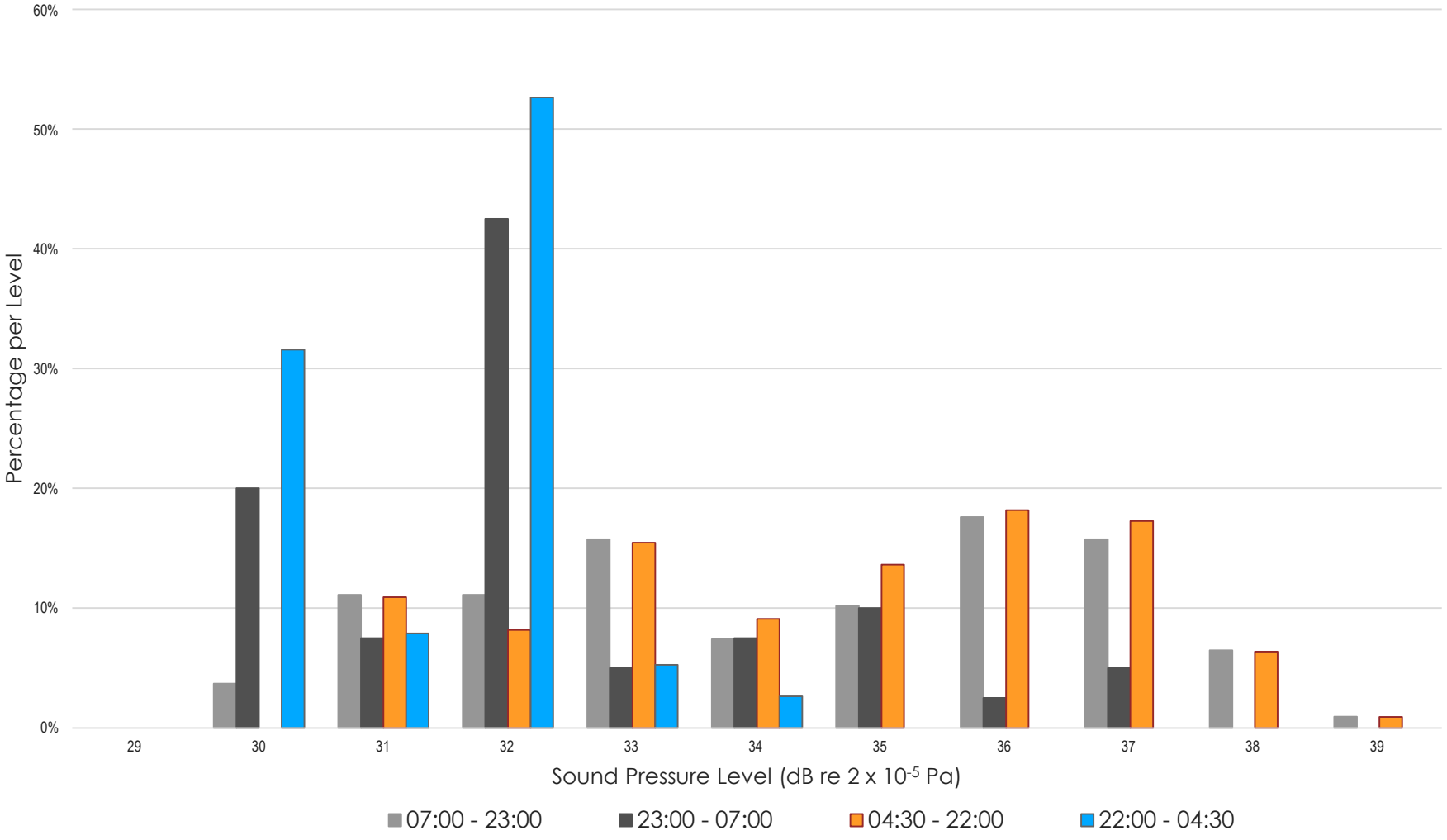
Dean Moor Solar Farm
$L_{A90,15\ minutes}$ Histogram
LT2 - Thursday 23 March to Monday 27 March 2023



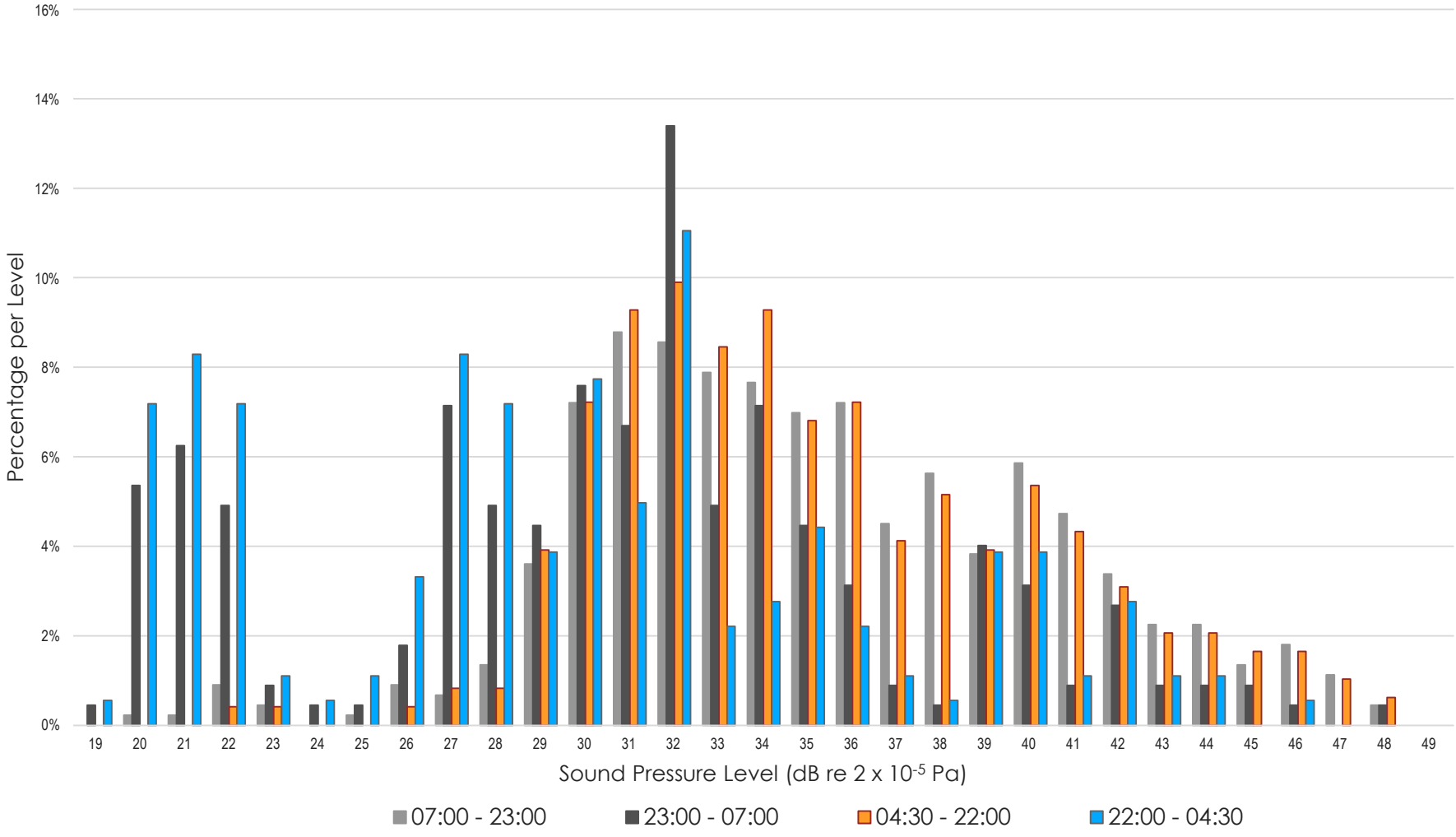
Dean Moor Solar Farm
$L_{A90,15\ minutes}$ Histogram
LT3 - Thursday 4 May to Thursday 11 May 2023



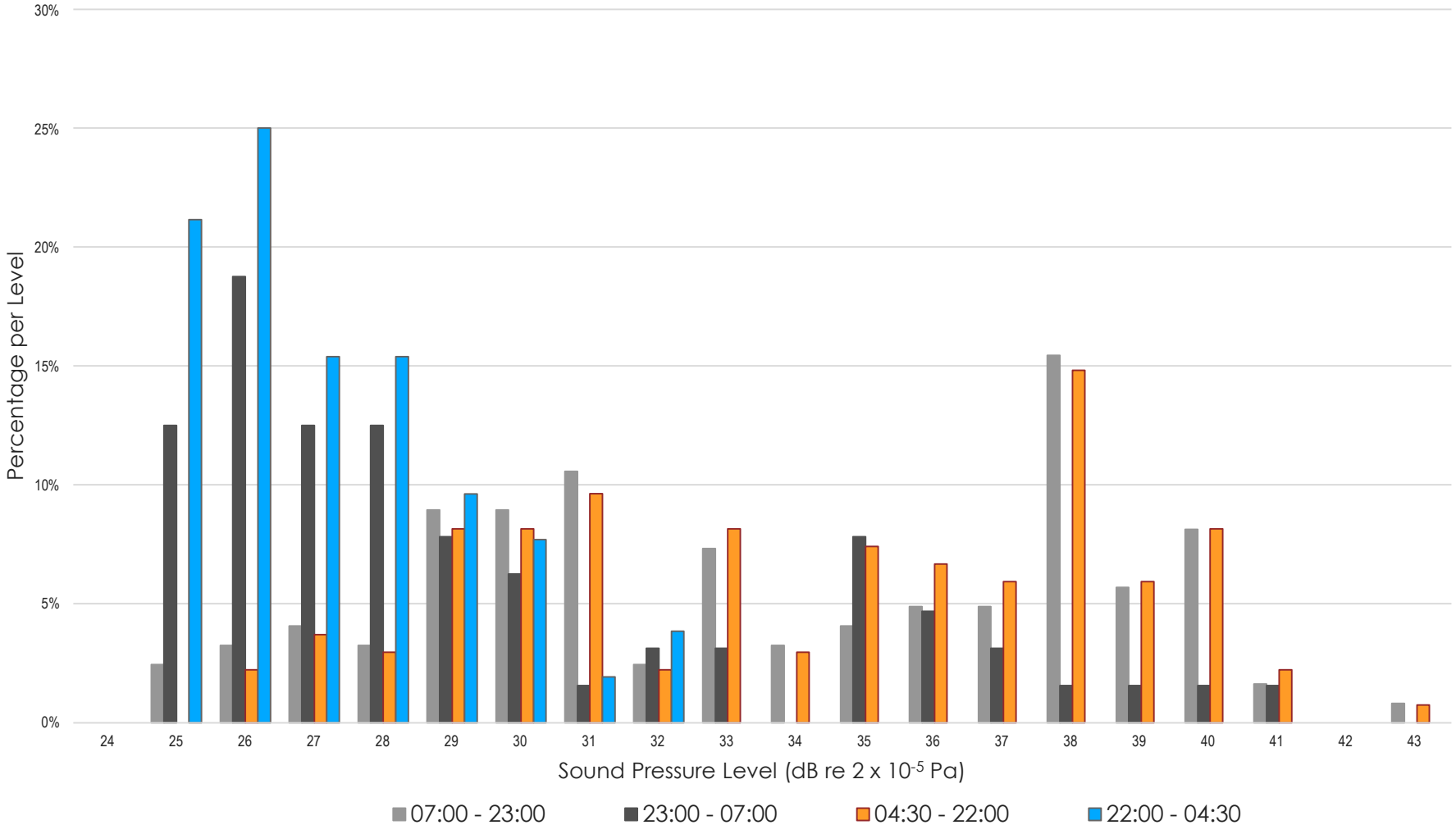
Dean Moor Solar Farm
$L_{A90,15\ minutes}$ Histogram
LT4 - Thursday 23 March to Monday 27 March 2023



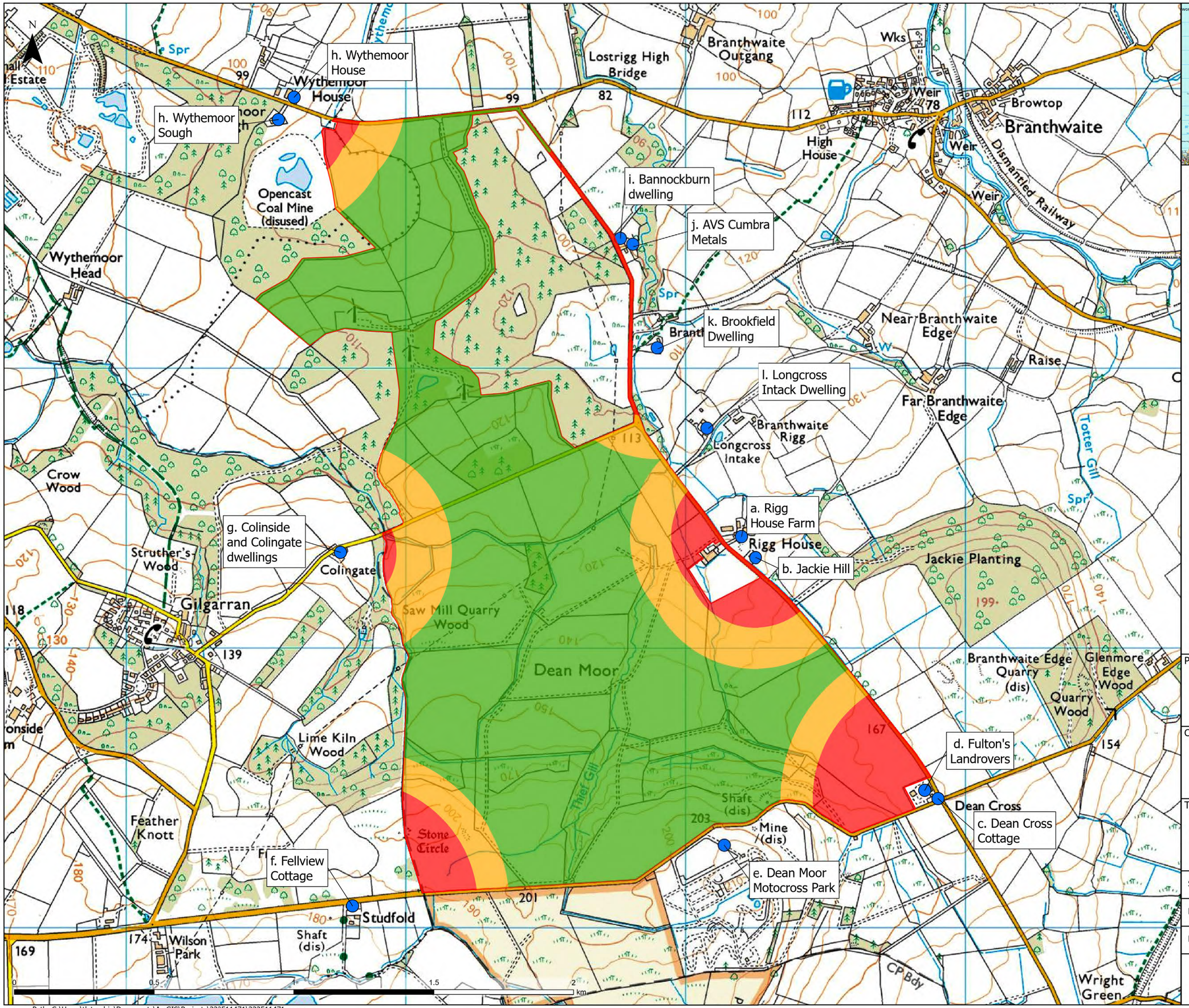
Dean Moor Solar Farm
$L_{A90,15\ minutes}$ Histogram
LT5 - Thursday 4 May to Thursday 11 May 2023

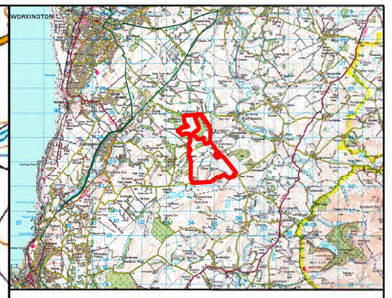


Dean Moor Solar Farm
$L_{A90,15\ minutes}$ Histogram
LT6 - Thursday 23 March to Monday 27 March 2023



Appendix F LOAEL and SOAEL Distances for PCS Units





Legend

- Order Limits
- Noise Sensitive Receptor

Noise Risk

- Above SOAEL
- Between LOAEL and SOAEL
- Below LOAEL

Project Title: Dean Moor Solar Farm

Client: FVS Dean Moor Limited

Title: DEAN MOOR SOLAR FARM DEVELOPMENT CONSENT ORDER Appendix F Q9.0.1 Receptor Noise Risk - PCS

Scale: 1:12,500 @ A3	Date: 10/09/2025
Drawn: TL	Checked: HC
Figure: 001	Sheet 1 of 1 | Rev: A

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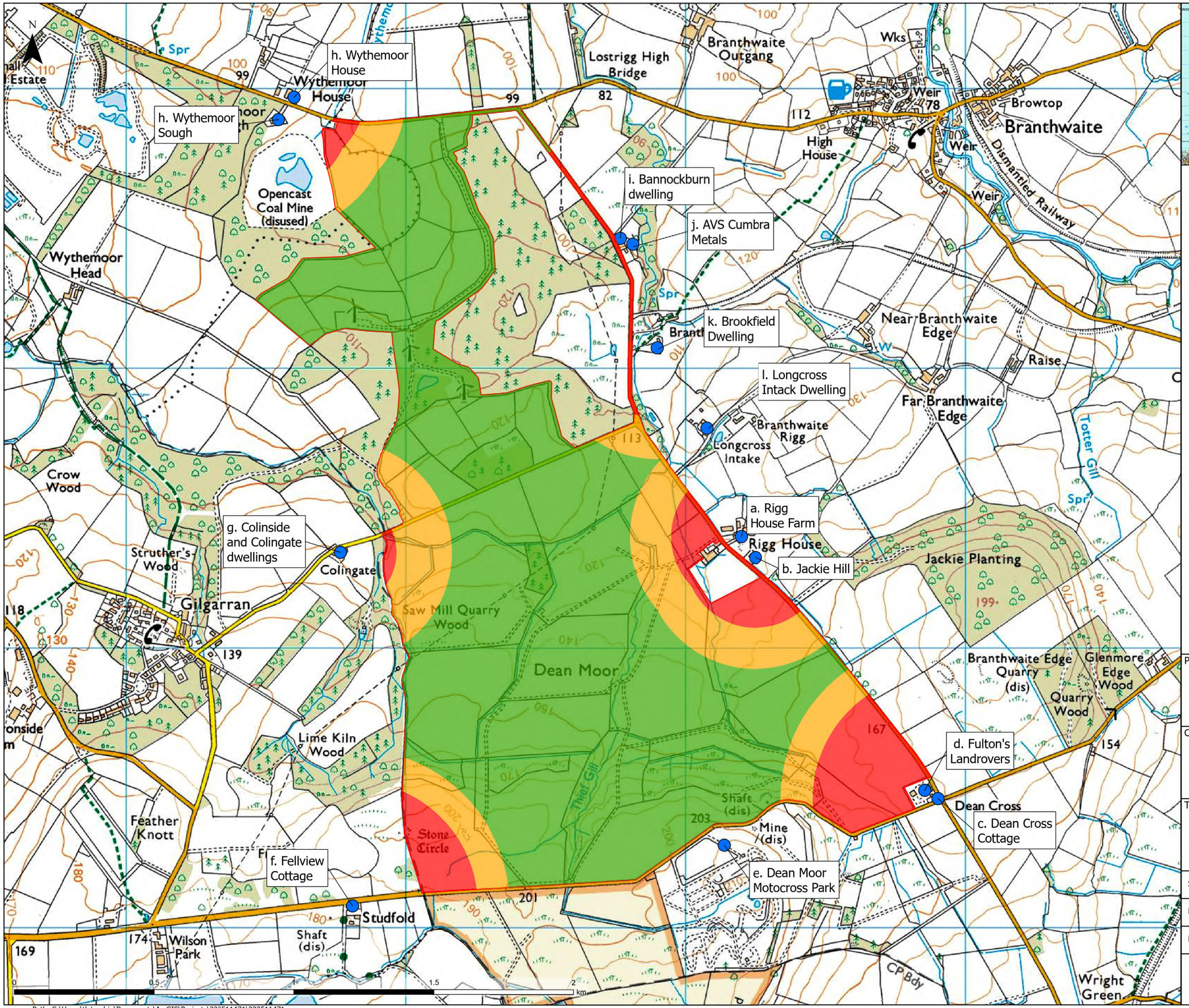

Legend

- Order Limits
- Noise Sensitive Receptor

Noise Risk

- Above SOAEL
- Between LOAEL and SOAEL
- Below LOAEL

Project Title: Dean Moor Solar Farm

Client: FVS Dean Moor Limited

Title: DEAN MOOR SOLAR FARM DEVELOPMENT CONSENT ORDER Appendix F Q9.0.1Receptor Noise Risk - POC Compound

Scale: 1:12,500 @ A3	Date: 10/09/2025
Drawn: TL	Checked: HC
Figure: 002	Sheet 1 of 1 — Rev: A

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h. Wythemoor House

h. Wythemoor Sough

i. Bannockburn dwelling

j. AVS Cumbra Metals

k. Brookfield Dwelling

l. Longcross Intack Dwelling

a. Rigg House Farm

b. Jackie Hill

c. Dean Cross Cottage

d. Fulton's Landrovers

e. Dean Moor Motocross Park

f. Fellview Cottage

g. Colinside and Colingate dwellings

Opencast Coal Mine (disused)

Wythemoor Head

Lostrigg High Bridge

Branthwaite Outgang

Wks

Weir

Browtop

Branthwaite

High House

Dismantled Railway

Near Branthwaite Edge

Raise

Far Branthwaite Edge

Branthwaite Rigg

Longcross Intake

Totter Gill

Jackie Planting

Crow Wood

Struther's Wood

Gilgarran

Colingate

Saw Mill Quarry Wood

Dean Moor

Lime Kiln Wood

Thier Gill

Stone Circle

Shaft (dis)

Mine (dis)

Dean Cross

Branthwaite Edge Quarry (dis)

Glenmore Edge Wood

Quarry Wood

Feather Knott

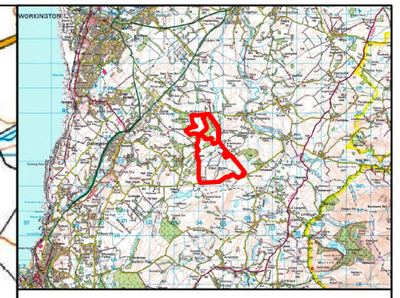
Studfold

Wilson Park

Wright Green

CP Bdy

0 0.5 1 1.5 2 km



Legend

- Order Limits
- Noise Sensitive Receptor

Noise Risk

- Above SOAEL
- Between LOAEL and SOAEL
- Below LOAEL

Project Title: Dean Moor Solar Farm

Client: FVS Dean Moor Limited

Title: DEAN MOOR SOLAR FARM DEVELOPMENT CONSENT ORDER Appendix F Figure 3 Receptor Noise Risk - PCS Further Mitigation

Scale: 1:12,500 @ A3	Date: 10/28/2025	
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Figure: 003	Sheet 1 of 1	Rev: A

Stantec

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