Tween Bridge Solar Farm

Environmental Statement
Chapter 13: Noise and Vibration

Planning Act 2008
Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

APFP Regulation 5(2)(a)

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13. Noise and Vibration

13.1. Introduction

13.1.1. This chapter of the ES assesses the potential noise and vibration effects of the Scheme on the local environment.

13.1.2. The noise and vibration assessments presented in this chapter cover the construction, operational and decommissioning phases of the Scheme and contribute to additional information provided in the **ES Chapter 17 Cumulative Impacts [Document Reference 6.2.17 Revision 4~~3~~]**.

13.1.3. The Order Limits are located in a semi-rural area, to the east of Thorne and north-east of Junction 5 of the M18 motorway. The M18 and M180 motorways are the most significant noise sources in the vicinity with additional contributions from smaller, local roads and the railway lines running between Thorne and Ealand. An existing wind farm (Tween Bridge Wind Farm) is contained within the Order Limits, however, the wind turbines themselves have been omitted from the Order Limits.

13.1.4. Construction and decommissioning noise and vibration impacts have been considered in line with British Standard BS 5228 and other relevant guidance including the impact of construction traffic on local roads.

13.1.5. Operational noise levels from the Scheme have been predicted to the nearest noise sensitive receptor locations in accordance with the methodologies detailed in British Standard and International Standard BS ISO 9613-2 **[Ref. 13-1]**. The impact of the predicted noise levels has been assessed against limits derived from a baseline noise survey undertaken in the vicinity of the Scheme, with the significance of the effects derived in accordance with appropriate standards and guidance. The Scheme will typically operate only during daylight hours. While this may include the early morning period, it will not be at full operational duty and will not include the most sensitive time of the night when people are trying to get to sleep. Therefore, the Scheme has been assessed against daytime noise limits. However, the Battery Energy Storage System (BESS) areas, and associated substations, could operate at any time and are assessed against night-time limits set to prevent sleep disturbance.

13.1.6. This chapter is supported by the following Appendices:

- **ES Appendix 13.1 – Baseline Noise Survey Reports [APP-114].**

- **ES Appendix 13.2 - Noise Source Information [REP2-053]**

13.1.7. Chapter is supported by the following figures:-

- **ES Figure 13.1 - Identified Noise Sensitive Receptors [APP-165];**
- **ES Figure 13.2 – Noise Monitoring Locations [APP-166];**
- **ES Figure 13.3 – Daytime Operational Noise Levels [REP2-059]; and,**
- **ES Figure 13.4 – Night-time Operational Noise Levels [REP2-060].**

13.2. Consultation

13.2.1. The principal consultations which have informed this chapter are summarised in the tables below.

Table 13-1: Summary of Consultation – Scoping Opinion

Consultee	Summary of Consultee Response	How Response Has Been Addressed By Applicant
EIA Scoping Opinion		
PINS EIA Scoping Opinion	ID 2.1.14 If tracking panels are to be used, the ES should assess the potential for significant noise effects on ecological and human receptors during operation.	Consideration of the use of tracking panels is included within **Section 13.4** of this ES chapter.
	ID 3.3.1 Table 3.4 of the Scoping Report proposes that impacts on human health will be considered within relevant ES aspect chapters, such as Air Quality and Noise, rather than in a standalone ES chapter. The Inspectorate is content with this approach. The EIA Methodology ES chapter should provide clear cross-referencing to where the relevant impacts on human health are	Impacts on Human Health in regards to noise is included in this Chapter as outlined at **ES Chapter 4 Approach to Environmental Impact Assessment [APP-041]**

	considered. Consideration should be given to direct and indirect impacts on human health receptors.	
	ID 3.11.1 The ES should assess impacts to users of PRoW or other recreational routes (including severance, delay, amenity and fear/ intimidation) during construction and decommissioning which are likely to result in significant effects. Any such assessment should be supported by pedestrian/ user counts where possible, with effort made to agree the locations for such counts with relevant consultation bodies. Where relevant, the ES should assess potential interactions between aspect assessments (for example traffic and transport, noise, dust, recreation and visual impact).	Noise and vibration impacts on PRoW and other recreational routes have been considered in **Section 13.5** of this chapter.
	ID 3.12.1 The Scoping Report proposes to scope out an assessment of impacts from construction noise on the basis that the noise is temporary and occurs during the day. Impacts from vibration are not specifically sought to be scoped out, nor are potential impacts described. No substantial evidence has been provided to suggest that noise or vibration impacts during construction would not be significant. The Inspectorate also notes the potential for construction noise impacts on ecological receptors including SPA/ Ramsar bird qualifying features.	Noise and vibration during the construction and decommissioning phases of the development are included in this Chapter including the effect of construction traffic. Additional guidance on the impact on ecological receptors is included in the **Report to Inform Habitat Regulations Assessment [Document**

	The Inspectorate does not agree that these matters can be scoped out. The ES should assess noise and vibration impacts arising from construction and decommissioning activities (including traffic) which are likely to result in significant effects. The assessment should include information on predicted construction and decommissioning traffic movements, traffic routing, noise and vibration emissions and distances from receptors. Any proposed mitigation measures (such as the proposed use of a push-piling rig rather than impact-driven piles) should be described and their delivery secured through the DCO or other legal mechanism.	**Reference 5.3 Revision 8~~6~~]**
	ID 3.12.2 The ES should identify ecological and cultural heritage receptors which could be impacted by noise and vibration from the Proposed Development and assess any likely significant effects on such receptors.	Ecological and heritage receptors are identified in **Table 13-10** of this ES chapter
City of Doncaster and North Lincolnshire Councils	Consultation was undertaken to agree the noise monitoring locations used in this assessment. Further consultations were undertaken to agree the assessment locations used in the assessment.	The noise monitoring survey was undertaken as agreed with the Authorities. No further action required.

Table 13-2: Summary of Consultation – Statutory Consultation

Consultee	Summary of Consultee Response	How Response Has Been Addressed By Applicant
Statutory Consultation		
Natural England	1.3.4 Noise and visual disturbance to SPA birds using functionally linked land. Natural England advises that noise and visual disturbance impacts on functionally linked land during construction, operation and decommissioning should be assessed in the HRA.	These elements have been addressed in the **Report to Inform Habitat Regulations Assessment [Document Reference 5.3 Revision 8~~6~~]** Consideration has been given to the potential noise impact on the Thorne and Hatfield SPA and mitigation measures are included in the **Outline Ecological Construction Management Plan [Document reference 7.5 Revision 6~~4~~]**
	1.4.3 Noise, visual and lighting disturbance impacts on nightjar within the Thorne and Hatfield Moors SPA during construction and operation. Natural England welcomes that "disturbance to nightjar utilising adjacent Moors during construction phase" has been screened in for further assessment. NatureScot's Disturbance Distances in selected Scottish Bird Species Guidance identifies breeding nightjar as having Medium/High sensitivity to disturbance and recommends a buffer zone of 150m-500m. Nightjar have been recorded nesting in close proximity to the site boundary (<50m), making them potentially susceptible to disturbance. We therefore advise that the HRA should include a detailed assessment of disturbance impacts to	

	nesting nightjar, including noise and visual disturbance. Our above advice on assessing noise disturbance impacts and identifying suitable mitigation measures (section 1.3.3) should be applied to the assessment, where relevant. Buffer zones or restrictions to timings of works may be required in close proximity to the Thorne and Hatfield Moors SPA boundary during nightjar nesting season. The potential impacts of noise, lighting, and visual disturbance on nightjar are briefly discussed in the Outline eCMP, though only in reference to the Humber Estuary SPA. We advise that noise to Thorne and Hatfield Moors SPA should be factored into the design of the final eCMP.	
	1.4.4 Noise, visual and lighting disturbance impacts on nightjar using functionally linked land during construction and operation. Natural England advises that the HRA should also assess the impacts of noise and visual disturbance on nightjar using functionally linked land around the SPA. As highlighted above, tagging studies have confirmed usage of the proposed development site by foraging nightjar. Nightjar forage at night; therefore, particular consideration should be given to any construction/operational activities and associated lighting/noise proposed during the nightjar breeding season.	

City of Doncaster Council	Paragraph 13.9.4 states that an assessment of the potential construction noise and vibration effects will be undertaken when the construction programme is known, and this will be presented in the Environmental Statement. Again, CDC would welcome the opportunity to review and comment on this, within the context of all proposed mitigation measures before the ES is finalised.	Construction Noise and Vibration have been considered in **Section 13.5** chapter and mitigation measures are included in the **Outline CEMP [Document Reference 7.1 Revision 6~~5~~].**
	Paragraph 13.9.7 explains that Table 13.16 summarises the identified effects and any mitigation, but that the table is currently only partially populated. Additional information is required to complete the cumulative and in combination effects portion. Again, this is to be included in the Environmental Statement. CDC would reiterate the importance of engagement taking place prior to the ES being finalised to allow for meaningful engagement to take place.	Table 13.16 of the Preliminary Environmental Information Report (PEIR) became **Table 13-25** of this chapter and is now completed.
Canal & River Trust	The Trust have raised comment with regards to the risks of horizontal directional drilling below the Stainforth & Keadby Canal, and the need to protect the canal from vibrational impacts below. 9.7.15 in Chapter 9 of the latest PEIR addresses this point, and highlights that specific risk assessments, method statements and environmental management plans, based on location specific topography, ground and groundwater conditions, will be undertaken and agreed with consultees, stakeholders	No action required within this ES Chapter.

	and regulators prior to commencement. The Trust welcome this approach. We request that this matter should be covered as part of Protective Provisions for the Trust within the DCO.	

13.3. Assessment Approach and Relevant Guidance

Layout Optionality

13.3.1. This section of the chapter summarises the assessment methodologies and guidance used in the production of this chapter.

13.3.2. As detailed in **ES Chapter 2 Scheme Description [APP-039]**, the Scheme design considered in this ES has two options:

- **Option 1 –** A combination of fixed and tracking solar panels (see **ES Figure 2.2b – Indicative Operational Layout Plan (Fixed and Tracker Solar Panel) [~~Document Reference 6.4.2.2b Revision 3~~REP4-038]** for illustrative details);
- **Option 2 –** Fixed Solar Panels (see **ES Figure 2.2a – Indicative Operational Layout Plan (Fixed Solar Panel) [**REP4-037**~~Document Reference 6.4.2.2a Revision 3~~]** for illustrative details).

13.3.3. The difference between the two designs is the inclusion of tracking solar panels in the first option. These are to be located in the northern portion of the Order Limits, in land parcels A3 to A9, A11a and C2.

13.3.4. All other aspects of the design i.e. the location of inverters, transformers etc are common to both options. Since noise from the motors associated with the tracking panels is negligible, there is no difference in the noise and vibration assessments for the two options, and the one set of judgements provided for the assessment of impacts, significant of effect conclusions and mitigation measures apply for both design options.

Legislative and Policy Framework

The Energy National Policy Statements (NPS).

13.3.5. The energy National Policy Statements (NPS) **[Ref. 13-2]** set out the government's policy for the delivery of energy infrastructure and provide the legal framework for planning decisions. They were first designated and published in 2011. Further updates were made in 2023 and 2024.

13.3.6. The NPS do not provide limits and specific guidance for the assessment of acoustic Impacts however, policies EN-1, EN-3, EN-5 and the Habitats Regulations Assessment (HRA) document do reference acoustics and offer generic advice without specific criteria.

Overarching National Policy Statement for Energy (EN-1) **[Ref. 13-3]**

Section 5.12 Noise and Vibration states:

"The Government's policy on noise is set out in the Noise Policy Statement for England.

It promotes good health and good quality of life through effective noise management. Similar considerations apply to vibration, which can also cause damage to buildings. In this section, in line with current legislation, references to "noise" below apply equally to the assessment of impacts of vibration….

Noise resulting from a proposed development can also have adverse impacts on wildlife and biodiversity. Noise effects of the proposed development on ecological receptors should be assessed by the Secretary of State in accordance with the Biodiversity and Geological Conservation section of this NPS at Section 5.4. This should consider underwater noise and vibration especially for marine developments. Underwater noise can be a significant issue in the marine environment, particularly in regard to energy production.

Factors that will determine the likely noise impact 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"*

National Policy Statement for Renewable Energy Infrastructure (EN-3) **[Ref. 13-4]**

13.3.7. In terms of noise and vibration, policy EN-3 does not provide limits and specific guidance for the assessment of acoustic impacts however, the document does reference acoustics and offer generic advice without specific criteria.

National Planning Policy Framework

13.3.8. In March 2012 the 'National Planning Policy Framework' (NPPF) **[Ref. 13-5]** was introduced as the current planning policy guidance in England. This document was last updated in February 2025. The document is generally not prescriptive and does not provide noise criteria. Instead, it places the onus on local authorities to develop their own local plans and policies.

"187. Planning policies and decisions should contribute to and enhance the natural and local environment by: ……..

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability……."

13.3.9. The document further states that:

"198. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;

b) identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason…"

Noise Policy Statement for England

13.3.10. The Noise Policy Statement for England (NPSE) **[Ref. 13-6]** sets out the government's policy on environmental, neighbourhood and neighbour noise for England. The policy sets out three aims:

- *"avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and,*
- *where possible, contribute to the improvement of health and quality of life."*

13.3.11. The NPSE introduces the following terms which are also used in the NPPF:

"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.

SOAEL – Significant Observed Adverse Effect Level

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

13.3.12. However, neither the NPSE nor the NPPF defines numeric bounds for NOEL, LOAEL or SOAEL. The limits of each effect level should be defined for each situation and location.

13.3.13. Further Government advice is available online as the Planning Practice Guidance (PPG): Noise **[Ref. 13-7]**. This advises on how planning can manage potential noise impacts in new developments. The online guidance refers to the NPPF and NPSE and presents a noise assessment hierarchy table to provide further

information on the boundaries between NOEL, LOAEL and SOAEL. This is shown in **Table 13-3.**

Table 13-3: Noise Assessment Hierarchy Table

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
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			
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			
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	Significant Observed Adverse Effect	Avoid

	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.		
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

The Control of Pollution Act

13.3.14. The Control of Pollution Act (CoPA) 1974 **[Ref. 13-8]** covers a wide range of environmental pollution including noise. Parts of the Act have been superseded by the Environmental Protection Act 1990.

13.3.15. Section 60 of CoPA relates to the 'Control of Noise on Construction Sites' and Section 61 relates to obtaining 'Prior Consent for Work on Construction Sites'. These parts of the Act are often used in conjunction with other standards to determine acceptable noise levels in relation to construction, hours of operation and specific working methods or mitigation.

The Environmental Protection Act

13.3.16. The Environmental Protection Act (EPA) 1990 **[Ref. 13-9]** requires local authorities to investigate noise complaints from premises (land and buildings) and vehicles, machinery or equipment in the street. This includes noise arising from construction sites.

Assessment of Significance

13.3.17. In accordance with the NPPF, and the NPSE, thresholds for the LOAEL and SOAEL have been proposed for each noise and vibration impact at noise-sensitive receptors.

13.3.18. The noise and vibration effects have been defined in accordance with the significance criteria presented in **Chapter 4: Approach to Environmental Impact Assessment [APP-041]**. Based on the descriptions of the adverse effect levels in the PPG for noise, recommended actions for each significance level have been provided. The significance level is the same for all the potential noise effects at all identified receptors. The noise and vibration significance criteria are presented in **Table 13-4**.

Table 13-4: Significance Level and Noise and Vibration Adverse Effect Level

EIA Significance Level	Noise and Vibration Adverse Effect Level	Impact and Action (to be applied to potential effects)
Major	SOAEL	Noise and Vibration causes a material change in behaviour and/or attitude. This level should be avoided.
Moderate	-	Noise and Vibration can be heard and causes small changes in behaviour or attitude. Noise should be mitigated and reduced to a minimum.
Minor	LOAEL	Noise and Vibration can be heard but does not cause a change in behaviour or attitude. No specific mitigation measures are required.
Negligible	NOEL	Noise and Vibration has no effect. No specific measures required.

13.3.19. Effects denoted as 'Moderate' or 'Major' are considered as significant effects for the purpose of this assessment.

Assessment Methodology

Construction & Decommissioning Noise Impacts

13.3.20. British Standard (BS) 5228:2009+A1 'Code of Practice for Noise and Vibration Control on Construction and Open Sites' **[Ref. 13-10 and 13-11]** is in two parts: Part 1 covers noise and Part 2 covers vibration. Part 1 does not provide specific limits for construction and decommissioning noise, but it does define methods of assessing the significance. The standard also provides practical information on construction noise and vibration reduction measures promoting a 'Best Practice Means' approach to control noise and vibration including a commentary on "non-acoustics factors" which influence the likelihood of receiving complaints such as mud on local roads and the need to inform residents.

13.3.21. Given the nature of activities during the construction phase and the Best Practical Means detailed in BS 5228, the noise and vibration measures detailed in the **Outline CEMP [Document Reference 7.1, Revision 6~~5~~]** and **Outline Ecological Construction Management Plan [Document Reference 7.5, Revision 6~~4~~]** are considered as embedded mitigation measures and are included in the assessments and calculations undertaken within this chapter.

13.3.22. A method for calculating noise levels associated with construction activities is provided in BS 5228 which considers the numbers and types of equipment operating, their associated Sound Power Level (L_W), the "on-time" within a working day and the distance to receptors, along with the effects of any screening.

13.3.23. The assessment of construction and decommissioning noise effects have been based on the LOAEL and the SOAEL thresholds detailed in **Table 13-5** below and derived from Annex E of BS 5228-1. The LOAEL levels are the 'lower cut offs' identified in BS 5288 and the SOAEL levels are the levels identified that, if exceeded for 'significant' periods of time (either continuously or sporadically) could result in 'widespread community disturbance or interfere with activities or sleep'.

13.3.24. BS 5228 also states that the SOAEL levels should not be exceeded for a period of 10 or more days of working in any 15 consecutive days or for a total number of days exceeding 40 in any six consecutive months.

13.3.25. Construction working hours are detailed in the **Outline CEMP [Document Reference 7.1, Revision 6~~5~~]**. Limited works would be undertaken outside of

these hours though some activities, including directional drilling, may need to be undertaken outside of peak daytime hours based on the requirements of the relevant bodies including National Rail and the National Highways. In the event of works outside of the agreed working hours, permission will be sought through the DCO by setting out the construction hours and any exceptional mechanisms.

Table 13-5: Adverse Effect Levels – Construction & Decommissioning Noise

Adverse Effect Level	Day	Sound Level $L_{Aeq,T}$ (dB)	
		Daytime 07:00 to 19:00	Night 19:00 to 07:00
SOAEL	Monday to Saturday	75	55
	Sundays		
LOAEL	Monday to Saturday	65	45
	Sundays		

13.3.26. Construction noise thresholds are higher than operational noise thresholds because it is recognised that construction works are temporary and involve some unavoidable noise. Irrespective of the limits, the contractor will be expected to use best practicable means to reduce noise and adhere to the measures detailed in the **Outline CEMP [Document Reference 7.1, Revision 6~~5~~]**.

Construction Vibration

13.3.27. The simplest approach to quantify vibration impacts is to use the peak particle velocity (PPV) as measured outside the building. Part 2 of BS 5228 suggests that for construction activities, it is considered more appropriate to provide guidance in terms of the PPV, since this parameter is usually linked to concerns over potential building damage.

13.3.28. The assessment of construction vibration is based on the LOAEL and SOAEL thresholds detailed in **Table 13-6**. The LOAEL corresponds to a level which 'might be just perceptible in residential environments'.

13.3.29. The SOAEL for construction vibration corresponds to a level which in residential environments would cause complaint but can be tolerated if prior warning and explanation has been given to residents. For non-residential receptors i.e. retail, employment, educational and health receptors, adverse effect levels are higher due to a higher tolerance for disturbance.

Table 13-6: Adverse Effect Levels – Construction Vibration

Adverse Effect Level	Peak Particle Velocity (PPV mm/s)
SOAEL	1
LOAEL	0.3

13.3.30. Given the separation distances between the Order Limits and the nearest receptors, groundborne vibration impacts are considered unlikely to be significant. While the distance between the receptors and the Order Limits is, in some instances around 15m, the distance to the actual construction activities is greater.

13.3.31. Some levels of groundborne vibration may be generated by activities such as installing frame supports using impact driven methods however, the measures detailed in the **Outline CEMP [Document Reference 7.1 Revision 5]** specifically the mitigation buffers, would attenuate the levels of vibration to imperceptible levels at the receptors, resulting in no significant impacts.

13.3.32. Given the above, no further assessment of groundborne construction vibration has been undertaken in this chapter.

Construction Traffic

13.3.33. Increased traffic movements during the construction phase may result in increased noise and vibration, with the delivery of construction material, the solar panels and other components etc.

13.3.34. The Technical Memorandum, Calculation of Road Traffic Noise (CRTN) (Department of Transport and Welsh Office, 1988) **[Ref 13-12]** is the accepted guidance for calculating road traffic noise. The document details an empirical prediction methodology and includes consideration of factors such as vehicle flow, speed, road gradient and road surface construction.

13.3.35. The Design Manual for Roads and Bridges LA 111 Noise and Vibration (Rev 2) **[Ref. 13-13]** sets out the methodology for assessing and quantifying the potential noise impacts associated with changes to the local road network.

13.3.36. Offsite traffic includes vehicle movements associated with the Scheme outside of the Order Limits i.e. construction traffic. Noise impacts from offsite traffic is deemed to be significant if a short-term increase in the predicted traffic noise level occurs in excess of 3dB(A).

13.3.37. The assessment have considered the potential change in traffic flow on 19 road links detailed in **Chapter 12: Transport and Access [**Document Reference 6.2.12 Revision 4~~APP-049~~**]**. The assessments are presented as a worst-case assessment assuming land parcels C and E are constructed concurrently.

Operational Noise

13.3.38. The calculations of operational noise levels have used a range of noise source data for plant and equipment associated with solar power generation and battery energy storage. The noise source information used in the calculations is considered a reasonable proxy for the likely plant and equipment, facilitating a worst-case assessment of the potential noise impacts in keeping with the guidance of the Energy National Policy Statements.

13.3.39. For this Scheme, operational noise levels have been predicted using BS ISO 9613-2: 2024. This is the accepted calculation methodology for sound during outdoor propagation. The calculation methodology includes consideration of a number of pertinent factors including distance propagation, screening, airborne absorption.

13.3.40. The calculations have been made using a 3D digital noise modelling software (IMMI) which is known to faithfully employ the calculation protocols of BS ISO 9613-2: 2024.

13.3.41. The standard method for the assessment of commercial and industrial noise affecting noise sensitive residential receptors is British Standard BS 4142 **[Ref. 13-14]**. The methodology typically derives the significance of the noise impact from the difference between the plant noise under consideration and the background sound level as represented by the L_{A90} parameter, determined in the absence of the plant noise. BS 4142 references the earlier version of the prediction standard (ISO 9613-2) as a validated calculation methodology to determine plant noise levels.

13.3.42. To assess the significance of the impact for residential receptors, noise limits for the various residential receptors are set in terms of the BS 4142 rating level and derived from the results of the baseline noise survey. **Table 13-7** sets out the anticipated adverse effect levels. BS 4142 is described in more detail below.

Table 13-7: Residential Receptors - Operational Noise Adverse Effect Levels

Operational Noise Criteria	Adverse Effect Level
Rating noise level less than noise limit	No Observed Adverse Effect Level (NOAEL)
Rating noise level equal to noise limit	Lowest Observed Adverse Effect Level (LOAEL)
Rating noise level less than or equal to noise limit +5dB	--
Rating noise level less than or equal to noise limit +10dB	Significant Observed Adverse Effect Level (SOAEL)

Operational Vibration

13.3.43. The types of plant and equipment used in the Scheme are unlikely to generate any significant levels of groundborne vibration and, given the distances between the sources and receptor locations, is unlikely to result in any adverse vibration effects. Given this, no further assessment of operational groundborne vibration has been undertaken in this chapter.

Non- Residential Receptors

13.3.44. Operational noise levels in non-residential, external spaces i.e. allotments, golf course and PRoWs have been assessed against the guidance detailed in the World Health Organisation Guidelines for Community Noise **[Ref. 13-15]**. In relation to 'Outdoors in parkland and conservation areas', the guidelines state:

"Existing quiet outdoor areas should be preserved and the ration of intruding noise to natural background sound level should be kept low."

13.3.45. No formal criteria are established for this therefore, the criteria for serious annoyance in outdoor living areas is used in this assessment: $L_{Aeq, 16hr}$ 55dB. This

is based on the premise that use of the identified non-residential receptors is transient in nature and brief exposure to noise levels below $L_{Aeq, 16hr}$, 55dB would result in no changes in behaviour and be of Minor significance. Exposure to noise levels greater than $L_{Aeq, 16hr}$ 55dB may result in changes in behaviour and are considered to be of Moderate significance.

Ecological Receptors

13.3.46. There is little formal guidance on the potential impact of noise and vibration on ecological receptors. Environment Agency (EA) guidance **[Ref. 13-16]** indicates it can cause changes in:

- Behaviour such as foraging;
- The pitch of bird song; and,
- Reproduction rates and population density.

13.3.47. The EA guidance also states that assessment in accordance with BS4142 is not appropriate for non-human species.

13.3.48. Guidance on disturbance to birds as a result of construction activities is, again, limited with no formal thresholds or criteria identified in any available documents. Some evidence indicates birds are high to moderately disturbed by irregular piling activity above 70dB though it is not clear if this relates to the ambient (L_{Aeq}) or max events (L_{Amax}) **[Ref. 13-17]**.

13.3.49. Moderate disturbance is expected in response to more regular piling activities above 70dB though again, the statistical parameter for this is not given.

13.3.50. Noise levels below 50dB are considered to result in low disturbance. Daytime noise levels from the M180 motorway will exceed this for locations close to the motorway.

13.3.51. Given the above, the following criteria are used for the ecological receptors. Note the L_{Aeq} parameter is used:

Table 13-8: Noise Impact Criteria for Ecological Receptors

Impact Significance	Noise Level, L_{Aeq} dB	
	Construction Phase	Operational Phase
Major	>70dB	--
Moderate	50dB to 70dB	>70dB
Minor	<50dB	50dB to 70dB

13.3.52. The criteria above are derived from guidance on impact on birds, principally to address the scoping response from Natural England. The assumption in the criteria is that operational noise would be a more regular source of noise, resulting in a degree of habituation and lower instances of disturbance. Construction noise is likely to be more irregular, resulting in greater disturbance.

Limitations to the Assessment

13.3.53. At this stage the equipment and technology used in the Scheme is not formally identified therefore representative noise sources have been used in the calculations. The need for flexibility in design, layout, and technology is acknowledged in a number of National Policy Statements including paras 4.3.11 and 4.3.12 of NPS EN-1 and section 3.6 of NPS EN-3, to address uncertainties inherent to a scheme.

13.3.54. The final selection of equipment and technology may necessitate additional calculations, but the Scheme will be designed to ensure noise levels of the final plant selection are within the appropriate limits identified within this chapter.

13.4. Baseline Conditions

Order Limits Description and Context

13.4.1. The Order Limits broadly lie between the settlements of Thorne and Crowle, occupying separate parcels of land within a relatively flat agricultural landscape predominantly in arable use. The Scheme's development parcels are dissected by several major roads and routes, including the M180 motorway, the A18, the South Humberside Main Line railway route and Stainforth & Keadby Canal.

13.4.2. Numerous other minor roads cross the landscape connecting scattered residential properties and farmsteads, many of which lie adjacent or in proximity to the Order Limits. The existing Tween Bridge Wind Farm lies in the northern part of the Order Limits.

13.4.1. The Scheme is described further in **ES Chapter 2 Scheme Description [APP-039]** of this ES.

Noise Sensitive Receptors

13.4.2. For the purposes of the assessment a study area of 1km from the Order Limits has been utilised. Due to the size of the Scheme, a selection of receptors has been identified. These include the closest residential, sensitive ecological areas, identified heritage assets and public rights of way.

13.4.3. The identified noise sensitive residential receptors are presented in **Figure 13.1 Identified Noise Sensitive Receptors** appended to this document **[APP-165]**.

13.4.4. Prior to the assessments, consultation was undertaken with City of Doncaster Council and North Lincolnshire Council to agree noise-sensitive receptors considered in this assessment. This includes the additional receptors which have been included following the PEIR produced for statutory consultation.

13.4.5. The assessment positions (AL01 etc) have been chosen to represent the closest noise-sensitive residential receptors to the Order Limits. **Table 13-9** below defines these receptors, along with the OS grid reference and approximate distance to the boundary of the Order Limits. Receptors HER01 to HER05 are heritage assets (listed buildings) identified in **Chapter 8: Cultural Heritage and Archaeology [~~Document Reference 6.2.8, Revision 3~~REP4-026]** and are understood to be residential in nature.

Table 13-9: Identified Noise Sensitive Receptors - Residential

Assessment Locations	Description	Easting	Northing	Approx. Distance to Order Limits (m)
AL01	Wilkinson Avenue	469583	414814	15
AL02	Broadgate Farm	469720	414513	15
AL03	Dairy Farm Cottage	470431	414345	240
AL04	Sandmoor Farm	470340	412999	170
AL05	St Georges Road	469784	412657	470
AL06	Orchard Farm	470903	412209	100
AL07	Clay Bank Farm	470919	411675	15
AL08	Steam House	470263	411135	400
AL09	Tolstem House	470210	410262	15

AL10	Stoupers Gate Farm	469937	409547	15
AL11	Crow Tree Farm	470950	409667	15
AL12	Green Bank	471584	410757	250
AL13	Coldstream Cottage	470832	408576	65
AL14	Plains House Farm	473046	409405	35
AL15	Goodcop Cottage	473415	409001	100
AL16	Woodcarr Farm	475956	408980	15
AL17	Common Farm	477525	409147	200
AL18	Belton Grange	477120	410043	15
AL19	7 Lakes Holiday Park	477617	411089	625
AL20	Windsor Road	476923	412984	15
AL21	Marsh Road	476632	412864	15
AL22	Rose Cottage	475733	413959	190
AL23	Moor Edge Cottage	474721	412553	90
HERO1	Grove House	471841	410933	10
HERO2	Sandhill Farm	472595	411281	60
HERO3	Dirtness Pumping Station	474981	409795	20
HERO4	Dirtness Cottage	475011	409822	40
HERO5	Mosswood Cottage	478543	409244	425

13.4.6. Non-residential receptors are detailed in **Table 13-10** below. These include ecologically sensitive areas identified in the **Report to Inform Habitat Regulations Assessment [Document Reference 5.3 Revision 8~~6~~]**public open spaces and named PRoWs identified in **Figure 3.1 Environmental Designations Plan [APP-140]**

Table 13-10: Identified Noise Sensitive Receptors – Non- Residential

Proposed Assessment Point	Description	Easting	Northing	Approx. Distance to Order Limits (m)
ECO1	Thorne and Hatfield Moor SPA	470991	408480	300
ECO2		473549	413218	20
ECO3		471526	414677	20
NRO1	Pig Hill Allotments	470256	415253	300
NRO2	Golf Course	477516	410144	50
PRoW	The Isle Greenway	--		N/A
PRoW	Peatlands Way Long Distance Walk	--		N/A

13.4.7. In predicting noise levels to ecological receptors, the closest point to the nearest noise source has been used. This is considered a worst-case assessment.

13.4.8. The PRoW's have been assessed through consideration of the predictive noise contours.

Baseline Survey Information

13.4.9. A baseline noise survey was undertaken at representative locations within the Order Limits between January and February 2024. The full details of the survey, including the monitoring locations, results and resultant noise limits are presented in Ion Acoustics Report reference A1972 R01 dated February 2024. This is included at **ES Appendix 13.1 - Baseline Noise Survey Report [APP-114]**.

13.4.10. The monitoring locations and duration of the survey were discussed and agreed with both City of Doncaster Council and North Lincolnshire Council ahead of the survey. Measurements were made at eight locations. These are identified in **ES Figure 13.2 - Noise Monitoring Locations** appended to this ES **[APP-166]**.

13.4.11. The measured, typical background sound levels for each monitoring position is summarised in **Table 13-11** below. For reference, the relative assessment locations are included.

Table 13-11: Typical Background Sound Levels

Monitoring Position	Relevant Assessment Locations	Period	Typical Background Sound Level, L_{A90} dB
MP1	AL20, AL21, AL22	Daytime	37
		Night	33
MP2	AL18, AL19	Daytime	48
		Night	41
MP3	AL14, AL15, AL16, AL17	Daytime	57
		Night	42
MP4	AL10, AL11	Daytime	53
		Night	42
MP5	AL08, AL09, AL12, AL13, HER01, HER02, HER03, HER04, HER05	Daytime	46
		Night	40
MP6	AL04, AL05, AL06, AL07	Daytime	40
		Night	34
MP7	AL01, AL02, AL03	Daytime	34
		Night	32
MP8	AL23	Daytime	36
		Night	32

13.4.12. No baseline vibration survey has been undertaken as the impact of vibration is assessed against absolute limits e.g. those in BS 5228-2, rather than relative change.

Future Baseline

13.4.13. Due to the nature of the area e.g. in close proximity to main transport infrastructure and adjacent to existing wind turbines, it is possible that the noise climate could marginally change in the future with increases in traffic flow etc.

13.4.14. The baseline noise survey represents the current noise climate across the Order Limits. While there may be some increase in noise level, it is considered that change throughout the life of the Scheme would not be significant and therefore, the noise levels measured are representative of the future baseline and no additional noise impacts will be present due to the change in the baseline noise climate.

Tween Bridge Wind Farm

13.4.15. Tween Bridge Wind Farm was granted consent in November 2008 by the Secretary of State for Business Enterprise and Regulatory Reform (now Energy and Climate Change). The consent was granted pursuant to a number of conditions relating to operational noise.

13.4.16. The planning consent for Tween Bridge Wind Farm stipulates a 25year lifespan, which would see the turbines decommissioned in 2037 (the site was commissioned in 2012). If the Wind Farm was decommissioned, it is possible that ambient and background sound levels in the area would fall at locations close to turbines but away from roads. However, the noise assessment supporting the Tween Bridge Wind Farm indicates that, for the majority of receptors, the predicted turbine noise levels fall below the background sound levels. This would indicate that windfarm noise would not have a significant effect on the overall noise levels. Therefore, if the Tween Bridge Wind Farm were to be decommissioned, it would not affect the prevailing noise climate.

Noise Limits

13.4.17. Construction noise limits are based on the adverse effect levels defined in **Table 13-5** above. These are absolute levels rather than criteria based on relative change.

13.4.18. Operational noise limits for residential receptors have been derived from the baseline survey data summarised above. In this instance, the limits for operational noise are set at parity with the typical background sound level. Therefore, the proposed noise limits are shown as the Typical Background Sound Level in **Table 13-11** but they will be set in terms of the BS 4142 rating level dB L_{Ar} with any character penalties applied. This will ensure a low noise impact in accordance with BS4142 and no more than a minor effect for the closest locations in accordance with the LOAEL thresholds from **Table 13-4**.

13.5. Assessment of Likely Significant Effects

Construction Noise

13.5.1. The construction phase of the Scheme has the potential to cause short-term audible noise at nearby receptors. Noise impacts are likely to vary through the construction phase as distances between the noise sources and receptors vary. Activities most likely to generate disturbance include:

- Site establishment including ground works. This may include works for site access roads and hard standings and construction of solar panel support structures;
- Construction of cable routes within the Order Limits; and,
- Construction traffic – increases in road traffic movements on the surrounding road network due to construction traffic have the potential to generate short-term noise impacts at receptor locations.

13.5.2. A qualitative assessment of construction noise in line with BS5228 has been undertaken, assessing noise levels from typical construction processes, proposing noise limits and identifying control measures that could be implemented at the closest receptors should it be necessary.

13.5.3. The Environmental Statement assumes that construction of the Scheme is built out over up to, a 54-month-period (2028- 2032) in either a single phased approach (development of Land Parcels completed one after another with the potential for breaks between development of Land Parcels) or through multiple phases (development of Land Parcels concurrently). For the multiple phase construction option, no more than two land parcels (within land parcels A-E) would be built out at the same time.

13.5.4. The current connection date for the Scheme, within the NESO Connection Agreement is 2029. As with all electricity generation projects, this date is under review by NESO as part of the ongoing connections reform process. If the NESO Connection Agreement remains with the connection date of 2029, it would be possible to operate a phased start to operational generation. This phased approach would connect each Land Parcel to the RWE on-site 400kV substation when construction of that Land Parcel was completed. In this operational scenario there would be partial Scheme operation from 2029-2032 (3 years). From 2032 onwards the full Scheme would be generating at full operational capacity. The full Scheme would operate for 40 years until 2072. If the NESO Grid Connection date varies, which is not within the Applicants direct control, the timeframe where there could be partial operation of the Scheme could reduce or fail to materialise. In this situation the full operational Scheme would operate for 40 years from its new grid connection date. In either connection scenario there will be full operational generation for 40 years, which would be the worst-case scenario operational time period for the Scheme.

13.5.5. Following 40- years of a fully operational Scheme, it is proposed that the Scheme will be decommissioned. This decommissioning with take approximately 24 months and will be in a phased approach.

13.5.6. The final construction programme will depend on the detailed layout, design and potential environmental constraints on the timing of construction activities. An indicative overview of the final construction programme will be set out in the Construction Environmental Management Plan(s) for information.

13.5.7. The noise impact at any one assessment location will have a shorter duration than the 54 month construction phase. Noise impacts will vary as construction activities progress across the Order Limits be that as a single phased or multiple phase approach.

13.5.8. Effects on specific identified receptors during the construction phase are expected to be short-term in duration, although the exact duration over which the impacts will occur at each receptor is not known.

13.5.9. Construction operations would generally only occur during daytime working hours, typically:

- 07:00 to 19:00hrs Monday to Saturdays; and,
- 09:00 to 13:00 on Sundays.

13.5.10. It may be necessary for some construction works to be undertaken outside of these hours though these would only be necessitated by unforeseen circumstances for activities that must be completed without pause, for example HDD work taking longer than anticipated and requiring completion once begun.

Construction Noise Predictions – Solar Panel Frame Construction

13.5.11. The preferred approach to install the solar PV modules support frames is by being pushed into the ground by mobile machinery similar in size to a tractor or JCB. That said, it may be necessary in some instances, where ground conditions require, to install the supports by impact driving.

13.5.12. Impact driving of the frame supports generate noise levels of up to L_{Aeq} 110dB at 1m from the machine while piling. Given this, a buffer of 175m is required between the impact piling machine and the closest residential receptor to achieve the LOAEL criteria. It is assumed the buffer zone would be secured through the CEMP.

13.5.13. For frame supports being installed at distances closer to receptors i.e. within 175m, it is recommended that push piling be undertaken. Push piling generates a sound pressure level of L_{Aeq} 75dB at 10m during operation.

13.5.14. During the calculations for the pushed piling activity, the following mode of operation is assumed:

- Pushing in frame posts (50% on- time); and
- Manoeuvring (idling) to the next installation point (50% on-time).

13.5.15. All predicted noise levels have been based on typical plant source noise levels taken from the appendices of BS5228 or from third party sources. The noise levels used in the calculations are detailed in **Table 13-12**.

Table 13-12: Construction Noise Sources – Frame Support Construction

Plant item / activity	No. of Plant items	L_{Aeq} at 10m	On time (%)	Effective L_{WA}
Pushing Panel supports and fence posts	1	75dB	50	100dB
Tracked Excavator	1	67dB	50	92dB
Effective Sound Power for the Activity				101 dB

13.5.16. Based on the above noise levels, and the distance between the closest solar PV modules to each receptor, the following calculations have been undertaken:

Table 13-13: Solar PV Module Support Construction Calculations – Residential Receptors

Assessment Location	Minimum Distance (Panel to Receptor), m	Piling Method	Predicted Noise Level at Receptor, L_{Aeq}, dB	Noise Limit, (LOAEL), dB
ALO1	220	Impact	63	65
ALO2	160	Pushed	49	65
ALO3	130	Pushed	51	65
ALO4	340	Impact	59	65
ALO5	990	Impact	50	65

AL06	200	Impact	64	65
AL07	70	Pushed	56	65
AL08	740	Impact	53	65
AL09	150	Pushed	50	65
AL10	115	Pushed	52	65
AL11	100	Pushed	53	65
AL12	460	Impact	57	65
AL13	193	Impact	64	65
AL14	45	Pushed	60	65
AL15	95	Pushed	53	65
AL16	70	Pushed	56	65
AL17	315	Impact	60	65
AL18	45	Pushed	60	65
AL19	620	Impact	54	65
AL20	860	Impact	51	65
AL21	540	Impact	55	65
AL22	220	Impact	63	65
AL23	310	Impact	60	65
HER01	430	Impact	57	65
HER02	75	Pushed	56	65
HER03	55	Pushed	58	65
HER04	65	Pushed	57	65
HER05	1180	Impact	49	65

13.5.17. The calculations above assume only one piling rig is used at each location. If multiple rigs are to be used, the noise levels would increase, depending on the relative proximity to the receptor.

13.5.18. The calculations demonstrate that, for the majority of receptors, the separating distance between the activity and receptor would allow for impact driven piles to be used. Where the solar PV modules are in closer proximity pushed piling should be used. If ground conditions necessitate impact piling be used within the 175m buffer area, it is recommended that further calculations be undertaken to more accurately quantify the potential noise impact and derive suitable noise mitigation measures.

13.5.19. By not exceeding the LOAEL effect level, the impact significance level is considered to be 'Minor adverse' in accordance with **Table 13-4** above.

13.5.20. Construction noise calculations to the identified ecological receptors are presented in **Table 13-14** below. The calculations include the embedded

mitigation measures detailed in the **Outline Ecological Construction Management Plan [Document Reference 7.5 Revision 3]**.

Table 13-14: Solar PV Module Support Construction Calculations – Ecological Receptors

Assessment Location	Minimum Distance (Panel to Receptor), m	Piling Method	Predicted Noise Level at Receptor, L_{Aeq}, dB
ECO1	325	Impact	60
ECO2	200	Impact	64
ECO3	200	Impact	64

13.5.21. The calculations above indicate that, with the 200m buffer between the construction areas and the ecological receptors, the predicted noise levels could potentially fall in the Moderate adverse impact range in accordance with the criteria detailed in **Table 13-8**. However, once the timings of the works are considered, the resultant impact would be Minor adverse.

Construction Compounds

13.5.22. The Order Limits is to accommodate up to 31 main construction compounds. The main construction compounds are at least 300m from the nearest noise sensitive dwelling.

13.5.23. The construction compounds, while being a hub of activities, including vehicle movements etc, accommodate very few static noise sources. Information provided indicates that the compounds are largely powered by solar or battery units with only a small, standby generator for emergency power.

13.5.24. Given this, the construction compounds are not considered a significant source of noise and would be removed once the construction phase is completed. To that end, noise impacts arising from the construction compounds has not been considered in any further detail in this assessment.

Construction Phase Traffic

13.5.25. In the first instance, the change in traffic flow, as a result of the Scheme, has been considered against the scoping criteria from DMRB LA111. A comparison of the Do-minimum vs the Do-something scenarios assuming two land parcels are constructed concurrently is presented in Table **13-15** below:

Table 13-15: Construction Traffic Noise Impacts

Road Link	Do Minimum 2023		Do-Something 2023		Difference, dB
	AADT two way flow	BNL, L_{A10} dB*	AADT two way flow	BNL, L_{A10} dB*	
1. March Road	4,506	65.6	4,506	65.6	+/-0
2. North Common Road	3,244	64.2	3,244	64.2	+/-0
3. A614	6,457	67.2	6,457	67.2	+/-0
4. Marshlands Road	8,706	68.5	8,706	68.5	+/-0
5. Coulman Street	4,180	65.3	4,180	65.3	+/-0
6. Moor Edges Road	840	58.3	840	58.3	+/-0
7. High Bridge Road	161	51.2	161	51.3	+0.1
8. Green Bank Road	110	49.5	110	49.5	+/-0
9. A614	5,108	66.2	5,108	66.2	+/-0
10. A18	7,883	68.1	7,912	68.1	+/-0
11. A18	7,950	68.1	7,964	68.1	+/-0
12. A18	7,582	67.9	7,582	67.9	+/-0
13. A18	8,289	68.3	8,289	68.3	+/-0
14. Sandtoft Road	2,318	62.8	2,318	62.8	+/-0
15. Low Levels Bank	2,224	62.6	2,224	62.6	+/-0
16. A161	2,434	63.0	2,434	63.0	+/-0
17. Wharf Road	8,279	68.3	8,279	68.3	+/-0
18. A18	5,317	66.4	5,388	66.4	+/-0
19. Marsh Road	113	49.6	113	49.6	+/-0
* BNL – Basic Noise Level calculated using the traffic flow data					

13.5.27. It is noted that the predicted BNLs detailed in **Table 13-14** are based on the Annual Average Daily Traffic (AADT) parameter which, while not strictly in accordance with the methodology of CRTN, still gives a valid representation of the relative change between scenarios as a result of construction traffic.

13.5.28. The calculations above demonstrate that, across all links, the relative change in road traffic noise during the construction phase is less than 1dB. This is considered to be of Negligible significance in accordance with the criteria in **Table 13-4**.

Directional Drilling

13.5.29. The construction plans propose the use of Horizontal Directional Drilling (HDD) in up to 29 places where cable routes cross existing roads, railways, canals and rivers. The locations are identified on **ES Figure 2.4 Indicative HDD Crossing Plan [APP-137]**. The drilling locations are relatively removed from the nearest receptors, being a minimum of 180m from the closest receptor location .

13.5.30. Drilling activity would typically be undertaken during daytime hours however, when used to drill under train lines or the motorway, the relevant authorities may require that the activity be undertaken outside of peak periods or during the night.

13.5.31. HDD is undertaken using a number of items of plant and equipment which generate noise. BS5228-1 gives the following noise levels:

- Directional Drilling (Generator) 77dB at 10m;
- Mounting Supports for Directional Drilling 87dB at 10m.

13.5.32. At 180m, noise from the operation c~~w~~ould be up to L_{Aeq} 58dB which would fall comfortably below the daytime SOAEL level for short duration activities. At greater distance, the noise levels would be lower.

13.5.33. At 180m, groundborne vibration is unlikely to be perceptible or result in any adverse impacts.

13.5.34. In locations where drilling outside of daytime hours is required, the predicted noise levels generally fall below the night-time SOAEL criteria (L_{Aeq} 55dB) for short duration, night-time activities. At dwellings in the vicinity of drill location 19 as identified on drawing reference **ES Figure 2.4 Indicative HDD Crossing Plan [APP-137]**, specifically Crow Tree Farm (identified as the representative worst-case residential receptor for the assessment of night-time drilling noise), the initial calculation indicates the -SOAEL criterion could be exceeded, with a predicted level of L_{Aeq} 58dB. This could be a temporary, moderate effect (significant) based on the significance levels in **Table 13-4**. It is noted however, that in the absence of any detailed information these are outline calculations

based on assumed noise source levels and distance attenuation alone. They do not include any correction for screening by intervening buildings, soft ground or atmospheric absorption. More detailed calculations would be required as part of any Section 61 consent application under the Control of Pollution Act 1974 to more accurately determine the noise levels at receptor locations in this vicinity and inform the use of site-specific mitigation measures to ameliorate any impacts i.e. temporary barriers, timings of works. A suitably designed temporary barrier could comfortably afford up to 10dB of attenuation, resulting in noise from the drilling operation falling well below the SOAEL criteria, giving a temporary, minor effect (not significant) significance.

~~13.5.34.~~13.5.35. The **Outline Construction Environmental Management Plan [Document Reference 7.1 Revision 6~~5~~]** sets out appropriate commitments for the control of noise at paragraph 4.6.1 of the document.

Operational Assessment

~~13.5.35.~~13.5.36. A computer noise model has been constructed using the IMMI noise modelling software to calculate the operational noise levels at the identified noise sensitive receptors. Within the modelling software, propagation of noise has been calculated in accordance with BS ISO 9613-2 with the following input parameters:

- Downwind propagation (noise levels under crosswind and upwind conditions will be less).
- Soft ground between the noise source and the receiver locations (G = 1.0),
- Average, ambient air temperature of 10°C and 70% Relative Humidity.

Noise Data

~~13.5.36.~~13.5.37. At this stage, the specifics of the noise generating equipment are not confirmed, however in keeping with the guidance of NPS EN-1 and EN-3, a worst-case assessment has been undertaken including the following noise generating assets:

- 210. Solar Central Inverters with Inverter Skids;
- 432. Battery Storage Containers;
- 108 Battery MVS Units.

~~13.5.37.~~13.5.38. The noise data for the various sources used in the computer model are described below. Note that the actual equipment provided may differ from this.

Solar Central Inverter and Inverter Skids

~~13.5.38.~~13.5.39. There are 210. localised central inverter and inverter skids stations within the Scheme. **Table 13-16** gives a sound power spectrum for at typical centralised inverter unit operating at 100% capacity.

Table 13-16: Octave band spectra of example inverter unit

Noise Source	Sound Power Levels in Octave Bands, Hz dB							L_{WA}, dB
	63	125	250	500	1000	2000	4000	
Central Inverter and Inverter Skid	89	87	90	88	84	81	86	91

Battery Storage Containers

~~13.5.39.~~13.5.40. The BESS are containerised and generate little noise which would be perceptible outside of the container envelope. However, the HVAC units that are used to control the internal temperature/environment within the containers do generate some noise.

~~13.5.40.~~13.5.41. For the purposes of this assessment the SunGrow ST2752-UX battery and HVAC system have been used. The sound power level presented below represents typical energy from individual HVAC units, and therefore this total level should be met for each HVAC unit selected.

Table 13-17: BESS HVAC Units Sound Power Level Spectrum

Noise Source	Sound Power Levels in Octave Bands, Hz dB							L_{WA}, dB
	63	125	250	500	1000	2000	4000	
HVAC per Battery unit	77	69	76	75	77	78	70	82

~~13.5.41.~~13.5.42. The noise levels detailed above represent the HVAC units operating at 100%. This is considered to be a rare occurrence, only occurring during extremes of temperature when higher levels of cooling / heating are required. Due to the conservative estimates presented it forms a robust assessment for operating installation.

BESS MVS Unit

~~13.5.42.~~13.5.43. Within the calculations undertaken, noise data for the Sungrow MVS5140-LS-US has been used for the BESS Medium Voltage Stations (MVS). The sound power level used in the calculations is presented below:

Table 13-18: BESS MVS Units Sound Power Level Spectrum

Noise Source	Sound Power Levels in Octave Bands, Hz dB							L_{WA}, dB
	63	125	250	500	1000	2000	4000	
MVS Units	85	84	87	82	77	74	68	84

RWE On-Site 400kV Substation and 132kV Substation

~~13.5.43.~~13.5.44. There are many electrical components within the seven 132kV Substation and RWE on-site 400kV Substation however, based on previous experience and measured data for similar electrical substations, it is likely that the power transformers are the dominant sources.

~~13.5.44.~~13.5.45. Based on library information from measured data, **Table 13-19** sets out the chosen octave band sound power level for the transformers within the proposed 132kV and 400kV substations.

Table 13-19: Octave band spectra of example substation Satellite Substation

Noise Source	Sound Power Levels in Octave Bands, Hz dB							L_{WA}, dB
	63	125	250	500	1000	2000	4000	
132kV Substation Transformer	91	87	93	88	74	64	63	88
400kV Substation Transformer	80	96	94	92	79	70	63	90

Tracking Solar Panels

~~13.5.45.~~13.5.46. The tracking mechanism is understood to use a small, 24V DC motor mounted to the rear of the panels and adjusts the aspect of the panels slightly every five to ten seconds, throughout the day.

~~13.5.46.~~13.5.47. Limited information is available relating to noise from tracking solar panels though indicative information gives very low noise levels of less than L_{WA} 50dB per motor.

~~13.5.47.~~13.5.48. Given the minimum distance between the tracking solar panels and the closest noise sensitive receptor (approximately 150m), the predicted level from one tracking unit in operation would be less than L_{Aeq} 10dB. Even with multiple units operating at the minimum distance, the total noise levels would still be very low. When additional distance and noise screening effects from intervening panels and other structures, are included, the noise from operation of the tracking solar panels would be very low at any of the closest noise sensitive receptor locations and unlikely to be a factor, even cumulatively, to the significance of the noise impacts from the wider Scheme.

~~13.5.48.~~13.5.49. Given this, noise from the tracking systems has been scoped out of the predictive operational assessments in this Chapter.

Modelling Scenarios

~~13.5.49.~~13.5.50. To carry out the assessment, two scenarios have been modelled as follows:

Daylight Hours with Solar Farm Operations

- Noise generating assets including: Central Inverters with Inverter Skid, Containerised Battery Units (HVACs), and Battery Power Conversion Units;

Night-time Sensitive Hours with Batteries Operation

- Noise generating assets including: Containerised Battery Units (HVACs) and Battery Power Conversion Units and Transformers.

~~13.5.50.~~13.5.51. The daylight operation therefore represents the worst-case with all sources operating at 100% duty (full power).

~~13.5.51.~~13.5.52. Although it is possible that the Scheme could operate in the early morning periods that would normally be considered to be part of the night, it would not operate at the most-sensitive periods of the night-time nor at 100% capacity.

~~13.5.52.~~13.5.53. Therefore, the night-time scenario considers sources associated with the BESS compounds as identified above.

Daytime Operational Noise Assessment

~~13.5.53.~~13.5.54. The noise predictions are presented in the first instance as a noise contour plot in **ES Figure 13.3 Daytime Operational Noise Levels** appended to this chapter **[REP2-059]**, showing the predicted specific noise levels (dB L_{Aeq}) and the identified receptor locations. The contours assume that all equipment is running at full capacity, which is only likely to occur in the middle of a sunny day when all plant is operating at 100%.

~~13.5.54.~~13.5.55. The contour plots demonstrate that the identified PRoW's fall within the 40dB to 45dB noise band when at closest approach to the BESS facility towards Moor Owners Road. In other locations, the PRoWs fall well below this level. In all instances, the noise levels in the vicinity of the PRoWs fall well below the L_{Aeq} 50dB criteria for 'Moderate Annoyance' in accordance with the WHO.

~~13.5.55.~~13.5.56. Given the above outcome, operational noise at the PRoWs is considered to be at the LOAEL effect level, in so far as noise may be heard, but it would not cause a change in behaviours. Given this, the impact significance is considered to be minor adverse.

~~13.5.56.~~13.5.57. In addition to the noise contours, the specific noise level has been calculated at the identified assessment locations.

~~13.5.57.~~13.5.58. For the purposes of the calculations below, the residential and heritage receptors are grouped on the assumption that the heritage assets (listed buildings) are residential in nature. The impact at these receptors is calculated in accordance with BS 4142. The rating level is calculated from the predicted specific noise level and includes a weighting for readily identifiable characteristics. In this instance a +2dB correction has been applied on the premise that some tonal content could be 'just perceptible'. In reality, given the low predicted noise levels, the separating distances and the relatively high ambient noise climate, it is unlikely that any tonality would be perceptible at the receptors. However, in the interests of presenting a worst-case assessment, the weighting is included.

~~13.5.58.~~13.5.59. The Scheme will only operate during daylight hours, with full capacity reached around the middle of a sunny day. However, as indicated above, the solar farm could feasibly operate, during the summer months, before 07:00 hours. The predicted noise levels are given in **Table 13-20**.

Table 13-20: Daytime Operational Noise Assessment – Residential Receptors

Assessment Location	Predicted (Specific) level, L_{As} dB	Rating level dB L_{Ar}	Typical Background Sound Level dB L_{A90}	Difference, dB
ALO1	23.5	25	34	-9
ALO2	25.1	27	34	-7
ALO3	29.7	32	34	-2
ALO4	30.4	32	40	-8
ALO5	23.6	26	40	-14
ALO6	33.4	35	40	-5
ALO7	33.8	36	40	-4
ALO8	23.4	24	46	-22
ALO9	29.4	31	46	-15
AL10	30.2	32	53	-21
AL11	35.0	37	53	-16
AL12	25.6	28	46	-18
AL13	30.0	32	46	-14
AL14	39.5	41	57	-16
AL15	31.1	33	57	-24
AL16	34.5	36	57	-21
AL17	31.0	33	57	-24
AL18	33.8	36	48	-12
AL19	21.9	24	48	-24
AL20	19.6	22	37	-15
AL21	23.0	25	37	-12
AL22	25.5	28	37	-9
AL23	25.1	27	36	-9
HERO1	22.7	25	46	-21
HERO2	31.1	33	46	-13
HERO3	34.3	36	46	-10
HERO4	33.7	36	46	-10
HERO5	17.9	20	46	-26

~~13.5.59.~~13.5.60. The results presented in **Table 13-19** indicate that the noise generated by the Scheme would fall well below the typical background sound levels at all of the assessment locations during the daytime period. This is an indication of the Scheme having a low noise impact in accordance with BS4142 and falling at

the NOAEL in accordance with **Table 13-3**. This effect level would result in a 'Negligible' impact significance in accordance with the criteria in **Table 13-4**.

~~13.5.60.~~13.5.61. The predictions to the non-residential receptors are presented in **Table 13-21** below.

Table 13-21: Daytime Operational Noise Assessment – Non-Residential Receptors

Assessment Location	Predicted Operational Noise Level, L_{Aeq} dB	Impact Significance
NRO1	28.6	Minor
NRO2	36.5	Minor
ECO1	28.0	Minor
ECO2	35.3	Minor
ECO3	29.8	Minor

~~13.5.61.~~13.5.62. The assessments above demonstrate that the impact significance of operational noise in the non-residential receptors is Minor adverse.

~~13.5.62.~~13.5.63. Overall, the impact of operational noise at all receptor locations (residential and non-residential), is Minor adverse at worst. It is reiterated, that the assessment assumes all plant and equipment, including all elements of the solar farm and BESS, are operating at 100% duty (full power) in the daytime operational scenario.

Night-time Operational Noise Assessment

~~13.5.63.~~13.5.64. For the typical night-time scenario, only noise sources associated with the BESS facility would be operating (HVAC units, MVS units). The noise contour is shown in **Figure 13.4 - Night-time Operational Noise Levels [REP2-060]**.

~~13.5.64.~~13.5.65. The contour plot demonstrates that noise from the operational BESS units is well removed from the nearest noise sensitive receptor locations, with the majority of the receptors falling outside of the 30 dB(A) contour line.

~~13.5.65.~~13.5.66. Predicted noise levels at the identified residential receptors are given in **Table 13-22**.

Table 13-22: Night-time Operational Noise Assessment – Residential Receptors

Assessment Point	Predicted (Specific) level, L_{As} dB	Rating level dB L_{Ar}	Typical Background Sound Level dB L_{A90}	Difference, dB
ALO1	17.3	19	32	-13
ALO2	19.3	21	32	-11
ALO3	23.3	25	32	-7
ALO4	30.5	33	34	-1
ALO5	23.2	25	34	-9
ALO6	27.5	30	34	-4
ALO7	21.7	24	34	-10
ALO8	17.6	20	40	-20
ALO9	13.0	15	40	-25
AL10	11.5	14	42	-28
AL11	12.4	14	42	-28
AL12	20.7	23	40	-17
AL13	10.1	12	40	-28
AL14	17.9	20	42	-22
AL15	17.9	20	42	-22
AL16	31.6	34	42	-8
AL17	29.6	32	42	-10
AL18	30.7	33	41	-8
AL19	20.2	22	41	-19
AL20	12.7	15	33	-18
AL21	14.6	17	33	-16
AL22	15.2	17	33	-16
AL23	23.4	25	32	-7
HERO1	15.7	18	40	-22
HERO2	26.6	29	40	-11
HERO3	20.2	22	40	-18
HERO4	19.7	22	40	-18
HERO5	15.9	18	40	-22

~~13.5.66.~~13.5.67. The results presented in **Table 13-21** indicate that the noise generated by the battery storage facilities is of a very low level and is below the night-time background sound level at all receptor locations. This again falls in the NOAEL

category in accordance with **Table 13-3** and the 'Negligible' significance band from **Table 13-4**.

~~13.5.67.~~13.5.68. It is assumed the golf course, allotments and PRoWs would not be used during the night-time period. The impact at the ecological receptors is presented in **Table 13-23** below:

Table 13-23: Night-time Operational Noise Assessment – Non-Residential Receptors

Assessment Location	Predicted Operational Noise Level, L_{Aeq} dB	Impact Significance
ECO1	7.6	Minor
ECO2	32.6	Minor
ECO3	20.6	Minor

~~13.5.68.~~13.5.69. The noise impact at the ecological receptors is shown to be Minor adverse.

~~13.5.69.~~13.5.70. Overall, the noise impact at all receptors during the night-time period is again shown to be, at worst, Minor adverse.

Decommissioning Phase

~~13.5.70.~~13.5.71. The noise and vibration effects during the decommissioning phase are expected to be similar, if not lower than those in the construction phase, and therefore not significant. Embedded mitigation measures similar to those proposed for the construction phase are recommended for the decommissioning phase, subject to the detailed design. These would be secured through the Decommissioning Environmental Management Plan.

13.6. Mitigation, Enhancement and Residual Effects

Mitigation by Design

13.6.1. For the construction phase, the embedded mitigation measures, detailed in the **Outline CEMP [Document Reference 7.1, Revision 6~~5~~]** and the **Outline Ecological Construction Management Plan [Document Reference 7.5, Revision 6~~4~~]** are included in the construction and decommissioning calculations presented above.

~~13.6.1.~~13.6.2. With specific reference to directional drilling at drill location 19, measures including temporary noise barriers may be required should activities be

undertaken outside of daytime hours. As secured through the commitments set out within the **oCEMP [Document Reference 7.1 Revision 6]**, where works are required outside of the core working hours, they will comply with any restrictions agreed with the relevant planning authorities and any conditions arising from the Section 61 consent process under the Control of Pollution Act 1974 once the details of the activity have been defined i.e. location of activity, plant to be used, hours of operation etc.

~~13.6.2.~~13.6.3. For the operational period, the iterative design approach taken through the PEIR and statutory consultation phases detailed in **Chapter 3: Site Description, Site Selection and Iterative Design Process [REP2-019]** is considered mitigation by design and is included in the assessments presented above.

Additional Mitigation

~~13.6.3.~~13.6.4. Mitigation measures in addition to the embedded measures are included as 'Additional Mitigation' and, in terms of noise and vibration, are detailed below.

Construction Noise and Vibration

~~13.6.4.~~13.6.5. With the inclusion of the embedded mitigation, it is concluded that the impact of noise and vibration during the construction phase would be, at worst, Minor adverse. As such, no additional mitigation measures are proposed.

Operational Noise Mitigation.

~~13.6.5.~~13.6.6. The calculations detailed in **Table 13-20** to **Table 13-23** indicate that the impact of operational noise at the nearest noise sensitive receptors is Negligible to Minor adverse. As such, no additional mitigation measures are required.

~~13.6.6.~~13.6.7. This may change once the final plant and equipment are identified. In this event, it may be possible to locate noisier plant and equipment further from receptor locations or, in some instances, use acoustic barriers to reduce noise levels from specific noise sources i.e. the BESS compounds. Some equipment is also available with noise-reduced options which may be appropriate. An acoustic barrier, if required, must be imperforate, well-sealed at the junction with the floor (no air gaps) and with a superficial mass of at least 12 kg/m^2 for effective noise control. These measures would be subject to detailed design.

Decommissioning Phase

~~13.6.7.~~13.6.8. The noise and vibration effects during the decommissioning phase are expected to be similar, if not lower than those in the construction phase. As such, similar measures to those proposed for the construction phase are recommended for the decommissioning phase.

~~13.6.8.~~13.6.9. Decommissioning noise and vibration measures will be implemented where appropriated and proportionate, facilitated via a Decommissioning Environmental Management Plan (DEMP), broadly in line with the submitted **Outline DEMP [~~Document Reference 7.3, Revision 4~~REP5-026].**

Summary of Mitigation

Table 13-24: Mitigation

Ref	Measure to avoid, reduce or manage any adverse effects and/or to deliver beneficial effects	How measure would be secured		
		By Design	By S.106	By DCO Requirement
1	CEMP	--	--	X
2	DEMP	--	--	X
3	Construction Buffer Zones	--	--	X
4	Acoustic Noise Barrier	X	--	--
5	Selection of appropriate plant	X	--	--
6	Maximise separation distances, based on noise of selected plant	X	--	--

Enhancements.

~~13.6.9.~~13.6.10. In terms of noise and vibration, it is unlikely that this Scheme would provide any enhancements to the local area. However, noise levels are already high due to the existing road traffic noise sources.

Residual Effects

13.6.11. The short-term effects of the construction phase would be controlled through both the **Outline CEMP [Document Reference 7.1 Revision 6~~5~~]** and **Outline ECMP [Document Reference 7.5 Revision 6~~4~~]**. This includes the use of buffer

zones, Best Practical Means and the timing of works. Specific mitigation measures to address any HDD undertaken outside of daytime hours would be designed and implemented as part of a Section 61 consent application.

~~13.6.10.~~13.6.12. ~~This~~ The above measures will ensure the noise impacts during the construction phase are suitably controlled and any residual effects would be **N~~n~~egligible to Minor adverse** due to the short-term nature of the construction phase.

~~13.6.11.~~13.6.13. The assessments undertaken indicate that noise during the operational phase is, **Negligible to Minor adverse**, with no specific additional mitigation measures required. Given the conservative nature of the assessment undertaken, there will be no significant residual noise effects.

13.7. Summary

Introduction

13.7.1. This chapter of the ES identifies the potential effects of the Scheme in terms of noise and vibration.

Baseline Conditions

13.7.2. An environmental noise survey has been undertaken to quantify the current noise climate across the Order Limits and the results have been used to derive appropriate noise limits at the identified noise sensitive receptors.

13.7.3. No vibration monitoring has been undertaken as part of this assessment.

Likely Significant Effects

13.7.4. With the embedded mitigation measures proposed, noise impacts during the construction phase would be, at worst, Minor adverse at the nearest receptor locations.

13.7.5. Additionally, adherence to proposed measures will ensure that groundborne vibration would not be perceptible at the receptor locations, giving a Negligible impact.

13.7.6. Overall, it is demonstrated that construction noise and vibration is temporary in nature, and with the implementation of the embedded mitigation measures, there will be no significant adverse impacts.

13.7.7. The assessments of the noise during the operational phase indicates that noise during the daytime and night-time period would be Minor adverse at worst, requiring no specific noise mitigation measures.

Conclusion

13.7.8. With use of embedded construction phase mitigation measures in place, the Scheme is unlikely to result in any significant adverse effects on any of the identified noise sensitive residential and non-residential receptors.

13.7.9. During the operational phase, the noise and vibration impacts are, at worst, Minor adverse, requiring no specific mitigation measures.

13.7.10. During the decommissioning phase, the embedded mitigation measures would ensure that the Scheme is unlikely to result in any significant adverse effects on any of the identified noise sensitive residential and non-residential receptors.

13.7.11. **Table 13-25** summarises the identified effects and any mitigation.

Table 13-25: Summary of Effects, Mitigation and Residual Effects

Receptor / Receiving Environment	Description of Effect	Nature of Effect	Sensitivity Value	Magnitude of Effect	Geographical Importance	Significance of Effects	Mitigation / Enhancement Measures	Residual Effects
Construction								
Identified Sensitive Receptors (residential and Non-residential)	Noise	Temporary/Direct	High	Not Applicable	Local	Minor (Not Significant)	Embedded mitigation measures detailed in the **Outline CEMP [Document Reference 7.1, Revision 5].**	Negligible / Minor Adverse (Not Significant)
Identified Sensitive Receptors in the vicinity of drilling location 19	Noise	Temporary/Direct / Only during Night-Time Working	High	Not Applicable	Local	~~13.7.12.~~ Moderate (Significant)	Additional mitigation measures proposed by the **Outline CEMP [Document**	Negligible / Minor Adverse (Not Significant)

(residential and Non-residential)							**Reference 7.1, Revision 5]** and to be confirmed / derived through calculations controlled by S61 process.	
Identified Sensitive Receptors (residential and Non-residential)	Vibration	Temporary/Direct	High	Not Applicable	Local	Negligible	Embedded mitigation measures detailed in the **Outline CEMP [Document Reference 7.1, Revision 5].**	Negligible

Identified Sensitive Receptors (residential and Non-residential)	Construction Traffic Noise	Temporary/Direct	High	Not Applicable	Local	Negligible	None	Negligible
Operation								
Identified Sensitive Receptors (residential and Non-residential)	Noise	Permanent/Direct	High	Not Applicable	Local	Minor (Not Significant)	None required	Negligible / Minor Adverse (Not Significant)
Identified Sensitive Receptors (residential and Non-residential)	Vibration	Permanent/Direct	High	Not Applicable	Local	Negligible	None required	Negligible

13.8. References

- Ref. 13-1: British Standards Institute (2024) BS ISO 9613-2: 2024 Acoustics – Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors.
- Ref. 13-2: Department for Energy Security and Net Zero (2025) National Policy Statements for energy infrastructure
- Ref. 13-3: Department for Energy Security and Net Zero (2025). Overarching National Policy Statement for energy (EN-1)
- Ref. 13.4: Department for Energy Security and Net Zero (2025). National Policy Statement for renewable energy (EN-3)
- Ref. 13-5: Ministry of Housing Communities & Local Government (2024) National Planning Policy Framework
- Ref. 13-6: Department for Environment, Food and Rural Affairs (2010) Noise Policy Statement for England
- Ref. 13-7: Ministry of Housing, Communities and Local Government, Ministry of Housing, Communities & Local Government (2018 to 2021) and Department for Levelling Up, Housing and Communities. Planning Practice Guidance: Noise
- Ref. 13-8: Control of Pollution Act (1974)
- Ref. 13-9: Environmental Protection Act (1990)
- Ref. 13-10: British Standards Institute (2014) BS5228-1:2009 +A1:2014 Code or practice for noise and vibration control on construction and open sites – Part 1: Noise.
- Ref. 13-11: British Standards Institute (2014) BS5228-2:2009 +A1:2014 Code or practice for noise and vibration control on construction and open sites – Part 2: Vibration.
- Ref. 13-12: HMSO (1988) Department of Transport Welsh Office Calculation of Road Traffic Noise.
- Ref. 13-13: Highways England (2020) Design Manual for Roads and Bridges LA111 Noise and Vibration Revision 2.

- Ref. 13-14: British Standards Institute (2019) BS4142:2014 +A1:2019 Methods for rating and assessing industrial and commercial sound.
- Ref. 13-15: World Health Organization (1999) Guidelines of Community Noise
- Ref. 13-16: Environment Agency (2022) Noise and vibration management: environmental permits
- Ref. 13-17: Institute of Estuarine & Coastal Studies (2013) Waterbird Disturbance Mitigation Toolkit

13.9. Glossary

Descriptive Noise Units

13.9.1. Noise is defined as unwanted sound. The range of audible sound is from 0dB to 140dB. The frequency response of the human ear is usually taken to be about 18Hz (number of oscillations per second) to 18 000Hz. The ear does not respond equally to different frequencies at the same level. It is more sensitive in the mid-frequency range than the lower and higher frequencies and, because of this, the low and high frequency components of a sound are reduced in importance by applying a weighting (filtering) circuit to the noise measuring instrument (the sound level meter). The weighting, which is most widely used, and which correlates best with subjective response to noise is the A-weighting. This is an internationally accepted standard for noise measurements.

13.9.2. For variable noise sources such as traffic, an increase of 1dB(A), which equates for example to an approximate 25% increase in road traffic, is barely perceptible. In addition, a doubling of traffic flow will increase the overall noise by 3dB(A), providing that a number of factors, including speed, remain unchanged. The 'loudness' of a noise is a purely subjective parameter, but it is generally accepted that an increase/decrease of 10dB(A) corresponds to a doubling or halving in perceived loudness.

13.9.3. External noise levels are rarely steady but rise and fall according to surrounding activities. In an attempt to produce a figure that relates this variable noise level to the subjective response, a number of noise metrics have been developed. These include:

L_{Aeq}	This is the 'equivalent continuous A-weighted sound pressure level, in decibels', and is defined in British Standard BS7445 as the "value of the A-weighted sound pressure level of a continuous, steady sound that, within a specified time interval, T, has the same mean square sound pressure as a sound under consideration whose level varies with time".
L_{Amax}	This is the maximum noise level recorded over a particular measurement period. The fast time weighting is usually used.

L_{A10}	The L_{A10} is the noise level that is exceeded for 10% of the measurement period and gives an indication of the noisier levels. It is a unit that has been used over many years for the measurement and assessment of road traffic noise.
L_{A90}	The L_{A90} is the noise level that is exceeded for 90% of the measurement period and gives an indication of the noise level during quieter periods. It is often referred to as the 'background' noise level.
Basic Noise Level (BNL)	This is the initial noise level calculated in accordance with CRTN and is based on the vehicle flow on a section of road in a given time frame i.e. 1-hour or 18-hours. The BNL is expressed as a L_{A10} value at a nominal distance of 10m from the nearside carriageway edge.