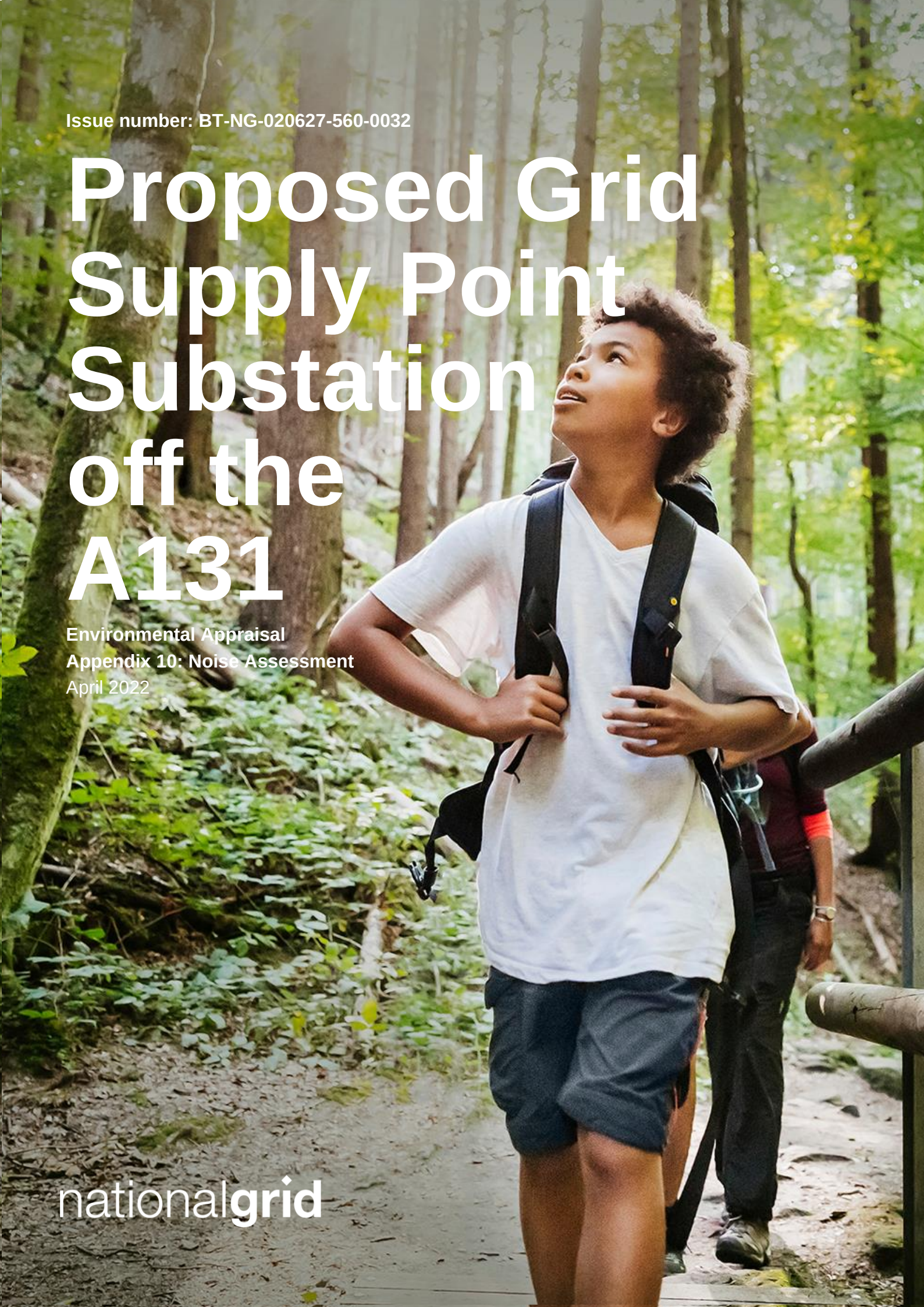

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Proposed Grid Supply Point Substation off the A131

Environmental Appraisal
Appendix 10: Noise Assessment
April 2022

nationalgrid

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Appendix 10: Noise Assessment

1. Introduction

1.1 Purpose of this Document

1.1.1 This appendix sets out the assessment of potential noise and vibration impacts relevant to the proposed GSP substation.

1.1.2 The assessment of potential noise and vibration impacts has been conducted in accordance with good practice guidance and in line with current planning policy.

1.1.3 The assessment includes consideration of the following sources of noise and/or vibration impacting upon nearby residential noise and vibration sensitive receptors (NSR):

- Construction noise;
- Construction vibration; and
- Operational noise.

1.1.4 Operational substations are not material sources of vibration to an extent that is likely to lead to adverse impacts, even directly adjacent to plant. This is based on National Grid's vast experience of operating substations. There is significant distance between the proposed GSP substation and nearby NSR. Additionally, proposed plant would be installed on vibration isolation fittings as standard practice. Operational vibration is therefore scoped out of the assessment.

1.1.5 Consideration of potential impacts from noise and vibration on ecological receptors and historic receptors is provided in Sections 3.3 and 3.4 of the Environmental Report, respectively.

1.1.6 Good practice measures are proposed to manage potential adverse noise and vibration impacts.

1.1.7 This appendix is supported by the following Annexes:

- Annex 1: Policy and Guidance;
- Annex 2: Baseline Survey Details;
- Annex 3: Construction Noise and Vibration Data;
- Annex 4: Noise Modelling; and
- Annex 5: Noise Impact Assessment of Atypical Scenarios.

2. Planning Policy and Guidance

2.1.1 Details of planning policy are provided in Annex 1, and comprises the following documents:

- National Planning Policy Framework (NPPF);
- Noise Policy Statement for England (NPSE); and
- Planning Practice Guidance for Noise (PPGN).

2.1.2 In summary, the planning policy guidance requires planning policy decisions to 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. Effects are defined in the NPSE in terms of the following concepts:

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected;
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected; and
- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

2.1.3 It is noted that while the NPSE refers to SOAELs as defined above, this is different to significance in Environmental Impact Assessment (EIA) terms. Any reference to 'significance' or similar in this report is in the context of NPSE and NPPF criteria and not EIA.

2.1.4 Relevant LOAELs and SOAELs have been identified for the proposed GSP substation taking account of the sources of exposure and receptors based on the following guidance documents, further details of which are provided in Annex 1:

- BS 5228-1:2009+A1:2014 Code of Practice for noise and vibration control on construction and open sites – Part 1: Noise (BS 5229-1);
- BS 5228-2:2009+A1:2014 Code of Practice for noise and vibration control on construction and open sites – Part 2: Vibration (BS 5228-2);
- BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound (BS 4142); and
- BS 8223:2014 Guidance on sound insulation and noise reduction for buildings (BS 8233).

3. Assessment Methodology

3.1 Baseline Sound Level Survey Methodology

3.1.1 A sound level survey has been conducted to obtain baseline data for use in the assessment of construction and operational noise.

3.1.2 Noise measurements were conducted in general accordance with the methodology detailed in BS 7445-1:2003 'Description and measurement of environmental noise. Guide to quantities and procedures' (BS 7445).

3.1.3 The sound level meter recorded a range of parameters including the following:

- LAeq,T – The A-weighted equivalent continuous sound pressure level over the measurement period T, representative of the 'average' sound pressure level over a given period, in this case 15 minutes.
- LA10,T – The LA10 is defined as the noise level that is exceeded for 10% of the measurement period, and is usually regarded as a descriptor of road traffic noise.
- LA90,T – The LA90 is defined as the noise level that is exceeded for 90% of the measurement period, and is usually regarded as a descriptor of the background noise level.
- LAFmax,T – The LAFmax is the maximum A-weighted noise level during the sample period, measured using a fast time weighting.

3.1.4 Broadband and 1/3octave band values were also measured for the above parameters.

3.1.5 Long-term noise monitoring consisted of the deployment of noise loggers which were installed at locations representative of nearby NSR, and left unattended for a period of at seven days to capture the fluctuation of ambient and background sound levels. Attended observations were undertaken during the installation and collection of equipment to capture qualitative information on the main noise sources and of the character of noise at the measurement locations and in the area.

3.1.6 Microphones were fitted with windshield and were tripod mounted between 1.3m – 1.5m from ground level. The measurement locations were free-field, at least 3.5m from any reflective surfaces, other than the ground.

3.1.7 Weather conditions were monitored during the survey and data affected by periods of adverse weather were be omitted from the subsequent analysis.

3.2 Construction Noise Assessment Methodology

3.2.1 The study area for construction noise impacts is 300m from the site boundary, based on guidance from BS 5228-1.

3.2.2 Construction and decommissioning noise levels have been calculated at NSRs within the study area in accordance with the methodology described in Annex F of BS 5228-1.

3.2.3 The predicted construction noise levels at NSRs were compared against the lower noise level threshold (Category A) as detailed in Section E.3.2 of BS 5228-1, which is 65dB $L_{Aeq,T}$ during daytime periods (07:00 - 19:00 Monday to Friday, 08:00 - 13:00 on Saturdays). Works may also occur during other weekend and bank holiday daytime periods (13:00 - 17:00 Saturdays and 08:00 - 17:00 on Sundays and Bank Holidays) where a 55dB $L_{Aeq,T}$ threshold would apply. Works are not expected during evening and night-time periods except under rare circumstances (e.g. if it is unsafe to stop works). However, such occurrences would not be considered notable in isolation and are therefore not considered further in this assessment.

3.2.4 The following effect levels apply for the assessment of construction noise:

- The LOAEL is equal to the pre-existing ambient sound level; and
- SOAEL is equal to the BS 5228-1 Category A values.

3.2.5 Consideration is also given to the duration of works in determining the overall impact at nearby receptors.

3.3 Construction Vibration Assessment Methodology

3.3.1 The study area for construction vibration impacts is 100m from the site boundary, based on guidance from BS 5228-2.

3.3.2 Annex E of BS 5228-2 provides empirical formulae for predicting vibration levels from various construction activities, including piling and vibratory compaction. Calculations are in terms of the vibration peak particle velocity (PPV).

3.3.3 BS 5228-2 also provides guidance on the effects of vibration levels, as shown in Table 3.1.

Table 3.1: Guidance on effects of vibration levels

Vibration level	Effect
0.14 mm/s PPV	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.3 mm/s PPV	Vibration might be just perceptible in residential environments.
1.0 mm/s PPV	It is likely that vibration of this level in residential environments will cause complaint but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s PPV	Vibration is likely to be intolerable for any more than a very brief exposure to this level in most building environments.

3.3.4 The following effect levels apply for the assessment of construction vibration:

- The LOAEL is equal to 0.3 mm/s; and
- SOAEL is equal to 1.0 mm/s

3.4 Operational Noise Assessment Methodology

3.4.1 The study area for operational noise impacts is 1000m from the site boundary, based on guidance from ISO 9613:1996 ‘Acoustics – Attenuation of sound during propagation outdoors – Part 2: General Method of calculation’ (ISO 9613).

3.4.2 The assessment follows the methodology stated in BS 4142 and is based on the background noise detailed in Section 4 of this Appendix, and plant noise data detailed in Section 5.

3.4.3 BS 4142 assesses the potential effects by comparing the 'rating sound level' of an industrial source to the typically representative ‘background sound level’ at the location of nearby receptors.

3.4.4 Certain acoustic features can increase the potential for a sound to attract attention, and therefore increase its relative impact than that expected from a simple comparison between the specific sound level and the background sound level. In particular, BS 4142 identifies noise that contains audible tonality, impulsivity and/or intermittency and recommends that a correction be added to the specific sound level. The specific sound level along with any applicable correction is referred to as the 'rating level'. It should be noted that the penalties can be additive i.e. if they have a combination of tonal, impulsive, and intermittent acoustic characters.

3.4.5 Where tonality is audible at a receptor a penalty of between 0 and 6dB may be applied. Subjectively, a 2dB penalty may be applied where a tone is just perceptible, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible.

3.4.6 Where impulsivity is audible at a receptor a penalty of between 0 and 9dB may be applied. Subjectively, a 3dB penalty may be applied where impulsivity is just perceptible, 6dB where it is clearly perceptible, and 9dB where it is highly perceptible.

3.4.7 If intermittency is readily distinctive against the residual acoustic environment at the receptor, a penalty of 3dB can be applied.

3.4.8 Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment at the receptor, a penalty of 3dB can be applied.

3.4.9 The greater the difference between the rating level and the background sound level; the greater the likelihood of complaints. The assessment criteria given by BS 4142 are as follows:

- A difference of +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of +5dB could be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that there will be an 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.

3.4.10 The assessment should also consider the context of the sound. Where the initial estimate of the impact needs to be modified due to the context, all pertinent factors should be considered, including:

- the absolute level of the sound;
- the character and level of the residual sound compared to the character and level of the specific sound; and
- the sensitivity of the receptor, including whether dwellings already incorporate design measures that secure good internal and/or outdoor conditions, such as: façade insulation treatment, ventilation and/or cooling that will reduce the need to have windows open to provide rapid or purge ventilation and acoustic screening.

3.4.11 The following effect levels apply for the assessment of operational noise:

- The LOAEL is equal to the background sound level, depending on context; and
- SOAEL is equal to 5dB above the background sound level, depending on context.

3.4.12 When considering context, BS 4142 refences BS 8233 as providing context where background and rating noise levels are low. BS 8233 recommends internal sound levels in bedroom spaces of ≤30dB $L_{Aeq,8h}$ during night-time periods and states that the attenuation of sound through a particularly open window for ventilation is 15dB. As such, suitable internal sound levels in bedroom spaces (≤30dB $L_{Aeq,8h}$) would be expected to be achieved where the sound rating level is below 45dB externally. The sound rating level includes penalties for acoustic character and as such the absolute sound level would be lower. With closed windows, internal sound levels would be much lower.

3.4.13 Sound levels have been predicted via computer noise modelling using SoundPlan software (version 8.2), based on the colocation methodology described in ISO 9613.

4. Baseline Data

4.1.1 The section examines the NSR and the existing baseline acoustic environment in the study area. A site location plan is provided in Figure A10.1 which shows the site, NSR locations, survey locations, and study areas.

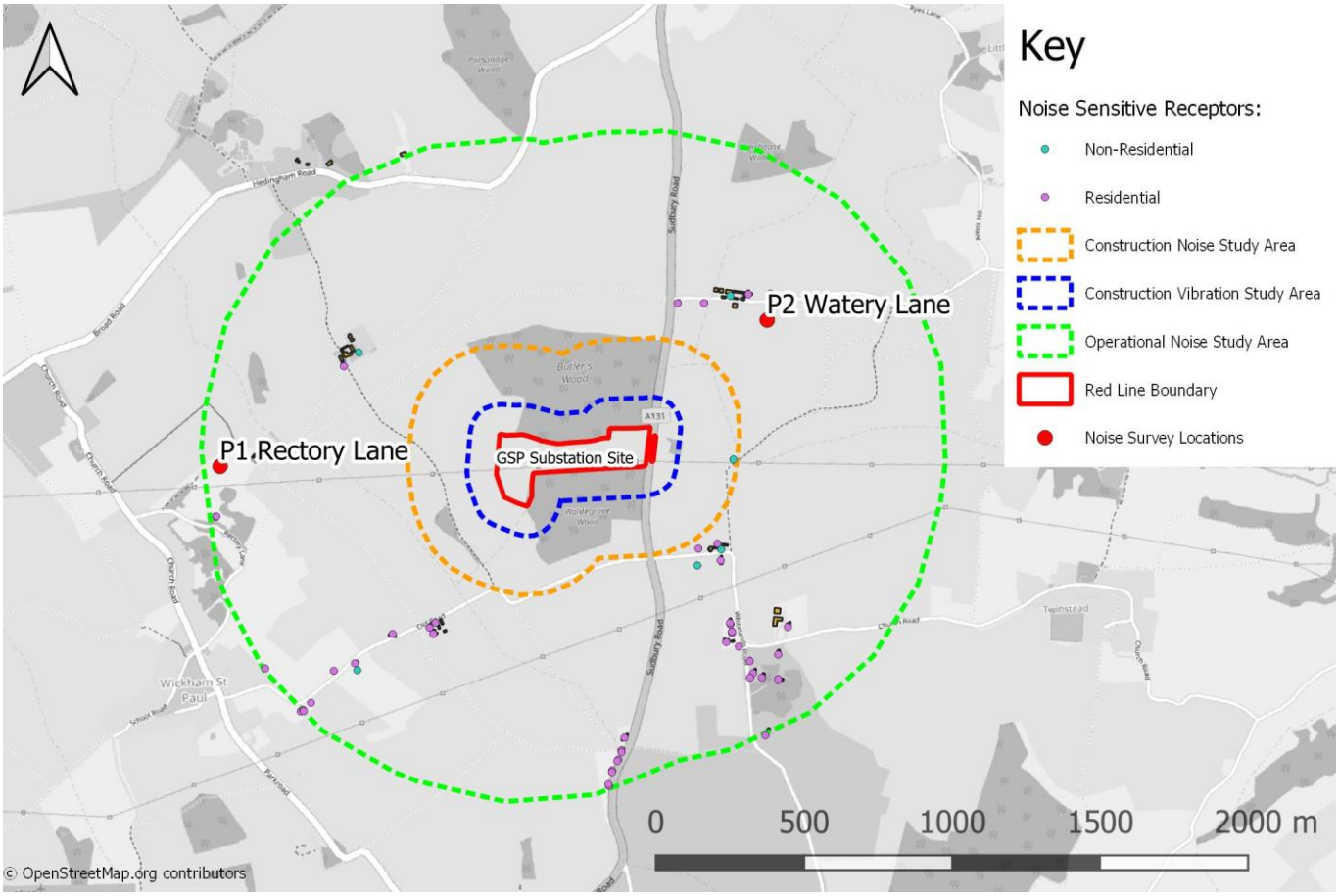

Figure A10.1: Site Location Plan

4.1.2 There are relatively isolated receptors located in all directions from the proposed GSP substation site. The closest residential NSRs to the site are:

- approximately 325m to the southeast located off Whitelands Road;
- approximately 420m to the northeast off Watery Lane;
- approximately 460m to the southwest located off Old Road; and
- approximately 550m to the northwest at Butlers Hall Farm.

4.1.3 A baseline survey was conducted between Tuesday 6 July and Tuesday 13 July 2021 and comprised long duration unattended measurements at two locations.

4.1.4 The survey locations are shown in Figure A10.1. Details of the survey are provided in Annex 2 of this Appendix.

4.1.5 Location P1 was positioned approximately 930m to the west of the site, to the northwest of Rectory Lane, Wickham St Paul. Location P2 was positioned off Watery Lane, approximately 535m northeast of the site. The locations were selected as being representative of nearby NSR, being away from main noise sources such as the A131.

4.1.6 The noise climate in the vicinity of the proposed GSP substation site and at nearby NSR is typical of a rural area, being generally quiet with the exception areas close to main roads. The main noise source in the area is road traffic on the A131, which is a moderately busy road running between Sudbury to the north and Halstead to the south. Other sources of noise include rustling foliage, birdsong, local road traffic, and general rural ambient sounds.

4.1.7 The results of the survey are summarised in Table 4.1. Full results are provided in Annex 2 of this Appendix. Values are presented in terms of the range of values experienced during the survey period, and typical values, based on either the logarithmic average or the mode, as appropriate to the measurement perimeter.

Table 4.1: Summary of Measured Sound Levels

Location	Average Sound Levels, dB $L_{Aeq,15min}$	Maximum Sound Level, dB $L_{Amax,F,15min}$	Background Sound Level, $L_{A90,15min}$
Daytime (07:00 – 23:00):			
P1 Rectory Lane	24 – 55 Log average: 43	36 – 83 Mode: 59	21 – 44 Mode: 32
P2 Watery Lane	33 – 58 Log average: 46	45 – 79 Mode: 60	20 – 49 Mode: 33
Night-time (23:00 – 07:00):			
P1 Rectory Lane	20 – 54 Log average: 40	29 – 73 Mode: 57	19 – 38 Mode: 20
P2 Watery Lane	20 – 59 Log average: 43	38 – 81 Mode: 55	18 – 44 Mode: 19

Notes:

Log average = logarithmic average. Sound pressure levels are measured using a decibel (dB) scale, which is logarithmic. A logarithmic average therefore equates to the average sound pressure level experienced during the respective time period.

Mode = Modal average. With regards to statistical parameters, the mode represents the value (rounded to the nearest dB) that most often occurred during the measurement period and can therefore be regarded as 'typical' values.

4.1.8 The results show that sound levels at the two locations are broadly comparable. This is expected given that there is only one main noise source in the area, the A131. The measured background sound levels are therefore considered to be representative of other NSR in the study area.

4.1.9 The typical background sound level during daytime periods was 32 to 33dB $L_{A90,15min}$. For the purposes of this assessment, the lower value of 32dB $L_{A90,15min}$ will be used for all NSR.

4.1.10 During night-time periods the typical background sound level was 19 to 20dB $L_{A90,15min}$. Similarly, for the purposes of this assessment, the lower value of 19dB $L_{A90,15min}$ will be used for all NSR.

5. Assessment

5.1 Construction Noise

5.1.1 Construction noise calculations are provided in Annex 3 of this Appendix. These indicate that the daytime LOAEL, taken to be equal to the ambient sound level of approximately 43dB $L_{Aeq,T}$, would be exceeded at nearby NSR at distances of approximately 800m (although calculations of construction noise beyond 300m should be treated with caution), and therefore there is potential for adverse impacts.

5.1.2 However, the daytime SOAEL of 65dB $L_{Aeq,T}$ would only be exceeded within approximately 100m of the proposed GSP substation site where there are no NSRs.

5.1.3 Exceedance of the LOAEL in the context of construction noise is an indication that it would generally be perceptible above the existing noise climate at nearby NSR but not intolerable. In the context of the NPPF, such impacts such be managed and minimised. Best practicable means (BPM) will be employed to reduce noise emissions from construction works. Further details of management of construction noise impacts are provided in Section 6.1 of this Appendix.

5.2 Construction Vibration

5.2.1 Construction vibration calculations are provided in Annex 3 of this Appendix. These indicate that exceedance of the LOAEL of 0.3mm/s PPV (where vibration likely to be perceptible in residential environments) would occur within the following distances from works:

- 45m from vibratory compaction; and
- 170m from percussive piling.

5.2.2 There are no residential NSRs within these distances from the proposed GSP substation site, with the closest NSR being approximately 325m from the site. As such, vibration from construction activities is likely to be below the construction vibration LOAEL and is therefore not likely to be perceptible at nearby NSR. That said, BPM will be still employed to further reduce potential vibration emissions from due to construction works. Further details of the management of construction noise impacts are provided in Section 6.1.

5.3 Operational Noise

5.3.1 The operational noise assessment considers the 'typical' expected noise levels under normal operational conditions of the proposed GSP Substation.

Operational Transformer Noise Data

5.3.2 The main source of noise from the proposed GSP substation during operation will be from the two super-grid transformers (SGTs). The make and model of transformer has not yet been specified. As such, the assessment is based National Grid's specification document TS2.03, which provides upper noise limits for SGTs, and therefore provides a worst-case assessment.

5.3.3 TS2.03 indicates that upper sound power limit for the proposed SGT specification is 95 dBA $L_{W.}$ This assumes it is being operated at 50% of load and 102.5% of excitation voltage. Each of the two SGTs would typically operate at 50% load such that there is capacity to operate only one SGT at 100% load during an outage without affecting supply.

BS 4142 Assessment

5.3.4 Resultant sound levels have been predicted via computer noise modelling using SoundPlan software (version 8.2). Figures showing the model and the noise contour plots are provided Annex 4 of this Appendix. The highest sound level predicted at the nearby NSRs has been considered (the plant noise level and impact at other receptors will therefore be lower).

5.3.5 The highest predicted specific sound level at nearby NSR is 8dB $L_{Aeq,T}$ at Ben Gramor Lodge, The Green, Twinstead, located approximately 325m to the southeast of the proposed GSP substation site.

5.3.6 The results of the BS 4142 assessment of the operation of the proposed GSP substation during normal conditions are presented in Table 5.1. This assumes two SGTs operating at 50% load. The rating sound level is taken from the worst-case affected residential NSR. Noise impacts at all other residential NSR will therefore be lower.

Table 5.1: BS 4142 Assessment – Normal Operation

	Value			
Parameter	**Daytime**	**Night-time**	**BS 4142 Clause**	**Commentary**
Background sound level, dB L_{A90}	32	19	8.1	Typical background sound level at nearby receptors based on measured noise data
Specific sound level, dB $L_{Aeq,T}$	8	8	7.3	Calculated via noise model based on worst-case plant specification data.
Acoustic feature correction, dB	6	6	9.2	Assumed potential tonal audibility at receptor as worst-case. In practice likely to be less.
Sound rating level, dB $L_{Ar,T}$	14	14	9	Sum of specific sound level and acoustic corrections.
Difference in rating noise relative to background sound level, dB	-18	-5	11	The rating sound level is below the typical background sound level during both daytimes and night-time periods at the worst-case NSR. Therefore, the impact of noise due to the normal operation of the proposed GSP substation is low during daytime and night-time periods at the worst-case residential NSR, depending on context. Noise impacts at all other residential NSR will be even lower. In context, the specific sound level is very low at NSR such that suitable conditions for sleeping can be achieved, even with open windows for ventilation. In context, the impact of noise from the proposed SGTs during normal operation remains low. **Outcome: Low impact**
Uncertainty			10	Uncertainty has been minimised through the use of long-term noise survey data and worst-case plant specification data. In practice impacts would be expected to be lower than reported. The outcome of the assessment is unlikely to be altered by uncertainty.

Notes:

BS 4142 Clause refers to the corresponding clause in BS 4142 relating to that aspect of the assessment.

5.3.7 The results indicate that during normal operation of the proposed GSP substation the impact of noise at nearby receptors will be low during daytime and night-time periods, depending on context. In terms of context, the absolute sound level is very low and would be unlikely to adversely impact nearby NSR both internally and externally. The outcome of the assessment is therefore not affected by context and the outcome remains a low impact.

5.4 Non-Residential Receptors

5.4.1 There are a number of non-residential noise sensitive receptors in the vicinity of the proposed GSP substation site. These include a scout campsite approximately 270m to the

east, and protected lanes approximately 310m to the south (Old Road), and approximately 440m to the northeast (Watery Lane). The sound rating level at these locations would also be below the background sound level during both daytime and night-time periods and as such the impact of noise from the normal operation of the proposed GSP substation would be low.

5.5 Atypical Scenarios

5.5.1 Atypical scenarios include when cooling is required, likely to be only during periods of outages of one SGT, and periods when the backup generator is required during emergency conditions or testing. The backup diesel generator will be installed for use during emergency conditions to ensure the proposed GSP substations system remain operational, for example during an unforeseen outage. Backup generators are run briefly on a monthly basis to test their operation. This varies from manufacturer to manufacturer but is typically for around 5-10 mins approximately once a month during a daytime period. An assessment of potential noise impacts from the operation of cooling plant and emergency backup generator is provided in Annex 5 for information.

5.5.2 Noise due the operation of the cooling plant would be below the background sound level during daytime periods and comparable to the background sound level during night-time periods. However, the absolute sound level from the cooling plant would be low and suitable internal sound levels in bedroom spaces of nearby residential NSR would still be achieved. In context, noise impacts from the cooling plant would be low at nearby residential NSR.

5.5.3 Noise levels from the emergency generator are expected to exceed background sound levels during both daytime and night-time periods. However, the absolute sound level from the emergency back-up generator would be low and would not cause unsuitable internal sound levels in bedroom spaces of nearby residential NSR. Furthermore, the use of the emergency backup generator would be infrequent, particularly at night. In context, noise impacts from the emergency backup generator would be low at nearby residential NSR.

6. Management and Best Practice Measures

6.1 Construction Noise and Vibration

Core Principles

6.1.1 In developing the noise control measures to be used, the following hierarchy will be followed:

- control at source – for example the selection of quieter equipment;
- the choice of location for equipment on site;
- control of working hours; and
- the provision of acoustic enclosures around equipment or barriers around work sites.

6.1.2 As per the hierarchy above, the first source of control for noise pollution is to control at the source. To this end, where reasonably practicable, efforts will be made to use equipment that reduces the noise produced where located in close proximity to sensitive receptors.

6.1.3 Where works may be required to be undertaken outside of the core hours, the local planning authority will be notified in advance along with any neighbouring receptors.

Best Practicable Means

6.1.4 Section 72 of the Control and Pollution Act 1974 requires projects to use Best Practicable Means (BPM) to reduce noise during construction. The following BPM measures will be implemented:

Site Planning and Preparation

- Methods of construction and associated plant will be selected so as to reduce noise and vibration in the first instance, thus reducing the need for the use of percussive and vibratory equipment, particularly for night-time working.
- In accordance with good practice measure GG10, the layout of the site compound and piling rigs will be planned to locate activities or equipment that may produce a noticeable nuisance from noise and vibration away from sensitive receptors such as Butler's Wood and Waldegrave Wood where practicable. Work sites will be planned and designed to limit reserving of vehicles and the noise associated with reversing beacons.
- Noise implications will be considered when planning activities such as deliveries of cable drums and bulk materials. Deliveries will be restricted to normal working hours, where reasonably practicable.
- Measures to reduce impacts from noise during construction may include but not be limited to reduction of working width and use of alternative plant or vehicles. This will be reviewed and agreed with the site ecologist.
- Before works commence, the site workforce will be fully briefed on the need to keep all noise generated to a low level (GG05). Additional briefings will be given in advance of any night time works to further limit unnecessary noise.

Plant and Machinery

- Plant will be inspected on arrival to site only plant that conforms with or better than relevant national or international standards, directives or recommendations on noise or vibration emissions (including The Noise Emission in the Environment by Equipment for Use Outdoors Regulations 2001) will be used (GG12).
- Compressors, percussion tools and vehicles will be fitted with effective silencers of a type recommended by the manufacturers and at least to the requirements of BS 5228-1:2009+A1:2014.
- Audible vehicle reversing sirens will be set on as low a setting as is compatible with safety requirements and machines in intermittent use will be shut down in intervening periods of non-use when it is safe to do so.

Section 61 Consent

6.1.5 As the nearest residential property is over 300m from the site, it is not expected that the contractor will be required to submit applications for Section 61 consents. If Section 61 consent is deemed necessary, the contractor will engage with the planning authority to identify construction activities that may require it. This will include a list of the activities/stages for which separate Section 61 applications will be required to enable all parties to agree the most efficient approach to the Section 61 approval(s).

6.2 Operational Noise

6.2.1 The assessment assumes that the proposed SGTs will be housed within noise enclosures, and this is considered as embedded measure of the design that has been committed to by National Grid, as detailed in Table 3.1 of the Environmental Report.

6.2.2 The impact of noise from the operation of the proposed GSP substation is expected to be low during normal operation, operation of the cooling plant, and during use of the backup generator. While no mitigation is required due to the impact from the backup generator being low and only during emergency scenarios and short-term testing best practicable means would be applied, principally through plant selection such that the quietest available plant is procured where possible.

7. Conclusions

7.1.1 This appendix sets out the assessment of potential noise and vibration impacts relevant to the proposed GSP substation. The assessment of potential noise and vibration impacts has been conducted accordance with good practice guidance in line with current planning policy, covering both construction and operational noise.

7.1.2 A baseline noise survey has been conducted to inform the assessment. The results of the survey indicate that ambient and background sound levels in the vicinity of the proposed GSP substation and nearby NSR are generally low, particularly during night-time periods, and are typical of a rural area.

7.1.3 The assessment of construction noise and vibration impact indicates that impacts would be low, principally due to the distance between the proposed GSP substation site and nearby NSR. Impacts will also be reduced through BPM.

7.1.4 With regards to operational noise, the assessment indicates that a low impact is expected during normal operation, and during atypical situations, such as when the use of SGT cooling plant, or when back-up generators may be required during emergency conditions.

7.1.5 The assessment assumes that the proposed SGTs will be housed within enclosures, and this has been committed to by National Grid. No further specific mitigation measures are required.

References

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International Organization for Standardization. International Standard 9613-2:1996. Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation.

Annex 1: Policy and Guidance

1. Planning Policy

1.1 National Planning Policy Framework

1.1.1 The National Planning Policy Framework (NPPF) includes statements relating to noise and the requirement to take it into account in the planning process. Section 174 of the NPPF indicates that the planning system should contribute to and enhance the natural and local environment by:

> *'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. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans.'*

1.1.2 Section 185 is specifically related to noise and requires planning policy decisions to:

- 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; and
- Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.

1.1.3 The terms 'adverse impacts' and 'significant adverse impacts' are defined within the explanatory note of the Noise Policy Statement for England, 2010 (NPSE).

1.2 Noise Policy Statement for England

1.2.1 The NPSE sets out the long-term vision of Government noise policy: 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.

1.2.2 The NPSE outlines three aims for the effective management and control of environmental noise:

- 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.

1.2.3 In its aims, the NPSE uses the key phrases 'significant adverse' and 'adverse'. The NPSE states in its explanatory note that there are two established concepts that are currently being applied to noise impacts, which are:

- NOEL – No Observed Effect Level. This is the level below which no effect can be detected; and
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.

1.2.4 The NPSE then extends this concept to include:

- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.

1.2.5 The NPSE notes that it is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to vary for different noise sources, receptors and times. Relevant SOAELs have been identified for the proposed GSP substation taking account of the sources of exposure and receptors.

1.3 Planning Practice Guidance for Noise

1.3.1 The Planning Practice Guidance for Noise (PPGN) provides further detail about how the effects of noise can be categorised. The noise exposure hierarchy from PPGN is reproduced in Table A1.1.

Table A1.1: PPGN Noise exposure hierarchy

Response	Examples of outcomes	Increasing effect level	Action
	No Observed Effect Level		
Not present	No effect	No Observed Effect	No specific measures required
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response.		
	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.	Significant Observed Adverse Effect	Avoid

Response	Examples of outcomes	Increasing effect level	Action
	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

1.4 Assessment Guidance

BS 5228-1:2009+A1:2014 Code of Practice for noise and vibration control on construction and open sites – Part 1: Noise

1.4.1 BS 5228-1:2009+A1:2014 Part 1 (BS 5228-1) provides guidance on the prediction and assessment of construction noise as it affects those exposed to it. Calculation procedures are set out in Annex F of BS 5228 for predicting the likely noise levels from specific construction activities at a receptor; considering distance, ground absorption, screening, reflections and the percentage on-time for an activity.

1.4.2 BS 5228-1 Annexes C and D provide generic noise data for various items of plant which can be used for undertaking predictions where no specific information is available.

1.4.3 Annex E of BS 5228-1 provides a number of assessment methodologies for determining noise impacts due to construction activities. Predicted construction noise levels are then compared against the threshold, in combination with other factors such as duration of activity, to determine likely impacts.

BS 5228-2:2009+A1:2014 Code of Practice for noise and vibration control on construction and open sites – Part 2: Vibration

1.4.4 BS 5228-2:2009+A1:2014 Part 2 (BS 5228-2) provides guidance on vibration levels that can be used to assess the likely impacts of construction activities. Annex B of BS 5228-2 gives guidance on the effects vibration effects in terms of human response to vibration and structural response to vibration.

1.4.5 BS 5228-2 Annex E provides empirical formulae for predicting vibration levels from various construction activities, including piling and vibratory compaction. Threshold distances can be calculated for vibration from likely construction activities. Properties falling within these threshold distances are potentially affected by vibration from proposed construction activities and will be highlighted as key sensitive receptors for future stages of assessment.

BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound

1.4.6 BS 4142:2014+A1:2019 (BS 4142) provides a method for assessing the impact of sound from industrial or commercial premises.

1.4.7 BS 4142 assesses the potential effects by comparing the 'rating sound level' of an industrial source to the typically representative ‘background sound level’ at the location of nearby receptors.

1.4.8 The rating sound level is a combination of the 'specific sound level' of a source impacting upon a NSR, together with any applicable penalties that may be applied for acoustic character, such as tonality or impulsivity.

1.4.9 BS 4142 indicates that the initial assessment of noise impact should consider context, including the absolute sound level, the character and level of the residual sound, and the sensitivity of the receptor.

BS 8223:2014 Guidance on sound insulation and noise reduction for buildings

1.4.10 BS 8233:2014 (BS 8223) provides guidance for the control of noise in and around buildings. BS 8233 provides guideline noise levels for providing good external and internal conditions and is referenced with BS 4142 and a means of applying context to the potential impacts, in particular with regards to absolute sound levels in instances where both the background and rating noise levels are low.

Annex 2: Baseline Survey Details

1. Equipment details

Location	Equipment Type	Manufacturer	Type	Serial Number	Last Calibration Date
P1 Rectory Lane	Sound level meter	01dB	FUSION	12811	24/11/2020
	Microphone	GRAS	40CD	415859	24/11/2020
	External Preamplifier	01dB	Pre No22	1915119	24/11/2020
	Internal Preamplifier	01dB	FUSION	12811	24/11/2020
	Calibrator	01dB	CAL31	93744	24/11/2020
P2 Watery Lane	Sound level meter	01dB	FUSION	11200	11/2/2020
	Microphone	GRAS	40CE	226400	11/2/2020
	External Preamplifier	01dB	Pre No22	1605098	11/2/2020
	Internal Preamplifier	01dB	FUSION	11200	11/2/2020
	Calibrator	Brüel & Kjær	4231	2385276	11/3/2021

2. Survey locations

Location	Eastings	Northings	Photograph
P1 Rectory Lane	583201	237066	

Location	Eastings	Northings	Photograph
P2 Watery Lane	585047	237560	

3. Weather Conditions

3.1.1 Weather conditions were monitored during the survey. Conditions were generable favourable, with low wind speeds and dry. Data is available on request.

4. Covid-19

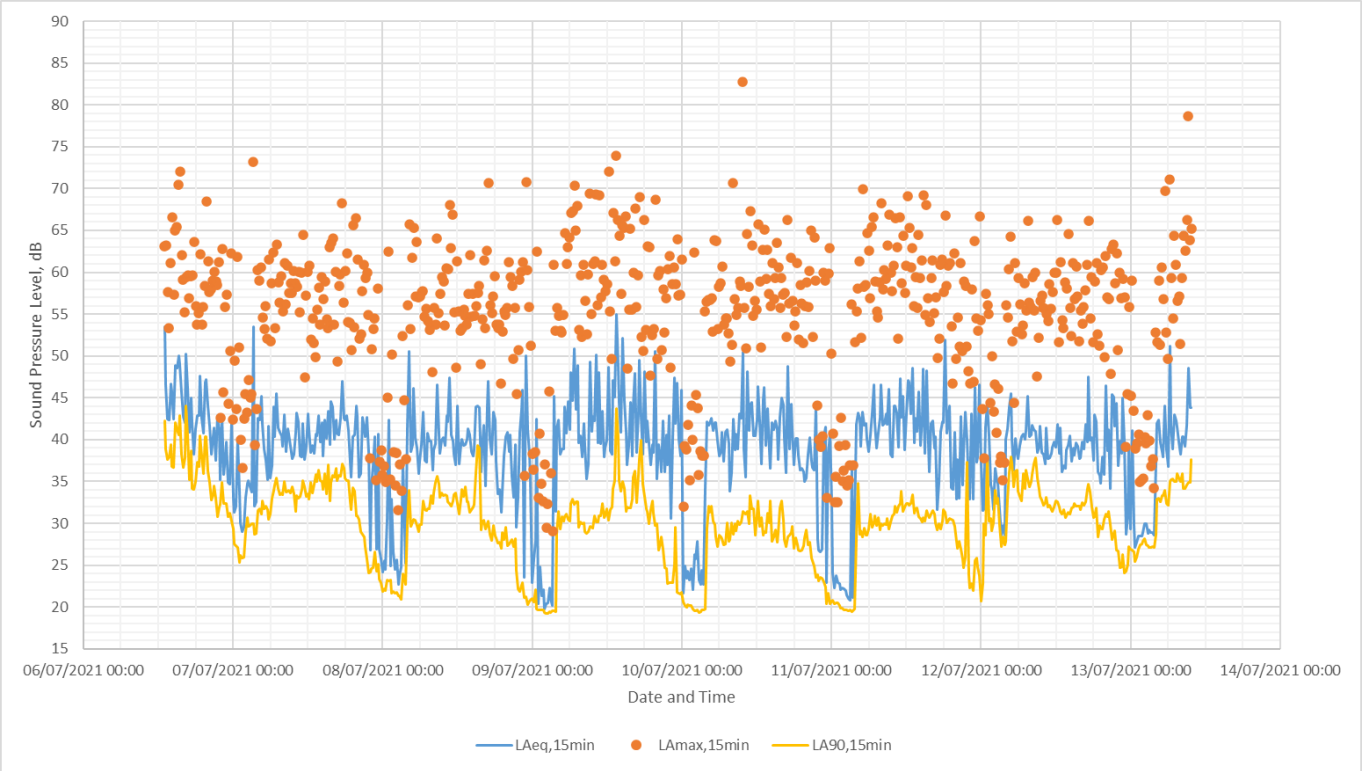
4.1.1 The survey was conducted during the Covid-19 pandemic when certain restrictions were in place limiting people's travel. This has the potential to affect noise levels, particularly from road traffic sources. Institute of Acoustics (IOA) guidance is that noise surveys should still be conducted but that the potential effects of the restrictions on noise levels should be considered.

4.1.2 In this case, there is potential for reduced traffic on the A131 which is the main noise source in the area. However, this effect is likely to negligible. Additionally, the purpose of the survey is to obtain background sound levels for the purpose of setting noise limits. As such, any potential effect is likely to lead to a conservative assessment. The results of the survey have also been compared to measurements in the area, conducted as part of a previous study in 2012. The measured sound levels are comparable, indicating that the effect of the Covid-19 restrictions on measured sound levels is likely to negligible for this survey.

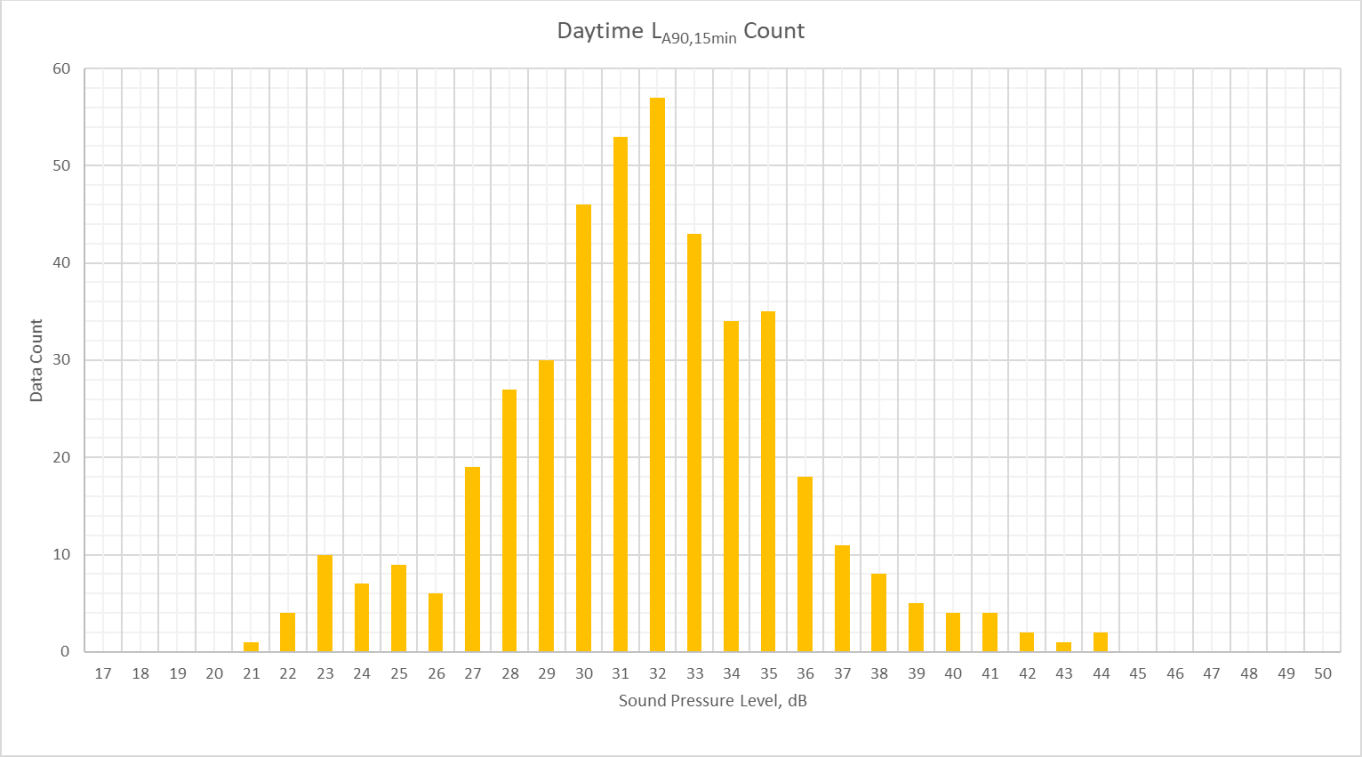
5. Results

P1 Rectory Lane

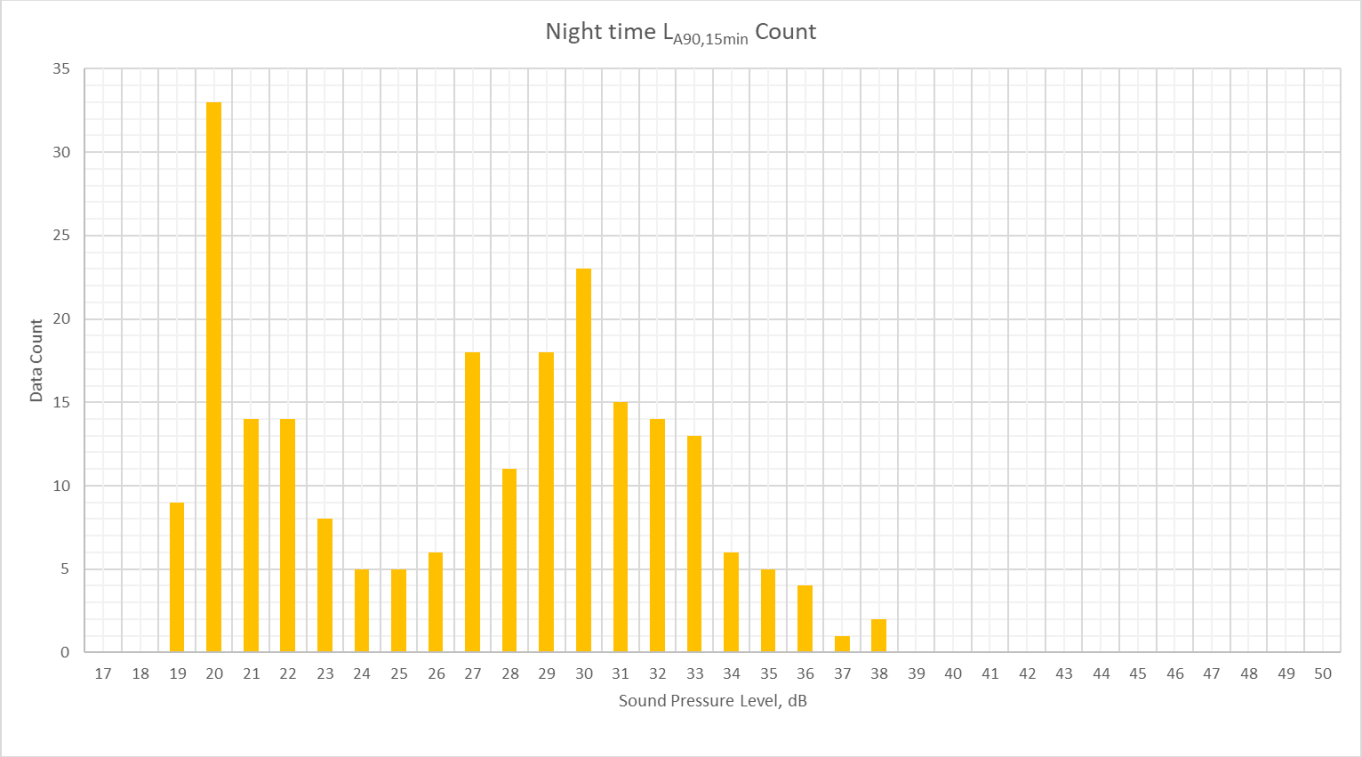
5.1.1 The following figure shows the temporal variation in sound levels at P1 Rectory Lane throughout the survey period.



5.1.2 The following figure shows the statistical distribution of background ($LA_{90,15min}$) sound levels at P1 Rectory Lane throughout the survey period during daytime periods.

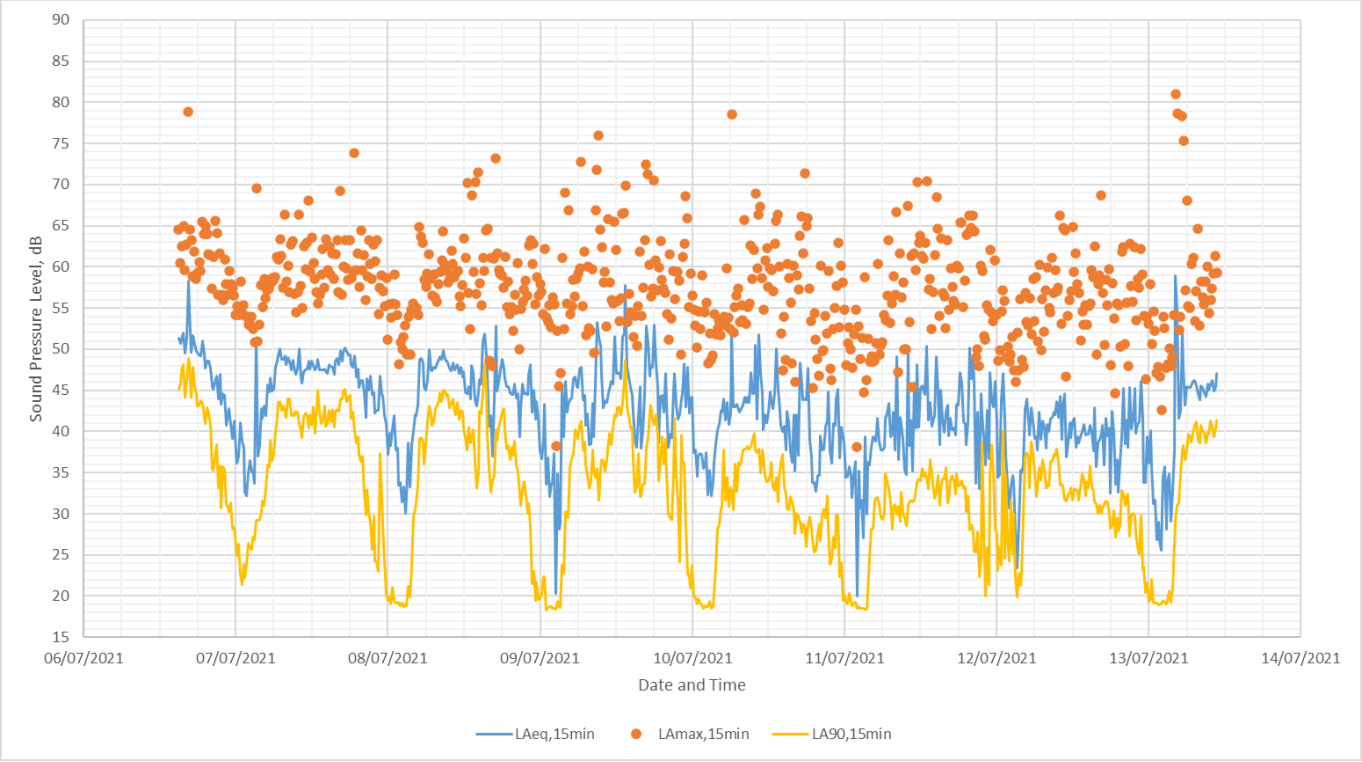


5.1.3 The following figure shows the statistical distribution of background ($LA_{90,15min}$) sound levels at P1 Rectory Lane Hall throughout the survey period during night-time periods.

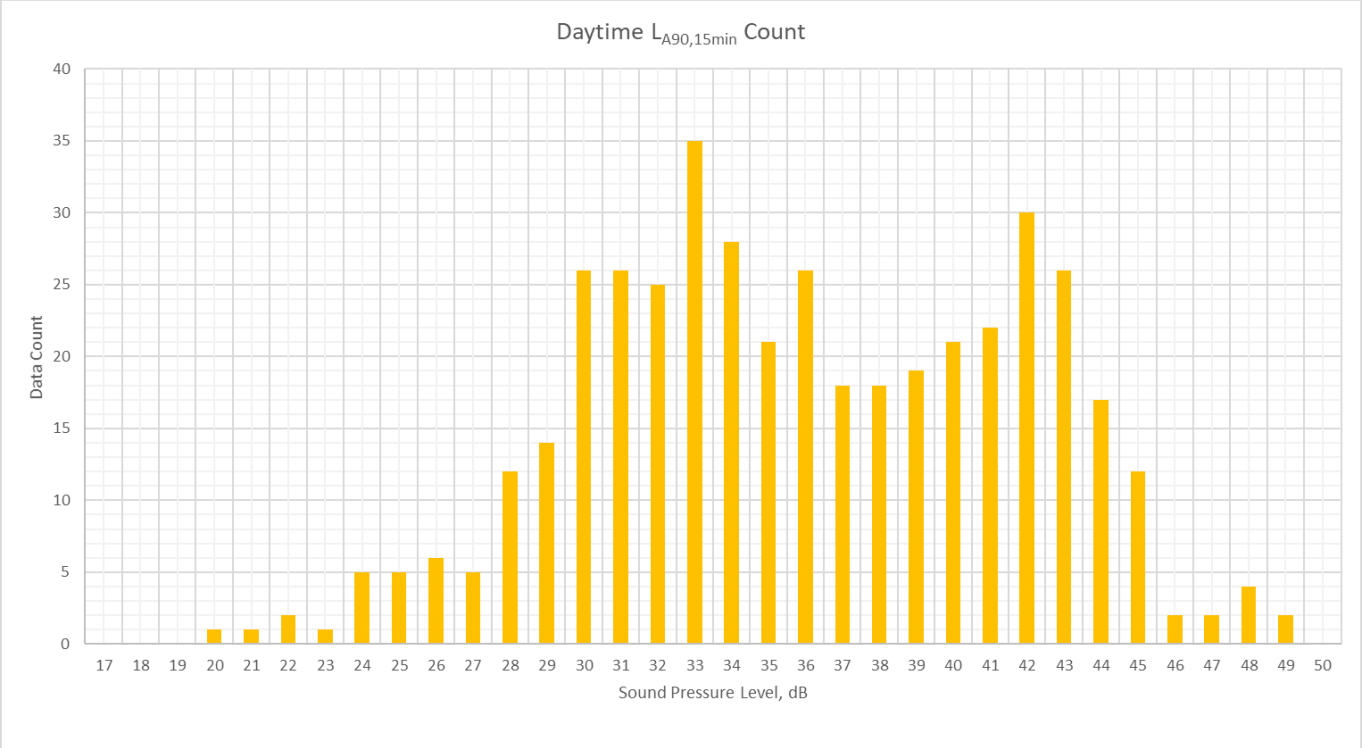


P2 Watery Lane

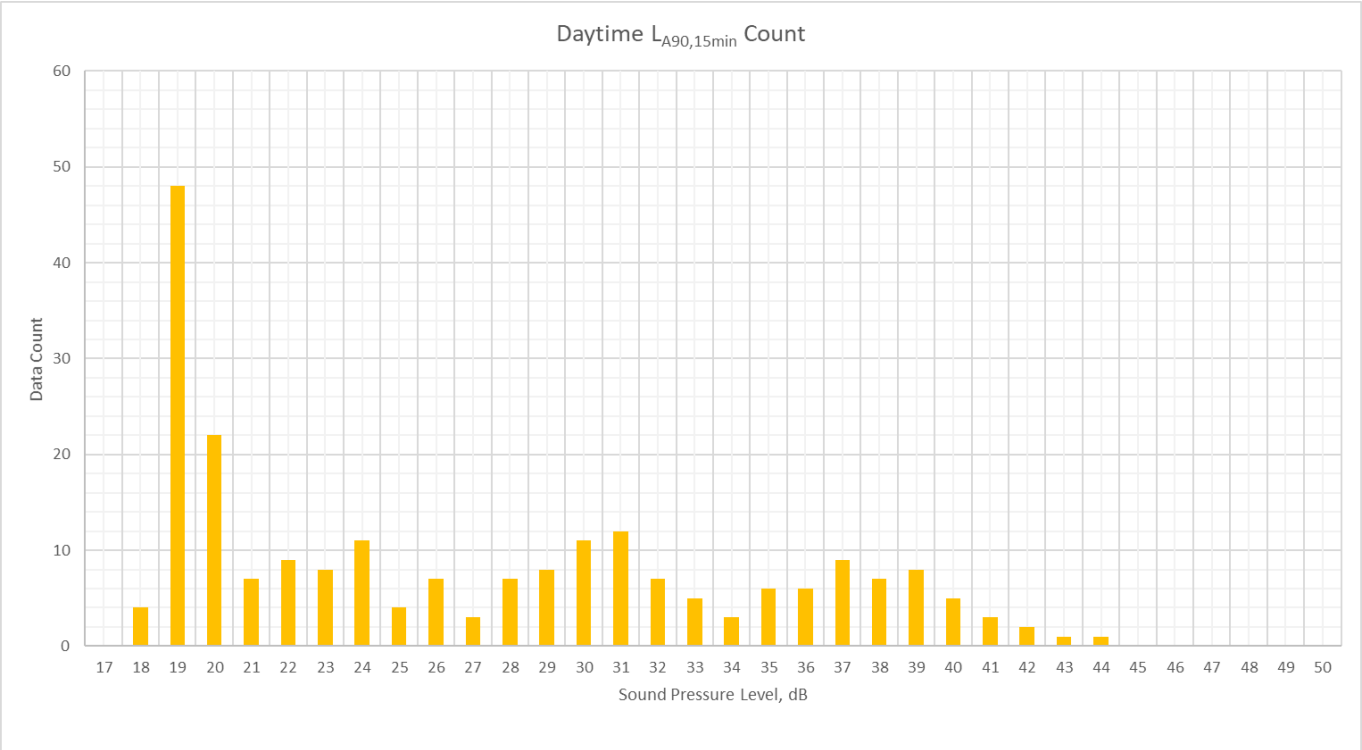
5.1.4 The following figure shows the temporal variation in sound levels at P2 Watery Lane throughout the survey period.



5.1.5 The following figure shows the statistical distribution of background ($LA_{90,15min}$) sound levels at P2 Watery Lane throughout the survey period during daytime periods.



5.1.6 The following figure shows the statistical distribution of background ($LA_{90,15min}$) sound levels at P2 Watery Lane throughout the survey period during night-time periods.



Annex 3: Contruction Noise and Vibration Data

Proposed GSP Substation Construction Activity Plant and Noise Data

Activity	Plant item	Number of plant items	BS 5228 ref	% On-time	A-weighted Sound Pressure Level at 10m, dBA	Likely screening attenuation, dB	Average activity sound power level, dBA
Site Preparation	Tracked excavator	2	C2.7	70	70	0	107
	Dozer	3	C2.1	70	75	0	
Substation Assembly	Telehandler	2	C4.55	50	70	0	110
	Generator	2	C3.33	90	57	10	
	Vibratory piling rig	1	C3.8	25	88	0	

Proposed GSP Substation Construction Activity Noise Levels Over Distance

Activity	Average activity sound power level, dBA	Sound Pressure Level, dBA, at distance, m					
		10	25	50	100	200	300
Site Preparation	107.1	82	74	68	62	56	53
Substation Assembly	110.2	85	77	71	65	59	56

Proposed GSP Substation Construction Activity Noise SOAEL Distances

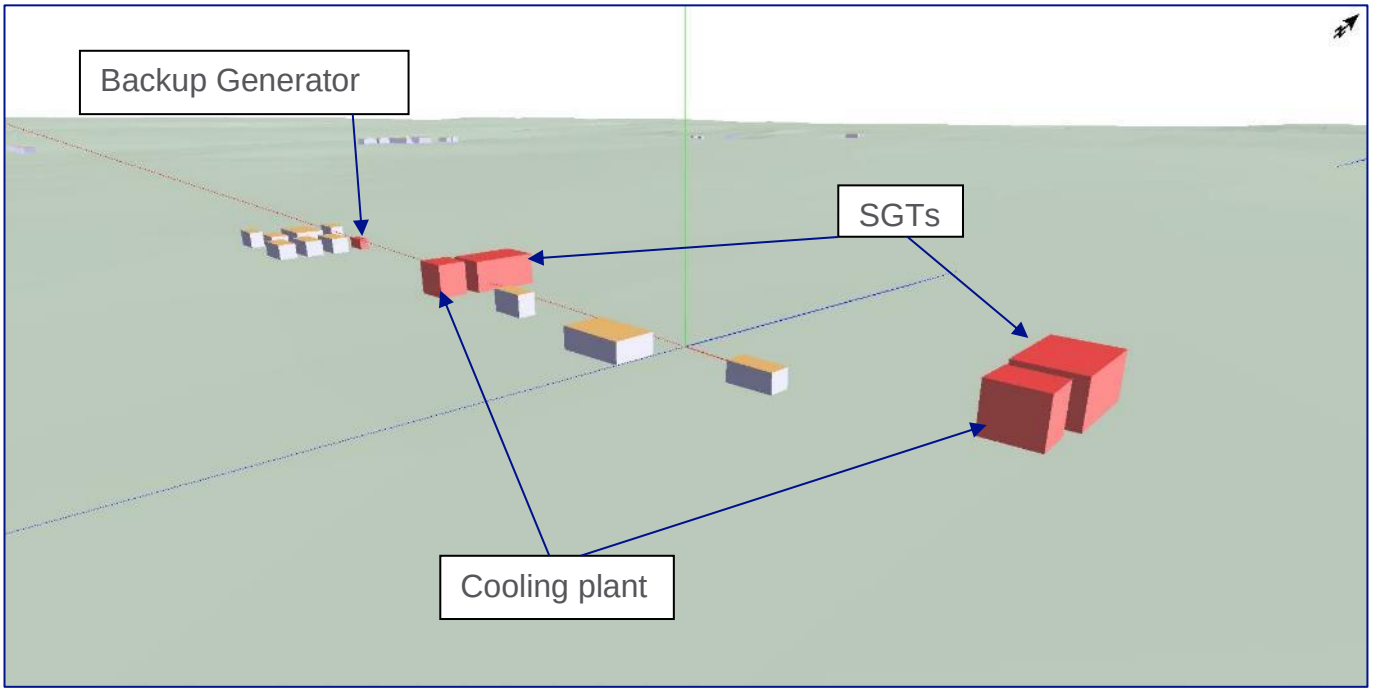
Activity	Average activity sound power level, dBA	Distance within which SOAEL may be exceeded, m		
		Daytime (65 dBA)	Evenings and Weekends (55dBA)	Night-time (45 dBA)
Site Preparation	107	71	225	712
Substation Assembly	110	103	325	1029

Indicative Construction Vibration Threshold Distances

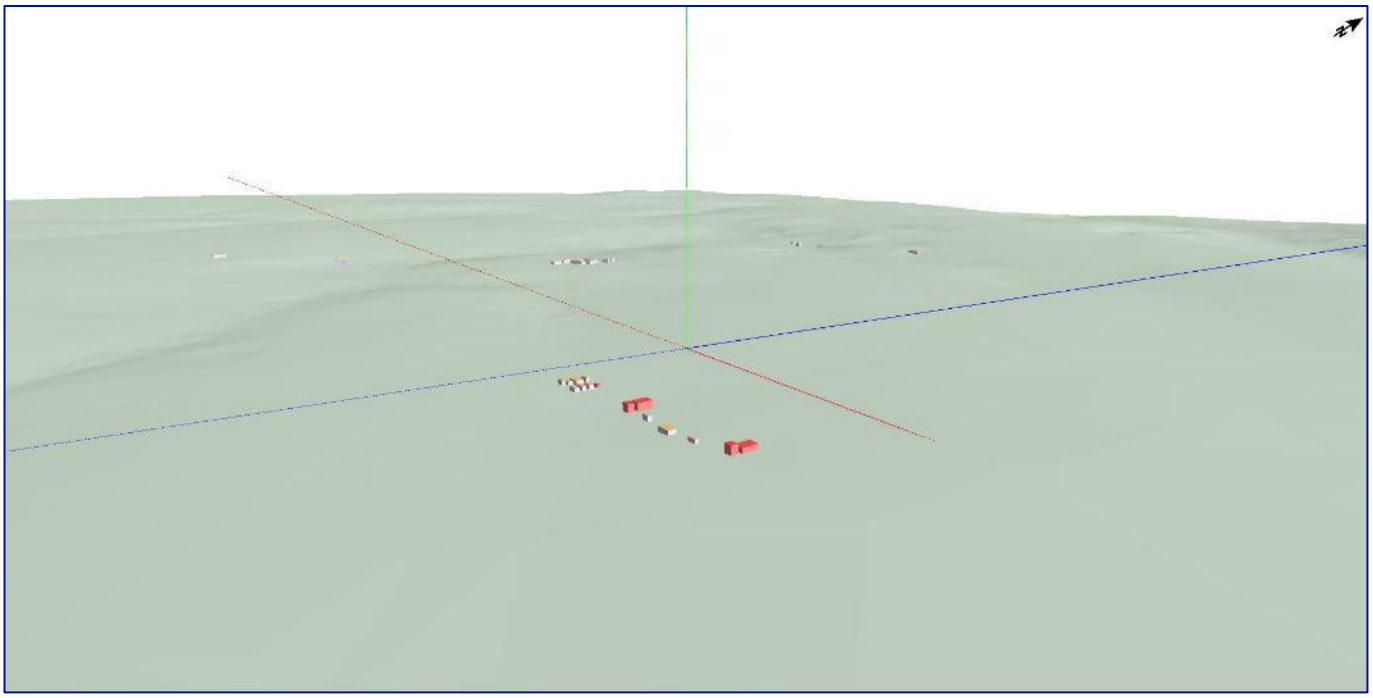
Activity	Distance within which SOAEL may be exceeded, m	Distance within which cosmetic building may occur, m
Ground Compaction	18	<2
Percussive Piling	70	<10

Annex 4: Noise Modelling

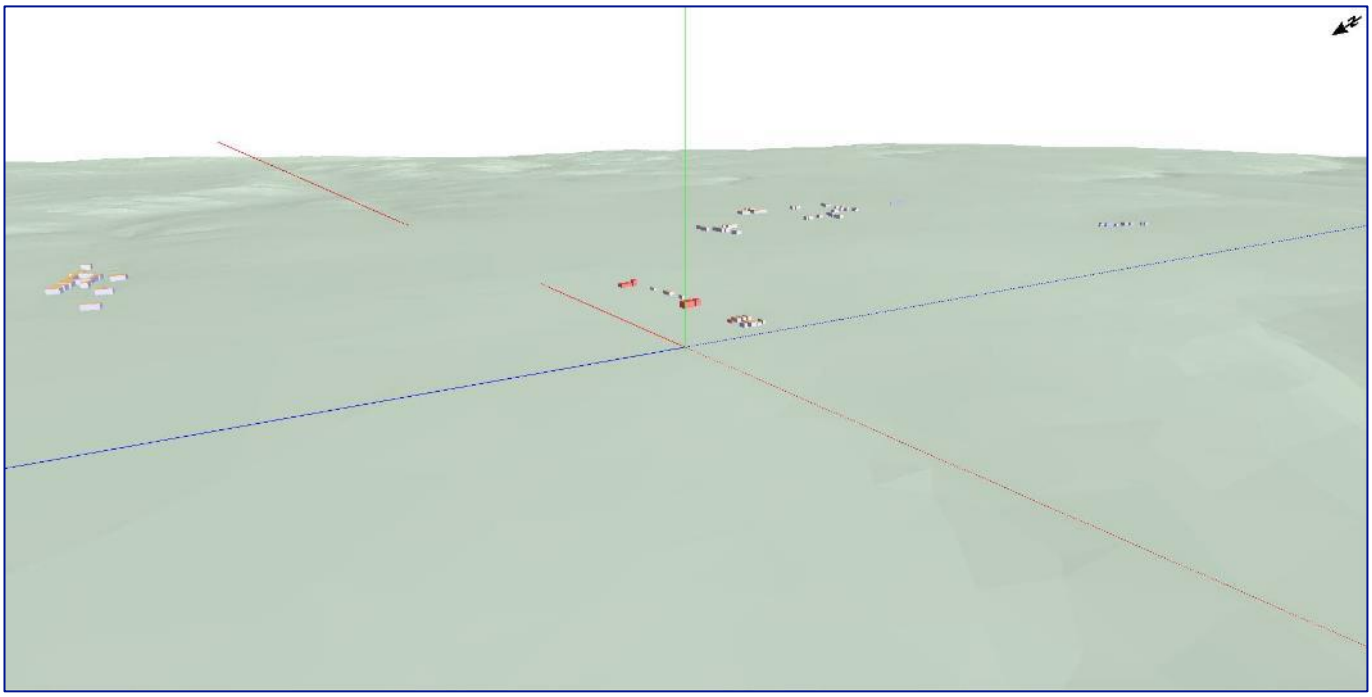
SoundPlan Model and Plant Locations



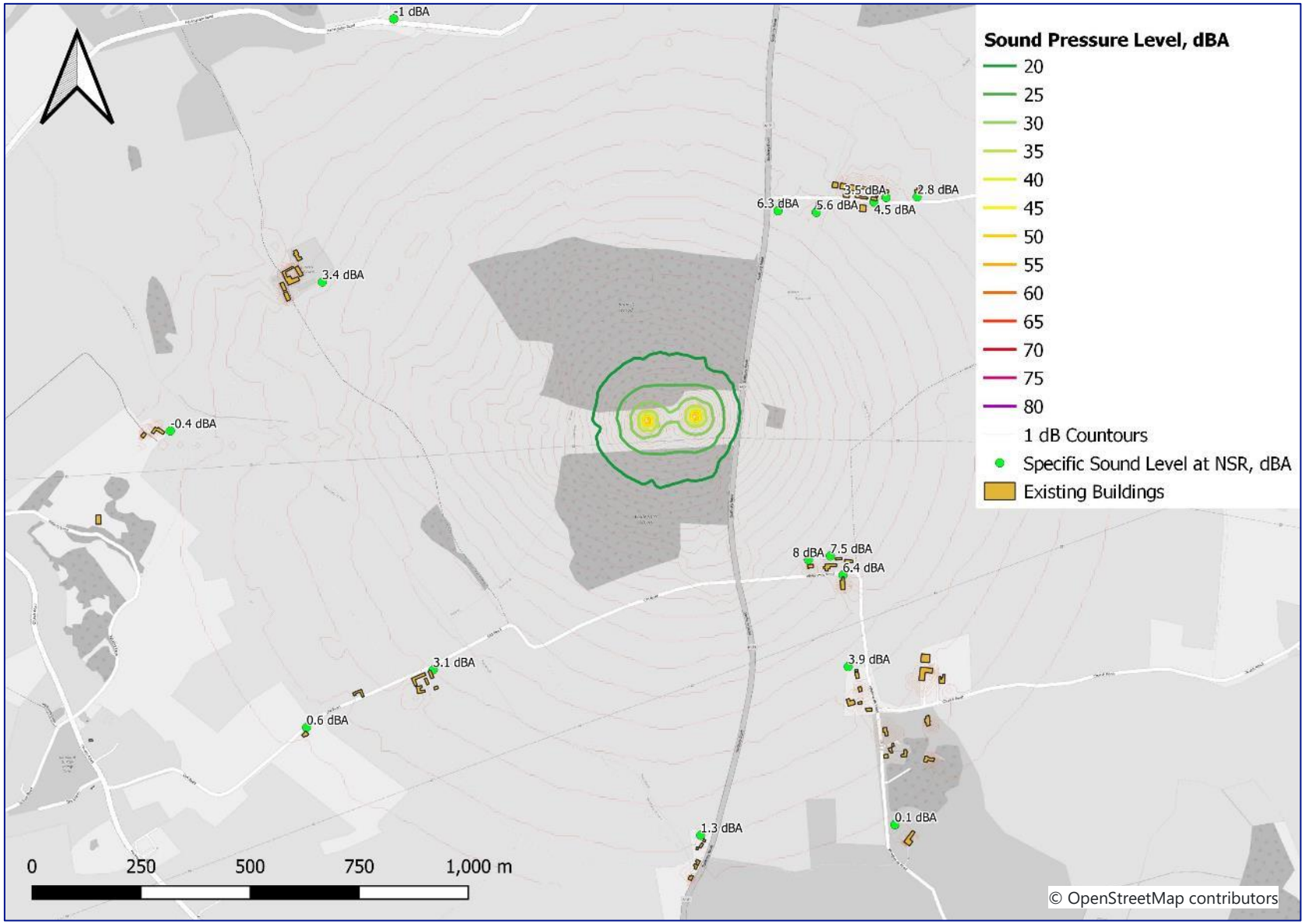
SoundPlan Model Showing View to Northwest



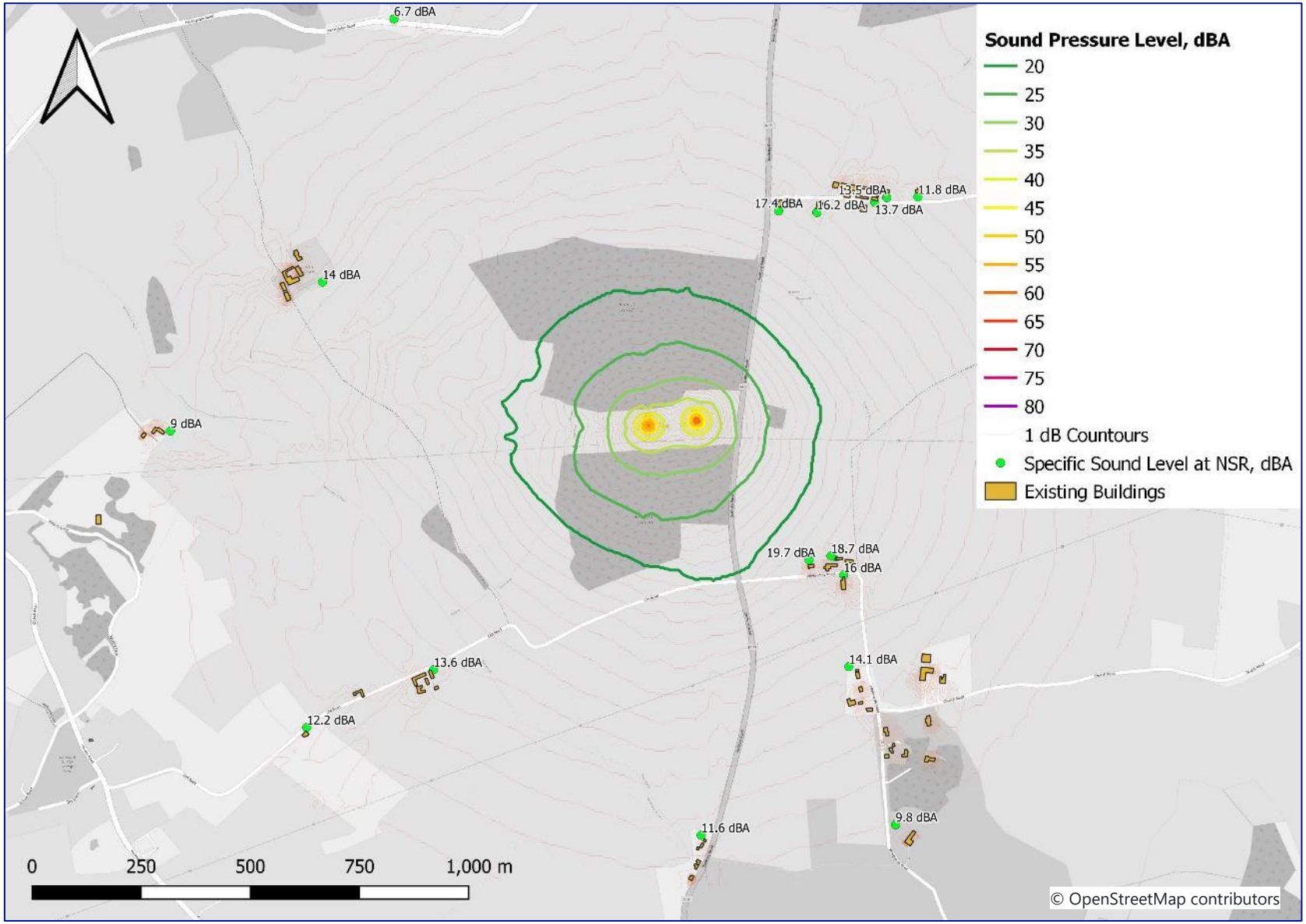
SoundPlan Model Showing View to Southeast



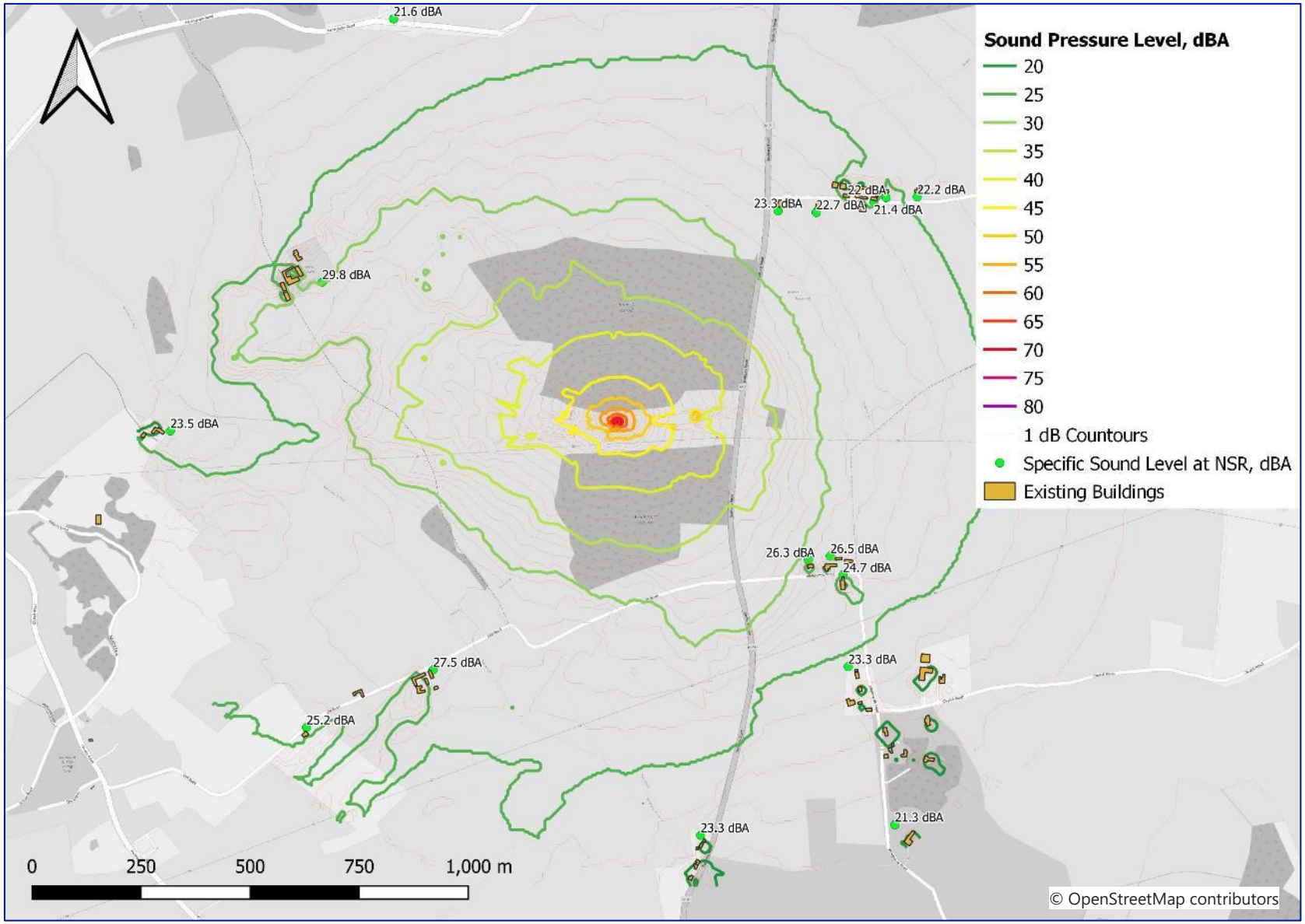
SoundPlan Contour Plot – Normal Operation Scenario



SoundPlan Contour Plot – Cooling Scenario



SoundPlan Contour Plot – Backup Generator Scenario



Annex 5: Noise Impact Assessment of Atypical Scenarios

1. Introduction

1.1.1 Atypical scenarios include when cooling is required, likely to be only during periods of outages of one SGT, and periods when the backup generator is required during emergency conditions or testing.

1.1.2 Resultant sound levels have been predicted via computer noise modelling using SoundPlan software (version 8.2). Figures showing the model and the noise contour plots are provided Annex 4 of this Appendix. The highest sound level predicted at the nearby NSRs has been considered (the plant noise level and impact at other receptors will therefore be lower).

2. Operational Plant Data - Cooling plant and backup generator

2.1 Background

2.1.1 Under normal SGT operating conditions (i.e. at 50% load), cooling plant would not be expected to operate. Exceptions to this would typically be during an outage (planned or otherwise) of one of the two SGTs where the load on a single SGT would increase. The maximum sound power of the cooling plant, as stated in TS2.03, is 84 dBA LW.

2.1.2 A backup diesel generator will be installed for use during emergency conditions to ensure the proposed GSP substation system remains operational, for example during an unforeseen outages. Additionally, backup generators are run briefly on a monthly basis to test their operation. This varies from manufacturer to manufacturer but is typically for around 5-10 mins approximately once a month.

2.1.3 Upper noise limits for standby diesel generators are contained in National Grid's specification document TS3.12. The standard specification is a sound pressure level of 85 dBA at a distance of 1m from the unit, however, National Grid may specify generators with a noise level not exceeding 75 dBA at 1m. The equivalent sound power level of the generator would therefore vary depending on the size of the unit, but an adjustment of 21dB is a reasonable worst-case assumption (based on 10 times the logarithm of the measurement surface area at a distance of 1m, assuming $125m^2$), leading to an equivalent sound power level of 96 dBA LW.

2.2 BS 4142 Assessment - Cooling Scenario

2.2.1 The results of the BS 4142 assessment of the operation of the proposed GSP substation during conditions where cooling is required are presented in Table A5.1. There is no specific criteria for SGTs operating at 100% load and as such it is assumed both SGTs are running at 50% load with cooling plant operating for both units.

Table A5.1: BS 4142 Assessment – Cooling Scenario

Parameter	Value		BS 4142 Clause	Commentary
	Daytime	Night-time		
Background sound level, dB L_{A90}	32	19	8.1	Typical background sound level at nearby receptors based on measured noise data
Specific sound level, dB $L_{Aeq,T}$	20	20	7.3	Calculated via noise model based on worst-case plant specification data.
Acoustic feature correction, dB	0	0	9.2	Cooling plant not likely to be tonal, especially if dominant compared to SGT noise.
Sound rating level, dB $L_{Ar,T}$	20	20	9	Sum of specific sound level and acoustic corrections.
Difference in rating noise relative to background sound level, dB	-12	+1	11	Low impact during daytime and night-time, depending on context. In context, the specific sound level is very low at NSR such that suitable conditions for sleeping can be achieved, even with open windows for ventilation. Additionally, the cooling plant would only operate rarely, primarily during outages of one SGT where the other SGT is required to take the increased load. In context, the impact of noise from the proposed cooling plant is low. **Outcome: Low impact**
Uncertainty			10	Uncertainty has been minimised through the use of long-term noise survey data and worst-case plant specification data. In practice impacts would be expected to be lower than reported. The outcome of the assessment is unlikely to be altered by uncertainty.

Notes:

BS 4142 Clause refers to the corresponding clause in BS 4142 relating to that aspect of the assessment.

2.2.2 The results indicate that on occasions where cooling may be required, this would cause a low impact during both daytime and night-time periods, depending on context. The specific sound level is comparable to the typical existing background sound level and below the existing average ambient sound level (approximately 40dB $L_{Aeq,8h}$) during night-time periods. Additionally, the specific sound level is low and suitable internal sound levels in bedroom and living spaces would still be achieved, even with open windows, when compared to the guidance sound levels stated in BS 8233. Additionally, cooling is less likely to be required during night-time periods and as such would be an infrequent occurrence. In context, the impact of noise from the operation of cooling plant is low.

2.3 BS 4142 Assessment - Backup Generator operation

2.3.1 The results of the BS 4142 assessment of the operation of the proposed GSP substation during the backup generator is required are presented in Table A5.2. It is assumed that both SGTs are operating at 50% load with a backup generator operating.

Table A5.2: BS 4142 Assessment – Backup Generator Scenario

Parameter	Value		BS 4142 Clause	Commentary
	Daytime	Night-time		
Background sound level, dB L_{A90}	32	19	8.1	Typical background sound level at nearby receptors based on measured noise data
Specific sound level, dB $L_{Aeq,T}$	30	30	7.3	Calculated via noise model based on worst-case plant specification data.
Acoustic feature correction, dB	6	6	9.2	Assumed potential tonal audibility at receptor as worst-case. In practice likely to be less.
Sound rating level, dB $L_{Ar,T}$	36	36	9	Sum of specific sound level and acoustic corrections.
Difference in rating noise relative to background sound level, dB	+4	+17	11	While there is a potential exceedance of the background sound level, in context, the specific sound level is still very low at NSR such that suitable conditions for sleeping can be achieved, even with open windows for ventilation. Additionally, the plant would only operate rarely during outages. In context, the impact of noise from the proposed emergency backup generator is low. **Outcome: Low impact**
Uncertainty			10	Uncertainty has been minimised through the use of long-term noise survey data and worst-case plant specification data. In practice impacts would be expected to be lower than reported. The outcome of the assessment is unlikely to be altered by uncertainty.

Notes:

BS 4142 Clause refers to the corresponding clause in BS 4142 relating to that aspect of the assessment.

2.3.2 Noise levels from the emergency generator are expected to exceed background sound levels during both daytime and night-time periods. However, the absolute sound level from the emergency back-up generator would be low and would not cause unsuitable internal sound levels in bedroom spaces of nearby residential NSR would still be achieved. Furthermore, the use of the emergency backup generator would be infrequent, particularly at night. The specific sound level is comparable to the existing typical background sound level during daytime periods and below the existing average ambient sound level during both daytime and night-time periods (approximately 43dB $L_{Aeq,16h}$ and 40dB $L_{Aeq,0h}$, respectively). Additionally, the specific sound level is low and suitable internal sound levels in bedroom and living spaces would still be readily achieved, even with open windows for ventilation, when compared to the guidance sound levels stated in BS 8233. The use of the backup generator during night-time period would also be infrequent and typically only when required during emergency conditions. In context, the impact of noise from the operation of the backup generator is low. However, it is recommended that reasonable

measures are taken to reduce the noise level of the backup generator, principally through plant selection such that the quietest available plant is procured where possible.

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