

The Great Grid Upgrade

Brinsworth to Chesterfield

Brinsworth to Chesterfield

Environmental Appraisal Report - Part 4 of 5

October 2026



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Appendix F	Noise Impact Assessment
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Appendix F

Noise Impact

Assessment

The Great Grid Upgrade

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Environmental Appraisal Report - Appendix F: Noise Impact Assessment

07 November 2025



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1. Introduction

1.1 Purpose of the Statement

- 1.1.1 This noise impact assessment report, prepared by National Grid Electricity Transmission's Environmental Engineering Team, accompanies the full planning application for the development of a new 400kV National Grid (NG) substation east of Long Lane, Whiston, Rotherham. The purpose of this report is to assess the possible impacts of the operational stage of the Scheme.
- 1.1.2 The Great Grid Upgrade is the largest overhaul of the electricity grid in generations and comprises several major infrastructure projects that will both scale up the grid and update National Grid's existing networks. It will enable National Grid to carry more clean, secure energy from where it is generated to where it is needed, boosting energy security and helping the nation become more self-sufficient.
- 1.1.3 The Scheme will include the installation of new reactive plant which has the potential to create an adverse noise impact to surrounding receptors. This noise impact assessment has therefore been completed to identify, address, and consider any mitigation measures (if required), to ensure operational noise from the Scheme will not give rise to an adverse effect to receptors.

1.2 Site and Surrounding Environment Description

- 1.2.1 The Scheme is centred at approximately 53.401038, -1.3340127 longitude and latitude, southeast of Rotherham, located approximately 1 km northeast of the M1 Junction 33, approximate postcode S60 4JJ. It is predominantly surrounded by agricultural fields, with the M1 located approximately 250 m to the south. The nearest residential area is considered to be Whiston, within the Metropolitan Borough of Rotherham, located northeast of the Scheme. Figure 1.1 below, shows aerial imagery of the local area with the proposed red line boundary.

Figure 1.1 Aerial view showing location of the Scheme red line boundary - Source © Google Earth



1.3 Proposed Substation Location and Description

- 1.3.1 The proposed substation will operate at voltages up to 400kV, with equipment including two Supergrid Transformers (SGT), a shunt reactor, a power quality filter, circuit breakers, disconnectors, relay room and a Gas Insulated Switchgear (GIS) control building.

Existing Operational Noise Sources

Overhead Lines outside of the substation

- 1.3.2 The 4ZH 400kV overhead line (OHL) passes through the Scheme boundary, with the XEA 275kV OHL located approximately 100m to the north, and the 4ZV 275kV OHL located approximately 300m to the south, over the M1. These OHLs all span into the existing Brinsworth substation, which is located approximately 750m to the west.
- 1.3.3 As part of the project, works will also include modification works to the existing 4ZH OHL conductors to connect the Scheme to the grid, as well as installing additional pylons to the south to connect to the 4ZV OHL.

1.4 Development Proposals

Reactive Equipment

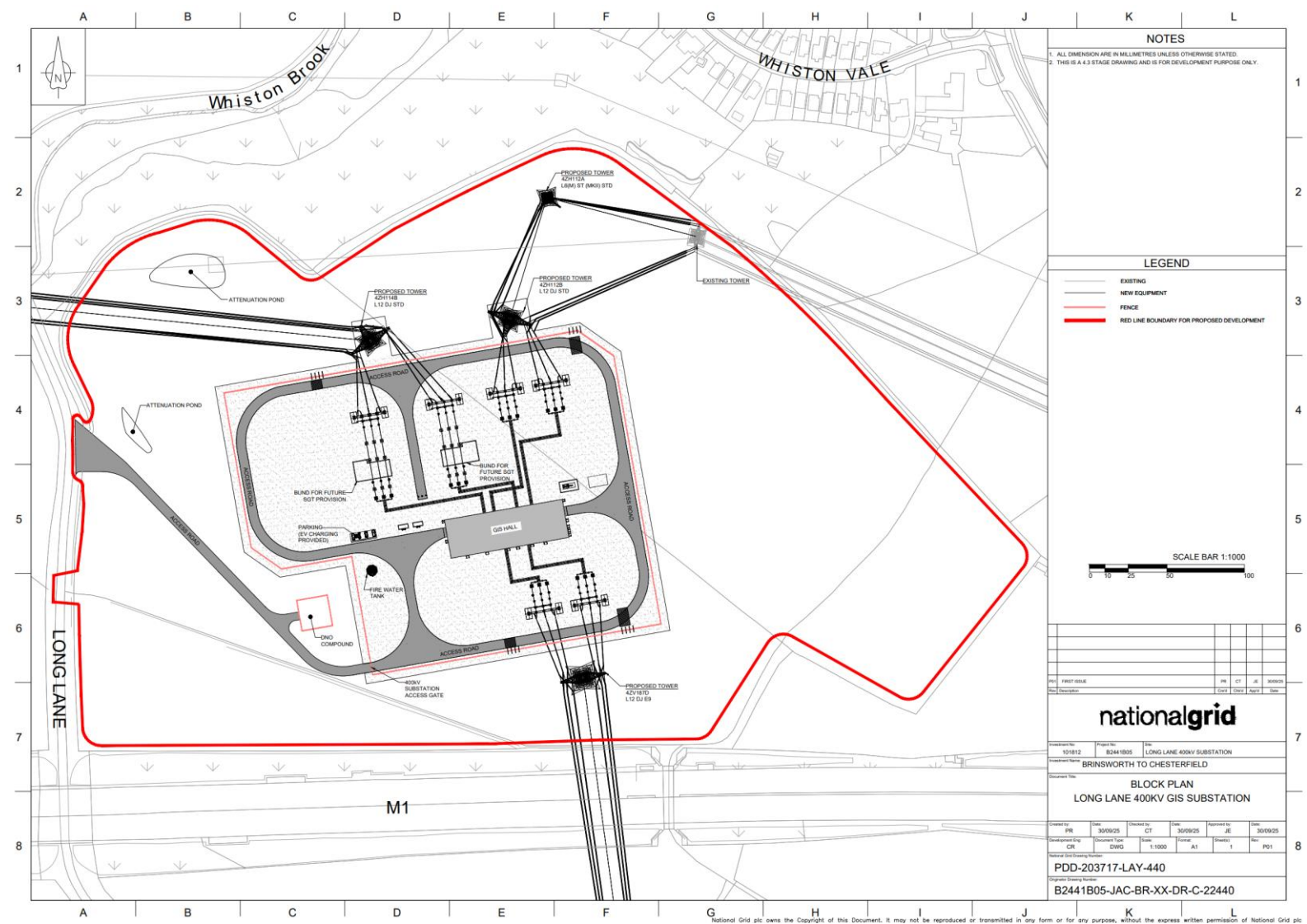
- 1.4.1 Items of equipment generally termed 'reactive plant', in most cases are the significant sources of noise in high voltage substations. Reactive plant, such as SGTs and shunt reactors, are predominantly responsible for the tonal 'hum' associated with substations. It is proposed to install two 400/275kV 1100MVA SGTs, a 400kV 250MVAR shunt reactor, and power quality filter equipment indicatively consisting of a Static Compensator. It should be noted that this equipment is not proposed to be installed during the construction of the substation, but when capacity on the grid is required for the equipment. It is still considered that an operational assessment of this equipment is required during the planning application as agreed with Rotherham Metropolitan Borough Council (RMBC).
- 1.4.2 The substation also comprises circuit breakers, disconnectors/isolators, and current/voltage transformers often termed as switchgears and high voltage plant equipment. Switchgear noise is generated by the operation of circuit breakers and isolators. Switchgears operate very infrequently, typically only a few times a year for outages and maintenance, and in emergencies to protect the substation and electricity network infrastructure from lightning strikes or faults. Noise from switchgear is impulsive in character (i.e., of very short duration) and operates with a dull 'thud' while isolators would operate with a 'click'.

Energised / Passive Equipment within the substation

- 1.4.3 The GIS include the short circuit connections from the OHLs, and the terminal OHL spans into the substation. As this substation will comprise of GIS equipment, instead of Air Insulated Switchgear (AIS), insulators, and gas insulated busbars, will not 'crackle' or 'fizz' due to the occurrence of a phenomenon called corona discharge.

- 1.4.4 Corona discharge occurs when the voltage gradient (or electrical stress) on the surface of energised components and fittings exceeds the corona inception level, which is a function of the insulating properties of the surrounding air. Energised components are designed to operate below this level, however in certain conditions such as damp or wet weather and following long dry spells when surface contamination may build up, the corona inception level may be exceeded, meaning corona discharge may occur in AIS substations. Corona discharge may be audible when close to AIS substations, but it is not continuous and not considered significant.
- 1.4.5 Figure 1.2 below presents the proposed site layout, which is also presented in Appendix A.

Figure 1.2 Proposed site layout – Proposed Long Lane 400kv Substation with the two new SGTs, a shunt reactor, and power quality filter equipment - Source National Grid



1.5 Proposed Operational Noise Sources Subject to Assessment

- 1.5.1 The main noise sources of the Scheme are the two SGTs, shunt reactor, and power quality equipment. Unmitigated noise from this equipment is heard as a highly tonal 'hum', consisting of exact acoustic harmonics of the UK electricity supply frequency. The fundamental acoustic frequency is 100 Hz (Hertz or cycles per second) accompanied by harmonics of 200 Hz, 300 Hz and 400 Hz etc. The tonality is considered an 'acoustic feature' according to BS 4142:2014+A1:2019.
- 1.5.2 The proposed equipment will be procured under contracts with National Grid's suppliers and made to registered designs. These designs will undergo factory tests to ensure the sound power of the equipment comply or are below the maximum permitted sound power level outlined in National Grid's Technical Specifications.
- 1.5.3 Once energised, the equipment will be in continuous operation 24/7.

1.6 Operational Noise Sources Scoped out of Assessment

SGT Cooling System

- 1.6.1 Under normal operating conditions, the cooling systems of the SGTs will rarely operate. Cooling systems may operate during emergency conditions and during times of unusually high demand, typically where the transformer is required to operate above 75% of designs full load. Such conditions usually occur only during exceptional events, (i.e. extreme weather combined with faults elsewhere on the system, requiring an SGT to carry a higher than normal load). These conditions would usually persist for a short duration and as such cooler operation can typically be regarded as an exceptional event. Therefore, SGT cooling system noise is excluded from this assessment.

Auxiliary Substation Equipment

- 1.6.2 Circuit breakers, disconnectors and switches are also a potential source of noise. Their purpose is to disconnect the site from the high voltage transmission system in response to a fault or external event such as a lightning strike, and to isolate and earth parts of the site for maintenance.
- 1.6.3 The sound from a circuit breaker is impulsive and sounds like a car door slam, similar in level and duration, and the sound of disconnectors and switches is less impulsive and sounds like a 'click' or 'clack', this equipment would operate very rarely.
- 1.6.4 The majority of breaker activations would take place during commissioning when there may be 10 or 20 activations during working hours only. Once commissioned, they may typically operate just a few times a year and in some years, they may never operate at all. Whilst the sound of this equipment when operating may be audible just beyond the site boundary, it is unlikely to be noticeable even in a quiet rural environment.

- 1.6.5 Other items of equipment form part of this development but do not produce noise, or produce very low-level noise that would generally not be audible beyond the site boundary. These items of auxiliary equipment include small current transformers, voltage transformers, low voltage site supplies, control kiosks, battery rooms and site lighting. Therefore, auxiliary substation equipment noise is excluded from this assessment.

Operational Traffic

- 1.6.6 The proposed substation will be unmanned. As such there is expected to be no significant increase in operational traffic generated by the Scheme. Operational traffic noise has therefore been scoped out from this assessment.

Operational Vibration

- 1.6.7 The installation of the SGTs typically employs measures to minimise vibrations from its operation, such as antivibration pads, therefore operational vibration is excluded from the scope of the assessment.

1.7 Noise Sensitive Receptors

- 1.7.1 Residential properties surrounding the Scheme are considered to be the most exposed receptors that could be affected by the Scheme. These are:
- Whiston Vale – Residential properties located up to and beyond 200m northeast of the site (from the noise modelling 41 Whiston Vale is considered the most exposed building for receptors along Whiston Vale); and
 - Garnes – Residential property located approximately 250m east of the site.
- 1.7.2 The Receptors listed above are considered the most sensitive due to their proximity to the Scheme.
- 1.7.3 Figure 1.3 below, shows an aerial photograph of the Scheme and Receptors.

Figure 1.3 Aerial view of the Scheme red line boundary and Receptors – Source © Google Earth



2. Assessment Methodology and Scope of Works

2.1 Planning Policy and Guidance on Noise

2.1.1 This acoustic report has been prepared to be submitted in support of a proposed planning application.

2.1.2 Reference to the planning guidance documentation is presented in this report:

- National Planning Policy Framework (NPPF), 2024;
- Noise Policy Statement for England (NPSE), 2010;
- Planning Practice Guidance – Noise, 2019; and
- BS 4142:2014+A1:2019 – ‘Methods for Rating and Assessing Industrial and Commercial Sound’.

2.1.3 A summary of the relevant information with respect to noise contained within the planning documentation listed above is presented below.

2.2 National Planning Policy Framework (NPPF) – 2024

2.2.1 The NPPF sets out the Government’s planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced.

2.2.2 With respect to noise, the NPPF states in Section 15, Paragraph 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. 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;

2.2.3 Additionally, the NPPF document states in Section 15, Paragraph 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;

2.3 Noise Policy Statement for England (NPSE) – 2010

- 2.3.1 The NPSE was published on 15th March 2010. It sets out the long-term vision of government noise policy, to promote good health and a good quality of life through the management of noise.
- 2.3.2 The NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise. The NPSE does not apply to noise in the workplace (occupational noise).
- 2.3.3 The NPSE sets out the long-term vision of Government noise policy which is to:
Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.
- 2.3.4 This long-term vision is supported by the following aims, through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:
- 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.
- 2.3.5 The aim of the NPSE is to provide clarity regarding policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion.
- 2.3.6 There are established concepts being applied to noise impacts and which are presented in the NPSE. They are:
- NOEL – No Observed Effect Level:
- This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.
- LOAEL – Lowest Observed Adverse Effect Level:
- This is the level above which adverse effects on health and quality of life can be detected.
- SOAEL – Significant Observed Adverse Effect Level:
- This is the level above which significant adverse effects on health and quality of life occur.
- 2.3.7 The first aim of the NPSE states:
Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

- 2.3.8 The second aim of the NPSE states:
- Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.*
- 2.3.9 The first aim of the NPSE states that significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development. As well as, where possible, to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim.
- 2.3.10 The second aim of the NPSE refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur.

2.4 Planning Practice Guidance – Noise, 2019

- 2.4.1 The Planning Practice Guidance (PPG) in noise was published by the Department for Levelling Up, Housing and Communities and Ministry of Housing, Communities & Local Government in March 2014 and updated in July 2019.
- 2.4.2 Noise needs to be considered when development may create additional noise or would be sensitive to the prevailing acoustic environment, including any anticipated changes to that environment from activities that are permitted but not yet commenced.
- 2.4.3 Regarding whether noise is likely to be a concern, the PPG states:
- At the lowest extreme, when noise is not perceived to be present, there is by definition no effect. As the noise exposure increases, it will cross the ‘no observed effect’ level. However, the noise has no adverse effect so long as the exposure does not cause any change in behaviour, attitude or other physiological responses of those affected by it. [...]. If the noise exposure is at this level no specific measures are required to manage the acoustic environment.*
- As the exposure increases further, it crosses the ‘lowest observed adverse effect’ level boundary above which the noise starts to cause small changes in behaviour and attitude, [...]. The noise therefore starts to have an adverse effect and consideration needs to be given to mitigating and minimising those effects (taking account of the economic and social benefits being derived from the activity causing the noise).*
- Increasing noise exposure will at some point cause the ‘significant observed adverse effect’ level boundary to be crossed. Above this level the noise causes a material change in behaviour [...] during periods when the noise is present. If the exposure is predicted to be above this level the planning process should be used to avoid this effect occurring, [...]. While such decisions must be made taking account of the economic and social benefit of the activity causing or affected by the noise, it is undesirable for such exposure to be caused.*

At the highest extreme, noise exposure would cause extensive and sustained adverse changes in behaviour and / or health without an ability to mitigate the effect of the noise. The impacts on health and quality of life are such that regardless of the benefits of the activity causing the noise, this situation should be avoided.

2.4.4 Table 2.1, below, summarises the noise exposure hierarchy presented in the PPG:

Table 2.1 National Planning Practice Guidance noise exposure hierarchy

Response	Examples of outcomes	Increasing effect level	Action
No Observed Effect Level (NOEL)			
Not present	No effect	No observed effect	No specific measure required
No Observed Adverse Effect Level (NOAEL)			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measure required
Lowest Observed Adverse Effect Level (LOAEL)			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g., turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level (SOAEL)			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g., avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid

Response	Examples of outcomes	Increasing effect level	Action
Present and very disruptive.	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g., regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect.	Prevent

2.5 BS 4142:2014+A1:2019 – ‘Methods for Rating and Assessing Industrial and Commercial Sound’

- 2.5.1 BS 4142 describes methods for rating and assessing sound of an industrial and / or commercial nature.
- 2.5.2 This includes sound from industrial and manufacturing processes, including sound from fixed installations comprising mechanical and electrical plant and equipment.
- 2.5.3 The methods described in BS 4142 use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident.
- 2.5.4 BS 4142 assesses the likelihood of any adverse impact from proposed or existing industrial / commercial activities on existing or proposed Receptors.
- 2.5.5 To assess the potential impact, the measured background sound level at the closest Receptors or at a representative location, is arithmetically subtracted from the rating level. This is the specific sound level of the assessed source corrected for acoustical characteristics that may make the sound more subjectively noticeable to the Receptors.
- 2.5.6 The method in BS 4142 is based on the difference between the measured background sound level, without the influence of any industrial noise source assessed, and the rating level of the industrial source assessed, at the receiver location.
- 2.5.7 The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.
- 2.5.8 Typically, the greater the difference between the background sound level and the rating level, the greater the magnitude of the impact.
- 2.5.9 A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- 2.5.10 A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context.
- 2.5.11 The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background

sound level, this is an indication of the specific sound source having a low impact, depending on the context.

2.5.12 Regarding the context, BS 4142 states the following:

An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.

2.5.13 Main specific terms used in BS 4142 are presented below:

Ambient sound level, $L_a = L_{Aeq,T}$ – equivalent continuous A-weighted sound pressure level, L_{Aeq} , of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T. The ambient sound level is a measure of the residual sound and the specific sound when present.

Background sound level, $L_{A90,T}$ – A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, T, measured using time weighting, F, and quoted to the nearest whole number of decibels.

Residual sound level, $L_r = L_{Aeq,T}$ – ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound.

Specific sound level, $L_s = L_{Aeq,T_r}$ – equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r .

Rating level, L_{ar,T_r} – specific sound level plus any adjustment for the characteristic features of the sound.

2.5.14 The background sound level is an underlying level of sound over a period, T, and might in part be an indication of relative quietness at a given location. It does not reflect the occurrence of transient and/or higher sound level events and is generally governed by continuous or semi-continuous sounds.

2.5.15 The background sound level should be measured at the assessment location(s), where possible. Where this is not possible, an alternative location, representative of the assessment locations, can be used.

2.5.16 The measurement time interval should be sufficient to obtain a representative value of the background sound level for the period of interest. This should comprise continuous measurements of normally not less than 15 min intervals, which can be contiguous or disaggregated.

2.5.17 The specific sound level needs to be determined at the assessment location(s) as a discrete entity, distinct and free of other influences contributing to the ambient sound. BS 4142 suggests that the specific sound needs to be evaluated over an appropriate reference time interval, 1 hour during daytime and 15 minutes during night-time.

2.5.18 The daytime period is defined as the hours ranging from 07:00 to 23:00. The night-time period comprises the hours from 23:00 to 07:00.

- 2.5.19 BS 4142 states that, where possible, the specific sound level by measurement of the ambient sound level and the residual sound level needs to be determined at the assessment location(s).
- 2.5.20 Where determining the specific sound level by direct measurement is not practicable, for example in the case of a source not yet in operation, the method of calculation has to be reported and justified in detail.
- 2.5.21 The rating level in BS 4142 depends on certain acoustic features that can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level.
- 2.5.22 Where such features are present at the assessment location, a character correction is added to the specific sound level to obtain the rating level.
- 2.5.23 BS 4142 states that it is typically feasible to undertake a subjective assessment of characteristics, based on the correction guidelines, as follows:
- Tonality:** +2 dB for a 'just perceptible' tone, +4 dB for 'clearly perceptible', +6 dB for 'highly perceptible' tones;
- Impulsivity:** +3 dB for 'just perceptible' impulsivity, +6 dB for 'clearly perceptible', rising to +9 dB for 'highly perceptible' impulsivity;
- Intermittency:** if the on / off-time of the specific sound is readily distinctive at the Receptors, a +3 dB character correction is added; and,
- Other sound characteristics:** where the noise source features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied.
- 2.5.24 If characteristics likely to affect perception and response are present in the specific sound, within the same reference period, then the applicable corrections ought normally to be added arithmetically.
- 2.5.25 However, if any single feature is dominant to the exclusion of the others, then it might be appropriate to apply a reduced or even zero correction for the minor characteristics.

2.6 Local Planning Policy, Rotherham Metropolitan Borough Council

- 2.6.1 The Rotherham Metropolitan Borough Council Local Plan, adopted in June 2018, sets out the framework for the growth and development of the area. It identifies how and where new development and regeneration should take place and thereby promotes and manages the future development of the District Council.
- 2.6.2 The Local Plan includes a number of strategic policies said to guide the amount, form and location of new development, and local policies that should guide the consideration of Planning Applications for new development.
- 2.6.3 The following development policies are relevant to noise:

Policy SP 52: Pollution Control

“Development proposals that are likely to cause pollution, or be exposed to pollution, will only be permitted where it can be demonstrated that mitigation measures will minimise potential impacts to levels that protect health, environmental quality and amenity. When determining planning applications, particular consideration will be given to:

b. the presence of noise generating uses close to the site, and the potential noise likely to be generated by the proposed development. A Noise Assessment will be required to enable clear decision-making on any planning application.

4.297 Proposals for industrial development or other uses which are likely to generate noise will be assessed on their circumstances. Locational characteristics will be taken into account and consideration given to appropriate noise reduction. In noise sensitive locations applicants will be required to demonstrate through a Noise Assessment prepared to an acceptable and agreed standard, that the development is constructed to a standard and / or incorporates noise reduction measures which will ensure that the resulting noise levels at specified locations will not exceed acceptable maximum levels.”

- 2.6.4 It is understood that during consultations with Rotherham Metropolitan Borough Council, an operational noise assessment was requested.

2.7 Assessment Methodology

- 2.7.1 Based on the above and given that transformers are industrial noise sources in nature, it is therefore considered that the methodology based on BS 4142:2014+A1:2019, ‘Methods for rating and assessing industrial and commercial sound’ has been adopted for this assessment of the potential noise from the site, with the intention to design rating levels at or below background sound levels at receptors.

3. Acoustic Survey

3.1 Measurement Locations and Equipment

3.1.1 Baseline sound levels at the site have been established by means of an automated noise survey completed between 20th June 2025 to 28th June 2025, considered representative of the most exposed receptors, presented as Measurement 1 in Figure 3.1 below.

Figure 3.1 Aerial view showing locations of the Schemes red line boundary, noise monitoring Measurement 1, and receptors (white circles) – Source © Google Earth



3.1.2 Measurements are considered representative of the receptors shown in Table 3.1 below:

Table 3.1 Measurement location and representative receptors

Measurement Location	Receptors
1	Whiston Vale, Garnes

3.1.3 There is notable geography between receptors along Whist Vale and Measurement 1, resulting in shielding of road noise from the M1. It is considered the location of Measurement 1 resulted in higher noise levels than along Whiston Vale. Although absolute noise levels from the assessment indicate that this geographical limitation does not influence the impact.

3.1.4 Class 1 sound level meters (SLMs) were used and calibrated as per the requirements presented in Section 5.2 of BS 4142. A field calibration check was carried out before and after every measurement session and the drift noted was less than 0.1 dB in each case. The details of the SLMs used in this NIA are presented in Table 3.2 below.

Table 3.2 Sound level meter details

Monitoring Location	Description	Manufacturer	Type	Serial Number	Laboratory Calibration Date
1	Sound Level Meter	Brüel & Kjær	2250	3007838	30/01/2026
	Microphone		4952	2993522	
	Pre-amplifier	Brüel & Kjær	4231	3011044	28/03/2026
	Calibrator				

3.2 Weather Conditions

- 3.2.1 The weather conditions during the installation and collection were noted to be suitable during these times, i.e. temperatures around 25°C, wind speeds less than 5m/s, dry ground conditions, and around 30% cloud cover.
- 3.2.2 The weather conditions were also recorded during the unattended monitoring period using a weather station Vaisala Weather Transmitter WXT530 connected to the sound level meter. Following the guidance in BS 4142, measurement periods affected by adverse weather conditions (15 minute periods with wind speeds higher than 5m/s and periods where rainfall occurred) have been excluded from all tabulated numbers and calculations presented later in the report.
- 3.2.3 From the measurement data, no measurements were filtered due to wind conditions, and 28 15 minute measurements were discarded due to rainfall.

3.3 Acoustic Survey Observations

- 3.3.1 During installation and collection of the equipment the acoustic environment was dominated by traffic along the M1, occasional birdsong, and infrequent overhead aircraft.

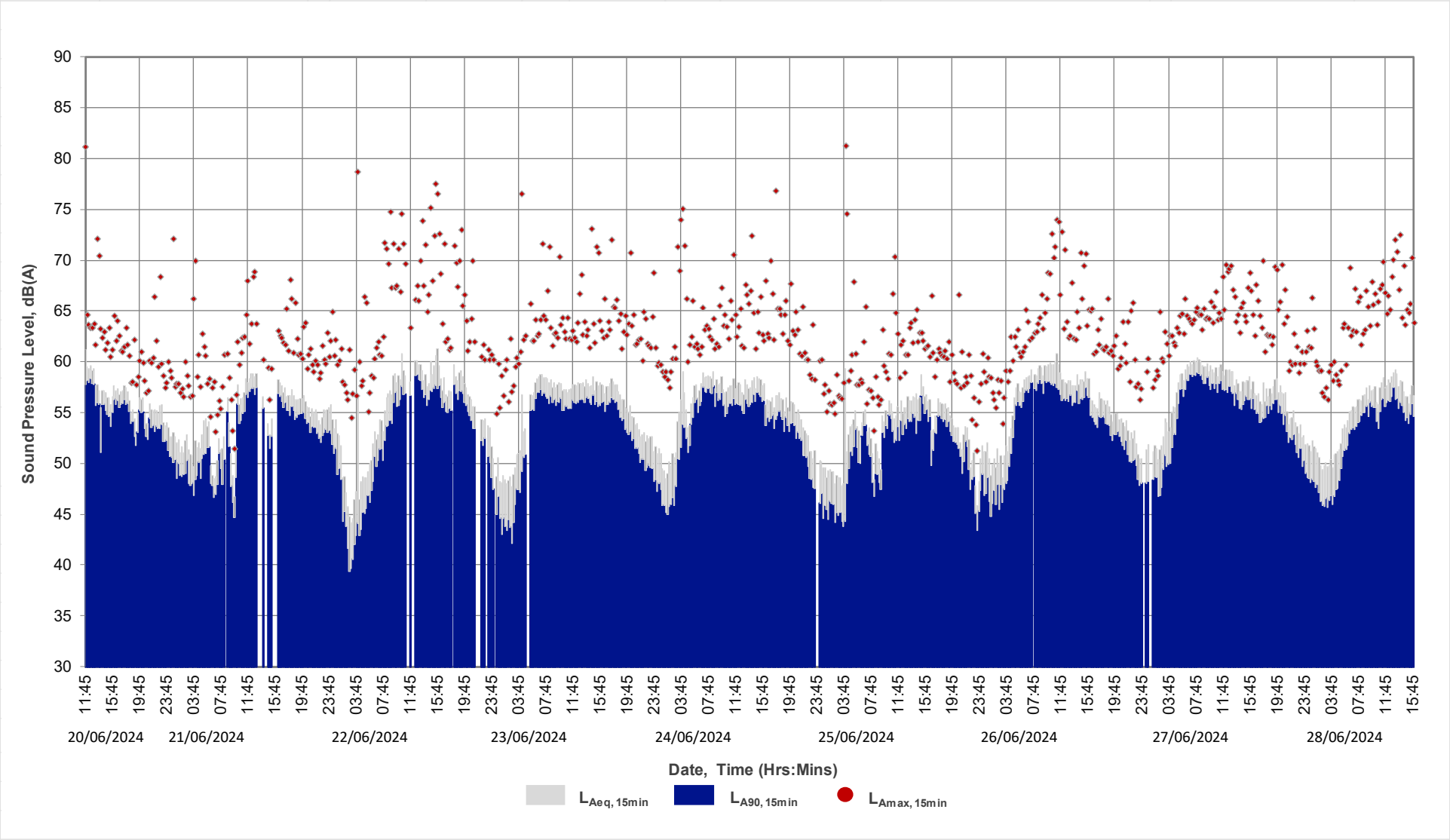
3.4 Survey Procedure

- 3.4.1 The sound level meters were configured to measure the A-weighted equivalent sound pressure level, L_{Aeq} , the A-weighted level exceeded for 90% of the time, considered to be representative of the background or ambient level of a noise environment (L_{A90}), and the L_{Amax} noise indices at high resolution 0.100ms as per the requirements of BS 4142. This data has been post-processed to obtain 15-minute period noise levels.

3.5 Automated Noise Monitoring Results

- 3.5.1 Detailed time history graphs showing the A-weighted L_{Aeq} , L_{A90} , and L_{Amax} sound levels measured during each consecutive 15-minute period of the survey are presented in Figure 3.2.

Figure 3.2 Time history graph of Measurement 1



3.5.2 The measurement data has also been processed to determine the typical ambient daytime ($L_{Aeq,16hour}$) and night-time ($L_{Aeq,8hour}$) levels, presented in Table 3.3 below.

Table 3.3 Measurement 1 Ambient Noise Levels

Date	Daytime sound level ($L_{Aeq,16hour}$, dB)	Night-time sound level ($L_{Aeq,8hour}$, dB)
Friday 20/06/2024	57*	53
Saturday 21/06/2024	56	52
Sunday 22/06/2024	58	54
Monday 23/06/2024	57	54
Tuesday 24/06/2024	57	52
Wednesday 25/06/2024	55	54
Thursday 26/06/2024	58	55
Friday 27/06/2024	58	52
Saturday 28/06/2024	57*	

* Data does not represent full period

3.5.3 The ambient sound levels have been logarithmically averaged to determine the typical daytime and night-time ambient sound levels, presented in Table 3.4 below.

Table 3.4 Typical Ambient Sound Levels

Measurement Location	Typical Daytime sound level ($L_{Aeq,16hour}$, dB)	Typical Night-time sound level ($L_{Aeq,8hour}$, dB)
Measurement 1	57	54

3.6 Background Sound Levels

3.6.1 Statistical analysis of the background sound levels has also been carried out to determine a representative background sound level for the monitoring location.

3.6.2 Figure 3.3, and Figure 3.4 present histograms of the daytime and night-time background sound levels for Measurement 1.

Figure 3.3 Measurement 1 Daytime background sound level histogram

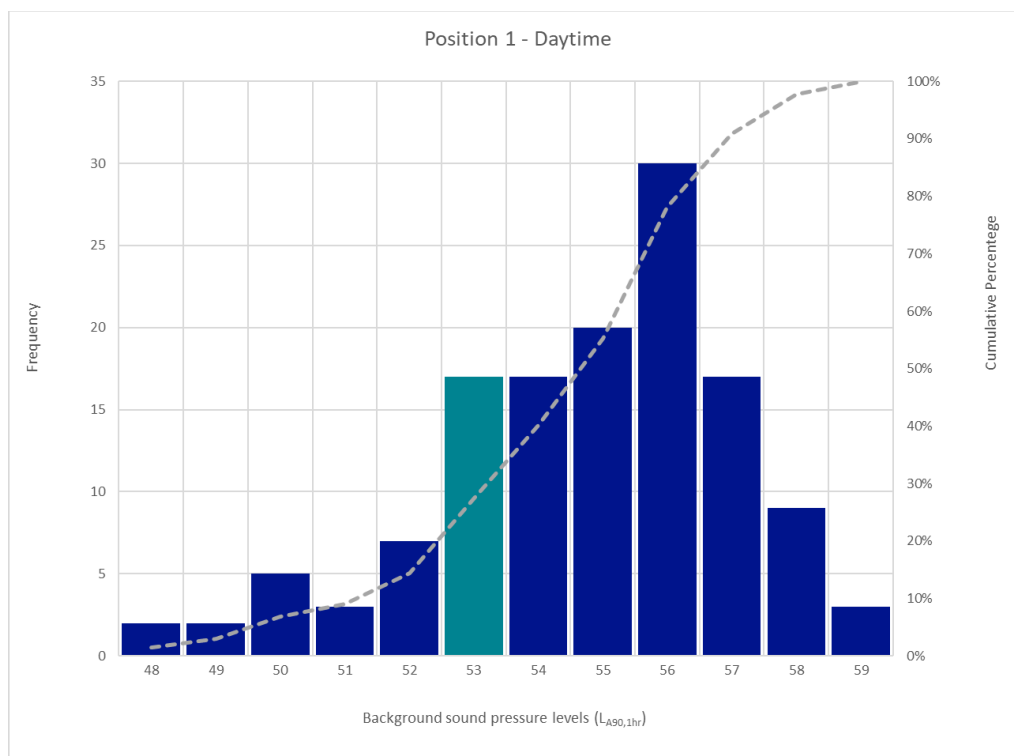
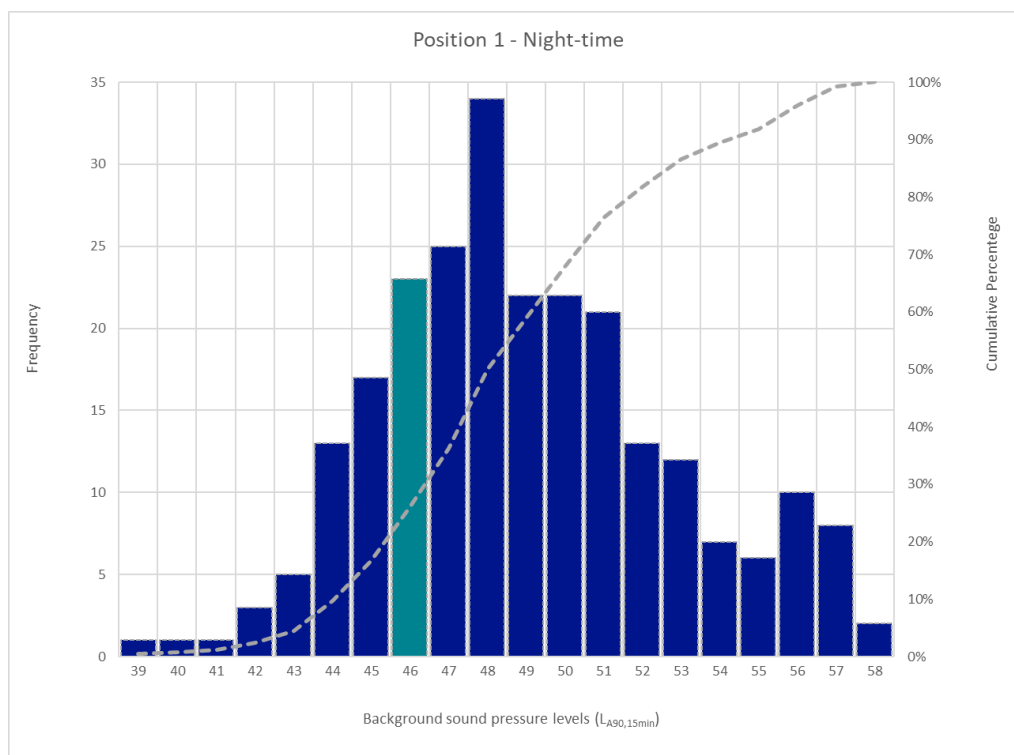


Figure 3.4 Measurement 1 Night-time background sound level histogram



3.6.3 During night-time periods, the background sound levels ($L_{A90,15min}$) are lower than the daytime background sound levels, and as the equipment will operate 24/7. This makes the night-time period a more onerous assessment. Therefore, only the night-time assessment is presented in this assessment.

3.6.4 Based on the analysis of the background levels presented above, a representative background sound level of **46 dB(A)** has been selected for the receptors.

- 3.6.5 In line with BS 4142, a typical background sound level should be selected and should not automatically be assumed to be the minimum value. The typical background sound level presented above has been carefully selected based on the statistical cumulative percentage analysis, which indicates that background sound levels will typically exceed the chosen representative sound levels approximately 70-75% of the time.
- 3.6.6 In light of the above it is considered that the selected background sound levels are conservative and will aid in providing a robust assessment.

4. Noise Impact Assessment

4.1 SGT Sound Power Levels

- 4.1.1 Sound power levels from the SGTs of the Scheme have been derived from National Grids Technical Specification 2.03, Power Transformers and Reactors, TS 2.03, Issue 7, June 2021.
- 4.1.2 This document specifies the maximum sound power level for transformer units under specific operating conditions, in accordance with IEC 60076-10, Power transformers - Part 10: Determination of sound levels.
- 4.1.3 The limits for transformers are presented in Table 2a of the document and reproduced in Table 4.1 below.

Table 4.1 Table 2a from TS 2.03 – Maximum Sound Power Levels – Transformers.

Equivalent Double Wound Rated Power (MVA)	Maximum Sound Power Level of Main Unit at 50% Load and 102.5% excitation voltage (Log sum of measured 50% Load noise and measured 102.5% excitation voltage No Load noise) dB(A)	Maximum Sound Power Level of Cooler dB(A)
<100	72	n/a
100 to 199	92	84
200 to 350	95	87
>350	According to site specific requirements	87 (at reduced capacity stage) and 93 (maximum)

- 4.1.4 The rated power of the proposed SGTs are 1100 MVA. From previous assessments of SGTs with >1000 MVA power, sound power levels of up 97 dB(A) have been used, therefore a sound power level of **97 dB(A)** has been used for the 1100 MVA SGTs.
- 4.1.5 Once an SGT has been manufactured it undergoes Factory Acceptance Testing (FAT) to demonstrate conformance with National Grid's Technical Specifications. The sound power levels of transformers are often below the maximum allowable sound power level outlined in the Technical Specifications. Once energised, the SGTs will be in continuous operation 24/7.

4.2 Shunt Reactor Sound Power Levels

- 4.2.1 Sound power levels from the Shunt Reactor of the proposed site have also been derived from National Grids Technical Specification 2.03, Power Transformers and Reactors, TS 2.03, Issue 7, June 2021.

- 4.2.2 The limits for shunt reactors are presented in Table 2b of the document and reproduced in Table 4.2 below.

Table 4.2 Table 2b from TS 2.03 – Maximum Sound Power Levels – Shunt Reactors.

Power (MVA _r)	Maximum Sound Power Level of Main Unit dB(A)	Maximum Sound Power Level of Cooler dB(A)
<100	88	84
100 to 199	89	84
200	91	87
>200	According to site specific requirements	

- 4.2.3 The rated power of the proposed Shunt Reactor is 250 MVA_r. From previous assessments of Shunt Reactors with >250 MVA_r power, sound power levels of up to 97 dB(A) have been used, therefore a sound power level of **97 dB(A)** has been used.
- 4.2.4 Once a Shunt Reactor has been manufactured it undergoes Factory Acceptance Testing (FAT) to demonstrate conformance with National Grid's Technical Specifications. The sound power levels of Shunt Reactors are often below the maximum allowable sound power level outlined in the Technical Specifications. Once energised, the Shunt Reactor will be in continuous operation 24/7.

4.3 Static Compensator Sound Power Levels

- 4.3.1 Sound power levels from Static Compensators are different to SGTs and Shunt reactors due to the comparatively lower number of units that are on the grid. The assessment of Static Compensators is detailed in National Grid's Technical Specification 2.32, Static Compensator - Statcom, TS 2.32, Issue 1, February 2016, under section 6.5 Environmental Operational Noise Control, reproduced below:
- 6.5.1 The Solution Provider shall include a noise model for the proposed STATCOM equipment using an industry standard noise modelling package. The noise studies shall include;*
- a) Tables of raw sound power data to enable independent noise modelling*
 - b) Tables of equipment operating modes and associated sound powers*
 - c) Details of proposed acoustic mitigation and insertion loss*
 - d) Incorporation of site layout and equipment design including heights and dimensions of principal noise sources*
 - e) Details of the source input data used*
 - f) Tables of contributions at residential receivers*
 - g) Details of key assumptions made in the noise modelling*
 - h) A statement specifying whether or not a dB penalty for tonality has been applied (and if so, at source or at receiver) in accordance with BS 4142:2014*

i) Clear noise contour maps with contours to below background

6.5.2 Site specific noise requirements shall be detailed within the Enquiry Documentation.

6.5.3 The noise model shall consider float, full output, any lifetime load profile detailed in the Enquiry Documentation as operational scenarios for the equipment and any operating points that the Solution Provider considers to be more onerous for Environmental Noise.

6.5.4 Design of the proposed STATCOM equipment shall aim to achieve the lowest practicable (below background) BS 4142 assessment level at the most sensitive receivers.

6.5.5 NGET aims to achieve a 0 dB assessment level at sensitive receivers. The Solution Provider should note that the local planning authority may impose a more stringent condition for audible noise.

6.5.6 The noise performance data required for air-cored reactors shall be determined in accordance with BS EN ISO 3746 or BS EN 9614. The Solution Provider is reminded that where air-cored reactors are utilised, calculations shall take full account of the maximum continuous rated fundamental and harmonic currents as declared in TS 3.3.2. For transformers and iron-cored reactor noise requirements see TS 2.3.

6.5.7 The Solution Provider shall provide details at the Tender stage of the methodology they intend to follow to demonstrate compliance of their installed equipment against the noise model.

6.5.8 Under certain circumstances BS 4142 may be deemed to be out of scope. In these circumstances it may be necessary to refer to alternative standards instead of or in addition to BS 4142. A deviation shall be agreed with NGET at the Tender stage.

Informative: Alternative standards include the World Health Organisation night time noise guidelines and BS 8233.

6.5.9 The design of the STATCOM shall take into account all possible noise mitigation measures in order to reduce the noise generated from the STATCOM and its associated equipment. This shall take into account at least the following:

a) Compensator transformer noise enclosure.

b) Air-cored reactor sound shields.

c) Power electronic valve cooling incorporating fans for the outdoor air cooler banks and the use of noise barriers with appropriate placement to utilise attenuation from inherent features like buildings.

d) Power electronic valve cooling room which incorporates sound proof doors, walls and silenced ventilation intakes/extracts etc.

e) Building HVAC equipment intakes and extracts which are silenced and the control system arranged to minimise the impact at the receiver, e.g. the first extractor fans to operate for increasing temperature shall be located away from the receiver.

6.5.10 In the event that the noise assessment determines that some or all of the noise mitigation

methods are not necessary at first, the design of the STATCOM shall allow these mitigation methods to be installed in the future. This is especially pertinent in respect of air-cored reactor sound shields and the Solution Provider is reminded that the temperature rise test of any air-cored reactors shall be undertaken with the sound shields in place. Additionally, the design and layout of any mitigation methods shall be consistent with safe operation and maintenance and also future relocation of the STATCOM.

4.3.2 An indicative sound power level of the Static Compensator has been used to inform this assessment, taken from current operating Static Compensators used on the grid, which is a single point source, with a sound power level of **76 dB(A)**, which is noted to be minimal in comparison to the SGTs and Shunt Reactor.

4.4 Noise Model Parameters

4.4.1 The specific sound level at Receptors have been calculated using acoustic modelling software Datakustik CadnaA. This software’s calculation method is based on ISO 9613-2:1996 and considers the distance between source and receiver including reflection or screening effects from buildings. Details of the noise model parameters are presented in Table 4.3.

Table 4.3 Noise model parameter details

Parameter	Detail
Software Version	Datakustic CadnaA, Version 2025 MR 2 (64Bit) build 209.5501
Calculation Methodology	ISO 9613-2 (1996) Reflection Order of 3 used
Mapping	OpenStreetMap and proposed layout drawing reference: PDD-101812-203717-LAY-302_P02)
Topography	Height point taken form LIDAR composite digital terrain model, available at: https://environment.data.gov.uk/survey
Ground Absorption	Partially absorptive (G = 0.7)
Building Heights	Assumed 5 m for single storey buildings, 8 m for two storey buildings
Noise Contours	The model has been set to a 1 m x 1 m spacing. Grid height of 4 m used for first floor, night-time assessments
Noise Levels	The model produces “free-field” data

- 4.4.2 It is proposed that groundworks to cut into the ground where the Scheme is located is required, to place the equipment on a flat and level surface. It is anticipated that this would result in a further reduction in noise levels to Receptors, although at the time of this assessment, availability of the terrain with the cut-in works is not available.
- 4.4.3 The 3D sound model includes the following noise sources, as shown in Table 4.4.

Table 4.4 Description of sound sources used in unmitigated noise model

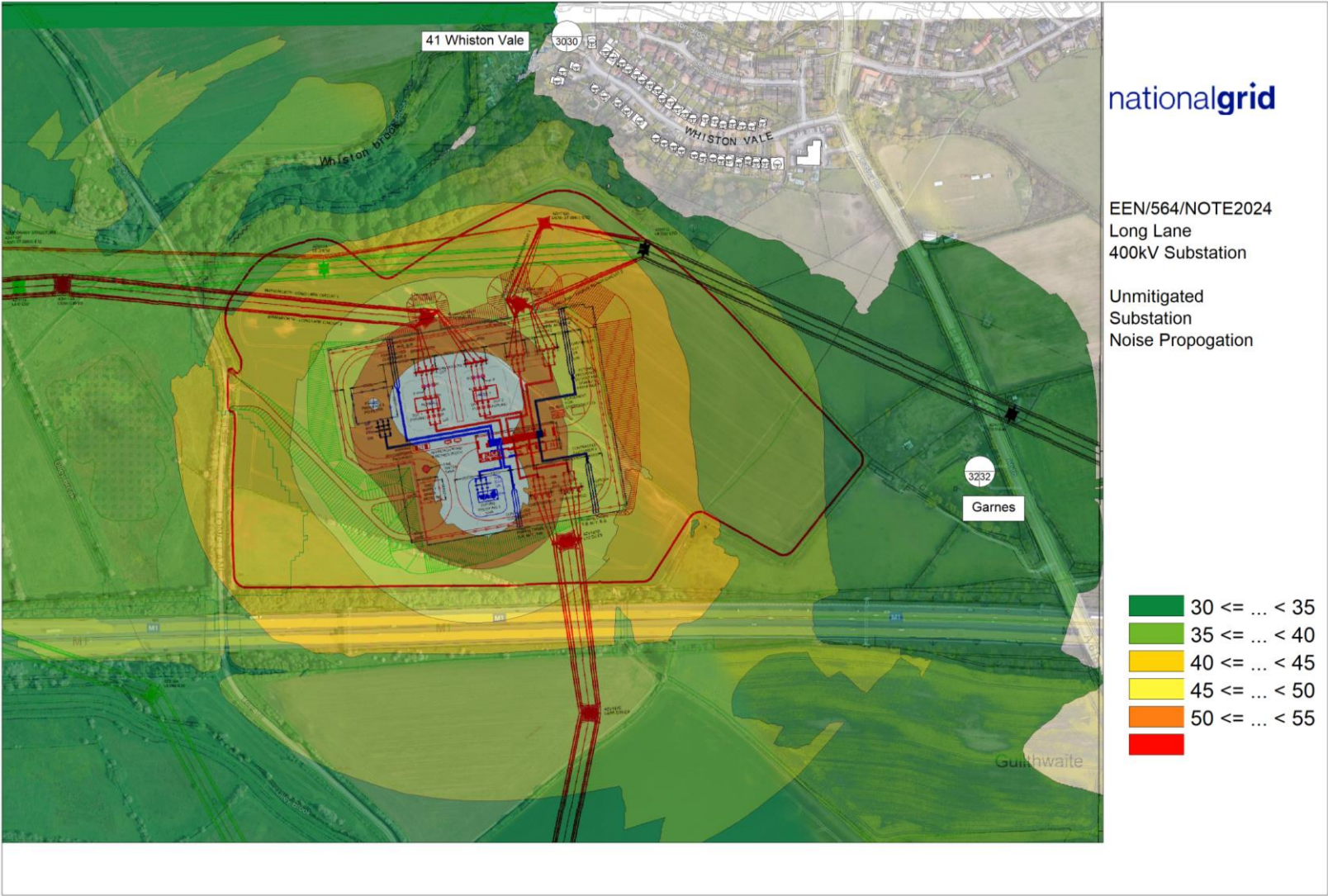
Name	Description	Type of Source	A-Weighted Sound Power Level L_{WA} of Main Tank dB(A)
SGT1 &2 Tank	Omnidirectional source located at the proposed SGT locations. Main tank emitting at 200 Hz at 4 m above ground level.	Point source	97 dB(A)
Shunt Reactor	Omnidirectional source located at the proposed Shunt Reactor location. Emitting at 200 Hz at 4 m above ground level.	Point source	97 dB(A)
Static Compensator	Omnidirectional source located at the Static Compensator location. Emitting at 200 Hz at 4 m above ground level.	Point source	76 dB(A)

- 4.4.4 In the United Kingdom with electrical mains frequency of 50 Hz, the fundamental frequency is 100 Hz and its harmonics, i.e., 200 Hz, 300 Hz, 400 Hz, etc. The emitting frequency of 200 Hz has been selected for the transformer tank sources in the 3D sound model. Modelling all the acoustic energy at 200 Hz presents a conservative approach to the assessment, as this is typically the most audible frequency, as a proportion of the acoustic energy will occur at higher order harmonics, e.g., 300, 400Hz etc..., which are attenuated to a greater extent with distance from the noise source.

4.5 Unmitigated Assessment

- 4.5.1 A specific sound level contour plot showing the propagation of sound from the proposed transformers at the proposed site and Receptors is presented in Figure 4.1, below.

Figure 4.1 Proposed unmitigated specific sound level, L_s , propagation



- 4.5.2 Predicted specific sound levels at each receptor location are presented in Table 4.5, below.

Table 4.5 Predicted unmitigated specific sound levels at Receptors

Description	Predicted specific sound level, dB(A)
Garnes	32
41 Whiston Vale	30

- 4.5.3 The rating level is calculated from the specific sound level and the addition of character corrections, applied using the subjective method outlined in BS 4142, presented in Table 4.6 below.

Table 4.6 BS 4142 character corrections

Acoustically Distinguishing Characteristic	Description	Correction
Tonality	Transformer noise can be heard as a highly tonal 'hum', consisting of exact acoustic harmonics of the UK electricity supply frequency. Due to high background sound levels, it is considered that a character correction for tonality is not applicable.	0
Impulsivity	The nature of the operation of transformers does not present any impulsivity characteristics as these operate constantly with similar load with no peaks in their operation that could create impulsive sounds. Therefore, no impulsivity corrections have been applied.	0
Intermittency	The nature of the operation of transformers does not present any intermittency characteristics as these operate constantly on a 24/7 basis. No intermittency correction has been applied.	0

- 4.5.4 Based on the character corrections and background level presented above and the predicted sound levels at the different Receptors, Table 4.7 presents the rating level initial assessment for the Scheme.

Table 4.7 BS 4142 initial assessment – SGTs Operation

Receptor	Specific Sound Level dB(A)	Background Sound Level dB(A)	Character Corrections			Rating Level dB(A)	Excess Rating Level Over Background dB(A)
			Tonality	Intermittency	Impulsivity		
Garnes	32	46	0	0	0	32	-12
41 Whiston Vale	30	46	0	0	0	30	-16

4.5.5 Based on the results presented above, impacts are anticipated to be negligible to all Receptors. Therefore, additional assessment of acoustic mitigation is not considered.

4.6 Context

- 4.6.1 Assessments indicate that acoustic mitigation does not need to be recommended, as unmitigated noise levels from the Scheme are considered acceptable.
- 4.6.2 The predicted rating levels at Receptors range are -12 and -16 dB below background noise levels. As rating levels are lower than the background sound level, it is unlikely that tonal noise would be audible, and no character corrections have been applied.
- 4.6.3 The following contextual matters are also considered noteworthy:
- The specific sound level used in this assessment for the SGTs is based on 102.5% voltage and 50% load. Typically, the transformers will operate at a lower voltage and load and, subsequently, with a lower sound power level.
 - Moderately conservative background sound levels have been used in the assessment. This is considered robust, as background sound levels throughout the survey regularly exceed the chosen representative background sound level.
 - The absolute predicted noise levels are low and would not, in their own right, be expected to have a material adverse impact to Receptors.

4.7 Uncertainty

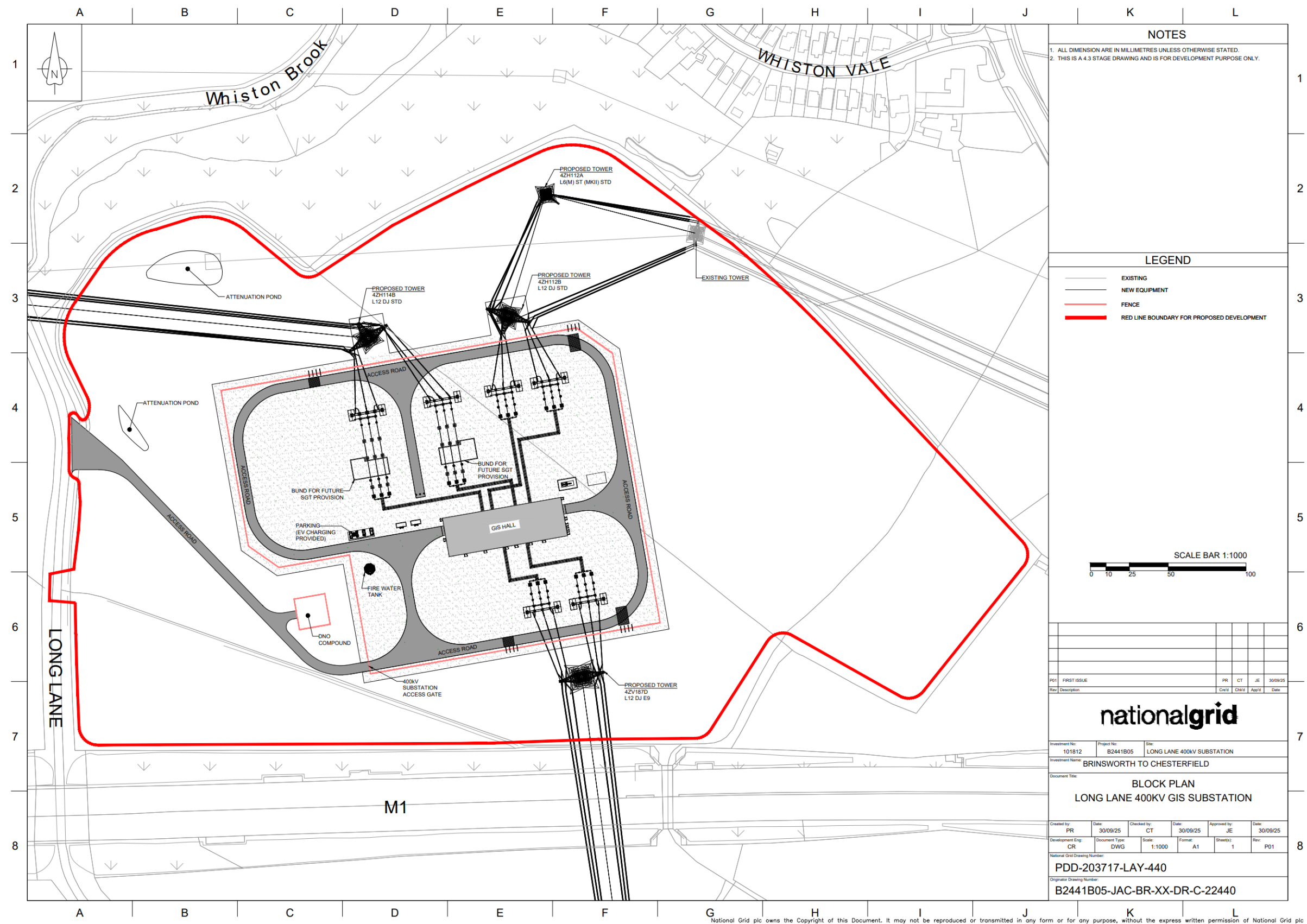
- 4.7.1 The background sound levels derived from the acoustic survey for the assessment are considered to be suitably representative for surrounding Receptors. The weather conditions were continuously monitored during the unattended measurement using a weather station and those periods with wind speeds higher than 5 m/s, and/or rainfall as discussed in BS 4142 were discarded from the dataset for the assessment.
- 4.7.2 Source sound power levels have been based on higher voltages and loads than would typically occur, at 102.5% voltage and 50% load from the National Grid Technical Specification document.
- 4.7.3 Specific noise levels have been calculated using a 3D sound model and rated noise levels have considered character corrections.
- 4.7.4 Based on the aforementioned, it is considered that the uncertainty of the measurements, the determination of the background levels have minimal influence on the outcome of the assessment.

5. Conclusions

- 5.1.1 The National Grid Electricity Transmission Environmental Engineering Team have undertaken a noise impact assessment for operational noise to accompany a full planning application for the Scheme of the new Long Lane 400kV Substation, approximately 1 km northeast of the M1 Junction 33. The main noise sources of the Scheme are two SGTs, one Shunt Reactor, and power quality filter equipment indicatively consisting of a Static Compensator. Additional substation elements, such as circuit breakers, disconnectors or switches have been scoped out of this assessment.
- 5.1.2 An unattended noise survey was undertaken at one location considered representative of the most exposed receptors between 20th June 2025 to 28th June 2025.
- 5.1.3 A 3D noise model, without acoustic mitigation, was created to predict noise levels from the operation of the Scheme to Receptors. The assessment is considered in general accordance with BS 4142, to evaluate the potential impacts.
- 5.1.4 Without mitigation, negligible impacts are predicted for all Receptors, as all rating levels are below the representative background level. **It is therefore recommended that enclosures are not required.**
- 5.1.5 Given the context in which the negative rating level over background sound level calculated from the BS 4142 assessment at all Receptors is predicted, **it is considered that an adverse impact from the site is not likely for any of the identified Receptors.**

Appendix A. Drawings

Appendix A Drawings



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