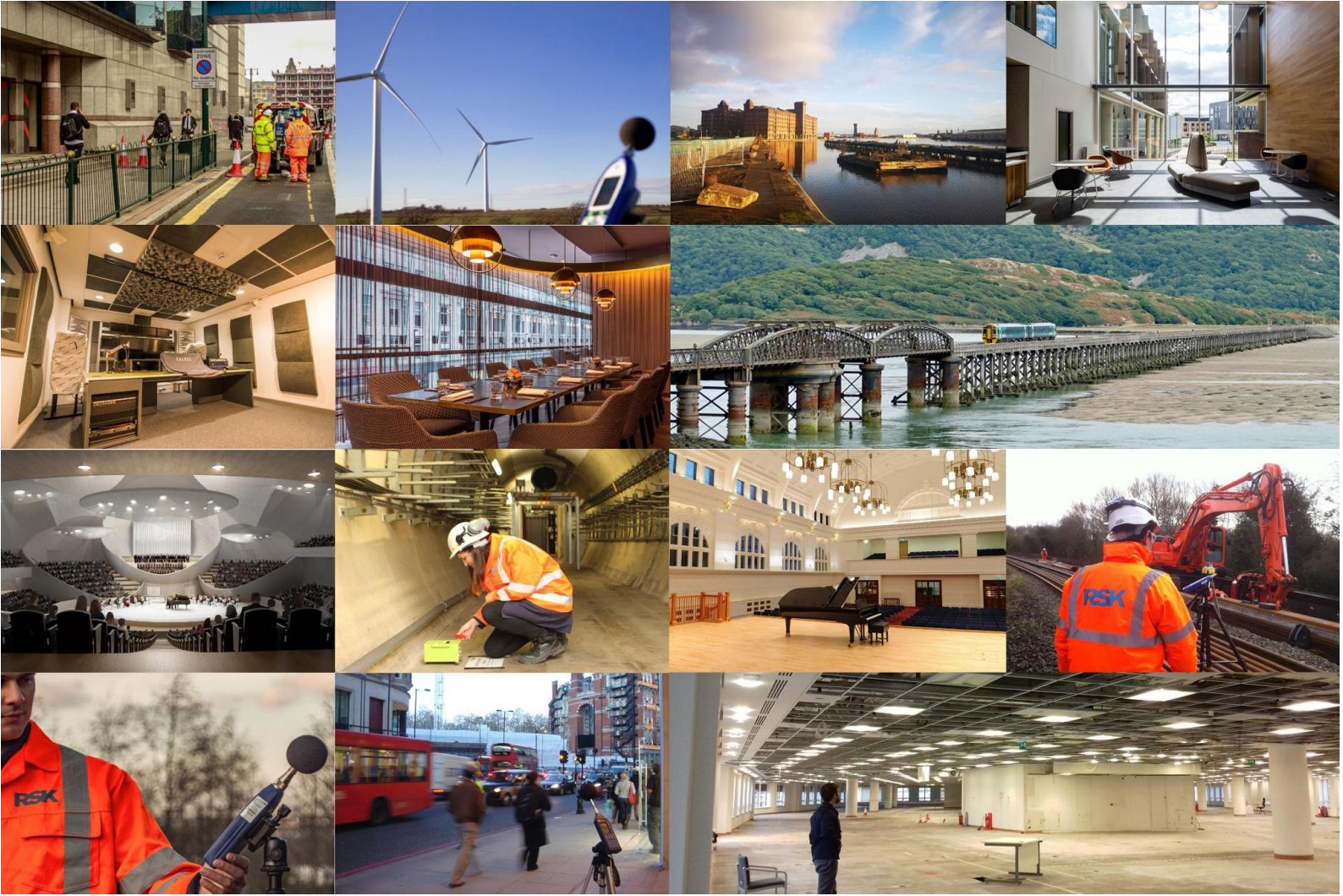




NOISE IMPACT ASSESSMENT

NMGH SUBSTATION 10 RELOCATION

Manchester University NHS Foundation Trust

2062932-RSKA-RP-001-(02)



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General notes

Project Name:	NMGH Substation 10 Relocation
Title:	Noise Impact Assessment
Client:	Manchester University NHS Foundation Trust
Issue Date:	19 March 2025
Report No.	2062932-RSKA-RP-001-(02)

Revision:	Description:	Author(s):	Reviewer:	Date:
01	Draft Issue	Aidan Duffy	Daniel Vallis	03/03/2025
02	Client Updates	Daniel Lilley	Daniel Vallis	19/03/2025

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Date: 19/03/2025

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Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSKA for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Acoustics Ltd.



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1 Introduction

1.1 Instruction and Objectives

RSK Acoustics (RSKA) has been instructed by Manchester University NHS Foundation Trust to undertake a noise impact assessment in support of the relocation of Substation 10 at North Manchester General Hospital.

The assessment is informed by a baseline noise survey undertaken at one position representative of nearest noise sensitive receptors (NSRs), to determine typical background noise levels during both daytime and night-time periods.

This report describes the assessment methodology and the baseline conditions currently prevailing across the immediate area to evaluate the suitability of the new Substation 10 location, considering the noise impact at NSRs in proximity to the proposed new location.

The aim of this noise impact assessment is to:

- Quantify and report the prevailing noise climate at nearest noise sensitive receptors (NSRs) to the proposed new Substation compound;
- Present relevant impact assessment thresholds from national guidelines and British Standards, principally BS 4142:2014+A1:2019;
- Provide noise limits for equipment to be located within Substation 10 to assist in the procurement of plant items, limiting the operational noise impact of Substation 10 at the nearest NSRs;
- Assess predicted noise levels against the relevant noise impact thresholds; and
- Specify noise mitigation measures where necessary.

1.2 Site Location and Description

The proposed relocation site is currently a plant area, immediately surrounded by NMGH wards and grounds. An agricultural area is situated to the east of NMGH site, with a heavy goods vehicle (HGV) rental yard located beyond. Residential areas are situated to the north and east of the NMGH site. Further afield lies a series of residential estates and occasional parkland, serviced by a local road network.

1.2.1 Existing Receptors

The nearest NSRs have been identified as being the closest and/or most exposed to the development site; for assessment purposes, this is understood to be the hospital wards overlooking the proposed development. In the interests of brevity, these have collectively been referred to as “NSR1” within this report.

Ref	NSR Name	NSR Type	Distance from Development Site (m; Direction)
NSR1	Hospital Façade	Hospital	6; S

Table 1 NSR Locations





Figure 1 Identified NSR

1.3 Development Proposals

It is understood that development plans involve the relocation of Substation 10 at North Manchester General Hospital, to a location close to the hospitals Entrance 1. It is understood that the development is set to include:

- One 800 kVA transformer;
- Two 2.5 MVA prime rated generators;
- Two 3200A bus coupled LV switchboards;
- Above-ground bulk fuel tanks, pumps sets, fuel fill systems etc; and
- One combined generator flue stack.

At present, the site has an area reserved for a potential third generator to be included within the compound, situated within an 'expansion zone'. On this basis, a third generator has been considered as a part of this assessment to inform a maximum permissible noise limit for this aspect of plant, should it be installed at a later date.

The use of the generators in emergency scenarios has not been considered within this report, as it is understood to occur only during a national contingency event; however, it has been confirmed that, outside of an emergency situation, the following test schedule will apply to ensure the functionality of the generators at Substation 10:

- A 1-hour period monthly (for each generator) for onload testing;
- A 4-hour period (for each generator) yearly for a full bank load test.

It is understood that the 800 kVA transformer housed by the substation will be running at all times and has therefore been assessed as such.



1.4 Exclusions

The following elements have been excluded from the assessment:

- It is anticipated that operation of Substation 10 and associated plant items will not result in significant vibration. Therefore, an assessment of operational vibration has not been undertaken.
- The impact of noise and vibration from construction activities is expected to be short term and managed by the contractor via the use of Best Practicable Means (BPM). Therefore, impacts from construction noise and vibration have not been considered at this stage.
- Included as part of the development are two 3200A Bus Coupled LV Switchboards. In RSKA's experience, the operation of this item of plant does not generate noise with the exception of an initial 'click' in the event of the circuit breakers activating. Therefore, the switchboards have not been considered as a part of this assessment.
- As part of the assessment, noise limits have been set for the proposed generators. As part of the generator function, above ground fuel pump sets and fuel fill systems are required. It is RSKA's understanding that these items will be included within the generator housing, and therefore are incorporated within the overall generator noise limits as opposed to separate noise limits.
- Due to air quality requirements, it is anticipated that 2.no flue stacks are to be constructed. It is RSKA experience that flue stacks themselves are not noise producing; however, there is potential for noise breakout from the structure and for radiated noise from within the development to propagate at the flues termination. At present, plans are for the termination of the flues to be at a height of 20m. Due to this height being significantly above the height of the hospital façade, it is not expected that radiated noise from the flue termination would be significant at the identified NSRs. Furthermore, with regard to noise break-out from the flue itself, it is anticipated that appropriate design measures will be employed by the client at the detailed design stage where appropriate. When considering these factors, it is considered that this aspect of the development will not cause further noise impact at the NSRs and, therefore has not been considered further within this assessment.
- It is RSKA understanding that a further existing generator is located in relative proximity to the proposed site. It is considered that this is part of the existing noise environment monitored at the site during baseline noise modelling and therefore has not been assessed as part of this report.



2 Regulatory Framework

2.1 National Policy and Guidance

2.1.1 National Planning Policy Framework (NPPF): 2024

The National Planning Policy Framework (NPPF) (published March 2012, updated February 2021 and December 2023) is the means by which noise is considered within the planning regime. The NPPF does not contain assessment design target, instead providing a series of policies, giving local authorities the flexibility in meeting the needs of local communities. The NPPF states:

“Planning policies and decisions 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.

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 impact 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.*

Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or ‘agent of change’) should be required to provide suitable mitigation before the development has been completed.”

2.1.2 Noise Policy Statement for England (NPSE): 2010

Environment, Food and Rural Affairs (Defra) and sets out the approach to noise within the Government’s sustainable development strategy.

The significance of impacts from noise are defined within the NPSE as follows:

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

- *NOEL – (No Observed Effect Level) - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.*
- *LOAEL (Lowest Observed Adverse Effect Level) - This is the level above which adverse effects on health and quality of life can be detected.*

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

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



The three aims of the NPSE are to:

“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.

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.

Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.”

2.1.3 Planning Practice Guidance (PPG)

The Department for Communities and Local Government ‘Planning Practice Guidance’ (PPG) expands upon the NPPF and NPSE. The guidance does not include any specific noise levels but sets out further principles that should underpin a noise assessment. The PPG states:

“Plan-making and decision making need to take account of the acoustic environment and in doing so consider:

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

It then refers to the NPSE and states that the aim is to identify where the overall effect of the noise exposure falls in relation to SOAEL, LOAEL and NOEL and presents a table, reproduced below. The implication of the final line of the table is that only the ‘noticeable and very disruptive’ outcomes are unacceptable and should be prevented. All other outcomes (i.e. all other lines in the table) can be acceptable, depending upon the specific circumstances and factors such as the practicalities of mitigation.

Response	Examples of outcomes	Increasing effect level	Action
NOAEL (No Observed Effect Level)			
Not present	No effect	No observed effect	No specific measures required
NOAEL (No Observed Adverse Effect Level)			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No observed adverse effect	No specific measures required
LOAEL (Lowest Observable Adverse Effect Level)			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed adverse effect	Mitigate and reduce to a minimum



Response	Examples of outcomes	Increasing effect level	Action
SOAEL (<i>Significant Observed Adverse Effect Level</i>)			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant observed adverse effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable adverse effect	Prevent

Table 2 Summary of noise exposure hierarchy

2.2 British Standards and other Guidance Documents

2.2.1 British Standard (BS) 7445-1:2003

The three-part standard BS 7445 'Description and measurement of environmental noise. Guide to quantities and procedures' provides the framework within which environmental noise should be quantified. Part 1 provides a guide to quantities and procedures and Part 2 provides a guide to the acquisition of data pertinent to land use. Part 3 provides a guide to the application of noise limits.

BS 7445 also refers to a further standard, BS EN 61672, which prescribes the equipment necessary for such measurements. Whilst BS 7445 does not prescribe the meteorological conditions under which noise measurements should or should not be taken, it does (part 2, paragraph 5.4.3.3) recommend that in order:

"...to facilitate the comparison of results (measurements of noise from different sources), it may be necessary to carry out measurements under selected meteorological conditions which are reproducible and correspond to quite stable propagation conditions."

These conditions include:

- Wind speed not exceeding 5 m/s (measured at a height of 3 to 11 metres above the ground);
- No strong temperature inversions near the ground; and
- No heavy precipitation

2.2.2 BS 4142:2014+A1:2019

BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound' describes the methods for rating and assessing noise of an industrial or commercial nature. The standard is applicable for the purpose of assessing sound from multiple sources at existing dwellings, including the following:

- Sound for industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and



- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from the premises or processes, such as that from forklift trucks, or that from train of ship movements on or around an industrial and/or commercial site.

Where certain acoustic features are present at the assessment location, a character correction should be applied to the specific sound level to give the rating level to be used in the assessment. The difference between the background noise level and the noise rating (including any penalties) is then calculated.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB is likely to be an indication of adverse impact depending on the context.
- 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.

As indicated above, 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. BS4142 states that:

“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”.

Where the initial estimate of the impact needs to be modified due to the context, all pertinent factors should be taken into account, including:

- The absolute level;
- The character and level of the residual sound; and
- The sensitivity of the receptor and whether dwellings will already (or likely) to incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:
 - façade insulation treatments;
 - ventilation and/or cooling; and
 - acoustic screening.

2.3 Local Authority Consultation

Once formally instructed, RSKA began the consultation process with the Environmental Health Team and Manchester City Council on 4 December 2024. This email detailed RSKA's proposed approach to the assessment and requested Manchester City Council's assistance in terms of establishing noise impact criteria for the development. Received 10 December 2024, Karen Williamson (Environmental Protection Officer) confirmed the following:

‘Regarding the emergency generators, we would ask that these are tested within a working day and times. The emergency generators should not be over 10dB background noise level’.

Whilst further guidance has been sought from Manchester City Council, any further confirmation has not been obtainable, with noise limits for emergency plant not detailed in the Manchester City Council Planning and Noise Technical Note (October 2022). Based on RSKA's involvement with similar projects, an assessment criterion of a noise level not exceeding background sound levels by greater than 10 dB(A) has been established for this assessment.



2.4 Local Authority Guidance

2.4.1 Manchester City Council Planning and Noise Technical Note (October 2022)

Manchester City Council Planning and Noise Technical Note (October 2022) describes Manchester City Councils approach to noise from new developments. Stated within the document on Page 24, the following guidance is given with respect to noise and vibration from fixed plant/equipment:

‘Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (LAeq) below the typical background (LA90) level at the nearest noise sensitive location’.

It is therefore concluded that, for plant items not considered as emergency equipment, the rating level of the equipment does not exceed 5dB below measured background levels.



3 Noise Survey Method

3.1 Survey Details

3.1.1 Baseline Noise Survey

A baseline noise survey was undertaken from 19 November 2024 to 26 November 2024 to obtain data for both midweek and weekend periods.

The monitoring position was selected with consideration to the site constraints, security of the monitoring equipment and accessibility of positions with the intention of quantifying noise from surrounding sources such as the contribution from road traffic, overall hospital activity and the third-party HGV yards situated further to the east. It was not possible to install the sound level meter within the curtilage of the NSRs and, therefore, proxy locations were chosen based on proximity to the identified NSRs. Observations made during installation and collection determined that the noise environment at the monitoring location was consistent with that witnessed at the NSRs.

A summary of the monitoring position is provided in Table 3 and is shown graphically in Figure 1.

Monitoring position	Location Coordinates (Lat, Long)
MP1	53.5183705, -2.2284416

Table 3 Monitoring position Details



Figure 2 Unattended Monitoring Position



3.2 Survey Observations

3.2.1 Baseline Noise Survey

The acoustic environment was observed by the consultant to comprise the following during the equipment installation and collection at MP1:

- Consistent road traffic noise audible from within hospital grounds and wider road network;
- Passing pedestrians and associated conversation;
- Occasional hospital vehicles approaching main entrance to drop off and collect patients.

3.3 Survey Equipment

Noise monitoring was undertaken using the following equipment, detailed in Table 4:

Equipment	Type	Serial Number	Calibration Due
Class 1 Sound Level Meter	01dB Fusion	15170	26/04/2025
Weather Station	WXT530	V1630673	N/A
Acoustic Calibrator	Rion NC-74	34236428	06/08/2025

Table 4 Noise Monitoring Equipment

All measurements were undertaken with the microphone positioned away from reflecting surfaces and at a height of 1.5 m above the ground, considered to be under free-field measurement, to the requirements of BS 7445. The calibration of each sound level meter was checked before and after the measurements, using the acoustic calibrator at 94 dB at 1 kHz; no significant calibration drift was noted (+/- 0.3 dB). The sound level meters used conform to the Class 1 requirements of BS EN 61672-1: 2013 'Electroacoustics. Sound level meter, Specifications'. The calibrator used conforms to the requirements of BS EN 60942: 2018 'Electroacoustics, Sound calibrators.' The equipment used has a calibration history that is traceable to a certified calibration institution.

3.4 Weather Conditions

Weather conditions were measured using the co-located weather station throughout the period of the survey. The weather data are summarised in Table 5 below. Where periods of rain or high wind speeds (above 5 m/s) have been identified in the hourly or 15-minute data, the measured noise levels for these periods have been excluded from further analysis.

Date	Temperature (°C)		Average Wind Speed (m/s)	Accumulated Precipitation (mm)
	High	Low		
20.11.24	3	-2	2.1	0.0
21.11.24	2	-5	1.0	1.1
22.11.24	4	0	1.3	0.7
23.11.24	14	0	1.1	2.5
24.11.24	14	9	0.9	5.0
25.11.24	10	5	1.1	0.3
26.11.24	8	4	0.7	1.7

Table 5 Unattended Noise Survey Weather Conditions



4 Noise Survey Results

4.1 Baseline Noise Survey Results

Summary of the measured noise levels is presented in Table 6.

To display a summarised dataset within this section, the following methods have been used:

- Ambient levels, dB $L_{Aeq, T}$, are calculated via logarithmic average of contiguous 15-minute records across the assessment periods;
- Statistical values, dB $L_{A10, T}$ and $L_{A90, T}$, are calculated via arithmetic average of contiguous 15-minute records across the assessment periods;
- Maximum levels, dB L_{AFmax} , are summarised as the highest individual $L_{AFmax, 15min}$ recorded across each assessment period; and
- All values have been rounded to the nearest decibel.

Date	Time Period (hh:mm)	Measured Noise Levels, dB(A)			
		$L_{Aeq, T}$	$L_{AFmax, T}$	$L_{A90, T}$	$L_{A10, T}$
20/11/24	11:15-23:00	51	71	48	53
20/11/24	23:00-07:00	49	72	45	49
21/11/24	07:00-23:00	52	80	49	54
21/11/24	23:00-07:00	53	70	46	50
22/11/24	07:00-23:00	53	83	47	54
22/11/24	23:00-07:00	46	63	43	47
23/11/24	07:00-23:00	50	72	45	53
23/11/24	23:00-07:00	45	58	43	46
24/11/24	07:00-23:00	49	69	44	51
24/11/24	23:00-07:00	47	74	42	46
25/11/24	07:00-23:00	51	72	46	52
25/11/24	23:00-07:00	47	64	43	47
26/11/24	07:00-10:15	53	72	49	55

Table 6 Summary of Noise Measurements- MP1



5 Derivation of Design Targets

5.1 Derivation of Background Sound Levels

Whilst it has been established that the generators would not be tested during night-time hours, the proposed substation will be required to remain operational 24 hours per day. Therefore, background sound levels have been obtained for both the daytime (07:00-23:00) and night-time (23:00-07:00) periods, allowing for consideration of both the emergency generator testing procedures and substation operation. The methodology detailed in BS 4142: 2014+A1: 2019 provides an example of statistical analysis to determine the representative background noise level during the daytime ($L_{A90, 1h}$) and night-time ($L_{A90, 15-min}$).

The analysis adopts the methodologies applied within the standard to the NSRs with the representative monitoring position background levels. Graphs of the statistical analyses of the background noise levels are shown in Appendix C.

Time Period	Representative Background Sound Level, dB $L_{A90, T}$
Daytime (07:00-23:00)	44
Night-time (23:00-07:00)	41

Table 7 Representative Background Sound Levels at NSRs

A graphical representation of the statistical analysis is included in Appendix D – Representative Background Noise Levels.

5.2 Design Targets

5.2.1 Emergency Generators

Initial Design Target

It has been confirmed that, outside of an emergency situation, the following test schedule will apply to ensure the functionality of the generators at Substation 10:

- A 1-hour period monthly (for each generator) for onload testing;
- A 4-hour period (for each generator) yearly for a full bank load test.

Analysis of the representative baseline data to inform the assessment of fixed plant noise has considered the context of the hourly noise levels ($L_{A90, 1h}$) measured during daytime hours (07:00 – 23:00).

Such an approach is in line with the requirements of BS 4142 and is considered to suitably provide a representative value for the background noise in the local environment. According to BS 4142, where the rating level ($L_{AR, Tr}$) does not exceed the background sound level ($L_{A90, T}$), this is an indication of the specific sound source having a low impact.

In the absence of specific local guidance on relaxed noise limits for emergency plant, consultation with Manchester City Council has confirmed that the following guidance is applicable for the development:

'Regarding the emergency generators, we would ask that these are tested within a working day and times. The emergency generators should not be over 10dB background noise level'.

Based on the statistical analysis performed on the dataset, the initial design targets are summarised in Table 8:

NSR	Representative Background Sound Level, dB $L_{A90, 1h}$	Design Target, dB $L_{AR, Tr}$
NSR1	44	54

Table 8 Generator Initial Design Targets (excluding character corrections)



Acoustic Correction

As no plant items have been procured at this stage, estimations have been made with regard to acoustic correction.

Due to the purpose of this assessment being to provide noise emission limits to assist with the procurement of plant items, this aspect of the assessment has been considered based upon RSKA experience of the characteristics of the noise produced by similar generators, alongside the proposed running time.

Tonality

BS 4142 discusses the addition of rating penalties (to the specific noise) as a factor of 'perceptibility', where the prominence of tonal or impulsive sound from a source can be readily distinguishable over the residual noise. The residual noise is the ambient sound remaining at the assessment location when the specific sound source is suppressed (i.e., no noise emissions from the source at the receptor).

Given the existing high noise environment at the identified NSRs and the uncertainty of the spectral emission data for the final plant to be installed, the following approach has been adopted which accounts for the audibility of tonal components based on the level of change of existing ambient noise levels:

- Specific Level being 5 dB or more below the Residual Level: 0 dB (no correction)
- Specific Level being up to 5 dB below the Residual Level: 2 dB (just perceptible)
- Specific Level being up to 5 dB above the Residual Level: 4 dB (clearly perceptible)
- Specific Level being greater than 5 dB above the Residual Level: 6 dB (highly perceptible)

Therefore, during the procurement of plant items, it is recommended that the above criteria be implemented in discussion with RSKA staff, to ensure that the plant item procured does not exceed the specified criteria.

Impulsivity and Intermittency

RSKA experience supports that when in use, generators are a consistent source of noise with little prospect of impulsivity. It is therefore considered unnecessary to apply an impulsive correction.

Also, it is not considered likely that the plant would have distinguishing on/off conditions within a given reference period (1 hour for daytime, 15 minutes for night-time). As such, a character correction under the definition of "intermittent" noise in BS 4142 has not been added.

Character Corrections Applied

As the generators to be installed are yet to be confirmed, definitive character corrections cannot be implemented beyond reasonable doubt to aid with plant item procurement. It is therefore recommended that the design team liaise with RSKA when selecting the generators to be installed, to ensure that the required character corrections do not result in noise levels being exceeded at the identified NSRs.

Table 10 shows the maximum afforded design target noise levels at the NSRs once character corrections are considered. This is derived by affording the maximum design target whilst applying methods laid out in Section 4.2.1 for the corrections, without exceeding the stipulation of 10dB above representative background sound level.

NSR	Representative Background Sound Level, dB $L_{A90, 1h}$	Corrected Design Target, dB $L_{AR, Tr}$
NSR1	44	49

Table 9 Generator Design Targets Following Acoustic Correction- Noise Impact at NSRs

5.2.2 Substation

The following requirements are set out in the Manchester City Council Planning and Noise Technical Note (October 2022), when considering the noise impact of fixed plant items:



‘Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location’.

It has been confirmed that the proposed substation set to be located within the Substation 10 site is to run 24 hours per day.

Analysis of the representative baseline data to inform the assessment of fixed plant noise has considered the context of the hourly noise levels ($L_{A90,1h}$) measured during daytime hours (07:00 – 23:00) and 15-minute interval noise levels ($L_{A90,15-min}$) measured during night-time hours (23:00 – 07:00).

Such an approach is in line with the requirements of BS 4142 and is considered to suitably provide a representative value for the background noise in the local environment. According to BS 4142, where the rating level ($L_{AR,Tf}$) does not exceed the background sound level ($L_{A90,T}$), this is an indication of the specific sound source having a low impact.

Based on the statistical analysis performed on the dataset, the design targets are summarised in Table 9:

Time Period	Background Sound Level, dB $L_{A90, T}$	Design Target, dB $L_{AR,Tf}$
Daytime (07:00-23:00)	44	39
Night-time (23:00-07:00)	41	36

Table 10 Substation Design Targets



6 Noise Prediction Model

6.1 Methodology

The predicted noise levels likely to be generated from the site have been calculated using a noise prediction model. These predictions realise the noise propagation of any plant noise in isolation at the nearest sensitive receptors to the site taking terrain and local topographical features into consideration. Each generator has been assessed individually, in line with testing protocol, to ascertain an estimated noise limit to aid in the procurement process.

The noise predictions (specific sound levels at noise sensitive receptors) are based on International Standard ISO 9613-2:2024 '*Attenuation of sound during propagation outdoors – general method of calculation*'. ISO 9613 provides a method for the prediction of noise levels in the community from sources of known sound emission.

The ISO 9613-2 method predicts noise levels under meteorological conditions favourable to noise propagation from the sound source to the receiver, such as downwind propagation, or equivalently, propagation under a moderate ground-based temperature inversion as commonly occurs at night.

A computer noise model of the site has been produced using SoundPLAN v9.1 based on site layout information passed on by the client, with consideration of the positioning/orientation of all buildings and structures.

Input data in the form of noise emission levels has been assigned to the proposed plant, adjusted to the geometry and nature of the site operations for the site.

The noise prediction method described in ISO 9613 is suitable for a wide range of engineering applications where the noise level outdoors is of interest. The noise source(s) may be moving or stationary and the method considers the following major mechanisms of noise attenuation:

- Geometrical divergence (also known as distance loss or geometric damping);
- Atmospheric absorption;
- Ground effect;
- Reflection from surfaces, and
- Screening by obstacles, barriers and buildings.

6.2 Modelling Parameters

An overview of the modelling parameters is given in Table 12 overleaf:



Item	Setting
Algorithms	International Standard: ISO 9613-2
Façade Corrections	Predictions are at 1 m from a given façade
Ground Absorption	Ground Absorption had been set to reflect the terrain of the area, which is mostly hard ground (0.1). 1 = Soft Ground, 0 = Hard Ground
Meteorological Conditions	10 degrees Celsius; 70% humidity; and Wind from source to receiver.
Façade Corrections	Calculations are free field. No façade corrections have been applied.
Source Modelling	See Section 6.3
Terrain	Terrain has been derived from NextMap Britain 2m_Contours and with consideration of the conditions observed by RSKA staff members in attendance.
Site Layout	Digitised based on site layout as per Appendix A.

Table 11 Detailed Modelling Parameters

6.3 Noise Source Data

6.3.1 Generators

The two enclosed generators were each modelled as industrial noise sources, with sound power emitting equally across the surface of each façade. Sound reduction of the enclosure is considered in Section 7.1. The noise source was modelled with dimensions:

- Width – 20.5m
- Length – 3.8m
- Height – 2.5m

The non-enclosed generator was also modelled as an industrial noise source, with sound power emitting equally across the surface of each façade. This noise source was modelled with dimensions:

- Width – 1.5m
- Length – 2.0m
- Height – 2.0m

As a specific make and model of each generator has not yet been identified (the procurement strategy ultimately being informed by this exercise), a nominal frequency spectrum for a diesel generator has been applied to all sources. This information has been obtained from British Standard BS 5228-1:2009+A1:2014; details are shown in Table 13 below.

Item	Sound Pressure Level at 10 m per Frequency Band, dB L _{PZ}								Total, dB L _{PA}
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
C4.80 Diesel Generator	54	64	59	56	55	52	49	45	60

Table 12 Frequency Spectrum Data for Noise Sources – Generator

For each assessment scenario, this spectral shape was adjusted incrementally to determine a maximum allowable limit, such that the resultant rating level does not exceed the defined threshold at the NSR.



6.3.2 Substation

The substation was modelled as an industrial noise source with sound power emitting equally across the surface of each façade, within a solid built enclosure. For the purpose of the assessment, source levels have been taken from previous on-site measurements by RSKA staff on a similar development. Table 14 details the frequency spectrum data applied:

Item	Sound Pressure Level at 1 m per Frequency Band, dB L _{PZ}								Total, dB L _{PA}
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
800 kVA Transformer	43	70	61	49	44	41	33	24	55

Table 13 Frequency Spectrum Data for Noise Sources – Substation

From information provided by the client, the enclosure is understood to comprise a brick/block cavity wall and a beam & block roof. In the absence of specific acoustic performance test data for these building elements, sound reduction indices have been derived via the 'Insul 9.0' modelling software by Marshall Day Acoustics.

Building Element	Sound Reduction Index per Octave Band, dB R					R _w	C; C _{tr}
	125	250	500	1000	2000		
Wall	49	52	51	60	70	59	-1; -3
Roof/Ceiling	43	44	52	56	61	55	-1; -4

Table 14 Predicted Sound Reduction Indices per Building Element, dB R



7 Operational Noise Impact

7.1 Emergency Generators

Each generator has been considered in separate individual scenarios and calibrated so that the highest resultant specific sound level at NSRs does not exceed those detailed in Table 9. They have also been assessed individually as to follow the testing protocol provided by the client. Two of the generators are within separate enclosures, which are expected to significantly aid in the reduction of possible noise impacts at the NSRs, and the other generator does not have an enclosure. A noise limit for the generators has been estimated to aid in the procurement of these plant items.

At the request of the client, this assessment details maximum plant noise emission levels with respect to the generators. With the intention of aiding procurement of plant items, Table 16, overleaf, details the maximum permissible noise emission levels of the generators.

Plant Type	Specific Sound Level at NSR (dB)	Estimated Rating Level at Most Affected NSR (dB)	Sound Pressure Level at 1 Metre (dB)
'Expansion Zone' Generator	49	54	66dB from Generator
Enclosed Generator (North)	49	54	60dB from Enclosure
Enclosed Generator (South)	49	54	62dB from Enclosure

Table 15 Maximum Permissible Plant Noise Emission

Following ongoing discussions with the client, it is understood that the above limits at 1 m from the enclosure will be secured as part of the detailed design process. This may entail a combined approach, whereby specific procurement of generators with low noise emissions is sought and careful consideration / specification of enclosures for the purpose of noise reduction.

7.2 Substation

The substation has been considered in a separate scenario to the generators, on account of the fact that it may be operational 24 hours per day.

7.2.1 Predicted Noise Levels at NSRs

The following noise levels are predicted at the NSR following the installation of the proposed (containerised) substation.

NSR	Specific Sound Level, dB $L_{A5,T}$
NSR1	<5

Table 16 Predicted Specific Sound Level at NSR (Substation)

7.2.2 Correction for Distinctive Characteristics

Based on the low specific sound level shown above, it is considered that any tonal, impulsive or intermittent characteristics that may be present at source would be imperceptible at the NSR. Therefore, no additional correction has been made on this basis.

7.2.3 Comparison Between Rating Level and Background Sound Level

The derived Rating Level at each NSR and comparison to background noise levels for the daytime and night-time periods, are as follows:



Time Period	Rating Level at NSR (dB)	Corrected Design Target, dB $L_{AR,Tr}$	Difference, dB
Daytime	<5	39	< -44
Night-time	<5	36	< -41

Table 17 Comparison of Rating Level and Background Sound Level (Substation)

Based on the comparison in Table 19 above, it is considered that the proposed substation will comply with the requirements set out by Manchester City Council. Therefore, no further mitigation is considered necessary.



8 Uncertainty

It is accepted that uncertainty may arise from all levels of measurement and assessment and reasonably practicable steps have been made at all stages with the aim of reducing uncertainty.

The following measures have been taken into consideration when determining the uncertainty of this assessment:

- Background sound level measurements have been obtained at a representative assessment location over a duration of four days to appropriately characterise the existing residual environment during the intended operational hours of the proposed development;
- Representative background levels obtained during the daytime and night-time have been utilised to inform the assessment;
- Use of monitoring equipment in accordance with section 5 of BS 4142: 2014+A1: 2019, using Class 1 instrumentation;
- Measurement procedures followed in accordance with section 6 of BS 4142: 2014+A1: 2019 with all precautions taken to minimise interference; and
- Specific sound levels have been calculated to the requirements of ISO 9613-2: 1996 which is the widely accepted procedure for the calculation of sound propagation (including favourable wind conditions from source to receiver). The assessment is informed by comparison of the predicted Rating Levels against the representative background sound levels at each receptor in accordance with section 7 of BS 4142: 2014+A1: 2019.
- In the absence of spectral content from the generators yet to be procured, a nominal +6dB character correction has been applied to the calculations in the event that the generator produces a clearly distinctive tone at the NSR.
- Uncertainty arises from the sound reduction index calculations of the generator enclosure. The software manufacturer specifies an inherent uncertainty in the calculation process that equates to $\pm 3\text{dB}$ when considering the R_w metric. As such, a -3dB uncertainty correction was applied to account for the uncertainty; this is considered a pragmatic approach to produce a worst-case scenario.

Given the nature of the assessment, which is intended to provide noise constraints and design criteria for plant items yet to be identified, it is considered that the points raised above are sufficient to account for the inherent uncertainty in this report. It is recommended that further assessment is undertaken at detailed design stage and/or compliance testing to validate the outcomes presented in this report.



9 Conclusions

A noise impact assessment has been undertaken with the intention of aiding plant item procurement in respect of the generators at Substation 10 at North Manchester General Hospital. Furthermore, the impact of a proposed substation within the site has also been considered. The assessment focuses on the operational impact of the development at the nearest NSRs to the requirements of BS 4142: 2014+A1: 2019 and those of Manchester City Council.

A baseline noise survey has been utilised to determine representative background noise levels at those closest existing receptors to the site, and a computer noise model has been developed, incorporating the proposed test operation of plant items associated with Substation 10 and also a 24-hour substation also set to be constructed at the site. Using this approach and inclusive of the potential character corrections that may arise at the procurement stage, noise emission limits have been advised for the generators and the noise impact of the substation has been assessed.

With consideration to the proposed substation, it has been concluded that the predicted operational noise impact is deemed acceptable when assessed to the requirements of local and national guidance.

It is recommended that the design team liaise with RSKA staff to ensure the correct implementation of character corrections with respect to ensuring compliance to design targets.



References

- British Standard 4142: 2014+A1:2019, '*Methods of rating industrial and commercial sound*'. British Standards Institution.
- British Standard 7445-1: 2003, '*Description and measurement of environmental noise – Part 1: Guide to quantities and procedures*'. British Standards Institution.
- ISO 9613-2:2024 '*Attenuation of sound during propagation outdoors – general method of calculation*'. International Organization for Standardization.
- National Planning Policy Framework – Department for Communities and Local Government. March 2012 (as amended February 2019)
- Noise Policy Statement for England (NPSE). DEFRA, 2010.
- World Health Organization (WHO), '*Guidelines for Community Noise – 1999*'.



Glossary of Acoustic Terminology

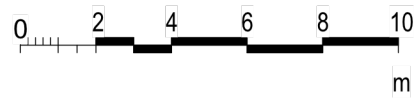
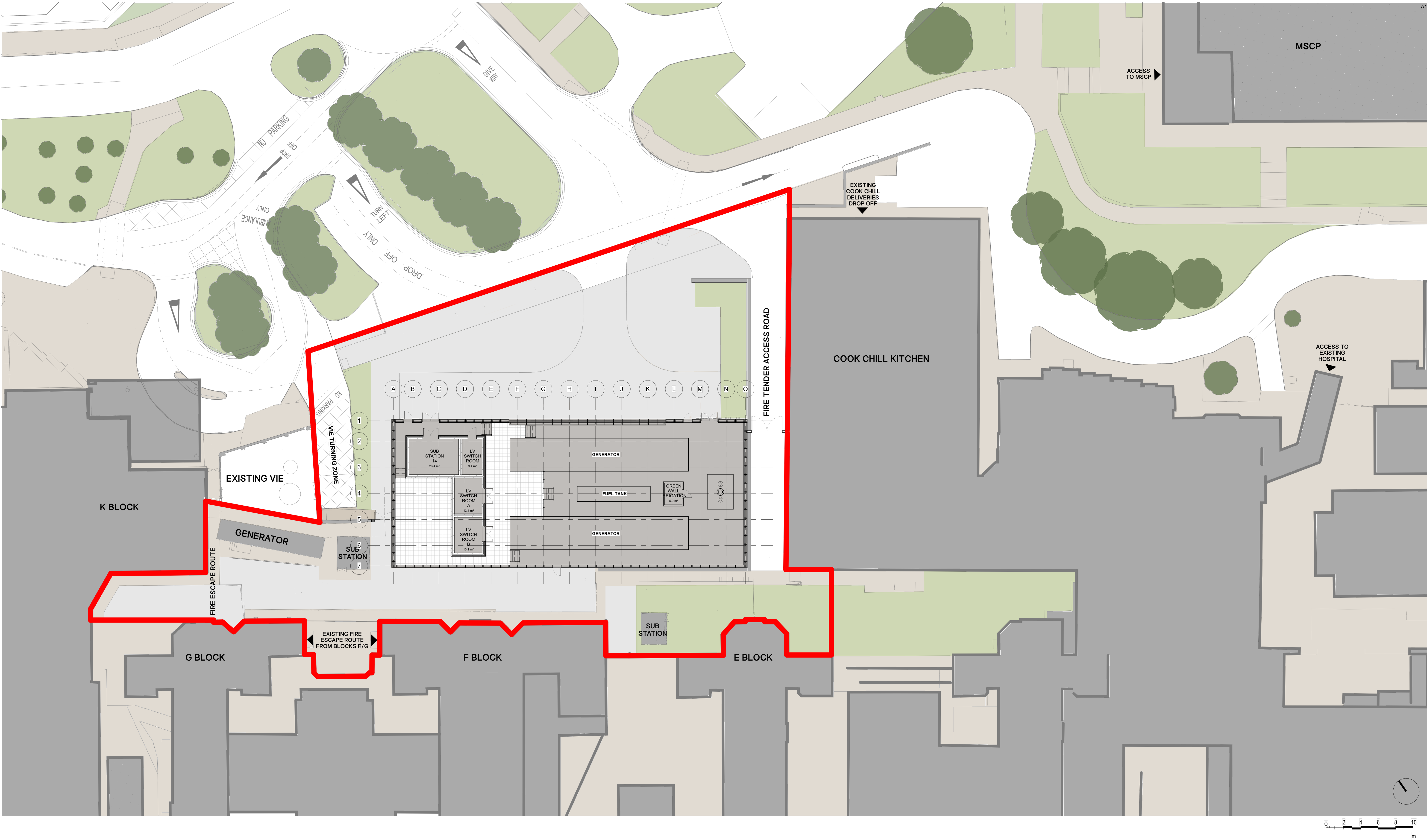
Term	Definition
Ambient sound	The total sound at a given place, usually a composite of sounds from many sources near and far.
Background sound, $L_{A90, T}$	A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval.
dB	Decibel. Scale for expressing sound pressure level. It is defined as 20 times the logarithm of the ratio between the root mean square pressure of the sound field and a reference pressure i.e. 2×10^{-5} Pascal.
dB(A)	A-weighted decibel. This provides a measure of the overall level of sound across the audible spectrum with a frequency weighting to compensate for the varying sensitivity of the human ear to sound at different frequencies. Example sound levels include: 140 dB(A) Threshold of pain 120 dB(A) Threshold of feeling 100 dB(A) Loud nightclub 80 dB(A) Traffic at busy roadside 60 dB(A) Normal speech level at 1m 40 dB(A) Quiet office 20 dB(A) Broadcasting studio 0 dB(A) Median hearing threshold (1000 Hz)
Frequency	The repetition rate of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted as kHz, e.g. 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20kHz.
$L_{Aeq, T}$	This is defined as the notional steady sound level over a stated period of time (T), would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.
NR	Noise rating. A set of curves based on the sensitivity of the human ear. They are used to give a single-figure rating for a range of frequencies.
Rating level	Specific sound level of a source plus any adjustment for the characteristic features of the sound.
Residual sound	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.
Sound absorption	Process whereby sound energy is converted in to heat. Sound absorption properties is expressed as the sound absorption coefficient α or the sound absorption class (A-E).
Sound insulation	The reduction or attenuation of airborne sound by a solid element between source and receiver.
Specific sound	Sound pressure level produced by the source being assessed at the assessment location.



Appendix A: Proposed Site Layout

The proposed site layout, provided by the client, is reproduced overleaf for reference.





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NOTES

KEY

Site boundary

REVISIONS		
REV.	DATE	AMENDMENT
P01	18/10/24	Planning Issue
P02	22/11/24	Planning Issue
P03	07/03/25	Planning Issue

KEYPLAN

CLIENT

Manchester University NHS Foundation Trust

NHS

Manchester University NHS Foundation Trust

PROJECT

North Manchester General Hospital

SCALE@A1	DATE	ORIGINATOR	CHECKED	AUTHORISED
1 : 200	07/03/25	LH	DB	AS

DESCRIPTION

Proposed Site Plan

STAGE

Stage 3

SR NO.

6512

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STATUS PURPOSE FOR ISSUE

S2 Planning

DRAWING NO.

23135-SRA-NM172-00-DR-A-02002

REV.

P03

Appendix B: Monitoring Position Photographs



Figure 3 Monitoring Position MP1 Photographs



Appendix C: Measured Noise Levels and Background Noise Level Graphs

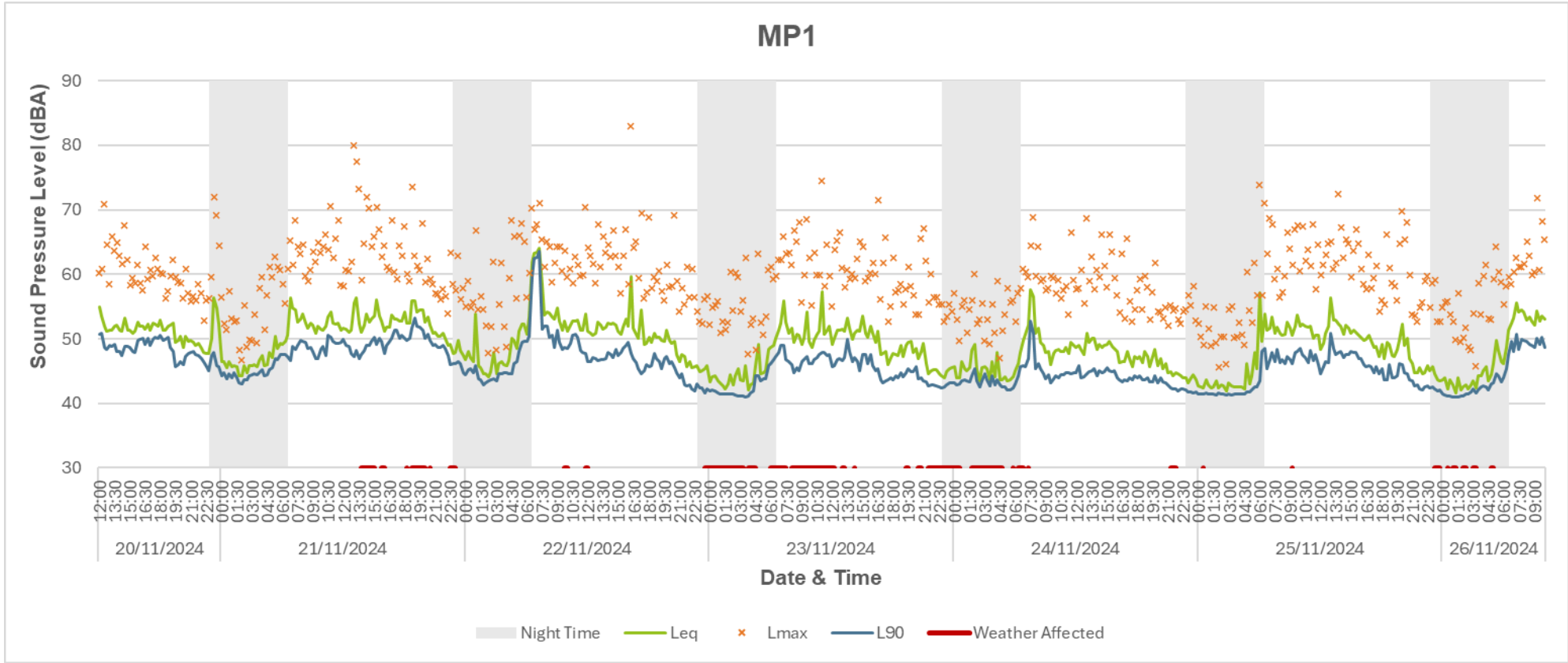


Figure 4 MP1 Time History



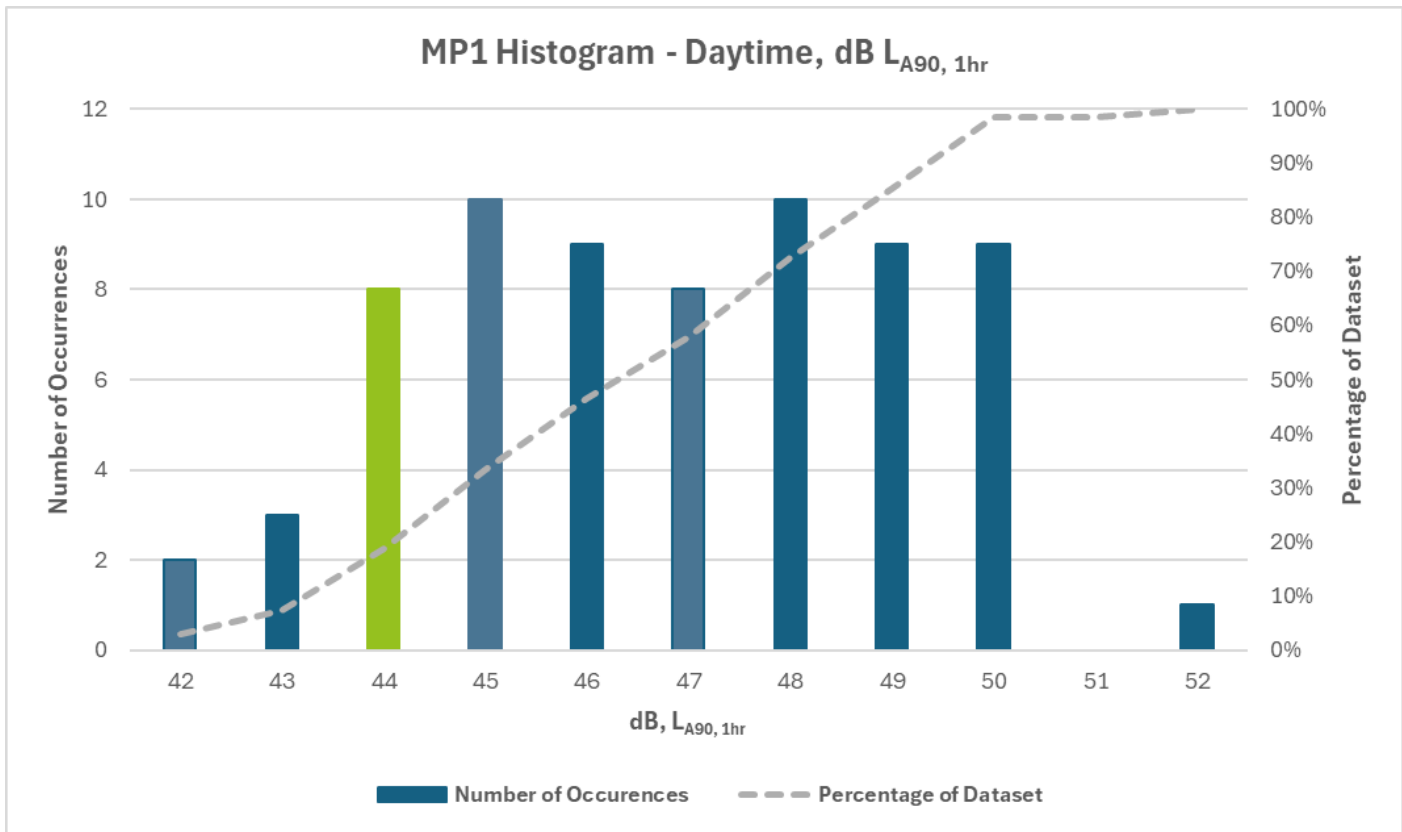


Figure 5 MP1 Background Analysis (Daytime)

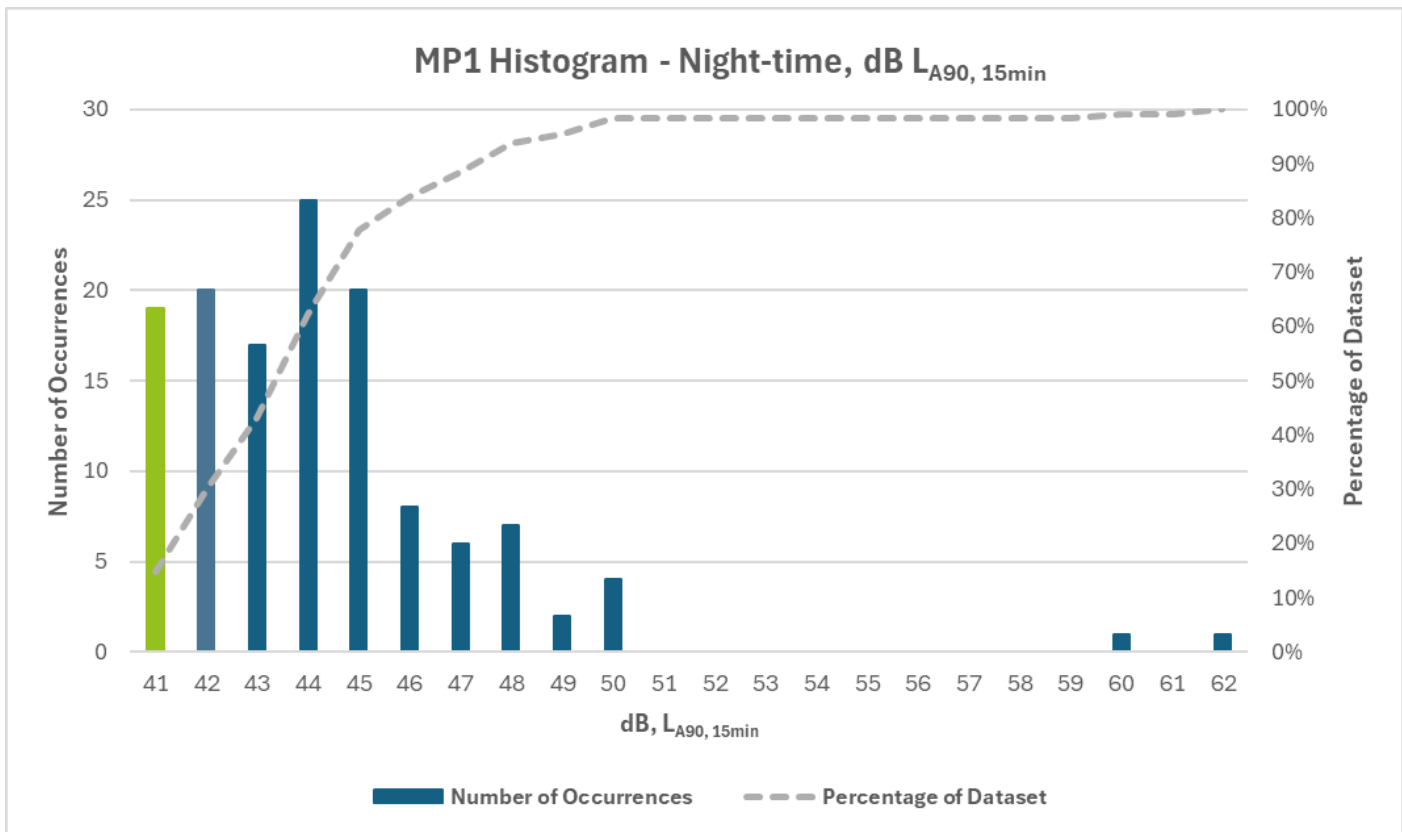


Figure 6 MP1 Background Analysis (Night-time)



