



ACOUSTICS CENTRAL

WBST: Backlot Kitchen Expansion

# Noise Survey

20240101-0 R1

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# Noise Survey

20240101-0 R1

## Warner Bros Studios Tour

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Hertfordshire  
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### Document History and Version Control

Version	Purpose/Change	Author	Date
V1.0	First Issue	<b>Lee Montague</b> BEng(Hons) MIOA	26 <sup>th</sup> January 2024

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## Executive Summary

Planning permission is being sought to expand the 'backlot' kitchen of the existing Warner Bros Studios Tour (WBST) facility. As part of the work, it is proposed to re-locate and add some new mechanical service plant equipment.

As there is some risk of noise disturbance to existing residents on Royce Grove, the potential for noise from these mechanical services should be considered.

The noise levels at the existing dwellings have been quantified using long term unattended noise monitoring. These have been used, along with guidance from BS 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* to set appropriate thresholds for the Lowest Observed Adverse Effect Level (LOAEL) during the day and night.

The plant selections have not yet been made for some equipment, but all plant will be attenuated as necessary to meet the noise limits specified here. As necessary, a planning condition stating noise limits can be applied to the planning permission (if it were to be granted) and an example condition wording has been provided.

<b>1</b>	<b>Introduction</b>	<b>5</b>
<b>2</b>	<b>Site Description</b>	<b>5</b>
<b>3</b>	<b>Noise Survey</b>	<b>7</b>
3.1	General	7
3.2	Guidance and Standards	7
3.3	Measurement Positions	7
3.4	Noise Monitoring Equipment	8
3.5	Data Recorded	9
3.6	Meteorological Conditions	9
3.7	Results	10
<b>4</b>	<b>Noise Criteria</b>	<b>11</b>
4.1	Planning Policy	11
4.2	BS4142:2014+A1:2019.	11
4.3	Noise Limits	11

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## Attachments

### **20240101-0 R1 TH1.1 to TH1.13**

Noise Survey Results: Time History Graph Figures

### **Appendix A**

Glossary of Acoustics Terms

### **Appendix B**

Document Naming and Version Control Policy

### **Appendix C**

Planning Guidance

## 1 Introduction

- 1.1 Planning permission is being sought to expand the 'backlot' kitchen of the existing Warner Bros Studios Tour (WBST) facility. As part of the work, it is proposed to re-locate existing and install new mechanical service plant.
- 1.2 To ensure nearby residential noise sensitive receptors are not disturbed by noise from mechanical services equipment, noise limits should be adhered to. This report sets out details of a noise survey conducted at site and noise limits, in line with relevant industry guidance have been established.
- 1.3 The report is necessarily technical in nature; however, every effort has been made to make it as clear as possible. In this regard, the Glossary of Acoustics Terms attached as Appendix A gives further explanation on relevant acoustics terminology used within the report.

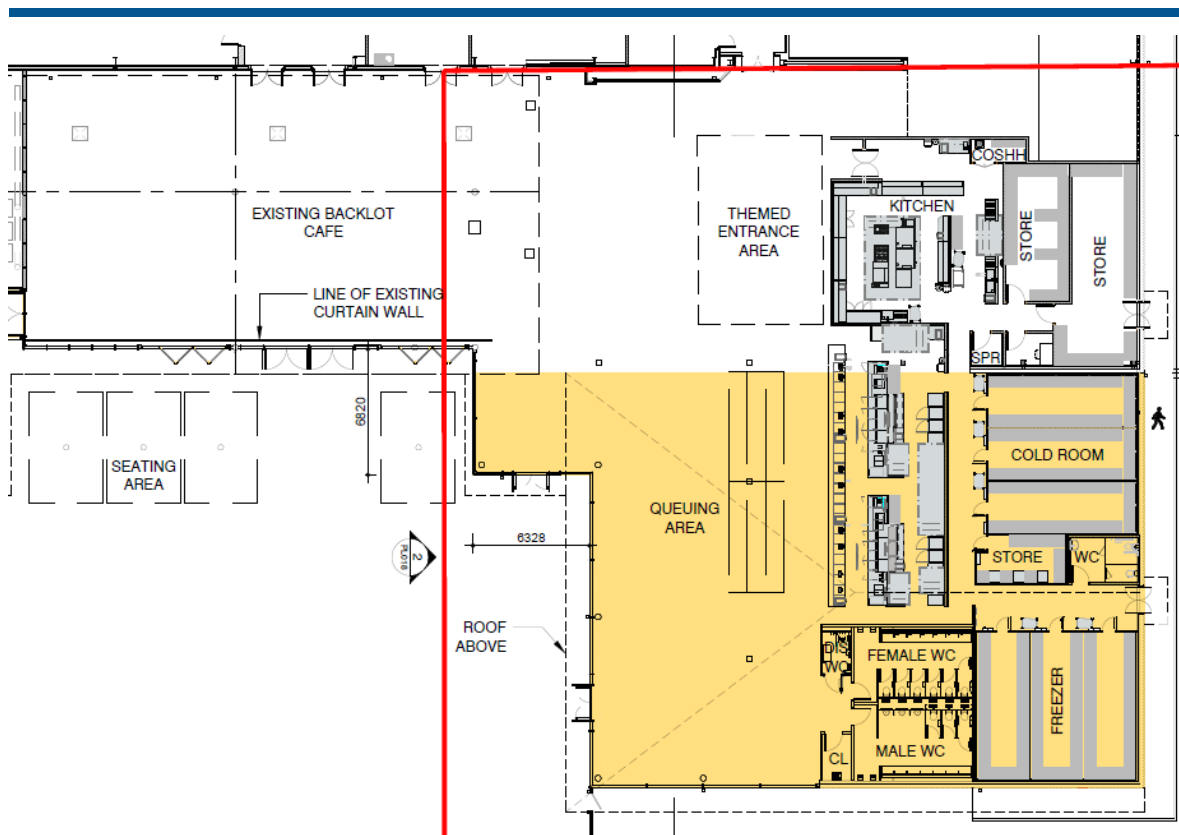
## 2 Site Description

- 2.1 The area to be expanded is part of the Warner Bros Studio Tour facility and is located towards the north roundabout of the overall site. The site and surrounding area can be seen in the plan below.



F1 Figure indicating site location

- 2.2 The nearest noise sensitive receptors are on the opposite side of Aerodrome Way, being the 2 storey houses on Royce Grove. These are approximately 100m away from the closest proposed façade of the new extension.
- 2.3 There are also residences to the north of the proposed development area on Offord Grove, however these are approximately double the distance away from scheme than the receptors on Royce Grove, so are not considered further; as providing relevant noise limits are met at Royce Grove, they will also be met at Offord Grove.
- 2.4 The proposed scheme can be seen in the figure below:



F2 Figure indicating proposed site layout

- 2.1.1 It can be seen that the back of house areas (i.e. storage and freezers) as well as guest toilets are located against the new proposed façade which will have no windows. These create a buffer to the potentially noisier kitchen space. Therefore, noise breakout is not expected to be a material issue.
- 2.1.2 The new extended dining area is to be glazed, as per the existing dining space, with no significant changes in noise emissions from diners expected.
- 2.1.3 The existing louvres in the façade that serve mechanical services plant that face east towards the residences are to be removed, with the existing louvre in the northern most façade expanded. This new louvre area is set away from residences, perpendicular to them. This is likely to yield

lower noise emissions at residences all else being equal; although new plant will be designed to suitable noise limits (see later in this report).

- 2.1.4 New condensers may be installed externally towards the northern boundary with the multi-storey carpark, to be located behind a screen.
- 2.1.5 The main kitchen ventilation plant is expected to operate from 0630 hours to 2200 hours most days with occasional events where it may operate until 2300. Cooling condensers serving the refrigeration systems will operate 24/7.
- 2.1.6 There are no changes to any externally installed equipment such as speakers for background music in the 'backlot' area. We note the scheme is subject to historic planning conditions (Condition 25 of 15/1852/FUL) restricting noise emissions from these elements. No changes to these speakers or uses in the external 'backlot' area of the tour are proposed.
- 2.1.7 There are no specific changes proposed to any servicing or deliveries, with vehicles accessing site via the studio side and unloading to the north of the building, between the tour and the studio multi-storey carpark.
- 2.1.8 The external exhibits to the east of the restaurant are replicas of buildings and these provide levels of acoustic screening from the restaurant / dining area to the closest houses beyond Aerodrome way directly opposite.
- 2.1.9 In terms of the residential houses, there are no windows in the side (west facing) elevation of 55 Royce Grove, with windows in the north and south facades at approximately right angles to the studios. There are windows in the side elevation of 57 Royce Grove facing the studios. 41-47 Royce Grove have their rear façade and windows facing the studios.

### 3 Noise Survey

#### 3.1 General

- 3.1.1 In order to quantify the noise levels at and around the site, an environmental noise survey was carried out, commencing at 12h00 on Friday 12<sup>th</sup> January 2024 and concluding at 15h00 on Wednesday 24<sup>th</sup> January 2024.
- 3.1.2 This period was selected as the tour facility was closed to the public on some of the days (15-19 January), and therefore less noise than typical was expected from the external areas which might have affected levels measured at the survey positions (see below for further details).

#### 3.2 Guidance and Standards

- 3.2.1 The survey instrumentation, methodology and reporting of results has been carried out following guidance contained within British Standard 7445-1:2003 - *'Description and measurement of environmental noise - Part 1: Guide to quantities and procedures'*,

#### 3.3 Measurement Positions

- 3.3.1 Noise measurements were made using a single unattended noise monitor. The location of the monitor is illustrated in the following figure and described below:



F3 Figure indicating the noise measurement positions MP1 on the site

- MP1 Free field position 1.5m above ground level set back  $\approx 21\text{m}$  from edge of road to be best representative of the nearest dwellings to the east of site on Royce Grove.

3.3.2 This position was deemed suitably representative of those on Royce Grove as the distance from the dominant noise source (the road) was equivalent.

3.3.3 There was some risk that noise from the existing tour site may be higher at this position than to the residents due to closer proximity; however, as noted in section 3.1.2 the survey was undertaken during a period where the tour was shut to the public to reduce the risk or otherwise the effects of this occurring.

3.3.4 We also note that background noise levels ( $L_{90}$  values) are typically dominated by road traffic and not patron noise.

### 3.4 Noise Monitoring Equipment

3.4.1 All noise measurements were made with the equipment detailed in the following table.



Item	Manufacturer	Type
Sound Level Analyser	Norsonic	118
Outdoor microphone enclosure	Norsonic	1212
Acoustic Calibrator	Castle	GA607

T1 Equipment used during noise measurements

3.4.2 The sound level analyser presented in the above table conforms to the Type 1 specification as given in BS EN 61672-1:2003 - ‘Electroacoustics - Sound level meters - Part 1: Specifications’. The calibrator presented in the above table conforms to the Class 1 specification as specified in IEC 60942:2003 – ‘Electroacoustics - Sound calibrators’.

Calibrations

3.4.3 The measurement instrumentation, including sound level analyser, preamplifier and microphone have undergone traceable calibration by either a competent laboratory or the equipment manufacturer within the last two years.

3.4.4 The acoustic calibrator has undergone traceable calibration by either a competent laboratory or the equipment manufacturer within the last year. The calibration certificates for the above equipment can be provided on request.

3.4.5 A field calibration check was undertaken on the noise measurement equipment before and after the survey to ensure a consistent and acceptable level of accuracy was maintained. No significant drift was noted to have occurred. We note additional calibrations were also made while the batteries were changed on 17<sup>th</sup> and 19<sup>th</sup> January and no significant drift was noted to have occurred then either.

**3.5 Data Recorded**

3.5.1 Noise data at MP1 was recorded over consecutive 15-minute periods in all relevant indices, including  $L_{Aeq}$ ,  $L_{A90}$ , and  $L_{AMax,F}^1$ . See attached Appendix A for an explanation of noise units used.

3.5.2 Octave band data for each of the above indices was also recorded at all positions, the filters for which met the requirements of BS EN 61260:1996, Class 1.

**3.6 Meteorological Conditions**

3.6.1 Based upon publicly available weather data (Wunderground.com), the temperatures during the survey were generally cold, on occasion reaching below freezing, with the last few days of the survey being more mild for the time of year.

3.6.2 The weather for the majority of the survey was fine with no rain and no significant winds; however the following days were affected by adverse weather:

- Sunday 21<sup>st</sup> January: Rain, heavier at end of day into the 22<sup>nd</sup> and high winds
- Monday 22<sup>nd</sup> January: Rain in early hours and high winds throughout the day
- Tuesday 23<sup>rd</sup> January: light rain for periods in the day; high winds overnight into 24<sup>th</sup>

<sup>1</sup> Maximum A-weighted sound pressure level using time-weighting “F” and “S”. As stated in BS EN 61672-1:2003 Design-goal time constants are 0,125 s for time-weighting F (Fast) and 1 s for time weighting S (Slow).

- Wednesday 24<sup>th</sup> January: High windows in early hours, but fine conditions after around 9am

3.6.3 The data gathered over these periods have been omitted from our analysis when establishing representative background noise levels. Given the long duration of the survey which had many fine days, which covered both weekday and weekend, this is not expected to materially affect any outcomes (the survey lasting a significant duration much longer than commonly conducted for such assessments).

### 3.7 Results

3.7.1 The noise climate was observed to be dominated by road traffic on Aerodrome Way. There were vehicle passbys in the tour carpark close the noise monitor, as well as occasional staff walking past nearby, but these were infrequent and unlikely to materially affect the overall background (L<sub>90</sub>) levels when considering the overall representative levels across the daytime period.

3.7.2 The attached time-history graph figures 20240101-0 R1 TH1.1 to TH1.13 present the noise levels measured at MP1 in terms of 15 minute periods. A clear diurnal pattern can be seen each day with noise levels elevated during the daytime, with AM and PM peaks in road traffic, then reducing in the evenings and reaching a minimum overnight.

3.7.3 The representative daytime and night time background noise levels, as derived in accordance with BS4142 guidance are shown in the table below.

Location	Representative L <sub>A90</sub> , dB	
	Daytime (0700-2300 only)	Night time (2300-0700)
MP1	50	38

T2 Representative background noise levels at the nearest residential properties.

3.7.4 We note that there is the potential for the plant to operate in the fringe hours of the morning from 0630. As noted in attached Appendix C, such a period can be considered more sensitive than the daytime hours, but representative values for the entire night time may be too low compared to those during these short fringe periods. Therefore separate noise limits for plant that might operate in these hours can be set.

3.7.5 For plant that might operating in such periods, a representative noise levels is 45dB L<sub>A90</sub>. This is based on the values recorded on Sunday mornings which are the lowest of the survey during the relevant period, giving a robust level whereby during these periods on weekday the representative levels are higher.

## 4 Noise Criteria

### 4.1 Planning Policy

- 4.1.1 National planning policy related to noise includes the NPPF<sup>2</sup>, NPSE<sup>3</sup> and PPG<sup>4</sup> on noise. Further details on these are set out in Appendix C.
- 4.1.2 Locally, the scheme falls within the remit of Three Rivers District Council (TRDC). The general planning policies that might be applicable for the matters of this report regarding noise are as follows:
- Core Strategy (adopted Oct 2011): Policy CP1: Overarching Policy on Sustainable Development
  - Core Strategy (adopted Oct 2011): Policy CP13: Design of Development
  - Development Management Policies LDD (July 2013): Policy DM9: Contamination and Pollution
- 4.1.3 We are not aware of any specific written policy specifically setting out numerical guidance for plant noise emissions, therefore we look to relevant industry guidance. This can be found in the form of BS4142:2014+A1:2019.

### 4.2 BS4142:2014+A1:2019.

- 4.2.1 Full details of BS4142 are set out in attached Appendix C. As set out in the Appendix, the Lowest Adverse Effect Level (LOAEL) is considered to be absolute thresholds of 45 dB and 40 dB  $L_{Ar,Tr}$  during the day and night respectively. Where background sound levels are higher, the LOAEL threshold is 5 dB above the existing background sound level. These thresholds are in full accordance with BS 4142:2014 (see below).
- 4.2.2 This level of up to 5dB above background would be appropriate and suitable to ensure national planning policy requirements are met (i.e. a LOAEL not exceeded), but also that TRDC policies as noted above are also satisfied.
- 4.2.3 However, given historic planning conditions for other aspect of the WBSL development, in this particular instance for the use in assessing specifically fixed mechanical service plant in connection with this particular scheme, we propose a noise limit set 5dB below the representative background noise level.

### 4.3 Noise Limits

- 4.3.1 Based upon the survey results and the above noted criteria, the following noise limits apply:

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<sup>2</sup> National Planning Policy Framework – Ministry of Housing, Communities and Local Government, December 2023

<sup>3</sup> <https://www.gov.uk/government/publications/noise-policy-statement-for-england>

<sup>4</sup> Planning Practice Guidance on Noise <sup>4</sup> <https://www.gov.uk/guidance/noise--2>

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Location	Noise Limit, L <sub>Ar</sub> dB	
	Daytime (0700-2300 only)	Night time (2300-0700)
MP1: Royce Grove	45	33

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T3 Plant noise limits (rating level) at the nearest residential properties.

- 4.3.2 For the fringe period of 0630-0700, a noise limit of 40dB L<sub>Ar</sub> should apply.
- 4.3.3 These limits are to apply to cumulative effect of all plant combined when operating at design duty in the relevant time periods. The limits are to apply at the nearest noise sensitive receptors (i.e. Royce Grove) and should be assessed in accordance with BS4142:2014, utilising feature correction penalties where applicable.
- 4.3.4 With the above limits adhered to, it would satisfy both national and local planning policy.
- 4.3.5 If necessary, the above criteria can be applied as a planning condition. We would suggest the following condition wording:

*All permanent plant, machinery and equipment installed or operated in connection with the kitchen extension development shall be so enclosed and/or attenuated so that noise levels at noise sensitive receptors does not exceed the noise limits as set out in table T3 of Acoustics Central report 20240101-0 R1 (v1.0, dated 25<sup>th</sup> January 2024); or otherwise to a level of 5dBA below the existing representative background noise level during the relevant period of operation, as assessed in accordance with BS4142:2014+A1:2019.*

Figure 20240101-0 R1 TH1.1

Noise Levels Recorded at Position MP1, 12 January 2024

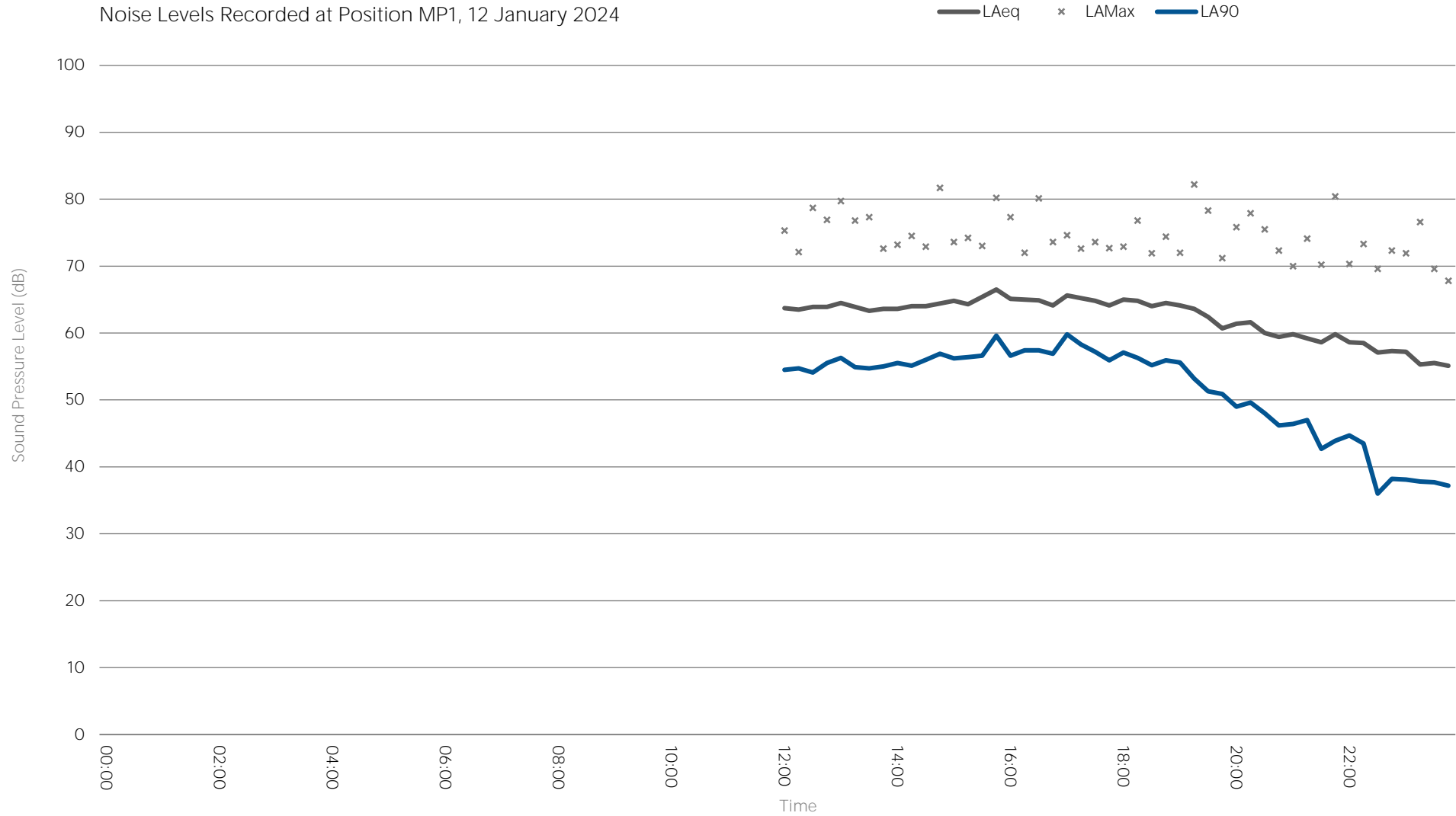


Figure 20240101-0 R1 TH1.2

Noise Levels Recorded at Position MP1, 13 January 2024

— LAeq    x LAMax    — LA90

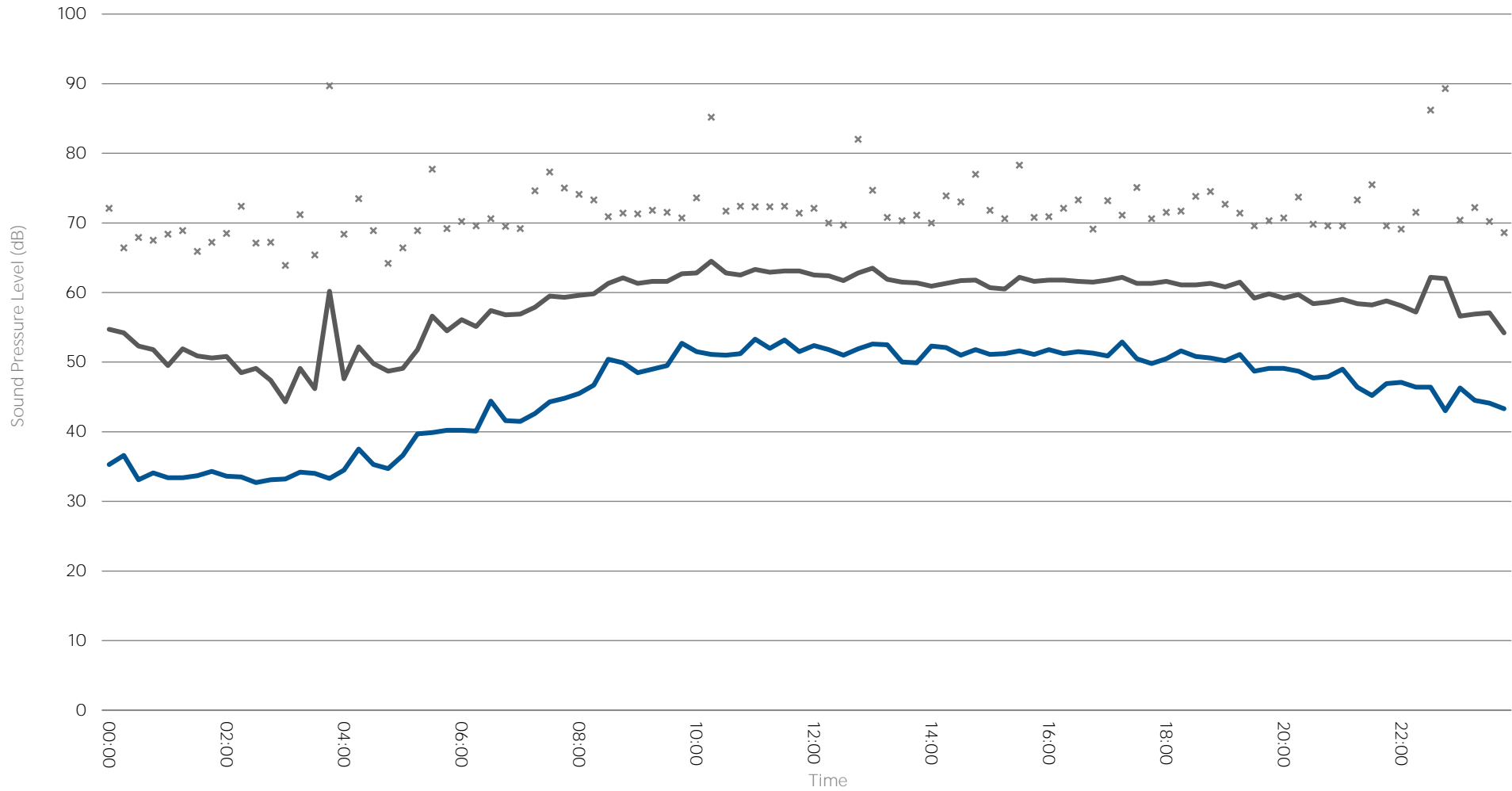


Figure 20240101-0 R1 TH1.3

Noise Levels Recorded at Position MP1, 14 January 2024

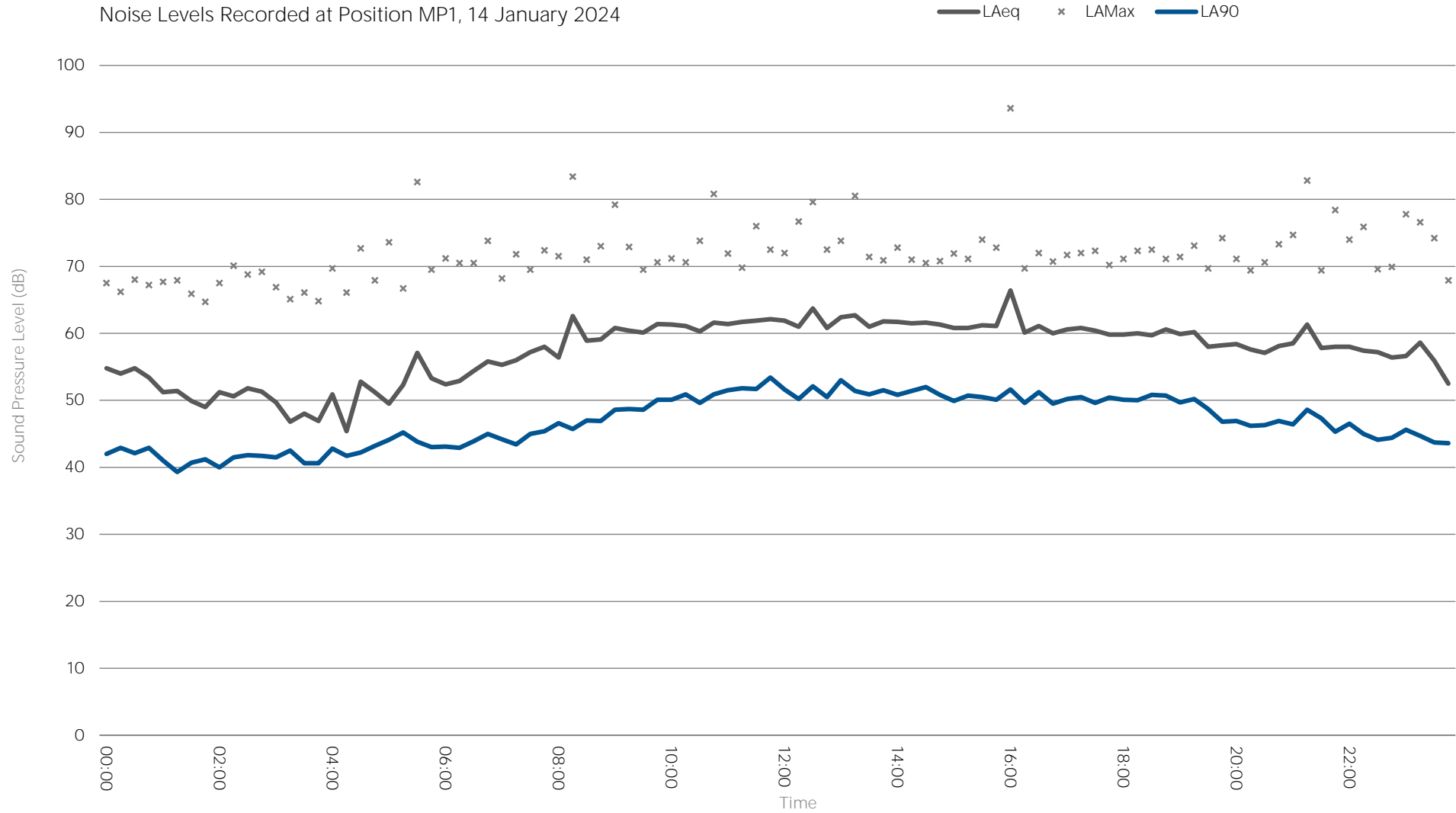


Figure 20240101-0 R1 TH1.4

Noise Levels Recorded at Position MP1, 15 January 2024

— LAeq    x LAMax    — LA90

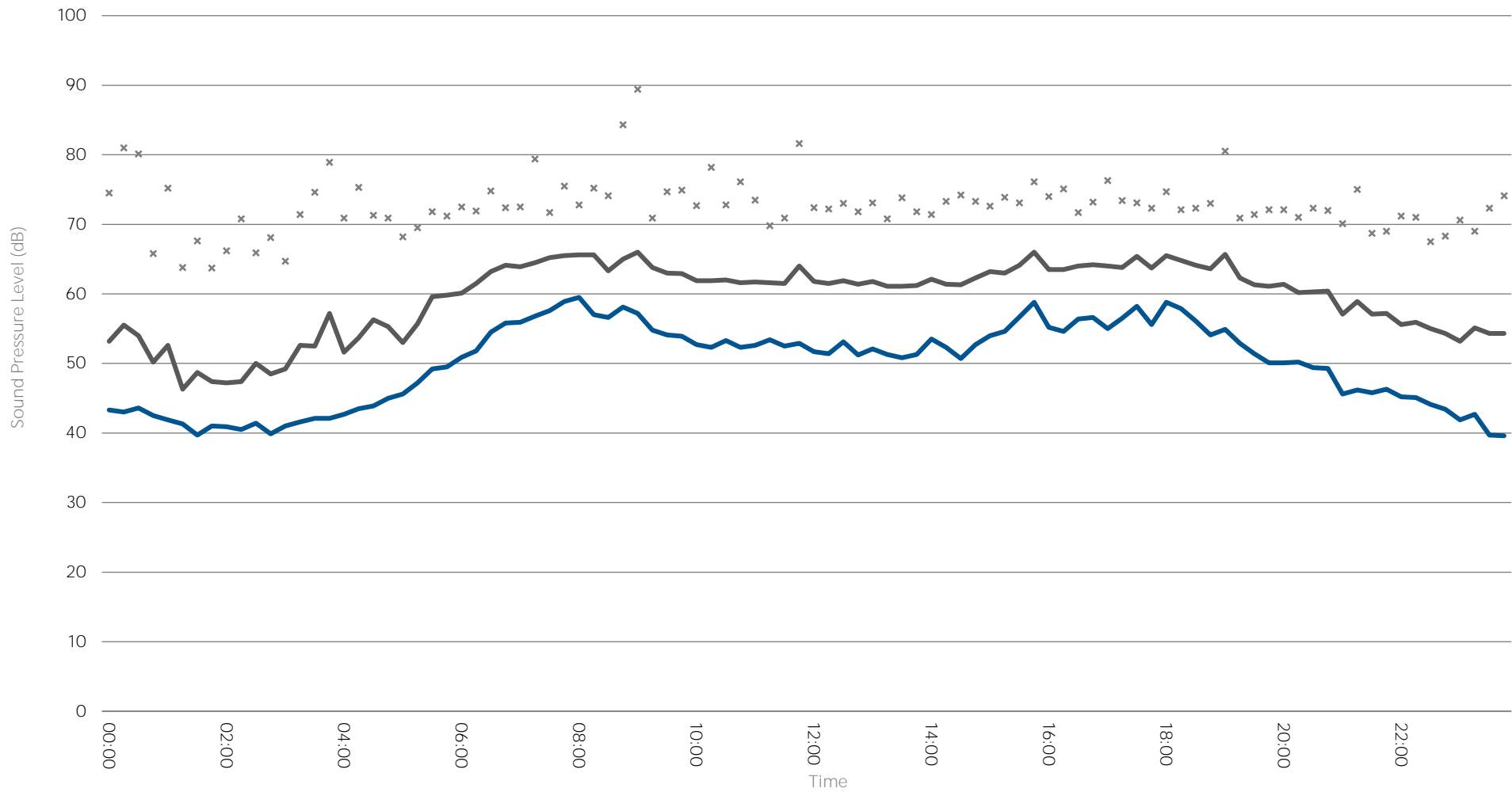




Figure 20240101-0 R1 TH1.5

Noise Levels Recorded at Position MP1, 16 January 2024

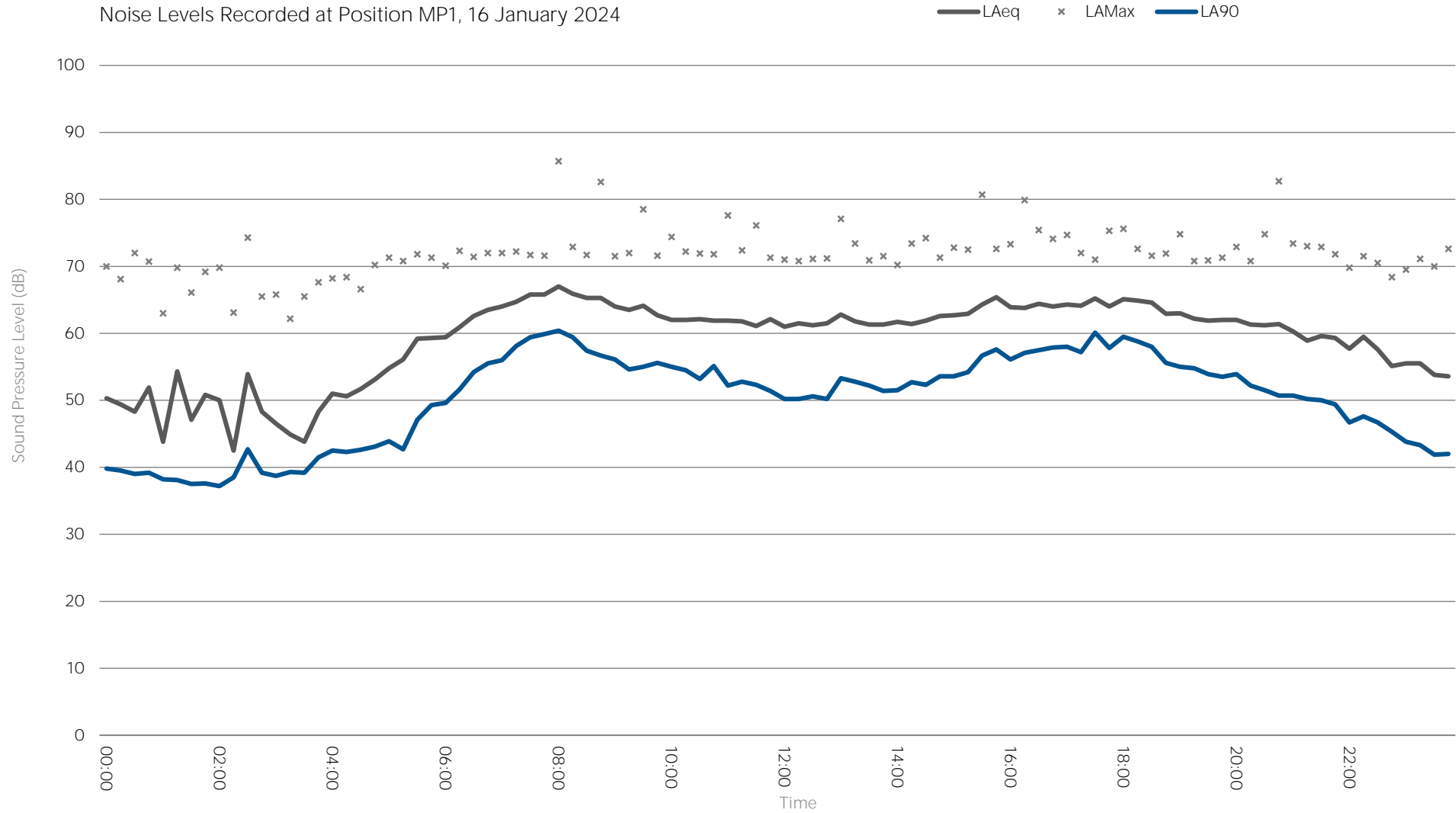


Figure 20240101-0 R1 TH1.6

Noise Levels Recorded at Position MP1, 17 January 2024

— LAeq \* LAMax — LA90

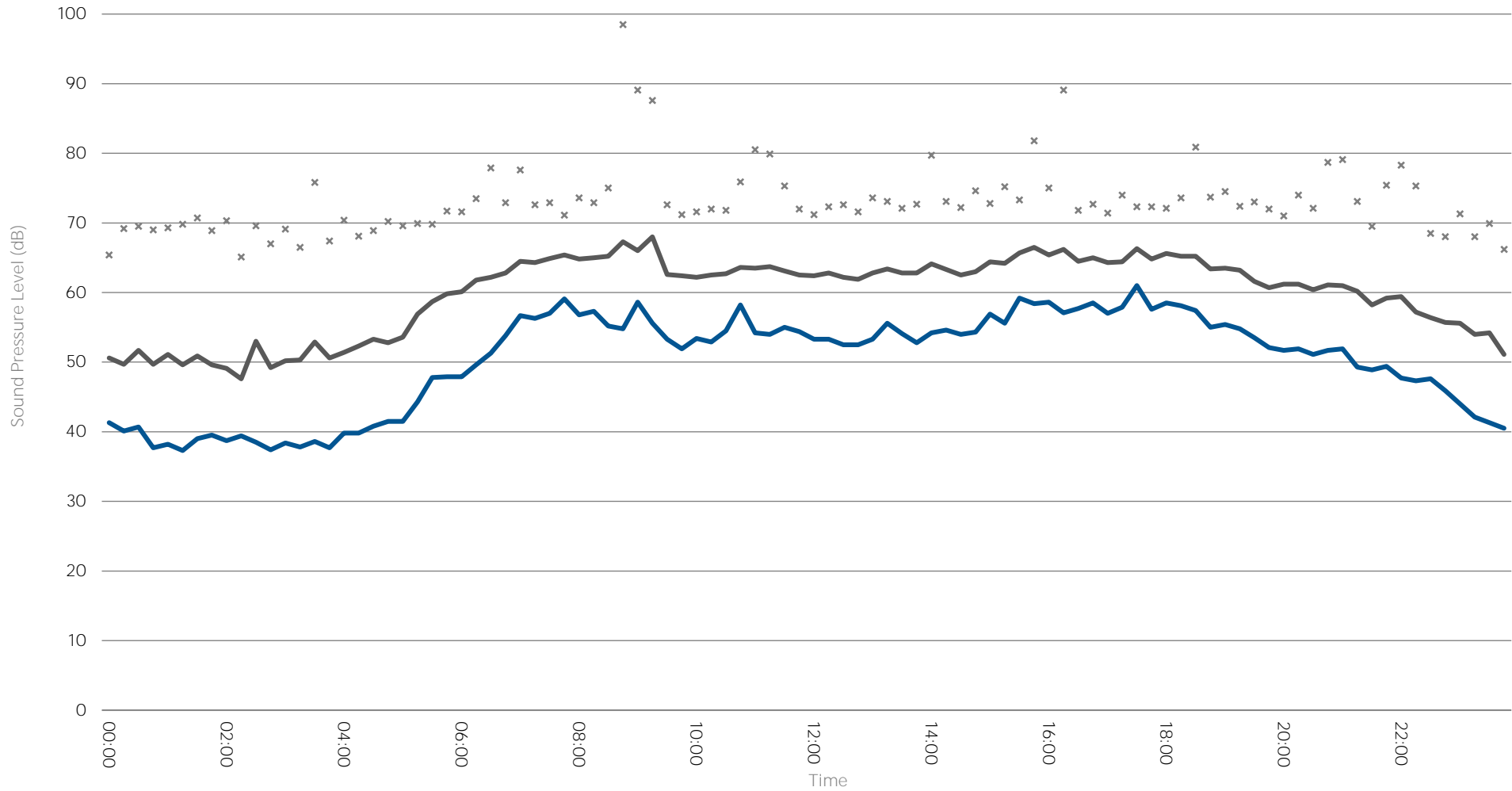


Figure 20240101-0 R1 TH1.7

Noise Levels Recorded at Position MP1, 18 January 2024

— LAeq \* LAMax — LA90

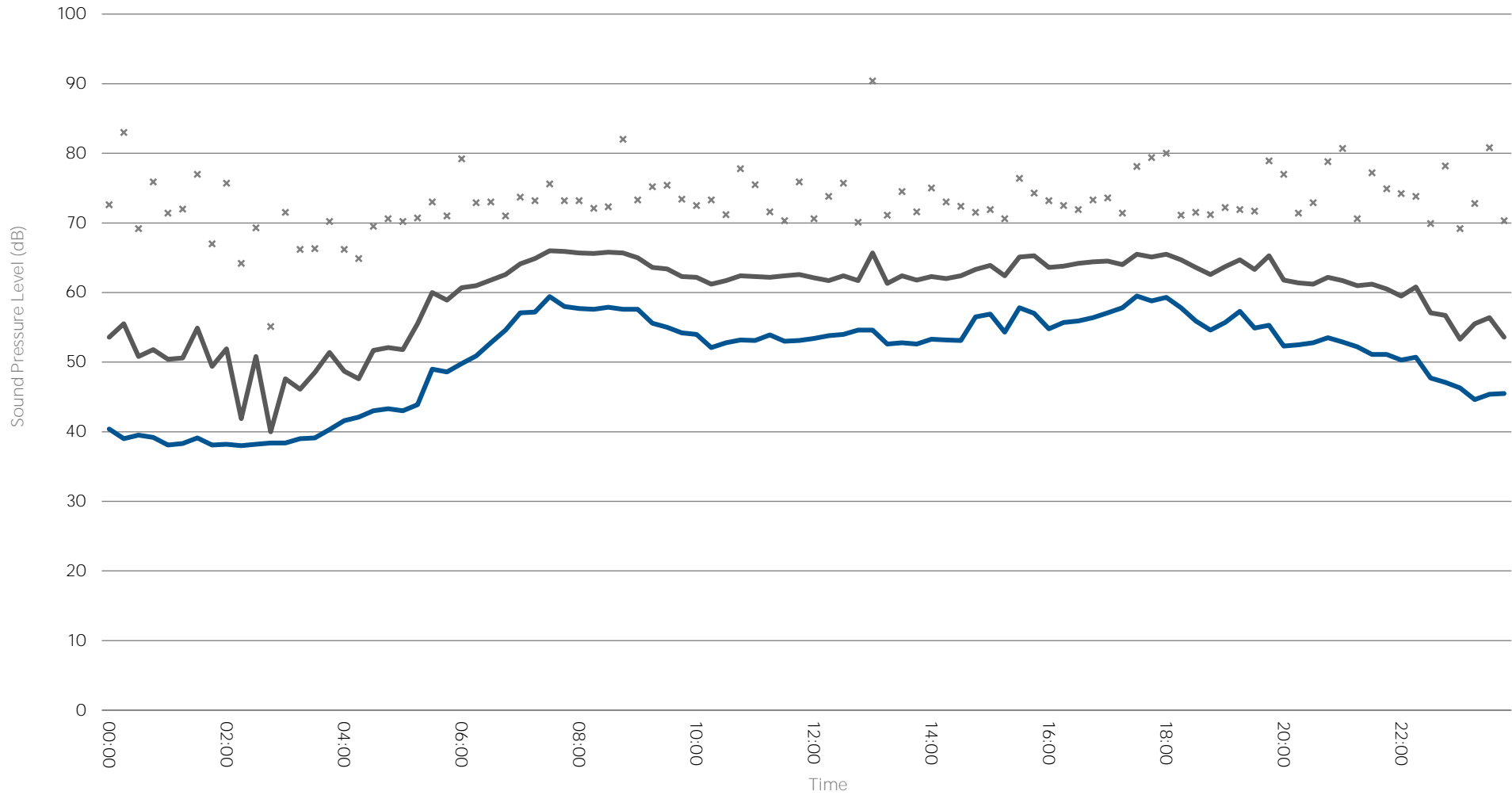


Figure 20240101-0 R1 TH1.8

Noise Levels Recorded at Position MP1, 19 January 2024

— LAeq \* LAMax — LA90

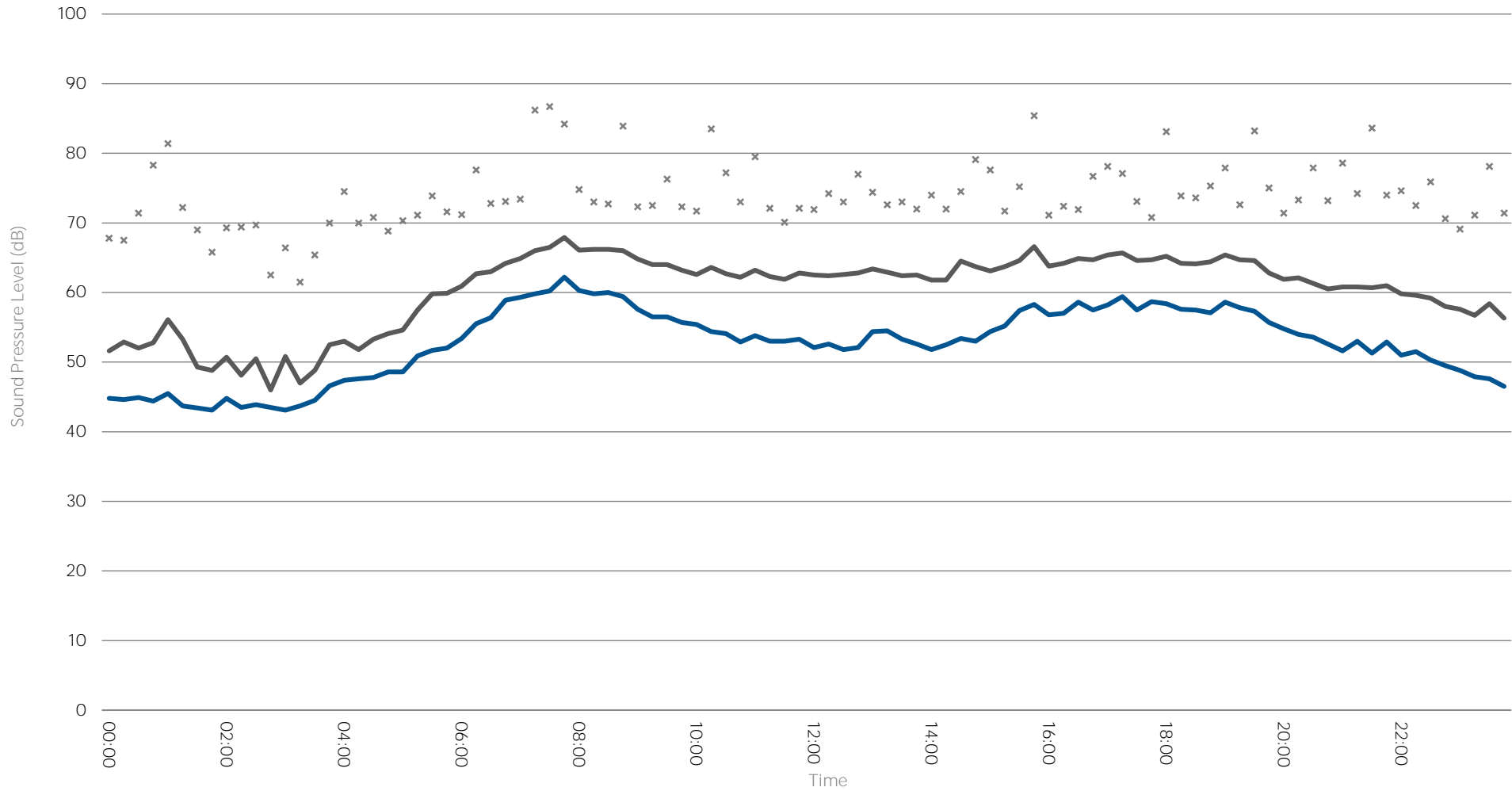


Figure 20240101-0 R1 TH1.9

Noise Levels Recorded at Position MP1, 20 January 2024

— LAeq \* LAMax — LA90

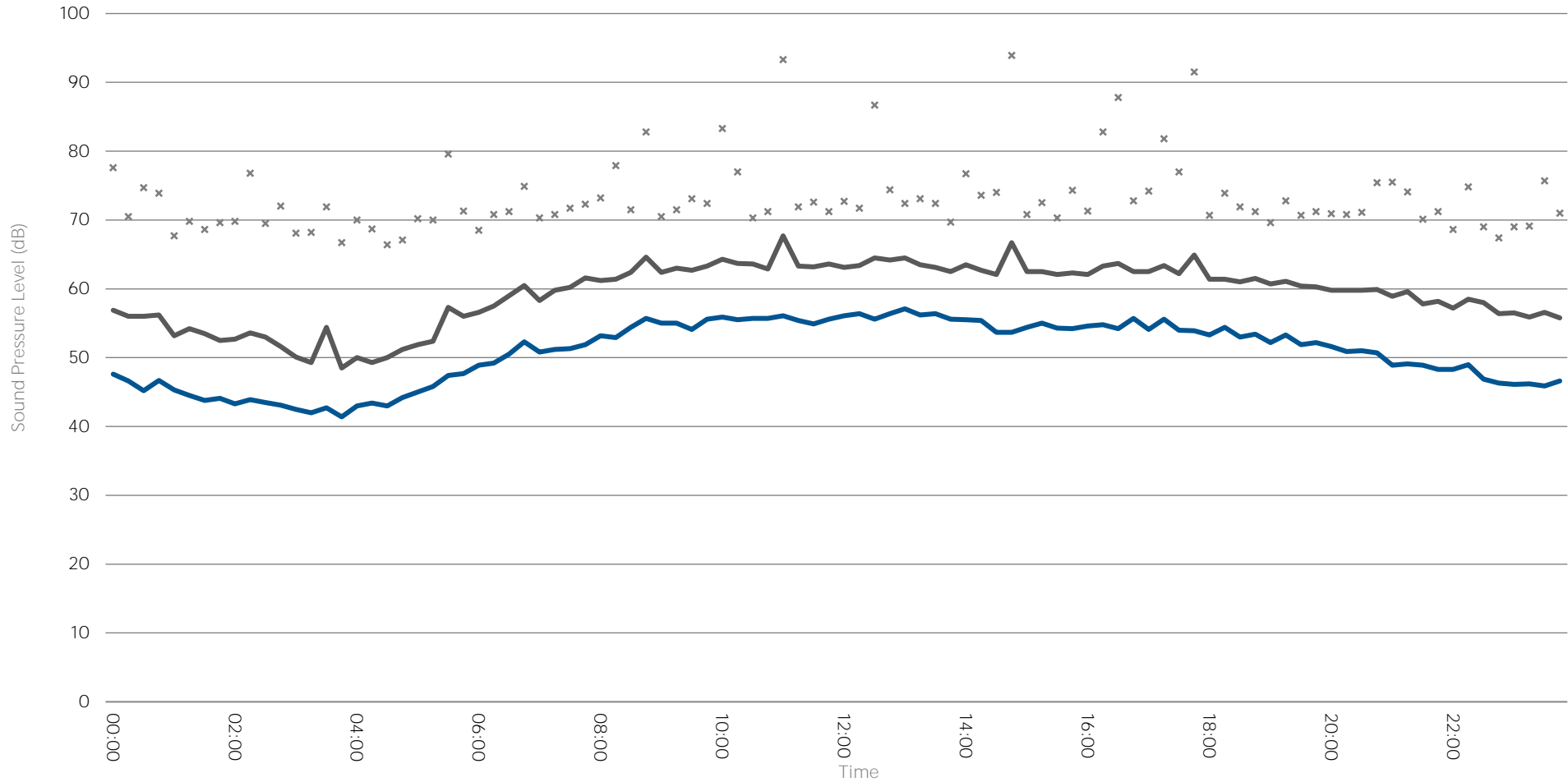


Figure 20240101-0 R1 TH1.10

Noise Levels Recorded at Position MP1, 21 January 2024

— LAeq \* LAMax — LA90

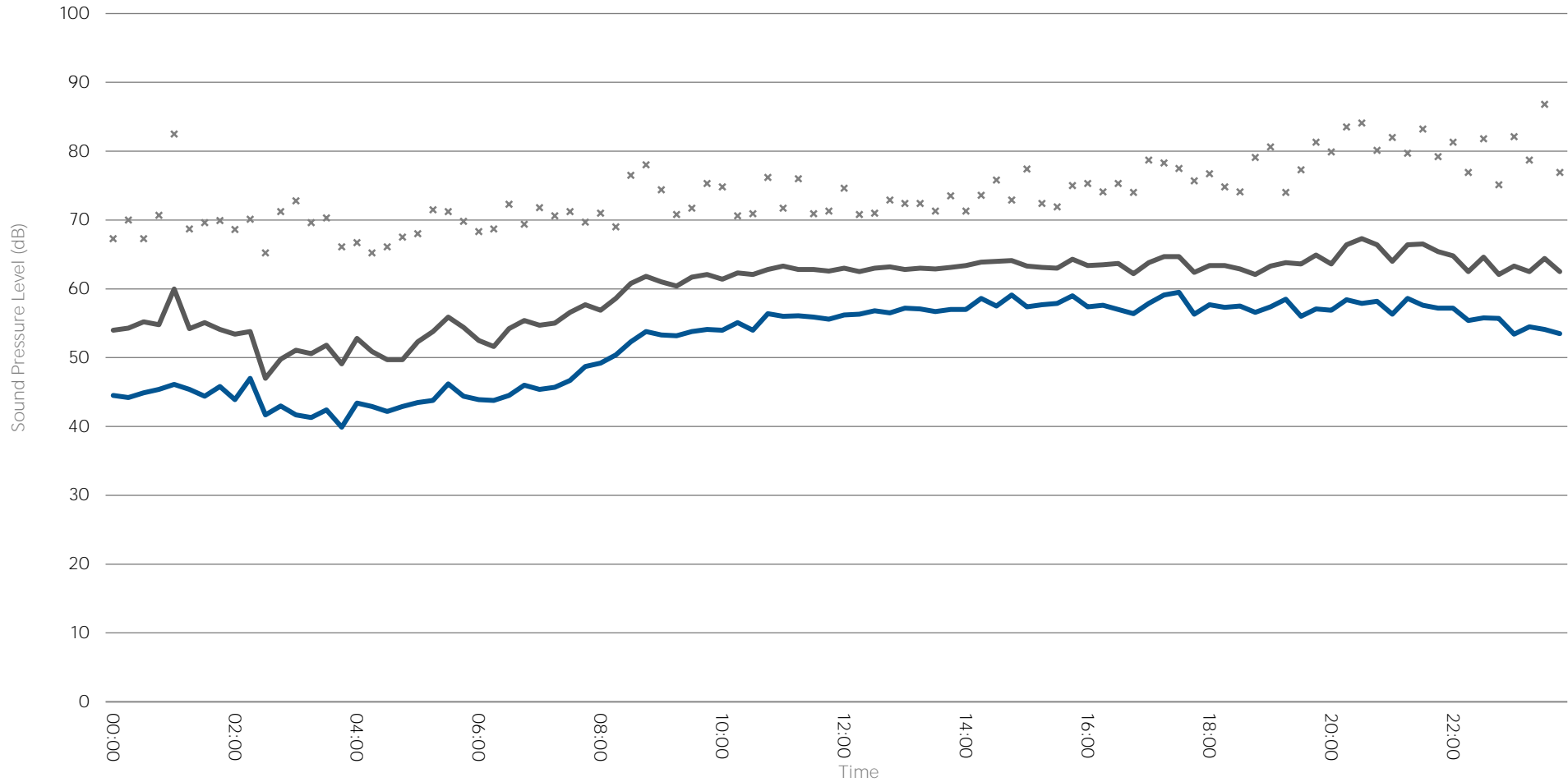


Figure 20240101-0 R1 TH1.11

Noise Levels Recorded at Position MP1, 22 January 2024

— LAeq \* LAMax — LA90

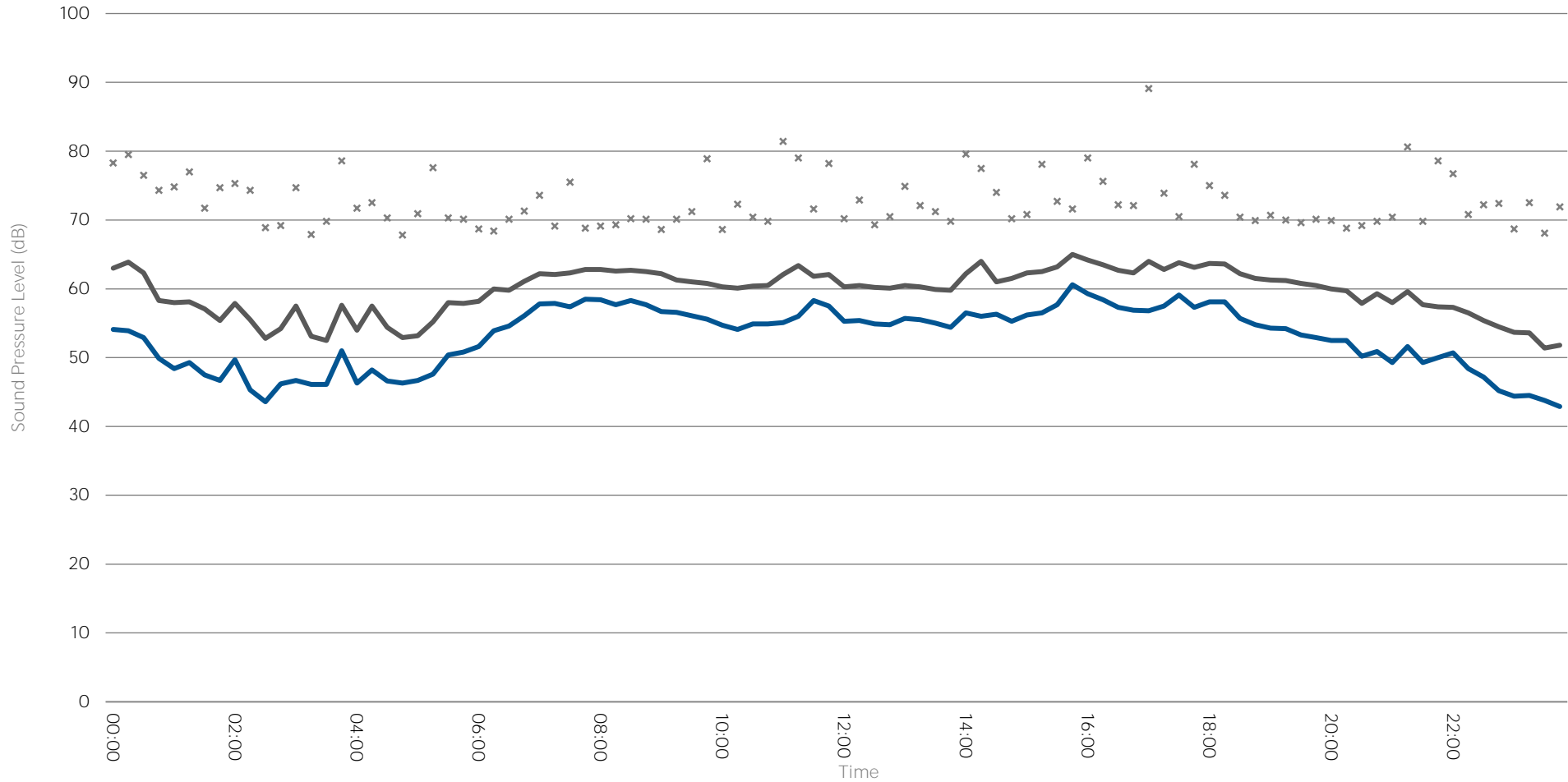


Figure 20240101-0 R1 TH1.12

Noise Levels Recorded at Position MP1, 23 January 2024

— LAeq \* LAMax — LA90

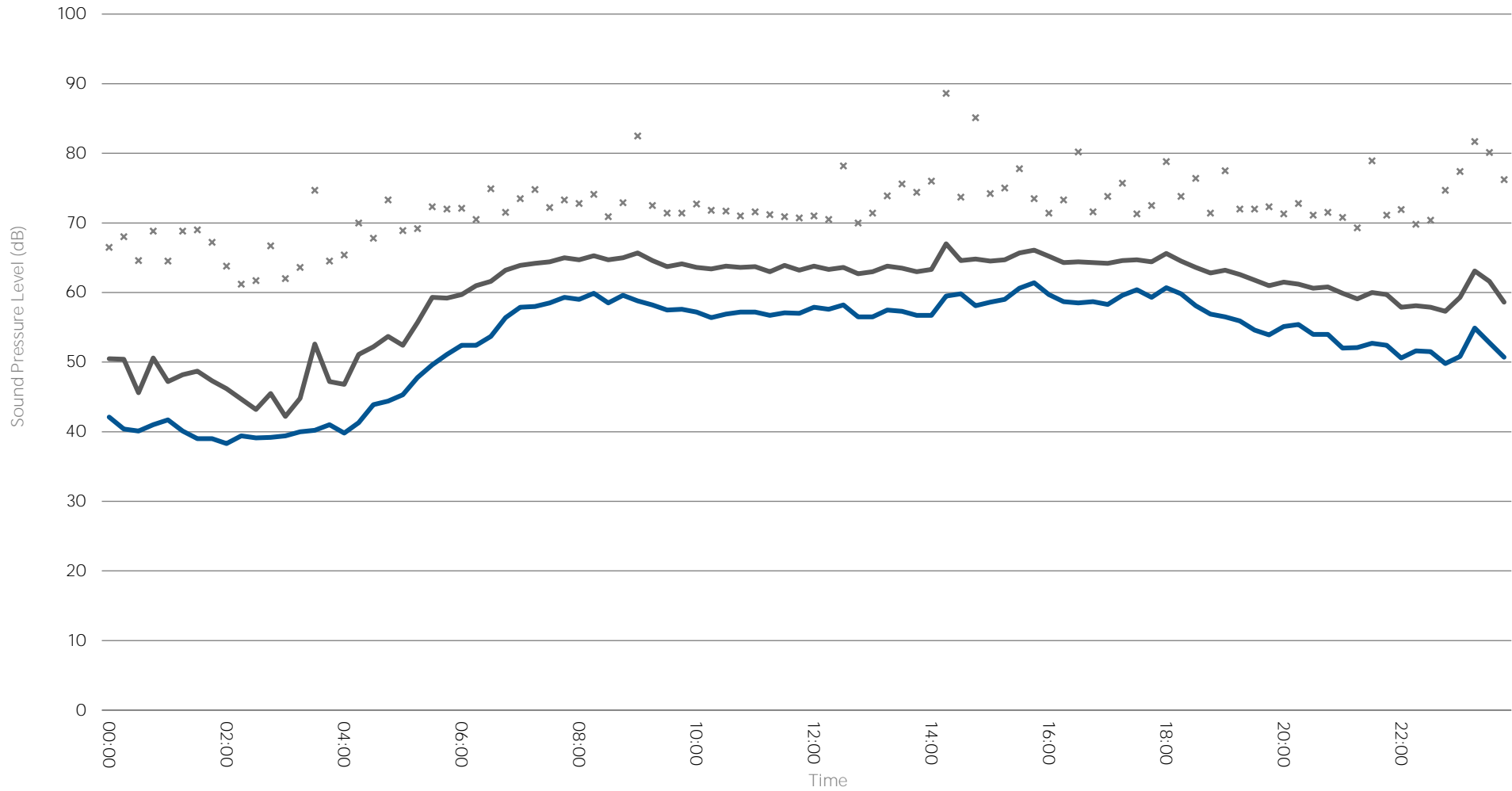
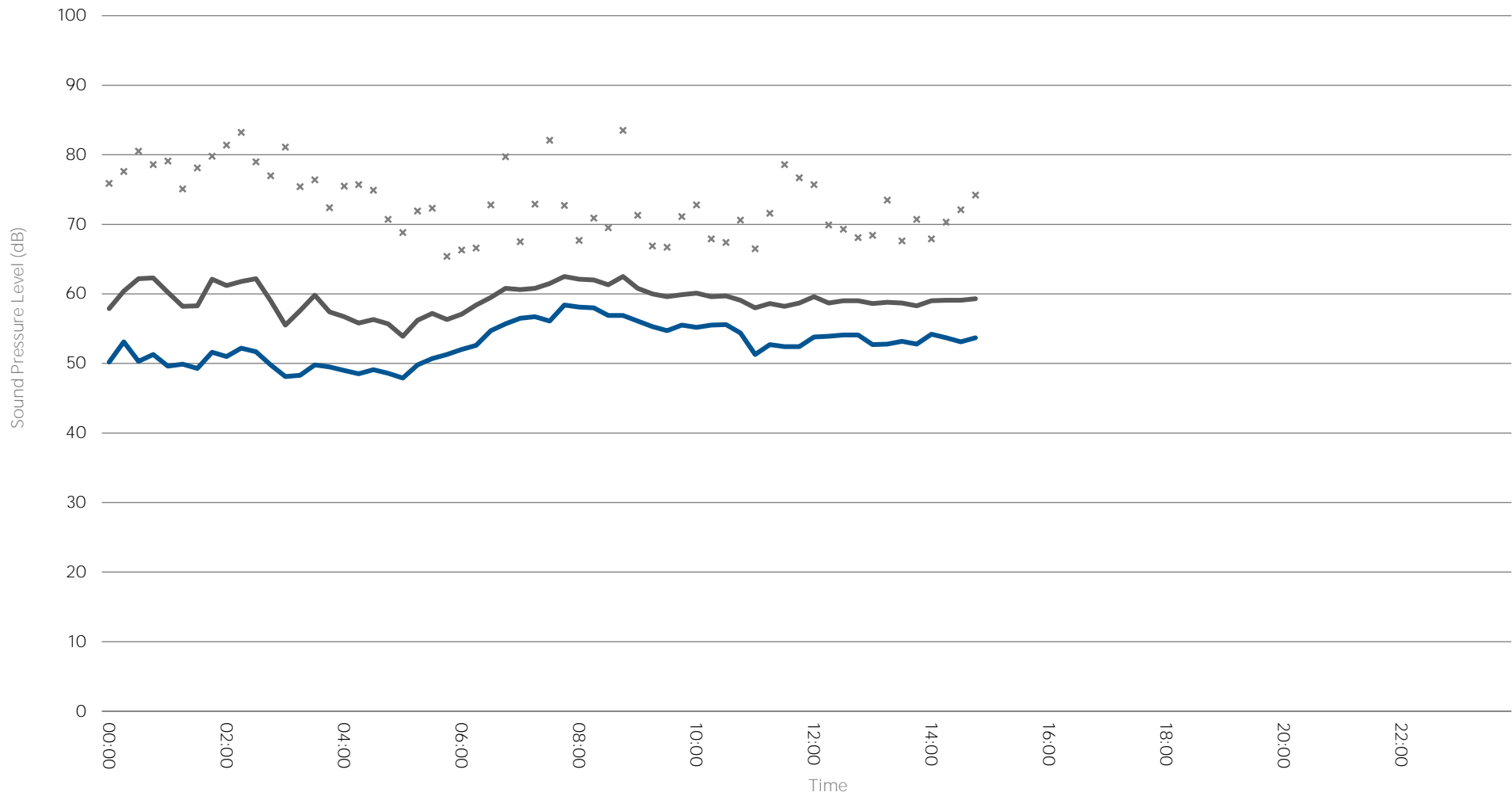




Figure 20240101-0 R1 TH1.13

Noise Levels Recorded at Position MP1, 24 January 2024

— LAeq \* LAMax — LA90



## Appendix A

### Glossary of Acoustics Terms – Noise Levels

#### Single Figures and Spectra

Generally speaking, the human ear is capable of hearing noise within the frequency range 20Hz to 20kHz. To make handling of data more meaningful and manageable, the range is often divided into 'bands', each of which covers a specific part.

For most acoustics applications, either octave or third-octave bands are used. Each band has a specific centre frequency which is used to identify it. When reported, the band centre frequency is given, along with the associated noise level, e.g. 63dB  $L_{eq}$  at 500Hz.

Noise levels can also be reported as single figure values where all energy contained within the measured frequency range is summed to provide a single figure. However, as the human ear does not hear noise at different frequencies with equal loudness, a weighting curve is often applied to levels before summing to account for this fact.

The most common curve is the A-weighting curve, and its use is denoted by including the letter 'A' with either the index e.g. 63dB  $L_{Aeq}$ , or with the decibel suffix (if the index is described elsewhere), e.g. 63dBA. 'B' and 'C' weighting curves may also be applied, depending on the application. A 'Z' is used to indicate a single figure where no weighting has been applied, e.g. 63dB  $L_{Zeq}$ .

#### Noise Level Indices

Noise level measurements can be made and reported in a variety of indices. The index is reported using the letter  $L$  to indicate Level, followed by, for example, abbreviations to represent the specifics of the index, and time intervals where applicable. The most commonly used are given below.

#### $L_{eq,T}$ (dB) - Equivalent Continuous Sound Pressure Level

The  $L_{eq,T}$  value is the sound pressure level in decibels of a continuous steady sound that within a specified time interval,  $T$ , has the same mean-squared sound pressure as a sound that varies with time. It is often used as a descriptor of the **ambient noise climate**, and commonly seen as a single A-weighted figure  $L_{Aeq,T}$ .

#### $L_{max}$ (dB) - Maximum Sound Pressure Level

The  $L_{max}$  value is the highest recorded sound pressure level in decibels averaged across a specified time constant during a noise measurement of certain duration. Two time constants are used, Fast and Slow, where the time constants are 0.125s and 1s respectively. The time constant is denoted in the index,  $L_{max,F}$  for Fast and  $L_{max,S}$  for Slow. It is often used to identify transient events that have a high-level relative to the ambient noise climate, and commonly seen as a single A-weighted figure  $L_{Amax}$ .

$L_{10,T}$  (dB) - Equivalent Continuous Sound Pressure Level

The  $L_{10,T}$  value is the sound pressure level in decibels that is exceeded for 10% of a given time interval, T. It is often used as a measurement of noise from transportation sources such as road and rail. It is commonly seen as a single A-weighted figure  $L_{A10,T}$ .

$L_{90,T}$  (dB) - Equivalent Continuous Sound Pressure Level

The  $L_{90,T}$  value is the sound pressure level in decibels that is exceeded for 90% of a given time interval, T. It is often used as a descriptor of the **background noise climate**, and commonly seen as a single A-weighted figure  $L_{A90,T}$ .

## Appendix B

### Document Naming and Version Control Policy

All documents are issued with a unique number which comprises the principle 8-digit project and 1-digit subsection numbers, for example 20151203-0, and a reference indicating iteration of document type, for example R1 for Report 1, M2 for Memorandum 2 etc.

All documents employ version control through the use of a unique version number. The version numbers employ two levels of hierarchy, and use the format illustrated below:

**V 1 . 2**

Major Minor

#### Major

A major revision occurs when the report is revised to reflect significant changes in design strategy. For example, wide scale changes to building footprint or general arrangements, changes to principle construction type (e.g. masonry to lightweight), reselection of mechanical services plant etc. A change in strategy that takes place within the same RIBA work stage for example will prompt a major revision to a document.

#### Minor

A minor revision occurs when the report is revised to reflect minor changes to the design implementation. For example a change in the type of natural vent, extract fan, surface finish etc. to be used, on the project. Minor revisions will also occur when there is a change in wording of the report text.

#### Reporting

The Document History and Version Control table on the second page of each report identifies the versions through which the document has moved, along with the date, author that produced the version, and a description of its purpose or change.

#### Electronic File Naming

Reports issued electronically use the following format:

2012xxxx	-	x	Rx	Noise Assessment Report	v1.0	yyyy.mm.dd.pdf
Project Number		Subsection	Report Number	Report Name	Version	Date File Extension

## Appendix C

### C1.1 National Planning Policy Framework

C1.1.1 The National Planning Policy Framework (NPPF)<sup>5</sup> sets out the Government's planning policies for England and how these are expected to be applied.

C1.1.2 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 noise pollution.

C1.1.3 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:

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

Noise Policy Statement for England<sup>6</sup>

C1.1.4 The Noise Policy Statement for England (NPSE) seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. The statement applies to all forms of noise, including environmental noise, neighbour noise and neighbourhood noise.

C1.1.5 The statement sets out the long term vision of the government's noise policy, which is to *"promote good health and a good quality of life through the effective management of noise within the context of policy on sustainable development"*.

C1.1.6 The NPSE adopts established concepts from toxicology that are currently being applied to noise effects. The concept details noise level thresholds, at which the effects of an exposure may be classified into a specific category. The classification categories as detailed within NPSE are as follows:

- No Observed Effect Level (NOEL) - the level below which no effect can be detected. Below this level no detectable effect on health and quality of life due to noise can be established;
- Lowest Observable Adverse Effect Level (LOAEL) - the level above which adverse effects on health and quality of life can be detected; and
- Significant Observed Adverse Effect Level (SOAEL) - the level above which significant adverse effects on health and quality of life occur.

C1.1.7 The first aim of the NPSE is to avoid significant adverse effects on health and quality of life, taking into account the guiding principles of sustainable development. The second aim considers

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<sup>5</sup> National Planning Policy Framework – Ministry of Housing, Communities and Local Government, December 2023

<sup>6</sup> <https://www.gov.uk/government/publications/noise-policy-statement-for-england>

situations where effects are established between the LOAEL and SOAEL. In such circumstances, all reasonable steps should be taken to mitigate and minimise the effects. However, this does not mean that such adverse effects cannot occur. The third aim seeks to improve health and quality of life, where possible, through the pro-active management of noise, whilst also taking account of the guiding principles of sustainable development.

C1.1.8 It is recognised that SOAEL does not have a single objective noise-based level that is applicable to all sources of noise in all situations; therefore, the SOAEL is likely to be different for different sources, receptors and at different times of the day.

Planning Practice Guidance<sup>7</sup>

C1.1.9 Planning practice guidance on noise attempts to clarify the thresholds set out above. To this end, the table below taken from the guidance summarises the noise exposure hierarchy, based on the likely average response.

Perception	Examples of Outcomes	Increasing Effect Level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, 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 perceived change in the quality of life.	Lowest Observed Adverse Effect Level Observed Adverse Effect	Mitigate and reduce to a minimum
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, 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 Level Significant Observed Avoid Adverse Effect	
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

T4 Summary of the noise exposure hierarchy, based on the likely average response

Development<sup>7</sup> <https://www.gov.uk/guidance/noise--2>

**C1.2 BS 4142:2014+A1:2019 - Methods for rating and assessing industrial and commercial sound**

C1.2.1 When assessing the impact of mechanical services or general industrial / commercial noise on new or existing dwellings it is relevant to consider the guidance provided within BS 4142:2014+A1:2019 - *Methods for rating and assessing industrial and commercial sound*.

C1.2.2 BS 4142 provides an assessment methodology and criteria relating to:

*a) sound from industrial and manufacturing processes;*

*b) sound from fixed installations which comprise mechanical and electrical plant and equipment;*

*c) sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and*

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

C1.2.3 The application of the standard is detailed below:

*This standard is applicable to the determination of the following levels at outdoor locations:*

*a) rating levels for sources of sound of an industrial and/or commercial nature; and*

*b) ambient, background and residual sound levels,  
for the purposes of:*

*1) investigating complaints;*

*2) assessing sound from existing, proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and*

*3) assessing sound at proposed new dwellings or premises used for residential purposes.*

C1.2.4 This shows that where it is proposed to install a new commercial noise source, such as new service yards. It is appropriate to assess the noise impact against the guidance and assessment methodology set out within BS 4142.

C1.2.5 The standard recommends the following reference time period,  $T_r$ , over which the specific sound should be evaluated, for each of the day and night periods:

*$T_r = 1$  hour during the day; and*

*$T_r = 15$  minutes during the night.*

C1.2.6 The assessment time periods allow for the full variation of the operations of any site to be taken into account whilst ensuring that the calculated noise level is not significantly reduced by potentially significant periods of inactivity at the beginning and end of the assessment period which may occur when assessing as the full day and night time operations.

C1.2.7 The reason for the shorter night time period is identified in the standard as follows:

*The shorter reference time interval at night means that short duration sounds with an on time of less than 1 h can lead to a greater specific sound level when determined over the reference time interval during the night than when determined during the day.*

- C1.2.8 The standard states that daytime is typically between 07:00 h and 23:00 h accordingly night-time is between 23:00 h and 07:00 h.

#### Noise Rating Level

- C1.2.9 To take account of the potentially attention-grabbing nature of an industrial noise source the standard provides a method to calculate a rating level for the noise source by applying corrections or 'penalties' based on any notable characteristics of the noise, when considered against the noise climate at the receptor.
- C1.2.10 The rating level of noise for the assessment periods,  $L_{A,r,Tr}$  is the calculated noise level at the nearest receiver location, adjusted depending on the acoustic characteristic of the noise source. Adjustment factors are based on any tonality, impulsivity, intermittency and 'other' sound characteristics present in the resultant noise level at the receiver position.
- C1.2.11 The level of any penalty will depend both on the type of noise source and the context in which it is perceived. A noise source which is highly tonal when significantly above the existing background noise level close to the source but may not be considered tonal at the nearest noise sensitive receptor where it is significantly below the existing background noise level. Due to this the same source may be considered to have different rating corrections to different receptors.
- C1.2.12 The period of time for which an individual noise source is active during the relevant reference time period (detailed above) will also be taken into account within the rating level.
- C1.2.13 The rating level, including appropriate correction factors, will be considered and applied to each source and receiver path individually. The corrections factors detailed within BS 4142:2014 are repeated below:

#### Tonality

*For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible.*

#### Impulsivity

*A correction of up to +9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3 dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible and 9 dB where it is highly perceptible.*

*NOTE 2 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. 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.*



*Intermittency*

*When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. This can necessitate measuring the specific sound over a number of shorter sampling periods that are in combination less than the reference time interval in total, and then calculating the specific sound level for the reference time interval allowing for time when the specific sound is not present. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.*

*Other sound characteristics*

*Where the specific sound 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.*

- C1.2.14 When considering which correction factors to apply it will be necessary to consider the existing noise climate and what sound sources contribute to it in addition to the proposed noise source. For example, where a noise generating activity is proposed adjacent to an existing identical noise generating site, the impact of the new noise source would be less than if it were to be planned in a location where its character and type is different to and more noticeable than any existing noise source nearby.

*Background Sound Level*

- C1.2.15 The initial assessment of impacts within BS 4142 requires a comparison of the noise rating level with the existing background noise level. To quantify the background level the standard states the following:

*In using the background sound level in the method for rating and assessing industrial and commercial sound it is important to ensure that values are reliable and suitably represent both the particular circumstances and periods of interest. For this purpose, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods.*

- C1.2.16 The periods of interest over a 24 hour day are usually related to daytime activities (07:00-23:00 h) and night time (23:00-07:00 h). However, the standard makes the following statement:

*Among other considerations, diurnal patterns can have a major influence on background sound levels and, for example, the middle of the night can be distinctly different (and potentially of lesser importance) compared to the start or end of the night-time period for sleep purposes. Furthermore, in this general context it can also be necessary to separately assess weekends and weekday periods.*

- C1.2.17 Therefore, the periods of time which are typically considered 'waking up' and 'falling asleep' stages, for example 06:00 to 07:00 h and 23:00 to 24:00 h, may need to be considered independently. Alternative periods may also be identified where breakdown beyond the standard day and night time analysis will be necessary, for example where background sound levels are shown to be regularly elevated. Similarly, both weekend and weekday periods may need to be considered separately, with criteria set for both. The requirement to analyse specific time periods will be considered for each site individually.

Assessment of Impacts

- C1.2.18 To assess the impact of industrial noise at a receptor the noise rating level of the source at that receptor must be calculated and then compared to the existing background noise level.

*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. 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.*

- C1.2.19 The initial impact assessment is undertaken by comparing the noise rating level to the existing background sound level. The impacts provided by BS 4142 are reproduced below:

*Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level (see Clause 8) from the rating level (see Clause 9), and consider the following.*

*NOTE 1 More than one assessment might be appropriate.*

*a) Typically, the greater this difference [between industrial site noise rating level and baseline background level], the greater the magnitude of the impact.*

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

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

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

*NOTE 2 Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.*

- C1.2.20 Based on the above the Lowest Observed Adverse Effect Level (LOAEL) is considered to be 5 dB above the existing background noise level as this is the first indication of an adverse impact.

- C1.2.21 Following the initial impact assessment, it is necessary to modify the assessment based on context. This includes the following:

*Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.*

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

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

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

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

*NOTE 3 Consideration ought to be given to evidence on human response to sound and, in particular, industrial and/or commercial sound where it is available. A number of studies are listed in the "Effects on humans of industrial and commercial sound" portion of the "Further reading" list in the Bibliography.*

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

*i) facade insulation treatment;*

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

*iii) acoustic screening.*

C1.2.22 The guidance above shows that where the absolute level of noise is considered to be low, either inside or outside a dwelling the impact can be considered to be low even if the initial comparison with the background noise levels shows that the impact could be considered to be high. It is also necessary to consider any design features within the receptor which may reduce the impact, such as façade insulation, ventilation and/or cooling that will reduce the need to have windows open.

C1.2.23 In order to quantify the noise impact within dwellings with enhanced façade/ventilation it is appropriate to consider absolute noise levels. When considering noise levels within dwellings it is appropriate to consider guidance within BS8233:2014. This is highlighted within Example assessments (6 and 8) of BS4142 which both look at situations where an external noise source potentially affects residents indoors. Whilst these examples aren't completely applicable in the situation where new dwellings are located close to an existing source it is worth noting that in both of these examples the standard states that other guidance such as BS 8233 might also be applicable.

C1.2.24 BS 8233 provides guidance for assessing industrial noise within dwellings against absolute thresholds as detailed below.

### C1.3 BS 8233:2014 – Guidance on sound insulation and noise reduction for building

C1.3.1 When considering the control of noise in and around buildings it is appropriate to consider the guidance provided within BS 8233:2014 as stated within the document scope:

*This British Standard provides guidance for the control of noise in and around buildings. It is applicable to the design of new buildings, or refurbished buildings undergoing a change of use, but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building...*

C1.3.2 The above shows that the document does not provide guidance on assessing the effects of changes in external noise levels on the occupants of existing buildings, however the absolute criteria within rooms are considered by Acoustics Central to be relevant to new and existing sources. This is also in line with the examples within BS 4142:2014+A1:2019.

C1.3.3 Section 6.5 “Noise from industry” of the standard provides guidance on the assessment of new dwellings affected by industrial noise:

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

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

*b) background noise level.*

C1.3.4 It is important to highlight that the guidance above only states that the method for rating the noise levels from BS 4142 should be used, not an assessment in line with BS 4142.

C1.3.5 Table 4 of section 7.7 proposes the following noise criteria within dwellings for steady external noise sources in Table 4. The table and relevant notes are reproduced below:

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

NOTE 2 The levels shown in Table 4 are based on the existing guidelines issued by the WHO and assume normal diurnal fluctuations in external noise. In cases where local conditions do not follow a typical diurnal pattern, for example on a road serving a port with high levels of traffic at certain times of the night, an appropriate alternative period, e.g. 1 hour, may be used, but the level should be selected to ensure consistency with the levels recommended in Table 4.

NOTE 3 These levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.

NOTE 4 Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or  $L_{Amax,F}$ , depending on the character and number of events per night. Sporadic noise events could require separate values.

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

If applicable, any room should have adequate ventilation (e.g. trickle ventilators should be open) during assessment.

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

Table 4 of BS 8233:2014

C1.3.6 Paragraph 7.7.1 states where the noise criteria in table 4 applies:

*This subclause applies to external noise as it affects the internal acoustic environment from sources without a specific character, previously termed "anonymous noise". Occupants are usually more tolerant of noise without a specific character than, for example, that from neighbours which can trigger complex emotional reactions. For simplicity, only noise without character is considered in Table 4. For dwellings, the main considerations are:*

- a) for bedrooms, the acoustic effect on sleep; and
- b) for other rooms, the acoustic effect on resting, listening and communicating.

*NOTE Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.*


C1.3.7 As stated above the noise criteria within Table 4 apply to sources without a specific character. As stated above where the noise source does have a specific character it may be appropriate to lower

the noise criteria. Applying the rating corrections detailed within BS 4142, as detailed in section 6.5 of BS 8233 artificially increases the assessed noise level. When comparing this rating level to the criteria stated in Table 4 of BS 8233:2014 the effect, essentially, is to reduce the criteria in line with the characteristics of the noise source.

- C1.3.8 Increasing the assessed noise levels, by following the guidance in section 6.5 and applying BS 4142 rating corrections, is essentially the same as reducing the noise criteria.
- C1.3.9 The notes to table 4 also state that where the noise source does not follow normal diurnal patterns, as would be the case with industrial noise, it may be appropriate to change the assessment time periods. It is considered that changing the reference time period to those within BS 4142 (1 hour during the day and 15 minutes at night) is suitable.
- C1.3.10 Based on the guidance a noise rating level assessed internally of 35 dB  $L_{Ar,1hour}$  in the day and 30 dB  $L_{Ar,15min}$  at night is considered to be the threshold of the Lowest Observed Adverse Effect Level (LOAEL). When taking account of a 10-15 dB loss for a partially open window this corresponds to 45-50 dB  $L_{Ar,1hour}$  externally during the day and 40-45 dB  $L_{Ar,15min}$  at night.





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