

ACOUSTICS CENTRAL



Borde Hill Stables

Plant Noise Assessment

20221108-0 R3

Borde Hill Stables

Plant Noise Assessment

20221108-0 R3

Borde Hill

Haywards Heath
West Sussex
RH16 1XP

Document History and Version Control

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Executive Summary

Planning consent has been granted for the extension of and alterations to the existing stables building at Borde Hill. New mechanical services plant items are proposed to be installed to serve the building. One of the planning conditions attached to the consent relates to external noise emissions from the plant items.

A noise survey has been undertaken at the site, the methodology and results of which are presented within this report.

Based on the results of the survey conducted at the site and the requirements of the relevant planning condition, atmospheric noise limits for mechanical services plant have been defined, applicable outside nearby noise sensitive windows.

An assessment of atmospheric noise emissions from the proposed plant installation has been carried out. Accounting for screening provided by the extended stables building and the recommended atmospheric-side silencers to the extract fans, noise from the proposed plant items is calculated to fall within the relevant noise limit and is therefore compliant with the requirements of planning condition 11.

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Attachments

20221108-0 R3 TH1.1 – TH1.5

Time history graphs illustrating noise levels recorded at position MP1

20221108-0 R3 TH2.1 – TH2.6

Time history graphs illustrating noise levels recorded at position MP2

20221108-0 R3 SCH1

Schedule of manufacturer's plant noise data

20221108-0 R3 SCH2

Schedule of noise mitigation measures

20221108-0 R3 CS1 to CS15

Plant noise assessment calculation sheets

Appendix A

Glossary of Acoustics Terms

Appendix B

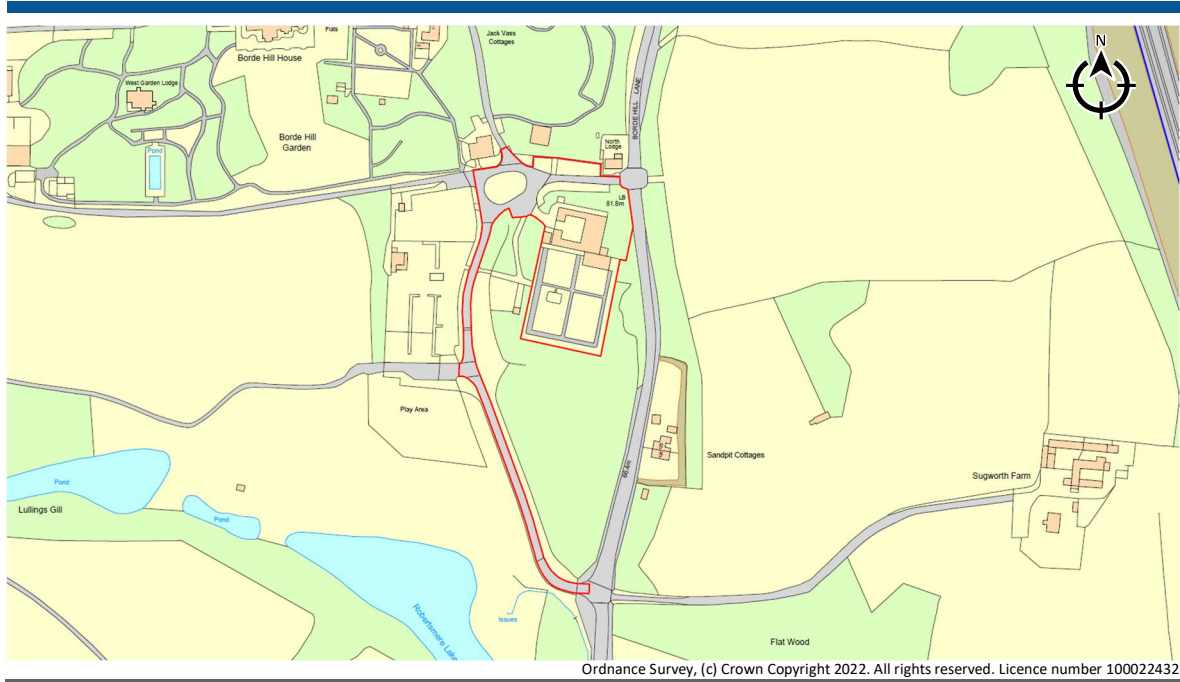
Document Naming and Version Control Policy

1 Introduction

- 1.1 Planning consent has been granted for the extension of and alterations to the existing stables building at Borde Hill. New mechanical services plant items are proposed to be installed to serve the building. One of the planning conditions attached to the consent relates to external noise emissions from the plant items.
- 1.2 Acoustics Central has been instructed to undertake a noise survey at the site to quantify the existing background noise climate, define suitable limits for atmospheric plant noise emissions accounting for the requirements of the planning condition, and undertake an assessment of plant noise emissions.
- 1.3 This report details the methodology and results of the survey, the plant noise limits, and the assessment to nearby noise sensitive locations including details of any necessary noise mitigation measures.
- 1.4 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 Borde Hill Estate, which extends to 2,300 acres, is located to the north of Haywards Heath in West Sussex. Borde Hill Garden and the stables building are located within the wider estate, to the west side of Borde Hill Lane. The site can be seen in the image below.



F1 Figure indicating site location

- 2.2 The stables building is located approximately 17m from the edge of Borde Hill Lane, with a garden area between. Areas to the north and west of the building are used for car parking, with gardens and grounds beyond. To the south of the stables building there is an associated walled garden area, beyond which further south is woodland used as a forest kindergarden. There are existing residences to the north of the stables building (North Lodge) and to the Southeast (Sandpit cottages, 125-126 Borde Hill Lane).

3 Design Requirements

3.1 Planning Condition

- 3.1.1 The planning consent for the extension of and alterations to the stables building (Mid Sussex District Council planning reference DM/23/3210) includes a planning condition relating to external plant noise emissions. The condition is duplicated below:

The use hereby permitted shall not come into use until a scheme has been submitted to the LPA demonstrating that the noise rating level ($L_{Ar,Tr}$) of plant and machinery within the build shall be at least 5dB below the background noise level ($L_{A90,T}$) at the nearest residential facade. All measurements shall be defined and derived in accordance with BS4142: 2014+A1:2019. The assessment shall be carried out with the plant/machinery operating at its maximum setting. The approved measures shall be implemented before the development is brought into use and thereafter be maintained in accordance with the approved details.

3.2 BS 4142:2014

- 3.2.1 The relevant British Standard regarding noise from plant affecting dwellings is BS 4142:2014¹. The primary methodology of the standard compares the rating level of the noise of the plant to the representative background noise level (during the relevant period of operation).
- 3.2.2 The rating level is the predicted noise level at the noise sensitive location, with various penalties added for acoustic features expected to increase the significance of the source, such as tonality, impulsivity and intermittency.
- 3.2.3 The greater the excess of rating level over background noise level, the greater the likelihood of an adverse noise impact. On this comparison of rating level to background noise, BS 4142:2014 notes:

a) Typically, the greater this difference, the greater the magnitude of the impact.

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

c) A difference of around +5dB 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.

¹ BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

4 Environmental Noise Survey

4.1 General

4.1.1 In order to quantify the noise levels at and around the site, unattended environmental noise surveys have been carried out. The measurements were conducted over the following periods:

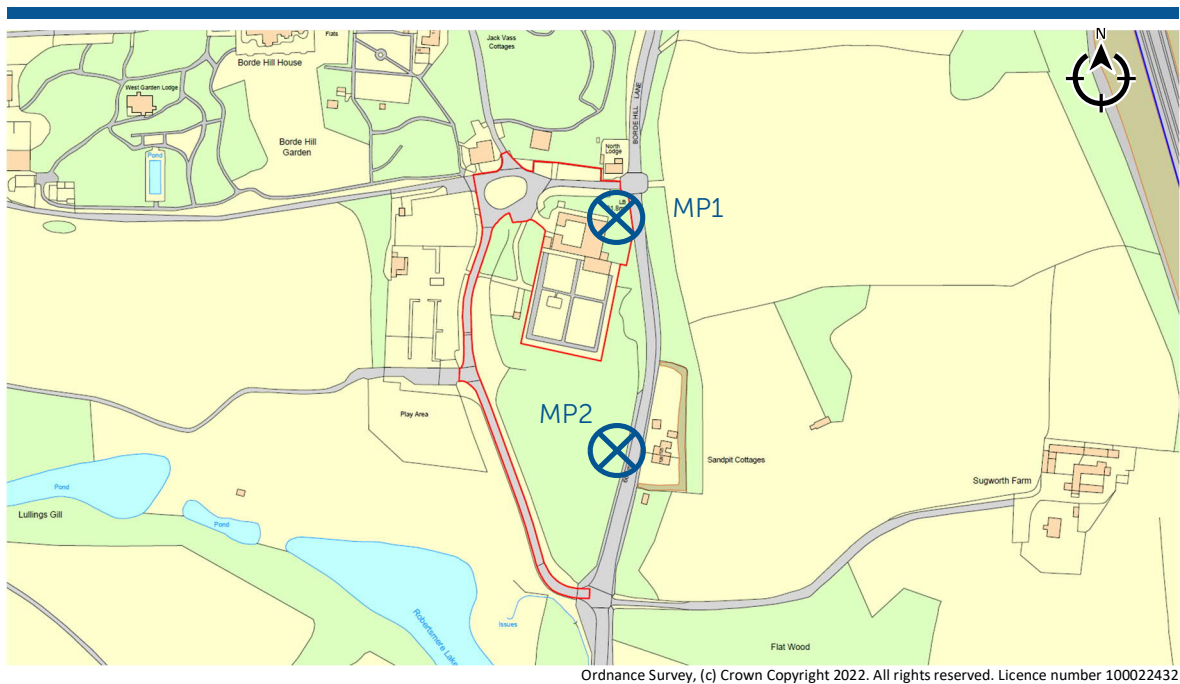
- 13:00 hours Thursday 8th December and 13:15 hours Tuesday 13th December 2022;
- 11:00 hours Friday 13th January and 10:45 hours Tuesday 17th January 2023.

4.2 Guidance and Standards

4.2.1 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'*,

4.3 Measurement Positions

4.3.1 Noise measurements during each survey period were made using one unattended noise monitor. The locations of the monitors are illustrated in the following figure and described below:



F2 Figure indicating the noise measurement positions MP1 and MP2 on the site

- MP1 11m back from Borde Hill Lane; 3m above ground level in free field location. This location is considered representative of the noise climate at the nearby house to the north as well as to the road facing façade of the stables building itself.
- MP2 10m back from Borde Hill Lane, 1.2m above ground level in free field conditions. This location is considered representative of the noise climate at the nearby houses to the southeast on the opposite side of Borde Hill Lane.

4.4 Noise Monitoring Equipment

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

Item	Manufacturer	Type
Sound Level Analyser	NTi	XL2-TA
Acoustic Calibrator	NTi	CAL200

T1 Equipment used during noise measurements

4.4.2 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

- 4.4.3 The measurement instrumentation, including sound level analysers, preamplifiers and microphones have undergone traceable calibration by either a competent laboratory or the equipment manufacturer within the last two years.
- 4.4.4 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.
- 4.4.5 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 is maintained. No significant drift was noted to have occurred.

4.5 Data Recorded

- 4.5.1 Noise data was recorded over consecutive 15-minute periods (with a 1 minute resolution) in all relevant indices, including L_{Aeq} , L_{A90} , and $L_{A_{Max,F}}^2$. See attached Appendix A for an explanation of noise units used.
- 4.5.2 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.

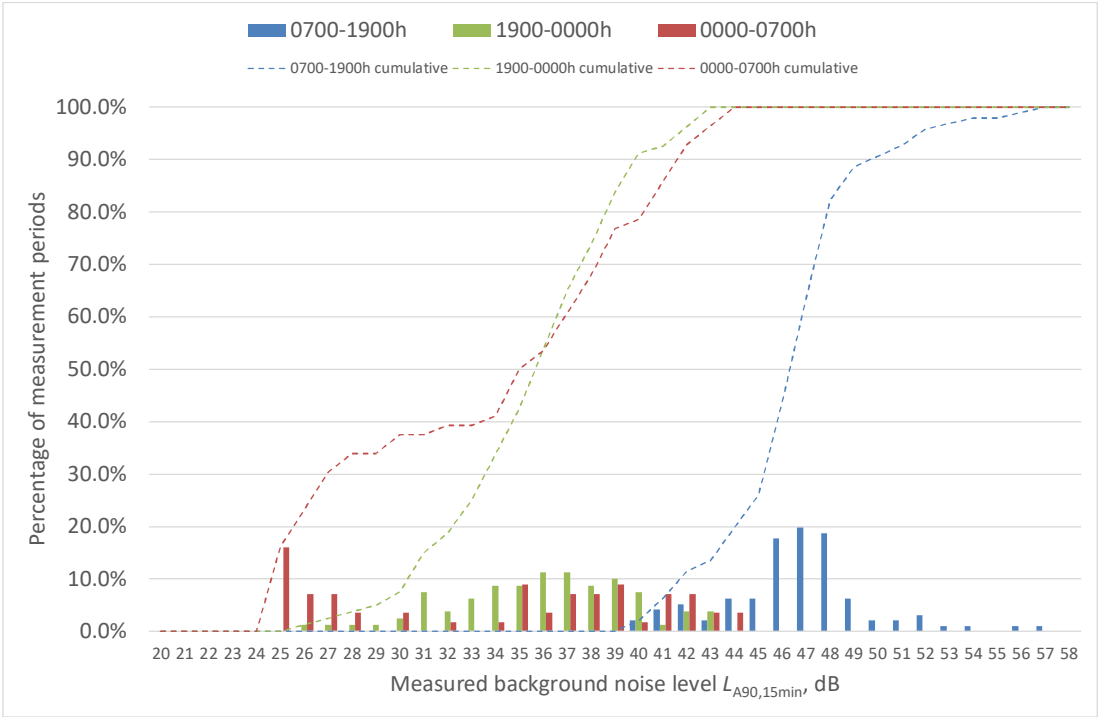
² Maximum A-weighted sound pressure level using time-weighting "F" and "S". As stated in BS EN 61672-1:2003 Design-goal time constants are 0,125 s for time-weighting F (Fast) and 1 s for time weighting S (Slow).

4.6 Meteorological Conditions

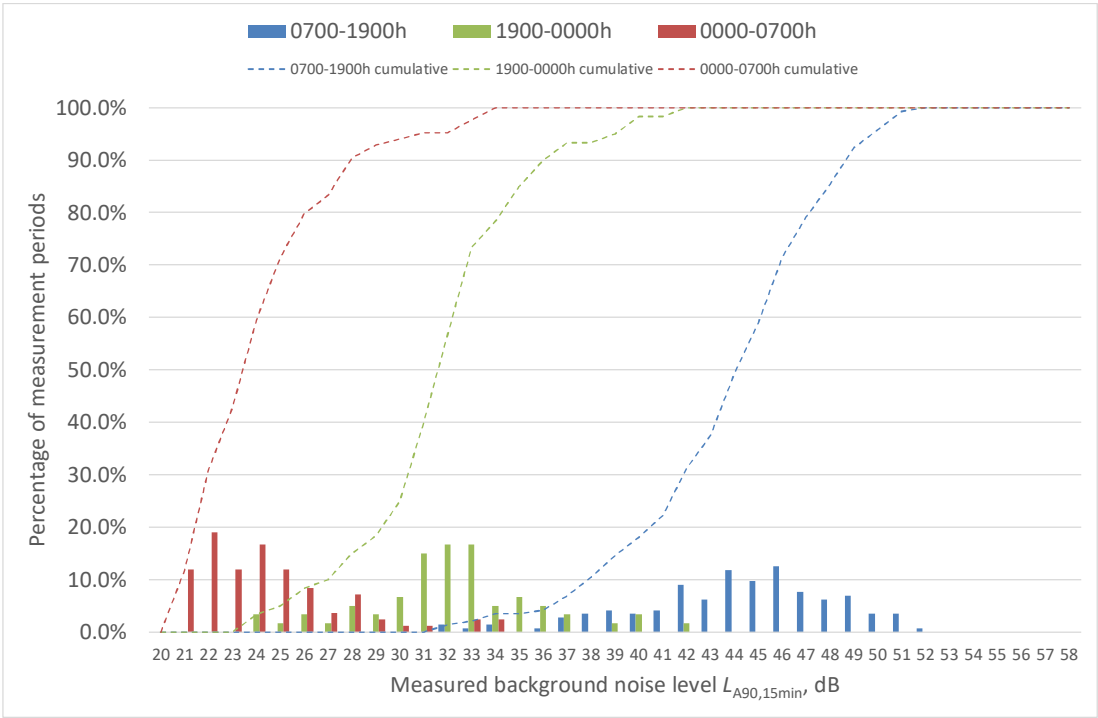
- 4.6.1 During the December 2022 measurements at position MP2, temperatures were cold, generally ranging between 0°C and 6°C during daylight hours and between -6°C and 0°C during the evening and night time. Wind speeds were low, publicly available data suggesting it did not exceed 5m/s. Weather data indicates there was a brief period of light rainfall during the daytime on Friday 9th December, which is not expected to have had any material effect on noise levels. From around 1600 hours on Sunday 11th December there was snowfall which settled on the ground which will have affected noise levels measured from then until the end of the survey period on Tuesday 13th.
- 4.6.2 During the January 2023 measurements at position MP1, temperatures were cool from Friday 13th to Sunday 15th, generally ranging between 8°C and 11°C during daylight hours and between 5°C and 8°C during the evening and night time. On Monday 16th to Tuesday 17th it was colder, generally ranging between 0°C and 5°C during daylight hours and between -6°C and 0°C during the evening and night time. There were some periods of modest winds during the daytime on Friday 13th and on Saturday 14th, for the remainder wind speeds were low not generally exceeding 5m/s. There were some periods of rainfall which affected measured noise levels on Saturday 14th January approximately 0100 to 1400 hours, and Sunday 15th 2300 hours to Monday 16th 0400 hours.

4.7 Results

- 4.7.1 The noise climate was observed to be predominantly affected by intermittent road traffic on Borde Hill Lane.
- 4.7.2 The attached time-history figures TH1.1 – TH1.5 present the noise levels measured at MP1 in 15-minute periods. The attached time-history figures TH2.1 – TH2.6 present the noise levels measured at MP2 in 15-minute periods.
- 4.7.3 Histograms of the measured background noise levels during the day (0700-1900h), evening (1900-0000h) and night-time (0000-0700h) periods are shown in the following figures. Survey periods affected by snow, high winds or rainfall have been excluded from this analysis.



F3 Histogram of $L_{A90,15min}$ background noise levels measured at position MP1 during survey



F4 Histogram of $L_{A90,15min}$ background noise levels measured at position MP2 during survey

- 4.7.5 Based on the measurement results, the following are considered to be representative background noise levels:

Location	Representative Background Noise Level ($L_{A90,15min}$), dB		
	Daytime (0700-1900)	Evening (1900-0000)	Night time (0000-0700)
MP1 - north	45	34	27
MP2 - south	42	31	22

T2 Measured background noise levels, $L_{A90,15min}$

5 Plant Noise Assessment

5.1 General

- 5.1.1 In order to compare the noise from the proposed plant items with the requirements, an atmospheric plant noise assessment has been carried out.
- 5.1.2 In essence, the assessment starts with manufacturer's plant noise levels, takes account of any system or propagation losses, and compares the resultant levels with the relevant plant noise limits.
- 5.1.3 Our calculations take into account propagation losses such as distance, reflections and screening from intervening structures where these obscure the plant from direct view, as well as the effects of any mitigation that is proposed.

5.2 Proposed Scheme

- 5.2.1 The proposed plant installation comprises the following items:
- 1 no. external condenser unit
 - 1 no. supply air handling unit
 - 3 no. extract fans
- 5.2.2 The condenser unit, supply air handling unit and one of the extract fans will be located externally, immediately to the north of the extended stables building. Two of the extract fans will be located inside the building, with associated ductwork terminating in the façades.
- 5.2.3 The proposed plant locations are illustrated on the following drawings produced by Gatwick Park Mechanical Services Ltd:
- C3170/5A AIR CONDITONING SERVICES
 - C3170/6A VENTILATION SERVICES
- 5.2.4 The relevant manufacturer's noise data for the proposed plant items can be seen in the attached Plant Noise Schedule SCH1.
- 5.2.5 The plant will be available for use during the daytime and evening (0700-0000).

5.3 Assessment Locations

- 5.3.1 One assessment position has been selected to represent the noise sensitive location most exposed to noise from the proposed equipment. The position is shown in figure F5 and described below:
- AP1: Residences to southeast - Sandpit cottages, 125-126 Borde Hill Lane



F5 Assessment Positions

5.3.2 There is a residence to the north of the stables building known as North Lodge, but as this forms part of the Borde Hill Estate, and will be used by the operator of the stables building restaurant, it is excluded from the assessment.

5.4 Plant Noise Limits

5.4.1 Plant noise limits are set out in the table below, derived based on the results of the survey and the requirements of planning condition 11.

Location	Plant 'rating' noise emission limit, $L_{A,r,Tr}$ dB
	Plant operational hours (0700-0000)
AP1 - Sandpit cottages, 125-126 Borde Hill Lane	26

T3 Plant Noise Emission Limits

5.4.2 The above limits apply to the combined, cumulative noise emission from all new plant items, when running at design duty and are to apply outside the nearest noise sensitive receptors.

5.5 Noise Mitigation Measures

- 5.5.1 The proposed plant items are to be installed to the north side of the extended stables building, which will provide the Sandpit Cottages residences to the south with screening from plant noise. These effects have been included within the calculations.
- 5.5.2 In order to control atmospheric plant noise emissions to within the relevant limits, the extract fans are to have in-duct atmospheric-side silencers fitted. The minimum insertion loss requirements for these are set out in attached schedule SCH2.

5.6 BS 4142 Character Corrections

- 5.6.1 The octave band plant data provided by the manufacturers as detailed in SCH1 suggests that noise from the units is not tonal in nature, except for kitchen extract fan EF/01 which may be tonal around the 125Hz octave band.
- 5.6.2 Noise from this extract fan to the assessment receiver position AP1 will be significantly reduced by screening from the intervening building and $\approx 115\text{m}$ distance. The calculated noise levels from the exhaust termination and from the casing breakout are both 10dBA. It is therefore not expected that any potential tonality would be perceptible at the receiver, meaning the 'specific' noise level and 'rating' noise level are identical in this case.

5.7 Assessment Results

- 5.7.1 By utilising the methodology set out above we calculate noise levels at the aforementioned assessment positions as presented in the following table. The noise limits are also reproduced for ease of comparison.

Location	Plant operational hours (07h00 - 00h00)	
	Noise Limit	Calculated
	$L_{Ar,Tr}$ dB	$L_{Ar,Tr}$ dB
AP1: Sandpit cottages, 125-126 Borde Hill Lane	26 dBA	25 dBA

T4 Noise limits and levels calculated for the proposed plant

- 5.7.2 As the above table shows, accounting for screening provided by the extended stables building and the recommended atmospheric-side silencers to the extract fans, noise from the proposed plant items is calculated to fall within the relevant noise limit and is therefore compliant with the requirements of planning condition 11.
- 5.7.3 Details of the calculations are set out in the attached sheets CS1 to CS15.

6 Conclusions

- 6.1 Planning consent has been granted for the extension of and alterations to the existing stables building at Borde Hill. New mechanical services plant items are proposed to be installed to serve the building. One of the planning conditions attached to the consent relates to external noise emissions from the plant items.
- 6.2 Based on the results of a noise survey conducted at the site and the requirements of the relevant planning condition, atmospheric noise limits for mechanical services plant have been defined, applicable outside nearby noise sensitive windows.
- 6.3 An assessment of atmospheric noise emissions from the proposed plant installation has been carried out. Accounting for screening provided by the extended stables building and the recommended atmospheric-side silencers to the extract fans, noise from the proposed plant items is calculated to fall within the relevant noise limit and is therefore compliant with the requirements of planning condition 11.

Figure 20221108-0 R1 TH1.1

Noise Levels Recorded at Position MP1, 13 January 2023

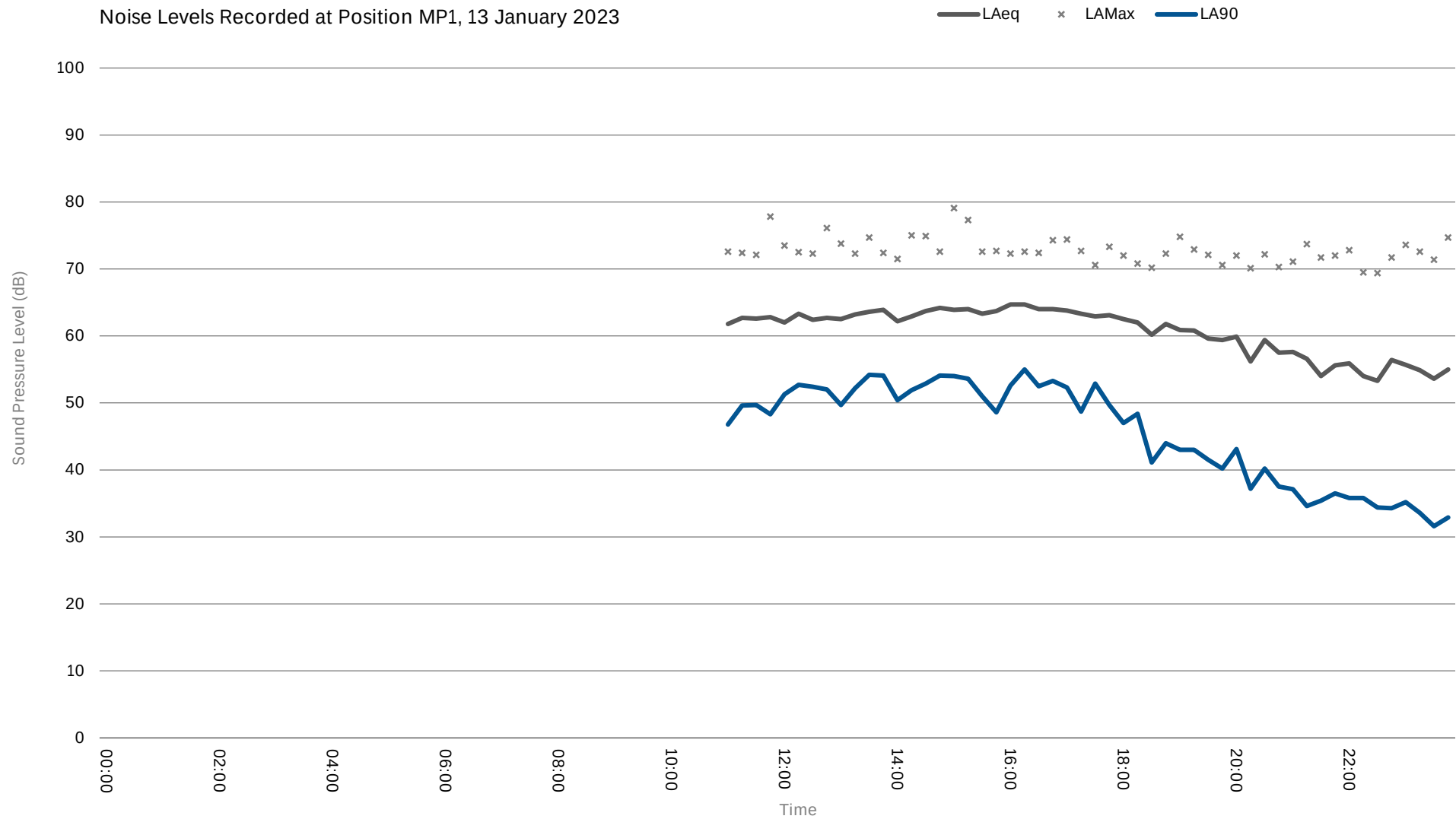
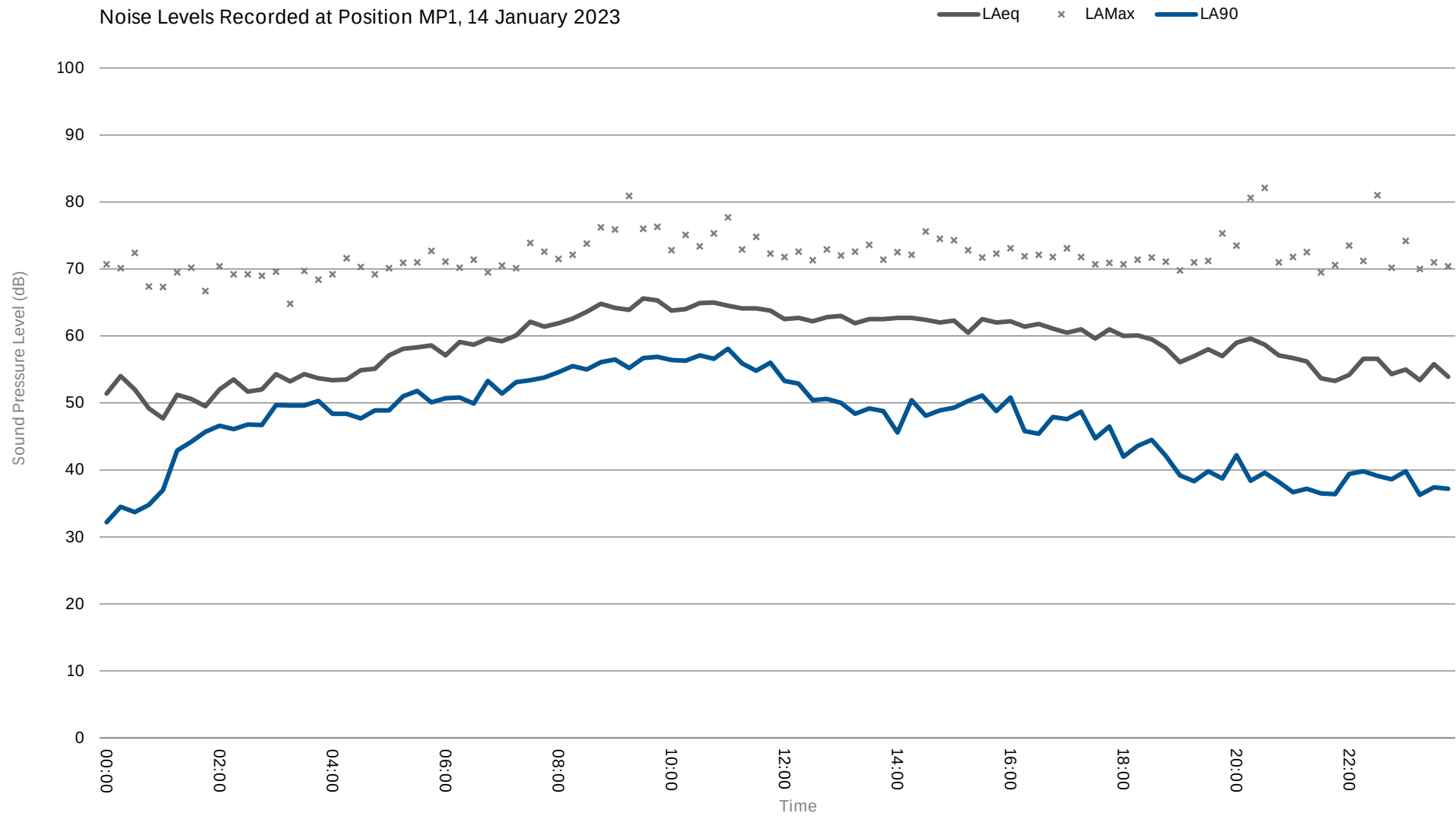


Figure 20221108-0 R1 TH1.2

Noise Levels Recorded at Position MP1, 14 January 2023



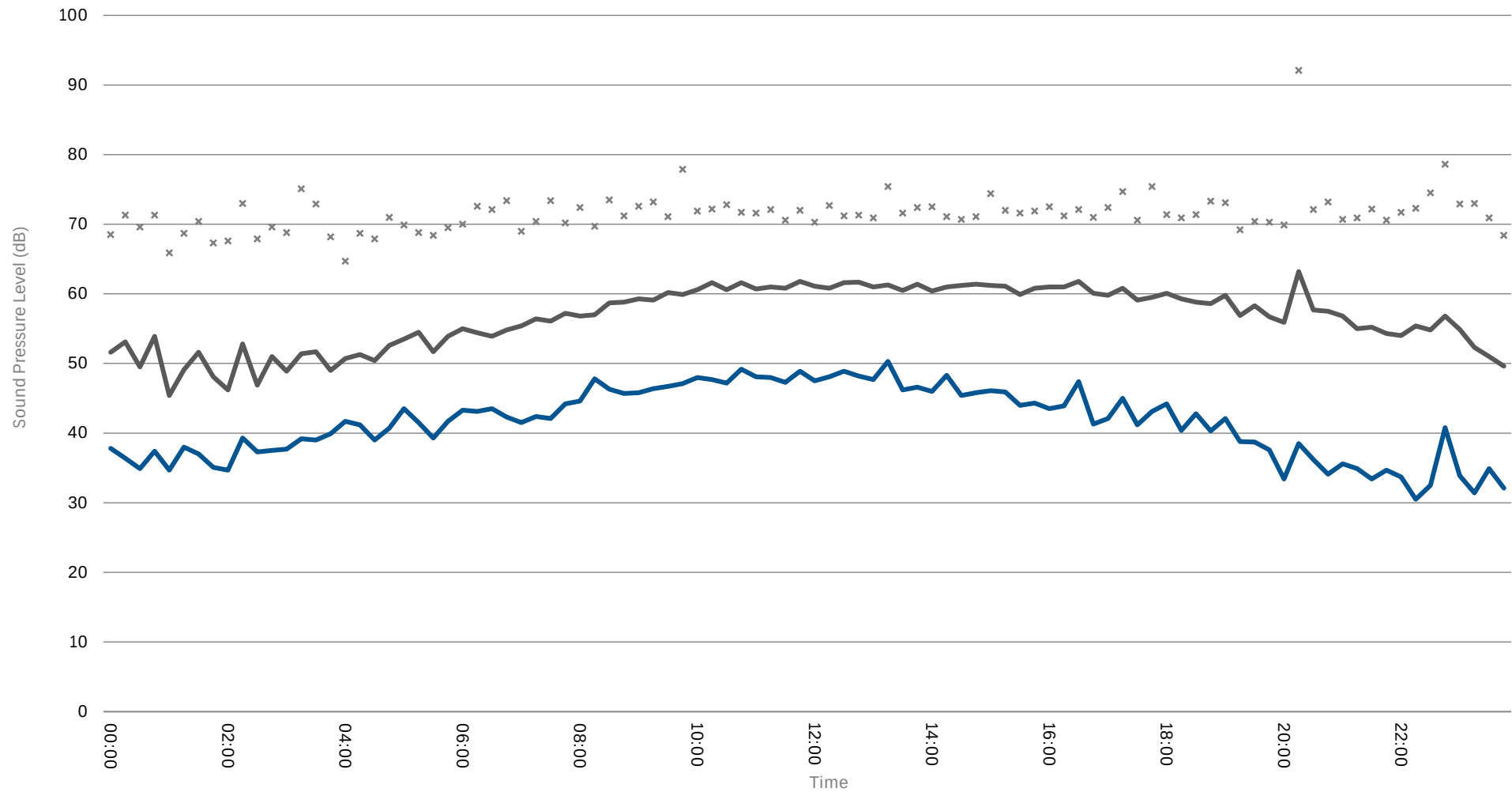
Borde Hill Stables

Environmental Noise Survey Report

Figure 20221108-0 R1 TH1.3

Noise Levels Recorded at Position MP1, 15 January 2023

— LAeq x LAMax — LA90



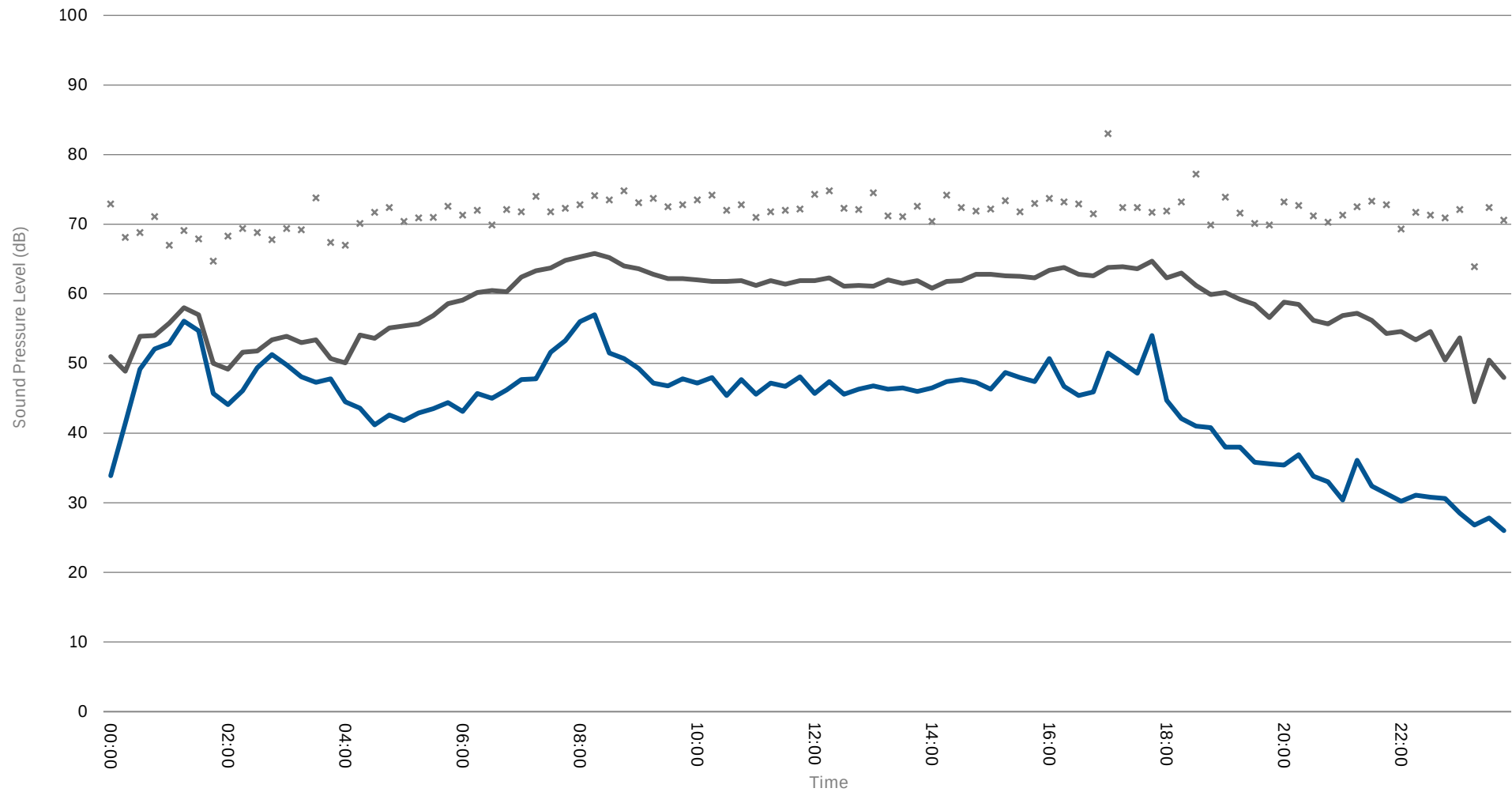
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Figure 20221108-0 R1 TH1.4

Noise Levels Recorded at Position MP1, 16 January 2023

— LAeq x LAMax — LA90



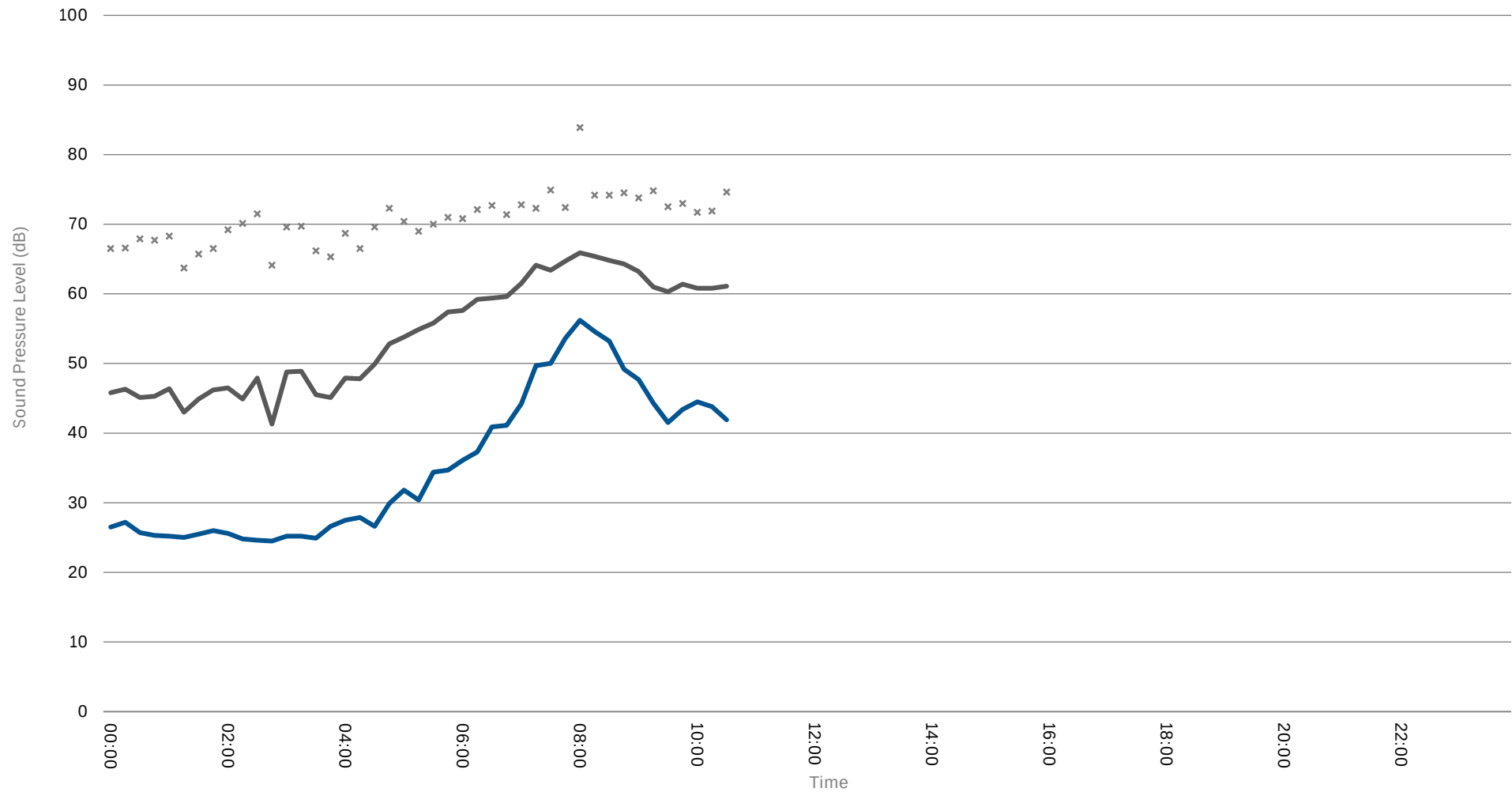
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Figure 20221108-0 R1 TH1.5

Noise Levels Recorded at Position MP1, 17 January 2023

— LAeq × LAMax — LA90



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Environmental Noise Survey Report

Figure 20221108-0 R1 TH2.1
Noise Levels Recorded at Position MP2, 08 December 2022

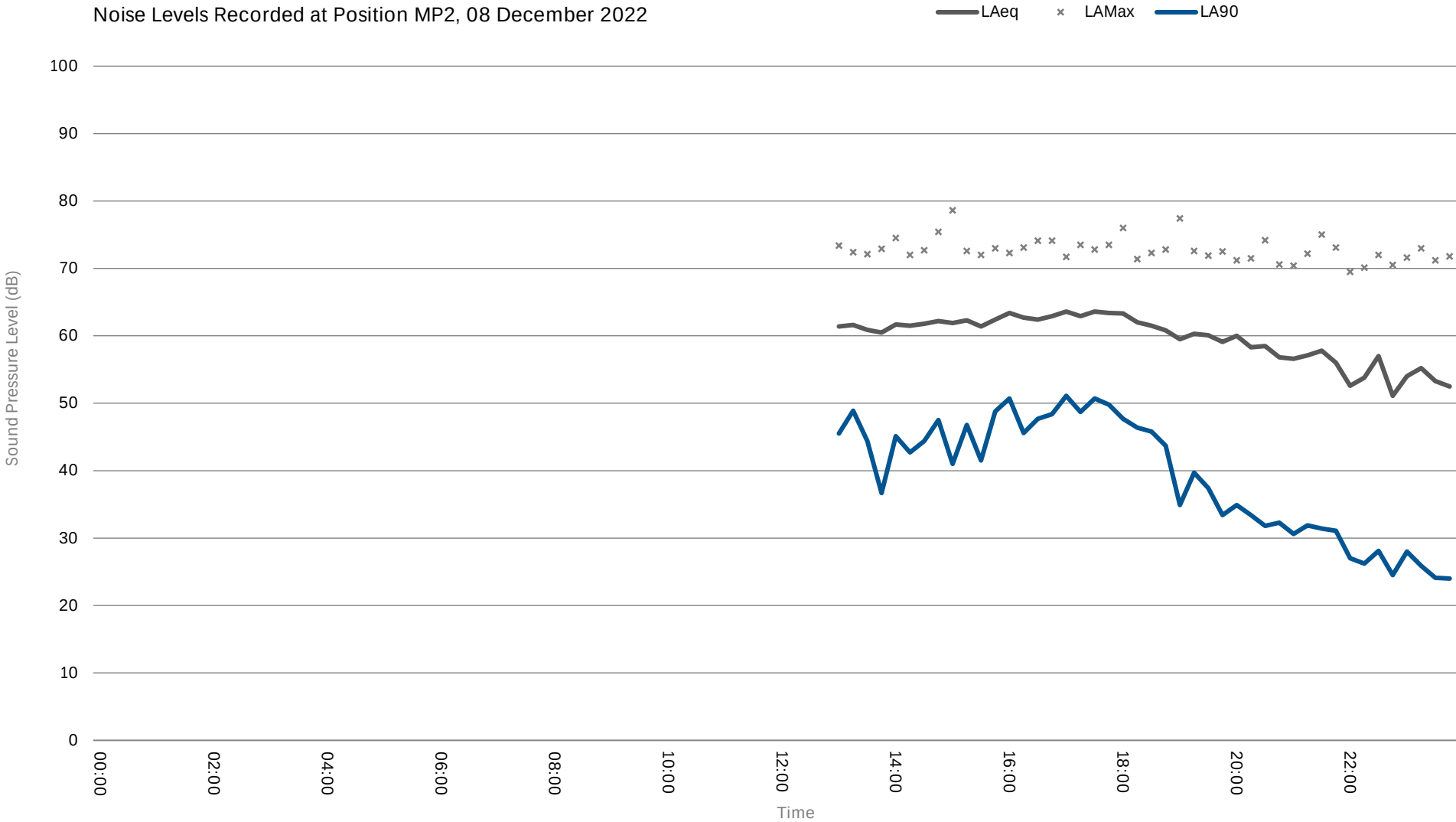


Figure 20221108-0 R1 TH2.2

Noise Levels Recorded at Position MP2, 09 December 2022

— LAeq x LAMax — LA90

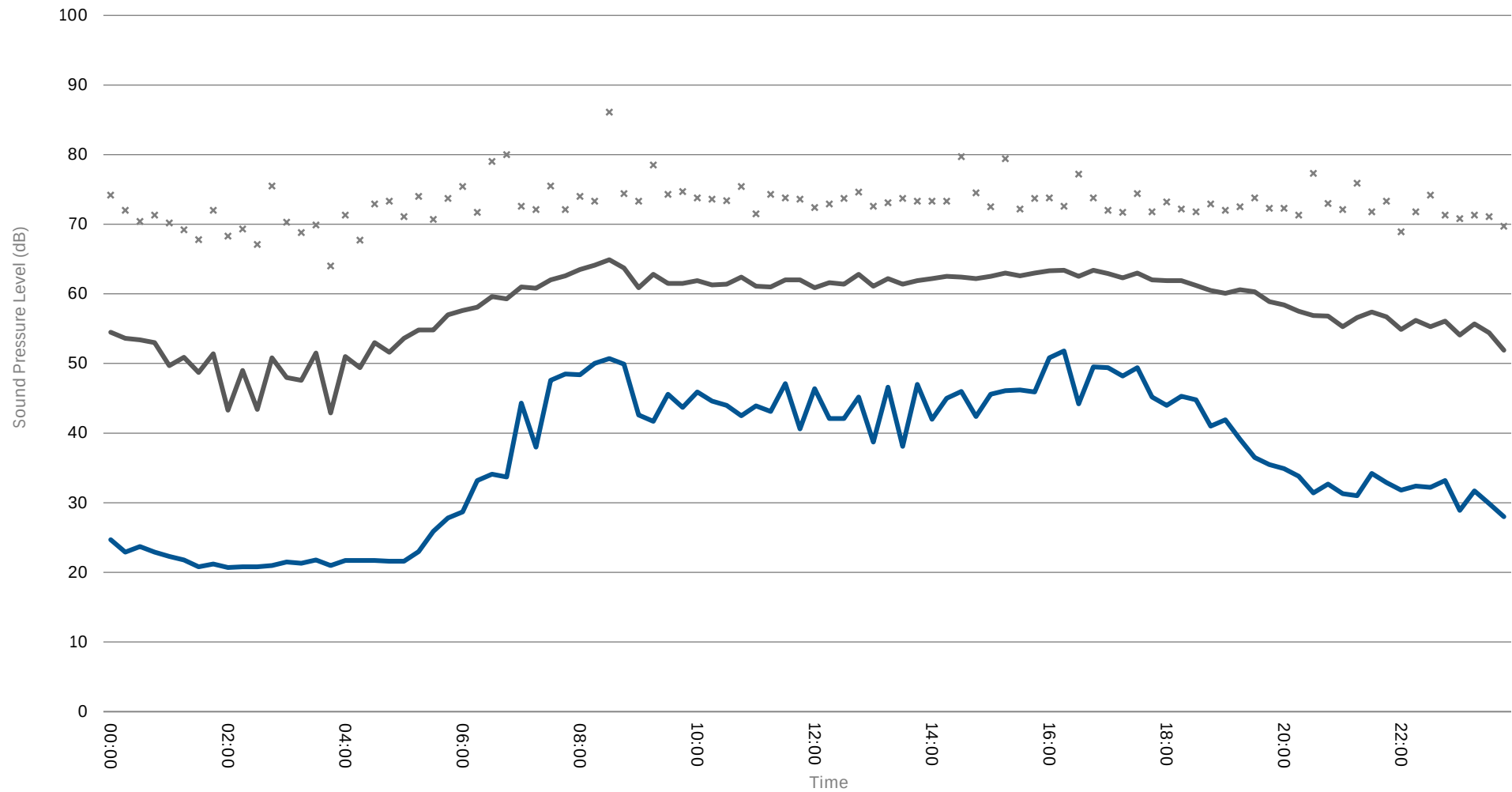
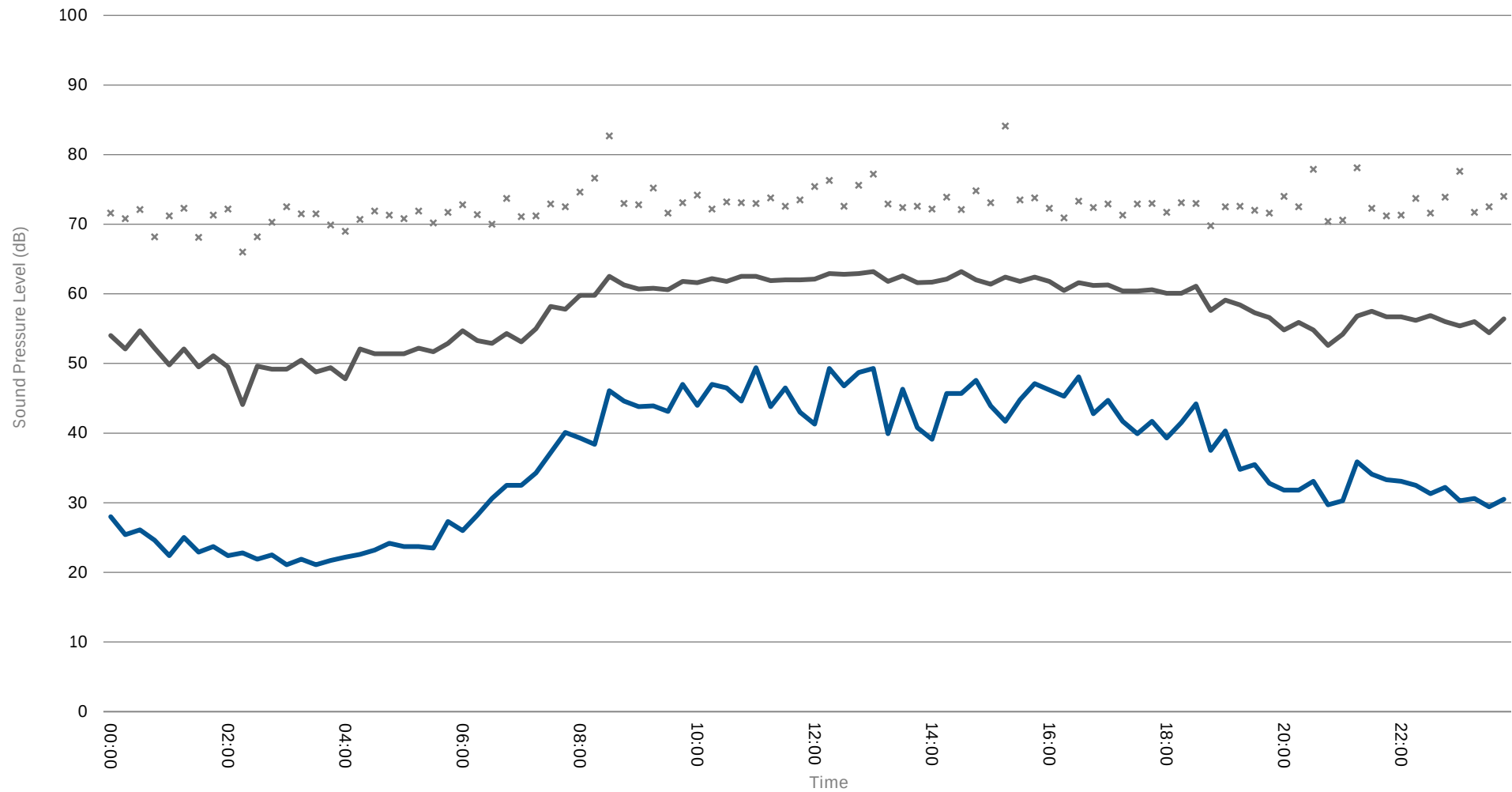


Figure 20221108-0 R1 TH2.3

Noise Levels Recorded at Position MP2, 10 December 2022

— LAeq × LAMax — LA90



Borde Hill Stables

Environmental Noise Survey Report

Figure 20221108-0 R1 TH2.4

Noise Levels Recorded at Position MP2, 11 December 2022

— LAeq x LAMax — LA90

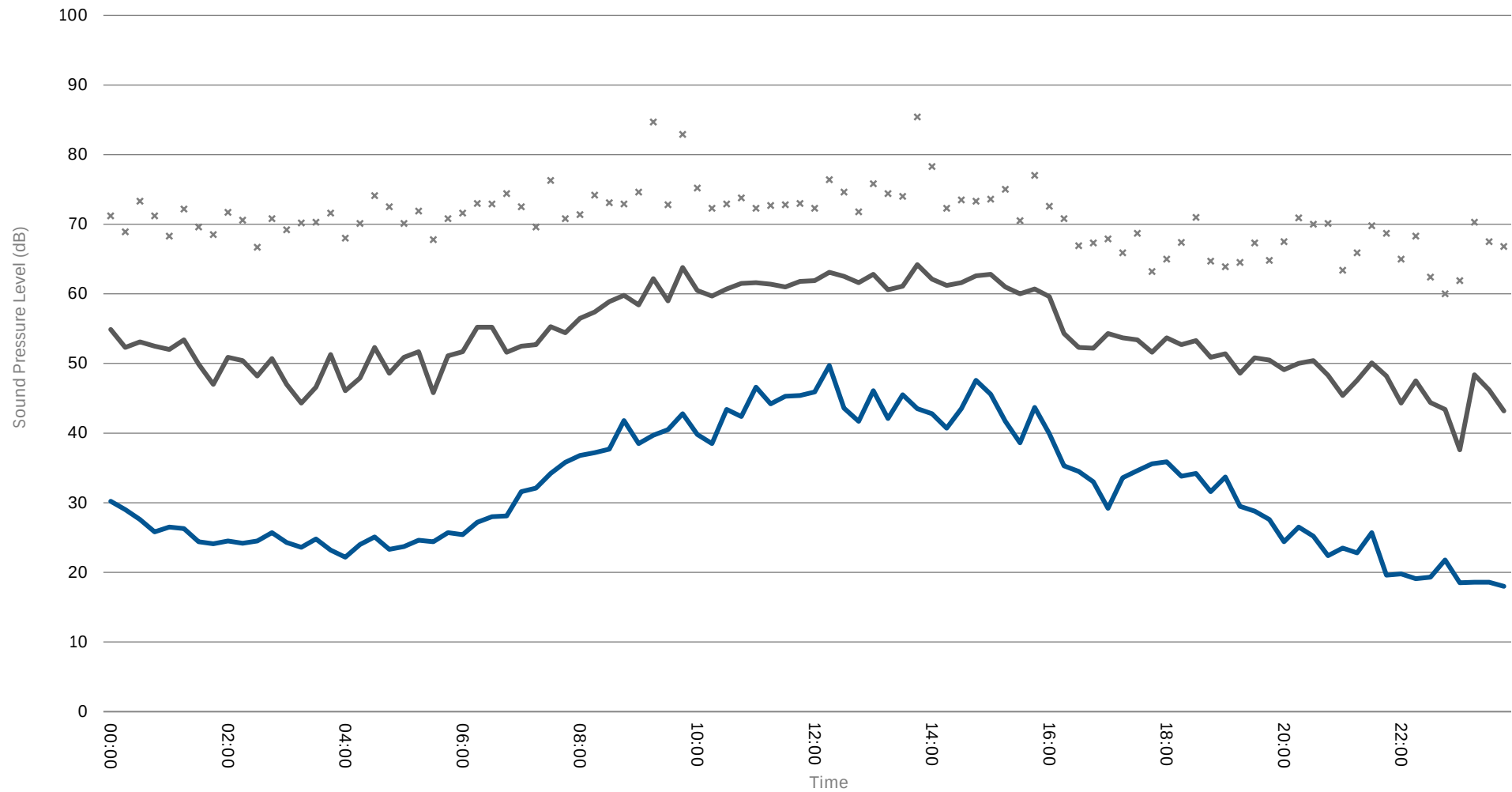
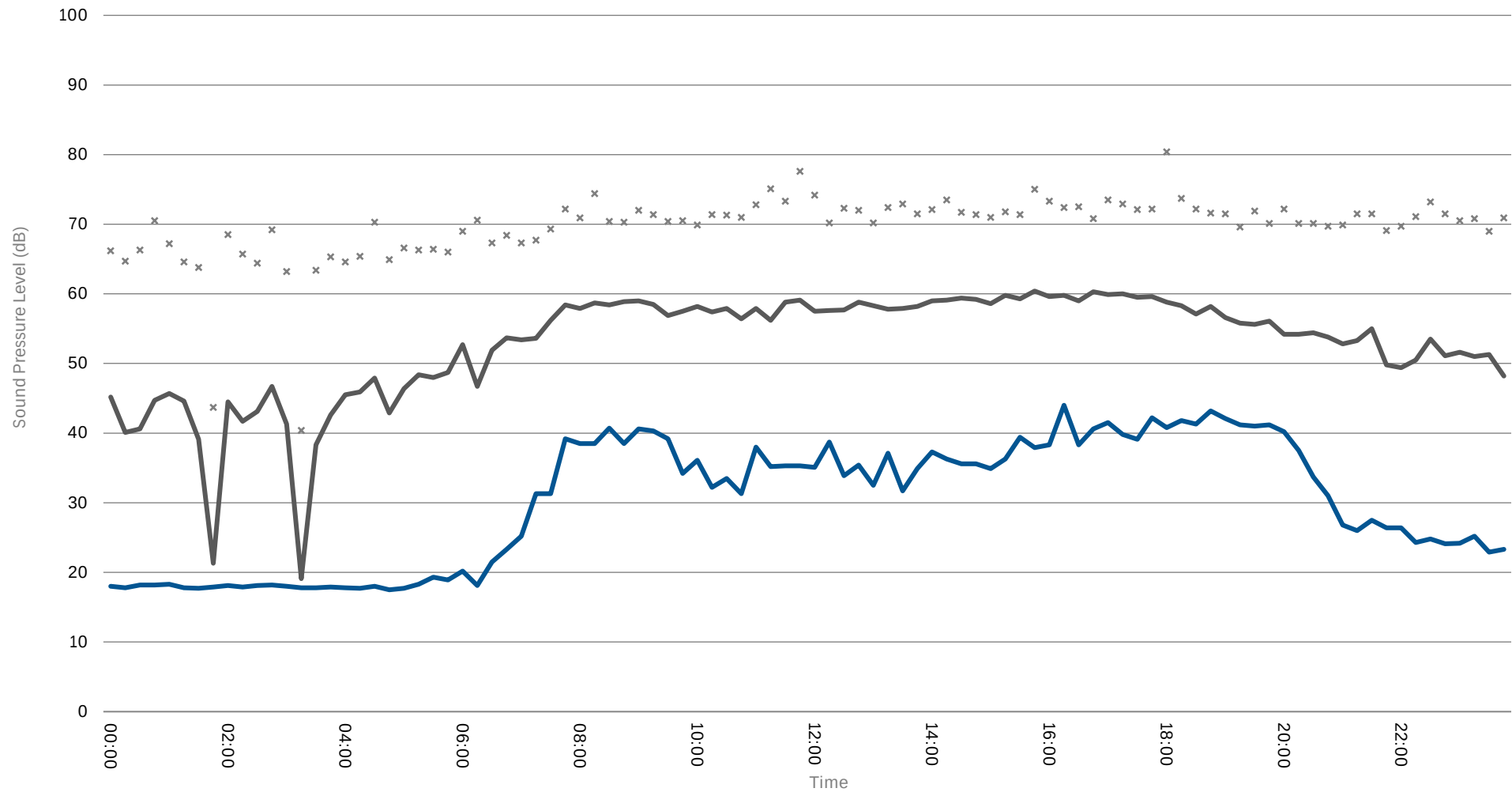


Figure 20221108-0 R1 TH2.5

Noise Levels Recorded at Position MP2, 12 December 2022

— LAeq × LAMax — LA90



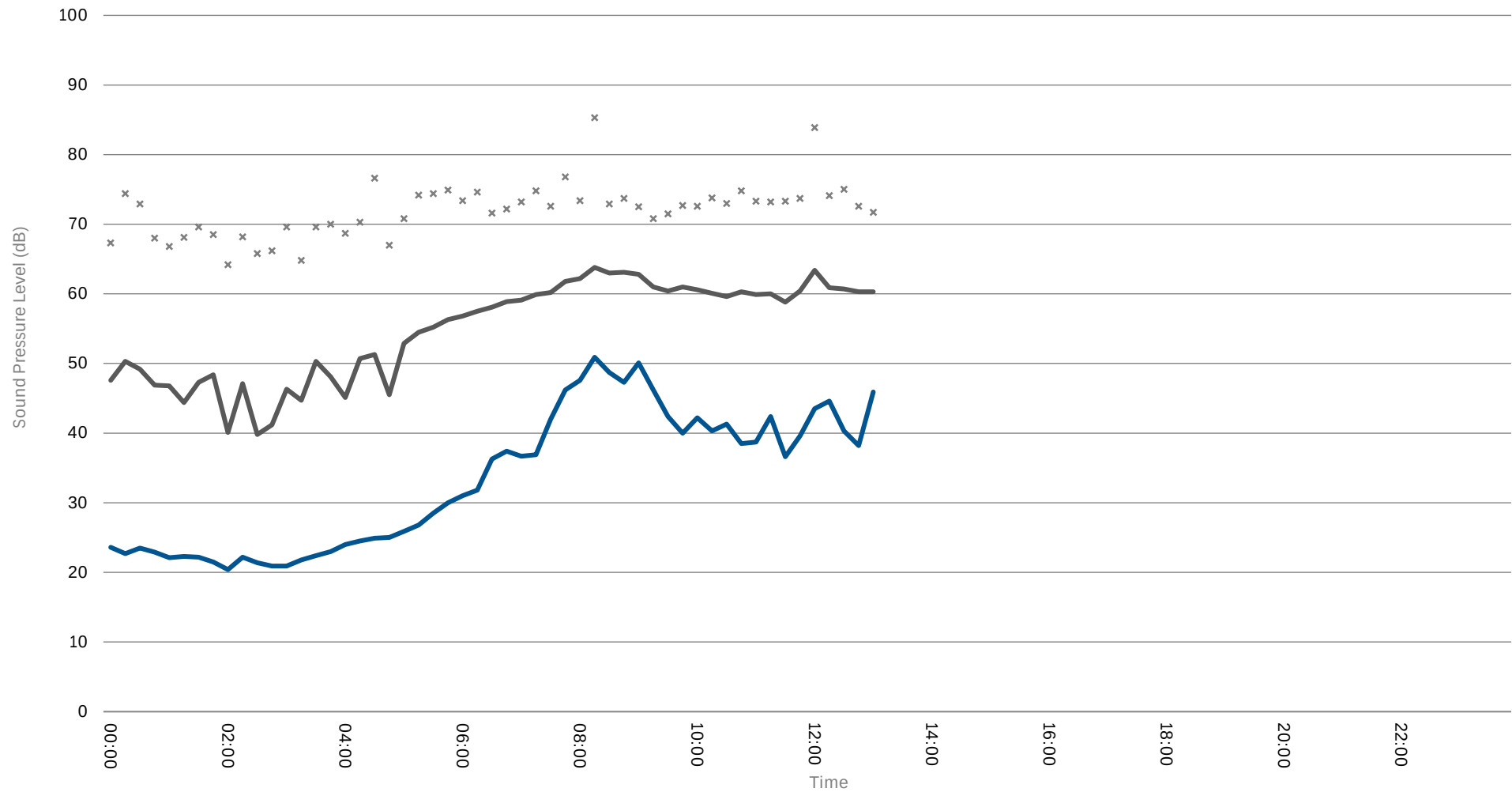
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Environmental Noise Survey Report

Figure 20221108-0 R1 TH2.6

Noise Levels Recorded at Position MP2, 13 December 2022

— LAeq × LAMax — LA90



Borde Hill Stables

Plant Noise Schedule

Reference	Description	Unit Details	Data Source	Noise Level Type	dB(A)	Noise Levels (dB)							
						63	125	250	500	1k	2k	4k	8k
AC/01 cooling	External air conditioning unit	Mitsubishi PUHY-P300	Man	Sound Pressure, Lp @ 1m		76	63	63	60	54	50	45	40
AC/01 cooling low noise	External air conditioning unit	Mitsubishi PUHY-P300	Man	Sound Pressure, Lp @ 1m		52	53	48	46	40	35	33	33
AC/01 heating	External air conditioning unit	Mitsubishi PUHY-P300	Man	Sound Pressure, Lp @ 1m		75	69	66	63	58	54	50	47
AC/01 heating low noise	External air conditioning unit	Mitsubishi PUHY-P300	Man	Sound Pressure, Lp @ 1m		60	58	52	49	44	40	39	41
EF/01 exhaust	Kitchen extract fan	HELIOS GBD 710/4 T120 GIGABOX EXTRACT FAN	Man	Sound Power, Lw		-	93	87	83	81	81	76	71
EF/01 breakout	Kitchen extract fan	HELIOS GBD 710/4 T120 GIGABOX EXTRACT FAN	Man	Sound Power, Lw		-	86	76	68	68	64	63	62
EF/02 exhaust	WC extract fan	HELIOS SVS-EC 250	Man	Sound Power, Lw		-	75	78	72	66	68	61	53
EF/03 exhaust	Glass wash extract fan	HELIOS SVS-EC 200	Man	Sound Power, Lw		-	83	81	80	71	72	65	59
AHU/01 intake	Supply AHU	Salda AmberAir 6-KR MD50 N S	Man	Sound Power, Lw		75	78	64	59	51	45	41	42
AHU/01 breakout	Supply AHU	Salda AmberAir 6-KR MD50 N S	Man	Sound Power, Lw		69	69	66	55	46	44	34	29

Mitigation Schedule

Reference	Description	Location	Insertion Losses (dB)							
			63	125	250	500	1k	2k	4k	8k
ATT-EF01-EXT	43% free area ≈600mm long rectangular (melinex)	EF/01 atmospheric exhaust	4	7	11	12	13	9	5	4
ATT-EF02-EXT	≈600mm long circular	EF/02 atmospheric exhaust	2	6	6	12	20	25	20	17
ATT-EF03-EXT	≈600mm long circular	EF/03 atmospheric exhaust	2	6	6	12	20	25	20	17

Calculation Sheet

AC/01 heating to AP1

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - AC/01 heating									
Sound Pressure Levels @ 1m		75	69	66	63	58	54	50	47 64 dBA
<i>Full Conformal Area</i>									
Distance (m)	1								
Type - Anechoic									
dB(A)		91	85	82	79	74	70	66	63 81 dBA
		16	16	16	16	16	16	16	16
<i>Silencer</i>									
Silencer - NONE									
Levels after Silencer		91	85	82	79	74	70	66	63 81 dBA
		0	0	0	0	0	0	0	0
<i>Maekawa Screening Loss</i>									
Path Difference (m)	0.05								
Levels After Barrier		86	79	75	71	64	59	52	46 73 dBA
		-5	-6	-6	-8	-9	-12	-14	-17
<i>Point Source Radiation Loss</i>									
Radiation - Hemispherical									
Levels after loss		78	71	67	63	56	51	44	38 65 dBA
		-8	-8	-8	-8	-8	-8	-8	-8
<i>Point Source Distance Loss</i>									
Start Distance (m)	1								
End Distance (m)	115								
Levels After Loss		37	30	26	22	15	9	3	-3 23 dBA
		-41	-41	-41	-41	-41	-41	-41	-41
<i>External Receiver</i>									
External Receiver - AP1									
Sound Pressure, Lp		37	30	26	22	15	9	3	-3 23 dBA

Calculation Sheet

AHU/01 intake to AP1

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - AHU/01 intake									
Sound Power Levels		75	78	64	59	51	45	41	42 64 dBA
<i>Silencer</i>									
Silencer - NONE									
Levels after Silencer		75	78	64	59	51	45	41	42 64 dBA
		0	0	0	0	0	0	0	0
<i>End Reflection</i>									
Width/Diameter (m)	1.6								
Length (m)	0.8								
Rec or Circ - Rectangular									
Free or Flush - Flush									
Noise Out		72	78	64	59	51	45	41	42 64 dBA
		-3	0	0	0	0	0	0	0
<i>External Grille Directivity</i>									
Width (m)	1.6								
Height (m)	0.8								
Angle (°)	60								
Levels after Correction		72	77	63	57	48	42	38	39 63 dBA
		0	-1	-1	-2	-3	-3	-3	-3
<i>Maekawa Screening Loss</i>									
Path Difference (m)	1								
Levels After Barrier		62	65	48	39	28	22	18	19 50 dBA
		-10	-12	-15	-18	-20	-20	-20	-20
<i>Point Source Radiation Loss</i>									
Radiation - Hemispherical									
Levels after loss		54	57	40	31	20	14	10	11 42 dBA
		-8	-8	-8	-8	-8	-8	-8	-8

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Point Source Distance Loss</i>									
Start Distance (m)	1								
End Distance (m)	115								
Levels After Loss		12	16	-2	-10	-21	-27	-31	-30
		-41	-41	-41	-41	-41	-41	-41	-41
<i>External Receiver</i>									
External Receiver - AP1									
Sound Pressure, Lp		12	16	-2	-10	-21	-27	-31	-30
									0 dBA

Calculation Sheet

AHU/01 breakout to AP1

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - AHU/01 breakout									
Sound Power Levels		69	69	66	55	46	44	34	29 60 dBA
<i>Silencer</i>									
Silencer - NONE									
Levels after Silencer		69	69	66	55	46	44	34	29 60 dBA
		0	0	0	0	0	0	0	0
<i>Maekawa Screening Loss</i>									
Path Difference (m)	1.00								
Levels After Barrier		59	57	51	37	26	24	14	9 45 dBA
		-10	-12	-15	-18	-20	-20	-20	-20
<i>Point Source Radiation Loss</i>									
Radiation - Hemispherical									
Levels after loss		51	49	43	29	18	16	6	1 37 dBA
		-8	-8	-8	-8	-8	-8	-8	-8
<i>Point Source Distance Loss</i>									
Start Distance (m)	1								
End Distance (m)	115								
Levels After Loss		10	7	2	-12	-23	-25	-35	-40 -4 dBA
		-41	-41	-41	-41	-41	-41	-41	-41
<i>External Receiver</i>									
External Receiver - AP1									
Sound Pressure, Lp		10	7	2	-12	-23	-25	-35	-40 -4 dBA

Calculation Sheet

EF/01 exhaust to AP1

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Noise Source										
Noise Source - EF/01 exhaust										
Sound Power Levels		-	93	87	83	81	81	76	71	87 dBA
Silencer										
Silencer - ATT-EF01-EXT										
Levels after Silencer		-	86	76	71	68	72	71	67	78 dBA
		-	-7	-11	-12	-13	-9	-5	-4	
End Reflection										
Width/Diameter (m)	0.71									
Length (m)	-									
Rec or Circ - Circular										
Free or Flush - Flush										
Noise Out		-	84	76	71	68	72	71	67	78 dBA
		-	-2	0	0	0	0	0	0	
External Grille Directivity										
Width (m)	0.7									
Height (m)	0.7									
Angle (°)	60									
Levels after Correction		-	83	75	70	66	69	68	64	76 dBA
		-	0	-1	-2	-2	-3	-3	-3	
Maekawa Screening Loss										
Path Difference (m)	1.00									
Levels After Barrier		-	71	60	52	46	49	48	44	59 dBA
		-	-12	-15	-18	-20	-20	-20	-20	
Point Source Radiation Loss										
Radiation - Hemispherical										
Levels after loss		-	63	52	44	38	41	40	36	51 dBA
		-	-8	-8	-8	-8	-8	-8	-8	

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Point Source Distance Loss</i>									
Start Distance (m)	1								
End Distance (m)	115								
Levels After Loss		-	22	10	3	-3	0	-1	-5
		-	-41	-41	-41	-41	-41	-41	-41
<i>External Receiver</i>									
External Receiver - AP1									
Sound Pressure, Lp		-	22	10	3	-3	0	-1	-5

Calculation Sheet

EF/01 breakout to AP1

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - EF/01 breakout									
Sound Power Levels		-	86	76	68	68	64	63	62 75 dBA
<i>Silencer</i>									
Silencer - NONE									
Levels after Silencer		-	86	76	68	68	64	63	62 75 dBA
		-	0	0	0	0	0	0	0
<i>Maekawa Screening Loss</i>									
Path Difference (m)	1.00								
Levels After Barrier		-	74	61	50	48	44	43	42 60 dBA
		-	-12	-15	-18	-20	-20	-20	-20
<i>Point Source Radiation Loss</i>									
Radiation - Hemispherical									
Levels after loss		-	66	53	42	40	36	35	34 52 dBA
		-	-8	-8	-8	-8	-8	-8	-8
<i>Point Source Distance Loss</i>									
Start Distance (m)	1								
End Distance (m)	115								
Levels After Loss		-	24	11	1	-1	-5	-6	-7 10 dBA
		-	-41	-41	-41	-41	-41	-41	-41
<i>External Receiver</i>									
External Receiver - AP1									
Sound Pressure, Lp		-	24	11	1	-1	-5	-6	-7 10 dBA

Calculation Sheet

EF/02 exhaust to AP1

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Noise Source										
Noise Source - EF/02 exhaust										
Sound Power Levels		-	75	78	72	66	68	61	53	75 dBA
Silencer										
Silencer - ATT-EF02-EXT										
Levels after Silencer		-	69	72	60	46	43	41	36	64 dBA
		-	-6	-6	-12	-20	-25	-20	-17	
End Reflection										
Width/Diameter (m)	0.5									
Length (m)	0.5									
Rec or Circ - Rectangular										
Free or Flush - Flush										
Noise Out		-	65	72	60	46	43	41	36	64 dBA
		-	-4	0	0	0	0	0	0	
External Grille Directivity										
Width (m)	0.5									
Height (m)	0.5									
Angle (°)	60									
Levels after Correction		-	65	71	59	44	40	38	33	63 dBA
		-	0	-1	-1	-2	-2	-3	-3	
Maekawa Screening Loss										
Path Difference (m)	-1.00									
Levels After Barrier		-	65	71	59	44	40	38	33	63 dBA
		-	0	0	0	0	0	0	0	
Point Source Radiation Loss										
Radiation - Quarterspherical										
Levels after loss		-	60	66	54	39	35	33	28	59 dBA
		-	-5	-5	-5	-5	-5	-5	-5	

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Point Source Distance Loss</i>									
Start Distance (m)	1								
End Distance (m)	115								
Levels After Loss		-	19	25	13	-2	-6	-8	-13
		-	-41	-41	-41	-41	-41	-41	-41
<i>External Receiver</i>									
External Receiver - AP1									
Sound Pressure, Lp		-	19	25	13	-2	-6	-8	-13

Calculation Sheet

EF/03 exhaust to AP1

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Noise Source										
Noise Source - EF/03 exhaust										
Sound Power Levels		-	83	81	80	71	72	65	59	80 dBA
Silencer										
Silencer - ATT-EF03-EXT										
Levels after Silencer		-	77	75	68	51	47	45	42	69 dBA
		-	-6	-6	-12	-20	-25	-20	-17	
End Reflection										
Width/Diameter (m)	0.4									
Length (m)	0.4									
Rec or Circ - Rectangular										
Free or Flush - Flush										
Noise Out		-	72	74	68	51	47	45	42	68 dBA
		-	-6	-1	0	0	0	0	0	
External Grille Directivity										
Width (m)	0.4									
Height (m)	0.4									
Angle (°)	135									
Levels after Correction		-	66	63	53	36	32	30	27	57 dBA
		-	-5	-11	-15	-15	-15	-15	-15	
Maekawa Screening Loss										
Path Difference (m)	1.00									
Levels After Barrier		-	54	48	35	16	12	10	7	42 dBA
		-	-12	-15	-18	-20	-20	-20	-20	
Point Source Radiation Loss										
Radiation - Hemispherical										
Levels after loss		-	46	40	27	8	4	2	-1	34 dBA
		-	-8	-8	-8	-8	-8	-8	-8	

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Point Source Distance Loss</i>									
Start Distance (m)	1								
End Distance (m)	115								
Levels After Loss		-	5	-1	-14	-33	-37	-39	-42
		-	-41	-41	-41	-41	-41	-41	-41
<i>External Receiver</i>									
External Receiver - AP1									
Sound Pressure, Lp		-	5	-1	-14	-33	-37	-39	-42
									-7 dBA

Calculation Sheet

AC/01 heating to AP2

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - AC/01 heating									
Sound Pressure Levels @ 1m		75.0	68.5	65.5	63.0	57.5	54.0	50.0	47.0
<i>Full Conformal Area</i>									
Distance (m)	1.0								
Type - Anechoic									
		16.2	16.2	16.2	16.2	16.2	16.2	16.2	16.2
<i>Silencer</i>									
Silencer - NONE									
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Maekawa Screening Loss</i>									
Path Difference (m)	0.3								
		-6.9	-8.3	-10.2	-12.6	-15.2	-18.0	-20.0	-20.0
<i>Point Source Radiation Loss</i>									
Radiation - Quarterspherical									
		-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
<i>Point Source Distance Loss</i>									
Start Distance (m)	1.0								
End Distance (m)	53.0								
		-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5
<i>External Receiver</i>									
External Receiver - AP2									
Sound Pressure, Lp		44.8	36.9	32.0	27.1	19.0	12.7	6.7	3.7

Calculation Sheet

AHU/01 intake to AP2

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - AHU/01 intake									
Sound Power Levels		75.0	78.0	64.0	59.0	51.0	45.0	41.0	42.0
<i>Silencer</i>									
Silencer - NONE									
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>End Reflection</i>									
Width/Diameter (m)	1.6								
Length (m)	0.8								
Rec or Circ - Rectangular									
Free or Flush - Flush									
		-3.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>External Grille Directivity</i>									
Width (m)	1.6								
Height (m)	0.8								
Angle (°)	60.0								
		-0.1	-0.7	-1.4	-2.0	-2.6	-2.8	-2.8	-2.8
<i>Maekawa Screening Loss</i>									
Path Difference (m)	-1.0								
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Point Source Radiation Loss</i>									
Radiation - Quarterspherical									
		-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
<i>Point Source Distance Loss</i>									
Start Distance (m)	1.0								
End Distance (m)	53.0								
		-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5
<i>External Receiver</i>									
External Receiver - AP2									
Sound Pressure, Lp		32.2	37.8	23.2	17.6	8.9	2.8	-1.2	-0.2

Calculation Sheet

AHU/01 breakout to AP2

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - AHU/01 breakout									
Sound Power Levels		69.0	69.0	66.0	55.0	46.0	44.0	34.0	29.0
<i>Silencer</i>									
Silencer - NONE									
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Maekawa Screening Loss</i>									
Path Difference (m)	-1.0								
		0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Point Source Radiation Loss</i>									
Radiation - Quarterspherical									
		-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
<i>Point Source Distance Loss</i>									
Start Distance (m)	1.0								
End Distance (m)	53.0								
		-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5
<i>External Receiver</i>									
External Receiver - AP2									
Sound Pressure, Lp		29.5	29.5	26.5	15.5	6.5	4.5	-5.5	-10.5

Calculation Sheet

EF/01 exhaust to AP2

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - EF/01 exhaust									
Sound Power Levels		-	93.1	86.6	83.2	81.0	80.8	76.0	71.1
<i>Silencer</i>									
Silencer - ATT-EF01-EXT									
		-	-7.0	-11.0	-12.0	-13.0	-9.0	-5.0	-4.0
<i>End Reflection</i>									
Width/Diameter (m)	0.7								
Length (m)	-								
Rec or Circ - Circular									
Free or Flush - Flush									
		-	-2.5	0.0	0.0	0.0	0.0	0.0	0.0
<i>External Grille Directivity</i>									
Width (m)	0.7								
Height (m)	0.7								
Angle (°)	60.0								
		-	-0.3	-0.9	-1.6	-2.2	-2.8	-2.8	-2.8
<i>Maekawa Screening Loss</i>									
Path Difference (m)	-1.0								
		-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Point Source Radiation Loss</i>									
Radiation - Quarterspherical									
		-	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
<i>Point Source Distance Loss</i>									
Start Distance (m)	1.0								
End Distance (m)	53.0								
		-	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5
<i>External Receiver</i>									
External Receiver - AP2									
Sound Pressure, Lp		-	43.9	35.2	30.2	26.4	29.6	28.8	24.9

Calculation Sheet

EF/01 breakout to AP2

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
Noise Source									
Noise Source - EF/01 breakout									
Sound Power Levels		-	86.1	75.6	68.2	68.0	63.8	63.0	62.1
Silencer									
Silencer - NONE									
		-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Maekawa Screening Loss									
Path Difference (m)	-1.0								
		-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Point Source Radiation Loss									
Radiation - Quarterspherical									
		-	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
Point Source Distance Loss									
Start Distance (m)	1.0								
End Distance (m)	53.0								
		-	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5
External Receiver									
External Receiver - AP2									
Sound Pressure, Lp		-	46.6	36.1	28.7	28.5	24.3	23.5	22.6

Calculation Sheet

EF/02 exhaust to AP2

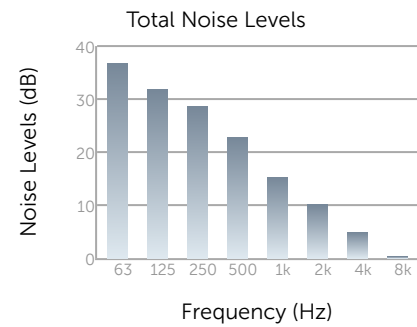
		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - EF/02 exhaust									
Sound Power Levels		-	75.1	77.6	72.2	66.0	67.8	61.0	53.1
<i>Silencer</i>									
Silencer - ATT-EF02-EXT									
		-	-6.0	-6.0	-12.0	-20.0	-25.0	-20.0	-17.0
<i>End Reflection</i>									
Width/Diameter (m)	0.5								
Length (m)	0.5								
Rec or Circ - Rectangular									
Free or Flush - Flush									
		-	-4.1	0.0	0.0	0.0	0.0	0.0	0.0
<i>External Grille Directivity</i>									
Width (m)	0.5								
Height (m)	0.5								
Angle (°)	60.0								
		-	0.0	-0.6	-1.3	-1.9	-2.5	-2.8	-2.8
<i>Maekawa Screening Loss</i>									
Path Difference (m)	-1.0								
		-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Point Source Radiation Loss</i>									
Radiation - Hemispherical									
		-	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0	-8.0
<i>Point Source Distance Loss</i>									
Start Distance (m)	1.0								
End Distance (m)	53.0								
		-	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5
<i>External Receiver</i>									
External Receiver - AP2									
Sound Pressure, Lp		-	22.5	28.5	16.5	1.7	-2.1	-4.3	-9.2

Calculation Sheet

EF/03 exhaust to AP2

		Octave Band Centre Frequency (Hz)							
		63	125	250	500	1k	2k	4k	8k
<i>Noise Source</i>									
Noise Source - EF/03 exhaust									
Sound Power Levels		-	83.1	80.6	80.2	71.0	71.8	65.0	59.1
<i>Silencer</i>									
Silencer - ATT-EF03-EXT									
		-	-6.0	-6.0	-12.0	-20.0	-25.0	-20.0	-17.0
<i>End Reflection</i>									
Width/Diameter (m)	0.4								
Length (m)	0.4								
Rec or Circ - Rectangular									
Free or Flush - Flush									
		-	-5.5	-1.0	0.0	0.0	0.0	0.0	0.0
<i>External Grille Directivity</i>									
Width (m)	0.4								
Height (m)	0.4								
Angle (°)	15.0								
		-	2.0	2.9	3.7	4.5	5.3	5.9	5.9
<i>Maekawa Screening Loss</i>									
Path Difference (m)	-1.0								
		-	0.0	0.0	0.0	0.0	0.0	0.0	0.0
<i>Point Source Radiation Loss</i>									
Radiation - Quarterspherical									
		-	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0	-5.0
<i>Point Source Distance Loss</i>									
Start Distance (m)	1.0								
End Distance (m)	53.0								
		-	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5	-34.5
<i>External Receiver</i>									
External Receiver - AP2									
Sound Pressure, Lp		-	34.2	37.0	32.4	16.1	12.7	11.4	8.5

Project Name	Borde Hill Stables
Project Reference	20221108-0
Reference	AP1
Description	Sandpit cottages
Noise Limit (dBA)	26
Calculated Level (dBA)	25



Noise Sources

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
AC/01 heating	1	37	30	26	22	15	9	3	-3
AHU/01 intake	1	12	16	-2	-10	-21	-27	-31	-30
AHU/01 breakout	1	10	7	2	-12	-23	-25	-35	-40
EF/01 exhaust	1	-	22	10	3	-3	0	-1	-5
EF/01 breakout	1	-	24	11	1	-1	-5	-6	-7
EF/02 exhaust	1	-	19	25	13	-2	-6	-8	-13
EF/03 exhaust	1	-	5	-1	-14	-33	-37	-39	-42

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

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