

National Trust

Castlefield Viaduct Phase 2

Acoustic Assessment

Reference: 282210-50/R01

P02 | 9 August 2024



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Ove Arup & Partners Limited
8 Fitzroy Street
London
W1T 4BJ
United Kingdom
[arup.com](https://www.arup.com)

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		Name	Chris Wong	Sam Peckham	David Hiller
		Signature			
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		Name	Chris Wong	Sam Peckham	David Hiller
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Executive summary

This report provides an assessment of the existing and future noise climate on and around Castlefield Viaduct Phase 2.

An environmental noise survey has been undertaken and used to determine noise limits that have been set according to local and national policy and guidance, including consultation with Manchester City Council Environmental Health. Measures to meet these noise limits and improve the soundscape in the development have been advised where information is available.

We have also provided outline acoustic design recommendations for areas within the Viaduct (staff facilities, Engagement Centre).

Audio recordings of the Viaduct

As part of the survey, 3D ‘Soundfield’ recordings were made to document how the acoustic environment varies between Phase 1 and Phase 2 of the Viaduct. Samples of the recordings, corresponding to the location numbers below, can be accessed and listened to by clicking [this link](#) (available within 14 days of the issue date of this report).

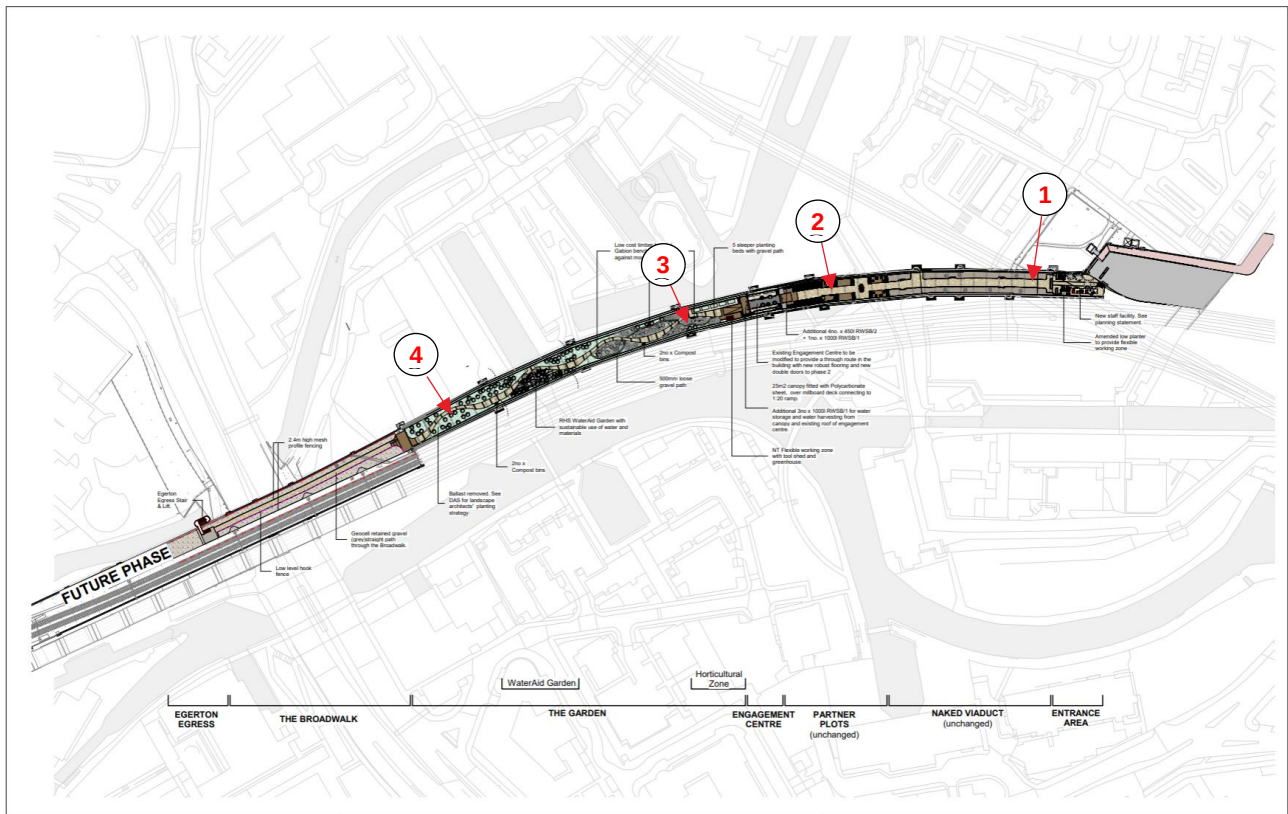


Figure 1: Map of Soundfield recordings made on the Viaduct.

1. Introduction

1.1 Purpose of report

This acoustic report has been prepared by Arup on behalf of the National Trust (NT) to support the developing design and planning application for Castlefield Viaduct Phase 2.

The proposed scheme consists of an extension to the existing Phase 1 gardens to include new garden areas, an outdoor multipurpose zone and a through route via 'the Broadwalk' to Egerton Street. The scheme also includes some amendments to the existing gardens, including a new entrance area with staff facilities and a viewing terrace, and incorporation of the RHS WaterAid Garden into The Garden area.

This assessment considers both the impact of environmental noise associated with the Phase 2 scheme on nearby residential receptors, and of existing environmental noise on the Phase 2 gardens and staff facilities.

Outline advice is included on soundscaping measures which could improve the Phase 2 acoustic environment for visitors. 3D audio recordings of the existing sound environment have been made available to provide context.

1.2 Scope of report

The report covers the following elements:

- Section 2: Policy, guidance and legislation used to inform the noise assessment and set criteria.
- Section 3: Site context, including existing and future sources of noise, and nearby noise-sensitive receptors.
- Section 4: Acoustic design recommendations, including advice on achieving appropriate acoustic standards both externally and internally, and commentary on potential soundscaping measures.
- Section 5: Summary of baseline environmental noise survey.
- Section 6: Assessment of noise associated with the Scheme against planning requirements and guidance, including noise from fixed plant, patrons and events.

1.3 Exclusions

The scope of this report does not include:

- Vibration assessment.
- Construction noise assessment.

2. Policy and standards

A summary of relevant policy, guidance and legislation is provided below.

- Manchester City Council's (hereafter referred to as MCC) Planning and Noise Technical Guidance 2022 – Includes the core development principles and assessment criteria relating to entertainment noise and plant noise.
- The National Planning Policy Framework 2023 (NPPF) – Defines the Government's planning policies and objectives for England.
- Noise Policy Statement for England (NPSE) – Defines more specific noise-related planning objectives and introduces effect levels in terms of Government policy.
- National Planning Practice Guidance - Noise (PPG-N) – Provides further information on the effect levels defined within NPSE and presents example outcomes to help characterise these effects.

Reference is also made to the following standards and guidance documents.

- BS EN 61672-1:2013 Specification for Sound Level Meters (British Standard, 2013)
- ISO 1996: Acoustics – Description, Measurement and Assessment of Environment Noise (Part 1 and Part 2) (ISO, 2003 and 2007)
- BS 4142:2014+A1:2019. Methods for Rating and Assessing Industrial and Commercial Sound (British Standard, 2014 and 2019)
- BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings (British Standard, 2014)
- Environmental Noise Guidelines for the European Region (World Health Organisation, 2018)
- Guide to Specification, Chapter 11: Acoustics (British Council for Offices, 2019)

2.1 Consultation with Local Authority

Discussions were held with MCC Environmental Health to understand their key concerns relating to noise and acoustic design. The following key points are noted:

- Regarding proposed activities on Castlefield Viaduct, MCC are keen to avoid any amplified music or speech on external parts of the viaduct, especially at night-time.
- MCC expressed that the existing external noise from nearby entertainment venues already presents noise break-in risks at nearby sensitive receptors and do not want to exacerbate this.
- If cinema screenings are considered, MCC suggested exploring the use of headphones instead of speakers to avoid amplification. Fashion shows could be acceptable provided that patron noise does not exceed reasonable limits.
- In general, daytime events were more acceptable to MCC as opposed to night-time events since background noise levels are higher during the day.
- Using the Engagement Centre as an internal event space (potentially with amplified speech and music) would be acceptable to MCC if it can be demonstrated that the sound insulation performance is sufficient to minimise noise breakout to nearby sensitive receptors.

3. Site context

Castlefield Viaduct is situated in Castlefield, Manchester. The viaduct is adjacent to two other viaducts which carry a Metrolink tram line (the central viaduct) and a railway line (the southern viaduct). Castlefield Viaduct currently consists of the existing National Trust gardens to the east, up to the Engagement Centre building. To the west of the Engagement Centre building lies the proposed Phase 2 development site, extending up to the western side of Egerton Street (Mancunian Way).

3.1 Site map

The site map in Figure 2 indicates the existing noise sources and receptors identified during Arup's noise survey (see Table 1 for receptor details).

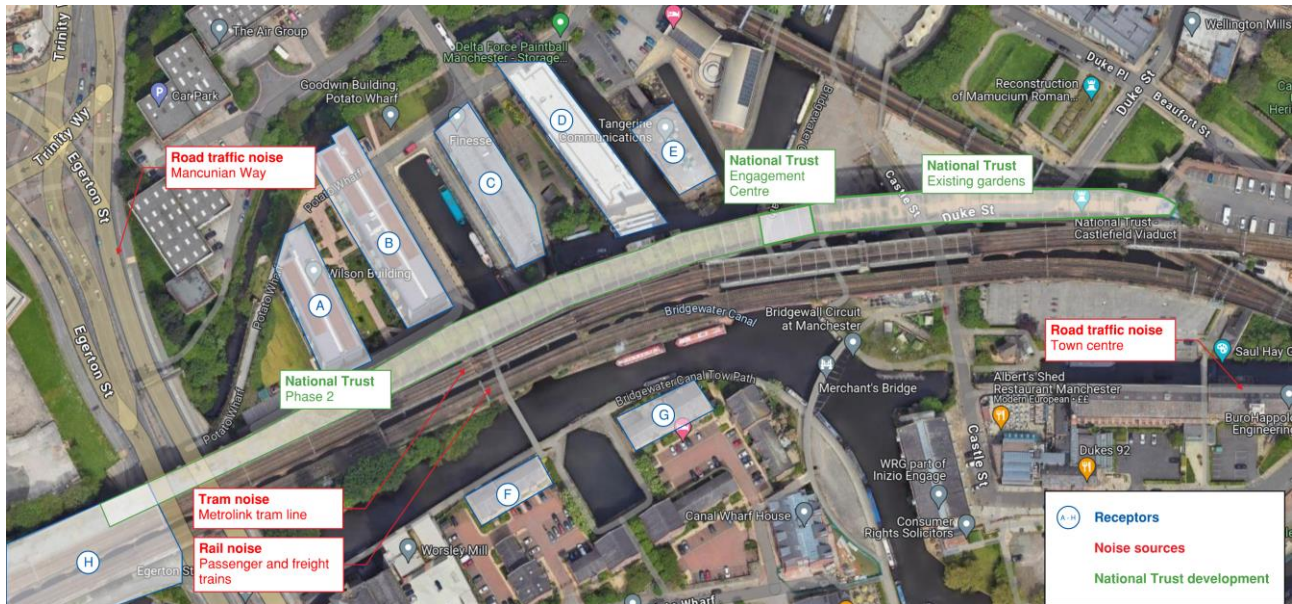


Figure 2: Map showing the noise sources and receptors near Castlefield Viaduct.

3.2 Existing noise sources

The baseline noise climate around Castlefield Viaduct is predominantly characterised by the following noise sources:

- Operational rail and tram noise from the adjacent viaducts.
- Road traffic from Mancunian Way (Egerton Street) and local roads.
- Other intermittent sources of transportation, such as aircraft, canal boats and helicopters.
- Industrial, commercial and construction activities in the vicinity of the site.

3.3 Nearby noise sensitive receptors

Nearby noise sensitive receptors (NSRs) have been identified using maps and drawings of the Proposed Development, as well as information regarding committed developments from MCC. Receptors were agreed with MCC during consultation. Details of the identified nearest NSRs are shown in Figure 2 and in Table 1.

Table 1: Nearby sensitive receptor details.

Receptor	Receptor Type	Approximate distance in plan from closest point of the site (metres)
A - Wilson Building, Potato Wharf	Residential	8
B - Goodwin Building, Potato Wharf	Residential	8
C - Whitworth Building, Potato Wharf	Residential	8
D - Saville Building, Potato Wharf	Residential	8
E - Giants Basin, Potato Wharf	Office	15
F - Bridgewater House	Residential	50
G - Ashton House	Residential	50
H – Embassy Village (committed development)	Residential	5

- A sound-absorbing ceiling finish to reduce reverberant noise buildup from large groups.

4.1.4 The Garden

The Garden encompasses most of the new Phase 2 section between the Engagement Centre and The Broadwalk. The current design features a densely planted, winding path with activity spaces dotted along. Activities in these spaces should not use amplified sound, to avoid exceeding noise limits at the nearby receptors (particularly at Potato Wharf).

Based on Arup's noise survey data, the noise climate will be louder and road traffic noise from Mancunian Way will be more audible in this area. It is understood that physical screening (e.g. timber fences, green walls) is not desirable here due to cost and the aspiration to keep the viaduct structure visible.

The designers may wish to introduce some sound masking into the garden design, promoting positive sounds over the existing urban traffic/rail noise. This could include:

- Careful choice of plant species to maximise wind-induced 'rustling' and encourage birds.
- Water features (in addition to the RHS WaterAid Garden) that include a 'cascade' or 'waterfall' element with water dropping into a pool, distributed around The Garden.
- Artificial soundscaping involving distributed loudspeakers, perhaps hidden within planters.

4.1.5 The Broadwalk

The Broadwalk features a walkway from the Egerton egress on the west side of Mancunian Way that connects to The Garden. It is understood there are no particular acoustic ambitions for The Broadwalk. In any case, an impractical amount of acoustic mitigation would be required to reduce the road traffic noise from Mancunian Way underneath.

5. Baseline environmental noise survey

A baseline noise survey was carried out by Arup at the measurement locations outlined in Figure 4 to establish the existing noise climate on Castlefield Viaduct and at the identified noise-sensitive receptors. Details of the survey and a summary of the results are presented below and in the Appendix.

The survey consisted of unattended noise measurements and weather monitoring from Tuesday 21 to Thursday 30 May 2024 at two locations, as well as attended noise measurements and 3D Soundfield recordings on the 21 May at nine locations.

5.1 Measurement locations

The measurement locations for the installation of unattended noise monitoring equipment and attended noise measurements are outlined in Table 2¹ and Figure 4. 3D soundfield recordings were also taken on the viaduct.

Table 2: Unattended and attended measurement locations (shown spatially in Figure 4).

Location	Description	Unattended noise monitoring	Attended noise measurements	3D soundfield recordings
U1	West edge of National Trust Phase 2 viaduct	☒	☒	☒
U2	East edge of National Trust Phase 2 viaduct	☒	☒	☒
A2	West side of Potato Wharf, facing Mancunian Way	☐	☒	☐
A3	East of the Wilson Building in Potato Wharf	☐	☒	☐
A4	East side of Potato Wharf	☐	☒	☐
A5	By the canal on Bridgewater Canal tow path	☐	☒	☐
A6	Existing National Trust viaduct garden (west)	☐	☒	☒
A7	Existing National Trust viaduct garden (centre)	☐	☒	☒
A8	Existing National Trust viaduct garden (east)	☐	☒	☒

¹ An additional location A1 had been proposed during survey planning but was omitted due to safety issues.



Figure 4: Unattended (red) and attended (blue) measurement locations.

5.2 Instrumentation

The sound level meters and microphones used for the baseline survey are Class 1, conforming to BS EN 61672-1:2013. All equipment is calibrated annually according to international standards, together with traceable records. Calibration certificates can be provided upon request. Onsite calibration checks were conducted and no significant drift was recorded.

The monitoring equipment installed at locations U1 and U2 for unattended measurements consisted of the following in Table 3.

Table 3: Unattended monitoring instrumentation.

Description	Serial number	Item Type
Rion NL-52 Kit A	00120480	Sound level meter
RION NH-25 Preamplifier	10479	Preamplifier
Microphone RION UC-59	03152	Microphone
Calibrator RION NC-74	35015346	Calibrator
Rion NL-52 Kit E	00264533	Sound level meter
RION NH-25 Preamplifier	64658	Preamplifier
Microphone RION UC-59	09681	Microphone
Calibrator RION NC-74	34467730	Calibrator
Kestrel 5500 Kit C	2119013	Weather station

The equipment used for the attended measurements and 3D soundfield recordings consisted of the following in Table 4.

Table 4: Attended measurements and recording instrumentation.

Description	Serial number	Item Type
Rion NL-52 Kit D	00231671	Sound level meter
RION NH-25 Preamplifier	21615	Preamplifier
Microphone RION UC-59	04716	Microphone
Calibrator RION NC-74	34336008	Calibrator
Soundfield microphone	0495	Soundfield microphone
Conditioning amplifier	ST9036	Conditioning amplifier
8 channel recorder 788T SSD	JC1318291000	Recorder
Audioroot eSMART	3-760013 430252	Power splitter

5.3 Measurement methodology

At each location, L_{Aeq} , L_{A10} , L_{A90} and L_{Amax} metric values were measured. All broadband measurements were A-weighted and used a fast time constant (0.125s).

The sound level meter was mounted on a tripod with the microphone set approximately at 1.2 to 1.5 metres above viaduct level. All measurements were taken under acoustically free-field conditions, with windshields fitted to the microphones. All equipment was secured with chains and weighted, and located at least 2 metres from the viaduct edges to avoid the possibility of being blown or knocked over. Measurements were carried out by Arup staff Chris Wong and Sam Peckham.

5.4 Results summary

A summary of the measured noise levels is presented for the unattended monitoring locations in Table 5 and for the attended locations in Table 16 of the Appendix. More detailed results (including weather monitoring data and photos) are provided in the Appendix.

‘Typical’ background sound level is defined by MCC as the “*minimum value of the averaged individual L_{A90} 15-minute periods*” (Planning and Noise Technical Guidance) and calculated levels are shown in Table 5. The calculations of the ‘typical’ daytime and night-time background levels at measurement locations U1 and U2 are demonstrated in Section A.1.3 of the Appendix.

Table 5: Measured baseline sound levels at the unattended monitoring locations.

Measurement location (see Figure 4)	Sound pressure level, free-field				Comments
	Daytime $dBL_{Aeq,16hour}$	Night-time $dBL_{Aeq,8hour}$	Typical Daytime $dBL_{A90,15min}$	Typical Night-time $dBL_{A90,15min}$	
U1	63	58	53	48	Dominated by continuous road traffic noise from Mancunian Way and tram and train noise from adjacent viaduct.
U2	59	54	48	43	Dominated by tram and train noise from adjacent viaduct. Continuous road traffic noise also audible from Mancunian Way, but quieter compared to U1.

6. Noise assessment

6.1 Criteria

6.1.1 MCC noise criteria

The following relevant noise criteria are reproduced from MCC's Planning and Noise Technical Guidance 2022:

- 'Music noise levels in the 63Hz and 125Hz octave centre frequency bands (L_{eq}) should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB ($L_{eq,5min}$), respectively.' (Section 3.7.1.2)
- 'Entertainment noise ($L_{Aeq,5min}$) should be controlled to 5dB below the typical background noise level (L_{A90}) in each octave band at the nearest noise sensitive location.' (Section 3.7.1.2)
- 'The development should be designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.' [regarding industrial and commercial noise in BS 4142] (Section 3.7.1.5)
- 'Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.' (Section 3.7.1.5)

The 'typical' background level is defined in the Appendix of the Planning and Noise Technical Guidance as "the minimum value of the averaged individual [L_{A90}] 15-minute periods". MCC guidelines dictate that entertainment noise, plant noise and the overall development should achieve a rating level of 5dB L_{Aeq} below the 'typical' background level at the nearest noise sensitive locations, which are outlined in Table 6.

Table 6: 'Typical' background sound levels at representative measurement locations for each nearby sensitive receptor.

Nearby sensitive receptor	Representative measurement location	MCC typical background sound level $L_{A90,15min}$	
		Daytime	Night-time
A - Wilson Building, Potato Wharf	U1	53	48
B - Goodwin Building, Potato Wharf	U1	53	48
C - Whitworth Building, Potato Wharf	U2	48	43
D - Saville Building, Potato Wharf	U2	48	43
E - Giants Basin, Potato Wharf	U2	48	43
F - Bridgewater House	U1	53	48
G - Ashton House	U2	48	43
H – Embassy Village (committed development)	U1	53	48

6.1.2 WHO noise criteria

MCC refers to the WHO guidelines for absolute noise criteria at residential receptors with respect to critical health effects. These noise criteria are reproduced in Table 7.

Table 7: WHO community noise guideline values.

Environment	Critical health effect(s)	L _{Aeq} (dB)	Time base (hours)	L _{Amax,f} (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

6.2 Entertainment and event noise

National Trust has expressed a desire to use spaces along the viaduct for entertainment purposes, including the outdoor activity spaces along The Garden and the Multipurpose Zone, as well as in the Engagement Centre. Any entertainment noise should meet the entertainment noise limits outlined in Table 8, based on the MCC's Planning and Noise Technical Guidance 2022. Outdoor amplified speech and music should be avoided to meet these limits.

Additional information such as operational times, event frequency and building construction will allow for detailed calculations to ascertain whether entertainment noise is likely to meet these limits.

Table 8: Entertainment noise criteria at nearby sensitive receptors.

Nearby sensitive receptor	Entertainment noise limit at receptor	
	L _{Aeq,5min}	
	Daytime	Night-time
A - Wilson Building, Potato Wharf	48	43
B - Goodwin Building, Potato Wharf	48	43
C - Whitworth Building, Potato Wharf	43	38
D - Saville Building, Potato Wharf	43	38
E - Giants Basin, Potato Wharf	43	38
F - Bridgewater House	48	43
G - Ashton House	43	38
H – Embassy Village (committed development)	48	43

In addition, any noise generated by music should not exceed the limits at low frequencies specified in Table 9.

Table 9: Music noise criteria at nearby sensitive receptors.

Octave band frequency (Hz)	Music noise limit at receptor dB (L _{eq,5min})
63	47
125	41

6.3 Plant noise emissions

Existing outdoor building services plant includes an outdoor air-cooled heat pump condensing unit on the west façade of the Engagement Centre. Details for additional plant are to be confirmed.

Table 10 outlines the rating levels at receptors, which is the specific sound level plus any adjustments for the characteristic features of the plant noise in accordance with BS 4142, such as intermittency, tonality and impulsivity. The total rating level of existing and additional plant should not exceed these rating levels at the receptors.

Table 10: Plant noise rating level at nearby sensitive receptors.

Nearby sensitive receptor	Rating level at receptor $L_{Ar,5min}$	
	Daytime	Night-time
A - Wilson Building, Potato Wharf	48	43
B - Goodwin Building, Potato Wharf	48	43
C - Whitworth Building, Potato Wharf	43	38
D - Saville Building, Potato Wharf	43	38
E - Giants Basin, Potato Wharf	43	38
F - Bridgewater House	43	38
G - Ashton House	43	38
H – Embassy Village (committed development)	48	43

6.4 Patron noise

The development of Castlefield Viaduct Phase 2 is expected to increase visitor numbers to a forecasted estimate of 120,000 visitors and users per year. Table 11 outlines the estimated number of daily visitors after Phase 2 opens.

Table 11: Estimated number of daily visitors after Phase 2 opens, based on current numbers.

Occupancy profile	Estimated daily visitors
Average	300 – 400
Busy	1000 +

There is no recognised method for calculating the outdoor noise levels from patrons and no recognised method for assessing the impact of patron noise on sensitive receptors. Patron noise is therefore assessed qualitatively by considering the following.

Patron noise will be variable depending on the day of the week and time of day. The Viaduct's opening hours are 1030-1630, placing it firmly within daytime hours. The Viaduct is expected to take the significant majority of its visitors at the weekend.

From observation, and by its nature as a garden, the atmosphere on the Viaduct is generally calm and introspective. It is assumed that a management plan will be implemented to direct patrons and encourage responsible behaviour (avoid shouting, screaming, portable music etc).

The character of the surrounding area is urban, with significant amounts of transportation and pedestrian noise already present. A modest amount of noise from patrons using the Viaduct is therefore considered to be in keeping with the general acoustic environment and is not considered to present a significant risk.

7. Observations on noise climate

7.1 Soundscaping

As part of the baseline survey, 3D soundscape recordings were taken to audibly demonstrate the sound climate in the existing National Trust garden and in the proposed Phase 2 development site.

There is a clear distinction between the existing garden and Phase 2. The existing garden is relatively tranquil with a blend of metropolitan noise (road, trains, trams) with nature noise (birdsong, rustling of leaves). Conversely, Phase 2 has a much more urban and hostile soundscape towards the west, being more exposed to the continuous road traffic noise from Mancunian Way, louder tram and train noise (due to the higher speeds) and construction work on nearby sites.

To address this, Arup suggests that the use of discreetly placed distributed audio masking elements (such as the WaterAid garden, choices of planting which intentionally rustle and make sound, etc.) could reduce the potential for sensory dissonance between the visual and auditory in Phase 2.

3D soundscape recordings are available for listening to at the locations described in Table 2 and Figure 4.

8. References

Document	Author
Planning and Noise Technical Guidance 2022	Manchester City Council
National Planning Policy Framework (NPPF) 2023	UK Government
Noise Policy Statement for England (NPSE)	UK Government
National Planning Practice Guidance - Noise (PPG-N)	UK Government
BS EN 61672-1:2013 Specification for Sound Level Meters	British Standard
ISO 1996: Acoustics Description, Measurement and Assessment of Environment Noise (Part 1 and Part 2) (ISO, 2003 & 2007)	ISO
BS 4142:2014+A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound	British Standard
BS 4142:2014+A1:2019 Methods for Rating and Assessing Industrial and Commercial Sound	British Standard
BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings	British Standard
Environmental Noise Guidelines for the European Region 2018	World Health Organisation
Guide to Specification 2019	British Council for Offices

A.1 Appendix - Baseline survey

A.1.1 Unattended logger data

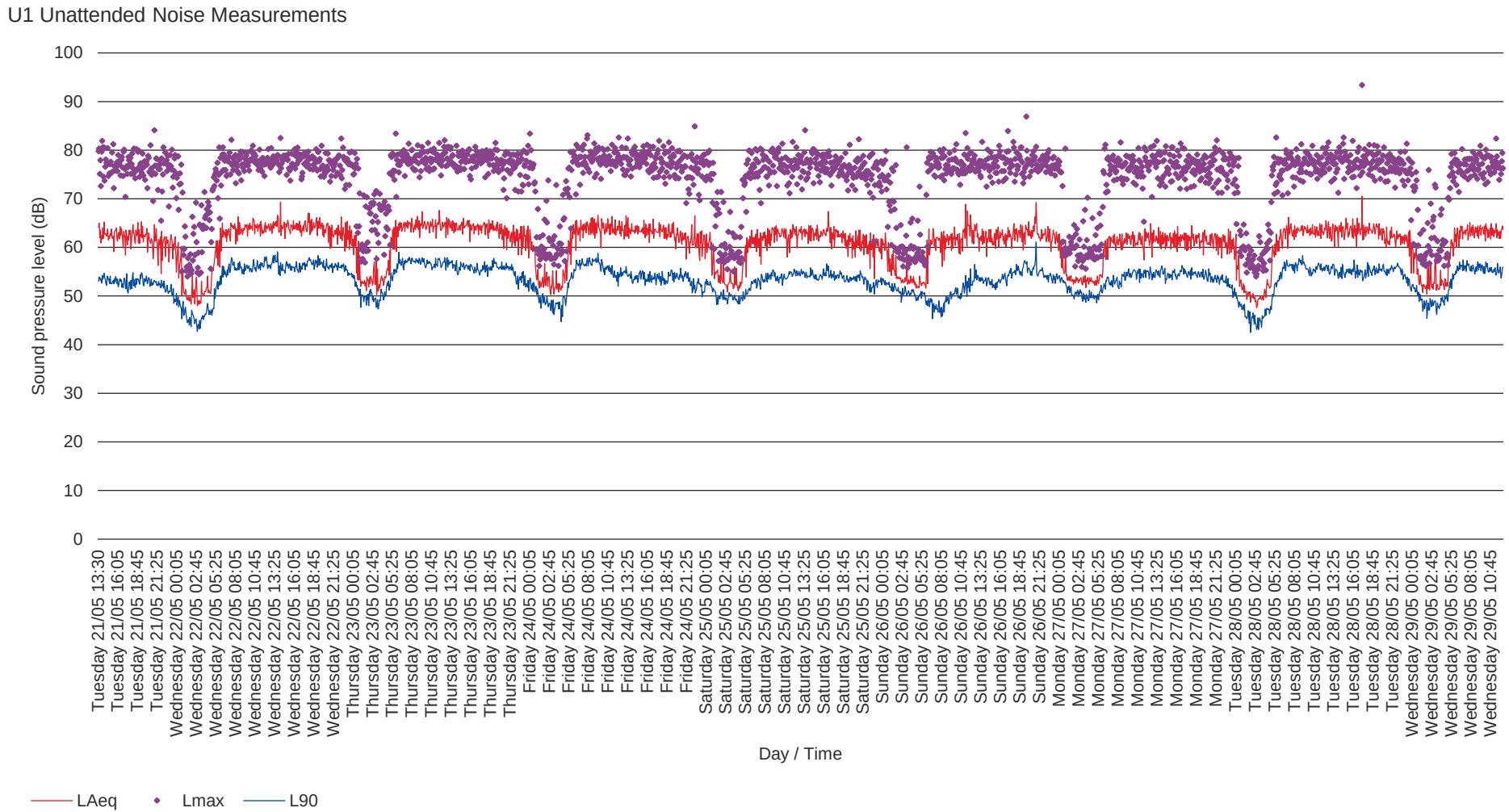


Figure 5: Unattended noise measurements at Location U1.

U2 Unattended Noise Measurements

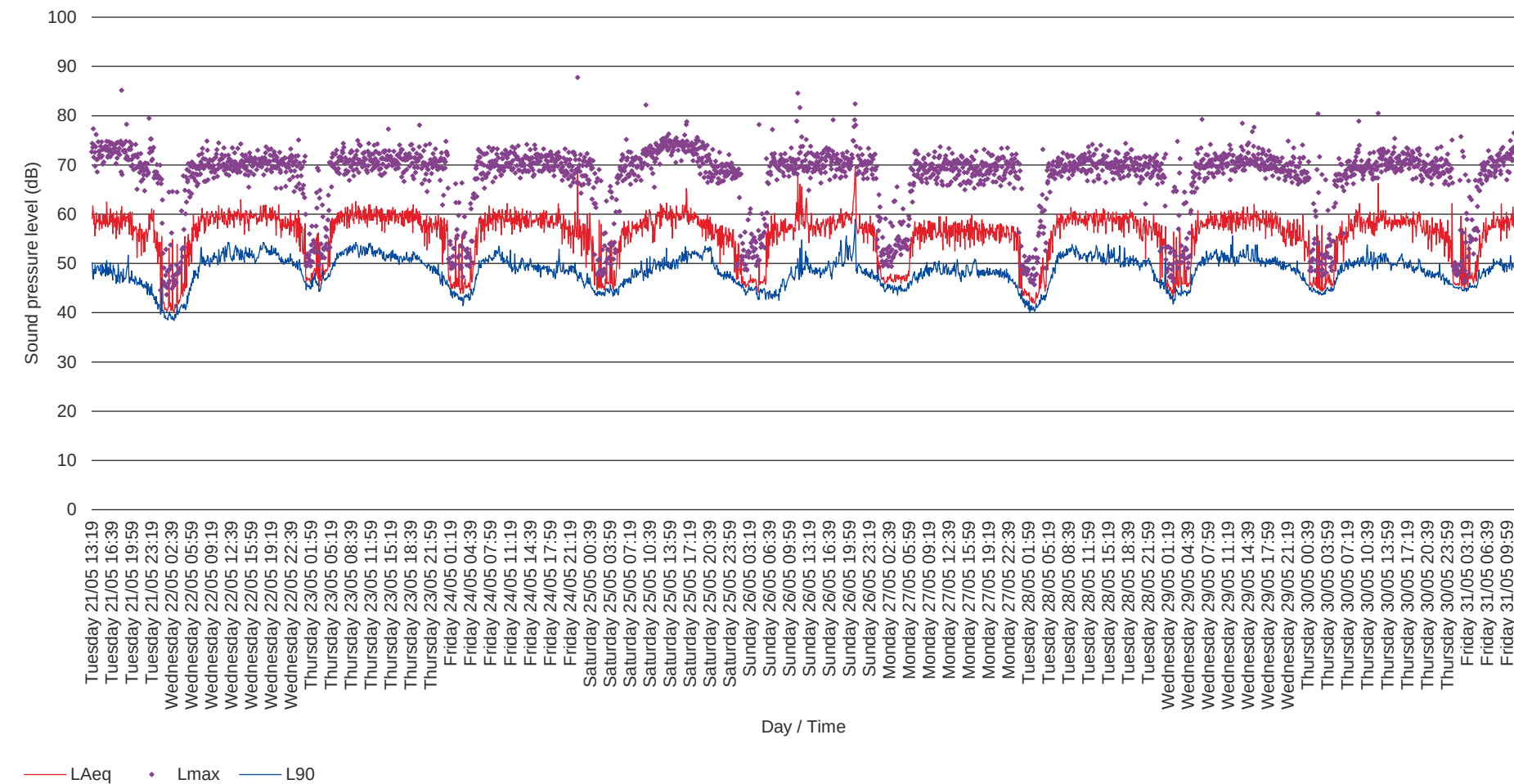


Figure 6: Unattended noise measurements at Location U2.

A.1.2 Weather monitoring data

Weather monitoring was carried out alongside the sound level monitoring. Figure 7 to Figure 13 illustrate the temperature and wind speed on these days.

Tuesday 21/05/2024 Weather monitoring results

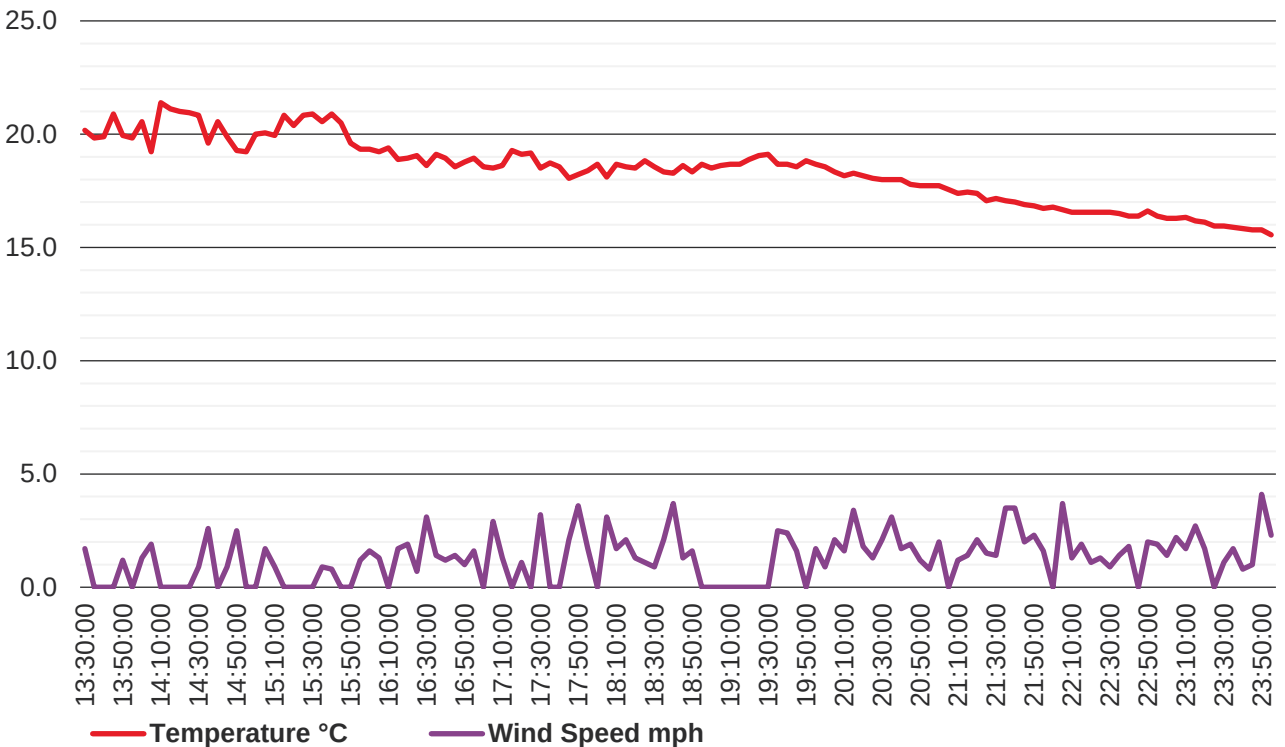


Figure 7: Weather monitoring data for Tuesday 21st May.

Wednesday 22/05/2024 Weather monitoring results

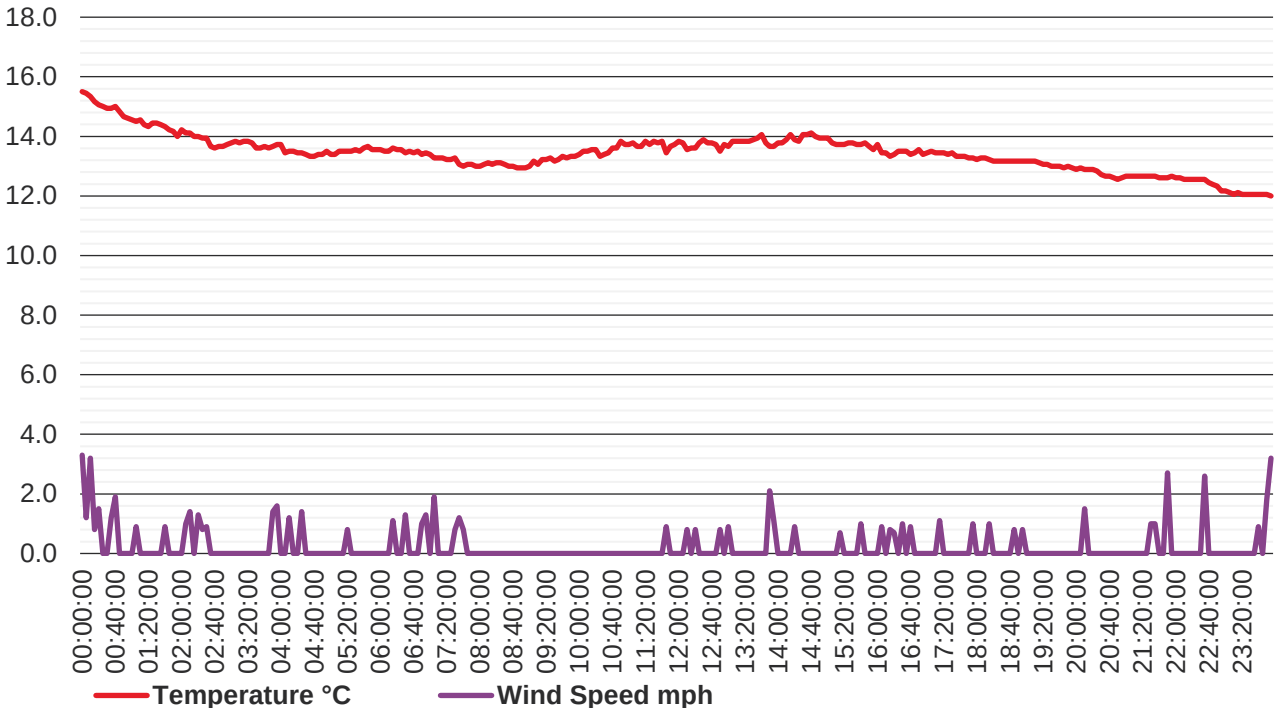


Figure 8: Weather monitoring data for Wednesday 22nd May.

Thursday 23/05/2024 Weather monitoring results

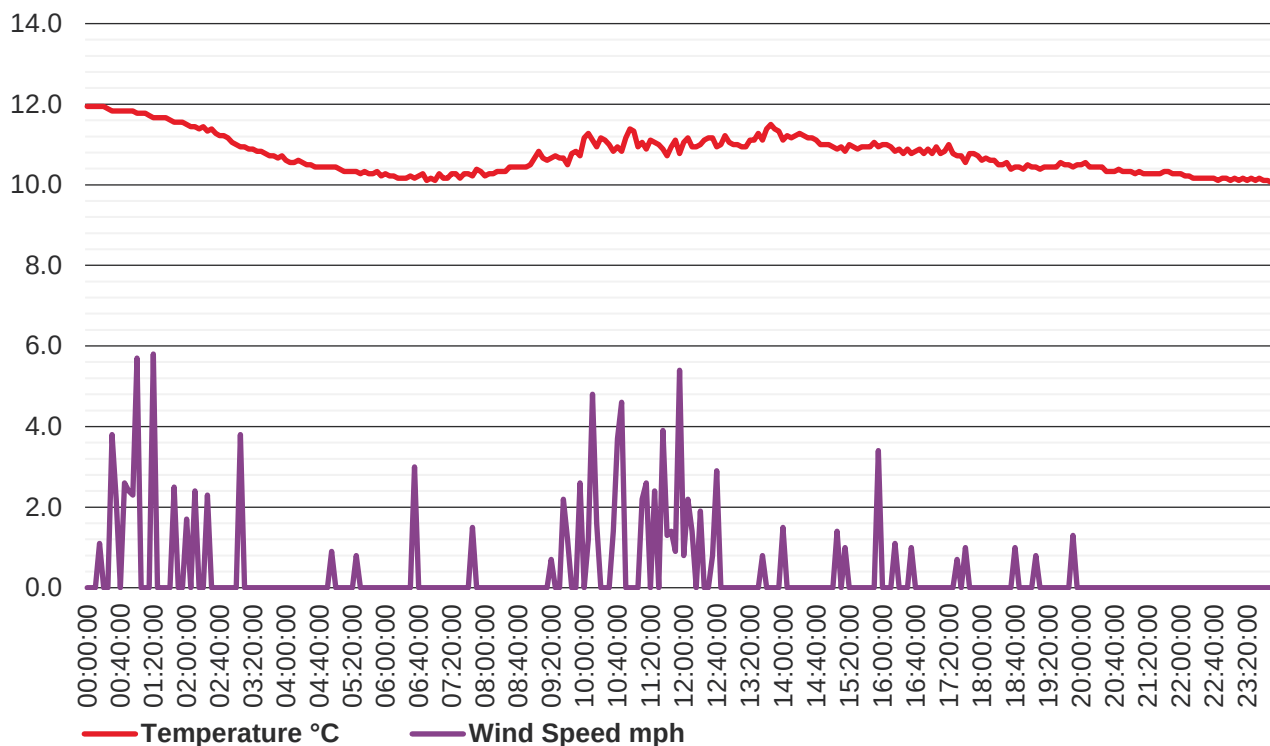


Figure 9: Weather monitoring data for Thursday 23rd May.

Friday 24/05/2024 Weather monitoring results

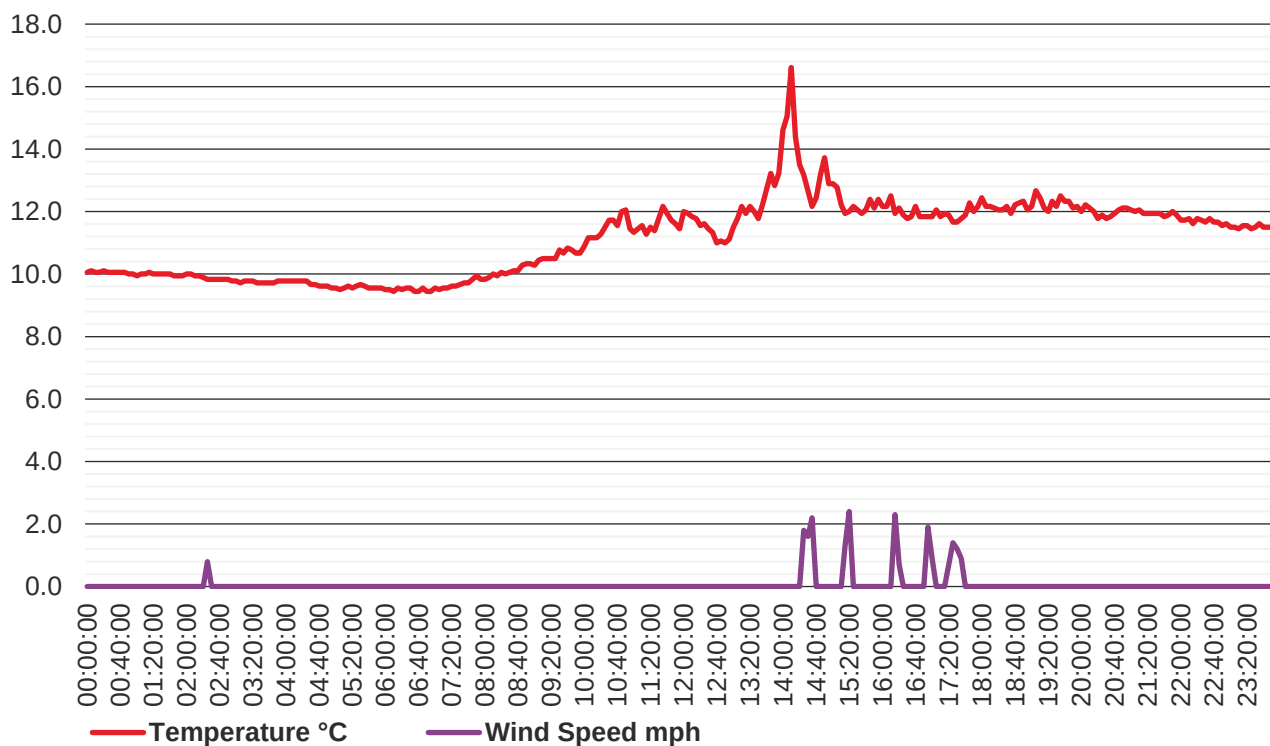


Figure 10: Weather monitoring data for Friday 24th May.

Saturday 25/05/2024 Weather monitoring results

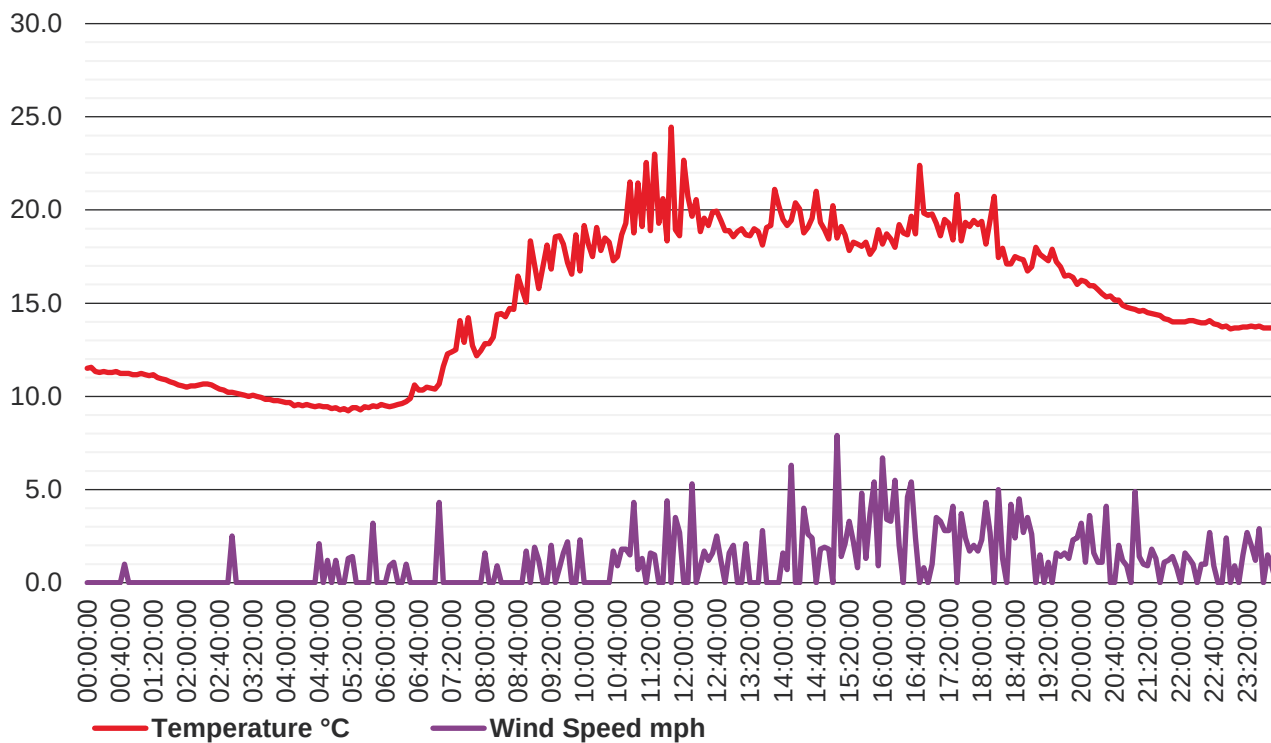


Figure 11: Weather monitoring data for Saturday 25th May.

Sunday 26/05/2024 Weather monitoring results

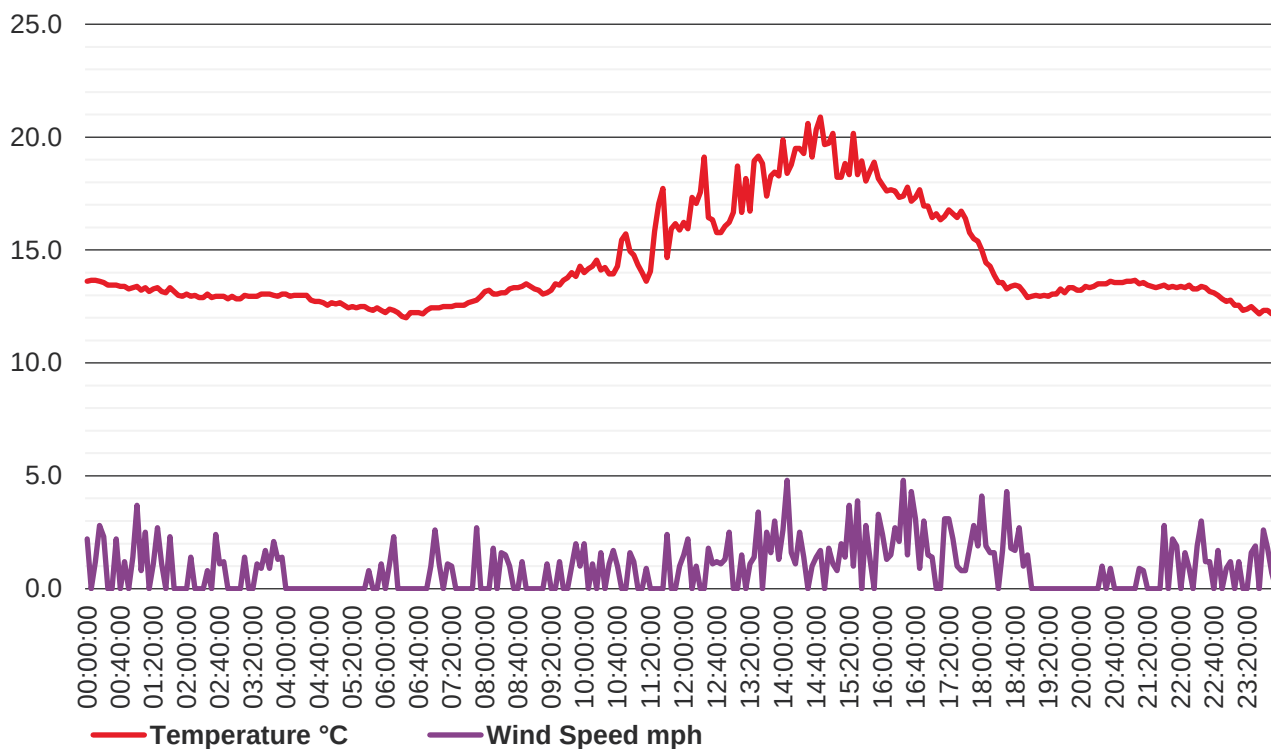


Figure 12: Weather monitoring data for Sunday 26th May.

Monday 27/05/2024 Weather monitoring results

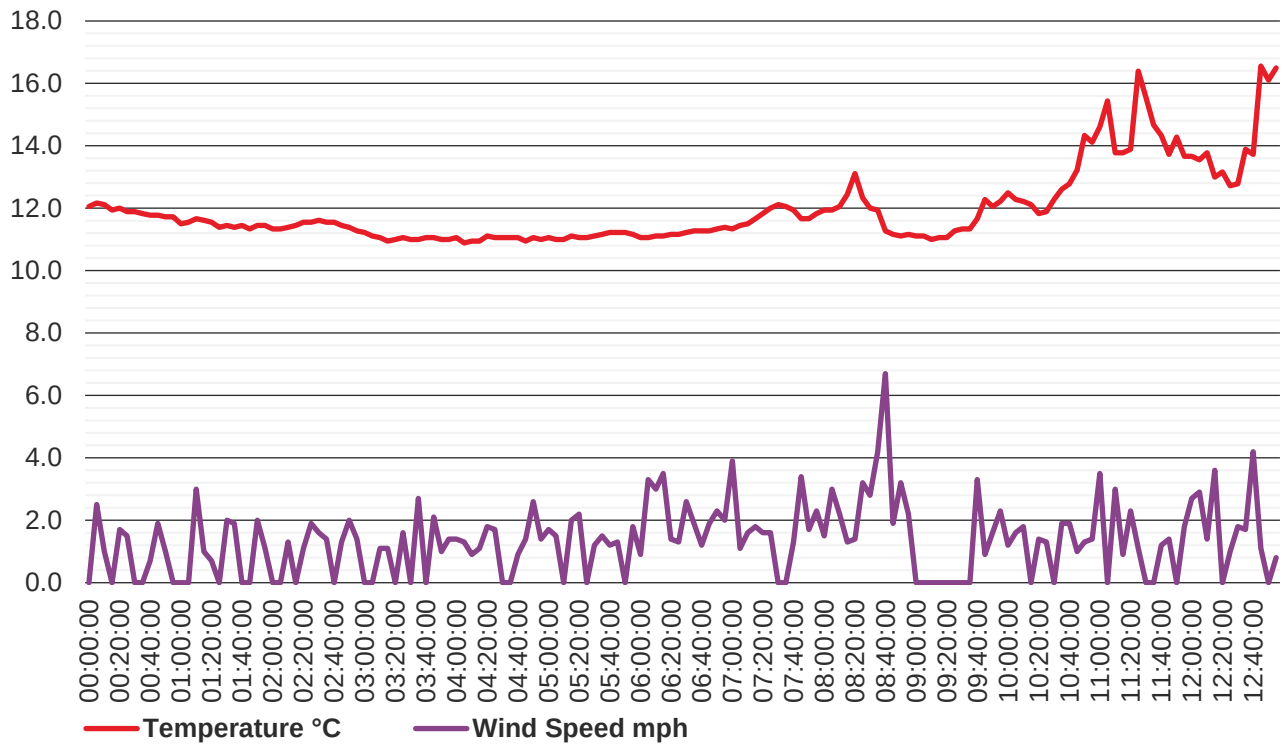


Figure 13: Weather monitoring data for Monday 27th May.

A.1.3 'Typical' background sound level calculations

Table 12: Calculation of the 'typical' daytime background sound level according to MCC's Planning and Noise Technical Guidance Appendix at Location U1.

	LA90,15min									
U1 DAYTIME	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Arithmetic average
Time	21/05/2024	22/05/2024	23/05/2024	24/05/2024	25/05/2024	26/05/2024	27/05/2024	28/05/2024	29/05/2024	
07:00:00		55.2	56.5	56.1	52.5	47.7	52.5	56.5	56.0	54.1
07:15:00		55.6	57.2	57.1	53.1	47.8	52.7	56.2	56.2	54.1
07:30:00		57.1	57.3	56.2	53.2	47.1	53.1	56.4	55.8	54.1
07:45:00		56.7	57.4	56.9	53.4	48.2	53.1	56.2	56.3	54.4
08:00:00		55.4	57.4	56.8	53.0	46.9	52.8	55.8	55.6	53.8
08:15:00		55.7	57.1	57.2	54.2	46.6	52.2	56.7	55.6	54.0
08:30:00		56.2	57.2	56.5	54.0	48.2	53.0	56.0	55.2	54.2
08:45:00		55.9	57.3	57.4	54.2	49.3	54.4	57.4	55.4	54.9
09:00:00		55.0	57.3	57.4	54.6	48.9	53.7	56.8	56.0	54.6
09:15:00		55.3	56.7	57.2	54.7	50.2	54.0	57.3	56.3	55.0
09:30:00		55.8	57.3	56.9	53.8	50.1	55.1	56.1	55.9	54.8
09:45:00		55.9	57.0	55.8	53.7	50.5	54.3	55.6	55.5	54.5
10:00:00		55.6	56.4	56.3	53.6	51.2	54.2	54.6	55.5	54.4
10:15:00		55.2	56.8	55.1	54.0	50.7	55.4	55.3	56.2	54.6
10:30:00		56.9	56.9	55.8	53.0	49.8	54.3	54.7	55.1	54.2
10:45:00		55.4	56.4	55.8	53.9	50.3	54.8	55.2	55.4	54.4
11:00:00		56.8	55.8	55.3	53.6	51.9	54.8	55.8	55.2	54.8
11:15:00		56.0	56.2	55.0	54.5	52.2	54.3	56.2	55.4	54.8
11:30:00		56.3	56.7	54.4	54.6	50.8	54.2	56.0	54.7	54.4
11:45:00		56.2	57.7	54.1	54.5	52.1	54.8	55.6	55.8	54.7
12:00:00		57.0	56.6	53.1	55.0	51.8	54.8	55.8	54.9	54.6
12:15:00		57.5	56.4	54.4	54.7	52.5	54.5	55.5	54.5	54.8
12:30:00		55.9	57.0	54.4	54.6	53.3	55.1	55.6	55.7	54.9
12:45:00		56.0	56.4	54.6	54.7	54.1	54.1	55.1		54.8

13:00:00		56.9	56.6	54.9	54.7	54.0	53.9	55.3		55.0
13:15:00		57.7	56.8	54.8	54.7	53.3	55.1	56.1		55.3
13:30:00	54.0	57.3	56.5	54.3	54.3	53.5	54.6	54.9		54.7
13:45:00	53.0	57.4	56.6	54.2	54.2	53.2	54.3	55.7		54.6
14:00:00	53.9	55.0	56.0	52.9	53.9	53.3	55.9	54.0		54.1
14:15:00	54.3	55.7	54.6	53.6	54.4	52.7	54.8	54.6		54.3
14:30:00	52.9	55.8	55.5	53.7	54.8	53.1	53.8	55.5		54.2
14:45:00	53.6	55.0	56.2	53.5	53.9	52.6	54.2	54.6		53.9
15:00:00	53.0	56.6	56.4	54.8	53.6	52.4	54.1	54.5		54.1
15:15:00	52.7	56.3	56.1	54.1	53.4	52.2	54.1	55.2		54.0
15:30:00	53.0	56.0	56.1	54.4	54.0	51.8	54.4	55.3		54.1
15:45:00	53.3	55.5	56.0	53.2	53.9	52.9	55.0	55.0		54.1
16:00:00	52.5	55.6	56.0	53.0	54.4	53.0	53.6	55.2		53.9
16:15:00	53.0	56.4	55.8	53.8	54.4	53.6	54.3	54.9		54.3
16:30:00	52.5	55.3	55.2	53.5	55.5	53.8	54.8	55.1		54.4
16:45:00	52.4	55.4	55.2	53.7	54.7	53.9	55.5	54.5		54.3
17:00:00	53.1	55.9	55.6	54.0	54.1	53.3	55.2	55.0		54.6
17:15:00	51.9	56.6	54.6	53.3	54.4	54.5	54.9	54.2		54.3
17:30:00	51.6	56.5	55.4	53.9	53.5	54.5	54.0	53.8		54.0
17:45:00	52.9	56.4	55.9	53.6	53.9	54.6	54.6	54.4		54.3
18:00:00	52.9	57.6	55.7	53.1	54.1	54.9	54.7	55.0		54.6
18:15:00	52.6	57.2	55.5	53.1	54.3	55.3	54.7	55.7		54.7
18:30:00	52.9	56.7	55.8	53.2	54.3	55.6	54.6	54.4		54.5
18:45:00	53.3	56.2	55.7	52.9	53.7	54.6	54.1	55.4		54.3
19:00:00	53.3	57.4	56.3	54.4	53.1	54.7	54.7	55.4		54.7
19:15:00	54.2	56.8	56.9	54.9	53.7	56.4	54.3	55.3		55.1
19:30:00	52.7	56.7	56.5	54.6	53.4	56.7	54.7	55.4		54.9
19:45:00	53.2	56.9	55.9	53.6	53.5	55.6	54.0	55.4		54.6
20:00:00	53.2	56.0	55.9	54.5	53.6	55.4	54.6	55.5		54.7
20:15:00	53.5	55.7	56.1	53.6	53.4	54.5	53.6	55.6		54.3
20:30:00	52.4	56.2	56.0	54.4	53.9	55.4	54.6	54.8		54.5
20:45:00	52.6	56.0	56.0	54.1	54.1	56.5	53.7	55.3		54.6

21:00:00	53.0	56.0	55.9	53.6	54.1	54.9	53.1	55.3		54.3
21:15:00	52.5	55.8	55.8	54.5	54.2	54.5	53.7	55.9		54.4
21:30:00	52.4	56.0	55.9	54.1	53.1	55.2	53.5	55.3		54.2
21:45:00	52.3	56.3	55.3	53.5	53.8	55.3	53.5	55.9		54.4
22:00:00	52.3	56.1	54.7	52.2	52.1	54.2	53.3	56.2		53.8
22:15:00	52.1	55.9	52.6	51.4	51.2	54.1	53.6	56.0		53.5
22:30:00	51.2	56.1	52.9	51.5	51.5	53.5	52.7	55.1		53.1
22:45:00	51.5	55.7	53.8	51.7	52.3	54.3	53.2	54.8		53.4

Minimum of the
 $L_{A90,15min}$
 arithmetic
 averages

53.1 dB

Table 13: Calculation of the 'typical' night-time background sound level according to MCC's Planning and Noise Technical Guidance Appendix at Location U1.

U1 NIGHT-TIME Time	$L_{A90,15min}$								Arithmetic average
	Tuesday 21/05/2024	Wednesday 2024/05/22	Thursday 2024/05/23	Friday 2024/05/24	Saturday 2024/05/25	Sunday 2024/05/26	Monday 2024/05/27	Tuesday 2024/05/28	
23:00:00	50.8	55.7	53.7	52.8	51.1	53.6	52.3	54.3	53.3
23:15:00	51.6	54.8	53.0	52.6	52.4	53.4	52.3	53.5	53.0
23:30:00	50.4	54.6	52.9	50.7	53.0	53.1	51.6	53.2	52.4
23:45:00	49.2	54.5	52.2	51.0	53.1	54.2	50.5	52.7	52.0
00:00:00	49.2	54.0	52.7	52.9	52.9	54.0	50.3	51.6	52.1
00:15:00	49.0	53.4	52.1	52.4	52.6	53.2	49.6	51.7	51.6
00:30:00	48.4	52.3	52.5	52.4	52.8	53.2	48.4	51.2	51.2
00:45:00	46.6	51.0	51.9	52.1	52.5	53.0	48.3	50.7	50.5
01:00:00	46.9	49.8	51.2	51.2	52.1	52.2	47.7	49.8	49.8
01:15:00	46.9	50.2	49.5	51.0	52.0	51.2	46.8	49.8	49.3
01:30:00	44.9	49.8	49.3	49.1	51.6	51.3	46.0	47.6	48.3
01:45:00	45.1	49.1	49.9	49.7	52.2	51.0	45.8	48.1	48.4
02:00:00	44.9	49.8	49.2	49.8	51.0	49.8	44.4	47.9	48.0

02:15:00	46.1	49.3	48.7	50.2	51.0	50.6	44.5	47.6	48.1
02:30:00	44.7	50.7	48.3	49.7	50.1	50.8	45.7	47.9	48.3
02:45:00	44.0	49.2	48.5	49.4	50.1	50.3	44.8	48.6	47.8
03:00:00	43.7	49.5	47.4	48.9	50.6	51.0	43.9	48.3	47.5
03:15:00	44.1	48.0	47.0	50.5	50.6	49.6	44.8	48.2	47.5
03:30:00	45.6	47.7	47.6	50.2	50.7	49.7	44.5	48.0	47.6
03:45:00	45.5	49.5	48.5	49.5	50.4	49.4	45.5	47.9	48.0
04:00:00	46.3	50.7	47.8	49.5	51.0	49.4	46.2	49.0	48.4
04:15:00	47.7	49.7	46.8	49.0	50.7	50.2	46.7	49.2	48.5
04:30:00	46.7	50.5	47.6	48.7	49.8	50.0	47.5	49.2	48.6
04:45:00	46.8	52.6	49.8	49.4	49.2	49.9	46.8	49.7	49.3
05:00:00	47.0	51.7	49.0	49.6	49.9	49.8	49.0	50.4	49.5
05:15:00	50.5	54.0	51.5	49.5	50.3	49.6	50.5	52.9	51.2
05:30:00	52.0	54.4	53.3	50.7	50.5	49.9	52.5	53.0	52.3
05:45:00	52.3	55.1	54.3	50.8	50.5	51.3	52.8	54.0	52.9
06:00:00	52.7	55.4	54.2	51.4	48.6	51.1	53.4	54.7	53.3
06:15:00	54.4	56.9	55.5	52.5	48.6	52.0	54.1	56.0	54.5
06:30:00	54.9	56.8	56.7	53.1	48.7	53.1	55.6	55.7	55.1
06:45:00	54.4	56.9	56.6	53.1	47.8	53.3	56.4	56.3	55.3

Minimum
of the
LA90,15min
arithmetic
averages

47.5 dB

Table 14: Calculation of the 'typical' daytime background sound level according to MCC's Planning and Noise Technical Guidance Appendix at Location U2.

	LA90,15min											
U2 DAYTIME	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Arithmetic average
Time	21/05/2024	22/05/2024	23/05/2024	24/05/2024	25/05/2024	26/05/2024	27/05/2024	28/05/2024	29/05/2024	30/05/2024	31/05/2024	
07:00:00		47.7	52.1	50.2	46.4	43.3	46.8	51.8	50.8	49.9	48.8	48.6
07:15:00		49.1	52.1	50.6	46.6	43.6	46.6	51.3	50.6	49.3	48.7	48.8
07:30:00		51.9	52.6	50.5	47	43.4	47.4	51.5	50.3	49.8	49.1	49.3
07:45:00		50.3	52.8	51.5	47.3	43.8	47.7	51.6	51.7	50.1	50	49.6
08:00:00		50.2	51.9	50.8	47.8	43.6	47.8	51.5	50.6	49.6	49.9	49.3
08:15:00		50	52.4	51.2	47.9	43.4	48	52.5	51.6	49.6	50.3	49.6
08:30:00		50.9	52.9	51.5	48	44.8	47.9	52.2	51.4	50.1	49.9	50.0
08:45:00		50.3	52.9	52	48.3	46.4	48.8	53	51.4	50.1	50.3	50.4
09:00:00		49.9	53.2	52.2	48.5	46.1	48.1	52.7	51.9	50.6	49.8	50.3
09:15:00		50.6	53.1	52.5	48.6	45	47.9	53.4	52.4	49.9	49.2	50.4
09:30:00		51	53.9	51.5	47.7	45.8	49.1	52.4	51.2	50.7	49.1	50.3
09:45:00		51.2	52.9	51	47.9	46.9	48.4	52.1	50.7	50.6	49.7	50.1
10:00:00		51.4	51.6	50.7	48.1	47.8	49.1	52.7	50.6	50.5	48.6	50.3
10:15:00		50.1	52.6	50.5	48	48.2	50.1	52	52.1	49.6	49.3	50.5
10:30:00		51.1	52.4	50.6	48.6	47.2	48.7	51	51.3	52.1	50.3	50.1
10:45:00		50.6	53.2	50.5	48.2	47	49.1	51.2	51.3	50.2	49.4	50.1
11:00:00		51.9	52.1	49.4	48.8	48.6	49.4	51.6	50.9	50.4	49.5	50.3
11:15:00		52.5	52.2	50.3	50.5	49.8	47.9	51.9	50.8	50	48.6	50.7
11:30:00		50.8	53.1	48.9	49.5	47.1	48	51.3	50.4	49.5		49.9
11:45:00		52	53.8	48.9	49.5	48.7	48.7	51.4	52	50.3		50.6
12:00:00		53.6	52.7	49.4	50.1	48	49.2	51.9	51.6	50.6		50.8
12:15:00		53.5	52	48.9	48.9	48.8	48.1	52.2	50.9	49.7		50.4
12:30:00		51.1	52.4	48.6	49.5	49.3	48.6	50.9	49.9	51.6		50.0
12:45:00		51	51.9	49.7	49.5	50.8	47.7	51.4	50.8	50.6		50.4
13:00:00		51.6	52.3	49.9	49.4	49.3	48.2	51.6	50.3	50.8		50.3
13:15:00		53	52.8	50.9	50.3	48.8	49	53.1	51.8	51.4		51.2

13:30:00	47.8	52.6	52.1	49.5	49.6	49.4	48.9	51.5	51.5	50.8		50.3
13:45:00	48.4	52.4	51.9	49	49.5	48.3	48.3	52.1	51.8	51.1		50.2
14:00:00	48.4	51.2	51.5	50.1	49.3	48.6	50	51	51.4	50.8		50.2
14:15:00	49.5	51	50.5	49.1	49.3	48	47.7	50.4	51.4	49.9		49.7
14:30:00	48.6	51.3	51.5	49.9	50.7	48.5	47.2	51	53.2	48.9		50.2
14:45:00	48.3	50.8	51.3	49.6	49.2	48.4	47.2	50.2	50.8	49.7		49.5
15:00:00	48.1	52.6	51.7	49.4	50	47.9	47.7	50.8	50.8	49.9		49.9
15:15:00	48.7	51.6	51.3	49	50.2	47.9	47.4	51.2	52	49.8		49.9
15:30:00	48.3	52.1	51.7	49.2	51.2	48.4	48.9	51.6	51	49.7		50.3
15:45:00	48.9	51.3	51.4	49.1	50.8	48.2	49.2	52	50.7	50.6		50.2
16:00:00	48	51.6	51.1	49.1	51.2	48.7	47.8	51.3	51.7	50.9		50.1
16:15:00	49	51.7	51.3	48.4	50.8	49	48.1	51.6	50.9	51.7		50.1
16:30:00	48.2	50.4	50.5	49.2	51.4	50	48.9	50.6	50.6	50.7		50.0
16:45:00	47.5	50.7	50.9	49.1	50.7	48.1	50.3	50.5	49.9	49.6		49.7
17:00:00	48.2	51.2	51.2	49.1	51.5	47.5	50.7	51.1	50.3	49.7		50.1
17:15:00	47.2	52.5	50.5	48.7	51.8	49.3	48.9	50.2	50.3	49.2		49.9
17:30:00	46.9	53.1	51.1	48.1	51.3	49.6	47.6	50.1	49.4	49.6		49.7
17:45:00	47.7	53.1	51.1	48.8	52.2	49.9	48	49.6	50.4	50.1		50.1
18:00:00	47.2	54.2	50.9	48.6	52.2	49.9	48	51.3	50.3	48.8		50.3
18:15:00	47.5	53.3	50.6	48.2	51.9	50.9	48.1	51.1	50.2	49		50.2
18:30:00	46.7	52.8	51	47.9	51.8	53.7	47.6	50.2	50.2	48.6		50.2
18:45:00	47	52.2	50.9	47.3	51.8	49.7	48.1	50.1	50.7	48.9		49.8
19:00:00	47.8	52.2	51.4	48.9	51.3	49.8	48.2	50.9	50.5	49.1		50.1
19:15:00	49.4	52.4	51.7	49.7	50.9	50.6	47.8	50.7	50.3	50.7		50.4
19:30:00	46.2	51.9	50.9	50	52.1	52	48.2	50.2	50.5	48.8		50.2
19:45:00	46.9	52.6	51	48.5	52.6	51.5	47.8	50.7	50	48.7		50.2
20:00:00	46.6	52	51.2	49.1	52.9	53	48.5	50.1	49.6	48.3		50.3
20:15:00	46.5	51.9	50.4	48.1	52.6	50.9	47.9	49.9	49.1	47.6		49.7
20:30:00	46.7	51.5	50.1	48.5	52.7	51.7	48.8	49.3	49.2	47.9		49.8
20:45:00	46.1	50.5	49.9	48.5	52.9	54.6	48.1	49.8	49.5	47.5		50.0
21:00:00	46.1	50.4	49.5	48.2	50.5	49.2	47.6	49.9	49.2	47.9		49.0
21:15:00	46.2	50.1	49.3	48.7	49.9	48.6	48.1	50.2	49.6	47.3		49.0

21:30:00	45.8	50.2	49.6	49	48.9	49.8	47.5	49.7	49.7	47.6		48.9
21:45:00	45.4	50.6	49.1	48.9	49.6	49.2	47.5	50.6	49.2	47.5		48.9
22:00:00	45.3	50.6	49.2	48.5	48	48.3	47.6	50.6	48.6	47.7		48.5
22:15:00	45.3	50.4	48.5	47.9	47.8	48.2	47.5	50	48.6	48		48.2
22:30:00	44	50.9	48.8	47.2	47.6	47.9	47.1	48.9	48.1	47.7		47.8
22:45:00	45	50.4	48.7	47.5	47.6	48.1	46.7	48.1	49.1	47.9		47.9

Minimum
of the
L_{A90,15min}
arithmetic
averages

47.8 dB

Table 15: Calculation of the 'typical' daytime background sound level according to MCC's Planning and Noise Technical Guidance Appendix at Location U2.

	L _{A90,15min}										
U2 NIGHT-TIME	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Arithmetic average
Time	21/05/2024	2024/05/22	2024/05/23	2024/05/24	2024/05/25	2024/05/26	2024/05/27	2024/05/28	2024/05/29	2024/05/30	
23:00:00	44.1	49.7	48.0	47.3	47.1	47.8	46.6	47.5	48.1	47.0	47.3
23:15:00	44.1	49.4	48.0	46.7	47.3	47.6	46.5	46.7	48.0	47.0	47.1
23:30:00	43.5	49.8	46.7	45.6	47.6	47.6	45.9	46.7	47.2	46.1	46.7
23:45:00	42.8	49.0	46.5	45.6	47.5	48.3	45.2	46.1	46.8	46.7	46.5
00:00:00	41.9	49.0	47.0	46.6	47.5	47.4	45.5	45.1	46.6	45.9	46.3
00:15:00	41.4	48.4	46.6	46.1	46.9	47.0	43.8	46.0	46.2	46.1	45.9
00:30:00	41.3	47.5	46.2	46.2	46.6	47.0	43.4	45.0	45.7	45.7	45.5
00:45:00	40.2	46.3	45.8	45.3	46.5	47.1	43.5	45.3	45.3	45.7	45.1
01:00:00	40.8	45.5	45.1	44.8	46.0	46.5	42.4	44.1	44.9	45.3	44.5
01:15:00	40.2	45.5	43.9	44.4	45.9	45.6	42.0	44.3	44.4	45.0	44.1
01:30:00	39.0	45.4	43.8	43.8	46.0	45.5	42.0	43.2	44.5	45.1	43.8
01:45:00	38.8	44.9	44.2	43.8	45.5	44.7	42.0	43.0	44.6	44.9	43.6
02:00:00	38.9	46.0	43.7	44.1	45.5	44.6	40.7	42.2	44.2	45.2	43.5
02:15:00	39.7	45.8	43.7	43.9	44.9	45.1	41.0	42.6	44.2	45.1	43.6

02:30:00	39.0	47.3	43.0	43.9	44.2	45.2	40.8	43.4	43.9	44.5	43.5
02:45:00	38.9	46.1	43.0	44.0	43.9	45.0	40.8	44.4	43.9	44.6	43.5
03:00:00	38.6	45.6	42.8	43.5	44.6	45.2	40.5	43.8	43.7	44.9	43.3
03:15:00	39.3	44.7	42.4	44.7	45.0	44.5	41.3	43.7	43.9	44.6	43.4
03:30:00	40.1	44.9	42.8	44.6	44.8	44.9	41.3	44.0	44.2	44.8	43.6
03:45:00	40.2	46.6	43.4	44.3	44.6	44.8	42.0	44.0	44.8	45.4	44.0
04:00:00	40.8	47.1	43.4	45.0	44.7	44.6	42.8	44.3	44.8	45.3	44.3
04:15:00	41.5	46.7	43.1	44.1	44.8	45.1	42.9	44.1	44.5	45.2	44.2
04:30:00	41.1	46.8	43.0	43.6	43.3	44.7	43.1	43.8	44.8	45.3	44.0
04:45:00	41.4	47.6	44.2	44.0	42.9	45.0	43.0	44.1	44.5	45.3	44.2
05:00:00	41.0	47.2	44.1	44.7	44.5	44.5	44.4	44.6	44.9	45.9	44.6
05:15:00	42.3	48.9	45.2	43.8	44.2	44.6	45.3	46.4	46.0	48.0	45.5
05:30:00	44.0	49.2	47.1	45.4	44.6	44.5	46.4	47.3	46.9	47.0	46.2
05:45:00	44.8	49.9	47.7	45.8	44.7	45.3	47.3	48.0	48.0	47.7	46.9
06:00:00	46.0	50.3	49.3	45.7	43.1	45.7	48.0	48.7	48.4	48.4	47.4
06:15:00	46.8	51.6	49.5	45.9	44.2	46.0	49.0	50.0	48.7	47.7	47.9
06:30:00	47.8	51.2	50.6	46.3	43.6	46.9	50.0	49.9	48.6	48.7	48.4
06:45:00	47.7	52.1	50.6	46.5	43.5	47.7	51.4	50.2	48.8	48.3	48.7

Minimum of
the L_{A90,15min}
arithmetic
averages

43.3 dB

A.1.4 Attended measurement results

Table 16 shows the attended noise measurement results at the locations indicated in Figure 4.

Table 16: Arithmetic average of baseline sound measurements at the attended locations on Tuesday 21st May.

Measurement location (see Figure 4)	Start time [hh:mm]	Duration [hh:mm:ss]	Sound pressure level, free-field				Comments
			dBL _{Amin}	dBL _{A90,5min}	dBL _{Aeq,5min}	dBL _{Amax}	
U1	13:52	00:10:00	50	53	63	83	Dominated by continuous road traffic noise from Mancunian Way and tram and train noise from adjacent viaduct.
U2	13:40	00:05:00	46	49	61	88	Dominated by tram and train noise from adjacent viaduct. Continuous road traffic noise also audible from Mancunian Way, but quieter compared to U1.
A2	15:20	00:10:00	52	56	62	74	Dominated by continuous road traffic noise from Mancunian Way and intermittent tram and train noise from adjacent viaduct. Construction noise audible from nearby sites.
A3	15:35	00:10:00	50	52	61	74	Dominated by intermittent tram and train noise from adjacent viaduct. Construction noise audible from nearby sites.
A4	15:58	00:10:00	47	50	56	69	
A5	16:13	00:10:00	51	53	59	70	Dominated by intermittent tram and train noise from adjacent viaduct.
A6	12:31	00:10:00	44	47	56	71	Dominated by tram and train noise from adjacent viaduct. Birdsong, rustling of leaves and patron noise audible.
A7	12:15	00:10:00	45	48	59	82	
A8	12:01	00:15:00	44	47	61	83	

A.1.5 Survey photos



Figure 14: Location U1 monitoring equipment, located at the western end of the National Trust Phase 2 viaduct land, in line with the western-most residential receptor at Potato Wharf, facing west.



Figure 15: Location U2 monitoring equipment (including noise logger and weather station), located on the eastern side of Phase 2 on the National Trust viaduct land, in line with the eastern-most residential receptor at Potato Wharf, facing north.



Figure 16: Attended measurement location A2, located at ground level on the western side of the Potato Wharf residential area, facing west towards Mancunian Way.



Figure 17: Attended measurement location A2, located at ground level on the western side of the Potato Wharf residential area, facing Mancunian Way. Construction site shown to the north.



Figure 18: Attended measurement location A3, located at ground level in the centre of the Potato Wharf residential area, facing south towards the viaduct.



Figure 19: Attended measurement location A4, located at ground level in the centre of the Potato Wharf residential area, facing south towards the viaduct.



Figure 20: Attended measurement location A5, located at ground level along Bridgewater Canal to the south of Castlefield Viaduct.



Figure 21: Attended measurement location A6, located on the western side of the existing National Trust viaduct garden.



Figure 22: Attended measurement location A6, located in the centre of the existing National Trust viaduct garden.



Figure 23: Attended measurement location A8, located near the eastern entrance of the existing National Trust viaduct garden.