Emanuel House

Noise Break-in Assessment

Westminster City Council

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2023/OCT/04

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Contents

Tables

Figures

1. Introduction

The existing glazing throughout a block of flats Emanuel House, Rochester Row, London has come to its end of life and requires replacement.

AtkinsRéalis' Acoustics, Noise and Vibration have been commissioned to undertake a noise survey and subsequent assessment works to inform the selection of the new glazing to be installed across the site.

This report presents the methodology and findings of the survey and noise break-in assessment.

A glossary of acoustic terms used in this report is presented in Appendix A.

2. Site Description

The site is a seven-storey residential building with commercial use at ground floor level. Façades are located along Rochester Row, a highly populated street with heavy road traffic and Greencoat Place, a more sparsely populated street with infrequent traffic.

The building is understood to be concrete framed, with additional panelling surrounding each glazing unit associated with the residences above ground floor level.

The existing glazing is understood to be single glazed sash windows, and the ventilation strategy is understood to be fully passive.

3. Design Criteria

The limits for internal noise levels associated with environmental noise sources are shown below. These limits have been derived from appropriate guidance, which are set out in Appendix B.

Table 3-1 Internal Ambient Noise Level Limits

Location	07:00 to 23:00	23:00 to 07:00
All rooms	35 dB $L_{Aeq,16hr}$	-
Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$, 45 dB L_{Amax}[1]

[1] to be exceeded no more than 15 times per night-time from sources other than emergency sirens.

4. Environmental Noise Survey

4.1. Survey Overview

The noise survey methodology and results are summarised below.

The aim of the survey was to establish the existing environmental noise levels at the locations representative of the building façades and a sound level reduction provided by the existing glazing with respect to external sources. Unattended long-term measurements were used to establish existing environmental noise levels around the site.

The key noise level descriptors recorded during the survey were:

- $L_{Aeq,T}$ and $L_{eq,T}$ in octave bands, representing ambient noise levels.
- $L_{A90,T}$, representing background noise levels.
- $L_{Amax,T}$, representing maximum noise levels.
- D_w, representing sound level reduction provided by existing glazing.

Definitions of the above descriptors are provided in Appendix A.

4.2. Survey Instrumentation

Instrumentation used during the unattended measurements of the survey is listed in Table 4-1, with reference to unattended measurement positions shown in Figure 4-1 further below.

Table 4-1 Unattended Survey Instrumentation

Measurement Position	Equipment	Type	Serial Number	Date of Calibration	Calibration Certificate Number
Position MP1	Sound Level Meter	01dB FUSION	11199	13/03/2023	UCRT23/1323
	Microphone	GRAS 40CE	233344	13/03/2023	UCRT23/1323
	Pre-amplifier	PRE 22	1605096	13/03/2023	UCRT23/1323
	Calibrator	CAL21	34565046	13/03/2023	UCRT23/1322
Position MP2	Sound Level Meter	01dB FUSION	11195	07/11/2022	UCRT22/2325
	Microphone	GRAS 40CE	233226	07/11/2022	UCRT22/2325
	Pre-amplifier	PRE 22	1605094	07/11/2022	UCRT22/2325
	Calibrator	CAL21	34565045	07/11/2022	UCRT22/2319

All sound level monitoring equipment has Class 1 accuracy and holds the current manufacturer's calibration certificates, available on request.

All microphones were fitted with windshields. The meters were calibrated before and after all measurements, with no significant differences noted in levels.

4.3. Site Conditions

When setting up and collecting the equipment, the weather was noted to be of clear skies with little to no wind and dry roads.

The noise climate around the site was noted to be dominated by road traffic noise alongside local business noise and distant construction works not associated with the site.

4.4. Measurement Positions

Unattended measurement positions MP1 and MP2 are described below, as well as set out within Figure 4-1:

- MP1 – Positioned 1m from the façade of the building at roof level overlooking Rochester Row. Representative of noise affecting this façade.
- MP2 – Positioned 1m from the façade of the building at roof level overlooking Greencoat Place. Representative of noise affecting this façade.

The site, surrounding area and measurement positions (MP) are shown in Figure 4-1 below.

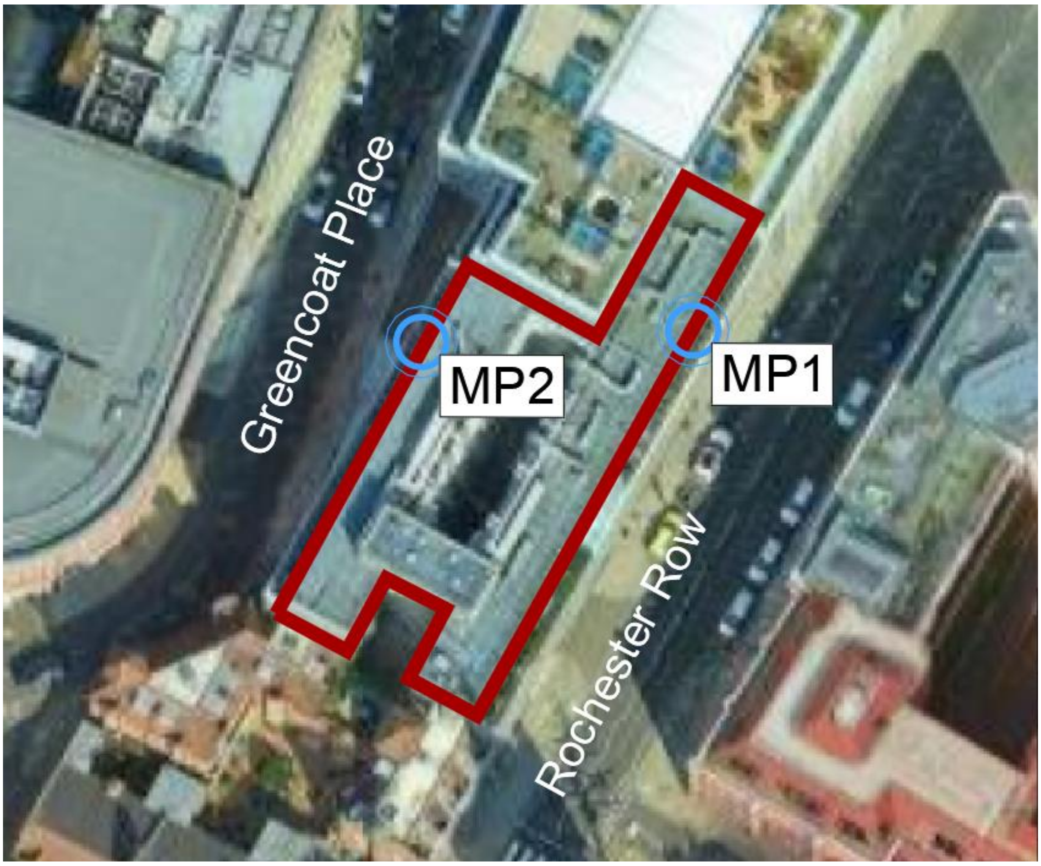

Figure 4-1 Site Plan and Unattended Measurement Positions

4.5. Survey Results

4.5.1. Unattended Measurements

Time history graphs of the measured L_{Aeq}, L_{A90} and $L_{AF,max}$ levels at measurement positions MP1 and MP2 are presented in Appendix C. A summary of all measurements is provided in the tables below.

Table 4-2 Measured Free-field Ambient Noise Levels at Position MP1

Date	Period	Ambient Noise Level $L_{eq,T}$, (dB) across octave bands (Hz)								$L_{Aeq,T}$ (dB)
		63	125	250	500	1k	2k	4k	8k	
Friday 22/09/2023	Day (07:00-23:00)	64*	60*	61*	57*	58*	55*	51*	43*	**62***
	Night (23:00-07:00)	58	55	61	53	53	49	42	35	**57**
Saturday 23/09/2023	Day (07:00-23:00)	62	59	61	57	58	58	49	40	**63**

	Night (23:00-07:00)	59	56	61	53	53	49	42	34	**57**
Sunday 24/09/2023	Day (07:00-23:00)	63	60	61	57	57	53	46	38	**61**
	Night (23:00-07:00)	59	56	59	52	52	48	43	36	**56**
Monday 25/09/2023	Day (07:00-23:00)	64	60	60	57	58	56	49	41	**62**
	Night (23:00-07:00)	58	55	59	51	51	47	42	35	**56**
Tuesday 26/09/2023	Day (07:00-23:00)	65*	61*	60*	57*	57*	55*	50*	43*	**62***
	Night (23:00-07:00)	N/A**								

*Partial measurement period
**Period not measured

Table 4-3 Measured Free-field Night-Time Maximum Noise Levels at Position MP1

Date	Period	Maximum Noise Level $L_{Fmax,T}$, (dB) across octave bands (Hz)								$L_{AF,max,T}$ (dB)$^{+}$
		63	125	250	500	1k	2k	4k	8k	
Friday 22/09/2023	Night (23:00-07:00)	65	63	65	65	66	66	62	54	**71**
Saturday 23/09/2023	Night (23:00-07:00)	69	66	67	67	65	62	59	49	**70**
Sunday 24/09/2023	Night (23:00-07:00)	70	72	68	67	66	64	61	56	**71**
Monday 25/09/2023	Night (23:00-07:00)	70	67	71	69	67	64	62	53	**72**
Tuesday 26/09/2023	Night (23:00-07:00)	N/A**								

$^{+}$10th highest 1-minute $L_{AF,max}$ measured
**Period not measured

Table 4-4 Measured Free-field Ambient Noise Levels at Position MP2

Date	Period	Maximum Noise Level $L_{eq,T}$, (dB) across octave bands (Hz)								$L_{Aeq,T}$ (dB)
		63	125	250	500	1k	2k	4k	8k	
Friday 22/09/2023	Day (07:00-23:00)	61*	58*	56*	55*	53*	51*	47*	43*	**58***
	Night (23:00-07:00)	57	54	52	48	47	43	37	28	**51**
Saturday 23/09/2023	Day (07:00-23:00)	60	57	57	58	55	52	46	38	**60**
	Night (23:00-07:00)	58	55	53	52	49	44	38	31	**53**
Sunday 24/09/2023	Day (07:00-23:00)	60	56	55	52	50	47	41	34	**55**

	Night (23:00-07:00)	58	54	53	49	47	45	41	34	**52**
Monday 25/09/2023	Day (07:00-23:00)	61	59	57	56	54	52	47	40	**59**
	Night (23:00-07:00)	57	54	51	47	45	41	36	29	**50**
Tuesday 26/09/2023	Day (07:00-23:00)	62*	60*	58*	55*	53*	52*	48*	41*	***59**
	Night (23:00-07:00)	N/A**								

*Partial measurement period
**Period not measured

Table 4-5 Measured Free-field Night-Time Maximum Noise Levels at Position MP2

Date	Period	Maximum Noise Level $L_{Fmax,T}$, (dB) across octave bands (Hz)								$L_{AF,max,T}$ (dB)+
		63	125	250	500	1k	2k	4k	8k	
Friday 22/09/2023	Night (23:00-07:00)	66	73	68	61	59	55	52	44	**65**
Saturday 23/09/2023	Night (23:00-07:00)	60	67	66	70	72	64	58	49	**74**
Sunday 24/09/2023	Night (23:00-07:00)	68	68	66	63	63	62	61	52	**69**
Monday 25/09/2023	Night (23:00-07:00)	66	63	61	59	60	60	57	49	**66**
Tuesday 26/09/2023	Night (23:00-07:00)	N/A**								

+10th highest 1-minute $L_{AF,max}$ measured
**Period not measured

5. Noise Break-in Assessment

5.1. Overview

To adequately control noise break-in to habitable rooms and bedrooms throughout the building to meet the internal noise criteria detailed in section 3, it is necessary for the various elements of the external building fabric to provide certain minimum levels of sound insulation performance.

In general, when considering sound reduction, it is the openings in the structure that limit the overall sound insulation performance. More specifically, windows tend to form the weakest elements of any building due to their limited mass when compared to most typical types of exterior wall construction.

5.2. Façade Construction

It is understood that the façade is to remain as existing. The façade is understood to be a concrete frame with pre-fabricated concrete spandrel panels fixed to the frame that house the glazing units. The concrete panels are understood to have a depth of 100 mm.

In absence of detailed information, for the purposes of this assessment the concrete has been assumed to have a typical density of 2300 kg/m^3 and therefore a sound reduction index (R_w) of 50 dB R_w.

5.3. Glazing Systems

The table below sets out the sound reduction (R) performance requirements for the glazing system along each façade of the building. The specification is inclusive of road traffic correction (C_{tr}), which accounts for traffic noise.

The assessment was carried out in line with BS EN ISO 12354-3:2017[1], and room and glazing dimensions taken from the living space of Flat 47, measured during the site visit. We were informed while on site that most rooms in the building are approximately the same size so this room size has been assumed for the entirety of the flats.

The reverberation time within the spaces are assumed to be 0.5 seconds.

The R_w and C_{tr} values and indicative glazing configurations quoted in the table are for guidance only; alternative configurations may be utilised.

The octave band sound reduction performances quoted in the table must be achieved by the glazing system as a whole. The specification therefore applies to the glazing, the frames and all seals on any openable parts of the systems and any required ventilation or condensation control mechanisms. This list is not exhaustive: no part of the glazing system shall cause the figures not to be achieved.

When selecting appropriate glazing, the supplier should be expected to prove by means of certified test results that the sound reduction figures can be achieved by the system being proposed. The tests shall be conducted in accordance with BS EN ISO 10140:2021 Parts 1 to 5[2].

[1] BS EN ISO 12354-3:2017 Building acoustics – Estimation of acoustic performance of buildings from the performance of elements

[2] BS EN ISO 1014-1 to 5 – Acoustics. Laboratory measurement of sound insulation of building elements

Table 5-1 Minimum Sound Reduction Values for Windows

Glazing Type *Indicative Configuration*	Min. Sound Reduction Index (R) across octave band centre frequency (Hz)						R_w	C_{tr}	$R_w + C_{tr}$
	125	250	500	1k	2k	4k			
G1 *Standard thermal double glazing*	20	18	26	33	33	30	**30**	**-4**	**26**
G2 *6mm glass, 12-24mm air gap, 4mm glass*	22	22	28	39	39	42	**33**	**-4**	**29**
G3 *10mm acoustic laminate glass, 12-24mm air gap, 6mm glass*	26	27	34	40	39	46	**37**	**-4**	**33**
G4 *8mm acoustic laminate glass, 12-24mm air gap, 8.8mm acoustic laminate glass*	26	28	35	44	48	54	**40**	**-5**	**35**

The locations of the above glazing specifications are set out in section 5.5.

5.4. Ventilation

The current ventilation strategy for the building is passive, and it is understood that this is to remain unchanged.

Ventilation systems incorporating passive air intakes are acceptable along both façades of the building. The ventilators should have an installed element-normalized level difference ($D_{n,e}$) when tested in accordance with BS EN ISO 10140:2021 Parts 1 to 5 of not less than that indicated in the following table:

Table 5-2 Minimum Sound Reduction Values for Ventilators

Ventilator Type *Indicative Product*	Element Normalized Level Difference ($D_{n,e}$) across octave band centre frequency (Hz)						$D_{n,e,w}$	C_{tr}	$D_{n,e,w} + C_{tr}$
	125	250	500	1k	2k	4k			
V1 *Direct Path Trickle Vent*	36	28	26	28	30	25	**29**	**-1**	**28**
V2 *Glidevale Fresh 90dB*	43	32	40	42	50	57	**42**	**-3**	**39**
V3 *Glidevale Fresh 80dB*	48	39	44	52	66	61	**49**	**-3**	**46**

The locations of the above ventilator specifications are set out in section 5.5.

5.5. Glazing & Ventilation Specification Locations

The glazing and ventilator requirement locations are set out in Table 5-3 below:

Table 5-3 Glazing and Ventilation Requirement Locations

Location	Floor Level	Room Type	Glazing Type	Ventilation Type
Rochester Row Façade	First Floor to Third Floor	All Rooms*	G2	V1
		Bedrooms	G4	V3
	Fourth Floor and up	All Rooms*	G1	V1
		Bedrooms	G3	V2
Greencoat Place Façade	First Floor to Third Floor	All Rooms*	G1	V1
		Bedrooms	G4	V3
	Fourth Floor and up	All Rooms*	G1	V1
		Bedrooms	G3	V2
Courtyard Façades (Internal Facing)	All Floors	All Rooms*	G1	V1
		Bedrooms	G1	V1

*except bedrooms

6. Conclusions

The existing glazing throughout a block of flats Emanuel House, Rochester Row, London has come to its end of life and requires replacement.

AtkinsRéalis' Acoustics, Noise and Vibration have been commissioned to undertake a noise survey and subsequent assessment to inform the selection of the new glazing to be installed across the site.

Appropriate internal noise criteria have been established in line with relevant national and local guidance.

A noise break-in assessment has been undertaken, assuming a sound reduction of R_w 50 dB for the existing façade, and it has determined that varying degrees of enhanced glazing and ventilators are required of the building envelope.

The required acoustic performance for the glazing and ventilators has been identified and allocated to specific façades in section 5 of this report.

The acoustic specifications provided in this report should be provided to glazing and ventilation suppliers, who should certify that any proposed product meets the requirements.

Appendices

Appendix A. Glossary of Acoustic Terms

A-weighting — The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.

dB — Decibel. The unit of sound level.

dBA — The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.

$L_{Aeq,T}$ — The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level.

The suffix "T" represents the time period to which the noise level relates, e.g.(15 min) would represent a period of 15 minutes and (2300-0700) would represent a measurement time between 11 pm and 7 am.

$L_{A90,T}$ — The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.

The suffix "T" represents the time period to which the noise level relates, e.g. (15 min) would represent a period of 15 minutes and (2300-0700) would represent a measurement time between 11 pm and 7 am.

$L_{AFmax,T}$ — The A-weighted maximum sound level. The highest level that occurs over a time period "T", with a specified time weighting. Typically used time weightings are fast "F" (with 125 ms duration used to establish the sound level) and slow "S" (1 s duration), resulting in $L_{AFmax,T}$ and $L_{ASmax,T}$ measurements respectively.

R_w — Weighted sound reduction, which is a measure of the acoustic effectiveness of a building partition, door or other building element in blocking noise transmission from one side of the element to the other. This value is the result of measurements in acoustic laboratories in accordance with the relevant Standards. The higher the R_w, the better the acoustic performance of the building element. This metric is typically used to define the acoustic performance requirements of a building element for selection purposes.

$D_{n,e,w}$ — Element normalized level difference, which is a measure of the acoustic effectiveness of a building element, typically ventilators, in blocking noise transmission from one side of the element to the other. This value is the result of measurements in accordance with the relevant Standards. The higher the $D_{n,e,w}$, the better the acoustic performance of the building element. This metric is typically used to define the acoustic performance requirements of a building element for selection purposes.

C_{tr} — Urban traffic noise spectrum correction, the single number rating method defined in BS EN ISO 717 that uses a standard reference curve to determine the weighted value of airborne sound insulation. When added to R_w and $D_{n,e,w}$ the urban traffic noise spectrum takes into account low frequency noise.

Sound Insulation — When sound hits a surface, some of the sound energy travels through the material. 'Sound insulation' refers to ability of a material to stop sound travelling through it.

Appendix B. Internal Noise Design Criteria

B.1. The World Health Organisation (WHO) Guidelines 1999

The Guidelines for Community Noise (World Health Organisation, 1999) included values for community noise in specific environments.

It is important to note that the WHO Guidelines are aspirational, as illustrated by the National Noise Incidence Study (INNIS, 2000), which indicates that 55% of the population of England and Wales are exposed to external noise levels above 55 dB $L_{Aeq,day}$. A National Physical Laboratory (NPL) report (with reference CMAM16, dated September 1998) reviewing the original 1980 WHO Guidelines and the 1995 draft version of the current Guidelines stated:

"Exceedances of the WHO guideline values do not necessarily imply significant noise impact and indeed, it may be that significant impacts do not occur until much higher degrees of noise exposure are reached."

"As such, it would be unwise to use the WHO guidelines as targets for any form of strategic assessment, since, given the prevalence of existing noise exposure at higher noise levels, there might be little opportunity for and little real need for any across the board major improvements. On the other hand, the most constructive use for the WHO guidelines will be to set thresholds above which greater attention should be paid to the various possibilities for noise control action when planning new developments. It is important to make clear at this point that exceedances do not necessarily imply an over-riding need for noise control, merely that the relative advantages and disadvantages of noise control action should be weighed in the balance."

To prevent moderate annoyance in outdoor living areas, such as gardens and balconies of dwellings, the WHO Guideline value is 50 dB $L_{Aeq,16hr}$. This can be described as an upper limit for the average noise level across the daytime and evening period (07:00 to 23:00). The corresponding guideline value to prevent serious annoyance is stated as 55 dB $L_{Aeq,16hr}$.

However, it is again noted that these levels are aspirational in nature, as described above.

In terms of the internal noise environment, in order to achieve maximum speech intelligibility and to avoid moderate annoyance, the guideline value for noise levels within dwellings is stated as 35 dB $L_{Aeq,16hr}$ (covering the day and evening 07:00 to 23:00). The corresponding value for the night period (23:00 to 07:00) to avoid sleep disturbance is 30 dB $L_{Aeq,8hr}$.#

Additionally, in terms of sleep disturbance, a guideline value of 45 dB L_{max} is given. In relation to this value, the Guidelines state:

"When the background noise is low, noise exceeding 45 dB L_{max} should be limited, if possible…"

"For a good sleep, it is believed that indoor sound pressure levels should not exceed 45 dB L_{max} more than 10-15 times per night…"

B.2. WHO Environmental Noise Guidelines 2018

An updated version of the Guidelines was published in October 2018. It constitutes a significant revision of the 1999 Guidelines, rather than comprising minor amendments. In relation to road traffic and railway noise, the guidance states the following:

"Road Traffic Noise

For average noise exposure, the GDG strongly recommends reducing noise levels produced by road traffic below 53 decibels (dB) L_{den} as road traffic noise above this level is associated with adverse health effects.

For night exposure, the GDG strongly recommends reducing noise levels produced by road traffic during night time below 45 dB L_{night} as night-time road traffic noise above this level is associated with adverse effects on sleep.

To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from road traffic in the population exposed to levels above the guideline values for average and night noise exposure. For specific interventions, the GDG recommends reducing noise both at the source and on the route between the source and the affected population by changes in infrastructure."

"Railway Noise

For average noise exposure, the GDG strongly recommends reducing noise levels produced by railway traffic below 54 dB L_{den}, as railway noise above this level is associated with adverse health effects.

For night noise exposure, the GDG strongly recommends reducing noise levels produced by railway traffic during night time below 44 dB L_{night}, as night-time railway noise above this level is associated with adverse effects on sleep.

To reduce health effects, the GDG strongly recommends that policy-makers implement suitable measures to reduce noise exposure from railways in the population exposed to levels above the guideline values for average and night time noise exposures. There is, however, insufficient evidence to recommend one type of intervention over another."

The L_{den} is an equivalent sound level that represents the situation over the full 24 hours day, taking account of the L_{day} (07:00 to 19:00), with a penalty of 5 dB(A) for evening noise $L_{evening}$ (19:00-23:00) and a penalty of 10 dB(A) for night time noise L_{night} (23:00-07:00). The L_{night} index is equivalent to the $L_{Aeq,8hr}$ index as used in other standards such as BS 8233 (but not necessarily the same numerical guidelines).

The guidance no longer specified L_{Amax} criteria but states in section 2.2.2 of the document:

"In many situations, average noise levels like the L_{den} or L_{night} indicators may not be the best to explain a particular noise effect. Single-event noise indicators – such as the maximum sound pressure level (L_{Amax}) and its frequency distribution – are warranted in specific situations, such as in the context of night-time railway or aircraft noise events that can clearly elicit sleep awakenings and other physiological reactions that are mostly determined by L_{Amax}. Nevertheless, the assessment of the relationship between different types of single-event noise indicators and long-term health outcomes at the population level remains tentative. The guidelines therefore make no recommendations for single-event noise indicators."

As with the 1999 WHO document, the guideline values in the 2018 document represent aspirational targets to be achieved in the long term, rather than values that should immediately be adopted into relevant policy.

This is reflected in the following excerpt from the government's Aviation 2050 consultation document (which relates to aircraft noise but the principle of the statement is relevant to other noise sources):

"The government is considering the recent new environmental noise guidelines for the European region published by the World Health Organisation (WHO). It agrees with the ambition to reduce noise and to minimise adverse health effects, but it wants policy to be underpinned by the most robust evidence on these effects, including the total cost of action and recent UK specific evidence which the WHO report did not assess."

There, other current standards and guidance , such as BS 8233, still represent the most relevant and appropriate basis for assessment.

B.3. British Standard BS 8233:2014

Guideline values for dwellings with respect to internal and external noise levels are included in BS 8233:2014 Guidance on sound insulation and noise reduction for buildings (BSi).

The standard states 50 dB $L_{Aeq,T}$ as being desirable as a steady state noise level not to be exceeded in gardens. It also states 55 dB $L_{Aeq,T}$ as an upper guideline value. The time period *T* is usually taken to be the 16 hour day (07:00 to 23:00).

Paragraph 7.7.3.2 of the standard goes on to say the following:

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable to noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity spaces might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels.

Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space."

It can be seen that external noise levels, especially on small balconies to apartment blocks, are not proposed to be a controlling index by which suitability of a residential site is defined.

Therefore, when designing noise sensitive developments that incorporate gardens or other external amenity areas, the intent shall be to provide an area for each property in which the noise levels are consistent with these standards. Where there standards cannot be achieved, then reasonable measures shall be employed to provide screening or other forms of mitigation so as to minimise the noise levels in the external amenity areas.

An important principle here is that sustainable development sites will often be exposed to relatively high levels of environmental noise, and while means are available to insulate internal spaces, they are not always available to protect external spaces. Strict adherence to the enforcement of such external noise criteria would preclude development in the majority of areas considered for development in semi-urban or urban environments or in areas in the vicinity of transportation noise sources. This is why the external standards shall be viewed as targets or triggers of mitigation measures rather than thresholds not to be exceeded in all circumstances.

Buildings can be designed to achieve specific levels of insulation against external noise. It is reasonable, therefore, to set specific internal noise standards as the test of whether a development satisfies the requirements of the NPPF and the aims of the NPSE. In essence, these require a high quality design that achieved a good standard of amenity.

Guidance in respect of indoor ambient noise levels is contained in Table 4 of BS 8233:2014 and tabulated below:

Table B-1 Table 4 of BS8233:2014

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

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.

The previous edition of BS 8233 included quantitative guidance with respect to night-time L_{Amax} noise levels in bedrooms. BS 8233:2014 does not provide such guidance, however in paragraph 7.7.5.1.1 it is noted that the recommendations for ambient noise in hotel bedrooms are similar to those for living accommodation and Table H.3 in Annex H.3 gives example night-time L_{Amax} limits in hotel bedrooms of 45-55 dB.

The WHO study informing the 1999 Guidelines derived the L_{Amax} night time noise standard on the basis of 10 to 15 occurrences per night.

B.4. City of Westminster Guidance

The Draft Noise Technical Guidance Note (September 2020) issued by City of Westminster sets out noise thresholds for residential development, which are derived from the above BS 8233 and WHO guidance. These noise thresholds are set out below:

Table B-2 City of Westminster Noise Technical Guidance Note Noise Thresholds

Location	07:00 to 23:00	23:00 to 07:00
All rooms	35 dB $L_{Aeq,16hr}$	-
Bedroom	30 dB $L_{Aeq,8hr}$	30 dB $L_{Aeq,8hr}$, 45 dB L_{Amax}[1]

[1]to be exceeded no more than 15 times per night-time from sources other than emergency sirens.

Appendix C. Time History of Measured Levels

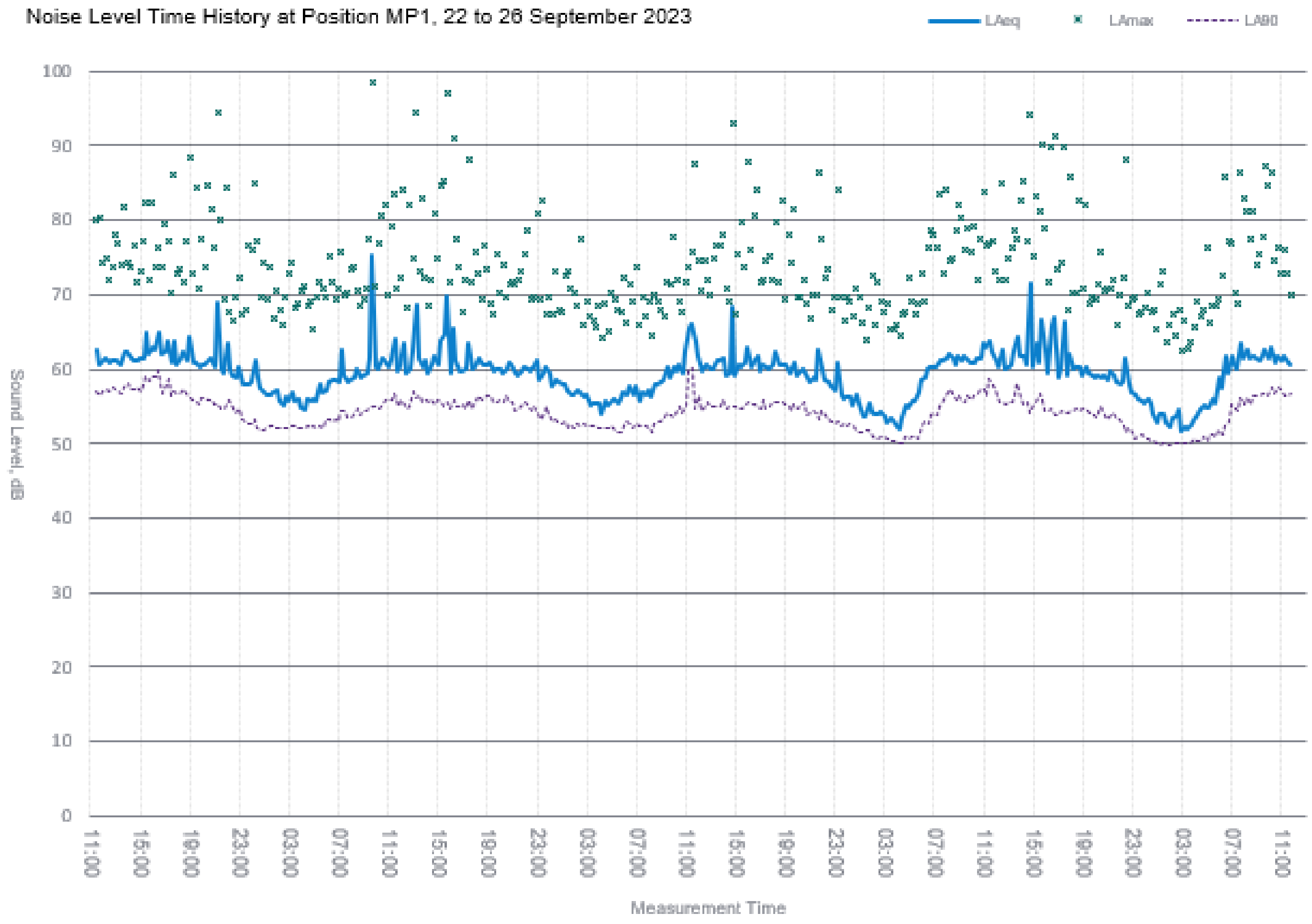

Figure C-1 MP1 (Rochester Row) Time History

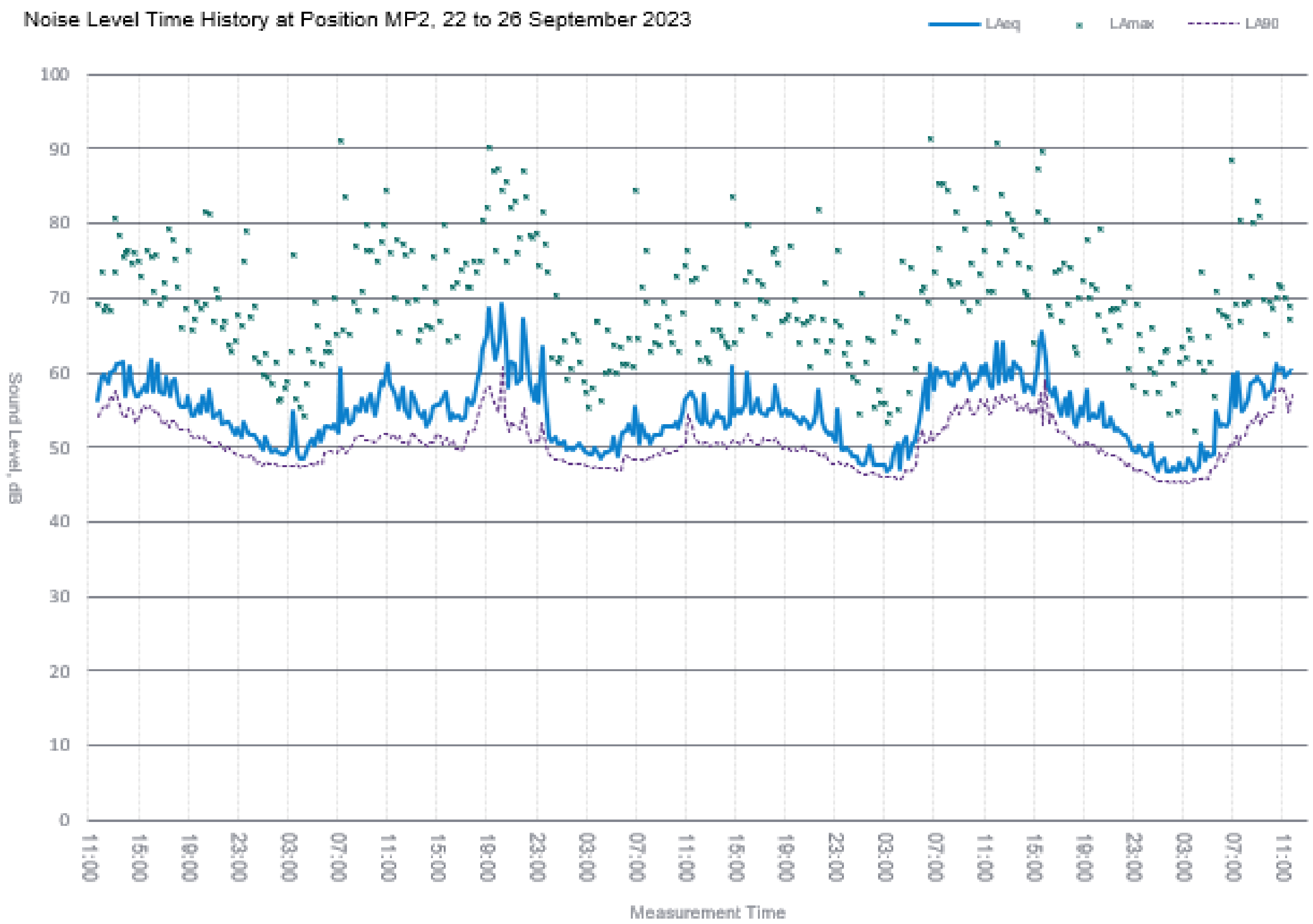

Figure C-2 MP2 (Greencoat Place) Time History

James Whiddett-Turle
AtkinsRealis
Woodcote Grove
Ashley Road
Epsom
KT18 5BW