

SANDY BROWN

Consultants in Acoustics, Noise & Vibration

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Bonded Warehouse, Manchester

Acoustic planning report

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Summary

Sandy Brown has been commissioned by Manchester Quays Limited to provide an acoustic planning report in relation to the proposed refurbishment of the Bonded Warehouse, Quay Street, Manchester, M60 9EA.

Most recently the building has been used as B1 offices. It is proposed that the use classes for the development change to:

- Level 1: approximately half the floorplate to remain as B1 office, with the remainder changing to class E light industrial / drinking establishment / leisure, which would include the introduction of music studios
- Level 2: approximately half the floorplate to remain as B1 office, with the remainder changing to class E drinking establishment / leisure / cafe / restaurant,
- Level 3: generally B1 office with a small area of class E retail / cafe / restaurant
- Level 4 to Level 6 remain as B1 office.

An environmental noise survey has been carried out with a view to determining the existing background noise levels in the area and setting appropriate plant noise limits in line with the requirements of Manchester City Council (MCC). The noise survey was performed between 7 March 2014 and 18 March 2014 and originally presented as part of the Old Granada Studios assessment in SBA report 14105-R01-C *Acoustic assessment report*.

Additional attended sample measurements were performed in June 2015 and August 2017 at key positions around the site.

Based on the requirements of Manchester City Council and on the results of the noise survey, the relevant plant noise limits at the most affected nearby sensitive premises have been set. Additionally, based on the measured background noise levels in the vicinity of the site and surrounding noise sensitive premises, external noise limits for internal amplified sound have been set.

There will be café and restaurant uses (Class E) at Level 2 and Level 3. Noise transfer to the vertical and horizontally adjacent office space will be operationally managed to ensure that any disturbance is minimised. Internal limits have been set to ensure that operational noise egress from these units does not exceed the requirements of MCC at the existing nearest external noise sensitive receptors.

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1 Introduction

Sandy Brown has been commissioned by Manchester Quays Limited to provide an acoustic planning report in relation to the proposed development at the Bonded Warehouse, Quay Street, Manchester, M60 9EA.

An environmental noise survey has been carried out at the site, the purpose of which was to establish the existing background noise levels in the vicinity of nearby noise sensitive premises. Additional sample noise measurements have been performed at a number of locations around the site to help in the assessment of noise in relation to this development and the greater St John's masterplan.

This report presents the survey method, results of the environmental noise survey, results from the acoustic testing and a discussion of acceptable limits for noise emission from building services plant and amplified sound.

2 Site description

2.1 The site and its surroundings

The Bonded Warehouse is on the site of the former Granada Studios. Each level of the building is currently registered as office (B1). It is proposed to change the use of units within Level 1 to Level 3. The proposals indicate different uses within the building as follows:

- Level 1: Approximately half the floor plate is to remain as B1 offices (B1), with the remainder designated as light industrial / drinking establishment / leisure (B2/A4/D2/E). This would include the introduction of music studios
- Level 2: Approximately 50% of the floorplate to be club house dining/ drinking (E), with the rest as work spaces and meeting rooms (B1)
- Level 3: Majority of the floorplate to remain as office (B1) with a small area of retail / cafe / restaurant (A1/A3/E)
- Level 4-Level 6 are intended to remain as offices (B1).

The site location (in orange, towards the centre of the image) is shown in Figure 1 in relation to its surroundings.



Figure 1 Site map (courtesy of Google Earth Pro)

2.2 Adjacent premises

The nearby existing sensitive premises (NSP) are indicated in Figure 1. NSP 1 refers to the Marriott Hotel on Water Street. NSP 2 refers to residential buildings along Lower Byrom Street and Atherton Street, and the proposed Manchester Grande Hotel. NSP 3 refers to various residential buildings along Liverpool Road. NSP 4 refers to the residential properties between Byrom Street and Lower Byrom Street. NSP 5 is the Museum of Science and Industry.

The Bonded Warehouse sits in the centre of the St John's Masterplan with proposed developments to the north, east and west of the site; these are highlighted red in Figure 1. Where developments include residential premises, they are shaded red in the image.

The Factory cultural centre is proposed directly to the west of the Bonded Warehouse. To the north-west, two residential towers are proposed; St John's Living Tower 1 and 2. To the north of the site is the proposed Central Village Enterprise Cluster, currently under development, and Central Village residential scheme. To the north-east is the redevelopment of the Old Granada Studios buildings, also currently under development. To the east of the site are the proposed buildings associated with the South Village development.

3 Method

Details of the equipment used, the noise indices and the weather conditions during the survey are provided in Appendix A. Further information on the specific survey method is provided in this section.

3.1 Unattended measurements

Three continuous unattended noise surveys were undertaken at the site to determine the existing noise levels in the vicinity of the site and nearby noise sensitive premises. These are indicated in Figure 1 as positions A to C.

3.1.1 *Marriott Hotel*

A 3 day continuous unattended noise survey was undertaken at position A to determine the existing noise levels in the vicinity of the Marriott Hotel. The unattended measurements were performed over 5 minute periods between 14:48 on 7 March 2014 and 08:38 on 10 March 2014.

The microphone was positioned on the roof of the medical centre at first floor level. This location was chosen to be representative of the background noise levels experienced at the Marriott Hotel. These measurements can also be used for the assessment of noise egress to St John's Living Tower 1 and Tower 2 and the Central Village Enterprise Cluster which includes two floors of residential accommodation.

3.1.2 *Liverpool Road*

A 4 day continuous unattended noise survey was undertaken at position 2 to determine the existing noise levels in the vicinity of the residential properties along Liverpool Road and the Museum of Science and Industry. The unattended measurements were performed over 5 minute periods between 14:24 on 14 March 2014 and 14:14 on 18 March 2014.

The microphone was positioned out of a sixth storey window in the Bonded Warehouse. This location was chosen to be reasonably representative of the background noise levels experienced at the premises on Liverpool Road adjacent to the site. These measurements can also be used to assess noise egress to The Factory.

3.1.3 *Lower Byrom Street*

A 3 day continuous unattended noise survey was undertaken at position 3 to determine the existing noise levels in the vicinity of the residential properties around Lower Byrom Street. The unattended measurements were performed over 5 minute periods between 16:51 on 14 March 2014 and 17:31 on 17 March 2014.

The microphone was positioned out of a third storey window in the HQ building facing lower Byrom Street. This location was chosen to be representative of the background noise levels experienced at the dwellings in this area. These measurements can also be used to assess noise egress to South Village.

3.2 Attended measurements

Attended sample measurements were performed on 11 and 12 June 2015 by Jose Maria Gonzalez at a number of locations around the site. These are indicated in Figure 1 as positions 1 to 3. Additional measurements were carried out on 16 August 2017 at positions 2 and 4 by Ben Phillips.

The attended measurements were carried out over 5 minute periods, with the purpose of determining the existing noise levels from road traffic, pedestrians and other significant noise sources in the area.

In each case the microphone was mounted on a tripod approximately 1.5 m above the ground level and within approximately 3 m of the facade of an adjacent building. It should be noted that measurements at position 4 were screened from the surrounding road network and Water Street was closed during the 2017 measurements.

3.3 Sound insulation

The airborne sound insulation of the existing floors has been carried out in February 2015, June 2015 and August 2017 between areas where potentially noisy activities are adjacent to proposed offices. During the 2015 testing, the building was derelict but internal partitions were still in place. During the 2017 testing, the strip-out of the internals was near completion and the majority of internal partitions and doors had been removed.

3.3.1 Test location conducted in 2015

The locations of the internal ambient noise level measurements and sound insulation tests undertaken in February and June 2015 are detailed in Figure 2 to Figure 4. Tests were carried out with the internal partitions and doors installed.

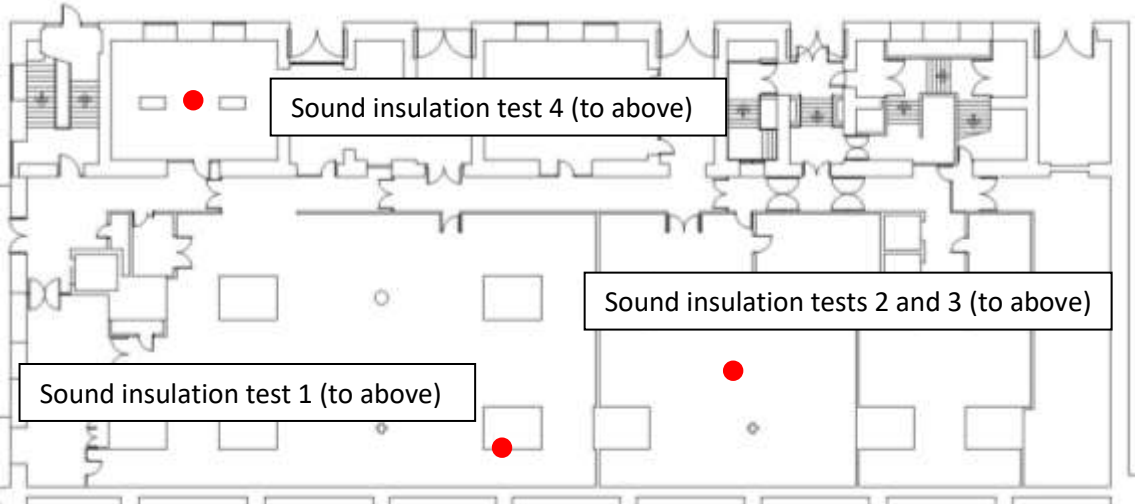


Figure 2 Test locations – Existing upper ground floor plan

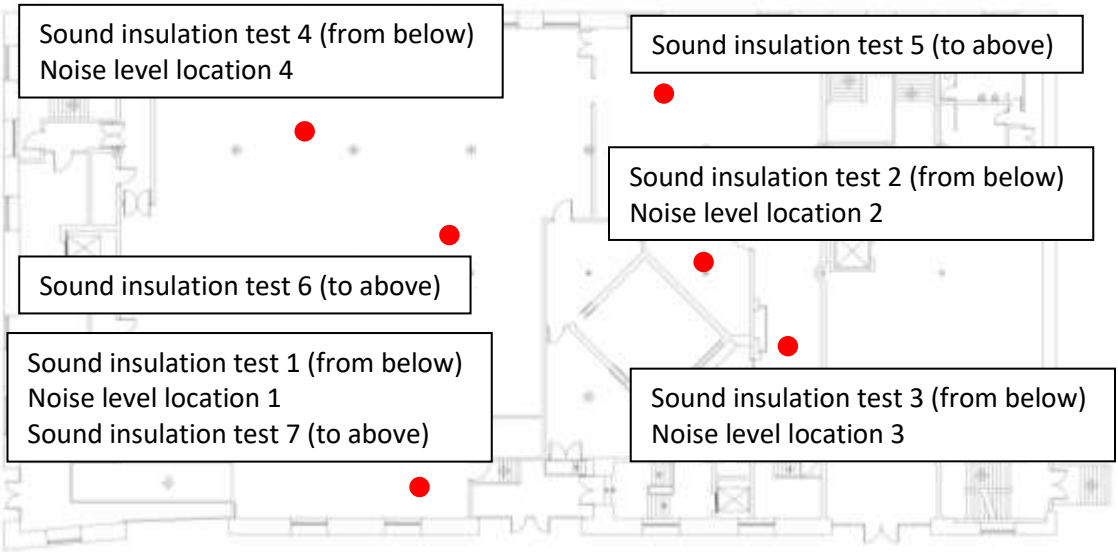


Figure 3 Test locations – Existing first floor plan

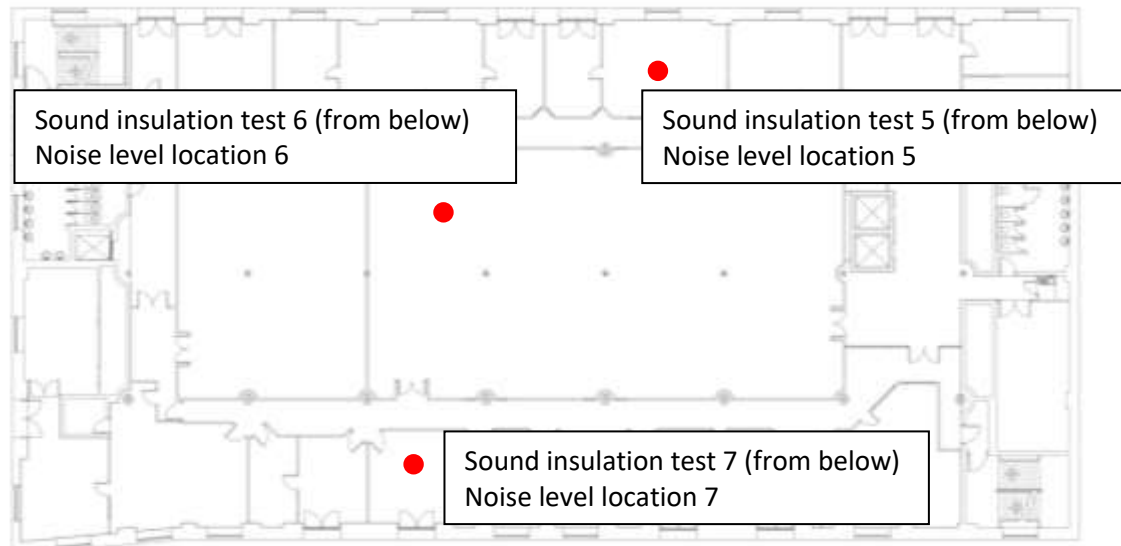


Figure 4 Test locations – Existing second floor plan

3.3.2 Testing conducted in 2017

The locations of the sound insulation tests undertaken in August 2017 are detailed in Figure 5 and Figure 6. Tests were carried out in the stripped out building. The images below have been edited to reflect the conditions on site.

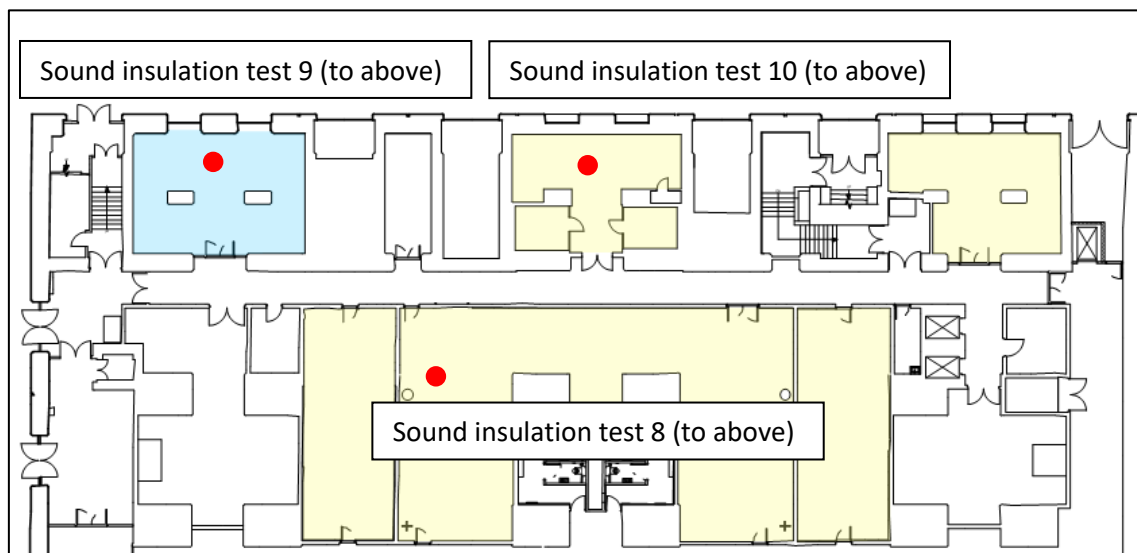


Figure 5 Test locations – 2017 Level 1 floor plan

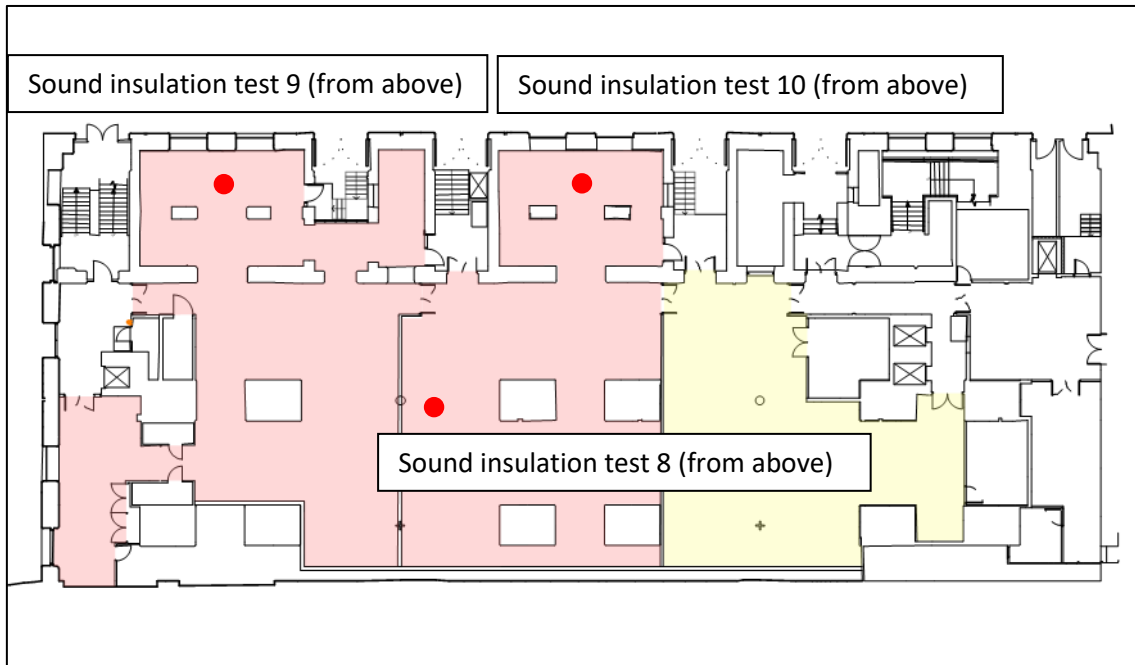


Figure 6 Test locations – 2017 Level 2 floor plan

4 Measurement results

4.1 Observations

4.1.1 External noise climate

The dominant noise sources observed at the site during the survey consisted of the following:

- Constant road traffic noise from Trinity Way
- Road traffic noise from Water Street (apart from in August 2017 when the road was closed)
- Train passes on the Ordsall Junction railway lines.

Less significant noise sources included pedestrians passing by, distant demolition works, and local pedestrians.

4.1.2 Internal sound insulation

The sound insulation of existing floors was limited by the floor construction and gaps between the floor and the facade/internal structural elements.

4.2 Unattended measurement results

The results of the unattended noise measurements are summarised in the following tables. Graphs showing the results of the unattended measurements are provided in Appendix B.

In line with BS 4142:2014 and MCC noise egress criteria, for the purpose of analysis and establishing representative background sound levels, day and night time typical levels have been quantified using statistical analysis from the continuous logging measurements.

Daytime and night time statistical analysis of representative values for each of the unattended noise monitoring locations around the site are given in Appendix C, the results of which are summarised in the following sections.

4.2.1 Position A

The day and night time ambient noise levels measured at position A, near the Marriott Hotel, are presented in Table 1.

Table 1 Ambient noise levels measured during the survey at position A

Date	Daytime (07:00 – 23:00)	Night (23:00 – 07:00)
	$L_{Aeq,16h}$ (dB)	$L_{Aeq,8h}$ (dB)
Friday 7 March 2014	56 *	52
Saturday 8 March 2014	55	52
Sunday 9 March 2014	54	53
Monday 10 March 2014	56 *	-

* Measurement not made over full period due to monitoring start and end time

In line with BS 4142:2014 and the requirements of MCC, for the purpose of analysis and establishing representative background sound levels, day and night time typical levels have been quantified using statistical analysis from the continuous logging measurements.

Daytime and night time statistical analysis of representative values for position A are given in Figure 7 and Figure 8.

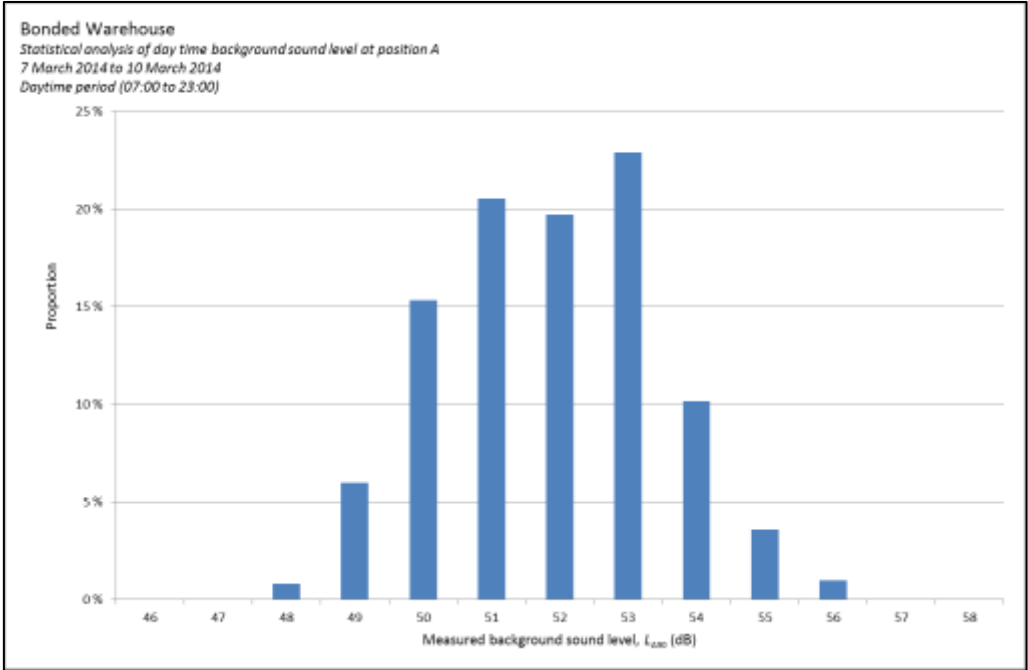


Figure 7 Position A – Statistical analysis of daytime background sound levels

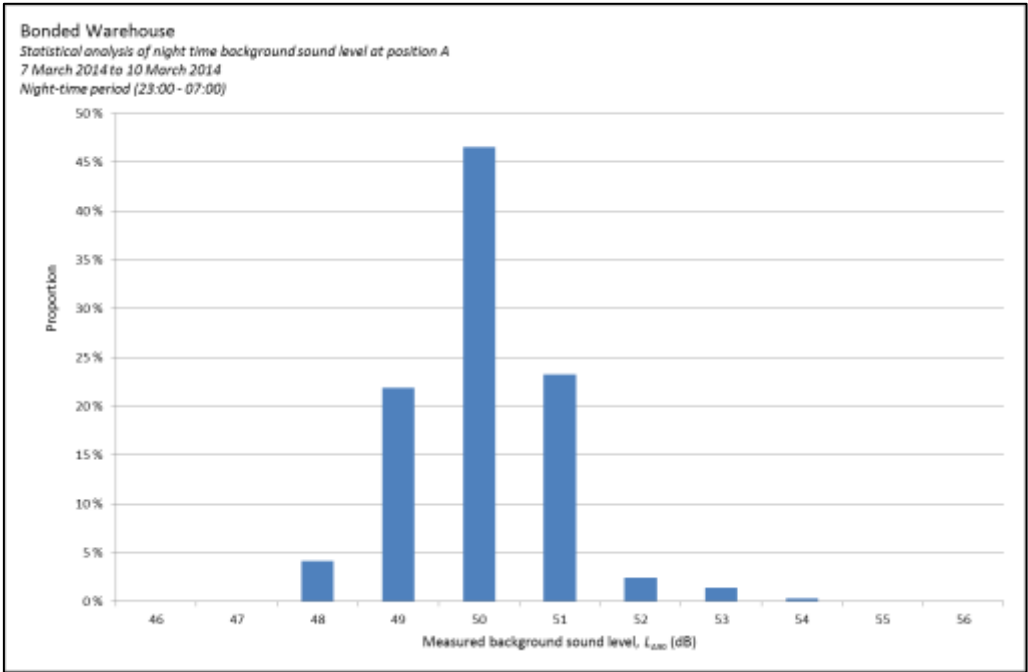


Figure 8 Position A – Statistical analysis of night time background sound levels

Based on the results of the statistical analysis, the typical background sound level at position A are L_{A90} 51 dB during the daytime and L_{A90} 50 dB at night.

The typical average octave band sound pressure levels corresponding to the representative background sound level, L_{A90} (dB), are provided in Table 2.

Table 2 Indicative octave band background noise levels measured at position A

Time of day	Indicative background noise level, $L_{90,5min}$ (dB)						
	Octave band centre frequency (Hz)						
	63	125	250	500	1k	2k	4k
Daytime (07:00-23:00)	52	51	50	49	47	39	29
Night (23:00-07:00)	48	50	49	50	45	40	32

4.2.2 Position B

The day and night-time ambient noise levels measured at position B are presented in Table 3.

Table 3 Ambient noise levels measured during the survey at position B

Date	Daytime (07:00 – 23:00)	Night (23:00 – 07:00)
	$L_{Aeq,16h}$ (dB)	$L_{Aeq,8h}$ (dB)
Friday 14 March 2014	58 *	54
Saturday 15 March 2014	58	53
Sunday 16 March 2014	57	53
Monday 17 March 2014	58	54
Tuesday 18 March 2014	60 *	-

* Measurement not made over full period due to monitoring start and end time

Daytime and night-time statistical analysis of representative values for position B are given in Figure 9 and Figure 10.

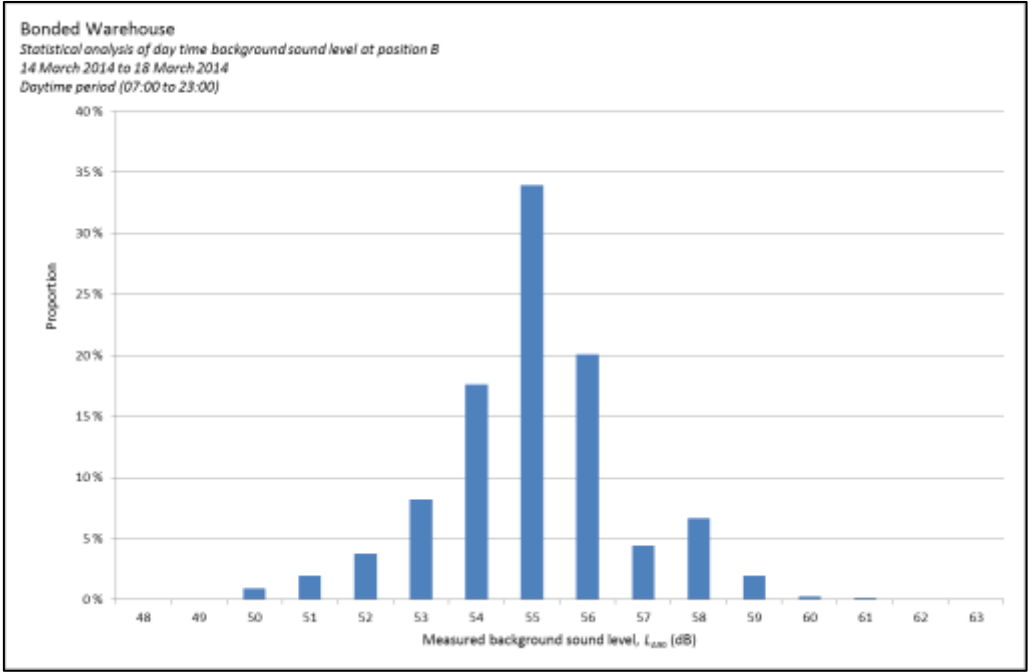


Figure 9 Position B – Statistical analysis of daytime background sound levels

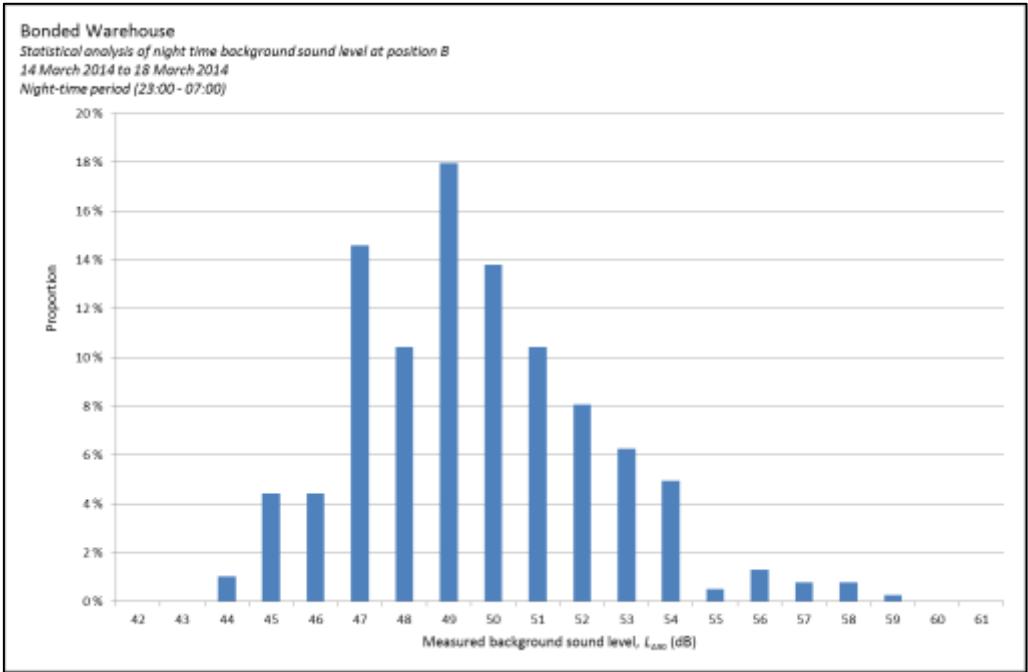


Figure 10 Position B – Statistical analysis of night time background sound levels

Based on the results of the statistical analysis, the typical background sound level at position B are L_{A90} 55 dB during the daytime and L_{A90} 47 dB at night.

The typical average octave band sound pressure levels corresponding to the representative background sound level, L_{A90} (dB), are provided in Table 4.

Table 4 Indicative octave band background noise levels measured at position B

Time of day	Indicative background noise level, $L_{90,5min}$ (dB)						
	Octave band centre frequency (Hz)						
	63	125	250	500	1k	2k	4k
Daytime (07:00-23:00)	58	54	53	49	53	47	32
Night (23:00-07:00)	52	49	47	42	44	38	23

4.2.3 Position C

The day and night-time ambient noise levels measured at position C, near Lower Byrom Street, are presented in Table 5.

Table 5 Ambient noise levels measured during the survey at position C

Date	Daytime (07:00 – 23:00)	Night (23:00 – 07:00)
	$L_{Aeq,16h}$ (dB)	$L_{Aeq,8h}$ (dB)
Friday 14 March 2014	57 *	53
Saturday 15 March 2014	57	55
Sunday 16 March 2014	58	51
Monday 17 March 2014	59 *	-

* Measurement not made over full period due to monitoring start and end time

Daytime and night-time statistical analysis of representative values for position A are given in Figure 11 and Figure 12.

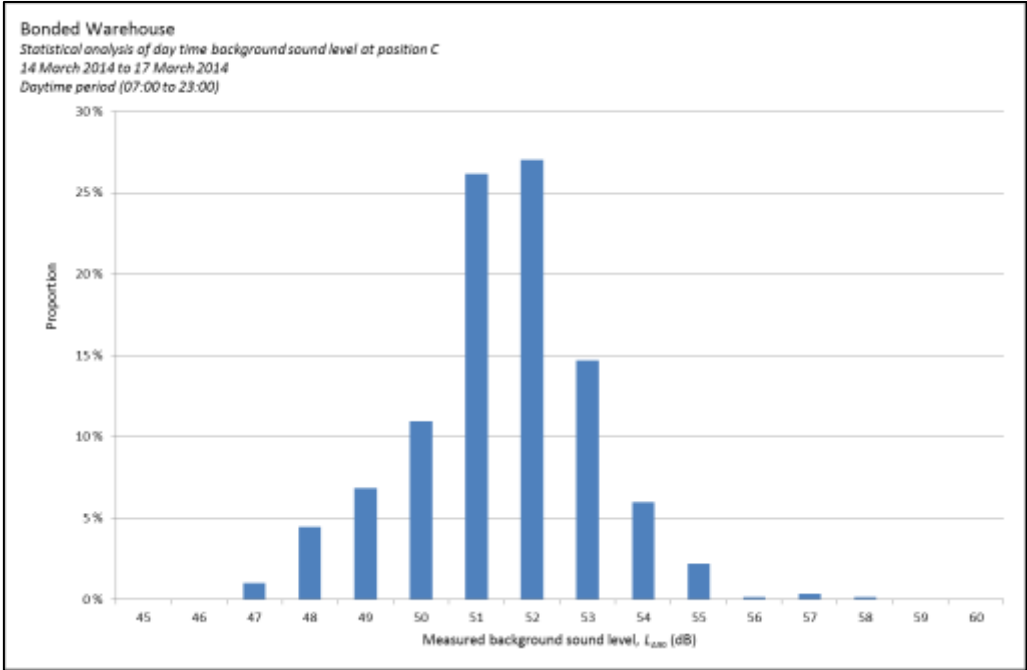


Figure 11 Position C – Statistical analysis of daytime background sound levels

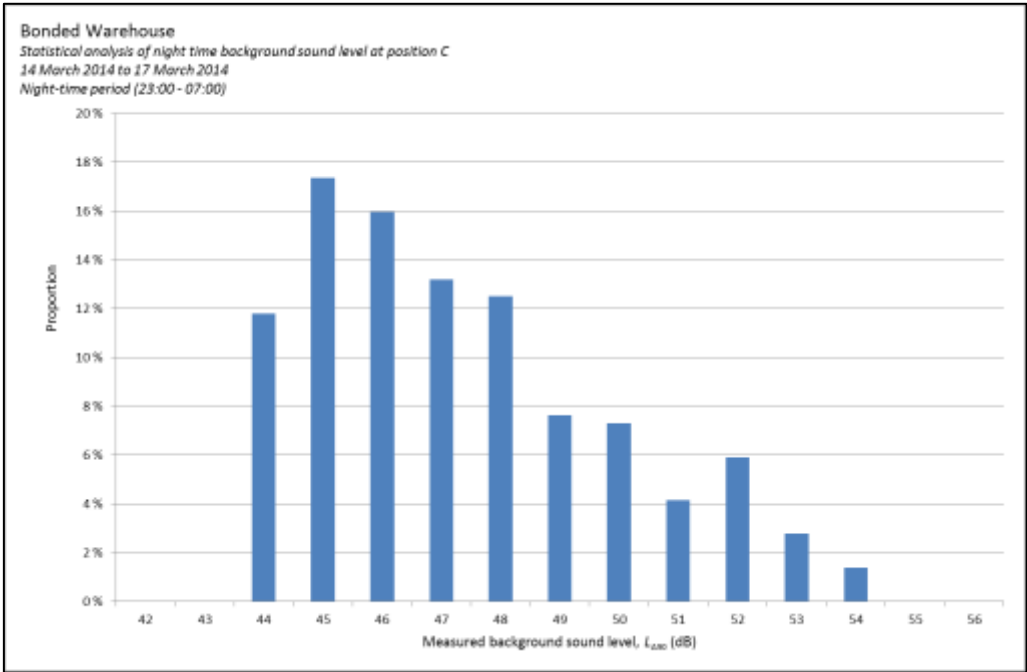


Figure 12 Position C – Statistical analysis of night time background sound levels

Based on the results of the statistical analysis, the typical background sound level at position C are L_{A90} 51 dB during the daytime and L_{A90} 45 dB at night.

The typical average octave band sound pressure levels corresponding to the representative background sound level, L_{A90} (dB), are provided in Table 6.

Table 6 Indicative octave band background noise levels measured at position C

Time of day	Indicative background noise level, $L_{90,5min}$ (dB)						
	Octave band centre frequency (Hz)						
	63	125	250	500	1k	2k	4k
Daytime (07:00-23:00)	34	38	39	44	48	44	37
Night (23:00-07:00)	33	37	35	38	42	38	32

4.3 Attended measurement results

4.3.1 Daytime measurement results

The sound pressure levels recorded during the daytime attended measurements are summarised in Table 7 to Table 10 along with the dominant noise sources noted.

Table 7 Sound pressure levels from attended measurements at position 1

Date	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
11 Jun 15	17:44	68	83	56	Road traffic noise along Water Street, aircraft overhead, pedestrians, slamming doors.
	17:49	68	81	58	
	17:54	68	83	58	

Table 8 Sound pressure levels from attended measurements at position 2

Date	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
12 Jun 15	15:53	58	67	54	Cars passing by along Atherton Street, distant road traffic from New Quay Street, distant demolition works, pedestrians.
	15:58	59	74	53	
	16:03	60	72	55	
17 Aug 17	18:59	59	86	52	

Table 9 Sound pressure levels from attended measurements at position 3

Date	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
12 Jun 15	16:11	68	80	52	Cars passing by along Lower Byron Street, distant plant, distant road traffic from New Quay Street, distant demolition works, pedestrians.
	16:16	66	78	50	
	16:22	70	84	53	

Table 10 Sound pressure levels from attended measurements at position 3

Date	Start time	Sound pressure levels (dB)			Noise sources
		$L_{Aeq,5min}$	$L_{AFmax,5min}$	$L_{A90,5min}$	
17 Aug 17	18:27	47	57	44	Distant road traffic on Trinity Way, construction noise from Ordsall Chord, distant sirens
	18:33	48	61	44	
	18:39	47	54	45	

4.3.2 Comments on external noise climate

An analysis of the results from the unattended survey, performed in March 2014, the attended measurements performed in June 2015, and the attended measurements from August 2017 has been carried out. Generally, the noise climate is very similar between survey dates except for the unattended measurements at position B in March 2014 and the attended measurement at position 4 in August 2017. This difference is believed to be due to the Water Street road closure in August 2017 and additional screening at the sample measurement location.

4.4 Internal sound insulation

4.4.1 Sound insulation

The airborne sound insulation performance of the separating floor between Level 3 and Level 4 was measured in three locations in February 2015. The airborne sound insulation performance of the floor separating Level 2 and Level 3 was measured in four locations in June 2015. The airborne sound insulation performance of the floor between Level 1 and Level 2 was measured in three locations in August 2017.

Results of the airborne sound insulation measurements are given in Table 11.

Observations on-site indicate:

- The airborne sound insulation of the separating floor (first floor) for test 1 is limited by flanking sound transmission via internal masonry walls.
- The airborne sound insulation of the separating floor (first floor) for test 4 is limited by local weaknesses which include holes in the floor and gaps where the floor meets the facade (photographs of the weaknesses are provided in Appendix D)
- The airborne sound insulation of the separating floor (second floor) for tests 5 and 7 is limited by flanking sound transmission via the facade.
- The airborne sound insulation of the separating floor between Level 1 and Level 2 was limited by the floor, with high frequency sound transmission through gaps at the facade and structural columns.

Table 11 Measured airborne sound insulation

Test	Airborne sound insulation, $D_{nT,w}$ (dB)
Level 2 to Level 3 – June 2015	
Test 1	51 ¹
Test 2	58 ¹
Test 3	53 ¹
Test 4	43
Level 3 to Level 4 – February 2015	
Test 5	56 ²
Test 6	60
Test 7	53
Level 1 to Level 2 – August 2017	
Test 8	37 ³
Test 9	32 ³
Test 10	43 ³

¹ Measured sound insulation performance limited by background noise above 2 kHz

² Measured sound insulation performance limited by background noise above 800 Hz

³ Reverberation time measurements in the receiving space could not be conducted due to site conditions; reverberation measurements taken from source position 2 which provides similar acoustic conditions have been used in calculating the $D_{nT,w}$.

5 Building services noise egress limits

5.1 Standard guidance

Guidance for noise emission from proposed new items of building services plant is given in BS 4142: 2014 '*Methods for rating and assessing industrial and commercial sound*'.

BS 4142 provides a method for assessing noise from items such as building services plant against the existing background sound levels at the nearest noise sensitive.

BS 4142 suggests that if the noise level is 10 dB or more higher than the existing background sound level, it is likely to be an indication of a significant adverse impact. If the level is 5 dB above the existing background sound level, it is likely to be an indication of an adverse impact. If the level does not exceed the background level, it is an indication of having a low impact.

If the noise contains 'attention catching features' such as tones, bangs etc, a penalty, based on the type and impact of those features, is applied.

5.2 Local Authority criteria

Manchester City Council (MCC) provides guidance in relation to plant noise emissions in *Planning and Noise Technical Guidance* (December 2015), which states the following in relation to plant noise egress:

'The development should be designed so as to achieve a rating level of 5 dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.'

Corrections for tonal or attention catching characteristics would need to be applied to the rating level in accordance with BS4142:2014.

5.3 Plant noise limits

5.3.1 Basic limits

Based on the above criteria, the cumulative noise level resulting from the operation of all new plant should not exceed the limits set out in Table 12.

Table 12 Plant noise limits at 1 m from the nearest noise sensitive premises

Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, L_{Aeq} (dB)
<i>Near the Marriot Hotel, St John's Living Tower 1 and Tower 2, Central Village Enterprise Cluster and Residential accommodation</i>	
Daytime (07:00-23:00)	46
Night-time (23:00-07:00)	45
<i>Liverpool Road, The Factory, The Museum of Science and Industry</i>	
Daytime (07:00-23:00)	50
Night-time (23:00-07:00)	44
<i>Lower Byrom Street, South Village</i>	
Daytime (07:00-23:00)	46
Night-time (23:00-07:00)	40

The limits set out in Table 12 do not include any attention catching features. The penalties for attention catching features may be significant, and will need to be considered as the building services design progresses. This is discussed further in Section 5.3.2.

5.3.2 Attention catching features

If the proposed plant noise contains attention catching features (such as tonal elements, whines, whistles, bangs etc), the plant should be designed to achieve a limit below those set out above, based on the type and impact of the features.

If appropriate, a subjective assessment of the plant features can be adopted. Where the plant noise contains tonal elements, the following corrections can be made depending on how perceptible the tone is at the noise receptor:

- 0 dB where the tone is not perceptible
- 2 dB where the tone is just perceptible
- 4 dB where the tone is clearly perceptible
- 6 dB where the tone is highly perceptible

Where the plant noise is impulsive, the following corrections can be made depending on how perceptible the impulsivity is at the noise receptor:

- 0 dB where the impulse is not perceptible
- 3 dB where the impulse is just perceptible
- 6 dB where the impulse is clearly perceptible
- 9 dB where the impulse is highly perceptible

For noise which is equally both impulsive and tonal, then both features can be taken into account by linearly summing the corrections for both characteristics.

If the plant has other distinctive characteristics, such as intermittency, then a 3 dB correction can be made.

If a subjective assessment is not appropriate then an objective assessment can be made. A noise source is deemed to be tonal if the time averaged sound pressure level in a one-third octave band exceeds the level in adjacent one-third octave bands by the level differences given below:

- 15 dB in the low frequency one-third octave bands (25 Hz to 125 Hz)
- 8 dB in the mid frequency one-third octave bands (160 Hz to 400 Hz)
- 5 dB in the high frequency one-third octave bands (500 Hz to 10000 Hz)

If an objective assessment identifies the plant noise to be tonal then a 6 dB correction must be made.

5.4 Assessment

At this stage, no information is available in relation to the proposed installation of building services plant, and this will need to be assessed in detail as the design progresses. However, all plant items will be designed to achieve the plant noise limits set out above, including any corrections for attention catching features.

6 Amplified sound

6.1 External noise limits

MCC in their *Planning and Noise technical Guidance* document dated December 2015 stipulates the following in relation to amplified music associated with a new development:

Entertainment noise (L_{Aeq}) should be controlled to 10 dB below the background noise level (L_{A90}) without the entertainment noise present, in each octave band at the nearest noise sensitive location.

Based on the representative daytime and night time octave band background sound levels given in Section 4.2, suitable operational noise egress limits are provided in Table 13.

Table 13 amplified sound limits at 1 m from noise sensitive premises

Location of noise sensitive premises/Time of day	Maximum sound pressure level at 1 m from noise sensitive premises, L_{eq} (dB)						
	Octave band centre frequency (Hz)						
	63	125	250	500	1k	2k	4k
<i>Near the Marriot Hotel, St John's Living Tower 1 and Tower 2, Central Village Enterprise Cluster and Residential accommodation</i>							
Daytime (07:00-23:00)	42	41	40	39	37	29	19
Night (23:00-07:00)	38	40	39	40	35	30	22
<i>Liverpool Road, The Factory, The Museum of Science and Industry</i>							
Daytime (07:00-23:00)	48	44	43	39	43	37	22
Night (23:00-07:00) ¹	42	39	37	32	34	28	13
<i>Lower Byrom Street, South Village</i>							
Daytime (07:00-23:00)	24	28	29	34	38	34	27
Night (23:00-07:00)	23	27	25	28	32	28	22

¹ The Museum of Science and Industry is only a noise sensitive premises during the daytime

6.2 Assessment of amplified sound egress

6.2.1 Units on Level 2 and Level 3

Calculations of internal noise limits to meet the external noise limits given in Table 13 have been based on the existing facade construction of brickwork and 6 mm glazing to windows, the distance to the nearest noise sensitive premises and existing screening.

Note in some locations the glazing is boarded up, if the glazing is to be replaced, it is recommended that glazing equivalent to that already installed in the building should be used (ie, 6 mm glazing).

Based on the above, the reverberant sound pressure limits given in Table 14 would apply within the retail / cafe / restaurant units on Level 2 and Level 3.

Table 14 Internal noise limits from amplified sound to meet external noise limits at nearby noise sensitive receptors

	Octave-band centre frequency (Hz)						
	63	125	250	500	1000	2000	4000
Daytime limit, L_{eq} (dB)	91	92	93	93	92	87	78
Night-time limit, L_{eq} (dB)	91	94	94	90	93	90	76

Note the night-time limits are generally higher than the daytime limits due to the daytime limits being applicable to commercial and residential receptors and night time limits being applicable to residential receptors, which are further from the Bonded Warehouse.

6.2.2 Music and Radio studios on Level 1

One of the proposed uses for the partially underground Level 1 spaces includes music and radio studios. Amplified sound from these units will need to meet the external limits in Table 13. The location of the music and radio studios are indicated in Figure 13 with 'A' and 'B' respectively.

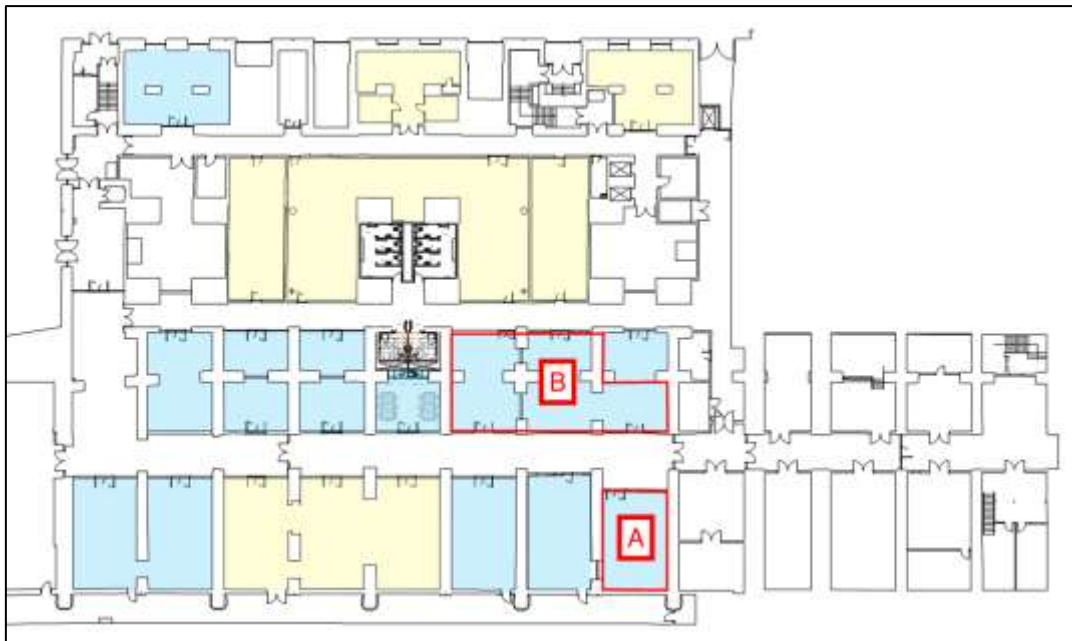


Figure 13 Location of music studio ('A') and radio studio ('B')

The studios are located within the arches at the rear of the building, therefore they are not vertically adjacent to other demises. The sound insulation performance of partitions, doors, ceilings, ventilation will require careful consideration such that noise from the units does not adversely affect adjacent units and such that noise from adjacent units is suitably controlled within the studios.

6.3 Internal noise transfer assessment

6.3.1 Internal noise criteria

Guidance on acceptable internal noise levels for various types of use relevant to the development are given in BS 8233: 2014 *Sound insulation and noise reduction for buildings – Code of practice* and *British Council for Offices Guide to Specification 2014: Best practice in the specification for offices*. These will be used to determine the required sound insulation to separating building elements. The guidance given by BS 8233 is shown in Table 15.

Table 15 Internal noise criteria for various types of use

Internal space	Design range	
	BS8233	BCO
Cellular offices	L_{Aeq} 35-40 dB	NR35
Speculative offices	-	NR38
Open-plan offices	L_{Aeq} 45-50 dB	NR40

As the proposals indicate open-plan office space with the possibility for cellular spaces, the criteria for speculative offices are considered appropriate for this scheme.

6.3.2 Guidance on internal limits

The risk of activities within one space causing disturbance to vertically adjacent occupants depends on the sound insulation provided by the separating floor, the level of amplified sound in the 'source' unit, the sensitivity to noise in the 'receiving' unit and the ambient noise level in the 'receiving' unit. Generally, the greatest risk for disturbance occurs where noisy activities are located adjacent to spaces that are sensitive to noise.

The internal ambient noise level in the office spaces were measured during the testing carried out at the site. However, the building services (such as the ventilation system) were not operational and therefore noise levels in the offices once fitted out and occupied would be expected to be higher than those measured. Therefore, basing the assessment on these levels would be overly stringent.

6.3.3 Operational management

To minimise the risk of disturbance to office workers within the Level 1, Level 2 and Level 4 commercial spaces, operational management will be implemented to ensure the internal levels do not exceed 5 dB less than those presented in Table 15 within adjacent speculative office space.

Operational management will primarily involve limiting amplified music, where it is understood the bar operators have aspirations only for relatively quiet background music.

There are no aspirations for high levels of amplified music (eg levels associated with loud bars, DJ sets or live music).

Should future incoming tenants desire high levels of amplified music, then enhancements to the floor and partitioning would need to be considered.

6.3.4 Music and radio studios

The location of the music and radio studios are indicated in Figure 13 with 'A' and 'B' respectively. They are located within the arches to the west of the development, and therefore don't have a vertical adjacency.

It is recommended that the partitions that separate the studios from the adjacent occupiable spaces have an on-site sound insulation performance of at least $D_{nT,w}$ 60 dB and an allowance be made for high performance acoustic doors. Careful consideration will also be required for the ventilation of this space which may include dedicated ventilation systems.

7 Conclusion

A noise survey has been carried out to determine the existing background noise levels in the vicinity of the site and surrounding noise sensitive premises. On the basis of the requirements of the Local Authority, the relevant plant noise limits at the most affected nearby sensitive premises have been set.

These limits are cumulative, and apply with all plant operating under normal conditions. If plant items contain tonal or attention catching features, the limits will be more stringent.

Additionally, based on the existing background noise levels in the vicinity of the site and surrounding noise sensitive premises, external noise limits for amplified sound egress have been set.

There will be café and restaurant uses (Class E) at Level 2 and Level 3. Noise transfer to the vertical and horizontally adjacent office space will be operationally managed to ensure that any disturbance is minimised. Internal limits have been set to ensure that operational noise egress from these units does not exceed the requirements of MCC at the nearest existing external noise sensitive receptors.

Where music studios are proposed, enhancements will be required to the separating partitions, doors and ventilation systems such that noise from the studios doesn't adversely affect adjacent tenant and such that noise from adjacent tenants doesn't adversely affect the use of the studio.

Appendix A

Survey details

Equipment

The calibration details for the equipment used during the survey are provided in Table A1.

Table A1 Equipment calibration data

Equipment description	Type/serial number	Manufacturer	Calibration expiry	Calibration certification number
Unattended measurement at position A and C – Measurements conducted in March 2014				
Sound level meter	NL-52/00932326	Rion	25 Nov 15	1311554
Microphone	UC-59/035549	Rion	25 Nov 15	1311554
Pre-amp	NH-25/32354	Rion	25 Nov 15	TCRT17/1087
Calibrator	NC-74/34125432	Rion	19 Feb 15	1204153
Unattended measurement at position B – Measurements conducted in March 2014				
Sound level meter	SVAN948/9365	Svantek	2 Apr 15	1304131
Microphone	SV22/4013841	Svantek	2 Apr 15	1304131
Pre-amp	SV12L/10614	Svantek	2 Apr 15	1304131
Calibrator	SV30/10569	Svantek	2 Apr 15	1304129
Sound insulation measurement in 2015 and sample measurement in June 2015				
Sound level meter	Nor118/31754	Norsonic	24 Jun 16	1207294
Microphone	40AF/62396	Gras	24 Jun 16	1207294
Pre-amp	1206/30873	Norsonic	24 Jun 16	09740
Calibrator	1251/31322	Norsonic	24 Jun 16	1207293
Sound insulation and sample measurements in August 2017				
Sound level meter	Nor118/31754	Norsonic	15 Feb 19	09740
Microphone	40AF/62396	Gras	15 Feb 19	09740
Pre-amp	1206/30873	Norsonic	15 Feb 19	09740
Calibrator	1251/31322	Norsonic	13 Feb 19	09735
All sound insulation measurements				
Loudspeaker	EON 15 G2	JBL	N/A	N/A
Noise source	MR1	Neutrik	N/A	N/A

Calibration of the sound level meters used for the tests is traceable to national standards. The calibration certificates for the sound level meters used in this survey are available upon request.

The sound level meters and microphones were calibrated at the beginning and end of the measurements using their respective sound level calibrators. No significant deviation in calibration occurred.

Noise indices

The equipment was set to record a continuous series of broadband sound pressure levels. Noise indices recorded included the following:

- $L_{Aeq,T}$ The A-weighted equivalent continuous sound pressure level over a period of time, T.
- $L_{AFmax,T}$ The A-weighted maximum sound pressure level that occurred during a given period with a fast time weighting.
- $L_{A90,T}$ The A-weighted sound pressure level exceeded for 90% of the measurement period. Indicative of the background sound level.

The L_{A90} is considered most representative of the background sound level for the purposes of complying with any local authority requirements.

Sound pressure level measurements are normally taken with an A-weighting (denoted by a subscript 'A', eg L_{A90}) to approximate the frequency response of the human ear.

A more detailed explanation of these quantities can be found in BS7445: Part 1: 2003 *Description and measurement of environmental noise, Part 1. Guide to quantities and procedures*.

Weather conditions

During the measurements obtained between 7 March 2014 and 10 March 2014, weather reports for the area indicated that temperatures varied between 2°C at night and 16°C during the day, and the wind speed was less than 11 m/s. During the measurements obtained between 14 March 2013 and 18 March 2014, weather reports for the area indicated that temperatures varied between 11°C at night and 1°C during the day, and the wind speed was less than 10 m/s.

During the attended measurements carried out on between 11 June 2015 and 12 June 2015, the weather was clear and dry and no rain occurred. Wind speeds varied between approximately 0 m/s and 2 m/s.

During the attended measurement in August 2017, the weather was clear and dry with wind speed less than 5 m/s.

These weather conditions are considered suitable for obtaining representative measurements.

Appendix B

Results of unattended measurements at position A, B and C

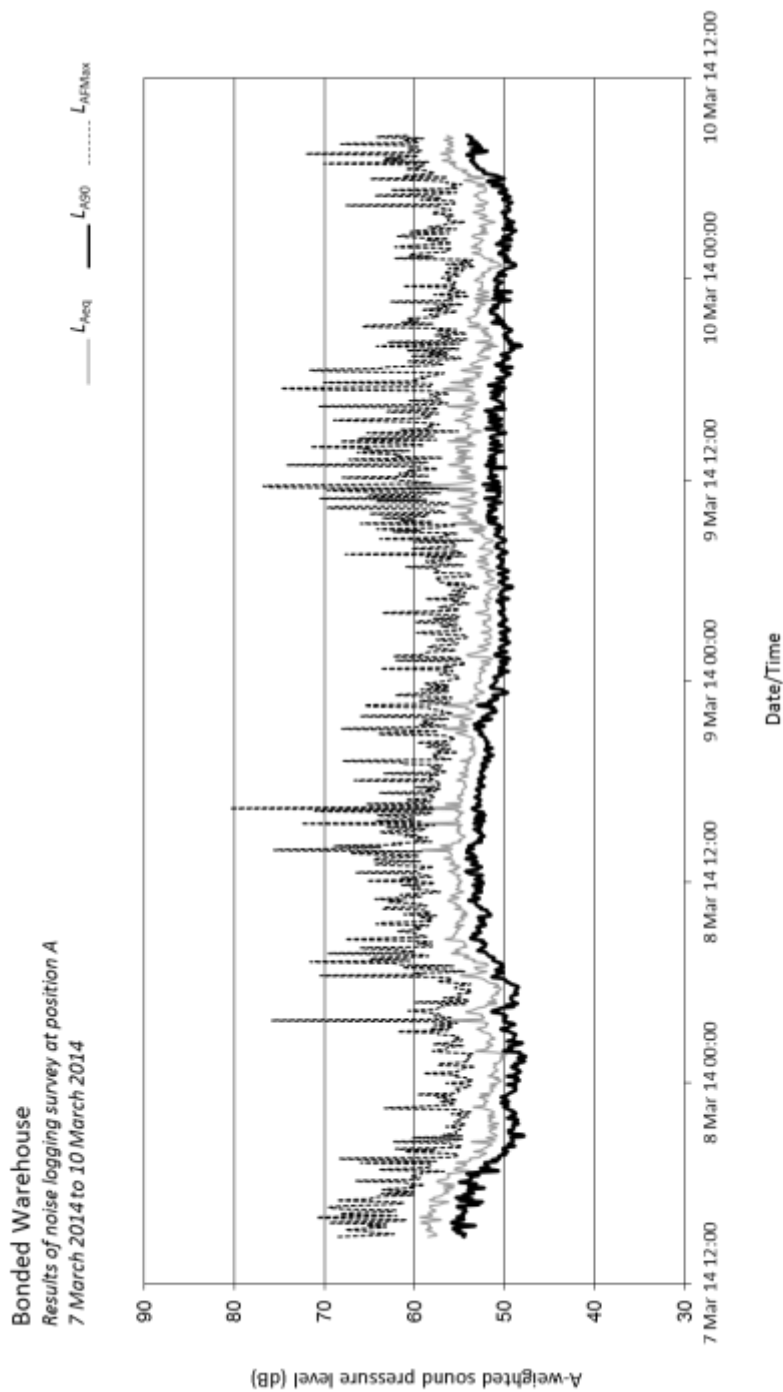


Figure B1 Results of unattended noise survey at position A

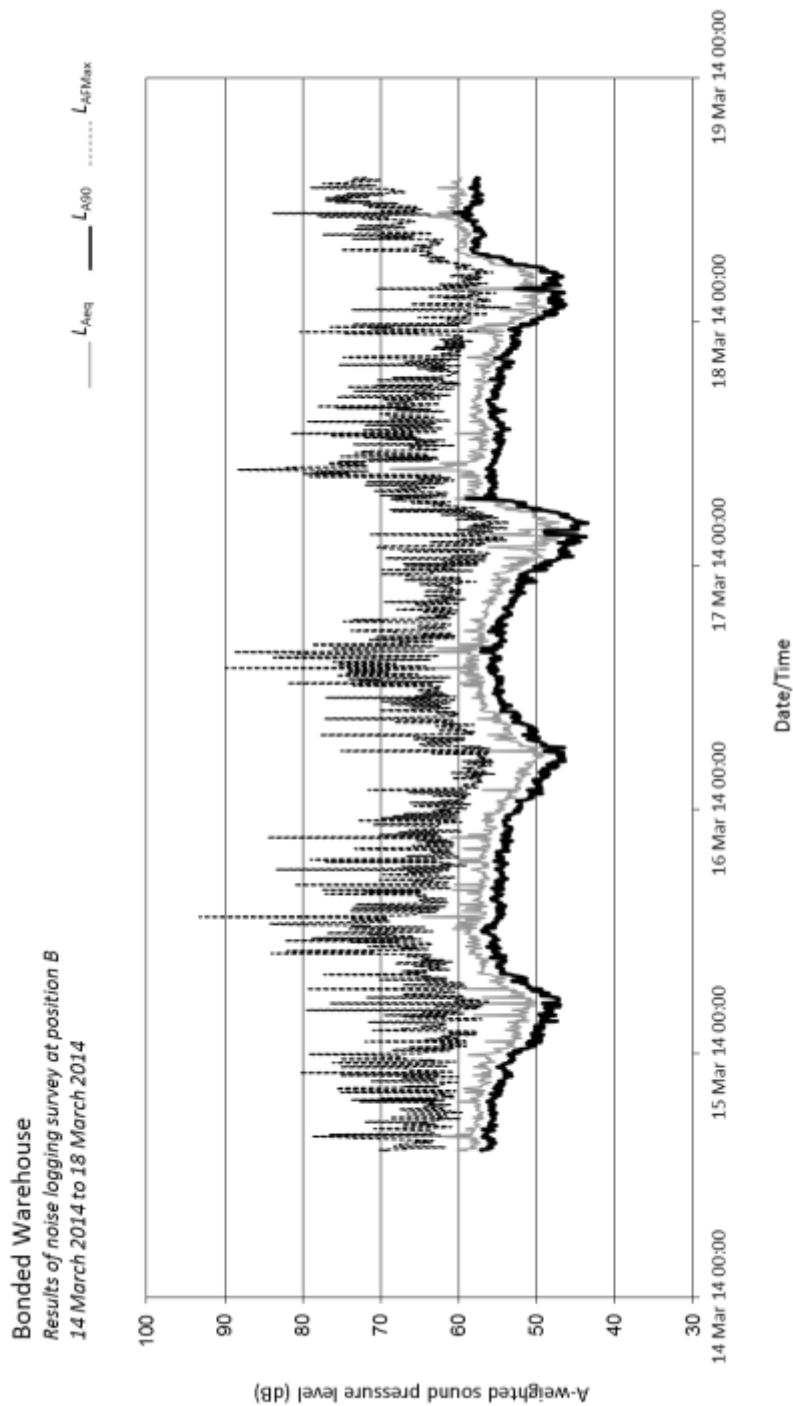


Figure B2 Results of unattended noise survey at position B

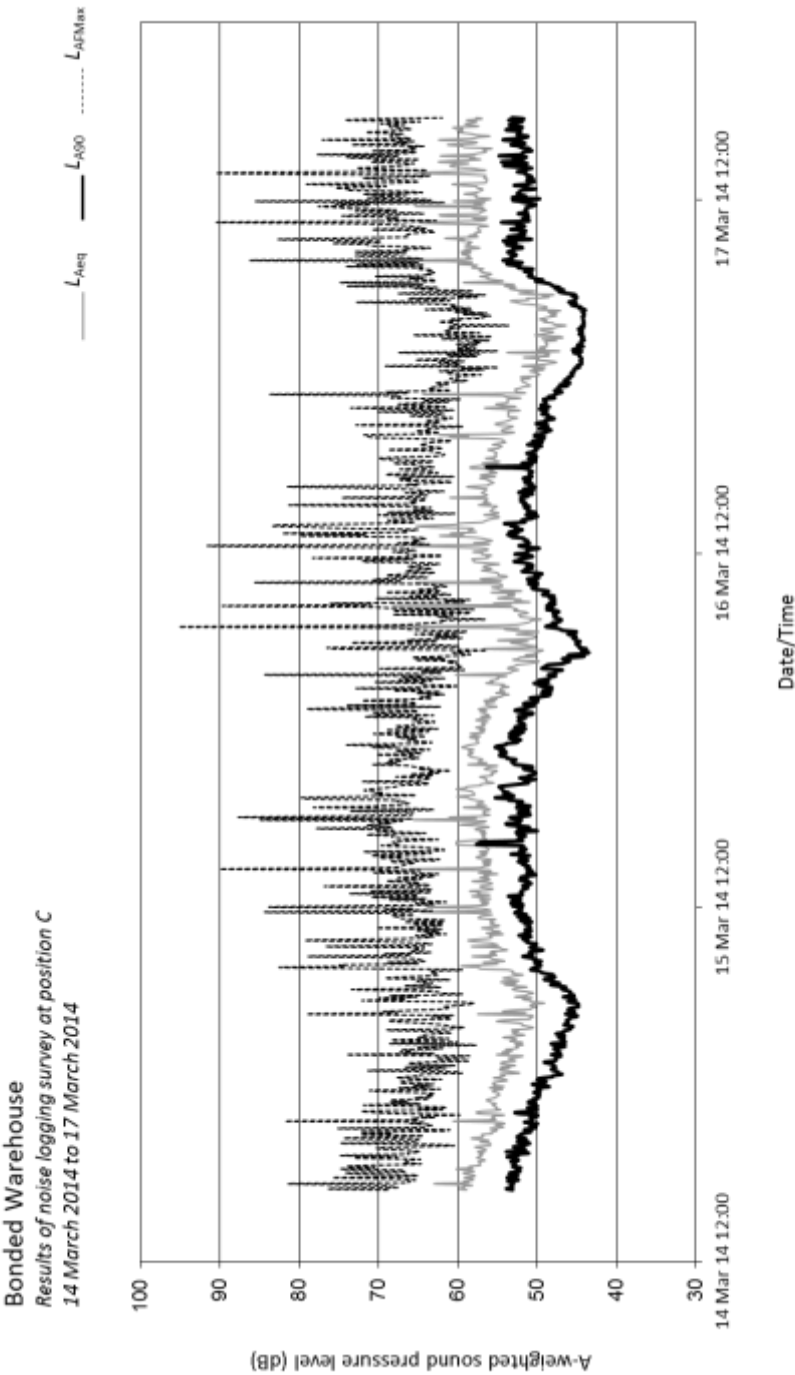


Figure B3 Results of unattended noise survey at position C