



COLIN SHENTON

**65 PRINCESS STREET,
MANCHESTER**

NOISE ASSESSMENT FOR PLANNING PURPOSES

05 February 2021

AEC REPORT: P3980/R3/RDC

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CONTENTS

	Page
1.0 INTRODUCTION	3
2.0 BACKGROUND AND SITE DESCRIPTION	3
3.0 BASIS OF ASSESSMENT	4
4.0 NOISE MEASUREMENTS	8
5.0 ASSESSMENT OF PROPOSED DEVELOPMENT	10
6.0 SUMMARY AND CONCLUSIONS	13
FIGURE 1 – Existing Site Showing Monitoring Locations	14
APPENDIX A – Acoustic Terminology in Brief	14
APPENDIX B – Noise Survey Details	17

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1.0 INTRODUCTION

- 1.1 Acoustic & Engineering Consultants Limited (AEC) has been instructed by Colin Shenton to undertake a noise assessment in relation to the proposed conversion of a former 3-storey office into a single dwelling property at 65 Princess Street, Manchester.
- 1.2 This report details the noise levels measured on site, presents the assessment criteria and discusses the implications on glazing and ventilation requirements to achieve acceptable internal noise levels to meet the Local Authority requirements.
- 1.3 Acoustic terminology is discussed in brief in Appendix A.

2.0 BACKGROUND AND SITE DESCRIPTION

- 2.1 The proposed development is located at 65 Princess Street and is situated in a row of terraced commercial buildings in Manchester's city centre near St Peter's Square, Manchester. As identified on the attached Figure 1.
- 2.2 The front elevation of the site overlooks Princess Street and St Peter's Square beyond.
- 2.3 There is a tram station on St Peter's Square and trams go past the site towards Victoria Station. It is understood that the last tram that travels through this section runs no later than 0100h, Monday – Sunday.
- 2.4 The rear elevation of the site faces onto an external courtyard area which is formed by the buildings that face Kennedy Street.
- 2.5 The building to the right of the development at 67 Princess Street is The Waterhouse public house. AEC understands that the venue has the following opening times:
 - Monday to Friday, 0800 – 0000h;
 - Saturday, Sunday, 0800 – 0100h.
- 2.6 In front of the public house on Princess Street, there is also a small external seating area, however, the operating times are unknown. It is understood that there is no external amplified music associated with the public house.
- 2.7 63 Princess Street is occupied by the Rozafa Greek restaurant. The operating times of the restaurant are unknown.
- 2.8 While the site is a 'listed building', it is understood that there is a possibility that all of the existing glazing may be replaced, and this has formed the basis of AEC's assessment.
- 2.9 It is understood that the dwelling will have an air conditioning system on the Princess Street elevation. This may result in items external mechanical plant needing to be installed within the rear courtyard of the development and a noise level limit has been set in section 5 of this report.

- 2.10 Leading out from the living / kitchen room to the rear courtyard, there is to be a small external amenity space.

3.0 BASIS OF ASSESSMENT

Determining of External Noise Levels

- 3.1 Chapters 6.2 to 6.7 of British Standard 8233:2014 '*Guidance on sound insulation and noise reduction for buildings*' (BS8233) describes how noise levels can be determined and assessed from different sources.
- 3.2 Chapter 6.5 of BS8233 provides guidance on how to assess noise from industrial and commercial sites. While this document does not mention how to assess noise from tram noise, therefore, long-term measurements were undertaken to measure a number of tram pass bys.
- 3.3 Paragraph 6.5.2 states that where industrial noise affects residential or mixed residential areas, the methods for rating noise in BS4142: 2014+A1: 2019 '*Methods for rating and assessing industrial and commercial sound*', (BS4142) should be applied.

National Planning Policy Framework

- 3.4 The latest Planning Policies are included in the National Planning Policy Framework published by the Department for Communities and Local Government and dated March 2012 and revised in February 2019. However, any sections relating to 'Noise' were updated in July 2018.
- 3.5 This planning policies which relate specifically to noise are presented in paragraphs 170, 180 and 182 which are reproduced below:

170. Planning policies and decisions should contribute to and enhance the natural and local environment by:

(e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of noise.

180. Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

(a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life ⁶⁰;

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

182. *Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.*

- 3.6 Further to the above, the Governments 'Planning Practice Guidance' dated 6 March 2014 indicates:

'Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.'

- 3.7 In addition, the guidance indicates that, whilst noise can override other planning concerns, it should not be considered in isolation from the economic, social and other environmental dimensions of any proposed development.

Local Authority Requirements

- 3.8 Manchester City Council (MCC) has outlined their requirements for noise assessments to accompany planning applications in 'Planning & Noise – Technical Guidance' (2015) (PNTG).
- 3.9 Section 3.6.1.1 of this document states "Manchester City Council has adopted the following internal limits for residential properties:
- *Bedroom (night-time – 23.00 – 07.00) 30dB_{L_{Aeq}} (individual noise events should not normally exceed 45dB_{L_{Amax,F}} by more than 15 times);*
 - *Living Rooms (daytime – 07.00 – 23.00) 35dB_{L_{Aeq}}.*
- 3.10 These levels are based on guidance presented in BS8233 and the Association of Noise Consultants (ANC) document 'ProPG: Planning and Noise - New Residential Development', 2017 (ProPG).
- 3.11 In addition to the above, ProPG assumes that the attenuation of free-field external noise levels to internal noise levels provided by a window partially open for ventilation is up to 15dB. Therefore, to ensure that whole dwelling (background) ventilation can be provided via a partially open window at the nearby properties, AEC would propose that the external noise levels outside habitable rooms should not exceed 50dB_{L_{Aeq,T}} during the daytime, and 45dB_{L_{Aeq,T}} and 60dB_{L_{Amax,F}} at night.
- 3.12 In locations where the noise has a specific character such as the patron noise associated with the public house, AEC propose that the design aim should be to achieve internal noise levels at least 5dB below those presented in above.

Ventilation & Overheating

- 3.13 The ventilation specifications presented in BS8233 and ProPG are based on achieving the requirements of Approved Document F (ADF) 'Ventilation' (2010) of the Building Regulations only.
- 3.14 ADF requires that continuous whole dwelling ventilation is provided to limit the accumulation of moisture and other pollutants originating within a building. This is typically achieved either via a partially opened window, or by a whole building ventilation system through the provision of trickle ventilators or mechanical ventilators. ADF states that '*The ventilation provisions will not necessarily meet cooling needs*'.
- 3.15 In relation to purge ventilation, ProPG suggests that as this should only occur occasionally (e.g. to remove odour from painting and decorating or from burnt food), the desired internal noise levels are not generally applicable. Therefore, internal noise levels with windows being opened for purge ventilation has not been discussed further.
- 3.16 AEC has not been presented with a thermal assessment for this development and we cannot provide a comment on if the property may be adversely affected by excessive or prolonged internal high temperatures (overheating). Therefore, the indicative overheating assessment presented in this report is only based on the noise levels measured on-site and would only apply to elevations where there is a risk of overheating, which would be determined by others.
- 3.17 In order to provide guidance on the relationship between internal noise levels and the control of overheating in residential properties, the ANC issued '*Acoustic ventilation and Overheating – Residential Design Guide*' (AVO) in January 2020. It is important to note that this is a design guide only and not a statutory document and the Local Authority may have their own requirements.
- 3.18 AEC understands that there are no specific Local Authority requirements in relation to acceptable internal noise level limits in habitable rooms with windows open to aid with the control of overheating. Therefore, this indicative assessment is based on the guidance presented AVO.
- 3.19 Table 3.3 of AVO presents guidance for allowable noise from transportation sources whilst windows are open for the control of overheating. With reference to this document AEC would propose that windows can be utilised in the control of overheating provided that the resultant internal ambient noise levels are below approximately 50dB_{L_{Aeq,16h}} during the daytime, and 42dB_{L_{Aeq,8h}} and 65dB_{L_{Amax,F}} during the night-time.
- 3.20 These internal noise levels are the upper end of the medium risk category for adverse effects. Where these internal noise levels would be exceeded, AVO states that "*noise causes a material change in behaviour (e.g. having to keep windows closed most of the time)*". In this situation, AEC would suggest alternative means for the control of overheating are considered. This would need to be in the form of either a system which provides ambient air at high ventilation rates, known as 'ventilative cooling', or a systems which provide cooler air, commonly referred to as 'comfort cooling systems'.
- 3.21 AVO states that where transportation is the main source of noise, "*it is assumed that a partially open window will provide an outside-to-inside level difference of 13dB and is*

considered representative of typical domestic rooms with simple façade openings of around 2% of the floor area”.

- 3.22 Considering the above, it is considered acceptable to control summertime heating via opening windows where external free-field noise levels are no greater than those presented in the following Table 3.1. This is based on simple façade openings to around 2% of the floor area.

Table 3.1 – External Free-Field Noise Level Limits for the Control of Overheating via Openable Windows

Activity	Location	Noise Level Limit, dB		
		Daytime 0700 – 2300h	Night-Time 2300 – 0700h	
		L _{Aeq,16h}	L _{Aeq,8h}	L _{Amax,F}
Resting	Living Room	63	-	-
Dining	Dining Room/Area	63	-	-
Sleeping (daytime resting)	Bedroom	63	55	75

Indoor Ambient Noise Level Limits from Mechanical Services

- 3.23 Where a ‘ventilative cooling’ or ‘comfort cooling’ system is required for the control of overheating, AVO states that the ‘desirable upper internal ambient noise level limit’ is 30dBL_{Aeq}, and 35dBL_{Aeq}, for bedrooms and living / dining rooms, respectively.

Atmospheric Plant Noise Emissions

- 3.24 Based on guidance presented in MCC’s document PNTG, the following is stated in relation to setting noise level limits for industrial sources, such as external services plant, at noise sensitive premises:

“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.”

External Noise Level Limits

- 3.25 For traditional external areas that are used as an amenity space, such as gardens and patios, BS8223 states that it is desirable that ambient noise levels should be not exceed 50dBL_{Aeq,16h} during the daytime, with an upper limit of 55dBL_{Aeq,16h}.
- 3.26 Furthermore, PNTG provides a limit for 50dBL_{Aeq,16h} to stop ‘*moderate annoyance*’, and an upper limit of 55dBL_{Aeq,16h} for ‘*serious annoyance*’.

4.0 NOISE MEASUREMENTS

- 4.1 An extended unattended noise level survey was undertaken by AEC on both the front (Location A, Princess Street) and rear (Location B, courtyard) over a weekend period. In both instances, the microphone was installed at 1st floor level, 1m from the façade of the existing building.
- 4.2 At Location A, noise levels were measured between 1700h on Friday 18 October, to 0700h on Monday 21 October. At Location B, noise levels were measured between 1715h on Friday 18 October, to 0645h on Sunday 20 October 2019. Full logged data over 15-minute periods is held on file by AEC and is available on request.
- 4.3 All measurements were undertaken in general accordance with BS7445-1: 2003 'Description and measurement of environmental noise. Guide to quantities and procedures'.
- 4.4 A full measurement procedure is presented in Appendix B and the measured data is presented in Graphs B1 to B5 and a summary of the daytime and night-time noise levels are presented below.

Daytime

- 4.5 Daytime noise levels at both locations were due to road traffic, trams, patrons from The Waterhouse public house and nearby pedestrians.
- 4.6 The measured noise levels at both locations are summarised in Table 4.1, below. The noise levels are presented as a full 16-hour daytime ambient noise level between 0700 and 2300h on each day (unless where otherwise stated).
- 4.7 As shown in the graphs at the back of this report, the daytime noise levels remained relatively constant throughout each of the daytime measurement periods.

Table 4.1 – Measured Façade Daytime Ambient Noise Levels

Date	Noise Levels, dBL _{Aeq, T}	
	Location A (Princess Street)	Location B (Rear Courtyard)
Friday, 18/10/19	67 ¹	56 ¹
Saturday, 19/10/19	69	53
Sunday, 20/10/19	64	-

¹ – Not a full daytime period. Period of measurement was approximately 8 hours.

Night-time

- 4.8 During the night-time period, noise levels at both locations were due to road traffic and pedestrians walking past the site, trams and patrons from The Waterhouse public house. It was noted that the noise from the trams and patrons reduced once the trams stopped and the public house closed.
- 4.9 Maximum noise levels at both locations were due to vehicles and pedestrians on Princess Street. These are presented in Table 4.2, below. In addition, in brackets next to the highest maximum, the tenth highest maximum noise level during each period is presented. This value has been used in order to exclude sirens and other erroneous noise sources from the assessment.
- 4.10 The measured noise levels at both locations are summarised in Table 4.2, below. In addition to the overall 8-hour night-time ambient noise levels, the ambient noise levels measured between 2300 and 0100h have also been provided. The hours between 2300 and 0100h include the closing of the public house and have been considered worst case.
- 4.11 During observations by a member of AEC staff, no amplified music was audible on either elevation during the night-time measurement period.

Table 4.2 – Measured Facade Night-time Noise Levels

Date	Location A (Princess Street)			Location B (Rear Courtyard)		
	0700-2300h, Ambient, dBL _{Aeq,T}	2300-0100h, Ambient, dBL _{Aeq,T}	Highest Maximum, dBL _{Amax,F}	0700-2300h, Ambient, dBL _{Aeq,T}	2300-0100h, Ambient, dBL _{Aeq,T}	Highest Maximum, dBL _{Amax,F}
Friday, 18/10/19	65 ¹	66	95 (85)	49 ¹	51	70 (65)
Saturday, 19/10/19	62	65	93 (81)	48	50	72 (65)
Sunday, 20/10/19	63	63	87 (83)	-		-

¹ – Not a full daytime period. Period of measurement was approximately 8 hours.

- 4.12 As shown in Table 4.2, above, the ambient noise levels during the period 2300-0100h were marginally higher on the Friday night than any other night at both locations.

Background Noise Levels

- 4.13 AEC understands that the any building services plant would be located in the rear courtyard. Therefore, the nearest receptor to the units could be the bedrooms of the development itself, which at their closest, would be around 5m away.
- 4.14 In order to comply with the requirements of the PNTG, a method is shown in this guidance to calculate the 'typical' background noise level at a receptor from a set of long-term noise measurement data.
- 4.15 The methodology includes arithmetically averaging the measured background noise level during the same 15-minute period for each day (e.g., Friday, 1200-1215h, Saturday, 1200-1215h and Sunday, 1200-1215h). Based on this, the 'typical' background noise levels used in this assessment are presented in Table 4.3, below.

Table 4.3 – Typical Façade Background Noise Levels

Elevation	Noise Level, dBL _{A90,15min}	
	Daytime	Night-time
Rear Courtyard	45	42

5.0 ASSESSMENT OF PROPOSED DEVELOPMENT

External Noise levels

- 5.1 At both locations, the measurements were undertaken under façade conditions. Therefore, in accordance with guidance presented in BS7445-2: 'Description and measurement of environmental noise - Part 2: Guide to the acquisition of data pertinent to land use', a -3dB correction has been applied to the measured façade levels in order to obtain free-field noise levels which have been used in this assessment.
- 5.2 The typical daytime and night-time ambient and maximum noise levels affecting the two elevations proposed is presented in Table 5.1, below. This has been based on the measured noise levels presented in Tables 4.1 and 4.2, respectively.

Table 5.1 – Free-field External Noise Levels Affecting Glazed Facades

Location	Noise Levels		
	Daytime Ambient, dBL _{Aeq,16h}	Night-time	
		Ambient, dBL _{Aeq,8h}	Maximum, dBL _{Amax,F}
Princess Street Elevation	≤ 65	≤ 62	≤ 82
Rear Courtyard Elevation	≤ 53	≤ 46	≤ 62

Assessment of Whole Dwelling Ventilation and Glazing Requirements

- 5.3 AEC understands that the habitable rooms on the Princess Street elevation are to be mechanically ventilated.
- 5.4 In relation to the rear courtyard façade, a comparison of the determined noise levels presented in Table 5.1, and the noise levels presented in Table 3.1, indicates that all habitable rooms in the development would need their windows to be kept closed and alternate means of whole dwelling (background) ventilation would need to be provided. This would be provided in the form of acoustic trickle vents.
- 5.5 The sound insulation performance of the glazing and ventilators, to meet the requirements stated in PNTG, have been calculated based on the spectrum data measured on-site and

the room sizes and glazing areas presented on the architectural drawings, and these are presented on Figure 2 and in Table 5.2, below.

- 5.6 The acoustic trickle vents required for the rear courtyard is also presented below. As mechanical ventilation has been proposed on the Princess Street elevation, there is no requirement for acoustic trickle vents on this façade.

Table 5.2 – Outline Requirements to Achieve Internal Noise Level within Habitable Rooms

Elevation	Sound Insulation Performance			
	Daytime		Night-Time	
	Glazing	Ventilator	Glazing	Ventilator
Princess Street	35dBR _w / 32dBR _w + C _{tr}	-	44dBR _w and 38dBR _w + C _{tr}	-
Rear Courtyard	31dBR _w and 27dBR _w + C _{tr}	33dBD _{ne,w}	31dBR _w and 27dBR _w + C _{tr}	33dBD _{ne,w}

- 5.7 Example glazing build-ups to achieve the required sound insulation performances are presented in Table 5.3, below.

Table 5.3 – Example Glazing Constructions

Sound Insulation Performance	Example Construction
44dBR _w / 38dBR _w + C _{tr}	10mm / 16mm Argon / 8.8mm Optiphon
35dBR _w / 32dBR _w + C _{tr}	10mm Glass / 16mm Cavity / 6mm Glass
31dBR _w / 27dBR _w + C _{tr}	6mm Glass / 16mm Cavity / 6mm Glass

- 5.8 Prior to any glazing being installed, octave band sound insulation performance data of the glazing build-ups and ventilators selected must be verified by AEC or others.
- 5.9 Windows can be openable for purge ventilation provided that they are effectively acoustically sealed when closed, and it is important that any frames and seals do not downgrade the sound insulation performance of the glazing.
- 5.10 Due to the existing constructions, It is anticipated that the external envelope and roof will achieve a sound insulation performance of at least 55dBR_w.

Control of Overheating

- 5.11 In relation to the control of overheating in dwellings, a comparison between the noise levels presented in Table 5.1 and the allowable external noise level limits in Table 3.1, indicate that only habitable rooms on the rear courtyard elevation can have windows open to aid with the control of overheating.
- 5.12 On the Princess Street elevation, however, windows must be closed to aid with the control of overheating. As previously stated, this will be achieved via an air conditioning system.

Plant Noise – Internal

- 5.13 The ventilation system will need to ensure that internal ambient noise levels in bedrooms and living / dining rooms, presented in Section 3.24, are achieved.
- 5.14 To control airflow generated noise in ductwork systems to bedrooms, the maximum duct velocities are presented in Table 5.3, below.

Table 5.3 – Maximum Ductwork Airflow Velocities

Noise Level, dB(A)	Duct Velocity, m/s		
	Main Duct	Branch Duct	Final Runout
30 (NR25)	5.0	4.5	2.5

Plant Noise – External

- 5.15 As any proposed external items of plant have not yet been confirmed, at this stage, AEC has determined a plant noise level limit that would need to be achieved to comply with MCC's requirements.
- 5.16 It is understood that any plant will operate at the same duty throughout the night-time and daytime periods. Based on this, in order to achieve the requirements of PNTG, the rating noise level must not exceed 5dB below the 'typical' background noise level of 42dBL_{A90,T}.

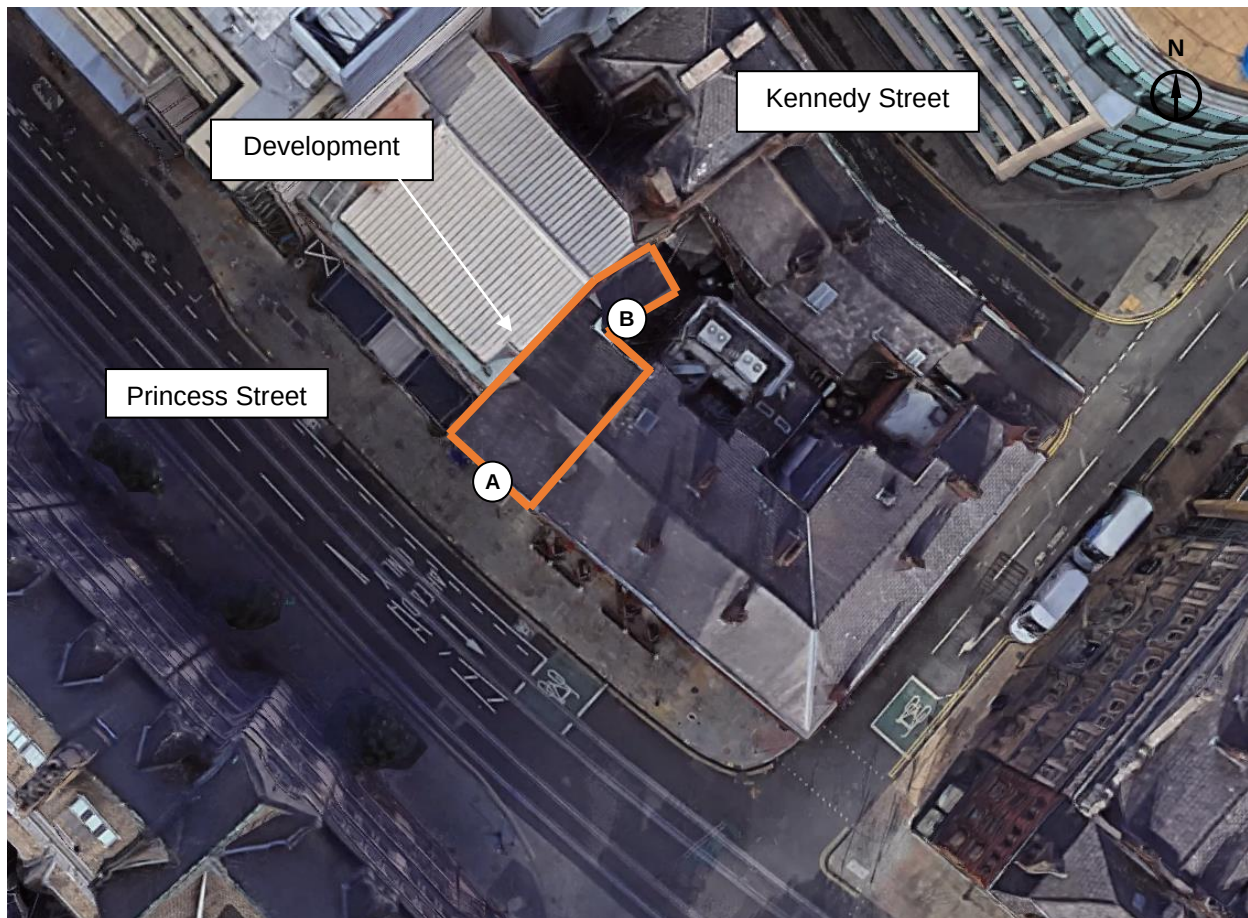
Noise Levels within External Amenity Areas

- 5.17 Based on the noise levels presented in Table 5.1, within the ground floor external area, noise levels in this space would not exceed the PNTG upper limit of 55dBL_{Aeq, 16h}.
- 5.18 Furthermore, they are only marginally (3dB) above the limit of 50dBL_{Aeq,16h}, and, therefore, AEC would deem this to be acceptable.

6.0 SUMMARY AND CONCLUSIONS

- 6.1 Acoustic and Engineering Consultants Limited (AEC) has been appointed by Colin Shenton to undertake a noise assessment relating to a single dwelling property at 65 Princess Street, Manchester. This noise assessment is required to accompany the associated planning application for the development.
- 6.2 This assessment considers the noise levels measured on-site and provides outline guidance on the required sound insulation performance of the external envelope, including the glazing, to meet the Local Authority's internal noise level limits.
- 6.3 Manchester City Council require that the development should be designed in order to achieve the desired internal noise level limits as stated in their document '*Planning and Noise Technical Guidance*', dated December 2015.
- 6.4 It is understood that the Princess Street elevation of the development will be mechanically ventilated. The rear courtyard elevation will not be mechanically ventilated.
- 6.5 The noise level measurements undertaken by AEC were unattended, with logging noise level meters installed on two facades of the building; one facing Princess Street, and one facing the rear courtyard.
- 6.6 At both locations, the noise sources around the site were road traffic and tram noise on Princess Street, as well as patron noise from The Waterhouse Public House and local pedestrians.
- 6.7 A summary of the measured noise levels is presented in Section 4, with the full measurement data presented in Appendix B. These noise levels have been assessed against the design criteria in Section 5.
- 6.8 Based on the noise assessment, AEC has proposed appropriate glazing that is necessary to control internal noise levels to meet the levels presented in PNTG in all habitable rooms during both the daytime and night-time periods. These are presented in Section 5, above.
- 6.9 A plant noise limit has been set where there is any proposed external plant.
- 6.10 Noise levels within the external amenity space have also been calculated so as to be below the upper limits of the PNTG and therefore, should be deemed acceptable.
- 6.11 This assessment demonstrates that appropriate planning conditions can be applied to the proposed development to ensure that internal noise levels will comply with the requirements of Manchester City Council.
- 6.12 Therefore, based on the above, noise should not be considered a determining factor in relation to any planning permission being sought.

FIGURE 1 – Existing Site Showing Monitoring Locations



Map data @2021 Google United Kingdom

APPENDIX A – Acoustic Terminology in Brief

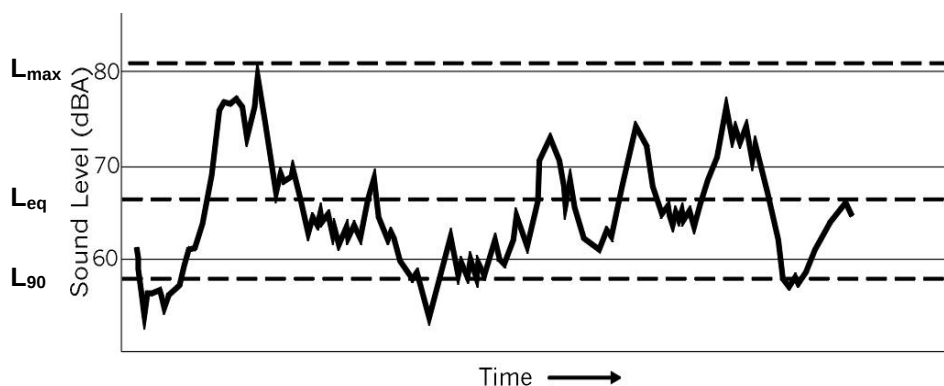
Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air. The rate at which the pressure fluctuations occur determines the pitch or *frequency* of the sound. The frequency is expressed in Hertz (*Hz*), that is, cycles per second. The human ear is sensitive to sounds from about 20 Hertz to 20,000 Hertz. Although sound can be of one discrete frequency - a 'pure tone' - most sound is made up of many different frequencies.

The human ear is more sensitive to some frequencies than others, and modern instruments can measure sound in the same subjective way. This is the basis of the A-weighted sound pressure level *dBA*, normally used to assess the effect of noise on people. The *dBA* weighting emphasises or reduces the importance of certain frequencies within the audible range.

Sound Units

In order to assess environmental noise, measurements are carried out by sampling over specific periods of time, such as fifteen minutes or one hour, the statistically determined results being used to quantify various aspects of the sound.

The figure below shows an example of sound level varying with time. Because of this time variation the same period of sound can be described by several different levels. The most common of these are described below. It should be noted that in many instances in the main body of text, the unit will be preceded by a *dB* descriptor in the report e.g. $L_{Aeq,T}$ could be written $dB L_{Aeq,T}$



Example of Sound Level Varying With Time

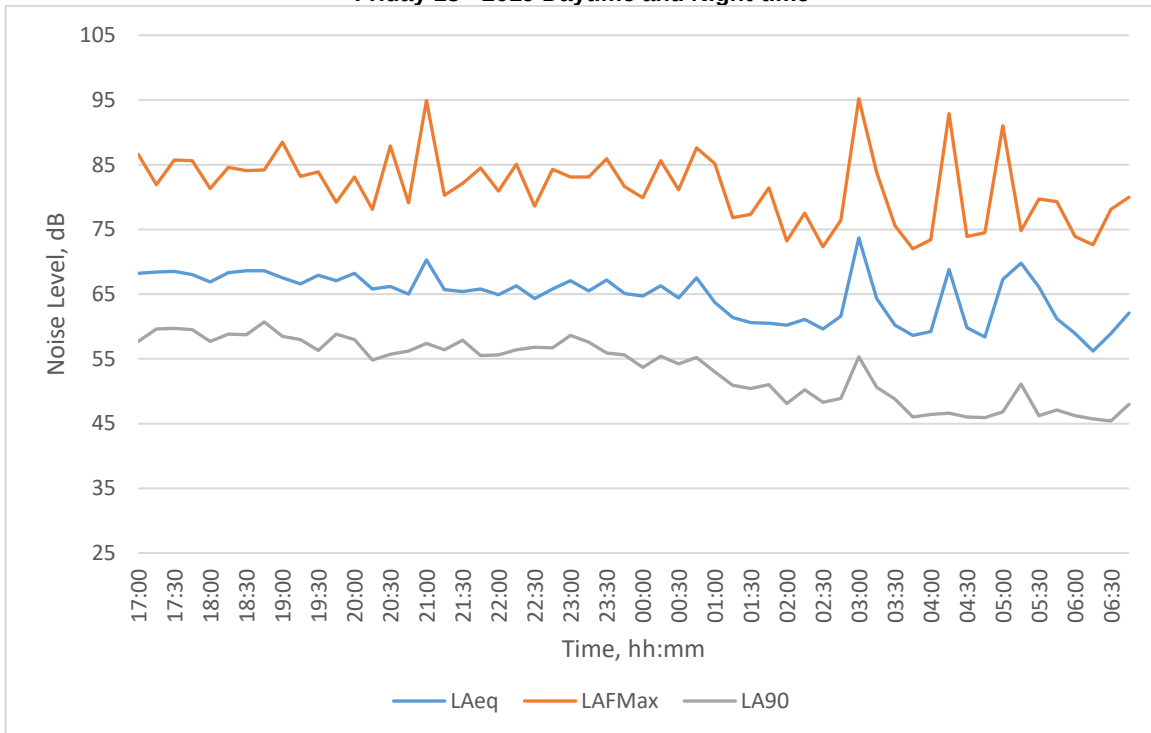
$L_{Aeq,T}$	The equivalent continuous (A-weighted) sound level. It may be thought of as the "average" sound level over a given time, <i>T</i> . It is used for assessing noise from various sources: industrial and commercial premises, construction sites, railways and other intermittent noises and can be considered as the "ambient" noise level.
$L_{A90,T}$	The (A-weighted) sound level exceeded for 90% of a measurement period. It is the value often used to describe background noise.
L_{Amax}	The maximum (A-weighted) sound level measured during a given time. 'Fast' or 'Slow' meter response should be cited.

Free-field Level	This refers to the sound level measured outside, away from reflecting surfaces.
Façade Level	This refers to the sound level measured outside, at 1m from a hard reflecting surface, typically 3dB greater than the free-field level.
R_w	Single number rating used to describe the <u>laboratory</u> airborne sound insulation properties of a material or building element over a range of frequencies, typically 100-3150Hz.
$D_{nT,w} + C_{tr}$	As above only the resultant figure is adjusted by a spectrum adaptation term in relation to the low frequency sound insulation performance.
$D_{n,e,w}$	Weighted element-normalised level difference. Single number rating used to describe the sound insulation performance.

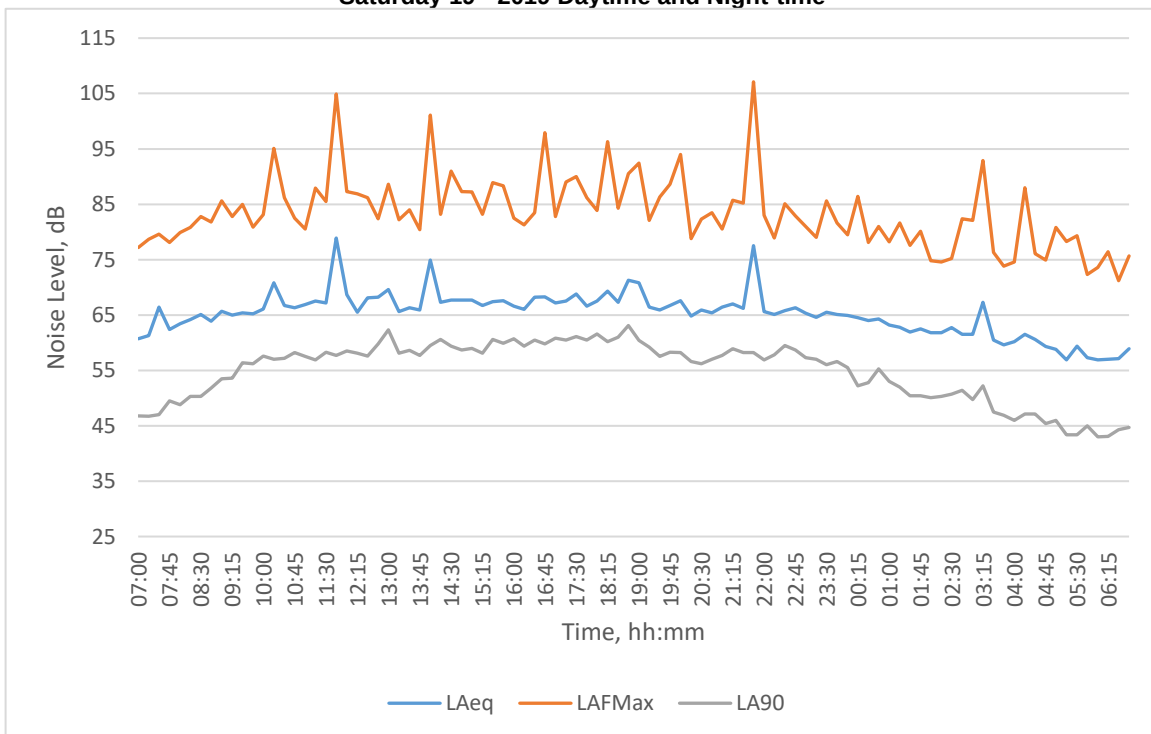
APPENDIX B – Noise Survey Details

Date & Time of Survey:	Friday 18 October 2019, 1700h to Monday 21 October 2019, 0830h					
Personnel:	Ross Chamberlain (AEC).					
Equipment Used:	Cirrus CR:171B Real Time Analyser (AEC Kit 3) Cirrus CR:171B Real Time Analyser (AEC Kit 5)					
Calibration:	The sound level analysers, which conforms to BS EN 61672-1: 2003 ' <i>Electro acoustics – sound level meters - Part 1 Specifications</i> ' for Class 1 Type Z meters, was in calibration and check calibrated before and after the measurement periods using a Brüel & Kjær type 4231 (94dB) calibrator. There was no significant drift of calibration. Calibration certificates are available on request.					
Weather Conditions:	Date	Period	Wet/Dry	Temp°C	Wind Speed & Direction	Cloud Cover
	18/10/19	Day	Dry	High 12°C, Low 9°C	6mph north	60%
	18/10/19 – 19/10/19	Night	Dry	High 9°C, Low 8°C	6mph north	55%
	19/10/19	Day	Dry	High 12°C, Low 7°C	6mph east	25%
	19/10/19 – 20/10/19	Night	Dry	High 8°C, Low 7°C	3mph east	35%
	20/10/19	Day	Dry	High 11°C, Low 6°C	10mph south	35%
	20/10/19 – 21/10/19	Night	Dry	High 10°C, Low 9°C	9mph south	60%
Measurement Locations:	Two microphones were connected via individual extension cables and fixed externally at a location 1m any façade via a pole. The first microphone was installed on the Princess Street elevation on the 1 st floor level, which is identified as A on Figure 1. The second microphone was installed on the courtyard elevation on the 1 st floor level, which is identified as B on Figure 1.					
Measurement Details:	Measurements were logged continuously over 1s for post processing and assessment. This location was selected to represent the worst-case affected façade of the development that would be affected by road, tram and patron noise.					
Façade / Free-Field:	All measurements were façade level. The measured daytime and night-time periods for the unattended survey is presented on Graphs B1 to B5.					
Measured Data:	Full 1/3 rd octave band centre frequency data was obtained for all measurements.					

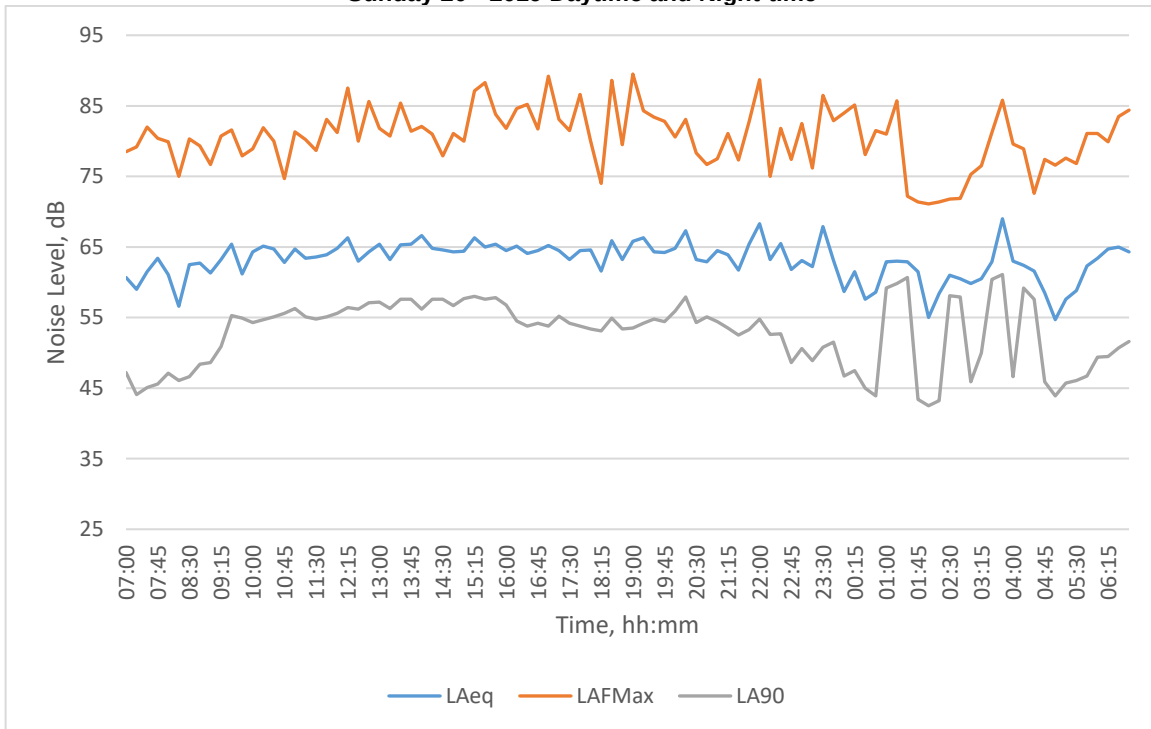
**GRAPH B1 – Measured Façade Noise Levels – Princess Street Elevation
Friday 18th 2019 Daytime and Night-time**



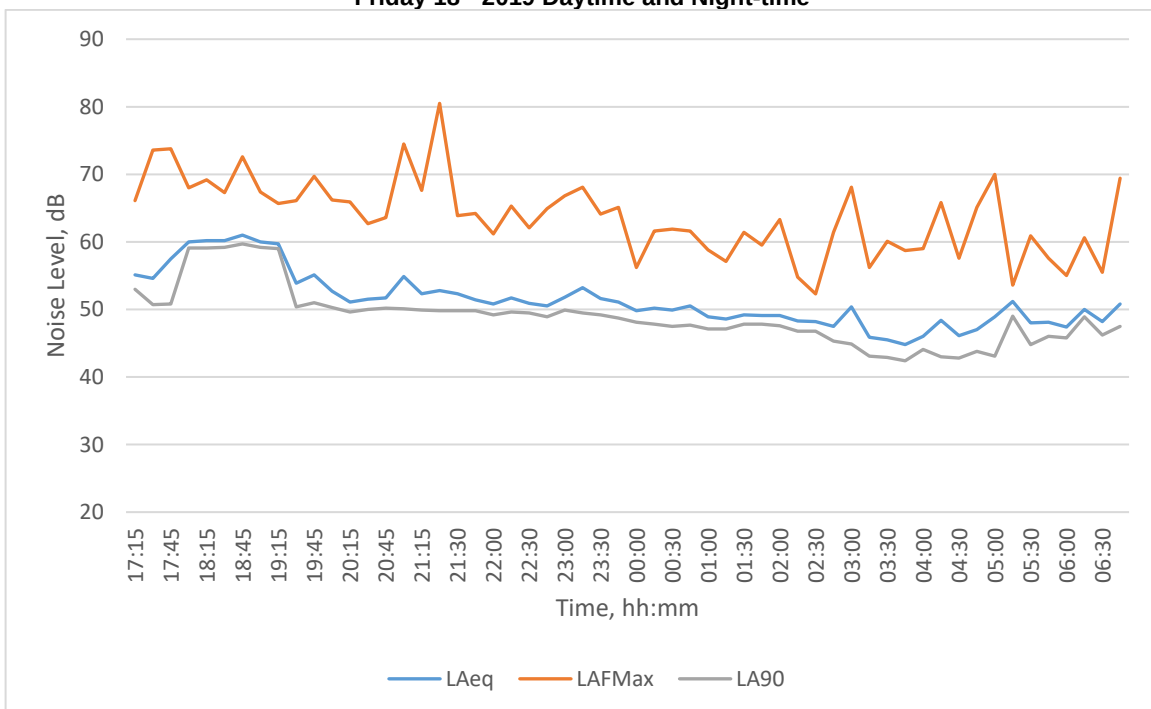
**GRAPH B2 – Measured Façade Noise Levels – Princess Street Elevation
Saturday 19th 2019 Daytime and Night-time**



**GRAPH B3 – Measured Façade Noise Levels – Princess Street Elevation
Sunday 20th 2019 Daytime and Night-time**



**GRAPH B4 – Measured Façade Noise Levels – Courtyard Elevation
Friday 18th 2019 Daytime and Night-time**



GRAPH B5 – Measured Façade Noise Levels – Courtyard Elevation
Saturday 19th 2019 Daytime and Night-time

