Noise Survey of a proposed D2 Gym (Yoga Studio and Martial Arts Centre)

Client:	Mr Kayvon Dehghan
Address:	294, Barlow Moor Road, Chorlton , Greater Manchester, M21 8HA,
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Authored By	Mr J Barratt-Gibson, MSc, AMIOA	--	--
Approved By	A T Martin MSc, MIOA, MIET, MInstSCE	--	--
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Executive summary

It is proposed that the ground floor unit at 294 Barlow Moor Road Chorlton Manchester M21 8HA undergo a change of use from a shop (Class A1) to a gym (Class D2). Specifically, the proposal is for the ground floor unit to be converted into a yoga and martial arts studio.

An environmental noise survey and noise impact assessment has been undertaken to assess the potential increase in noise levels in the area due to the development. A noise breakthrough analysis of the floor separation the development and the residential dwelling above has also been undertaken.

The gym noise breakout assessment indicates that provided the recommendations within the report are implemented all noise breaking out of the development will fall a minimum of 1.9 – 28.6 dB below the prevailing background sound level. Thus indicating low impact on the surrounding area.

The analysis of the noise breaking through the separating floor indicated the existing floor to be insufficient. Floor upgrades have also been provided to ensure all internal noise criteria within the adjoining flat can be achieved, thus, indicating low impact.

Further mitigation has been recommended to minimise uncertainty in the predictions presented and ensure the amenity of the NSR's is protected. An overview of all recommendations can be seen below.

Recommendations and mitigation Overview
- All glazing within the development requires a minimum sound reduction of 44 dB $R_{w.}$ - All doors within the development require a minimum sound reduction of 44 dB $R_{w.}$ - The separating floor should be upgraded as per suggestions within the body of the report. - The operational hours should be between 07:00 – 21:00 - Where possible all doors and windows should remain fully closed throughout periods of operation.

The findings of this report will require written approval from the Local Authority prior to work commencing.

1. Introduction

1.1 Overview

NOVA Acoustics Ltd has been commissioned to prepare a noise assessment for a proposed yoga martial arts centre (Class D2) ('the Proposed Development') at 294 Barlow Moor Road Chorlton Manchester M21 8HA ('the Site').

The Applicant is preparing a planning application to be submitted to Manchester City Council.

Accordingly, the following technical noise assessment has been produced to accompany the Application to Manchester City Council.

This report details the existing background sound climate at the nearest receptors, as well as the sound emissions associated with the Proposed Development.

This noise assessment is necessarily technical in nature; therefore, a glossary of terms is included in Appendix A to assist the reader.

1.2 Scope & Objectives

The scope of the noise assessment can be summarized as follows:

- Baseline sound monitoring survey to evaluate the prevailing sound levels at the nearest sensitive receptor ('NSR') to Site;
- Detailed sound modelling, acoustic calculation and analysis in accordance with ISO9613 – 1 prediction methodology to predict sound levels at the NSR.;
- A detailed assessment of the suitability of the Site, in accordance with relevant standards in respect of sound from the proposed sources; and
- Recommendation of mitigation measures, where necessary, to comply with the requirements of the National Planning Practice Guidance in England and Wales, Entertainment Noise Guidance, BS8233:2014 and other relevant standards.

1.3 Legislation, Policy and Guidance

This report is to be primarily based on the following legislation, policy and guidance.

- National Planning Policy Framework (2019)
- Noise Policy Statement for England
- IEMA Guidelines on Noise Impact Assessments
- BS8233:2014`Guidance on sound insulation and noise reduction for buildings'
- ISO 9613-2 Attenuation of sound during propagation outdoors
- BS EN 12354-4 Building Acoustics
- Entertainment Noise Legislation

2. Site Description & Background Information

2.1 Site & Surroundings

The proposed development is situated on the corner of the cross junction between Barlow Moor Road (A5145) which runs north to south, Handy Lane that runs east, and Mauldeth road that runs west. The surrounding area is a mixture of residential properties, with some commercial units and a school. The commercial units include the: 'Co-op' which operates between 06:00 – 22:00, 'Money Gram' which operates between 08:30 – 18:00, 'Andrew Wood Photography' which operates between 09:00 – 18:00. Also, in the vicinity is 'Aladin lounge', 'Premier Masala Indian Takeaway' and 'Star Pizza' which all operate up until 23:00 – 00:00 among others. The nearby food establishments all have associated external plant. The surrounding roads are considered to have moderate to high traffic flow. The surrounding transport routes also include a tram line running directly through Handy Lane and Mauldeth Road. The closest dwelling to the proposed development is the flat which is directly above the proposed development. Due to this dwellings proximity, it will be considered the noise sensitive receptor (NSR) in the subsequent assessment.



Figure 1.0 - Site and Surroundings

2.2 Background

It is proposed that the ground floor unit undergo a change of use from a shop (Class A1) to a gym (Class D2). Specifically, the proposal is for the ground floor unit to be converted into a yoga and martial arts studio (Brazilian Jiu Jitsu). The noise risk associated with yoga is relatively low as this is considered to be a low noise activity in comparison to an average gymnasium or fitness studio. Conversation with the client indicated that the gym will also be used for Brazilian Jiu-jitsu which is a form of grappling and as such the noise from this activity is also considered low risk in comparison to other forms of martial arts such as kickboxing. Specifically, because grappling does not involve

the impact noise from hitting pads and shouts associated with other types of martial arts. In general activities on site will involve some light physical activity and background music with no use of free weights. The proposed operational hours of the development are 07:00 – 21:00, 7 days a week.

3. Environmental Noise Survey

In order to characterise the sound profile of the area of the proposed development, a long term 72 hour environmental sound survey was carried out from the 10th of April 2019 to the 13th of April 2019.

3.1 Measurement Methodology

For the long-term sound monitoring, the sound level meter was placed at 1st-floor level, protruding from a window to the rear of the proposed site. The microphone was positioned approximately 1m away from the building's façade. The monitoring position was chosen in order to collect representative sound levels of the area during the week and weekend day time and night time periods. This position was also representative of the sound levels at the NSR. The measurement position can be found in Figure 1.0.

3.2 Measurement Equipment

Piece of Equipment	Serial No	Calibration Deviation
CESVA SC420 Class 1 Sound level meter	T244498	≤0.5
CESVA CB006 Class 1 Calibrator	901910	

Table 1.0 – Measurement Equipment

All equipment used during the survey was field calibrated at the start and end of the measurement period with a negligible deviation of ≤0.5 dB. All sound level meters are calibrated every 24 months and all calibrators are calibrated every 12 months, by a third-party calibration laboratory. All microphones were fitted with a protective windshield for the entire measurements period. Calibration certificates can be provided upon request.

3.3 Weather Summary

As the environmental noise survey was carried out over a long un-manned 72-hour period no records of weather conditions were taken. However, during the setup and collection of the monitoring equipment, the weather was calm with wind speeds of less than 5m/s and no precipitation. All measurements have been compared with met office weather data of the area and periods of elevated weather conditions have been excluded from the subsequent calculations. The weather conditions were suitable for the measurement of environmental noise in accordance with BS7445 Description and Measurement of Environmental Noise.

3.4 Results

3.4.1 Summary Results

The following table shows a summary of the sound survey results; L_{Aeq}, L_{Amax}, L_{A90} and the L_{A10} for the measurement period.

Measurement Position MP1				
Measurement Time Period ('t')	**$L_{Aeq,t}$**	**$L_{Amax,t}$**	**$L_{A90,t}$**	**$L_{A10,t}$**
Day 1 - 10/05/19 - 08:30 - 23:00	57.0	89.0	54.0	59.0
Night 1 – 10/05/19 – 23:00 – 07:00	52.0	89.0	48.0	55.0
Day 2 - 11/05/19 - 07:00 – 19:00	58.0	89.0	54.0	60.0
Night 2 – 11/05/19 – 23:00 – 07:00	50.0	73.0	46.0	52.0
Day 3 - 12/05/19 - 07:00 – 23:00	54.0	90.0	51.0	56.0
Night 3 – 12/05/19 – 23:00 – 07:00	51.0	80.0	45.0	55.0
Day 4 – 13/05/19 – 07:00 – 08:30	54.0	72.0	53.0	54.0

Table 2.0 – Sound Survey Summary Results

The following table shows a summary of the sound survey results; L_{Aeq}, L_{Amax}, L_{A90} and the L_{A10} for the operational hours of the proposed development 07:00 – 21:00.

Measurement Position MP1				
Operational Hours ('t')	**$L_{Aeq,t}$**	**$L_{Amax,t}$**	**$L_{A90,t}$**	**$L_{A10,t}$**
Day 1 – 10/05/19 – 08:30 – 21:00	58.0	89.0	54.0	59.0
Day 2 – 11/05/19 – 07:00 – 21:00	58.0	89.0	54.0	60.0
Day 3 – 12/05/19 – 07:00 – 21:00	54.0	90.0	51.0	56.0
Day 4 – 13/05/19 – 07:00 – 08:30	55.0	80.0	53.0	56.0

Table 3.0 – Sound Survey Operational Hours Results

3.4.2 Background Sound Level Summary Results

The following table shows a summary of the background sound level results during the operational hours of the proposed yoga and martial arts studio.

Measurement Position MP1				
Operational Hours ('t')	**$L_{A90,t}$**	**Statistically most Repeated $L_{A90,t}$**	**Min. $L_{A90,t}$**	**Max. $L_{A90,t}$**
Day 1 – 10/05/19 – 08:30 – 21:00	54.0	50.0	48.0	56.0
Day 2 – 11/05/19 – 07:00 – 21:00	54.0	50.0	46.0	55.0
Day 3 – 12/05/19 – 07:00 – 21:00	51.0	48.0	43.0	54.0
Day 4 – 13/05/19 – 07:00 – 08:30	53.0	50.0	48.0	51.0

Table 4.0 – Background Sound Survey Operational Hours Results

The following table shows a summary of the average, statistically most repeated and lowest octave band L_{90} background sound levels throughout the operational period of the yoga studio and martial arts centre on the lowest measured operational period Day 3 Sunday.

Measurement Position MP1							
Frequency Analysis	**Z-weighted Octave Band Sound Pressure Level, Hz (dB)**						
	63	**125**	**250**	**500**	**1K**	**2K**	**4K**
Day 3 – Average L_{90} - 07:00 – 21:00	50.0	46.0	44.0	43.0	44.0	39.0	30.0
Day 3 – statistically most repeated $L_{90,15min}$ – 07:00 – 21:00	45.0	55.0	52.0	40.0	48.0	46.0	41.0
Day 3 - Lowest $L_{90,15min}$ 07:00 – 21:00	43.3	43.3	41.5	38.5	36.8	31.5	26.4

Table 5.0 – Background Sound (L90) Octave Band Leq,15min during day & night

3.5 Subjective impression & Context

Whilst on site the engineer noted the surrounding acoustic environment was moderate to high along the front façade of the building, however significantly lower to the rear. Along the front façade, the dominant noise source was that of road traffic using Barlow Moore Road. Some commercial noise was also audible however this was secondary in nature in comparison to the road noise. To the rear of the site during the day time the road noise was again dominant however significantly lower in level in comparison to the front. Located along the rear facades of the neighbouring buildings there were multiple kitchen extraction associated with the neighbouring takeaways. These were not active at the time of the site visit however are assumed to be the dominant noise source in the area during the periods in which they operate. This is further corroborated by the time history of presented in Appendix E in which then kitchen extraction system operation is clearly definable.

4. Noise Assessment

4.1 Music and Gym Activity Noise Assessment

The following section analyses:

- The music and gym activity noise breaking out of the ground floor unit
- The structure-borne music and gym activity noise transferring through the adjoining building to the dwelling above.

4.1.1 Music and Activity Noise Level

The following table presents the unweighted sound pressure levels, associated with the proposed development. No specific noise levels from martial arts and yoga activities could be obtained and thus example noise levels from fitness gym have been used. These levels were measured in Pure

Gym during peak times of operation. The data includes noise from both gym music and fitness activities. Considering the actual use of the proposed gym will be yoga and martial arts (Brazilian Jiu-Jitsu) which are fairly low noise level activities it is assumed that the use of the noise levels presented below will provide a robust and conservative assessment.

Sound Source	A-weighted Octave Band Sound Pressure Level, Hz (dB)							
	63	125	250	500	1K	2K	4K	Overall (LAmax)
Peak L_{max} music and Activity Noise	76.1	83.1	82.3	79.6	77.4	72	73.3	82.6

Table 6.0 – Music and Activity Noise Level

4.1.2 Music and Gym Activity Breakout Analysis

The music and gym activity noise breaking out of the proposed yoga and martial arts studio has been calculated considering the weakest element of the façade the glazing, The buildup and attenuation provided by the glazing has been taken from INSUL Sound Insulation Prediction Software. It is assumed the existing shop front is constructed from 8mm glass. An initial assessment found this to be insufficient and thus secondary glazing is advised. The total configuration should be 8mm glass, 100mm cavity, 6mm glass.

Description	A-weighted Octave Band Sound Pressure Level, Hz (dB)							
	63	125	250	500	1K	2K	4K	Overall (A)
L_{MAX} Peak Music and Gym Activity	76.1	83.1	82.3	79.6	77.4	72	73.3	82.5
Rw of secondary glazing	17.0	27.0	39.0	46.0	50.0	47.0	50.0	44.0
External noise level	53.1	50.1	37.3	27.6	21.4	19.0	17.3	32.5
Distance correction 2m	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0	-6.0
Noise Level at NSR	47.1	44.1	31.3	21.6	15.4	13.0	11.3	26.5

Table 7.0 – Music and Gym Activity Level at NSR Summary

4.1.3 Background Sound Level

The background sound level is the underlying level of sound over a period, T, and is indicative of the relative quietness at a given location. It does not reflect the occurrence of transient and/or higher sound level events and is generally governed by continuous or semi-continuous sounds.

To ensure the background sound level values used within the assessment are reliable and suitably represent both the particular circumstance and periods of interest, efforts have been made to quantify a 'typical' background sound level for a given period.

The table below outlines a summary of the lowest and statistically most repeated octave band background sound level for the operational period.

Measurement Position MP1							
Frequency Analysis	**Z-weighted Octave Band Sound Pressure Level, Hz (dB)**						
	63	**125**	**250**	**500**	**1K**	**2K**	**4K**
Day 3 – Average L_{90} – 07:00 – 21:00	50.0	46.0	44.0	43.0	44.0	39.0	30.0
Day 3 – statistically most repeated $L_{90,15min}$ – 07:00 – 21:00	45.0	55.0	52.0	40.0	48.0	46.0	41.0
Day 3 - Lowest $L_{90,15min}$ 07:00 – 21:00	43.3	43.3	41.5	38.5	36.8	31.5	26.4

Table 8.0 – Summary of Background Sound Levels

Discussion

As can be seen in the table above the statistically most repeated octave band $L_{90s,}$ during the Sunday the lowest measured day, exceed the average and the lowest measured L_{90s} across the majority of the frequency spectrum. Consequently, these noise levels are not deemed typical. The average L_{90} measured across the operational period sits between the statistically most repeated values and the lowest measured values for the majority of the frequency spectrum. Thus, these levels are deemed 'Typical' and will be used in the subsequent assessment.

The following table shows a summary of the background sound level results during the operational hours of the proposed yoga and martial arts studio.

Measurement Position MP1				
Operational Hours ('t')	**$L_{A90,t}$**	**Statistically most Repeated $L_{A90,15min}$**	**Min. $L_{A90,15min}$**	**Max. $L_{A90,15min}$**
Day 3 – 12/05/19 – 07:00 – 21:00	51.0	48.0	43.0	54.0

Table 9.0 – Background Sound Survey Operational Hours Results -Day 3

Discussion

As can be seen in the table above the statistically most repeated L_{A90} is 48.0 dB which occurred on the lowest measured day, Day 3 Sunday. Looking at the range of $L_{A90,15mins}$ we note that the statistically most repeated value sits in the mid-range and thus is deemed typical and will be used in the subsequent assessment.

4.1.4 Music and Gym Activity Noise Breakout Assessment

The calculated music and gym activity level at the NSR is compared with the 'typical' background sound level during the operational period of the proposed site. The analysis is shown in the following table.

NSR 1								
Amplified Music Breakout Assessment	**A-weighted Octave Band Sound Pressure Level, Hz (dB)**							
	63	**125**	**250**	**500**	**1K**	**2K**	**4K**	**Overall (A)**
Music and Gym Activity Noise Level at the NSR	47.1	44.1	31.3	21.6	15.4	13.0	11.3	26.5
Background Sound Level (L90)	50.0	46.0	44.0	43.0	44.0	39.0	30.0	48.0
Exceedance over Background Sound Level	-2.9	-1.9	-12.7	-21.4	-28.6	-26.0	-18.7	-21.5

Table 10.0 – Gym Noise Breakout Assessment

Discussion

As can be seen in the assessment above considering the weakest element of the façade, the glazing the gym noise emissions breaking out of the development fall below the typical background sound level of the area. Thus, indicating low impact on the NSR and any other surrounding dwellings. Furthermore, when considering that the noise emission produced by the operations at the site i.e yoga will be significantly lower than the example noise levels used in the assessment any impact is reduced further.

4.1.5 Assessment of Structure Borne Noise Transference

The Proposed Development adjoins a dwelling which is situated directly above and thus there is a high likelihood that the neighbouring dwelling will be impacted by structure-borne noise transferring through the adjoining partition, as well as flanking sound. Due to this, a sound insulation test of the existing floor was undertaken to assess the existing performance. The results of the sound insulation test can be seen in the table below. The sound testing certificate can be seen in Appendix F.

Frequency Analysis	**Floor Sound Insulation Test Results (dB)**						
	125	**250**	**500**	**1K**	**2K**	**4K**	**$D_{nt,w + Ctr}$**
Measured Dnt of separating floor	22.6	25.9	36.0	40.3	49.0	53.2	33.0

Table 11.0 – Sound Insulation Test Results

Discussion

As can be seen in the table above the results of the sound insulation test indicates that the floor between the development and the flat above scored 33 dB $D_{nt,w + CTR.}$ This level of sound insulation does not achieve the minimum requirements set out in the building regulations part E and thus the

floor will need upgrading to ensure the occupants of the flat above are fully protected from noise transference.

The following analysis shows the required sound insulation of the adjoining partition, it must be noted that NR 15 curve is too stringent at mid and higher frequencies and will be likely significantly lower than background noise levels in habitable spaces. The partition will be designed to achieve the NR15 criteria within the 63Hz and 125Hz octave bands.

Frequency Analysis	Z-weighted Octave Band Sound Pressure Level, Hz (dB)							
	63	125	250	500	1K	2K	4K	Overall (A)
Music and gym activity level	76.1	83.2	82.3	79.6	77.4	72	73.3	82.5
NR15/25Curve (dB)	47.0	35.0	35.0	29.0	25.0	22.0	20.0	30.0
Required Octave Band SRI (R_w)	29.1	48.1	47.3	50.6	52.4	50	53.3	52.5

Table 12.0 – Gym Noise Transfer Analysis

Flanking sound within an existing building cannot be objectively analysed and thus the above performance is based on all potential flanking routes being treated. Any comment building elements that adjoin separate areas of the building, such as common internal wall and floors, steelwork, risers or lift shafts should be acoustically treated to minimise flanking sound.

4.1.6 Recommendations & Mitigation

Building Envelope

a) Glazing

Windows can be considered the weakest point of a façade in terms of noise reduction. All glazed elements installed in the development including doors and screens require a minimum sound reduction index value of 44 dB R_w. The glazing unit shown in Table 13.0 would provide a suitable sound reduction. Any other window capable of providing attenuation of 44.0 dB R_w will be suitable. The performance is specified for the whole window unit, including frame and other design features.

Glazing Configuration	Attenuation (dB)
Double Glazing 8mm Glass – 100mm Air Cavity – 6mm Glass	44.0 R_w

Table 13.0 – Glazing SRI

Any other configuration of roof that would achieve at least these insulation figures will be suitable for the development.

a) Doors

All doors that are not glazed, leading to external areas including fire exits installed in the proposed development require a minimum sound reduction index of 44.0 dB Rw the unit suggested below provides the required amount of sound reduction however any door with a sound reduction index could be installed.

Door Type	Attenuation (dB)
Huet Doors IDX 43	45.0 dB R_w

Table 14.0 – Door SRI

Sound Insulation of Separating Floor

The acoustic performance of the partition floor is calculated using INSUL software, the buildup is based on the existing floor which is assumed to be 200mm existing timber joist.

- Existing floorboards (all gaps and holes fully sealed with acoustic sealant)
- Existing 200mm joists
- Existing ceiling
- Independent timber frame ceiling minimum drop 200mm
- Minimum 100 Rockwool RW3 insulation minimum density 60kg/m^3
- 2 x 15mm Fireboards

Frequency (Hz)	63	125	250	500	1K	2K	4K	R_w
Partition floor	31.0	48.0	60.0	72.0	78.0	78.0	86.0	65.0

Table 15.0 – Partition floor SRI

Noise Management Plan

The following recommendations are measures that should be implemented on the operation of the site to ensure low likelihood of impact at the NSR.

- The operational hours should be between 07:00 – 21:00
- Where possible all doors and windows should remain fully closed throughout periods of operation.

Appendix A – Acoustic Terminology

Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure.
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa (20x10-6 Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. Lmax is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L90 can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L10 can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided. The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Sound Level	Location
0dB(A)	Threshold of hearing
20 to 30dB(A)	Quiet bedroom at night
30 to 40dB(A)	Living room during the day
40 to 50dB(A)	Typical office
50 to 60dB(A)	Inside a car
60 to 70dB(A)	Typical high street
70 to 90dB(A)	Inside factory
100 to 110dB(A)	Burglar alarm at 1m away
110 to 130dB(A)	Jet aircraft on take off
140dB(A)	Threshold of Pain

The ear is less sensitive to some frequencies than to others. The A-weighting scale is used to approximate the frequency response of the ear. Levels weighted using this scale are commonly identified by the notation dB(A).

In accordance with logarithmic addition, combining two sources with equal noise levels would result in an increase of 3 dB(A) in the noise level from a single source. A change of 3 dB(A) is generally regarded as the smallest change in broadband continuous noise which the human ear can detect (although in certain controlled circumstances a change of 1 dB(A) is just perceptible). Therefore, a 2 dB(A) increase would not be normally be perceptible. A 10 dB(A) increase in noise represents a subjective doubling of loudness.

A noise impact on a community is deemed to occur when a new noise is introduced that is out of character with the area, or when a significant increase above the pre-existing ambient noise level occurs.

For levels of noise that vary with time, it is necessary to employ a statistical index that allows for this variation. These statistical indices are expressed as the sound level that is exceeded for a percentage of the time period of interest. In the UK, traffic noise is measured as the L_{A10}, the noise level exceeded for 10% of the measurement period. The L_{A90} is the level exceeded for 90% of the

time and has been adopted to represent the background noise level in the absence of discrete events. An alternative way of assessing the time varying noise levels is to use the equivalent continuous sound level, L_{Aeq}.

This is a notional steady level that would, over a given period of time, deliver the same sound energy as the actual fluctuating sound. To put these quantities into context, where a receiver is predominantly affected by continuous flows of road traffic, a doubling or halving of the flows would result in a just perceptible change of 3 dB, while an increase of more than 25%, or a decrease of more than 20%, in traffic flows represent changes of 1 dB in traffic noise levels (assuming no alteration in the mix of traffic or flow speeds).

Note that the time constant and the period of the noise measurement should be specified. For example, BS4142:2014 specifies background noise measurement periods of 1 hour during the day and 15 minutes during the night. The noise levels are commonly symbolised as $L_{A90,1hour}$ dB and $L_{A90,15mins}$ dB. The noise measurement should be recorded using a 'FAST' time response equivalent to 0.125ms.

Appendix B – Legislation, Policy and Guidance

This report is to be primarily based on the following legislation, policy and guidance.

National Planning Policy Framework (2019)

Government policy on noise is set out in the National Planning Policy Framework (NPPF), published in 2019. This replaced all earlier guidance on noise and places an emphasis on sustainability. In section 15, Conserving and enhancing the natural and local environment, paragraph 170e, it states:

Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans;

Paragraph 180 states:

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;*
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; and*
c) *Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.*

Noise Policy Statement for England

Paragraph 180 of the NPPF also refers to advice on adverse effects of noise given in the Noise Policy Statement for England (NPSE). This document sets out a policy vision to:

Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

To achieve this vision the Statement identifies the following three aims:

Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *Avoid significant adverse impacts on health and quality of life;*
- *Mitigate and minimise adverse impacts on health and quality of life;*
- *Where possible, contribute to the improvement of health and quality of life.*

In achieving these aims the document introduces significance criteria as follows:

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur. It is stated that "significant adverse effects on health and quality of life should be avoided while also considering the guiding principles of sustainable development".

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected. It is stated that the second aim above lies somewhere between LOAEL and SOAEL and requires that: "all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also considering the guiding principles of sustainable development. This does not mean that such adverse effects cannot occur."

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise. This can be related to the third aim above, which seeks: "where possible, positively to improve health and quality of life through the pro-active management of noise while also considering the guiding principles of sustainable development, recognising that there will be opportunities for such measures to be taken and that they will deliver potential benefits to society. The protection of quiet places and quiet times as well as the enhancement of the acoustic environment will assist with delivering this aim."

The NPSE recognises that it is not possible to have a single objective noise-based measure that is mandatory and applicable to all sources of noise in all situations and provides no guidance as to how these criteria should be interpreted. It is clear, however, that there is no requirement to achieve noise levels where there are no observable adverse impacts but that reasonable and practicable steps to reduce adverse noise impacts should be taken in the context of sustainable development and ensure a balance between noise sensitive and the need for noise generating developments.

Any scheme of noise mitigation outlined in this report will, therefore, aim to abide by the above principles of the NPPF and NPSE whilst recognizing the constraints of the site.

IEMA Guidelines on Noise Impact Assessments

The IEMA Guidelines for Environmental Noise Assessment address the key principles of noise impact assessment and are applicable to all development proposals where noise effects may occur. The guidelines set out key principles for noise impact assessment relevant to all types of project regardless of size. The guidance provides advice with regards to the collection of baseline noise data, prediction of noise levels and how noise should be assessed. The guidance recognizes that the effect associated with a noise impact will be dependent on a number of factors including but not limited to the sensitivity of the receptor, frequency and duration of the noise source and time of day. The Guidelines accept that a simple change in noise levels using a single noise indicator may fail to adequately reveal the actual noise impact of the proposal. The character of the noise must be considered and the Guidelines suggest comparing several noise indicators such as the LAeq, LAmax and LA90 as a more rigorous approach.

Absolute levels such as those set out in WHO Guidelines are also considered and the Guidelines suggest that a change in noise levels in an area where the existing levels are above WHO Guidelines

should be considered as having more of an adverse effect than a change in noise levels in an area where existing levels are well below.

The Guidelines stop short of providing specific assessment criteria which developments should achieve but instead suggests that the methodology adopted should be selected on a site by site basis regarding relevant national and local standards.

The Guidelines contain effect descriptors for changes in noise levels and for noise effect levels. These are summarized below:

Effect Descriptors	
Very substantial	Greater than 10 dB L_{Aeq} change in sound level perceived at a receptor of great sensitivity to noise
Substantial	Greater than 5 dB L_{Aeq} change in sound level at a noise sensitive receptor, or a 5 to 9.9 dB LAeq change in sound level at a receptor of great sensitivity to noise
Moderate	A 3 to 4.9 dB L_{Aeq} change in sound level at a sensitive or highly sensitive noise receptor, or a greater than 5dB LAeq change in sound level at a receptor of some sensitivity
Slight	A 3 to 4.9 dB L_{Aeq} change in sound level at a receptor of some sensitivity
None/Not Significant	Less than 2.9 dB L_{Aeq} change in sound level and/or all receptors are of negligible sensitivity to noise or marginal to the zone of influence of the proposals

Table 16.0 – IEMA Guidelines effect descriptors

Noise Effect Level		
Time	**Lowest Observed Adverse Effect Level**	**Significant Observed Adverse Effect Level**
07:00 - 23:00	50 dB $L_{Aeq,16\ hour}$	60 dB $L_{Aeq,16\ hour}$
23:00 - 07:00	40 dB $L_{Aeq,8\ hour}$	55 dB $L_{Aeq,8\ hour}$
	60 dB L_{AFMax} (at the facade)	80 dB L_{AFMax} (at the facade)

Table 17.0 – IEMA Guidelines noise effect level

The Guidelines are not prescriptive as to how a noise impact assessment should be carried out, and allow assessors to consider factors such as frequency spectra, days and times of operation, frequency of operation and any other factor which allows the noise to be assessed in context.

BS8233:2014`Guidance on sound insulation and noise reduction for buildings'

The British Standard BS 8233: 2014, Guidance on Sound insulation and noise reduction for buildings provides additional guidance on noise levels from sources without specific character in the built environment, based on the recommendations of the World Health Organization; specifically, WHO

Guidelines on Community Noise, 1999. The criteria desirable levels of steady state, "anonymous" noise in unoccupied spaces within dwellings, from sources such as road traffic, mechanical services and other continuously running plant, are tabulated below:

Activity	Location	07:00 – 23:00	23:00 – 07:00
Resting	Living Room	35 dB $L_{Aeq,16hour}$	--
Dining	Dining Room/Area	40 dB $L_{Aeq,16hour}$	--
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Table 18.0 - BS8233 criteria for internal noise levels in dwellings

It is noted, however that where development is considered necessary or desirable, despite external noise level above WHO guidelines, the above target levels may be relaxed by up to 5 dB.

The standard also recommends that for traditional external amenity areas, such as gardens, it is desirable that external noise levels do not exceed 50 dB $L_{Aeq,T}$, and that 55 dB $L_{Aeq,T}$ would be acceptable in noisier environments. However, it is recognised that these values may not be achievable in all areas where development is desirable and in such locations, development should be designed to achieve the lowest practicable levels.

General recommendations for mitigation to enable these targets to be achieved are provided, including the use of bunds and barriers to reduce external noise and space planning and sound insulation for the control of internal noise levels.

For this assessment, the above criteria are considered to be the LOAEL as defined in the NPSE above.

ISO 9613-2 Attenuation of sound during propagation outdoors

The ISO 1996 series of standards specifies methods for the description of noise outdoors in community environments. Part 2 of ISO 9613 is intended to enable noise levels in the community to be predicted from sources of known sound emission. The method is general in the sense that it may be applied to a wide variety of noise sources, and cover most of the major mechanisms of attenuation.

This standard provides guidance on the outdoor propagation of sound. It is widely used to establish the different attenuations that occur during the transmission of the sound from the sources to the receivers. The total attenuation is the sum of the following: geometrical divergence, atmospheric absorption, ground effect, barriers, and miscellaneous other effects.

BS EN 12354-4 Building Acoustics

Estimation of acoustic performance of buildings from the performance of elements – Transmission of indoor sound to the outside

This European Standard describes a calculation model for the sound power level radiated by the envelope of a building due to airborne sound inside that building, primarily by means of measured sound pressure levels inside the building and measured data which characterize the sound transmission by the relevant elements and openings in the building envelope. These sound power

levels, together with those of other sound sources in or in front of the building envelope, form the basis for the calculation of the sound pressure level at a chosen distance from a building as a measure for the acoustic performance of buildings.

Entertainment Noise Legislation

Noise from entertainment venues, e.g. noise from recorded music, live bands or karaoke, ca be particularly annoying for residents and business if it is not adequately contained within the venue. When considering the potential impact of a proposal for a entertainment premises or residential near to entertainment premises a consideration for the overall noise level (L_{Aeq}) and the 63Hz and 125Hz octave band noise levels. Music noise in the 63Hz and 125Hz octave bands, which is described as 'bass noise' is particularly difficult to contain and the impulsive and non-steady character of low frequency music noise is particularly disturbing for residents exposed to it.

A lively city centre bar can operate around 95 dB L_{Aeq} and nightclubs can be even higher at 105 dB L_{Aeq}. The range of level of 63Hz and 125Hz octave bands is wider than the a-weighted levels and can be up to 115 dB L_{eq} and 110 dB L_{eq} respectively (Davies et al 2005).

There is a lack of consensus on an assessment method for noise levels within habitable rooms regarding entertainment noise. The design aim should be to design to 'inaudible'*. The building structure is therefore key, and will usually involve a high performing solution in either the music venue or residential premises. Existing noise standards/criteria are not appropriate for evaluating low frequency noise; in almost all other situations the established noise descriptors are based on the A-weighted sound level (dBA) which effectively filters out low frequency sound (Moorhouse et al 2011).

**Noise is considered to be inaudible when it is at a sufficiently low level such that it is not recognizable as emanating from the source in question and it does not alter the perception of the ambient noise environment that would prevail in the absence of the source in question. The DEFRA report 'Noise from Pubs and Clubs – Phase 1', which, on page 17 reproduces the Institute of Acoustics (IOA) working group guidance to achieve music noise levels which are 'virtually inaudible' inside a residential property.*

When dealing with noise control, especially at the lower frequencies it is usual to look at the octave band data as a Z-weighting (linear) and not the A-weighting, due in main to the amount you have to 'take off', resulting in meaningless data (-26.2dB at 63Hz) and also with respect to the sound insulation performance of various constructions materials. Rather than just A-weighted levels being assessed e.g. internal noise levels as per BS8233:2014; a low frequency band analysis should be carried out (McCullough *et al* 2004).

In the 'Procedure for the assessment of low frequency noise complaints – Revision 1', Moorhouse *et al* (2011**)** use limits for low frequency noise levels in 1/3 octave bands between 10Hz and 160Hz. For the assessment of low frequency music noise, it is more practical to consider the 63Hz and 125 Hz octave bands. The Noise Council's Code of Practice on 'Environmental Noise Control at Concerts' suggests limits on both these octave bands. The DEFRA report 'Noise from Pubs and Clubs – Phase 1' suggests limits on 1/3 octave bands. However, the problem with this suggestion, and one of the reasons it is not widely used, is due to the difficulty in obtaining 1/3 octave band sound insulation

performance data for various construction materials. With regards to assessing music noise at the 63 Hz and 125 Hz octave band levels a good correlation is shown between the NR 15 curve and Moorhouse curve at low frequencies. See Figure 2.0.

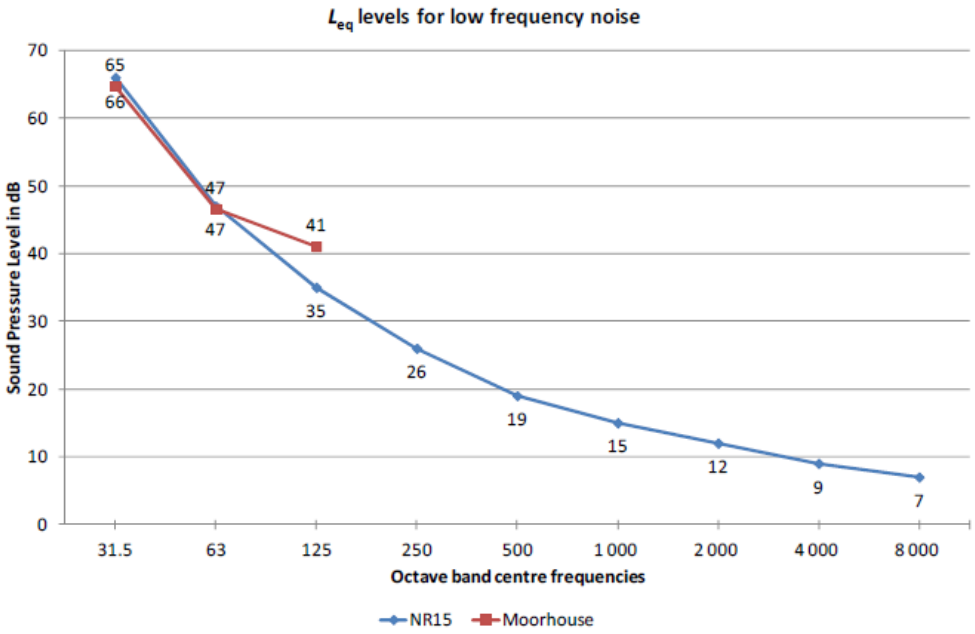


Figure 2.0 – Moorhouse Low Frequency Noise Rating Curve

However, The NR curve may be too stringent at mid and higher frequencies and may be lower than background noise levels in habitable spaces. Further, the NR curve is most commonly used to set limits for mechanical services noise in buildings i.e. steady, continuous noise sources. Music noise has distinctive characteristics and as such can be described as unsteady and non-continuous in comparison. Even though the Moorhouse curve does not specifically relate to entertainment noise (as per the caveat in the revised edition) these levels provide a good practical basis to assess low frequency music noise. They also provide a workable prediction for planning applications and a measurement method and assessment for in-situ low frequency issues in existing habitable spaces. Therefore, a criterion that would achieve a condition of 'inaudible' / 'virtually inaudible' which is applicable for new residential developments that are structurally connected to entertainment venues (or vice versa) would be: *'Music noise levels in the 63Hz and 125Hz octave centre frequency bands (L_{eq}) should be controlled so as not to exceed (in habitable rooms) 47dB and 41dB (L_{eq}), respectively'.* This criterion may also be applicable for new residential developments that are structurally separate from an existing entertainment venue.

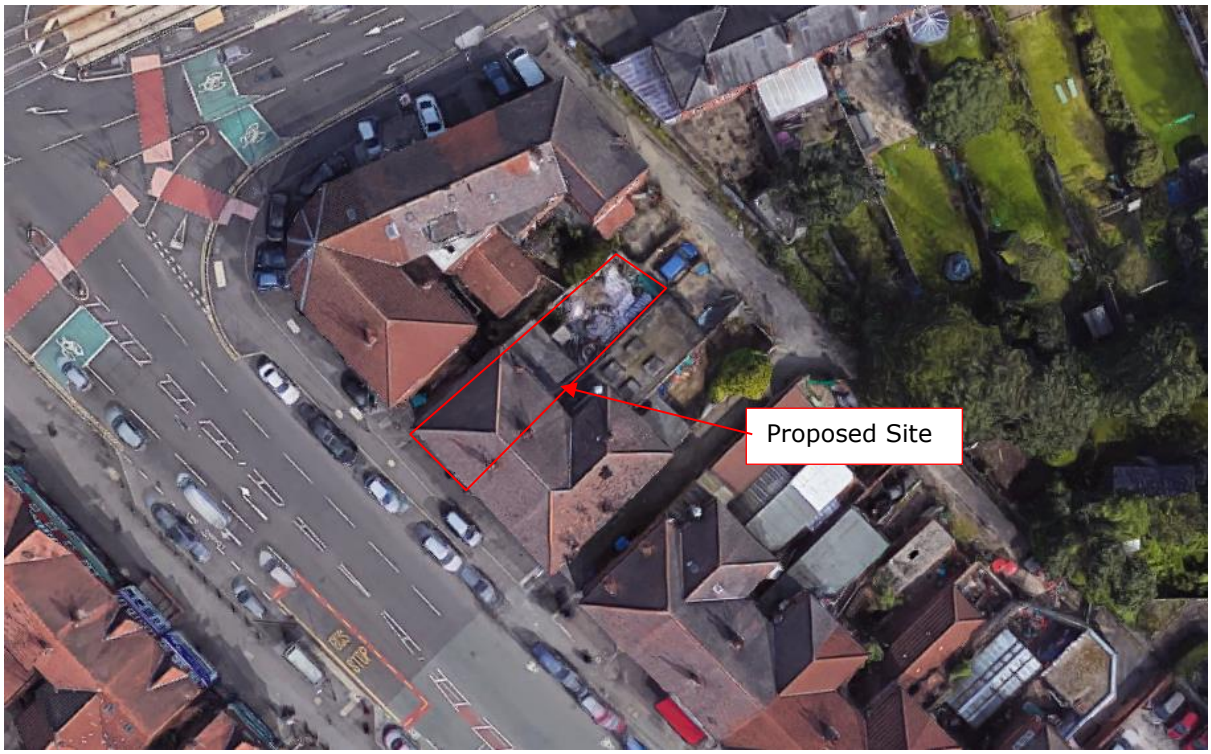
References:

i) *Institute of Acoustics (2002) – Good practice guide on the control of noise from pubs and clubs – Draft Annex 2.*

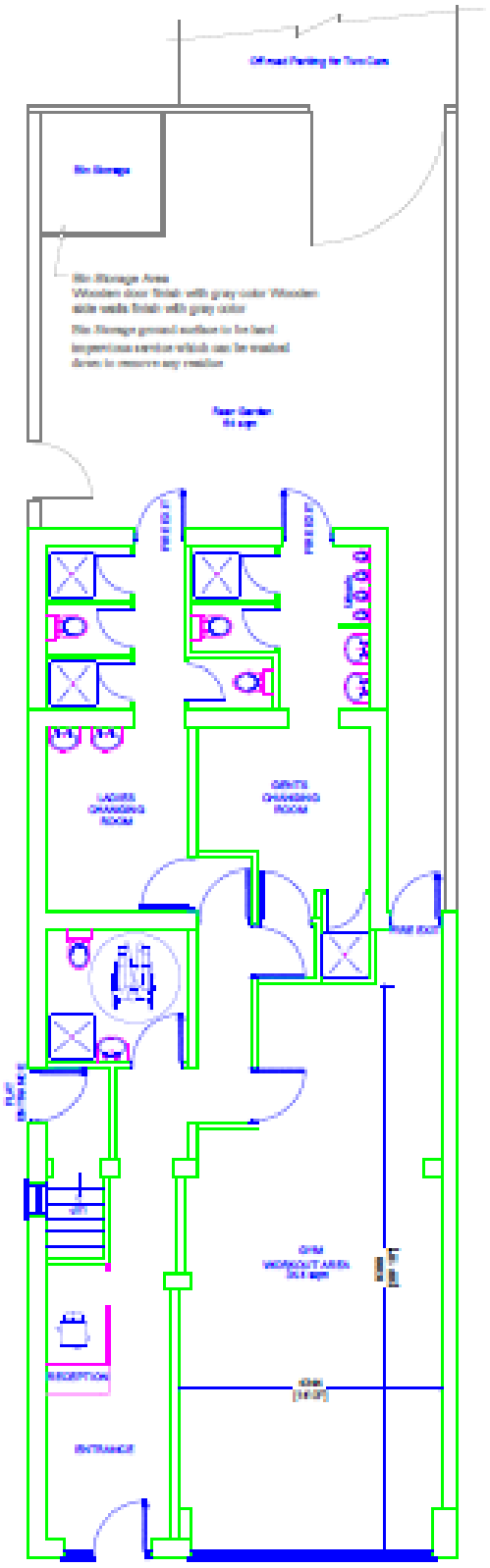
ii) *McCullough et al (2004) A practical evaluation of objective noise criteria used for the assessment of disturbance due to entertainment music*

iii) *Moorhouse et al (2005) Proposed criteria for the assessment of low frequency noise disturbance, Defra (updated in 2008 and 2011)*

Appendix C - Location Plan

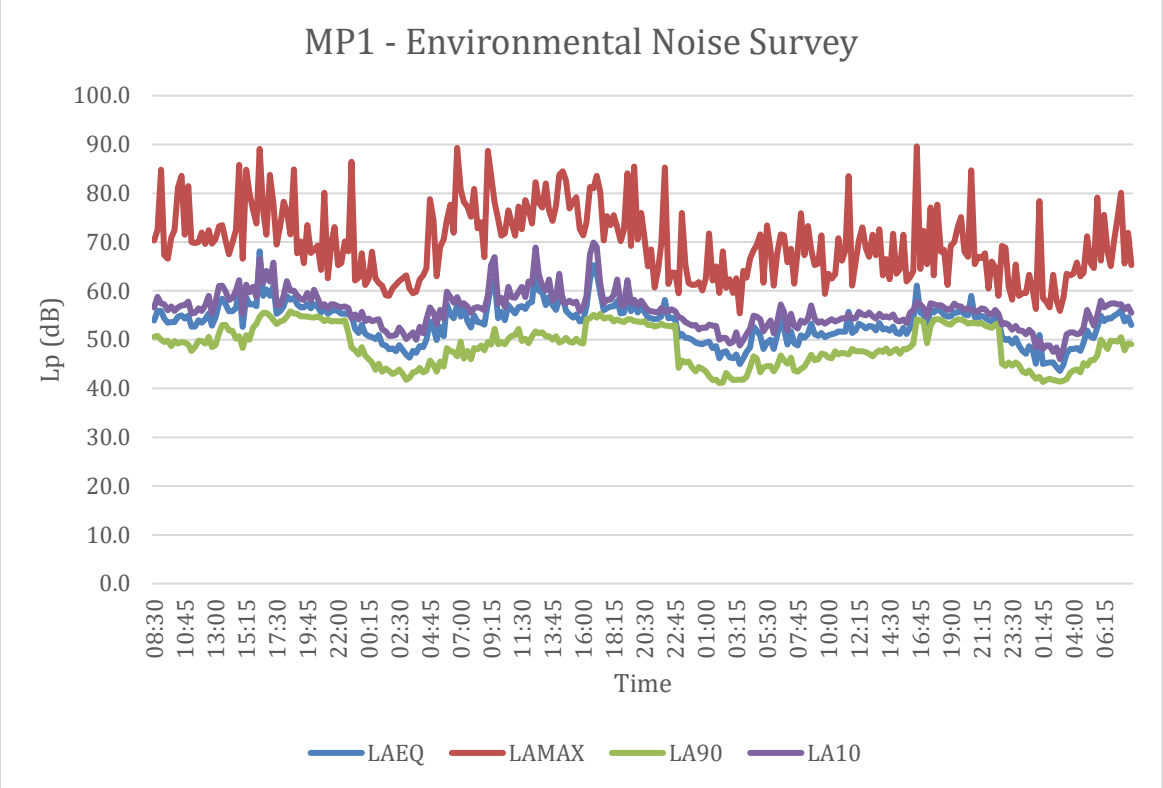


Appendix D – Site Plans



Proposed Ground Floor Plan

Appendix E – Environmental Sound Survey



Appendix F – Sound Insulation Test Report

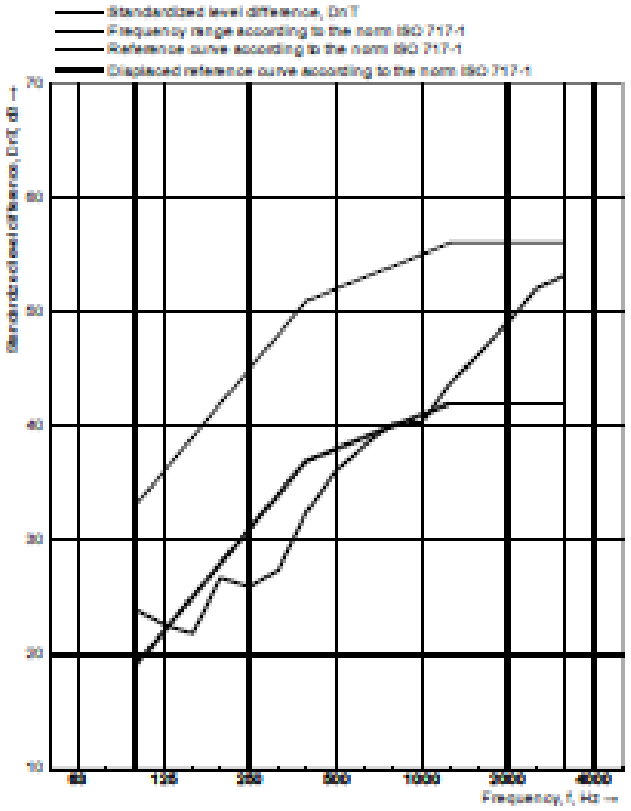
Standardized level difference according to Resistance to the passage of sound approved document E
Field measurements of airborne sound insulation between rooms

Client : Kayvon Dehghan — Test date : 03 May 2019

Description and identification of the building construction and test arrangement, direction of measurement :
See report

Source room volume : 163.00 m³
Receiving room volume : 50.00 m³

Frequency f Hz	DnT (1/3 octave) dB
50	--
63	--
80	--
100	24.0
125	22.8
160	21.8
200	26.7
250	25.9
315	27.4
400	32.5
500	36.0
630	38.3
800	40.2
1000	40.3
1250	43.7
1600	46.3
2000	49.0
2500	52.0
3150	53.2
4000	--
5000	--



Rating according to ISO 717-1
DnT,w (C;Ctr) = 39 (-1 ; -5) dB;

Evaluation based on in situ measurement results obtained by an engineering method (1/3 octave)

No. of test report : 3397KD – A
Name of test institute : NOVA Acoustics Ltd
Date : 16 May 2019
Signature : J. Barratt-Gibson