

# Waterhouse Gardens, Manchester (Block C & D)

Acoustic Assessment Report -  
Planning Condition 18 (Commercial/Amenity Noise)  
Planning Condition 19 (Residential Noise Insulation)

**Client:**

Domis Construction Limited  
Douglas House, Green St  
Wigan, WN3 4DQ

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**JAMESON  
ACOUSTICS**

Consultants in acoustics,  
noise and vibration

Document Control

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|                |                                                                                     |
|----------------|-------------------------------------------------------------------------------------|
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## 1.0 Introduction

Jameson Acoustics Limited has been commissioned by Domis Construction Limited to provide acoustic design and testing services to assist in the discharge of two planning conditions associated with the Waterhouse Gardens development (Block C & D) in Manchester. The conditions are as follows.

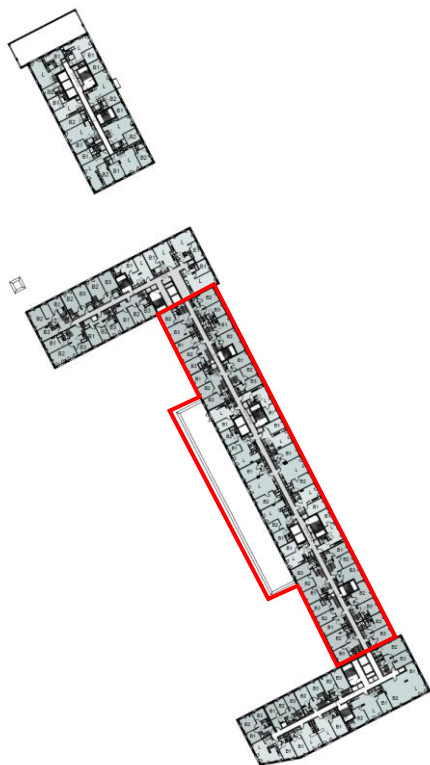
| No | Wording                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 18 | <p>Notwithstanding the noise and vibration section of the ES stamped as received by the City Council, as Local Planning Authority, on the 19 January 2018, (a) prior to the first use of each commercial unit and gym area within each phase as indicated on drawings A2942 198 R16, A2943 199 R16 and A2943 200 R16 stamped as received by the City Council, as Local Planning Authority, on the 19 January 2018, a scheme of acoustic insulation shall be submitted for approval in writing by the City Council, as Local Planning Authority. (b) The approved scheme shall then be implemented and a post completion survey submitted for approval in writing by the City Council, as Local Planning Authority, prior to the first use of each of the commercial units and the gym area within each phase. The measures implemented shall be retained and maintained for as long as the development remains in use.</p> <p><i>Reason - In order to limit the outbreak of noise from the commercial premises pursuant to policies SP1 and DM1 of the Core Strategy (2007) and saved policy DC26 of the Unitary Development Plan for the City of Manchester (1995).</i></p> |
| 19 | <p>Notwithstanding the noise and vibration section of the ES stamped as received by the City Council, as Local Planning Authority, on the 19 January 2018, (a) prior to the first occupation of the residential accommodation within each phase hereby approved, the accommodation shall be insulated in accordance with a scheme submitted for approval in writing by the City Council, as Local Planning Authority.</p> <p>(b) The approved scheme shall then be implemented and a post completion survey submitted for approval in writing by the City Council, as Local Planning Authority, prior to the first occupation of the residential accommodation within each phase. The measures implemented shall be retained and maintained for as long as the development remains in use.</p> <p><i>Reason: To secure a reduction in noise from traffic or other sources in order to protect future residents from noise disturbance pursuant to policies SP1, H1 and DM1 of the Core Strategy (2007) and saved policy DC26 of the Unitary Development Plan for the City of Manchester (1995).</i></p>                                                                      |

## 2.0 Project & Assessment Overview

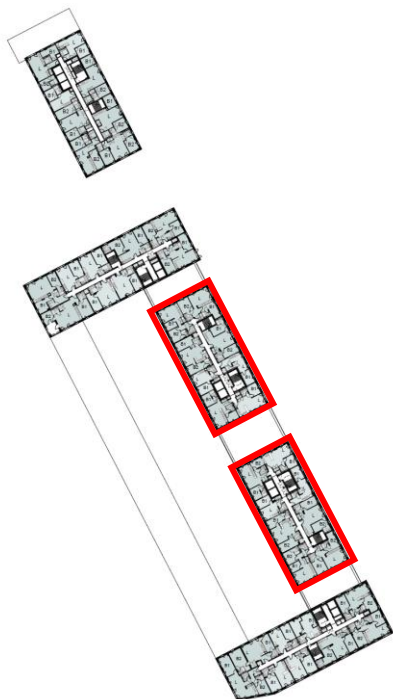
Blocks C & D comprise two residential blocks linked by a common podium containing residential amenity spaces, including a gym, games rooms, private cinema and lounges (all at ground floor). There are no commercial (retail) units in this sector of the project. See below the site wide ground, first and typical upper-level floor plans indicating the locations of Blocks C & D.



Ground floor plan

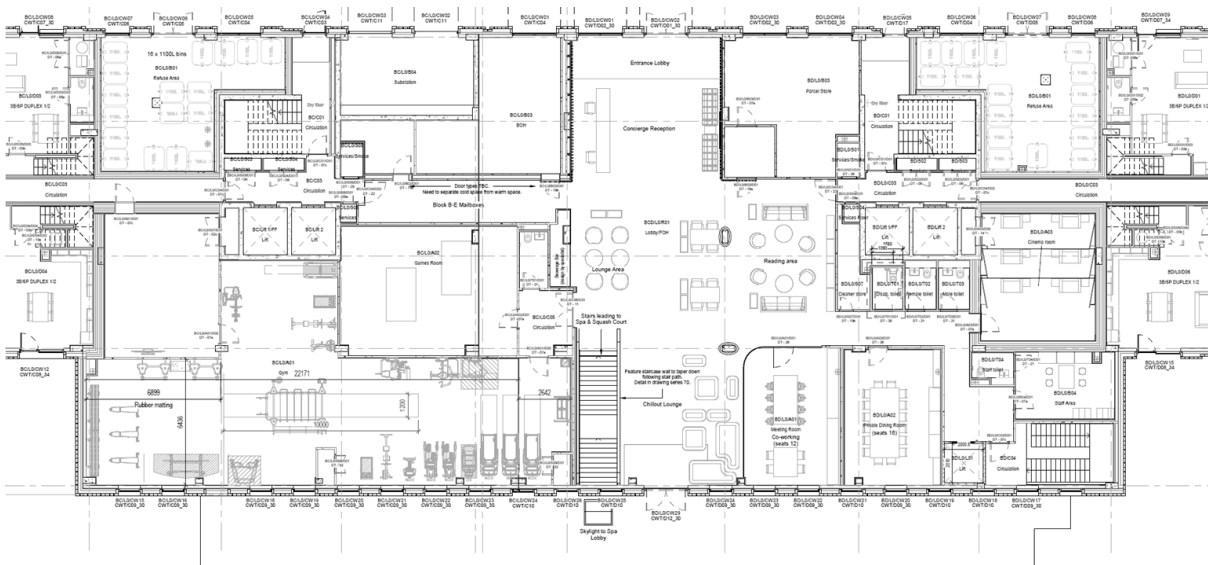


First floor plan



Typical upper floor plan

A more detailed plan of the ground floor amenity floor layout is shown below.



Ground floor amenity plan (Blocks C & D)

The amenity spaces continue into the lower ground floor space of Block F to the side of Blocks C & D. The amenities in Block F will be covered under a separate Report once Block F is completed and ready for testing.

This report shall cover the following in relation to Blocks C & D:

**Condition 18: Commercial/Amenity Noise Transfer**

| Commercial/Amenity Space | Operational noise breakout to externals | Operational noise transfer (horizontal – party wall) | Operational noise transfer (vertical – party floor) |
|--------------------------|-----------------------------------------|------------------------------------------------------|-----------------------------------------------------|
| Gym                      | ✓                                       | ✓                                                    | ✓                                                   |
| Games Room               | N/A                                     | ✓                                                    | ✓                                                   |
| Private Dining Room      | ✓                                       | N/A                                                  | ✓                                                   |
| Cinema Room              | N/A                                     | ✓                                                    | ✓                                                   |

\* assessment of noise breakout to externals and party floor noise transfer will be covered under separate Block B Report.

In addition to the above, a structure-borne (impact) noise assessment relating to the gym floor is provided.

**Condition 19: Residential Sound Insulation Scheme**

- Confirmation of design specifications for façade elements to achieve acceptable internal noise levels within dwellings, along with confirmation of ventilation provisions.
- Pre-completion noise level measurement results in selected apartments confirming acceptable internal noise levels from external traffic noise intrusion have been achieved.
- Pre-completion noise level measurement results in selected apartments confirming acceptable mechanical ventilation noise levels have been achieved.

## 3.0 PC 18 – Amenity Noise Transfer

### 3.1 Acoustic Criteria

For separating elements between amenity spaces and residential accommodation appropriate wall/floor/ceiling specifications were specified based on the following.

1. 'Reasonable' assumed maximum anticipated operational sound levels in rooms as below (considered suitable to permit the intended usage).

| Room            | Operational $L_{eq}$ Noise Level (dB)<br>Octave Band Centre Frequency (Hz) |     |     |     |    |    |    |
|-----------------|----------------------------------------------------------------------------|-----|-----|-----|----|----|----|
|                 | 63                                                                         | 125 | 250 | 500 | 1k | 2k | 4k |
| Private Dining  | 75                                                                         | 75  | 75  | 75  | 75 | 80 | 80 |
| Cinema          | 83                                                                         | 83  | 85  | 85  | 85 | 85 | 85 |
| Gym, Games Room | 83                                                                         | 83  | 85  | 85  | 85 | 85 | 85 |

2. Walls/floors designed to achieve noise levels no greater than 5dB  $L_{eq}$  below anticipated background in each octave band in receiver space. At low frequency, noise not to exceed 47 dB  $L_{eq}$  at 63 Hz and 41 dB  $L_{eq}$  at 125 Hz absolute limits of 'virtual inaudibility'.
3. Gym to be in operation 24/7. No (or limited loudness) music played. Gym studio to be used for yoga/stretching only, and not spin/HIIT classes with high levels of amplified music.
4. Impact (structure-borne) noise to be controlled to achieve not higher than 30-25 dB  $L_{Amax}$  in habitable rooms (day/night). *NB: A new design guide was issued late in the detailed design process – ProPG Gym Acoustics Guidance – which advises a maximum limit of G25 (day) and G20 (night) in habitable rooms for noise from heavy impacts. Specifications were adjusted to align with ProPG.*
5. Games and Private Dining rooms to be operational during social daytime hours only (e.g. 12:00-22:00hr). The space to be centrally managed by concierge to avoid loud anti-social behaviour and excessive music noise.
6. Cinema to be operational during social daytime hours only (e.g. 12:00-22:00hr). Note, final operational noise limits for cinema to be determined through pre-completion sound testing. Limiting audio levels to be programmed into the AV system (electronic sound limiter).

For the gym and cinema, the above noise levels represent reasonably loud activity/listening noise levels. For the cinema, the levels are not commensurate with a commercial cinema, but are considerably louder than what would be considered 'normal' living room listening levels.

## 3.2 Design Specifications

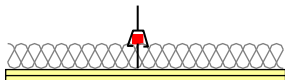
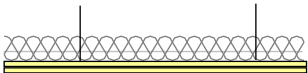
### 3.2.1 Overview

The elements to consider are:

1. Floors/ceilings – all amenity areas to apartments above.
2. Separating walls – gym to apartment, and cinema to apartment.
3. Specific gym isolation treatment (gym floor to control impact noise).
4. Specific cinema isolation treatment (to control low frequency sound and structure-borne noise from loudspeakers).
5. Facades to amenity spaces (external noise breakout).

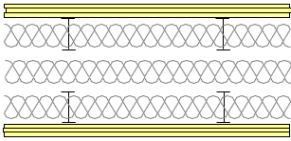
### 3.2.2 Floors/Ceilings

The following table presents the design specifications for ceilings to all amenity spaces. Note, the floor slab is 225 mm in-situ solid concrete.

| Space     | Specification                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
|-----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cinema    |  <p>Full acoustic mass-barrier ceiling on specialist acoustic hangers designed to achieve a <b>max. system natural frequency of 15Hz under load</b> (considering load of ceiling and services/fit-out ceilings installed below the mass-barrier ceiling).</p> <p>Ceiling to comprise 2 layers of 15mm dense plasterboard (e.g. SoundBloc). The min. void depth shall be 200mm containing a min. 100mm thick mineral wool quilt (10-30 kg/m<sup>3</sup>).</p> <p>Decorative ceiling installed below (to contain HVAC systems directly serving the room).</p> |
| Gym/Games |  <ul style="list-style-type: none"> <li>• 150 mm (min.) ceiling void (metal frame).</li> <li>• 25 mm (min.) mineral wool quilt (10-30 kg/m<sup>3</sup>).</li> <li>• 2 x 15 mm dense plasterboard (e.g. SoundBloc).</li> </ul>                                                                                                                                                                                                                                                                                                                               |
| All other |  <ul style="list-style-type: none"> <li>• 150 mm (min.) ceiling void (metal frame).</li> <li>• 1 x 12.5 mm plasterboard (e.g. Wallboard).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                        |

### 3.2.3 Separating Walls

Both the gym and the cinema share a separating wall with a residential apartment. For both adjacencies, the same enhanced twin-stud wall type was specified, as detailed below.

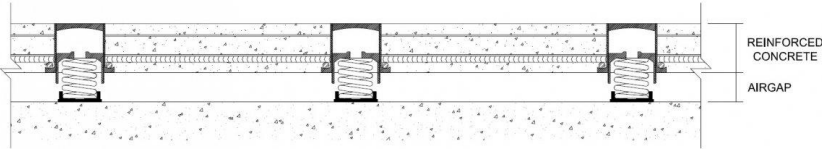
| Element                            | Solution                                                                                                                                                                                                                                                                                                                                                                                                          |
|------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Separating walls to gym and cinema |  <ul style="list-style-type: none"><li>• 3 x 15 mm dense plasterboard (e.g. SoundBloc).</li><li>• IWL twin I-stud (with acoustic neoprene braces).</li><li>• 4 x 100mm mineral wool (10-30 kg/m³) and 2 x 100 mm stone wool.</li><li>• 3 x 15 mm dense plasterboard (e.g. SoundBloc).</li></ul> <p>Walls built slab to slab.</p> |

3.2.4 Specific Gym Isolation Treatment

In addition to the above, a specialist isolated floor solution was specified to control impact and rhythmic excitations of the structure from gym activities (e.g. heavy weight impacts/drops, CV machines and general aerobic activities). This comprised a heavyweight isolated floor slab with appropriate finishes.

The floor was specified to satisfy the ProPG G-curve value of G20 when tested to ‘ProPG Method 1’. This method is deemed suitable in this instance as the gym equipment inventory has been restricted as follows:

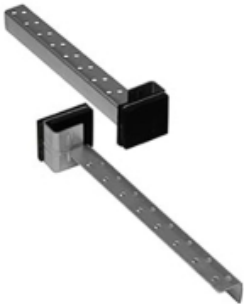
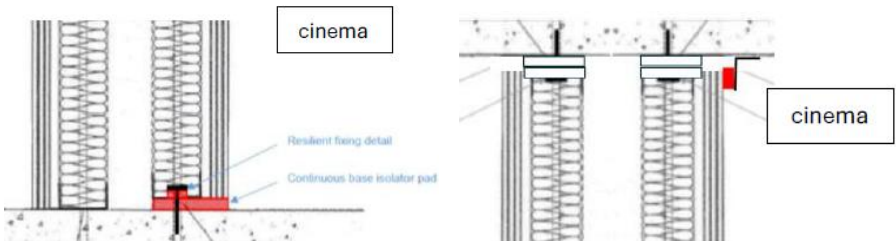
- 1. Free-weights (dumbbells) up to 50 kg only.
- 2. No leg press machines permitted.
- 3. Fixed weight machines to be supplied with acoustic dampener collars to pin loaded plates.
- 4. No free Olympic bar to be supplied (smith-press squat/bench weight machine only).

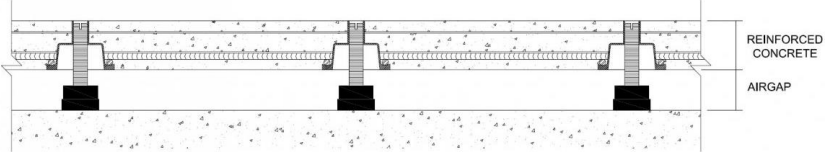
| Element                    | Solution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Spring Isolated Floor Slab | <p>A heavyweight ‘floating’ floor to achieve a <b>maximum system natural frequency of 6Hz under operational load.</b></p> <p>A suitable solution would be supplied by a specialist isolated floor company such as <b>Mason UK</b>, e.g.:</p> <ul style="list-style-type: none"><li>• Floor finish (see below),</li><li>• 100 mm concrete (ca. 2,300 kg/m³),</li><li>• Jack-up spring floor system (ca. 50-100 mm air void),</li><li>• Perimeter isolator strips to isolate the floor from the surrounding walls.</li></ul>  |
| Floor Finishes             | <ul style="list-style-type: none"><li>• <b>FREE WEIGHTS ZONE:</b> 40mm thick rubber gym matting comprising min. 12mm resilient layer with 30mm Pliteq GenieMat FIT30 floor.</li><li>• <b>ALL OTHER ZONES (CV/STUDIO):</b> Min. 12mm resilient layer achieving min. 12 dB ΔLw.</li></ul>                                                                                                                                                                                                                                                                                                                         |

3.2.5 Specific Cinema Isolation Treatment

The cinema will have a powerful surround sound system with subwoofers capable of producing high levels of low frequency sound energy. To minimise the risk of this low frequency energy entering the structure, a room-in-room principle was followed with design (isolated walls, floor and ceiling). In addition to the ceiling on isolated hangers, this comprised a heavyweight concrete floating floor slab (on jack-up neoprene mounts). Wall linings on all sides of the cinema were built full height slab to slab, but with resilient base and head isolators to prevent structure-borne sound flanking via the plasterboard. All linings were braced back with neoprene acoustic braces. This solution, whilst not only improving airborne sound insulation, provides protection of any potential structure-borne noise transfer from wall mounted loudspeakers.

The specifications of these solutions are presented below. Note, that in addition to this treatment, limiting audio levels will be determined through pre-completion testing presented herein. At the time of writing, the cinema was not ready for final commissioning (i.e. to calibrate the electronic noise limiter to these levels) but this work is scheduled and will be completed prior to occupation.

| Element               | Solution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cinema wall isolation | <p>Linings to the cinema side of the wall to be braced back using British Gypsum GAB3 neoprene acoustic braces, as pictured below.</p>  <p>Cinema-side linings to be installed on base-isolator strips providing a <b>max. natural frequency of 25Hz</b>, e.g. Mason base isolator, as per the below sketch. At the head of the cinema side of the lining, an isolated head (angle bracket) will be required, as shown below, e.g. Mason AB-716.</p>  |

| Element      | Solution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Floor        | <p>A heavyweight 'floating' floor to achieve a <b>maximum system natural frequency of 8Hz under operational load</b>.</p> <p>A suitable solution would be supplied by a specialist isolated floor company such as <b>Mason UK</b>, e.g.:</p> <ul style="list-style-type: none"><li>• Floor finish (see below),</li><li>• 100 mm concrete (ca. 2,300 kg/m<sup>3</sup>),</li><li>• Rubber on shuttering, or jack-up spring floor system (ca. 50-100 mm air void),</li><li>• Perimeter isolator strips to isolate the floor from the surrounding walls.</li></ul>  |
| Loudspeakers | <p>Subwoofers to be floor mounted (off the isolated slab). Crossover frequency to be set at &lt;315 Hz.</p> <p>Wall/ceiling mounted loudspeakers to have a cross-over frequency of &gt; 315 Hz and can be hard mounted to isolated wall linings. If installed flush into decorative linings, loudspeakers to be closed back type to minimise backward sound energy output.</p>                                                                                                                                                                                                                                                                    |

3.3 Pre-completion Testing

3.3.1 Overview

Jameson Acoustics visited site on Tuesday 11 March 2025 between the hours of 18:00-22:00 to carry out a series of pre-completion sound tests of the amenity spaces. These tests comprised:

- 1. Airborne sound insulation testing across separating wall and floors (amenity to residential);
- 2. Heavy impact (weight drop) testing of the gym floor.

All tests were conducted using Class 1 sound level meters, hand-calibrated before and after the testing (with no observed deviations).

3.3.2 Airborne Sound Insulation Tests

The sound insulation testing was carried out in accordance with BS 140-4 with the aim of establishing sound level difference from source to receiver rooms. From this, maximum operational noise levels for the amenity spaces can be calculated so which would ensure noise levels in the receiver room (apartment) do not exceed the criteria detailed in Section 3.1.

The following table summarises the sound insulation test locations and results, expressed as *field* element normalised sound level differences,  $D_{nT}$ . These values include corrections for background noise levels and reverberation times in the receiver rooms, as per the test standard.

NB: Due to access restrictions, it was not possible to measure the performance of the Games Room floor, but this room has the same ceiling construction to that of the Gym, which is considered to be sufficiently representative.

| Element | Source room    | Receiver room                 | Element normalised level difference, $D_{nT}$ (dB) at OBCF (Hz) |     |     |     |    |    |    | $D_{nT,w}$ (dB) |
|---------|----------------|-------------------------------|-----------------------------------------------------------------|-----|-----|-----|----|----|----|-----------------|
|         |                |                               | 63                                                              | 125 | 250 | 500 | 1k | 2k | 4k |                 |
| Floor   | Gym            | Block C (L01)<br>Apt C106 Bed | 42                                                              | 44  | 50  | 55  | 72 | 72 | 76 | <b>60</b>       |
| Wall    | Gym            | Block C (L00)<br>Apt C107 Liv | 46                                                              | 55  | 62  | 68  | 73 | 78 | 79 | <b>72</b>       |
| Floor   | Cinema         | Block D (L01)<br>Apt D107 Liv | 52                                                              | 58  | 65  | 68  | 77 | 79 | 81 | <b>74</b>       |
| Floor   | Cinema         | Block D (L01)<br>Apt D107 Bed | 51                                                              | 60  | 64  | 67  | 80 | 80 | 82 | <b>74</b>       |
| Floor   | Cinema         | Block D (L01)<br>Apt D106 Bed | 51                                                              | 58  | 62  | 69  | 80 | 80 | 81 | <b>74</b>       |
| Wall    | Cinema         | Block D (L00)<br>Apt D106 Liv | 43                                                              | 57  | 61  | 71  | 73 | 75 | 78 | <b>72</b>       |
| Floor*  | Private Dining | Block D (L01)<br>Apt D107 Bed | 44                                                              | 56  | 60  | 65  | 80 | 80 | 80 | <b>71</b>       |

Based on the results of the above, the following maximum operational noise levels would apply to each amenity space to ensure noise levels in receiver rooms do not exceed 47 dB  $L_{eq,5min}$  at 63 Hz, 41 dB  $L_{eq,5min}$  at 125 Hz and -5 dB below background in all other octave band centre frequencies. NB: Background noise levels were measured to be typically ~25-28 dBA in apartments (day and night, maintained by MVHR ventilation systems on trickle), thus higher frequency limits are based on the NR 15 curve.

| Receiver room          | Maximum permissible noise levels, $L_{eq,5min}$ (dB) at OBCF (Hz) |           |           |           |           |           |           |
|------------------------|-------------------------------------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|
|                        | 63                                                                | 125       | 250       | 500       | 1k        | 2k        | 4k        |
| <b>Gym, Games Room</b> | <b>89</b>                                                         | <b>85</b> | <b>76</b> | <b>74</b> | <b>87</b> | <b>84</b> | <b>85</b> |
| <b>Cinema</b>          | <b>90</b>                                                         | <b>98</b> | <b>87</b> | <b>86</b> | <b>88</b> | <b>87</b> | <b>87</b> |
| <b>Private dining*</b> | <b>91</b>                                                         | <b>97</b> | <b>86</b> | <b>84</b> | <b>95</b> | <b>92</b> | <b>91</b> |

\*Note, the private dining space does not directly share a party floor with dwellings (it occupies a space with a flat roof above, hence the high operational noise limits).

For the gym/games room, the above levels are considered to be sufficient to accommodate the intended usage, i.e. social noises (patrons laughing/talking), games or use of CV machinery and general fitness activities. For comparison, the following table presents maximum  $L_{eq,1min}$  noise levels recorded in a large commercial gym (at No1 Deansgate) during a busy lunchtime period.

| Desc.                               | Highest measured $L_{eq,1min}$ noise level (dB) at Octave Band Centre Frequency (Hz) |     |     |     |    |    |    |
|-------------------------------------|--------------------------------------------------------------------------------------|-----|-----|-----|----|----|----|
|                                     | 63                                                                                   | 125 | 250 | 500 | 1k | 2k | 4k |
| Main fitness area of commercial gym | 51                                                                                   | 54  | 62  | 71  | 74 | 73 | 72 |

The following table presents measured  $L_{max}$  noise levels from heavy weight drops onto a Pliteq floor matting solution, as surveyed by Jameson Acoustics at a similar residential gym facility.

| Desc.                                                      | Reverberant $L_{max}$ Noise Level in Gym (dB)<br>at Octave Band Centre Frequency (Hz) |     |     |     |    |    |    |
|------------------------------------------------------------|---------------------------------------------------------------------------------------|-----|-----|-----|----|----|----|
|                                                            | 63                                                                                    | 125 | 250 | 500 | 1k | 2k | 4k |
| 30kg weight drop from knee height (onto Pliteq rubber mat) | 82                                                                                    | 72  | 65  | 65  | 63 | 63 | 62 |

A comparison of the above values against the maximum permissible noise levels demonstrates that typical/sensible use of the gym/games areas are unlikely to exceed MCC noise requirements in nearby structurally-connected dwellings, and should thus be considered acceptable. The space shall be centrally managed, with anti-social behaviour (e.g. shouting) not to be tolerated.

For the cinema, the specialist audio sound system to the room shall be commissioned prior to occupation. This commissioning will set the maximum 'loudness' of the subwoofers and satellite loudspeakers that will be programmed into a locked electronic noise limiter. The limits will ensure that at maximum loudness, the audio system will not exceed the above permissible noise levels in the cinema and thus satisfy the MCC noise requirements in adjacent apartments.

For the private dining (and all other general amenity spaces), the operational noise levels would be dominated by speech (patrons talking/laughing) and the permissible noise levels presented above would be considered more than ample. In the event of parties in the private dining room, amplified music (ambient to raised loudness) could be played, but the use of this room will still need to be sensibly managed.

### 3.3.3 Gym Impact Floor Tests

Impact testing was carried out between 20:00-21:30hr (to obtain low background noise levels in apartments). The testing was carried out in accordance with Method 1 of ProPG, comprising the dropping of a 24 kg kettlebell weight onto the gym floor whilst simultaneously logging noise levels in the 3nr nearest habitable rooms.

Class 1 sound level meters were set up to continuously record maximum  $L_{max}$  noise levels in one-third octave bands within three receiver rooms, as below, over short 1-second intervals with an integral time of 125 ms.

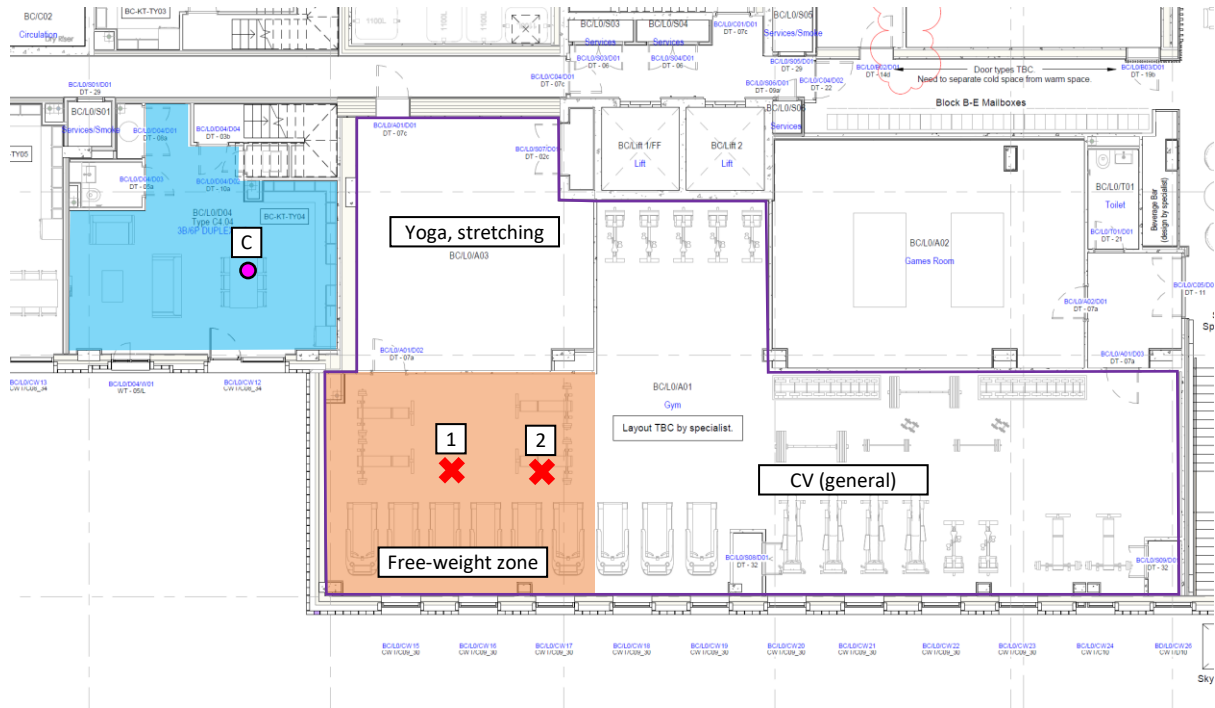
- A. Block C – C106 Living Room (first floor apartment above gym),
- B. Block C – C107 Bedroom (first floor bedroom in duplex adjacent to gym),
- C. Block C – C107 Living Room (ground floor living room in duplex adjacent to gym).

The weight was dropped onto three floor samples:

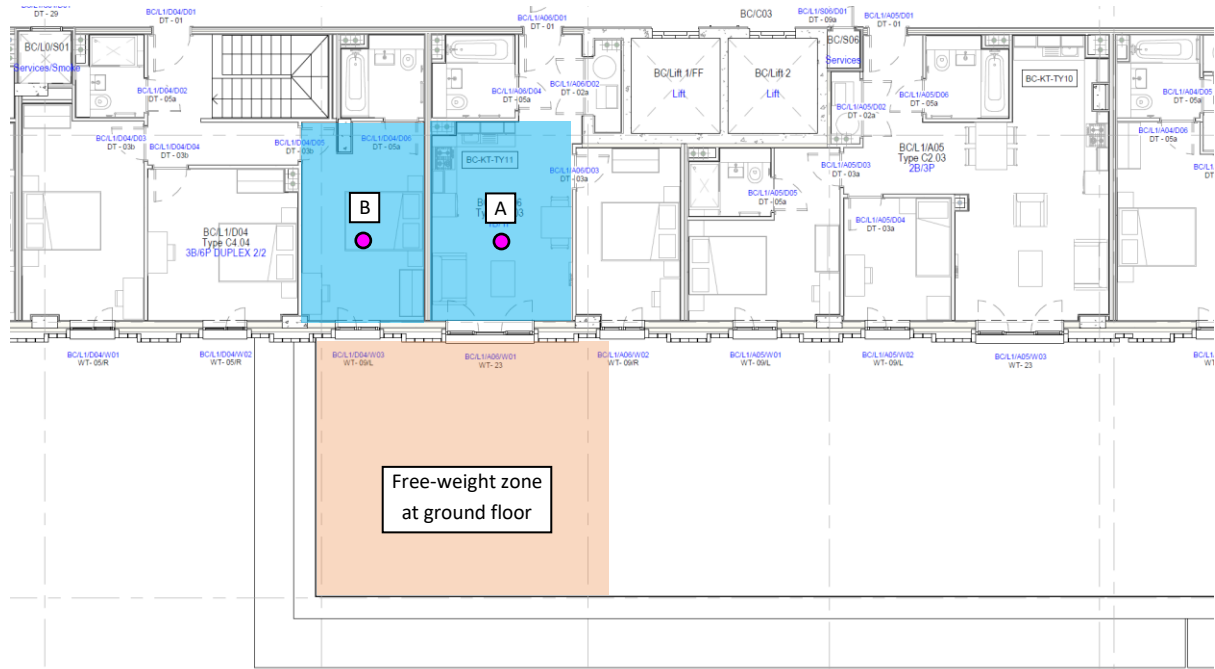
- the bare surface of the sprung isolated floor slab,
- isolated slab + resilient underlayer,
- isolated slab + resilient underlayer + Pliteq GenieMat FIT30.

The weight was dropped three times per sample from a height of ca. 0.5 m (approximately knee height) in two locations in the designated free weights area of the gym – (1) in the centre span of the structural grid, and (2) on a column line.

The test locations and related receiver room positions are shown below.



Ground floor

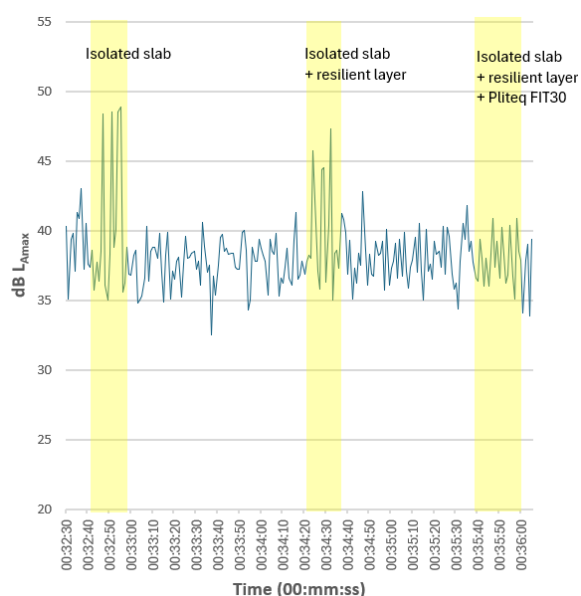


First floor

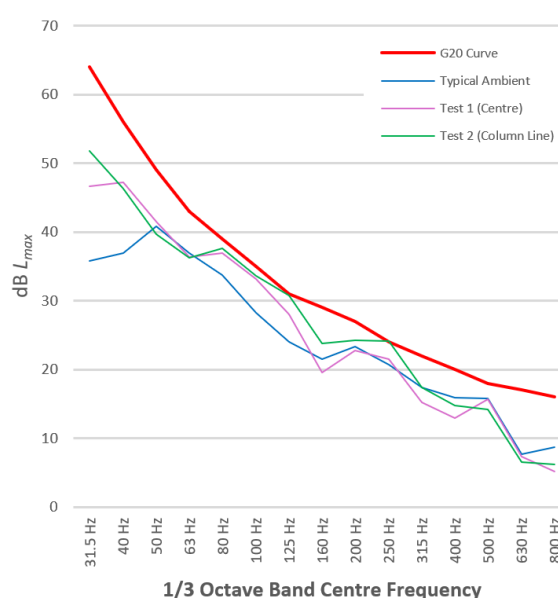
The resultant measured  $L_{Amax}$  noise levels are summarised below for each receiver, presented as an average of the three drops, together with the typical ambient  $L_{Amax}$  noise level.

| Scenario                                    | Measured $L_{Amax}$ Level in Apartments (dB) |              |              |
|---------------------------------------------|----------------------------------------------|--------------|--------------|
|                                             | [A] C106 Liv                                 | [B] C107 Bed | [C] C107 Liv |
| Typical ambient                             | 32-33                                        | 24-25        | 24           |
| Bare slab – centre span                     | 54                                           | 50           | 44           |
| Bare slab – column line                     | 54                                           | 52           | 46           |
| Resilient layer – centre span               | 45                                           | 40           | 39           |
| Resilient layer – column line               | 44                                           | 42           | 39           |
| SOLUTION (above+Pliteq FIT30) – centre span | 32                                           | 25           | 24           |
| SOLUTION (above+Pliteq FIT30) – column line | 33                                           | 26           | 25           |

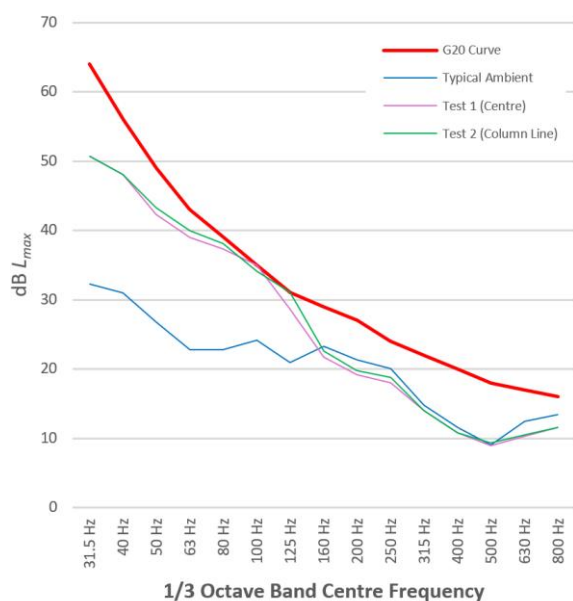
The following Figures present the frequency-spectral graphs comparing the results of testing onto the complete floor solution (incl. Pliteq FIT30) with the ProPG G20 curve to demonstrate compliance. For receiver room A, the typical ambient  $L_{max}$  noise levels in the room were too high to provide a graphic illustration of compliance against the G20 curve. In lieu, a graphical illustration of the time history graph has been provided, which illustrates that the dropping of weights onto the complete floor solution does not influence the prevailing ambient  $L_{Amax}$  noise levels in the receiver room.



Receiver Room A



Receiver Room B



Receiver Room C

The results demonstrate the gym floor is satisfying ProPG curve G20 for heavy weight impacts and should thus be considered acceptable.

### 3.4 External Noise Breakout

The only two 'noisy' amenity spaces with an external façade to consider are the gym and the private dining room. Both spaces have an external elevation facing south-west. Based on survey results taken by Jameson Acoustics during demolition and construction phase noise monitoring of the site, the typical lowest external background noise levels anticipated in this area of the site in the late evening (private dining operation) and through the night-time (gym operation) are summarised below.

| Desc.      | Typical lowest background noise level, L <sub>90</sub> (dB)<br>at Octave Band Centre Frequency (Hz) |     |     |     |    |    |    | L <sub>A90</sub> (dB) |
|------------|-----------------------------------------------------------------------------------------------------|-----|-----|-----|----|----|----|-----------------------|
|            | 63                                                                                                  | 125 | 250 | 500 | 1k | 2k | 4k |                       |
| Evening    | 57                                                                                                  | 51  | 49  | 48  | 46 | 38 | 27 | 49                    |
| Night-time | 51                                                                                                  | 43  | 42  | 42  | 42 | 35 | 23 | 45                    |

Both the gym and the private dining room have sealed (fixed pane) windows. There is no reliance on façade openings for ventilation as both rooms are comfort cooled. The windows have been specified and selected to achieve a minimum sound reduction performance of 30 dB  $R_w + C_{tr}$ . The windows are punched in to an external wall comprising solid brick, insulated cavity and SFS with insulation and double layer plasterboard linings.

The nearest noise sensitive windows to the site are those of a proposed residential development directly opposite these rooms at a distance of approximately 40 metres. Based on the MCC requirement to ensure operational (entertainment) noise does not exceed a level -5 dB below the prevailing background at the

nearest noise sensitive windows, our assessment indicates the following maximum operational noise levels would be permissible in the gym and the private dining room. Calculations are based on the industry standard equation for noise breakout, as follows.

$$SPL_{out} = SPL_{in} - SRI + 10 \log_{10} \left( \frac{S}{r^2} \right) - 14$$

, where  $SPL_{out}$  is the resultant noise level outside,  $SPL_{in}$  is the reverberant noise level inside the venue,  $SRI$  is the composite sound reduction of the façade,  $S$  is the area of the façade ( $m^2$ ), and  $r$  is the distance.

## GYM – NIGHT-TIME

| Desc.                                          | dB, at Octave Band Centre Frequency, Hz |           |           |           |           |           |           | A-weighted, dB(A) |
|------------------------------------------------|-----------------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-------------------|
|                                                | 63                                      | 125       | 250       | 500       | 1k        | 2k        | 4k        |                   |
| $SPL_{out}$ (limits), $L_{eq,5min}$            | 46                                      | 38        | 37        | 37        | 37        | 30        | 18        | <b>40</b>         |
| SRI, composite                                 | -23                                     | -25       | -28       | -31       | -35       | -37       | -41       | -                 |
| <i>SRI window</i>                              | -20                                     | -22       | -25       | -28       | -32       | -34       | -38       | -                 |
| <i>SRI wall</i>                                | -40                                     | -43       | -48       | -53       | -58       | -62       | -65       | -                 |
| $10 \log(S/r^2)$ , $S=100m^2$ , $r=40m$        | -12                                     | -12       | -12       | -12       | -12       | -12       | -12       | -                 |
| -14                                            | -14                                     | -14       | -14       | -14       | -14       | -14       | -14       | -                 |
| <b><math>SPL_{in}</math> (max permissible)</b> | <b>95</b>                               | <b>89</b> | <b>91</b> | <b>94</b> | <b>98</b> | <b>93</b> | <b>85</b> | <b>101</b>        |

## PRIVATE DINING – EVENING

| Desc.                                          | dB, at Octave Band Centre Frequency, Hz |            |            |            |            |            |           | A-weighted, dB(A) |
|------------------------------------------------|-----------------------------------------|------------|------------|------------|------------|------------|-----------|-------------------|
|                                                | 63                                      | 125        | 250        | 500        | 1k         | 2k         | 4k        |                   |
| $SPL_{out}$ (limits), $L_{eq,5min}$            | 52                                      | 46         | 44         | 43         | 41         | 33         | 22        | <b>44</b>         |
| SRI, composite                                 | -23                                     | -25        | -28        | -31        | -35        | -37        | -41       | -                 |
| <i>SRI window</i>                              | -20                                     | -22        | -25        | -28        | -32        | -34        | -38       | -                 |
| <i>SRI wall</i>                                | -40                                     | -43        | -48        | -53        | -58        | -62        | -65       | -                 |
| $10 \log(S/r^2)$ , $S=40m^2$ , $r=40m$         | -16                                     | -16        | -16        | -16        | -16        | -16        | -16       | -                 |
| -14                                            | -14                                     | -14        | -14        | -14        | -14        | -14        | -14       | -                 |
| <b><math>SPL_{in}</math> (max permissible)</b> | <b>105</b>                              | <b>101</b> | <b>101</b> | <b>104</b> | <b>106</b> | <b>100</b> | <b>93</b> | <b>109</b>        |

The results for both spaces indicate very high operational noise levels would be permissible before the MCC external noise breakout criteria was reached.

For both spaces, these permissible levels exceed those required to control internal noise transfer to structurally-connected dwellings. With reference to Section 3.3.2, the maximum permissible levels for internal noise transfer are deemed to be ample for the intended use of the two amenity rooms. Hence, external noise breakout from the gym and private dining would be deemed to have a very low probability of adverse noise impact.

## 4.0 PC 19 – Residential Noise Insulation Scheme

### 4.1 Acoustic Criteria

Facades to the residential accommodation in Block C & D have been designed to achieve the following internal noise levels:

| Area                | Location    | Daytime<br>(07:00-23:00) | Night time<br>(23:00-07:00)              |
|---------------------|-------------|--------------------------|------------------------------------------|
| Apartment/Townhouse | Living Room | 35 dB $L_{Aeq,16hr}$     | -                                        |
|                     | Bedroom     | 35 dB $L_{Aeq,16hr}$     | 30 dB $L_{Aeq,8hr}$<br>45 dB* $L_{Amax}$ |

\* Not to be regularly exceeded by scheduled noise events (e.g. trains, buses, etc.).

In addition, the following low frequency noise limits shall be achieved during music events at the Arena.

| Area                | Location              | Desirable Internal Noise Level from Arena Events,<br>$L_{eq,5min}$ at Octave Band Centre Frequency |       |
|---------------------|-----------------------|----------------------------------------------------------------------------------------------------|-------|
|                     |                       | 63 Hz                                                                                              | 63 Hz |
| Apartment/Townhouse | Living Room / Bedroom | 47 dB                                                                                              | 41 dB |

All apartments are ventilated with whole-house mechanical ventilation systems (MVHR) which have been designed to maintain the 35 dB  $L_{Aeq}$  (daytime bed/liv) and 30 dB  $L_{Aeq}$  (night-time bed) noise levels during normal operation. Two boost modes exist, for which relaxations are permitted under the IOA/ANC Guide *Acoustics, Ventilation & Overheating* (AVO), as follows:

- Extract boost – extract rates are increased to remove humid air in bathrooms: noise levels in bedrooms would be unchanged (extract ducts do not serve bedrooms) and noise levels in living rooms should not exceed 35 dB  $L_{Aeq}$ .
- Summer boost – manual switch to boost supply/extract air for summer cooling: this condition effectively helps to reduce the reliance on openable windows in the summer. As such, the AVO permits a relaxation of up to +5 dB on the above  $L_{Aeq}$  limits in bedrooms and living rooms. NB: As an alternative to having the window open, the +5 dB provides far better acoustic conditions in the apartments than opening the windows.

### 4.2 Design Specifications

#### 4.2.1 Facades

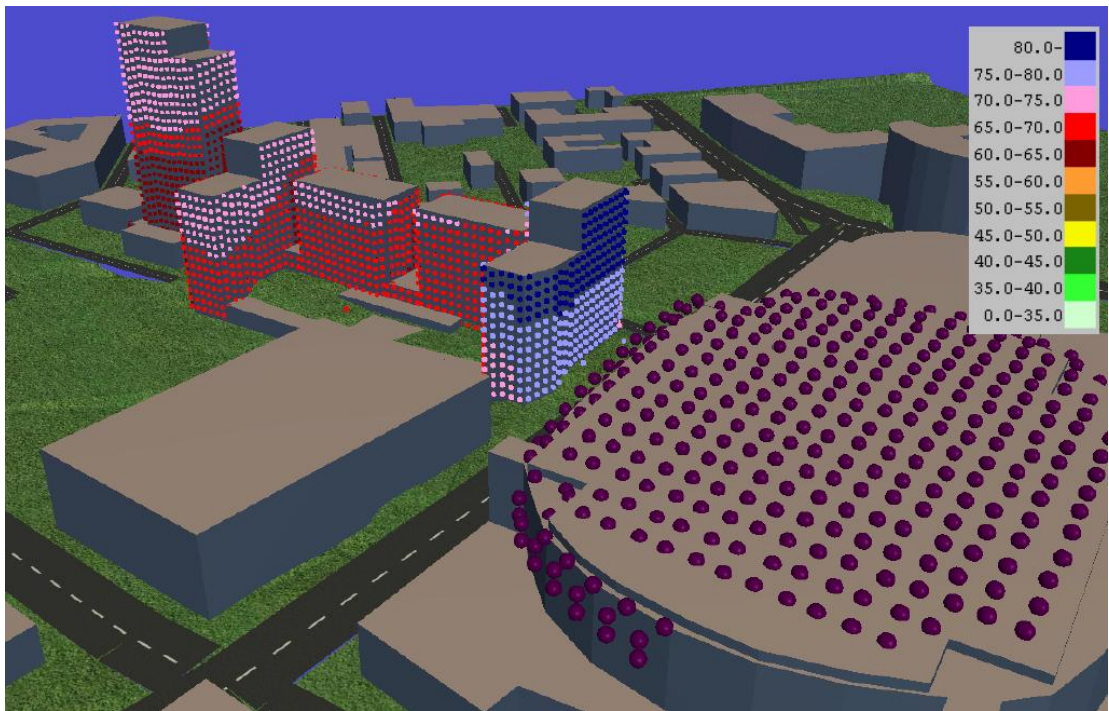
In Blocks C & D, all apartments will have facades formed from brick/SFS external walls with punched in double glazed windows.

For the window systems, the following acoustic specification informed the specification to satisfy the above noise requirements.



| Façade Zone (ref. Figure above) | Minimum Sound Reduction, R (dB) at OBCF |        | Min. Overall $R_w + C_{tr}$ (dB) | Example Glass Configuration (Guidance Only) |
|---------------------------------|-----------------------------------------|--------|----------------------------------|---------------------------------------------|
|                                 | 63 Hz                                   | 125 Hz |                                  |                                             |
| GOLD                            | 25                                      | 16     | 34                               | 13.5 (lam) / 16 arg / 10 (tough) mm         |
| BLUE                            | -                                       | -      | 30                               | 10 / 16 arg / 6 mm                          |

Event (music) noise levels from the Arena were surveyed and reviewed by means of noise modelling to set the above specification, as shown below.

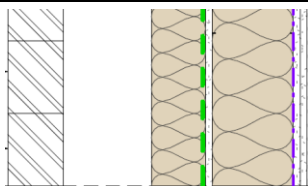


The window systems were supplied by Lancashire Double Glazing, who confirm the specification of the window systems as follows:

**Gold:** Aluminium frame, 8.8 [acoustic lam.] / 16 / 10 mm configuration, with a certified performance of 37 dB  $R_w + C_{tr}$  and low frequency performances achieving/exceeding the low frequency figures.

**Blue:** Aluminium frame, 6.8 [lam.] / 14 / 8 mm [toughened] configuration, with a certified performance 33 dB  $R_w + C_{tr}$ .

The specification of the external walls to Block C & D is as follows.

| Type                                    | Sketch                                                                            | Build-Up                                                                                                                                                                                                                                                    |
|-----------------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Standard Brick/SFS to Residential Areas |  | <ul style="list-style-type: none"> <li>• 102.5mm traditional brick.</li> <li>• External cavity (with mineral wool slab).</li> <li>• Weatherboarding.</li> <li>• 100-150mm SFS (full filled with mineral wool).</li> <li>• 2 x 15mm plasterboard.</li> </ul> |

The sound reduction performance of this construction was estimated to provide a sound reduction performance of 53 dB  $R_w + C_{tr}$  with low frequency performance of 40 dB  $R$  at 63 Hz and 43 dB  $R$  at 125 Hz, which far exceeds the requirements to satisfy the noise limits presented in Section 4.1.

## 4.2.2 Ventilation Systems

The MVHR units providing ventilation to apartments are by Nuaire (model MRXBOXAB-ECO). Associated noise levels for units to 1-bed, 2-bed and 3-bed dwellings were reviewed at design stage and found to satisfy the noise limits in Section 4.1 under normal and boost conditions.

## 4.3 Pre-completion Testing

### 4.3.1 External Noise Intrusion

Automated noise level measurements were taken from 12:00 hours on Wednesday 5 March 2025 to 16:00 hours on Tuesday 11 March 2025 at 4nr positions (habitable rooms) as described below.

The positions were selected to establish the typical prevailing daytime and night-time internal noise levels within living rooms and bedrooms of a range of apartments across the site. The survey also captured Arena event noise levels in apartments during an event on Friday 7 March 2025 (Five, live boy band) to verify low frequency noise levels at 63 Hz and 125 Hz.

| Position | Description ( <i>Window Spec Zone</i> )                    |
|----------|------------------------------------------------------------|
| 1        | Block D – Level 02 – D206 Bedroom ( <i>Gold Zone</i> )     |
| 2        | Block D – Level 02 – D204 Living Room ( <i>Gold Zone</i> ) |
| 3        | Block C – Level 06 – C607 Living Room ( <i>Gold Zone</i> ) |
| 4        | Block C – Level 04 – C402 Bedroom ( <i>Blue Zone</i> )     |

Windows were closed and MVHR units were switched off (to solely measure external noise intrusion).



The microphones were fitted with windshields and mounted in the centre of the rooms, at least 1.4 metres from walls at a height of 1.6-1.7 metres.

The equipment was programme to continuously log all relevant A-weighted broadband (dBA) and linear spectral noise level indices, including  $L_{eq}$ ,  $L_{90}$ ,  $L_{10}$  and  $L_{max}$ , over 5-minute, 15-minute and 1-hour intervals.

The instrumentation used for the survey is summarised below. The sound level meters were hand-calibrated at the beginning and end of the survey periods. No significant deviations in calibration level were noted.

| Description               | Equipment                                | Serial Nr      | Lab Calibration Expiry | Lab Calibration Certificate Nr |
|---------------------------|------------------------------------------|----------------|------------------------|--------------------------------|
| Class 1 sound level meter | Svantek 971A (with Type 7152 microphone) | 124663 (82835) | 26 Aug 2026            | 1509611-1                      |
| Class 1 sound level meter | Svantek 971A (with Type 7152 microphone) | 131635 (85533) | 4 Nov 2026             | 1510429-1                      |

| Description               | Equipment                                | Serial Nr      | Lab Calibration Expiry | Lab Calibration Certificate Nr |
|---------------------------|------------------------------------------|----------------|------------------------|--------------------------------|
| Class 1 sound level meter | Svantek 971A (with Type 7152 microphone) | 127647 (84398) | 12 Apr 2025            | 13 Apr 2023                    |
| Class 1 sound level meter | Svantek 971A (with Type 7152 microphone) | 131642 (85571) | 26 July 2025           | 26 July 2023                   |
| Class 1 sound calibrator  | Cirrus CR:515                            | 57570          | 12 Nov 2025            | 1171319                        |

Due to the nature of the survey, i.e. unmanned, it is not possible to describe the noise climate throughout the duration of the survey period. However, on install and collection, weather conditions were considered suitable for obtaining representative internal readings. Based on internet weather reports for the full duration of the survey, conditions generally remain suitable for representative readings, with mostly clear skies, and no periods of rainfall or unduly adverse weather.

The results of the surveys have been plotted on Time History Graphs 22015-G1 to G4 enclosed in Appendix B. The graphs present the uncorrected 15-minute A-weighted (dBA)  $L_{eq}$  and  $L_{max}$  levels at each position throughout the duration of the survey. NB: Daytime results during site working hours were unduly affected by construction activity noise. These periods shall be discounted from the assessment.

The  $L_{Aeq}$  results are summarised below and compared against the internal noise requirements.

## Position 1 – D206 Bedroom

| Period Commencement (Day/Night of...) 2025 | Ambient Noise Level (dB)             |                                        |
|--------------------------------------------|--------------------------------------|----------------------------------------|
|                                            | Daytime $L_{Aeq,16hr}$ (07:00-23:00) | Night-time $L_{Aeq,8hr}$ (23:00-07:00) |
| Wed 5 March                                | 22*                                  | 21                                     |
| Thu 6 March                                | –*                                   | –*                                     |
| Fri 7 March                                | 22*                                  | 20                                     |
| Sat 8 March                                | 21*                                  | 20                                     |
| Sun 9 March                                | 22                                   | 20                                     |
| Mon 10 March                               | 24*                                  | 20                                     |
| <b>Upper Limit</b>                         | <b>35</b>                            | <b>30</b>                              |
| Compliance/Exceedance                      | ✓                                    | ✓                                      |

\* excluding periods of construction noise.

## Position 2 – D204 Living Room

| Period Commencement (Day/Night of...)<br>2025 | Ambient Noise Level (dB)                |                                           |
|-----------------------------------------------|-----------------------------------------|-------------------------------------------|
|                                               | Daytime $L_{Aeq,16hr}$<br>(07:00-23:00) | Night-time $L_{Aeq,8hr}$<br>(23:00-07:00) |
| Wed 5 March                                   | 28*                                     | 25                                        |
| Thu 6 March                                   | 29*                                     | 26                                        |
| Fri 7 March                                   | 28*                                     | 25                                        |
| Sat 8 March                                   | 27*                                     | 25                                        |
| Sun 9 March                                   | 27                                      | 24                                        |
| Mon 10 March                                  | 30*                                     | 25                                        |
| <b>Upper Limit</b>                            | <b>35</b>                               | <b>30</b>                                 |
| Compliance/Exceedance                         | ✓                                       | ✓                                         |

\* excluding periods of construction noise.

## Position 3 – C607 Living Room

| Period Commencement (Day/Night of...)<br>2025 | Ambient Noise Level (dB)                |                                           |
|-----------------------------------------------|-----------------------------------------|-------------------------------------------|
|                                               | Daytime $L_{Aeq,16hr}$<br>(07:00-23:00) | Night-time $L_{Aeq,8hr}$<br>(23:00-07:00) |
| Wed 5 March                                   | 25*                                     | 24                                        |
| Thu 6 March                                   | 26*                                     | 26                                        |
| Fri 7 March                                   | 24*                                     | 22                                        |
| Sat 8 March                                   | 24*                                     | 23                                        |
| Sun 9 March                                   | 25                                      | 22                                        |
| Mon 10 March                                  | 27*                                     | 23                                        |
| <b>Upper Limit</b>                            | <b>35</b>                               | <b>30</b>                                 |
| Compliance/Exceedance                         | ✓                                       | ✓                                         |

\* excluding periods of construction noise.

## Position 4 – C402 Bedroom

| Period Commencement (Day/Night of...)<br>2025 | Ambient Noise Level (dB)                |                                           |
|-----------------------------------------------|-----------------------------------------|-------------------------------------------|
|                                               | Daytime $L_{Aeq,16hr}$<br>(07:00-23:00) | Night-time $L_{Aeq,8hr}$<br>(23:00-07:00) |
| Wed 5 March                                   | 27*                                     | 24                                        |
| Thu 6 March                                   | 28*                                     | 26                                        |
| Fri 7 March                                   | 27*                                     | 25                                        |
| Sat 8 March                                   | 27*                                     | 25                                        |
| Sun 9 March                                   | 28                                      | 25                                        |
| Mon 10 March                                  | -*                                      | -                                         |
| <b>Upper Limit</b>                            | <b>35</b>                               | <b>30</b>                                 |
| Compliance/Exceedance                         | ✓                                       | ✓                                         |

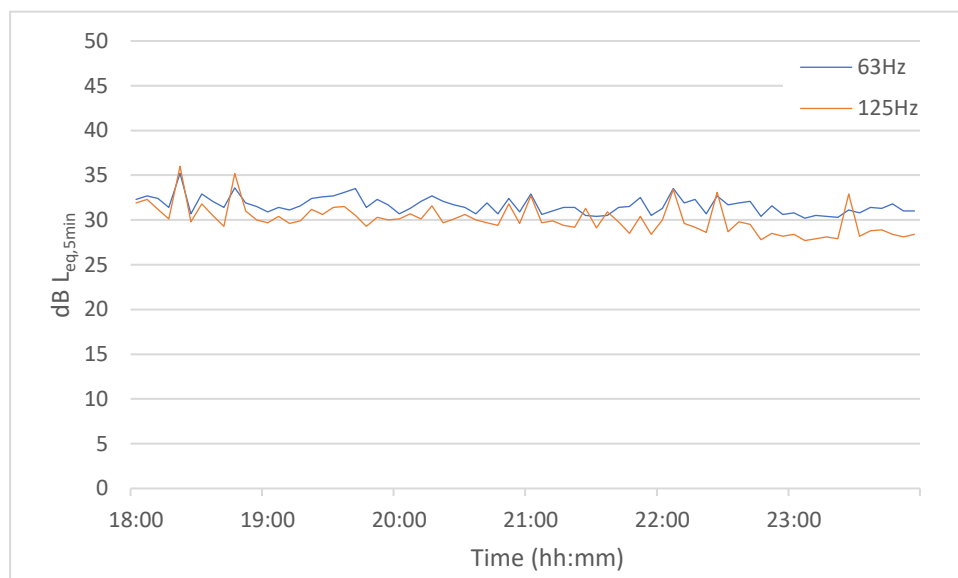
\* excluding periods of construction noise.

The following table summarises the measured 10-15<sup>th</sup> highest internal  $L_{Amax,5min}$  (night-time) noise levels in each test apartment. Note, living rooms are not subject to the maximum noise criterion at night, however, we have presented the data regardless, as this provides a good indication of compliance in adjacent bedrooms.

| Position             | 10-15 <sup>th</sup> Highest Noise Level at Night, dB<br>$L_{Amax,5min}$ (23:00-07:00) | Upper Limit, dB<br>$L_{Amax,5min}$ (23:00-07:00) | Compliance/ Exceedance |
|----------------------|---------------------------------------------------------------------------------------|--------------------------------------------------|------------------------|
| 1 - D206 Bedroom     | 35                                                                                    | 45                                               | ✓                      |
| 2 - D204 Living Room | 39                                                                                    | 45                                               | ✓                      |
| 3 - C607 Living Room | 38                                                                                    | 45                                               | ✓                      |
| 4 - C402 Bedroom     | 41                                                                                    | 45                                               | ✓                      |

The results demonstrate that, in all tested apartments, the internal noise levels achieved the upper limits of acceptable internal noise levels (as presented in Section 4.1).

For music noise, the worst affected apartment of the 4nr test is test room 3 (C607 Living Room) as this is most exposed to music noise emitted from the roof of the Arena. Measurements at low sound frequency during the live music concert on Friday 7 March 2025 are summarised below.



The results demonstrate that, in the most exposed/affected apartment to Arena music noise breakout, there were no undue rises in low frequency sound levels within the apartment, with levels falling below the limit of 47 dB  $L_{eq,5min}$  at 63 Hz and 41 dB  $L_{eq,5min}$  at 125 Hz.

## 4.3.2 Ventilation System Noise Levels

Internal noise level measurements were taken in 3nr sample apartments with MVHR units operating at trickle (normal) duty and in summer boost mode. The test apartments captured a typical 1-bed and 2-bed apartment. The measurements were taken between 20:00-21:00hr on Tuesday 5 March 2025.

At the time of the survey, there was limited availability/accessibility to apartments with power to operate the MVHR units. Nevertheless, all apartments have the same MVHR unit and operate with the comparable duties (flow rates and static pressures).

The results of the testing are summarised below. These values are the total noise levels in test rooms (i.e. due to traffic noise intrusion and the operation of the MVHR system).

| Apartment    | Room        | Condition    | Measured, dB<br>L <sub>Aeq</sub> | Upper Limit, dB<br>L <sub>Aeq</sub> | Compliance/<br>Exceedance |
|--------------|-------------|--------------|----------------------------------|-------------------------------------|---------------------------|
| D103 (1 bed) | Living Room | Trickle      | 23                               | 35                                  | ✓                         |
|              |             | Summer boost | 27                               | 40                                  | ✓                         |
|              | Bedroom     | Trickle      | 22                               | 30                                  | ✓                         |
|              |             | Summer boost | 29                               | 35                                  | ✓                         |
| D204 (2 bed) | Living Room | Trickle      | 26                               | 35                                  | ✓                         |
|              |             | Summer boost | -*                               | 40                                  | -                         |
|              | Bedroom 1   | Trickle      | 25                               | 30                                  | ✓                         |
|              |             | Summer boost | -*                               | 35                                  | -                         |
|              | Bedroom 2   | Trickle      | 25                               | 30                                  | ✓                         |
|              |             | Summer boost | -*                               | 35                                  | -                         |
| D304 (2 bed) | Living Room | Trickle      | 27                               | 35                                  | ✓                         |
|              |             | Summer boost | 36                               | 40                                  | ✓                         |
|              | Bedroom 1   | Trickle      | 25                               | 30                                  | ✓                         |
|              |             | Summer boost | 34                               | 35                                  | ✓                         |
|              | Bedroom 2   | Trickle      | 26                               | 30                                  | ✓                         |
|              |             | Summer boost | 34                               | 35                                  | ✓                         |

\* could not be measured due to fault with summer boost switch.

The results demonstrate compliance with the MCC noise requirements for normal conditions and the AVO guidance for summer boost conditions in all test cases.

## 7.0 Conclusion

Jameson Acoustics Limited has been commissioned by Domis Construction Limited to provide acoustic design and testing services to assist in the discharge of two planning conditions associated with the Waterhouse Gardens development (Block C & D) in Manchester.

The report confirms the design intent/specifications for the control of operational noise from the use of amenity spaces and the noise insulation scheme for residential apartments, and the results of associated pre-completion testing demonstrates compliance with design criteria, set in line with MCC requirements, in all cases.

## Appendix A – Acoustic Terminology

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|-------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>dB</b>                     | Decibel - Used as a measurement of sound level. Decibels are not an absolute unit of measurement but an expression of ratio between two quantities expressed in logarithmic form.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>dB(A)</b>                  | The human ear is more susceptible to mid-frequency noise than the high and low frequencies. The 'A'-weighting scale approximates this response and allows sound levels to be expressed as an overall single figure value in dBA. The <sub>A</sub> subscript is applied to an acoustical parameter to indicate the stated noise level is A-weighted (e.g. $L_{Aeq,T}$ in dB). Noise levels in dBA do not have a linear relationship to each other; for similar noises, a change in noise level of 10dBA represents a doubling or halving of subjective loudness. A change of 3dBA is only just perceptible. |
| <b><math>L_{Aeq,T}</math></b> | $L_{Aeq,T}$ is the equivalent continuous sound pressure level. It is an average of the total sound energy measured over a specified time measurement period, $T$ .                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b><math>L_{10,T}</math></b>  | $L_{10}$ is the noise level exceeded for 10% of the measurement period $T$ (i.e. the quietest 10% of the measurement) and has, for many years, been used in the assessment of road traffic noise.                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b><math>L_{90,T}</math></b>  | $L_{90}$ is the noise level exceeded for 90% of the measurement period $T$ (i.e. the quietest 10% of the measurement) and is often used to describe the 'background' noise level.                                                                                                                                                                                                                                                                                                                                                                                                                          |
| <b><math>L_{max}</math></b>   | $L_{max}$ is the maximum sound pressure level recorded over the measurement period, $T$ . $L_{max}$ is often used in assessing scheduled environmental noise 'events' (such as train passbys), particularly at night where such events may cause sleep disturbance.                                                                                                                                                                                                                                                                                                                                        |
| <b><math>R_w</math></b>       | The weighted sound reduction index, $R_w$ , is a single figure description of sound reduction as defined in BS EN ISO 717-1. It is single-number quantity which characterizes the airborne sound insulating properties of a material or building element over a range of frequencies. The $R_w$ is calculated from sound insulation measurements taken in an acoustic laboratory. Sound insulation ratings derived from site measurements are invariably lower than the laboratory figures and are referred to as the apparent weighted sound reduction index, $R'_w$ .                                    |
| <b><math>D_{n,e,w}</math></b> | The weighted element-normalised level difference, $D_{n,e,w}$ , is a single figure description of the sound insulation performance of small building elements, such as a trickle ventilator.                                                                                                                                                                                                                                                                                                                                                                                                               |
| <b><math>C_{tr}</math></b>    | $C_{tr}$ is correction term applied against the sound insulation single-number values (e.g. $R_w$ ) to provide a weighting against low frequency performance. The reference values used within the $C_{tr}$ calculation are based on urban traffic noise.                                                                                                                                                                                                                                                                                                                                                  |

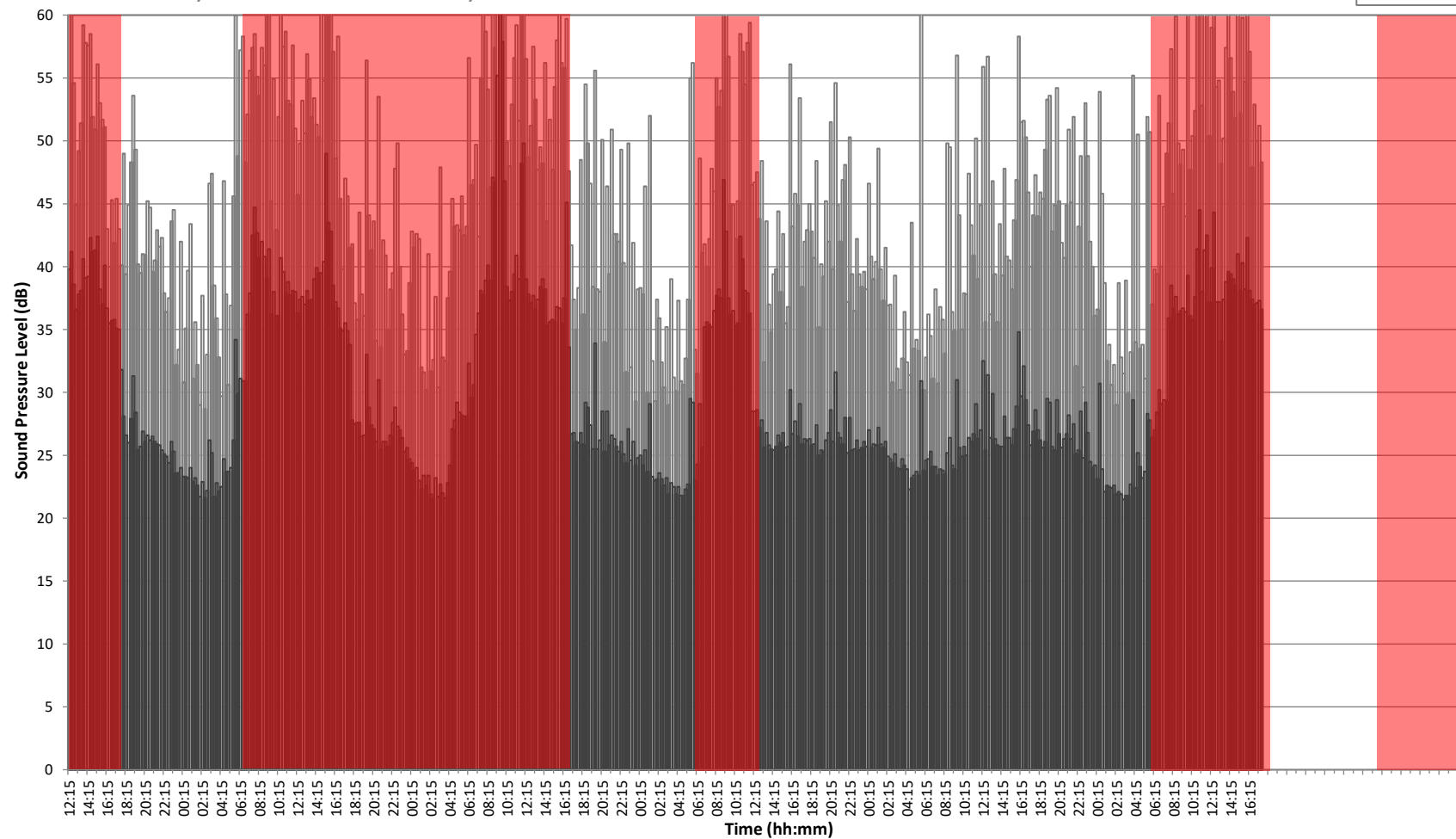
## **Appendix B – Internal Noise Levels (Time History Graphs)**

## Waterhouse Gardens, Block C & D

### Measurement Position 1 (D206 Bedroom)

Wednesday 5 March 2025 - Tuesday 11 March 2025

**22015-G1**

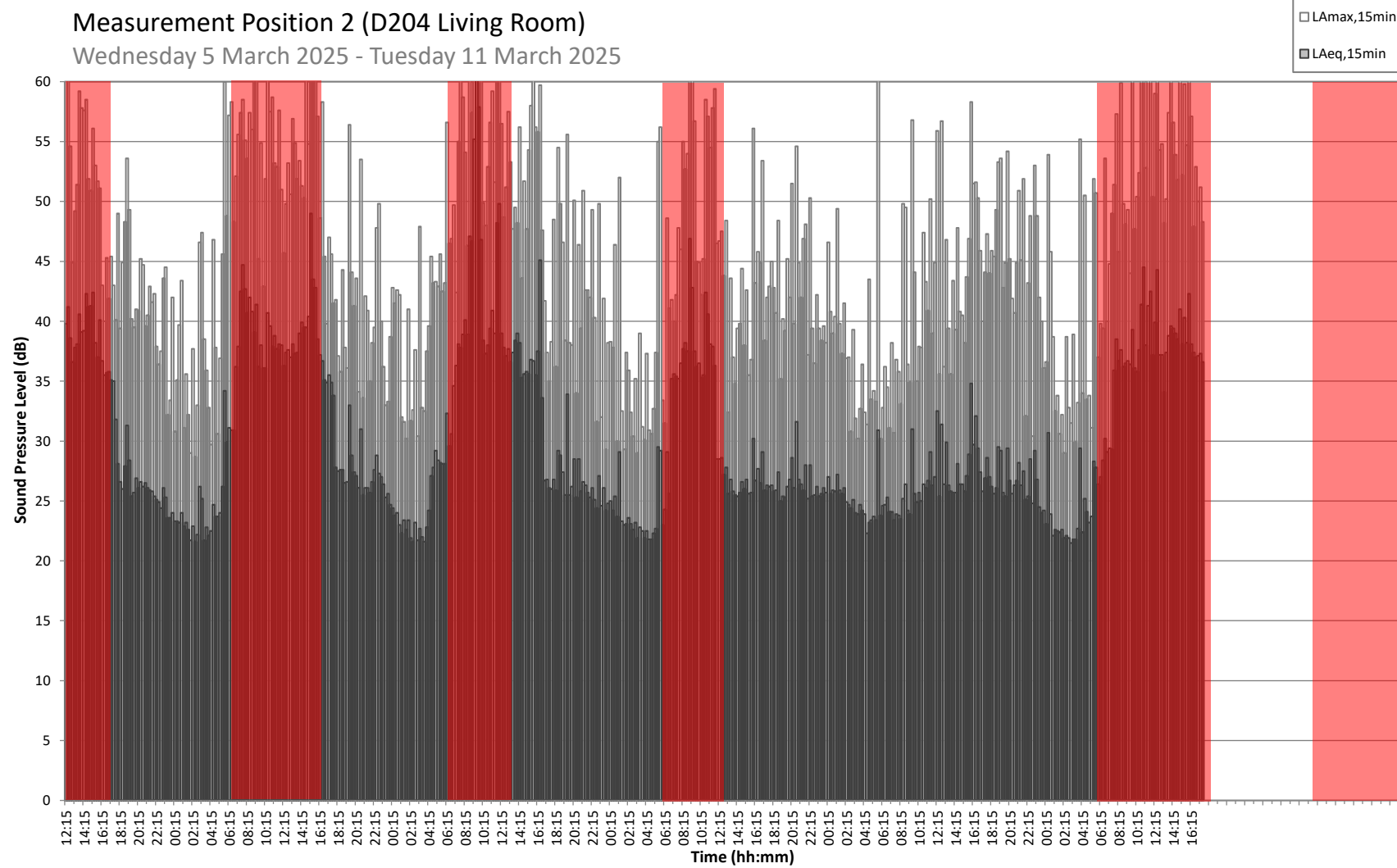
☐ LAm<sub>max,15min</sub>☐ LAeq,15min

## Waterhouse Gardens, Block C & D

Measurement Position 2 (D204 Living Room)

Wednesday 5 March 2025 - Tuesday 11 March 2025

22015-G2

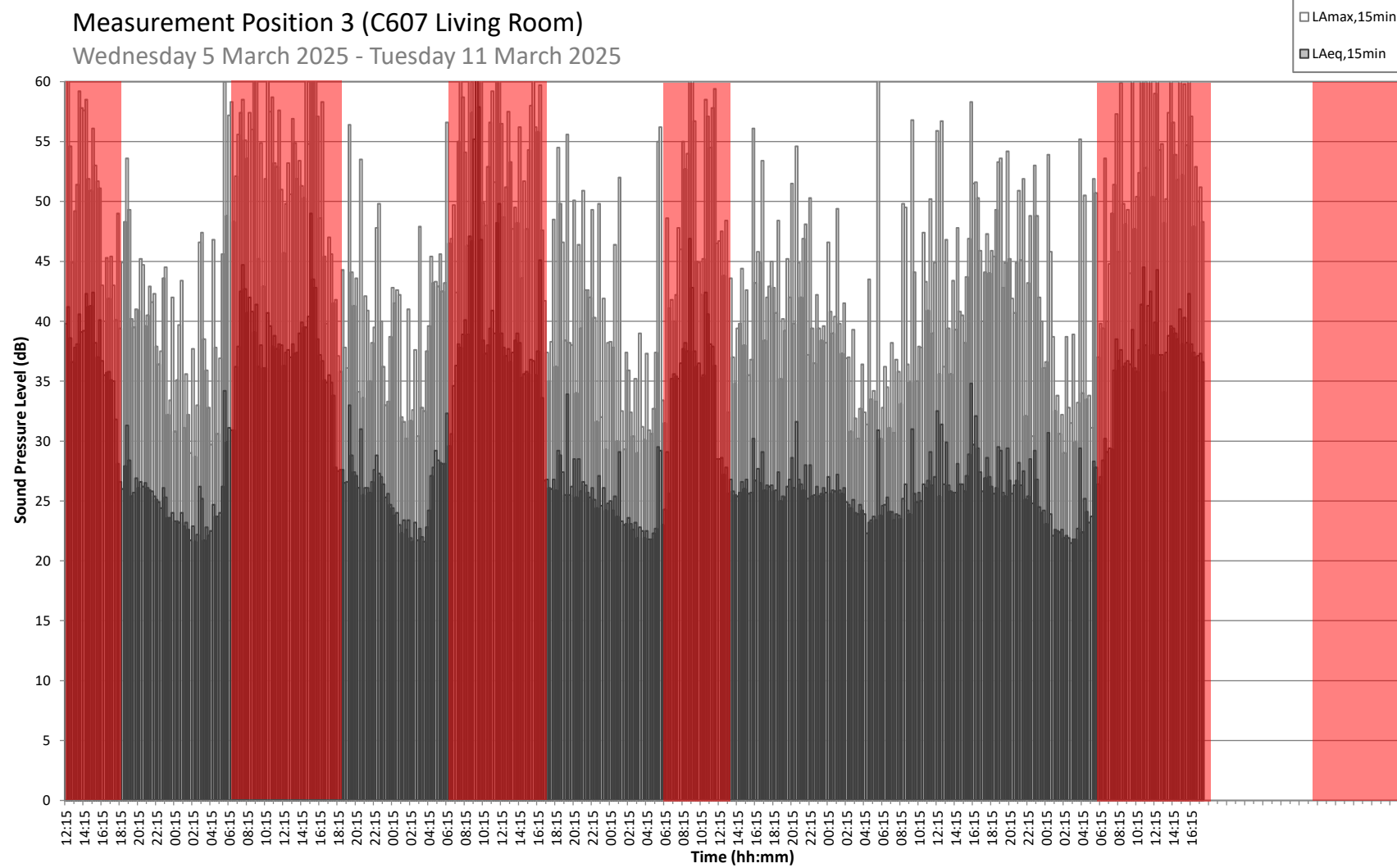


## Waterhouse Gardens, Block C & D

Measurement Position 3 (C607 Living Room)

Wednesday 5 March 2025 - Tuesday 11 March 2025

22015-G3



## Waterhouse Gardens, Block C & D

Measurement Position 4 (C402 Bedroom)

Wednesday 5 March 2025 - Tuesday 11 March 2025

22015-G4

