

MILLER GOODALL

ACOUSTICS - AIR QUALITY - LIGHTING

STAGE 3 ACOUSTIC DESIGN

on behalf of

IQSA SERVICES LTD

for the site at

ECHO STREET, MANCHESTER

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Summary

This report details the results of an environmental noise survey and provides the acoustic design strategy at Stage 3 for the proposed residential development at Echo Street, Manchester.

Comprehensive acoustic performance criteria are provided which incorporate all relevant statutory and planning requirements together with suitable guidance from documents including BS 8233:2014, BS 4142:2014, BB93:2015 and the client's aspirations.

The report includes the following information:

- Acoustic design criteria
- Building envelope design strategy
- Internal sound insulation design strategy
- Room acoustics design strategy
- External noise limits for building services

Record of changes

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1 Introduction

1.1 Miller Goodall Ltd has on behalf of IQSA Services Ltd, undertaken noise survey works and a noise assessment in respect of the impact of noise on and from a new residential-use building comprising three towers with ground floor study, recreation and ancillary areas.

1.2 This document provides full details of the acoustic criteria adopted for the project and summarises the acoustic design developed during the RIBA Stage 3 design stage. It is the intention that this report should be read in conjunction with relevant drawings and specifications produced by other design disciplines, including Architecture, M&E and Structural, and is provided as supplemental information to these.

1.3 The following sections of this report provide details of all relevant acoustic criteria from sources which include the Local Planning Authority and Part E of the Building Regulations.

1.4 The report then gives details of the acoustic design strategies which have been implemented in the different elements of the proposed development including the control of noise emissions to the environment, control of external noise ingress, the sound insulation of internal constructions (e.g. walls, floors, doors etc.), the control of reverberation in internal spaces and building services noise and vibration.

1.5 Colour marked-up plans are appended to this report that show the recommended acoustic ratings for partitions and doors and the target acoustic criteria for Environmental and NR noise limits within rooms, reverberation time (RT) and impact sound insulation.

1.6 A glossary of acoustic terminology is also provided.

2 Site Description

2.1 The site is located at Echo Street, Manchester, at the former site of Chandos Hall. The site location is shown outlined in red in Appendix 1.

2.2 The site is bounded to the south by the trainline running between Manchester Piccadilly and Manchester Oxford Road, beyond which are university buildings and the Mancunian Way (A57(M)) overpass approximately 250 m away. To the east, the site is directly bounded by Echo Street and an office building with the A6 and Piccadilly train station beyond.

2.3 North of the site, across Granby Row is the existing iQ student accommodation, with Fairfield Street and offices beyond. To the west of the site is Vimto Park and University buildings.

2.4 The primary noise sources in the area are the A6 and Fairfield Street, with anonymous traffic noise from other surrounding roads and intermittent noise from the train line.

3 Proposed Development

3.1 It is proposed to construct three residential towers of approximately 94 m, 112 m and 130 m height, from west to east. The three towers will comprise a mix of studio apartments and multi-room flats with shared kitchens, all of which are rooms for residential use for students. The ground floor of the development is proposed for a mixture of study, recreation and ancillary uses e.g. study rooms, gaming room and parcel stores.

3.2 Parts of the ground floor will be double-height to accommodate the entrance atrium, as well as a gym / studio area, various study areas, leisure areas and cooking / dining facilities. Additionally, there will be two multi-bed flats on the ground floor.

3.3 Externally there are two amenity areas, an east and west courtyard, which are bounded by the building itself. The west courtyard is proposed as a quieter study area, while the larger east courtyard will have open space which may be used for hosting fitness classes and social events. There are no balconies, roof-top or other external amenity areas proposed at the development.

3.4 Mechanical services plant is proposed to be located primarily in basement plant rooms beneath the development, and on the roofs of the three residential towers. This is in addition to MVHR units proposed for each bedroom / studio and kitchen in the development.

4 Local Authority Guidance and Consultation

4.1 Manchester City Council – Planning and Noise Technical Guidance (October 2022)

4.1.1 In October 2022, Manchester City Council published the latest edition of their Planning and Noise Technical Guidance document, which details the general approach to noise. This supersedes previous editions of the document, and is more recent than the planning application previously submitted for a similar scheme at this site in 2018.

Residential Developments

4.1.2 For residential developments, the Council has adopted the following noise limits:

- *Bedrooms (night time – 23.00 – 07.00) 30 dB L_{Aeq} (individual noise events should not normally exceed 45 dB $L_{Amax,F}$ by more than 10 times)*
- *Living rooms (daytime – 07.00 – 23.00) 35 dB L_{Aeq}*
- *Gardens and terraces (daytime) 55 dB L_{Aeq}*

4.1.3 These standards appear to have been drawn from BS 8233:2014 (see Section 5.2 for more detail). The document later advises that a noise limit of "*no more than 35dB for internal rooms during daytime*". Additionally, it is assumed that "Gardens and terraces" refers to all external amenity areas.

Entertainment Venues

4.1.4 While there is no entertainment venue as part of the development, it is proposed to have some entertainment / recreation spaces which are structurally connected to the apartments. This guidance is therefore not directly applicable, but it is appropriate to make reference to it as guidance rather than strict criteria when considering noise from these spaces.

4.1.5 The document makes two statements regarding entertainment noise depending on whether the entertainment venue is structurally connected to the receptor or not. For new residential developments that are structurally connected to entertainment venues (or vice versa):

"*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 ($L_{eq,5min}$) respectively.*"

4.1.6 And for a new entertainment venue that is structurally detached from other building uses:

"*Entertainment noise ($L_{Aeq,5min}$) should be controlled to 5dB below the typical background noise level (L_{A90}) in each octave band at the nearest noise sensitive location.*"

4.1.7 In this case the entertainment rooms within the development are small rooms located centrally within the building and do not present any risk of entertainment noise impact to external residential receptors.

Noise and vibration from fixed plant / equipment

4.1.8 Specifically with regard to noise from fixed plant / equipment, the document states in Section 3.7.1.5 that:

"*Externally mounted ancillary plant, equipment and servicing shall be selected and/or acoustically treated in accordance with a scheme designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (L_{A90}) level at the nearest noise sensitive location.*"

4.1.9 The document also advises that structure-borne noise and vibration should be considered, e.g. where ventilation equipment is being installed on the roof of a residential apartment block.

Consultation

4.1.10 It has been agreed with Manchester City Council Environmental Health that break-in noise from external environmental sources (primarily road and rail) will be mitigated to achieve the noise limits for residential development outlined in 4.1.2 above, and that mechanical services noise within apartments will be limited to NR 29 for kitchen/dining/living room spaces and NR 24 for bedrooms and studios.

5 Acoustic Standards and Guidance

5.1 ProPG: Planning & Noise – Professional Practice Guidance on Planning & Noise – New Residential Development – May 2017

5.1.1 ProPG: Planning and Noise is new guidance with the aim of delivering sustainable development and promoting good health and well-being through the effective management of noise which may impact on new residential developments. The guidance aims to complement the national planning policy and encourages the use of good acoustic design at the earliest phase of the planning process. It builds upon the recommendations of various other guidance documents including NPPF, NPSE and PPG-Noise, BS 8233 and WHO.

5.1.2 The guidance is applicable to new residential developments which would be exposed predominantly to noise from existing transport sources. The ProPG advocates a risk-based approach to noise using a two-stage process:

- Stage 1 – an initial noise risk assessment of the proposed development site; and
- Stage 2 – a systematic consideration of four key elements: –

- Element 1 – demonstrating a 'Good Acoustic Design Process';
- Element 2 – observing internal 'Noise Level Guidelines';
- Element 3 – undertaking an 'External Amenity Area Noise Assessment'; and
- Element 4 – consideration of 'Other Relevant Issues'.

5.1.3 The ProPG approach is underpinned by the preparation and delivery of an 'Acoustic Design Statement' (ADS), whereby the higher the risk for noise at the site, the more detailed the ADS. The ADS should address the following issues:

- Present the initial site noise risk assessment, including the pre-development acoustic conditions prior to development;
- Describe the external noise levels that occur across the site both before and after any necessary mitigation measures have been incorporated. The external noise assessment with mitigation measures in place should use an informed judgement of typical worst-case conditions;
- Demonstrate how good acoustic design is integrated into the overall design and how the proposed acoustic design responds to specific circumstances of the site;
- Confirm how the internal noise level guidelines will be achieved, including full details of the design measures and building envelope specifications;
- A detailed assessment of the potential impact on occupants should be undertaken where individual noise events are expected to exceed 45 dB $L_{AF,max}$ more than 10 times a night inside bedrooms;
- Priority should be given to enable the use of openable windows where practical across the development. Where this is not practical to achieve the internal noise level guidelines with windows open, then full details of the proposed ventilation and thermal comfort arrangements must be provided;
- Present the findings of the external amenity area noise assessment;
- Present the findings of the assessment of other relevant issues;
- Confirm for a low-risk site how adverse impacts of noise will be mitigated and minimised;

- Confirm for a medium or high noise risk site how adverse impacts of noise will be mitigated and minimised and clearly demonstrate that a significant adverse noise impact has been avoided.

5.1.4 ProPG target noise levels are based on existing guidance from BS 8233 and WHO (see below). Table 1 below outlines the guidance noise levels for different room types during day and night times.

Table 1: ProPG guideline indoor ambient noise levels for dwellings

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining room / area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB L_{AFmax}

5.1.5 The footnotes to this table suggest that internal noise level limits can be relaxed by up to 5 dB where development is considered necessary or desirable, and still represent "reasonable" internal conditions. They also suggest that in such cases, external levels which exceed WHO guidance target levels (see WHO section below) may still be acceptable provided that reasonable internal noise levels are achieved. Although, where the acoustic environment of external amenity areas is intrinsic to the overall design, "noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$". The wording of ProPG (and BS 8233:2014) is clear that exceedance of guideline noise levels in external areas should not prohibit the development of desirable developments in any event.

5.2 BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

5.2.1 This standard carries the full weight of an adopted British Standard, provides recommended guideline acoustic design criteria for new dwellings and is supported by guidance contained within WHO GCN[1]. The guideline noise design criteria of BS 8233 apply to external noise "*without a*

[1] World Health Organisation Guidelines for Community Noise, 1999

specific character" (previously and sometimes termed or referred to as "*anonymous noise"*) such as that associated with road and rail traffic.

Internal Amenity

5.2.2 The Standard states that for external noise without a specific character, such as road traffic, it is desirable that the internal ambient noise level does not exceed the guideline values shown in Table 2, below.

5.2.3 The note to paragraph 7.7.1 states that where noise has a specific character (i.e. it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content) *"lower noise limits might be appropriate".*

Table 2: BS 8233: 2014 guideline indoor ambient noise levels for dwellings

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

5.2.4 Note 7 to Table 4 of BS 8233 states:

> *"Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved."*

5.2.5 Guidance on reasonable acoustic design criteria for individual noise events are also provided, and the Standard advises that:

> *"regular individual noise events…can cause sleep disturbance. A guideline value may be set in terms of SEL[2] or $L_{Amax,F}$ depending on the character and number of events per night. Sporadic noise events could require separate values".*

[2] Sound exposure level or L_{AE}

5.2.6 For Internal spaces, the Standard states that;

"…to avoid sleep disturbance, sound pressure levels at the outside facades of living spaces should not exceed 45 dB L_{Aeq} (taken as a façade level, and equating to a free-field external level of 42 dB L_{Aeq}) and 60 dB L_{AFmax} so that people may sleep with bedroom windows open."

5.2.7 With regard to specific types of buildings (other than residential) BS 8233 states that;

"*…sound from adjacent spaces can affect the intended use, depending on the noise activity, noise sensitivity and privacy requirement. A matrix may be used to determine the sound insulation requirement of separating partitions once the noise activity, noise sensitivity and privacy requirements for each room and space are established.*"

5.2.8 An example matrix is then provided for determining on-site sound insulation between spaces based on the privacy requirement, activity noise and noise sensitivity of spaces, and this is reproduced below:

Table 3: Table 3 of BS 8233:2014 - Example on-site sound insulation matrix (dB $D_{nT,w}$)

Privacy requirement	Activity noise of source room	Noise sensitivity of receiving rooms		
		Low sensitivity	Medium sensitivity	Sensitive
Confidential	Very high	47	52	57 [A)]
	High	47	47	52
	Typical	47	47	47
	Low	42	42	47
Moderate	Very high	47	52	57 [A)]
	High	37	42	47
	Typical	37	37	42
	Low	No rating	No rating	37
Not Private	Very high	47	52	57 [A)]
	High	37	42	47
	Typical	No rating	37	42
	Low	No rating	No rating	37
NOTE: Background noise can also influence privacy. See also 7.7.6.3 [of BS 8233:2014] [A)] $D_{nT,w}$ 55 dB or greater is difficult to obtain on site and room adjacencies requiring these levels should be avoided wherever practical.				

External Amenity

5.2.9 BS 8233:2014 adopts guideline external noise values provided in WHO for external amenity areas such as gardens, patios and private outdoor amenity spaces. BS 8233:2014 adopts guideline external noise level limits provided in WHO for external amenity areas such as gardens and patios. The standard states that it is "*desirable*" that the external noise does not exceed 50 dB $L_{Aeq,16hr}$ with an upper guideline value of 55 dB $L_{Aeq,16hr}$ whilst recognising in paragraph 7.7.3.2 that development in higher noise areas, such as urban areas or those close to the transport network, may require a compromise between elevated noise levels (i.e., above 55 dB $L_{Aeq,16hr}$) and other factors that determine if development in such areas is warranted. In such circumstances, the development should be designed to achieve the lowest practicable noise levels in external amenity areas, but should not be prohibited.

5.2.10 The standard also states:

> *"Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels. Achieving levels of 55 dB $L_{Aeq,T}$ or less might not be possible at the outer edge of these areas, but should be achievable in some areas of the space."*

5.3 Department for Education Building Bulletin 93 – Acoustic design of schools: performance standards (BB93)

5.3.1 BB93 Version 17 was published in February 2015 and is the guidance document used for the acoustic design of schools. There is no specific equivalent guidance for the design of higher education buildings, so guidance is taken from the document for the purposes of assessing the educational / study areas of the development.

5.3.2 BB93 lays out minimum performance requirements for a range of typical educational spaces in terms of internal ambient noise levels, reverberation time, impact sound insulation and a method

for determining the appropriate airborne sound insulation between adjacent spaces. Due to the variety of different potential spaces provided in BB93, typical activity noise and noise tolerances are given for each space, with the following table provided for determining the performance for airborne sound insulation between new build spaces:

Table 4: Table 3a of BB93

Minimum $D_{nT,w}$ (dB)		Activity noise in source room (see Table 1 BB93)			
		Low	Average	High	Very High
Noise tolerance in receiving room (see Table 1 BB93)	High	Not applicable	35	45	50
	Medium	40	45	50	55
	Low	45	50	55	55

5.3.3 The airborne sound insulation requirement between rooms shown in Table 4 above is reported as a $D_{nT,w}$ (on-site) value, which must be achieved as a minimum when tested on site. For design purposes, these values must be converted to equivalent R_w (laboratory test rating) values.

5.4 World Health Organisation (WHO) Guidelines for Community Noise 1999

5.4.1 The WHO Guidelines 1999 recommends that to avoid sleep disturbance, indoor night-time guideline noise values of 30 dB L_{Aeq} for continuous noise and 45 dB L_{AFmax} for individual noise events should be applicable. It is to be noted that the WHO Night Noise Guidelines for Europe 2009[3] makes reference to research that indicates sleep disturbance from noise events at indoor levels as low as 42 dB L_{AFmax}. The number of individual noise events should also be taken into account and the WHO guidelines suggest that indoor noise levels from such events should not exceed approximately 45 dB L_{AFmax} more than 10 – 15 times per night.

5.4.2 The WHO document recommends that steady, continuous noise levels should not exceed 55 dB L_{Aeq} on balconies, terraces and outdoor living areas. It goes on to state that to protect the majority of individuals from moderate annoyance, external noise levels should not exceed 50 dB L_{Aeq}.

[3] WHO Night Noise Guidelines for Europe 2009

5.5 BS 4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

5.5.1 BS 4142:2014+A1:2019[4] provides guidance on the assessment of the likelihood of complaints relating to noise from industrial sources. It replaced the 1997 edition of the Standard in October 2014 and was amended in June 2019. The amended version corrected a number of printing errors and further clarified that the standard is used to assess external noise levels, and not internal noise levels (although this can form part of the discussion regarding context). The key aspects of the Standard are summarised below.

5.5.2 The standard presents a method of assessing potential noise impact by comparing the noise level due to industrial sources (the Rating Level) with that of the existing background noise level at the nearest noise sensitive receiver in the absence of the source (the Background Sound Level).

5.5.3 The Specific Noise Level - the noise level produced by the source in question at the assessment location - is determined and a correction applied for certain undesirable acoustic features such as tonality, impulsivity or intermittency. The corrected Specific Noise Level is referred to as the Rating Level.

5.5.4 In order to assess the noise impact, the Background Sound Level is arithmetically subtracted from the Rating Level. The standard states the following:

- *Typically, the greater this difference, the greater the magnitude of the impact,*
- *A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context,*
- *A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context,*
- *The lower the Rating Level is relative to the measured Background Sound Level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the Rating Level does not exceed the Background Sound Level, this is an indication of the specific sound source having a low impact, depending on the context.*

[4] BS 4142:2014+A1:2019 Methods for rating and assessing industrial and commercial sound

5.5.5 In addition to the margin by which the Rating Level of the specific sound source exceeds the Background Sound Level, the 2014+A1:2019 edition places emphasis upon an appreciation of the context, as follows:

> *An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.*

5.5.6 The 2014 edition of BS 4142 also introduced a requirement to consider and report the uncertainty in the data and associated calculations and to take reasonably practicable steps to reduce the level of uncertainty.

5.6 Building Control Requirements

5.6.1 The development will be required to satisfy the performance standards set down in Approved Document E to the Building Regulations 2000, 2003 edition, amended 2004.

5.6.2 Consultation with the Approved Inspector has been undertaken during RIBA Stage 3 in respect of establishing minimum criteria for sound insulation performances.

5.7 BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting

5.7.1 BS 6472 provides guidance on predicting human response to vibration in buildings from a variety of sources over the frequency range 0.5 Hz to 80 Hz. Part 1 describes how to determine the Vibration Dose Value (VDV) from frequency-weighted vibration measurements, which is then used to estimate the probability of adverse comment.

5.7.2 Consideration is given to the time of day / night, and the use of the space e.g. residential, office or workshop. Generally, residences are more sensitive to vibration than other occupied areas. Furthermore, there are a number of descriptors associated with building vibrations which can affect the perception of them including the time-history (continuous, intermittent or occasional) and the vibration characteristics (constant amplitude, variable amplitude or impulsive).

5.7.3 Impulsive vibration is generally most likely to result in an adverse impact, particularly if irregularly or rarely occurring.

5.7.4 Additionally, human response to vibration is also dependent on the axis of oscillation of the vibration – forward / backward, left / right, or up / down. Different frequency weightings therefore have to be applied to measurements in these different axes. The frequency weightings are defined in BS 6841.

5.7.5 For residential receptors, the levels of vibration and the associated probability of adverse impact for the day and night time period, shown in Table 1 of BS 6472-1:2008 have been reproduced below in Table 5:

Table 5: Vibration dose value ranges which might result in various probabilities of adverse comment within residential buildings (Table 1 of BS 6472-1:2008)

Place and time	Low probability of adverse comment $m.s^{-1.75}$ 1)	Adverse comment possible $m.s^{-1.75}$	Adverse comment probable $m.s^{-1.75}$ 2)
Residential buildings 16h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8h night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

1) Below these ranges, adverse comment is not expected

2) Above these ranges adverse comment is very likely

6 Environmental Noise Survey

6.1 Measurements of Existing Noise Sources

2023 Survey

6.1.1 Noise measurements were undertaken in accordance with BS 7445-1: 2003[5] by James Sharpe and Jo Miller of Miller Goodall Ltd. The calibration of the sound level meter was checked before and after measurements with negligible deviation (≤ 0.1 dB). Details of the equipment used are shown in Table 6, below.

[5] BS 7445-1: 2003 Description and measurement of environmental noise - Part 1: Guide to quantities and procedures

Table 6: Noise monitoring equipment

Equipment Description	Type Number	Manufacturer	Serial No.	Date Calibrated	Calibration Certification Number
Class 1[6,7] Integrating Real Time 1/3 Octave Sound Analyser	NTi XL2-TA	NTi Audio	A2A-11111-E0	13/09/2021	05451/1
Microphone	NTi MC230A	NTi Audio	A14423	13/09/2021	05451/1
Class 1 Calibrator[8]	CAL 200	Larson Davies	14154	10/10/2022	05964/1
Class 1[9,10] Integrating Real Time 1/3 Octave Sound Analyser	NTi XL2-TA	NTi Audio	A2A-15860-E0	27/02/2023	05145/1
Microphone	NTi MC230A	NTi Audio	A16445	28/02/2023	05145/1

6.1.2 Noise monitoring was undertaken at the times specified in Table 7, below. Weather conditions were determined both at the start and on completion of the survey. It is considered that meteorological conditions were appropriate for environmental noise measurements. Measurement locations are shown in Appendix 1.

[6] IEC 61672-1 (2002) Electroacoustics – Sound level meters Part 1: Specifications

[7] IEC 61260 (1995) Electroacoustics – Octave-band and fractional-octave-band filters

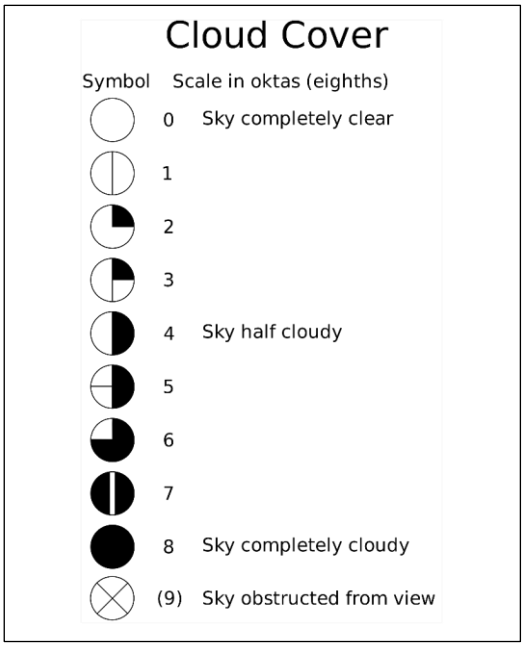
[8] IEC 60942 (2003) Electroacoustics – Sound calibrators

[9] IEC 61672-1 (2002) Electroacoustics – Sound level meters Part 1: Specifications

[10] IEC 61260 (1995) Electroacoustics – Octave-band and fractional-octave-band filters

Table 7: Dates, times and weather conditions during noise measurements

Measurement Locations	Date/Time	Weather conditions		
		Description	At Start of Survey	On Completion
MP1 and MP2	03/02/2023, 11:00 to 09/02/2023, 13:00	Temperature:	9 °C	8 °C
		Precipitation:	Light	Dry
		Cloud cover (oktas – see opposite):	5	4
		Any fog/snow/ice?	No	No
		Any damp roads/wet ground?	Slight	No
		Wind speed:	4 m/s	5 m/s
		Wind direction:	W	
		Any conditions that may cause temp. inversion (e.g. calm nights with no cloud):	No	No



6.1.3 Measurements were made under free-field conditions at a height of approximately 3.8 m above ground. The noise sources within the vicinity of the measurement locations are summarised in Table 8, overleaf:

Table 8: Description of noise sources affecting the site

Measurement Locations	Noise Sources
MP1	Road traffic, limited train pass-bys due to train strike on 03/03/2023
MP2	Road traffic dominant

6.1.4 A summary of the broadband measurement data is provided in Table 9 below in day- and night-time periods. All data are sound pressure levels in dB re 20 μPa.

Table 9: Summary of noise measurements

Measurement Location	Period	Date	$L_{Aeq,T}$ (dB)	Overall L_{AFmax} (dB)	$L_{A10,T}$ (dB)	$L_{A90,T}$ (dB)
MP1	Day*	02/02/2023	56.4	85.6	57	52
	Night	02/02/2023 – 03/02/2023	55.5	86.5	54	49
	Day	03/02/2023	55.9	79.7	57	52
	Night	03/02/2023 – 04/03/2023	53.4	77.8	55	50
	Day	04/02/2023	56.7	90.6	55	51
	Night	04/02/2023 – 05/02/2023	53.0	82.3	55	48
	Day	05/02/2023	58.9	88.7	61	52
	Night	05/02/2023 – 06/02/2023	54.9	85.2	55	47
	Day	06/02/2023	60.4	86.8	62	52
	Night	06/02/2023 – 07/02/2023	55.2	83.8	55	48
	Day	07/02/2023	58.6	84.1	60	54
	Night	07/02/2023 – 08/02/2023	55.2	83.8	55	48
	Day*	08/02/2023	64.2	93.1	66	55
MP2	Day*	02/02/2023	58	91.6	59	55
	Night	02/02/2023 – 03/02/2023	56.9	86.6	57	53

Day	03/02/2023	57.9	87.0	59	55
Night	03/02/2023 – 04/03/2023	56.2	84.0	57	54
Day	04/02/2023	57.6	89.3	58	54
Night	04/02/2023 – 05/02/2023	55.4	86.6	57	52
Day	05/02/2023	61.9	87.5	64	54
Night	05/02/2023 – 06/02/2023	56.5	78.5	58	52
Day	06/02/2023	62.6	87.9	64	54
Night	06/02/2023 – 07/02/2023	56.1	79.4	57	53
Day	07/02/2023	59.8	83.5	61	55
Night	07/02/2023 – 08/02/2023	56.5	82.8	57	52
Day*	08/02/2023	63.2	88.3	63	56

* Measurements during the daytime periods of 02/02/2023 and 08/02/2023 are less than 16-hour daytime periods due to the set-up and collection of equipment. However, the data has been included here for completeness

6.1.5 Each measurement period consisted of sequential 100 ms samples which therefore allowed the variation in noise level over time to be assessed. The 100 ms noise levels have not been presented in this report but are kept on file for future reference.

6.1.6 Octave band frequency data was obtained during surveying and this was utilised within noise modelling software to determine noise levels at the proposed development.

2017 Survey

6.1.7 Noise measurements have previously been undertaken by Miller Goodall Ltd in May / July 2017 at various positions in Chandos Hall – now demolished. Attended and unattended measurements of the existing noise climate were made as follows:

- 11th May 2017: Attended measurements of individual train pass-bys at different heights on the south elevation and 30-minute attended measurements of weekday, daytime ambient noise levels at different heights on west and east facing elevations of the now demolished Chandos Hall building.

- 11th – 15th May 2017: Continuous unattended noise logging at two heights (5th and 11th floors) on the south facing elevation of the now demolished Chandos Hall building. Included weekday and weekend periods.
- 6th – 10th July 2017: Continuous unattended noise logging 1 m from the east and west facing elevations of the now demolished Chandos Hall building. Included weekday and weekend periods.

6.2 These noise measurements were undertaken in accordance with BS 7445-1:2003 by Colin Foster and Michael Rickard of Miller Goodall Ltd. All instrumentation used during the surveys was fully calibrated and traceable to UKAS standards and satisfy the requirements for Class 1 instruments described in BS EN 61672-1:2013. Details of the equipment used are shown in Table 10 below. The calibration of the sound level meters was checked before and after measurements with negligible deviation (≤ 0.1 dB).

Table 10: Noise monitoring equipment

Equipment Description	Type Number	Manufacturer	Serial No.	Date Calibrated	Calibration Certification Number
Class 1[11],[12] Integrating Real Time 1/3 Octave Sound Analyser	NOR 140	Norsonic	1406815	12/01/17	474629844
Class 1[11],[12] Integrating Real Time 1/3 Octave Sound Analyser	NOR 140	Norsonic	1406017	22/05/15 23/05/17	U18820 03238/2
Class 1 Calibrator[13]	Type 4231	Brüel & Kjær	2478249	25/07/16 18/05/17	02817/1 03238/1
Class 1 Calibrator[13]	NOR 1251	Norsonic	34123	05/07/17	02777/1
Outdoor microphone housing	NOR 1217	Norsonic	12175738	N/A	N/A
Outdoor microphone housing	NOR 1217	Norsonic	12175146	N/A	N/A

[11] IEC 61672-1 (2002) Electroacoustics – Sound level meters Part 1: Specifications

[12] IEC 61260 (1995) Electroacoustics – Octave-band and fractional-octave-band filters

[13] IEC 60942 (2003) Electroacoustics – Sound calibrators

6.2.1 As with the 2023 environmental noise measurements, meteorological conditions were noted by the engineers on site and were considered suitable for reliable noise measurements i.e. no rain and wind speeds below 5 m/s. For unattended noise logging, meteorological conditions were determined from reviewing forecasts and data measured at nearby weather stations (www.wunderground.com).

6.3 There were periods during the unattended measurements taken between 11th – 15th May when adverse meteorological weather conditions may have influenced the results. In particular, the possible influence due to rainfall was determined as follows:

- 10:00 - 14:30 on 12/07/2017: approx. 0.5 - 2 mm/hr; Data still considered useable
- 02:30 - 06:00 on 14/07/2017 approx. 0.5 - 4.5 mm/hr; Data still considered useable
- 07:00 onwards on 15/07/2017 approx. >3 mm/hr; Data excluded from analysis

6.3.1 The weather conditions for all other periods were considered suitable for reliable measurements. There was no rainfall and wind speeds remained low (below 5 m/s) throughout, generally from a westerly / south-westerly direction.

6.3.2 Table 11 below describes the noise sources which were audible at each of the measurement positions during the environmental noise measurements.

Table 11: Description of noise sources affecting the site

Measurement Locations	Noise Sources
South facing elevation (overlooking railway)	Railway noise dominant. Train pass-bys are all quite slow, due to proximity of Piccadilly Station. Mixture of diesel (louder) and electric (quieter) trains. Occasional diesel freight trains during day and night. Occasional horns. Rail squeal often audible, due to track curve near Piccadilly, though not directly adjacent to Chandos Hall. Distant general road traffic hum dominant in between train movements. At upper levels the rail noise reduces a little and traffic hum becomes more noticeable. Some noise at higher floors from fixed M&E plant on rooftops of university buildings.

Measurement Locations	Noise Sources
East facing elevation (facing towards Piccadilly station)	Distant general road traffic hum dominant. Ambient noise levels are higher at the upper floors of the existing building where there is a direct line of sight to Piccadilly station taxi drop off / interchange area. Some playground noise from existing nursery audible at lowest floors. Rail noise audible but not significant.
West facing elevation (facing towards Vimto Park)	Distant general road traffic hum dominant. Louder at higher floors of the existing building. Subjectively lower noise levels than east facing elevation. Rail noise audible but not significant.
MP1 facing railway line	Railway noise dominant. Train pass-bys are all quite slow, due to proximity of Piccadilly Station. Mixture of diesel (louder) and electric (quieter) trains. Occasional diesel freight trains during day and night. Horns from railway occasionally. Occasional rail noise squeal, due to track curve near Piccadilly, though not directly adjacent to Chandos Hall. Distant general road traffic hum dominant in between train movements.
MP2	Railway noise evident at this position but not always dominant. Noise from general road traffic on Granby Row and the A6 and surrounding road network more dominant.

6.3.3 A summary of the broadband and spectral measurement data recorded at Chandos Hall is provided in Table 12 overleaf in day- and night-time periods. All data are sound pressure levels in dB re 20 μPa and are façade reflected sound pressure levels.

6.3.4 Each measurement period consisted of sequential 1 second samples which therefore allowed the variation in noise level over time to be assessed. The following observations may be made by inspection of the measurement data:

- The highest maximum noise levels occur during train pass-bys on lower floors of the south facing elevation. The maximum noise levels on this elevation reduce with height, being approximately 6 dB lower at 15th floor than at 2nd floor.

- On the south facing elevation, the L_{Aeq} remains reasonably constant irrespective of changes in height.
- Environmental noise levels are slightly higher on the east facing elevation (facing Piccadilly) than the west (facing Vimto Park)

Table 12 - External noise levels derived from unattended measurements at existing (at the time) Chandos Hall (2017)

Location	Descriptor	Sound Pressure Level, dB in Octave Band Centre Frequency, Hz								dBA
		63	125	250	500	1k	2k	4k	8k	
Southern elevation 2nd Floor	Day L_{eq}	73.4	64.5	64.2	62.1	61.8	58.3	58.7	53.7	**66.8**
	Night L_{eq}	68.3	61.1	61.6	59.1	58.3	54.5	58.5	52.9	**64.4**
	*Typical Night L_{Max}	91.6	79.7	81.7	78.4	77.5	74.3	75.6	73.4	**83.3**
Southern elevation 5th Floor	Day L_{eq}	72.4	63.5	63.2	61.1	60.8	57.3	57.7	52.7	**65.8**
	Night L_{eq}	67.3	60.1	60.6	58.1	57.3	53.5	57.5	51.9	**63.4**
	*Typical Night L_{Max}	90.6	78.7	80.7	77.4	76.5	73.3	74.6	72.4	**82.3**
Southern elevation 13th Floor	Day L_{eq}	71.5	64.7	62.3	60.9	62.1	56.3	51.2	45.3	**65.2**
	Night L_{eq}	67.0	60.8	59.2	57.9	59.1	53.7	51.4	44.8	**62.5**
	*Typical Night L_{Max}	88.6	78.5	74.6	74.8	72.5	70.1	68.0	62.8	**77.9**
Eastern elevation 5th Floor	Day L_{eq}	68.8	61.4	59.0	58.1	58.4	54.0	51.0	46.2	**62.3**
	Night L_{eq}	63.8	57.9	56.1	55.6	55.3	49.8	47.1	42.4	**59.0**
	*Typical Night L_{Max}	84.6	75.3	72.9	74.1	71.9	68.6	66.7	60.1	**76.8**
Western elevation 5th Floor	Day L_{eq}	67.6	61.9	56.8	56.1	55.9	51.6	48.0	44.6	**60.0**
	Night L_{eq}	61.8	57.7	52.9	52.6	51.6	46.3	41.2	36.3	**55.5**
	*Typical Night LMax	81.9	74.5	70.3	71.5	69.6	66.4	62.2	57.3	**74.3**

7 Environmental Vibration Measurements

7.1 Vibration measurements were also undertaken at the site, in both August 2018 and February 2023. The surveys were undertaken within the basement of Chandos Hall (pre-demolition) over a 72-hour period in 2018, and at MP1 on the foundation for the new development in 2023. As the vibration affecting the site is primarily vertical (z-axis), only the results for this axis have been reported.

Table 13: Summary of environmental vibration measurement results

Date at start of period	Day (0700 – 2300) VDV ($ms^{-1.75}$); z-axis	Night (2300 – 0700) VDV ($ms^{-1.75}$); z-axis
17th August 2018	0.010*	0.010
18th August 2018	0.007	0.004
19th August 2018	0.007	0.016
20th August 2018	0.012*	N/A
10th February 2023	NA	0.037
11th February 2023	0.039	0.023
12th February 2023	0.026	0.030
13th February 2023	0.039	0.037
14th February 2023	0.040	0.039
15th February 2023	0.041	0.038

7.2 The measured vibration levels both during the 2018 and 2023 surveys are significantly below the threshold for 'low probability of adverse comment', shown in Table 5. Levels of vibration measured in 2023 are slightly higher than those measured in 2018 for the following reasons:

- 2023 measured at ground level not basement
- 2023 measurement position closer to the rail line than the 2017 survey

7.3 However, it must be noted that these levels are still below the threshold for 'low probability of adverse comment.' Described in BS 6472-1:2008. Vibration is therefore not considered to be a problem at this site, so is not assessed beyond this point.

8 Internal Ambient Noise Levels

8.1 Criteria

Apartments Criteria

8.1.1 Table 14 sets out the proposed internal noise limits for the residential dwellings within the development. The noise limits must be achieved with the rooms unoccupied, and normally furnished.

Table 14: Proposed Internal Noise Level Criteria within Apartment Dwellings

Room	Internal Noise Level from Environmental Sources	Mechanical Service Noise Level
Any bedroom or room for residential purpose	• ≤ 30 dB $L_{Aeq,8hr}$ at night (23:00 – 07:00) • Not exceed 45 dB L_{Amax} more than 15 times during the night (23:00 – 07:00). • ≤ 35 dB $L_{Aeq,16hr}$ during day (07:00 – 23:00)	≤ NR 24
Any residential living room/ lounge/ area for quiet rest or study	• ≤ 35 dB $L_{Aeq,16hr}$ during day (07:00 – 23:00)	≤ NR 29

8.1.2 On 1st August 2023, Laura Miller (Environmental Protection Officer) at Manchester City Council confirmed that these limits are reasonable.

Non-Residential Areas Criteria

8.1.3 Internal Ambient Noise Level (IANL) criteria have been set for the non-residential ground floor spaces using guidance contained within BB93 and BS 8233 depending on the type of space. For the purposes of selecting M&E equipment within habitable spaces, Noise Rating (NR) limits for mechanical services can be derived using the following formula:

- Spaces on façade (having outside glazing): $NR \approx dB - 9$
- Internal spaces (not having outside glazing): $NR \approx dB - 6$

8.1.4 NR limits apply to noise emissions from both breakout and duct-borne noise from mechanical services.

8.1.5 The following Table 15 lays out the internal ambient noise level limits for each space – these criteria are also shown on the markup in Appendix 2.

Table 15: Internal Ambient Noise Limits

Room	Room Type	Guidance Used	IANL Limit $L_{Aeq,T}$ (dB)	NR Limit
L0.00 Entrance Lobby	Atrium	BB93	≤ 45	≤ 36
L0.01 Reception	Atrium	BB93	≤ 45	≤ 36
L0.02 Gym	Gymnasium	BB93	≤ 40	≤ 31
L0.03 Shift Studio	Gymnasium	BB93	≤ 40	≤ 31
L0.04 Focus Lounge	Resource / Breakout Area	BB93	≤ 40	≤ 31
L0.05 Group Focus	Quiet Study Area	BB93	≤ 40	≤ 31
L0.06 Individual Focus	Quiet Study Area	BB93	≤ 40	≤ 31
L0.07 Group Focus	Quiet Study Area	BB93	≤ 40	≤ 31
L0.08 Group Focus	Quiet Study Area	BB93	≤ 40	≤ 31
L0.09 Group Focus	Quiet Study Area	BB93	≤ 40	≤ 31
L0.10 Group Focus	Quiet Study Area	BB93	≤ 40	≤ 31
L0.11 Individual Focus	Quiet Study Area	BB93	≤ 40	≤ 31
L0.12 Corridor	Circulation	BB93	≤ 45	≤ 39
L0.13 Lounge	Living Room	BS 8233	≤ 35	≤ 26
L0.14 Table Top Snug	Resource / Breakout Area	BB93	≤ 40	≤ 31
L0.15 Analogue Arena	Resource / Breakout Area	BB93	≤ 40	≤ 31

Room	Room Type	Guidance Used	IANL Limit $L_{Aeq,T}$ (dB)	NR Limit
L0.16 Diner	Dining Room	BB93	≤ 40	≤ 31
L0.17 AV Cupboard	Store Room	BB93	N/A	N/A
L0.18 Gaming	Resource / Breakout Area	BB93	≤ 40	≤ 34
L0.19 Karaoke	Resource / Breakout Area	BB93	≤ 40	≤ 31
L0.20 Cinema	Relaxation	BS 8233	≤ 35	≤ 26
L0.21 Analogue Arena	Resource / Breakout Area	BB93	≤ 40	≤ 31
L0.22 Electric Lounge	Resource / Breakout Area	BB93	≤ 40	≤ 34
L0.23 Private Dining	Dining Room	BB93	≤ 40	≤ 31
L0.24 Private Dining	Dining Room	BB93	≤ 40	≤ 31
L0.25 W/C	Toilet	BB93	≤ 45	≤ 39
L0.26 W/C	Toilet	BB93	≤ 45	≤ 39
L0.27 W/C	Toilet	BB93	≤ 45	≤ 39
L0.28 W/C	Toilet	BB93	≤ 45	≤ 39
L0.29 W/C	Toilet	BB93	≤ 45	≤ 39
L0.30 Office	Office	BB93	≤ 40	≤ 31
L0.31 Parcel Store	Store Room	BB93	N/A	N/A
L0.32 Comms Room	Store Room	BB93	N/A	N/A
L0.33 Staff Welfare	Staff Room	BB93	≤ 40	≤ 31
L0.34 Staff Changing / Shower Lobby	Changing Room	BB93	≤ 45	≤ 39
L0.35 Staff Shower	Changing Room	BB93	≤ 45	≤ 39
L0.36 Staff Acc. W/C	Toilet	BB93	≤ 45	≤ 39
L1.00 Diner Platform	Dining Room	BB93	≤ 45	≤ 36

8.2 General

8.2.1 Detailed calculations have been undertaken to determine the sound insulation performance requirements of the external building envelope (glazing and solid elements).

8.2.2 It was assumed that the noise levels which will impact on the south and west facing elevations of the new building will be the same to the noise levels derived from the measurements on the south and west facing elevations of the now demolished Chandos Hall building.

8.2.3 It was not possible to undertake measurements on the north facing elevation of Chandos Hall. However, it has been assumed that the noise levels on this elevation were no higher than those measured at the other elevations of Chandos Hall. Measurements from 2023 at MP2 have supplemented the 2017 data for the predictions of internal noise ingress.

8.2.4 The new building is significantly different to the previous building in its extent along Granby Row and the railway line, and therefore a computer model was used to predict the noise levels impacting upon the overall site.

8.2.5 Modelling Parameters

8.2.6 Predictions of noise levels across the site have been made using the CadnaA noise modelling package. Specific model parameters were applied as follows:

- Propagation of noise using algorithms within ISO 9613: 1993 *Acoustics - Attenuation of sound during propagation outdoors*.
- Roads were modelled as line sources at a height of 0.5 m above ground level and calibrated using spectral data measured during the 2023 survey.
- Train noise was modelled as line sources at a height of 1.0 m above track level and calibrated using spectral data measured during the 2017 survey.
- Default ground absorption G = 0.0 (equivalent to hard ground e.g. tarmac which dominates the area)
- Ground attenuation: spectral all sources
- No adverse meteorological effects
- Two orders of reflection
- Topographical data was obtained using NextMap Britain 2 m contours for the site and surrounding assessment area.

8.3 Validation of the Noise Model

8.3.1 Noise level receptor points were incorporated into the CadnaA model at the noise survey measurement locations to calibrate the model using the measured octave band L_{eq} and L_{Fmax} noise levels. These are calibrated to the average day- and night-time $L_{Aeq,T}$ and typical night-time L_{AFmax} noise levels recorded at the site. The modelled results agreed with the measured results to within around ± 1 dB L_{Aeq} and around ± 1 dB L_{AFmax}.

8.4 Noise Model Predictions

8.4.1 Three scenarios were modelled using the indicative master plan provided by *Sheppard Robson* (ref: *ECHO-SRA-ZZ-XX-DR-A-00803_P01*): daytime L_{Aeq} noise levels affecting the site, night-time L_{Aeq} noise levels and night-time L_{AFmax} noise levels. Noise grids for each scenario are provided in Appendix 3 at 10 m above local ground level, correlating to the windows subject to the highest levels of environmental noise.

8.4.2 The noise modelling demonstrates the drop-off in noise levels with increasing distance from the train line at the south of the site and the A6 / Fairfield Street to the east / north - the most significant noise sources affecting the site. The noise levels also diminish with increasing height away from the ground.

8.5 Proposed Ventilation Strategy

8.5.1 The proposed ventilation strategy for the site is to utilise mechanical ventilation throughout. It is understood that windows will be openable at the occupier's discretion but not required as part of the general ventilation strategy.

8.5.2 All residential spaces are proposed to be ventilated using high-efficiency heat recovery mechanical ventilation (MVHR) units, serving each room independently with local control. All MVHR units will have supply and extract ducts to provide background ventilation, and an enhanced 'boost' setting which will assist with overheating and limit the need to open windows throughout the daytime.

8.6 Refuse Chutes

8.6.1 It appears from the floor plans that there are no refuse chutes currently proposed in any of the towers, however if these are to occur anywhere in the building then appropriate acoustic design will be necessary to avoid high levels of noise impacting adjacent spaces.

8.7 Mitigation for Achieving Good Acoustic Design – Environmental Noise Break-In

8.7.1 The sound insulation performance of the solid part of the façade was determined using specialist acoustic modelling software (Insul V9.0.24), based on the following construction information, as supplied by *Sheppard Robson* and described from outside to inside:

- Brickslip/GRC Rainscreen Panel. Galvanized Metal Support Tray Panel, Metal support frame, 200mm Non-combustible Insulation, 12.5mm Sheathing Board., 100mm SFS Metal Frame (TBC by Specialist) and insulation, 2 x 15mm Plasterboard

8.7.2 It is understood that the glazing strategy will comprise three options, laminate glass options have been selected by Guardian Glass and are described below with quoted performance figures:

- Glazing Type 1: 10.8 mm acoustic laminate glass with sound reduction coating, 16 mm air gap, 6 mm float glass pane
- Glazing Type 2: 10.8 mm acoustic laminate glass, 16 mm air gap, 6 mm float glass pane
- Glazing Type 3: 6 mm float glass pane, 16 mm air gap, 6 mm float glass pane.

8.7.3 The sound reduction index for each element used in the noise break-in calculations are detailed in Table 16 overleaf:

Table 16: Sound Reduction Index for Break-in Calculations

Element	Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)								R_w dB	C_{tr} dB	$R_w + C_{tr}$ dB
	63	125	250	500	1000	2000	4000	8000			
Brick Slip Wall	26	44	52	56	60	59	67	57	59	-4	55
Glazing Type 1	21*	26	32	40	48	44	58	53*	42	-6	36
Glazing Type 2	21*	26	30	37	43	42	55	50*	39	-6	33
Glazing Type 3	18	24	22	29	39	33	38	38	32	-3	29

* Manufacturer's data not provided for this frequency; value is predicted as a reasonable worst-case based on specific build-up proposed. Recommend original test report for this glazing option is obtained from manufacturer.

8.7.4 It is recommended that the above acoustic requirements be included in the technical specifications for the solid facade cladding elements. The supplier of the external wall systems must provide robust technical supporting evidence to show that the inclusion of their systems within the overall wall build-ups will achieve the required acoustic performances.

8.7.5 All glazed elements must achieve the requirements, which apply to complete glazed assemblies, i.e. including frames and seals.

Residential Rooms

8.7.6 In order to assess the potential glazing requirements for dwellings, noise ingress calculations were undertaken based on the methodology in BS EN 12354-3[14]. The assessment has been based on room dimensions at the exposed façades:

- Studio dimensions: Floor area 20.2 m^2, Height 2.7 m, Glazed area 14.1 m^2
- Bedroom dimensions: Floor area 12.3 m^2, Height 2.7 m, Glazed area 4.7 m^2

[14] BS EN 12354-3:2000 Building acoustics. Estimation of acoustic performance in buildings from the performance of elements - Airborne sound insulation against outdoor sound

- 'Normal' internal surface finishes e.g. carpeted with curtains etc.

8.7.7 The areas of the proposed site where internal noise may exceed the standards are bedrooms on elevations closest to, and facing the trainline. Night-time periods have been assessed as the standards are more onerous than for daytime periods and based on the survey and modelling data, night -time is the worst-case assessment period for all receptors.

8.7.8 Noise ingress calculations have taken account of direct break-in through the façade and glazing elements, as well as through the ceiling-void via the blanking panel, MVHR plenum and MVHR ductwork.

8.7.9 Additionally, to determine the noise break-in to each room through the ceiling void, plenum and MVHR ductwork, a number of other materials have to be defined which have been set as described below in Table 17:

Table 17: Sound Reduction Index for MVHR Break-in Calculations

Element	Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)								R_w dB	C_{tr} dB	$R_w + C_{tr}$ dB
	63	125	250	500	1000	2000	4000	8000			
Standard Weather Louvre	0.5	1.7	2.2	2.4	2.6	2.8	4.4	7.1	3	0	3
0.6 mm Steel Plenum	5	7	11	16	21	26	31	31	20	-4	16
Plastic duct	4	2	4	8	15	21	28	28	13	-3	10
Ceiling: 2 x 15 mm Duraline	18	21	26	31	35	36	33	33	34	-4	30

8.7.10 Internal noise levels at the worst-case locations have been assessed across the site, and graphics showing where the uprated glazing configurations will be required are shown in the graphics in appendix 4. Points are at highlighted at 3 x 3 m across the whole development site and roughly represent window locations.

8.7.11 Where uprated acoustic glazing is required, points are purple / red corresponding to glazing types 1 and 2 respectively, while 6 / 16 / 6 glazing is represented by green points. These graphics show the worst-case scenario for bedrooms and kitchens.

Non-residential rooms

8.7.12 To achieve the internal ambient noise levels in ground floor non-residential rooms which are on the external façades of the building, noise break-in must be considered. This is particularly true for noise-sensitive spaces such as the Cinema and study spaces.

8.7.13 The break-in assessment to the ground floor spaces has been conducted based on the daytime ambient noise levels.

8.7.14 The assessment has shown that in general, the glazing type 3 is sufficient for controlling noise break-in to the non-residential spaces of the building. However, for a few areas, glazing type 2 is required to control noise break-in.

8.7.15 The areas requiring increased glazing performance are:

- Karaoke
- Cinema

8.8 Flanking Sound Insulation of Curtain Walls

8.8.1 Flanking noise across light weight façade systems can be a significant limiting factor in achieving suitable sound insulation across walls and floors. Current drawings indicate that partitions and floors will return to curtain walling in a number of locations.

8.8.2 The $D_{nf,w}$ value is a total flanking sound transmission of the façade system and comprises a number of individual sound transmission paths and a number of factors directly affect the overall performance, which can only be established by full façade testing in an accredited laboratory. Although we can compare the proposed design with similar library data and assess the possible overall performance, we cannot guarantee the performance of the overall system.

8.8.3 Our preliminary comments on the recommended flanking performance of the curtain walls are provided below.

8.8.4 Vertical Transmission Between Floors

Ground Floor to First Floor Habitable Room

8.8.5 We recommend that the curtain wall provides a minimum vertical flanking sound insulation performance of $D_{n,f,w}$ 66 dB, based on a lab measured coupling length of 2.24 m. This is a very high level of flanking sound insulation and likely to require a twin transom, split mullion detail with a fully decoupled frame and acoustic enhancements (as specified by the supplier).

8.8.6 Wherever possible mullions should be boxed-in using two layers of 12.5 mm plasterboard (sealed against the glass using non-setting acoustic sealant or a proprietary trim piece with seals) so that they are not exposed on the room side at their interface with external wall linings. The movement zone at the slab edge may require enhancements, and it may be advisable to board over the transoms on both room sides (e.g. using drop ceilings and board coverings at finished floor level). This detail will require further development as the design progresses.

Residential Floors

8.8.7 We recommend that the curtain wall provides a minimum vertical flanking sound insulation performance of $D_{n,f,w}$ 55 dB, based on a lab measured coupling length of 2.24 m. This is a high level of flanking sound insulation and likely to require a twin transom, split mullion re-joined with a joining spigot and acoustic enhancements (as specified by the supplier). Wherever possible mullions should be boxed-in using two layers of 12.5 mm plasterboard (sealed against the glass using non-setting acoustic sealant or a proprietary trim piece with seals) so that they are not exposed on the room side at their interface with external wall linings. This detail will require further development as the design progresses.

8.8.8 Horizontal Transmission Across Party Walls

Ground Floor party wall junctions

8.8.9 We recommend that the curtain wall provides a minimum horizontal flanking sound insulation performance of $D_{n,f,w}$ 57 dB, based on a lab measured coupling length of 2.24 m. This is a high level of flanking sound insulation and likely to require a twin mullion arrangement at the junction that is fully boxed in on both room sides. This detail will require further development as the design progresses.

8.8.10 This performance is set to maintain the integrity of the wall partition but it may be possible to revise down the flanking performance if a slight shortfall in the currently proposed sound

insulation criteria is considered acceptable. Reducing flanking performance to $D_{n,f,w}$ 53 dB only causes a predicted shortfall of 1 dB in the overall partition performance.

Residential party wall junctions

8.8.11 We recommend that the curtain wall provides a minimum horizontal flanking sound insulation performance of $D_{n,f,w}$ 53 dB, based on a lab measured coupling length of 2.24 m. This is a high level of flanking sound insulation and likely to require a twin mullion arrangement at the junction that is fully boxed in on both room sides. This detail will require further development as the design progresses.

8.9 External Noise Levels

8.9.1 The predicted daytime noise levels at site are predicted to be above 50 dB L_{Aeq} at almost all locations, which would exceed the lower guideline noise criteria for external amenity spaces. However, it is understood that there are no private balconies proposed on any part of the building and the only.

8.9.2 Noise levels in external amenity areas at ground floor level are expected to be between approximately 55 – 58 dB L_{Aeq} during the day time which is at the upper end of the advisable noise levels quoted in BS 8233:2014. It must be noted that the standard also states these are guidelines only and:

"*…are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres … a compromise between elevated noise levels and other factors … might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.*"

8.9.3 As the development is to provide student accommodation in a city centre close to major transport routes and there is easy access to other external amenity areas close to the site, it is considered that the noise levels at the site are acceptable in this case for external amenity areas.

9 Impact of Noise from the Proposed Development

9.1 Plant Noise Limits

9.1.1 Mechanical services plant selections for the development have not yet been made, so it is not possible to assess noise emissions from the site at this stage. Therefore, plant noise limits are set

for the site in accordance with appropriate guidance documentation, information available from Manchester City Council and data collected during the environmental noise surveys. These limits should be achieved at the nearest noise-sensitive receptors for the combined mechanical services plant noise emissions.

9.1.2 As detailed in Section 4 of this report, Manchester City Council would be expected to request that mechanical services noise limits are set at a level equivalent to 5 dB below the representative background noise level. Frequency charts of the background noise levels measured at the site are shown in Figures 1 – 4 below, with the representative level highlighted in red.

Figure 1 - LA90 frequency chart 07:00 - 23:00 at South

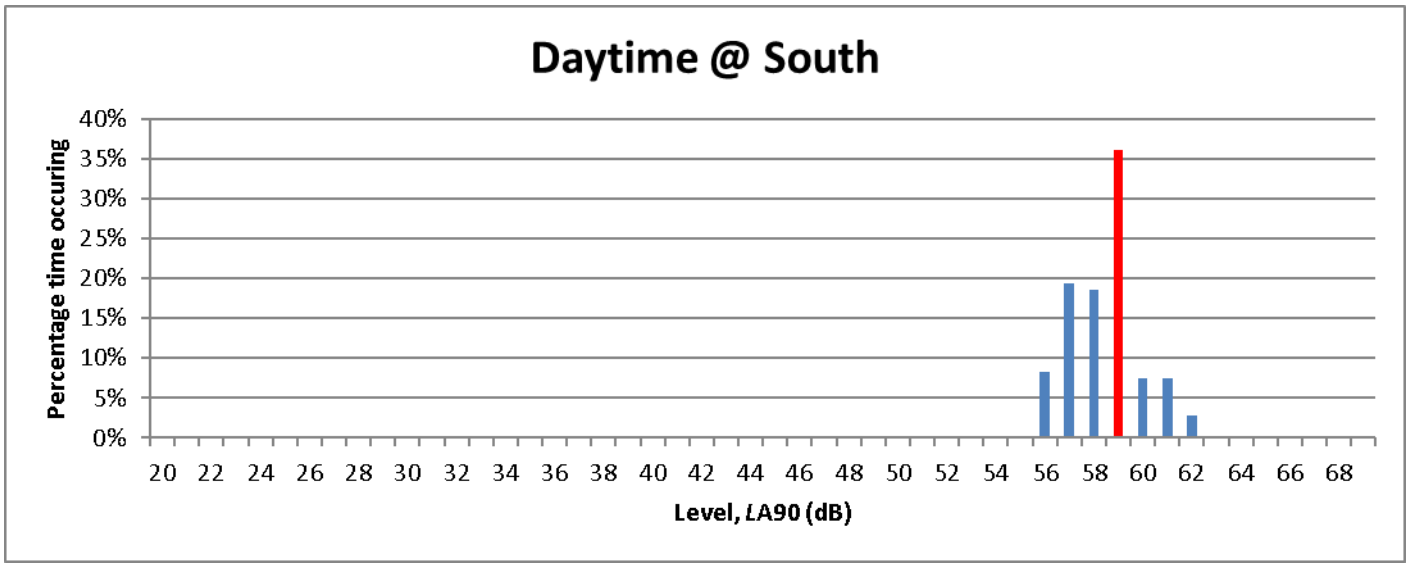


Figure 2 - LA90 frequency chart 23:00 - 07:00 at South

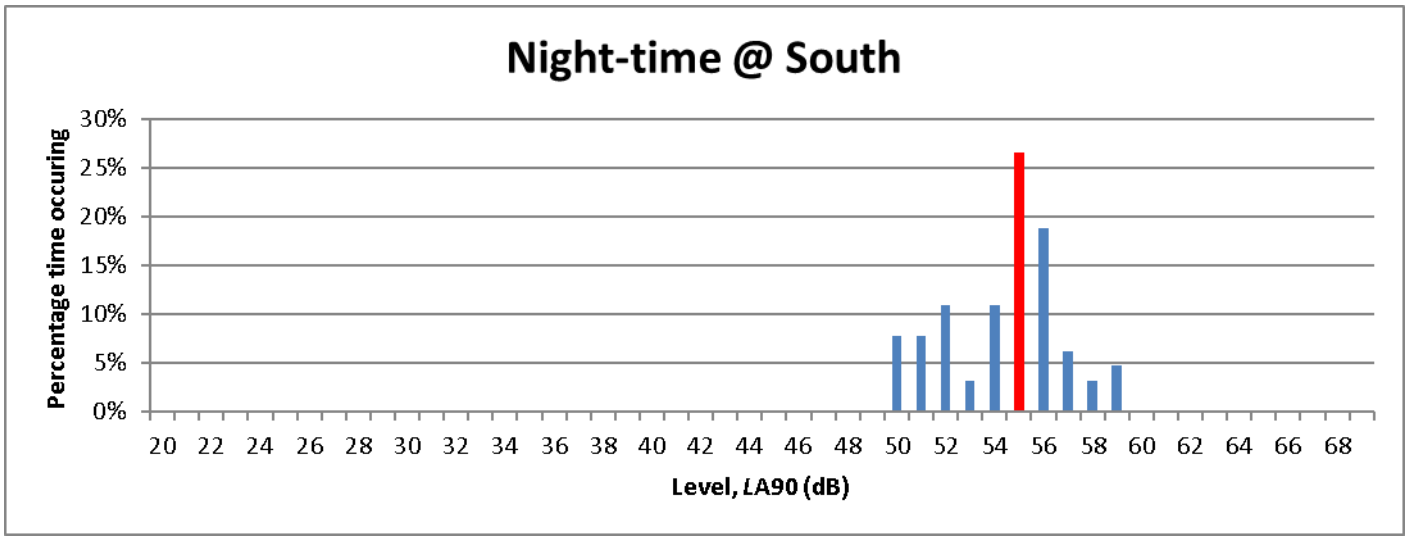


Figure 3 - LA90 frequency chart 07:00 - 23:00 at North

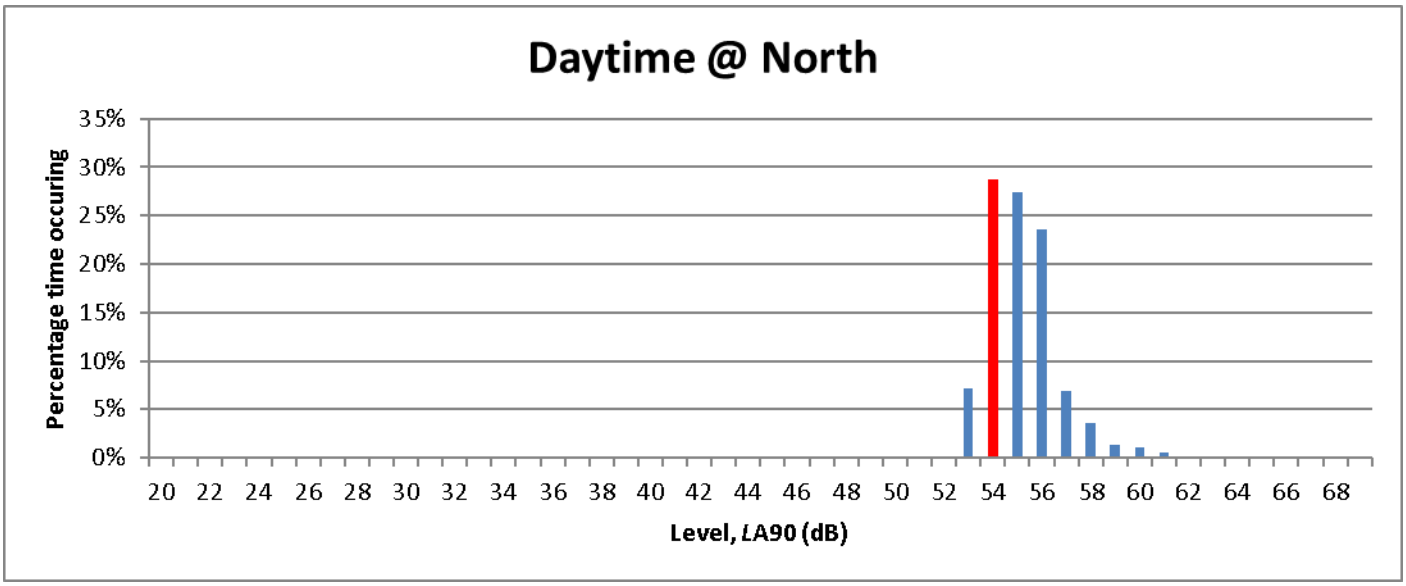
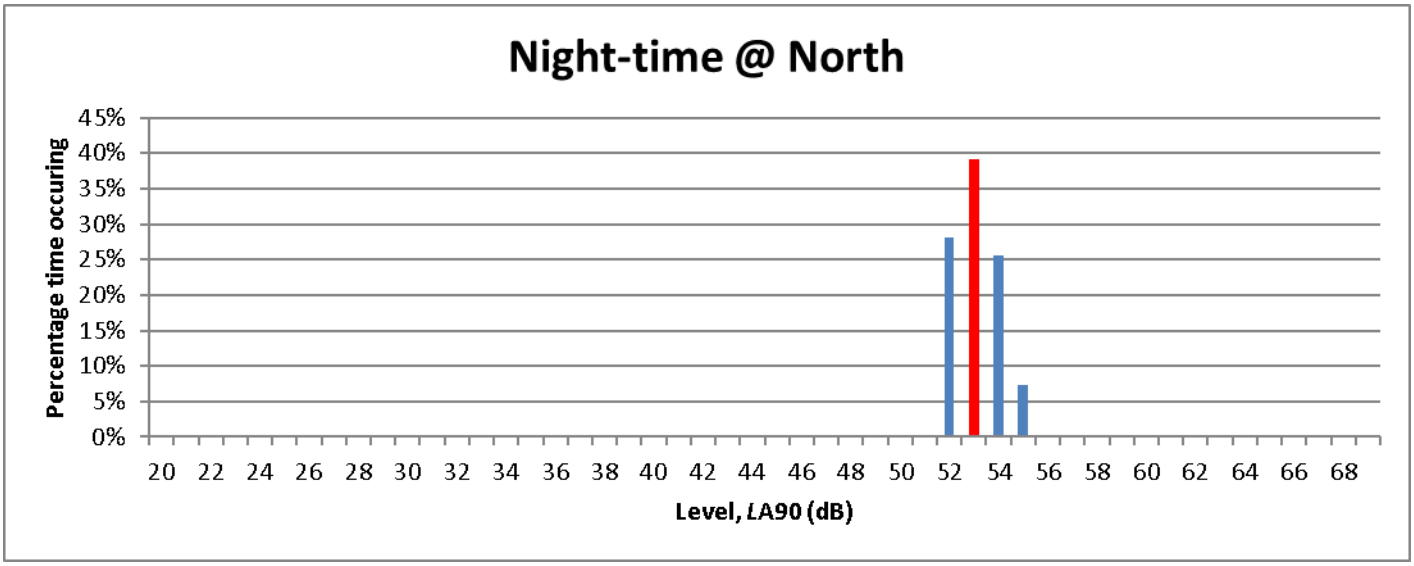


Figure 4 - LA90 frequency chart 23:00 - 07:00 at North



9.1.3 Based on the values highlighted in the figures and guidance from Manchester City Council above, the mechanical services plant noise limits are as shown in Table 18 overleaf.

Table 18: Mechanical services plant noise limits

Receptor Location	Daytime noise limit, dB (07:00 – 23:00)	Night-time noise limit, dB (23:00 – 07:00)
South of site e.g. Manchester Piccadilly Hotel, Moffat Building	59 – 5 = 54	55 – 5 = 50
North of site e.g. Fairfield Hall, Lambert House	54 – 5 = 49	53 – 5 = 48

9.1.4 It is understood that all major mechanical services plant will be installed either in basement plant rooms or at roof level. Additionally, each bedroom, kitchen and studio will have an MVHR unit. The plant noise limits laid out in Table 18 above should be achieved by the combined mechanical services noise from the development.

9.1.5 It is understood that there is some diesel-powered plant in the basement plant room which is for emergency use only and is maintained on standby, with 30 minutes operational testing each week. These items are therefore exempt from mechanical services plant noise limits and will not be assessed.

10 Internal Acoustic Design

10.1 Nomenclature

10.1.1 There are a number of different ways of stating sound insulation performances and it is important to be clear about which is being used. Full definitions of the different units are provided in the glossary appended to this document and a summary of those units used in this report is given in the following paragraphs.

10.1.2 Laboratory measured airborne sound insulation performances are stated as R_w (dB) or as $R_w + C_{tr}$ (dB). Values increase as the performances gets better. The C_{tr} value is a correction which penalises partitions that have relatively poor low frequency performance. Manufacturers publish their data in terms of R_w (dB) or $R_w + C_{tr}$ (dB).

10.1.3 In-situ measured airborne sound insulation performances are stated as $D_{nT,w} + C_{tr}$ (dB). Values increase as the performances get better, and are affected by the specific dimensions of the rooms, quality of workmanship and flanking sound paths including at junctions.

10.1.4 In-situ measured impact sound insulation performances are stated as $L'_{nT,w}$ (dB). Values decrease

as the performances get better, and are affected by the specific dimensions of the rooms, quality of workmanship and flanking sound paths including at junctions.

10.2 Sound Insulation

Internal Partitions

10.2.1 The acoustic strategy drawings indicate the sound insulation requirements of partitions based on achieving on-site airborne sound insulation requirements derived from the guidance contained within BS 8233 and BB93 (Sections 5.2 and 5.3 respectively).

10.2.2 Table 19 below presents the agreed criteria for residential apartments:

Table 19: Sound Insulation Criteria for residential apartments

Room Type	Agreed Criteria
Studios	Airborne Walls: 45 dB $D_{nT,w}$ + C_{tr} Aiborne Floors: 45 dB $D_{nT,w}$ + C_{tr} Impact Floors: 62 dB $L_{nT,w}$
Bedrooms	Airborne Walls: 43 dB $D_{nT,w}$ + C_{tr*} Aiborne Floors: 45 dB $D_{nT,w}$ + C_{tr} Impact Floors: 62 dB $L_{nT,w}$
Kitchens with party walls	Airborne Walls: 45 dB $D_{nT,w}$ + C_{tr} Aiborne Floors: 45 dB $D_{nT,w}$ + C_{tr} Impact Floors: 62 dB $L_{nT,w}$
* Building Control stated requirement for these partitions is only 40 dB R_w; the proposed criteria has been agreed with the client as more suitable	

10.2.3 Partitions should be constructed full height from structural floor to structural soffit with no penetrations for glazing or ventilation in the dividing element.

10.2.4 Partition constructions have been based on the following drawings provided by *Sheppard Robson*:

- ECHO-SRA-ZZ-00-DR-A-22100
- ECHO-SRA-ZZ-01-DR-A-22101
- ECHO-SRA-ZZ-02-DR-A-22102

- ECHO-SRA-ZZ-03-DR-A-22103
- ECHO-SRA-ZZ-05-DR-A-22105
- ECHO-SRA-ZZ-XX-DR-A-22601
- ECHO-SRA-ZZ-XX-DR-A-22602
- ECHO-SRA-ZZ-XX-DR-A-22603
- ECHO-SRA-ZZ-XX-DR-A-22604

10.2.5 Drylining constructions as proposed have been reproduced below to meet the acoustic requirements on-site:

Table 20: Proposed partition constructions

R_w Rating Requirement	Stud type	Typical board linings	Mineral wool in cavity (mm)	British Gypsum ref:
59 R_w (-5 C_{tr})	92 mm AcouStud	2 x 12.5 mm Gyproc SoundBloc	100 mm Isover (APR1200)	A206A292
58 R_w (-5 C_{tr})	92 mm AcouStud	2 x 12.5 mm Gyproc SoundBloc	50 mm Isover (APR1200)	A206A291
62 R_w	Twin independent 48 mm 'C' studs	2 x 15 mm Gyproc SoundBloc	50 mm Isover (APR1200)	A216009
		1 x 12.5 mm Gyproc Habito + 1 x 15 mm Gyproc SoundBloc F to each side		N/A
52 R_w	70 mm 'C' stud	2 x 15 mm Gyproc SoundBloc	N/A	A206167S
49 R_w	70 mm 'C' stud	2 x 12.5 mm Gyproc WallBoard	25 mm Isover (APR1200)	A206047
47 R_w	70 mm 'C' stud	2 x 15 mm Gyproc WallBoard	N/A	A206016S
46 R_w	70 mm 'C' stud	2 x 12.5 mm Gyproc FireLine	N/A	A206079
45 R_w	70 mm 'C' stud	2 x 12.5 mm Gyproc WallBoard	N/A	A206015
37 R_w	70 mm 'C' stud	1 x 15 mm Gyproc FireLine	N/A	A206078

Doorsets

10.2.6 Doorsets to all occupied spaces on the ground floor (except ancillary) partitions should provide a minimum laboratory airborne sound insulation performance of 30 dB R_w, with the exception of

noise sensitive spaces, which should have a minimum laboratory airborne sound insulation performance of 35 dB R_w. This applies to the gym / fitness studio. From discussion with the clients' acoustician, 40 dB R_w doorsets are advisable for karaoke, gaming and cinema spaces due to the potentially high noise source levels.

10.2.7 Approved Document E states that minimum 29 dB R_w doorsets are appropriate for all cluster flat, bedroom, kitchen and studio doors on all floors.

10.2.8 Doors must be sealed effectively around their perimeter, including the threshold, within a substantial frame.

10.2.9 In order to maintain their acoustic integrity, acoustically rated doorsets will not be undercut or have grilles for ventilation or any other purpose. Additionally, it is considered good practice for doors to be located as far as possible either side of a partition to minimise the risk of flanking sound via the corridor, although it is noted that this is not always possible in practice.

Detailing at Junctions

10.2.10 Typical causes of flanking sound losses are set out below together with information on suggested mitigation.

- T-junctions –Wherever separating walls form junctions with lower performance walls or with wall linings it is imperative that the higher performance wall carries through the lower performance wall.

- Wall junction with linings on façade – Where separating walls form a junction with external wall linings, it is necessary to ensure that the junction is well sealed and that the wall lining is not continuous behind the partition.

- Junctions with ceilings – Separating walls must extend from slab to slab and not terminate at the underside of the plasterboard ceilings.

- Blockwork head deflections 20mm or less: the gap at the head should be packed to the full depth of the block with mineral wool and the joint sealed on both sides with non-setting acoustic sealant.

- Blockwork head deflections between 20 and 40 mm: the gap at the head should be packed to the full depth of the block with mineral wool and the joint sealed on both sides with a board material providing a minimum mass per unit area of 9.8 kg/m^2 (e.g. 1 layer of 15 mm

plasterboard or 18 mm Plywood). A non-setting sealant should be used at joints between the block, board and slab underside.

- Drywall head deflections: a timber head stop equal to the channel width should be used at the head of the partition. Steel angles or two layers of board should be used to close the joint for partition ratings > R_w 45 dB.

- Drywall junctions with profiled slab decks (along profile): profiles to be tightly packed with mineral wool and underside of deck over-boarded with plasterboard plank spanning the width of three profiled steel downstands; head deflection as above.

- Drywall junctions with profiled roof decks (across profile): wall built up to steel tray, profiles filled with mineral wool and two layers of plasterboard closely cut to follow steel deck profile, overlapping with wall boards below. All edges sealed with non-setting mastic.

- Floor finishes and resilient floor coverings must be broken between adjacent rooms and not be continuous underneath acoustic rated walls.

Services penetrations

10.2.11 Wherever possible, services should not pass through partitions dividing acoustically sensitive spaces, but be routed via an adjoining corridor or non-sensitive space. Where there is no option but to pass services through sound-resisting partitions, care must be taken to see that the acoustic integrity of the partition is not compromised.

Services / SVPs

10.2.12 Any pipework passing through noise sensitive spaces or resulting in openings in partitions should be acoustically sealed. Guidance within Approved Document E states that:

"*Pipes and ducts. … should be enclosed for their full height. The enclosure should be constructed of material having a mass per unit area of at least 15 kg/m^2. Either line the enclosure, or wrap the duct or pipe within the enclosure, with 25 mm unfaced mineral wool.*"

10.2.13 Boxing out of services should therefore be achieved with two layers of 12.5 mm plasterboard (minimum 8 kg/m^2). Any boarding option will require 25 mm unfaced mineral wool insulation within. Any access doors or hatches to risers within noise sensitive spaces should provide the same level of acoustic performance and be well sealed when closed. Boarding should be full

height, taken from structural floor up to the soffit, and sealed at the top and bottom with non-hardening acoustic sealant.

10.2.14 Flanking sound can also occur along common ventilation ductwork. This must be considered in the design of the building services systems and mitigated, as necessary, using cross talk attenuators within the ductwork.

Basement to Ground Floor

10.2.15 As mechanical services selections are finalised in the basement plant areas, it may prove necessary to provide an acoustic upgrade to the floor construction between the basement plant areas and the ground floor.

10.2.16 It is understood that the separating floor will be a 250 mm flat concrete deck floor, assumed to have a density of 2,450 kg/m^3. To determine the necessity and performance of any acoustic products, an assessment should be undertaken following the selection of mechanical services plant in these areas.

Ground Floor and Above

10.2.17 The floors are understood to comprise 210 mm flat concrete deck floor, with a minimum density of 2,450 kg/m^3. It is understood the soffit at the ground floor will either be left exposed, with acoustic treatment, mechanical services and lighting etc. hung below, or will have a suspended plasterboard ceiling.

10.2.18 In high noise-source areas on the ground floor (karaoke, cinema, gaming room, gym), it will be necessary to control noise transfer to the floor above. Based on the concrete construction of the flooring above, our initial advice is that at minimum the ceiling should achieve at least 25 kg/m^2 mass (e.g. 2 x 15 mm Gyproc SoundBloc) and be fixed using acoustic hangers with a ≥ 300 mm void and install additional mineral wool in the void, a minimum of 100 mm thick and at least 12 kg/m^3. Analogue Games, Private Dining areas, amenity, circulation, W/C's, staff rooms and group focus rooms will require 1 x 12.5 mm Gyproc SoundBloc with 25 mm insulation above.

10.2.19 This has been based on initial assumptions of noise levels but will require further review as the design develops. Any penetrations through the floor / ceiling construction should be carefully sealed, such that the acoustic integrity of the floor is not compromised.

Upper storeys

10.2.20 All residential rooms, i.e. studios, bedrooms and kitchens will require 2 x 15 mm SoundBloc (or better) ceilings to be installed with 50 mm insulation in the void. It is understood that all circulation areas, i.e. corridors, stairwells and cluster corridors will have a Quattro plasterboard ceiling, which should have a minimum 200 mm void above.

Impact Sound Insulation of Floors

10.2.21 The Building Regulations set down impact sound insulation performances which must be achieved in all areas of a dwelling, e.g. including corridors, bathrooms ect. In order to provide adequate impact sound resistance to dwellings a resilient floor covering is typically bonded to the concrete floor surface of the areas above.

10.2.22 It is understood that bedrooms will have a timber floor fitted, while all other areas will be finished with vinyl. Guidance in ADE states that the resilient floor covering should meet the following specification:

- *Any resilient material, or material with a resilient base, with an overall uncompressed thickness (of the resilient layer) of at least 4.5 mm; or*
- *Any floor covering with a weighted reduction in impact sound pressure level (ΔL_w) of not less than 17 dB when measured in accordance with BS EN ISO 140-8:1998 and calculated in accordance with BS EN ISO 717-2:1997.*

10.2.23 All spaces above dwellings should therefore incorporate a resilient layer beneath the floor finish with a weighted reduction in impact sound pressure level of at least L_w Δ17 dB (e.g. 3 mm Regupol 4515, 2 mm Pliteq GenieMat RST or equivalent underlay).

Bathroom Pods

10.2.24 It is understood that pre-fabricated bathrooms pods are proposed throughout the residential areas of the development. The following construction details are understood to be proposed at Stage 3 and will be further developed at Stage 4:

- Corridor walls are to be continuous and pods are to butt up against the rear (room side of the walls
- A section for a riser door / access panel is to be cut through the corridor wall allowing for access to the rear of the pod from corridors

- Riser doors / access panels which close off the access holes are to have acoustic performance not less than 29 dB R_w
- Pod risers are to be closed at each floor by the slab such that there is no direct transmission route between floors via the pod riser. Penetrations through the slabs for pipes and other services are to be core drilled through the concrete slab and must be effectively sealed at each floor.

10.2.25 There is no sound insulation performance requirement for the pod walls separating bathrooms from their associated bedroom. However, the pods are understood to be lined on the room side with 15 mm SoundBloc plasterboard, with two layers 15 mm SoundBloc plasterboard between the top of the pod and the soffit.

10.2.26 Consideration must be given to the effective impact sound isolation of the proposed bathroom pods from the structural concrete floor, in order to control impact sound transmission to rooms immediately below the pods. It is not known at this stage whether a resilient floor covering extending underneath the pods will be a suitable solution, or whether the pods will need to have their own bespoke isolation mountings.

Gym / Studio

10.2.27 It is proposed to locate a gym / studio at the north-west corner of the building on the ground floor. It has been assumed that the gym may be used late at night and very early in the morning (approx. 5 am until midnight) similar to commercial gyms, which are times when residents on upper floors may be expected to be resting or sleeping.

10.2.28 High levels of vibration, airborne and structure-borne noise may be generated by gym equipment and activities, in particular by free weights and aerobic classes. Very high levels of sound insulation will therefore be required between the gym and residential spaces above.

10.2.29 It is therefore suggested that an isolated floor slab and an enhanced acoustic soffit be used to partially isolate these spaces from the rest of the building. Additionally, a proprietary resilient floor / floor layer is likely to be required for absorbing some of the impact from free weights. Even with additional impact absorption however, it is possible that weight drops would still be audible via structure-borne noise in the residential rooms above.

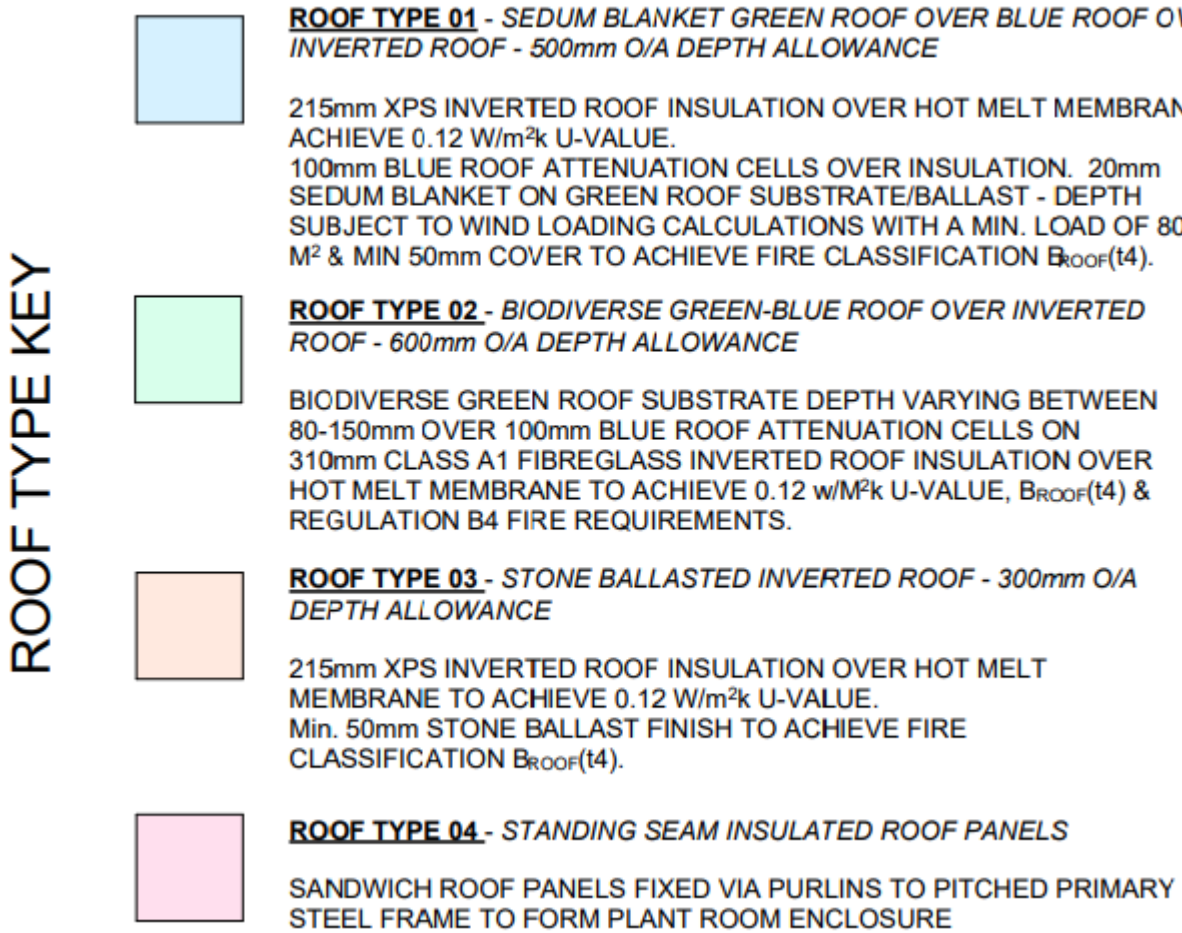
10.2.30 Isolation of the floor slab will need to be achieved wherever the slab interfaces with sheer walls, columns and all other concrete members which are continuous to the structure above ground level. There must be no rigid connection between slab and concrete structure at any location.

10.2.31 Casting the floor slab separately from the rest of the ground floor slab, and isolating with a suitable resilient movement joint detail is recommended to prevent bridging between the gym floor slab and other parts of the structure which are outside of the gym area.

Roof

10.2.32 There are four proposed roof types at the development, two of which are above habitable rooms and are described below in Figure 5, reproduced from *Sheppard Robson* drawing ref: *ECHO-SRA-ZZ-XX-DR-A-SK044_P02*:

Figure 5 - Roof types



10.2.33 Roof types 3 and 4 are only used above the stair core and plant rooms respectively, not above habitable rooms. Only roof type 01 and 02 are above habitable rooms. With the suspended ceilings proposed within habitable rooms, these roof buildups are sufficient for the control of external noise ingress from both environmental and rain noise.

10.2.34 Roof mounted mechanical services plant selections have not been made at this stage, but generally it will be necessary to ensure that mechanical services plant is structurally isolated from the building. It may be necessary to consider flexible connections in ductwork, resilient mounts or isolated frame systems (e.g. bigfoot system).

10.2.35 Roof and ceiling buildups are subject to acoustic review as mechanical services selections are made to ensure appropriate sound insulation can be achieved.

10.3 Lifts

10.3.1 Lifts are located within the three cores and are proposed to be constructed from 250 mm concrete and are adjacent to studio rooms on the 2nd – 15th floor.

10.3.2 We would anticipate that this would be sufficient to control typical noise transfer between lifts and the adjacent rooms. It is likely that an independent wall lining would be necessary to mitigate potential impulsive noise from the lift shaft, e.g. 15 mm Duraline plasterboard on independent studs to the room side of the core wall, with insulation in the cavity.

10.3.3 In addition, noise and vibration generated by the lift installations must be kept as low as practicable. The following is suggested for inclusion in relevant lift design documentation:

- The lift car should be made of a well-damped construction to minimise noise generation and if necessary, acoustically absorbent treatment should be installed. The operation of the lift doors should be as quiet as possible, and the door panels should be well damped and fitted with rubber buffers, to minimise the vibration imparted to the building structure as doors open and close.
- The noise generated by the lift installations in adjacent spaces shall not exceed NR 38 when measured 2 metres from any part of the lift shaft.
- The noise levels inside the lift cars as the lift operates shall not exceed L_{Amax} = 55 dB. The noise levels on lift landings from the operation of lift doors and devices announcing lift arrivals shall not exceed L_{Amax} = 65 dB.

- Suitable anti-vibration measures shall be provided so as to ensure that there is no perceptible vibration from any part of the operating cycle of the lift in any floor slab in any part of the building, and to ensure that the maximum vibration values measured on the floor slabs in adjacent residential areas do not exceed the following Vibration Dose Value (VDV),

as defined in BS 6472-1:2008:

0.1 m/sec$^{1.75}$ (Night time 8 hours) ; and 0.2 m/sec$^{1.75}$ (Daytime 16 hours)

10.4 Room Acoustics

10.4.1 The assumed absorption coefficients (α) for the purposes of calculation are laid out below in Table 21.

Table 21: Absorption coefficients used in calculations

Material	Absorption coefficient (α) at Octave Band Centre Frequency (Hz)					
	125	250	500	1k	2k	4k
Plasterboard (wall)	0.15	0.1	0.06	0.04	0.04	0.05
Linoleum / vinyl (floor)	0.02	0.02	0.03	0.04	0.04	0.05
Needle carpet (floor)	0.01	0.02	0.05	0.15	0.3	0.4
Hard soffit (painted concrete)	0.01	0.01	0.02	0.02	0.02	0.05
Glazing	0.1	0.07	0.05	0.03	0.02	0.02
Class A	N/A	0.7	0.9	0.9	0.9	0.8
Class B	N/A	0.6	0.8	0.8	0.8	0.7
Class C	N/A	0.4	0.6	0.6	0.6	0.5

10.4.2 Reverberation criteria for all ground-floor spaces with reverberation requirements and the minimum areas of acoustic absorption are set out below. Absorbent materials should be spread as evenly as possible across the walls and ceilings, especially in larger volume open spaces. Particularly in double height spaces, absorptive material should be provided at low level on walls as well as on the ceiling to control the reverberation at head-height, rather than just at high level.

10.4.3 British Gypsum Quattro products are proposed for corridor areas and achieve a minimum Class C absorption provided a 200 mm void without the requirement for additional mineral wool infill in the void. Approved Document E lays out two methods for establishing appropriate levels of absorptive material for the control of reverberation time. Method A is the typical method used, and is easier to adhere to, as reproduced below:

"*For entrance halls, corridors or hallways, cover an area equal to or greater than the floor area, with a Class C absorber or better. It will normally be convenient to cover the ceiling area with the additional absorption.*"

10.4.4 For stairwells, an area equivalent to the total floor area should be treated with Class D absorber, or an area equivalent to 50 % total floor area should be treated with Class C or better absorbers. The treatment should be equally distributed throughout the stairwell and is typically done by covering the underside of all landings and the ceiling area of the top floor.

10.4.5 Acoustic treatment requirements for plant rooms in the basement and at roof level have not been assessed at this stage, but will be determined when mechanical services selections have been finalised at a later stage.

Table 22: Reverberation criteria and absorption requirements

Room Name	RT Criterion T_{mf} (s)	Baseline Room Finishes	Floor area (m^2)	Floor to ceiling / soffit height (m)	Minimum required area (m^2)
Individual Focus Large	≤ 0.8	Walls: Plasterboard Floor: Needle Carpet Ceiling: Exposed / hard finish	45	3.7	25 Class A, or 29 Class B, or 40 Class C
Small Group Focus	≤ 0.8	Walls: Plasterboard Floor: Needle Carpet Ceiling: Suspended Plasterboard	11	2.6	3 Class A, or 3.5 Class B, or 5 Class C
Group Focus Room	≤ 0.8	Walls: Plasterboard Floor: Needle Carpet	16.6	2.6	5 Class A, or 6 Class B, or 7 Class C

Room Name	RT Criterion T_{mf} (s)	Baseline Room Finishes	Floor area (m^2)	Floor to ceiling / soffit height (m)	Minimum required area (m^2)
		Ceiling: Suspended Plasterboard			
Individual Focus Small	≤ 0.8	Walls: Plasterboard Floor: Needle Carpet Ceiling: Suspended Plasterboard	23	3	8 Class A, or 10 Class B, or 13 Class C
Office	≤ 1	Walls: Plasterboard Floor: Needle Carpet Ceiling: Suspended Plasterboard	23.3	3	5 Class A, or 6 Class B, or 7 Class C
Reception	≤ 1.5	Walls: Plasterboard	308	3	40 Class A, or 48 Class B, or 65 Class C

Room Name	RT Criterion T_{mf} (s)	Baseline Room Finishes	Floor area (m^2)	Floor to ceiling / soffit height (m)	Minimum required area (m^2)
		Floor: Needle Carpet Ceiling: Exposed / hard finish			
Staff Welfare	≤ 1	Walls: Plasterboard Floor: Needle Carpet Ceiling: Exposed / hard finish	26.9	3	5 Class A, or 6 Class B, or 8 Class C
Gaming	≤ 0.5	Walls: Plasterboard Floor: Needle Carpet Ceiling: Exposed / hard finish	4	2.6	2 Class A, or 2.5 Class B, or 3 Class C

Room Name	RT Criterion T_{mf} (s)	Baseline Room Finishes	Floor area (m^2)	Floor to ceiling / soffit height (m)	Minimum required area (m^2)
Karaoke	≤ 0.5	Walls: Plasterboard Floor: Needle Carpet Ceiling: Exposed / hard finish	12	2.7	8 Class A, or 9 Class B, or 12 Class C
Cinema	≤ 0.6	Walls: Plasterboard Floor: Needle Carpet Ceiling: Exposed / hard finish	22	2.8	12 Class A, or 15 Class B, or 20 Class C
Private Dining	≤ 0.8	Walls: Plasterboard Floor: Linoleum or vinyl	23	3	12 Class A, or 14 Class B, or 19 Class C

Room Name	RT Criterion T_{mf} (s)	Baseline Room Finishes	Floor area (m^2)	Floor to ceiling / soffit height (m)	Minimum required area (m^2)
		Ceiling: Exposed / hard finish			
Studio	≤ 1.5	Walls: Plasterboard Floor: Linoleum or vinyl Ceiling: Exposed / hard finish	34	3.7	10 Class A, or 11 Class B, or 14 Class C
Gym	≤ 1.5	Walls: Plasterboard Floor: Linoleum or vinyl Ceiling: Exposed / hard finish	69.6	3.7	22 Class A, or 24 Class B, or 32 Class C
Combined Gym / Studio	≤ 1.5	Walls: Plasterboard	104	3.7	32 Class A, or 36 Class B, or 48 Class C

Room Name	RT Criterion T_{mf} (s)	Baseline Room Finishes	Floor area (m^2)	Floor to ceiling / soffit height (m)	Minimum required area (m^2)
		Floor: Linoleum or vinyl Ceiling: Exposed / hard finish			

11 Consideration of Other Discipline Requirements

11.1.1 It is recommended that you confirm the suitability of all recommended noise mitigation measures with your architects, structural engineers, building contractors, fire consultants and material manufacturers prior to procurement and field application so that when the recommended noise control measures are implemented on site they will satisfy the requirements of all disciplines, therefore, should not cause any health and safety issues.

12 Conclusions

12.1 A noise assessment has been undertaken to predict the impact of environmental noise on a proposed residential development at Echo Street, Manchester. Computer noise modelling has been utilised, in addition to baseline noise measurements to determine the façade sound insulation performance requirements. This included assessment of noise break-in through mechanical ventilation elements.

12.2 Sound insulation requirements have been determined for the non-residential, ground-floor spaces using BS 8233 and BB93 as appropriate, and proposed partition constructions assessed to confirm appropriate levels of performance.

12.3 Reverberation criteria have also been proposed for the non-residential, ground-floor areas using guidance contained within BB93. Areas of absorbent material required have been determined for Class A, Class B or Class C material in each space.

12.4 Airborne and impact sound insulation requirements have been determined for the various spaces throughout the development, and proposals made for improving acoustic performance where appropriate.

13 Health and Safety Information

The Construction (Design and Management) Regulations (CDM 2015) are the main set of regulations for managing the health, safety and welfare of construction projects. CDM 2015 applies to all building and construction work and includes new build, demolition, refurbishment, extensions, conversions, repair and maintenance in order to reduce injury and ill health.

Under the regulation we are Designers. As a Designer, our decisions can affect the health and safety of workers and others who will construct, maintain, repair, clean, refurbish and eventually demolish or remove the building or structure, as well as those who will use it as a completed workplace. Taking risks arising from the design into account can positively affect the project and make it easier for these risks to be managed by contractors and those who will maintain or use the structure. Our designs must contribute to the safe delivery of a project without risks to health.

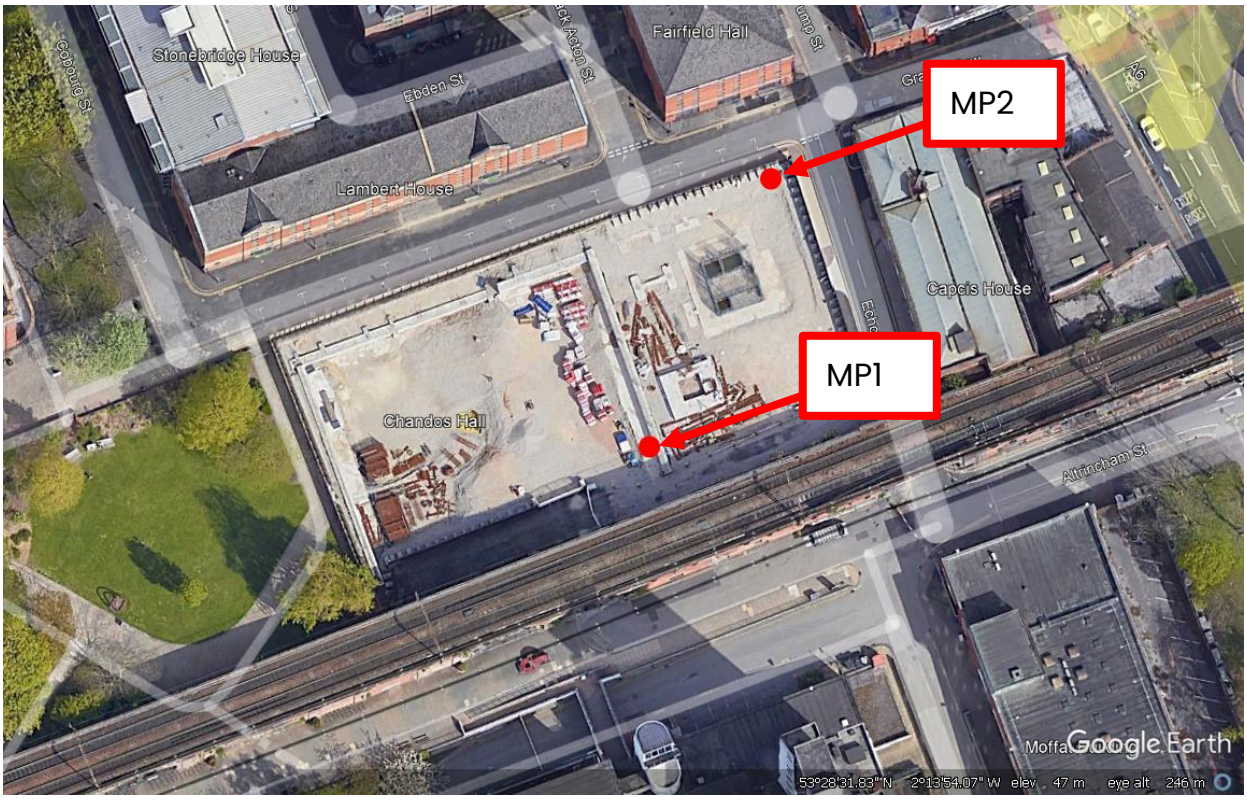
As Designers we must:

- understand and be aware of significant risks that workers and users can be exposed to and how these can arise from our design decisions;
- have the right skills, knowledge, and experience and be adequately resourced to address the health and safety issues likely to be involved in the design;
- check that Clients are aware of their duties;
- co-operate with others who have responsibilities, in particular the Principal Designer;
- take into account the general principles of prevention when carrying out our design work;
- provide information about the risks arising from our design;
- co-ordinate our work with that of others in order to improve the way in which risks are managed and controlled.

APPENDICES

Appendix 1: Measurement Positions

2023



2017



Appendix 2: Ground Floor Wall Ratings and Acoustic Criteria



Ground Floor Partitions and Criteria

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Bolton
BL7 9RP
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KEY

- R_w 47 dB
- R_w 49 dB
- R_w 51 dB
- R_w 53 dB
- R_w 62 dB

- 45 IANL
- 39 NR Limit
- 65 Impact Noise Limit
- 1.5 RT Criteria (s)

- R_w 30 dB doorset
- R_w 35 dB doorset
- R_w 40 dB doorset

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1	02/08/2023	Initial issue	JL	MR

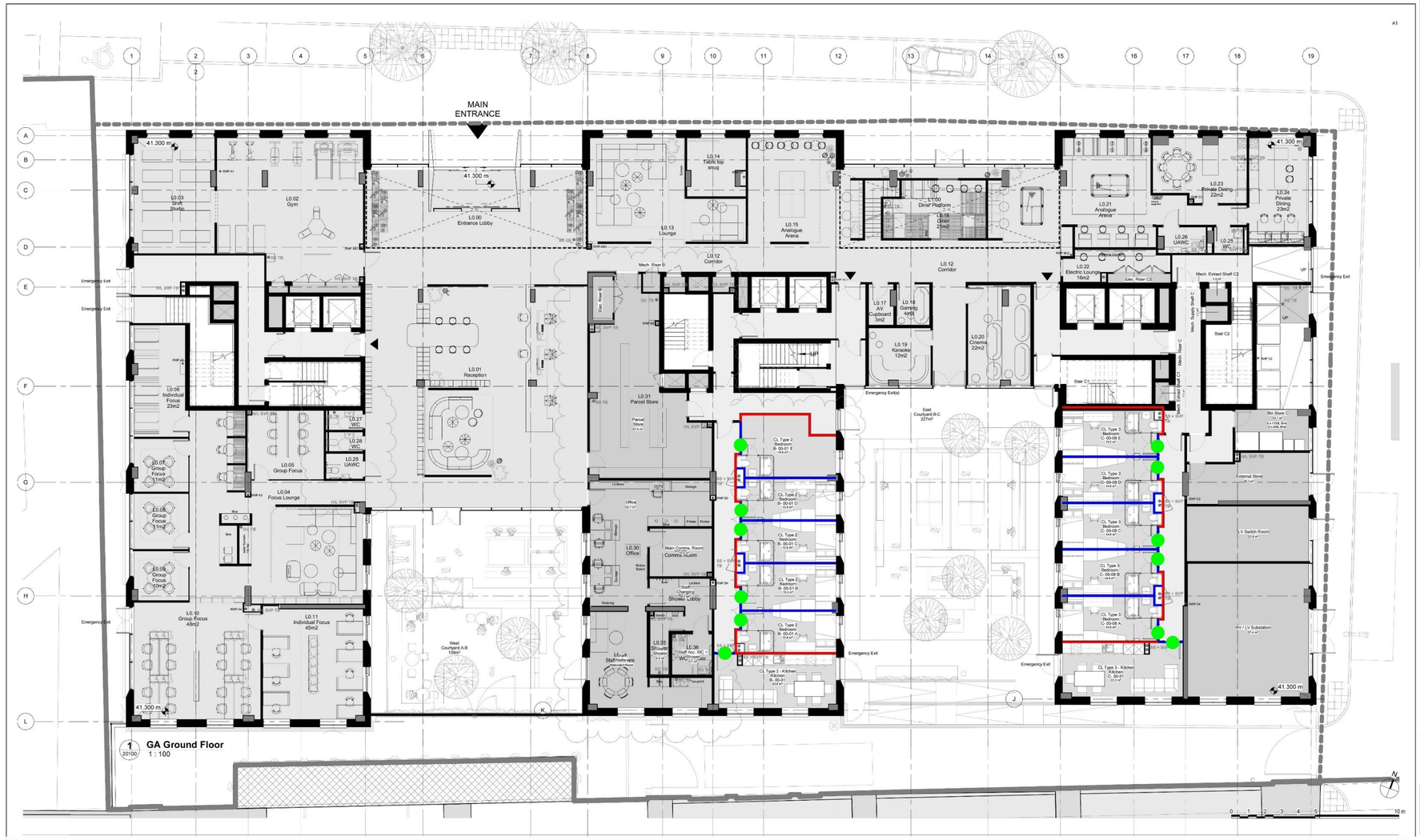
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ACOUSTICS - AIR QUALITY - LIGHTING

Project: Echo Street

Client: IQSA Services Ltd

Scale @ A1: NTS | **Project Number: 101531-3**

Ground Floor Partitions and Criteria



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KEY

- $D_{nT,w} + C_{tr}$ 45 dB
- $D_{nT,w} + C_{tr}$ 43 dB
- R_w 29 dB doorset

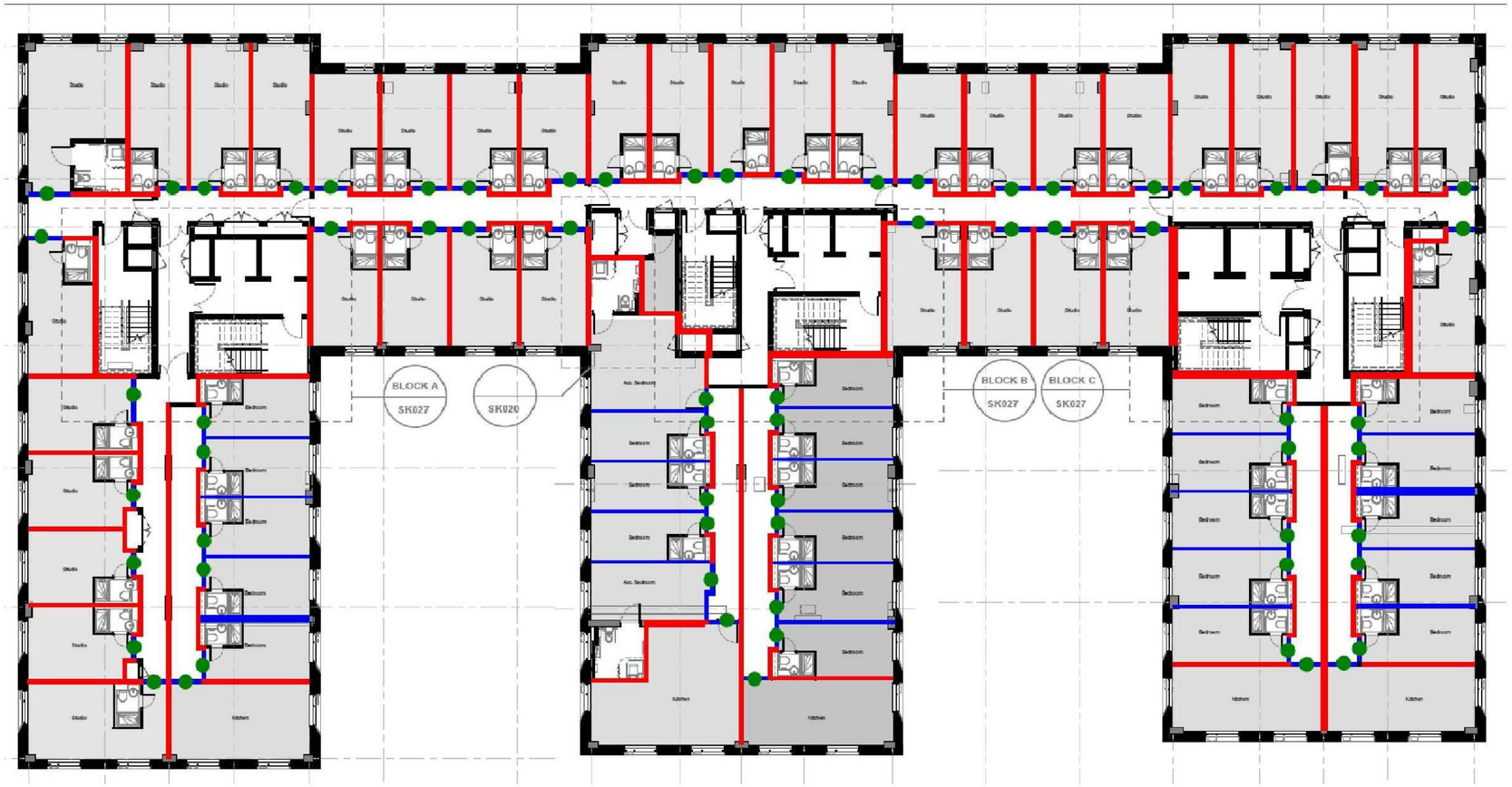
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Typical Residential Floor Partitions

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KEY

- $D_{nT,w}$ + C_{tr} 43 dB
- $D_{nT,w}$ + C_{tr} 45 dB
- R_w 29 dB doorset

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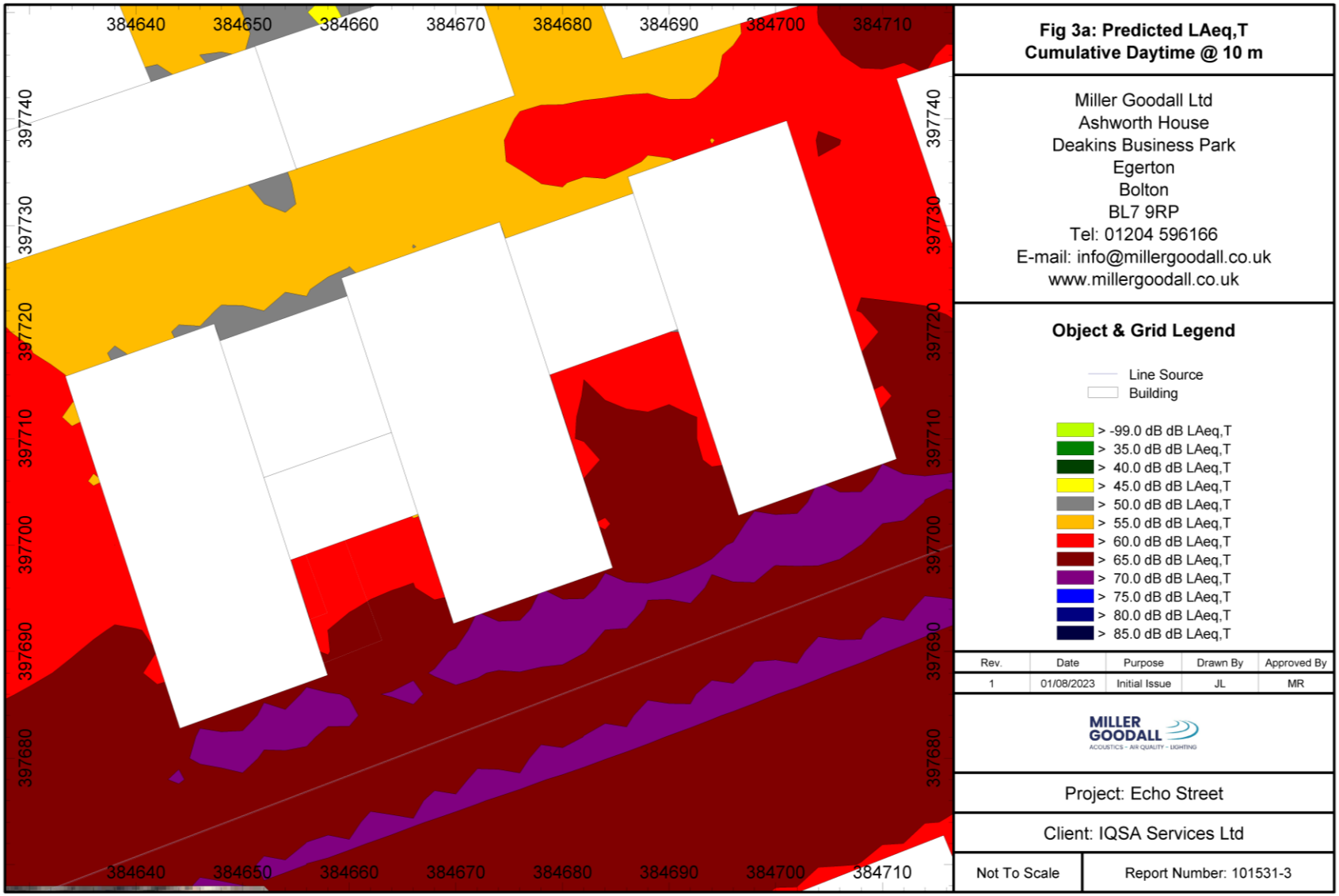
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Project: Echo Street

Client: IQSA Services Ltd

Not To Scale | **Project Number: 101531-3**

Appendix 3: Grid noise maps



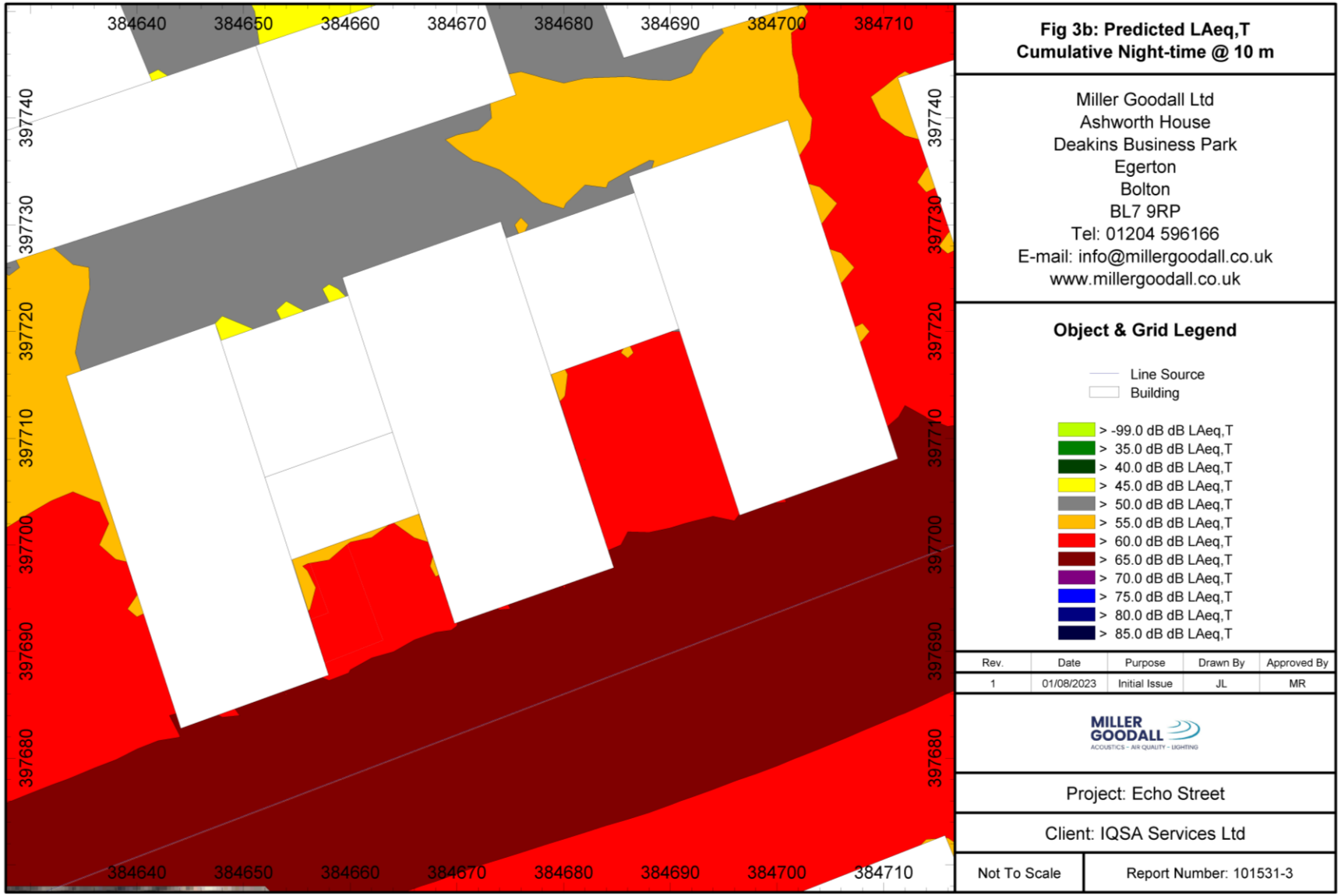


Fig 3b: Predicted LAeq,T Cumulative Night-time @ 10 m

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Object & Grid Legend

- Line Source
- Building
- > -99.0 dB dB LAeq,T
- > 35.0 dB dB LAeq,T
- > 40.0 dB dB LAeq,T
- > 45.0 dB dB LAeq,T
- > 50.0 dB dB LAeq,T
- > 55.0 dB dB LAeq,T
- > 60.0 dB dB LAeq,T
- > 65.0 dB dB LAeq,T
- > 70.0 dB dB LAeq,T
- > 75.0 dB dB LAeq,T
- > 80.0 dB dB LAeq,T
- > 85.0 dB dB LAeq,T

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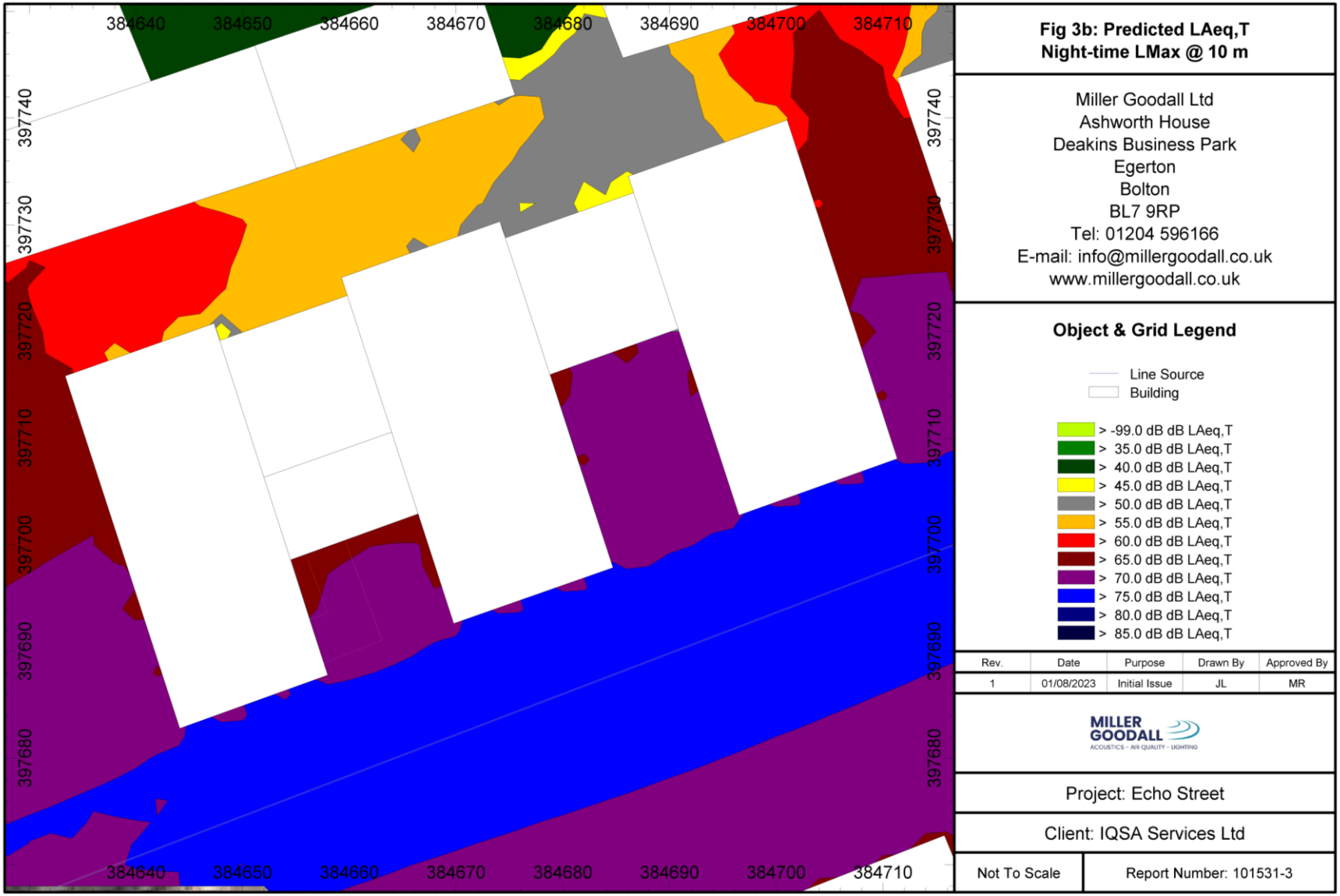


Fig 3b: Predicted LAeq,T Night-time LMax @ 10 m

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Object & Grid Legend

- Line Source
- Building

- > -99.0 dB dB LAeq,T
- > 35.0 dB dB LAeq,T
- > 40.0 dB dB LAeq,T
- > 45.0 dB dB LAeq,T
- > 50.0 dB dB LAeq,T
- > 55.0 dB dB LAeq,T
- > 60.0 dB dB LAeq,T
- > 65.0 dB dB LAeq,T
- > 70.0 dB dB LAeq,T
- > 75.0 dB dB LAeq,T
- > 80.0 dB dB LAeq,T
- > 85.0 dB dB LAeq,T

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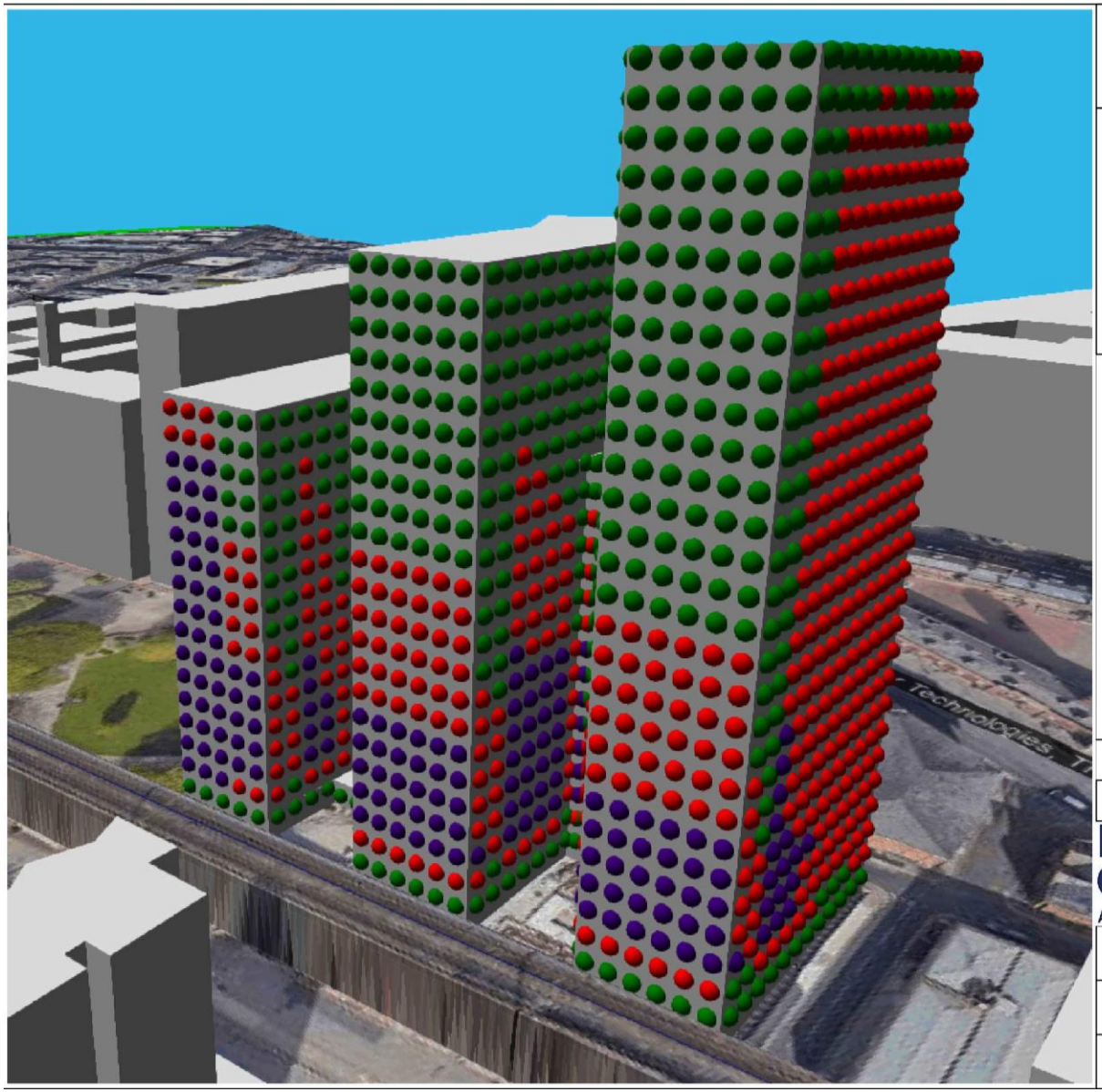
Project: Echo Street

Client: IQSA Services Ltd

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Appendix 4: Façade Glazing Markups





Glazing Markup from South-East

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KEY

- Glazing Type 1
- Glazing Type 2
- Glazing Type 3

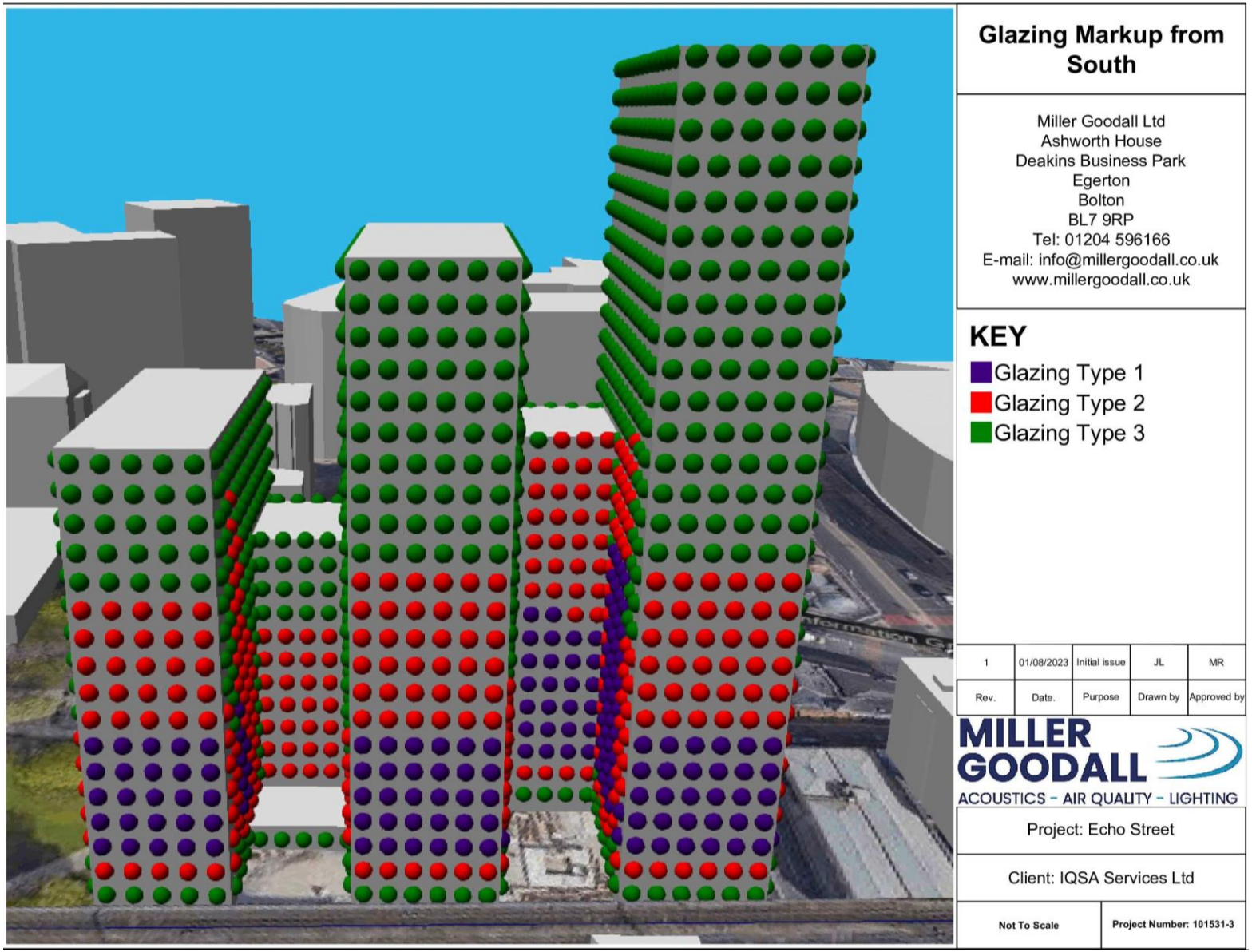
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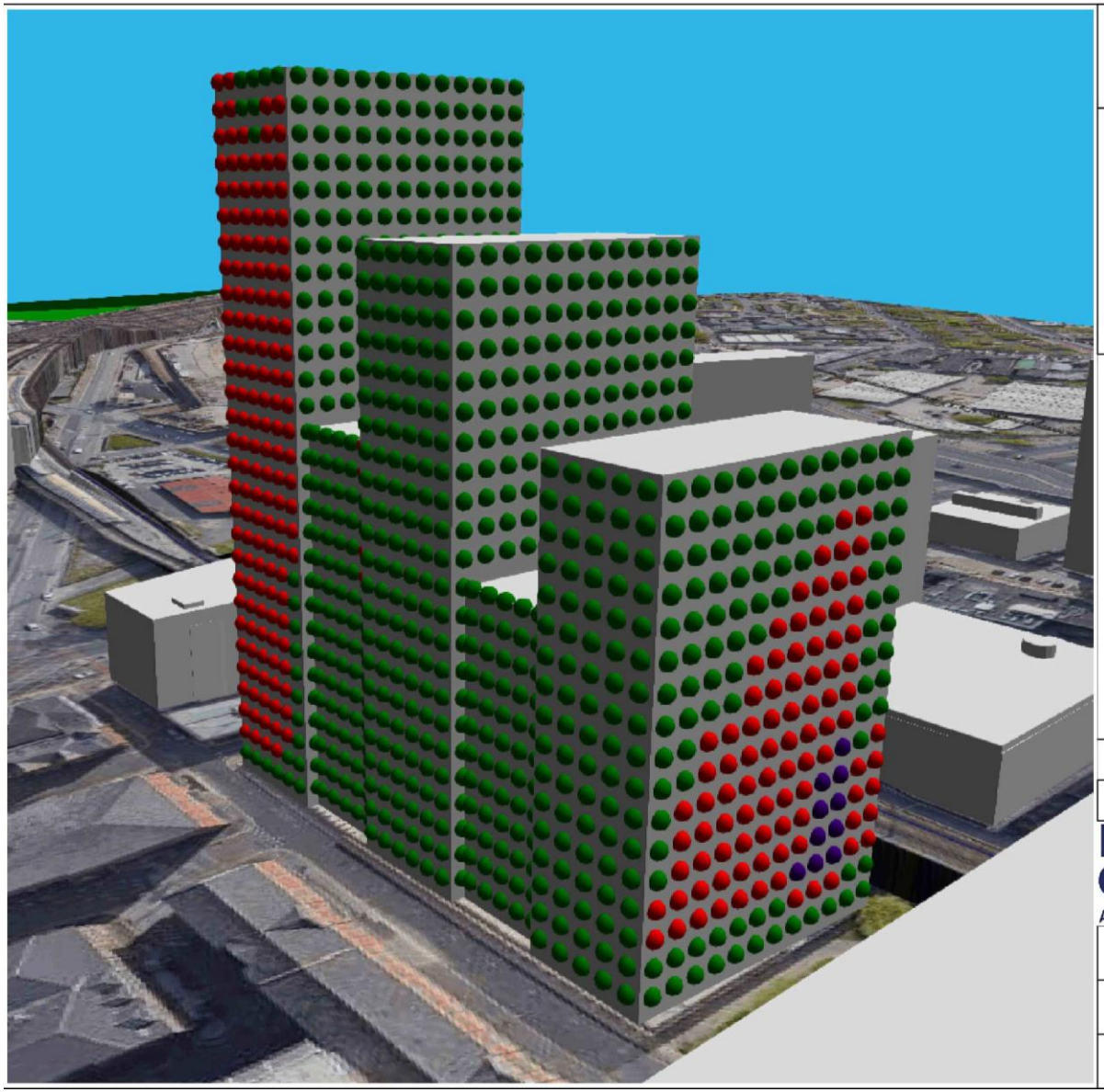
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Project: Echo Street

Client: IQSA Services Ltd

Not To Scale | Project Number: 101531-3


Glazing Markup from South
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KEY
Glazing Type 1
Glazing Type 2
Glazing Type 3
1 01/08/2023 Initial issue JL MR
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Glazing Markup from North West

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KEY

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- Glazing Type 2
- Glazing Type 3

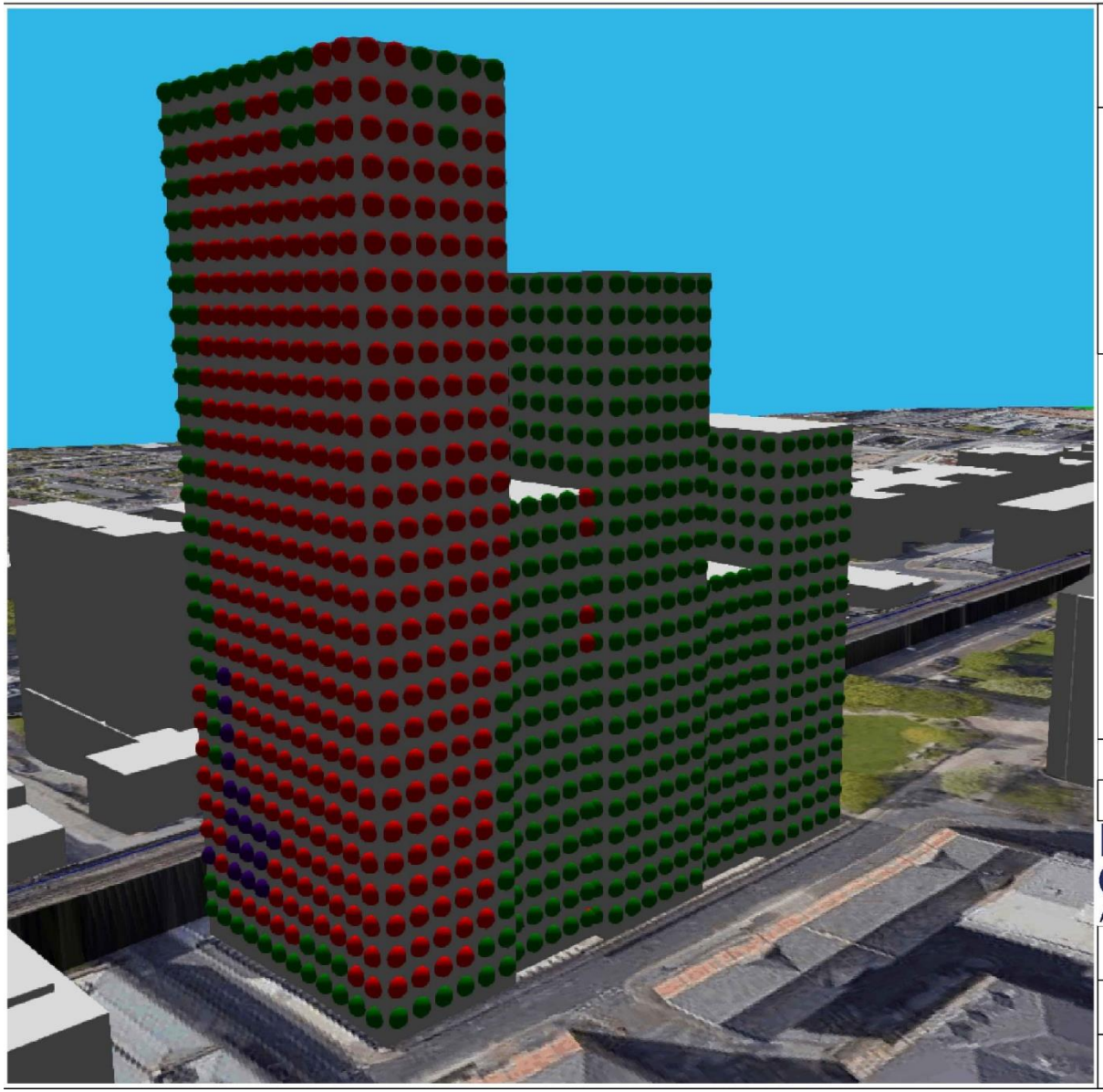
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Glazing Markup from North-East

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KEY

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Glossary of Terms

Decibel (dB) The unit used to quantify sound pressure levels; it is derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 μPa, the threshold of normal hearing is in the region of 0 dB, and 140 dB is the threshold of pain. A change of 1 dB is usually only perceptible under controlled conditions.

dB L_A Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB L_A broadly agree with an individual's assessment of loudness. A change of 3 dB L_A is the minimum perceptible under normal conditions, and a change of 10 dB L_A corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB L_A; normal conversation about 60 dB L_A at 1 meter; heavy road traffic about 80 dB L_A at 10 meters; the level near a pneumatic drill about 100 dB L_A.

$L_{A90,T}$ The A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142: 2014+A1:2019 it is used to define background noise level.

$L_{Aeq,T}$ The equivalent continuous sound level. The sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter.

L_{Amax} The highest A weighted noise level recorded during the time period. It is usually used to describe the highest noise level that occurred during the event.

R_w Single number rating used to describe the sound insulation of building elements and is defined in BS EN ISO 10140-2: 2010 (formerly BSEN ISO 140-3:1995). It is derived by measurement under laboratory conditions and does not take into account the effects of flanking transmissions.

$D_{nT,w}$ The weighted standardized level difference is a single figure rating used to describe the sound insulation of a construction separating two rooms, for example a wall or floor, and

is defined in BS EN ISO 16283-1:2014 (formerly BSEN ISO 140-4:1998). It is derived by measurement of an in-situ construction and therefore takes into account the effects of flanking transmissions, workmanship etc.

C_{tr} A single-number spectrum adaptation term used to characterise the sound insulation rating with respect to urban traffic. It is defined in ISO 717-1:20-13.

NR curves Noise Rating – or NR - curves were developed by the International Organization for Standardization (ISO) to determine the acceptable indoor acoustic environment for hearing preservation, speech communication and annoyance. They are most often used to quantify noise within a building from mechanical and electrical (M&E) systems.


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