

**FERROUS, CHAPLETOWN STREET, MANCHESTER - PROPOSED RESIDENTIAL DEVELOPMENT
NOISE IMPACT ASSESSMENT**

**On behalf of:
Capital & Centric (Nineteen) Limited**

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1.0 INTRODUCTION

- 1.1 Hepworth Acoustics Limited has prepared this noise and vibration assessment on behalf of Capital & Centric Ltd in respect to the erection of a 15 storey building, containing 107 apartments (Use Class C3), ancillary amenity facilities and landscaping, and a multipurpose events pavilion (Use Class E / Sui Generis), the 'proposed development', on land at Chapeltown Street, Manchester, the 'application site'
- 1.2 The noise and vibration assessment has therefore included:
- i. Measurement of tram noise and ground vibration levels at the development site;
 - ii. Assessment of potential noise impact on the development;
 - iii. Assessment of potential vibration impact from the tram line on the development;
 - iv. Recommendation of an appropriate noise mitigation scheme.
- 1.3 The various noise units and indices referred to in this report are described in Appendix I. All noise levels mentioned in the text have been rounded to the nearest decibel, as fractions of decibels are imperceptible.
- 1.4 The development land, which is currently open and unused, was most recently used as a storage compound for a nearby residential development.
- 1.5 To the south of the site is the Ashton-under-Lyne to Piccadilly tram line. The line passes approximately 6m from the southern elevation of the building and trams are timetabled to run every 6 minutes between approximately 05:30 and 00:30. Trams are only briefly visible as they pass the site as they are well shielded by the newly built Phoenix development to the west and move steeply down into a tunnel to the east to pass under Great Ancoats street. Due to the tunnel the trams pass the site fairly slowly to control the respective descent and ascents as necessary. Beyond the tram line is Longacre Street a very lightly trafficked road. Along Longacre Street the commercial units have been demolished and construction is taking place of new residential developments.
- 1.6 To the north of the site is Chapletown Street, with apartment blocks opposite. The road is lightly trafficked and primarily provides resident access to other residential developments on the road. To the east the site narrows and is partly bounded by Great Ancoats street, some 90m from the eastern elevation of the building.

2.0 ACOUSTIC DESIGN CRITERIA

NPPF

- 2.1 The National Planning Policy Framework (NPPF) 2021 states at paragraph 174 that “Planning policies and decisions should contribute to and enhance the natural and local environment by: ... *e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of ... noise pollution ...*”.
- 2.2 Further, paragraph 185 states that “*Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should: a) mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life ...*”.

NPSE:2010

- 2.3 The Noise Policy Statement for England (NPSE) 2010, which is referred to the in NPPF, includes three aims:
- i. Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
 - ii. Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
 - iii. Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.
- 2.4 Therefore, it is necessary to refer to established national guidance such as the acoustic design goals for residential development that are set out in British Standard 8233: 2014, *Guidance on sound insulation and noise reduction for buildings*, which carries the full weight of an adopted British Standard.

- 2.5 As transportation noise is the predominant source of noise on the site. The noise mitigation measures will focus on noise control measures to limit the impact of these sources.

BS 8233: 2014, 'Guidance on sound insulation and noise reduction for buildings'

- 2.6 No specific guidance is given in the NPPF on acoustic criteria, therefore the guidance discussed below has been used for acoustic design purposes which carries the full weight of an adopted British Standard.
- 2.7 Guidance on acceptable noise levels in habitable rooms and private gardens is set out in British Standard 8233: 2014, 'Guidance on sound insulation and noise reduction for buildings' (referred hereafter as BS 8233). The design criteria recommended in BS 8233 for daytime periods (07:00–23:00) and night-time periods (23:00–07:00) are summarised in Table 1.

Table 1: BS 8233:2014 Recommended Acoustic Design Criteria

Activity	Location	Daytime (07:00 - 23:00)	Night-time (23:00 - 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 $L_{Aeq,8hr}$

- 2.8 BS 8233 also recognises that regular individual noise events at night can cause sleep disturbance but does not provide specific design criteria. Peaks of noise from individual events such as these are usually described in terms of dB L_{Amax} values. ProPG: Planning & Noise 'Professional Practice Guidance on Planning & Noise' 2017 states that *"in most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night."*
- 2.9 For outdoor amenity spaces, such as balconies, gardens and patios, BS 8233 states that it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments'. However, BS 8233 acknowledges that these are only guidelines and some flexibility may need to be applied for residential developments in higher noise areas near to major roads. The standard states that *'it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or*

making efficient use of land resources to ensure development needs can be met, 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. 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'

- 2.10 For this development a small number of proposed apartments will have balcony amenity areas as well as a communal rooftop landscaped amenity space for the residents is also proposed. For outdoor amenity spaces, such as balconies, gardens and patios, BS 8233 states that 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'* therefore it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments'.
- 2.11 However, BS 8233 further acknowledges that these are only guidelines, and some flexibility may need to be applied for residential developments in higher noise areas. The standard states that *'it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, 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'*.
- 2.12 BS 8233 states that if there is a reliance on closed windows to meet the guide values, *"there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the*

resulting noise level". Further, it is stated that assessments should be based on a room with *"adequate ventilation provided (e.g. trickle ventilators should be open)"*.

2.13 For this development we therefore recommend the following noise criteria be adopted:

- Daytime noise levels within 35 dB $L_{Aeq,16hr}$ inside living rooms and bedrooms, and within 40 dB $L_{Aeq,16hr}$ including kitchen/diners (where appropriate); and
- Night-time noise levels within 30 dB $L_{Aeq,8hr}$ and generally not exceeding 45 dB L_{Amax} in bedrooms (i.e. typically no more than 10 times per night).

Plant Noise Limits

- 2.14 The results of the environmental noise survey have been used as a basis for recommending appropriate noise design limits for any external building services equipment associated with ground floor commercial uses, in accordance with British Standard 4142:2014+A1:2019, *'Methods for rating and assessing industrial and commercial sound'* (referred to hereafter as BS 4142) These acoustic design limits are described in Section 4.0.
- 2.15 BS 4142 is the appropriate guidance for assessing and controlling the potential noise impact from noise sources such as mechanical services plant installations.
- 2.16 BS 4142 requires a 'rating' level ($L_{Ar,Tr}$) calculated from the operation of the noise source to be compared with the background sound level ($L_{A90,T}$) which is measured in the absence of the noise source, evaluated over a 1-hour period for daytime operations and 15-minute period for night-time operations.
- 2.17 The rating level ($L_{Ar,Tr}$) is based on the 'specific' sound level ($L_{Aeq,Tr}$) attributed to the operating noise source, with 'character corrections' added where appropriate for sound sources where 'certain acoustic features can increase the significance of impact'.
- 2.18 The character correction is applied where necessary to the specific sound level in order to obtain the rating level and can take into account tonality, intermittency, impulsivity and characteristics otherwise distinctive against the prevailing noise climate in the area.
- 2.19 An initial estimate of the potential noise impact from the operating noise source is determined by comparing the difference between the rating level and the background level.

2.20 Regarding the outcome of the initial estimate, BS 4142 states that:

- Typically, the greater this difference, the greater the magnitude of 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; and,
- The lower the rating level is relative to the measured background level, the less likely it is that the operation will have an adverse impact or a significant adverse impact. Where the rating level is does not exceed the background sound level, this is an indication of the specific sound source having low impact, depending on the context.

2.21 BS 4142 states that all pertinent factors must be taken into account regarding the context in which the noise occurs, including but not limited to:

- The absolute level of sound.
- The character and level of the residual sound compared to the character of the specific sound; and, the sensitivity of the receptor and whether dwellings or other premises used for residential purposes will actually incorporate design measures that ensure good internal and/or outdoor acoustic conditions such as acoustic screening

3.0 TRAM NOISE SURVEY

- 3.1 Noise levels were measured at one location on the site, approximately six metres from the nearside tram line, representative of the nearest elevation of the proposed development as shown in Figure 1.
- 3.2 Attended noise measurements were carried between approximately 12:00 and 13:00 hours on Thursday 7th October and between 12:00 and 13:00 on Tuesday 12th October.
- 3.3 Both monitoring surveys were carried out using a Brüel & Kjær 2250 'Type 1' sound level meter (serial no. 3011706). Noise levels were measured at a microphone height of approximately 1.5 metres above the ground in 'free-field' conditions. A windshield was fitted to the microphones during all noise measurements and calibration checks were carried out before and after the noise survey with no variance observed.
- 3.4 Additional confirmatory measurements were carried out at a microphone height of approximately 5m to assist in the calculation of tram noise propagation at 1st floor level and above.
- 3.5 In addition to measurement of overall 'A'-weighted noise levels, frequency analysis was carried out to assist with the appropriate specification of noise mitigation measures.
- 3.6 The weather conditions during the survey were dry, mild and calm (<1 m/s).
- 3.7 Trams run on the line between approximately 05:30 – 00:00 Monday to Saturday and between 06:30 – 23:30 on Sundays, generally the number of trams using the line is summarised in Table 2.

Table2: Summary of Tram Movements on the Ashton-under-Lyne to Piccadilly line.

Period	Trams
Day (07:00 – 23:00)	180
Night (23:00 – 07:00)	30

- 3.8 The tram track that runs past the site is of a 'continuously welded track' construction, i.e. there are no gaps between the rails, and therefore trams run relatively smoothly past the site.
- 3.9 Noise levels were measured during the passage of each tram in terms of the 'sound exposure level' (L_{AE}) and the maximum sound pressure level, L_{Amax} .

- 3.10 The results of the tram pass-by noise surveys are shown in Appendix II. Tram noise exposure levels have been evaluated as described below.

Tram Noise Exposure Values

- 3.11 Tram noise is evaluated in terms of the 'equivalent continuous noise level', L_{Aeq} for the day and night time periods. These L_{Aeq} values can be calculated from the results of the noise survey using the formula:

$$L_{Aeq}(T) = L_{AE \text{ Average}} + 10 \log N - 10 \log T$$

where $L_{Aeq}(T) = L_{Aeq}$ over time period T

$L_{AE \text{ Average}} = \text{Average 'Sound Exposure Level'}$

N = Number of tram passes in time period T

T = Time period in seconds

- 3.12 Tram noise calculations have been undertaken using an average SEL of 79 dB, and the results are shown in Table 3.

Table 3: Tram Noise Exposure Values at Ground Floor Level

Location	Daytime dB L_{Aeq} (0700-2300 hrs)	Night-time dB L_{Aeq} (2300-0700 hrs)
6m from Tram Line (ground floor height)	59	51

- 3.13 Measured noise levels at a ground level height of 5m were approximately 4 dB below those measured at ground floor level
- 3.14 The measured L_{Amax} noise levels of trams passing were in the range of 77 – 79 dB(A) at ground floor level and 74 – 76 dB(A) at first floor level.
- 3.15 In order to achieve recommended noise levels inside the dwellings some noise mitigation measures will be necessary, as described in Section 5.

4.0 TRAM VIBRATION ASSESSMENT

4.1 Guidance on measuring and assessing the potential annoyance resulting from vibration in buildings is set out in British Standard 6472, 2008 '*Guide to the evaluation of human exposure to vibration in buildings*'. The standard includes a section on intermittent vibrations which requires the vibration exposure to be determined in terms of a 'vibration dose value', VDV. This takes into account the magnitude of the vibration and the duration of exposure.

4.2 The vibration dose value for the day or night-time period can be calculated using the formula:

$$VDV_{b/d, day/night} = \left(\int_0^T a^4 t(dt) \right)^{1/4}$$

Where; $VDV_{b/d, day/night}$ is the vibration dose value $a(t)$ is the frequency weighted acceleration in ms^{-2}

T is the total period of day or night (in seconds) during which vibration can occur

4.3 Ground vibration from passing trams was measured between approximately 10:00 – 13:00 on Tuesday 12th October 2021. The vibration measurements were carried out using a Vibrock V901 vibration meter (s/n: 7906) and tri-axial VDV transducer.

4.4 The measured vibration levels on site and the number of tram pass-bys during the measurement are shown in Table 4. From the vibration measurements the Vibrock meter extrapolates the 16 hour daytime and 8 hour night dose values on the assumption that the vibration dose obtained within the measurement period continues for the whole 8 or 16 hour period. The extrapolated vibration exposure values are shown in Table 5.

Table 4: Measured 1 hour Tram Vibration Dose Values in $ms^{-1.75}$

	VDV			Number of Trams
	X	Y	Z	
10:00-11:00	0.026	0.023	0.073	11
11:00-12:00	0.025	0.023	0.059	10
12:00-13:00	0.025	0.024	0.064	10

Table 5: Extrapolated Daytime Tram Vibration Dose Values in $\text{ms}^{-1.75}$

	VDV		
	X	Y	Z
Daytime (07:00-23:00)	0.026	0.024	0.071
Night-time (23:00-07:00)	0.022	0.022	0.061

Assessment of Vibration Impact

- 4.5 Vibration dose values (in $\text{ms}^{-1.75}$) in residential buildings at which various degrees of adverse comment may be expected are quoted in BS 6472 and are reproduced in Table 6.

Table 6: Extract from BS 6472

	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Daytime (07:00-23:00)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Night (23:00-07:00)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

- 4.6 The vibration dose values for day and night obtained from measurements at the site, as shown in Tables 4 and 5, are well below the thresholds for the onset of adverse comment that are quoted in BS 6472. Therefore, no special vibration isolation measures will be necessary at this site and vibration is not considered any further in this report.

5.0 RECOMMENDED NOISE MITIGATION MEASURES

- 5.1 Generally, windows of standard well-fitted thermal double glazing (4mm glass – 4mm glass) have a sound reduction performance of $25 \text{ dB } R_w + C_{tr}$. Therefore, where external noise levels exceed $60 \text{ dB } L_{Aeq,16hr}$ during the daytime and/or $55 \text{ dB } L_{Aeq,8hr}$ and/or $70 \text{ dB } L_{Amax}$ at night, higher specification glazing will be necessary. Therefore, sound insulation measures will be necessary for some of the proposed apartments and our recommendations are detailed below.
- 5.2 We understand that mechanical ventilation in the form of an MVHR system is proposed for all living rooms and bedrooms of all dwellings on the proposed development. This measure will provide future residents with the option of ventilating the rooms without opening a window, whilst still achieving the adopted internal noise criteria. Thus, the recommendations made below are on the assumption that windows will be closed for ventilation, except for periods of rapid/purge ventilation.
- 5.3 Windows can be openable but must have compressible seals for effective sealing when closed.

Northern Elevation

- 5.4 During our visits to the site, there was no noticeable noise or activity taking place in the area with a view to the northern elevations of the proposed development.
- 5.5 Windows of standard thermal double glazing (4 mm glass - 4 mm glass) will be suitable in order to control internal ambient noise levels to within the BS 8233 criteria on this elevation. As shown in Blue on Figure 2.

Western Elevation

- 5.6 For the majority of glazing on the western elevation windows of standard thermal double glazing (4 mm glass - 4 mm glass) will be suitable in order to control internal ambient noise levels to within the BS 8233 criteria. As shown in blue on Figure 3.
- 5.7 However, a small number of windows of apartments closest to the tram line will require an upgraded specification of glazing as shown in Figure 3.

South & East Elevations

- 5.8 The south and east elevations are those exposed to noise from the tram line and Ashton Old Road further to the east. Therefore, In order to ensure that noise levels incident upon the South and East elevations are controlled within the BS 8233 criteria we recommend some habitable rooms are fitted with an upgraded glazing as shown in Figures 4 & 5.

Specifications

- 5.9 A number of double glazing specifications are recommended, the required performance level of the glazing could be achieved with the following:
- **37 dB $R_w + C_{tr}$** - '10 mm glass - 12mm cavity – 8.4mm Stadip Silence Acoustic Laminated Glass'
 - **35 dB $R_w + C_{tr}$** - '10 mm glass - 12mm cavity – 6.4mm Stadip Silence Acoustic Laminated Glass'
 - **33 dB $R_w + C_{tr}$** - '8 mm glass - 12mm cavity – 6.4mm Stadip Silence Acoustic Laminated Glass'
 - **30 dB $R_w + C_{tr}$** - '4mm glass – 12mm cavity – 6.4mm Stadip Silence Acoustic Laminated Glass'
 - **27 dB $R_w + C_{tr}$** - '4 mm glass - 12 mm cavity – 6mm glass
 - **25 dB $R_w + C_{tr}$** - '4 mm glass - 12 mm cavity – 4mm glass

Garden/Balconies

- 5.10 For outdoor amenity spaces, such as balconies, gardens and patios, BS 8233 states that 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'* therefore it is desirable that the external noise level does not exceed 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments'.
- 5.11 The calculated daytime noise exposure level is 59 dB $L_{Aeq,16hr}$, which is 4dB higher than the BS8233 upper guideline limit of 55dNB $L_{Aeq,T}$.
- 5.12 However, BS 8233:2014 further acknowledges that these are only guidelines, and some flexibility may need to be applied for residential developments in higher noise areas near major roads. The standard states that *'it is also recognised that these guideline values are not achievable in all circumstances*

where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, 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’.

Noise Design Limits for Mechanical Services Plant

- 5.13 As BS 4142 is applicable guidance for assessing plant noise, an appropriate design criterion for noise from proposed plant at this development would be to control the rating level from any new externally mounted plant associated with the development to within the existing representative background sound levels ($L_{A90,T}$) at the nearest dwellings.
- 5.14 The nearest dwellings to the proposed development are located adjacent to the west of the development is the Phoenix development. However, any new externally mounted plant that forms part of the development will also have to be controlled within suitable levels outside the proposed accommodation within the development itself.
- 5.15 The objective is to quantify a background sound level which is representative of the noise climate during the period of interest; Section 8.1 of BS 4142 states “*the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods.*”.
- 5.16 Some brief daytime, and night time measurements were carried out on site on Tuesday 12th October and Wednesday 13th October. Full results of the noise surveys can be seen in Appendix II, with a summary showing the range of the measured levels in terms of the minimum and maximum levels shown in Table 7 below.

Table 7: Lowest Measured Background Noise Levels (dB)

Location	Daytime (07:00-23:00)	Night-time (23:00-07:00)
	$L_{A90,T}$	$L_{A90,T}$
Chapletown Street	51	45

- 5.17 On this basis, the recommended plant noise design limits for new equipment installed as part of the development are shown in Table 8. The following plant noise emission limits which are to be achieved

at 1m from any noise sensitive window based on achieving a level 5 dB below the prevailing background noise level.

Table 8: Plant Noise Design Limits at Nearest Dwellings (dB)

Daytime (07:00-23:00)	Night (23:00-07:00)
46 $L_{Ar,1h}$	40 $L_{Ar,15\ min}$

- 5.18 Controlling plant within these design limits will ensure that there is no significant noise impact at the nearest existing and proposed dwellings.
- 5.19 Whilst details of any new plant and their installation locations are not currently available, providing plant noise design limits will ensure that these considerations are part of the design process at an early stage; benefiting the development and the local area.
- 5.20 The plant noise design limits in Table 3 apply to the BS 4142 rating level of the sound generated by the plant. As discussed in Section 2, the rating level is the specific sound level (plant noise level at the nearest dwellings) plus any necessary corrections for different acoustic characteristics.

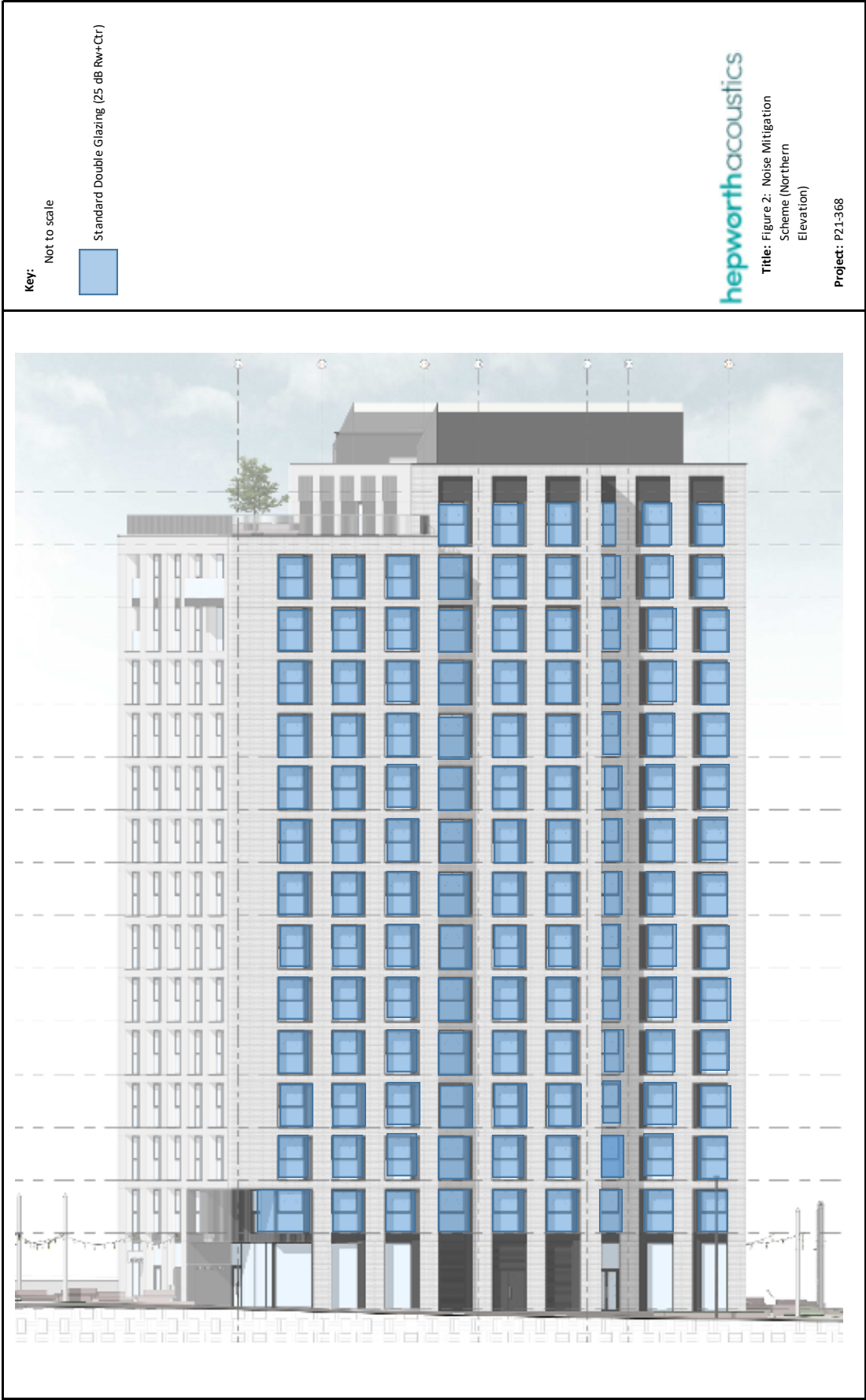
Outline Advice for Plant

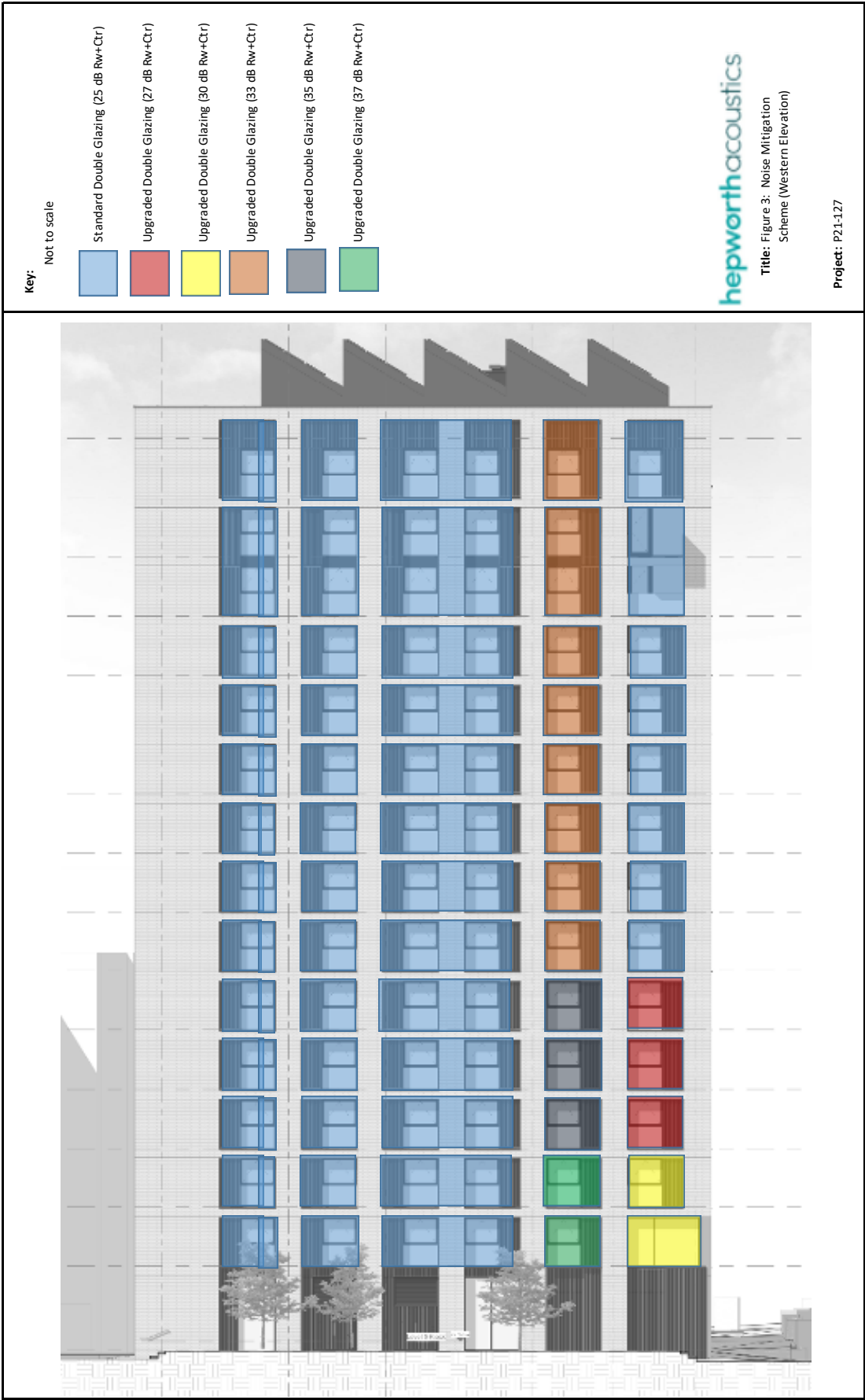
- 5.21 In our experience of plant installations at similar developments, they do not generally exhibit impulsive characteristics, however they can be intermittent and/or tonal. The exact characteristics of the sound will depend on what equipment is installed and what the resulting levels are at the nearest dwellings, as these characteristics do not attract corrections to the BS 4142 assessment where they are not noticeable at the assessment location.
- 5.22 Nevertheless, we would recommend making outline allowances for intermittency and tonality as a precaution, resulting in a cumulative correction of at least 5 dB; i.e. 3 dB for intermittency and 2 dB for tonality. This would mean controlling the cumulative specific sound level at the nearest dwellings from any new plant to within 42 dB $L_{Aeq,1h}$ during that daytime and 36 dB $L_{Aeq,15\ min}$ during the night-time, potentially lower.

6.0 SUMMARY

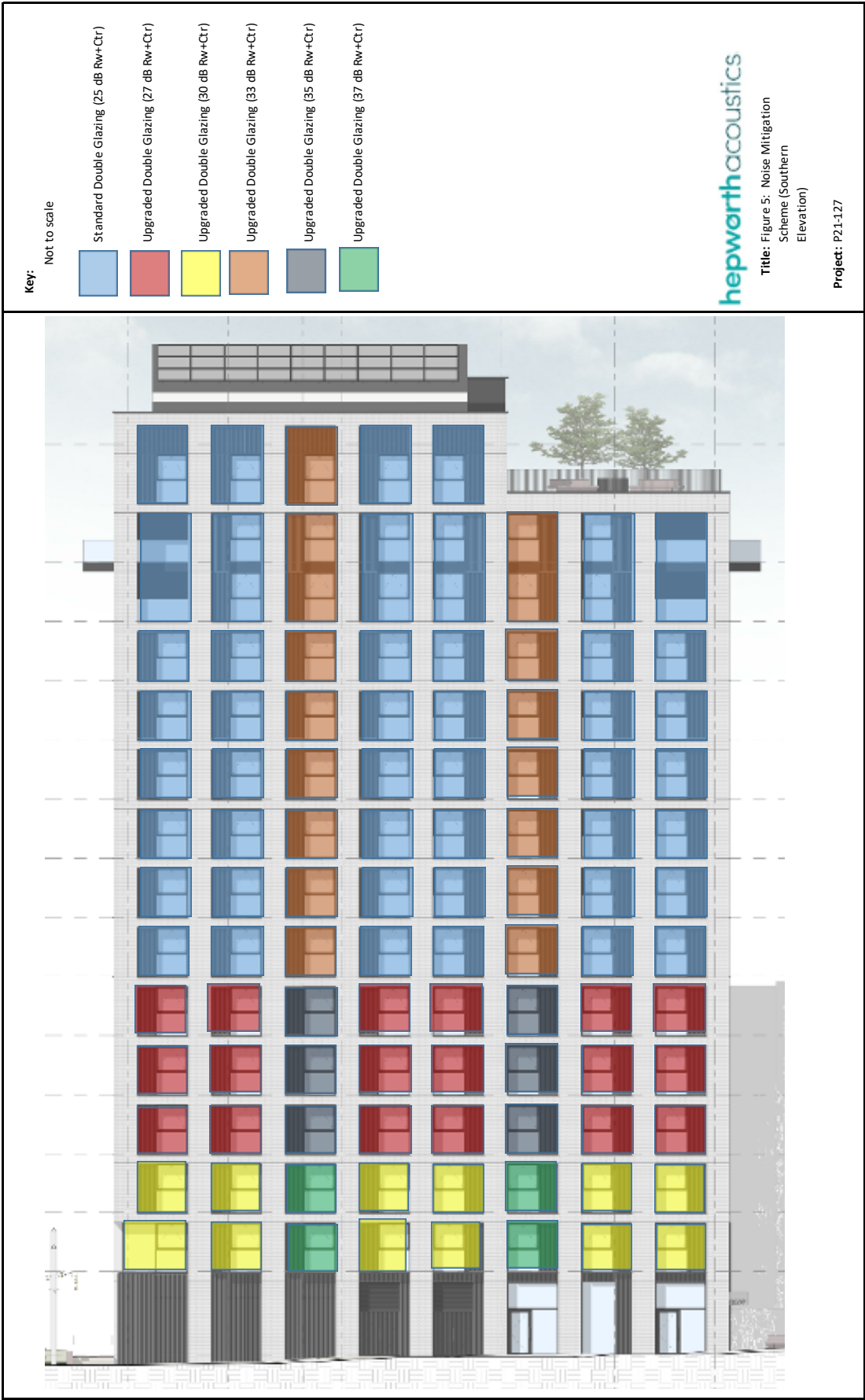
- 6.1 Hepworth Acoustics Ltd was commissioned by Capital & Centric to carry out a noise and vibration assessment in connection with a planning application for a residential development at Chapletown Street in Manchester.
- 6.2 Appropriate acoustic design criteria have been adopted based on relevant national guidance.
- 6.3 A noise and vibration survey has been carried out using attended measurements in order to determine the ambient noise and vibration levels incident upon the development.
- 6.4 Suitable plant noise limits have been derived for any new externally mounted plant which forms part of the new development. Recommendations for sound insulation measures have been provided in order to adequately control external noise ingress to the newt apartments.











Appendix I: Noise Units & Indices

Sound and the decibel

A sound wave is a small fluctuation of atmospheric pressure. The human ear responds to these variations in pressure, producing the sensation of hearing. The ear can detect a very wide range of pressure variations. In order to cope with this wide range of pressure variations, a logarithmic scale is used to convert the values into manageable numbers. Although it might seem unusual to use a logarithmic scale to measure a physical phenomenon, it has been found that human hearing also responds to sound in an approximately logarithmic fashion. The dB (decibel) is the logarithmic unit used to describe sound (or noise) levels. The usual range of sound pressure levels is from 0 dB (threshold of hearing) to 120dB (threshold of pain).

Due to the logarithmic nature of decibels, when two noises of the same level are combined together, the total noise level is (under normal circumstances) 3 dB(A) higher than each of the individual noise levels e.g. 60 dB(A) plus 60 dB(A) = 63 dB(A). In terms of perceived 'loudness', a 3 dB(A) variation in noise level is a relatively small (but nevertheless just noticeable) change. An increase in noise level of 10 dB(A) generally corresponds to a doubling of perceived loudness. Likewise, a reduction in noise level of 10 dB(A) generally corresponds to a halving of perceived loudness.

The ear is not equally sensitive to sound at all frequencies. It is less sensitive to sound at low and very high frequencies, compared with the frequencies in between. Therefore, when measuring a sound made up of different frequencies, it is often useful to 'weight' each frequency appropriately, so that the measurement correlates better with what a person would actually hear. This is usually achieved by using an electronic filter called the 'A' weighting, which is built into sound level meters. Noise levels measured using the 'A' weighting are denoted dB(A) or dBA.

Frequency and Hertz (Hz)

As well as the loudness of a sound, the frequency content of a sound is also very important. Frequency is a measure of the rate of fluctuation of a sound wave. The unit used is cycles per second, or hertz (Hz). Sometimes large frequency values are written as kiloHertz (kHz), where 1 kHz = 1000 Hz.

Young people with normal hearing can hear frequencies in the range 20 Hz to 20 kHz. However, the upper frequency limit gradually reduces as a person gets older.

Glossary of Terms

When a noise level is constant and does not fluctuate, it can be described adequately by measuring the dB(A) level. However, when the noise level varies with time, the measured dB(A) level will vary as well. In this case it is therefore not possible to represent the noise climate with a simple dB(A) value. In order to describe noise where the level is continuously varying, a number of other indices can be used. The indices used in this report are described below.

C_{tr}	This is an A-weighted urban traffic noise spectrum, which can be added to $D_{nT,w}$ or R_w in some standards to take into account different source spectra such as low frequency sound.
R_w	This is the 'Weighted Sound Reduction Index', and is a single figure quantity of R, the laboratory measured Sound Reduction Index.
$L_{Aeq,T}$	This is the A-weighted 'equivalent continuous noise level' which is an average of the total sound energy measured over a specified time period. In other words, L_{Aeq} is the level of a continuous noise which has the same total (A-weighted) energy as the real fluctuating noise, measured over the same time period. It is increasingly being used as the preferred parameter for all forms of environmental noise.
L_{Amax}	This is the maximum A-weighted noise level that was recorded during the monitoring period.
$L_{A10,T}$	This is the A-weighted noise level exceeded for 10% of the time period. L_{A10} is usually used as a measure of traffic noise.
$L_{A90,T}$	This is the A-weighted noise level exceeded for 90% of the time period. L_{A90} is used as a measure of background noise.
L_{AE}	This is the A-weighted 'Sound Exposure Level' which is used for measuring discrete noise events. Essentially it is a measure of the sound energy of the whole noise event normalised to a period of 1 second. The SEL value can be used to calculate the actual L_{Aeq} value for a given time period if the number of noise events is known.

Appendix II: Noise Survey Results

Date(s): Thursday 7th October, Tuesday 12th October & Wednesday 13th October 2021

Equipment: Brüel & Kjær 2250 'Type 1' sound analyser (serial no. 3011706) with tripod, extension cable, pole and calibrator

All levels in dB(A)

Tram pass-bys

Date	Time	Measured Noise Levels (dB)	
		L _{Amax}	SEL
7 th Oct	12:02	78.6	80.5
"	12:06	77.6	82.1
"	12:07	77.3	81.3
"	12:09	78.7	84.8
"	12:17	79.0	83.0
"	12:23	79.3	83.3
"	12:32	79.4	85.1
"	12:40	75.8	83.5
"	12:41	79.5	84.2
"	12:50	78.6	84.3
"	12:52	78.1	83.9
"	13:03	77.5	82.8
"	13:03	76.9	83.2
"	13:10	75.9	82.5
"	13:12	78.1	83.0