Noise Impact Assessment for Mixed Residential/Commercial Development

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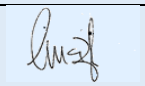
Signature				
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BRIEF FOR CONSULTANCY:

This report has been prepared by Acoustics & Noise Limited, Newport, South Wales, for Property Index Cardiff Ltd., 113 – 116 Bute Street, Cardiff, CF10 5EQ under the instruction of Chris Spiteri.

Order No: n/a

OBJECTIVES:

To investigate the noise impact on the proposed development at 133 – 135 Commercial Street, Newport.

Where applicable recommend mitigation to meet the impact criteria.

NON-TECHNICAL SUMMARY:

It is proposed to develop and extend the upper storeys of 133 – 135 Commercial Street, Newport for residential use with the ground floor units being refurbished for retail use. The site is bounded by a number of other commercial properties and fronts onto a one-way vehicle thoroughfare. The site is located within a city centre location and the acoustic climate is characterised by road traffic and intermittent activity from passers-by.

In response to a pre-application, the following comments were provided:

"*No information has been provided assessing the potential noise impact from road traffic or nearby adjacent commercial uses including deliveries and plant / equipment on the proposed residential units to be built. The applicant will also need to consider any potential commercial noise from the four proposed retail units to be located on the ground floor of the development that could also have an impact on existing residents in the vicinity.*

I therefore recommend that in order for this section to make an informed comment the applicant should submit a full noise assessment to assess any potential noise impact of the above mentioned noise sources on future and existing residents in the vicinity. The report should include, if appropriate, measures to be applied to mitigate excess noise impact.

The report shall be prepared by a person with appropriate acoustic qualifications and should be with full regard to all relevant guidance including BS8233:2014 - Guidance on Sound Insulation and Noise Reduction for Buildings and BS4142:2014 Methods for rating and assessing industrial and commercial sound."

At this stage, the occupants of the proposed retail unit are unknown, but it is possible that there may be items of plant associated with the proposed use such as chillers, condensers and A/C units and that these may be required to operate 24/7.

The operation of this plant has the potential to impact on the amenity of the nearest residential properties.

As the details of the plant associated with this development are unknown at this stage, this report determines a maximum rating level that will result in a low impact at the nearest receptors.

This report concludes that the total maximum rating level for the plant should not exceed 39 dB, when assessed at the nearest receptor and this should be used to inform the M&E design and purchasing decisions to ensure that any noise impact will be low when assessed at the nearest sensitive receptors.

The proposed residential units on the upper floors of the development will be impacted upon by the external noise levels from the city centre activities along Commercial Street and Hill Street.

This report assesses the whole site and makes recommendations for the glazing solutions based upon desirable internal ambient noise levels within dwellings as detailed in BS 8233:2014.

The measured external ambient noise levels at the site indicate that an open window ventilation strategy would not be suitable for any of the habitable rooms within the north east and north west elevations of the development overlooking Hill Street and Commercial Street. Furthermore, an open window ventilation strategy would not be suitable for habitable rooms within the south west elevation of Plot 135.

A scheme of sound insulation is required to control the noise ingress. The recommended scheme requires that the glazing is in the closed position.

This assessment details the minimum sound reduction performance required. Manufacturers' data should be used to confirm that recommended minimum acoustic performance specification of 27 dB $R_w + C_{tr}$ is achievable from the full glazing unit including frames, glazing and any ventilation provision.

It is assumed that the glazing solutions are in the closed position to control the noise ingress. The decision on whether the glazing should be permanently closed is outside the scope of this assessment and our technical expertise. This decision should be taken by appropriate authorities.

At this stage, the occupants and usage of the retail units are unknown and therefore, it is not possible to assess any impact until the activity noise from the occupants is determined. Noise from activities within the retail units could potentially impact on the proposed residential properties located on the upper floors and it may be necessary to assess the sound reduction performance of the separating floor between the retail unit and the residential unit above. Mitigation to the separating floors, if required, will be considered at the detailed design stage.

With regard to the noise impact during deliveries to neighbouring retail units, this report concludes that with the recommended glazing in the closed position, the required internal ambient noise levels within all habitable rooms overlooking Commercial Street and Hill Street can be achieved during a delivery.

All habitable rooms subject to sound mitigation measures will need to be provided with an alternative, effective means of ventilation which must be agreed with Building Control. It is important that any alternative ventilation strategy provides the required levels of ventilation and does not compromise the façade insulation or the resulting internal noise levels. Recommendations for suitable ventilation are outside the scope of this assessment and technical expertise.

1.0 DESCRIPTION OF SITE

1.1 The site is located at 133 – 135 Commercial Street, Newport, NP20 1LY and is currently a mixed residential/retail, city centre, end-terraced property.

1.2 The site is bounded by a number of other commercial properties and fronts onto a one-way vehicle thoroughfare.

1.3 The site is in a city centre location and the acoustic climate is characterised by road traffic and activities associated with both the daytime and night time economy.

1.4 At the time of the survey, intermittent construction work was ongoing at a development 40m to the south of the site.

2.0 DISCUSSION

2.1 Proposal

2.1.1 It is proposed to develop the upper storeys for residential use with the ground floor units being retained and refurbished for retail use.

2.1.2 In response to a pre-application, the following comments were provided:

"No information has been provided assessing the potential noise impact from road traffic or nearby adjacent commercial uses including deliveries and plant / equipment on the proposed residential units to be built. The applicant will also need to consider any potential commercial noise from the four proposed retail units to be located on the ground floor of the development that could also have an impact on existing residents in the vicinity.

I therefore recommend that in order for this section to make an informed comment the applicant should submit a full noise assessment to assess any potential noise impact of the above mentioned noise sources on future and existing residents in the vicinity. The report should include, if appropriate, measures to be applied to mitigate excess noise impact.

The report shall be prepared by a person with appropriate acoustic qualifications and should be with full regard to all relevant guidance including BS8233:2014 - Guidance on Sound Insulation and Noise Reduction for Buildings and BS4142:2014 Methods for rating and assessing industrial and commercial sound."

2.1.3 Acoustics and Noise Ltd were engaged by Property Index Cardiff Ltd to undertake a noise impact assessment for the above proposal to satisfy the comments from Newport City Council.

2.2 Description of Proposed Development

2.2.1 The development proposal seeks planning permission for the conversion of, and extension to, the upper floors of 133 – 135 Commercial Street, Newport for residential use comprising 23 units whilst retaining and refurbishing the 3 No ground floor units for retail occupation.

2.2.2 At this stage, the occupants of the proposed retail unit are unknown, but it is possible that there may be items of plant associated with the proposed use such as chillers, condensers and A/C units and that these may be required to operate 24/7.

2.2.3 The operation of this plant has the potential to impact on the amenity of the nearest residential properties.

2.2.4 The proposed residential units will be in a busy city centre location and will be impacted upon by noise from both the daytime and night time economy.

2.2.5 The proposed layout of the residential units is presented in Appendix 4.

3.0 ASSESSMENT METHODOLOGY

3.1 Relevant Guidance

3.2 As a matter of best practice, this assessment has been undertaken based on the relevant guidance on noise. This includes but not necessarily exclusive to:

3.3 BS 8233 - Guidance on Sound Insulation and Noise Reduction for Buildings [1]

3.3.1 For many common situations, BS 8233 [1] suggests criteria, such as suitable sleeping/resting conditions, and proposes noise levels that normally satisfy these criteria for most people.

3.3.2 The foreword advises that the information detailed in BS 8233 [1] "*…takes the form of guidance and recommendations. It should not be quoted as it were a specification or a code of practice and claims of compliance cannot be made to it.*".

3.3.3 Section 7.7.2 details the guideline values for desirable internal ambient noise levels within dwelling houses, flats and rooms in residential use (when unoccupied) when such properties are exposed to steady external noise sources.

3.3.4 These guideline values range from 35 - 40 dB $L_{Aeq,16hrs}$ during the daytime period and 30 dB $L_{Aeq,8hrs}$ during the night time period as detailed in Table 1 below.

Table 1 – BS 8233 Internal Noise Level Guidelines

Activity	Location	07:00 – 23:00 hrs	23:00 – 07:00 hrs
Resting	Living Room	35 dB $L_{Aeq,16hrs}$	--
Dining	Dining room	40 dB $L_{Aeq,16hrs}$	--
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq,16hrs}$	30 dB $L_{Aeq,8hrs}$

3.3.5 The guidelines also provide scope for relaxing these values by up to 5 dB and still achieve reasonable internal conditions.

3.3.6 The internal noise level in a room is calculated by subtracting the sound reduction performance of the external façade from the noise level outside the room.

3.3.7 It should be noted that the acoustic performance of the building envelope will be reduced in the event windows are opened for ventilation or cooling purposes, typically reducing the insulation to no more than 10 to 15 dB(A).

3.3.8 For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,16hrs}$ with an upper guideline value of 55 dB $L_{Aeq,16hrs}$ which would be acceptable in noisier environments.

3.3.9 It is recognised that these guideline values may not be achievable in all circumstances where development might be desirable. In higher noise areas, a compromise between elevated noise levels and other factors such 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.

3.3.10 The guideline values presented in BS8233 [1], applies to external noise as it affects the internal acoustic environment from sources without a specific character such as road traffic noise.

3.3.11 BS 8233 [1] provides both simple and detailed calculation methods for determining the internal ambient noise levels attributable to the external noise level. These methods are based on those given in BS EN 12354-3 [2].

3.3.12 The indoor sound pressure level is estimated from the measured or calculated outdoor sound pressure level by using the sound level difference of the façade.

3.3.13 The more rigorous calculation method described in BS 8233 [1] uses octave band data to determine the internal noise level and is more appropriate where the external noise may exhibit specific characteristics.

3.3.14 BS 8233 [1] also states in section 7.7.2 that "*…regular individual noise evets can cause sleep disturbance. A guideline value may be set in terms of SEL of* $L_{Amax,F}$ *depending on the character and number of events per night…*"

3.3.15 However, BS 8233 does not quantify what the L_{Amax} guideline value should be and therefore this assessment anticipates that any L_{Amax} criteria will make reference to the value presented in the W.H.O. guidelines [3].

3.4 **Guidelines for Community Noise, W.H.O. [3]**

3.4.1 Community noise is defined as noise emitted from all sources except noise at the industrial workplace.

3.4.2 The effects of noise within dwellings, typically, are sleep disturbance, annoyance and speech interference. During the night time period, the critical effect is sleep disturbance.

3.4.3 For a restful sleep, the W.H.O. guidelines [3] recommend that the indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10 to 15 times per night.

3.4.4 In addition, the Guidelines [3] also state that "*…at night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax} so that people may sleep with the windows open…the noise reduction from outside to inside with the windows partly open is 15dB*".

3.5 **Objective Assessment using BS 4142 [4]**

3.5.1 **General guidance**

3.5.1.1 The Foreword to the standard states "*Response to sound can be subjective and is affected by many factors, both acoustic and non-acoustic. The significance of its impact, for example, can depend on such factors as the margin by which a sound exceeds the background sound level, its absolute level, time of day, and change in the acoustic environment, as well as local attitudes to the source of the sound and the character of the neighbourhood.*"

3.5.1.2 The scope of BS 4142 includes the following guidance "*The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident*".

3.5.1.3 It should be noted that exclusions to the use of the standard is carefully defined as follows

- *"The determination of noise amounting to a nuisance is beyond the scope of this British Standard "and that the*
- *"Sound of an industrial and/or commercial nature does not include sound from the passage of vehicles on public roads and railway systems" also*
- *"The standard is not intended to be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels" and.*
- *"The standard is not applicable to the assessment of low frequency noise"*

Therefore, the consideration of any of the above is outside the scope of this report.

3.5.1.4 The Scope of the standard goes on to state that:

"*This standard is applicable to the determination of the following levels at outdoor locations:*

- *Rating levels for sources of sound of an industrial and/or commercial nature; and*
- *Ambient, background, and residual levels*

For the purposes of:

- *Investigating complaints;*
- *Assessing sound from proposed, new, modified or additional sources(s) of sound of an industrial and/or commercial nature; and*
- *Assessing sound at a proposed new dwellings or premises used for residential purposes.*"

3.5.1.5 The unit of measurement usually used for measuring environmental sound is the A weighted decibel (dB). The "A weighting" is an internationally agreed frequency response, generally similar to that of the human ear, so that measured sound levels correspond reasonably well with what is heard.

3.5.1.6 In most situations, sound levels vary continuously, and it is customary to use a system of percentile values, which enable the noise climate to be described statistically. For example, the L_{A10} is the A-weighted noise level exceeded for 10% of a given time period and in the case of road traffic, for which it is widely used, it provides an indication of typical maximum levels. The L_{A90}, being the noise level exceeded for 90% of the time, represents the typical minimum noise level in an area and is often referred to as the background noise level.

3.5.1.7 Sometimes it is convenient to give a single figure summarising all the sound received by equating it to the equivalent continuous sound level L_{Aeq} in dB, which would contain the same sound energy as the actual fluctuating sound levels.

3.5.1.8 In general, sound is liable to provoke adverse comment whenever its level exceeds, by a certain margin, that of the pre-existing background sound level. Measurement locations are chosen that will give results that are representative of the ambient sound and residual sound at the assessment location(s).

3.5.1.9 Specific, ambient and background sound measurements are usually taken at a height of 1.2m to 1.5m above the ground and under similar conditions to the assessment location(s) and at least 3.5m from any other reflecting surface. Where this is not possible, calculated levels as per an accepted methodology e.g. BS 5288 or ISO 9613-2, can be used.

3.5.2 **Specific Sound Level**

3.5.2.1 The specific sound level in terms of L_{Aeq}, produced by the sound source under investigation, is determined at the assessment location(s) as a discrete entity, distinct and free of other influences contributing to the ambient sound.

3.5.3 **Reference Time Interval**

3.5.3.1 The specific sound level is evaluated over an appropriate reference time interval, T_r defined in the standard as:

- 1 hour during the daytime period (07:00 – 23:00 hours)
- 15 minutes during the night time period (23:00 – 07:00 hours)

3.5.4 **Background Sound Level**

3.5.4.1 The background sound level is discussed in Clause 8.1 in BS 4142 as follows "*The background sound level is an underlying level of sound over a period, T, and might in part be an indication of relative quietness at a given location. It does not reflect the occurrence of transient and/or higher sound level events and is generally governed by continuous or semi-continuous sounds".*

3.5.4.2 And *"…Since the intention is to determine a background sound level in the absence of the specific sound that is under consideration, it is necessary to understand that the background sound level can in some circumstances legitimately include industrial and/or commercial sounds that are present as separate to the specific sound.*

3.5.4.3 BS 4142 [4] gives guidance on the lowest limit to which the background sound level can be measured as follows "*Care is necessary in circumstances where background sound levels are low to ensure that self-generated and electrical noise within the measurement system does not unduly influence reported values, which might be the case if the measured background sound levels are less than 10 dB above the noise floor of the measuring system.".*

3.5.4.4 BS 4142 provides extensive guidance on assessing the representative background sound level advising that "*In practice, there is no "single" background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment should be representative of the period being assessed."*

3.5.4.5 When introducing a new noise-sensitive receptor to an area with extant industrial and/or commercial sound, BS 4142 [4] notes that '*Where a new noise-sensitive receptor is introduced and there is extant industrial and/or commercial sound, it ought to be recognised that the industrial and/or commercial sound forms a component of the acoustic environment. In such circumstances other guidance and criteria in addition to or alternative to this standard can also inform the appropriateness of both introducing a new noise-sensitive receptor and the extent of required noise mitigation*'.

3.5.4.6 The scope of BS 4142 [4] also states that '*The standard is not intended to be applied to derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels*'.

3.5.4.7 In such circumstances it may be more appropriate to determine the indoor sound levels arising from sound levels outside by using the calculation methods detailed in BS 8233 [1].

3.5.4.8 The calculation methods used in BS 8233 [1] utilise octave-band spectrum data to calculate the internal sound levels by consideration of the sound insulation of the building envelope.

3.5.5 **Residual Sound Level**

3.5.5.1 The ambient sound level i.e., all sounds near and far measured without the specific sound level present is termed the residual level. If the residual level is close to the specific sound level, the specific sound level is corrected to account for the addition of the background sound to the specific sound level measured.

3.5.5.2 Where the ambient sound level and the measured specific sound level are within 10dB of each other, then the specific sound level is corrected as follows

$$L_S = 10lg\left(10^{\frac{L_A}{10}} - 10^{\frac{L_R}{10}}\right)$$

where:
L_S is the specific sound level;
L_A is the ambient sound level; and
L_R is the residual sound level.

3.5.5.3 As per the guidance in BS 4142 "*Where it is not possible to determine the specific sound level by measurement of the ambient sound level and the residual sound level at the assessment location(s), for example, because the difference between the ambient sound level and the residual sound level is >3 dB, determine the specific sound level by a combination of measurement and calculation. Report the method of calculation in detail and give the reason for using it.*"

3.5.6 **Correction to Specific Sound for On-Time of Source**

3.5.6.1 If the specific sound is intermittent and either steady or cyclic and the on-time of the source is less than the reference time interval, then the specific sound level corrected for the effect of the residual level determined above is further corrected for the on-time using the correction term:

$$10 \lg \left(\frac{T_o}{T_r} \right)$$

where T_o is the on-time of the specific source

and T_r is the reference time period.

3.5.7 **Specific Sound Acoustic Features Corrections**

3.5.7.1 Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background level.

3.5.7.2 If the source sound has a feature which makes it particularly noticeable, e.g., a tonal or impulsive characteristic, a character correction is added to the measured or calculated specific sound level to obtain the rating level in order to account for its more noticeable nature.

3.5.8 **Rating Level**

3.5.8.1 The correction for any acoustic features present in the sound source is added to the specific sound level to give the rating level $L_{Ar,Tr}$ which is then compared with the background sound level, $L_{A90,T}$, by subtracting the background sound level from the rating level and the significance of impact is assessed.

3.5.9 **Uncertainty**

3.5.9.1 Consideration should be given to the level of uncertainty in the data and associated calculations. Where the level of uncertainty could affect the conclusion, any assessment should take reasonably practicable steps to reduce the level of uncertainty.

3.5.10 **Assessment of Impacts**

3.5.10.1 The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

3.5.10.2 An initial estimate of the impact of the specific sound is normally obtained by subtracting the measured background sound level from the rating level and using the magnitude of this difference to assess the magnitude of impact as summarised in Table 2 below. Typically, the greater this difference, the greater the magnitude of the impact.

Table 2 – BS 4142 Impact Significance Criteria

Rating Level minus Background Sound Level	BS 4142 Significance of Impact
+10 dB	A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context
+5 dB	A difference of around +5 dB or more is likely to be an indication of an adverse impact, depending on the context
≤ 0 dB	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 context.

3.5.10.3 Adverse impacts include, but are not limited to, annoyance and sleep disturbance.

3.5.10.4 It should be noted that not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

3.5.10.5 Following consideration of the context in which the specific sound occurs/will occur, it may be appropriate to modify the initial estimate of the impact.

4.0 IMPACT ASSESSMENT

4.1 **Impact Assessment of Plant Noise as per BS 4142 [4]**

4.1.1 As the details of any plant are unknown, this report calculates the maximum allowable rating level for the plant so that it will have a low impact at any sensitive receptor when assessed as per BS 4142 [4].

4.1.2 The conclusions of this report should be used to inform the M&E design and purchasing decisions for any required plant.

4.1.3 **Assessment Location**

4.1.3.1 The nearest sound sensitive receptor will be located within the residential units on the upper floors of the proposed development.

4.1.3.2 The measurements were conducted at the front elevation overlooking Commercial Street at first floor level.

4.1.4 **Reference Time Interval**

4.1.4.1 It is assumed that the plant associated with the proposed development may be required to operate 24/7.

4.1.4.2 The appropriate reference time period is 15 minutes as defined in BS 4142 [4] and reflects the potential impact during the more sensitive night time period. It follows that if the potential impact is minimised for the night time period then the daytime impact will also be effectively addressed.

4.1.5 **Suitability of Measurement Equipment**

4.1.5.1 BS 4142 [4] gives guidance on the lowest limit to which the background sound level can be measured. The requirement for the measurement equipment is that the measured background sound levels are greater than 10 dB above the inherent noise level of the measuring system.

4.1.5.2 The meter used for the surveys was a BK 2250 which has a specified inherent noise level of 16.6 dB(A) which means that sound levels of equal to or greater than 16.6 + 10 = 27 dB(A) will meet the above criteria.

4.1.5.3 The lowest recorded background sound level during the survey was 37 dB $L_{A90,15\ mins}$. This comfortably exceeds the internal noise floor of the measurement equipment as described above.

4.1.6 **Ambient Sound Level**

4.1.6.1 The plant is not yet operational, so the measurement of the specific sound level was not possible.

4.1.7 **Representative Background Sound Level**

4.1.7.1 This report assesses the representative background sound level by the following statistical method.

4.1.7.2 The sound levels at the survey location are represented by 15-minute samples collected over a continuous 24-hour period. These samples have been sorted into 'value bins' represented by unit dB values over the range 25 – 75 dB. The total value in each 'bin' represents the number of times a 15-minute sample sound level has a value equal to the 'bin' value.

4.1.7.3 So, for example, if the 33dB 'bin' has a value of 14, this indicates that for 14 of the 15-minute periods collected during the 24-hour survey, the sound level measured was 33 dB.

4.1.7.4 The results of this data analysis, using the data samples collected during the night time period only (23:00-07:00), are displayed as an easy to understand histogram shown in Appendix 3.

4.1.7.5 To determine a representative value for the sound levels measured during the night time, we need to describe the survey data in terms of a typical value. This is often described as a measure of 'central tendency'.

4.1.7.6 The term 'central tendency' refers to the "middle" value or perhaps a typical value of the data and is measured using the mean, median or mode.

4.1.7.7 **Preferred Measure of Central Tendency**.

4.1.7.8 When you have a normally distributed set of data you can legitimately use either the mean or the median as your measure of central tendency. In any symmetrical distribution the mean, median and mode are equal.

4.1.7.9 However, when the data is skewed the median is generally considered to be the best representation of the central location or typical value of the data. The more skewed the distribution the greater the difference between the median and the mean and the greater emphasis should be placed on using the median as opposed to the mean.

4.1.7.10 In our analysis of the night time survey data, we have used the median to determine the central tendency of the data and describe the representative noise levels at the survey location.

4.1.7.11 In this case the representative value for the night time background sound level was determined to be 39 dB $L_{A90,15mins}$ (see Appendix 3).

4.1.8 **Residual Sound Level**

4.1.8.1 The plant is not yet operational, so the measurement of the residual sound level was not necessary.

4.1.9 **Acoustic Feature Correction**

4.1.9.1 The plant is not yet operational, so it is not possible to determine any acoustic features.

4.1.10 **Rating Level**

4.1.10.1 BS 4142 [4] requires the acoustic corrections are added to the specific sound level to give the rating levels for each item of plant, $L_{Ar,Tr}$. However, in this case details of any plant are unknown and therefore, a maximum rating level is determined based on the representative baseline background sound level.

4.1.11 **Uncertainty**

4.1.11.1 There is a potential for uncertainty in how representative the measured background sound levels are due to the relatively short survey period. However,

this uncertainty was minimised by undertaking the survey throughout a complete 8-hour night time period and determining a representative value by statistical methods.

4.1.11.2 The uncertainty due to atmospheric effects is minimal due to the short source receiver distance.

4.1.12 **Determination of Maximum Rating Level**

4.1.12.1 BS 4142 [4] states that "*Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact...*".

4.1.12.2 In this case, the representative background sound level was determined to be 39 dB $L_{A90,15mins}$.

4.1.12.3 Therefore, to ensure that the impact from any plant required for the proposed retail units will be low, the plant should be designed with a total maximum rating level not exceeding 39 dB, when assessed at the nearest sensitive receptor, following the procedures in BS 4142 [4].

4.2 **Road Traffic Impact Assessment for Proposed Residential Units**

4.2.1 There is the potential for a noise impact at the proposed residential units from activities associated with both the daytime and night time economy.

4.2.2 Analysis of the audio files collected during the survey, indicate that the acoustic climate at the site is dominated by road traffic travelling along Hill Street and Commercial Street, with additional intermittent noise from passer-bys on the streets below.

4.2.3 For the purposes of this assessment, it is assumed that all habitable rooms with a clear line of site to the road traffic travelling along Hill Street and/or Commercial Street are exposed to the same level of noise as determined from the survey.

4.2.4 There are no external amenity spaces associated with the proposed residential units and therefore, the sensitive receptors will be located within the habitable rooms.

4.3 Assessment Criteria

4.3.1 As this report is intended to accompany a full planning application, noise criteria are not yet available from Newport City Council.

4.3.2 However, given our past experience with similar developments in Newport, we anticipate that any conditions issued by Newport City Council will be based upon those issued for a similar, recent City Centre residential development.

4.3.3 These conditions are influenced by the guideline values published in the WHO Guidelines [3] and BS 8233 [1] and have been interpreted below:

"…details of noise mitigation shall be submitted to ensure the following internal noise levels are achieved – 35 dB(A) Leq 16hours (day) and 30 dB(A) Leq 8hours (night)…"

"…at night (23:00 – 07:00), internal noise levels for single events shall not exceed 45 dB LAmax…"

4.3.4 The above anticipated criteria correspond to the desirable internal ambient noise levels detailed in BS 8233 [1].

4.4 External Noise Levels

4.4.1 As the L_{Amax} criteria applies to the night time only, this assessment only considers mitigation to achieve the night time internal noise criteria. It follows that as the night time criteria are more onerous than the daytime, then any mitigation that is suitable to achieve the night time criteria will also achieve the daytime criteria.

4.4.2 The external noise levels were measured at the façade of front elevation of the building at the first floor of the property (see Appendix 2).

4.4.3 For the purposes of this assessment, it is assumed that the measured noise levels are representative of the noise levels outside all habitable rooms with a clear line of site to activities on Hill Street and Commercial Street. As the road is one way, all road traffic will travel via Hill Street on to Commercial Street and therefore the measured noise levels are representative of all elevations overlooking Hill Street or Commercial Street.

4.4.4 To avoid over specifying the sound mitigation and to align with the 45 dB internal L_{Amax} criteria of no more than 10 to 15 times a night [3], the L_{Amax} data has been analysed and the outlying data has been excluded from the calculations.

4.4.5 In this case, we have assumed that the ten highest data points from the survey data represent ten events with L_{Amax} greater than 45 dB. The eleventh value is used to represent the external noise level for single noise events when determining suitable mitigation (see Appendix 3).

4.4.6 This level has been determined to be 75 dB L_{Amax}. There were only 10 instances of L_{Amax} with levels greater than 75 dB.

4.4.7 The external noise levels used in the calculations refer to free-field noise levels. However, the survey results detailed in this report represent the façade noise level, 1m from the façade.

4.4.8 Levels of noise determined at one metre from the façade should be assumed to be 3dB(A) higher than their corresponding free-field values.

4.4.9 In this case, therefore, the calculated night time façade noise levels are assumed to be 3dB higher than the required free-field levels and should be reduced accordingly.

4.4.10 The external free-field night time noise levels at the front elevation are summarised in Table 3 below.

Table 3 – External Night Time Noise Levels at Habitable Rooms

Description	**$L_{Aeq,t}$ (dB)**	**L_{Amax} (dB)**
Façade Noise Level	55	75
Façade Correction	-3	+3
External Free Field Noise Level	52	72

4.5 Internal Noise Levels, North East and North West Elevations

4.5.1 The internal noise level in a room is calculated by subtracting the sound reduction performance of the external façade from the noise level outside the room.

4.5.2 In this case, the sound insulation performance of the external façade is assumed to be equivalent to the weakest acoustic element which will be the glazing.

4.5.3 **Open Window Ventilation Strategy**

4.5.3.1 Whenever possible, it is desirable to open the windows to provide background ventilation and when partially open windows are relied upon for background ventilation, the sound reduction of the façade is reduced to 15 dB [3].

4.5.3.2 To achieve the anticipated internal noise criteria of 30 dB $L_{Aeq,8hrs}$ with an open window during the night time period, the external noise level would be required to be below 30 + 15 = 45 dB $L_{Aeq,8hrs}$.

4.5.3.3 Following analysis of the results, it is clear that the external noise levels are in excess of 45 dB $L_{Aeq,t}$ during the night time period and an open window ventilation strategy is not suitable for elevations overlooking the road traffic travelling along either Hill Street or Commercial Street.

4.5.4 **Minimum Façade Sound Insulation Performance**

4.5.4.1 Table 4 below details the calculations for the minimum required sound insulation for each of the façades to achieve the anticipated internal ambient noise criteria.

Table 4 – Minimum Façade Sound Insulation Calculations, Front Elevation

	External Free-Field Noise Level	Criteria	Minimum Façade Sound Insulation $R_w + C_{tr}$ (dB)
Daytime $L_{Aeq,16hr}$ (dB)	57	35	22
Night Time $L_{Aeq,8hr}$ (dB)	52	30	22
Night Time L_{Amax} (dB)	72	45	27

4.5.4.2 From the calculations detailed in Table 4 it is clear that the minimum sound insulation performance required is determined from the L_{Amax} values.

4.5.4.3 From Table 4 it can be seen that the sound insulation performance will need to be at least 27 dB $R_w + C_{tr}$.

4.5.4.4 The sound insulation performance is quoted in terms of $R_w + C_{tr}$ which includes a correction to account for the low frequencies attributable to the vehicle movements, including HGV and delivery vehicles, on the street below as detailed in BS EN ISO 717 [5].

4.5.4.5 Manufacturers' data should be used to confirm that the above minimum acoustic performance specification is achieved from the full glazing unit including frames, glazing and any ventilation provision.

4.5.4.6 It is assumed that the glazing solutions are in the closed position to control the noise ingress.

4.5.4.7 All habitable rooms subject to sound mitigation measures will need to be provided with an alternative, effective means of ventilation which must be agreed with Building Control. It is important that any alternative ventilation strategy provides the required levels of ventilation and does not compromise the façade insulation or the resulting internal noise levels.

4.5.4.8 Recommendations for suitable ventilation are outside the scope of this assessment and technical expertise.

4.5.5 **External Noise Levels, South West Elevation**

4.5.5.1 For habitable rooms on the south west elevation, those located at a greater distance from the road will be exposed to reduced noise levels as the distance to the road increases.

4.5.5.2 The minimum acoustic performance for the glazing for habitable rooms that overlook the road traffic travelling along Commercial Street and Hill Street was determined from the night time L_{AFmax} value. The WHO guidelines [3] state that "*…at night, sound pressure levels at the outside façades of the living spaces should not exceed … 60 dB L_{Amax} so that people may sleep with the windows open…'.*

4.5.5.3 The measured external L_{AFmax} was determined to be 72 dB (free-field) at a distance of 2m from the road, which is 12 dB above the WHO guideline value. If we assume that the noise source that generated the L_{AFmax} event was the road traffic, and that the noise propagates as a point source, then at a distance of 8m, the noise level

will be reduced by 20*log(8/2) = 12 dB. For all habitable rooms within 8m of the road, an open window ventilation strategy will not be suitable.

4.5.5.4 With reference to the proposed development plans presented in Appendix 4, all habitable rooms within the south west elevation of plot 135 are located within 8m of the road and the recommended mitigation for habitable rooms overlooking the road traffic along Commercial Street and Hill Street is applicable.

4.5.5.5 The habitable rooms located within the south-west elevation of plots 133 and 134, will be exposed to external noise levels of less than 60 dB L_{AFmax} and the use of open windows to provide background ventilation is suitable for these rooms.

4.5.6 **External Noise Levels, South East Elevation**

4.5.6.1 The habitable rooms within the south-east elevation will be exposed to noise levels lower than 60 dB L_{AFmax} due to the increased distance from the noise source and the significant acoustic shielding from the building itself. The use of open windows to provide background ventilation is suitable for these rooms.

4.6 **Deliveries**

4.6.1 There is the potential for disturbance from deliveries serving the neighbouring retail units. It is anticipated that all deliveries to neighbouring properties will be restricted to Commercial Street. These deliveries will occur during the daytime only.

4.6.2 For the purposes of assessing the noise from any delivery operation a shorter assessment period of 1 hour is chosen to reflect the shorter duration and intermittent nature of the delivery operation.

4.6.3 Analysis of the daytime noise levels at the front of the property indicate that the ambient noise level during the loudest 1-hour period is 60 dB $L_{Aeq,1hour}$ (free-field).

4.6.4 If we assume that the noise from delivery operations result in the highest measured levels then the external noise level from deliveries can be assigned the value 60 dB $L_{Aeq,1hour}$.

4.6.5 During the daytime period, the internal ambient noise criteria is 35 dB $L_{Aeq,1hour}$ which represents the shorter assessment period chosen for the delivery operation.

4.6.6 As in the earlier section, the internal noise level in a room is calculated by subtracting the sound reduction performance of the external façade from the noise level outside the room.

4.6.7 In this instance, we can utilise the above relationship to calculate the minimum sound reduction required from the glazing at any habitable room overlooking a delivery.

4.6.8 The minimum sound reduction performance is calculated as 60 – 35 = 25 dB $R_w + C_{tr}$ dB.

4.6.9 This report has already recommended that a scheme of sound insulation is necessary for the habitable rooms overlooking Commercial Street so that the required internal ambient noise levels can be achieved during the night time.

4.6.10 From Table 4 above, it can be seen that the minimum sound reduction performance from the glazing units was recommended to be at least 27 dB $R_w + C_{tr}$. This is a 2 dB improvement on the minimum required during deliveries and would therefore provide the required internal ambient noise levels during the delivery operation.

4.7 **Impact from Proposed Retail Units**

4.7.1 At this stage, the occupants and usage of the retail units are unknown. It is not possible to assess the impact until the activity noise from the occupants is determined.

4.7.2 The potential impact from any plant associated with the proposed retail units is considered earlier in this report.

4.7.3 Noise from activities within the retail units could potentially impact on the proposed residential properties located on the upper floors and it may be necessary to assess the sound reduction performance of the separating floor between the retail unit and the residential unit above.

4.7.4 Mitigation to the separating floors, if required, will be considered at the detailed design stage.

5.0 CONCLUSIONS

5.1 Plant Noise

5.1.1 The representative background sound level at the site, determined from a 24-hour baseline sound survey, was calculated to be 39 dB $L_{A90,15minutes}$ during the night time period.

5.1.2 BS 4142 [4] states that "*Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact...*".

5.1.3 Therefore, to ensure that the impact from any plant required for the proposed retail units will be low, the plant should be designed with a total maximum rating level not exceeding 39 dB, when assessed at the nearest sensitive receptor, following the procedures in BS 4142 [4].

5.2 Residential Units

5.2.1 The conclusions of this report apply to the proposed development design and are based on anticipated conditions from Newport City Council.

5.2.2 This report has assessed the site and made recommendations for the glazing solutions based upon anticipated conditions which in turn are based on the conditions for a similar development within the City Centre.

5.2.3 The external noise levels at the site require that the glazing on the north east and north west elevations of the proposed development will need to be in the closed position to effectively mitigate noise ingress.

5.2.4 The glazing on the south west elevation of Plot 135 is also required to be in the closed position to effectively mitigate noise ingress.

5.2.5 With regard to the noise impact during deliveries to neighbouring retail units, the required internal ambient noise levels within all habitable rooms overlooking Commercial Street and Hill Street can be achieved with the recommended glazing in the closed position.

5.3 Impact from Proposed Retail Units

5.3.1 At this stage, the occupants and usage of the retail units are unknown. It is not possible to assess the impact until the activity noise from the occupants is determined.

5.3.2 Noise from activities within the retail units could potentially impact on the proposed residential properties located on the upper floors and it may be necessary to assess the sound reduction performance of the separating floor between the retail unit and the residential unit above.

5.3.3 Mitigation to the separating floors, if required, will be considered at the detailed design stage.

6.0 RECOMMENDATIONS

6.1 The conclusions of this report should be used to inform the M&E design and purchasing decisions to ensure that the impact from any plant, required for the proposed retail units on the ground floor, will be low when assessed at the nearest sensitive receptors.

6.2 Mitigation for all habitable rooms within the North East and North West elevations and habitable rooms within the South West elevation of Plot 135 should comprise glazing units that provides a minimum sound reduction performance of 27 dB $R_w + C_{tr}$.

6.3 Manufacturers' data should be used to confirm that the above minimum acoustic performance specification is achieved from the full glazing unit including frames, glazing and any ventilation provision.

6.4 It is assumed that the glazing solutions are in the closed position to control the noise ingress.

6.5 All habitable rooms subject to sound mitigation measures will need to be provided with an alternative, effective means of ventilation which must be agreed with Building Control. It is important that any alternative ventilation strategy provides the required levels of ventilation and does not compromise the façade insulation or the resulting internal noise levels.

6.6 Recommendations for suitable ventilation are outside the scope of this assessment and technical expertise.

P.A.T. 10/10/19
M.Sc., I.Eng., M.I.O.A., M.Inst.SCE., M.A.E.S.

Appendix 1
Survey Details

A1.0 SURVEY DETAILS

Background and Ambient Sound Survey

A1.1.1 The meter was calibrated at the start of the measurement procedure and checked after each set of measurements. No significant deviation i.e. > 0.5 dB was recorded.

A1.1.2 The survey commenced at 13:00 hours on 2nd October 2019 for a continuous 24-hour period.

A1.1.3 Weather conditions: 50% cloud cover, 15°C, dry, occasional slight intermittent breezes <2.5ms^{-1}.

A1.2 **Measurement Procedure:**

A1.2.1 The meter was located in a weather-proof container and powered with heavy duty rechargeable batteries. The microphone was located on a bracket extending 1m from the front façade of the existing building at first floor level. The microphone was inside an approved weather-proof microphone housing.

A1.2.2 The meter was adjusted to log and store L_{Aeq}, L_{A90} and L_{AFmax} in 15-minute periods for the duration of the survey (see Table 6).

A1.2.3 On completion of the survey, the data was downloaded to a computer for further analysis.

A1.2.4 The analysis consisted of using B&K 7820 Evaluator software to divide the results into the time periods 07:00-23:00 and 23:00-07:00.

A1.2.5 The data is further analysed to determine a representative value for the background noise using statistical methods to determine the median value. The data is presented in the results section.

A1.3 **Subjective Impressions**

A1.3.1 The acoustic environment during the survey was dominated by road traffic, intermittent construction activity and intermittent shopper noise from the street below.

A1.4 Equipment Used:

Table 5 – Equipment Used, Front Elevation

ITEM	Serial No	UKAS Calibration Certificate Date (if applicable)
(ANL-M4) B&K 2250 Handheld Analyser	2567736	Certificate: 15417 Date: 16/05/18
(ANL-C4) B&K 4231 Calibrator	2567363	Certificate: 15416 Date: 15/05/18

Table 6 – Meter Details, Front Elevation

Instrument:		2250
Application:		BZ7224 Version 4.7.5
Start Time:		10/02/2019 10:54:39
End Time:		10/03/2019 13:36:42
Elapsed Time:		1.02:42:03
Bandwidth:		1/3-octave
Max Input Level:		141.15
	Time	Frequency
Broadband (excl. Peak):	FSI	AZ
Broadband Peak:		A
Spectrum:	FS	Z
Instrument Serial Number:		2567736
Microphone Serial Number:		2560565
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field
Calibration Time:		10/02/2019 10:48:30
Calibration Type:		External reference
Sensitivity:		48.84 mV/Pa

Appendix 2
View of Measurement Position

A2.0 VIEW OF MEASUREMENT POSITION

Figure 1 – Measurement Position

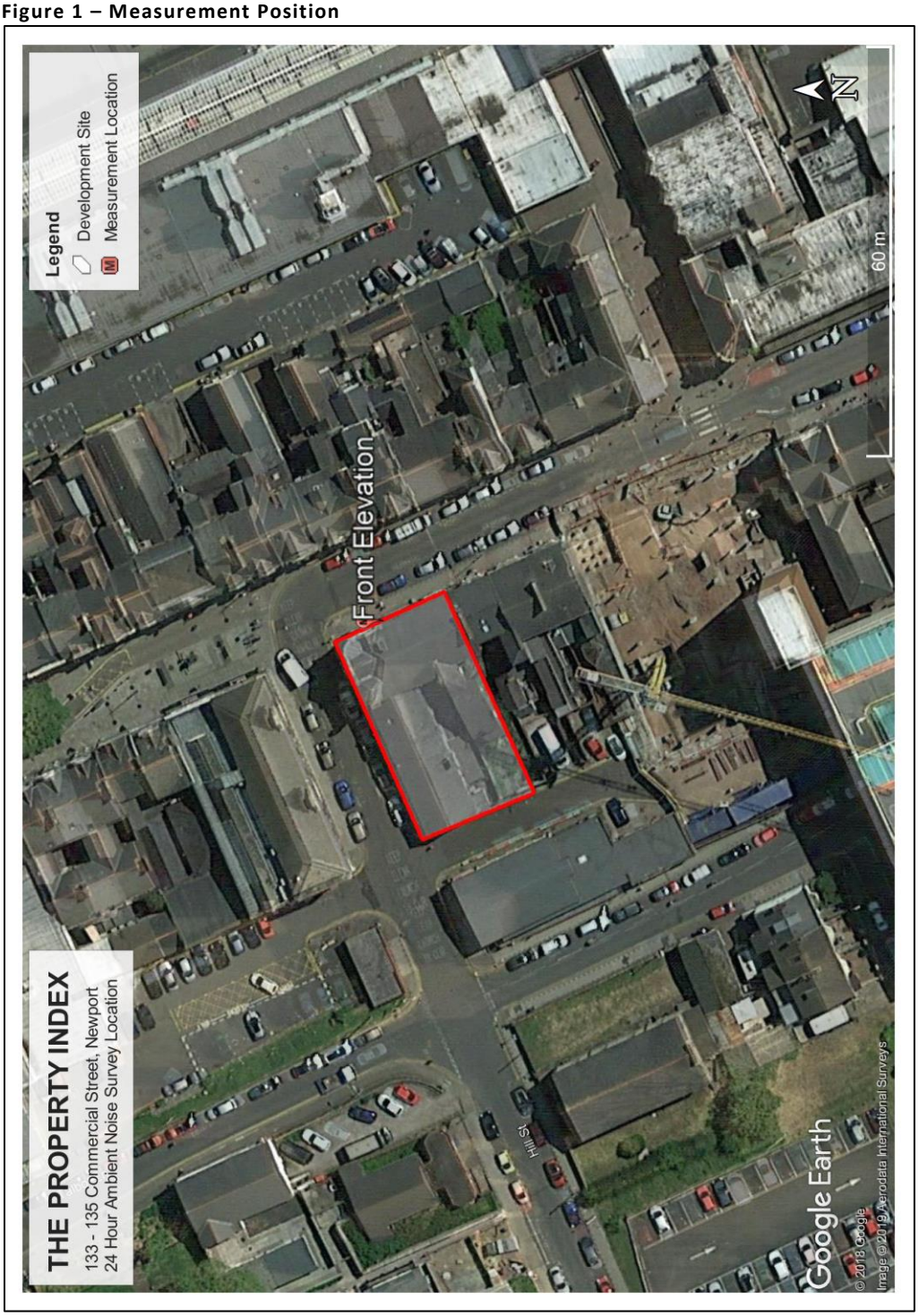


Figure 2 – View of Equipment Location, Front Elevation

Appendix 3
Survey Results

A3.0 SURVEY RESULTS

Table 7 – Summary of Survey Results (Façade Noise Levels, Front Elevation)

Front Elevation	Period	Duration, t	$L_{Aeq,t}$ (dB)	$L_{AF90,t}$ (dB)	L_{AFmax} (dB)
Daytime	07:00 – 23:00	16:00	60.4	45.6	99.1
Night Time	23:00 – 07:00	08:00	54.5	38.4	87.3

Table 8 – Daytime Façade Noise Levels, Front Elevation (07:00 – 23:00)

Start date	Start time	$L_{Aeq,15mins}$ (dB)	$L_{AF90,15mins}$ (dB)	L_{AFmax} (dB)
03/10/2019	07:00:00	65.6	45.2	86.6
03/10/2019	07:15:00	56.9	46.1	74.1
03/10/2019	07:30:00	57.7	44.9	71.9
03/10/2019	07:45:00	60.6	46.3	76.5
03/10/2019	08:00:00	60.6	46.4	83.5
03/10/2019	08:15:00	60.4	47.1	82.6
03/10/2019	08:30:00	58.9	47.4	75.0
03/10/2019	08:45:00	60.6	49.3	78.7
03/10/2019	09:00:00	66.2	50.8	84.4
03/10/2019	09:15:00	61.9	48.3	78.8
03/10/2019	09:30:00	58.7	52.0	75.4
03/10/2019	09:45:00	59.1	50.2	84.8
03/10/2019	10:00:00	58.7	52.4	76.7
03/10/2019	10:15:00	57.6	49.2	79.9
03/10/2019	10:30:00	61.9	50.8	82.4
03/10/2019	10:45:00	60.6	50.5	77.7
03/10/2019	11:00:00	61.7	52.4	79.1
03/10/2019	11:15:00	63.3	52.5	88.2
03/10/2019	11:30:00	60.6	52.8	80.1
03/10/2019	11:45:00	61.5	54.7	74.9
03/10/2019	12:00:00	60.8	53.6	82.2
03/10/2019	12:15:00	60.0	51.8	75.3
03/10/2019	12:30:00	58.5	52.5	74.4
03/10/2019	12:45:00	60.5	54.0	81.7
03/10/2019	13:00:00	60.4	53.1	81.8
03/10/2019	13:15:00	60.7	54.3	79.6
03/10/2019	13:30:00	60.6	52.6	79.3
03/10/2019	13:45:00	60.2	53.5	76.3
03/10/2019	14:00:00	59.2	52.1	78.0
03/10/2019	14:15:00	62.8	52.6	85.2
03/10/2019	14:30:00	61.0	52.7	76.1
03/10/2019	14:45:00	60.3	52.4	83.0
03/10/2019	15:00:00	59.2	49.5	76.5

Start date	Start time	$L_{Aeq,15mins}$ (dB)	$L_{AF90,15mins}$ (dB)	L_{AFmax} (dB)
03/10/2019	15:15:00	58.9	51.1	80.7
03/10/2019	15:30:00	66.2	50.1	99.1
03/10/2019	15:45:00	60.1	52.2	77.6
03/10/2019	16:00:00	59.7	51.3	74.2
03/10/2019	16:15:00	60.0	52.1	74.3
03/10/2019	16:30:00	60.1	52.9	81.7
03/10/2019	16:45:00	59.5	50.8	79.1
03/10/2019	17:00:00	62.0	53.2	83.5
03/10/2019	17:15:00	62.4	52.2	82.3
03/10/2019	17:30:00	62.7	55.7	81.7
03/10/2019	17:45:00	60.1	49.6	78.6
03/10/2019	18:00:00	59.4	48.2	79.2
03/10/2019	18:15:00	57.1	44.6	80.0
03/10/2019	18:30:00	58.6	45.7	75.7
03/10/2019	18:45:00	57.5	44.8	74.6
03/10/2019	19:00:00	62.4	43.4	93.3
03/10/2019	19:15:00	55.9	42.5	82.6
03/10/2019	19:30:00	56.5	42.0	71.7
03/10/2019	19:45:00	61.8	43.9	89.5
03/10/2019	20:00:00	57.9	43.1	77.3
03/10/2019	20:15:00	58.2	42.7	79.3
03/10/2019	20:30:00	54.4	41.9	70.9
03/10/2019	20:45:00	54.0	41.4	72.9
03/10/2019	21:00:00	56.9	43.9	75.7
03/10/2019	21:15:00	58.5	47.0	84.9
03/10/2019	21:30:00	54.9	45.2	74.0
03/10/2019	21:45:00	51.7	46.0	69.1
03/10/2019	22:00:00	54.0	43.1	76.9
03/10/2019	22:15:00	63.0	42.8	87.6
03/10/2019	22:30:00	53.9	42.5	68.9
03/10/2019	22:45:00	48.5	42.4	69.8

Table 9 – Night Time Façade Noise Levels, Front Elevation (23:00 – 07:00)

Start date	Start time	$L_{Aeq,15mins}$ (dB)	$L_{AF90,15mins}$ (dB)	L_{AFmax} (dB)
02/10/2019	23:00:00	52.7	40.6	75.4
02/10/2019	23:15:00	58.8	42.6	83.4
02/10/2019	23:30:00	59.3	43.4	87.3
02/10/2019	23:45:00	55.2	39.4	75.6
03/10/2019	00:00:00	48.8	39.4	69.4
03/10/2019	00:15:00	50.7	38.6	70.5
03/10/2019	00:30:00	47.3	38.9	68.8
03/10/2019	00:45:00	45.8	39.4	62.8
03/10/2019	01:00:00	49.8	39.3	66.7
03/10/2019	01:15:00	50.9	38.9	70.7
03/10/2019	01:30:00	40.3	38.9	51.8
03/10/2019	01:45:00	38.9	37.4	57.4
03/10/2019	02:00:00	48.0	37.9	70.9
03/10/2019	02:15:00	52.1	38.1	79.6
03/10/2019	02:30:00	49.4	37.9	69.7
03/10/2019	02:45:00	52.1	38.7	76.6
03/10/2019	03:00:00	41.1	38.7	63.3
03/10/2019	03:15:00	49.7	38.5	68.4
03/10/2019	03:30:00	52.1	37.2	75.3
03/10/2019	03:45:00	49.2	37.4	69.9
03/10/2019	04:00:00	41.5	37.5	62.3
03/10/2019	04:15:00	46.4	38.4	69.0
03/10/2019	04:30:00	48.5	38.3	71.2
03/10/2019	04:45:00	44.5	38.6	64.2
03/10/2019	05:00:00	51.3	39.1	73.8
03/10/2019	05:15:00	48.7	40.1	68.9
03/10/2019	05:30:00	59.9	42.9	82.9
03/10/2019	05:45:00	55.7	42.8	71.9
03/10/2019	06:00:00	55.6	42.6	79.1
03/10/2019	06:15:00	56.8	44.1	74.6
03/10/2019	06:30:00	55.7	46.1	74.6
03/10/2019	06:45:00	64.2	44.3	81.2

Table 10 – Analysis of L_{Amax} Events (Ranked Highest to Lowest), Front Elevation

id	Start date	Start time	L_{AFmax} (dB)
1	02/10/2019	23:30:00	87.3
2	02/10/2019	23:15:00	83.4
3	03/10/2019	05:30:00	82.9
4	03/10/2019	06:45:00	81.2
5	03/10/2019	02:15:00	79.6
6	03/10/2019	06:00:00	79.1
7	03/10/2019	02:45:00	76.6
8	02/10/2019	23:45:00	75.6
9	02/10/2019	23:00:00	75.4
10	03/10/2019	03:30:00	75.3
11	03/10/2019	06:15:00	74.6
12	03/10/2019	06:30:00	74.6
13	03/10/2019	05:00:00	73.8
14	03/10/2019	05:45:00	71.9
15	03/10/2019	04:30:00	71.2
16	03/10/2019	02:00:00	70.9
17	03/10/2019	01:15:00	70.7
18	03/10/2019	00:15:00	70.5
19	03/10/2019	03:45:00	69.9
20	03/10/2019	02:30:00	69.7
21	03/10/2019	00:00:00	69.4
22	03/10/2019	04:15:00	69.0
23	03/10/2019	05:15:00	68.9
24	03/10/2019	00:30:00	68.8
25	03/10/2019	03:15:00	68.4
26	03/10/2019	01:00:00	66.7
27	03/10/2019	04:45:00	64.2
28	03/10/2019	03:00:00	63.3
29	03/10/2019	00:45:00	62.8
30	03/10/2019	04:00:00	62.3
31	03/10/2019	01:45:00	57.4
32	03/10/2019	01:30:00	51.8

Figure 3 – Representative Night Time Background Sound Level Analysis

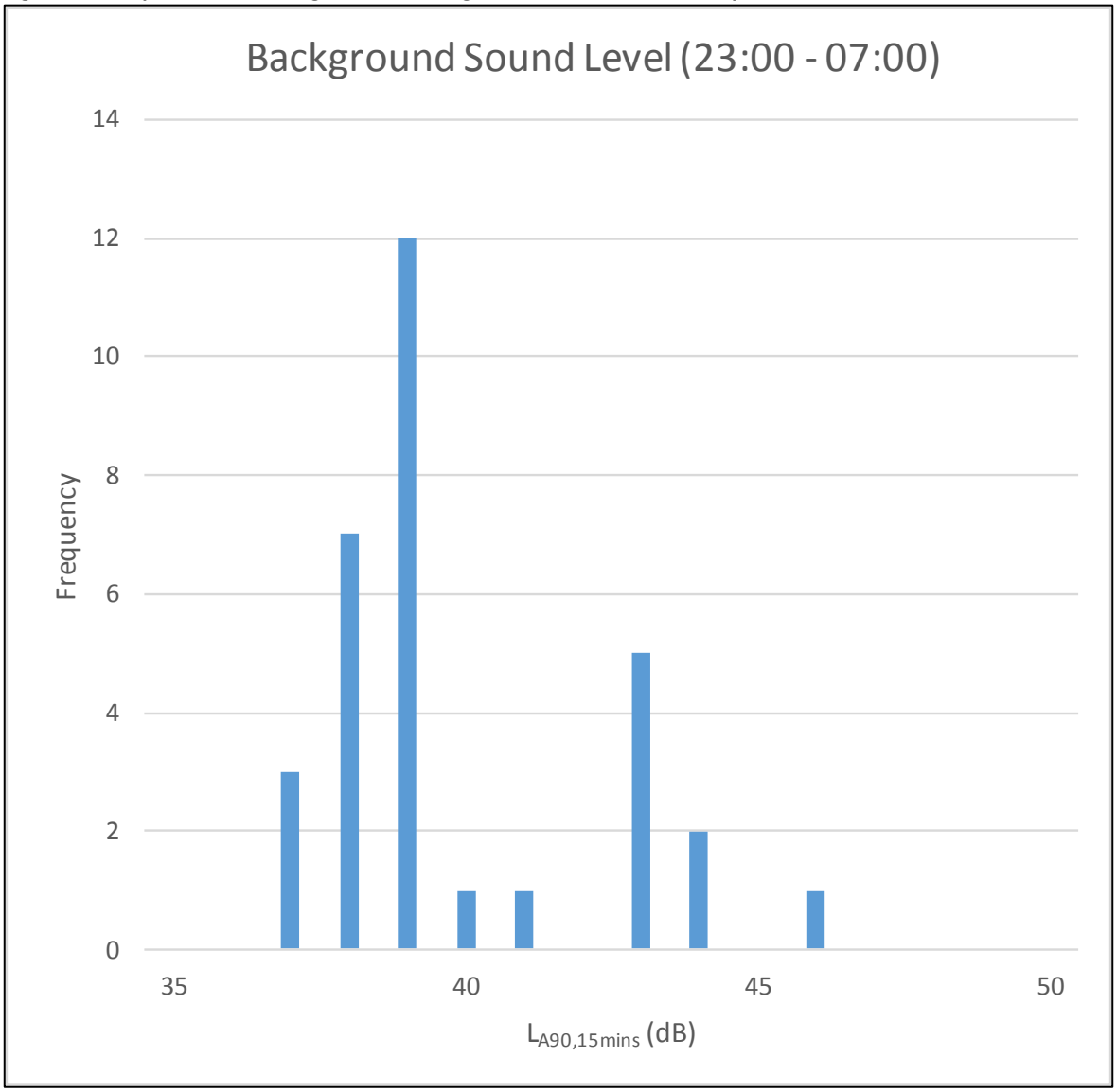


Table 11 – Statistical Analysis of Night Time Background Sound Level Frequency Distribution

Period	Minimum $L_{A90,15\ mins}$ (dB)	Maximum $L_{A90,15\ mins}$ (dB)	Mean Value $L_{A90,15\ mins}$ (dB)	Median Value $L_{A90,15\ mins}$ (dB)	Modal Value $L_{A90,15\ mins}$ (dB)
Night Time (23:00 – 07:00)	37	46	40	39	39

Appendix 4
Proposed Development Drawings

A4.0 PROPOSED DEVELOPMENT DRAWINGS

Figure 4 – Proposed First Floor Layout

Figure 5 – Proposed North East Elevation

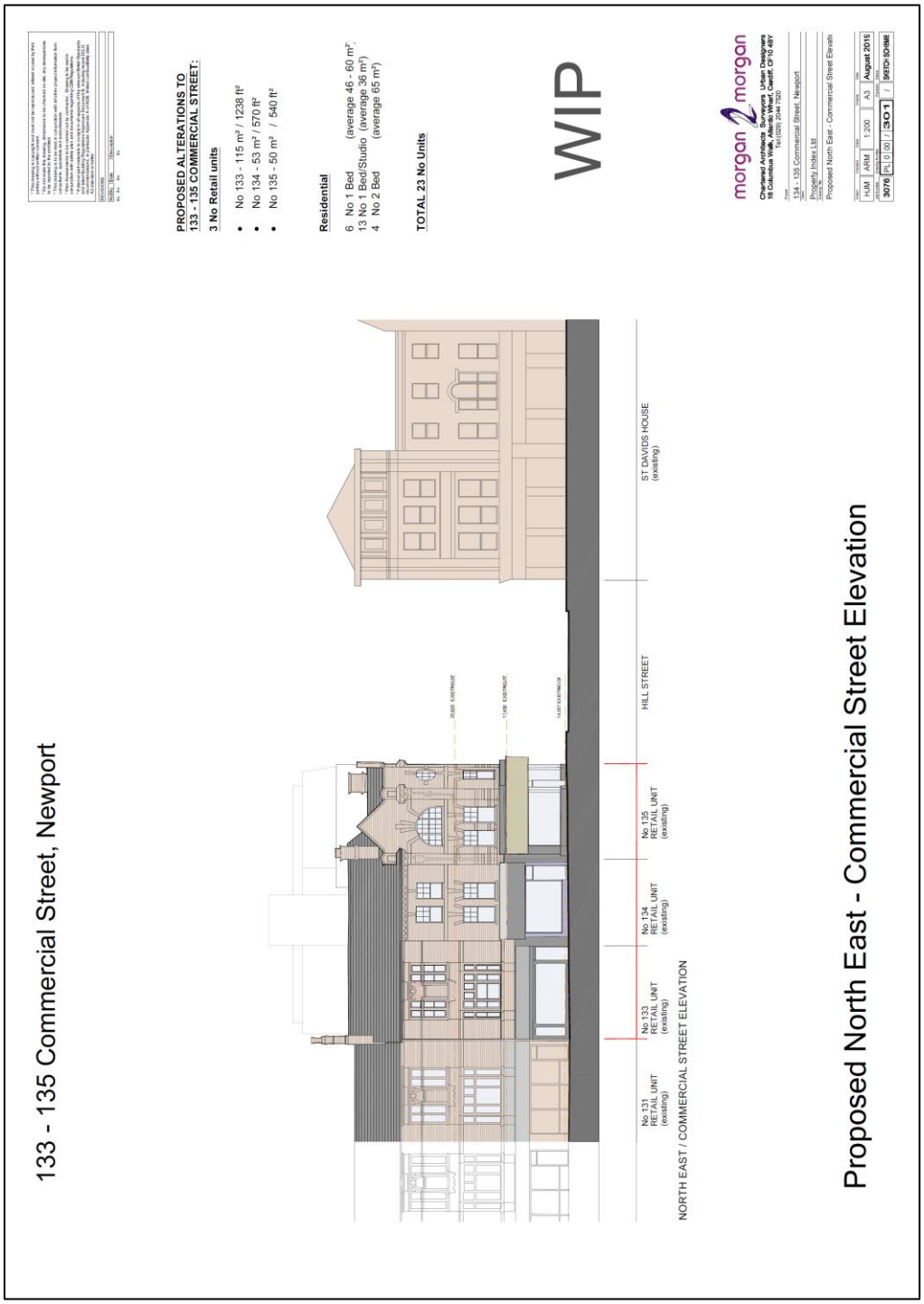


Figure 6 – Proposed South West Elevation

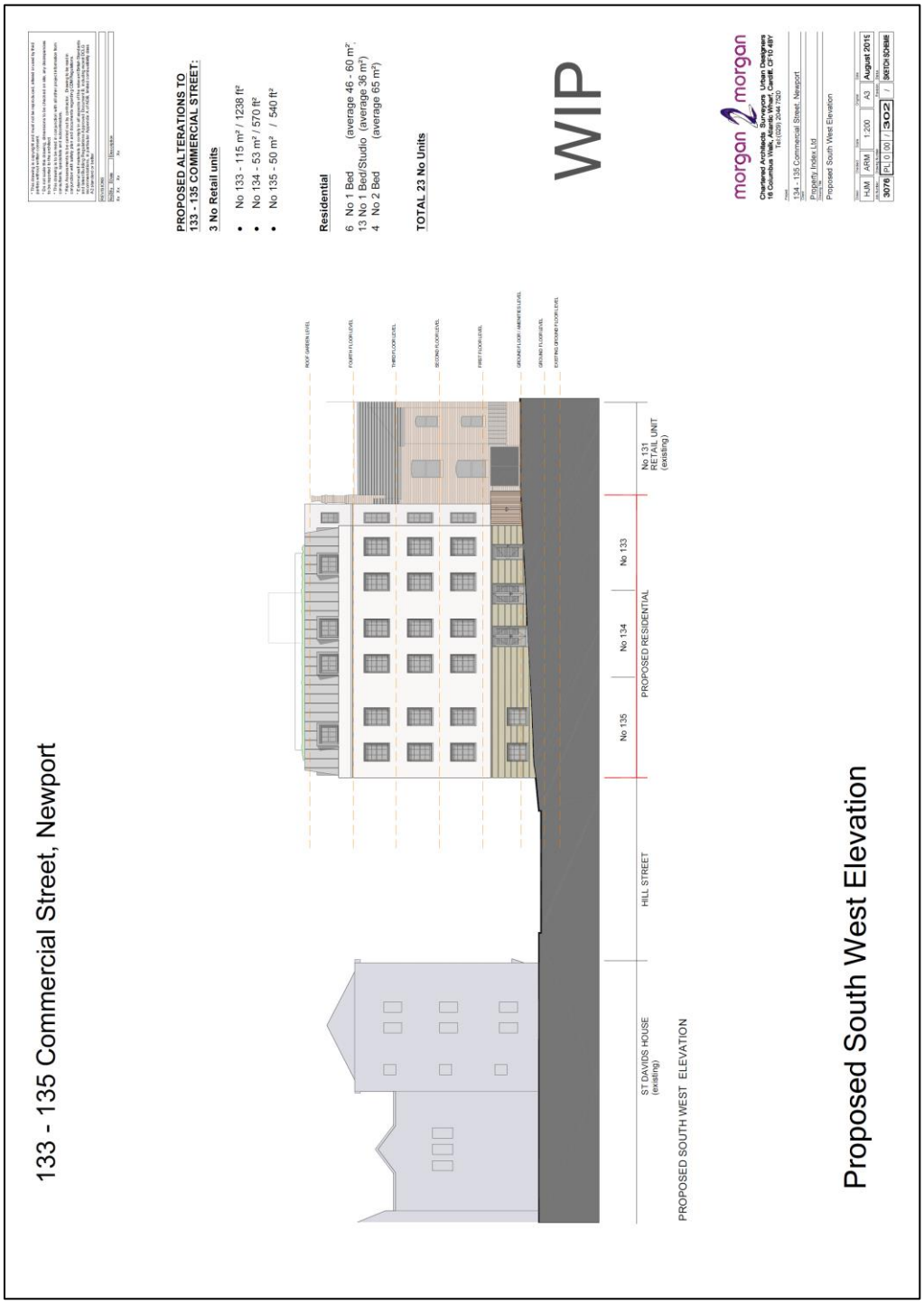
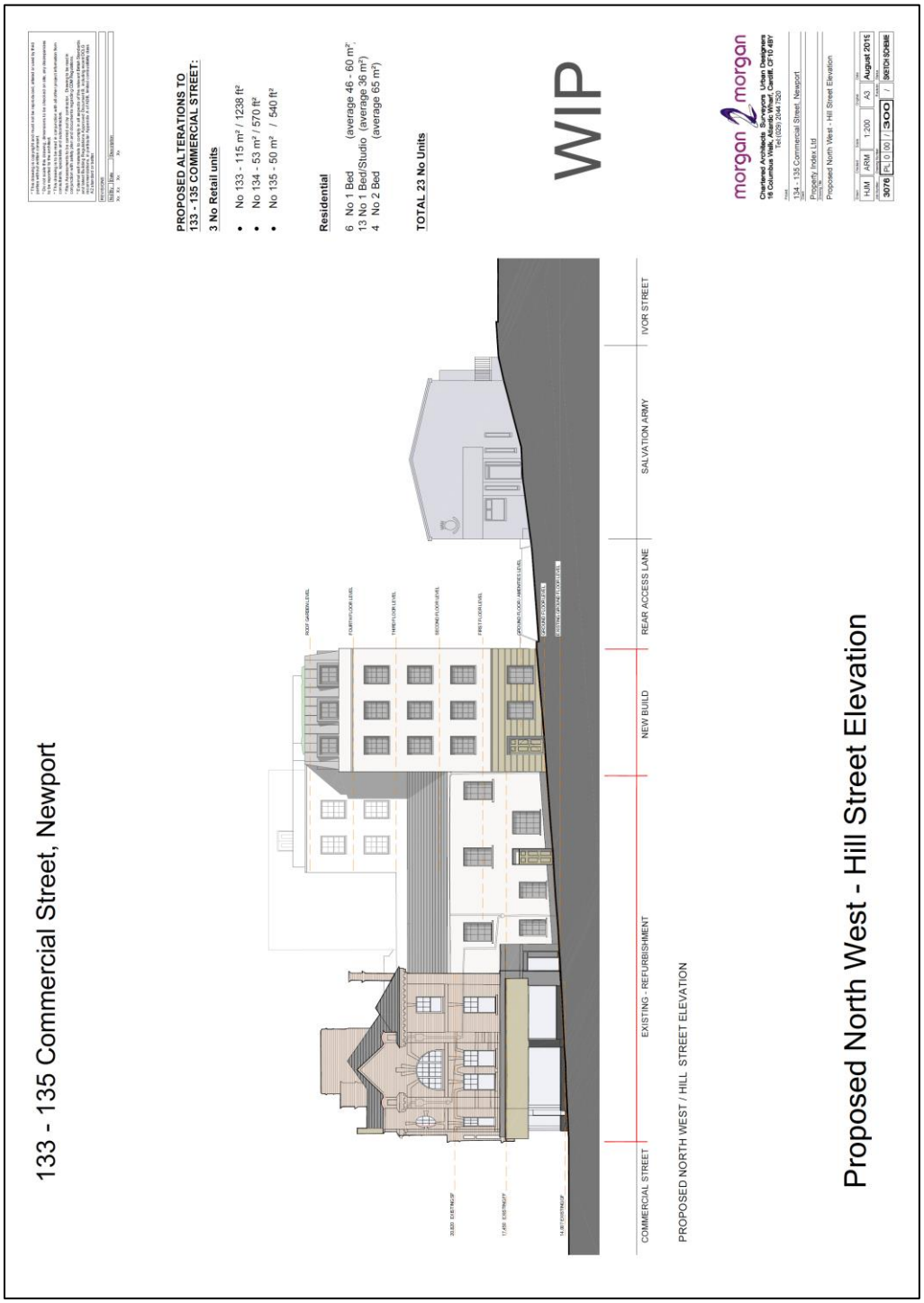


Figure 7 – Proposed South East Elevation

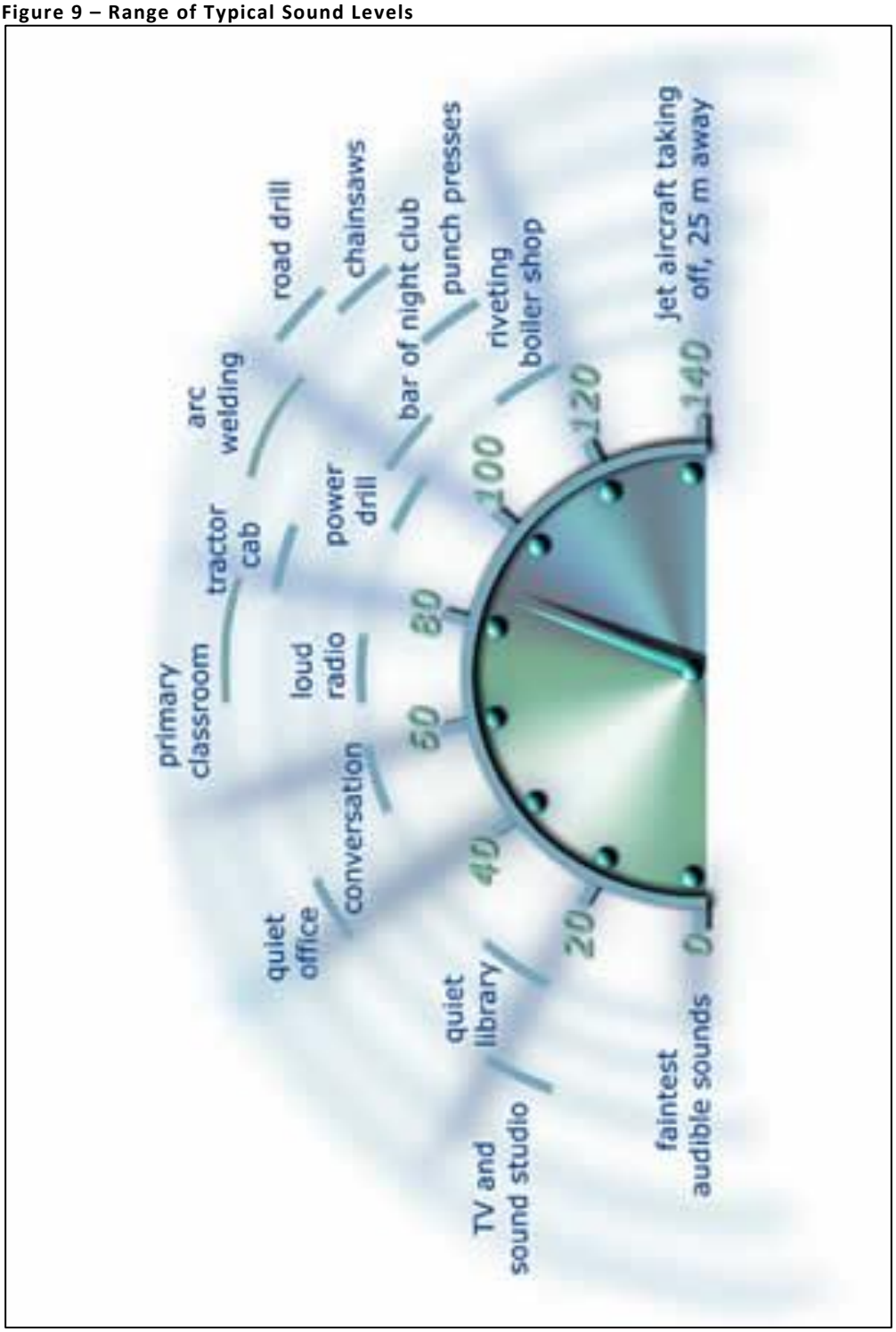
Figure 8 – Proposed North West Elevation



Appendix 5
Range of Typical Sound Levels

A5.0 RANGE OF TYPICAL SOUND LEVELS

Figure 9 – Range of Typical Sound Levels



Appendix 6
Glossary of Acoustic Terms

A6.0 GLOSSARY OF ACOUSTIC TERMS

A6.1 **Acoustic environment:**

Sound from all sound sources as modified by the e nvironment [BS ISO 12913-1:2013]

A6.2 **Ambient sound:**

Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far

NOTE The ambient sound comprises the residual sound and the specific sound when present.

A6.3 **Ambient sound level, $L_A = L_{Aeq,T}$:**

The equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, *T*

NOTE the ambient sound level is a measure of the residual sound and the specific sound when present.

A6.4 **Background sound level, $L_{A90,T}$:**

A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, *T*, measured using time weighting F and quoted to the nearest whole number of decibels

A6.5 **Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$:**

The value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t_2 - t_1$, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{Aeq,T} = 10lg\left\{\left(\frac{1}{T}\right)\int_{t_1}^{t_2}\left[\frac{p_A(t)^2}{{p_0}^2}\right]dt\right\}$$

where:

p_0 is the reference sound pressure (20 µPa); and

$p_A(t)$ is the instantaneous A-weighted sound pressure (Pa) at time t

NOTE The equivalent continuous A-weighted sound pressure level is quoted to the nearest whole number ofdecibels.

A6.6 **Measurement time interval, T_m:**

Total time over which measurements are taken

NOTE This may consist of the sum of a number of non-contiguous, short-term measurement time intervals.

A6.7 **Rating level, $L_{Ar,Tr}$:**

Specific sound level plus any adjustment for the characteristic features of the sound

A6.8 **Reference time interval, T_r:**

Specified interval over which the specific sound level is determined

NOTE this is 1 h during the day from 07:00 h to 23:00 h and a shorter period of15 min at night from 23:00 h to 07:00 h.

A6.9 **Residual sound:**

Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound

A6.10 **Residual sound level, $L_r = L_{Aeq,T}$:**

Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T

A6.11 **Specific sound level, $L_s = L_{Aeq,Tr}$:**

Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r

A6.12 **Specific sound source:**

Sound source being assessed

A6.13 **A-weighting:**

Normal hearing covers the frequency (pitch) range from about 20 Hz to 20,000 Hz but sensitivity is greatest between about 500 Hz and 5,000 Hz. The 'A-weighting' is an electrical circuit built into noise meters to approximate this characteristic of human hearing.

A6.14 **Decibel (dB):**

The logarithmic measure of sound level. 0dB (A) is the threshold of normal hearing. 140 dB (A) is the level at which instantaneous damage to hearing is caused. A change of 1 dB is detectible only under laboratory conditions.

A6.15 **dB(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(A) broadly agree with an individual's assessment of loudness. A change of 3 dB (A) is the minimum perceptible under normal conditions and a change of 10 dB(A) corresponds roughly to doubling or halving the loudness of a sound.

A6.16 **Free Field:**

A sound field in which no significant sound reflections occur.

A6.17 **L_{Amax}:**

The maximum 'A-weighted' level of sound recorded during a sound event. The time weighting used (fast or Slow) should be stated.

A6.18 **Tonality**:

The degree to which a sound contains audible pure tones. Broadband sound (across a wider range of frequencies) is generally less annoying than sound with identifiable tones.

A6.19 **Frequency:**

The number of cycles per second of a vibration usually expressed in units of Hertz, Hz

A6.20 **Hertz:**

Unit of frequency, equal to one cycle per second. Frequency determines the pitch of a sound.

Appendix 7
References

A7.0 REFERENCES:

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4 BS 4142:2014+A1:2019, " Methods for rating and assessing industrial and commercial sound", British Standards Institution 2019

5 BS EN ISO 717-1:1997, 'Acoustics - Rating of sound insulation in buildings and of building elements, Part 1: Airborne sound insulation', British Standards