Philip Dunbavin Acoustics Ltd
3 Bridgewater Court
Barsbank Lane
Lymm
WA13 0ER

ACOUSTIC CONSULTANTS

NOISE IMPACT ASSESSMENT

KIRKLEE HOUSE, MARKET STREET, HUDDERSFIELD

REPORT REFERENCE NO. J004669-7414-DH-02

MAY 2024

Tel: 01925 759380 Email: enquiries@pdaltd.com

Registered Number 2302847 England
Registered Office: 3 Bridgewater Court, Barsbank Lane, Lymm WA13 0ER

Document Control Sheet

Details of Assessment	
Client	C49 Architecture
Document Title	Noise Impact Assessment – Kirklee House, Market Street, Huddersfield
Report Reference	J004669-7414-DH-02

Client Address:	Company Address:
23 D Woodhead Road Holmfirth HD9 2JU	PDA Ltd 3 Bridgewater Court Barsbank Lane Lymm Cheshire WA13 0ER

Issue	Date	Author	Remark	Status
01	15/11/2023	David Hible BA(Hons) AMIOA	Initial	Issued
02	10/05/2024	David Hible BA(Hons) AMIOA	Ground Floor Unit Assessment	Current

	Name	Position
Prepared By	David Hible BA(Hons) AMIOA	Consultant
Checked By	Chris Wright BSc (Hons) MIOA	Consultant

This report has been prepared based upon a scope of works and associated resources agreed between the client and Philip Dunbavin Acoustics Ltd (PDA). This report has been prepared with all reasonable skill, care and diligence and has been based upon the interpretation of data collected. This has been accepted in good faith as being accurate and valid at the time of the collection. This report has been based solely on the specific design assumptions and criteria stated herein.

CONTENTS

1.0 SUMMARY

PDA Ltd was commissioned by C49 Architecture to carry out a noise impact assessment for the proposed development at Kirklee House, Market Street, Huddersfield. The proposed development consists of the conversion of an existing 9 storey office block into student accommodation. It is understood that there is to be 99 no. studio apartments across floors 1 to 9 and 8 no. penthouses across newly formed floors 10 and 11. There is to be a ground floor commercial unit with a study space, gym and students lounge to the basement.

A noise level survey has been undertaken at the site representative of daytime and night-time hours. The local noise climate to the north and east of site is dominated by road traffic from Market Street during day and night-time hours. To the west and south of site the noise climate is dominated by road traffic noise from Market Street and distant traffic noise from the A62. During the evening and night-time periods the noise climate is dominated by entertainment noise from the adjacent entertainment premises.

Based upon the measured and predicted noise levels, calculations have been undertaken for the studio apartments and penthouses to evaluate the internal noise levels. Recommendations are given for glazing, ventilation and building façade elements to meet the internal noise level requirements of good practice guidance given in BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings. Calculations suggest that the noise level criteria of BS8233:2014 can be achieved within the proposed accommodation. Further to this, guidance has been followed from Section 5 of the Kirklees Council – Noise Design Advice which considers internal noise ratings in order to protect future occupants from entertainment noise.

An assessment has been carried out of the proposed ground floor commercial space to ensure that the possible noise levels do not impact on existing and proposed residential receivers. In addition, noise limits have been provided for any proposed plant associated with the ground floor commercial space.

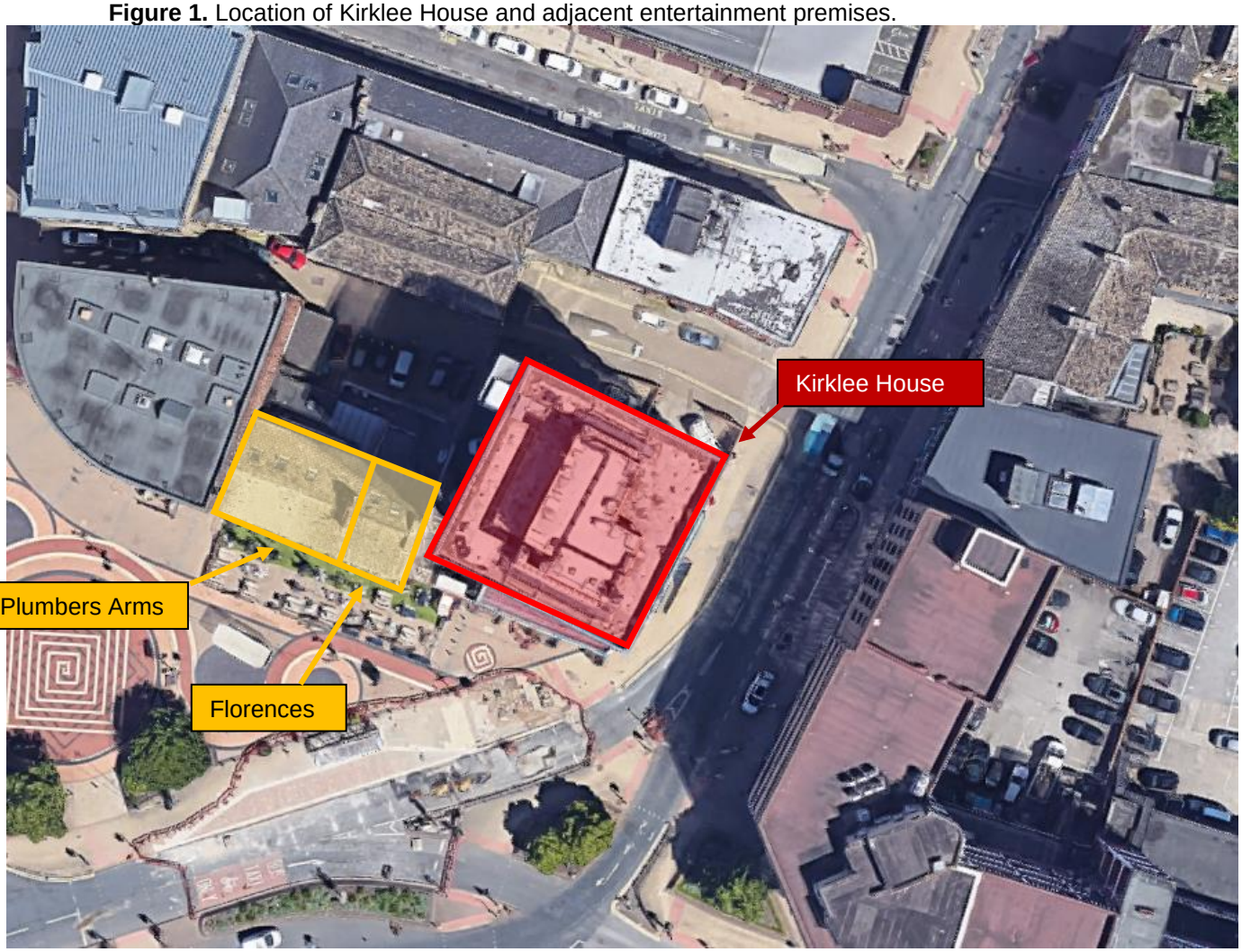
2.0 SITE DESCRIPTION

The proposed development consists of the conversion of an existing 9 storey office block into student accommodation. It is understood that there is to be 99 no. studio apartments across floors 1 to 9 and 8 no. penthouses across newly formed floors 10 and 11. There is to be a ground floor commercial unit with a study space, gym and students lounge to the basement.

The site is located within the centre of Huddersfield inside of the A62 ring road. Market Street runs directly to the east of site with Threadneedle Street to the north boundary. There are a number of commercial premises surrounding the development, with Class A4 use premises (Plumbers Arms, Florences Cocktail Bar) bordering directly to the south west.

An aerial image is presented below which outlines the location of the site.

Figure 1. Location of Kirklee House and adjacent entertainment premises.



3.0 NOISE ASSESSMENT CRITERIA

3.1 Kirklees Council – Noise Design Advice

As there are understood to be a number of Class A4 (drinking establishment premises) in close proximity of site, we would highlight the guidance given within Kirklees Council 'Noise Design Advice' document published in May 2007.

3.1.1 New noise sensitive premises near to places of entertainment

Where a development proposes to introduce new noise sensitive dwellings within the vicinity of places of entertainment, it is stipulated within the Kirklees Council document under Section 5 that:

'Developers should assess the likely impact of the entertainment premises on the noise environment. The residential premises must be designed to ensure that music and associated noise is inaudible inside any residential premises in the vicinity.

The minimum acceptable standard is-

5.1.1 NR 20 in bedrooms (23:00 to 07:00)

5.1.2 NR 25 in all habitable rooms (07:00 to 23:00)

5.1.3 All indoor levels shall be taken with windows open or closed (which ever makes the music appear louder) or with alternatively provided acoustic ventilation over and above "background" ventilation.

5.1.4 Noise Rating curves should be measured as a 15 minute linear L_{eq} at the octave band centre frequencies of 31.5 Hz to 8 kHz.

5.1.5 Other noise sources from the places of entertainment, such as air conditioning plant and kitchen odour extraction systems shall all be treated as industrial development and scenario 3 is acceptable.'

We would suggest that as the Plumbers Arms and Florences Cocktail Bar are understood to have live and pre-recorded music during their opening hours, they may be considered as places of entertainment and as such the above criteria should apply.

3.2 National Planning Policy Framework

National Planning Policy is guided by the National Planning Policy Framework (NPPF) updated in September 2023. With regard to Noise the Framework states the following;

Planning policies and decisions should contribute to and enhance the natural and local environment by:

- *preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.*

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:

- *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;*

- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason.*

The terms '*significant adverse*' and '*adverse*' impacts are defined in the explanatory notes of the 'Noise Policy Statement for England (NPSE) which states;

There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation. They are:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

The notes also offer an explanation of the term 'adverse impacts' as follows;

… refers to the situation where the impact lies somewhere between LOAEL and SOAEL. It requires that all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development (paragraph 1.8). This does not mean that such adverse effects cannot occur.

Although no specific noise limits for LOAEL and SOAEL have been defined, in 2014 the UK Government published a planning practice guidance document for noise which indicates where these limits fall with relation to the perception of noise, updated in July 2019. A summary is reproduced in Section 4.2 below, and the full document is published at https://www.gov.uk/guidance/noise--2. It is considered that guidance from other acoustic standards may be employed to determine suitable levels within the overall principal of the National Planning Policy Framework.

3.3 Planning Practice Guidance – Noise

The UK Planning Practice Guidance on noise offers further guidance on the typical levels which constitute the NOEL, LOAEL and SOAEL, reproduced in the table below.

Table 1. Planning Practice noise level guidance

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not Present	No Effect	No Observed Effect	No specific measures required
No Observed Adverse Effect Level			
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

3.4 BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings

Dwelling houses, flats and rooms in residential use

British Standard 8233:2014, *Guidance on Sound Insulation and noise reduction for buildings*, gives guidance on internal noise levels within dwellings, flats and rooms in residential use when unoccupied. The following criteria are for Living and Dining Rooms for daytime use and Bedrooms for night time.

Table 2. BS8233 recommended indoor ambient noise levels

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

It should however be stressed that the above criterion relates to steady noise, in this case from road traffic etc., excluding unusual noise events departing from the typical noise character of the area.

In addition BS 8233 suggests, '*regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values'.*

With regard to external areas of residential developments BS8233:2014 states the following;

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 $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized 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.

3.5 WHO Guidelines for Community Noise

In 1999, the WHO (World Health Organisation) published Guidelines for Community Noise, stating the following internal noise levels are applicable within dwellings.

Table 3. WHO Guidelines for Community Noise criteria

Specific Environment	Critical Health Effect(s)	L_{Aeq} dB	Time Base (hours)*
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	16
Inside bedrooms	Sleep disturbance, night time	30	8

* Typically taken to be daytime/evening - 07:00 – 23:00 hours and night time 23:00 – 07:00 hours.

It should be noted that while WHO guidelines stipulate an L_{Amax} criteria of 45 dB which should not be exceeded for 10 – 15 times per night-time period, Kirklees Council design advice states that the criteria should not exceed L_{Amax} 55 dB.

4.0 SURVEY DETAILS AND RESULTS

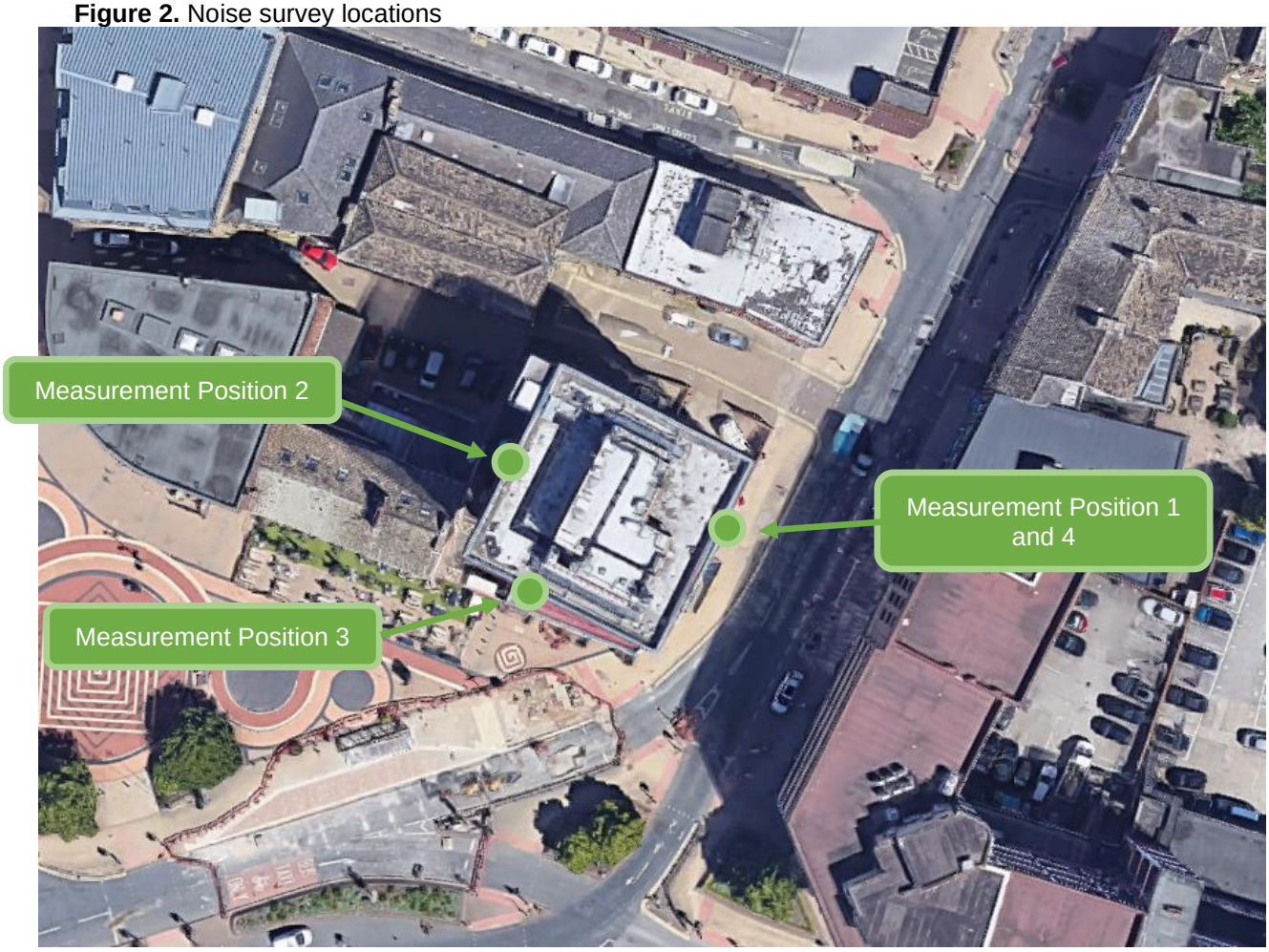
4.1 Environmental Noise Survey

A noise level survey was undertaken at the site between 11:46 hours on Friday 10th November and 10:48 hours on Monday 13th November 2023. The periods measured were deemed to be representative of day and night-time hours while including for typical weekend activity from the surrounding noise sources.

Long-term noise measurement were taken at the east façade facing onto Market Street (Position 1), west façade facing into the courtyard area of the Plumbers Arms and Florences (Position 2) and at the south façade facing onto Market Street and the front beer garden areas of Plumbers Arms and Florences (Position 3). In addition, a short-term measurement was carried out on the east façade facing onto Market Street (Position 4).

The measurement locations are shown in the figure below:

Figure 2. Noise survey locations



The measurement positions are detailed as follows:

- Measurement Position 1 – microphone located on a mast out of first floor window facing onto Market Street to the east.
- Measurement Position 2 – microphone located on a mast out of first floor window facing into rear courtyard of Plumbers Arms and Florences to the west.

- Measurement Position 3 – microphone located on a mast out of first floor window facing onto Market Street and beer gardens of Plumbers Arms and Florences to the south.
- Measurement Position 4 – microphone located on a mast out of sixth floor window facing onto Market Street to the east.

All measurements were made and partly attended by Mr David Hible and Mr Sam Iles of PDA Ltd. Measurements were of continuous 5 minute samples. The survey was conducted using 3 no. NTi XL2 sound level meters. Calibration certificates for the sound level meters are held.

The NTi meters are Class 1 frequency response as per BS EN 61672-1:2003. The sound level meters were field calibrated both before and after the measurement period, during which time no significant deviation from the calibrated level was observed. The sound level meters were fitted with a microphone windshield at all times.

All measurements were undertaken with a fast time-weighting and broadband statistics were measured throughout. In addition, octave band frequency spectra were recorded along with 16 bit/ 24kHz audio.

Weather

10/11/2023

- Temperature: 3 - 8°c
- Wind Speed: 1-5m/s E-N-E
- Mostly clear and no precipitation

11/11/2023

- Temperature: 3-9°c
- Wind Speed: 1-4m/s E-N-E
- Clear skies no precipitation

12/11/2023

- Temperature: 3-7°c
- Wind Speed: 1-3m/s East
- Overcast and scattered showers

13/11/2023

- Temperature: 7-11°c
- Wind Speed: 2-6m/s E-N-E
- Overcast and scattered showers

Noise Sources

The local noise climate to the north and east of site is dominated by road traffic from Market Street during day and night-time hours. To the west and south of site the noise climate is dominated by road traffic noise from Market Street and distant traffic noise from the A62. During the evening and night-time periods the noise climate is dominated by entertainment noise from the adjacent entertainment premises

4.2 Measurement Results

4.2.1 Environmental Noise

Measurement positions on site are shown on Figure 2 Section 4.1 of this report. A summary of the results is given below:

Table 4. Summary of long-term environmental noise measurements

Date	Position	Time Period (hh:mm)	$L_{Aeq,T}$ (dB)	Range of Night-Time $L_{Amax,5mins}$ (dB)[1]
10/11/2023	1	Day 11:46 – 23:00	63	-
		Night 23:00 – 07:00	57	51 – 93[1]
	2	Day 12:56 – 23:00	62	-
		Night 23:00 – 07:00	63	49 - 100[1]
	3	Day 12:04 – 23:00	61	-
		Night 23:00 – 07:00	59	55 - 90[1]
11/11/2023	1	Day 07:00 – 23:00	62	-
		Night 23:00 – 07:00	55	52 - 83
	2	Day 07:00 – 23:00	62	-
		Night 23:00 – 07:00	61	50 - 91
	3	Day 07:00 – 23:00	60	-
		Night 23:00 – 07:00	58	55 - 78
12/11/2023	1	Day 07:00 – 23:00	63	-
		Night 23:00 – 07:00	57	51 - 92
	2	Day 07:00 – 23:00	63	-
		Night 23:00 – 07:00	62	62 - 94
	3	Day 07:00 – 23:00	63	-
		Night 23:00 – 07:00	59	59 - 87
13/11/2023	1	Day 07:00 – 10:48	65*	-
	2	Day 07:00 – 10:46	65*	-
	3	Day 07:00 – 10:45	64*	-

*Measurements influenced by wind speeds exceeding 5m/s
[1]L_{Amax} results affected by fireworks

Table 5. Summary of short-term environmental noise measurements

Date	Position	Time Period (hh:mm)	$L_{Aeq,T}$ (dB)	Range of Night-time $L_{Amax,5mins}$ (dB)
10/11/2023	4	Day 11:45 – 12:45	61	-

5.0 EXTERNAL COMMERCIAL SPACE – BEER GARDENS

We would note that to the south of the adjacent commercial premises (Plumbers Arms, Florences) there is a large area of outdoor seating understood to be beer gardens associated with the premises'. As the survey has been undertaken during a period of the year where these spaces would be expected to be utilised a lot less than summer months, we have carried out a noise modelling exercise to predict the impact on the proposed residential receivers.

In order to assess noise levels associated with the proposed beer garden area we have considered using data given within the '*Average Speech Levels and Spectra in Various Speaking/Listening Conditions: A Summary of the Pearson, Bennett, & Fidell (1977*)' report. On-site observations and aerial images suggest that there are approximately 44 no. tables in total. Based upon this for each table we have assumed 2 no. persons to be speaking simultaneously, both with raised voices using data for a male and female. It is assumed the beer garden areas will be open during the existing opening hours of the premises understood to be between 11:00 hours and 24:00 hours Monday to Sunday.

Details of the following external sound power level used within our calculations are summarised within the following table:

Table 6. External Noise Break-out - Patrons in Beer Garden Areas with Raised Voices

Activity	A-Weighted Sound Power SWL (dB)	Sound Power Level Octave Band Centre Frequencies (Hz) dB(A)						
		125	250	500	1k	2k	4k	8k
Predicted noise level of male patron with raised voices	73	61	67	72	66	62	57	51
Predicted noise level of female patron with raised voices	71	43	63	68	66	62	57	51

5.1 Noise Propagation Calculations

A 3-dimensional noise model has been created using SoundPLAN noise modelling software. The software uses the method of ISO 9613 'Acoustics – attenuation of sound during propagation outdoors – general method of calculation' and takes into account geometric spreading, ground effects, air attenuation, barrier attenuation and reflections.

The model is based upon aerial photographs and the supplied proposed site layout plan provided by the Client. A ground absorption coefficient of 0 has been used to correspond with the intervening ground from the site through to the receivers which is predominately hard surfaces (i.e. hard standing, roads, buildings etc).

It should be noted that within the model, the noise source of the patrons are modelled as point sources. For the tables and seating areas we have inserted 88 no. point sources evenly split between male and female sound power levels, based on Section 5.1, and have assumed a height of 1m above the floor level within the model.

For the proposed residential receivers noise levels are calculated at a 4m first floor level and an additional 2.8m for each storey.

The SoundPLAN model would suggest the following noise levels calculated at the closest noise sensitive receivers. Only the highest calculated noise level has been reported in the table below.

Figure 3. Calculated noise levels at residential receivers from the neigbouring Beer Gardens.

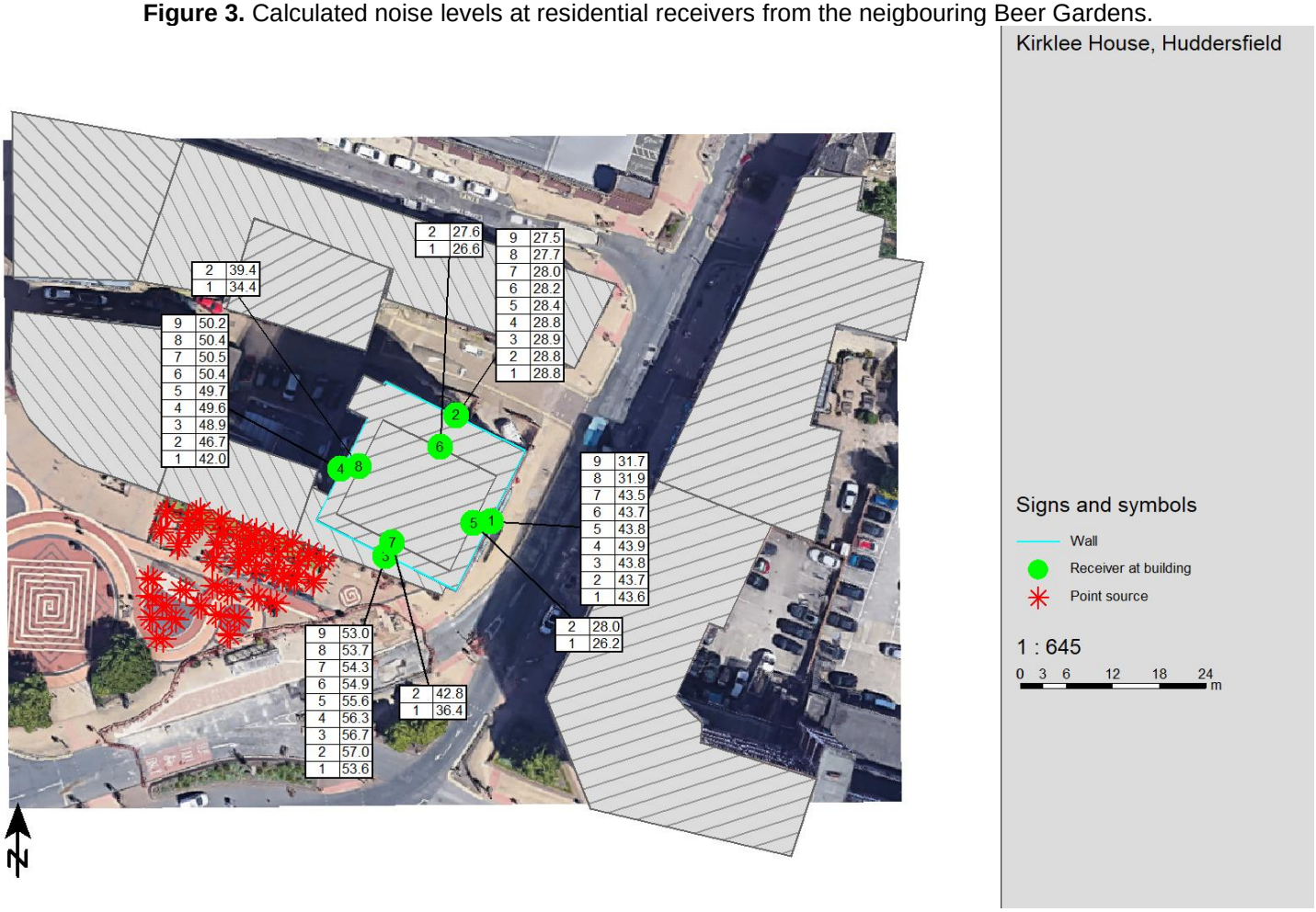


Table 7. Calculated noise levels at the closest receivers

Operational Period (hh:mm)	Calculated noise level at Eastern facade, dBA	Calculated noise level at Southern facade, dBA	Calculated noise level at Western facade, dBA	Calculated noise level at Northern facade, dBA
Daytime opening hours (11:00 – 24:00)	44	57	51	29

6.0 INTERNAL NOISE LEVEL PREDICTIONS

Based upon the measured noise levels given in Section 4 and predicted noise levels given in Section 5, calculations have been undertaken to determine internal noise levels for the conversion project. The proposed elevations and internal layouts are derived from the received C49 Architecture drawing package ref: '*NTL-PL-005'* to '*NTL-PL-011'.*

It is important to note that for the northern façade of the development, measurements taken at Position 1 (east) and Position 2 (west) have been utilised for the assessment. Furthermore, the comparative

synchronous measurements carried out between measurement Position 1 and 4 showed a reduction of 1 dB between first and sixth floor. We would consider this to be a negligible difference and have therefore, as a worst-case, used the measurement results from first floors across all floors. We would note that this is likely due to reflection from the surrounding buildings.

6.1 Glazing and Ventilation Attenuation Requirements

The dominant paths for noise transfer to the interior of buildings are generally the glazing and ventilation elements of the façade constructions. It is understood that the intention is to provide natural ventilation across all floors of the development. However, upon our initial assessment the measured noise climate across site indicates that an alternative means of ventilation will be required to the west and south facades for studio apartments. This is due to the criteria discussed within Section 3, focussing upon the Kirklees Council guidance for entertainment noise.

Thus, we have carried out our internal calculations based upon each studio apartment on the west and south facades being served by a Mechanically Ventilated Heat Recovery (MVHR) unit. Due to loss through the louvre opening, duct system and heating system, we consider the external noise ingress via this path negligible in comparison to the rest of the façade. However, it should be ensured that noise generated by the mechanical system itself does not give rise to exceedances of the internal noise criteria detailed in Section 3.0.

For studio apartments on the north and east facades and all of the penthouse facades the noise climate implies that natural ventilation may be achieved. Based on this premise, to achieve the required internal noise levels the development would require the following glazing and ventilator specifications.

The calculation of noise break-in to the residential rooms has been undertaken in accordance with the calculation methods of BS EN 12354-3:2000 *Building Acoustics – Estimation of acoustic performance of buildings from the performance of elements. Part 3: Airborne sound insulation against outdoor sound*, in octave bands. Reverberation time is taken as 0.5 seconds as per the BS EN 12354-3 reference time for dwellings.

Figure 4. First to Ninth Floor Glazing and Ventilation Schedule

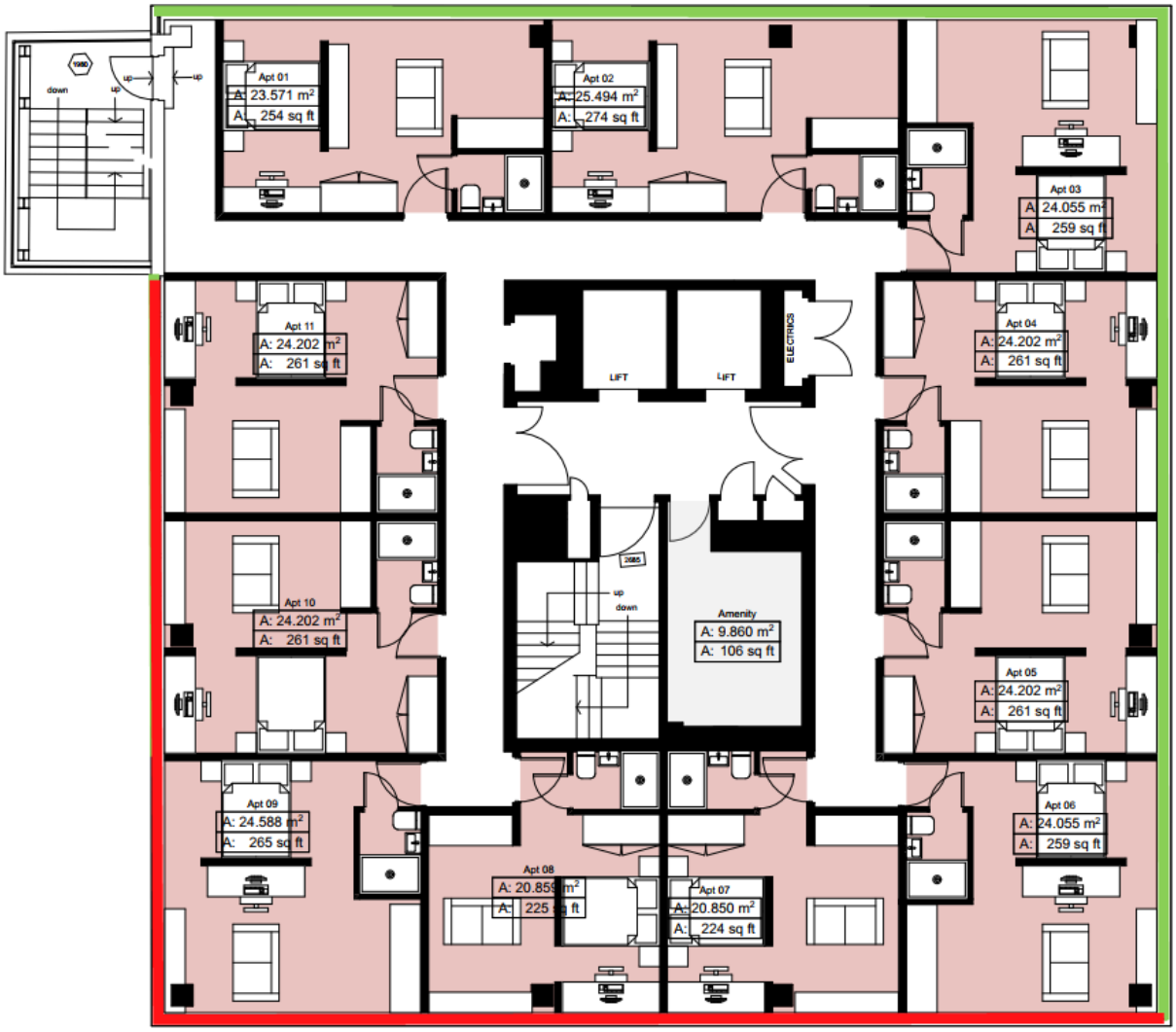


Figure 5. Tenth to Eleventh Floor Glazing and Ventilation Schedule

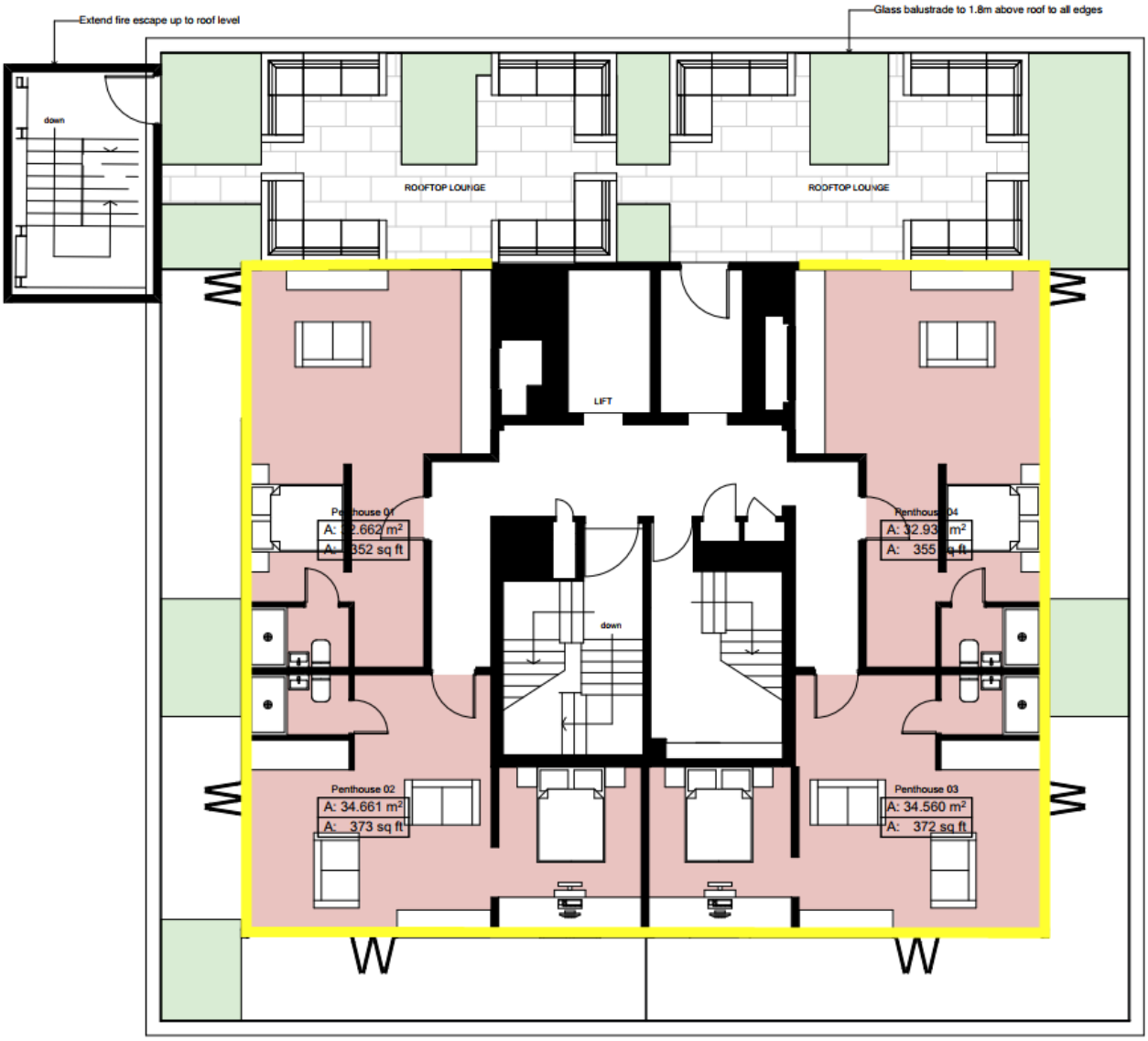


Table 8. Glazing and Ventilation Schedule

Colour	Floor	Room	Minimum Glazing Rating R_w dB	Minimum combined Ventilator Rating $D_{n,e,w}$ dB	Internal Noise Level Target		Calculated Internal Noise Level	
					$L_{Aeq,T}$ dB Day/Night	L_{Amax} dB Night*	$L_{Aeq,T}$ dB Day/Night	L_{Amax} Night
Green	1 - 9	Studio Apartment	37	33	35/30	55	33/27	48
Red	1 - 9	Studio Apartment		MVHR	35/30	55	27/25	38
Yellow	10 - 11	Penthouse		33	35/30	55	34/28	50

*Criteria derived from Kirklees Council – Noise Design Advice – See Section 3.5

With the glazing and ventilation specifications proposed in Table 5 above, calculations suggest that the internal Day and Night time BS8233:2014/WHO noise level requirements can be achieved. Calculated internal noise levels are given on the worst-case internal receivers. Calculations have been undertaken to determine L_{Amax} noise levels within the bedrooms at night time. Using the full night time L_{Amax} noise

levels measured across site with the glazing and ventilation specifications above, the calculated L_{Amax} values will not normally exceed 55 dB L_{Amax} in accordance with the guidance of Kirklees Council.

6.1.1 Entertainment Venue Noise

In addition to the above noise break-in calculations, an assessment has been made of the noise emissions from the adjacent entertainment venues Plumbers Arms and Florences Cocktail Bar.

The assessment has been carried out by utilising the measured audio files alongside the noise data to establish a 'worst-case' one hour period where we would consider the entertainment noise to be most prominent. This has resulted in assessing the internal noise levels against the noise levels measured between 18:30 – 19:30 hours during the Saturday day-time period and 23:00 – 24:00 hours during the Friday night-time period.

A summary of the calculated internal ambient noise ratings (NR) for the 'worst-case' receivers are presented in the Table below with comparison to the NR criteria given by Kirklees Council:

Table 9. Calculated internal noise levels within residential rooms.

Façade	Specification	Room	Internal Noise Rating Target		Calculated Internal Target	
			Day-time (NR) dB	Night-time (NR) dB	Day-time (NR) dB	Night-time (NR) dB
West Facade	Red	Apartment 10	25	20	18	15
South Facade		Apartment 9			22	18
North Facade	Green	Apartment 1			21	19

NOTE: East façade rooms have not been calculated due to the screening provided by the building itself. We would expect the internal levels due to entertainment noise to be less than that predicted at the north façade.

In regards to Section 5 of *Kirklees Council – Noise Design Advice* it can be seen how the calculated internal NR of the 'worst-case' receivers fall below the guidance of NR 25 and NR 20 for day and night-time respectively. Thus, we would consider this to meet the criteria of being understood to be 'inaudible'/'virtually inaudible'.

6.1.2 Glazing Specification and Installation Notes

Notes on Glazing Installation

For the glazing specifications in Table 10, all sound insulation values quoted must be achieved by the overall combination of frame and glazing, and not just by the glazing alone. The frame should not reduce the performance of the system overall. Glazing framing systems must be fully sealed with any small gaps (<10mm nominal) around the perimeter to be stuffed with dense mineral wool to full frame depth and sealed both sides with acoustic non-setting mastic, with additional weathering protection to be applied additionally externally to this. No gaps should be left unsealed.

Minimum performance requirements for the combination of glazing and framing recommended in the above tables are as follows:

Table 10. Required Minimum Sound insulation of Combined Glazing and Framing

Typical Product (glass/cavity/glass)	Minimum Sound Reduction Index R (dB) at Octave Band Centre Frequency (Hz)								R_w dB
	63	125	250	500	1k	2k	4k	8k	
10/20/6	27	25	30	36	39	35	44	44	**37**

Figures stated in the table above are based on Saint Gobain manufacturer quoted data. Acoustic ratings should be checked with the manufacturer and supported by laboratory test reports where necessary.

Point to note

It should be highlighted that it is crucial that the selected glazing product performance is equal to or greater than the performance values stated in **each** octave band in Table 10 above. Failure to do so may result in the Kirklees Council criteria being exceeded, notably in low frequencies.

6.1.3 Ventilator Requirements

Where natural ventilation is intended for the north, east and penthouse facades BS8233:2014 would suggest, '*the Building Regulations' supporting documents on ventilation recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice*.'

BS8233:2014 Annex G.1 further states, *if partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB, resulting in the target levels being exceeded. However, windows may still be openable for rapid or purge ventilation, or occupant's choice*.

The ventilator inlets described in the following table are calculated to provide adequate sound insulation to maintain internal noise levels compliant with the guidance criteria when used in conjunction with the selected glazing. Example ventilator products are noted below.

The acoustic specification relates to the combined performance of all ventilation elements. Where two or more ventilators are required to meet the ventilation requirement, the acoustic performance for a single ventilator must be selected so that the combined performance is as stated in the table below, e.g. for 2 no. ventilators, the acoustic performance of each will need to be $D_{n,e,w}$ 36 dB to meet a combined specification of $D_{n,e,w}$ 33 dB. Requirements should be checked with the manufacturer. Please note that the treatment is generally not considered necessary for non-habitable rooms such as bathrooms etc.

Table 11 below gives the acoustic performance of the ventilator used in the calculations. Any alternative vent should achieve the same performance or greater in each octave band.

Table 11. Required ventilator performance

Typical Product	Minimum Sound Reduction Index R (dB) at Octave Band Centre Frequency (Hz)								$D_{n,e,w}$ dB
	63	125	250	500	1k	2k	4k	8k	
Simon Acoustic TTF Slimline	38	38	35	35	31	32	35	40	**33**

Please note that the specification of vents is in terms of acoustic performance only. Ventilation strategy needs to be checked with Local Authority and other standards and regulations for compliance. It should be noted that inclusion of ventilators alone does not ensure compliance with Building Regulations or other regulatory requirements for ventilation. The ventilation strategy should be checked by others.

6.2 External Walls

It is assumed that the external wall is a brick cavity construction. Within our calculations it has been determined that the sound insulation performance of the external wall should be no less than 54 dB R_w.

6.3 Roof

It has been assumed that the roof to the penthouses on floor 11 will be of a lightweight construction. For the purposes of our assessment we have assumed the construction to be a Kingspan roof panel with a suspended ceiling below consisting of insulation and 1 no. 15mm plasterboard. From manufacturers data the sound insulation performance of the penthouse roofs should be no less than 58 dB R_w.

6.4 Rooftop Amenity Spaces

In order to assess the rooftop amenity spaces we have utilised the spot measurement data from Position 4 and reduced this by 10 dB due to the screening provided by the proposed 1.8m glass balustrade to all edges of floor 10 level. Therefore, we would predict a noise level that would fall below the lower guideline value of WHO with the addition of distance attenuation.

7.0 GROUND FLOOR COMMERCIAL UNIT

It is our understanding that there is to be a commercial unit to the ground floor level of the development. As the intended use is unknown we have assumed the use to be of a bar/restaurant. It is understood that concern has been raised by Kirklees Council in regards to the noise impact on the existing and proposed residential receivers in regards to Condition 5. Therefore we have carried out the following assessment which considers for noise break-out from the façade and roof of the proposed commercial unit, and noise transfer through the separating floor to the proposed residential units at first floor level.

7.1 Façade noise break-out to residential receivers

It is our understanding that the existing façade at ground floor level is to be retained and consists for areas of glazing and solid brick wall. It is assumed that the roof is of a lightweight timber construction with a suspended ceiling below.. We have utilised the drawing package provided ref: '*NTL-PL-005'* to '*NTL-PL-011'* to calculate the area of each façade element. In addition, we have utilised previously measured noise data of a busy bar/pub to establish a typical noise level for the commercial unit. The sound insulation performance calculation of each façade is presented in the tables below.

Table 12. Proposed Commercial Unit – Sound Insulation Performance – South Façade

Cladding Element	Proportion of Area m^2	Sound Reduction Index Octave Band Centre Frequencies (Hz) dB								
		63	125	250	500	1k	2k	4k	8k	
Glazing (4/12/4)	20	16	22	19	25	36	42	36	35	
Solid Brick Wall	72	41	44	40	44	52	59	65	65	
										A-Weighted Sound Pressure Level (dB)
Internal Noise Level (Bar/Pub)		64	77	76	83	83	79	72	72	**86**
Composite SRI		23	29	26	32	42	48	43	42	-
Direct to Free Field Correction		-6	-6	-6	-6	-6	-6	-6	-6	-
Façade Area Correction		20	20	20	20	20	20	20	20	-
Sound Power Level of entre Façade		55	62	64	65	54	44	43	44	**63**

Table 13. Proposed Commercial Unit – Sound Insulation Performance – East Façade

Cladding Element	Proportion of Area m^2	Sound Reduction Index Octave Band Centre Frequencies (Hz) dB								
		63	125	250	500	1k	2k	4k	8k	
Glazing (4/12/4)	30	16	22	19	25	36	42	36	35	
Solid Brick Wall	22	41	44	40	44	52	59	65	65	
										A-Weighted Sound Pressure Level (dB)
Internal Noise Level (Bar/Pub)		64	77	76	83	83	79	72	72	**86**
Composite SRI		18	25	22	28	38	44	39	37	-
Direct to Free Field Correction		-6	-6	-6	-6	-6	-6	-6	-6	-

Façade Area Correction	17	17	17	17	17	17	17	17	-
Sound Power Level of entre Façade	57	63	65	66	56	46	44	46	**65**

Table 14. Proposed Commercial Unit – Sound Insulation Performance – North Façade

Cladding Element	Proportion of Area m^2	Sound Reduction Index Octave Band Centre Frequencies (Hz) dB							
		63	125	250	500	1k	2k	4k	8k
Solid Brick Wall	14	41	44	40	44	52	59	65	65
									A-Weighted Sound Pressure Level (dB)
Internal Noise Level (Bar/Pub)		64	77	76	83	83	79	72	72	**86**
Composite SRI		41	44	40	44	52	59	65	65	-
Direct to Free Field Correction		-6	-6	-6	-6	-6	-6	-6	-6	-
Façade Area Correction		11	11	11	11	11	11	11	11	-
Sound Power Level of entre Façade		28	38	41	44	36	25	12	12	**43**

Table 15. Proposed Commercial Unit – Sound Insulation Performance – West Façade

Cladding Element	Proportion of Area m^2	Sound Reduction Index Octave Band Centre Frequencies (Hz) dB							
		63	125	250	500	1k	2k	4k	8k
Solid Brick Wall	20	41	44	40	44	52	59	65	65
									A-Weighted Sound Pressure Level (dB)
Internal Noise Level (Bar/Pub)		64	77	76	83	83	79	72	72	**86**
Composite SRI		41	44	40	44	52	59	65	65	-
Direct to Free Field Correction		-6	-6	-6	-6	-6	-6	-6	-6	-
Façade Area Correction		13	13	13	13	13	13	13	13	-
Sound Power Level of entre Façade		30	40	43	46	38	27	14	14	**45**

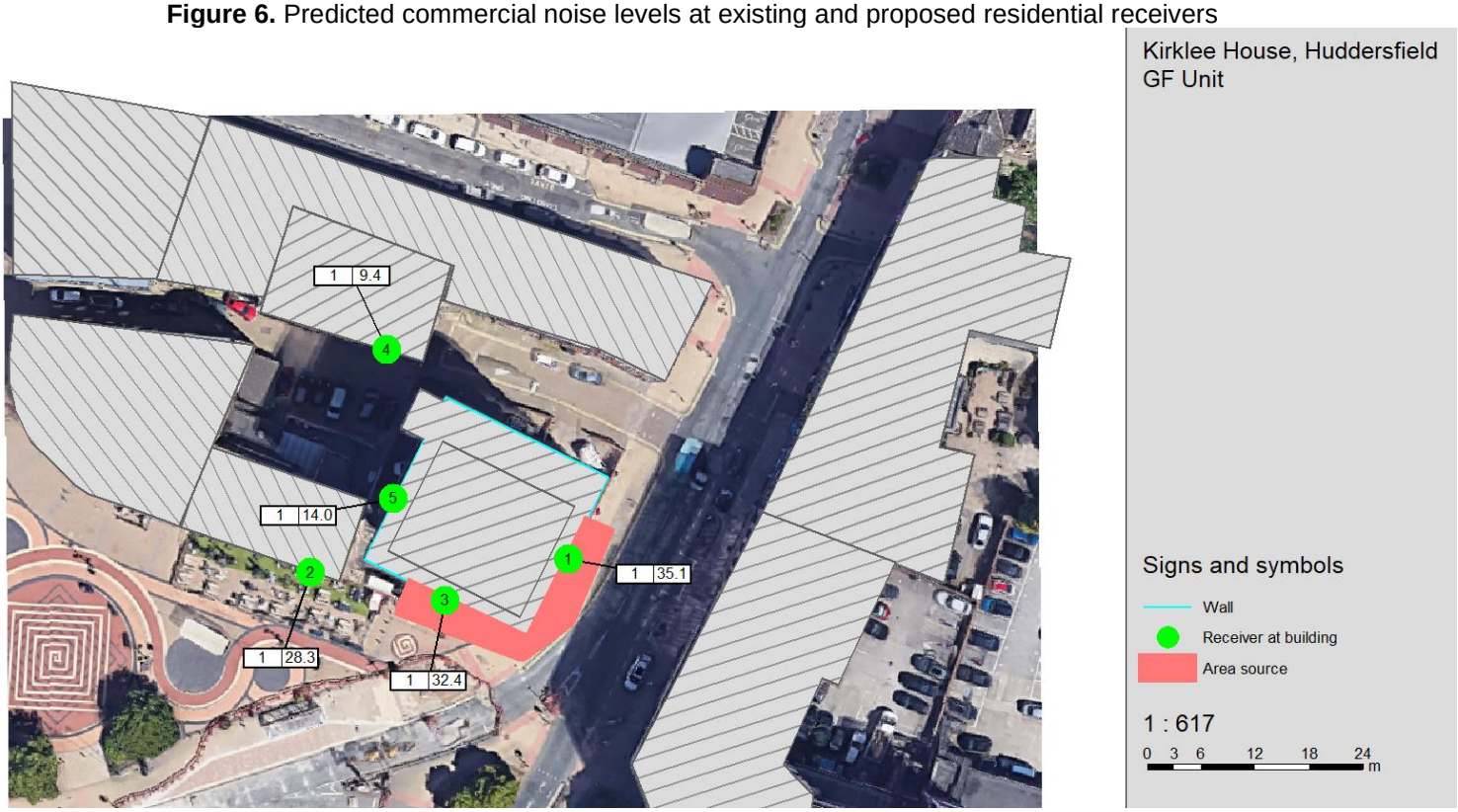
Table 16. Proposed Commercial Unit – Sound Insulation Performance – Roof

Cladding Element	Proportion of Area m^2	Sound Reduction Index Octave Band Centre Frequencies (Hz) dB							
		63	125	250	500	1k	2k	4k	8k
Lightweight Roof	20	12	24	39	46	51	53	53	53
									A-Weighted Sound Pressure Level (dB)
Internal Noise Level (Bar/Pub)		64	77	76	83	83	79	72	72	**86**
Composite SRI		12	24	39	46	51	53	53	53	-
Direct to Free Field Correction		-6	-6	-6	-6	-6	-6	-6	-6	-
Façade Area Correction		13	13	13	13	13	13	13	13	-
Sound Power Level of entre Façade		59	60	44	44	39	33	26	26	**47**

7.1.1 Noise Propagation Assessment – Ground Floor Commercial Noise Break-out

By utilising the calculated sound power levels of each façade and roof as presented in the tables in Section 7.1, we have implemented this as an area source for each façade and roof within a SoundPLAN model to the same specification as that detailed in Section 5.1. The results of the modelling process can be seen in the Figure below which states the noise levels at the closest existing and proposed residential receivers.

Figure 6. Predicted commercial noise levels at existing and proposed residential receivers



As can be seen from the Figure above the worst case predicted noise level at the existing receivers is at receiver 2 (Plumbers Arms) at 28 dB(A). The worst case predicted noise level at the proposed receivers of Kirklees House is at receiver 1 at 35 dB(A). In order to assess the internal ambient noise level in these receivers we have accounted for a partially open window (- 15dB as per Annex G of BS8233) which results in the following predictions. Please note that we have assumed the same noise level from the proposed commercial unit throughout day-time and night-time periods.

Table 17. Calculated internal noise levels within residential rooms.

Receiver	Predicted External Noise Level dB(A)	Existing Background Sound Level (Night-time) L_{A90} dB	Internal Noise Rating Target		Calculated Internal Noise Level	
			Day-time (NR) dB	Night-time (NR) dB	Day-time (NR) dB	Night-time (NR) dB
1 – Kirklees House	35	45	25	20	18	18
2 – Plumbers Arms	28	40			11	11

We would note that the predicted external noise level is below the typical background sound level during the night-time at each receiver. In addition, the predicted internal noise level is less NR20 which meets

the Kirklees Council criteria for night-time periods. We have provided the 'worst-case' receivers in the predictions above where noise levels at receivers 3, 4 and 5 are expected to be lower.

7.2 Commercial noise transfer through floor

It is our understanding that Kirklees Council have provided the following comment in regards to noise transfer between the proposed ground floor commercial space and first floor residential rooms:

> *'Class Use E allows shop uses and we have to be mindful of the wide range of uses. We therefore ask that any party wall/floor/ceiling is +10dB above Building Regulations requirements. Of note is that the 43dB quoted is a minimum requirement of Building Regs but should circumstances change, meeting Building Regs is not a defence from Statutory Nuisance.'*

In order to assess the separating floor we have assumed from on-site observations that the current construction is as follows:

- 100mm concrete block and beam, suspended mineral fibre tile ceiling with circa 200mm cavity.

We have utilised Insul (sound insulation prediction software) to predict the sound insulation performance of the partition which is stated at 47 dB $R_w + C_{tr.}$ We would suggest that due to the potential for high noise levels in the commercial space the existing construction is unlikely to achieve 53 dB $D_{nTw} + C_{tr}$ (+10 dB above Building Regulations). Therefore, we would suggest the following refurbishment to the ceiling of the ground floor unit:

- 100mm concrete block and beam, 2 no. 15mm Gyproc SoundBloc on suspended MF system forming a 200mm cavity, 100mm mineral wool insulation (minimum mass 10kg/m^2) in cavity.

The construction build up detailed above is predicted to achieve 61 dB $R_w + C_{tr.}$ In order to predict a likely on-site performance we have utilised Bastian (building sound insulation prediction software) which provides a predicted performance of 57 dB $D_{nTw} + C_{tr.}$ We would therefore consider this to be likely in achieving the required criteria as set out by Kirklees Council.

Furthermore, we would suggest that based upon an expected internal noise level of 86 dB(A) (as discussed in Section 7.1), the predicted internal noise level to a receiving residential room would be NR 25 based upon the upgraded floor construction. Therefore, we would suggest that the noise levels of the commercial unit should be limited to 86 dB(A) during day-time hours and 80 dB(A) during night-time hours in order to achieve NR20.

We would note that the assumed internal noise levels are based upon a bar/pub which does not fall into Class E, we would consider this to be a conservative approach which allows flexibility to the use of future occupants of the commercial unit. We would suggest that once the use is known, further assessment of the floor construction can be carried out at the detailed design phase.

7.3 Limit for any proposed plant to commercial unit

We have not been informed of any new potential external plant to the development, however we would suggest that the combined noise level from any newly introduced units should not exceed the following criteria which is based upon the measured existing background sound levels. Please note that we have set the noise limits 5 dB lower than the existing background sound level in accordance with Kirklees Council guidelines. Noise limits have been set against night-time hours as a conservative approach.

Table 18. Noise limits at receivers for any proposed plant

Receiver	Existing Background Sound Level (Night-time) L_{A90} dB	Noise Limit at Receivers (Night-time) dB (A)
1 – Kirklees House	45	40

2 – Plumbers Arms	40	35
3 – Threadneedle St	43	38

8.0 CONCLUSIONS

PDA Ltd was commissioned by C49 Architecture to carry out a noise impact assessment for the proposed development at Kirklees House, Market Street, Huddersfield. The proposed development consists of the conversion of an existing 9 storey office block into student accommodation. It is understood that there is to be 99 no. studio apartments across floors 1 to 9 and 8 no. penthouses across newly formed floors 10 and 11. There is to be a ground floor commercial unit with a study space, gym and students lounge to the basement.

A noise level survey has been undertaken at the site representative of daytime and night-time hours. The local noise climate to the north and east of site is dominated by road traffic from market street during day and night-time hours. To the west and south of site the noise climate is dominated by road traffic noise from Market Street and distant traffic noise from the A62. During the evening and night-time periods the noise climate is dominated by entertainment noise from the adjacent entertainment premises.

Based upon the measured and predicted noise levels, calculations have been undertaken for the studio apartments and penthouses to evaluate the internal noise levels. Recommendations are given for glazing, ventilation and building façade elements to meet the internal noise level requirements of good practice guidance given in BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings. Calculations suggest that the noise level criteria of BS8233:2014 can be achieved within the proposed accommodation. Further to this, guidance has been followed from Section 5 of the Kirklees Council – Noise Design Advice which considers internal noise ratings in order to protect future occupants from entertainment noise.

An assessment has been carried out of the proposed ground floor commercial space to ensure that the possible noise levels do not impact on existing and proposed residential receivers. In addition, noise limits have been provided for any proposed plant associated with the ground floor commercial space.

APPENDIX A – SURVEY DATA

Figure 7. Ambient Noise Level Survey – Measurement Position 1

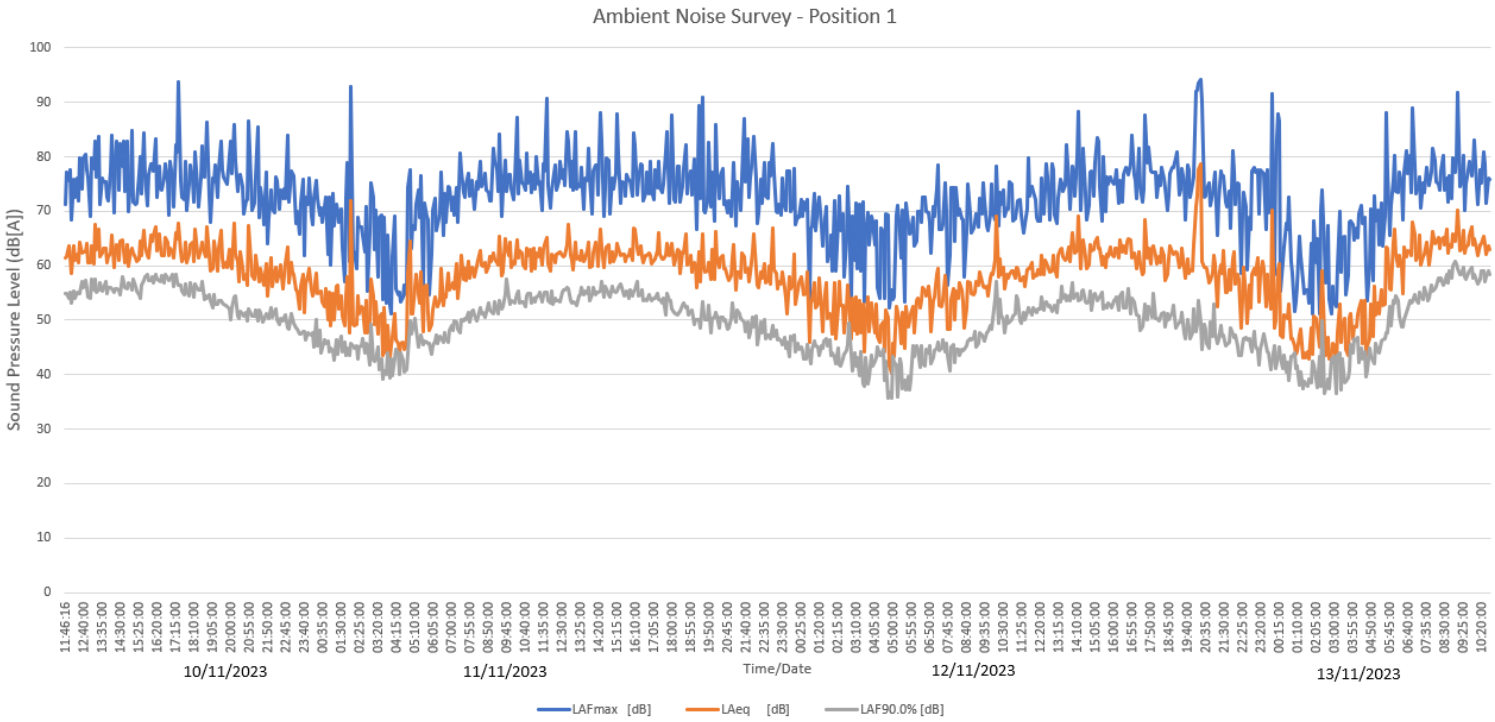


Figure 8. Ambient Noise Level Survey – Measurement Position 2

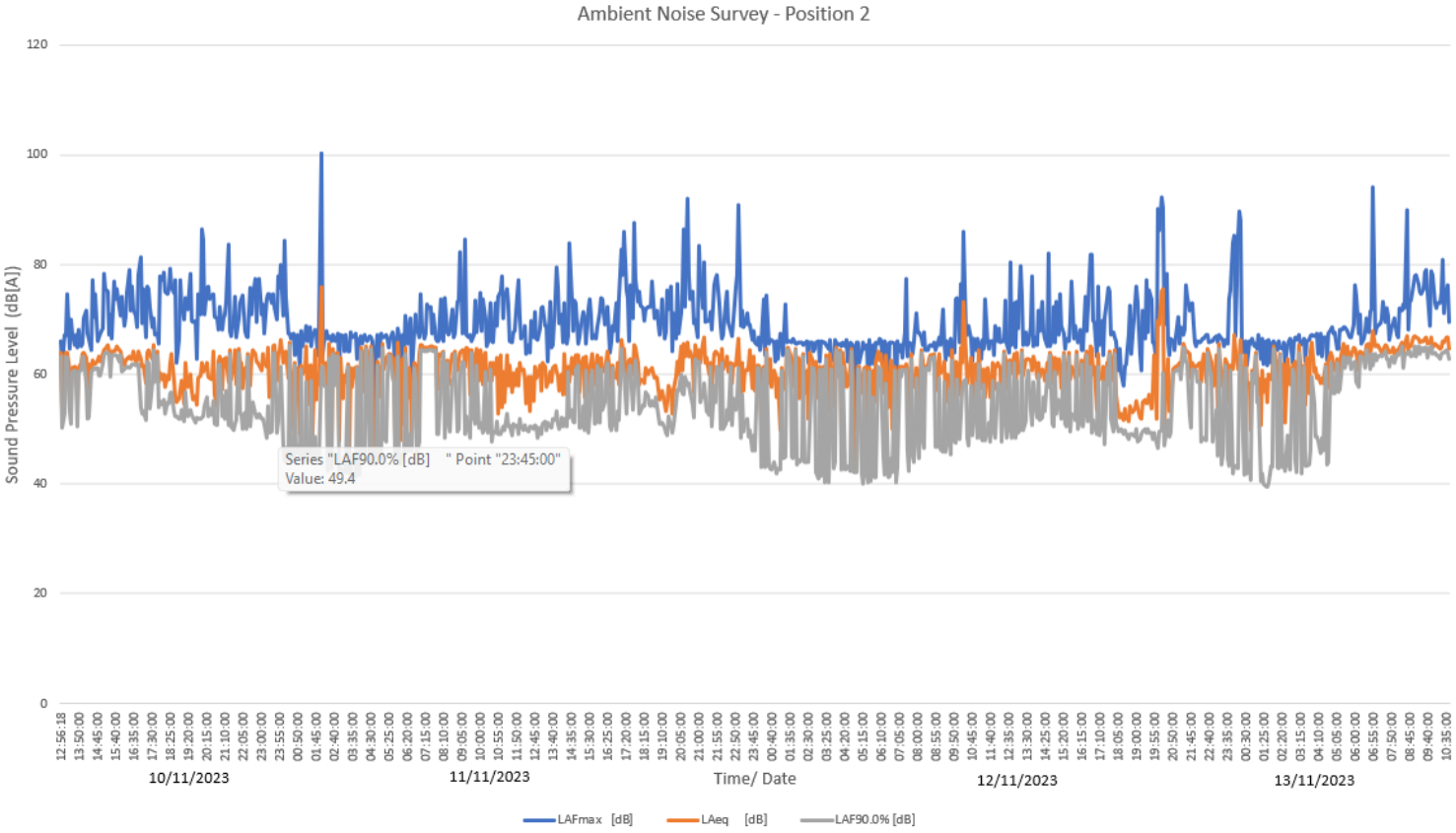


Figure 9. Ambient Noise Level Survey – Measurement Position 3

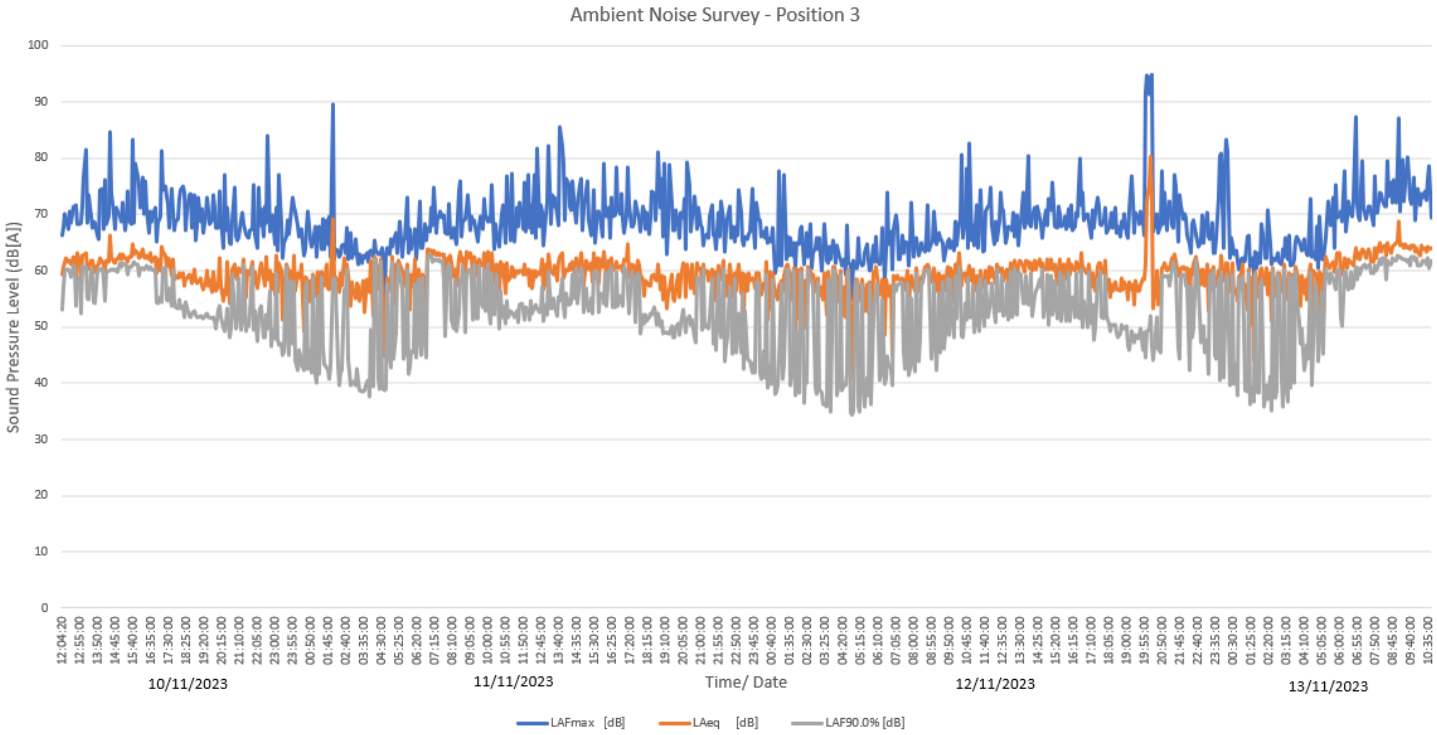


Table 12. Ambient Noise Level Survey – Measurement Position 4

Time	L_{AFMAX}	L_{AEQ}	$L_{AF90.0\%}$
11:45:00	73	60.5	54.6
11:50:00	70.4	60.2	54.6
11:55:00	78	62.8	54.2
12:00:00	69	59	54.2
12:05:00	68	57.8	52.8
12:10:00	73	62.1	54.9
12:15:00	73.5	61.4	53.7
12:20:00	73.7	60.2	53.8
12:25:00	75.7	61.2	54.4
12:30:00	74.6	61.8	54.5
12:35:00	73.4	61.9	56.6
12:40:00	76.6	60.6	55

APPENDIX B – NOTES FOR QUALITY CONTROL

1. Blockwork

All blockwork is to be mortared to an almost fair faced standard both horizontally and vertically. Only perfect blocks may be used with no pitting or cracks. The blockwork must seal effectively to the underside of the soffit.

Where blockwork walls form a cavity wall, care should be taken to avoid rubble and snots from bridging the cavity. This is especially important where one or more of the leaves is floating.

2. Plasterboard

All plasterboard joints are to be butted tight. The rule of thumb is that the joint should be tight enough over its entire length to prevent a normal business card from being inserted. Multiple layers should be fitted with staggered joints.

Base details and deflection heads are to be as per the British Gypsum White Book unless otherwise stated, and copious amounts of mastic to be used when fitting to the walls, floor and ceiling respectively.

3. Mineral Fibre

Mineral fibre slabs are to be butted tightly together and to boundary structures, to form a homogeneous layer.

4. Windows

All window frames are to be a good tight fit into the building structure with any gaps to be filled both internally and externally with a non-setting mastic in addition to the usual weather proofing seal to the exterior. Any gaps between the frame and building that are greater than 5 mm are to packed with a dense mineral fibre prior to mastic sealing.

5. Electrical Sockets

Electrical sockets must not be fitted back to back and removed areas of blockwork and plasterboard should be kept to an absolute minimum.

6. Water Pipes

All water pipes (and any other pipework) are to be resiliently mounted to avoid “water hammer”. This is particularly important for plasterboard walls.

7. Penetrations

Penetrations are to be dealt with as described in this report. Details for specific services penetrations may be supplied upon request.

8. Approved Samples and Inspections

Samples of each individual acoustic element should be provided for inspection at the beginning of its installation. Once approved, the Clerk of Works must ensure that the same level of quality continues throughout construction.

APPENDIX C – DEFINITION OF ACOUSTIC TERMS

The decibel

This is the basic unit of noise, denoted dB.

A Weighting

This is a weighting process which simulates the human ear's different sensitivity at different frequencies. A weighting can be shown two typical ways, 50 dB(A) L_{eq} or 50 dB $L_{Aeq.}$ Both mean the same thing. (See below for a definition of L_{eq}). The dB(A) level can be regarded as the overall level perceived by human beings.

L_{eq} and $L_{eq(s)}$

This is the equivalent continuous noise level which contains the same acoustic energy as the actual time-varying sound. In other words it is a kind of average noise level. It is denoted dB L_{eq} or, for A-weighted figures dB(A) L_{eq} or dB L_{Aeq}. It can also be expressed in terms of frequency analysis (see later). $L_{eq(s)}$ is the sample L_{eq} level.

L_n

This is the level exceeded for n% of the time. It is denoted dB L_n or, for A-weighted figures dB(A) L_n or dB $L_{An.}$ It can be expressed in terms of frequency analysis (see later). L_{90} is the level exceeded for 90% of the time and is a measure of the lowest level typically reached. L_{10} is the level exceeded for 10% of the time and is the highest level typically reached. L_{50} is the level exceeded for 50% of the time and, mathematically, it is the median.

L_{max}

This is the maximum level reached during a measurement period. The "time constant", or the ability of the equipment to respond to impulses is usually expressed along with it, e.g. "Fast", "Slow", etc. It is denoted dB L_{max} or, for A-weighted figures dB(A) $L_{max,}$ dB $L_{Amax,}$ etc. It can also be expressed in terms of frequency analysis.

Frequency Analysis

Whereas dB(A) gives a very useful overall figure, it has its limitations in that it cannot be used to model or predict the effect of noise control and mitigation as this nearly always has radically different performance at different frequencies.

Frequency analysis expresses an overall noise level at each frequency or band of frequencies in the audible range. Octave band analysis divides the audible range into 10 bands from 31.5 Hz to 16 kHz and the noise level in each band can be expressed in any form e.g. L_{eq}, L_{90}, L_{max} etc. One third octave band analysis uses 30 bands.

Narrow band analysis takes the process to resolutions of less than 1 Hz. This is useful for identifying the existence of tones (whines, hums, etc.) and in pin-pointing the sources.