Proposed Residential Development

Craythorne Lane, Boston PE21 6HA

soundsolution CONSULTANTS

Acoustic Design Statement

TECHNICAL REPORT

33516-R2

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Acoustic Design Statement

Prepared for: Neil Dowlman Architecture Ltd, 4-5 Church Street, Alford, Lincs, LN13 9EF

Site location: Craythorne Lane, Boston PE21 6HA

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1	21/11/2019	Original release	
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1 INTRODUCTION

1.1 The proposed residential development under consideration is located at Craythorne Lane, Boston PE21 6HA (hereinafter, "The Site"). Appendix B provides a site plan highlighting the development site boundary in red.

1.2 The development proposes the conversion of the existing nightclub building (currently disused) to form 12 No. residential flats as shown in the scheme design in Appendix C.

1.3 This document is intended to accompany a planning application to Boston Borough Council for the proposed scheme.

1.4 Sound Solution Consultants Ltd (SSC) has been commissioned to undertake a noise impact assessment to determine the level of impact from incident environmental and entertainment sources and provide commensurate noise mitigation for the residential proposals at the development.

1.5 A site-based study of environmental sound is used to evaluate the acoustic environment at The Site, in the context of the proposed for residential use. The methodology of assessment will refer to current practice and guidance documents which determine health limits and impacts and is guided by the incident sources of noise.

1.6 The Site is bounded by Craythorne Lane to the north and Sibsey Lane to the south and adjoins no.'s 30-31 Market place to the west. The development building adjoins a commercial building to the east (tattoo studio). The Pirana Nightclub exists directly opposite the site to the south. The immediate area about the development site is generally residential and commercial use.

1.7 It is evident that the development site is impacted upon by road traffic and entertainment noise from the adjacent night club. These sources of noise are considered herein, mindful of overarching requirements for planning and noise, as well as the proposed design. Appendix D shows photographs illustrating views of the development site during times of site assessment.

1.8 A Glossary of Acoustic Terms can be found in Appendix A that may assist with the terminology used within this report.

2 NOISE CRITERIA

NATIONAL PLANNING POLICY FRAMEWORK (NPPF)

2.1 The Department for Communities and Local Government introduced the National Planning Policy Framework (NPPF) in March 2012. The latest revision of the NPPF is dated June 2019.

2.2 The Framework replaced most planning policy, circulars and guidance including Planning Policy Guidance 24: Planning and Noise (1994). The NPPF defines the Government's planning policies for England and sets out the framework, within which local authorities must prepare their local and neighbourhood plans, reflecting the needs and priorities of their communities. The Government's stated purpose in producing the NPPF was to streamline policy so the planning process is less restrictive, to give a more easily understood framework for delivering sustainable development.

2.3 Under the heading of "Conserving and Enhancing the Natural Environment", specific noise pollution aims are detailed in Section 170 of the NPPF. It is stated that 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 … noise pollution…"

2.4 Considering "Ground Conditions and Pollution" it is also stated in Section 180 of the NPPF that planning policies and decisions should also ensure that any new development is appropriate for its location considering the likely effects of pollution on health, living conditions, the natural environmental, sensitivity of the site and wider area and impacts that could arise from the development. The aims in doing so 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.

2.5 Further NPPF aims related to noise include "Facilitating the sustainable use of minerals".

2.6 Section 182 of the NPPF refers to the 'agent of change' principle, putting the onus on the developer to provide mitigation for development to protect against long standing existing businesses (including nightclubs):

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed. "

2.7 It is stressed that the above references to noise should not be considered in isolation and that the theme, referred to as the "golden thread" of sustainability that runs through the NPPF is integral to noise.

2.8 The NPPF acknowledges that there is a host of existing sources of national and international guidance which can be used, in conjunction with the Framework, to inform the production of Local Plans and decision making.

NPPF – 'AGENT OF CHANGE'

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"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed. "

NOISE POLICY STATEMENT FOR ENGLAND (NPSE)

2.10 The Noise Policy Statement for England (NPSE) was published in March 2010. It sets out the long-term vision of government noise policy, which is fundamentally to: "Promote good health and good quality of life through the effective management and control of noise within the context of Government policy on sustainable development". The vision is supported by three key aims:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and reduce to a minimum, other adverse impacts on health; and
- Where possible, contribute to the improvement of health and quality of life.

2.11 The NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise but does not apply to noise in the workplace. The NPSE adopts the following concepts, to help consider whether noise is likely to have "significant adverse" or "adverse" effects on health and quality of life:

SOAEL – Significant Observed Adverse Effect Level.

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

LOAEL – Lowest Observed Adverse Effect Level.

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

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.

2.12 The NPSE emphasises that:

"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available (Defra, 2010)."

NATIONAL PLANNING PRACTICE GUIDANCE (PPG)

2.13 Revised Planning Practice Guidance was released in March 2014 to support the NPPF. The Guidance stipulates that Local Planning Authorities' plan making and decision making should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and
- Whether or not a good standard of amenity can be achieved.

2.14 The table below is in the Guidance to assist recognising "when noise could be a concern".

Perception	Examples of Outcomes	Increasing Effect Level	Action
Unnoticeable	No Effect	NOEL	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	
		LOAEL	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, 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 sleep disturbance. Affects acoustic character of the area and creates a perceived change in quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		SOAEL	

Perception	Examples of Outcomes	Increasing Effect Level	Action
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, 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
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Table 1 – Planning Practice Guidance to Support National Planning Policy Framework.

THE WORLD HEALTH ORGANISATION – GUIDELINES FOR COMMUNITY NOISE

2.15 The scope of WHO Guidelines for Community Noise was to consolidate scientific knowledge on the health impacts of community noise, to provide guidance to environmental health authorities and professionals trying to protect people from the harmful effects of noise in non-industrial environments. The health risk to human from exposure to environmental noise was evaluated and guidelines derived.

2.16 The WHO presents a measure to assess adverse health effects from steady-state 'anonymous' noises such as transportation sources.

"The effects of noise in dwellings, typically, are sleep disturbance, annoyance and speech interference. For bedrooms, the critical effect is sleep disturbance. Indoor guideline values for bedrooms are 30 dB LAeq for continuous noise.... At night-time, outside sound levels about 1 metre from facades of living spaces should not exceed 45 dB LAeq, so that people may sleep with bedroom windows open. This value was obtained by assuming that the noise reduction from outside to inside with the window open is 15 dB. To enable casual conversation indoors during daytime, the sound level of interfering noise should not exceed 35 dB LAeq."

"The capacity of a noise to induce annoyance depends upon its physical characteristics, including the sound pressure level, spectral characteristics and variations of these properties with time. During daytime, few people are highly annoyed at LAeq levels below 55 dB(A), and few are moderately annoyed at LAeq levels below 50 dB(A)."

PROFESSIONAL PRACTICE GUIDANCE: PLANNING & NOISE

2.17 Professional Practice Guidance on Planning and Noise has been developed by a working group consisting of representatives of the Association of Noise Consultants (ANC), Institute of Acoustics (IOA), Chartered Institute of Environmental Health (CIEH) and practitioners from a planning and local authority background. The guidance was made effective in May 2017 to provide a recommended approach to the management of noise within the planning system in England. The document draws upon the legislation, guidance and standards available at the time of publication and reflects the Noise Policy Statement for England (NPSE), the National Planning Policy Framework (NPPF) and Planning Practice Guidance (such as PPG-Noise), as well as other authoritative sources of guidance.

2.18 The initial noise risk assessment of the site without noise mitigation is summarised in Figure 1, where the indicative noise levels *"…should be interpreted with a degree of flexibility having regard to the locality, the project and the wider context."* Therefore, indicative levels should not strictly be used to determine the noise risk.

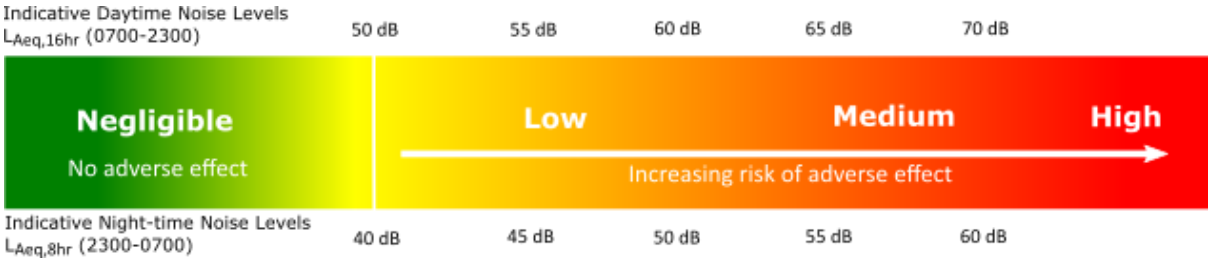


Figure 1 - Initial Site Noise Risk Assessment

2.19 When dealing with noise events, ProPG states that *"the initial site noise risk assessment should include the consideration of the individual noise events when the external $L_{Amax,F}$ exceeds 60 dB. A site should not be regarded as negligible risk if the $L_{Amax,F}$ exceeds, or is likely to exceed 60 dB more than 10 times a night. A site should be regarded as high risk if the $L_{Amax,F}$ exceeds, or is likely to exceed 80 dB more than 20 times a night."*

2.20 ProPG provides a summary of internal noise level guidelines as part of Stage 2 assessment requirements. These guidelines are derived from British Standard BS 8233:2014 *Guidance on Sound Insulation and Noise Reduction for Buildings* and The World Health Organisation *Guidelines for Community Noise* (1999).

Activity	Location	Daytime 07:00 to 23:00	Night time 23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq, 8h}$	-
Dining	Dining room / area	40 dB $L_{Aeq, 8h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq, 8h}$	30 dB $L_{Aeq, 8h}$ 45 dB $L_{Amax(F)}$

Table 2 – ProPG Internal Noise Level Guidelines.

2.21 The use of $L_{Amax(F)}$ as a health indicator should be treated in correlation with the overall $L_{Aeq, T}$ value during the night considering the number of transient events that occur on a regular basis.

The WHO (1999) study states in Section 3.4 of its text that indoor sound pressure levels should not exceed 45dB $L_{Amax(F)}$ more than 10-15 times per night. This definition is taken to define regularity of transient noise events against this health limit.

NOISE FROM PUBS AND CLUBS (PHASE II) - NANR 163, DEFRA 2006

2.22 Noise from Pubs and Clubs Phase II Final Report published by DEFRA in 2006, provides an extensive research study undertaken to determine the impact of entertainment noise occurring infrequently for more than an hour after 23.00 hours. Its reference may apply to music incident upon the proposed residential dwelling during the night hours 23:00 - 07:00, which might otherwise be "subjectively inaudible" inside residential dwellings.

2.23 The study reviews how inaudibility can objectively be defined, based upon laboratory tests where large range of residents are asked to subjectively rate the noise in some way (e.g. annoyance, loudness or audibility). The conclusions of testing indicate that

"the noise metric that appears to provide the best prediction of subjective response across the board for different entertainment noise types is the Absolute LAeq".

2.24 Table 4 of the Phase II report provides a relationship between the degree to which a resident might be accepting of music noise within their dwelling. A score of 1 correlates with where the large majority of residents surveyed could not hear music noise at this level (inaudibility). At a score of 2, a high percentage of people also reported this. The 'just acceptable' level correlates with the night-time noise limits inside bedrooms given by BS 8233:2014, the WHO and ProPG.

Semantic Descriptor	Score	Absolute dB $L_{Aeq,\ 5\ min}$
Clearly acceptable	1	17.0
	2	20.4
	3	23.8
	4	27.2
Just acceptable	5	30.6
Just unacceptable	6	34.0
	7	37.4
	8	40.8
	9	44.2
Clearly unacceptable	10	47.5

Table 3 – Relationship between acceptability and absolute dB $L_{Aeq,\ T}$ noise levels from entertainment noise inside a dwelling (NANR 163, Table 4).

4 ENVIRONMENTAL SURVEY SUMMARY & NOISE RISK

4.1 An environmental survey was undertaken from Friday 1st to Tuesday 5th November 2019 to quantify sound levels at the development site in accordance with BS 7445-2:1991. Reasonable measurement conditions were reported generally throughout the noise survey, such that the weather is not expected to have significantly or adversely influenced the levels measured. Noise measurements were taken at the locations detailed in Appendix C and highlighted on the Site Plan in Appendix B. The data at these locations is provided in graphical form in Appendix C.

4.2 The free-field sound level data in this section are summarised from raw data in Appendix C and account for a difference of 3 dB from the raw measurement data to allow for the influence of the building façade at Position 3, generally in accordance with the requirements of BS 8233:2014. The snapshots of environmental sound are taken to be representative of the climate across the development site and are used to evaluate the environmental noise impact for the development.

4.3 **An audio recording was made at Position 1 in order to identify sound sources. A direct line-out was taken from the sound level meter and fed into a Zoom H1 handy recorder enabled to capture real-time audio representative of position 1 to 128kbps MP3; audio was captured between 15:00 on Friday 1st to 04:00 on Sunday 3rd November 2019. The audio recorder was started at 15:00:00 hours in sync with the SLM time clock to cross reference audio events with SLM data.**

4.4 Night-time values summarised in Table 4 below are based on the highest measured 1-hour $L_{Aeq,\,T}$ during periods of nightclub operation and these periods were the highest-measured across the entire night period. The max levels quoted are based on the average of the top 15 measured $L_{AFmax,\,1,min}$ values for the night time period, which occurred during the night club operation on Friday and Saturday between 23:00 and 04:00 hours.

4.5 Based on analysis of the audio recording at P1, the period of nightclub operation was clearly identifiable with music and people noise (congregation with talking and shouting) clearly dominant between approximately 10:30 and 04:00 on Friday and Saturday nights.

4.6 Fireworks were identified from the audio recording at 20:00 hours lasting approximately 15 minutes; this is clearly identifiable from the time-history chart in Appendix C and has been omitted from the below summary.

Location	T	Time	Free-field sound pressure levels $L_{eq,T}$ / $L_{max(F)}$ dB re. 20µPa						
			125Hz	250Hz	500Hz	1KHz	2kHz	4kHz	A
Position 1: Front roof overlooking Sibsey Lane / nightclub	16h	Day	56	55	53	50	45	37	55
	1h*	Night	67	63	66	65	59	52	69
	8h	Night	64	60	62	60	55	48	64
		Max[1]	71	69	80	83	74	65	85
Position 2: Rear roof / Craythorne Lane	16h	Day	57	57	54	49	44	34	55
	1h*	Night	60	54	56	55	49	40	58
	8h	Night	57	53	52	49	44	37	54
		Max[1]	64	63	69	72	65	54	75
Position 3: 2nd floor facing road traffic / adj. nightclub entrance	16h	Day	52	52	49	52	48	42	55
	1h*	Night	58	59	66	64	59	51	68
	8h	Night	55	55	61	59	54	46	63
		Max[1]	62	65	78	82	74	66	85

*Highest-measured 1-hour period during nightclub operation, used for assessment.

Table 4 – Highest-measured, free-field day and night sound pressure levels at development site.

4.7 The table above shows that the night-time noise levels at the development are above 60 dB(A) $L_{Aeq,8hr}$ and regularly occurring max levels are above 80 dB $L_{AF(max)}$. Entertainment noise sources are outside the scope of ProPG guidance; however, the site may be considered high risk based on the magnitude of the noise levels due to the nightclub operation. It is evident from the spectral data that the entertainment noise does not have a dominant low frequency component but is characterised by strong mid frequency energy (people noise and music break-out).

4.8 Where there is a high noise risk, the pre-planning application advice stated in ProPG is as follows:

"High noise levels indicate that there is an increased risk that development may be refused on noise grounds. This risk may be reduced by following a good acoustic design process that is demonstrated in a detailed ADS. Applicants are strongly advised to seek expert advice."

BACKGROUND SOUND LEVELS

4.9 The 'typical' background sound levels are reported in this section in accordance with BS 4142 and have been established from histograms of the recorded $L_{A90,\ 15min}$ data at Positions 1, 2 and 3. These are shown in Appendix C. The reported levels are not used further in this assessment.

4.10 In line with Section 8.1.4 of BS 4142:2014, the monitoring duration should reflect the range of background noise levels for the period assessed. In practice, there is no single level for background sound as this is a fluctuating parameter, although a representative value of the period should be used. Note this is not either the lowest or mean average value of $L_{A90,15min}$.

[1] an arithmetic average of the 15 typical, maximum events during a representative night-time period have been used to determine values of $L_{Amax(F)}$.

From the commentary of BS 4142:2014, it is recognised that in using the background sound level in the method for rating and assessing industrial and commercial sound, the objective is not simply to ascertain a lowest measured background sound level, but rather to quantify what is typical during particular time periods. A representative level should account for the range of background sound levels and not automatically assumed to be the lowest value.

4.11 The following summary of $L_{A90,T}$ sound levels is presented from the measured data at Positions 1, 2 and 3 of the environmental assessment. This has been established in accordance with the assessment methodology of BS 4142:2014.

Measurement Data		Free Field Sound Pressure Level, dB $L_{A90,T}$ re. 20µPa					
Date	Time HH:MM	Position 1		Position 2		Position 3	
		Range	Rep.	Range	Rep.	Range	Rep.
01/11/19 to 05/11/19	07:00 – 23:00	39 – 54	46	42 –54	45	38 –59	48
	23:00 – 07:00	35 –64	36	40 – 54	41	35 – 64	37

Table 5 – Background $L_{A90,T}$ sound pressure levels.

5 ACOUSTIC DESIGN STATEMENT

5.1 The acoustic design will be dictated by entertainment noise sources incident on the proposed development. Whilst entertainment noise sources are outside the scope of the ProPG guidance document, the site is nevertheless deemed 'high risk' based on the measured levels during times of nightclub operation.

5.2 The requirements of this acoustic design statement require the provision for:

- Orientation of bedrooms away from the worst affected facades, as far as has been pracical.
- Acoustically rated windows (with secondary glazing to the worst affected facades).
- Sealed façade with mechanical ventilation strategy allowing for occupants to keep windows closed.
- External walls and roof should be internally lined to enhance sound insulation.

5.3 It should be note that where habitable rooms overlook the adjacent night club on the worst-affected facades, reducing entertainment noise sources to inaudibility internally may not be practical or possible. It is therefore recommended that the proposed layout, even as revised, bedrooms are oriented away from the worst affected facades and that kitchens and bathrooms are preferentially oriented to overlook the nightclub where possible, instead of living areas.

5.4 Commercial or industrial sources are deemed to be insignificant where entertainment sources dictate the acoustic design; the proposed façade elements will readily mitigate any noise impact from the adjacent tattoo studio or plant associated with surrounding buildings (which was not observed to be dominant outside of nightclub operation).

5.5 There are no amenity areas proposed in the development as to warrant consideration in this acoustic design statement.

5.6 Noise break-in calculations based on standard methodology for assessing environmental sources will be carried out; special consideration will be given to activity noise from the adjacent nightclub, as this type of noise source has potential to cause significant disturbance if audible internally within the proposed residential flats.

5.7 The sound insulation scheme for the development is illustrated in Appendix D, with calculation results in Appendix E.

GLAZING SPECIFICATION

5.8 The calculations undertaken in this section assume that acoustically rated glazing is installed to attenuate road traffic noise in accordance with BS 8233:2014 and World Health Organisation internal noise guidance criteria. The glazing specifications are based on achieving both the internal average and maximum criteria which require a suitable, accompanying ventilation strategy.

5.9 The specification accounts for the adjacent nightclub noise which can be attenuated to << 24 dB $L_{Aeq,\ 1h}$ for the worst-case evening and night period. The technical basis for this relates on the relationship between acceptability and absolute $L_{Aeq,\ T}$ noise levels inside a dwelling, shown in Table 2 of this report.

Area Ref	Glazing Configuration (glass-gap-glass)	Sound Reduction Index, SRI dB							Report Ref.
		125Hz	250Hz	500Hz	1KHz	2KHz	4KHz	Rw	
1 (front / side façade)	*Triple + secondary glazing 4-18-4-16-6.4 +6mm Sec.*	33	33	43	47	52	62	**45**	**Figure F1**
2 (rear façade)	*Double glazing + laminate 6-10-8.8 lam.*	25	26	38	41	41	48	**39**	**Figure F2**

Table 6 – Glazing performance specification.

5.10 The above-listed Sound Reduction Index Rw to BS EN ISO 140-3:1995 and BS EN ISO 717-1:1997 are based upon data provided by Velfac (Cambridge) Ltd. Alternative glazing configurations and window manufacturers may be used, so long as the above specifications are met in relevant façade locations.

5.11 The higher glazing specification of 45 dB R_w requires secondary glazing to mitigate activity noise associated with the adjacent nightclub to meet suitable internal levels in habitable rooms during the evening and night periods. The target is deemed suitable in the absence of strong low frequency components sometimes associated with entertainment sources and is representative of a very low internal level where breathing or internal domestic noise sources would prevail. It is not practical to mitigate transient max levels to guarantee inaudibility on the worst affected facades, therefore, it is recommended that bedrooms are re-oriented to face inwards (away from the front and nightclub facades) as far as practically possible.

5.12 It shall be noted that in the case of all habitable rooms of the development, it can be shown that opening the windows may exceed desirable internal noise criteria. The information in this section is therefore based upon securing a suitable internal environment with closed windows.

EXTERNAL WALLS AND ROOF

5.13 It is recommended that existing external walls and roof elements are lined internally to enhance sound insulation. This can be reviewed at the detailed design stage, where the calculations in Appendix F assume a minimum specification of 55 dB R_w and 50 dB R_w for walls and roof elements respectively.

5.14 Masonry external walls can be suitably enhanced utilising independent lining systems with insulation and double boarded plasterboard with mineral wool (min. 25 kg/m^2 e.g. 2 x 15 mm Soundbloc or equivalent, with 50 mm timber stud spaced at least 20 mm from the existing wall and containing 33 – 45 kg/m^3 density mineral wool slab).

5.15 The existing roof structure will need to be reviewed in order to specify suitable enhancements for sound insulation; typically, the internal roof lining should comprise a decoupled, suspended ceiling system utilising acoustic hangers or resilient bar system. The void space should be suitably large to contain 100 mm mineral wool slab insulation and double boarded plasterboard as above.

VENTILATION STRATEGY

5.16 It is recommended in this report that the building envelope design is developed for all rooms of the development under System 4: Continuous mechanical supply and extract with heat recovery (alternatively known as Mechanical Ventilation and Heat Recovery (MVHR)). Any scheme for ventilation must always comply with Building Regulations Part F; where, herein, the appraisal of noise break-in accounts for this condition.

5.17 It is noted that sealing occupants in buildings is not normally desirable, where the proposed system of ventilation gives occupants the option to keep windows closed when external noise levels are high and otherwise open them during other periods. Any ventilation system façade terminations should be ducted to the inside i.e. away from the worst-affected building facades.

5.18 Where mechanical ventilation is installed, an internal noise guidance limit of NR25 (63Hz to 8kHz) is recommended not to be exceeded from all ventilation systems installed in bedrooms and living areas. These values roughly equate to 30dB(A) as specified by WHO / BS 8233 criteria for suitable standards of internal noise, with the absence of low frequency sound. Internal noise levels from mechanical ventilation equipment should be verified using reference guidance; such as the Chartered Institute of Building Services Engineers Guide B5: Noise and vibration control, to ensure that suitably low internal noise levels result.

5.19 A mechanical ventilation and heat recovery system, a Nuaire MRXBOX95(AB)-WM2 as detailed in Appendix G, can operate to achieve BS8233;2014 internal criteria by means of the manufacturers' acoustic enclosure (1Z) and distribution box (DB). The system can also meet internal sound level criteria in the maximum setting that facilitates purge ventilation with windows closed. Comparable ventilation systems can be used at the development so long as the specifications are met. The suitability of the Nuaire system, as detailed, is verified in Table 7. The calculation uses the highest (supply side) noise levels of the proposed unit at full operating capacity (150W) as to provide a maximum of 75l/s ventilation rate. The calculation demonstrates

that the specified scheme of whole house ventilation will maintain suitable internal conditions where the unit is operated under rapid ventilation conditions of 75l/s.

#	Procedure	Data	Octave Band Noise Level dB								Total
			63	125	250	500	1000	2000	4000	8000	
1	MRXBOX95(AB)-WM2-1Z-DB	Lw dB	37	50	54	43	32	24	24	16	56
2	Duct losses[1]	2m	-2	-1	-1	-1	-1	-1	-1	-1	-
3	Branch losses[1]	x1	-3	-3	-3	-3	-3	-3	-3	-3	-
4	Bend losses[1]	x1	0	-1	-4	-6	-4	-4	-4	-4	
5	End reflection 150dia[1]	dB	-18	-13	-8	-4	-1	0	0	0	-
6	Lw at exit	Lw dB	14	32	38	29	23	16	16	8	40
7	Constant A (42m3 room)[2]	dB	4	3	2	1	0	-1	-2	-3	
8	Constant B (0.9m away)[2]	dB	-5	-5	-5	-5	-5	-5	-5	-5	
9	Lp in room[2]	Lw dB	13	30	35	25	18	10	9	0	37
10	*NR25*	*dB*	*55*	*44*	*35*	*29*	*25*	*22*	*20*	*18*	
11	*Excess to NR25*	*dB*	*-42*	*-14*	*0*	*-4*	*-7*	*-12*	*-11*	*-18*	
12	Lp(A) in room	dB(A)	-13	13	27	22	18	12	10	-1	**29**

1. *Assumes a 200mm x 90mm x 2000mm supply duct, single 50/50 split and unlined elbow with turning vanes, transforming to a 150dia exit, from section 6 of CIBSE Guide B5.*
2. *The internal noise level of the room is calculated from Section 7.2 of CIBSE Guide B5, assuming a typical internal reverberation time 0.5-1.0s and a measure 0.9m under the grill.*

Table 7 – Example MVHR system noise levels in habitable rooms, from CIBSE Guide B5.

6 CONCLUSIONS

6.1 An assessment of environmental noise and entertainment noise sources has been carried out with respect to the proposed development at Craythorne Lane, Boston PE21 6HA, to verify suitable building element design in the creation of residential accommodation.

6.2 Minimum specifications for building envelope elements have been recommended to meet BS 8233:2014 criteria and to provide suitable mitigation against entertainment noise sources; a suitable whole-house mechanical ventilation system has been proposed for the scheme whereby residents have the option to keep windows closed.

6.3 It has been demonstrated that appropriate internal sound levels can be achieved within the proposed residential dwellings with the implementation of the building elements specified, relating to glazing and ventilation and with appropriate enhancements to the external walls and roof structure. Even where bedrooms are re-oriented to face inwards i.e. away from the nightclub-facing facades, complete inaudibility from entertainment noise may unpractical and unlikely to be guaranteed, however a useful balance has been estimated based upon research.

6.4 In accordance with the National Planning Policy Framework and Planning Policy Guidance, it has been shown that noise incident on the development site can be mitigated by the developer to achieve suitable living conditions based on the recommendations set out in this report.

Appendix A: Glossary of Acoustic Terms

'A' weighting dB(A): Correction applied to the frequency range of a noise in order to approximate the response of the human ear. Noise measurements are often A-weighted using an electronic filter in the sound level meter.

Attenuation: Sound reduction, measured in decibels (dB).

Ambient Sound: The 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.

Background sound level: 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.

Calibration: A check of the function of a sound level meter by comparing the meter reading with a known sound pressure level.

Decibel (dB): The unit of sound level and noise exposure measurement. The range of audible sound pressures is approximately 0 dB to 140 dB.

Frequency (Hz): The pitch of the sound, measured in Hertz.

LAeq,T: The A-weighted equivalent continuous sound pressure level during a period. It is the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period, T.

Octave-bands: A division of the frequency range into recognised bands.

Rating level, LAr,Tr: The specific sound level plus any adjustment for the character of the sound.

Residual sound: Ambient sound remaining in the absence of the specific sound or that it is supressed as not to contribute to the ambient sound level.

Residual sound level, Lr or Leq,T: The equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given reference time interval, T.

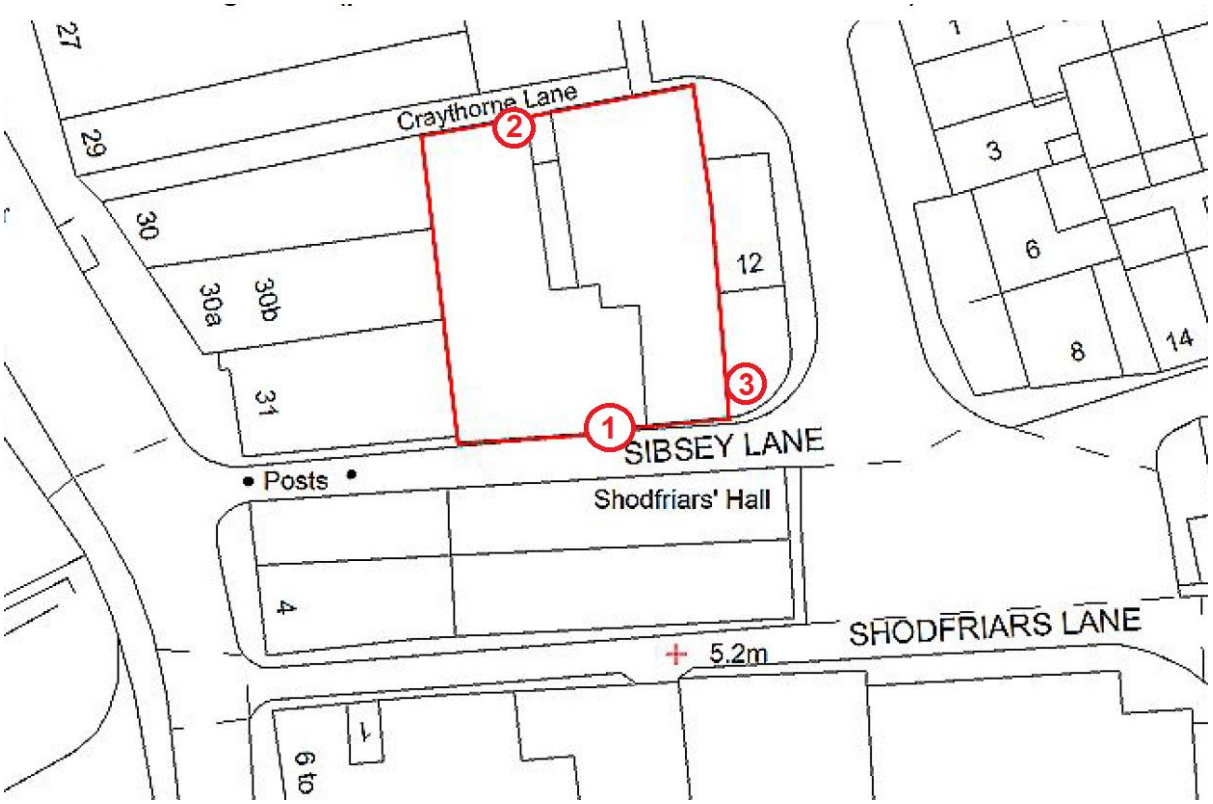
Sound pressure level (SPL): The basic measure of sound, expressed in decibels, usually measured with an appropriate frequency weighting (e.g. the A-weighted SPL in dB(A)).

Sound power level (Lw): The sound energy radiated per unit time by a sound source measured in watts (W). Sound power can be weighted (e.g. A-weighted) and is not influenced by environmental or physical factors such as weather or distance.

Specific sound: Sound source being assessed.

Specific sound level, Ls or Leq,T: The equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval, T.

Appendix B: Site Plan Highlighting Sound Measurement Locations



Position 1: Edge of existing roof, opposite nightclub (above Sibsey Lane).

Position 2: Far side roof (above Craythorne Lane).

Position 3: Second floor building end facing road traffic / adjacent to club entrance.

Figure B1 – Location Plan, illustrating the noise measurement positions.

Appendix C: Environmental Noise Survey Record & Data

The equipment used during the survey consisted of the following precision monitoring equipment and accessories which conform to BS EN 61672-1:2003 (Class 1) for sound level meters and BS EN 60942 (Class 1) for sound calibrators. All equipment listed in the Table below has traceable or UKAS calibration history valid during the relevant times of the site assessment; no greater than two years for sound level meters and one year for sound calibrators.

Position No.	Manufacturer	Model No.	Description	Serial No.	Calibration Due Date
3	Larson Davis	LxT	3rd Octave Band Sound Meter	4203	02/08/21
3	Larson Davis	PRMLxT1L	Microphone pre-amplifier	35997	
3	Larson Davis	337B02	½" Electret microphone	154590	
1	Larson Davis	LxT	3rd Octave Band Sound Meter	2680	07/02/21
1	Larson Davis	PRMLxT1L	Microphone pre-amplifier	29299	
1	Larson Davis	337B02	½" Electret microphone	122141	
2	Larson Davis	LxT	3rd Octave Band Sound Meter	4170	09/04/21
2	Larson Davis	PRMLxT1L	Microphone pre-amplifier	36076	
2	Larson Davis	337B02	½" Electret microphone	35766	
1,2,3	Larson Davis	CAL200	Sound Level Calibrator	8121	25/06/19 (UKAS)

Table C1 – Sound monitoring equipment.

The calibration of the sound level meter was checked using the handheld calibrator CAL200 at its verified reference level and frequency, 114 dB at 1kHz, before any measurements were taken. Validation checks at the end of the survey demonstrated acceptable drift across all parts of the study, across all sound level measurement equipment used, of ≤ 0.10 dB.

Interval noise data was recorded at the measurement locations at 15-minute and 1-minute periods, time synchronised to GMT and between sound level meters. The unattended sound level meters were configured to record data at their highlighted locations for the total of the survey period, therefore encompassing three, night-time periods (23.00 to 07.00) and three, entire daytime periods (07.00 to 23.00). Power failed at Potion 2 after 66 hours.

Weather conditions at the times of site attendance are reported in the Table below.

Weather conditions	Start	Finish	Additional comments
Wind velocity	< 1 m/s	< 3 m/s	Rainfall during the survey, generally from Sunday onwards. Does not affect the outcome of the assessment.
Wind direction	South-east	North	
Cloud cover/rain	Overcast / Dry	Overcast / Dry	
Day Temperature	12 °C	10 °C	

Table C2 – Recorded weather conditions.

Observation of the noise levels around the site consisted of, predominantly, road traffic local to the Site, along the A16 (approx. 80 m from site) which dominated sound levels across The Site during the daytime period. During the evening and night-time period, it is evident from audio recordings taken

at P1 that there are periods of entertainment noise clearly dominant during times of adjacent nightclub operation.

A brief description of the measurement positions is provided below:

Position 1) A microphone was placed at roof level, opposite the nightclub and overlooking Sibsey Lane. This measurement position is used to evaluate sound levels from entertainment and transportation noise sources.

Position 2) A microphone was placed at roof level, at the far end of the building overlooking Craythorne Lane. This measurement position is used to evaluate sound levels from transportation sources, and entertainment noise sources at the least-affected façade.

Position 3) A microphone was placed at second floor level at a façade location 1 m from an open window, facing road traffic and adjacent to the nightclub entrance. This measurement position is used to evaluate sound levels from entertainment and transportation noise sources.

Figure C1 – Photo showing Measurement Position 1. Plant shown is disused.

Figure C2 – Photo showing Measurement Position 2.

Figure C2 – Photo showing Measurement Position 3.

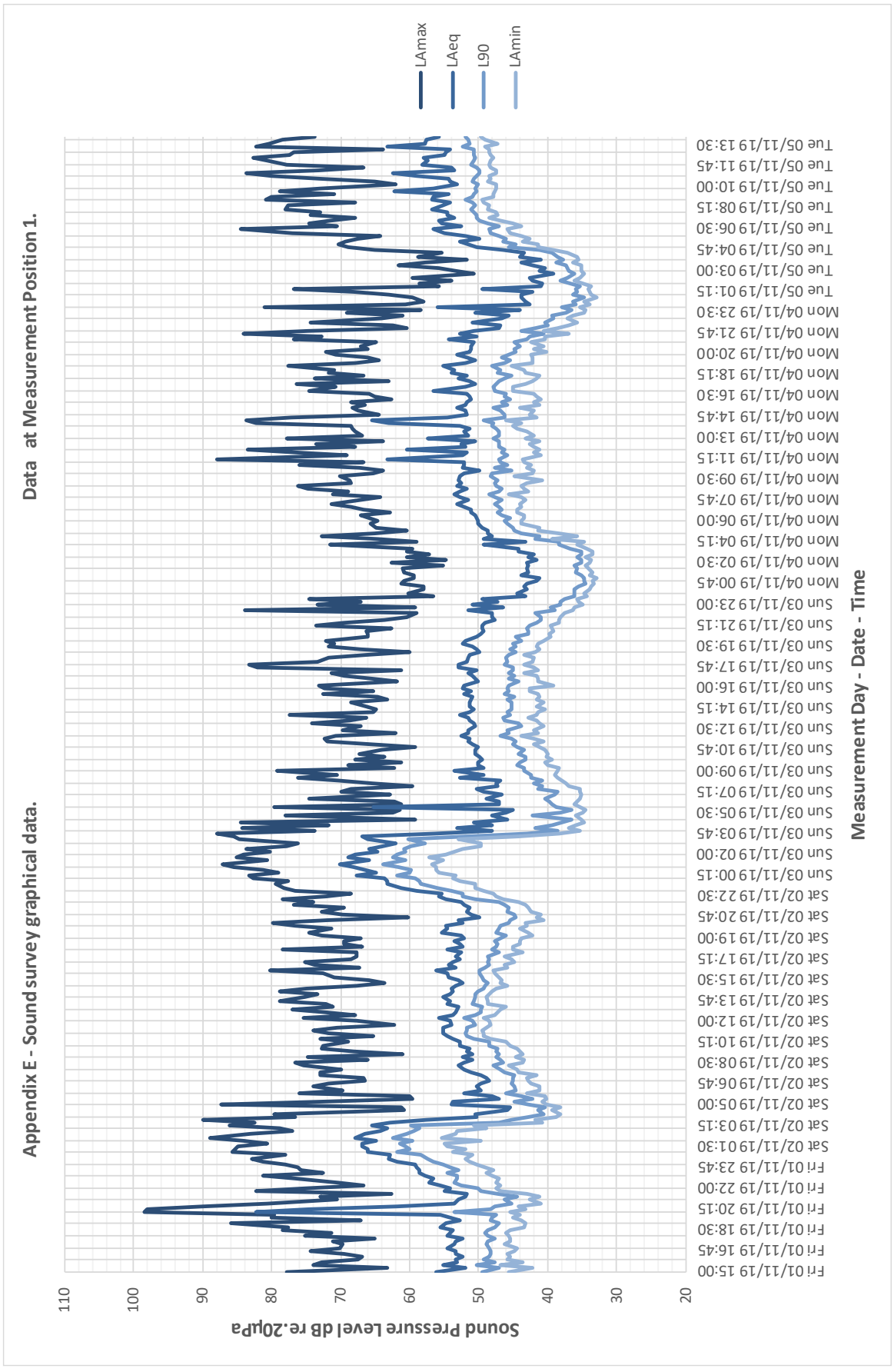


Figure C3 – Sound measurements at Position 1.

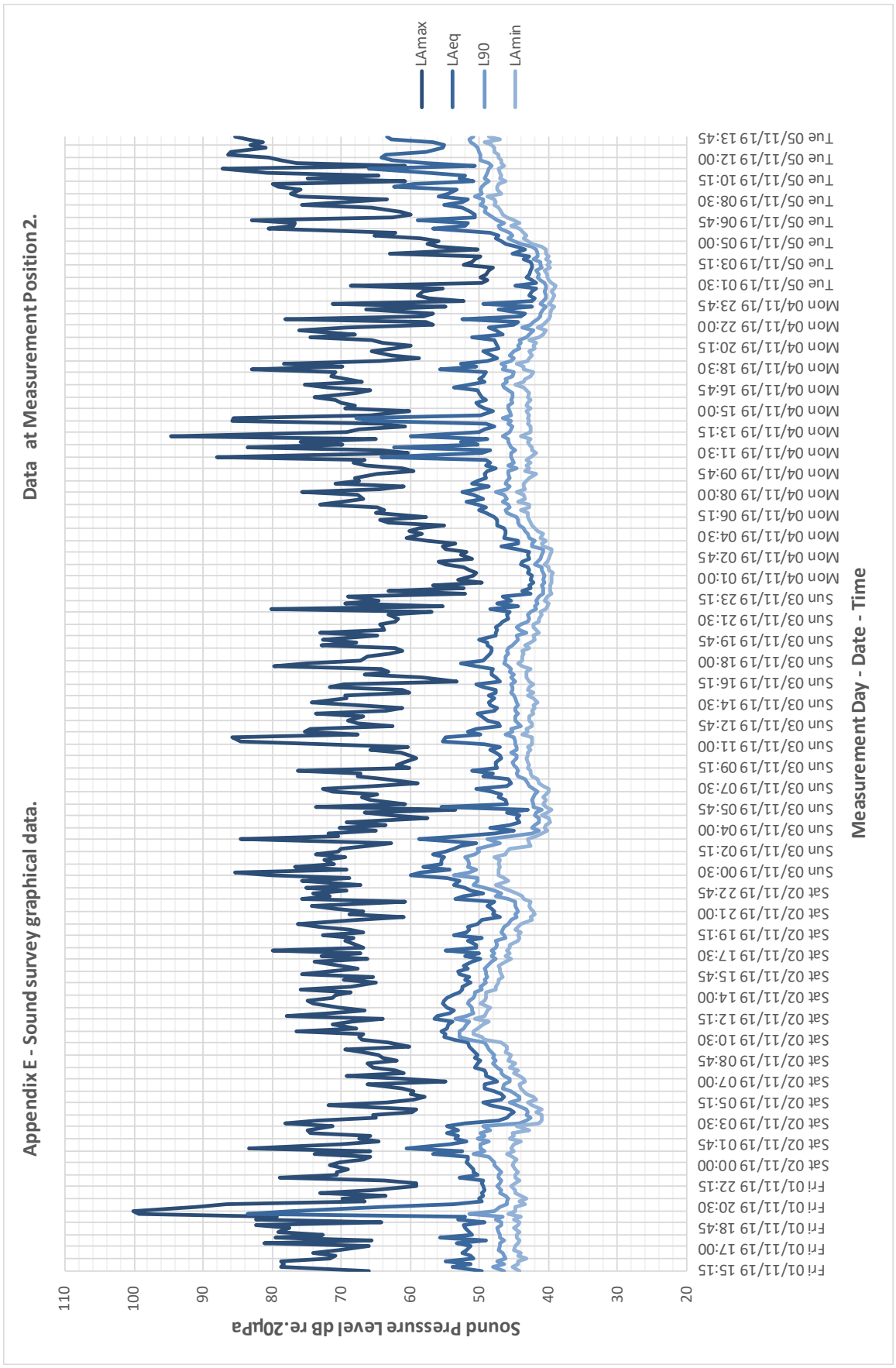


Figure C4 – Sound measurements at Position 2.

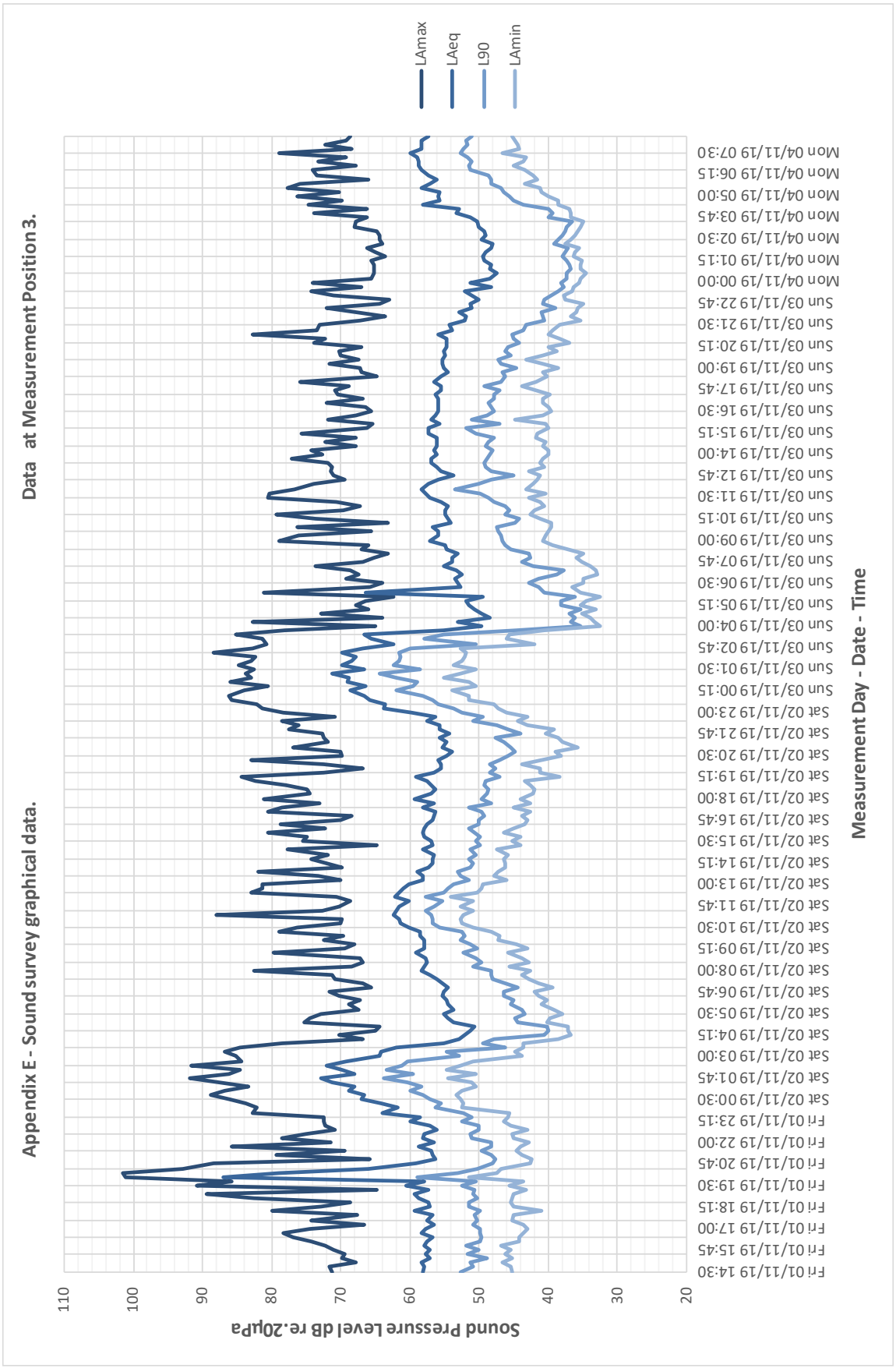


Figure C5 – Sound measurements at Position 3.

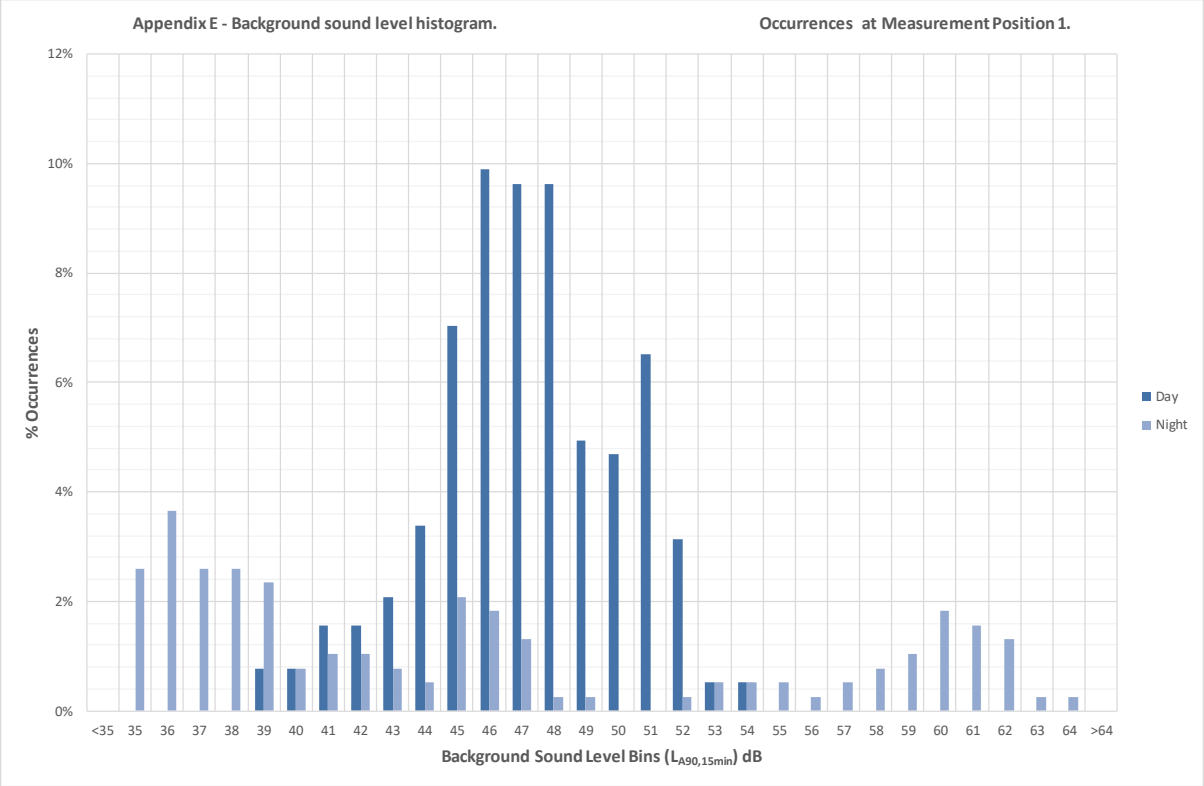


Figure C6 – Histogram of background sound measurements at Position 1.

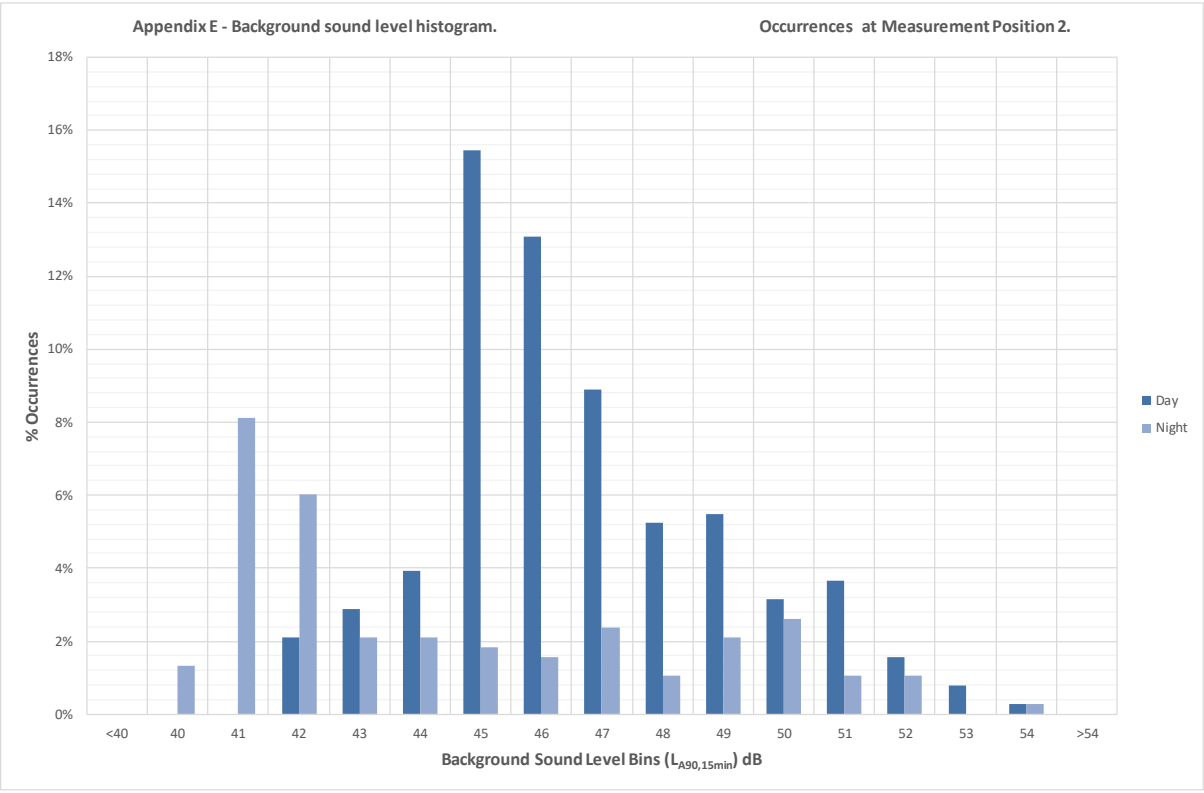


Figure C7 – Histogram of background sound measurements at Position 2.

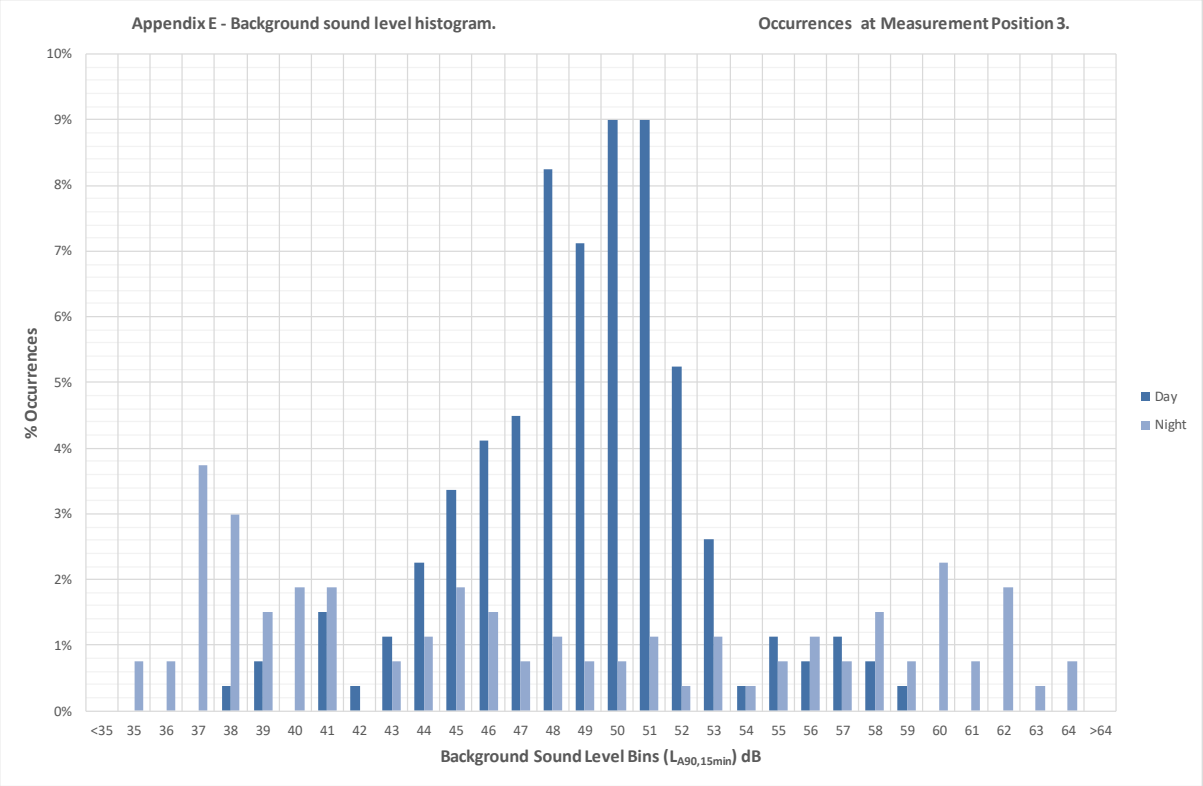


Figure C8 – Histogram of background sound measurements at Position 3.

Appendix D: Scheme Design

Figure D1 – Existing plans and elevations.

Figure D2 – Proposed plans and elevations.

Ref.	Colour	Glazing Configuration	Ventilation Scheme
1		Glazing 45 R_w	Mechanical (no vents to façade)
2		Glazing 39 R_w	Mechanical (no vents to façade)

Table D1 – Colour key for façades indicated in Figure D3 for all levels.

Appendix E: Noise Break in Calculations

Consideration is given for entertainment noise from the adjacent nightclub, where the highest measured 1-hour night-time $L_{Aeq,\ T}$ (representative of nightclub noise sources) has been used. Calculations have been undertaken based on achieving < 25 dB $L_{Aeq,T}$ for the night-time period, and mitigating $L_{Amax(F)}$ levels (attributable to nightclub activity) as far as practicable.

The building elements specified in this section are based upon their indicated locations from the architectural scheme layout drawings in Appendix D, along with the estimated room volumes and building specifications. The noise break-in calculations are summarised in based on a representative selection of (smaller) bedrooms and living areas within the development, as to not underpredict the resulting values in all similar areas. Where detailed information for the building specifications has not been made available, conservative estimates have been used in the calculations and are presented here.

The calculation method used follows Section G.2.1 of BS 8233:2014, based on the method given in EN 12354-3:2000, and considers the sound insulation of each major building façade component summarised as wall, glazing and ventilation parts. The representative sound levels are taken as the continuous equivalent free-field sound pressure level ($L_{eq,\ ff}$) outside the room elements under consideration and are used in the noise break-in calculations to determine suitable building elements for the sound insulation scheme at the development.

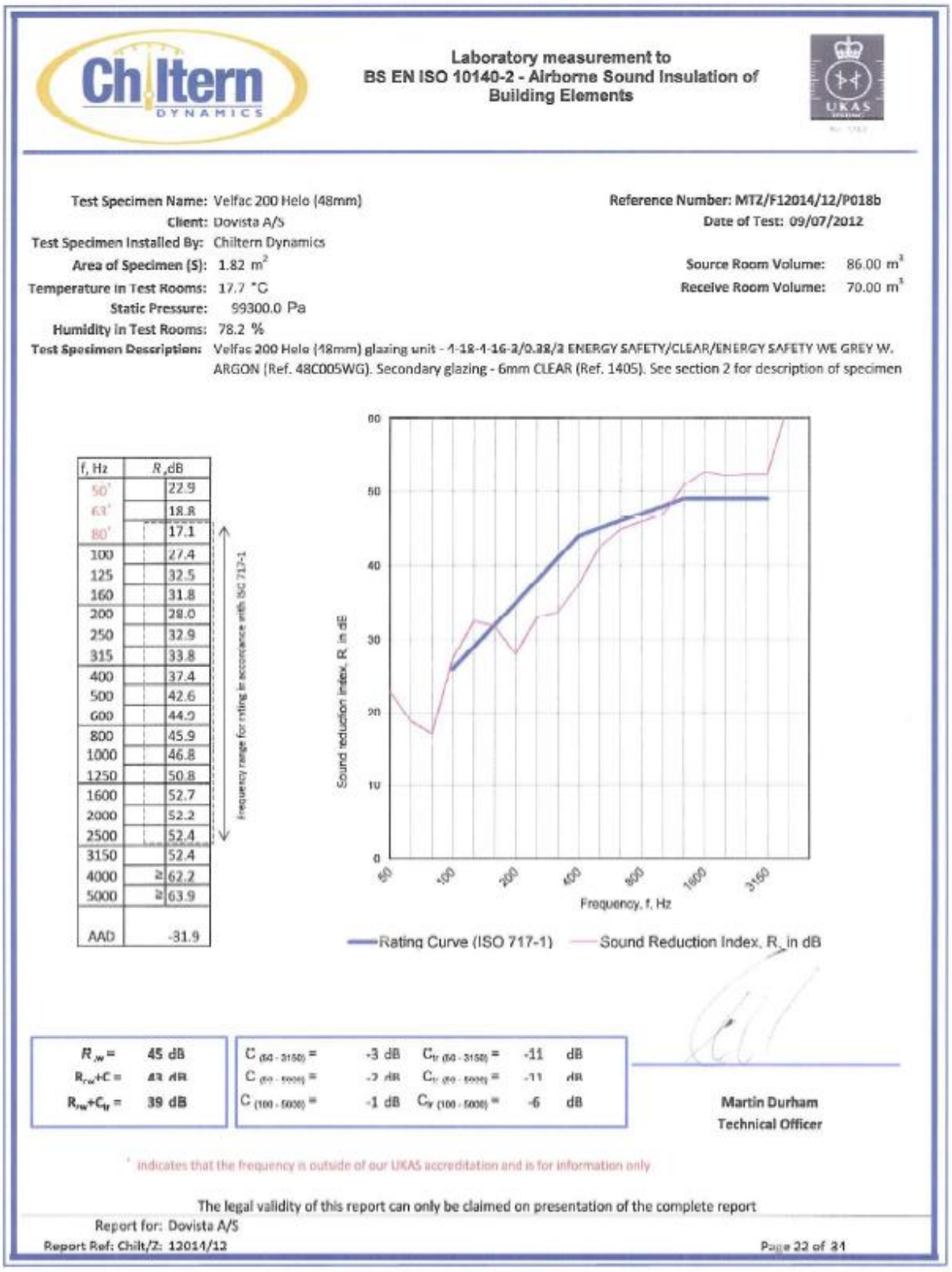
Where the development comprises of façade walls and roof (rated at least 55 dB R_w and at least 50 dB R_w respectively, with enhanced linings); these pose the least concern for sound insulating design, where the remaining (window and ventilation) components will have greatest influence on the resulting internal noise level.

The accuracy of a calculation model in accordance with EN 12354-3:2000 is heavily reliant on input data. To reduce inaccuracy by design, all window and ventilation data referenced in this assessment is based on ISO140 laboratory test records provided by leading manufacturers. It is acceptable to use alternative specifications however the minimum performance standards as specified must be met or exceeded with any alternative design approach. The specifications in this assessment have been verified by calculation as acceptable façade elements.

Calculation Summary according to BS 8233:2014 Section G2.1, from BS EN 12354-3:2000.									
Ref	Room Name	Sound Insulation Scheme, dB				Criteria, dB(A)			Pass / Fail Design Vs Criteria
						25	25	40	
		Wall	Glazing	Vent	Roof	Day	Night	Max	
		Rw	Rw	Dne,w	Rw	dB(A)	dB(A)	dB(A)	
1	Flat 2 Bedroom 1	55	45	-	-	< 20	21	34	PASS
2	Flat 3 Living room / kitchen	55	45	-	-	< 20	< 20	33	PASS
3	Flat 4 Bedroom 2	55	45	-	-	< 20	21	35	PASS
4	Flat 4 living room / kitchen	55	45	-	-	< 20	22	36	PASS
5	Flat 1 bedroom	50	39	-	-	22	22	33	PASS
6	Flat 1 living room	50	39	-	-	< 20	< 20	29	PASS
7	Flat 12 bedroom 1	55	45	-	50	< 20	21	34	PASS

Table E1 – BS 8233:2014 calculation summary for noise mitigation scheme achieving stringent internal noise level guidelines applied to dB $L_{Aeq,\ 1hr}$ and dB $L_{Amax(F)}$ due to entertainment sources.

Appendix F: Ventilation Specifications



Chiltern DYNAMICS

Laboratory measurement to BS EN ISO 10140-2 - Airborne Sound Insulation of Building Elements

UKAS

Test Specimen Name: Velfac 200 Helo (48mm)
Reference Number: MTZ/F12014/12/P018b
Client: Dovista A/S
Date of Test: 09/07/2012
Test Specimen Installed By: Chiltern Dynamics
Area of Specimen (S): 1.82 m²
Source Room Volume: 86.00 m³
Temperature in Test Rooms: 17.7 °C
Receive Room Volume: 70.00 m³
Static Pressure: 99300.0 Pa
Humidity in Test Rooms: 78.2 %
Test Specimen Description: Velfac 200 Helo (48mm) glazing unit - 4-18-4-16-3/0.38/3 ENERGY SAFETY/CLEAR/ENERGY SAFETY WE GREY W. ARGON (Ref. 48C005WG). Secondary glazing - 6mm CLEAR (Ref. 1405). See section 2 for description of specimen

f, Hz		R, dB
50*		22.9
63*		18.8
80*		17.1
100		27.4
125		32.5
160		31.8
200		28.0
250		32.9
315		33.8
400		37.4
500		42.6
630		44.9
800		45.9
1000		46.8
1250		50.8
1600		52.7
2000		52.2
2500		52.4
3150		52.4
4000	≥	62.2
5000	≥	63.9
AAD		-31.9

Frequency range for rating in accordance with ISO 717-1

R_w =	45 dB	$C_{(50-3150)}$ =	-3 dB	$C_{tr\ (50-3150)}$ =	-11 dB
R_w+C =	42 dB	$C_{(50-5000)}$ =	-2 dB	$C_{tr\ (50-5000)}$ =	-11 dB
R_w+C_{tr} =	39 dB	$C_{(100-5000)}$ =	-1 dB	$C_{tr\ (100-5000)}$ =	-6 dB

Martin Durham
Technical Officer

* indicates that the frequency is outside of our UKAS accreditation and is for information only

The legal validity of this report can only be claimed on presentation of the complete report

Report for: Dovista A/S
Report Ref: Chilt/Z: 12014/12
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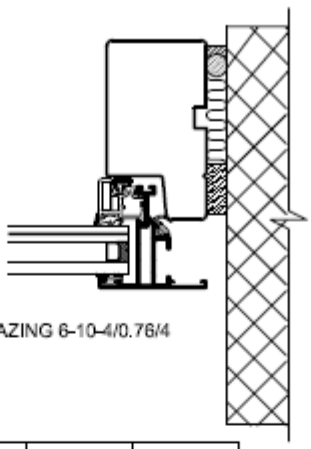
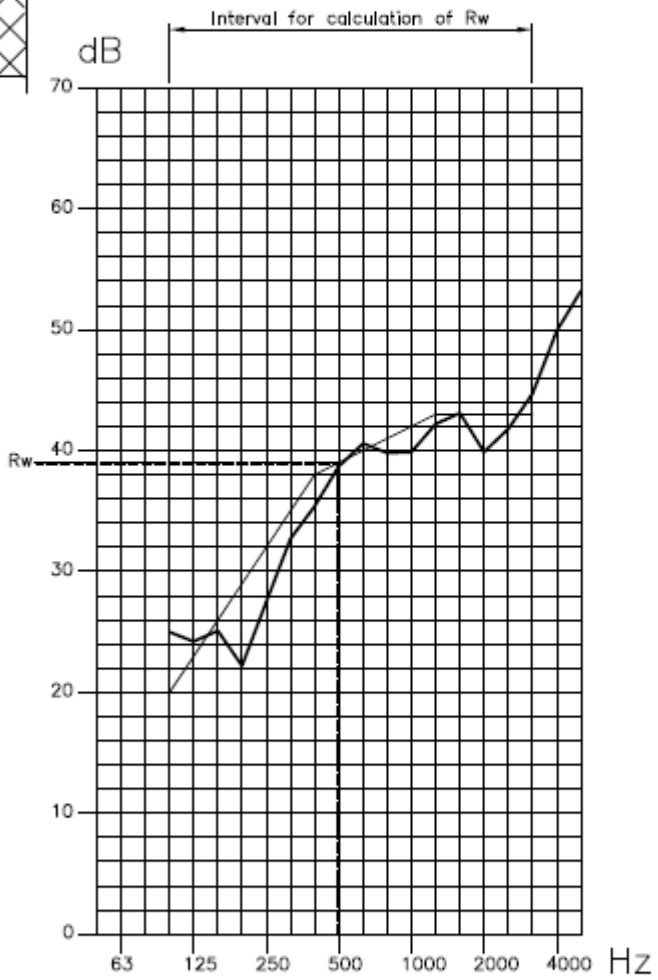
Figure F1 – Velfac Ltd. 45 dB Rw triple glazed unit: 4-18-4-16-6.4 + 6 mm Secondary glazing.



DOUBLE GLAZING 6-10-4/0.76/4

OFFICIAL REPORT AVAILABLE DANAK 2481

Frequency Hz	R dB	R dB
50	(24.9)	(25.8)
63	(25.5)	
80	(27.3)	
100	25.0	24.7
125	24.2	
160	25.1	
200	22.2	25.6
250	27.5	
315	32.7	
400	35.4	37.7
500	38.7	
630	40.6	
800	39.8	40.5
1000	39.9	
1250	42.2	
1600	43.1	41.4
2000	39.9	
2500	41.8	
3150	44.7	47.9
4000	49.9	
5000	53.2	
Rw	39	
Rw+C	37	
Rw+Ctr	34	



VELFAC
www. VELFAC.dk

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Tlf. +45 9675 5200
Fax +45 9675 5201

Emne
VELFAC 201
TEST RESULT - OUTLINE
SOUND REDUCING WINDOW

Kravspec. nr.				Mål	1:3
Matr.				Dato	18.12.2006
				Sign.	BTH
				Kontr.	
4				Sag nr.	T06037
3				Tegn. nr.	
2					M16
Udg	Uge/år	Sign.	Rettelse	Udgave nr.	01

Denne tegning må ikke overlades til, kopieres eller udnyttes af uvedkommende

Figure F2 – Velfac Ltd. 39dB Rw secondary glazed unit: 6-10-8.8 laminate.

Appendix G: Acousticians Qualifications and Status

Reporting:	**James Blakeley BSc. (Hons) MIOA**
Position Held:	Acoustic Consultant.
Qualifications:	BSc. (Hons) Audio Technology.
Affiliations:	Corporate Member of the Institute of Acoustics.
Acoustics Experience:	8 years.
Core Competences:	Environmental acoustics, building acoustics.

Surveying & Approval:	**Steve Skingle BSc. (Hons) MAES MIOA**
Position Held:	Principal Acoustic Consultant.
Qualifications:	BSc. (Hons) Acoustics.
	Institute of Acoustics Diploma in Acoustics and Noise Control.
Affiliations:	Corporate Member of the Institute of Acoustics.
	Corporate Member of the Audio Engineering Society.
Acoustics Experience:	18 years.
Core Competences:	Building acoustics, environmental acoustics, electro acoustics.