Noise impact assessment to a proposed residential development

Alexandra House, Warren Street, Stockport

Client: Ladson Stockport 2 Limited

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-	07/11/2023	Tommy Burn BSc (Hons) MIOA	Sam Message BSc (Hons), AMIOA

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0. SUMMARY

0.1. The client is preparing an application for the Prior Approval of the conversion of existing retail units at 2nd floor level of Alexandra House, Warren Street, Stockport to form residential apartments.

0.2. ACA Acoustics Limited have been commissioned to assess acoustic impacts to the proposed new residential development.

0.3. A sound level survey was carried out between the 2nd and 8th November 2023 along with subjective listening at the site.

0.4. Industrial and commercial sound sources consisting of mechanical services equipment serving adjoining commercial units, along with noise loading activity and moving bins within the rear service yard have been identified as subjectively audible at the assessment location.

0.5. An assessment of noise from the various industrial and commercial sources in the vicinity of the site indicates that without mitigation, noise from these commercial sources is at a level where there is a likelihood of significant adverse impact to future occupants. An acoustic specification of façade elements, including mechanical ventilation, is proposed to mitigate this impact.

0.6. The outline scheme for sound insulation of the building envelope has been developed such that internal sound levels during the daytime do not exceed LAeq 30dB within living rooms and bedrooms. Sound levels at night shall not exceed LAeq 25dB to bedrooms. These levels are at least 5dB more stringent than the guideline criteria in BS 8233:2014 to provide a good standard of amenity in residential dwellings. This ensures that noise intrusion from industrial and commercial sources will be low and will not be detrimental to the amenity of future occupants. Incorporating mechanical ventilation will allow residents to achieve appropriate ventilation rates and to mitigate overheating without having to open windows.

0.7. In summary, ACA Acoustics considers that allowing for the noise control measures set out in this report, no noise of an industrial or commercial nature will have an adverse impact on future occupants of the dwellings and therefore in accordance with The Town and Country Planning (General Permitted Development) (England) (Amendment) Order it is recommended that the application for Prior Approval is granted.

1. INTRODUCTION

The client is preparing an application to Stockport Council for the Prior Approval conversion of the second floor of Alexandra House, Warren Street, Stockport, to residential apartments.

ACA Acoustics Limited has been commissioned by the client to carry out an assessment of potential acoustic impacts from commercial premises to the proposed residential development.

This report presents results of a sound level and subjective observation survey and assessment of results.

2. ACOUSTIC CRITERIA & ASSESSMENT METHODOLOGY

2.1. Planning Guidance

2.1.1. The Town and Country Planning (General Permitted Development etc.) (England) (Amendment) Order

The application for Prior Approval is being made under The Town and Country Planning (General Permitted Development etc.) (England) (Amendment) Order, Class MA (GPDO). In accordance with the Order,

> "*Before beginning development under Class MA, the developer must apply to the local planning authority for a determination as to whether the prior approval of the authority will be required as to … impacts of noise from commercial premises on the intended occupiers of the development*".

It is important to consider the GPDO specifically refers to noise from commercial premises to the proposed development. Noise from other sources including traffic on nearby routes is not considered under the GPDO.

The Order does not include any assessment methodology nor criteria to be achieved and therefore it is relevant to consider guidance provided in relevant British Standards and other documents.

2.1.2. National Planning Policy Framework (NPPF) and Noise Policy Statement for England (NPSE)

The National Planning Policy Framework (referred to as NPPF) sets out the Government's planning policies for England and provides guidance on how these are expected to be applied, providing a framework within which Local Authorities can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

Paragraph 174 of the NPPF states that,

"*Planning policies and decisions should contribute to and enhance the natural and local environment by … e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability*".

Paragraph 185 also talks specifically about noise and advises,

"*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 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 Government's long-term policy aims relating to noise are contained in the Noise Policy Statement for England (referred to as NPSE). Stated aims of the NPSE are:

"*Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy of sustainable development:*

- *Avoid significant adverse impacts on health and quality of life,*
- *Mitigate and minimise adverse impacts on health and quality of life, and*
- *Where possible, contribute to the improvement of health and quality of life.*"

Paragraphs 2.19 to 2.24 clarify the above aims, referring to established concepts from toxicology; NOEL (No Observed Effect Level) and LOAEL (Lowest Observed Adverse Effect Level). It also introduces a new concept relating to *"significant adverse*" of SOAEL (Significant Observed Adverse Effect Level), however noting,

"*It is not possible to have a single objective noise-based measure that describes 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*".

The first aim of NPPF Paragraph 185 and the second underlying aim of the NPSE 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 considering the guiding principles of sustainable development, as set out in the NPPF. As neither the NPPF nor NPSE includes any numerical criteria, it is necessary to consider guidance

provided in other documents to determine suitable limits that would define the LOAEL on an individual basis.

Finally, it is also of benefit to consider Paragraph 2.7, which advises that,

> "*… the application of the NPSE should enable noise to be considered alongside other relevant issues and not to be considered in isolation. In the past, the wider benefits of a particular policy, development or other activity may not have been given adequate weight when assessing the noise implications*".

This provides clear guidance that noise must not be considered in isolation but as part of the overall scheme taking into account the overall sustainability and associated impacts of the proposed development; there is no benefit in reducing noise to an excessively low level if this creates or increases some other adverse impact. Similarly, it may be appropriate in some cases for noise to have an adverse impact if this is outweighed by the reduction or removal of some other adverse impact that is of greater significance to the development.

2.1.3. Planning Practice Guidance – Noise (PPG-N)

Related to the NPSE and the NPPF, The Department for Communities and Local Government has published additional guidance and clarifications within the Planning Practice Guidance – Noise (PPG-N), available at https://www.gov.uk/guidance/noise--2.

Paragraph 003 of the PPG advises,

> *"Plan-making and decision making need to 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.*
>
> *In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure … is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.*"

This guidance is like that set out in the NPPF and NPSE, however, Paragraph 005 of the PPG provides outline guidance on the definition of '*significant adverse effect*' and '*adverse effect*'. A copy of the table appended to Paragraph 005 is repeated below.

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

Figure 1: Noise exposure hierarchy, taken from Planning Practice Guidance - Noise

Although this table provides descriptive definitions for the NOEL, LOAEL and SOAEL, as with the NPPF and NPSE there are no numerical values provided.

2.1.4. British Standard 8233:2014+A1:2019

The introduction to BS 8233:2014 *Guidance on sound insulation and noise reduction for buildings* confirms that,

> *"This guide suggests criteria, such as suitable sleeping/resting conditions, and proposes noise levels that normally satisfy these criteria."*

Guidance limits for internal sound levels within living rooms and bedrooms, taken from Table 4 of BS 8233:2014, are shown in Table 1 below:

Activity	Location	07:00 – 23:00	23:00 – 07:00
Resting	Living Room	35dB LAeq, 16hr	-
Dining	Dining Room/Area	40dB LAeq, 16hr	-
Sleeping (daytime resting)	Bedroom	35dB LAeq, 16hr	30dB LAeq, 8hr

Table 1: BS 8233:2014 indoor ambient sound levels for dwellings

2.2. Noise from Nearby Mechanical Services Equipment

2.2.1. British Standard 4142:2014+A1:2019

The scope of BS 4142:2014+A1:2019 advises,

> "*This British Standard describes methods for rating and assessing sound of an industrial and/or commercial nature … to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident*".

The assessment method of BS 4142:2014+A1:2019 corrects the specific sound level from the source under investigation to account for characteristics that could make the sound more obtrusive to obtain a rating level. This rating level is compared against the prevailing background noise outside the noise-sensitive property.

While BS 4142:2014+A1:2019 is routinely used to assess the potential for an adverse impact on residential occupants due to commercial or industrial noise, it is important to consider that the scope of BS 4142:2014+A1:2019 specifically confirms that,

> "*Sound of an industrial and/or commercial nature does not include sound from the passage of vehicles on public roads and railway systems*".

3. REVIEW OF SITE LOCATION & DEVELOPMENT PROPOSALS

The development site is at Alexandra House, Warren Street, Stockport. The site currently consists of commercial units at ground floor level, and offices at first and second floor level. To the north is a loading area serving the nearby commercial units, and a small bin store. ACA Acoustics understand that planning for a new residential development to the north on the other side of the loading area is also proposed.

To the south, no industrial or commercial noise is audible, with road traffic on nearby routes subjectively dominant.

An aerial photograph (taken from Google Maps) is shown in Figure 2 below with the development site highlighted in yellow.

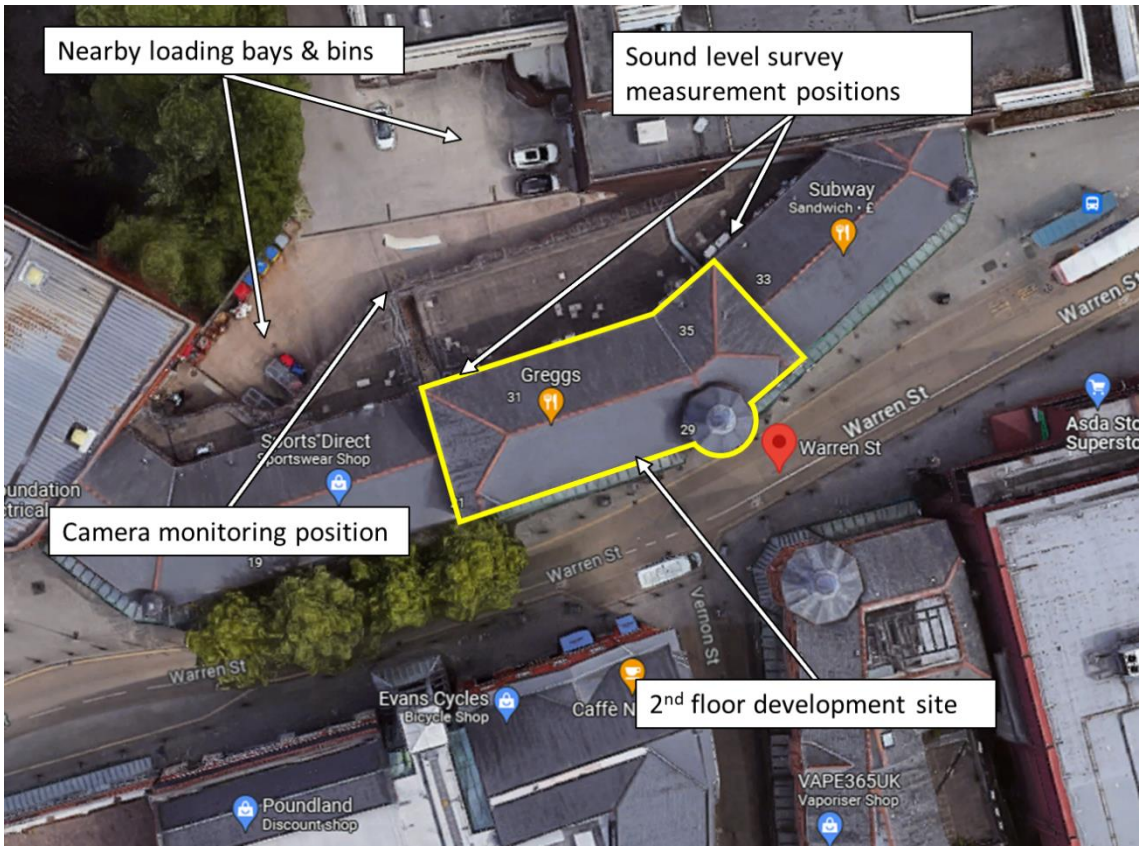


Figure 2: Site location (available at www.google.com/maps)

4. SOUND LEVEL SURVEY

To assess the impact of existing noise sources, A sound level survey has been conducted at the development site.

An unmanned survey was undertaken between the 2nd and 8th November 2023. The survey was set up by Tommy Burn of ACA Acoustics Limited. A sound level meter was situated at second floor level overlooking the loading bay area and bins. In addition, a second sound level meter was situated at ground floor flat roof level overlooking the roof mounted mechanical plant. A motion tracking camera was also installed to monitor the service yard for loading events.

Sound levels were recorded in consecutive 15-minute samples of overall LAeq, LAfmax, and LA90 values along with other statistical indices and octave band spectra. During visits to site ACA

Acoustics' consultant spent time on site undertaking subjective observations of the acoustic climate and audible sources. Sound levels from loading activities are generally screened from the proposed development units by the ground floor extension and flat roof, however are still subjectively audible at a low level during dips in nearby road traffic noise. Noise from the ground floor flat roof mechanical plant is subjectively audible towards the eastern end of the development site.

Weather conditions during the survey contained both dry and wet periods. The camera installed has been used to monitor periods when activity occurred within the service yard, and this has been used to monitor periods of rainfall too.

The measurement position is noted below.

Position Reference	Description
MP1	At second floor level overlooking the rear service yard to the west of the development
MP2	At ground floor flat roof level overlooking the installed mechanical plant to the east end of the development

Table 2: Sound level survey measurement positions

The following equipment was used during the survey; the sound level meter was calibrated before the survey and checked after with no deviation noted.

Equipment	Serial Number
NTi Audio Class 1 sound level meter type XL2-TA	A2A-16877-E0
Svantek calibrator type SV33B. Compliant to IEC 60942:2003	57595
Svantek Class 1 sound level meter type SV 307	84914
Svantek calibrator type SV33B. Compliant to IEC 60942-1:2003	83826

Table 3: Equipment used for the sound level survey

Figure 3 below shows the measured sound levels over the unmanned survey period at MP1.

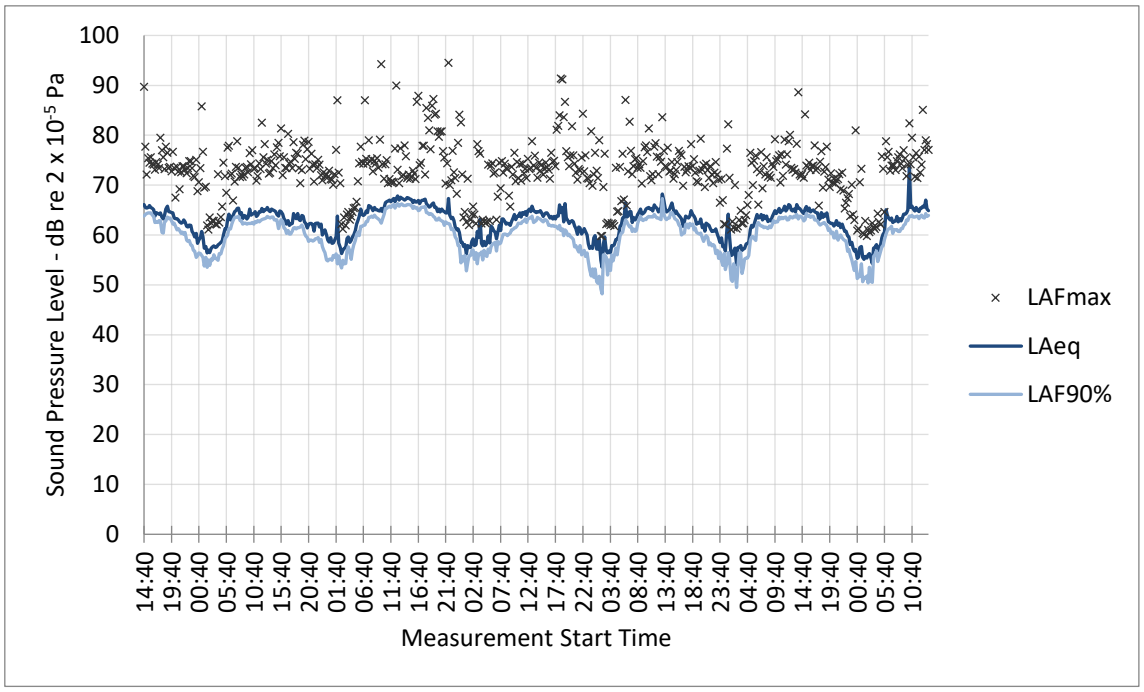


Figure 3: Sound level survey measurement results at MP1

Date	LAeq Daytime	LAeq Night-time	LAfmax Night-time
Thu, 02 Nov 2023	64 dB	60 dB	72 dB
Fri, 03 Nov 2023	64 dB	61 dB	73 dB
Sat, 04 Nov 2023	66 dB	60 dB	73 dB
Sun, 05 Nov 2023	64 dB	60 dB	73 dB
Mon, 06 Nov 2023	64 dB	60 dB	72 dB
Tue, 07 Nov 2023	64 dB	59 dB	71 dB
Wed, 08 Nov 2023	66 dB	-	-
Entire Measurement Period	**65 dB**	**60 dB**	**72 dB**

Table 4: Summary sound level survey results

In accordance with the methodology of BS 4142:2014+A1:2019 the representative background sound level should be used within the assessment. A histogram of the latest operating times of the service yard have been included in Figure 4 below.

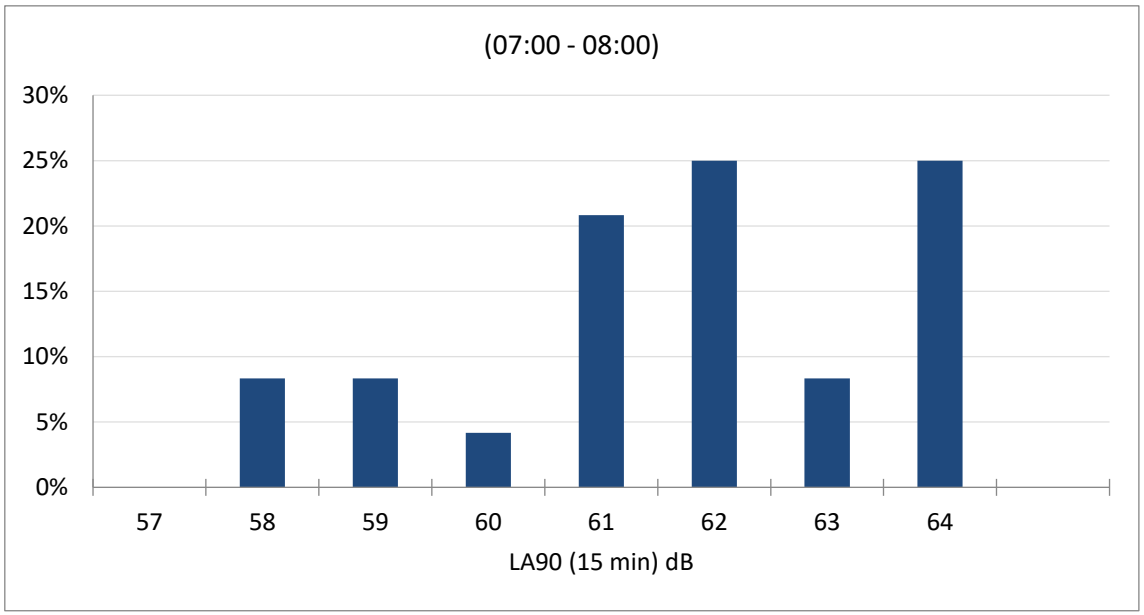


Figure 4: Spectogram of measured background sound levels during earliest loading times of the morning

4.1. Noise from Industrial and Commercial Sources

At ground floor flat roof level there are a number of condensing units situated externally. Summary sound level survey results of the installed mechanical equipment at MP2 are shown in tabular form below. The equipment was subjectively audible at the nearest residential windows, and the sound level meter was located around halfway between the equipment and these windows, and as such a -3dB distance correction has been applied to the below sound levels.

It is understood that the installed mechanical equipment serves adjoining restaurants and comprises of condensing units.

Time period	Description	LAeq	LA90
02/11/2023 00:00	Mechanical plant powered off	58dB	54dB
02/11/2023 00:30	Mechanical plant operating	60dB	59dB

Table 5: Summary sound level survey results

Results of the assessment indicate that noise from the nearby mechanical equipment is subjectively audible outside the proposed residential dwelling. This matches the opinion of the author while on site.

In addition, loading bays to the ground floor commercial units are situated to the rear of the development site. Sound levels have been measured from loading activities, and measured sound levels from a loading activity including a van delivering/collecting furniture from the adjacent second-hand furniture charity shops have been included in Table 6 below. This activity was also witnessed on site, and included reversing beepers, and bumping of goods as they were loaded.

Time period	Description	LAeq	LA90
08/11/2023 13:15	During loading activity	69dB	65dB
08/11/2023 13:30	After loading activity	65dB	65dB

Table 6: Summary sound level survey results

Loading activity is understood to only occur during daytime periods, and a background sound level of LA90 62dB is typical between 07:00 – 08:00 hours as shown in Figure 4.

5. BS 4142:2014+A1:2019 ACOUSTIC ASSESSMENT

Sound levels at both measurement positions included contribution from industrial and commercial sources. As a result, a BS 41412:2014+A1:2019 assessment has been provided in Table 7 below.

Description	Mechanical plant operating	Loading events	Relevant Clause	Commentary
Ambient sound level	LAeq 60dB	69dB	7.3.6	All plant active
Residual sound level	LAeq 58dB	65dB	7.3.3	Representative background sound level when no commercial sources were operating
Specific sound level	56dB	67dB	7.1 7.3.6	Calculated from the measured ambient and residual sound levels
Background sound level	LA90 54dB	LA90 62dB	8.1.3 8.3	Measured representative background sound level
Acoustic feature correction	Intermittency +3dB	Impulsivity +2dB	9.2	The sources were assessed to have audible characteristics
Rating level	LAr 59dB	69	9.2	
Excess of rating level over background sound level	**+5dB**	**+7dB**	**11**	**Assessment indicates likelihood of significant adverse impact without**

Table 7: BS 4142:2014+A1:2019 Assessment

The initial outcome of the BS 4142 assessment of operational noise emissions from the nearby commercial sources is that, without mitigation, there is a likelihood of significant adverse impact, depending on the context.

The primary context of this assessment is the development of new residential properties to an area of existing commercial use. In the author's experience the likelihood of adverse impact is reduced in this context compared to the reverse situation of bringing a new noise-generating use to an existing residential dwelling; in situations where a new noise source is introduced, residents notice a change in the acoustic climate, potentially causing a reduction of amenity. However, in this instance residents moving into the new residential flats would not be conditioned to any pre-existing lower levels. This lowers the potential adverse impact.

Section 11 of BS 4142:2014 discusses potential aspects which may alter the initial assessment result and advises that:

"*Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following … the sensitivity of the receptor and whether dwellings … will incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:*

i) Façade insulation treatment;

ii) Ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation", and;

iii) Acoustic screening.

This confirms that designing the sound insulation performance of façade elements to achieve appropriate internal sound levels mitigates the adverse impact, particularly where the scheme includes mechanical ventilation such that residents can achieve both background and rapid ventilation rates without needing to open windows.

An appropriate scheme of façade sound insulation and mechanical ventilation has been developed to ensure external noise intrusion to the dwellings is low.

Criteria for the habitable rooms have been set at a level 5dBA below guideline criteria contained in the ProPG. This will mitigate potential adverse impacts from the existing mechanical services equipment. Noise from the nearby plant to inside the new dwellings will be low and will not be detrimental to the amenity of future residents.

6. ASSESSMENT OF FAÇADE SOUND INSULATION

A scheme for sound insulation is necessary to ensure sound levels inside rooms of the new residential dwellings are reasonable and protect future occupants from nearby commercial noise sources.

A computer model has been set up using the measured sound levels incident on the façades of the development along with anticipated façade elements. These include contribution from mechanical plant and the loading events therefore will ensure that the amenity of future occupants is fully protected. The computer model is based on the calculation procedures outlined in BS EN ISO 12354-3:2000 and BS 8233:2014.

Confirmation of the acoustic performance of the building envelope elements used in the calculation model is provided in Table 8 below.

Description	Location	Rw (dB)	Rw + C'tr (dB)	Typical Construction
External façade walls	Entire development	52	48	Masonry brick-cavity-block construction
Roof	Entire development	52	44	Existing roof with 1 layer 12.5mm plasterboard ceiling and 100mm insulation in loft cavity
Windows & glazed doors	Entire development	41	36	Laminated double glazing with a-symmetric panes such as 6.5-12-8.38 or equivalent

Table 8: Acoustic performance specification for facade elements

Note that the constructions provided are typical and variations on the specification would be acceptable, so long as the installed construction achieved the specified sound insulation performance. The specification for glazed elements is for the window/door as a complete unit, including frames and seals and is based on data provided by Guardian Glass. It is recommended the glazing supplier submit test data confirming their unit will comply with the specified performance.

6.1. Ventilation Strategy

A suitable overheating mitigation strategy for all habitable rooms may incorporate mechanical ventilation heat recovery units (MVHR) or other mechanical extract ventilation, or comfort cooling systems such as reverse cycle heat pumps or air conditioning. Design of an appropriate mitigation strategy is beyond the scope of ACA Acoustics and should be considered by a suitable third party accordingly.

It is important that any self-noise (i.e., noise from the fans) and external noise intrusion through the ducted system must not cause internal sound levels to exceed the design requirements. To achieve these limits, it is recommended that the overall noise from any mechanical ventilation system will need to be no higher than LAeq 25dB to allow for accumulation of noise sources.

6.2. Calculated Internal Sound Levels

Copy of acoustic calculations for daytime and night-time noise intrusion into sample rooms is provided in Appendix A. Summary results are confirmed in Table 9 below and demonstrate that intrusive sound levels within rooms of the proposed residential units will comply with guidance criteria in BS 8233:2014. As discussed above, a criteria 5dBA more stringent than BS 8233 has been used, to ensure that commercial activity is not detrimental to the amenity of future occupants.

Calculations to Flat 5 include noise from the nearby mechanical services equipment as assessed in Section 4.1.

Plot / Room	Description	Calculated Internal Sound Level	Criteria
Unit 02 Living Room	Daytime LAeq	30dB	≤ 30dB
	Night-time LAeq	-	-
	Night-time LAfmax	-	-
Unit 01 Bedroom	Daytime LAeq	29dB	≤ 30dB
	Night-time LAeq	24dB	≤ 25dB
	Night-time LAfmax	36dB	≤ 45dB

Table 9: Summary internal sound levels within sample habitable rooms

7. CONCLUSION

ACA Acoustics have been commissioned to provide a noise impact assessment at Alexandra House, Warren Street, Stockport. The assessment is to be submitted in support of an application for permitted development.

ACA Acoustics have undertaken an external sound level survey, along with subjective listening and clarification of the acoustic environment. Assessments of noise from industrial and commercial sources in the vicinity has been undertaken.

An acoustic specification for façade insulation elements has been developed, including mechanical ventilation, to ensure internal sound levels within habitable rooms will be at least 5dBA better than recommended guideline criteria within BS 8233:2014+A1:2019.

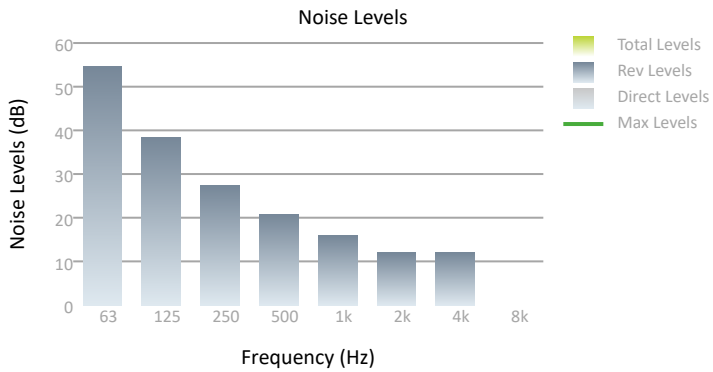
It is the author's opinion that, allowing for an appropriate mitigation strategy as set out in this report, sound intrusion to the proposed residential dwellings should not be detrimental to the amenity of future occupants and the site is suitable for the proposed development and therefore in accordance with the GPDO it is recommended that the application for Prior Approval is granted.

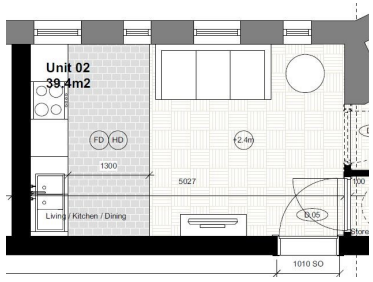
Appendix A

Acoustic Calculations

Alexandra House, Warren Street, Stockport

Reference	Unit 02 Livingroom Daytime LAeq
Description	
Target Sound Level	-
Max Sound Level	-
Calculated Sound Level	30.3dB(A)
Calculated Tmf T60 (s)	0.48
Volume (m^3)	36





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq, ff (Day)	1	54.5	38.4	27.3	20.8	15.9	11.9	12.1	-

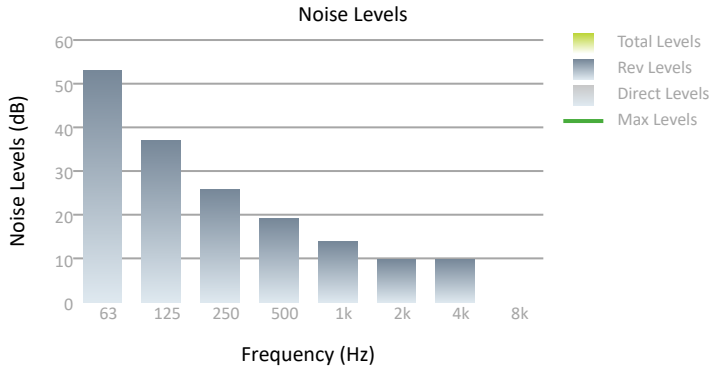
ACA Acoustics Limited

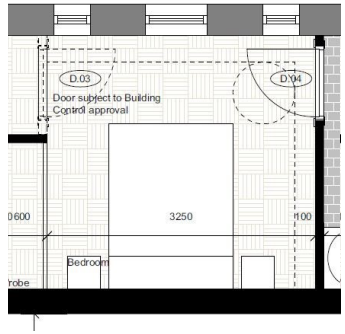
Head Office: 12 Sheep Street, Highworth, Wiltshire, SN6 7AA
London Office: 3 Shortlands, Hammersmith, London, W6 8DA
w: www.aca-acoustics.co.uk

Tel: 01793 766 324
Tel: 0203 609 8733

Alexandra House, Warren Street, Stockport

Reference	Unit 01 Bedroom Daytime LAeq
Description	
Target Sound Level	-
Max Sound Level	-
Calculated Sound Level	28.7dB(A)
Calculated Tmf T60 (s)	0.4
Volume (m^3)	28.8





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq, ff (Day)	1	52.9	37.0	25.8	19.1	13.8	9.7	9.8	-

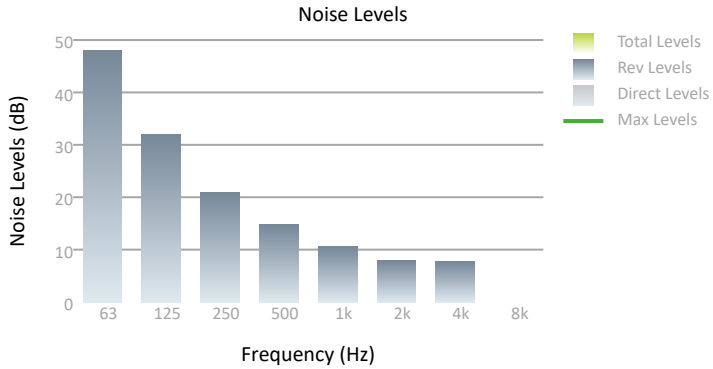
ACA Acoustics Limited

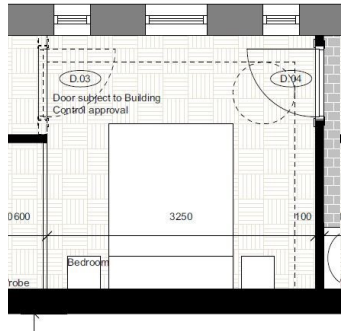
Head Office: 12 Sheep Street, Highworth, Wiltshire, SN6 7AA
London Office: 3 Shortlands, Hammersmith, London, W6 8DA
w: www.aca-acoustics.co.uk

Tel: 01793 766 324
Tel: 0203 609 8733

Alexandra House, Warren Street, Stockport

Reference	Unit 01 Bedroom Night time LAeq
Description	
Target Sound Level	-
Max Sound Level	-
Calculated Sound Level	23.9dB(A)
Calculated Tmf T60 (s)	0.4
Volume (m^3)	28.8





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Leq, ff (Night)	1	47.9	32.0	21.0	14.8	10.6	8.0	7.7	-

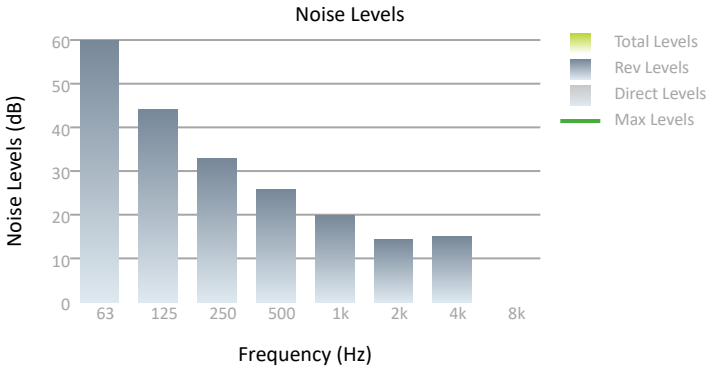
ACA Acoustics Limited

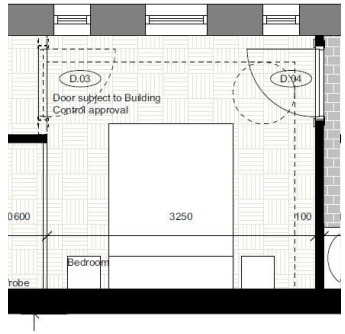
Head Office: 12 Sheep Street, Highworth, Wiltshire, SN6 7AA
London Office: 3 Shortlands, Hammersmith, London, W6 8DA
w: www.aca-acoustics.co.uk

Tel: 01793 766 324
Tel: 0203 609 8733

Alexandra House, Warren Street, Stockport

Reference	Unit 01 Bedroom Night time LAfmax
Description	
Target Sound Level	-
Max Sound Level	-
Calculated Sound Level	35.6dB(A)
Calculated Tmf T60 (s)	0.4
Volume (m^3)	28.8





Calculated Internal Sound Levels

Reference	Quantity	Noise Levels (dB)							
		63	125	250	500	1k	2k	4k	8k
Lmax, ff (Night)	1	59.9	44.0	32.8	25.9	19.9	14.4	15.0	-

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Calculation Sheet

Unit 01 Bedroom Daytime LAeq

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade (Daytime Leq)										
Source dBA	**65.0**									
Octave Band Frequencies										
Leq,ff		**69.0**	**67.0**	**63.0**	**61.0**	**61.0**	**57.0**	**52.0**	**46.0**	**Row A**
Facade Wall Element										
		-42.9	*-45.9*	*-49.9*	*-49.9*	*-58.9*	*-62.9*	*-64.9*	*-69.9*	
Facade Glazed Element										
		-35.1	*-39.1*	*-44.1*	*-52.1*	*-55.1*	*-56.1*	*-48.1*	*-*	
Facade Roof Element										
		-22.6	*-39.6*	*-49.6*	*-55.6*	*-60.6*	*-61.6*	*-62.6*	*-*	
Cumulative Lp										
Result		**46.7**	**31.2**	**20.9**	**14.2**	**9.4**	**5.8**	**6.6**	**-**	
ISO 12354-3 Lfs Correction										
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-*	
Room Corrections										
		6.2	*5.8*	*5.0*	*5.0*	*4.5*	*3.9*	*3.2*	*-*	
Internal Receiver Noise										
Internal Receiver Noise - Unit 01 Bedroom Daytime LAeq **Reverberant Field, LPrev:**		**52.9**	**37.0**	**25.8**	**19.1**	**13.8**	**9.7**	**9.8**	**-**	

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Manchester Office: Colony, 5 Piccadilly Place, Manchester, M1 3BR Tel: 0161 327 1681
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Calculation Sheet

Unit 01 Bedroom Night time LAeq

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade (Nighttime Leq)										
Source dBA	**60.0**									
Octave Band Frequencies										
Leq,ff		**64.0**	**62.0**	**58.0**	**56.0**	**56.0**	**52.0**	**47.0**	**41.0**	**Row A**
Facade Wall Element										
		-42.9	*-45.9*	*-49.9*	*-49.9*	*-58.9*	*-62.9*	*-64.9*	*-69.9*	
Facade Glazed Element										
		-35.1	*-39.1*	*-44.1*	*-52.1*	*-55.1*	*-56.1*	*-48.1*	*-*	
Facade Roof Element										
		-22.6	*-39.6*	*-49.6*	*-55.6*	*-60.6*	*-61.6*	*-62.6*	*-*	
Cumulative Lp										
Result		**41.7**	**26.2**	**16.0**	**9.8**	**6.1**	**4.1**	**4.5**	**-**	
ISO 12354-3 Lfs Correction										
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-*	
Room Corrections										
		6.2	*5.8*	*5.0*	*5.0*	*4.5*	*3.9*	*3.2*	*-*	
Internal Receiver Noise										
Internal Receiver Noise - Unit 01 Bedroom Night time LAeq **Reverberant Field, LPrev:**		**47.9**	**32.0**	**21.0**	**14.8**	**10.6**	**8.0**	**7.7**	**-**	

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Calculation Sheet

Unit 01 Bedroom Night time LAfmax

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade (Nighttime Lmax)										
Source dBA	**72.0**									
Octave Band Frequencies										
Leq,ff		**76.0**	**74.0**	**70.0**	**68.0**	**68.0**	**64.0**	**59.0**	**53.0**	**Row A**
Facade Wall Element										
		-42.9	*-45.9*	*-49.9*	*-49.9*	*-58.9*	*-62.9*	*-64.9*	*-69.9*	
Facade Glazed Element										
		-35.1	*-39.1*	*-44.1*	*-52.1*	*-55.1*	*-56.1*	*-48.1*	-	
Facade Roof Element										
		-22.6	*-39.6*	*-49.6*	*-55.6*	*-60.6*	*-61.6*	*-62.6*	-	
Cumulative Lp										
Result		**53.7**	**38.1**	**27.8**	**20.9**	**15.5**	**10.5**	**11.8**	**-**	
ISO 12354-3 Lfs Correction										
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	-	
Room Corrections										
		6.2	*5.8*	*5.0*	*5.0*	*4.5*	*3.9*	*3.2*	-	
Internal Receiver Noise										
Internal Receiver Noise - Unit 01 Bedroom Night time LAfmax **Reverberant Field, LPrev:**		**59.9**	**44.0**	**32.8**	**25.9**	**19.9**	**14.4**	**15.0**	**-**	

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Calculation Sheet

Unit 02 Livingroom Daytime LAeq

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Sound Level at Facade										
Source dBA	**65.0**									
Octave Band Frequencies										
Leq,ff		**69.0**	**67.0**	**63.0**	**61.0**	**61.0**	**57.0**	**52.0**	**46.0**	**Row A**
Facade Wall Element										
		-42.8	*-45.8*	*-49.8*	*-49.8*	*-58.8*	*-62.8*	*-64.8*	*-69.8*	
Facade Glazed Element										
		-35.5	*-39.5*	*-44.5*	*-52.5*	*-55.5*	*-56.5*	*-48.5*	*-*	
Facade Roof Element										
		-22.6	*-39.6*	*-49.6*	*-55.6*	*-60.6*	*-61.6*	*-62.6*	*-*	
Cumulative Lp										
Result		**46.7**	**31.0**	**20.6**	**14.1**	**9.2**	**5.7**	**6.4**	**-**	
ISO 12354-3 Lfs Correction										
		0.0	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*-*	
Room Corrections										
		7.8	*7.5*	*6.7*	*6.7*	*6.7*	*6.2*	*5.7*	*-*	
Internal Receiver Noise										
Internal Receiver Noise - Unit 02 Livingroom Daytime LAeq **Reverberant Field, LPrev:**		**54.5**	**38.4**	**27.3**	**20.8**	**15.9**	**11.9**	**12.1**	**-**	

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