

NOISE IMPACT ASSESSMENT

90 – 96 LIVERPOOL ROAD, HUYTON

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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.



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1.0 SUMMARY

At the request of ForHousing, Philip Dunbavin Acoustics Ltd has conducted an assessment of the ambient noise climate for the proposed residential development at 90 – 96 Liverpool Road, Huyton.

The proposed development is located at an existing three floor building with commercial units to the ground floor. The intended conversion is for the existing flats and office units on the first and second floors to be converted into 7 no. bedsits.

The local noise climate is dominated by Liverpool Road (A57) to the north of site with contributions from the bus stop and conversation from members of the public. To the south of the site distant traffic noise from the A57 is noted with occasional activity from the immediate road network to the south.

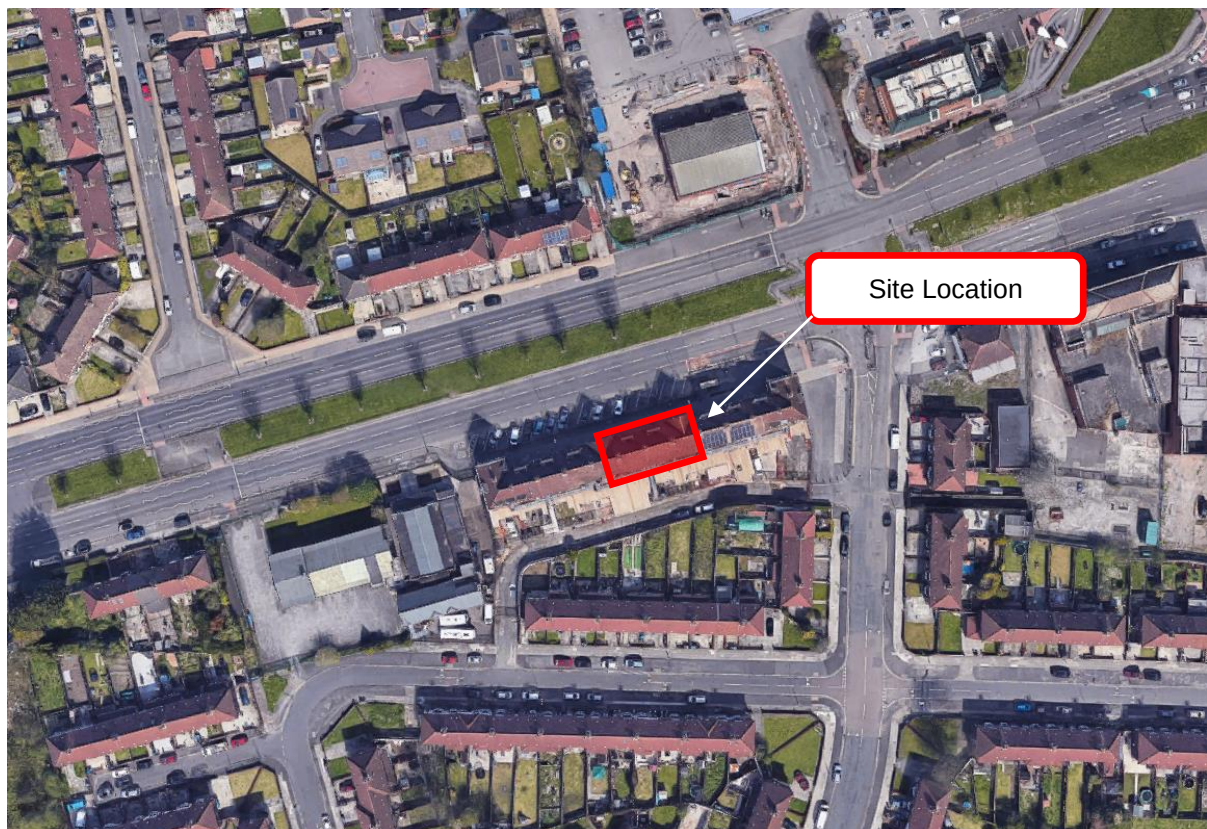
Mitigation is proposed to the building envelope to ensure that internal noise levels within habitable areas are suitable for resting and sleeping and are in accordance with the requirements of the NPPF and BS 8233:2014 “Guidance on sound insulation and noise reduction for buildings”. Noise mitigation advice for the proposed residential facades is given in Section 5.0 in the form of treatment to the glazing and ventilation.

2.0 SITE DESCRIPTION

The proposed development is located at an existing three floor building with commercial units to the ground floor. The intended conversion is for the existing flats and office units on the first and second floors to be converted into 7 no. bedsits. It is understood that the immediate neighbouring properties are a combination of residential and office units.

Immediately to the north of site is Liverpool Road (A57) with neighbouring commercial units to the east and west. To the rear of the site is Huyton House Road which consists of residential dwellings with a private access road intervening between the rear of the properties and site. The site location is highlighted in the Figure below.

Figure 1 – Site Location



3.0 ASSESSMENT CRITERIA

3.1 National Planning Policy Framework

National Planning Policy is guided by the National Planning Policy Framework (NPPF) updated in July 2021. 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 impact' and 'adverse impact' 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. A summary is reproduced in Section 3.2 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.

The National Planning Policy Framework also states:

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.

The focus of planning policies and decisions should be on whether proposed development is an acceptable use of land, rather than the control of processes or emissions (where these are subject to separate pollution control regimes). Planning decisions should assume that these regimes will operate effectively. Equally, where a planning decision has been made on a particular development, the planning issues should not be revisited through the permitting regimes operated by pollution control authorities.

3.2 Planning Practice Guidance – Noise

In March 2014 (updated July 2019) the UK Government published further guidance on the assessment of noise for planning purposes in the form of the on-line publication, Planning Practice Guidance on noise (<http://www.gov.uk/guidance/noise--2>). This document offers further guidance on the typical levels which constitute the NOEL, LOAEL and SOAEL. The relevant section is 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 perceived 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	Observed Adverse Effect	Mitigate and reduce to a minimum

	the acoustic character of the area such that there is a small actual or perceived change in the quality of life.		
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

It is notable from the above planning guidance that development should not normally be permitted above Significant Observed Adverse Effect Levels, and should aim to minimise Other Adverse Effect Levels (below SOAEL but above LOAEL). However, it is clear that noise is permitted to approach and/or exceed the Lowest Observed Adverse Effect Level, providing that noise is mitigated and reduced to a minimum.

3.3 BS8233:2014

BS8233 proposes acceptable noise levels for new residences. The guidance within BS8233 has been revised and updated in 2014 to take into account the most recent research and expert opinion on suitable noise levels for new developments.

3.3.1 Internal noise levels in domestic dwellings

With regard to residential development BS8233 gives the following criteria;

Table 2. BS8233:2014 indoor ambient noise levels for dwellings

Activity	Location	Design range $L_{Aeq,T}$	
		Daytime (07:00 - 23:00)	Night-time (23:00 – 07:00)
Resting	Living rooms	35	-
Dining	Dining room / area	40	-
Sleeping (daytime resting)	Bedroom	35	30

The above criteria apply to steady external noise sources, such as road traffic. Where specific noise events are likely to occur during the night time BS8233:2014 gives the following guidance;

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.

Where non-steady noise sources affect the site an additional 'penalty' may be appropriate. In this case the indoor ambient noise levels above may be reduced by an appropriate amount to reflect the additional potential disturbance caused by the particular character of the sound.

3.4 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.

In addition to the above continuous equivalent noise levels, WHO guidelines indicates that exceedances of 45 dB L_{Amax} for single sound events should be limited to no more than 10 – 15 times per night, when measured with a ‘fast’ time weighting.

3.5 Approved Document O (ADO)

Approved Document O (APO) 2021, provides guidance on meeting the requirements of the Building Regulations 2010, part ‘O1 Overheating mitigation’. The aim of the Building Regulations part O1 is to protect the health and welfare of occupants of the building by reducing the occurrence of high indoor temperatures.

Building Regulations part O1 requires that dwellings, institutions or any other buildings containing one or more rooms for residential purposes (other than a room in a hotel) to:

(a) *Limit unwanted solar gains in summer:*

(b) *Provide an adequate means to remove heat from the indoor environment*

However in meeting the obligations of ADO the buildings overheating mitigation strategy for use by occupants must consider ‘Noise at night’ in addition to other non-noise related considerations.

In regards to ‘Noise at night’, ADO stipulates the following.

In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am).

b. 55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am)

It should be noted that the above noise limits are with reference to internal noise levels within a bedroom. BS 8233 advises that based on a partially opened window noise at the external façade of the building will reduced by approximately 15 dB. Therefore ADO infers that windows will be required to remain closed when the external noise climate exceeds the following external noise limits.

55dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am)

70dB L_{AFmax}, more than 10 times a night (between 11pm and 7am)

Subsequently, where windows are required to be closed at night (due to the above noise limits being exceeded), the overheating mitigation strategy as required by ADO must provide an alternative method to removing heat other than relying on windows remaining open.

4.0 SURVEY DETAILS

4.1 Environmental Noise Survey

A noise level survey was undertaken at the site between 11:20 hours on Wednesday 3rd August and 10:09 hours on Thursday 4th August 2022; the noise level survey was chosen to be representative of daytime and night time hours.

The noise measurements were taken at two different locations on site, with one to the north façade and a second to the south façade of the existing building. This is indicated in the Figure below.

Figure 2. Noise survey locations



The measurement positions are detailed as follows:

- Measurement Location 1 (ML1) – microphone located on a pole which was extended 1m out of the second floor window on the north façade. This was deemed to have no reflective surfaces affecting the noise level measurements except for the façade.
- Measurement Location 2 (ML2) – microphone located on a pole which was extended 1m out of the second floor window on the south façade. This was deemed to have no reflective surfaces affecting the noise level measurements except for the façade.

The 3rd and 4th August measurements were made and partially attended by Mr David Hible of PDA Ltd. Measurements were of continuous 5 minute samples. The survey was conducted using 2x NTi XL2; one located at ML1 and the second used for ML2. 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.

The weather conditions during the noise survey were dry with wind speeds reported at 3-6m/s. Temperatures were between 14 – 23 degrees Celsius with mainly clear skies and approximately 10% cloud coverage.

Noise Sources

The local noise climate is dominated by road traffic noise from Liverpool Road (A57) to the north of site with contributions from the bus stop and conversation from members of the public. Traffic noise consists of that from cars, busses, motorbikes and HGVs. To the south of site distant traffic noise from the A57 is noted with occasional activity from the immediate road network to the south. Extraction and ventilation fan noise is also present to the south provided by the neighbouring commercial units.

4.2 Measurement Results

Environmental Noise

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

Table 4. Summary of environmental noise measurements

Position	Time Period (hh:mm)	Duration (hh:mm)	L _{Aeq,T} (dB)	Typical Night-time L _{Amax,5mins} (dB) ¹
ML1	Daytime 3/8/22 11:20 – 23:00 4/8/22 07:00 – 10:00	14:40	70	-
	Night-time 23:00 – 07:00	08:00	63	78
ML2	Daytime 3/8/22 11:36 – 23:00 4/8/22 07:00 – 10:09	14:33	53	-
	Night-time 23:00 – 07:00	08:00	46	55

Notes:

- 1 Typical L_{Amax} noise levels are those not exceeded more than 10 times over the whole night-time period.

5.0 NOISE BREAK-IN CALCULATIONS AND MITIGATION

5.1 Building Envelope Elements

Noise impact calculations have been based on façade constructions and room dimensions taken from drawings provided by Whiteley Eaves ref. '328_004_Liverpool Road – A1 – Proposed Ground and First Floor Plans and Elevations BR' and '328_005_Liverpool Road – A1 – Proposed Second Floor Plan and

Section BR'. The following construction elements have been used to model the external building envelope of the proposed residential development:

5.1.1 Walls

It is PDA's understanding that the external wall construction is of a double leaf 100mm brick, with 100mm cavity and 50mm of rockwool (10kg/m³) insulation. Within our calculations this is capable of achieving a sound reduction performance of 54 dB R_w. It is assumed that the performance of the existing external wall should be no less than 54 dB R_w.

5.1.2 Glazing

As the glazing is the acoustically weak area, the noise level incident on the façade will determine the type of glazing specified.

5.2 Design Assumptions

Assessment and specification of the acoustic performance of the building envelope and suitable glazing and attenuated ventilation, has been undertaken based on achieving the internal ambient acoustic conditions, specified in Section 3. Information on the sound insulation properties for specific element details have been obtained from manufacturers test data.

We would note that there was no significant noise observed from any other sources at the site other than noise from road traffic, general public and extraction fans.

For the purposes of the noise break-in calculations, dimensions have been taken from the first and second floor bedsits bordered by the north façade and calculated using the data taken from ML1. Noise break-in calculations have also been provided for the first and second floor bedsit rooms which border the south facing façade and calculated using the measurement data taken at ML2.

5.3 Calculated noise levels

Noise break-in through the proposed building façade has been calculated in octave frequency bands using the detailed method of BS 8233:2014 taking into account the octave band sound reduction of the façade elements, façade element areas, room volume and reverberation time in the finished rooms. For the purposes of calculation the finished reverberation time has been assumed to be 0.5 seconds in all frequencies in habitable rooms. The calculated octave frequency band internal noise levels have then been used to determine the overall A-weighted noise level in the habitable rooms which has been compared to the criteria of Section 3. Glazing and ventilation specifications have been selected to ensure that the criteria of Section 3 are achieved within the proposed dwelling.

Table 5. Glazing and ventilator schedule for habitable rooms

Colour	Floor	Bedsit / Façade	Room	Minimum Glazing Rating R_w dB	Minimum combined Ventilator Rating $D_{n,e,w}$ dB ³	Internal Noise Level Target $L_{Aeq,T}$ dB Day/Night	Calculated Internal Noise Level $L_{Aeq,T}$ dB Day/Night ¹	Internal Noise Level target L_{Amax} dB Night	Calculated Internal Noise Level L_{Amax} dB Night ^{1,2}
Red	1 st	Bedsit 4 (North Façade)	Bedroom	40	44	35/30	35/28	45	44
			Kitchen / Living	40	44	35/-	34/-	-	-
Yellow	2 nd	Bedsit 6 (North Façade)	Bedroom	38	40	35/30	34/27	45	43
Green	2 nd	Bedsit 6 (South Façade)	Kitchen / Living	31	29	35/-	30/-	-	-
Green	1 st	Bedsit 1 (South Façade)	Kitchen / Living	31	29	35/-	30/-	-	-

Notes

- 1 Calculated noise levels assuming closed windows and allowing for an inlet vent of specification detailed.
- 2 Calculated L_{Amax} noise level typically not exceeded more than 10 times per night.

The marked up glazing and ventilation schedule can be found in the Figures 3 and 4 below:

Figure 3. Glazing and Ventilation Schedule – North Façade

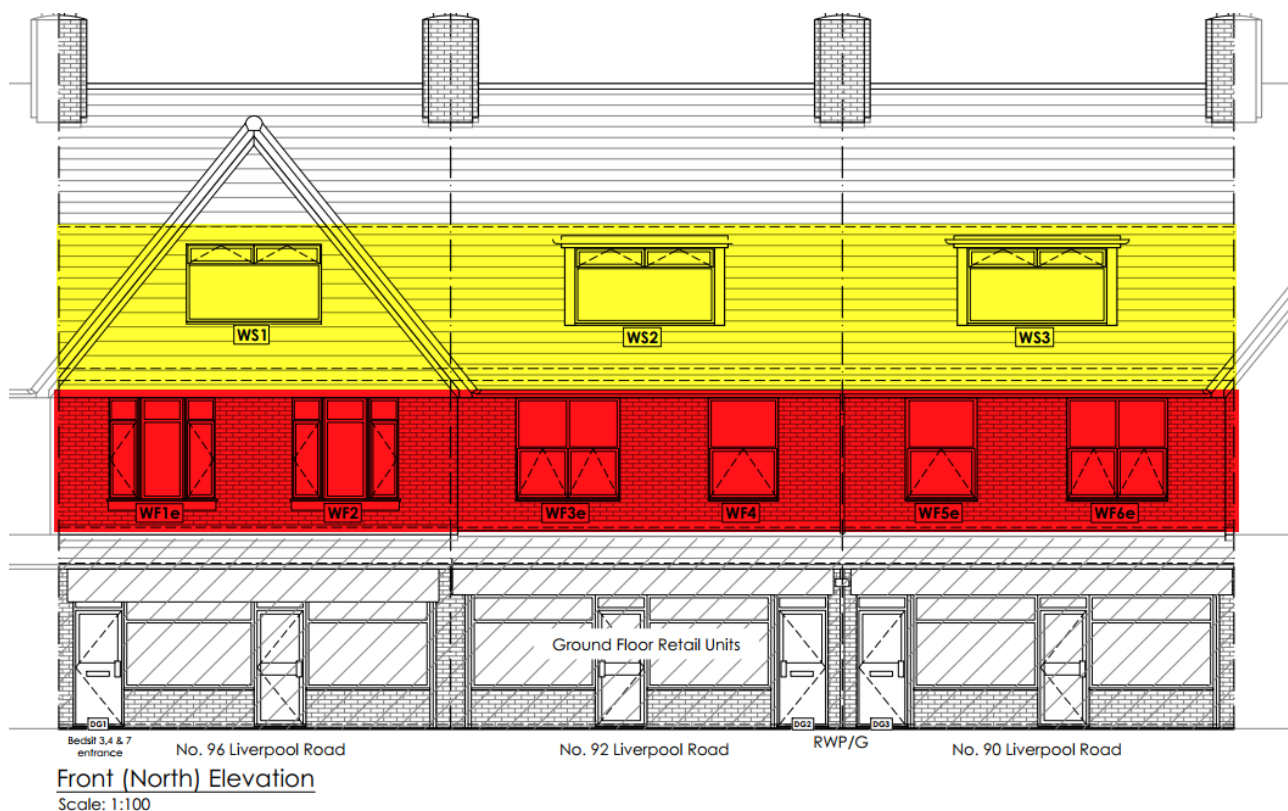
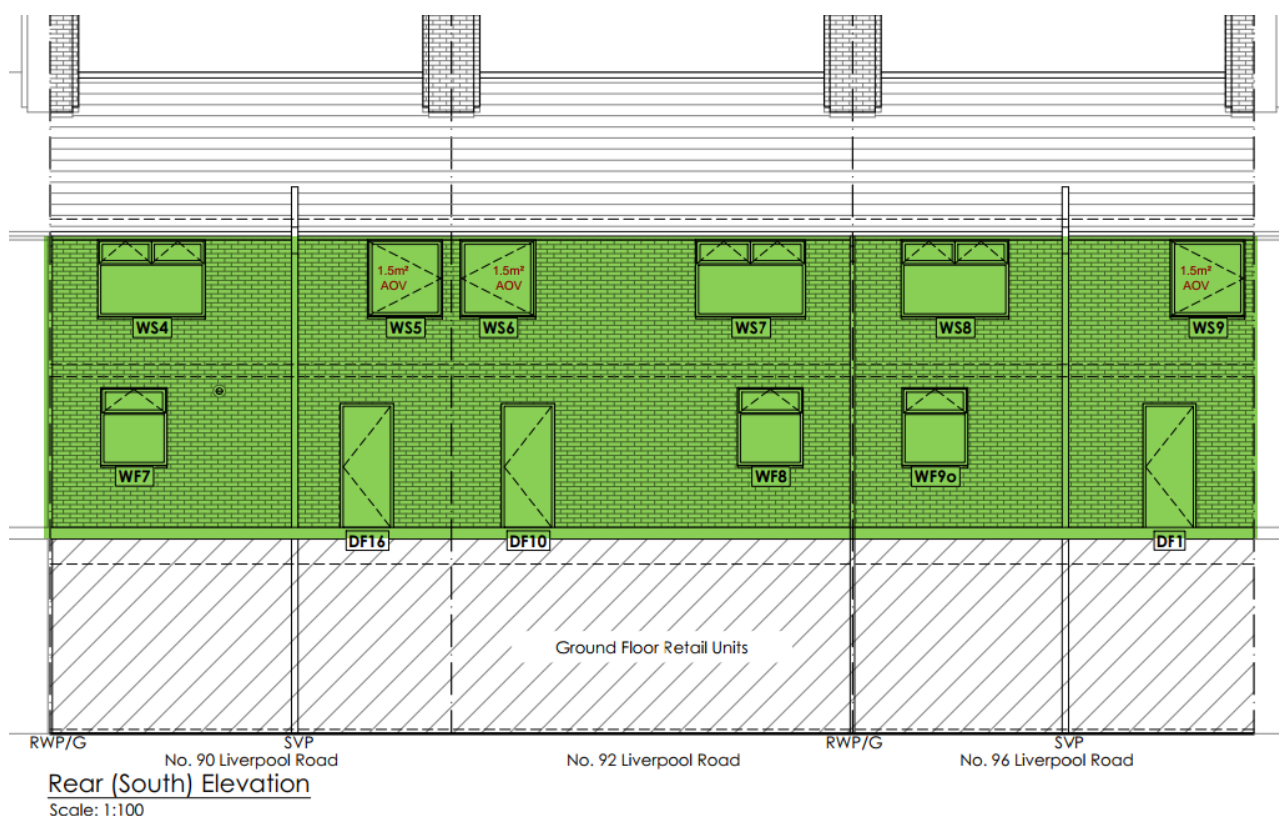


Figure 4. Glazing and Ventilation Schedule – South Façade



5.4 Glazing

Notes on Glazing Installation

For the glazing specifications in Table 5, 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 6. Required glazing performance (minimum)

R _w dB	Typical example (mm glass / mm cavity / mm glass)	Frequency band [Hz], R dB							
		63	125	250	500	1000	2000	4000	8000
31	4/12/4mm	16	22	19	25	36	42	36	35
38	10/12/6mm	20	26	27	34	40	38	46	46
40	8/12/8.8Acoustic laminate mm	23	28	27	35	45	46	52	52

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. Any areas of aluminium panelling (if proposed) adjacent to the window glass should meet the same minimum specification as the glass to which they are adjacent.

5.5 Ventilation

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 $D_{n,e,w}$ 43 dB to meet a combined specification of $D_{n,e,w}$ 40 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 7 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 7. Required ventilator performance (minimum)

Typical Product	Minimum Sound Reduction Index $D_{n,e}$ (dB) at Octave Band Centre Frequency (Hz)								$D_{n,e,w}$ dB
	63	125	250	500	1k	2k	4k	8k	
Simon Airstrip 300	23	28	26	26	29	29	29	36	29
Ducomax Largo 25	30	30	31	38	45	40	40	40	40
Greenwood EHA574	34	34	40	39	42	49	49	49	44

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.

5.6 Approved Document O (ADO), Method of Removing Heat

With reference to the noise survey results taken on site, it should be noted that noise levels at the northern façades of the proposed development are predicted to exceed the following criteria.

55dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am)

70dB L_{AFmax} , more than 10 times a night (between 11pm and 7am)

Consequently based on a partially open window, noise within the bedrooms to the north façade are predicted to exceed the following ADO limits above which windows are expected to remain closed to control the ingress of external noise.

40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am)

55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am)

Therefore for the northern facades the overheating mitigation strategy as required by ADO must provide an alternative method to removing heat other than relying on windows remaining open during the night time period.

6.0 CONCLUSION

At the request of ForHousing, Philip Dunbavin Acoustics Ltd has conducted an assessment of the ambient noise climate for the proposed residential development at 90 – 96 Liverpool Road, Huyton.

The proposed development is located at an existing three floor building with commercial units to the ground floor. The intended conversion is for the existing flats and office units on the first and second floors to be converted into 7 no. bedsits.

The local noise climate is dominated by Liverpool Road (A57) to the north of site with contributions from the bus stop and conversation from members of the public. To the south of site distant traffic noise from the A57 is noted with occasional activity from the immediate road network to the south.

Mitigation is proposed to the building envelope to ensure that internal noise levels within habitable areas are suitable for resting and sleeping and are in accordance with the requirements of the NPPF and BS 8233:2014 “Guidance on sound insulation and noise reduction for buildings”. Noise mitigation advice for the proposed residential facades is given in Section 5.0 in the form of treatment to the glazing and ventilation.

APPENDIX A – NOISE LEVEL SURVEY CHARTS

Figure 5. Ambient Noise Level Survey – ML1

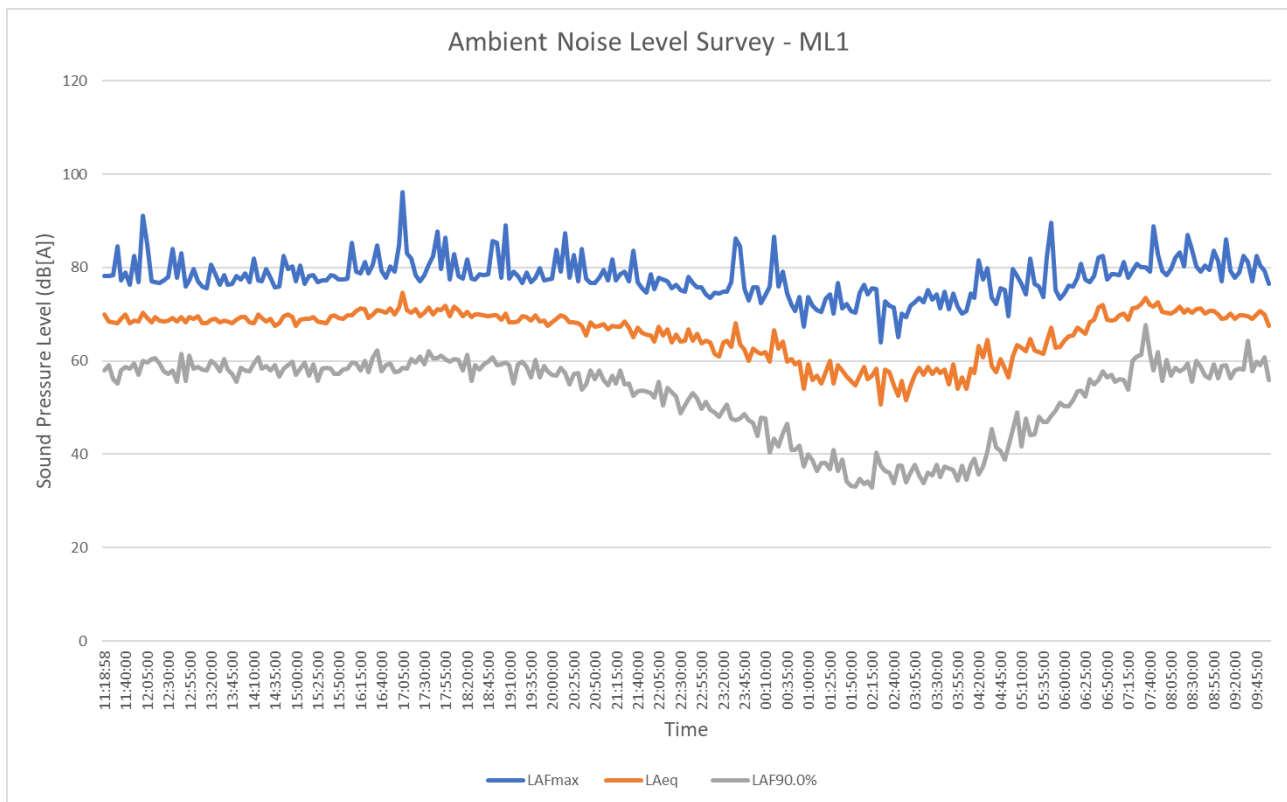
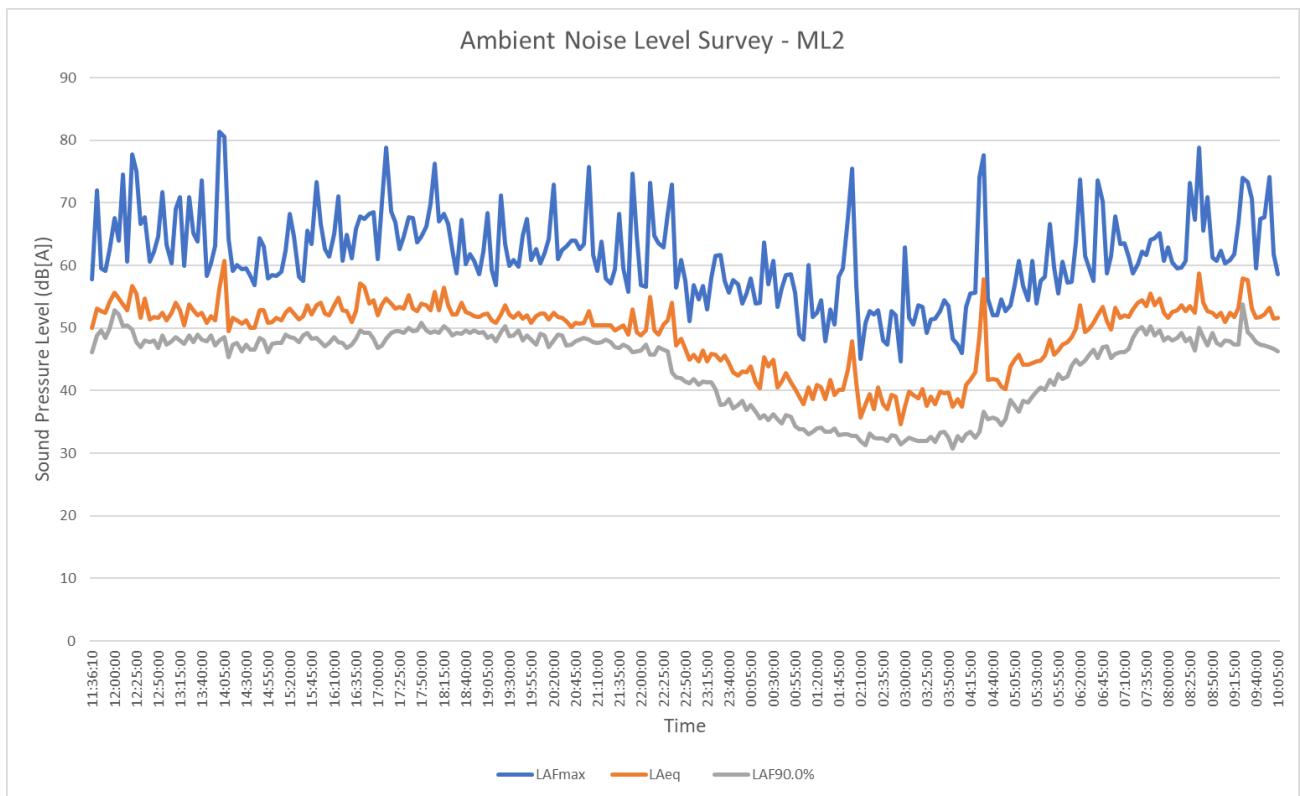


Figure 6. Ambient Noise Level Survey – ML2



APPENDIX B – 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.