soundtesting
acoustic consultancy & air leakage specialists

Environmental Noise Impact Report

Proposed Residential Development
Corner of Manchester Road and Trub road
Rochdale
OL11 2WH

Date of Report: 8th January 2021

Reference: 13955 Version 1

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1 General Information

1.1 Client Instructing Survey

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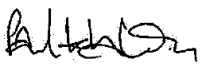
North West HA Projects Limited
New Laund Farm
Cuckstool Lane
Burnley
BB12 9NY

1.2 Date of Noise Survey

Tuesday 20th October2020

1.3 Report Author

	Name	Position	Signature	Date
Prepared by	P Klabou BA	Acoustic Consultant		08/01/2021
For and on behalf of: Soundtesting.co.uk Ltd				

1.4 Report Checked

	Name	Position	Signature	Date
Report Checked	B Bielicki MSc MIOA	Acoustic Consultant		08/01/2021
For and on behalf of: Soundtesting.co.uk Ltd				

2 Introduction

North West HA Projects Limited has instructed Soundtesting.co.uk Limited to undertake an environmental noise survey in order to assess the impact of sound from the nearby motorway, adjacent Manchester Road and other general noise within the local environment, which may have an impact on future residents of the proposed development. The proposed development is a 3-storey building consisting of 15 one-bedroom and two-bedroom apartments.

This report is prepared solely for North West HA Projects Limited. Soundtesting.co.uk Limited accepts no responsibility for its use by any third party.

This document has been prepared using the various documents listed within the appendices of this report, together with drawings, technical information and additional verbal representations made by third parties. We have not audited nor independently verified the content or accuracy of any of the documents and information provided to us in the preparation of this report.

If additional information comes to light subsequent to the production of this report, we reserve the right to revise our opinions and the conclusions reached within this report.

2.1 An Environmental Noise Assessment

Soundtesting.co.uk Ltd has undertaken an environmental noise assessment at the above site with noise levels measured externally over a 4-hour period, consisting of 3 one-hour measurements and 3 5-minute measurements. The measurements were made between 11:00 and 15:00 on a Wednesday. This report will state the measured noise levels and will refer to guidance relevant to the nature of this survey whilst considering Local Planning Authority guidance and conditions.

3 Assumptions, Limitations & Uncertainty

a. All suggested specifications require a good level of workmanship and for materials to be installed as the manufacture intends. Any poor workmanship may lead to weaknesses in the sound attenuation provided by the building elements.
b. It is assumed that the sound pressure levels measured on site during the environmental noise survey are typical of the site.
c. It is assumed that the technical data provided by glazing and ventilation manufacturers is up to date and correct.
d. It is assumed that drawings and information supplied by North West HA Projects Limited are up to date and correct.

4 Planning Policies, Guidance and Criteria

The planning policies and criteria listed below are taken from associated relevant guidance documents, all of which should be considered for the internal and external noise and vibration levels.

4.1 National Planning Policy

The National Planning Policy Framework (NPPF) July 2018 set out the Government's planning policies for England and how they are expected to be applied. It provides a framework within which the Local Authorities are to prepare local plans and use their planning powers to minimise the adverse impact of noise. It should contain the following in relation to noise impacts.

170. 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.'*

180. 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 impact resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life'*

NPPF characterises noise by grading and recommending actions and different effect levels as reproduced in Table 1.

Table 1: Noise Exposure Hierarchy Based on Likely Average Response			
Perception	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

4.2 Criteria

4.2.1 Local Authority Criteria

A Previous Planning Application was made to Rochdale Borough Council in respect of this site:

14/00418/OUT: Lomax Transport Services, Trub Farm Manchester Road Rochdale Lancashire OL11 2XG Outline application (including access only) for a residential development of 29 dwellings

Planning Granted: 12/02/2015

The above application was subject to conditions. The condition relevant to noise was:

15. No development shall take place until a scheme to protect the dwellings from noise generated by passing traffic on the M62 motorway has been submitted to and approved in writing by the Local Planning Authority. The scheme shall ensure noise levels of not more than 35dB(A) L_{eq} (8 hours) in bedrooms and 40 dB(A) L_{eq} (16 hours) in other habitable rooms between 07:00 and 23:00 hours and that any individual noise event in these rooms does not exceed 45 dB(A) L_{max} between 23:00 and 07:00 hours. Where windows need to remain shut in order to achieve these levels other means of ventilation shall be provided. The scheme shall thereafter be implemented in accordance with the duly approved details and a verification report submitted to and approved in writing by the Local Planning Authority to demonstrate that the required noise levels have been achieved for each plot before the dwelling on that plot is first occupied.

Reason: In order to ensure the implementation of appropriate noise attenuation measures for the proposed dwellings to ensure satisfactory living conditions for future occupiers of the development in accordance with the requirements of Unitary Development Plan policies H/3, BE/2 and EM/3.

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

The British Standard BS 8233:2014, Guidance on Sound Insulation and noise reduction for buildings, provides appropriate internal levels of noise within dwellings, flats and rooms in residential use when unoccupied.

Section 7.2.2 'Internal ambient noise levels in dwellings' of BS8233: 2014 states that 'In general, for steady external noise sources, it is desirable that the internal ambient noise level does not exceed the guideline values.

Table 2: Indoor Ambient Levels for Dwellings			
Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

Note 7 of section 7.7.2 states 'Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed up to 5 dB and reasonable internal conditions still achieved'.

In addition, note 4 of section 7.7.2 states, '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".

In the absence of a specific performance criterion within BS8233 for short-term noise maxima, reference can be made to guidance published by the WHO. In particular, the WHO publication 'Guidelines for Community Noise' (1999), from which the guidance given in BS8233: 2014 is itself derived, states that 'for a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more than ten to fifteen times per night'.

The WHO publication 'Guidelines for Community Noise' (1999) has since been updated in 2018; however, it is widely accepted by Local Authorities that 45dB L_{AFmax} is the target level for short-term noise maxima between 23:00-07:00.

4.2.3 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: A Summary of the Guidance Noise Levels				
Specific Environment	**Critical Health Effect (s)**	**L_{Aeq} (dB)**	**Time base (hours)***	**L_{AFmax} (dB)**
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	60

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

4.3 Other Standards

4.3.1 Calculation of Road Traffic Noise (CRTN)

CRTN sets out standard procedures for calculating noise levels from road traffic. The calculation method uses a number of input variables, including traffic flow volume, average vehicle speed, percentage of heavy goods vehicles (HGVs), type of road, site geometry and the presence of noise barriers or acoustically absorbent ground to predict the noise level for any receptor point at a given distance from the road.
CRTN states:

$$L_{A10,\ 18hour} = L_{A10,\ 3hour} - 1dB$$

This is then corrected to provide a $L_{Aeq,\ 16hour}$

$$L_{Aeq,16hour} = L_{A10,\ 18hour} - 2dB$$

4.4 Criteria Summary

To meet the anticipated requirements of Rochdale Borough Council Planning Authority, the assessment and recommendations will be made in reference to BS8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings and The WHO guidelines for Community noise. Please note that notwithstanding the anticipated L_{AFMax} criteria of:

> *"…any individual noise event in these rooms does not exceed 45 dB(A) L_{max} between 23:00 and 07:00 hours."*

The WHO clearly states that this criterion be paired with the following caveat:

> *'for a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more than ten to fifteen times per night'*

Further to the WHO advice, it is not possible to design a façade, such that every single external night-time noise event will result in an internal noise level of less than 45dB L_{AFmax}. Consequently, this report will design to meet the 10 – 15 times per night caveat.

The CRTN shortened Method, stated above, will be used to ascertain Daytime Average Noise Levels.

5 Site Description

The proposed development site is currently a polygon shaped area of turfed, flat ground, approximately 750m^2 in area. The Eastern side of site is flanked by Manchester Road (running North to South) and Trub Road to the North (Running East to West). Manchester Road is a main thoroughfare to Rochdale. At the time of the survey Manchester Road was in constant use whereas Trub Road, a small feeder road, was used sporadically. The centre of the parcel of land is approximately 90m due North from the near side carriageway of a raised section (+6m elevation) of the M62 motorway. The site is partially shielded by an existing, substantial, residential dwelling, 1022 Manchester Road, located between the Site and the M62. Located opposite the site is the OMC Ford car showroom. Located to the west of the site is Lomax Transport industrial unit and associated vehicle parking area. See below.



5.1 Subjective Observations

During site attendance, subjectively the main source of noise was due to road traffic, predominantly from the M62. The other major source of traffic noise was due to localised vehicle passes along Manchester Road. However, at the time of the survey, there were temporary traffic lights being used for the section of Manchester Road that passes under the M62, causing the traffic flow to differ from normal. Given the volume of vehicles using Manchester Road, it is likely that the normal flow would be steady and constant. As a result of the road works, traffic on the far side of Manchester road decelerated to a standstill, idled, then accelerated away upon the lights turning green, or, passed through at a reduced speed. Traffic on the near side flowed through in distinct packets of

approximately 20 vehicles. However, traffic travelling in this direction was also impeded by a further set of Temporary traffic lights, further up Manchester Road, in the direction of Rochdale causing traffic to back up, down Manchester Road.

Other noise sources included a jet wash being used very briefly on the OMC Ford site, noise due to flagpole rope slapping against the flag poles, due to wind and occasional sound of power tools being used at the roadworks site. Trub Road experienced only sporadic traffic and there were two instances of HGVs using the gates to Lomax Transport. It is of note that a previous planning application 14/00418/OUT, indicates the demolition of Lomax Transports' premises to allow for house building.

There was only a small variation in Average noise levels due to the M62 at any point on site. Conversely, the localised noise impact from car passes along Manchester road has a greater significance on the Eastern flank of site, compared to the West.

5.2 Weather

Table 4: Weather Conditions	
Description	**Daytime Average**
Temperature	15°C
Wind Speed	3.5m/s
Wind Direction	SW
Precipitation	Dry with 1 short shower
Damp road/ wet ground	Dampened, but only briefly
Fog/snow/ice	None

6 Noise Measurement Procedure

6.1 Personnel Present

Paul Klabou BA

6.2 Survey Equipment Used

Table 5: Survey Equipment Used			
Manufacturer	**Model**	Serial No.	Description
Rion	NL52	1054205	Real Time Analyser Sound Level Meter
Pulsar	Model 105	93357	Acoustic Calibrator

6.3 Calibration

The sound level meter was calibrated with the field calibrator to a level of 94.0 dB @ 1 kHz prior to and on completion of the survey. No significant drift in calibration was observed. The meter used during the survey is the type, precision grade, class 1.

Calibration certificates are available on request.

6.4 External Ambient Sound Measurements

The measurement locations chosen during the survey were deemed suitable for the determination of the noise levels that will impact upon the façades of the proposed development.

The sound level meter was set to measure L_{Aeq}, L_{A90}, L_{A10}, and L_{AFmax} in 5-minute periods, as well as A-weighted 1:1 octave spectrum analysis.

6.4.1 Monitoring Position 1

A microphone was placed 2 meters above the ground floor surface and 9m from the kerbside of Manchester Road. The sound level meter was set to record WAV file audio recordings for all maximum sound level events above 70 dBA.

6.4.2 Monitoring Position 2

A microphone was placed 2 meters above the ground floor surface at the South West Corner of the site. The sound level meter was set to record WAV file audio recordings for all maximum sound level events above 70 dBA.

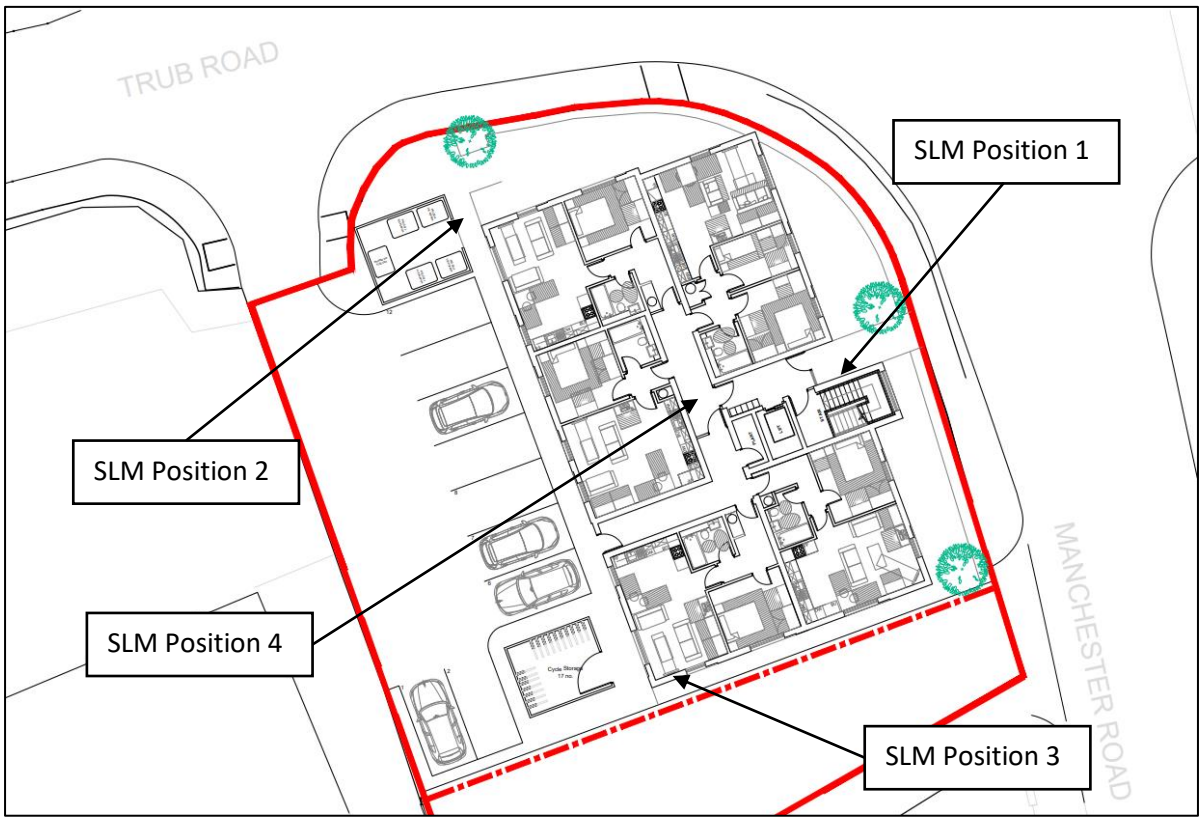
6.4.3 Monitoring Position 3

A microphone was placed 2 meters above the ground floor surface at the North West corner of site. The sound level meter was set to record WAV file audio recordings for all maximum sound level events above 70 dBA.

6.4.4 Monitoring Position 4

A microphone was placed 2 meters above the ground floor surface in the middle of site. The sound level meter was set to record WAV file audio recordings for all maximum sound level events above 70 dBA.

The detail below shows the proposed development and location positions of the Sound Level Meter (SLM), as they would be on the proposed site.



7 Results and Analysis

7.1 External Ambient Sound Measurement Analysis in Accordance with BS8233:2014

The following table presents the measured results from all monitoring positions.
Data charts can be found in the appendix.

Table 6: Measurement Results						
Monitoring position	Time Period	Time Base T	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)	L_{A90} (dB)	L_{A10} (dB)
1	Daytime	3hrs	69.4	73.4 – 91.3	66.3	71.4
2	Daytime	10min	66.6	82.9	63.9	67.5
3	Daytime	10min	66.9	74.1	65.3	68.1
4	Daytime	10min	66.5	73.4	64.9	67.9

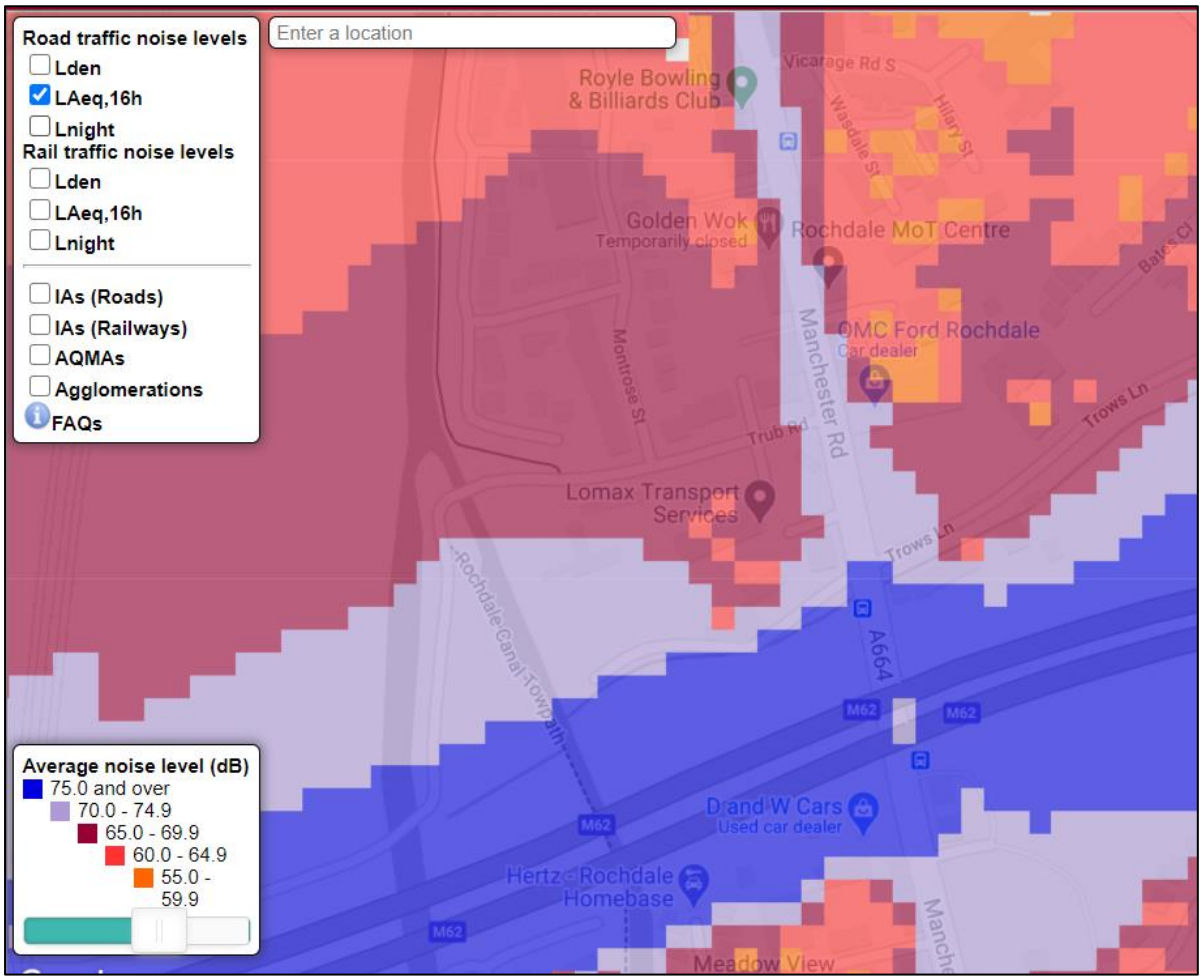
7.1.1 CRTN Predicted Noise Levels

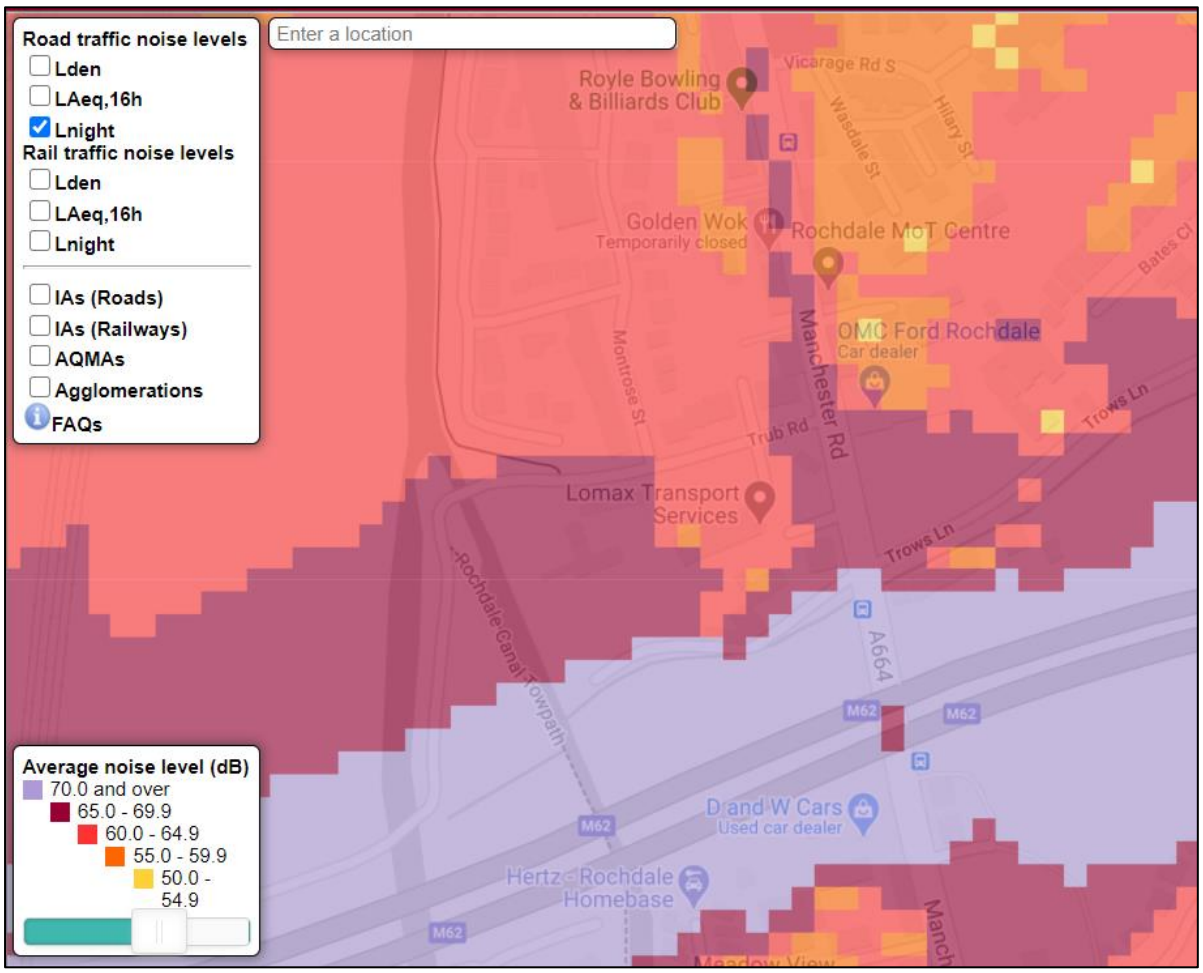
The measured $L_{A10,3hour}$ result is 71.4dB. This has been corrected as stated in section 4.3.1 to provide a $L_{Aeq,16hour}$ of 68.4dB.

7.2 Comparison with Extrium Noise Maps

Extrium Noise maps identify the same part of Manchester road as exhibiting the following noise pattern:

Table 7: Measurement Results		
Time Period	**Time Base T**	**$L_{Aeq,T}$ (dB)**
Daytime	16hrs	65 – 74.9
Night-time	8hrs	55 – 64.9





7.3 L_{AFmax} Analysis

The L_{AFmax} measured during the day (11:00 - 13:00) have been used to inform Night time L_{AFmax}. WHO Community Noise Guidelines states “For a good night sleep it is believed that indoor sound pressure should not exceed approximately 45dB L_{AFmax} more than 10 – 15 times per night (Vallet & Vernet 1991)”.

7.3.1 L_{AFmax} at Monitoring Position 1

The L_{AFmax} measurements are informed by instantaneous noise maxima events. For the site in question, the dominant source of L_{AFmax} events was observed to be vehicle passes along the adjacent Manchester Road. It is these L_{AFmax} events that are dominant and thus dictate the façade requirements of the Eastern flank of the proposed development and to a lesser extent, the north and south facing facades. The Western façade will most likely have a greater noise impact from the M62. It is the consultant's opinion that a noisy vehicle pass, causing a high L_{AFmax} event will be the same magnitude, regardless of the time of day it is measured. As such, the same data can be used to represent Night-time L_{AFmax} events. There is, however, uncertainty over the number of such noise events that are likely to occur in a given night-time period (23:00 – 07:00). It is most likely that there will be fewer vehicle passes per hour but not necessarily fewer elevated L_{AFmax} noise events over a given Night-time period.

To accommodate this uncertainty, the L_{AFmax} event used in this reports' calculation will best estimate a L_{AFmax} event that will likely not occur more than 10 – 15 times a night, under normal circumstances.

The Data obtained from the 3-hour survey has been analysed and the L_{AFmax} measurements exhibit a spread of values. The maximum measured L_{AFmax} was 91.3 dB, which occurred at 13:15. The next highest L_{AFmax} is 87.5 dB, which occurred at 13:00. 85.0 dB L_{AFmax} is exceeded 3 times and 80.0 dB L_{AFmax} is exceeded seven times during the 3-hour period. 21 measurements were between 75 and 78 dB L_{AFmax} dB, thus forming the most typical range of L_{AFmax} events. It is therefore proposed that a value of L_{AFmax} event between 75 – 78dB be used to inform the façade requirements of the proposed development. To factor in uncertainty, an additional 3dB will be added, giving values of 78 - 81dB L_{AFmax}. All the louder L_{AFmax} events were due to Vehicle passes along Manchester Road.

8 Recommendations

The estimated internal noise levels attributed by the external noise sources have been assessed over an average $L_{Aeq,T}$ and L_{AFmax} values from the daytime survey period.

8.1 Glazing & Ventilation Specification for Bedrooms – Front (NE) and Side (SE) Facades

The required minimum Acoustic performance for these rooms has been calculated. A specification that is predicted to achieve this performance is:

- 10mm glass / 20mm argon filled cavity / 8.8mm Pilkington Optiphon glass, double glazed unit; in well-sealed frames.
- Greenwood Airvac MA3051 passive wall vent.

8.2 Glazing & Ventilation Specification for All Other Facades

The required minimum Acoustic performance for these rooms has been calculated. A specification that is predicted to achieve this performance is:

- 10mm glass / 20mm argon filled cavity / 8.8mm Pilkington Optiphon glass, double glazed unit; in well-sealed frames
- 1 x Greenwood 5000EAW.AC2 slot in trickle vent.

8.3 Bedroom Ceilings in All Plots

All ceilings in bedrooms at every plot should consist of at least 2 layers 12.5mm plasterboard with 100mm 45kg/m^3 mineral fibre laid above the plasterboard and fitted tightly between the joists.

8.4 Ventilation

The ventilation can be a quality mechanical system or a passive ventilation system, such as those stated above.

8.4.1 Notes on Ventilation

NOTE 5 in section 7.7.2 of BS8233:2014 states “if relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.”

It is our understanding that all dwellings are to be ventilated either with passive wall vents or mechanically ventilated. Where mechanical ventilation is utilised, the system is to be designed by a suitably qualified engineer or M&E consultant. The system shall be designed so the sound levels from any external plant or inlet/outlets do not exceed the background noise level at any noise receptor, i.e. outside a neighbouring window. This may require further assessment once the type and location of system has been specified.

The glazing and ventilation suggestions have been calculated assuming the windows are tightly closed. However, it must be noted that windows are suggested to be openable to provide rapid or purge ventilation or means of escape.

Although the calculations demonstrate that the wall vent can be installed on any façade; it is recommended where possible to avoid installing ventilation systems on the façade that face the road. Where possible, installing ventilation on quieter facades would be beneficial to the overall acoustic performance.

8.5 Calculation Methodology

The calculations are based on one vent per room. If more ventilation is required, then further calculations will need be carried out.

All room dimensions used in calculations are based on drawings provided by the architect.

The calculations assume the external walls to be brick and block as stated in BS8233:2014.

The calculations assume each room has a reverberation time of 0.5 seconds.

The predictions also have been calculated assuming all windows are closed and trickle vents open.

The calculation specified in section G.2.1 of BS8233:2014 has been used to arrive at the stated results.

8.6 Building Elements

The following table shows the expected performance of the recommended building elements.

Table 8: Table Showing Recommended Building Elements							
Element	Description*	$R_w/D_{n,e,w}$ C; C_{tr} (dB)	Octave Centre Frequencies (Hz) SRI / $D_{n,e}$ (dB)				
			125	250	500	1k	2k
Glazing	10mm / 20mm argon / 8.8mm Pi Opt**	46 -2; -6	28	36	43	47	49
Ventilation	Greenwood Airvac MA3051	55 -1; -3	46	46	49	55	66
	Greenwood 5000EAW.AC2	42 -2; -4	40	37	33	46	53

**The selected units or products described have been used as a guide to form part of the specification. Other similar units or products can be used provided they can achieve the given minimum acoustic performance stated here.*

***Indicates a pane of Pilkington Optiphon glass*

8.7 Example of Estimated Performance

The following table compares the estimated performance values with the measured values.

Table 9: Estimated Performance				
Specification	Measured External		Estimated Internal	
	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)
Bedrooms (Daytime resting)	68.4	73.2 – 91.3	34	42
Other Habitable Rooms	68.4	-	35	-

9 Conclusion

This report demonstrates that by following our recommendations noise levels described in BS8233:2014 and WHO Guidelines for Community Noise can be achieved for internal noise levels in all habitable rooms and external amenity spaces; therefore, satisfying the anticipated requirements of the Local Planning Authority.

10 References

National Planning Policy Framework (NPPF)
BS 8233:2014 Guidance on Sound Insulation and Noise Reduction for Buildings
World Health Organisation Guidelines for Community Noise
BS 7445-1:2003 Description and measurement of environmental noise – Part 1: Guide to quantities and procedures
BS EN 12758:2011 Glass in building – Glazing and airborne sound insulation
BS 6262-2:2005 Glazing in buildings – Part 2: Code of practice for energy, light and sound
www.google.co.uk/maps

10.1 Drawing References

2472.2.001A - Proposed Site Plan.pdf
2472.2.005A - Proposed Ground Floor Plan.pdf
2472.2.006A - Proposed First Floor Plan.pdf
2472.2.007A - Proposed Second Floor Plan.pdf
2472.2.010A - Proposed Elevations 1.pdf
2472.2.011A - Proposed Elevations 2.pdf
2472.2.015A - Proposed Site Elevations.pdf

Appendix

Picture Showing Monitoring Position 1



Pictures Showing Site






13


OMC Ford
Smiths

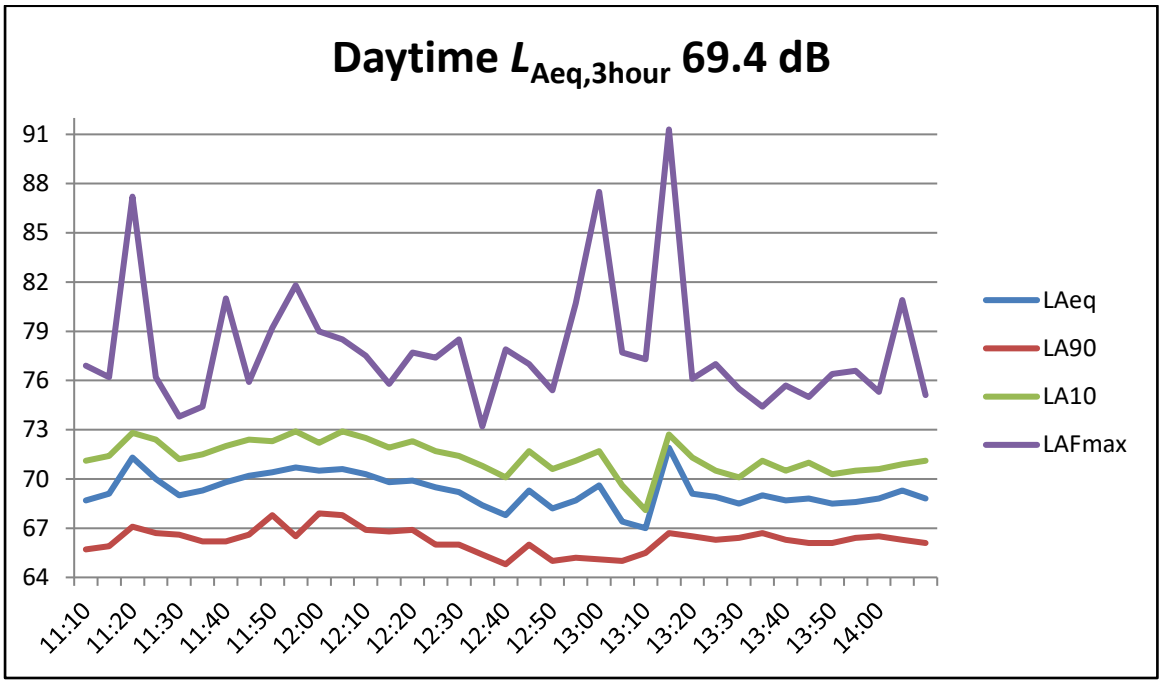

Ford
OMC Ford


LOMAX TRANSPORT
wedi
Entrance

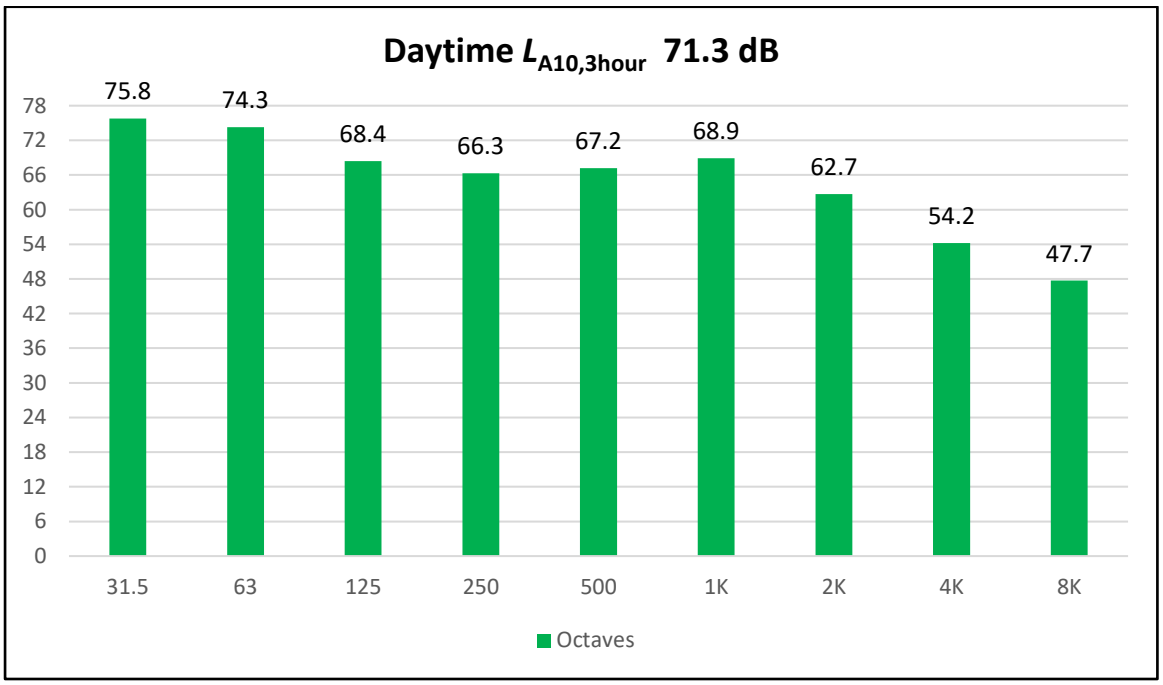


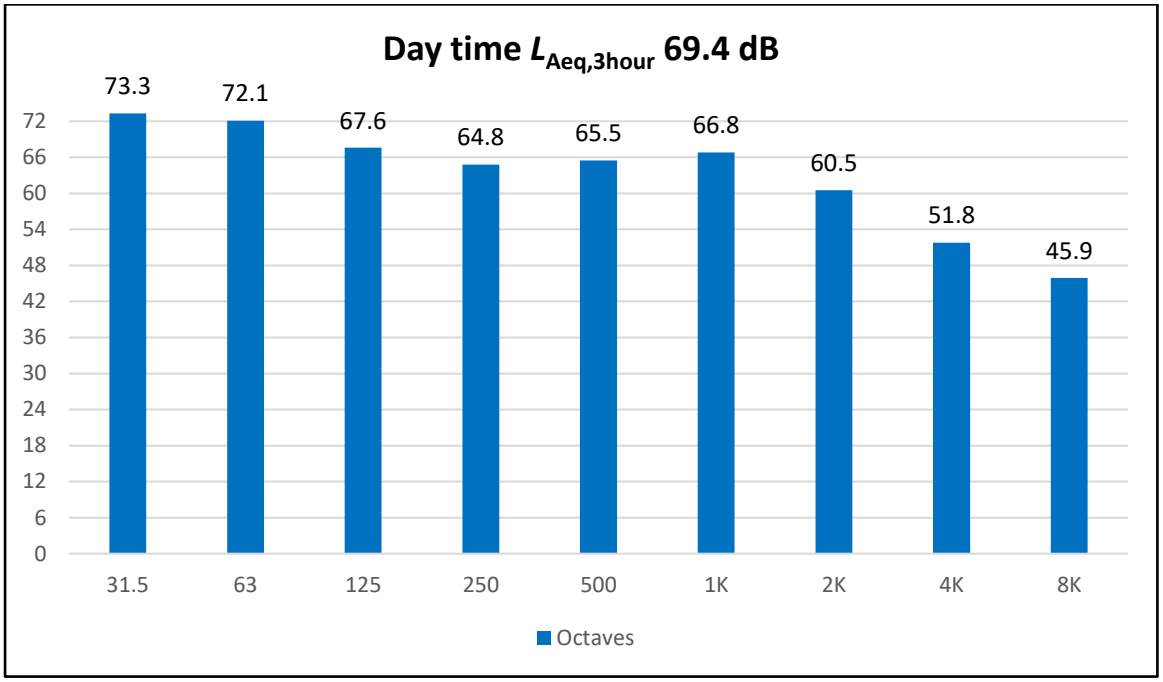
Measurement Results

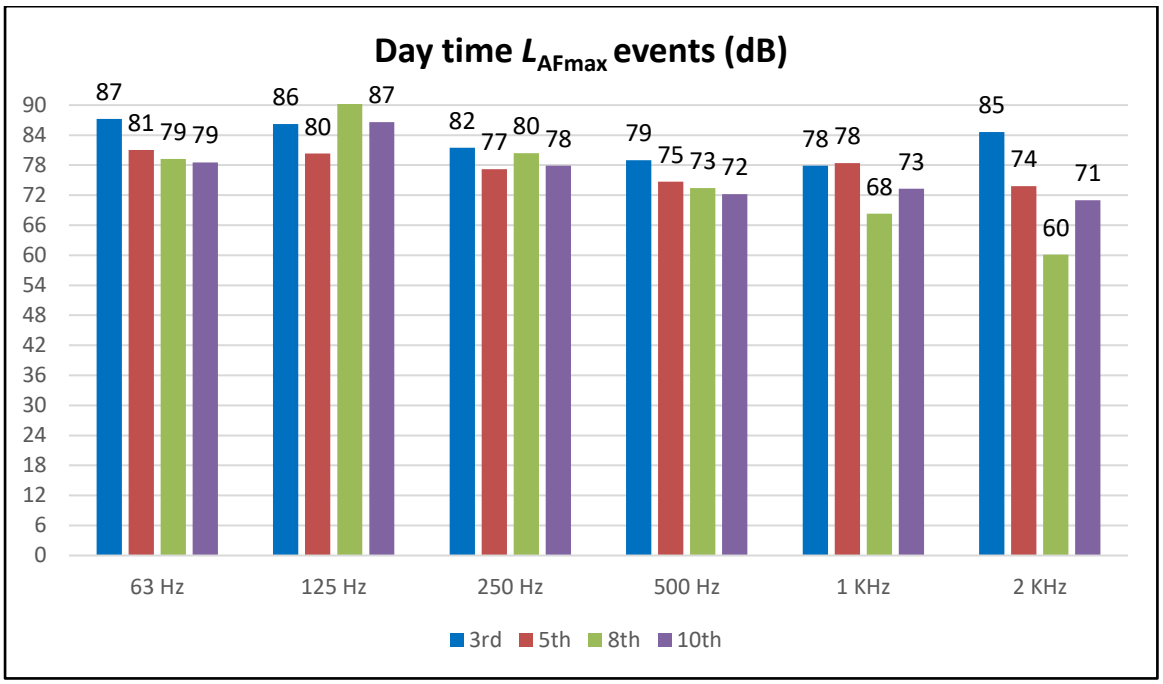
Monitoring Position 1



Un-weighted 1:1 Octave Results




Day time $L_{Aeq,3hour}$ 69.4 dB
73.3
72.1
67.6
64.8
65.5
66.8
60.5
51.8
45.9
72
66
60
54
48
42
36
30
24
18
12
6
0
31.5
63
125
250
500
1K
2K
4K
8K
Octaves


Day time L_{AFmax} events (dB)
87
81
79
79
86
80
87
82
77
80
78
79
75
73
72
78
78
68
73
85
74
60
71
90
84
78
72
66
60
54
48
42
36
30
24
18
12
6
0
63 Hz
125 Hz
250 Hz
500 Hz
1 KHz
2 KHz
3rd
5th
8th
10th