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ASSESSMENT OF INWARD TRAFFIC NOISE IMPACT AT RESIDENTIAL DEVELOPMENT AT BALLYOGAN, CO. DUBLIN

Technical Report Prepared For

Dun Laoghaire-Rathdown County Council
County Hall,
Marine Rd,
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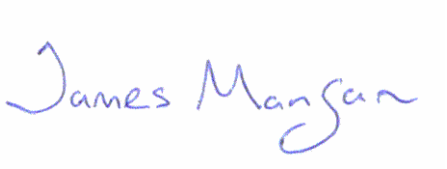
Signature		
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EXECUTIVE SUMMARY

AWN Consulting has been commissioned by Dun Laoghaire-Rathdown County Council to undertake an assessment of the potential noise impact associated with the M50 Motorway on a proposed new residential development located off Ballyogan Court, Ballyogan, Co. Dublin. For the assessment of noise, guidance has been taken from the following documents:

- The *Dublin Agglomeration Environmental Noise Action Plan: December 2013 - November 2018*;
- *BS8233: 2014 - Sound Insulation and Noise Reduction for Buildings – Code of Practice.*

Making reference to the above documents, the following daytime and night-time internal noise criteria are proposed:

- Daytime (07:00 to 23:00hrs) Living Rooms 35dB $L_{Aeq(16hr)}$
- Night-time (23:00 to 07:00hrs) Bedrooms 30dB $L_{Aeq(8hr)}$.

A proprietary acoustic model has been developed for the proposed site in order to calculate noise levels across the proposed development, taking into account the site layout and measured noise levels in the vicinity of the site.

The predicted noise levels at the external façade of all development buildings have been used to determine the internal noise levels within living room and bedroom spaces, taking account of the proposed building elements (i.e. glazing, walls, doors and roof), the surface area of each element and the receiving room volumes.

The assessment has determined that the internal noise environment within the development are within the recommended criteria adopted from BS 8233 using a glazing specification offering a sound insulation performance as follows:

Building Element	Typical Construction that would comply	Glazing Octave Band Centre Frequency (Hz)						Overall R_w
		125	250	500	1k	2k	4k	
Standard Glazing	6 – 12 – 6 DGU	20	19	29	38	36	45	33
Enhanced Glazing	10 – 12 – 16.8 DGU	28	32	43	46	48	55	45

Table A Minimum Glazing Performance Requirements, SRI (dB)

Consideration will be given to the inclusion of an upgraded roof system in certain more exposed areas of the site. The required performance of this system is as follows:

Building Element	Octave Band Centre Frequency (Hz)						Typical Configuration
	125	250	500	1k	2k	4k	
Roof	37	50	58	62	57	62	Slate tile, metal/timber frame with insulation in cavity, two sheets 12.5mm SoundBloc plasterboard fixed off resilient bar

Table B Sound Insulation Performance Requirements for Upgraded Roof, SRI (dB)

The required performance for acoustic ventilators is as follows:

- A “higher” specification acoustic vent to be applied to the noisier areas of the site. These acoustic ventilators shall achieve a sound insulation performance of 45dB $D_{n,e,w}$.
- A “lower” specification acoustic vent is to be included in the remaining units across the site. All other facades shall include acoustic ventilators achieving a minimum sound insulation performance of 38dB $D_{n,e,w}$.

Considering the above and other recommendations contained in this report, the assessment has concluded that the insulation capabilities of the development are deemed to be sufficient in order to achieve the target noise levels as outlined in Section 7.0 *Noise Mitigation and Protection Measures*, as set out in the Dublin Agglomeration Noise Action Plan.

CONTENTS

1.0 INTRODUCTION

AWN Consulting has been commissioned by Dun Laoghaire-Rathdown County Council to undertake an assessment of the potential noise impact associated with the M50 Motorway on a proposed new residential development off Ballyogan Court, Ballyogan, Co. Dublin.

The following has been undertaken and set out within the body of this report:

- Review of the relevant content of the standards that will be used for the noise assessment;
- Comment on the expected noise levels across the site due to road traffic noise;
- Calculation of sound insulation of the building performance taking into account the proposed building construction;
- Review of mitigation measures that will be considered in relation to the levels of noise incident on the site, and;
- Comment on compliance with the reference design criteria.

2.0 ASSESSMENT CRITERIA

2.1 Dublin Agglomeration Environmental Noise Action Plan (2013 – 2018)

Section 8.2.3, in particular clause (d), of the Dublin Agglomeration Noise Action Plan is relevant to this assessment and states:

> *"…the local authorities within the Dublin agglomeration will aim to implement the following actions relation to planning and development:*
>
> *d) To ensure that future developments are designed and constructed in accordance with best Irish practice to minimise noise disturbances and take into account the multi-function uses of street (e.g. movement, recreation), e.g. Urban Design Manual and the Design Manual for Urban Roads and Streets 2013."*

The 2009 *Urban Design Manual – A Best Practice Guide* stipulates that homes should be *"designed to prevent sound transmission by appropriate acoustic insulation or layout"* and that *"a good level of sound insulation can be provided through the careful choice of building materials in the development"*.

The 2013 *Design Manual for Urban Roads and Streets* addresses the issue of noise in Section 3.4.5. Noise and Air Pollution. Its focus is primarily on the design of roads themselves and thus it is not of direct relevance to this particular noise assessment of the impact of the existing road network on the site.

In summary, the *Dublin Agglomeration Noise Action Plan* and relevant guidance referenced therein call for developments to have a good level of sound insulation in accordance with best Irish practice. There is no Irish standard guidance that is directly applicable to this scenario, hence it is proposed to make reference to best practice international guidance (i.e. BS8233:2014, for example) for the purposes of arriving at appropriate design goals.

Section 6.2.1 of the Dublin Noise Action Plan provides some discussion of external noise levels that are considered to be desirably low and undesirably high, as below:

> *6.2.1 Areas with desirable low and undesirable high sound levels*
> *Following a review of existing guidance, as outlined in Chapter 2, and of the levels set the previous noise action plan, the following are the proposed thresholds for desirable low and undesirable high sound levels:*
>
> *Desirable Low Sound levels*
> *• < 50 dB(A) Lnight*
> *• < 55 dB(A) Lday*
>
> *Undesirable High Sound levels*
> *• > 55 dB(A) Lnight*
> *• > 70 dB(A) Lday*

It should be understood however that the above thresholds are not indicative of external noise levels above which planning permission should not be granted for a development. The Undesirably High Sound Levels do however signify that noise mitigation measures should be provided in order to achieve suitable internal noise levels within dwellings.

BS8233:2014 *Guidance on Sound Insulation and Noise Reduction for Buildings* sets out recommended internal noise levels for several different building types from external noise sources such as road traffic noise. BS8233:2014 is referenced in Section 16.10.3 *Residential Quality Standards – Apartments and Houses* of the *Dublin City Development Plan* 2016-2022, Written Statement - Volume 1 which comment that:

> *"Acoustic privacy is a measure of sound insulation between dwellings and between external and internal spaces. Development should have regard to the guidance on sound insulation and noise reduction for buildings contained in BS 8233:2014".*

2.2 British Standard BS 8233 (2014)

The standard, *BS8233: 2014 - Sound Insulation and Noise Reduction for Buildings – Code of Practice*, sets out recommended internal noise levels for several different building types from external noise sources such as road traffic noise. The guidance is primarily for use by designers and hence BS 8233 may be used as the basis for an appropriate schedule of noise control measures. The recommended internal noise levels for residential developments are set out below.

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

Table 1 Indoor ambient noise levels for dwellings from BS8233: 2014

In review, the following daytime and night time internal noise criteria are proposed:

- Daytime (07:00 to 23:00hrs) Living Rooms – 35dB $L_{Aeq(16hrs)}$
- Night-time (23:00 to 07:00hrs) Bedrooms – 30dB $L_{Aeq(8hrs)}$

3.0 SITE DESCRIPTION

The site is located off Ballyogan Court, Ballyogan, County Dublin. The site is located immediately adjacent to the M50 Motorway to the east. Figure 1 illustrates the site location (site boundary in red).

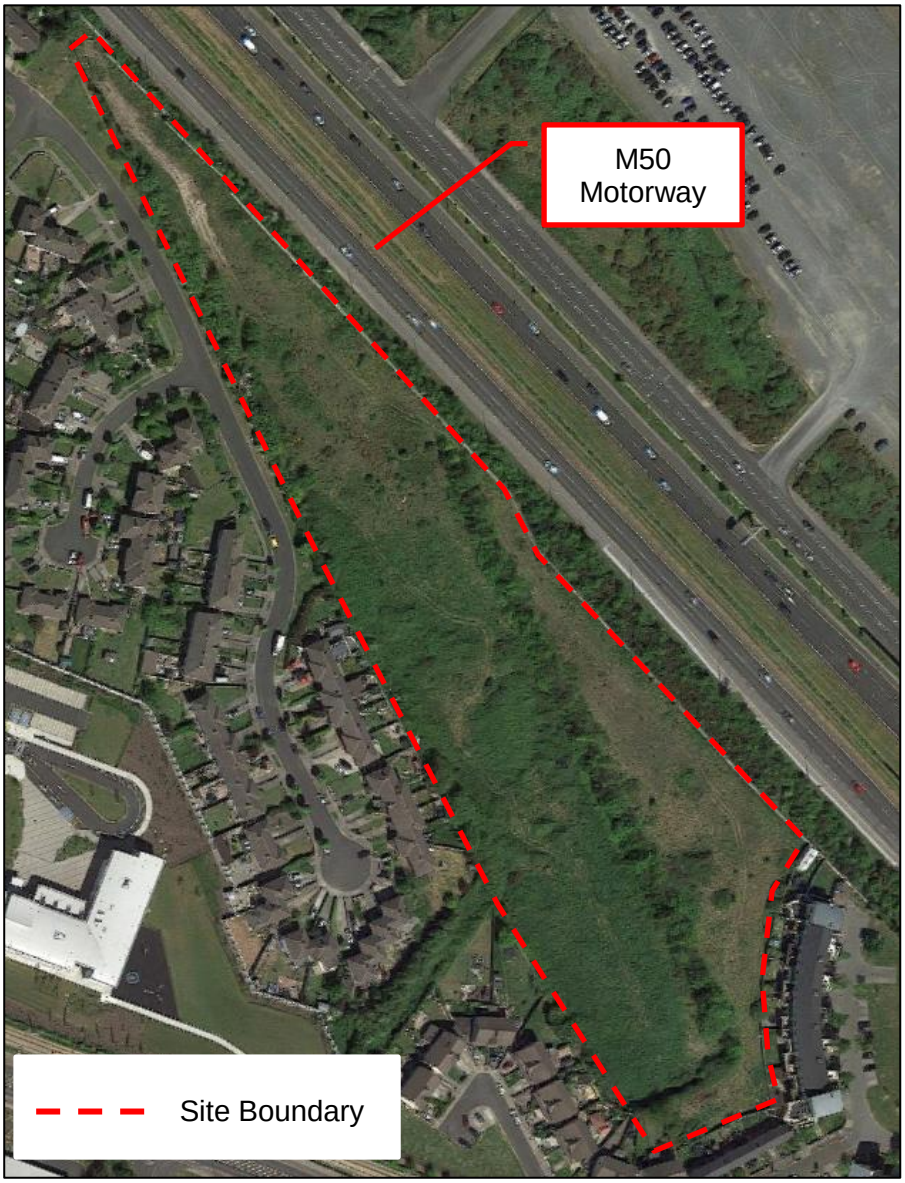

Figure 1 Site context and approximate line boundary

It is AWN's understanding that an existing boundary wall runs along the extent of the site and this will be kept as part of the proposed development.

4.0 ASSESSMENT METHODOLOGY

In order to determine the noise levels experienced at the most exposed facades of the proposed development, the following approach was undertaken:

- An attended survey was undertaken at the development site in the vicinity of the proposed residential properties;
- A noise model of the proposed development was developed using site layout plans and known M50 traffic flows;
- Noise levels were calculated across the site and at each of the proposed building facades, and;
- Internal noise levels were calculated taking into account the sound insulation performance of the building elements, i.e. the glazing, ventilation and wall elements.

Specific details are set out in the following sections.

4.1 Noise Survey

As the site was deemed not secure enough to leave a noise monitoring unattended for an extended period, an attended noise survey was conducted at the site in order to obtain a profile of typical noise levels over a typical daytime period. The survey was conducted between 10:00hrs to 13:00hrs on 27 March 2018. The equipment was set to log every 15 minute period.

The survey was conducted in accordance with the Shortened Measurement Procedure as per the Department of Transport (UK) Calculation of Road Traffic Noise.

The measurement locations were chosen to capture the prevailing noise environment at the nearest proposed building facades facing the M50. Figure 2 illustrates the location of the measurement positions.

The shortened measurement procedure involves a method whereby $L_{A10(18hour)}$ and L_{den} values are obtained through a combination of measurement and calculation as follows:

- Noise level measurements are undertaken at the chosen location over three consecutive hours between 10:00 and 17:00hrs;
- The duration of the sample period during each hour is selected to encompass sufficient traffic flows to ensure reliable results;
- The $L_{A10(18hour)}$ for the location is derived by subtracting 1dB from the arithmetic average of the three hourly sample values, i.e.
- $L_{A10(18hour)} = ((\sum L_{A10(15\ minutes)}) \div 3) - 1$ dB
- The derived L_{den} value is calculated from the $L_{A10(18hour)}$ value, i.e.
- $L_{den} = 0.86 \times L_{A10(18hr)} + 9.86$ dB

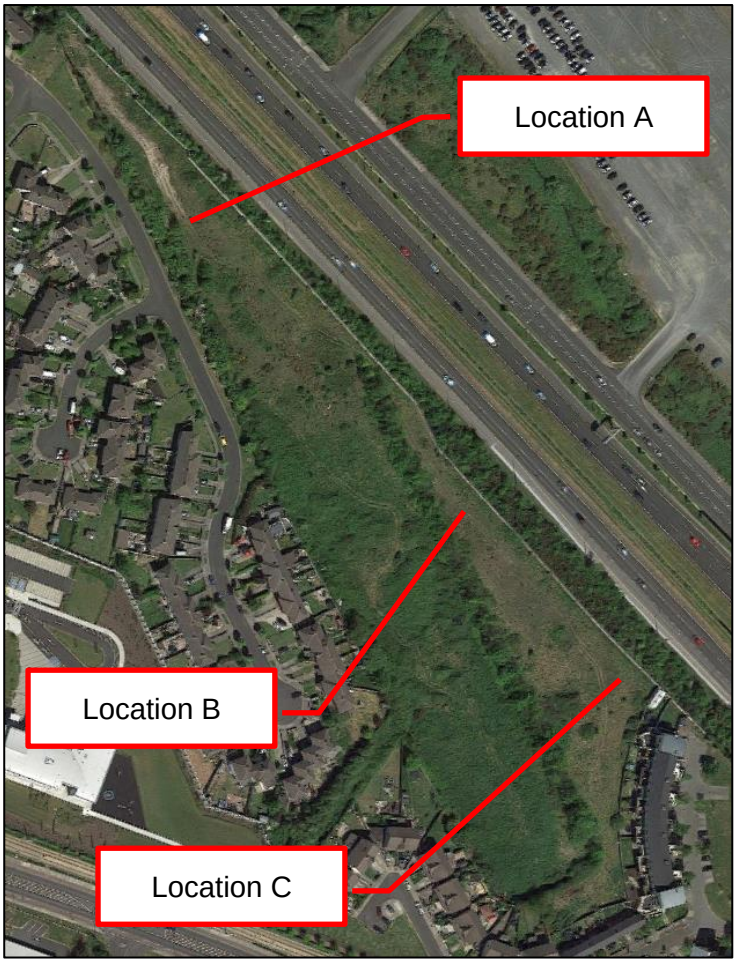

Figure 2 Noise Measurement Positions

4.2 Survey Results

The results of the noise survey are presented in Table 2.

Location	Time	Measured Noise Level, dB					Calculated L_{den}
		L_{Aeq}	L_{Amax}	L_{Amin}	L_{A10}	L_{A90}	
A	10:41	67	73	61	69	64	66
	11:45	66	72	61	68	64	
	12:39	65	71	61	67	63	
B	10:16	70	76	64	72	68	68
	11:22	69	75	64	71	67	
	12:20	69	75	64	71	67	
C	10:00	69	75	63	71	67	68
	11:05	69	74	64	70	67	
	12:04	69	76	64	71	67	

Table 2 Attended Survey Results

It was noted on site that traffic noise on the M50 was the dominant noise source at all measurement locations.

5.0 ASSESSMENT OF THE DEVELOPMENT SITE

Proprietary noise calculation software was used for the purposes of this impact assessment to calculate road traffic noise levels across the development site. The selected software, Brüel & Kjær Type 7810 *Predictor*, calculates noise levels in accordance with ISO 9613, (1996): *Acoustics – Attenuation of sound during propagation outdoors*, Part 2: *General method of calculation*. The general methodology and details of the software package used are presented in Appendix A.

In order to determine the noise levels at the various façades of the proposed development, the following information was included in the model:

- Site layout drawings of proposed development;
- OS mapping of surrounding environment.
- M50 Traffic flow data (Transport Infrastructure Ireland).

Noise levels recorded during the attended survey, as well as the calculated L_{den} values, were used to calibrate noise levels at the site.

Calibration Point	Measured Level (dB)	Predicted Level (dB)
A	66	65
B	69	67
C	69	67

Table 3 Calibration Summary

Receiver locations were positioned at several representative facades of the proposed buildings at ground and first floor level (and at higher level in the case of the apartment block), representing the living rooms and bedrooms for each property. The calculated noise levels at these receiver locations have been used to determine the required sound insulation specification of the building envelope to comply with the internal noise levels as recommended is BS 8233 discussed previously in Section 2.2.

In order to calculate noise levels over the appropriate periods in compliance with this standard, noise levels are calculated over daytime periods, i.e. 07:00 to 23:00hrs and night-time periods, 23:00 to 07:00hrs. Assessment locations have been chosen to represent the various predicted noise levels experienced at different points across the site. These are displayed in the figure below.

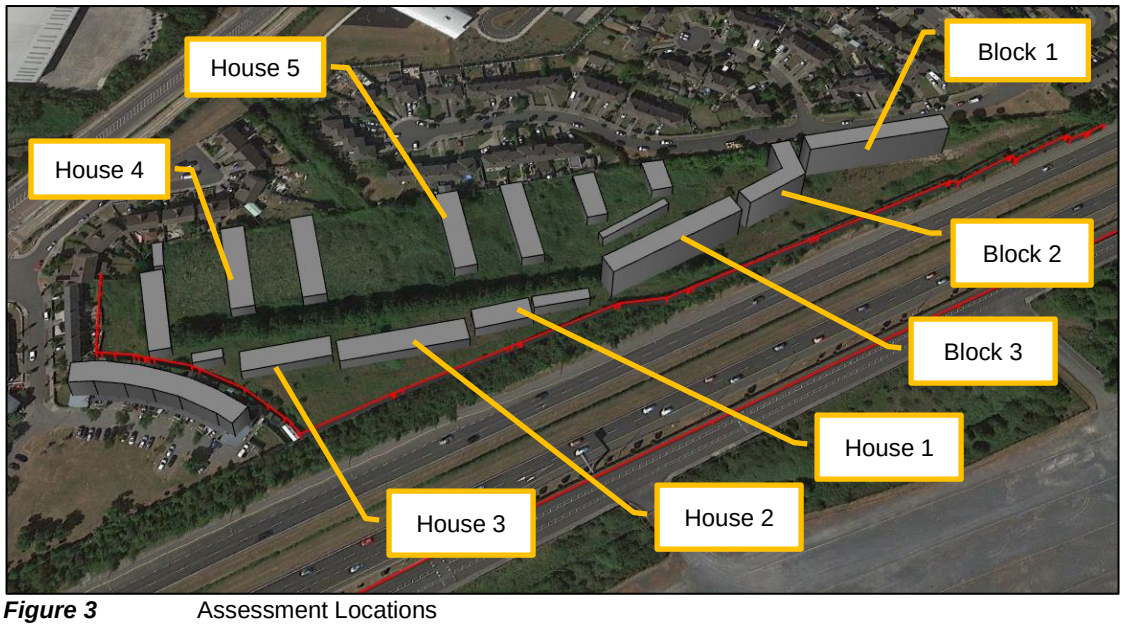

Figure 3 Assessment Locations

5.1 Daytime Predicted External Levels

Table 3 lists the calculated external noise levels at the facades of buildings in the various assessment locations during the day period. The facades listed below represent the most exposed facades that include glazing. It is understood by AWN that internal layouts have been orientated so that facades overlooking the motorway do not contain glazing into habitable rooms.

Location	Most Exposed Façade with Glazing	Predicted Road Traffic Noise Level dB (Daytime – $L_{Aeq, 16hr}$)
Block 1	4th Floor Corner Unit (south east)	68
	4th Floor Corner Unit (north west)	75
Block 2	4th Floor Corner Unit (south east)	72
	4th Floor Corner Unit (south west)	54
Block 3	4th Floor Corner Unit (north west)	73
	4th Floor Corner Unit (south east)	75
House 1	Ground Floor (north east façade)	66
	1st Floor (north west façade)	63
House 2	Ground Floor (north east façade)	66
	1st Floor (north west façade)	63
House 3	Ground Floor (north east façade)	65
	1st Floor (north west façade)	62
House 4	Ground Floor (south east façade)	58
	1st Floor (north west façade)	62
House 5	Ground Floor (north east façade)	59
	1st Floor (north west façade)	62

Table 3 Calculated Façade Noise Levels (Daytime)

The predicted daytime noise levels are calculated in the range of 58 to 75dB $L_{Aeq,16hr}$ with the higher levels predicted at façades closest to the M50 Motorway.

The results of the assessment indicate that noise levels at the site are at certain facades above the *significant threshold* noise levels set out in the Dublin Agglomeration Environmental Noise Action Plan of 70dB L_{day}.

Therefore, enhanced glazing, acoustic ventilators and upgraded roof systems are required in noisier areas of the site. This is detailed later in the report.

5.2 Night Time Predicted External Levels

Table 4 lists the calculated external noise levels at the facades of buildings in the various assessment locations during night-time period.

Location	Most Exposed Façade with Glazing	Predicted Road Traffic Noise Level dB (Daytime – $L_{Aeq, 16hr}$)
Block 1	4th Floor Corner Unit (south east)	61
	4th Floor Corner Unit (north west)	68
Block 2	4th Floor Corner Unit (south east)	65
	4th Floor Corner Unit (south west)	47
Block 3	4th Floor Corner Unit (north west)	66
	4th Floor Corner Unit (south east)	68
House 1	Ground Floor (north east façade)	59
	1st Floor (north west façade)	56
House 2	Ground Floor (north east façade)	59
	1st Floor (north west façade)	56

Location	Most Exposed Façade with Glazing	Predicted Road Traffic Noise Level dB (Daytime – $L_{Aeq, 16hr}$)
House 3	Ground Floor (north east façade)	58
	1st Floor (north west façade)	55
House 4	Ground Floor (south east façade)	51
	1st Floor (north west façade)	54
House 5	Ground Floor (north east façade)	52
	1st Floor (north west façade)	55

Table 4 Calculated Façade Noise Level (Night time)
NOTE Only 1st Floor rooms (bedrooms) are subject to the night time criteria.

The predicted night-time noise levels are calculated in the range of 47 to 68dB $L_{Aeq,8hr}$ with the higher levels predicted at façades closest to the M50 Motorway.

The results of the assessment indicate that noise levels at the site are at certain facades above the *Undesirable High Sound levels* noise levels set out in the Dublin Agglomeration Environmental Noise Action Plan of 55dB L_{night}.

Therefore, enhanced glazing, acoustic ventilators and upgraded roof systems are required in noisier areas of the site. This is detailed later in the report.

6.0 ASSESSMENT OF BUILDING SOUND INSULATION

Based on the predicted day and night-time noise levels presented in Section 5.0, the appropriate sound insulation performance of the building envelope can be specified in order to achieve the appropriate internal noise levels set out in Section 2.0.

6.1 Comment on Acoustic Zoning

The practice of acoustic zoning has been implemented during the course of the layout design process. Acoustic zoning is a very effective method of reducing the noise impact on the most sensitive areas of a development. In the first instance placing the tallest development buildings closest to the main source of noise, in this case the M50 to the east, will provide shielding to the other areas of the development. In particular by locating the external amenity areas internal to the site with development buildings screening the spaces from the road network, a large degree of acoustic screening can be obtained to reduce the noise levels in these external amenity areas that are further from the motorway.

Similarly, when considering the internal layout of the buildings overlooking the M50 road network the principal of acoustic zoning can also be applied and non-sensitive rooms, such as bathrooms, corridors and service cores can be located on the noisy side of the building. This approach is being adopted in this instance and the sensitive bedroom and living spaces are being placed on the quieter side of the buildings. Furthermore, it is AWN's understanding that no ventilators are contained in facades facing the M50 motorway.

6.2 Glazing

The glazed elements of the building envelope are typically the weakest element from a sound insulation perspective. A standard thermal double-glazed unit would generally be 6mm glass on the outer pane with a 12mm air gap and another 6mm glass on the inner pane (6-12-6). This specification of glazing has been assessed for all facades and is sufficient to achieve the required internal noise levels over the majority of the site.

In this instance, using the minimum the sound insulation performance as set out in Table 5 below is deemed suitable for the majority of apartments and houses under assessment in order to achieve an acceptable internal noise environment.

Glazing Specification	Octave Band Centre Frequency (Hz)						Typical Glazing Configuration
	125	250	500	1k	2k	4k	
Standard IGU	19	20	29	33	28	32	6/12/6 sealed

Table 5 Sound Insulation Performance Requirements for Glazing, SRI (dB)

It is important to note that the acoustic performance specifications detailed herein are minimum requirements which apply to the overall glazing system. In the context of the acoustic performance specification the 'glazing system' is understood to include any and all of the component parts that form part of the glazing element of the façade, i.e. glass, frames, seals, openable elements etc.

The areas that require mitigation by way of enhanced glazing are detailed in Section 7.1.

6.3 Wall Construction

In general all wall constructions, i.e. block work or concrete, offer a high degree of sound insulation, much greater than that offered by the glazing systems set out in Section 6.1. Therefore, noise intrusion via the wall construction will be minimal. The calculated internal noise levels across the building façade have assumed a minimum sound reduction index of 51dB R_w for this construction.

6.4 Ventilation

The units will be naturally ventilated with a demand control system, for units adjacent to the M50, no vents shall be located in facades or roofs facing towards the motorway. Where vents are included it has been determined through calculation that mitigation by way of two specifications of acoustic vents are required across the site. This is detailed in Section 7.3.

6.5 Roof System

For the assessment a standard roof system has been applied to all houses. For the majority of the houses, the calculated internal noise levels are below the internal daytime and night time criteria. In this instance, the minimum the sound insulation performance as set out in the table below is deemed suitable for the majority of houses under assessment in order to achieve an acceptable internal noise environment.

Roof Specification	Octave Band Centre Frequency (Hz)						Typical Glazing Configuration
	125	250	500	1k	2k	4k	
Standard Roof	29	37	43	46	42	46	Slate tiles, timber batten with standard insulation, 1 layer of 12.5mm standard plasterboard

Table 6 Assumed Sound Insulation Performance for Standard Roof, SRI (dB)

Certain houses (adjacent to M50) did not meet the internal noise level criteria and will require mitigation in the form of an upgraded roof system. This is detailed in Section 7.2 below.

7.0 PROPOSED MITIGATION

7.1 Enhanced Glazing

As mentioned above, a standard glazing unit is sufficient to achieve the required internal noise levels over the majority of the site however enhanced glazing is required in certain areas that are either facing or are in close proximity to the M50 motorway. These areas include corner units on apartment blocks with windows facing the M50 (all floors) and the glazing to the ground floor rear of the row of houses backing on to the motorway (as marked up in Figure 4 and Figure 5).

The required performance of proposed enhanced glazing is detailed in the table below.

Glazing Specification	Octave Band Centre Frequency (Hz)						Typical Glazing Configuration
	125	250	500	1k	2k	4k	
Double glazing	28	32	43	46	48	55	10/12/16.8 sealed

Table 7 Sound Insulation Performance Requirements for Enhanced Glazing, SRI (dB)

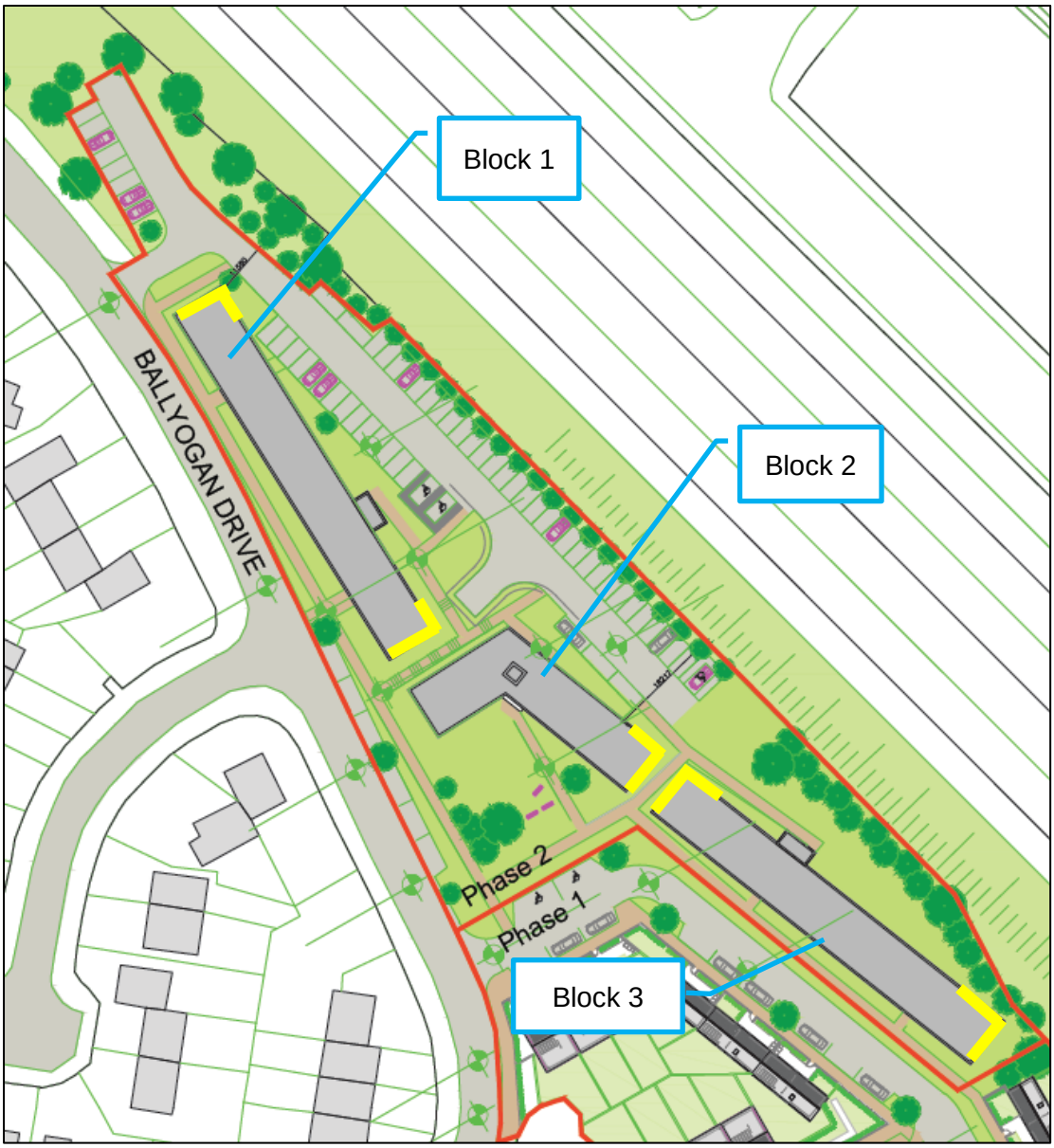

Figure 4 Enhanced Glazing - Apartments

Figure 5 Enhanced Glazing - Houses

Taking account of the external noise levels, the surface area of the glazing, walls and roof, and the relevant receiving room volumes, the calculated internal noise levels are below the internal daytime noise criterion for daytime periods within living rooms of 35dB $L_{Aeq,16hr}$. This glazing specification also achieves the appropriate 30dB $L_{Aeq,8hr}$ night-time within bedrooms of the apartments and houses under assessment.

7.2 Upgraded Roof

For the purposed of the assessment a standard roof system has been assumed for all houses. This system is sufficient for the majority of the development however certain units require an upgraded roof system. These areas are marked up in the figure below

The required performance of proposed upgraded roof system is detailed in the table below.

Building Element	Octave Band Centre Frequency (Hz)						Typical Configuration
	125	250	500	1k	2k	4k	
Roof	37	50	58	62	57	62	Slate tile, metal/timber frame with insulation in cavity, two sheets 12.5mm SoundBloc plasterboard fixed off resilient bar

Table 8 Sound Insulation Performance Requirements for Upgraded Roof, SRI (dB)

Figure 6 Upgraded Roof - Houses

7.3 Ventilation

No vents shall be located in facades or roofs facing towards the motorway.

For the facades of properties outlined in the figure below, acoustic ventilators shall achieve a sound insulation performance of 45dB $D_{n,e,w}$.

Note: In the case of the houses in assessment areas “House 1” these vents are part of the southwest façade (i.e. facing away from the motorway).

All other facades shall include acoustic ventilators achieving a minimum sound insulation performance of 38dB $D_{n,e,w}$.

Figure 7 "High" Specification Acoustic Vent - Houses

Options which can be considered in order to achieve compliance with background ventilation requirements will be adjustable hit and miss acoustic ventilators or trickle vents built into the façade or window frames respectively.

Appendix B lists several suppliers that stock acoustically attenuated ventilation.

7.4 Noise Barrier

For the purposes of the assessment a 3.5m barrier has been assumed. It is understood that an existing wall (~2 – 2.5m) is place and that this will be retained as part of the proposed development.

8.0 CONCLUSIONS

Guidance contained within BS 8233 has been used to determine a range of suitable internal noise levels for sensitive rooms within the buildings. The following daytime and night time internal noise criteria are proposed:

- Daytime (07:00 to 23:00hrs) Living Rooms – 35dB $L_{Aeq(16hrs)}$
- Night-time (23:00 to 07:00hrs) Bedrooms – 30dB $_{LAeq(8hrs)}$.

Calculated noise levels at the external façade of the houses under assessment have been used to determine the internal noise levels within living room and bedroom spaces, taking account of the proposed standard and enhanced building elements.

The assessment has determined that the internal noise environment within the sensitive areas of the development are predicted to be within the recommended criteria adopted from BS 8233 if the following mitigation measures are implemented;

- Glazing meeting the acoustic specification in this report on the majority of properties;
- Enhanced glazing in specified areas meeting the acoustic specification in this report;
- Upgraded roof system in specified areas meeting the acoustic specification in this report;
- The two types of acoustic ventilators, in the designated areas, meeting the acoustic specification in this report;
- Retention of a ~2 – 2.5m high boundary wall (of block or masonry construction) on the north and east boundary of the site, and extension of this by 1m in height.

APPENDIX A
NOISE MODEL TECHNICAL DATA

A.1 Noise Model

A computer-based prediction model has been prepared in order to quantify the noise level associated with the road traffic in the area of interest. This section discusses the methodology behind the noise modelling process.

A.2 Brüel & Kjær Type 7810 Predictor

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, Brüel & Kjær Type 7810 Predictor, calculates noise levels in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996*.

Brüel & Kjær Type 7810 Predictor is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. Predictor calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

A.3 Input Data and Assumptions

Layout information available for the site and the surrounding area has been extracted from the Autocad drawings provided. The layout is imported into the Brüel & Kjaer Type 7810 Predictor noise modelling software. The software predicts noise levels in accordance with *ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors: General method of calculation*.

A.4 Sound Power Data

The attended noise survey detailed in section 4.2 established day and night time noise levels at on the boundary of the site. The sources within the noise model have been tuned in order that these levels are predicted at the receiver locations in the model that are representative of the noise monitoring locations.

APPENDIX A
DETAILS OF NOISE MODEL (Continued…)

A.5 Modelling Calculation Parameters

Prediction calculations have been conducted in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996*.

In terms of the calculation a ground attenuation factor (general method) of 0.5 and no metrological correction were assumed for all calculations. The atmospheric attenuation outlined in Table A1 was assumed for all calculations.

Temp (ºC)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

Table A1 Atmospheric attenuation assumed for noise calculations (dB per km)

APPENDIX B
ACOUSTIC PRODUCT SUPPLIERS

Proprietary passive acoustic vents are available from:

Rytons
Design House,
Kettering Business Park,
Kettering,
Northamptonshire
NN15 6NL,
UK

Tel: +44 (01536) 511874
Fax: +44 (01536) 310455

admin@rytons.com
www.rytons.com

Polypipe Silavent
Sandall Stones Road
Kirk Sandall Industrial Estate
Kirk Sandall
Doncaster
DN3 1QR
UK
Tel: +44 (0) 8443 759 358
Fax: +44 (0) 1924 441 892

Vent.info@polypipe.com
www.polypipe.com