9 Noise and Vibration

9.1 Introduction

This chapter has been prepared by AWN Consulting Ltd.

AWN Consulting Ltd. has been commissioned to carry out a noise and vibration impact assessment of the proposed residential development on lands adjacent to 'The Grange' , at the junction of the Stillorgan and Brewery Road, Blackrock, Co. Dublin.

The proposed development comprises five blocks of residential apartments and associated amenities. The site is bounded by a section of the Stillorgan Road to the north east and a section of the Brewery Road to the north west.

In terms of the site, noise and vibration will be considered in terms of two aspects. The first is the outward impact of the development (i.e. the potential impact of the buildings on existing sensitive receptors in the study area) and the inward impact of existing noise and vibration sources on the development itself.

This assessment has been prepared by Damian Kelly of AWN Consulting. Damian is Director of Acoustics at AWN and holds a BSc from DCU and an MSc from QUB. He has extensive experience as an acoustic consultant working in the field since 1997 and is a member of the Institute of Acoustics. He is currently a sitting member of the Irish committee of this organisation. He has extensive knowledge in the field of noise modelling and prediction, having developed many of the largest and most complex examples of proprietary noise models prepared in Ireland to date. He is co-author of the EPA: Guidance Note for Noise – Licence Applications, Surveys and Assessments in Relation to Scheduled Activities NG4 (2012).

9.2 Study Methodology

The study has been undertaken using the following methodology:

- Baseline noise monitoring has been undertaken across the development site to determine the range of noise levels at varying locations across the site;
- A review of the most applicable standards and guidelines has been conducted in order to set a range of acceptable noise and vibration criteria for the construction and operational phases of the proposed development, this is summarised in the following sections;
- Predictive calculations have been performed to estimate the likely noise emissions during the construction phase of the project at the nearest sensitive locations (NSL's) to the site;
- Predictive calculations have been performed to assess the potential impacts associated with the operation of the development at the most sensitive locations surrounding the development site;
- A schedule of mitigation measures has been proposed, where relevant, to control the noise and vibration emissions associated with both the construction and operational phases of the proposed development, and;
- The inward impact of noise in the surrounding environment into the proposed buildings has also been assessed to determine the requirements, for additional noise mitigation to provide suitable residential amenity.

Construction Phase

Noise Guidance

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard BS 5228 – 1: 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites – Noise.

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on exiting ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded at this location, indicates a potential significant noise impact is associated with the construction activities.

This document sets out guidance on permissible noise levels relative to the existing noise environment. Table 9.1 sets out the values which, when exceeded, signify a potential significant effect at the facades of residential receptors as recommended by BS 5228 – 1. These are not cumulative levels, i.e. they relate to construction noise levels only.

Assessment category and threshold value period (L_{Aeq})	Threshold value, in decibels (dB)		
	Category A [Note A]	Category B [Note B]	Category C [Note C]
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends [Note D]	55	60	65
Daytime (07:00 – 19:00) and Saturdays (07:00 – 13:00)	65	70	75

Table 9.1 -Example Threshold of Potential Significant Effect at Dwellings

Note A) Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.

Note B) Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.

Note C) Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.

Note D) 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

It should be noted that this assessment method is only valid for residential properties.

This assessment process determines if a significant construction noise impact is likely. Notwithstanding the outcome of this assessment, the overall acceptable levels of construction noise set out in the Transport Infrastructure Ireland (TII) publication Guidelines for the Treatment of Noise and Vibration in National Road Schemes , which should not be exceeded at noise sensitive locations during the construction phase of the development. Table 9.2 sets out these levels.

Days and Times	Noise Levels (dB re. $2x10^{-5}$ Pa)	
	$L_{Aeq(1hr)}$	L_{Amax}
Monday to Friday 07:00 to 19:00hrs	70	80
Monday to Friday 19:00 to 22:00hrs	60*	65*
Saturdays 08:00 to 16:30hrs	65	75
Sundays & Bank Holidays 08:00 to 16:30hrs	60*	65*

Table 9.2 - Maximum Permissible Noise Levels at the Facade of Dwellings during Construction

Note * Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority.

Based on review of the baseline noise environment and the guidance documents referred to above, the following daytime (07:00 to 19:00hrs) construction noise criteria are proposed for the site:

65dB $L_{Aeq,1hr}$ at noise sensitive location

75dB $L_{Aeq,1hr}$ at commercial property

In exceptional circumstances there may be a requirement that certain construction works are carried out during night time periods.

Vibration Guidance

Peak Particle Velocity (PPV)

Peak particle velocity (PPV) is commonly used to assess the structural response of buildings to vibration. Reference to the following documents has been made for the purposes of this assessment in order to discuss appropriate PPV limit values.

- British Standard BS7385: 1993: Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration, and;
- British Standard BS5228-2: 2009 + A1: 2014: Code of practice for noise and vibration control on construction and open sites – Vibration.

BS5228-2 and BS7385 advise that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak component particle velocity (in frequency range of predominant pulse) of 15mm/s at 4Hz increasing to 20mm/s at 15Hz and 50mm/s at 40Hz and above. The standard also notes that below 12.5 mm/s PPV the risk of damage tends to zero.

The recommended vibration limits in order to avoid cosmetic damage to buildings, as set out in both documents referred to above, are reproduced in Table 9.3. The documents note that minor structural damage can occur at vibration magnitudes which are greater than twice those presented in Table 9.3. Major damage to a building structure is possible at vibration magnitudes greater than four times the values set out in the Table. It should be noted that these values refer to the base of the building.

Vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
4 to 15 Hz	**15 to 40Hz**	**40Hz and above**
15 mm/s	20 mm/s	50 mm/s

Table 9.3 - Transient Vibration Guide Values for Cosmetic Damage

Human response to vibration stimuli occurs at orders of magnitudes below those associated with any form of building damage, hence vibration levels lower than those indicated in Table 9.3 can lead to concern. BS5228-2 also provides a useful guide relating to the assessment of human response to vibration in terms of PPV during construction activities. Table 9.4 summarises the range of vibration values and the associated potential effects on humans.

Vibration Level, PPV	**Effect**
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies. At lower frequencies people are less sensitive to vibration.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1 mm/s	It is likely that a vibration level of this magnitude in residential environments will cause complaint.

Table 9.4 - Guidance on Effects of Human Response to PPV Magnitudes

The standard notes that single or infrequent occurrences of these levels do not necessarily correspond to the stated effect in every case. Where these values are routinely measured or expected then an assessment in accordance with BS 6472-1 might be more appropriate to determine whether time varying exposure is likely to give rise to any degree of adverse comment.

Vibration Dose Value (VDV)

Guidance relating to human response to vibration is contained within BS 6472 Guide to evaluation of human exposure to vibration in buildings (2008): Part 1 - Vibration sources other than blasting.

BS 6472 uses the Vibration Dose Value (VDV) which is measured or forecast over the day or night-time periods in terms of $m/s^{-1.75}$. The VDV parameter takes into account how people respond to vibration in terms of frequency content, vibration magnitude and the number of vibration events during an assessment period.

The following table, as set out in the standard, details the values of VDV where various comments from occupiers are possible. The standard notes that the values are applicable for both vertical and horizontal vibration with the appropriate weighting applied. The values in Table 9.5 will be adopted for this assessment.

Building Type	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential building – Day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential building – Night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

Table 9.5 - VDV ($m/s^{-1.75}$) above which Various Degree of Adverse Comment may be Expected in Residential Buildings

Operational Phase

Noise Guidance

Dublin Agglomeration Noise Action Plan

Here, consideration has been given to the content of the Dublin Agglomeration Noise Action Plan 2018 – 2023 (NAP). The document states that its 'key objective' is:

> *"as with the previous two Action Plans is to avoid, prevent and reduce, where necessary, on a prioritised basis the harmful effects, including annoyance, due to long term exposure to environmental noise from road traffic and rail sources. This will be achieved by taking a strategic approach to managing environmental noise and undertaking a 'balanced approach' within the context of sustainable development."*

It is important to state the following extract from the document:

> *"The Noise Action Plan is aimed at managing Environmental Noise and excludes, for the most part, noise from domestic activities, noise created by neighbours, noise at work places or construction noise as these can be dealt with under existing legislation such as the Environmental Protection Agency Act 1992 and Health & Safety legislation."*

In relation to noise limits the NAP sates:

> *"No national limit values exist in relation to environmental noise control. This Action Plan sets out certain criteria in relation to environmental sound levels which will be applied in identification of Quiet Areas and areas that have 'Undesirable' high sound levels or 'Desirable' low sound levels. These are set out below are and are fully described in each of the individual local authority volumes. These criteria are the same as those contained in the previous two action plans."*

The NAP states the following in relation to what it considers to be "'Undesirable' high sound levels or 'Desirable' low sound levels":

Desirable Low Sound Levels	Undesirable High Sound Levels
< 50 dB(A) L_{night}	>55 dB(A) L_{night}
< 55 dB(A) L_{day}	>70 dB(A) L_{day}

Table 9.6 - Review of Undesirable Hight and Desirable Low Sound Levels

The existing noise environment in the vicinity of the development will be commented upon in light of the above. The inward noise impact assessment presents in this chapter is based on the principles outlined in the Professional Guidance on Planning & Noise (ProPG) guidance document.

Internal Noise (BS 8233)

There are no statutory guidelines or specific local guidelines relating to appropriate internal noise levels in dwellings. In this instance, reference is made to BS 8233: 2014: Guidance on sound insulation and noise reduction for buildings.

BS 8233 sets out recommended internal noise levels for several different building types from external noise sources such as traffic. 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 indoor ambient noise levels for residential dwellings are set out in Table 9.7.

Activity	Location	Day (07:00 to 23:00hrs)	Night (23:00 to 07:00hrs)
Resting	Living Room	35	--
Dining	Dining Room/Area	40	--
Sleeping (daytime resting)	Bedroom	35	30

Table 9.7 - Indoor Ambient Noise Levels for Dwellings from BS8233: 2014

BS 8233 also provides some guidance on individual noise events, it 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_{AFmax}, depending on the character and number of events per night. Sporadic noise events could require separate values."*

Typically, a 45dB L_{AFmax} criterion is applied to individual noise events within bedrooms at night. This criterion is generally considered a noise level that should not typically be exceeded.

External Noise (BS 8233 Amenity Areas)

BS 8233 also provides desirable noise levels for external amenity areas such as gardens, patios and balconies. It states:

> *"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$, with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited."*

Offsite Noise Impacts

Once a development of this nature becomes fully operational, a variety of electrical and mechanical plant will be required to service the development. Most of this plant will be capable of generating noise to some degree. Some of this plant may operate 24 hours a day, and hence would be most noticeable during quiet periods (i.e. overnight). Noisy plant with a direct line-of-sight to noise sensitive properties would potentially have the greatest impact. Plant contained within plantrooms has the least potential for impact once consideration is given to appropriate design of the space.

In relation mechanical plant items noise emissions it is considered appropriate to make reference to the British Standard BS 4142: 2014: *Methods for Rating and Assessing Industrial and Commercial Sound*. This document is the industry standard method for analysing building services plant noise emissions to residential receptors.

BS 4142 describes methods for rating and assessing sound of an industrial and/or commercial nature. The methods described in this British Standard use outdoor sound levels 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.

For an appropriate BS 4142 assessment it is necessary to compare the measured external background noise level (i.e. the $L_{A90,T}$ level measured in the absence of plant items) to the rating level ($L_{Ar,T}$) of the various plant items, when operational. Where noise emissions are found to be tonal, impulsive in nature or irregular enough to attract attention, BS 4142 also advises that a penalty be applied to the specific level to arrive at the rating level.

The subjective method for applying a penalty for tonal noise characteristics outlined in BS 4142 recommends the application of a 2dB penalty for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible.

The following definitions as discussed in BS 4142 as summarised below:

"ambient noise level, $L_{Aeq,T}$"	is the noise level produced by all sources including the sources of concern, i.e. the residual noise level plus the specific noise of mechanical plant, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval [T].
"residual noise level, $L_{Aeq,T}$"	is the noise level produced by all sources excluding the sources of concern, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval [T].
"specific noise level, $L_{Aeq,T}$"	is the sound level associated with the sources of concern, i.e. noise emissions solely from the mechanical plant, in terms of the equivalent continuous A-weighted sound pressure level over the reference time interval [T].
"rating level, $L_{Ar,T}$"	is the specific sound level plus any adjustments for the characteristic features of the sound (e.g. tonal, impulsive or irregular components);
"background noise level, $L_{A90,T}$"	is the sound pressure level of the residual noise that is exceeded for 90% of the time period T.

If the rated plant noise level is +10dB or more above the pre-existing background noise level then this indicates that complaints are likely to occur and that there will be a significant adverse impact. A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.

The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.

Change in Traffic Noise Levels

The main potential source of outward noise impact associated with the proposed development relates to additional traffic flows on the surrounding road network. Given that traffic from the development will make use of existing roads already carrying traffic volumes, it is appropriate to consider the increase in traffic noise level that arises as a result of vehicular movements associated with the development.

In order to assist with the interpretation of the noise associated with vehicular traffic on public roads, Table 9.8 offers guidance as to the likely impact associated with any particular change in traffic noise level (Source DMRB, 2011).

Change in Sound Level, dB(A)	Subjective Reaction	DMRB Magnitude of Impact	EPA Magnitude of Impact
0	Inaudible	No Impact	Neutral
0.1 – 2.9	Barely Perceptible	Negligible	Imperceptible
3 – 4.9	Perceptible	Minor	Slight
5 – 9.9	Up to a doubling of loudness	Moderate	Moderate
10+	Doubling of loudness and above	Major	Significant

Table 9.8 - Likely Impact Associated with Change in Traffic Noise Level. Source: (DMRB 2011)

Vibration

No operational phase vibration impacts are predicted.

9.3 The Existing Receiving Environment (Baseline)

The site is located on lands to the north west of The Grange development, at the junction of the Stillorgan and Brewery Roads. The existing noise and vibration environments across the development site and in the vicinity of the nearest existing noise sensitive locations are dictated by transportation sources in the study area including the aforementioned Stillorgan and Brewery Roads. After development of the proposed residential blocks this is expected to remain to be the case.

The nearest existing residential noise sensitive locations to the proposed development are those located in The Grange development itself and private apartments, the opposite side of the Stillorgan Road and other private houses on the opposite side of the Brewery Road.

Baseline noise monitoring has been undertaken across the development site to determine the range of noise levels at varying locations across the site and to establish the existing noise climate the nearest noise sensitive locations and across the development site itself.

The survey was conducted in general accordance with ISO 1996: 2017: Acoustics – *Description, measurement and assessment of environmental noise*. Specific details are set out in the following sections.

Choice of Noise Monitoring Locations

Unattended noise monitoring was undertaken at one location within the development site (A). An additional two attended monitoring locations (B to C) were undertaken within the site representative of the existing noise environment at the closest noise sensitive locations and the noise climate within the development site.

The locations are described below and illustrated in Figure 9.1 and in Plates 9.1, 9.2 and 9.3.

Figure 9.1 - Noise Monitoring Locations (Source : Google Earth)

Plate 9.1 - Noise Monitoring Location A

Plate 9.2 - Noise Monitoring Location B

Plate 9.3 - Noise Monitoring Location C

Survey Periods

The survey was undertaken over the following surveys periods:

- Unattended noise monitoring was undertaken at Location A was undertaken between 12:30hrs on 15 July 2019 and 12:30hrs on 15 July 2019, and 12:30hrs on 22 July 2019;
- Attended noise monitoring was undertaken at Locations B to C between 12:50 to 14:45hrs on 15 July 2019 and 23:00hrs on 15 July to 00:50hrs on 16 July 2019.

Monitoring Equipment

The surveys were undertaken using the following monitoring equipment:

Location	Manufacturer	Model	Serial Number
A	Rion	NL-42	186671
B – C	Brüel & Kjaer	2250	2446897

Table 9.9 - Instrumentation Details

Measurement Parameters

The noise survey results are presented in terms of the following parameters.

L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period.

L_{AFmax} is the instantaneous maximum sound level measured during the sample period using the 'F' time weighting.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

Monitoring Results

The results of the noise monitoring completed at the various locations are discussed in the following sections.

Location A

Table 9.10 reviews the measured noise levels at Location A. Road traffic noise was the dominant noise source noted at this location.

Period	Measured Noise Levels, dB	
	$L_{Aeq,16hr}$	$L_{A90,16hr}$
Day (07:00 – 23:00hrs)	63	56
Period	Measured Noise Levels, dB	
	$L_{Aeq,8hr}$	$L_{A90,8hr}$
Night (23:00 – 07:00hrs)	56	44

Table 9.10 - Noise Monitoring Results at Location A

Daytime noise levels set back from the boundary of the site with Brewery Road are the order of 63dB $L_{Aeq,16hr}$ with ambient and background noise levels being dictated by road traffic noise from the Stillorgan Road and Brewery Road itself. Background noise levels across the sample day period were the order 56dB $L_{A90,16hr}$.

Again, road traffic movements along the Stillorgan Road and Brewery Road dictated overall ambient noise levels at this location during the night time period with levels of the order of 56dB $L_{Aeq,8hr}$ being reported. With the reduction of traffic volumes over the night period the background noise levels reduced to an average of 44dB $L_{A90,8hr}$.

The L_{AFmax} levels are also of an interest here, in particlaur in relation to night time periods. The L_{AFmax} values were measured at 5-minute intervals over the duration of the unattended monitoring survey. Figure 9.2 presents the distribution of the magnitude of L_{AFmax} events during the night period at the noise monitoring location considered for this assessment.

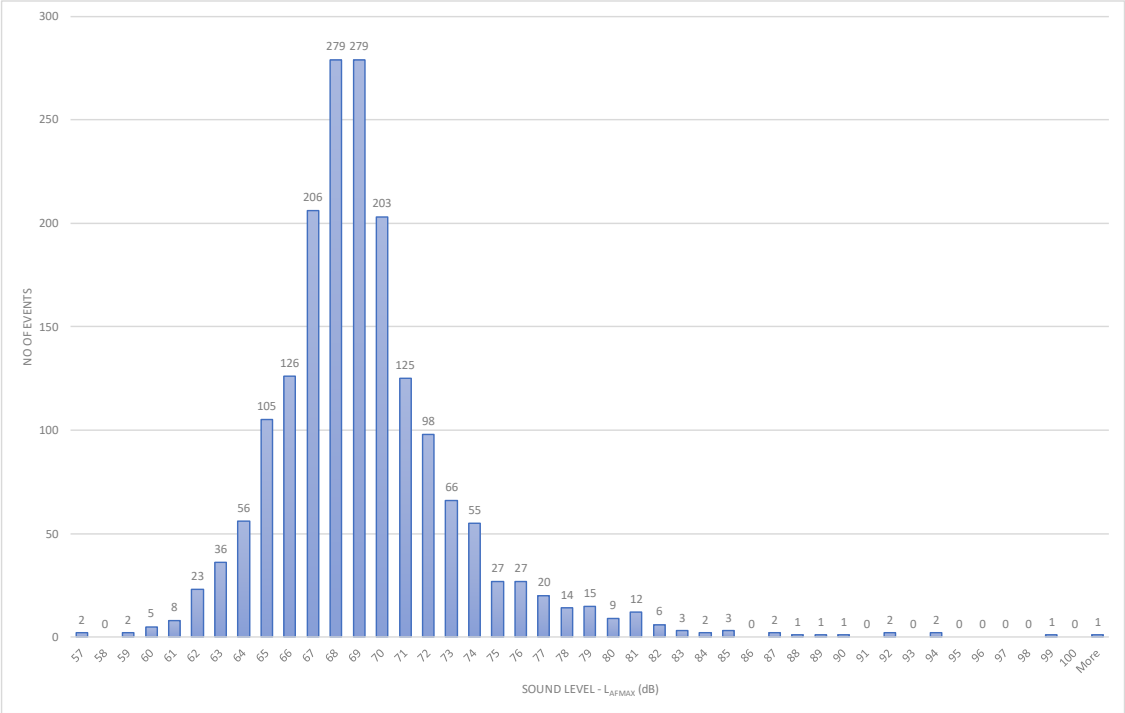

Figure 9.2 - Number of L_{AFmax} Events Measured During the Night Periods

Note these levels were measured set back slightly from the boundary of the site and some consideration needs to be given to slight increase in noise levels that will be expected at the facades

of the proposed buildings closest to Brewery Road. This will be discussed and considered as appropriate in relation to the inward noise impact assessment presented in the body of this report.

No significant level of vibration was noted at this location during setup and removal of the equipment from site.

Location B

Table 9.11 presents the results of the noise monitoring completed at Location B. This location is considered to be representative of noise levels within the existing Grange complex and in the rear gardens of the nearest off site noise sensitive locations located on the opposite side of Brewery Road.

Period	Start Time	Measured Noise Levels, dB		
		$L_{Aeq,15min}$	L_{AFmax}	$L_{A90,15min}$
Day	12:52	57	73	48
	13:31	57	72	49
	14:09	56	67	46
Night	23:00	50	64	39
	23:37	50	70	36
	00:16	47	63	36

Table 9.11 - Noise Monitoring Results at Location B

Daytime ambient noise levels at this location were dictated by road traffic movements on Brewery Road and a degree of bird song. Local traffic movements into The Grange development were also noted. Background noise levels were typically dictated by distant road traffic activity in the wider area. Noise levels were in the range of 56 to 57dB $L_{Aeq,15min}$ and 46 to 49dB $L_{A90,15min}$.

Ambient night time noise levels were again dictated by local road traffic movements with a reduced level of distant road traffic noise noted as the dominant background noise source. Noise levels were in the range of 47 to 50dB $L_{Aeq,15min}$ and 36 to 39dB $L_{A90,15min}$.

No significant level of vibration was noted at this location during site attendances.

Location C

Table 9.12 presents the results of the noise monitoring completed at Location C. This location is considered to be representative of noise levels within the apartment units on the opposite side of the Stillorgan Road.

Period	Start Time	Measured Noise Levels, dB		
		$L_{Aeq,15min}$	L_{AFmax}	$L_{A90,15min}$
Day	13:11	66	78	58
	13:50	66	77	58
	14:28	67	76	57
Night	23:18	63	74	49
	23:57	62	75	46
	00:34	60	74	40

Table 9.12 - Noise Monitoring Results at Location C

Daytime ambient noise levels at this location were dictated by road traffic movements on the Stillorgan Road. Local traffic movements into The Grange development were also noted. Background noise levels were typically dictated by distant road traffic activity in the wider area. Noise levels were in the range of 66 to 67dB $L_{Aeq,15min}$ and 58 to 57dB $L_{A90,15min}$.

Ambient night time noise levels were again dictated by local road traffic movements with a reduced level of distant road traffic noise noted as the dominant background noise source. Noise levels were in the range of 60 to 63dB $L_{Aeq,15min}$ and 40 to 49dB $L_{A90,15min}$.

No significant level of vibration was noted at this location during site attendances.

9.4 Characteristics of the Proposed Development

In summary, the project provides for the demolition (total c.1,398 sq m GFA) of:

- The Grange Select Marketing Suite' (1 storey)
- 'Oaktree Business Centre' (2 storeys)
- 'The Lodge' (2 storeys)

and the construction of a new 'Build to Rent' residential scheme of 287 residential apartment units; residential tenant amenity space of 961.5 sq m; a crèche facility of 658 sq m; and a substation of 96.5 sq m in the form of 6 new blocks (Blocks H, J, M, N, P and Q) ranging in height from 1 - 11 storeys. The residential element of the scheme provides for the following development mix:

- 19 x Studio Units (6.6%)
- 125 x 1 Bedroom Units (43.6%)
- 143 x 2 Bedroom Units (49.8%)

A total of 100 no. car parking spaces, 596 no. cycle spaces and 5 no. motorcycle spaces are also proposed together with all associated site development works.

The potential noise and vibration impact on the surroundings are considered for both the construction and operational phases of this development.

During the construction phase the main site activities will include site clearance, foundation works, building construction, road works, and landscaping. This phase has the greatest potential noise and vibration impacts on its surrounding environment, however this phase will be of short-term impact.

During the operational phase of the development, the primary source of outward noise in the operational context relates to any changes in traffic flows along the local road network and building services noise associated with commercial and office spaces.

The potential associated with each phase is assessed in the following sections.

9.5 Potential Impact of the Proposed Development

Construction Phase

Noise

A variety of items of plant will be in use for the purposes site clearance and construction. The type and number of equipment will vary between the varying construction phases depending on the phasing of the works. There will be vehicular movements to and from the site that will make use of existing roads. Due to the nature of these activities, there is potential for the generation of elevated levels of noise.

The closest noise sensitive locations to the main building works are the commercial properties immediately to the east and west (in the Grange development itself and the existing residential units on the far side of the Brewery Road) which are at distances of approximately 25m to 50m from building construction works respectively. The remainder of works will take place across the site at varying distances of up to 250m. Reference to the noise baseline survey results (Section 10.3) and guidance contained in BS 5228 Part 1 for construction noise levels discussed in Table 10.3, the threshold for significance from constriction activities is set as follows for the closest residential noise sensitive locations:

Significance Category - A: ,

Daytime (07:00 – 19:00hrs)/ Saturdays (07:00 – 13:00hrs)	65dB $L_{Aeq,1hr}$
Evening and Weekends	55dB $L_{Aeq,1hr}$

An appropriate construction noise limit at the nearest commercial buildings is considered to be 75dB $L_{Aeq,1hr}$.

For site clearance, building construction works and landscaping works (excavators, loaders, dozers, concreting works, mobile cranes, generators), noise source levels are quoted in the range of 70 to 80dB L_{Aeq} at distances of 10m within BS 5228-1. For the purposes of this assessment, a combined sound power value of 115dB L_w(A) has been used for construction noise calculations. This would include, for example, 5 no. items of construction plant with a sound pressure level of 80dB L_{Aeq} at 10m operating simultaneously along the closest works boundary.

Given, the type and number of construction equipment will vary over the course of the construction phase, noise levels have been calculated at the closest noise sensitive locations assuming the construction noise levels and distances noted above. For the purpose of the assessment, a standard site hoarding of 2.4m high has been included in the calculations for noise sensitive boundaries. The calculations also assume that the equipment will operate for 66% of the working time. Table 9.13 summarises the result of this assessment.

Construction Phase	Sound Power at construction works, dB L_w(A)	Calculated noise levels at varying distances, dB $L_{Aeq,1hr}$				
		20m	30m	50m	60m	100m
Site Clearance General Construction Landscaping Road Works	115	71	68	63	62	57

Table 9.13 - Indicative Construction Noise Levels at Nearest Noise Sensitive Locations

The predicted noise levels detailed in the Table 9.13 above indicate that during the main construction phase including site clearance, building construction works etc. assuming up to 5 items of plant are operating simultaneously at the closest noise sensitive boundaries, there is potential for the residential significance threshold to be exceeded at distances of up to 30m. Considering the closest residential noise sensitive locations, other than those within The Grange development to the proposed development lands are some 50m distant, and based on the predicted noise levels above, the associated construction noise impact is not considered significant.

In terms of the nearest commercial properties the predicted noise levels are the order of the significance threshold of 75dB $L_{Aeq,1hr}$. Again, the predicted associated construction noise impact is not considered significant.

Apartment units within the existing Grange development are the closest to the proposed blocks under consideration here. Due to the proximity of certain stages of the proposed works, in particular ground works and development of the sub structure, it may not be possible to achieve the recommended noise criteria that indicate a potential significant impact as defined in this assessment. In these instance, the initial predictions presented here, indicate noise levels with be the order of the daytime noise limits detailed Table 9.2 (i.e. 70dB $L_{Aeq,1hr}$).

In order to mitigate such impacts a schedule of best practice noise mitigation measures is included in Section 9.9 that will be considered by the relevant contractors as necessary.

Vibration

Potential for vibration impacts during the construction phase programme are likely to be limited given the ground breaking, piling and excavations required. There is potential for piling to be used for building and basement foundations for apartment buildings. For the purposes of this assessment the expected vibration levels during piling assuming augured or bored piles have been determined through reference to published empirical data. The British Standard BS 5228 – Part 2: Vibration, publishes the measured magnitude of vibration of rotary bored piling using a 600mm pile diameter for bored piling into soft ground over rock, (Table D.6, Ref. No. 106):

- 0.54mm/s at a distance of 5m, for auguring;
- 0.22mm/s at a distance of 5m, for twisting in casing;

- 0.42mm/s at a distance of 5m, for spinning off, and;
- 0.43mm/s at a distance of 5m, for boring with rock auger.

Considering the low vibration levels at very close distances to the piling rigs, vibration levels at the nearest buildings are not expected to pose any significance in terms of cosmetic or structural damage. In addition, the range of vibration levels is typically below a level which would cause any disturbance to occupants of nearby buildings.

In this instance, taking account of the distance to the nearest sensitive off-site buildings, vibration levels at the closest neighbouring buildings are expected to be orders of magnitude below the limits set out in Table 9.3 to avoid any cosmetic damage to buildings. Vibration levels are also expected to be below a level that would cause disturbance to building occupants, as set out in Table 9.4. The potential vibration impact during the construction phase if of short-term, neutral and imperceptible impact.

Operational Phase

Noise

Once the development is operational, the potential noise impacts to the surrounding environment are minimal. The residential aspect of the development is not expected to generate any significant noise sources over and above those which form part of the existing environment at neighbouring residential areas (road traffic noise, estate vehicle movements, children playing etc.) and hence no significant impact are expected from this area of the development site.

The main potential noise impact associated with the proposed development is considered therefore to relate to the generation of additional traffic to and from the site as a result of the new residential, commercial buildings. Potential noise impacts also relate to operational plant serving the commercial and apartment buildings, where relevant.

Once operational, there are no vibration sources associated with the development site.

Additional Vehicular Traffic on Surrounding Roads

A traffic impact assessment relating to the proposed development has been prepared by Waterman Moylan Consulting Engineers as part of this EIAR. Information from this report has been used to determine the predicted change in noise levels in the vicinity of a number of roads in the area surrounding the proposed development, for the opening year 2023 and the design year 2038.

For the purposes of assessing potential noise impact, it is appropriate to consider the relative increase in noise level associated with traffic movements on existing roads and junctions with and without the development given that traffic from the development will make use of the existing road network. Traffic flow data for the opening year of 2023 and the design year of 2038 in terms of the Annual Average Daily Traffic (AADT) has been assessed. The calculated change in noise levels during these two years are summarised in Table 9.14.

Link	2023 Opening Year		Change in noise levels, dB	2038 Design Year		Change in noise levels, dB
	Do Nothing	Do Something		Do Nothing	Do Something	
Junction 1	46,204	47,701	+0.1	52,082	53,579	+0.1
Junction 2	21,282	22,087	+0.2	23,989	24,794	+0.1
Junction 3	19,369	20,001	+0.1	21,834	22,465	+0.1

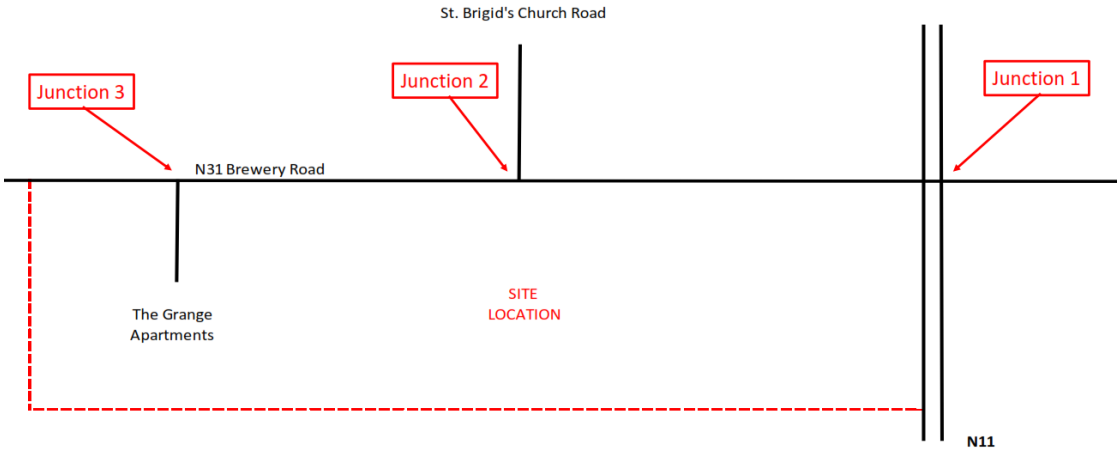

Table 9.14 - Change in Traffic Noise Levels with Proposed Development

The predicted increase in AADT traffic levels associated with the development is less than +0.2dB(A) in the vicinity of the roads assessed for both the opening and design years. This is largely due to the existing volume of traffic along the surrounding road network onto which the development traffic will travel. Reference to Table 9.8 confirms that this increase is inaudible and of neutral effect.

In summary, the predicted increase in noise levels associated with vehicles at road junctions in the vicinity of the proposed development is of long-term imperceptible impact.

Building Services Plant

Once operational, there will be building services plant items required to serve the commercial and residential aspect of the development. These will typically be limited to heating and cooling plant and extract units, depending on the building design and user requirements. Given the use of these buildings, the majority of plant items are likely to be required during daytime hours only, however, there may be requirement for night-time operational plant, depending on specific requirements.

The location or type of building services plant has not yet been established; therefore, it is not possible to calculate noise levels to the surrounding environment. In this instance, is it best practice to set appropriate noise limits that will inform the detailed design during the selection and layout of building services for the development.

These items will be selected at a later stage, however, they will be designed and located so that there is no negative impact on sensitive receivers within the development itself. The cumulative operational noise level from building services plant at the nearest noise sensitive location within the development (e.g. apartments, etc.) will be designed/attenuated to meet the relevant BS 4142 noise criteria for day and night-time periods as set out in this assessment. Based on the baseline noise data collected for this assessment it is considered an appropriate design criterion is the order of 35dB $L_{Aeq,15min}$. This limit is set in order to achieve acceptable internal noise levels within residential spaces based on prevailing noise levels in the area.

Taking into account that sensitive receivers within the development are much closer than off-site sensitive receivers, once the relevant noise criteria is achieved within the development it is expected that there will be no negative impact at sensitive receivers off site.

9.6 Potential Cumulative Impacts

The proposed development combined with other permitted developments in the area have the potential to result in cumulative noise or vibration impacts at surrounding noise sensitive locations during the construction and operational phases of the development.

The baseline scenario as measured, takes into account existing road traffic and other noise sources in the area.

Potential operational cumulative impacts relate to increased traffic flows resulting from other developments and any building services plant from other sources. The traffic noise assessment discussed in Table 9.14 considers the cumulative impact of this proposed development combined with existing flows and those associated with the residential development permitted in the wider area and future zoned lands. The noise impacts are determined to be long-term, imperceptible.

There are no expected cumulative noise impacts associated with building services plant from the proposed development and other development in the vicinity at external noise sensitive locations. The operation of any mechanical or electrical services associated with the proposed development will be designed to ensure the overall impact is deemed to be long-term and not significant.

Should the construction phase of the proposed development coincide with the construction of other permitted developments, there is potential for cumulative construction noise levels at noise sensitive locations. In the event that construction works are occurring at nearby sites simultaneously, it is unlikely that the construction noise levels presented in Table 9.2 will increase due to the proximity of construction works assessed which is considered to be worst case.

Existing Grange Development

Potential operational cumulative impacts relate to increased traffic flows resulting from other developments and any building services plant from other sources. The traffic noise assessment discussed in Table 9.14 considers the cumulative impact of this proposed development combined with existing flows and those associated with the residential development permitted in the wider area and future zoned lands. The noise impacts are determined to be long-term, imperceptible.

There are no expected cumulative noise impacts associated with building services plant from the proposed development and other development in the vicinity at external noise sensitive locations. The operation of any mechanical or electrical services associated with the proposed development will be designed to ensure the overall impact is deemed to be long-term and not significant.

Future Phase 2 Development

Evidently, the applicant does not control the entirety of remaining lands to provide consolidated development to the N11 frontage. This current application therefore relates to a Phase 1 development on lands that can deliver critically required residential units. OMP Architects have developed a phased Masterplan approach to provide an indicative future context for consideration by An Bord Pleanála, which is enclosed herewith. There has been a carefully considered design approach to development to ensure that the subject application can be delivered without compromising existing amenity or the future potential for development addressing the N11.

The Masterplan successfully integrates this new phase of development with the existing built fabric of The Grange. The approach has been to set the blocks around a central garden, which complements the existing scheme and delivers significant enhancements to the public realm.

Overall, it is estimated that there is potential for a further c. 250 units as part of a Phase 2 development. The development of these additional units is not expected to result in changes in traffic flow what would give rise to significant noise and / or vibration impacts, and similar to the approach proposed

here, as part of detailed design, due consideration will be given to mechanical plant selection such that suitable noise criteria are satisfied within and remote from the proposed development.

9.7 Do Nothing Scenario

In the absence of the proposed development being constructed, the noise environment at the nearest noise sensitive locations and across the development site itself will remain largely unchanged. The noise and vibration levels measured/noted during the baseline studies are considered representative of the Do-Nothing scenario. The Do-Nothing scenario is therefore considered neutral impact.

9.8 Risks to Human Health

Construction phase noise and vibration emissions will be temporary and transient and will be managed so as to minimise impact to population and human health by complying with all relevant guidance, as such the impact will be short-term and have a slight impact overall.

Operational phase noise will also be managed to achieve relevant noise limit values and is predicted to meet all such requirements. No operational phase vibration impacts are predicted. Therefore, the operational phase noise impacts will be neutral for the life of the development.

9.9 Mitigation Measures

Construction Phase

Best practice noise and vibration control measures will be employed by the contractor during the construction phase in order to avoid significant impacts at the nearest sensitive buildings. The best practice measures set out in BS 5228 (2009 +A1 2014) Parts 1 and 2 will be complied with. This includes guidance on several aspects of construction site mitigation measures, including, but not limited to:

- selection of quiet plant;
- noise control at source;
- screening, and;
- liaison with the public.

Further comment is offered on these items in the following paragraphs. Noise control measures that will be considered include the selection of quiet plant, enclosures and screens around noise sources, limiting the hours of work and noise monitoring, where required.

Selection of Quiet Plant

This practice is recommended in relation to static plant such as compressors and generators. It is recommended that these units be supplied with manufacturers' proprietary acoustic enclosures. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected wherever possible. Should a particular item of plant already on the site be found to generate high noise levels, the first action should be to identify whether or not said item can be replaced with a quieter alternative.

Noise Control at Source

If replacing a noisy item of plant is not a viable or practical option, consideration will be given to noise control "at source". This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier. For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

The following best practice mitigation measures will be implemented as necessary:

- Site compounds should be located away from noise sensitive boundaries within the site constraints. The use lifting bulky items, dropping and loading of materials within these areas should be restricted to normal working hours.
- For mobile plant items such as cranes, dump trucks, excavators and loaders, maintaining enclosure panels closed during operation can reduce noise levels over normal operation. Mobile plant should be switched off when not in use and not left idling.
- For steady continuous noise, such as that generated by diesel engines, it may be possible to reduce the noise emitted by fitting a more effective exhaust silencer system.
- For percussive tools such as pneumatic breakers, a number of noise control measures include fitting muffler or sound reducing equipment to the breaker 'tool' and ensure any leaks in the air lines are sealed. Erect localised screens around breaker or drill bit when in operation in close proximity to noise sensitive boundaries.
- For concrete mixers, control measures should be employed during cleaning to ensure no impulsive hammering is undertaken at the mixer drum.
- For all materials handling ensure that materials are not dropped from excessive heights, lining drops chutes and dump trucks with resilient materials.
- For compressors, generators and pumps, these can be surrounded by acoustic lagging or enclosed within acoustic enclosures providing air ventilation.
- All items of plant should be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

Screening

Screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to all other forms of noise control. Standard construction site hoarding (2.4m in height) with a mass per unit of surface area greater than 7 kg/m2 can provide adequate sound insulation.

Liaison with the Public

A designated noise liaison officer will be appointed to site during construction works. Any noise complaints should be logged and followed up in a prompt fashion by the liaison officer. In addition, prior to particularly noisy construction activity, e.g. piling, the liaison officer will inform the nearest noise sensitive locations of the time and expected duration of the noisy works.

Project Programme

The phasing programme will be arranged so as to control the amount of disturbance in noise and vibration sensitive areas at times that are considered of greatest sensitivity. If piling works are in progress on a site at the same time as other works of construction that themselves may generate significant noise and vibration, the working programme will be phased so as to ensure noise limits are not exceeded due to cumulative activities. This will be reviewed in relation to other potential cumulative works occurring on adjacent construction site in close proximity to noise sensitive properties which have the potential to lead to significant construction noise impacts.

Operational Phase

During the operational phase of the development, noise mitigation measures with respect to the outward impact of the development are not deemed necessary.

Additional Traffic on Adjacent Roads

During the operational phase of the development, noise mitigation measures with respect to the outward impact of traffic from the development are not deemed necessary.

Building Services Plant

Taking into account that sensitive receivers within the development are much closer than off-site sensitive receivers, once the relevant noise criteria included in Section 10.5 (i.e. 35dB $L_{Aeq,15min}$ at noise sensitive locations within the proposed development itself). is achieved within the development it is expected that there will be no negative impact at sensitive receivers off site, and therefore no further mitigation required.

9.10 Predicted Impacts of the Proposed Development

Construction Phase

During the construction phase of the project there is the potential for temporary noise impacts on nearby noise sensitive properties due to noise emissions from site activities. The application of binding noise limits and hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration impact is kept to a minimum as far as practicable.

During periods when construction works are occurring at distances of up to 30m from the nearest noise sensitive locations to the site boundary, there is potential for temporary, negative, moderate to significant noise impacts to occur.

For the remainder of construction periods, construction noise impacts will be short-term, negative, slight to moderate.

Vibration impacts during the construction phase will be short-term and negligible.

Operational Phase

The predicted change noise levels associated with additional traffic is predicted to be of imperceptible impact along the existing road network. In the context of the existing noise environment, the overall contribution of induced traffic is considered to be of neutral, imperceptible and long-term impact to nearby residential locations.

Noise levels associated with building services plant are expected to be well within the adopted day and night-time noise limits at the nearest noise sensitive properties taking into account the site layout, the nature and type of units proposed and distances to nearest residences. Assuming the operational noise levels do not exceed the adopted design goals, the resultant residual noise impact from this source will be of neutral, imperceptible, long term impact.

As detailed in this chapter, noise modelling was undertaken to assess the impact of and on the proposed development of the site with reference to noise limits typically applied by DCC and espoused in ProPG. As demonstrated by the assessment results, the predicted noise emissions associated with the proposed development of the site during the operational phases will be given due consideration as part of detailed design to ensure they are compliant with the adopted noise limit values which are based with due consideration of the effect on human health. Furthermore, any change in noise levels associated with traffic incident on the proposed buildings are predicted to be within suitable health based internal noise criteria once due consideration is given to the measures outlined in the relevant section of this assessment.

In essence, the noise levels that are encountered at the nearest noise sensitive locations are predicted to be within relevant noise criteria that have been adopted here. These criteria have been selected

with due consideration to human health, therefore, will not result in a significant impact on human health.

9.11 Monitoring

Construction Phase

The contractor will be required to ensure construction activities operate within the noise limits set out within this assessment. The contractor will be required to undertake regular noise monitoring at locations representative of the closest sensitive locations to ensure the relevant criteria are not exceeded.

Noise monitoring should be conducted in accordance with the International Standard ISO 1996: 2017: *Acoustics – Description, measurement and assessment of environmental noise*.

Operational Phase

Noise or vibration monitoring is not required once the development is operational.

9.12 Reinstatement

Not applicable.

9.13 Interactions

In compiling this impact assessment, reference has been made to the project description provided by the project co-ordinators, project drawings provided by the project architects and traffic flow projections associated with the development provided by the traffic consultants.

9.14 Difficulties Encountered

None.

9.15 Inward Noise Impact Assessment

The development lands in question are in proximity to the Stillorgan and Brewery Roads. The operation of these transport elements are potential noise sources to the residential developments proposed for the site itself.

Existing Noise Climate

The existing noise and vibration climate within the development lands was surveyed and the results summarised in Section 9.3 of this chapter. The results of the survey have indicated that the Stillorgan Road / Brewery Roads and, to a lesser extent the traffic on local roads, contribute significant noise levels at the measurement locations across the site.

In order to determine the inward noise impact for noise sensitive properties proposed as part of the development, it is necessary to determine the internal noise levels within the proposed buildings. These can then be compared against appropriate internal noise criteria from BS 8233, as summarised in Section 9.2 (Table 9.7).

It is possible to calculate internal noise levels within the residential properties proposed within the site, taking account of the existing and future potential noise environment, proposed constructions and the relevant sound insulation provided by the building elements (i.e. walls, roof, glazing etc.).

Noise Model of the Site

In order to calculate noise levels across the site, an acoustic model was developed in order to initially calibrate against noise survey data recorded on site. Proprietary noise calculation software was used for the purposes of establishing the prevailing noise levels on the proposed site. The selected software, Brüel & Kjær Type 7810 *Predictor*, calculates noise levels in accordance with the selected source.

The following information was included in the model:

- Site layout drawings of proposed development, and;
- OS mapping of surrounding environment.

Calibration of Noise Model

Noise data obtained during the survey Locations A, B and C were used to calibrate the noise model. The results of the calibration exercise are presented in Table 9.15 below for daytime periods, i.e. 07:00 to 23:00hrs and night-time periods, 23:00 to 07:00hrs and compared against those measured on site.

Location	Time Period	Measured Noise Level, dB	Predicted Noise Level, dB
A	Daytime, $L_{Aeq,16hr}$	63	63
	Night-time, $L_{Aeq,16hr}$	56	57
B	Daytime, $L_{Aeq,16hr}$	57	58
	Night-time, $L_{Aeq,16hr}$	50	52
C	Daytime, $L_{Aeq,16hr}$	66	67
	Night-time, $L_{Aeq,16hr}$	61	62

Table 9.15 - Predicted & Measured Noise Levels at Development Site

The model results are considered an accurate representation of traffic noise levels across the site, taking account other sources that contribute to the noise environment at the monitoring locations also.

Figures 9.3 and 9.4 display the calculated noise contours across the existing site for day and night-time periods at a height of 4m above ground. The results of the modelling exercise demonstrate that highest noise levels are experienced along the boundaries of the site in closest proximity to the Stillorgan Road and Brewery Road and that they reduce by the order of 15dB as you move into the site due to additional distance to the main noise sources.

Figure 9.3 - Predicted Existing Noise Contour Across the Development Site – Daytime

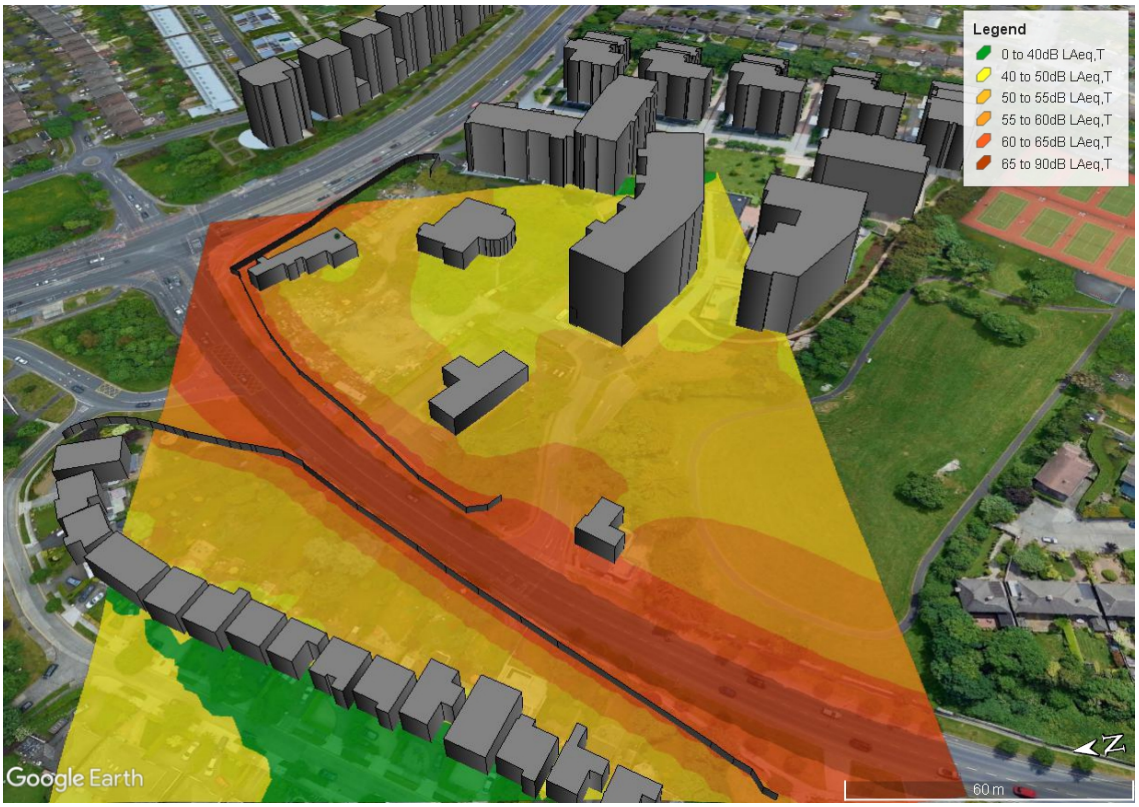

Figure 9.4 - Predicted Existing Noise Contour Across the Development Site - Night

Road traffic noise levels calculated across the site during daytime periods are highest along the immediate boundary of the site with Brewery Road as expected with noise levels reducing moving north within the site. Calculated noise levels are the order of 70dB $L_{Aeq,16hr}$ along the boundary with

Brewery Road reducing to <55dB $L_{Aeq,16hr}$ as you move into the site (due to screening offered by the existing buildings).

Night time noise levels are the order of 65dB $L_{Aeq,8hr}$ on the boundary of the site with Brewery Road with levels reducing to <50dB $L_{Aeq,8hr}$ as you move into the site (due to screening offered by the existing buildings).

The ProPG document is the most relevant and recent document used to assess new residential development in an area with an existing climate of environmental noise. This has therefore been used for the development site in question.

ProPG (2017)

The Professional Guidance on Planning & Noise (ProPG) document was published in May 2017. The document was prepared by a working group comprising members of the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA) and the Chartered Institute of Environmental Health (CIEH). Although not a government document, since it's adoption it has been generally considered as a best practice guidance and has been widely adopted in the absence of equivalent Irish guidance.

The ProPG outlines a systematic risk based 2 stage approach for evaluating noise exposure on prospective sites for residential development. The two primary stages of the approach can be summarised as follows:

- Stage 1 - Comprises a high-level initial noise risk assessment of the proposed site considering either measured and or predicted noise levels, and;
- Stage 2 – Involves a full detailed appraisal of the proposed development covering four "key elements" that include:
    - Element 1 - Good Acoustic Design Process;
    - Element 2 - Noise Level Guidelines;
    - Element 3 - External Amenity Area Noise Assessment

A key component of the evaluation process is the preparation and delivery of an Acoustic Design Statement (ADS) which is intended for submission to the planning authority. This document is intended to clearly outline the methodology and findings of the Stage 1 and Stage 2 assessments, to illustrate overall compliance of the scheme with best practice guideline. ProPG outlines the following possible recommendations in relation to the findings of the ADS:

A) Planning consent may be granted without any need for noise conditions;

B) Planning consent may be granted subject to the inclusion of suitable noise conditions;

C) Planning consent should be refused on noise grounds in order to avoid significant adverse effects ("avoid"); or,

D) Planning consent should be refused on noise grounds in order to prevent unacceptable adverse effects ("prevent").

Section 3.0 of the ProPG provides a more detailed guide on decision making to aid local authority planners on how to interpret the findings of an accompanying Acoustic Design Statement (ADS). A summary of the ProPG approach is illustrated in Figure 9.5.

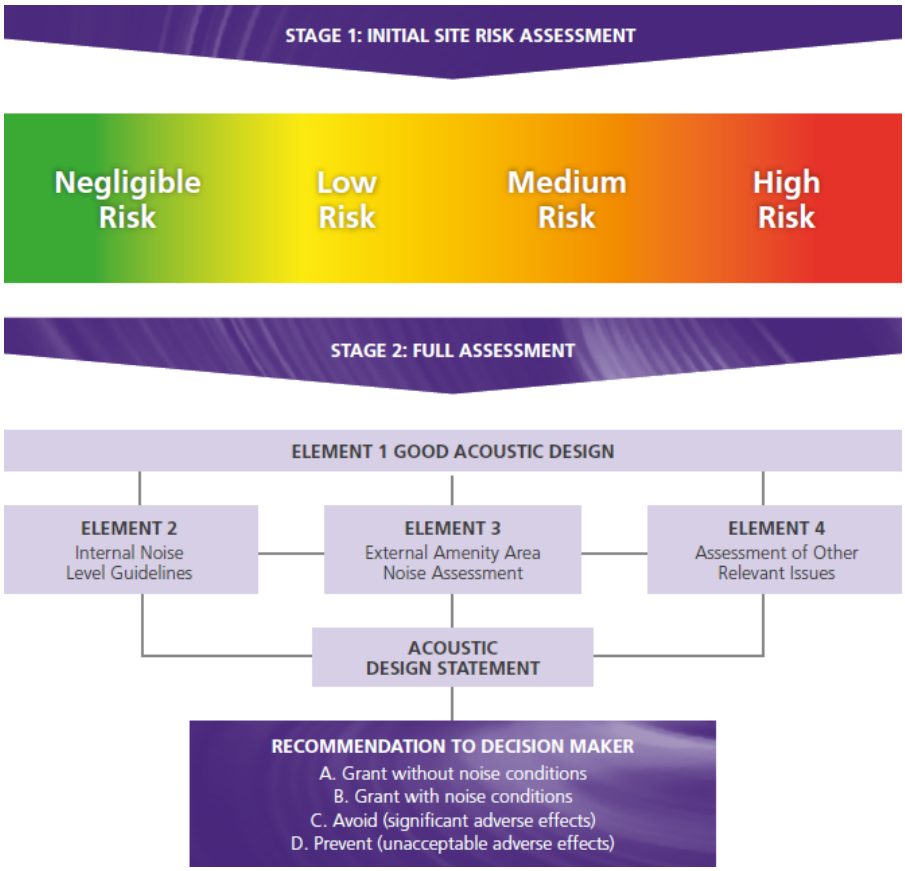

Figure 9.5 - ProPG Approach (Source: ProPG)

Stage 1 – Noise Risk Assessment

The initial noise risk assessment is intended to provide an early indication of any acoustic issues that may be encountered. It calls for the categorisation of the site as a negligible, low, medium or high risk based on the pre-existing noise environment. Figure 9.6 presents the basis of the initial noise risk assessment, it provides appropriate risk categories for a range of continuous noise levels either measured and/or predicted on site. It should be noted that a site should not be considered a negligible risk if more than 10 L_{AFmax} events exceed 60 dB during the night period and the site should be considered a high risk if the L_{AFmax} events exceed 80 dB more than 20 times a night.

Paragraph 2.9 of ProPG states that:

> *"The noise risk assessment may be based on measurements or prediction (or a combination of both) as appropriate and should aim to describe noise levels over a "typical worst case" 24-hour day either now or in the foreseeable future."*

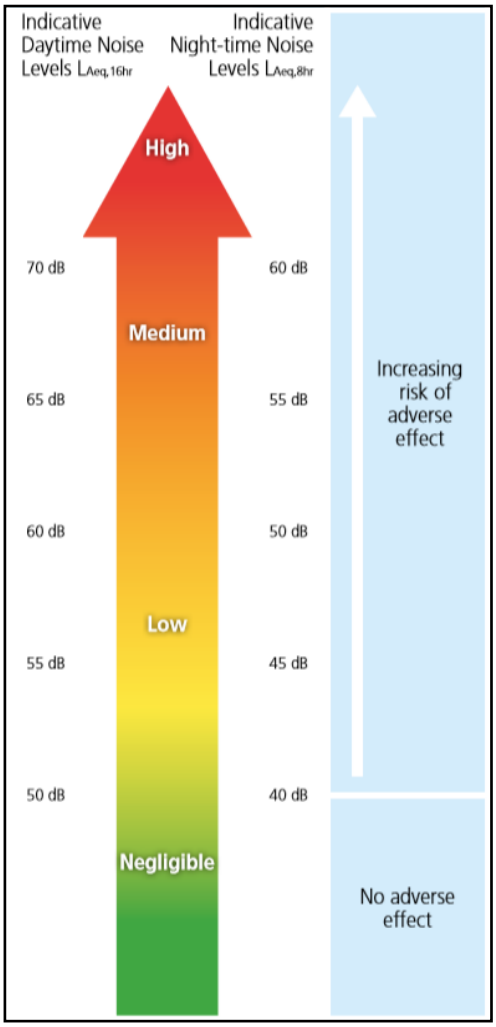

Figure 9.6 - ProPG Stage 1 – Initial Noise Risk Assessment

In this instance reference is made to baseline noise surveys undertaken at the site and the noise contours calculated across the site for existing noise sources. ProPG states the following with respect to the initial risk assessment:

> *"The risk assessment should not include the impact of any new or additional mitigation measures that may subsequently be included in development proposals for the site and proposed as part of a subsequent planning application. In other words, the risk assessment should include the acoustic effect of any existing site features that will remain (e.g. retained buildings, changes in ground level) and exclude the acoustic effect of any site features that will not remain (e.g. buildings to be demolished, fences and barriers to be removed) if development proceeds."*

The noise model prepared for this assessment has been used to predict noise levels across the site assuming the existing buildings are cleared. The results of this exercise are presented in Figures 9.7 and 9.8 for day and night periods respectively.

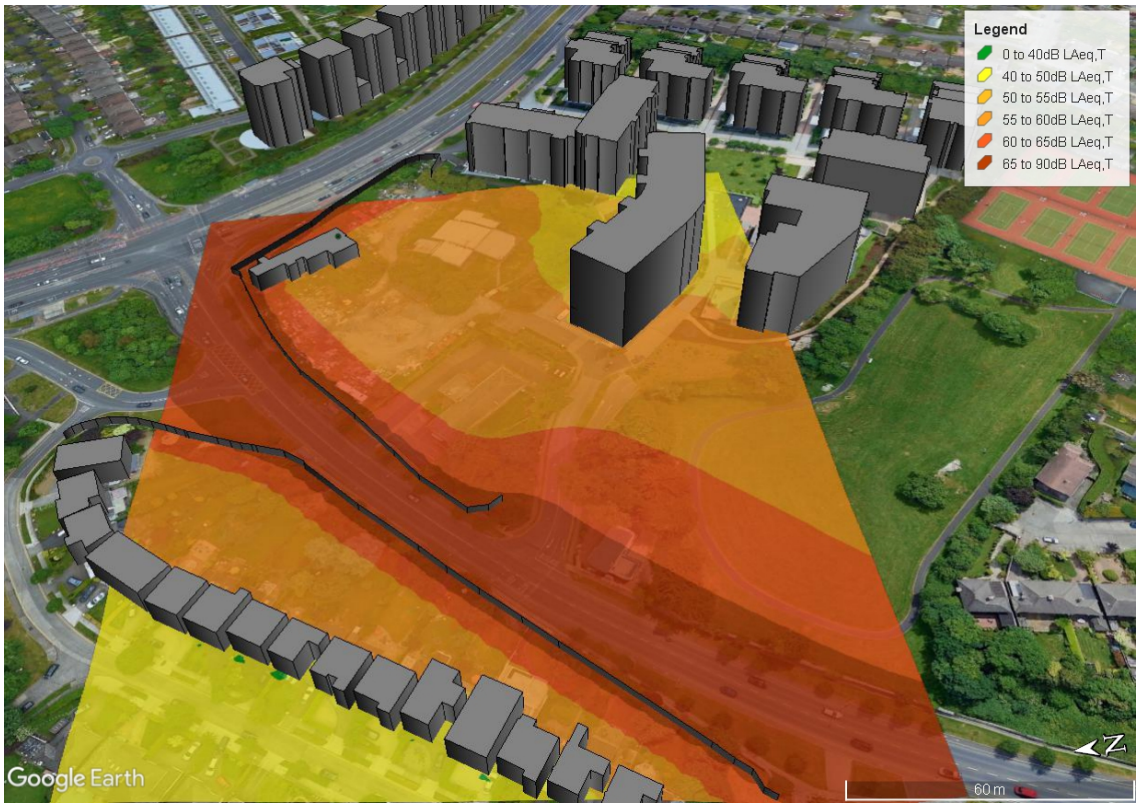

Figure 9.7 - Predicted Existing Noise Contour Across the Cleared Development Site - Daytime

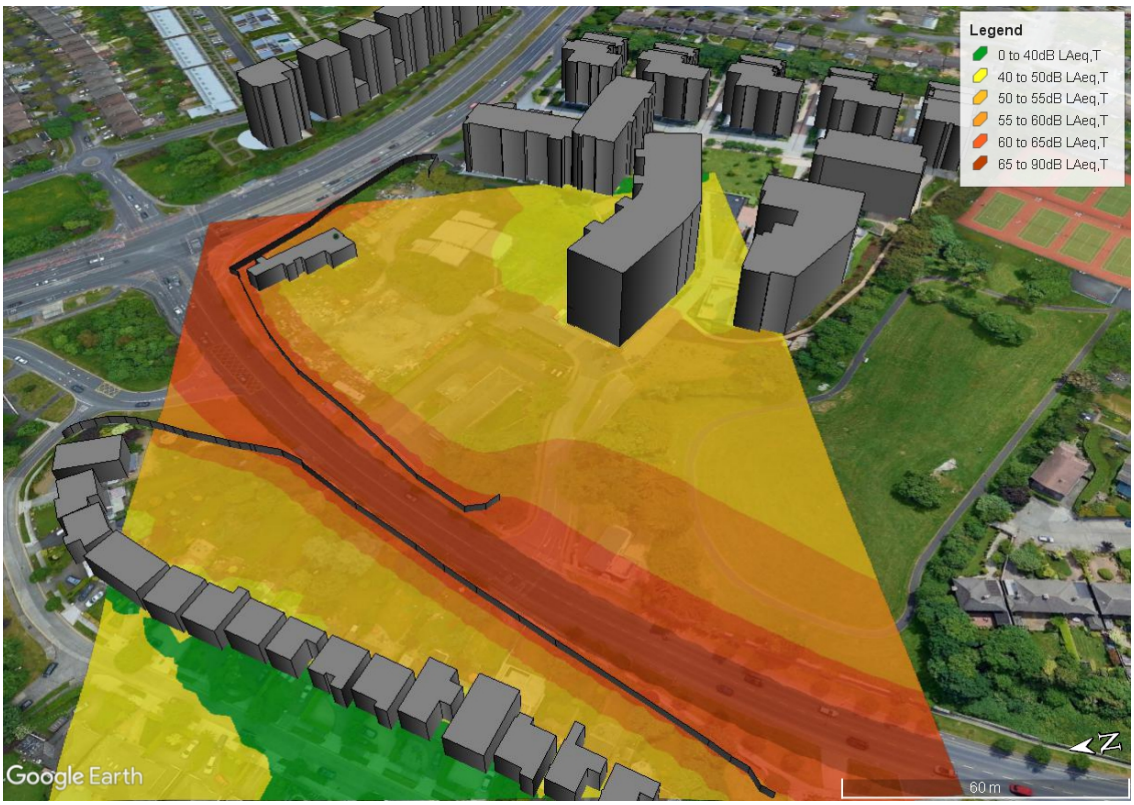

Figure 9.8 - Predicted Existing Noise Contour Across the Cleared Development Site - Night

With the removal of the existing buildings road traffic noise levels calculated across the majority of the site during daytime periods are between 55 and 70dB $L_{Aeq,16hr}$. Night time noise levels are the order of 47 to 62dB $L_{Aeq,8hr}$ across the site in this situation.

Giving consideration to the measured and predicted noise levels presented in the previous sections the initial site noise risk assessment has concluded that the level of risk across the site varies from medium to high noise risk.

Additionally, the Stage 1 Noise Risk Assessment requires analyses of the L_{AFmax} noise levels. In the case of the AWN survey the L_{AFmax} noise levels typically measured up to 80dB during the night with sporadic events also recorded above this level once consideration is given to the proximity of certain proposed blocks to Brewery Road. ProPG guidance considers 20 night events over 80dB to be a high risk, therefore this site would be considered a medium risk in terms of maxima events.

ProPG states the following with respect to medium and high risks:

Medium Risk — *As noise levels increase, the site is likely to be less suitable from a noise perspective and any subsequent application may be refused unless a good acoustic design process is followed and is demonstrated in an ADS which confirms how the adverse impacts of noise will be mitigated and minimised, and which clearly demonstrate that a significant adverse noise impact will be avoided in the finished development.*

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

Given the above it can be concluded that the development site may be categorised as *Medium to High Risk* and as such an Acoustic Design Strategy will be required to demonstrate that suitable care and attention has been applied in mitigating and minimising noise impact to such an extent that an adverse noise impact will be avoided in the final development.

It should be noted that ProPG states the following with regard to how the initial site noise risk is to be used,

"2.12 *It is important that the assessment of noise risk at a proposed residential development site is not the basis for the eventual recommendation to the decision maker. The recommended approach is intended to give the developer, the noise practitioner, and the decision maker an early indication of the likely initial suitability of the site for new residential development from a noise perspective and the extent of the acoustic issues that would be faced. Thus, a site considered to be high risk will be recognised as presenting more acoustic challenges than a site considered as low risk. A site considered as negligible risk is likely to be acceptable from a noise perspective and need not normally be delayed on noise grounds. A potentially problematical site will be flagged at the earliest possible stage, with an increasing risk indicating the increasing importance of good acoustic design."*

Therefore, following the guidance contained in ProPG does not preclude residential development on sites that are identified as having medium or high-risk noise levels. It merely identifies the fact that a more considered approach will be required to ensure the developments on the higher risk sites are suitable designed to mitigate the noise levels. The primary goal of the approach outlined in ProPG is to ensure that the best possible acoustic outcome is achieved for a particular site.

Proposed Development

The noise model was updated to incorporate the proposed buildings in order to determine noise levels across the site taking into account the screening effect of the new buildings and to determine specific noise levels at the most exposed residential facades Figures 9.9 and 9.10 display the calculated noise contours across the site at a height of 4m for day and night-time periods respectively.

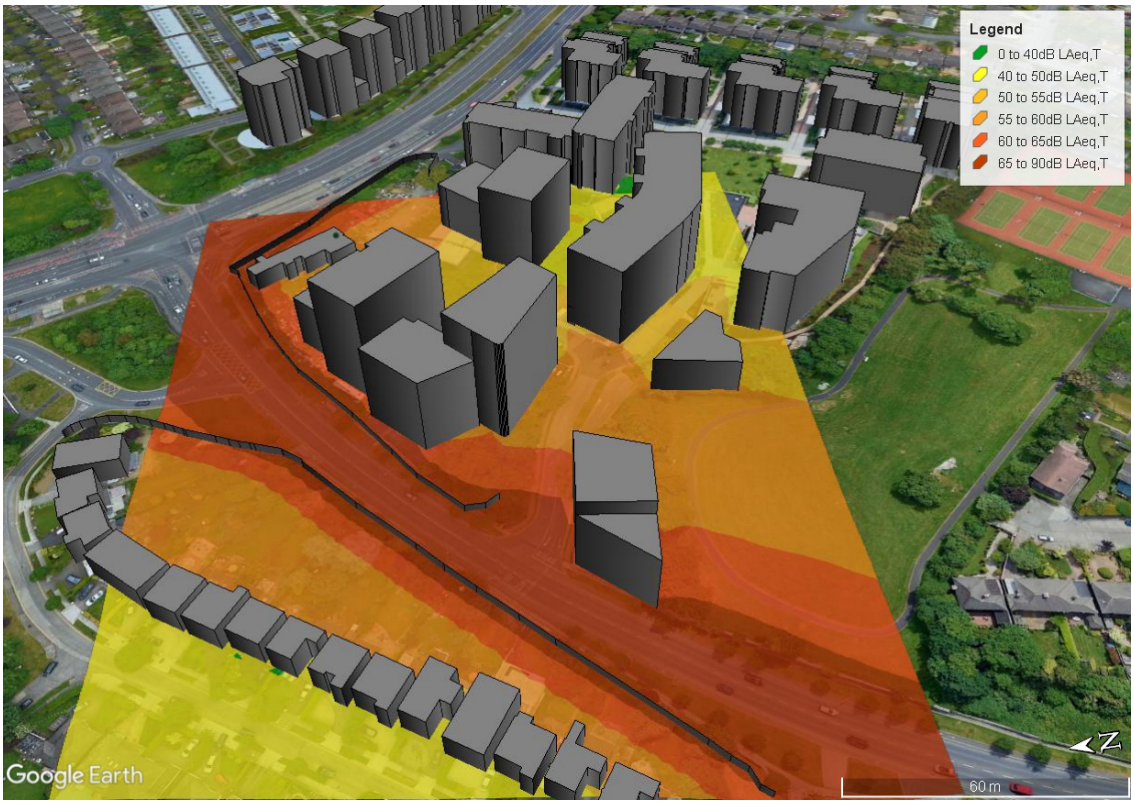

Figure 9.9 - Predicted Noise Contour Across the Developed Site – Daytime

The results of the assessment indicate that during daytime periods, noise levels are highest along the boundary of the site at the units / apartments with a line of sight of the Brewery Road. Calculated noise levels are between 68 and 71dB $L_{Aeq,16hr}$ along this section of the development. On the façades on blocks screened further into the site predicted noise levels 45 to 60dB $L_{Aeq,16hr}$ depending on the façade orientation and location.

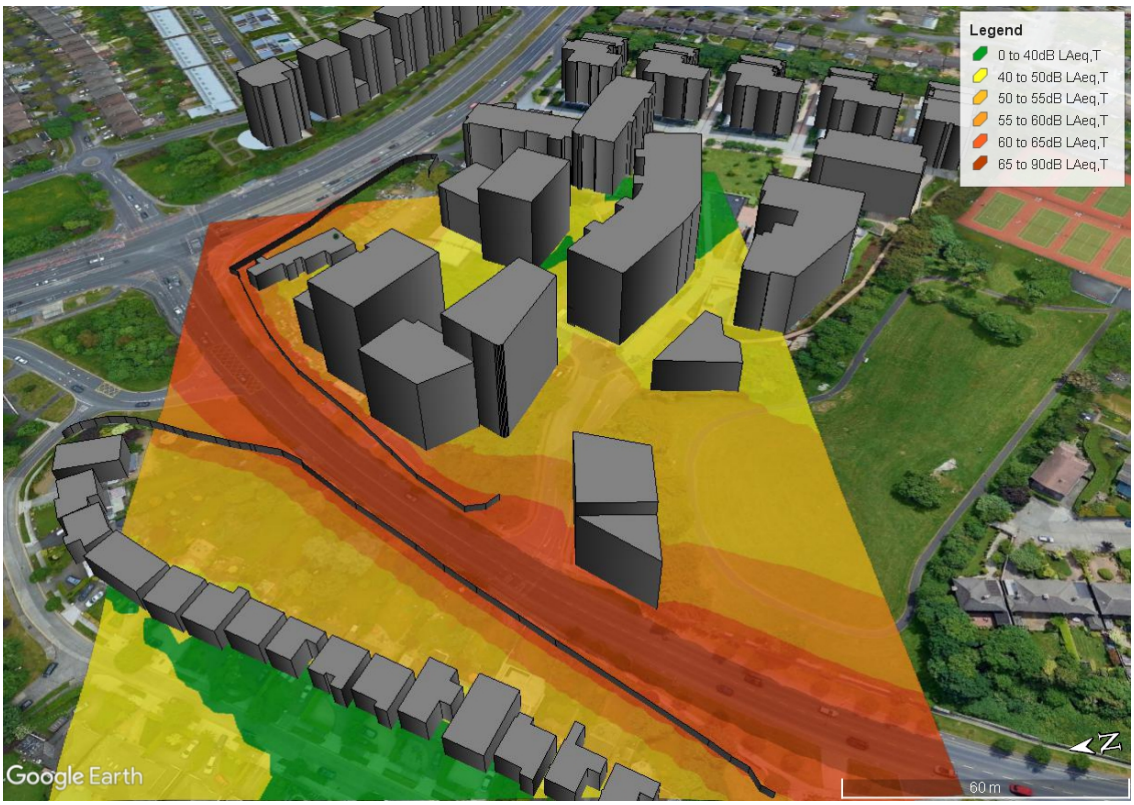

Figure 9.10 - Predicted Noise Contour Across the Developed Site – Night-time

The results of the assessment indicate that during daytime periods, noise levels are highest along the boundary of the site at the units / apartments with a line of sight of the Brewery Road. Calculated noise levels are between 62 and 65dB $L_{Aeq,8hr}$ along this section of the development. On the façades on blocks screened further into the site predicted noise levels 40 to 55dB $L_{Aeq,8hr}$ depending on the façade orientation and location.

Future Noise Environment

Given the location of the development there are no planned changes to the surrounding noise environment expected within future years which will significantly alter the noise environment measured. An increase of 25% in traffic is required to increase traffic noise levels by 1dB which is insignificant in the overall context of the noise environment across the site. Therefore, the future noise environment assumed for this project is expected to be within at least 1dB of the baseline scenario.

Stage 2 – Full Acoustic Assessment

Element 1 – Good Acoustic Design Process

In practice, good acoustic design should deliver the optimum acoustic design for a particular site without adversely affecting residential amenity or the quality of life or occupants or compromising other sustainable design objectives. Section 2.23 of the ProPG outlines the following checklist for Good Acoustic Design:

- Check the feasibility of relocating, or reducing noise levels from relevant sources;
- Consider options for planning the site or building layout;
- Consider the orientation of proposed building(s);
- Select construction types and methods for meeting building performance requirements;
- Examine the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc;
- Assess the viability of alternative solutions; and,
- Assess external amenity area noise.

In the context of the proposed development, each of the considerations listed above have been addressed in the following subsections.

Relocation of Reduction of Noise from Source

Noise sources incident upon the development site have been determined to be medium to high. With regards to road noise, this source is located outside the redline boundary of the site and therefore it is beyond the scope of this development to introduce any noise mitigation at source. Screening proposed as part of landscaping works will benefit noise levels across the site at ground level but will have no significant benefit in terms of residential units at upper levels that retain a direct line of sight to the adjacent roads.

Planning, Layout and Orientation

As part of the project design, the proposed buildings are set back from the road boundary. The orientation of the site is such that the buildings themselves screen the common external amenity areas associated with the development.

Select Construction Types for meeting Building Regulations

The design of all buildings is required to meet with all relevant parts of the Building Regulations. The specific detail of which will be completed at detailed design stage. In terms of the building sound

insulation, the glazed elements and any required ventilation paths to achieve compliance with Part F of the Building Regulations will be the weakest elements in the façade. For the purposes of this assessment it is assumed that the building with be ventilated by heat recovery units therefore removing the need to open windows to ventilate living spaces.

Consideration will therefore be given to the provision of sound insulation performance for glazing, where required to achieve suitable internal noise levels within the development. Achievement of acceptable internal ambient noise levels does not form part of building regulation requirements; however, this will be incorporated into the building design in line with best practice and compliance with the guidance set out in ProPG.

Impact of noise control measures on fire, health and safety etc.

The good acoustic design measures that have been implemented on site, e.g. locating properties away from the road are considered to be cost neutral and do not have any significant impact on other issues.

Assess Viability of Alternative Solutions

The main noise sources incident on the site are road and to a lesser extent Luas traffic. These sources are largely mitigated by the distance to the building, screening by the on-site building and orientation of building layouts to avoid overlooking of sensitive amenity spaces to the main noise sources. All the measures listed above aid in the control of noise intrusion to the residential and commercial buildings across the development site.

Assess External Amenity Area Noise

ProPG provides the following advice with regards to external noise levels for amenity areas in the development:

> *"The acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$."*

Noise levels across external amenity areas is addressed in the relevant section of this assessment.

Summary

Considering the constraints of the site, insofar as possible and without limiting the extent of the development area, the principles of Good Acoustic Design have been applied to the development.

Element 2 – Internal Noise Levels

Internal Noise Criteria

Element 2 of the ProPG document sets out recommended internal noise targets derived from BS 8233 (2014). The recommended indoor ambient noise levels are set out in Table 9.7 and are based on annual average data.

In addition to these absolute internal noise levels, ProPG provides guidance on flexibility of these internal noise level targets. For instance, in cases where the development is considered necessary or desirable, and noise levels exceed the external WHO guidelines, then a relaxation of the internal L_{Aeq} values by up to 5dB can still provide reasonable internal conditions.

Façade Noise Levels

Noise levels have been predicted across the development site during day and night-time periods. Table 9.16 presents the predicted noise levels for the various facades of the buildings on site that have been assumed for this assessment.

Ref	Period	$L_{Aeq,T}$ dB
RED	Day	65 – 72
	Night	60 – 67
ORANGE	Day	55 – 65
	Night	50 – 60
GREEN	Day	<55
	Night	<50

Table 9.16 - Summary of Predicted Façade Noise Levels

Figure 9.11 - Façade Noise Levels (see Table 9.16)

Discussion on Open/Closed Windows

The level of sound reduction offered by a partially open window is typically applied as 15dB[1] to 18dB.

Considering the design goals outlined in Table 9.7 and sound reduction across an open window of 15dB, the free-field noise levels that would be required to ensure that internal noise levels do not exceed 'good' or 'reasonable' internal noise levels have been summarised in Table 9.17.

Level Desired	Day 07:00 to 23:00hrs	Night 23:00 to 07:00hrs
Good (i.e. at or below the internal noise levels)	50 – 55dB $L_{Aeq,16hr}$	45dB $L_{Aeq,8hr}$
Reasonable (i.e. 5 dB above the internal noise levels)	55 – 60dB $L_{Aeq,16hr}$	50dB $L_{Aeq,8hr}$

Table 9.17 - External Noise Levels Required to Achieve Internal Noise Levels

For sensitive rooms that face on to the Brewery Road in the closest proposed blocks a reasonable internal noise level will not be achieved with windows open. For those on orange and green highlighted facades reasonable levels will be achieved with windows open.

A mechanical heat recovery ventilation (MHRV) system is proposed for the development therefore there is no requirement to have windows open to achieve background ventilation requirements. An appropriate acoustic specification for windows shall be provided in this instance to ensure the rooms achieve good internal noise levels.

For this assessment we have assumed that there will be negligible noise intrusion via ducting associated with the MVHR system.

Recommend Façade Treatment

The British Standard BS EN 12354-3: 2000: *Building acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound* provides a calculation methodology for determining the sound insulation performance of the external envelope of a building. The method is based on an elemental analysis of the building envelope and can take into account both the direct and flanking transmission paths.

The Standard allows the acoustic performance of the building to be assessed taking into account the following:

- Construction type of each element (i.e. windows, walls, etc.);
- Area of each element;
- Shape of the façade, and;
- Characteristics of the receiving room.

The principals outlined in BS EN 12354-3 are also referred to in BS8233 and Annex G of BS8233 provide a calculation method to determine the internal noise level within a building using the composite sound insulation performance calculated using the methods outlined in BS EN 12354-3. The methodology outlined in Annex G of BS8233 has been adopted here to determine the required performance of the building facades. This approach corrects the noise levels to account for the frequency content of the source in question. In this instance, rail and road traffic noise, depending on the buildings in question.

[1] Section 2.33 of ProPG, additional information can be found in the DEFRA NANR116: '*Open/Closed Window Research' Sound Insulation Through Ventilated Domestic Windows*'

Glazing

As is the case in most buildings, the glazed elements of the building envelope are typically the weakest element from a sound insulation perspective. In this instance the facades will be provided with glazing that achieves the minimum sound insulation performance as set out in Table 9.18.

Glazing Specification	Octave Band Centre Frequency (Hz)						R_w
	125	250	500	1k	2k	4k	
Red	28	36	45	52	52	52	41
Orange	24	21	32	37	42	43	35
Green	21	20	26	38	37	39	32

Table 9.18 - Sound Insulation Performance Requirements for Glazing, SRI (dB)

The glazing performance requirement for the various facades can be confirmed by reviewing the mark up presented in Figure 9.11.

The overall R_w outlined above are provided for information purposes only. The over-riding requirement is the Octave Band sound insulation performance values which may also be achieved using alternative glazing configurations. Any selected system will be required to provide the same level of sound insulation performance set out in Table 9.18 or greater.

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.

It is advised that the window supplier provides laboratory tests confirming the sound insulation performance, (to British Standard 2750 Part 3:1980 and British Standard 5821, or British Standard EN ISO 140 Part 3 1995 and British Standard EN ISO 717, 1997). It is important to note that the acoustic performance specifications detailed herein are minimum requirements which apply to the overall glazing system when installed on site.

Wall Construction

In general, all wall constructions (i.e. block work or concrete and spandrel elements) offer a high degree of sound insulation, much greater than that offered by the glazing systems. 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 50 dB R_w for this construction.

Internal Noise Levels

Taking into account the external façade levels and the specified acoustic performance to the building envelope, the internal noise levels have been calculated.

All locations are predicted to achieve good internal noise levels with windows closed. For locations highlighted orange and green in Figure 9.11, the good to reasonable internal noise levels are achieved with both windows open and closed.

Element 3 – External Amenity Areas

External noise levels within the public open spaces and private gardens across the development site are within the recommended range of noise levels from ProPG of between 50 – 55 dB $L_{Aeq,16hr}$ as illustrated in Figure 9.12. It is considered that the objectives of achieving suitable external noise levels is achieved within the overall site.

Figure 9.12 - Predicted Daytime Noise Levels across External Amenity Spaces

Conclusion

An initial site noise risk assessment has been carried out on the proposed mixed-use development at the lands adjacent to The Grange. The initial site assessment has classified the development site as having a medium to high noise risk in accordance with ProPG guidance. This was determined through a review of baseline noise measurements, noise modelling of the site for existing road noise.

The assessment concluded that overall environmental noise levels at the proposed residential buildings are not significant within the site and would not require any specific noise mitigation measures in order to achieve suitable internal noise levels with windows open and closed. Highest noise levels are calculated at units overlooking the Brewery Road site boundary with a direct line of sight to the road. In essence, the internal noise levels are predicted to be within relevant noise criteria that have been adopted here. These criteria have been selected with due consideration to human health, therefore, will not result in a significant impact on human health.

Boundary treatment is proposed along this boundary as part of proposed landscaping works. In addition to this physical screening, enhanced acoustic glazing are recommended along facades with a direct line of sight to the Brewery Road. Specific details of boundary treatments and glazing requirements are set out in the relevant sections of this assessment.

9.16 References

Dublin Agglomeration Noise Action Plan 2018 – 2023 (NAP)

BS 8233: 2014: Guidance on sound insulation and noise reduction for buildings.

British Standard BS 4142: 2014: Methods for Rating and Assessing Industrial and Commercial Sound

Design Manual for Roads & Bridges – Volume 11 Section 3

British Standard BS 5228 (2009 +A1 2014): Code of Practice for Control of Noise and Vibration on Construction and Open Sites *Part 1: Noise & Part 2: Vibration.*

British Standard BS 7385 (1993): *Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration*.

Calculation of Road Traffic Noise, Department of Transport Welsh Office, HMSO, 1988

EPA: *Guidance Note for Noise – Licence Applications, Surveys and Assessments in Relation to Scheduled Activities NG4* (2012).

ISO 1996: 2017: *Acoustics – Description, measurement and assessment of environmental noise.*

ISO 9613 (1996): *Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation.*