PROPOSED LARGE SCALE RESIDENTIAL DEVELOPMENT AT KNOCKRABO, MOUNT ANVILLE ROAD, GOATSTOWN, DUBLIN 14

NOISE AND VIBRATION ASSESSMENT OF DEVELOPMENT SITE

Technical Report Prepared For

Knockrabo Investments DAC

Technical Report Prepared By

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Our Reference

247501.0200NR02b

Date Of Issue

25 October 2024

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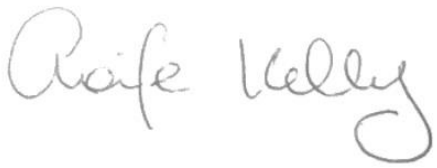
Document History

Document Reference		Original Issue Date	
247501.0200NR02		04 September 2024	
Revision Level	Revision Date	Description	Sections Affected
a	24 October 2024	Inclusion of construction and operational assessment for proposed development itself	All
b	25 October 2024	Addressed minor comments	All

Record of Approval

Details	Written by	Approved by
Signature		
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Date	25 October 2024	25 October 2024

EXECUTIVE SUMMARY

AWN Consulting has been commissioned to carry out a study in relation to the potential noise impacts incident to the proposed Large Scale Residential Development at Phase 2, Knockrabo, Co. Dublin. In addition an assessment of the outward noise and vibration construction and operational impacts from the proposed development itself on the closest noise sensitive locations (NSLs) in the area has been carried out.

An area of reservation for the Dublin Eastern Bypass (DEBP) runs to the north of the subject lands. Historically the proposal for this development was to construct a DEBP road with associated high noise levels due to the traffic volumes expected to be carried. However, the need for the DEBP is no longer clear and feedback from the planning authority was that the corridor could be used for other transport uses which would no longer generate high noise levels. However, in order to present a robust assessment for the current planning application, the future noise environment with the proposed DEBP as a road scheme in operation has been determined through modelling. This assessment has classified the development site as having a range of noise risks associated, ranging from low to high risk. The high risks only occur if the DEBP is developed.

Subsequent to the noise risk assessment a full Acoustic Design Statement has also been prepared to discuss how good acoustic design practice has been implemented. This document presents further discussion of the likely noise impact of both the external and internal areas of the proposed development.

It has been determined that mitigation measures in the form of boundary treatments to the external amenity spaces and façade treatments to development buildings will be required for the development in the event of the DEBP going ahead as a motorway. Furthermore, Winter Gardens have been provided to the facades most exposed to noise from the proposed DEBP. In addition, it will be necessary to provide enhanced acoustic glazing to the other façade elevations to ensure that when windows are closed that the internal noise environment is good. The specifications for all acoustic glazing have been provided in the body of this report. It is also proposed to provide mechanical ventilation to the development units which removes the need for any passive wall or window vents and effectively mitigates any noise intrusion via the ventilation path. However, if passive vents are required they must be selected to achieve an acoustic rating provided in this report.

In conclusion, there are no building regulations that require new developments to achieve a certain level of noise insulation from external sources. However, for this development the site was identified as potentially being exposed to elevated noise levels due to the potential operation of the proposed DEBP road scheme. As a result, this report has provided specifications and design advice to the developer to ensure that the internal noise environment within the development buildings is fully compliant with best practice standards. This also ensures compliance with the requirements of the local Dublin Agglomeration Noise Action Plan document.

Furthermore, vibration impacts on the proposed development have been assessed both during the construction and operational phase of the DEBP road scheme. During construction it is concluded that there will be no adverse impact on the development structures, once the appropriate limits are adhered to by the relevant contractors. During operation of the DEBP it is concluded that the proper maintenance of the road surface on the DEBP will ensure that traffic induced vibration by road traffic, including heavy goods vehicles, is unlikely to be generated at a magnitude that would be subjectively noticeable within the proposed development buildings. Furthermore, any vibration generated during the operation of the DEBP would be far below the level at which any damage would be caused to the development buildings.

During the construction phase of the proposed development itself project there will be a short-term increase in noise levels particularly during the early stage phases of work. Noise mitigation measures will be employed at the site to control site noise emissions as far as practicable. Overall, the impact is moderate and short-term impact with temporary significant effects during the construction phase.

Once operational, there are no significant noise impacts associated with the development itself on its surrounding environment.

CONTENTS

1.0 INTRODUCTION

AWN Consulting has been commissioned to carry out a detailed noise assessment in relation to the proposed Phase 2 Large Scale Residential Development at Knockrabo, Mt. Anville Road, Dublin 1. This report has been prepared by Dr. Aoife Kelly (Senior Acoustic Consultant) who holds a BSc (Hons) in Environmental Health and a PhD in Occupational Noise. She has completed the IOA Diploma in Acoustics and Noise Control and won the 2016 Acoustics and Noise Consultants (ANC) best diploma project for speech intelligibility in schools. Aoife is a member of the Institute of Acoustics (MIOA). Working in the area of acoustics since 2013, she has extensive experience and knowledge of all aspects of surveying, computer modelling, impact assessment of environmental noise for various sectors including, energy, industrial, commercial, and residential.

In summary with regards to noise and vibration the proposed development consists of the following:

- Construction of 158 No. residential units (12 No. houses and 146 No. apartments).
- Internal /external repair works for the existing 'Coach House' and the protected structures at Knockrabo Gate Lodge (West) and Gate and Piers.
- Works to Cedar Mount (a Protected Structure) to provide a childcare facility and Community / Leisure Uses.

Figure 1 presents the approximate outline of the proposed development site.

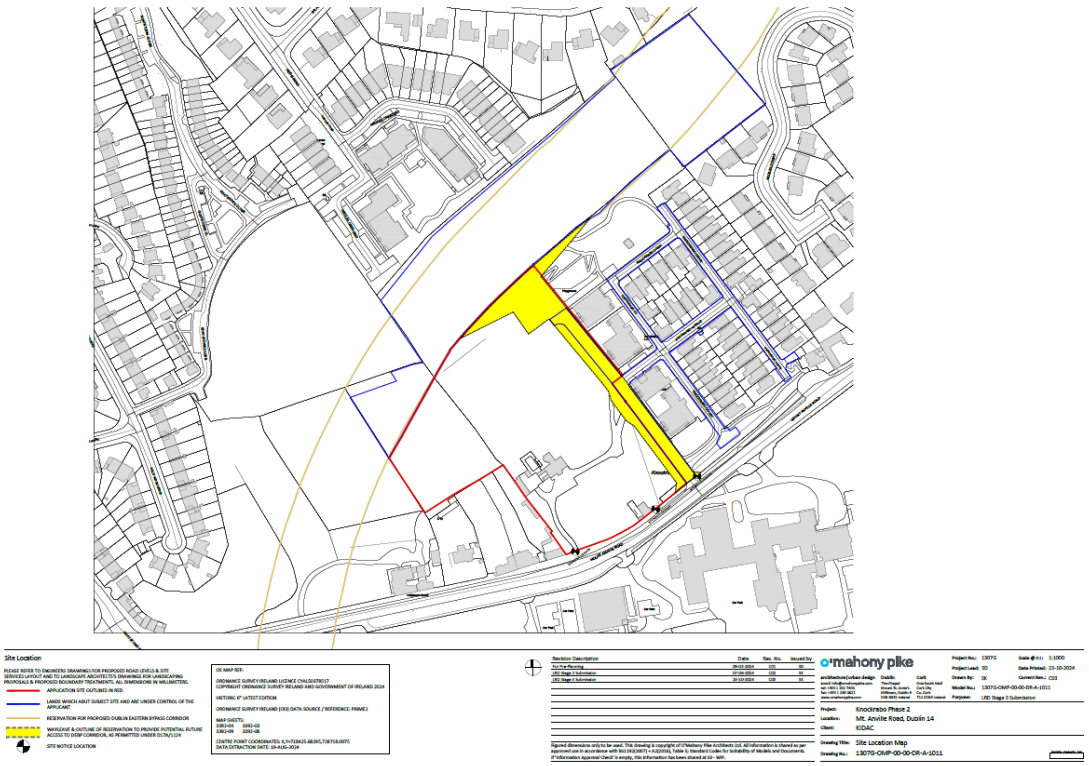

Figure 1 Location of proposed development

The main focus of the report is to provide input into the acoustic design of the proposed development, identify any potential noise impacts and provided measures to minimise or mitigate those impacts. Consideration will also be given to the construction and operational noise and vibration impacts on the proposed

development residents from the future Dublin Eastern By-Pass (DEBP) to the north of the site boundary.

In addition the report will also outline the outward construction and operational noise and vibration impacts from the proposed development itself on the closest noise sensitive locations (NSLs) in the area and identify any mitigation measures required to minimise those impacts. Appendix A presents a glossary of acoustic terminology that is used throughout this report.

2.0 REWIEW OF RELEVANT GUIDANCE AND CRITERIA

The proposed development is a mixed use residential development with surface car parking. The following criteria has been used to assess the potential inward impact of noise on the proposed development from the potential future DEBP and also assess the potential noise and vibration impacts of the proposed development on its surrounding environment during its construction and operational phases.

2.1 Dublin Agglomeration Noise Action Plan (NAP)

The *Dublin Agglomeration Environmental Noise Action Plan 2024 –2028* states the following with respect to assessing the noise impact on new residential development:

> *"The Draft Interim National Guidance for the Consideration of Transportation Noise in the Design of New Residential Development (2021) (described in Section 2.3.12), which the Local Authorities have cognisance of, recommends that consideration is given to the potential impact of transportation noise in line with Professional Planning Guidance (ProPG) on Planning & Noise: New Residential Development (ProPG, 2017).*

The NAP also outlines that

> *"To support proposals for a development an Acoustic Design Statements should be produced which will aid recommendations formulated by the decision maker."*

2.2 ProPG: Planning & Noise

The *Professional Practice 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
    - Element 4 - Other Relevant Issues

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, so as the planning authority can make an informed decision on the permission. 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 2.

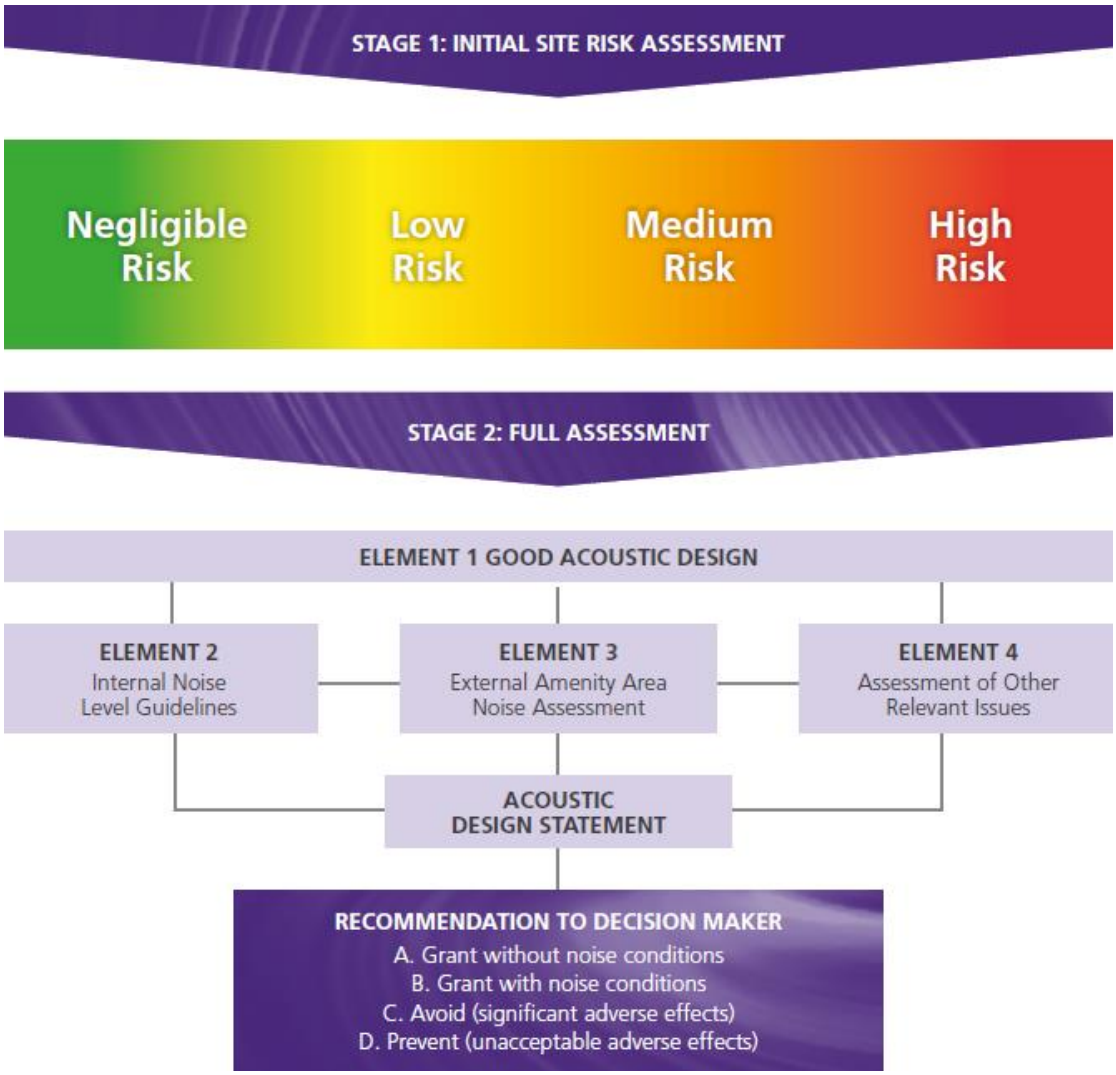

Figure 2 ProPG Approach (Source: ProPG)

2.3 WHO Environmental Noise Guidelines for Europe

The World Health Organisation (WHO) have published in October 2018 *Environmental Noise Guidelines for the European Region*. The objective of these guidelines is to provide recommendations for protecting human health from exposure to environmental noise from transportation, wind farm and leisure sources of noise.

The guidelines present recommendations for each noise source type in terms of L_{den} and L_{night} levels above which there is risk of adverse health risks.

However, it should be noted that the WHO guideline values referred to here are recommended to serve as the basis for a policy-making process to allow evidence-based public health orientated recommendations. They are not intended to be noise limits and the WHO document states the following regarding the implementation of the guidelines,

> *"The WHO guideline values are evidence-based public health-oriented recommendations. As such, they are recommended to serve as the basis for a policy-making process in which policy options are considered. In the policy decisions on reference values, such as noise limits for a possible standard or legislation, additional considerations – such as feasibility, costs, preferences and so on – feature in and can influence the ultimate value chosen as a noise limit. WHO acknowledges that implementing the guideline recommendations will require coordinated effort from ministries, public and private sectors and nongovernmental organizations, as well as possible input from international development and finance organizations. WHO will work with Member States and support the implementation process through its regional and country offices."*

It is therefore not intended to refer to the WHO guidelines in an absolute sense as part of this assessment and it will be a decision for national and local policy makers to adopt the WHO guidelines and propose noise limits for use.

2.4 Construction Noise Guidance

The DEBP works would be linear in nature in comparison to the fixed site construction works from the proposed development. As a result there are two different construction noise guidance documents applicable.

2.4.1 Construction Noise Guidance For DEBP Assessment (TII Guidance)

As per Transport Infrastructure Ireland (TII) guidance document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*[1], noise levels associated with the construction of road schemes may be calculated in accordance with methodology set out in *British Standard BS 5228 – 1: 2009+A1:2014: Code of practice for noise and vibration control on construction and open sites – Noise*. This standard sets out sound power levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels at selected locations. However, it is not possible to conduct detailed prediction calculations for the construction phase of a project due to the fact that the programme for construction works has not been established in detail.

The TII guidance document specifies noise levels that it typically deems acceptable in terms of construction noise during road scheme construction. These limits are set out in Table 1.

Days & Times	$L_{Aeq\ (1hr)}$ dB	L_{Amax} dB(A)
Monday to Friday 07:00 to 19:00hrs	70	80
Monday to Friday	60	65

1 *Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1, 25 October 2004* , Transport Infrastructure Ireland.

Days & Times	$L_{Aeq\ (1hr)}$ dB	L_{Amax} dB(A)
19:00 to 22:00hrs		
Saturday 08:00 to 16:30hrs	65	75
Sundays and Bank Holidays 08:00 to 16:30hrs	60	65

Table 1 Maximum Permissible Noise Levels at the Façade of Nearby Dwellings during Construction

2.4.2 Construction Noise Guidance For Proposed Site (BS 5228)

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phases 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 (NSL) into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a Construction Noise Threshold (CNT) that, if exceeded, indicates a potential significant noise impact is associated with the construction activities, depending on context.

The table below sets out the values which, when exceeded, signify a potential significant effect at the façades of residential receptors, as recommended by BS 5228-1:2009+A1:2014.

Assessment category and threshold value period (L_{Aeq})	Construction Noise Threshold (CNT), in decibels (dB)		
	Category A[2]	Category B[3]	Category C[4]
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends[5]	55	60	65
Daytime (07:00 - 19:00) and Saturdays (07:00 – 13:00hrs)	65	70	75

Table 2 Example Thresholds of Potential Significant Effect at Dwelling

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

Proposed Threshold Levels for Noise

Taking into account the proposed document outlined above and making reference to the baseline noise environment around the Proposed Development site (referred to in Section 3.2.1), CNTs are set using Category A for the closest NSLs external to the proposed development.

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

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

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

[5] 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

Significance of Construction Noise Levels (CNL)

In order to assist with interpretation of significance relative to calculated or measured construction noise level (CNL) compared to the CNT. Table 3 includes guidance as to the likely magnitude of impact associated with construction noise levels, relative to the threshold value. This guidance is taken from DMRB: Noise and Vibration LA 111 Sustainability and Environmental Appraisal LA 111 Noise and Vibration Revision 2 (UKHE 2020).

The approach is as follows:

- determine the threshold value for construction noise according to the method from BS5228-1 described above;
- compare the predicted construction noise level with the existing noise levels and the CNT according to the criteria in Table 2; and
- A significant effect is deemed to occur where a moderate or major impact is likely to occur for a period of greater that 10 days/nights over 15 consecutive day/nights, or greater than 40 days over 6 consecutive months.

Guidelines for Noise Impact Assessment Significance (Adapted from DMRB)	Classification of Impact CNL per Period	Determination
Negligible	Below or equal to baseline noise levels	Depending on range of CNL, and baseline noise level and duration
Minor	Above baseline and below or equal to CNT	
Moderate	Above CNT and Below or equal to CNT +5 dB	
Major	Above CNT +5 dB	

Table 3 Interpretation of CNL significance at NSLs

2.5 Construction Traffic Noise

In order to assist with interpretation of construction traffic noise, Table 4 includes guidance as to the likely magnitude of impact associated with changes in traffic noise levels along an existing road. This guidance is taken from the DMRB 2020. For construction traffic, due to the short-term period over which this impact occurs, the magnitude of impacts is assessed against the 'short-term' period in accordance with the DMRB document.

Increase in Traffic Noise Level (dB)	DMRB Magnitude of Impact (Short Term Period)
<1.0	Negligible
1.0 – 2.9	Minor
3 – 4.9	Moderate
≥5.0	Major

Table 4 Likely Effect Associated with Change in Traffic Noise Level – Construction Noise

The DMRB guidance outlined will be used to assess the predicted increases in traffic levels on public roads associated with the proposed development and comment on the likely impacts during the construction stage.

2.6 Review of Vibration Guidance

In the event that the proposed development is granted permission and constructed prior to the DEBP there will be the potential for vibration impacts to occur at the proposed residential properties during construction of the DEBP. Previous discussions with the TII have raised potential vibration impacts in particular due to the potential requirement for blasting during the construction of the DEBP.

Construction works from the proposed development itself will require the use of mechanical excavations, which have the potential to result in vibration impacts at vibration sensitive receptors (VSRs) if sufficiently close to the respective receptor.

Vibration standards come in two varieties: those dealing with cosmetic or structural damage to buildings and those dealing with human comfort. The range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

2.6.1 Cosmetic Damage to Buildings – For DEBP Assessment (TII Guidance)

It is expected that the DEBP construction programme would have to comply with the guidelines contained within the TII document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*. This document recommends that in order to ensure that there is no potential for damage during construction, vibration from construction activities should be limited to the values set out in Table 5.

Allowable vibration velocity (Peak Particle Velocity) at the closest part of any sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

Table 5 Allowable Vibration Levels During Construction Phase Unlikely to Cause Cosmetic Damage to Buildings

2.6.2 Cosmetic Damage to Buildings- For Proposed Development

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- BS 7385 – Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration (1993); and
- BS 5228 – Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration (BSI 2009 +A1 2014b).

BS 7385 – 2 (BSI 1993) states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS 5228-2 (BSI 2009 +A1 2014b) recommends 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 particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage, these limits may be reduced by up to 50%. In addition, where continuous vibration is such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

Table 6 sets out the limits as they apply to vibration frequencies below 4Hz where the most conservative limits are required. At higher frequencies, the limit values for transient vibration within Table B.2 of BS 5228-2 (BSI 2009 +A1 2014b) will apply, with similar reductions applied for continuous vibration and those for protected structures.

Structure Type	Allowable vibration velocity (PPV) at the closest part of any sensitive property to the source of vibration, at a frequency of	
	Transient Vibration	Continuous Vibration
Reinforced or framed structures. Industrial and heavy commercial buildings	50mm/s	25mm/s
Unreinforced or light framed structures. Residential or light commercial-type buildings	15mm/s	7.5mm/s
Protected and Historic Buildings[6]	6mm/s – 15mm/s	3 mm/s – 7.5mm/s
Identified Potentially Vulnerable Structures and Buildings with Low Vibration Threshold	3mm/s	

Table 6 Recommended Construction Vibration Thresholds for Buildings

Compliance with these vibration limits should ensure that there is little to no risk of cosmetic damage to buildings.

2.6.3 Human Response to Vibration from Proposed Site Construction Works

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 5 and Table 6 can lead to concern. BS5228-2 also provides a useful guide relating to the assessment of human response to vibration in terms of PPV. Whilst the guide values are commonly used to compare typical human response to construction works, they tend to relate closely to general levels of vibration perception from other general sources. Table 7 below 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 7 Guidance on Effects of Human Response to PPV Magnitudes

The standards note 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.

2.7 Mechanical and Electrical Plant

The proposed development is residential in nature comprising a mixture of houses, duplex and apartments. There will be minimal mechanical and/ or electrical plant items required to service the development that will generate noise levels outside of

[6] The relevant threshold value to be determined on a case by case basis. Where sufficient structural information is unavailable at the time of assessment, the lower value within the range will be used.

the site boundary or at the developments buildings themselves. Plant contained within plant rooms has the least potential for impact, once consideration is given to appropriate design of the space.

The closest NSLs to any operational plant items are the residential dwellings within the proposed development. To ensure there is no adverse impact on the future inhabitants of the proposed development itself, it is appropriate to refer to internal noise targets derived from BS 8233: 2014: *Guidance on Sound Insulation and Noise Reduction for Buildings*. The recommended indoor ambient noise levels and external noise levels derived are set out in Table 8 and are based on annual average data.

The derived external levels are based on the approximate attenuation provided by a partially open window of 15 dB, as advised in BS 8233 (BSI 2014c), and represent the appropriate noise level at the external façade of the building. For mechanically ventilated buildings, higher external noise levels will achieve the same internal noise levels as those with closed windows.

Activity	Location	Internal Noise Design Range dB $L_{Aeq,\ T}$	Derived External Levels dB $L_{Aeq,\ T}$
Residential Day	Living room	35	50
	Dining room/area	40	55
	Bedroom	35	50
Residential Night	Living room	35	50
	Dining room/area	40	55
	Bedroom	30	45

Table 8 Internal Noise Design Range for Residential Buildings (BS 8233:2014).

3.0 INWARD IMPACT ASSESSMENT STAGE 1 – NOISE RISK ASSESSMENT

3.1 Methodology

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 3 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.

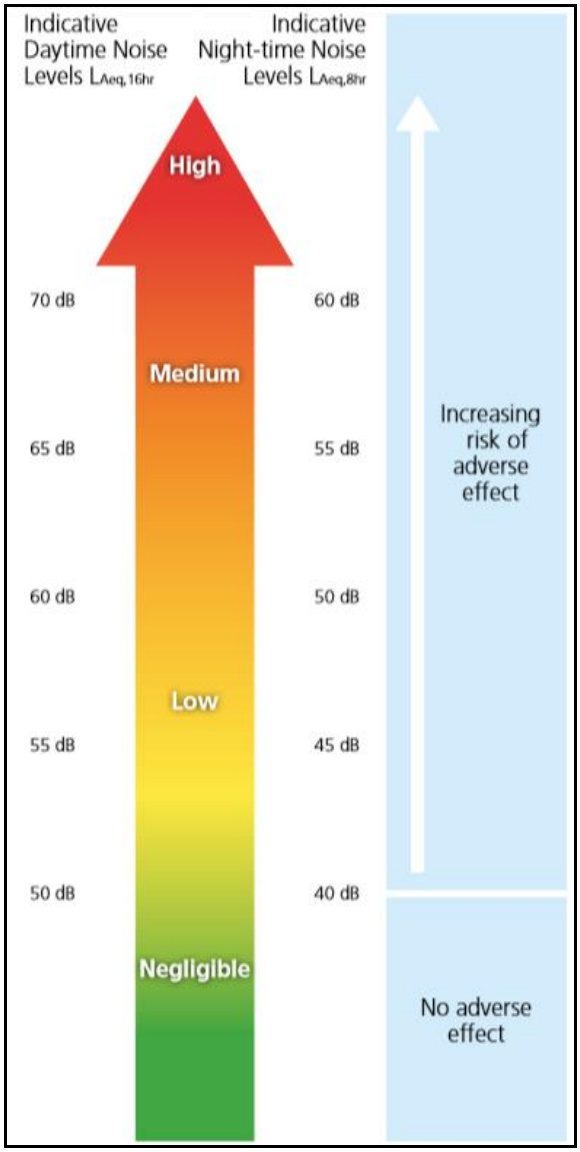

Figure 3 ProPG Stage 1 - Initial Noise Risk Assessment

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."

It is proposed to develop a 3D computer noise model of the development site and predict the noise levels across the entire site in order to investigate the noise risk. The noise model will use the calculated noise levels, discussed in Section 3.2, to validate the model. Furthermore, the model allows the site to be assessed taking into account the changes in topography that are required to allow development. This is to comply with the requirements of paragraph 2.8 of ProPG which states,

"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 initial risk assessment will include both the Round 4 EPA road traffic noise maps to the south of the site boundary and the noise generated by the future Dublin Eastern By-Pass (DEBP) to the north of the site boundary. The reservation for this future road scheme runs to the north of the proposed development. More detail on this is presented in the following section.

In this instance the site topography and surrounding buildings are not expected to change significantly during construction. In developing this methodology best practice guidance and methodology was used.

3.2 Baseline Noise Environment

3.2.1 Noise from Road Traffic

Figures 4 and 5 present the existing road traffic noise across the proposed development site as detailed in the Environmental noise directive (END) 2002/49/EC noise mapping (https://gis.epa.ie) for both L_{den} and L_{night} respectively. Within 20m of the Mount Anville road to the south of the site, the noise contours indicate that the proposed development site is partially located within the 60 to 64 dB L_{den} noise contours. The closest proposed buildings (Block E and Proposed New Gate House) are in the 55 to 59 dB L_{den} noise contour and then < 55 dB L_{den} noise contours are northwards across the rest of the site.

Figure 4 EPA Round 4 L_{den} Noise Maps (Source: EPA Maps)

The closest buildings to the south of the site (20m) are within the 45 to 49 dB L_{night} noise contours and in the < 45 dB L_{night} noise contours northwards across the rest of the site. These noise levels are typical of an urban environment location.

Figure 5 EPA Round 4 L_{night} Noise Maps (Source: EPA Maps)

3.2.2 Future Noise from Dublin Eastern Bypass

The Dun Laoghaire-Rathdown County Council County Development Plan 2022-2028 SLO No. 4 states:

> *"It is an Objective of the Council:*
> *To implement the requirements of the Dublin Eastern Bypass Corridor Protection Study Booterstown to Sandyford, 2011 and any subsequent updates to same and to promote potential additional future temporary uses of the Dublin Eastern Bypass reservation corridor, including a greenway /cycleway, a pedestrian walkway, biodiversity projects, recreational opportunities - inclusive of playing pitches - public transport provision and other suitable temporary uses, pending a decision from Transport Infrastructure Ireland/Central Government in relation to the future status of the Bypass. Any potential additional future short-term uses of the reservation corridor will be subject to a joint feasibility study to be undertaken by TII and the NTA. In the event that the corridor is no longer needed for the DEBP, a Dún Laoghaire-Rathdown County Council lead study should be carried out to determine the best use of the corridor prior to any development being permitted. This study may be informed by a future NTA study. This should include the consideration of sustainable transport, biodiversity and recreation projects including playing pitches, and engagement with the public."*

At this stage the temporary, short-term or long-term use for the DEBP is unknown. While it is understood that it may be used as a Sustainable Transport Corridor in the future, there is currently no information available to generate a future baseline noise environment. Therefore, as a highly conservative assessment, the future baseline noise environment has been modelled using the available noise levels from the highest noise generating activity for the corridor i.e. a motorway.

To predict the noise levels across the proposed development site with the influence of the DEBP, a 3D traffic noise model has been developed. The general methodology

and details of the software package used (i.e. Brüel & Kjær Type 7810 *Predictor)* are presented in Appendix A of this document.

The traffic noise model takes as inputs the 3D alignment of the road and the expected traffic flow in terms of the Annual Average Daily Traffic (AADT). Additional inputs giving details of the expected percentage of heavy goods vehicles (HGV) and traffic speed are also provided. These traffic details have been taken from the *Dublin Eastern Bypass Corridor Protection Study, January 2011* which suggests worst case traffic figures to be used as the basis of any noise assessment.

In the absence of any published documents detailing the expected traffic flow on the DEBP, Transport Infrastructure Ireland (TII) have previously advised that the traffic volumes and speed detailed in Table 9 should be used.

Carriageway	AADT	%HGV's	Speed, km/h
2-way flow	80,000	10	120

Table 9 Traffic Data for DEBP

As there has been no guidance given on the likelihood of a low noise road surface being used, a standard surface has been assumed. This assessment can, therefore, be considered a worst-case scenario for the current traffic flow and alignment. It is important to note that due to the proximity of the proposed DEBP to other existing residential properties in the area, it is highly likely that a low noise road surface would be considered by the road design team. The use of a low noise road surface is also identified as a noise mitigation measure within the *Dublin Agglomeration Noise Action Plan 2024-2028*. The NAP advocates for the use of noise reduction at source, through the use of low noise road surfacing, where feasible and appropriate to do so.

A low noise road surface will reduce the noise levels across the site by a minimum of 2 dB and up to 6 dB is possible depending on the surface chosen.

Finally, the traffic volumes and %HGV's that have been assumed are also considered to be representative of worst-case scenarios. Any reduction in traffic volume would see a corresponding reduction in noise level.

Figures 6 to 9 present the predicted noise levels across the development site for road traffic in terms of $L_{Aeq,16hr}$ day and $L_{Aeq,8hr}$ night at a height of 1.5m and 4m above ground level (AGL).

Figure 6 $L_{Aeq,16hr}$ Daytime Road Traffic Noise Levels, dB(A) – 1.5m AGL without development

Figure 7 $L_{Aeq,8hr}$ Night Road Traffic Noise Levels dB(A) – 1.5m AGL without development

Figure 8 $L_{Aeq,16hr}$ Daytime Road Traffic Noise Levels dB(A) – 4m AGL without development

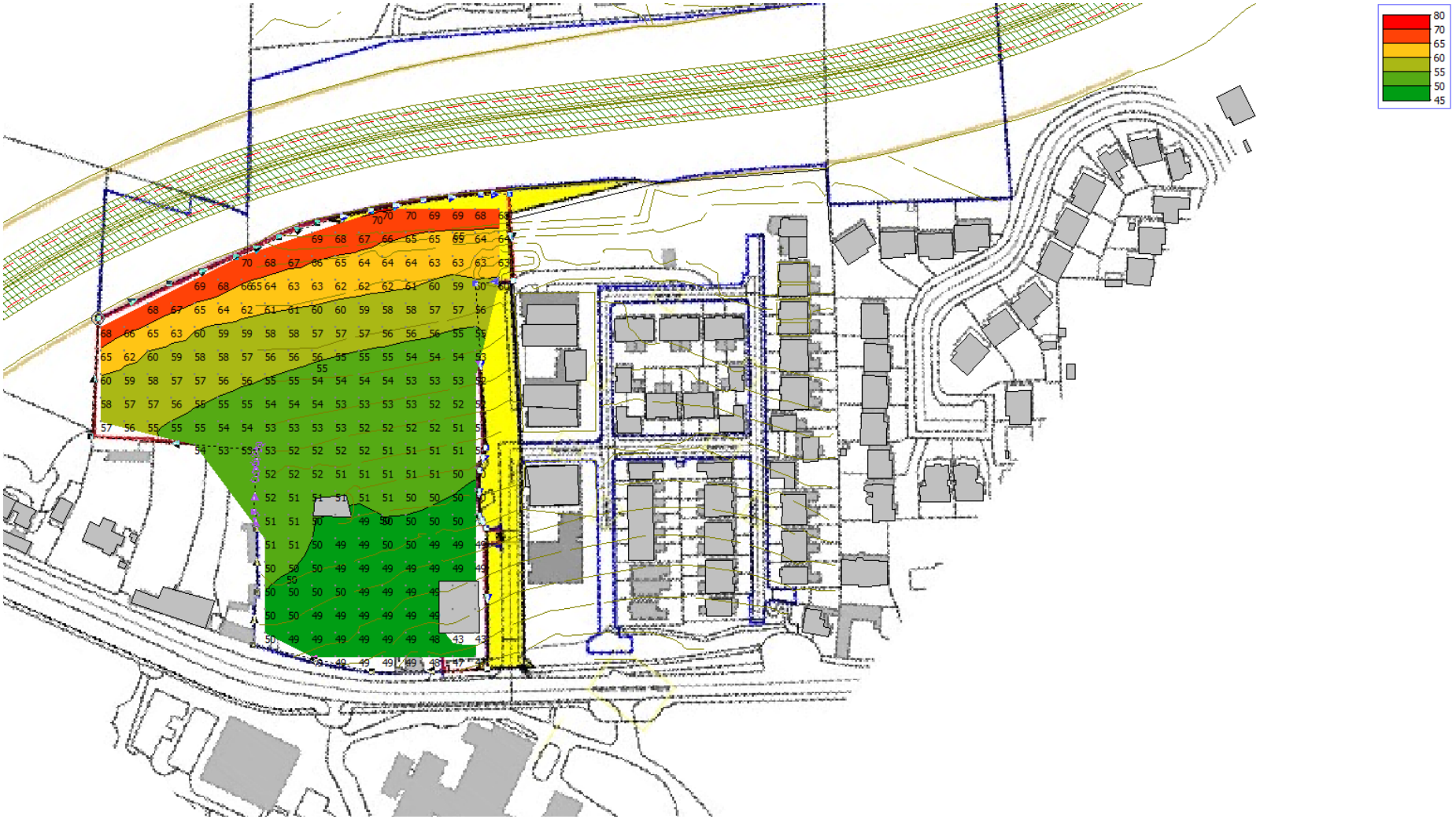

Figure 9 $L_{Aeq,8hr}$ Night Road Traffic Noise Levels dB(A) – 4m AGL without development

Table 10 summarises the expected noise levels across the site with the DEBP in operation.

Height AGL	Daytime $L_{Aeq,16hr}$, dB	Night-Time $L_{Aeq,8hr}$, dB
1.5m	50 – 76	43 – 69
4m	50 – 77	47 – 70

Table 10 Noise Levels at Development Site

3.3 Noise Risk Assessment Conclusion

Giving consideration to the 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 low to high noise risk. High risks only occur if the DEBP is developed as a motorway.

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

Negligible Risk *These noise levels indicate that the development site is likely to be acceptable from a noise perspective, and the application need not normally be delayed on noise grounds.*

Low Risk *At low noise levels, the site is likely to be acceptable from a noise perspective provided that 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 in the finished development.*

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 *Low 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 suitably 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.

4.0 INWARD IMPACT ASSESSMENT STAGE 2 – FULL ACOUSTIC ASSESSMENT

Note that the initial risk to the southern boundary, including existing and future road traffic noise, is considered a low noise risk and is not dealt with any further Stage 2 of the assessment.

Depending on the Sustainable Transport Corridor options considered for the future, this risk classification may be reduced to a low to medium risk category. However, the medium to high noise risk classifications apply to the future noise road traffic from the DEBP assuming its use as a motorway, and the stage 2 full acoustic assessment presented below is based on the DEBP operating as a motorway.

4.1 Element 1 – Good Acoustic Design Process

4.1.1 ProPG Guidance

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. It is important to note that ProPG specifically states that good acoustic design is not equivalent to overdesign or "*gold plating"* of all new development but that it seeks to deliver the optimum acoustic environment for a given site.

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.

4.1.2 Application of GAD Process to Proposed Application

Relocation or Reduction of Noise from Source

The existing road and proposed DEBP are 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.

Planning, Layout and Orientation

The facades of buildings to the southern section of the site are at least 20m from the site boundary. Those facades exposed to highest noise levels from the future DEBP have been provided with Winter Gardens to ensure that noise levels on the private balcony space is within reasonable targets. Note that Winter Gardens are only required as noise mitigation if the DEBP is developed as a motorway.

The Block G communal open space is located to the east of the building and a solid noise barrier will be provided to the northern boundary of this area to reduce the noise levels across the open space. This barrier is c3.0 metres high and is only required in the event that the DEBP is developed as a motorway.

Block F has been set back from the DEBP and the communal open space within this block is sheltered from the road by the development building itself. The roof garden area will also be provided with screening from the future DEBP.

There are open spaces provided to the Houses (H4A, H4A1, H4B, H3B, H3B1) and Duplex are sheltered from the road by the development buildings themselves.

Select Construction Types for meeting Building Regulations

A mix of construction types could be considered for the building envelope including masonry and curtain wall elements. Masonry construction types offer high levels of sound insulation performance. However, as is typically the case 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 in terms of sound insulation performance.

In this instance mechanical ventilation is being considered for the units to maximise the energy efficiency of the development. However, this approach also provides an acoustic benefit as it removes the need for window frame or through wall passive vents. However, if passive vents are required they can be accommodated by selecting acoustically attenuated vents as discussed in this document.

It should be noted that in the absence of the DEBP the noise environment at the site is low and good internal acoustic environments can be achieved with standard glazing specifications and even with open windows.

Note that with the DEBP it will not be possible to achieve the desirable internal acoustic environments with windows open in all areas. Instead, the proposal here will be to provide dwelling units with glazed elements and ventilation systems that have good acoustic insulation properties so that when the windows are closed the noise levels internally are good. Inhabitants will be able to open the windows if they wish, however, doing so will increase the internal noise level. This approach to mitigation is supported in ProPG where it states the following (note emphasis has been added in bold),

> "2.22 *Using fixed unopenable glazing for sound insulation purposes is generally unsatisfactory and should be avoided;* ***occupants generally prefer the ability to have control over the internal environment using openable windows, even if the acoustic conditions would be considered unsatisfactory when open****. Solely relying on sound insulation of the building envelope to achieve acceptable acoustic conditions in new residential development, when other methods could reduce the need for this approach, is not regarded as good acoustic design. Any reliance upon building envelope insulation with closed windows should be justified in supporting documents* "
>
> *Note 5 Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings*

used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded

2.34 *Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed,* ***which may be the case in urban areas and at sites adjacent to transportation noise sources****, special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment. In such circumstances, internal noise levels can be assessed with windows closed but with any façade openings used to provide "whole dwelling ventilation" in accordance with Building Regulations Approved Document F (e.g. trickle ventilators) in the open position (see Supplementary Document 2). Furthermore, in this scenario the internal L_{Aeq} target noise levels should not generally be exceeded*."

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

The noise control measures do not have any significant impact on other issues.

Assess Viability of Alternative Solutions

This will be explored as the project progresses and the noise model will be used to assess the acoustic benefit of any alternative solutions.

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 $L_{Aeq,16hr}$."*

The values are largely based on WHO guideline values.

For this development the good acoustic design principals employed have ensured that the private external spaces are positioned to benefit from the screening effect of the development buildings or specific screening included within the design. Figure 10 illustrates that for the current layout the vast majority of the outdoor amenity areas achieve a noise level ≤55 dB $L_{Aeq,16hr}$.

Figure 10 Noise Levels Across External Amenity Areas

The majority of the areas will experience noise levels that are within the recommended thresholds, however, the area in close proximity to the proposed DEBP will experience higher than ideal noise levels after the DEBP has been developed this is mitigated as much as is practical by providing a 3m high noise barrier to the boundary with the DEBP. Note that this barrier is only proposed to be installed if the DEBP is constructed. Prior to that this area of the site will be quiet and well within the most desirable level. It is important to note that the ProPG document allows for the impact of higher than desirable external noise levels to be off-set by *"a relatively quiet, protected, nearby, external amenity space for sole use by a limited group of residents as part of the amenity of their dwellings"*, for this site it's noted that there is additional external space set aside for the residents in the proposed development.

Regarding balcony spaces for apartments that face the DEBP, Winter Gardens have been specified to apartments on the facades most exposed to noise from the proposed DEBP. Once again the Winter Gardens are only required for noise mitigation if the DEBP is developed. This will ensure that the external noise level within these spaces will be within the 55 dB $L_{Aeq,16hr}$ criterion.

Summary

In terms of viable alternatives to acoustic treatment of façade elements, currently it is not considered likely that there will be further options for mitigation outside of the provision of boundary treatments, winter gardens and the use of proprietary acoustic glazing and ventilation.

4.2 Element 2 – Internal Noise Guidelines

Any mitigation measures outlined further in this report would only be necessary if the DEBP was developed into a motorway. If other uses are progressed e.g. greenway

/cycleway, a pedestrian walkway, biodiversity projects, recreational opportunities it is assumed that they will not be significant in terms of noise generation and there would be no mitigation needed.

However, the façade treatment mitigations proposed must be installed when the development is built. These mitigation measures are determined based on the highly conservative noise levels from a motorway. Therefore, further review of the DEBP options and potential noise sources would be required at detailed design stage before the development is built. It is recommended that in the event of the current development being granted permission the conditions attached are worded in such a way to allow the noise mitigation measures discussed in this report to be omitted if the DEBP is confirmed to not be proceeding.

4.2.1 Internal Noise Criteria

Element 2 of the ProPG document sets out recommended internal noise targets derived from BS 8233 *Guidance on sound insulation and noise reduction for buildings* (2014). The recommended indoor ambient noise levels are set out in Table 11 and are based on annual average data, that is to say they omit occasional events where higher intermittent noisy events may occur, such as New Year's Eve.

Activity	Location	(07:00 to 23:00hrs)	(23:00 to 07:00hrs)
Resting	Living room	35 dB $L_{Aeq,16hr}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16hr}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$ 45 dB $L_{Amax,T}$*

Table 11 ProPG Internal Noise Levels

*Note The document comments that the internal $L_{AFmax,T}$ noise level may be exceeded no more than 10 times per night without a significant impact occurring.

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 noise guidelines, then a relaxation of the internal L_{Aeq} values by up to 5 dB can still provide reasonable internal conditions.

4.2.2 Discussion on Open/Closed Windows

The typical level of sound reduction offered by a partially open window falls in the region of 10 to 15 dB[7].

Considering the design goals outlined in Table 11 and a sound reduction across an open window of 15 dB, the free-field noise levels that would be required to ensure that internal noise levels do not exceed good (i.e. at or below the internal noise levels) or reasonable internal noise levels (i.e. 5 dB above the internal noise levels) have been summarised in Table 12.

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 $L_{Aeq,16hour}$	45dB $L_{Aeq,8hour}$

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

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

Table 12 External Noise Levels Required to Achieve Internal Noise Levels

In this instance the external noise levels with the DEBP are such that it will not be possible to achieve the desired internal noise levels with windows open on those facades overlooking the proposed DEBP. Therefore, appropriate acoustic specifications to windows and ventilation systems will be provided to ensure the rooms are adequately ventilated and achieve the good internal noise levels detailed here. Elsewhere, some parts of the development are screened from the proposed DEBP by development buildings themselves and therefore noise levels will be lower. This will allow reasonable internal noise levels to be achieved with open windows.

If the DEBP is not developed then the desired internal noise levels can be met with open and closed windows.

4.2.3 Façade Levels

Table 13 summarises the range of noise levels at each façade of the most exposed Blocks of G, new houses (H4A, H4A1, H4B, H3B, H3B1), Block F and Duplex. Note that Block E and continued use of existing dwellings are located away from the proposed DEBP and is therefore screened out of this assessment.

Block	Facade	Daytime, dB(A)	Night-time, dB(A)
G	Northern	74 - 77	67 - 70
	Eastern	60 - 74	54 - 67
	Western	64 - 74	57 - 68
	Southern	54 - 67	47 - 60
New Houses (H4A, H4A1, H4B, H3B, H3B1)	Northern	57 - 76	50 - 70
	Eastern	54 - 73	47 - 66
	Western	75 - 59	52 - 69
	Southern	54 - 63	48 - 56
F and Duplex	Northern	59 - 70	53 - 63
	Eastern	53 - 68	46 - 61
	Western	54 - 66	48 - 59
	Southern	52 - 58	46 - 52

Table 13 Façade Noise Levels

4.2.4 Proposed 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[8] of BS8233 provides 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 road traffic noise as per the site noise model.

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 most exposed facades will be provided with glazing that, when closed, achieve the minimum sound insulation performance as set out in Table 14.

Glazing Specification	Octave Band Centre Frequency (Hz)						R_w
	125	250	500	1k	2k	4k	
Acoustic Glazing Type 1	20	19	29	38	36	45	32
Acoustic Glazing Type 2	27	29	36	41	42	52	39
Acoustic Glazing Type 3	31	37	46	54	56	63	49

Table 14 Sound Insulation Performance Requirements for Glazing, SRI (dB)

The acoustic specification listed in Table 14 can be achieved using a double or triple glazed unit with slightly thicker than standard glass. Figure 11 illustrates where the acoustic glazing specified here is required. Note that where Winter Gardens are specified the combined performance of the external Winter Garden glazing and the internal glazing to the apartment must meet the performance outlined in Table 14, in the event of the DEBP progressing as a motorway. Facades not highlighted in Figure 11 do not require any specific acoustic glazing.

[8] The methodology contained within Annex G of BS8233 is based on the assumption that the source is a line source (such as a road) and that the building facades are simple, i.e. do not have balconies. These assumptions are considered valid for the purposes of this assessment and have been adopted.

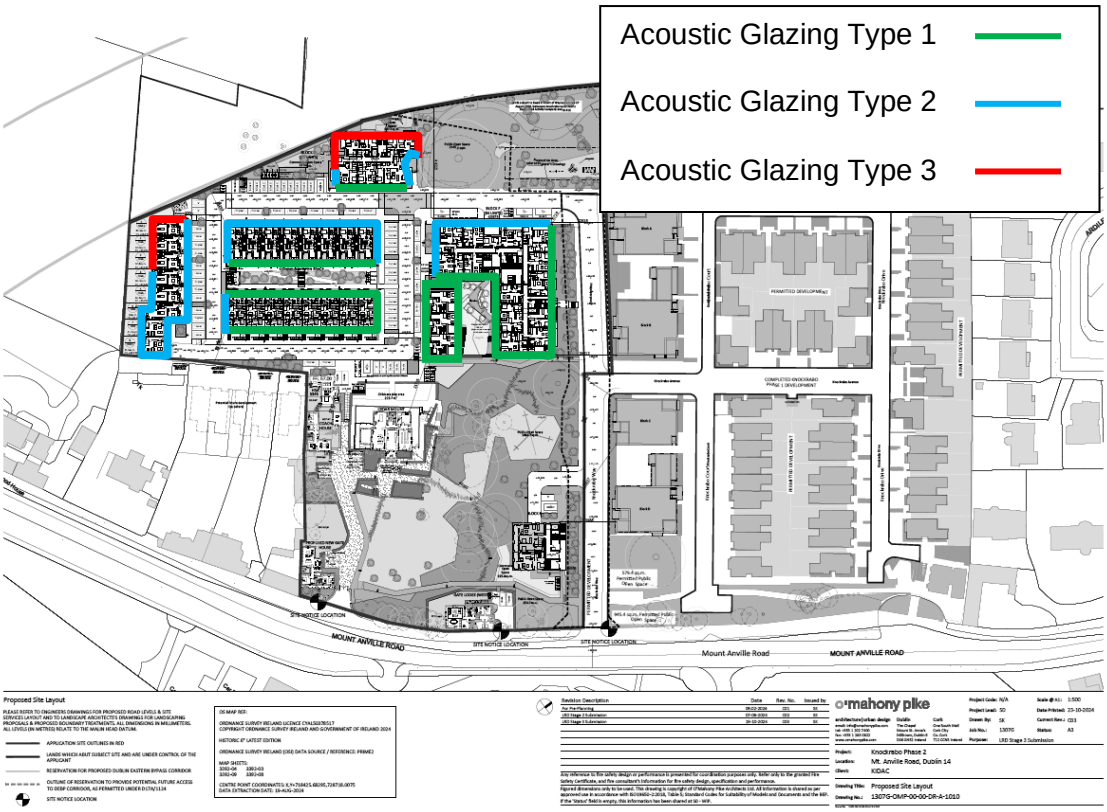

Figure 11 Extent of Acoustic Glazing

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.

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. 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.

Ventilation

The ventilation strategy for the development will be in accordance with Part F of the Building Regulations. The proposal may be to use mechanical heat recovery ventilation throughout which removes the need for any passive wall or window vents and effectively mitigates any noise intrusion via the ventilation path. Alternatively if passive vents are required they must be selected to achieve an acoustic rating of 55 dB $D_{ne,w}$ on those facades specified to have Glazing Type 3 and 45 dB $D_{ne,w}$ on facades specified to have Glazing Type 2.

4.2.5 Internal Noise Levels

Taking into account the external façade levels and the specified building envelope the internal noise levels have been calculated. In all instances the good internal noise criteria are achieved for daytime and night-time periods.

4.3 Element 3 – External Amenity Area Noise Assessment

As previously discussed, the majority of external private amenity areas are expected to achieve the recommended 55 dB $L_{Aeq,16hr}$ noise level recommended in ProPG.

4.4 Element 4 – Assessment of Other Relevant Issues

Element 4 gives consideration to other factors that *may* prove pertinent to the assessment, these are defined in the document as:

- 4(i) compliance with relevant national and local policy
- 4(ii) magnitude and extent of compliance with ProPG
- 4(iii) likely occupants of the development
- 4(iv) acoustic design v unintended adverse consequences

Each is discussed in turn below.

4.4.1 Compliance with Relevant National and Local Policy

There are no National policy documents relating to the acoustic design of residential dwellings. Locally the Dublin Agglomeration Noise Action Plan specifies that the guidance contained within ProPG should be used in assessing the noise impact on new residential developments.

This Acoustic Design Statement has been prepared in compliance with the requirements of ProPG and therefore complies with the requirements of local policy.

4.4.2 Magnitude and Extent of Compliance with ProPG

As discussed within this report the following conclusions have been drawn with regards to the extent of compliance with ProPG:

- All dwellings as part of the development have been designed to achieve the good level of internal noise levels specified within ProPG. The units require closed windows and open vents to achieve this level, and;
- Private and public external amenity areas have been assessed and specific acoustic design measures have been included to mitigate noise levels on these areas. This includes the provision of winter gardens and screening to the external spaces.

Based on the preceding it is concluded that the proposed development is in full compliance with the requirements of ProPG.

4.4.3 Likely Occupants of the Development

This element is not considered relevant here as the future occupants are unknown. It is included within ProPG to allow for some discussion on how the acoustic conditions may change depending on the likely occupants.

4.4.4 Acoustic Design v Unintended Adverse Consequences

Unintended adverse consequences did not occur on this project.

5.0 OTHER ASSESSMENTS

5.1 Construction Noise Impact of the DEBP on Proposed Development

Based on the information contained within the *Dublin Eastern Bypass Corridor Protection Study, January 2011* it is assumed that a variety of items of plant will be in use e.g. excavators, lifting equipment, dumper trucks, compressors and generators. It is also possible that rock breaking may be required on occasions and there will be vehicular movements to and from the site that will make use of existing roads.

Due to the fact that the construction programme has been established in outline form only, it is not possible to calculate the actual magnitude of noise emissions to the local environment. However, the following paragraphs present calculations of indicative noise levels for typical noise sources associated with road construction.

BS 5228: *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Part 1 Noise 5228 – 1: 2009+A1:2014* sets out typical noise levels for items of construction plant. Tables 15 and 16 lists the sound power levels of the plant used for calculation of the expected noise level at various distances from the roadway.

Plant Item (BS 5228 Ref.)	Sound Power Level, dB(A) re 10^{-12} W
Pneumatic breaker (C.8.12)	100
Wheeled loader (C.4.13)[9]	90
Tracked excavator (C.2.14)[4]	98
Dozer (C.2.10) [4]	99
Dump truck (C.2.30) [4]	98
Vibratory roller (C.5.20)	99
Asphalt Paver (C.5.31)	99
Wheeled Telescopic Crane (C.4.38)	102
Compressor (C.5.5)	89
Generator (C.4.84)	98
Road Roller (C.5.19)	104
HGV Movements (20 per hour)	77

Table 15 Typical Construction Plant Noise Levels

Plant Item	Distance from road, meters				
	10m	20m	35m	50m	60m
Pneumatic breaker (C.8.12)	64	58	55	51	49
Wheeled loader (C.4.13) [4]	54	48	45	41	39
Tracked excavator (C.2.14) [4]	62	56	53	49	47
Dozer (C.2.10) [4]	63	57	54	50	48
Dump truck (C.2.30) [4]	62	56	53	49	47
Vibratory roller (C.5.20)	63	57	54	50	48
Asphalt Paver (C.5.31)	63	57	54	50	48
Wheeled Telescopic Crane (C.4.38)	66	60	57	53	51
Compressor (C.5.5)	53	47	44	40	38
Generator (C.4.84)	62	56	53	49	47
Road Roller (C.5.19)	68	62	59	55	53
HGV Movements (20 per hour)	65	59	56	53	52

Table 16 Indicative Noise Levels from Construction Plant Items at Various Distances from the Road

[9] Assume noise control measures as outlined in Table B1 of BS 5228 – 1 (i.e. fit with an acoustic exhaust).

The noise levels presented are within the limit values shown in Table 1 for weekday daytime periods at distances greater than 10m from the works. The minimum distance has been chosen based on the closest buildings within this proposed development to the edge of the DEBP route corridor. It should be noted that the additional shielding benefit of the deep cutting which the DEBP will be located within has not been taken into account and therefore the noise levels presented in Table 16 are considered to be worst-case.

5.2 Construction Vibration Impact of the DEBP

During the construction of the DEBP the vibration levels at the existing residential properties along the scheme will have to be controlled by the contractor such that the vibration levels recommended in the TII guidelines are not exceeded. Considering that the proposed development buildings are set back a similar distance from the proposed DEBP route as other existing residential properties in the area it is concluded that the vibration limits in Table 5 will be the maximum levels experienced by the development buildings during construction of the DEBP. Furthermore, the structural design of the proposed development buildings has not yet commenced but the form of construction is likely to be as follows.

- Upper levels in multi-storey buildings – concrete or loadbearing masonry walls and reinforced concrete or prestressed concrete floors.

Considering this construction and making reference to *British Standard BS 7385: Evaluation and Measurement for Vibration in Buildings Part 2: Guide to Damage Levels from Ground Borne Vibration (1993)* there is no risk of structural damage from vibration levels of the order of those listed in Table 5. Therefore, it is concluded that there will be no adverse impact on the development structures as a result of blasting during the construction of the DEBP, once the appropriate limits are adhered to by the relevant contractors.

5.3 Operational Vibration Impact of the DEBP

As a vehicle travels along a road, vibration can be generated in the road and subsequently propagate towards nearby buildings. Such vibration is generated by the interaction of a vehicle's wheels and the road surface and by direct transmission through the air of energy waves. Some of these waves arise as a function of the size, shape and speed of the vehicle, and others from pressure fluctuations due to engine, exhaust and other noises generated by the vehicle. It has been found[10] that ground vibrations produced by road traffic are unlikely to cause perceptible structural vibration in properties located near to well-maintained and smooth road surfaces. Problems attributable to road traffic vibration can therefore be largely avoided by maintenance of the road surface.

It is therefore concluded that the proper maintenance of the road surface on the DEBP will ensure that traffic induced vibration by road traffic, including heavy goods vehicles, is unlikely to be generated at a magnitude that would be subjectively noticeable within the proposed development buildings. Furthermore, any vibration generated during the operation of the DEBP would be far below the level at which any damage would be caused to the development buildings.

[10] Traffic Vibration in Buildings, Construction Technology Update No. 39, June 2000, National Research Council of Canada

5.4 Construction Noise Impact of the Proposed Development on NSLs

Noise levels generated by the construction site operations and experienced at the closest NSLs will depend upon a number of variables, the most significant of which are:

- the amount of noise generated by plant and equipment being used at the development site, generally expressed as a sound power level;
- the periods of operation of the plant at the development site, known as the "on-time";
- the distance between the noise source and the receptor, known as the "stand-off";
- the attenuation due to ground absorption or barrier screening effects; and
- reflections of noise due to the presence of hard vertical faces such as walls.

A variety of items of plant will be in use for the purposes of site clearance, demolition, excavation, building construction and landscaping. 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 generation of high levels of noise to the surrounding environment.

The proposed general construction hours are 08:00 to 19:00 hrs, Monday to Friday and 08:00 to 14:00 hrs on Saturdays. No works shall take place on site on Sundays or Bank Holidays.

As discussed in Section 2.4.2 the construction noise threshold (CNT) is set using Category A from BS 8233-1 for the closest NSLs which sets the CNT.

- Daytime (07:00 – 19:00hrs weekdays) /Saturday AM: 65dB $L_{Aeq,12hr}$

The construction stage will be undertaken over a number of stages from site preparation through to building construction and internal fit out. In terms of the potential noise and vibration impacts, the key stages and activities are expected to involve:

- Site clearance;
- Ground works (excavation);
- Superstructure construction; and
- Internal fit out and refurbishment to existing buildings.

The construction programme will create typical construction activity related noise onsite. Indicative ranges of noise levels associated with construction may be calculated in accordance with the methodology set out in BS 5228-1:2009+A1:2014 *Code of Practice for Noise and Vibration Control on Construction and Open Sites – Noise.* This standard sets out sound power / sound pressure levels for plant items normally encountered on construction sites, which in turn enables the prediction of noise levels.

The following section discusses typical noise levels associated with the proposed development demolition/construction phase and comments on potential noise impacts at distances to the nearest NSLs during the key stages and types of activities that will occur on site.

5.4.1 Site Clearance, Bulk Excavation, Road Works and Foundations

For site clearance, bulk excavations and fill work, foundation and road works using excavators, loaders, dozers, concreting works, mobile cranes, generators, noise source levels are quoted in the range of 70 to 80 dB L_{Aeq} at distances of 10 m within BS 5228-1.

For ongoing construction activity associated with the above activities, a total construction noise level of 85 dB L_{Aeq} at 10m has been used for the purposes of indicative calculations representing a variety of plant items and activities over this stage. This would include, for example two items of plant at 80 dB L_{Aeq} and three items of plant at 75 dB L_{Aeq} operating simultaneously within one work area resulting in a total noise level of 85 dB L_{Aeq}.

This scenario is a robust assumption made for a development of this size, on the basis that it is unlikely that more than 5 no. items of such plant/equipment would be operating simultaneously in such close proximity to each other at all times. In reality, items of construction plant and machinery will be operating at varying distances from any one NSL.

5.4.2 Superstructure, Internal Fit Outs and Landscaping Works

Given the nature of the proposed construction phases which will include standard residential building techniques across the site, once the ground preparation and foundation works have been completed, a large portion of the work will involve manual labour and cranes with lower overall noise levels. For this phase of work, smaller items of mobile plant (excavators, cranes, dozers), landscaping and concreting works with lower noise emissions, a total construction noise level of 78 dB L_{Aeq} at 10m has been used for the purposes of indicative calculations. This would include, for example one item of plant at 75 dB L_{Aeq} and three items of plant at 70 dB L_{Aeq} operating simultaneously within a work area.

5.4.3 Indicative Construction Noise Levels

Indictive noise calculations have been undertaken which assume that plant items are operating for 66% of the time. Screening from 2.4m site hoarding is accounted for around the site boundaries. For most of the time, plant and equipment will be a greater distance from the nearest NSLs than those used within the calculations and the “on-time” of plant and equipment will be less than those assumed over a normal working day and consequently will have lower noise levels. The assessment presented is therefore representative of a best estimate conservative scenario representing construction activities. Table 17 presents the calculated noise levels at varying distances.

Activity	Predicted Construction Noise Level $L_{Aeq(1hour)}$ (dB)					
	15m	20m	30m	35m	40m	50m
Site Clearance, Bulk Excavation, Road Works and Foundations	73	70	67	65	64	62
General Site Work including Superstructure and Fit out	68	65	61	60	59	57

Table 17 Calculated Construction Noise Levels at Varying Distances

5.4.4 Closest Noise and Vibration Sensitive Receptors

Figure 12 below identifies the closest NSLs external to the proposed development. There are also two vibration sensitive locations (VSLs) identified within the development.

NSL1 Located 15m distance from the eastern boundary of the site is the Knockrabo residential development, Phase 1 and Phase 1A, (permitted under DLRCC Reg. Ref. D13A/0689 / An Bord Pleanála (ABP) Ref. PL.06D.243799 and DLRCC Reg. Ref. D16A/0821 (Phase 1); and DLRCC Reg. Ref. D16A/0960 (Phase 1A)).

NSL2 Located between 20m to 30m distance from the southwestern boundary of the site are Mount Anville Lodge' and by the rear boundaries of 'Thendara' (a Protected Structure – RPS Ref. 812) and ''The Garth' (a Protected Structure – RPS Ref. 819).

NSL3 Located between 35m to 40m distance from the southwestern boundary to the site are 'Chimes' and 'Hollywood House' (a Protected Structure – RPS Ref. 829).

VSL1 The western, southwestern and southern site boundary walls including 'Knockrabo Gate Lodge (West) Entrance Gates and Piers (Protected Structure RPS Ref 796).

VSL2 Cedar Mount' (a Protected Structure- RPS Ref. 783) and 'Knockrabo Gate Lodge (West)' (a Protected Structure RPS Ref. 796).

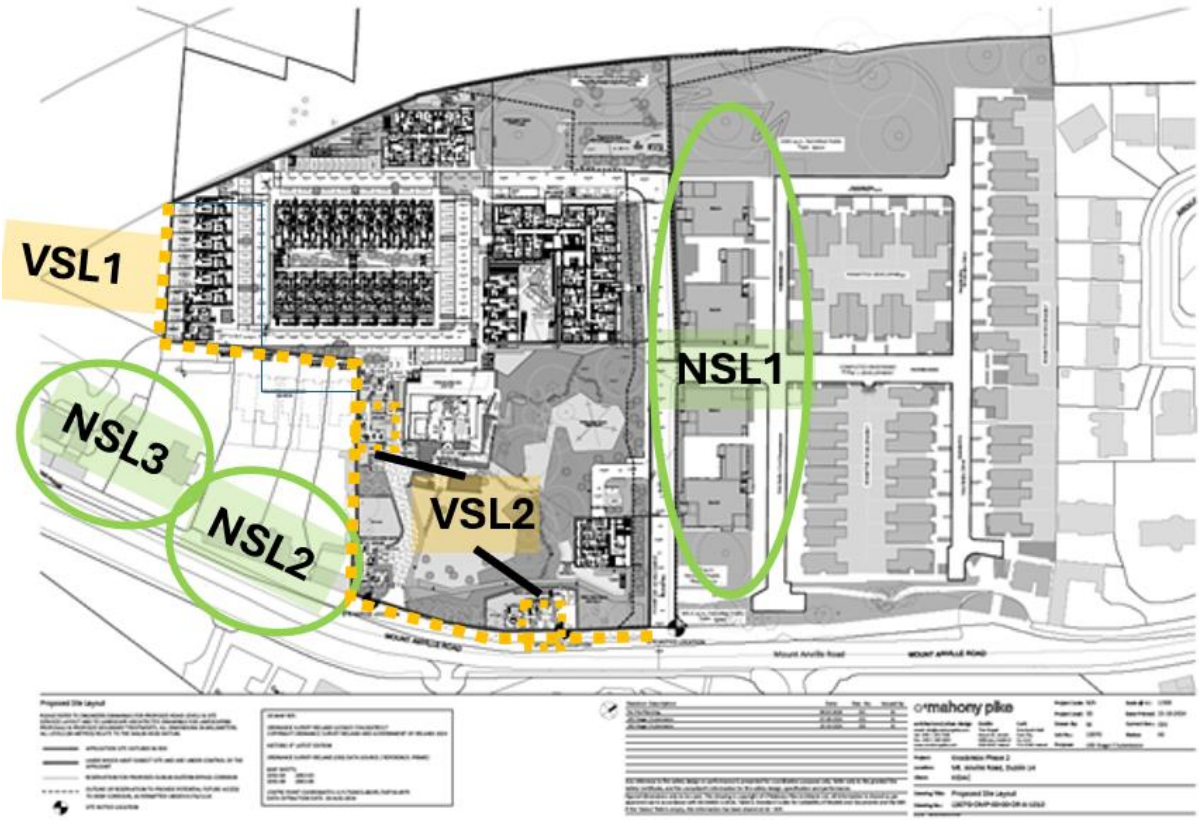

Figure 12 Existing NSLs and VSLs in the Surrounding Environment

5.4.5 Construction Noise Assessment

Reference to the construction noise levels in Table 17 indicate that for the early stage construction activities with higher noise emissions, the CNT of 65 dB $L_{Aeq,T}$ will be exceeded at the closest NSLs when activities are occurring along the closest site boundaries i.e. at NSLs 1,2 and 3. However the duration of these works taking place along the immediate boundary is limited in the overall period of the construction phase of the project. At distances of 20m and beyond, construction noise levels are calculated at or below 70 dB $L_{Aeq,T}$. Whilst the calculated noise levels are above the significance threshold of 65 dB $L_{Aeq,T,}$ construction noise levels reaching 70 dB for temporary periods of time are classified as Moderate (Reference to Table 3) and can be tolerated once advance notice is given to NSLs of the extent, timing and duration of the works.

During the general site construction works including construction of the development buildings, lower noise levels will be generated on site. There is potential for the CNT to be exceeded by a small margin at distances of less than 20m, if working along the immediate boundaries. When works are occurring at 20m or greater distances from NSLs the works are likely to be within the CNT.

Noise mitigation measures will therefore be required on site to reduce construction noise levels along these boundaries to reduce any potential significant effects. Recommended mitigation measures are presented in Section 6 of this report.

5.5 Construction Traffic Noise Impact of the Proposed Development on NSLs

This section has been prepared in order to assess likely noise effects associated with construction traffic using the local road network. In terms of the additional construction traffic on local roads that will be generated as a result of this development the following comment is presented. Considering that in order to increase traffic noise levels by 1 dB traffic volumes would need to increase by the order of 25% it is considered that additional traffic introduced onto the local road network due to the construction phase associated with various phases of the development will result in a negligible and not significant noise impact.

5.6 Construction Vibration Noise Impact of the Proposed Development on NSLs

The potential source of vibration during the construction phase will relate to any intrusive ground breaking activities depending on the methodology employed.

During surface breaking activities during the demolition of structures and ground elements, there is potential for vibration to be generated through the ground. Empirical data for this activity is not provided in BS 5228–2, however the likely levels of vibration from this activity will be significantly below the vibration criteria for building damage based on monitoring data and experience from other sites. AWN Consulting has previously conducted vibration measurements under controlled conditions, during trial construction works on a sample site where concrete slab breaking was carried out. The trial construction works consisted of the use of the following plant and equipment when measured at various distances:

- 3 tonne hydraulic breaker on small CAT tracked excavator; and
- 6 tonne hydraulic breaker on large Liebherr tracked excavator.

Vibration measurements were conducted during various staged activities and at various distances. Peak vibration levels during staged activities using the 3 tonne

breaker ranged from 0.48 to 0.25 PPV (mm/s) at distances of 10m to 50m respectively from the breaking activities. Using a 6 tonne breaker, measured vibration levels ranged between 1.49 to 0.24 PPV (mm/s) at distances of 10m to 50m respectively.

Whilst these measurements relate to a solid concrete slab, the range of values recorded provides some context in relation to typical ranges of vibration generated by construction breaking activity.

Referring to the vibration magnitudes above, vibration impacts at the closest sensitive buildings from ground breaking activities using heavy breakers are orders of magnitude below limits values associated with any form of cosmetic or structural damage for structurally sound or protected or historical buildings or structures referred to in Table 6. This assessment has been made using the lower value within the range (3mm/s) as there is no structural information available at the time of assessment i.e. this is the most conservative assessment.

From a human response to vibration perspective and taking account the distance to the nearest offsite sensitive buildings (NSLs 1-3 at 15m to 40m from the site boundaries) there are likely perceptible impacts from the intermittent use of heavy breakers.

Vibration mitigation measures will therefore be required on site to reduce construction vibration levels for human response only (no cosmetic building damage) along these boundaries to reduce any potential significant effects. Recommended mitigation measures are presented in Section 6 of this report.

5.7 Operational Noise Impact of the Proposed Development on NSLs

5.7.1 Additional Vehicular Traffic on Surrounding Roads

For the purpose of assessing the 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 proposed development, given that traffic from the development will make use of the existing road network.

Waterman Moylan Consulting Engineers have calculated the AADT for the Do Nothing and Do Something scenarios to accompany this planning application. Figure 13 illustrates the road links assessed as part of this study.

Traffic flows along the surrounding road network in terms of Annual Average Daily Traffic (AADT) for the Do Nothing (DN) and Do Something (DS) scenarios have been reviewed to calculate the change in traffic noise.

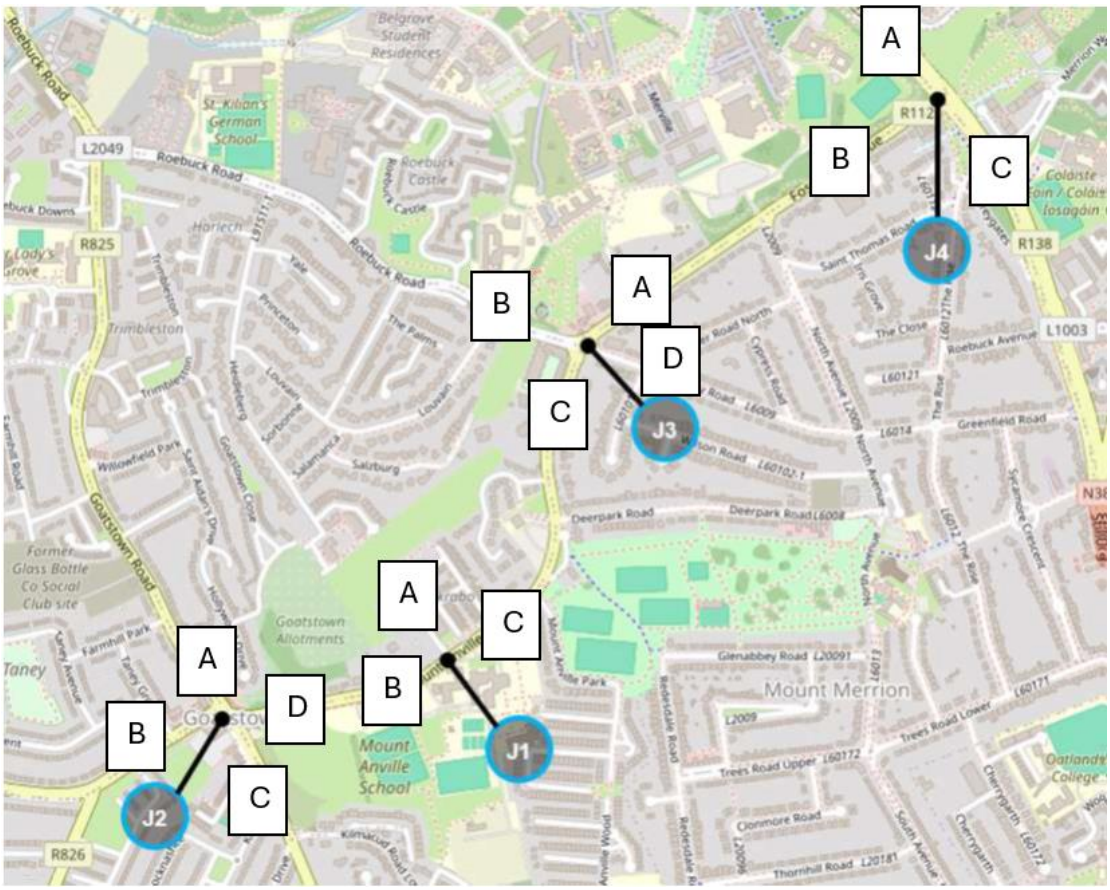

Figure 13 Road Links for Traffic Assessment

Table 18 summarises the AADT for the Proposed Development DN and DS scenarios across the four junctions.

Junction Ref.	Arm Ref.	Do Nothing AADT 2031	Do Something AADT 2031	Increase in noise level dB
1	A	633	1491	+3.7
	B	13301	13,438	0.0
	C	13,395	14,006	+0.2
2	A	14,423	14,491	0.0
	B	15,587	15,654	0.0
	C	20,067	20,161	0.0
	D	13,170	13,264	0.0
3	A	16,836	17,336	+0.1
	B	9,826	9,851	0.0
	C	12,879	13,516	+0.2
	D	6,142	6,780	+0.4
4	A	55,481	55,741	0.0
	B	17,867	18,066	0.0
	C	54,484	54,725	0.0

Table 18 Summary of Change in Noise Level, for Year 2031

The predicted increase in AADT traffic levels along the local road network surrounding the proposed development range between 0.0 to 3.7 dB(A) for the opening year 2031. Reference to Table 4 confirms that the traffic noise level increases for both assessment years along the majority of road links are negligible.

The exception to the above is Junction 1 Arm A Knocrabo Avenue which increase by 3.7 dB which is considered moderate.

5.7.2 Mechanical and Electrical Noise Sources

Once operational, there will be building services plant items required to serve the residential and community / leisure aspects of the proposed development. The specific requirements for mechanical and electrical plant items for each element of the residential buildings, community and crèche buildings have not yet been progressed at this stage of the design. Most of this plant will be capable of generating noise to some degree and may operate 24 hours a day. It would, therefore, be most noticeable during quiet periods (i.e. overnight). Noisy plant with a direct line-of-sight to noise sensitive properties as well as louder plant areas on roofs would potentially have the greatest impact.

Plant items will be selected, designed and located so that there is no adverse 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 proposed development will be designed/attenuated to not exceed the internal noise levels discussed in Table 8.

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

5.7.3 Creche Playground

Measurement of noise levels generated by children playing outdoors at several crèches indicate typical noise levels in the order of 56 dB $L_{Aeq,1hr}$ at distance of 5m. The nearest existing off-site noise sensitive locations to the southwest are approximately 65m from the Crèche play area (NSL2). Considering the distance and screening from existing boundary treatments, activities from the crèche are calculated to be below 40 dB $L_{Aeq,1hr}$ and hence, is well below the range of road traffic noise levels mapped to the south of the site. The resultant noise impact is therefore not significant.

6.0 MITIGATION MEASURES

6.1 Construction Phase Mitigation

6.1.1 Noise and Vibration Site Control Measures

With regard to construction activities, best practice control measures from construction sites within BS 5228 (2009 +A1 2014) *Code of Practice for Noise and Vibration Control on Construction and Open Sites Parts 1 and 2* will be used to control noise and vibration impacts. The contractor will ensure that all best practice noise and vibration control methods will be used as necessary in order to ensure impacts to nearby residential noise sensitive locations are not significant. This will be particularly important during any demolition and mechanical excavation works which are likely to be the activities to have the highest potential noise levels.

The following specific forms of noise control at source relevant to the development works will be implemented as set out below:

- For mobile plant items such as cranes, dump trucks, excavators and loaders, the installation of an acoustic exhaust and or maintaining enclosure panels closed during operation can reduce noise levels by up to 10 dB. Mobile plant will be switched off when not in use and not left idling.
- For percussive tools such as pneumatic concrete breakers a number of noise control measures include fitting a muffler or sound reducing equipment to the breaker 'tool' and ensure any leaks in the air lines are sealed. Erection of localised screens around breaker or drill bit when in operation in close proximity to noise sensitive boundaries. This measure is likely to be required during the early construction phase when demolition works are taking place in close proximity to the noise sensitive receptors on the boundary of the site.
- For all materials handling, ensure that materials are not dropped from excessive heights, lining drops chutes and dump trucks with resilient materials.
- All items of plant will 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.

6.1.2 Liaison with the Public

The following control measures will form part of the construction phase mitigation which includes:

- Environmental Liaison Officer: This will include a liaison manager and a good neighbours policy which will set up a chain of communication between Dún Laoghaire-Rathdown County Council (DLRCC), the local residents and the contractor; and,
- Complaints handling procedures.

The designated environmental liaison officer will be appointed to site during construction works. Any noise complaints will be logged and followed up in a prompt fashion by the liaison officer. In addition, where a particularly noisy construction activity is planned or other works with the potential to generate high levels of noise, or where noisy works are expected to operate outside of normal working hours etc., the liaison officer will inform the nearest noise sensitive locations of the time and expected duration of the noisy works.

6.1.3 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. During high noise generating 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 also be phased so as to schedule these works for daytime hours so as to avoid causing excessive disturbance.

As per DMRB Noise and Vibration (UKHE 2020) in cases of moderate to major magnitude of impacts, the duration of works determines the overall significance rating. As part of the mitigation measures, the durations advised in the DMRB Noise and Vibration (UKHE 2020) will be followed, where feasible, to reduce overall significance effects (i.e. scheduling works to occur for periods of less than ten days/nights over 15 consecutive day/night periods and less than 40 days over six consecutive months where significant effects are identified).

6.1.4 Monitoring

Noise monitoring will be conducted throughout the construction period at the site boundaries. Vibration monitoring will be conducted at site boundaries to the southeast and at protected structures within the development itself.

6.2 Operational Phase Mitigation

There is no specific noise mitigation measures required to control noise emissions from building services, mechanical or electrical plant to the surrounding environment due to the layout, design and operational noise levels associated with the proposed external plant items.

7.0 CONCLUSION

An initial site noise risk assessment has been carried out on the proposed Phase 2 residential development at Knockrabo, Mt. Anville Road, Dublin 14. The future noise environment with the proposed Dublin Eastern By-Pass (DEBP) in operation has been determined through modelling. However, the need for the DEBP is no longer clear and feedback from the planning authority was that the corridor could be used for other transport uses which would no longer generate high noise levels. In order to present a robust assessment for the current planning application, the future noise environment with the proposed DEBP in operation has been determined through modelling. This assessment has classified the development site as having a range of noise risks associated ranging from low to high risk. The high risks only occur if the DEBP is developed.

Subsequent to the noise risk assessment a full Acoustic Design Statement has also been prepared to discuss how good acoustic design practice has been implemented. This document presents further discussion of the likely noise impact of both the external and internal areas of the proposed development.

It has been determined that mitigation measures in the form of boundary treatments to the external amenity spaces and façade treatments to development buildings will be required for the development. Furthermore, Winter Gardens have been provided to the facades most exposed to noise from the proposed DEBP. In addition, it will be necessary to provide enhanced acoustic glazing to the other façade elevations to ensure that when windows are closed that the internal noise environment is good. The specifications for all acoustic glazing have been provided in the body of this report. It is also proposed to provide mechanical ventilation to the development units, which may remove the need for any passive wall or window vents and effectively mitigates any noise intrusion via the ventilation path. However, if passive vents are required they must be selected to achieve an acoustic rating provided in this report.

In conclusion, there are no building regulations that require new developments to achieve a certain level of noise insulation from external sources. However, for this development the site was identified as potentially being exposed to elevated noise levels due to the operation of the proposed DEBP road scheme. As a result, this report has provided specifications and design advice to the developer to ensure that the internal noise environment within the development buildings is fully compliant with best practice standards. This also ensures compliance with the requirements of the local Dublin Agglomeration Noise Action Plan document.

Furthermore, vibration impacts on the proposed development have been assessed both during the construction and operational phase of the DEBP road scheme. During construction it is concluded that there will be no adverse impact on the development structures, once the appropriate limits are adhered to by the relevant contractors. During operation of the DEBP it is concluded that the proper maintenance of the road surface on the DEBP will ensure that traffic induced vibration by road traffic, including heavy goods vehicles, is unlikely to be generated at a magnitude that would be subjectively noticeable within the proposed development buildings. Furthermore, any vibration generated during the operation of the DEBP would be far below the level at which any damage would be caused to the development buildings.

During the construction phase of the proposed development itself project there will be a short-term increase in noise levels particularly during the early stage phases of work. Noise mitigation measures will be employed at the site to control site noise

emissions as far as practicable. Overall, the impact is moderate and short-term impact with temporary significant effects during the construction phase.

Once operational, there are no significant noise impacts associated with the development itself on its surrounding environment.

APPENDIX A
GLOSSARY OF ACOUSTIC TERMINOLOGY

Ambient noise — The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.

Background noise — The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).

dB — Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 µPa).

dB(A) — An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'–weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

Hertz (Hz) — The unit of sound frequency in cycles per second.

$L_{Aeq,T}$ — This 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 (T).The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.

L_{AFmax} — is the instantaneous fast time weighted maximum sound level measured during the sample period.

Octave band — A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.

APPENDIX B

NOISE MODEL TECHNICAL DATA

B.1 Noise Model

A computer-based prediction model has been prepared in order to quantify the traffic noise level associated with the DEBP on the proposed development site. This section discusses the methodology behind the noise modelling process.

B.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 traffic noise levels in accordance with CRTN guidance.

Brüel & Kjær Type 7810 *Predictor* is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. *Predictor* predicts 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 sound power or traffic flow and average velocity;
- 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.

B.3 Prediction of traffic noise

Noise emissions during the operational phase of the project have been modelled using *Predictor* in accordance with CRTN. The CRTN method of predicting noise from a road scheme consists of the following five elements:

- divide the road scheme into segments so that the variation of noise within this segment is small;
- calculate the basic noise level at a reference distance of 10 metres from the nearside carriageway edge for each segment;
- assess for each segment the noise level at the reception point taking into account distance attenuation and screening of the source line;
- correct the noise level at the reception point to take account of site layout features including reflections from buildings and facades, and the size of source segment;
- combine the contributions from all segments to give the predicted noise level at the receiver location for the whole road scheme.

Note that all calculations are performed to one decimal place.

APPENDIX B

NOISE MODEL TECHNICAL DATA (Continued)

B.4 Input to the Noise Model

The noise model was prepared using the following data:

- topographical data and Ordnance Survey mapping supplied by O'Mahony Pike Architects.

B.5 Output of the Noise Model

Predictor calculates noise levels for a set of receiver locations specified by the user. The results include an overall level in daytime (i.e. 07:00 to 23:00hrs) and night time (i.e. 23:00 to 07:00hrs) levels.