Unit A16
Kingswood Business Park
Baldonnell, Dublin 22 Ireland

00353 1 452 1133
info@iacoustics.net
www.iacoustics.net

Acoustic Report

Adamstown Station Blocks A, C & D

Report Prepared by: Glen Plunkett, Acoustic Consultant, AMIOA, MSc Acoustics

Reviewed by: Jim Dunne, Managing Director, MIOA, MSc Acoustics

Issue Date	Revision	Status
24th March 2022	1	Draft
Final Report	2	For Planning

1 Introduction

iAcoustics have been engaged by Quintain Developments Ireland Ltd to provide an acoustic design statement supporting a planning application for Blocks A, C & D of the Adamstown Station mixed-use project in Adamstown, Co Dublin. This report details an inward and outward noise impact assessment for the proposed development. Recommendations are provided to protect residential amenities in the finished development.

Blocks A, C & D form part of the overall development at the Adamstown District Station site. An initial noise & vibration impact assessment was carried out in 2019 by MLM Consulting Engineers Ltd; baseline noise & vibration studies are presented in the MLM report, which is relevant to the development at large. Therefore further noise & vibration studies are not deemed necessary for this work; iAcoustics will refer to the baseline data gathered in the MLM report, which is presented in **Appendix A** for ease of reference.

Report objectives:

I. Review current best-practice standards & guidance for acoustic design in dwellings.
II. Review the baseline MLM noise & vibration data for the development site (comprising all blocks within Adamstown District Station).
III. Assess the predicted road and rail noise impacts for Blocks A, C & D.
IV. Undertake an assessment under the ProPG (2017) guidance document.
V. Provide recommendations ensuring that residential amenity is protected in the finished development.

The proposed development consists of:

- A development to be constructed in 3no. blocks (known as Block A, C and D) ranging in height from 2 to 9 storeys, including an ancillary residents Pavilion Amenity Building.
- 436no. apartments comprising 9no. studio units, 204no. 1-bedroom units, 213no. 2-bedroom units and 10no. 3-bedroom unit.
- Communal open space provided at podium and ground levels
- 220no. car parking spaces are to be provided in a mixture of on-street parking, podium and within the already permitted Block F multi-storey car park.
- The provision of 526no. bicycle parking spaces are provided through stacked (416no. spaces) and Sheffield (110no. spaces) bicycle parking spaces.

The development also includes the provision of all ancillary site development and landscape works.

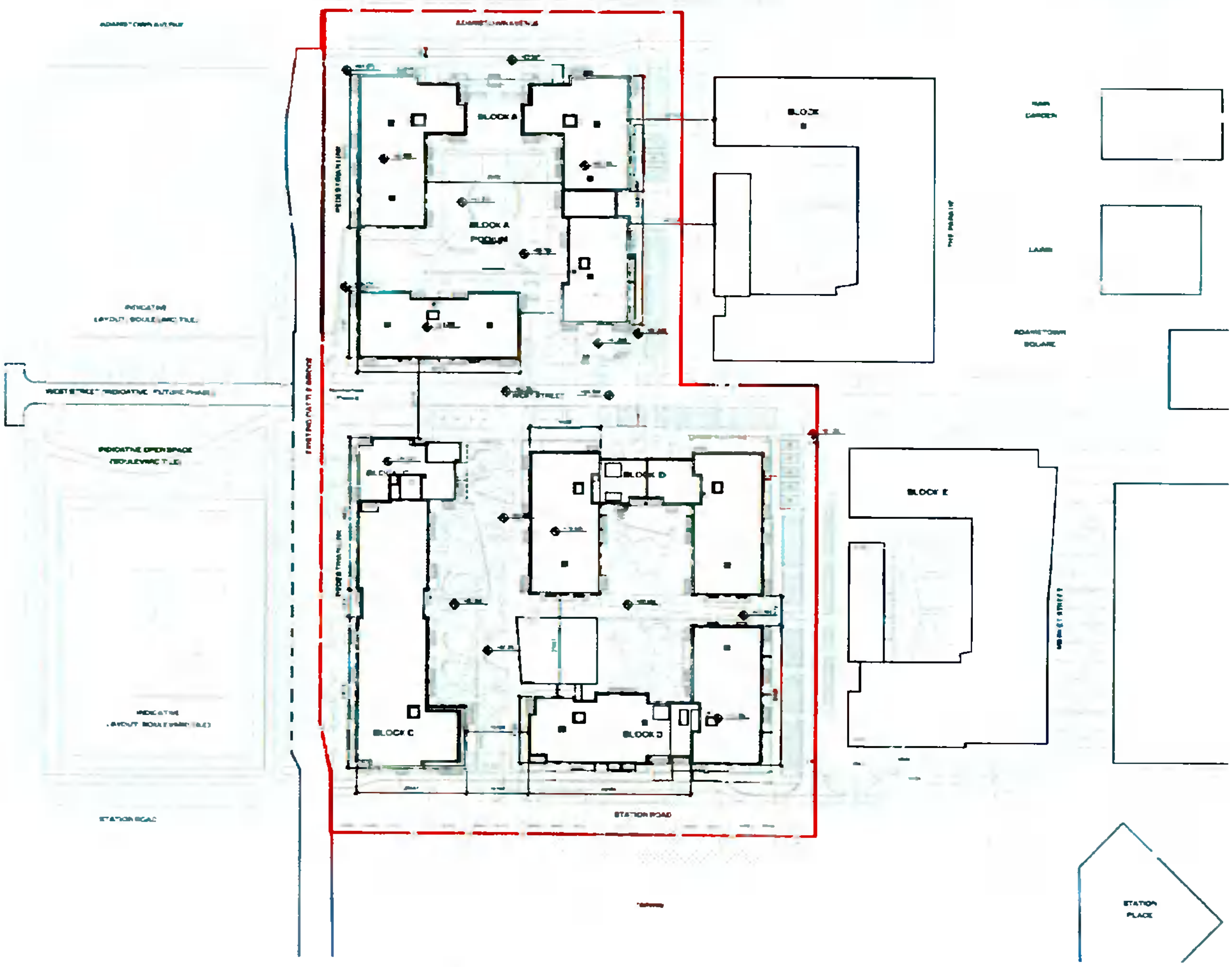

Figure 1-1 Extract from 'Proposed Site Plan' drawing ADC-HJL-ACD-00-DR-A-P0010. Red line denotes the application area.

2 Relevant Standards & Guidance

2.1 World Health Organisation (WHO) *Guidelines for Community Noise* 1999

The WHO drafted the Guidelines for Community Noise (1999) as a response to the need for action on community noise. The document is widely referenced throughout the industry as a benchmark in assessing acoustics for residential developments.

- For 'outdoor living areas', a daytime limit of $L_{Aeq,16hr}$ 55dB to safeguard against the likelihood of 'serious annoyance'. A second daytime limit of $L_{Aeq,16hr}$ 50dB is also given as a 'moderate annoyance' threshold.
- For 'internal living areas', a level of $\leq L_{Aeq,16hr}$ 35dB is desirable to maintain reasonable speech intelligibility indoors and prevent moderate annoyance during day and evening times.
- A night-time threshold value of $L_{Aeq,8hr}$ 30dB should not be exceeded *indoors* in the interest of preventing adverse effects of sleep. It follows that an internal level of $L_{Aeq,T}$ 30dB is equivalent to a façade level of $L_{Aeq,T}$ 45dB for continuous, steady noise (assuming a partially open window provides 15 dB's of reduction).
- When the background noise is low, single noise events exceeding 45dB L_{AFmax} inside bedrooms at night-time should be limited.

It should be noted that the WHO guideline values are not intended as noise limits. The WHO guideline values are evidence-based public health-oriented recommendations to serve as the basis for a policy-making process.

2.2 BS 8233:2014 guidance on sound insulation and noise reduction for buildings

This British Standard provides guidance for the control of noise in buildings, which includes guidance on hotels and rooms for long-term residential purposes. The Standard defines upper limits for internal ambient noise levels in habitable areas of a home; these values are outlined in Table 3.1. We consider that the guideline values defined in Table 3.1 should be applied to this project as a *design target*. BS 8233:2014 adds that where development is considered necessary or desirable, "*the internal target levels may be relaxed by up to 5dB and reasonable internal conditions be achieved*".

Activity	Location	07:00 – 23:00	23:00 – 07:00
Resting	Living Room	$L_{Aeq,16hr}$ 35dB	-
Dining	Dining Room	$L_{Aeq,16hr}$ 40dB	-
Sleeping	Bedroom	$L_{Aeq,16hr}$ 35dB	$L_{Aeq,8hr}$ 30dB

Table 2-1 BS 8233:2014 guidance on internal ambient noise levels in dwellings

BS 8233:2014 adds that where a development is considered necessary or desirable, *"the internal target levels may be relaxed by up to 5dB and reasonable internal conditions be achieved"*. This relaxation is also noted in the World Health Organisations' *Guidelines for Community Noise* (1999).

2.3 Project Ireland 2040: National Planning Framework (2018)

The National Planning Framework (2018) lists noise management as one of its Environment and Sustainability Goals for creating a clean environment for a healthy society. The Framework lists National Policy Objective 65 as follows,

"Promote the pro-active management of noise where it is likely to have significant adverse impacts on health and quality of life and support the aims of the Environmental Noise Regulations through national planning guidance and Noise Action Plans."

In addressing these issues, the National Planning Framework will support:

- **Noise Management and Action Planning**

Measures to avoid, mitigate, and minimise or promote the pro-active management of noise, where it is likely to have significant adverse impacts on health and quality of life, through strategic noise mapping, noise action plans and suitable planning conditions.

- **Noise, Amenity and Privacy**

This includes but is not limited to, good acoustic design in new developments, in particular residential development, through a variety of measures such as setbacks and separation between noise sources and receptors, good acoustic design of buildings, building orientation, layout, building materials and noise barriers and buffer zones between various uses and thoroughfares.

- **Quiet Areas**

The further enjoyment of natural resources, such as our green spaces, through the preservation of low sound levels or a reduction in undesirably high sound levels, is particularly important for providing respite from high levels of urban noise. As part of noise action plans, an extra value placed on these areas, in terms of environmental quality and the consequential positive impact on quality of life and health, due to low sound levels and the absence of noise, can assist in achieving this.

2.4 ProPG Planning & Noise (2017)

The Professional Guidance on Planning & Noise (ProPG) was developed to provide acoustic practitioners with guidance on a recommended approach to the management of noise within the planning system in the UK. ProPG has been widely adopted in Ireland in the absence of an Irish equivalent.

This ProPG encourages a systematic, proportionate, risk-based, 2-stage, approach. The approach encourages early consideration of noise issues, facilitates straightforward accelerated decision making for lower-risk sites and assists proper consideration of noise issues where the acoustic environment is challenging. The two sequential stages of the overall approach are:

I. Stage 1 – an initial noise risk assessment of the proposed development site; and
II. Stage 2 – a systematic consideration of four key elements.

The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

I. Element 1 – demonstrating a "Good Acoustic Design Process";
II. Element 2 – observing internal "Noise Level Guidelines";
III. Element 3 – undertaking an "External Amenity Area Noise Assessment";
IV. Element 4 – consideration of "Other Relevant Issues".

The approach is underpinned by preparing and delivering an "Acoustic Design Statement" (ADS). An ADS for a site assessed as high risk should be more detailed than for a site assessed as low risk. An ADS should not be necessary for a site assessed as negligible risk. Following the ProPG approach will lead to the choice of one of four possible recommendations from the noise practitioner to the decision maker:

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").

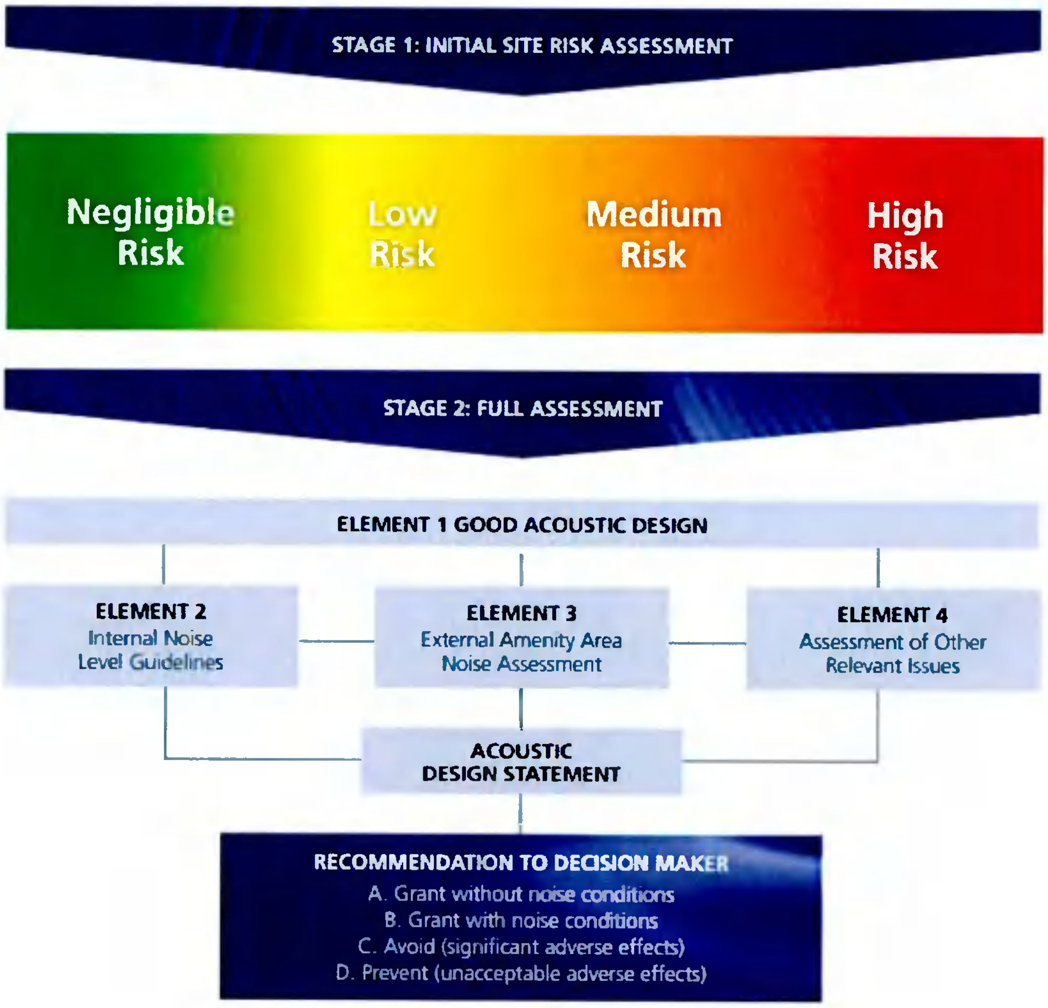

Figure 2-1 – Summary of ProPG procedure

3 Baseline Noise & Vibration Conditions

Baseline noise & vibration measurements were carried out by MLM Consulting (Sweco) in 2019. See Appendix A.

3.1 Noise

Figure 2 from the MLM Report is reproduced below as Figure 3-1. Two Noise Monitoring Positions are shown as NMP1 & NMP2.

Figure 3-1 Noise & Vibration Monitoring Locations

3.2 Vibration

According to MLM Consulting Engineers:

"Based on the measured values vibration impacts on the development from rail movements are not expected to have a negative effect".

Table 18: Summary of Vibration Measurement Results, VDV $ms^{-1.75}$				
Date	**Period**	**Axis**		
		X	**Y**	**Z**
Friday 11/10/19	Daytime (07:00 – 23:00)	0.021	0.021	0.037
	Night-time (23:00 - 07:00)	0.02	0.018	0.029
Saturday 12/10/19	Daytime (07:00 – 23:00)	0.025	0.021	0.038
	Night-time (23:00 - 07:00)	0.021	0.018	0.029
Sunday 13/10/19	Daytime (07:00 – 23:00)	0.024	0.022	0.039
	Night-time (23:00 – 07:00)	0.032	0.021	0.027
Monday 14/10/19	Daytime (07:00 – 23:00)	0.025	0.021	0.038
	Night-time (23:00 – 07:00)	0.026	0.018	0.025
Tuesday 15/10/19	Daytime (07:00 – 23:00)	0.038	0.022	0.036
	Night-time (23:00 – 07:00)	0.021	0.021	0.037

Table 3-1 Vibration measurement results

4 Noise Mapping

iAcoustics have undertaken desktop modelling using the CadnaA software package. Road and rail noise modelling was calculated in accordance with the CRTN[1] and CRN[2] methods, respectively. Road traffic data is provided in the Atkins Report. Input data from railway movements are unknown, however, predicted railway noise impacts are demonstrated on the EPA maps: https://gis.epa.ie/EPAMaps/. iAcoustics have also calibrated the noise maps against the data gathered in the MLM report.

Noise levels are presented as a horizontal grid at a specified height. We have given the predicted noise levels at 2m, 4m & 8m grid heights. The *façade levels* (receiver assumed as 1m from the façade) are also presented at specific points along the façade.

Figure Reference:	Map:
4-1	$L_{day}/L_{Aeq,16hr}$, Grid Height: 2m
4-2	L_{night}, Grid Height: 2m
4-3	$L_{day}/L_{Aeq,16hr}$, Grid Height: 4m
4-4	L_{night}, Grid Height: 4m
4-5	$L_{day}/L_{Aeq,16hr}$, Grid Height: 8m
4-6	L_{night}, Grid Height: 8m
4-7	Block A façade noise plot
4-8	Block C façade noise plot
4-9	Block D façade noise plot

[1] *Calculation of Road Traffic Noise. Department of Transport (UK). 1988.*
[2] *Calculation of Rail Noise. Department of Transport (UK). 1995.*

Figure 4-1 $L_{day}/L_{Aeq,16hr}$, Grid Height: 2m

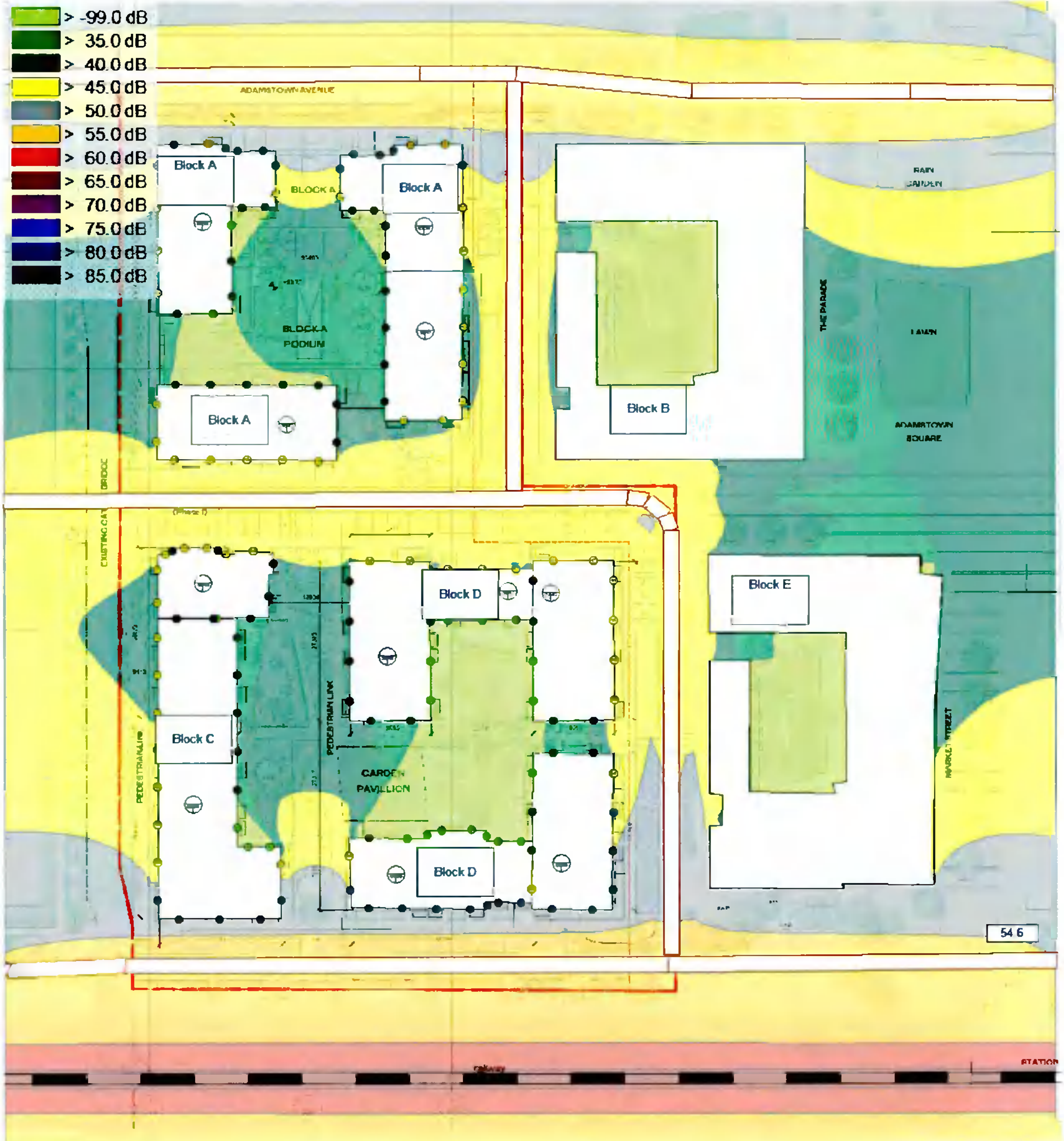

Figure 4-2 L_{night}, Grid Height: 2m

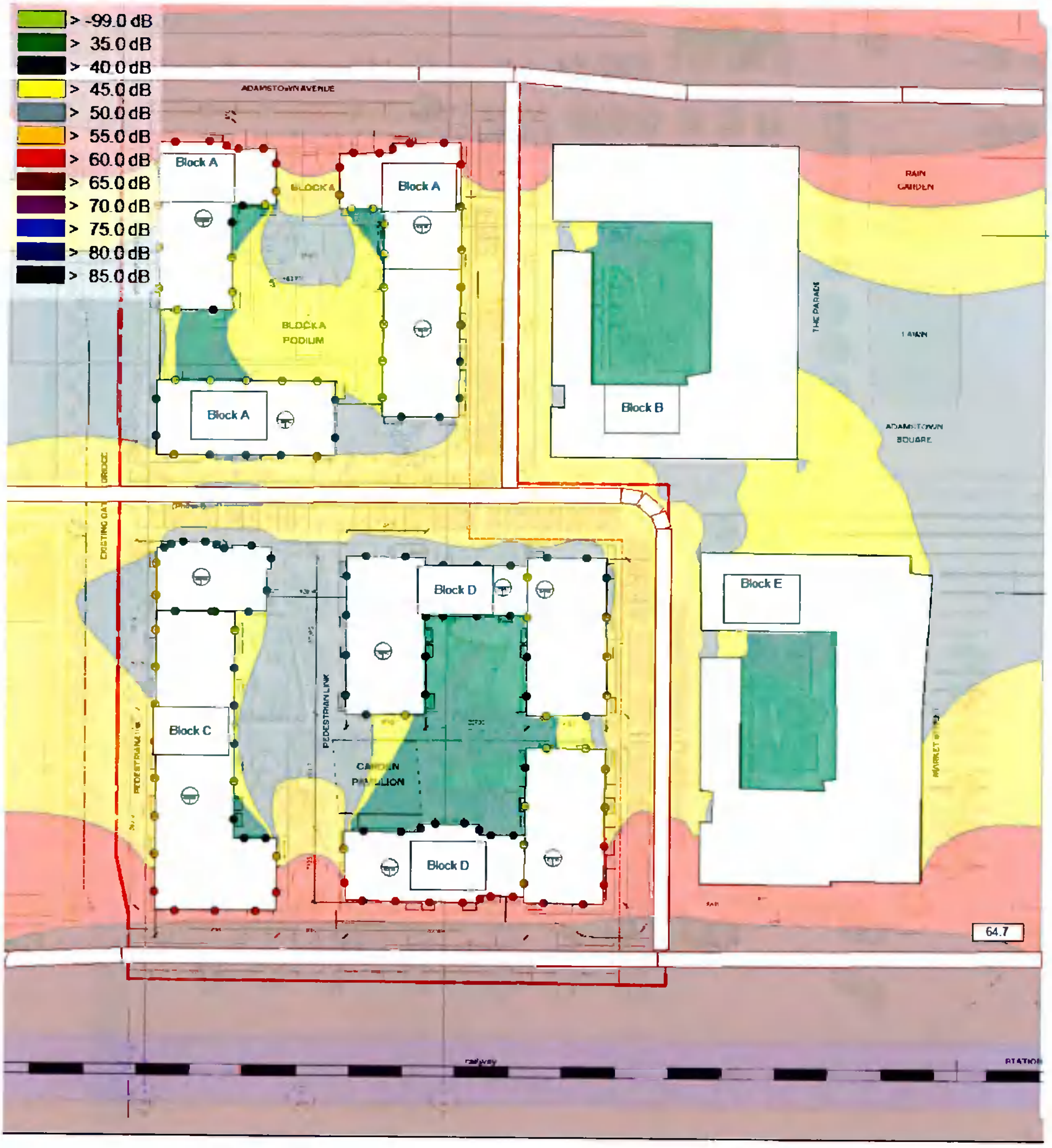

Figure 4-3 $L_{day}/L_{Aeq,16hr}$, Grid Height: 4m

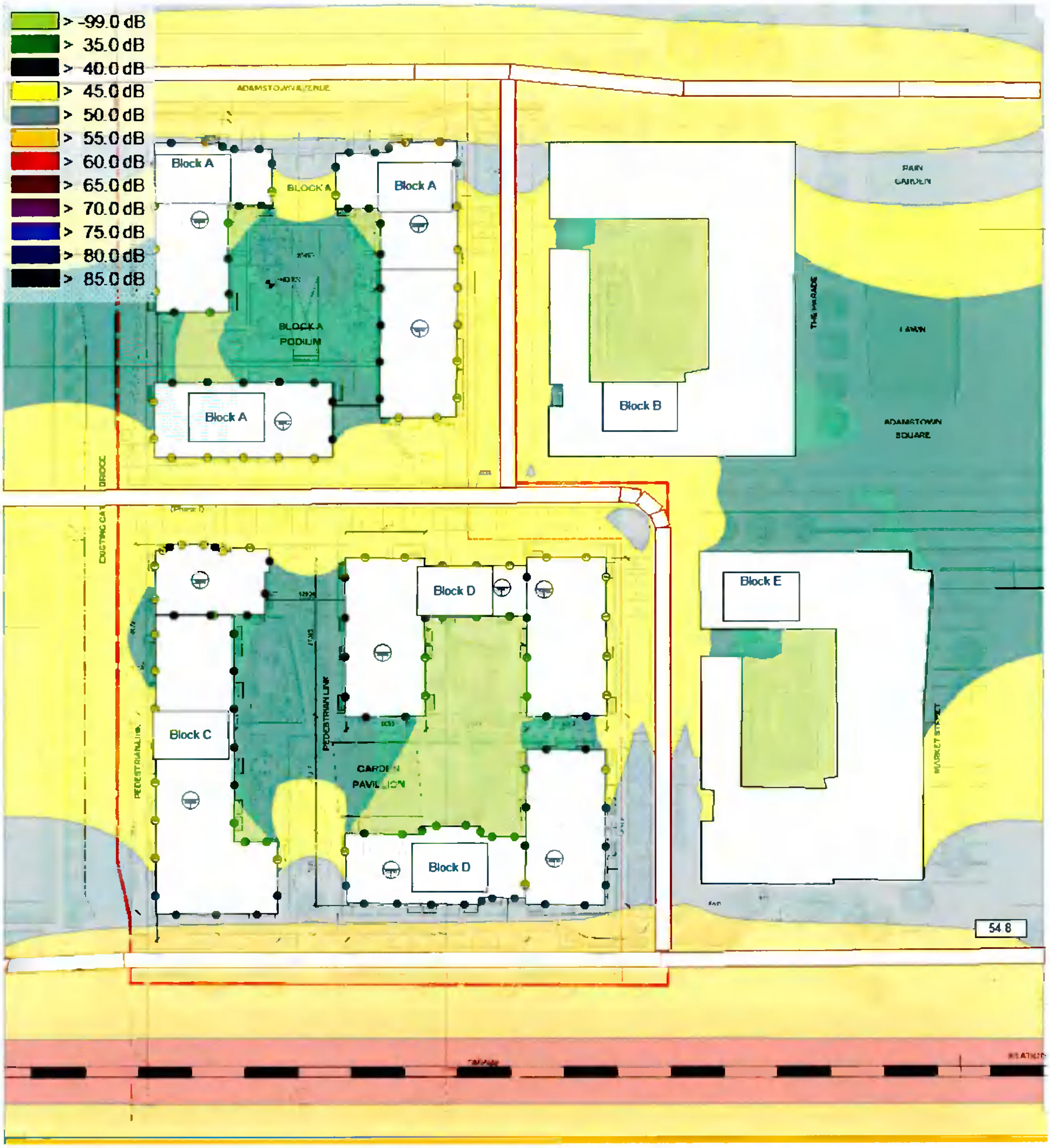

Figure 4-4 L_{night}, Grid Height: 4m

Figure 4-5 L_{day}/$L_{Aeq,16hr}$, Grid Height: 8m

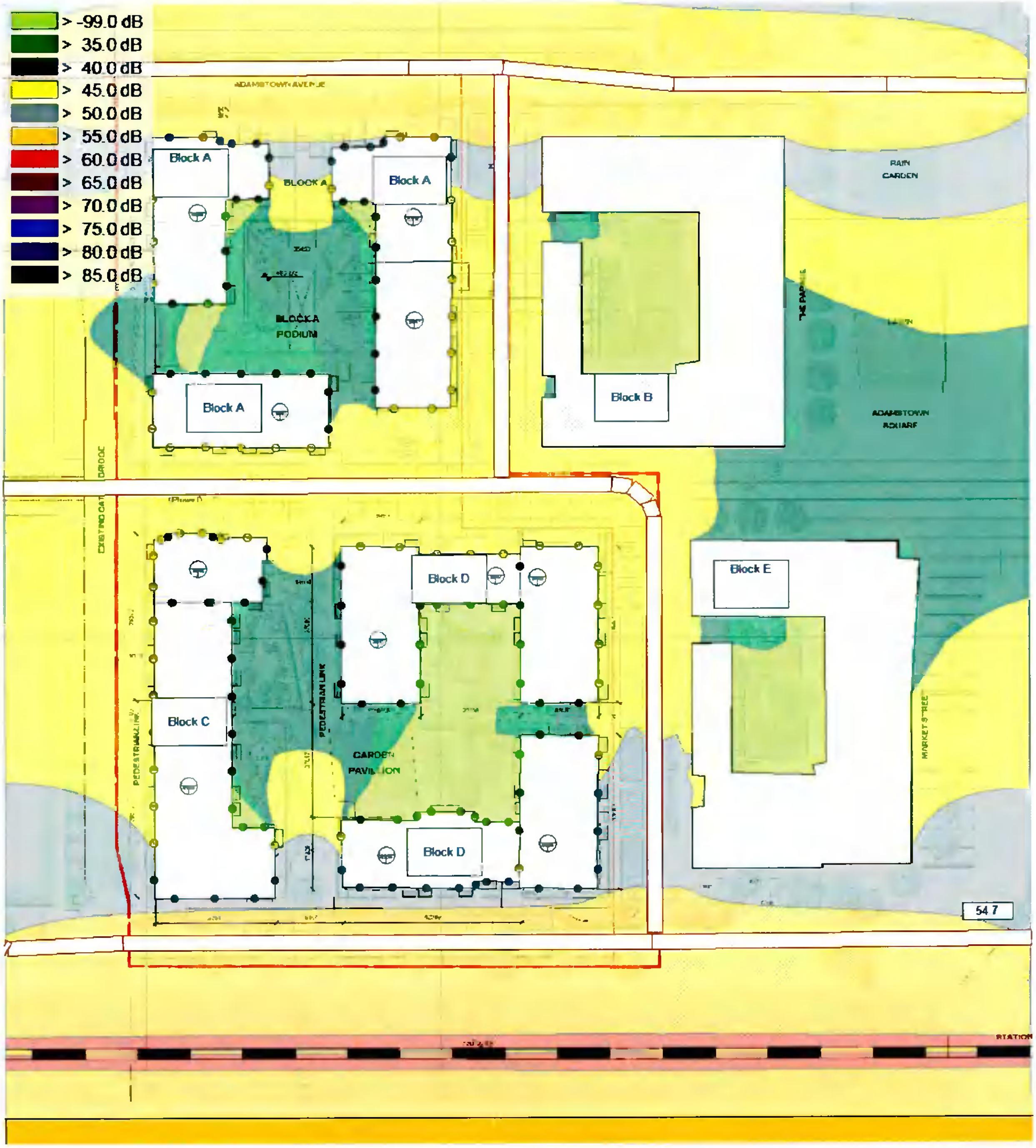

Figure 4-6 L_{night}, Grid Height: 8m

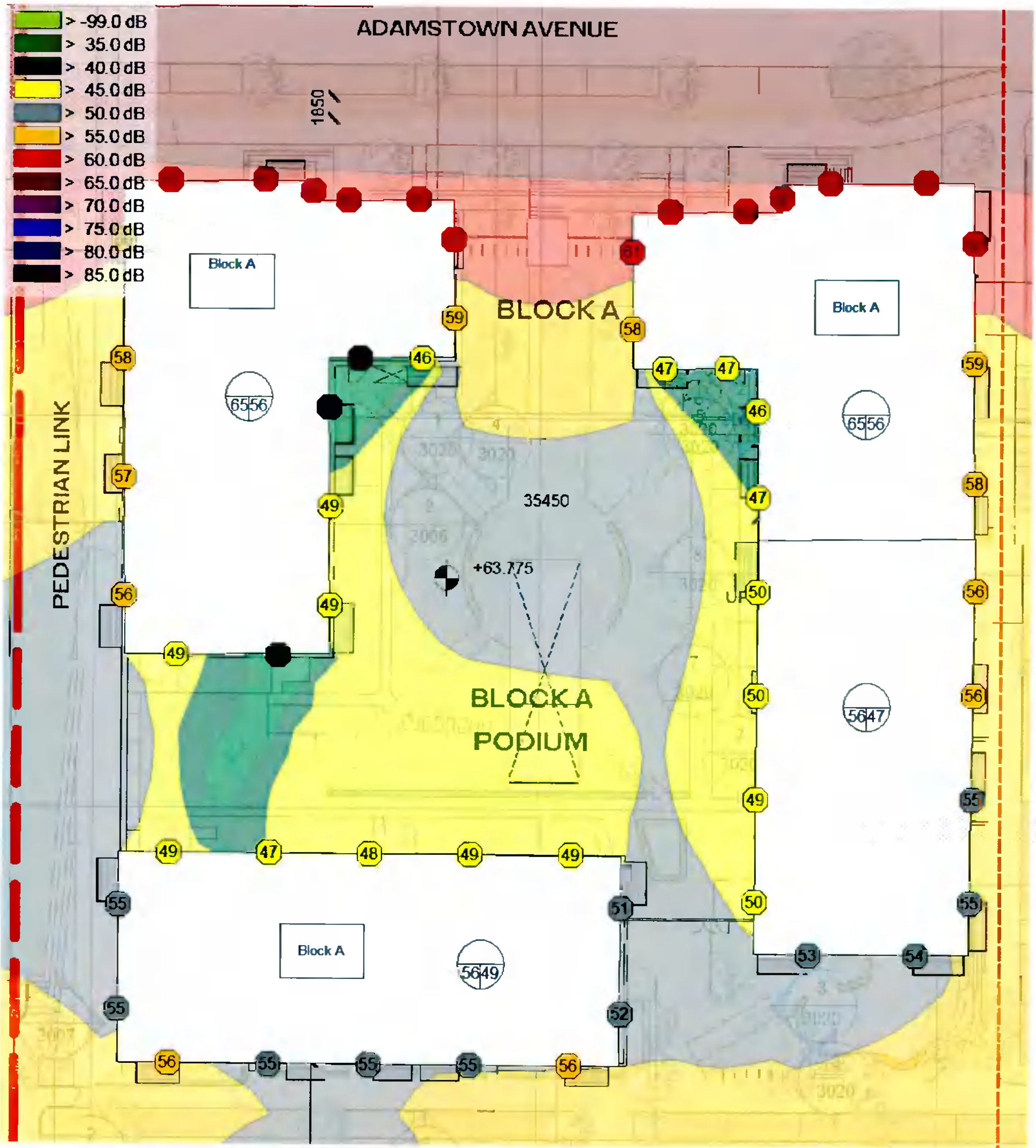

Figure 4-7 Block A façade noise plot

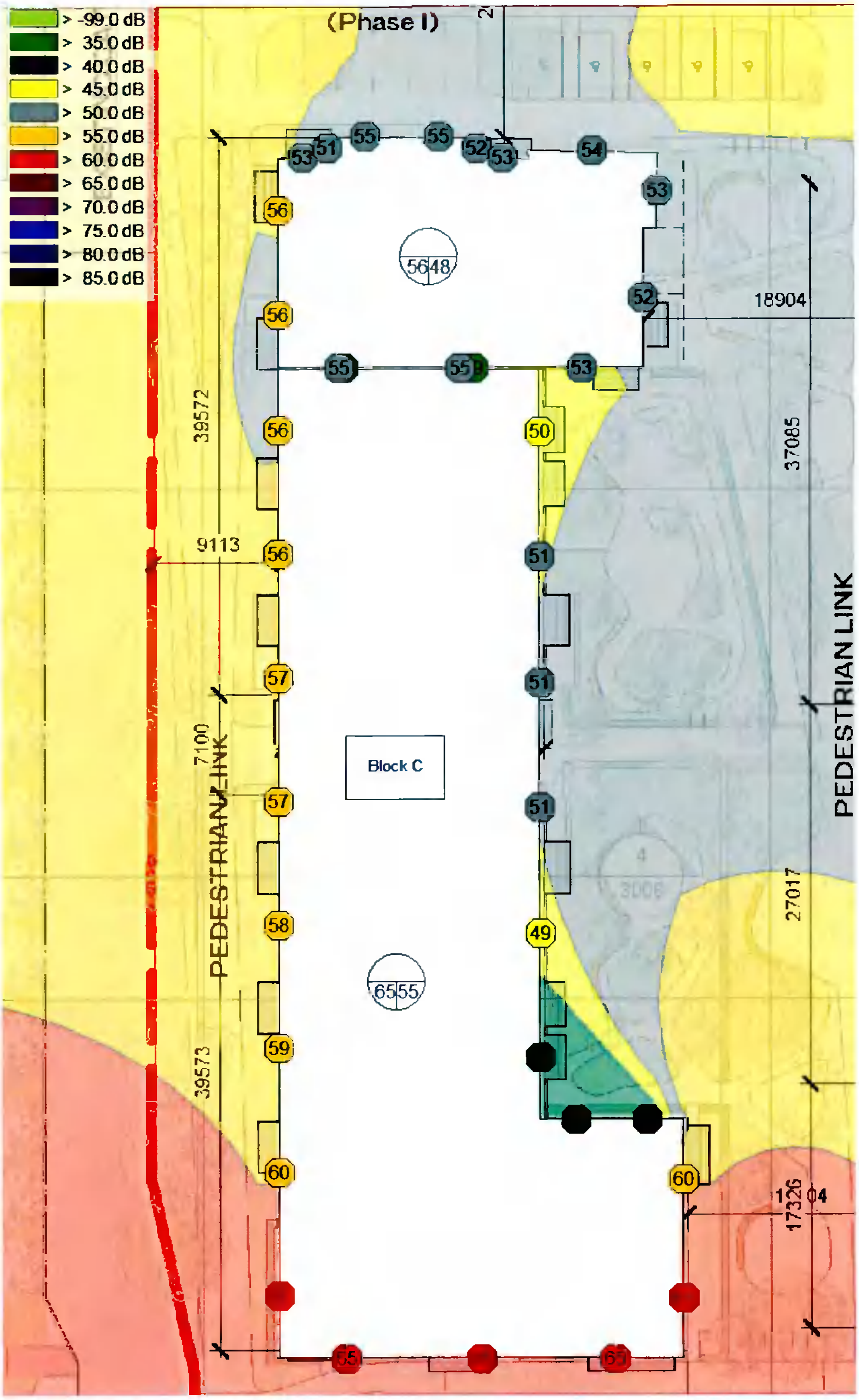

Figure 4-8 Block C façade noise plot

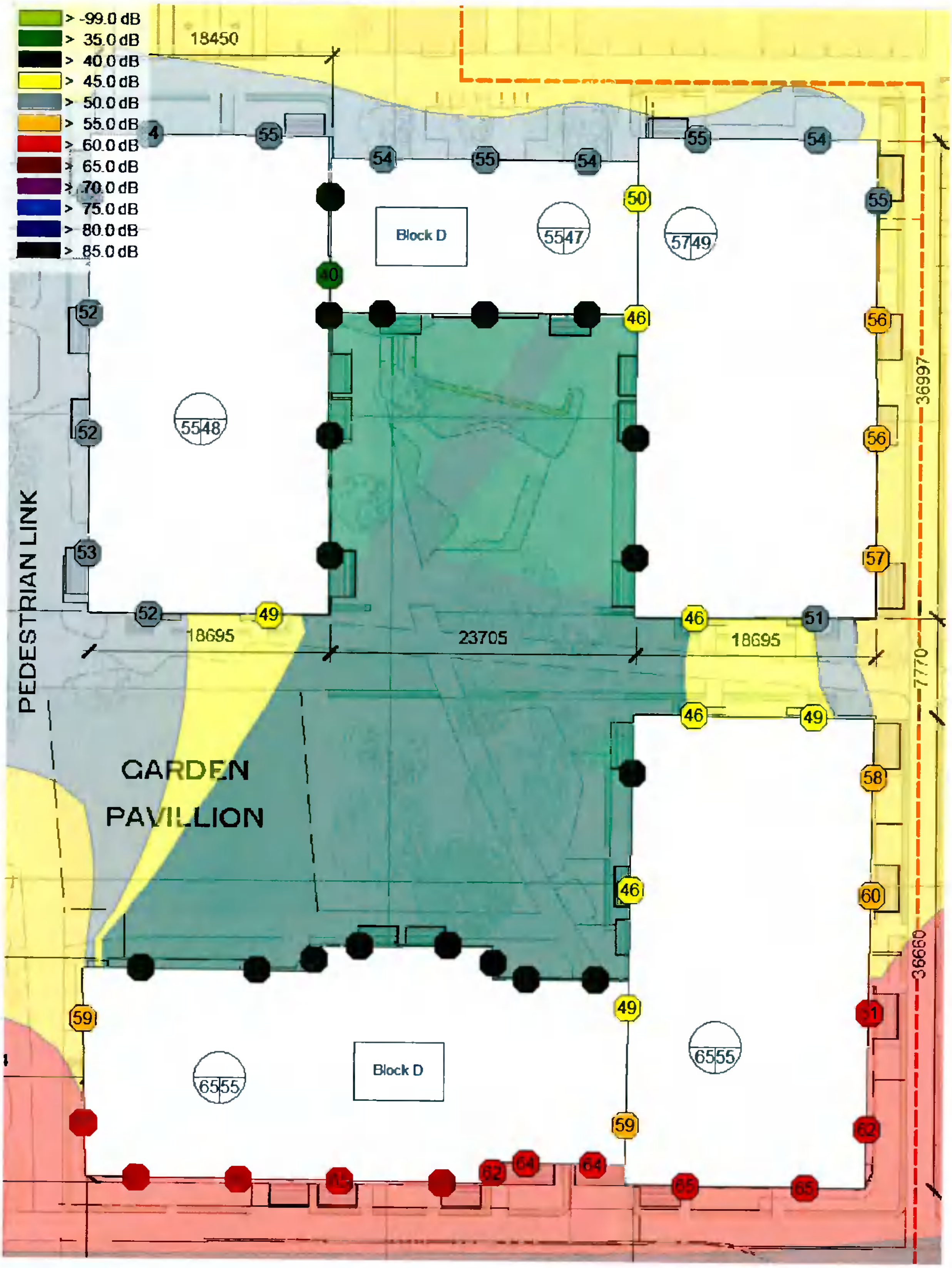

Figure 4-9 Block D façade noise plot

5 ProPG Assessment

5.1 Stage 1 – Initial Noise Risk Assessment

Figure 3-1 below summarises the *Stage 1 Initial Site Noise Risk Assessment* from Pro PG. The figure illustrates how an initial noise risk assessment is linked with an increased risk of adverse noise and broadly associated with indicative noise levels derived from current guidance and experience. The indicative noise levels are intended to provide a sense of the noise challenge at a potential residential development site and should be interpreted flexibly regarding the locality, the project and the broader context. In the final column, the initial noise risk assessment is aligned with pre-planning application guidance that highlights the increasing importance of good acoustic design as the noise risk increases. Based on the predicted noise levels across the subject site, the site is deemed **'medium-low'** risk according to the ProPG Stage 1 risk assessment.

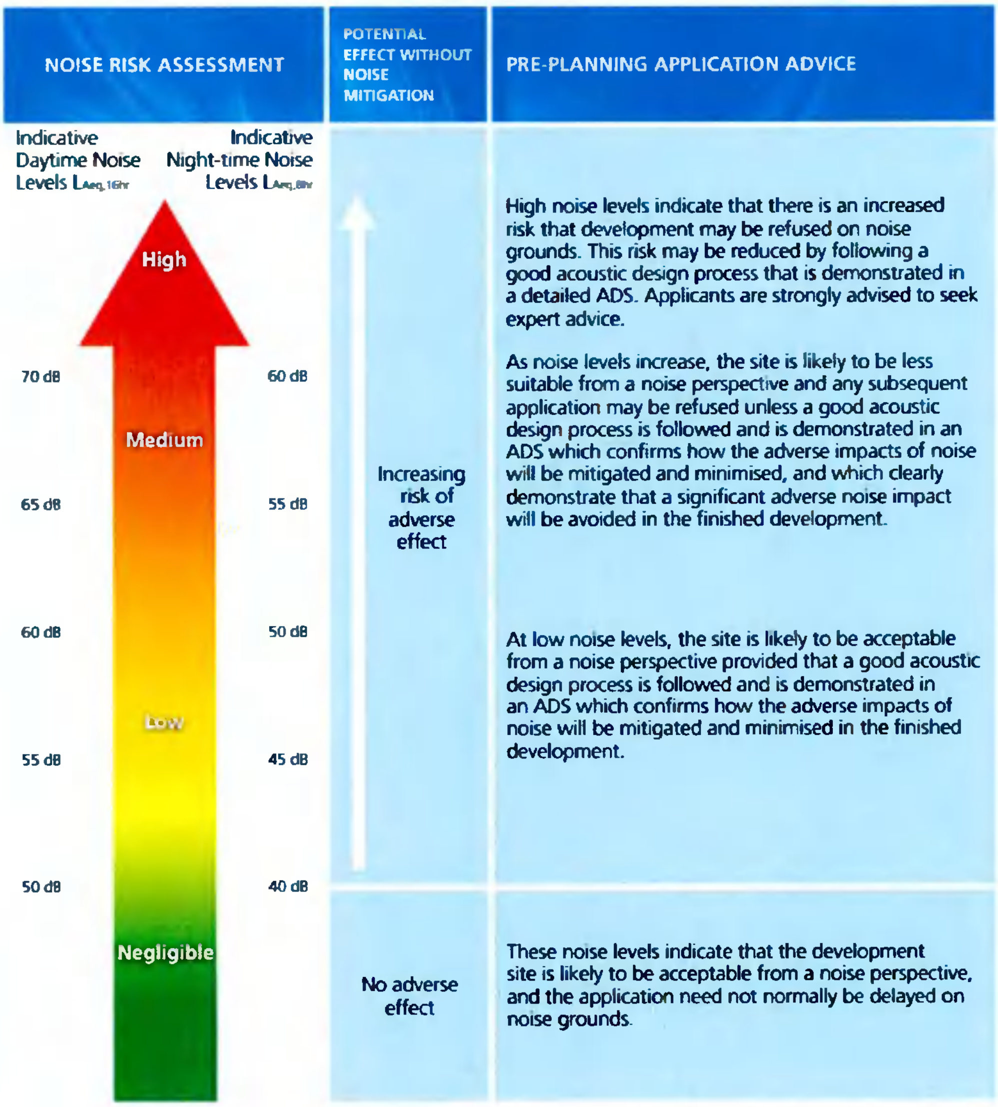

Figure 5-1 Stage 1 Initial Site Noise Risk Assessment from ProPG

The outcome of the ProPG Stage 1 noise risk assessment at a proposed residential development site is not the basis for the eventual recommendation to the decision-maker. A site considered to be high risk will be recognised as presenting more acoustic challenges than a site considered as low risk, with increasing risk indicating the increasing importance of good acoustic design.

5.2 Stage 2 – Four Key Elements of Acoustic Design

5.2.1 Element 1 – Good Acoustic Design Process

This element seeks to deliver Good acoustic design and should provide an integrated solution whereby the optimum acoustic outcome is achieved without design compromises that will adversely affect living conditions and the quality of life of the inhabitants or other sustainable design objectives and requirements. ProPG provides the following checklist:

1.	Check the feasibility of relocating or reducing noise levels from relevant sources.
Road traffic noise and rail is the dominant noise source impacting the development site. It is not possible to relocate or reduce this noise source. In the future, the electrification of the rail line will result in lower noise levels.	
2.	Consider options for planning the site or building layout.
There is limited scope to alter the building layout, given the size and shape of the site. In our opinion, the best practice would be to improve the sound insulation of the building façade (including glazed elements). This is dealt with in a later section.	
3.	Consider the orientation of the proposed building(s).
The current layout and arrangement of the Blocks creates central outdoor amenity areas that are shielded from road and rail noise sources which has an overall positive impact on acoustic conditions in the finished development.	
4.	Select construction types and methods for meeting building performance requirements.
The external façade of the building will be constructed as a twin leaf block cavity with internal plaster lining. This buildup will typically provide airborne sound insulation performances exceeding R_w 65dB, which will provide sufficient levels of 'soundproofing' even in a higher noise environment. The weakest elements of the façade will be the Glazing and any background ventilation elements. Section 4.2.2 of this report provides guidance on acoustic performance values for Glazing.	
5.	Examine the effects of noise control measures on ventilation, fire regulation, health and safety, cost, CDM (construction, design and management) etc.
The need to close windows to achieve reasonable acoustic conditions has no impact on the minimum ventilation requirements for dwellings. MVHR units will provide whole-house ventilation to dwellings. The use of laminated glass for acoustic purposes offers excellent noise reduction without compromising light transmittance or impact performance. The use of laminate glazing is not cost-prohibitive.	
6.	Assess the viability of alternative solutions.

The dominant noise source (road traffic & rail noise) is beyond the control of the designers.	
7.	Assess external amenity area noise.
Discussed further in section 4.2.3.	

5.2.2 Element 2 - Indoor Ambient Noise Levels

It is proposed that apartments will be fitted with Mechanical Ventilation & Heat Recovery (MVHR) systems to provide whole-house ventilation, meaning open windows are not required to provide background ventilation. Purge ventilation provisions may be relied on to improve thermal comfort or for the rapid dilution of outdoors and pollutants. It shall be assumed that the guideline acoustic values do not apply during periods of purge ventilation. The *Acoustics Ventilation & Overheating Residential Design Guide (2020)* states the following:

> *"It is considered reasonable to allow higher levels of internal ambient noise from transport sources when higher rates of ventilation are required in relation to the overheating condition. The basis for this is that the overheating condition occurs for only part of the time. During this period, occupants may accept a trade-off between acoustic and thermal conditions, given that they have some control over their environment. In other words, occupants may, at their own discretion, be more willing to accept higher short-term noise levels in order to achieve better thermal comfort. The importance of control is relevant to daytime exposure, but not to night-time exposure where the consideration is sleep disturbance. It is important to note that there is no specific research available to support this view regarding human response to combined exposure to heat and noise. However, the notion that control over one's environment moderates the response to exposure is well established in the field of thermal comfort, and underpins the adaptive thermal comfort model."*

Single noise events (assessed in terms of L_{AFMax} dB) is an essential consideration for the acoustic design of residential development. Given that windows can be kept closed at night-time with MVHR, the likelihood of adverse impacts due to a single noise event during night-time hours is low. Provided the acoustic performance values of the glazing system is met, we are satisfied that single-noise events (such as a passing car) will not exceed the WHO criteria of any more than ten events exceeding L_{AFMax} 45dB during the night with windows closed.

The solid elements of the building façade will be constructed as cavity blocks with an internal plaster lining. This buildup can provide high levels of sound insulation performance, even in high noise environments. The acoustic performance of the façade is dictated by weaker elements such as Glazing and the window frame. We propose an acoustic specification for Glazing throughout the development to achieve reasonable indoor noise levels when windows are closed and comply with the relevant guide values outlined in section 2. 3no. Glazing types are proposed in section 6.1.

5.2.3 Element 3 - External Amenity Spaces

For external areas that are used for amenity space, such as gardens and patios, the external noise level should not exceed 50 dB $L_{Aeq,16hr}$ with an upper guideline value of 55 dB $L_{Aeq,16hr}$. The guide values are taken from the W.H.O document *Guidelines for Community Noise (1999)*; these guide values are also cited in BS 8233:2014 and ProPG (2017).

Noise predictions show that all residents residing in Blocks A, C & D will have access to amenity spaces which achieves levels below the lower 50 dB $L_{Aeq,16hr}$ guide value. The layout and orientation of the blocks across the development site creates a central amenity area that is shielded from road and rail noise sources.

It is predicted that noise levels will exceed 55 dB $L_{Aeq,16hr}$ on private balconies at the southern facades of Blocks C & D due to their orientation and proximity to road and rail sources. We note that these relatively higher noise levels will only affect a limited number of dwellings which should be considered in the context of the development at large; the majority of private balconies across the site will experience acceptable noise levels.

With regard to those private balconies that will experience relatively high noise exposure levels, ProPG(2017) states:

> *"Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially off-set if the residents are provided, through the design of the development or the planning process, with access to:*
>
> - *A relatively quiet alternative or additional external amenity space for sole use by a household, (e.g. a garden, roof garden or large open balcony in a different, protected, location); and/or*
> - *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."*

Following the relevant guidance, the noise impacts experienced at 'noiser' facades will be offset by the fact that residents will have access to a relatively quiet nearby central garden/amenity space. 'Relatively quiet' means that the area has a predicted noise exposure level below 50 dB $L_{Aeq,16hr}$ from transportation sources.

It is relevant to note the following passage from BS 8233:2014 *guidance on sound insulation and noise reduction for buildings* relating to the guide values for outdoor amenity spaces:

> *"it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."*

5.2.4 Element 4 – Assessment of Other Relevant Issues

1.	Compliance with relevant national and local policy.

Currently, Ireland does not have any national or local policies specific to the acoustic design of residential dwellings. Part-E of the Building Regulations 2014 aims to provide "reasonable sound insulation between dwellings", but it does not address external noise entering a dwelling and therefore is beyond the scope of this report.

This ADS has been prepared in accordance with ProPG (2017) where relevant noise mitigation measures have been proposed to minimise the harmful effects of noise on future inhabitants, considering both internal and external noise.

5.3 Recommendation to Decision Maker

As described in section 2.5, following the ProPG approach will lead to the choice of one of four possible recommendations from the noise practitioner to the decision-maker:

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").

iAcoustics considers that,

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

Where the ProPG Stage 2 guidance has been followed and where the submitted development proposal is supported by an ADS that adequately demonstrates good acoustic design, then it should be possible for the noise practitioner to recommend that planning consent may be granted without the need for additional noise conditions.

5.4 Operational-Phase Impacts

During the operational phase of the development, there is a very low potential for adverse noise impacts to the surrounding environment. Typical noise sources for the residential aspect of this development will include vehicular movements, children playing etc. However, it is expected that these noise sources would not be above and beyond those noises which form part of the environment at the development location.

Noise levels from all mechanical plant servicing Blocks A, C & D should not exceed the values set out in Table 5-1 below.

Period	Noise Emission Limit Value
Daytime (07:00 to 19:00hrs)	55 dB $L_{Ar,T}$

Evening (19:00 to 23:00hrs)	50 dB $L_{Ar,T}$
Night-time (23:00 to 07:00hrs)	45 dB $L_{Aeq,T}$ & no tonality
Note: $L_{Ar,T}$ is the rating level as defined in BS 4142:2014.	

Table 5-1

The plant noise criteria are based on the limit values provided in the Environmental Protection Agency document - *Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4), 2016*. These limits values are widely used in the imposition of planning conditions by local authorities. At the design stage of this development, a detailed desktop assessment must be carried out by a suitably qualified acoustician to ensure that any proposed plant does not exceed the levels in Table 5-1.

6 Recommendations

6.1 Glazing

To protect residents from rail and road traffic noise impacts, the following *minimum* performance levels should be achieved. We propose 3no. glazing types, with a more onerous glazing specification required for facades that are more exposed to noise. The proposed performance levels have been deemed suitable following the calculation procedure described in BS 8233:2014 *guidance on sound insulation and noise reduction for buildings*. Refer To Appendix B for detailed calculation datasheets. Appendix C presents elevation markups showing the locations where each glazing type is proposed.

Octave Band, Hz:	125	250	500	1000	2000	4000	R_w	$R_w + C_{tr}$
Glazing Type 1 (façade levels between L_{day} 60-65 dB):	25	27	38	48	47	55	41	35
Example:	6mm/16mm Argon-filled cavity/8.8mm *Pilkington Optiphon Laminated*							
Glazing Type 2 (façade levels between L_{day} 55-60 dB):	24	24	32	37	37	44	35	32
Example:	10mm / 6-16mm cavity / 6mm							
Glazing Type 3 (façade levels ≤ L_{day} 55 dB):	20	21	33	40	36	48	35	32
Example:	10mm / 6-16mm cavity / 6mm							

Table 6-1 Table showing the minimum acoustic performance requirements for Glazing throughout the development. The values are quoted in terms of the Sound Reduction Index (SRI) in dB from 125Hz – 4kHz.

6.2 Window Frames & Ventilation Elements

It should be assumed that the acoustic performance values of the Glazing are inclusive of the window frame. uPVC frames offer little sound insulation performance, meaning they can detract from the overall performance of the window system. An acoustic assessment shall be completed at the design stage to ensure that the overall window system meets the minimum requirements in section 6. Ventilation elements (where specified) shall be selected so as to avoid any compromise to the overall glazing performance levels.

7 Conclusions

I. **Indoor noise levels:** Acceptable indoor levels can be achieved when windows are closed by meeting the minimum performances set out in Section 6 of this report. MVHR systems will provide ventilation and thermal confort, meaning that windows can remain closed (except for purge ventilation at the occupants' choice).

II. **Outdoor noise levels:** The noise levels for external amenity spaces (communal gardens, patios etc.) at the subject site are predicted to comply with the 50 & 55 dB $L_{Aeq,16hr}$ guide values proposed by the W.H.O. We see no significant constraints as regards noise levels in external amenity areas.

III. **Outward noise impacts:** The development is not expected to have any adverse impact on surrounding noise-sensitive locations. Residential development, by its nature, does not produce significant amounts of noise. Noise from the mechanical plant will be controlled through the imposition of noise limits at nearby noise-sensitive locations, and all mechanical plants shall be selected and designed to meet this criterion.

Appendix A – MLM Report

Quintain Developments Ireland Ltd
Adamstown District Centre – Phase 1

Phase 1 – Noise and Vibration Assessment Rev 05

MLM.
Group
Part of Sweco

Notice

This document and its contents have been prepared and intended solely for Quintain Developments Ireland Ltd information and use in relation to Adamstown District Centre Phase 1.

MLM Consulting Engineers Limited assumes no responsibility to any other party in respect of or arising out of or in connection with this document and/or its contents.

Certifying Body

MLM are full members of the ANC:

ANC | ACOUSTICS & NOISE CONSULTANTS

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00	I	Phase 1 – Inward Impact Assessment	Dominic Parkinson	Sam Laws	19/11/19
01	I	Phase 1 – Inward Impact Assessment	Dominic Parkinson	Sam Laws	18/02/20
02	I	Phase 1 – Inward Impact Assessment	Dominic Parkinson	Sam Laws	12/02/20
03	I	Phase 1 – Inward Impact Assessment	Dominic Parkinson	Sam Laws	23/03/20
04	I	Phase 1 – Inward Impact Assessment	Dominic Parkinson	Sam Laws	03/04/20
05	I	Phase 1 – Inward Impact Assessment	Dominic Parkinson	Sam Laws	06/04/20

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Appendix A - Glossary of Acoustic Terminology

Appendix B - Policy, Standards and Guidance

Appendix C - Environmental Noise Survey

Appendix D - Noise Maps

Appendix E - Façade Mitigation

1 Introduction

MLM Consulting Engineers Ltd has been commissioned by Quintain Developments Ireland Ltd to assess the impact of noise and vibration in support of a planning application for a proposed mixed-use development at lands north of Adamstown Station, Co. Dublin.

This report presents the results of the inward noise and vibration impact assessment of the site. Impact of noise and vibration sources namely traffic, rail and aircraft on the site have been assessed. In addition impact from the development itself such as plant, service yards and car parking noise have been reviewed. Our assessment has been undertaken based on the principles of Professional Practice Guidance (ProPG) – Planning & Noise.

The assessment is based on a detailed environmental noise and vibration survey undertaken on the Site. A summary of the noise and vibration survey is given in Section 5. A noise model validated at the monitoring positions has been used to predict the noise levels across the site and to inform the subsequent assessment in general accordance with ProPG Stage 2. Predicted future traffic data have also been considered in the assessment.

The report assess the predicted noise levels across the site and provide outline advice on good acoustic design options to achieve suitable ambient noise levels within habitable rooms and at external amenity areas.

Whilst every effort has been made to ensure that this report is easily understood, it is technical in nature; a glossary of terms is included in Appendix A to assist the reader.

Details of the Policy, Standards and Guidance used to inform this noise impact assessment are presented in Appendix B.

Full survey methodology and results are presented in Appendix C.

The following noise maps are also presented in Appendix D.

- Figure D.1: Noise Map due to Rail and Road Impacts – Daytime,
- Figure D.2: Noise Map due to Rail and Road Impacts – Night-time,
- Figure D.3: Noise Map due to Rail L_{Amax} Impacts – Night-time
- Figure D.4: Daytime BS8233 external amenity constraints.

Appendix E details our proposed Outline Façade Mitigation Measures.

2 Policy, Standards and Guidance Documents

A summary of the relevant policy, standards and guidance documents used to inform the noise impact assessment of the scheme is provided below. Further details are provided in Appendix B.

- British Standard BS 8233:2014;
- ProPG Professional Practice Guidance on Planning & Noise;
- British Standard BS 4142:2014;
- British Standard BS 6472-1:2008.

3 Consultation and Assessment Criteria

3.1 Consultation with the Local Authority

The Environmental Health Office for South Dublin was consulted by email on 9 October 2019. An outline of their general requirements were received Kieran Groarke, Environmental Health Officer. Reference is made to BS 41442 as detailed in Appendix B, in addition the following statement shall be achieved

Noise use Criteria

Noise due to the normal operation of the proposed development, expressed as Laeq over 15 minutes at the façade of a noise sensitive location, shall not exceed the daytime background level by more than 10 dB(A) and shall not exceed the background level for evening and night time. Clearly audible and impulsive tones at noise sensitive locations during evening and night shall be avoided irrespective of the noise level.

Although this assessment is primarily concerned with the impacts on the site and the mitigation of these, recommendation have been given in order to control the outward noise and vibration impacts at the nearest noise sensitive locations.

3.2 Noise Assessment Criteria

As advised in ProPG: Planning and Noise, the following noise level criteria defined within Table 1 have been adopted for this assessment, which would be expected to result in no adverse impact

Table 1: Noise Levels Criteria

Location	07:00 to 23:00	23:00 to 07:00
Living room	35 dB L_{Aeq}	-
Dining room	40 dB L_{Aeq}	-
Bedroom	35 dB L_{Aeq}	30 dB L_{Aeq} and, ≤10 events > 45 dB L_{Amax}
External Living Areas	50 dB L_{Aeq}	-

It should be noted that BS 8233 advises in Section 7.7.2 Note 7 that '*Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved*'.

4 Site Description and Development Proposals

4.1 Site Description

The site is located immediately north of the Adamstown Railway Station with existing residential building located to northern and eastern boundaries. To the north west of the site residential units are currently under construction. Further north of the site lies Weston Airport which serves mainly executive and light aircraft.

Figure 1 Site Location

4.2 Proposed Development

The proposed development comprises the construction of Phase 1 of the Adamstown District Centre. The proposed development provides for a mixed use commercial and residential development to be constructed in buildings ranging in height from 4 - 9 storeys arranged in three urban blocks on a site area of c.3.77ha in total.

The commercial element of the development consists of 1 no. supermarket unit, plus 20no. retail/café/restaurant units comprising of an overall total of c.9,653m2 of net floor space.

The residential element of the proposal comprises the provision of a total of 278 residential units, consisting of 16no. studio units, 66no. 1-bedroom units, 151no. 2-bedroom units and 45no. 3-bedroom units in a mix of apartments and duplexes.

A total of c.16,000 m² public realm space is to be provided, including significant civic spaces at the heart of the District Centre.

534no. car parking spaces to be provided through on-street parking, podium parking under Block B & E and in the proposed multi storey car park in the upper levels of Block F to cater for both residential and commercial demand. 2 no. bus bays are provided to the north and south of Station Road in the vicinity of Adamstown Station. 8no taxi/set down spaces are provided, 6no on Station Road and 2no. south of Block B. In addition, the removal of 2no. car parking spaces along Adamstown Avenue currently serving the Alderlie development for provision of a bus set down area.

A total of 702no cycle parking spaces (provided as 271no double stands in Block B and E and 80 no.

Sheffield stands in the public space) are provided throughout the development, to cater for both residential and commercial demand. The 50no. Sheffield stands at Adamstown Station are to be retained.

The development also includes the provision of temporary landscaping, temporary site hoarding and fencing and all ancillary site development and landscape works, including adjustments to Station Road.

5 Baseline Sound and Vibration Conditions

5.1 Survey Overview

The prevailing noise and vibration conditions in the area have been determined by an environmental survey. Measurements were conducted between Friday 11 and Tuesday 15 October 2019.

Full details of the survey, including survey methodology, equipment used, survey results and time history graphs are provided in Appendix C. However, for summary purposes, a brief description of the noise climate and relevant noise levels measured is provided in Figure 2 below

Figure 2. Site Plan Showing Noise and Vibration Measurement Locations

5.2 Local Noise Conditions

Whilst on site the noise climate was noted as being dominated by rail and local road movements. In addition noise from light aircraft and construction traffic was also noted

5.3 Local Vibration Conditions

Whilst on site vibration from rail or road traffic movements were subjectively imperceptible

6 Predicted Noise Levels at Building Facades

6.1 Noise Sources Impacting on the Site

Prediction of the likely noise levels at the facades of the development buildings has been undertaken. The noise sources incident on the development have been identified as follows:

- Rail noise
- Road noise
- Noise from Service Yard Activities (from Plot F)
- Potential noise levels from restaurant/bar areas (from the development itself)
- Noise levels from car parking movements

6.2 Road and Rail Noise Sources – Noise Modelling Approach

The likely effect of road and rail noise sources in the vicinity of the site has been predicted using the Cadna/A suite of noise modelling software, to determine the likely noise levels at the facades of the development and in the amenity areas. This software utilises standard acoustic principles in conjunction with approved prediction methodologies and is a tried and tested method for accurately predicting and assessing the impact of noise from a variety of sources.

In addition to the source noise levels used in the predictions, the model also considers the effects of the topographical conditions throughout the area, ground absorption, acoustic reflections and acoustic screening.

The noise model was validated to ensure that the levels predicted at the site boundary were an accurate reflection of real world measured noise levels at all measurement positions, both at daytime and night-time periods. Future traffic data for the roads within and surrounding the development have been used to predict the noise levels at the Site, using the CRTN prediction.

6.2.1 Road Traffic Data Assumptions

The noise predictions in this Assessment are based on the following AADT traffic data supplied by Atkins traffic consultants:

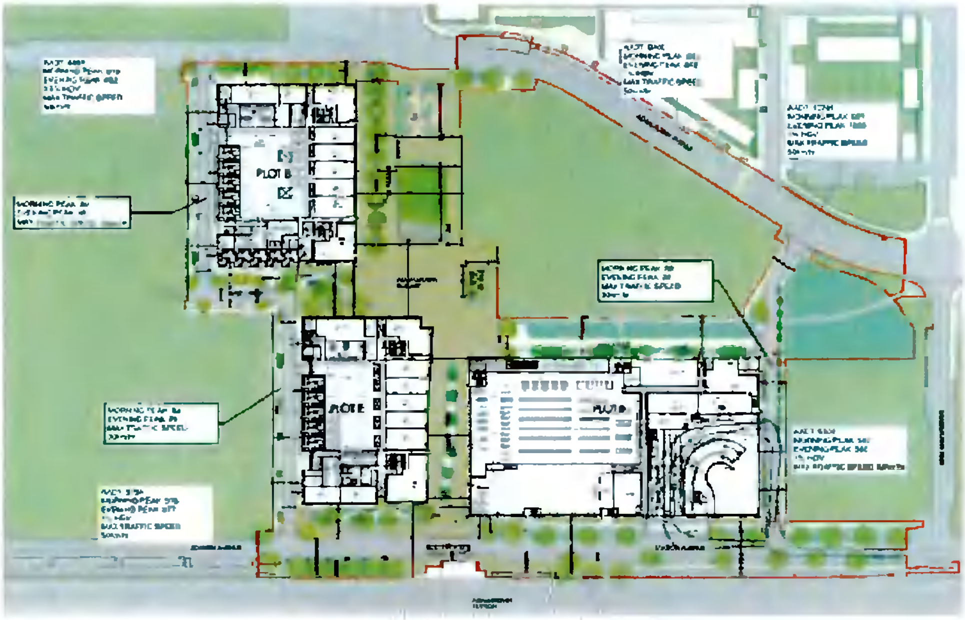


Figure 3: Traffic Data

It is understood that for internal roads an AADT of 375 is expected at a speed of 30km/h.

6.2.2 Rail Data Assumptions

For future rail movements it is understood that National Development Plan 2018-2027 sets out a proposal to provide, fast, high-frequency electrified services to Celbridge/Hazelhatch on the Kildare Line, expected completion Date of 2027. This service will run via Adamstown Station. The exact locations of the line and information of the trains serving line is unknown. It is expected however, that noise levels from the electric trains will be lower than that of the existing diesel passenger and freight trains currently utilizing the line.

Rail movements were predicted by using a combination of the measured noise data at each unattended location, the unmanned noise samples of rail movements measured at ANMP1 and the modelled noise levels.

6.2.3 Predicted Road & Rail Noise Levels

The figures in Appendix D of this report graphically present the propagation of noise across the site for both daytime and night-time periods. In addition, the predicted night-time L_{Amax} noise levels have been determined.

The Tables below present the maximum noise levels predicted at each building façade within Phase 1.

Table 2: Predicted Road and Rail Noise Levels at Plot B

Facade	Daytime L_{Aeq} 07:00 to 23:00	Night-time L_{Aeq} 23:00 to 07:00	Night-time L_{Amax} 23:00 to 07:00
North Residential	66	61	70
South Residential	58	50	70
East Residential	60	54	70
West Residential	58	50	70
Courtyard Residential	48	43	70
Retail (Ground Floor)	66	N/A	N/A

Table 3: Predicted Road and Rail Noise Levels at Plot E

Facade	Daytime L_{Aeq} 07:00 to 23:00	Night-time L_{Aeq} 23:00 to 07:00	Night-time L_{Amax} 23:00 to 07:00
North Residential	58	49	70
South Residential	65	59	76
East Residential	60	52	72
West Residential	59	53	70
Courtyard Residential	50	43	70
Retail (Ground Floor)	65	N/A	N/A

Table 4: Predicted Road and Rail Noise Levels at Plot F

Facade	Daytime L_{Aeq} 07:00 to 23:00
Retail	66

6.3 Predicted Noise from Service Yard Activities (from Plot F)

The main service yard areas to Plot F is located within the envelope of the building at ground floor level. Due to the enclosed nature of the service yard and loading dock HGV movements are considered to be the dominant source of noise. The Plot highlighted in red in the figure below is the nearest residential Plot G2 which is proposed for Phase 2 of the works.

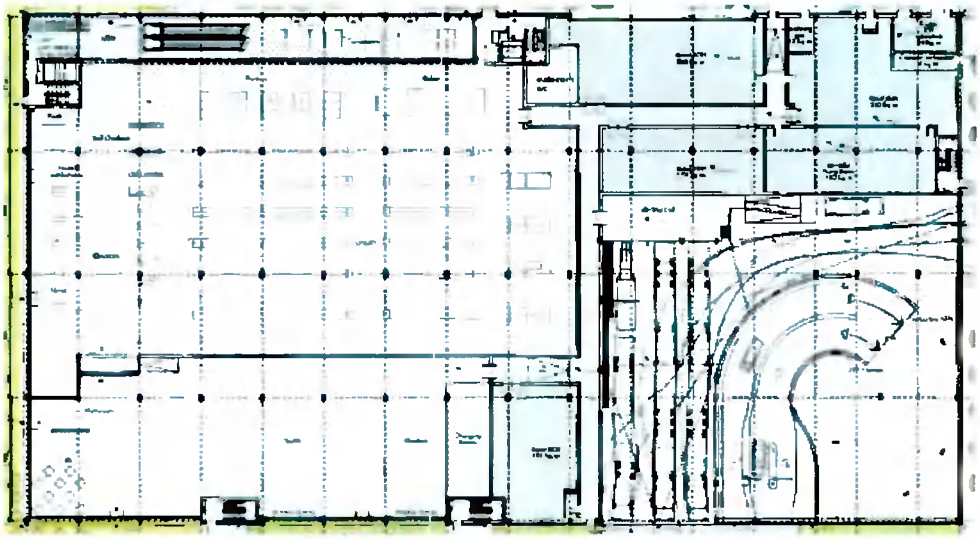


Figure 4: Plot F – Service Yard

Prediction calculations of the likely noise levels at Plot G2 façade have been undertaken based on the noise levels presented in Table 5 and assumptions:

- Deliveries will only be undertaken during daytime hours
- A maximum of 2 HGV's will access the site in any given daytime hour
- Distance loss will be insignificant

Table 5: Service Yard Noise Levels

Description	Duration	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Typical Levels (Leq) measured at 5m from an HGV Delivery	5 min	82	69	65	65	64	61	59	54	69

The predicted noise levels at the apartments of G2 are presented below

Table 6: Predicted Noise Levels at G2 Residential Facade

Description	Duration	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Predicted Noise Level at G2	1 hour	74	61	57	57	56	53	51	46	61

6.4 Noise levels from Restaurant/bar areas (from the development itself)

Within residential Plots B and E F&B units are proposed at ground floor level. Prediction calculations have been undertaken to determine the likely noise levels at the nearest apartment on the first floor due noise transfer via the façade of the Bar or Restaurant.

Calculations have been undertaken based on the following.

Noise levels within the bar/restaurant will as per Table 7 below
High levels of music will not be played
The façade of the bar/restaurant will meet the Sound Reduction Indices given in Table 8
Typical bar/restaurant façade will be 19 m x 4 m 100% glazed
Distance loss -7dB
Screening loss -5dB (by the building itself)

Table 7: Typical Bar/Restaurant Noise Levels

Description	Duration	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Typical Levels (Leq) measured at 5m from an HGV Delivery	5 min	82	69	65	65	64	61	59	54	69

Table 8: Bar/Restaurant Façade Sound Insulation Requirements

Description	Sound Reduction Indices (dB) at Octave Band Centre Frequencies (Hz)								Rw
	63	125	250	500	1k	2k	4k	8k	
Assumed Glazing	23	27	29	36	41	42	52	52	39

The predicted noise levels via the glazed façade of the bar/restaurant at the above apartment's windows are given below.

Table 9: Predicted Noise Levels at Apartment

Description	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Noise Level at Apartment	55	49	48	47	38	29	9	-	46

6.5 Noise levels from car parking movements (Plot F to Plot E/G)

The multi-story car park is located within Plot F.

Prediction calculations of the likely noise levels at the nearest residential Plot façade have been undertaken based on the noise levels presented in Table 5 and assumptions

- Car parking may occur during night-time 30 min period
- Typically up to 10 cars could be parking at any one time
- Distance loss will be insignificant

Table 10: Car Parking Noise Levels

Description	Duration	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Typical Levels (Leq) at a car park	20 seconds	71	64	59	59	58	58	54	50	72

The predicted noise levels at the nearest residential apartment are presented below:

Table 11: Predicted Noise Levels at G2 Residential Facade

Description	Duration	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Predicted Noise Level at Apartment	30 min	61	54	49	49	48	48	44	50	54

7 External Building Fabric Assessment

7.1 Internal Noise Level Guidelines

In order to achieve appropriate noise levels within internal living spaces, the dwellings themselves need to be considered with regard to the level of façade mitigation required. BS 8233:2014 and ProPG recommend internal noise levels of <35 dB(A) in living rooms and bedrooms during the daytime (07:00 – 23:00) and <30 dB(A) in bedrooms during the night-time (23:00 – 07:00). In addition, ProPG recommends that individual noise events should not normally exceed 45 dB $L_{Amax,F}$ more than 10 times per night in bedrooms and no event higher than 55 dB $L_{Amax,F}$ should be permitted.

7.2 Assumptions

The assessment assumes the following room sizes (l x w x h):

Bedroom – 3.4m x 3.4m x 2.6m (l x w x h)
Living Room – 5.7m x 5.7m x 2.6m
Retail – 10.m – 10.6m x 3.2m

Glazing dimensions and have taken from the supplied drawings. It has also been assumed that bedrooms are to be acoustically 'soft', with carpets, curtains and other soft furnishings, living rooms and retail units to be less acoustically absorptive. For the purposes of our analyses we have assumed the following absorption coefficients:

Table 12: Assumed Reverberation Time

Room	Reverberation Time (Seconds)
Bedroom	0.6
Living Room	0.8
Retail	1.0

As a reference, the following standard constructions and associated acoustic performance have been considered for the external wall and roof.

Wall & Roof

The Table below sets out the performance requirement for the external wall (non-glazed elements)

Table 13: Sound Reduction of Example External Wall, R (dB)

External Wall Example	Sound Reduction Indices at Octave Band Centre Frequency (Hz)								R_w
	63	125	250	500	1k	2k	4k	8k	
Brick/Block Cavity	31	36	40	41	45	52	52	46	52
Roof	31	36	40	41	45	52	52	46	52

7.3 Façade Mitigation

It is understood that mechanical ventilation is proposed for apartments. Based on the predicted noise levels the following glazing types and the corresponding sound reduction indices have been proposed:

Table 14: Proposed Sound Façade Sound Insulation Performance

Description	Example Configuration	Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								R_w
		63	125	250	500	1k	2k	4k	8k	
Type 1	6mm glass/12mm/6mm	16	20	19	29	38	36	45	45	32
Type 2	6mm glass/12mm/6.1mm	21	25	25	32	38	38	43	43	35
Type 3	10mm/12mm/6mm	22	26	27	34	40	38	46	46	37
Type 4	10mm/12mm/6.4mm	23	27	29	36	41	42	52	52	39

The glazing system performance specifications detailed above apply to the glazing package as a whole, inclusive of glazing, framing, spandrel panels, etc. The performance of the glazing systems will depend on many factors, such as the glazing configuration, size of window panels, quality of framing, quality of sealing, etc. Performance specifications are frequency specific. Overall performance values are given for guidance purposes only. Any ventilation element which penetrates the façade will need to be selected to ensure the specified glazing performance values are not compromised.

Details of proposed locations of the glazing types are provided in Appendix E.

8 External Amenity Areas Noise Assessment

BS 8233:2014 and ProPG advise that 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 $L_{Aeq,16hr}$. But they also recognise that these guideline values are not achievable in all circumstances where development might be desirable, such as city centres or urban areas adjoining the strategic transport network. In such a situations the guidance advise that the development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.

Figure D 6 in Appendix D identifies the site-wide noise levels in the context of the guidance contained within BS 8233 for external amenity areas. The contours show noise levels at 1.5 metres above existing ground level and show compliance and marginal noise compliance.

It can be seen that residential courtyard areas meet the design range values for external amenity. As such it is considered that residents are provided with an external amenity that meets the requirements of BS 8233/WHO and ProPG.

Areas open to the rail and road noise sources do exceed the recommended guideline values in public areas. Although these areas are not directly associated with the residential blocks the installation of an acoustic barrier along the northern and southern boundary would be of benefit to the developments as a whole.

9 Building Services Noise Emission

9.1 Proposed Plant Installations

At this stage of the design, the layouts and plant specifications are still under development, and therefore a noise limiting exercise has been undertaken

9.2 Nearest Noise Sensitive Receivers (NNSR)

The nearest/worst-affected existing noise-sensitive receptors are expected to be the existing properties to the north of the development along Adamstown Avenue and future apartments that are part of the development itself.

For existing properties noise limiting levels have been set based on the requirements Environmental Health Office for South Dublin and the methodology given BS 4142 British Standard 4142:2014 Method for Rating and Assessing Industrial and Commercial Sound. The nearest noise sensitive receptor is given below.

For plant emissions impacting on the development itself limiting levels have been set based on the proposed façade requirements detailed within this report.

9.3 External Sound Level Criteria – NNSR

The Assessment is based on the following guidance:

- Local Authority Acoustic Requirements; and
- British Standard 4142:2014 Method for Rating and Assessing Industrial and Commercial Sound.

The noise criteria set out in Table 15 are proposed in accordance with the requirements of South Dublin County Council. These limits are based on achieving a level no more than 10 dB above background during the daytime and equal to or below the typical measured background noise level at the nearest noise sensitive receptor during evening and night-time periods

Table 15: Proposed Plant Noise Rating Limits

NNSR Location	Operating Period	Typical Measured Background Noise Level at NMP3 $L_{A90,T}$	Proposed "Rating Level" At The Nearest Noise Sensitive Receptor $L_{Ar,T}$
Adamstown Avenue	Daytime (07:00-23:00)	44	54
	Night-time (23:00-07:00)	37	37

The above limits apply to the total sound emission level from all static plant and processes within the proposed Development. Individual plant items may need to be designed to a lower limit such that the overall total achieves the stated criteria above. Should the proposed plant items be found to be tonal, or impulsive in nature (so as to attract attention), a penalty correction would likely be applied to the above limits.

9.4 Development Residential Façade

In order to meet the internal noise requirements for apartments it is recommended that noise from plant servicing the development do not exceed the following noise levels at the façade of the apartment.

Table 16: Proposed Sound Façade Sound Insulation Performance

Limiting Sound Pressure Levels (dB) at Octave Band Centre Frequencies (Hz)								NR
63	125	250	500	1k	2k	4k	8k	
67	57	49	43	40	37	35	33	40

9.5 Practical Control Measures

Screening of any external plant as well as provision of sound attenuators to items of plant may be necessary to control the transmission of sound and achieve the above criteria as well as to reduce the sound level produced by the plant to a reasonable extend around the footprint of the building itself.

Environmental attenuators and possibly other means of sound mitigation such as acoustic louvres or acoustic screens may be required to control sound emanating from the plantrooms, air intake and discharge points or from externally mounted plant.

Locating the future plant installation as far as possible from the noise sensitive receptor and using the proposed building to screen any future plant items would to ensure compliant emissions sound levels

10 Vibration Impact Assessment

10.1 Vibration Measurements

Vibration as a direct vibration dose value (VDV) has been measured in the vertical and two horizontal axes as one hour samples throughout the daytime and night-time periods

Unattended vibration measurements were undertaken at one position adjacent to the south site boundary at a distance of 25 metres from the railway line as shown in Figure 5: below. No perceptible vibration was detected during the periods of attendance during installation and retrieval of the equipment.

Figure 5: Vibration Measurement Position (VMP)

An inventory of the vibration monitoring equipment used is shown below

Table 17: Inventory Of Vibration Monitoring Equipment

Item	Make & Model	Serial Number
Seismograph	Vibrock V801	747

The summarised results of the environmental vibration measurements are presented in Table 18 below

Table 18: Summary of Vibration Measurement Results, VDV ms$^{-1.75}$

Date	Period	Axis		
		X	Y	Z
Friday 11/10/19	Daytime (07:00 – 23:00)	0.021	0.021	0.037
	Night-time (23:00 – 07:00)	0.02	0.018	0.029
Saturday 12/10/19	Daytime (07:00 – 23:00)	0.025	0.021	0.038
	Night-time (23:00 07:00)	0.021	0.018	0.029
Sunday 13/10/19	Daytime (07:00 – 23:00)	0.024	0.022	0.039
	Night-time (23:00 – 07:00)	0.032	0.021	0.027
Monday 14/10/19	Daytime (07:00 – 23:00)	0.025	0.021	0.038
	Night-time (23:00 – 07:00)	0.026	0.018	0.025
Tuesday 15/10/19	Daytime (07:00 – 23:00)	0.038	0.022	0.036
	Night-time (23:00 – 07:00)	0.021	0.021	0.037

10.2 Vibration Assessment Results

The below ground structure of a building or hard surface will affect the levels of vibration present due to a remote source. Different types of foundation will affect the amount of vibration that is transferred from the ground to either the building or the hard surface.

VDV vibration levels were measured on the ground at the site at the approximate façade of the nearest residential location. The highest measured daytime VDV, 16 hour was 0.039 m/s-1.75 and the highest night-time VDV, 8 hour was 0.032 m/s-1.75. These values are significantly below the VDV value range for low probability of adverse comment when assessed under BS 6472:2008.

Based on the measured values vibration impacts on the development from rail movements are not expected to have a negative effect.

11 Conclusions

MLM Consulting Engineers Limited has been commissioned by Quintain Developments Ireland Ltd to assess the impact of noise and vibration in support of a planning application for the Phase 1 mixed use development at Adamstown Station, Co. Dublin.

This report presents the results of the assessment and outline mitigation measures in order to control noise from the following sources in line with Professional Practice Guidance (ProPG) – Planning & Noise.

- To control noise levels from bar and restaurant establishments glazing performance requirements have been given based on typical noise levels from a busy bar/restaurant without loud music.
- Noise from the car parking activities are predicted to be within the internal noise criteria assuming the proposed facade sound insulation performance requirements are met.
- Service Yard activities and deliveries to and within Plot F can be controlled assuming the area is enclosed within Plot F and operations are restricted to daytime periods only.
- Limiting noise level have been set at the façade of the development apartments and the nearest noise sensitive locations as per the requirements of the Local Authority and best guidance practice.

The underlying noise modelling exercise and acoustic assessment is based on a detailed noise survey undertaken at the site, in addition to predicted traffic flows once the development is complete.

This assessment demonstrates that appropriate internal ambient noise levels are entirely achievable through the use of suitable façade treatments.

This assessment also demonstrates that BS8233:2014 and World Health Organisation target noise levels can be achieved within the residential courtyards. To control noise levels in public areas it is recommended that a barrier is installed to the northern and southern boundaries.

Appendix A - Glossary of Acoustic Terminology

Wording	Description
Sound Pressure	Sound, or sound pressure, is a fluctuation in air pressure over the static ambient pressure
Sound Pressure Level (Sound Level)	The sound level is the sound pressure relative to a standard reference pressure of 20μPa (20x10-6 Pascals) on a decibel scale.
Decibel (dB)	A scale for comparing the ratios of two quantities, including sound pressure and sound power. The difference in level between two sounds s1 and s2 is given by 20 log10 (s1 / s2). The decibel can also be used to measure absolute quantities by specifying a reference value that fixes one point on the scale. For sound pressure, the reference value is 20μPa.
A-weighting, dB(A)	The unit of sound level, weighted according to the A-scale, which takes into account the increased sensitivity of the human ear at some frequencies.
Noise Level Indices	Noise levels usually fluctuate over time, so it is often necessary to consider an average or statistical noise level. This can be done in several ways, so a number of different noise indices have been defined, according to how the averaging or statistics are carried out.
$L_{eq,T}$	A noise level index called the equivalent continuous noise level over the time period T. This is the level of a notional steady sound that would contain the same amount of sound energy as the actual, possibly fluctuating, sound that was recorded.
$L_{max,T}$	A noise level index defined as the maximum noise level during the period T. L_{max} is sometimes used for the assessment of occasional loud noises, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
$L_{90,T}$	A noise level index. The noise level exceeded for 90% of the time over the period T. L_{90} can be considered to be the "average minimum" noise level and is often used to describe the background noise.
$L_{10,T}$	A noise level index. The noise level exceeded for 10% of the time over the period T. L_{10} can be considered to be the "average maximum" noise level. Generally used to describe road traffic noise.
Free-Field	Far from the presence of sound reflecting objects (except the ground), usually taken to mean at least 3.5m
Facade	At a distance of 1m in front of a large sound reflecting object such as a building façade.
Fast Time Weighting	An averaging time used in sound level meters. Defined in BS 5969.

Appendix B - Policy, Standards and Guidance

British Standard BS 8233:2014[1]

BS 8233:2014 provides guidance on internal acoustic environments in difference types of space. The Standard advises that, for steady external noise sources, it is desirable for internal ambient noise levels to not exceed the guidance values, as detailed below.

Table B.1: BS 8233:2014 Indoor Ambient Noise Levels (IANL)

Activity	Location	Daytime 07:00 – 23:00	Night-time 23:00 – 07:00
Resting	Living room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$

BS 8233:2014 goes on to suggest that where a development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions will still be achieved.

With regards to maximum noise levels, the Standard identifies that regular individual noise events (such as passing trains or scheduled aircraft etc.) can cause sleep disturbance. The Standard does not provide a guideline design target, but simply goes on to suggest that a guideline value may be set in terms of SEL or L_{AFmax} depending upon the character and number of events per night. It goes on to suggest that more sporadic noise events could require separate values.

In respect of external noise levels, the guidance in BS 8233:2014 suggests that "it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments."

BS 8233:2014 provides a much more detailed narrative on noise levels in external amenity areas and acknowledges that it may not always be necessary or feasible to ensure that noise levels remain within these guideline values.

In respect of gardens and patios, BS 8233:2014 states; "however it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited."

It is clear from the narrative of BS 8233:2014, that proposed development within noisy environments should be designed to ensure that the recommended internal design standards are achieved, and that noise levels in external amenity areas are designed to effectively control and reduce noise levels, although it acknowledges that in certain circumstances meeting the external design recommendations may not be feasible, or necessary, especially where the provision of such spaces is desirable for other technical, planning or policy reasons.

[1] British Standard BS 8233:2014 Guidance on sound insulation and noise reduction for buildings, BSI, 2014

ProPG: Professional Practice Guidance on Planning & Noise[2]

ProPG was published on 22 June 2017 and the scope is restricted to new residential development exposed predominantly to airborne noise from transport sources. The guidance encourages better acoustic design for new residential development and aims to protect people from the harmful effects of noise. The guidance was prepare by the Institute of Acoustics, the Association of Noise Consultants and the Chartered Institute of Environmental Health. It encourages a holistic design process where acoustics is integral to the living environment. This covers careful site layout and better orientation of rooms within dwellings. ProPG acknowledges and reflects the Noise Policy Statement for England, the National Planning Policy Framework and Planning Policy Guidance – Noise. The recommended approach for new residential development is in two stages; Stage 1 is an initial noise risk assessment of the proposed development site for an early indication of the initial suitability of the site for new residential development. Stage 2 is a systematic consideration of four key elements:

Demonstrating a "Good Acoustic Design Process";
Observing internal "Noise Level Guidelines",
Undertaking an "External Amenity Area Noise Assessment",
Consideration of "Other Relevant Issues"

For reference, the indicative noise levels for the initial site noise risk assessment as presented in ProPG are illustrated below.

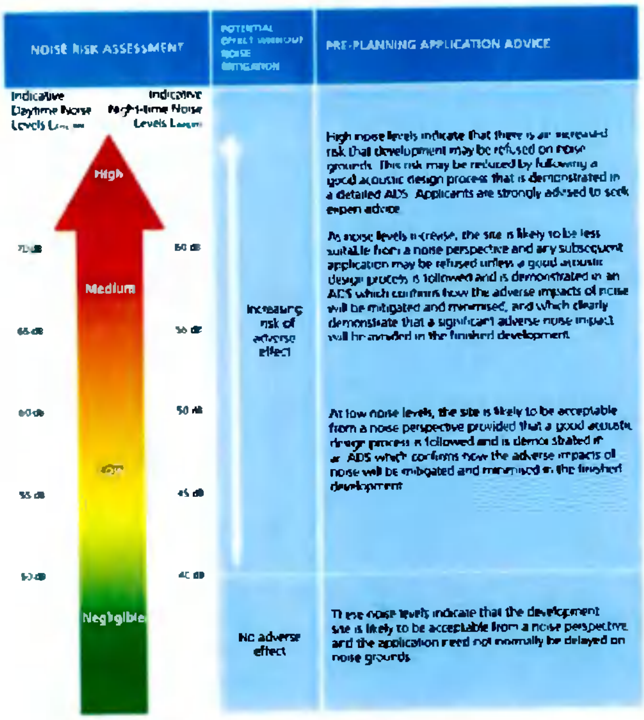


Figure B.1: Stage 1 – Initial Site Noise Risk Assessment

[2] ProPG: Professional Practice Guidance on Planning & Noise. ANC, IOA, CIEH, May 2017

Good Acoustic Design Process

General principles (in order of preference):

i. Maximising spatial separation of noise sources and receptors;
ii. Reducing existing noise levels or relocating noise sources, if possible;
iii. Using existing topography and existing structures;
iv. Incorporating noise barriers as part of the scheme;
v. Using layout to reduce noise propagation across the site;
vi. Using orientation to reduce noise exposure of sensitive rooms;
vii. Using building envelope to mitigate noise

Internal Noise Level Guidelines

This guidance is based on BS 8233:2014 and World Health Organisation recommendations. In addition to these values, there is a recommendation for individual noise events to not normally exceed 45 dB L_{AmaxF} more than ten times a night in bedrooms.

ProPG guidance clearly states "*designing the site layout and the dwellings so that the internal target noise levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet the 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, subject to the further advice in Note 7.*"

Note 7 from ProPG, states that "*Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved. The more often internal L_{Aeq} levels start to exceed the internal L_{Aeq} target levels by more than 5 dB, the more that most people are likely to regard them as "unreasonable". Where such exceedances are predicted, applicants should be required to show how the relevant number of rooms affected has been kept to a minimum. Once internal L_{Aeq} levels exceed the target levels by more than 10 dB, they are highly likely to be regarded as "unacceptable" by most people, particularly if such levels occur more than occasionally. Every effort should be made to avoid relevant rooms experiencing "unacceptable" noise levels at all and where such levels are likely to occur frequently, the development should be prevented in its proposed form*"

External Amenity Areas

External amenity areas which are an intrinsic part of the overall design should ideally not be above 50-55 dB $L_{Aeq,16hr}$ or designed to achieve the lowest practicable noise levels (BS 8233:2014).

If significant adverse noise impacts remain on any private external amenity space then this is partially off-set if residents are provided with access to a "relatively quiet" alternative external amenity space.

Consideration of Other Relevant Issues

Compliance with relevant national/local policy;
Magnitude and extent of compliance with ProPG;
Likely occupants of the development;
Acoustic design versus unintended adverse consequences;
Acoustic design versus planning objectives.

British Standard BS 4142 2014[1]

BS 4142 sets out a method to assess the likely effect of sound from factories, industrial premises or fixed installations and sources of an industrial nature in commercial premises, on people who might be inside or outside a dwelling or premises used for residential purposes in the vicinity.

The procedure contained in BS 4142 for assessing the effect of sound is to compare the measured or predicted sound level from the source in question, the $L_{Aeq,T}$ 'specific sound level', with the $L_{A90,T}$ background sound level at the assessment location.

Where the sound contains a tonality, impulsivity, intermittency and other sound characteristics, then a correction depending on the grade of the aforementioned characteristics of the sound is added to the specific sound level to obtain the $L_{Ar,Tr}$ 'rating sound level'. A correction to include consideration of a level of uncertainty in sound measurements, data and calculations can also be applied when necessary.

BS 4142 states: "The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs". An estimation of the impact of the specific sound can be obtained by the difference of the rating sound level and the background sound level and considering the following:

Table B.2: Classification of Industrial/Commercial Noise Impacts

Difference Between Rating Sound Level and Background Sound Level (Db)	Impact Category (depending on the context)
+ 10 dB or more	Significant adverse impact
+ 5 dB	Adverse impact
Equal or less than	Low impact

For the daytime, the assessment is typically carried out over a reference time period of one hour, but at night-time it is carried out over a 15 minute period. The periods associated with day or night, for the purposes of the Standard, are considered to be 07.00 to 23.00 and 23.00 to 07.00, respectively.

Interpreting the guidance given in BS4142:2014, an estimation of the impact of the rating sound is summarised in the following text:

A rating sound level that is +10 dB above the background sound level is likely to be an indication of a Significant Observed Adverse Effect Level;
A rating sound level that is +5 dB above the background sound level is likely to be an indication of a Lowest Observed Adverse Effect Level;
The lower the rating sound level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating sound level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, and would therefore classified as a No Observed Adverse Effect Level.

[1] BS 4142 2014 'Methods for Rating & Assessing Industrial & Commercial Sound', BSI, 2014

British Standard BS 6472-1:2008[1]

BS 6472:2008 "Guide to evaluation of human exposure to vibration in buildings, Part 1, Vibration sources other than blasting "describes how to determine the vibration dose value, VDV, from frequency-weighted vibration measurements. The vibration dose value is used to estimate the probability of adverse comment which might be expected from human beings experiencing vibration in buildings. Consideration is given to the time of day and use made of occupied space in buildings, whether residential, office or workshop. BS 6472 states that in homes, adverse comment about building vibrations is likely when the vibration levels to which occupants are exposed are only slightly above thresholds of perception.

Vibration magnitudes that would normally result in adverse comment can sometimes be tolerated, particularly for temporary disturbances or infrequent brief events; an example would be a construction project. However, to reduce adverse comment, the affected community would usually need to be advised of the likely effects, the duration of the activity and that the likelihood of building damage is very low even when vibration levels are well above perception thresholds.

BS 6472 contains a methodology for assessing the human response to vibration in terms of either the vibration dose value, or in terms of the acceleration or the peak velocity of the vibration, which is also referred to as peak particle velocity. The advice contained in BS 6472 states that when the vibration is intermittent, as is the case at this site with the only significant potential source of vibration being the railway line, the vibration dose value, or VDV, may be used to assess the potential for impacts.

Appropriately-weighted vibration measurements can be aggregated to derive the vibration dose values. The vibration dose value is a single figure descriptor that represents the cumulative dose of transient vibrations, taking into account the frequency spectrum and duration of each event. The vibration dose value is determined over a 16-hour daytime period or 8-hour night-time period. Its significance in terms of human response for people in those places can be derived from Table 6. The judgement made is of the probability that the determined vibration dose might result in adverse comment by those who experience it

Table B 3: Vibration Dose Values ($m s^{-1.75}$) above which various degrees of adverse comment may be expected in residential buildings

Period	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
Residential Buildings 16-hour day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential Buildings 8-hour night	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

The above guidance relates to vibration measured at the point of entry into the human body, which is usually taken to mean the ground surface or at a point mid-span of an upper storey floor, rather than the point of entry into the building, for example, a foundation element. Where the vibration is measured at another location, BS 6472 states that a transfer function should be applied; however, BS 6472 does not contain any guidance on suitable transfer functions.

There are two key aspects to the effect that the building structure will have on the measured vibration levels; the first is generally a reduction as the vibration passes into the foundations of a building. Then, the vibration is likely to be attenuated as it propagates up a structure such as a house and amplified as it propagates across a suspended floor, as might be found in the upper storeys of residential properties. Each of these factors is considered below.

[1] BS 6472:2008 'Guide to evaluation of human exposure to vibration in buildings, Part 1, Vibration sources other than blastin', BSI, 2008

Regarding the transfer of vibration through the foundations of the proposed building, guidance is provided on the Handbook of Urban Rail Noise and Vibration Control (HURNVC), published by the Federal Transit Administration, USA, written by H J Saurenam, J T Nelson and G P Wilson. The HURNVC sets out attenuation factors that can be applied to calculate the transfer function between vibrations measured on unloaded ground and vibration at a foundation. The type of foundations has to be decided yet, but we have assumed that it could either be piled or strip foundations.

To extrapolate the measured vibration levels up the building to a suspended upper storey, an amplification factor is required. Based on figures presented in Transmission of Ground-borne Vibration in Buildings by Jorgen Jakobsen, Journal of Low Frequency Noise and Vibration, Vol. 8 No. 3, 1989, both low and a high amplification factors have been considered appropriate for this assessment. The "high" and "low" amplification correspond to the upper and lower bounds of potential resonance for a slab on columns.

Appendix C - Environmental Noise Survey

Baseline Sound Conditions

The prevailing sound conditions in the area have been determined by an environmental sound survey. Measurements were conducted between Friday 11 and Tuesday 15 October 2019

Measurements

Unattended sound measurements were carried out at three positions; NMP1, NMP2 and NMP3 for the duration of the survey. Additional monitoring was undertaken attended location ANMP1 in order to gain a detailed description of train movements

The measurement positions are described below and shown in Figure C.1

Figure C.1. Measurement positions

NMP1 – Unattended measurement position on the southern boundary of the site, the microphone was installed on the boundary fence at a height of approximately 2m above ground level and at a distance of 25m from the railway line. This location is representative of the ambient noise levels at the southern facade

NMP2 – Unattended measurement position on the eastern boundary of the site, the microphone was installed on the boundary fence at a height of approximately 2m above ground level and at a distance of 3m from the road east of the site. This location is representative of the ambient noise levels at the eastern facade.

NMP3 – Unattended measurement position on the northern boundary of the site, the microphone was installed on the boundary fence at a height of approximately 2m above ground level and at a distance of 3m from the Adamstown Avenue. This location is representative of the ambient noise levels at the residential properties north of the site.

ANMP3 – Attended measurement position at 5m from the southern boundary, the microphone was installed on a tripod approximately 1.5 m ground level and at a distance of 3 m from Station Avenue.

All noise measurements were undertaken by a consultant certified as competent in environmental noise monitoring, and, in accordance with the principles of BS 7445[5]. All acoustic measurement equipment used during the noise survey conformed to Type 1 specification of British Standard 61672[6].

A full inventory of this equipment is shown below.

Table C1: Inventory of Sound Measurement Equipment

Item	Make & Model	Serial Number	Calibration Certificate Number	Date of Expiration of Calibration
Sound Level Meter	Sonitus	913		
Preamplifier	01dB PRE-22N"	1507093	UCRT18/1266	1 March 2020
Microphone	GRAS 40CE	217662		
Sound Level Meter	Sonitus	0904		
Preamplifier	01dB PRE 22N"	20998	TCRT19/1015	7 January 2021
Microphone	GRAS 40CE	03875		
Sound Level Meter	Sonitus	914		
Preamplifier	01dB PRE-22N"	31972	TCRT17/1180	12 April 2021
Microphone	GRAS 40CE	03797		
Sound Level Meter	Rion NL 52	00620901		
Preamplifier	Rion NH-25	10684	TCRT18/1581	4 July 2020
Microphone	Rion UC-59	03978		
Calibrator	Brüel & Kjær 4231	2615249	UCRT18/1612	14 June 2020

The sound measurement equipment used during the survey was calibrated at the start and end of the measurement period. No significant drift in calibration was found to have occurred.

The calibrator used has been calibrated by an accredited calibration laboratory within the twelve months preceding the measurements. Calibration certificates are available upon request.

During the measurement period, there was some rain and wind on Sunday morning and Monday daytime. These periods have been excluded from the Assessment.

All microphones were fitted with a protective windshield.

Noise Climate

Since the survey was largely unattended it is not possible to comment on the specific nature of the noise climate for the entire duration of the survey, however whilst on site the noise climate was noted as being dominated by rail and local road movements. In addition noise from light aircraft and construction traffic was also noted.

Survey Results

A summary of the daytime and night-time noise levels logged is presented below. The L_{Aeq} average level, typical L_{A90} level and the L_{AFmax} 90[th] percentile level are given. The values are rounded to the nearest whole number.

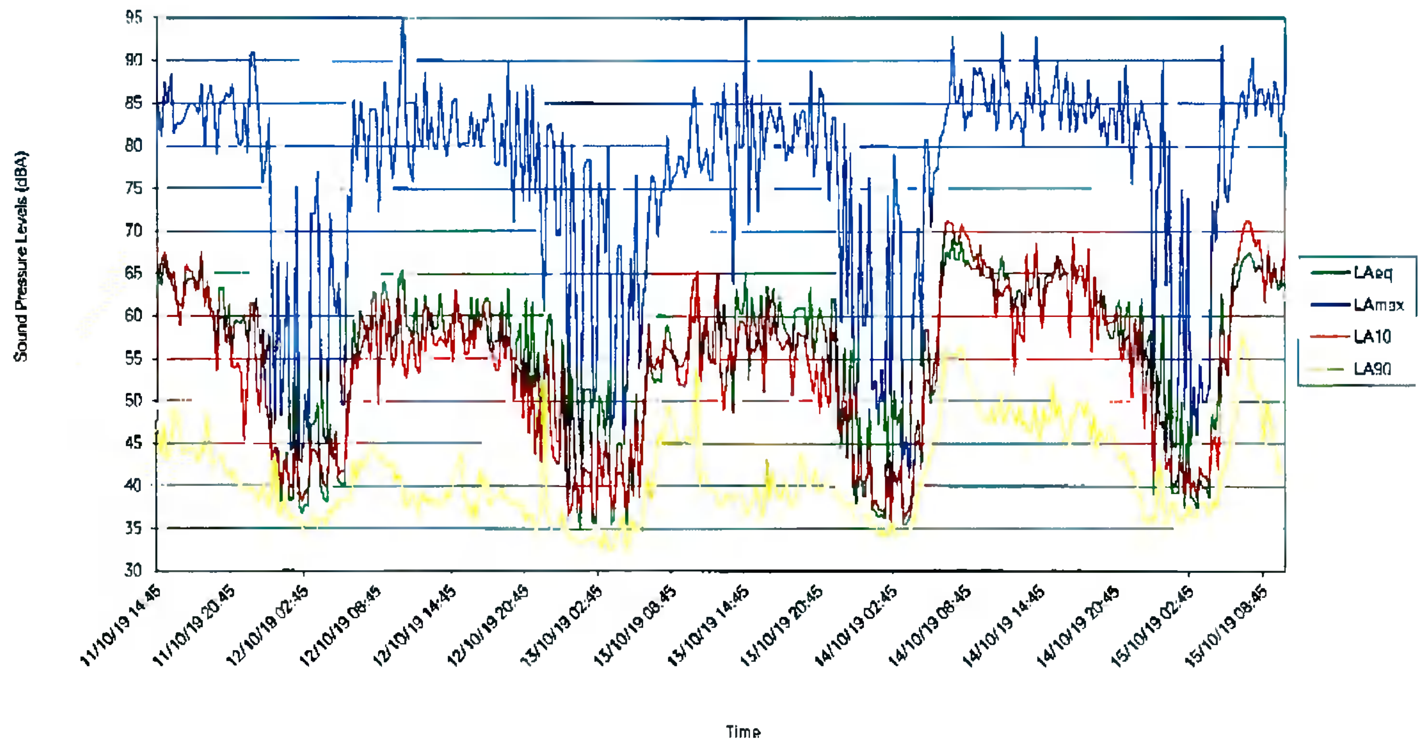
[5] British Standard 7445: 2003. Description and measurement of environmental noise. BSI.
[6] British Standard 61672: 2013. Electroacoustics, Sound level meters. Part 1 Specifications. BSI.

Table C2: Measured Broadband Sound Levels (dB)

Measurement Position	Period	$L_{Aeq,T}$ (dB)	$L_{A90,T}$ (dB)	L_{AFmax} (dB)
NMP1	Daytime (07:00 – 23:00)	63	44	88
	Night-time (23:00 – 07:00)	54	36	81
NMP2	Daytime (07:00 – 23:00)	61	44	87
	Night-time (23:00 – 07.00)	51	38	80
NMP3	Daytime (07.00 – 23:00)	54	44	80
	Night-time (23:00 – 07:00)	46	37	70

Adamstown District Centre Phase 1
Inward Impact Assessment

Microphone Position 1 (N1)
Measured LAeq, LAMax, LA10 & LA90 Time Histories
11/10/2019 - 15/10/2019



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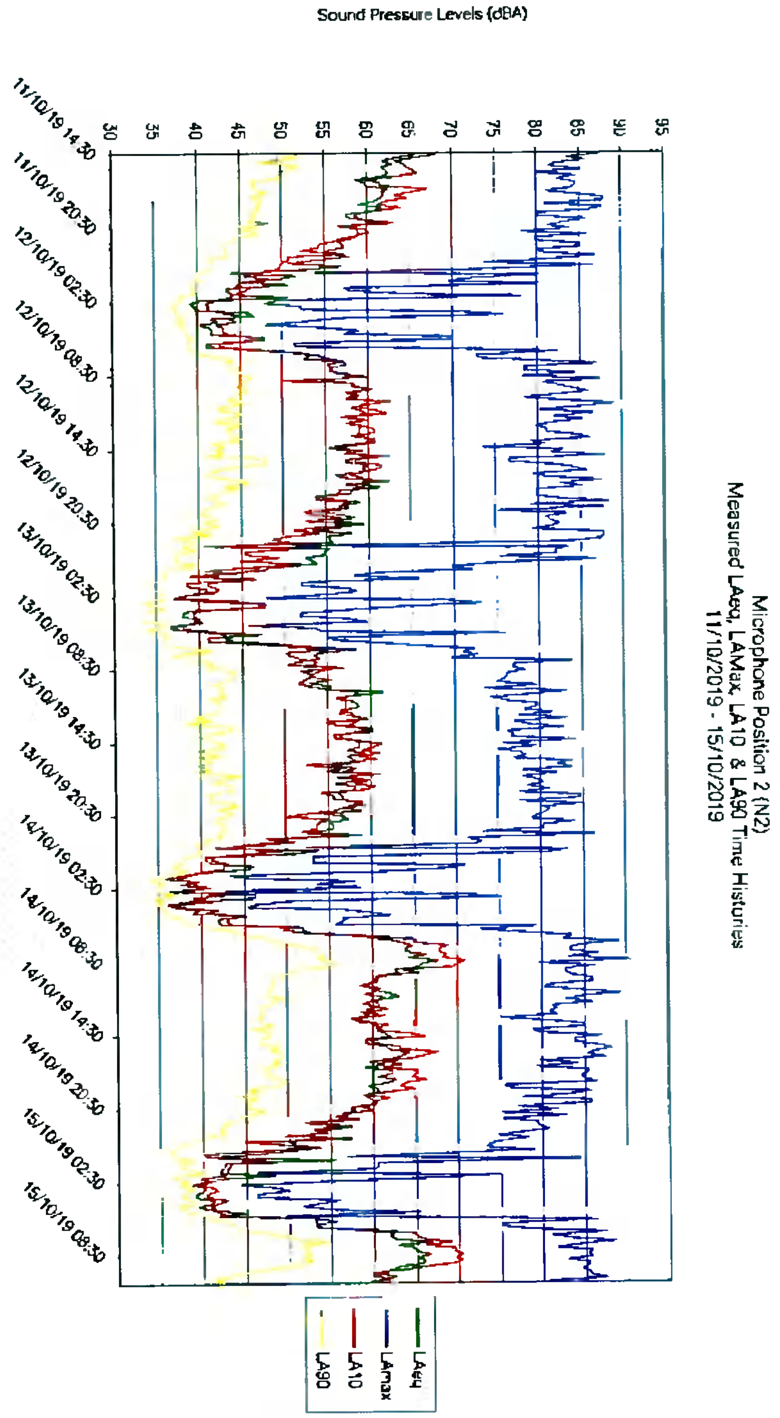
Adamstown District Centre Phase 1
nward Impact Assessment

Microphone Position 2 (N2)
Measured LAeq, LAMax, LA10 & LA90 Time Histories
11/10/2019 - 15/10/2019



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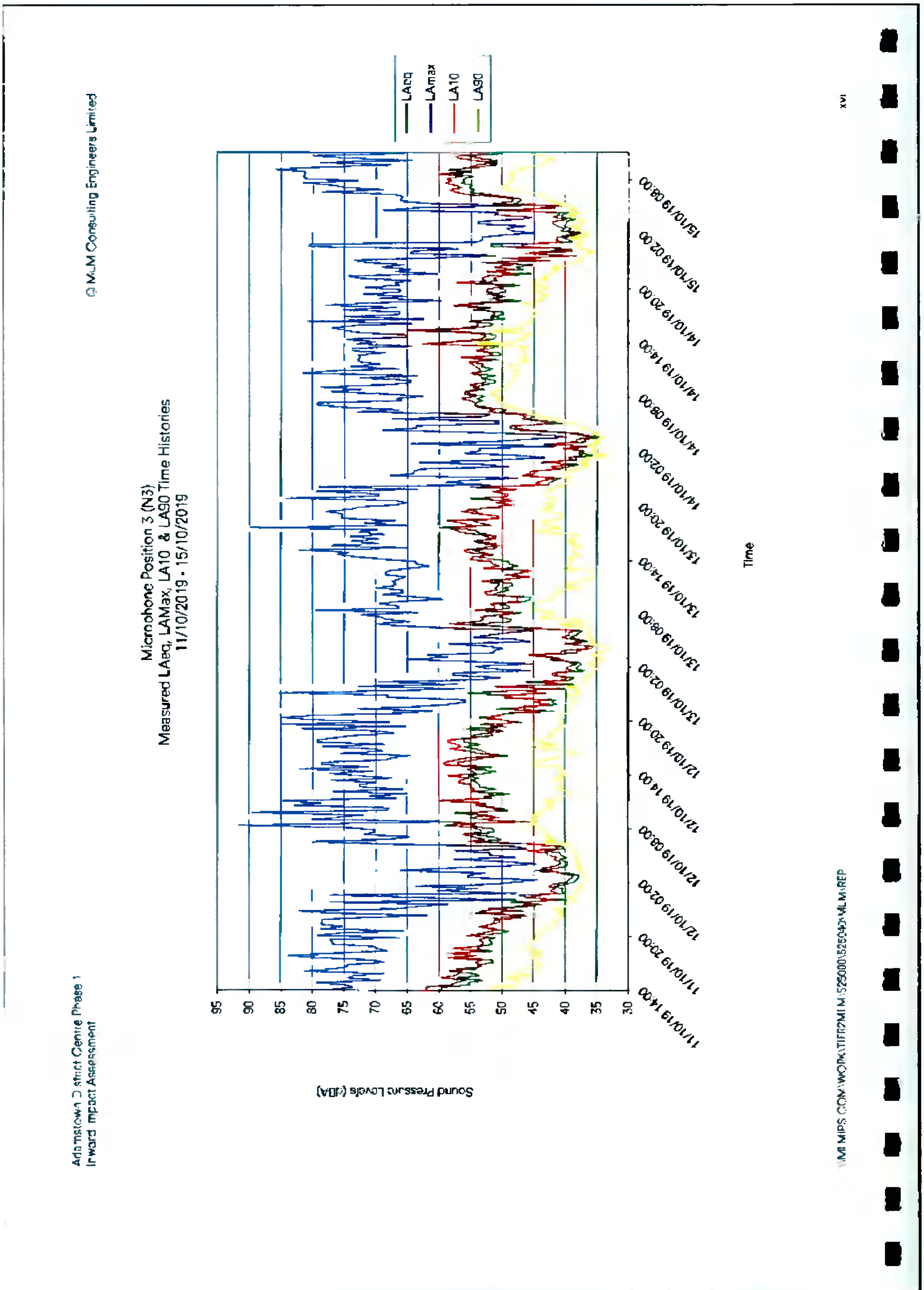
Microphone Position 3 (N3)
Measured LAeq, LAMax, LA10 & LA90 Time Histories
11/10/2019 - 15/10/2019
LAeq
LAmax
LA10
LA90
Sound Pressure Levels (dBA)
Time
95
90
85
80
75
70
65
60
55
50
45
40
35
30
11/10/19 14:00
11/10/19 20:00
12/10/19 02:00
12/10/19 08:00
12/10/19 14:00
12/10/19 20:00
13/10/19 02:00
13/10/19 08:00
13/10/19 14:00
13/10/19 20:00
14/10/19 02:00
14/10/19 08:00
14/10/19 14:00
14/10/19 20:00
15/10/19 02:00
15/10/19 08:00

Appendix D - Noise Maps

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Adamstown District Centre Phase 1
Inward Impact Assessment

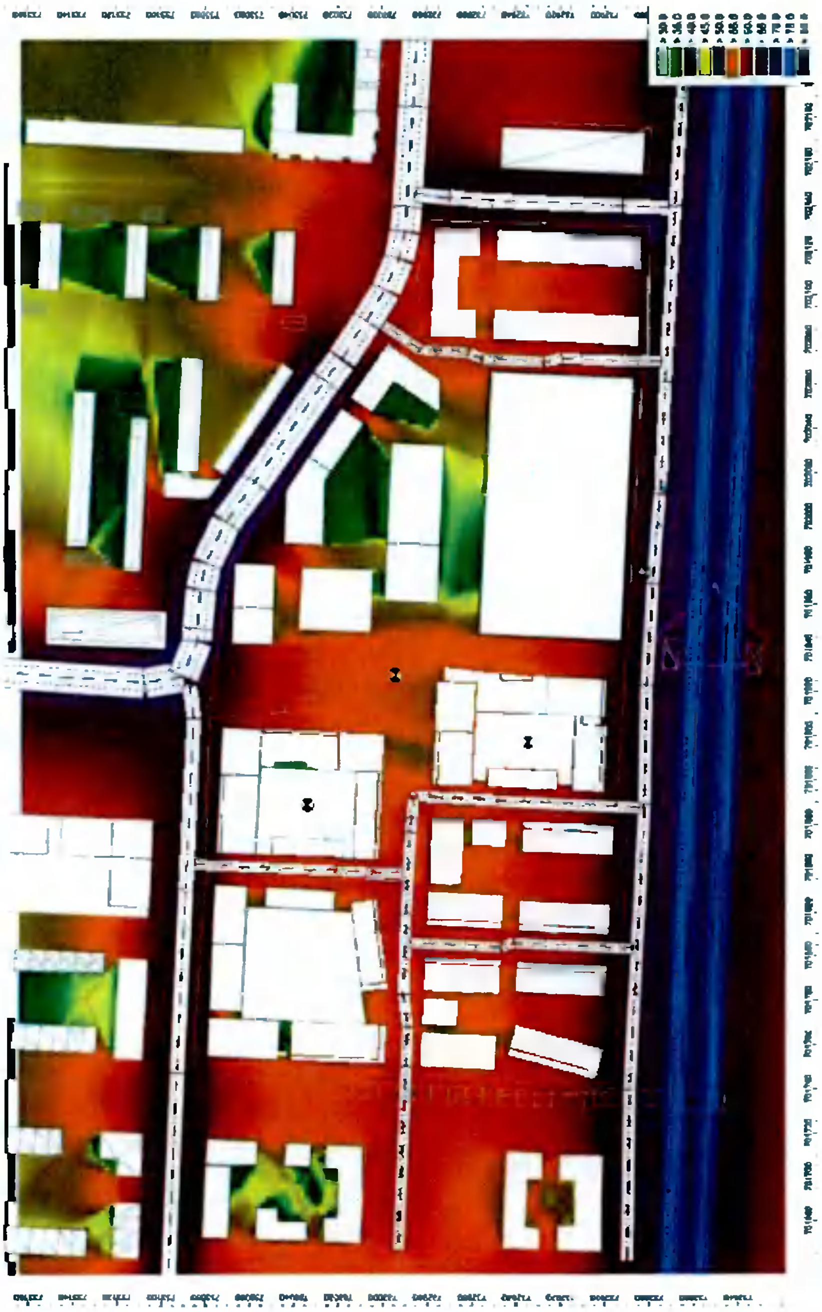

Figure D.1: Predicted Daytime Noise Levels from Road and Rail (Grid at 0m high)

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Adamstown District Centre Phase 1
Inward Impact Assessment

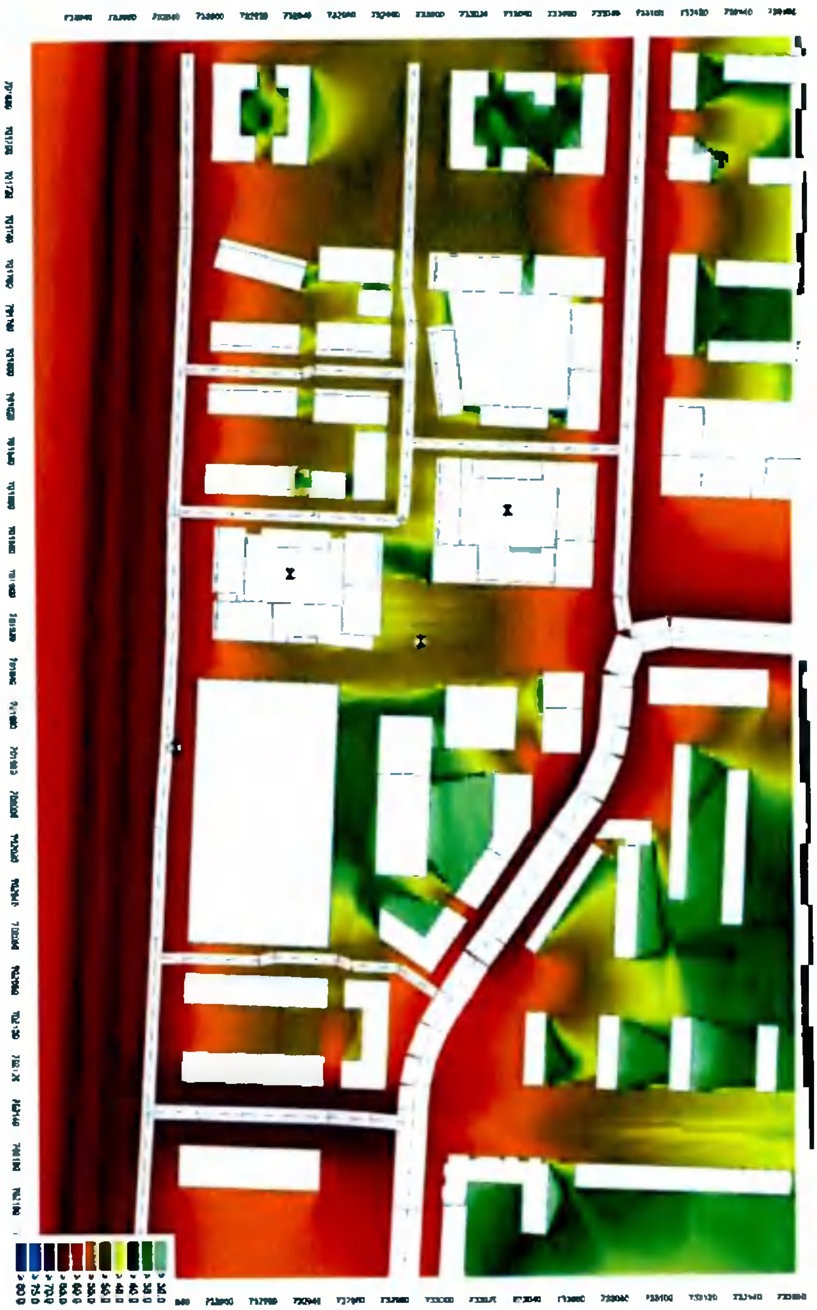

Figure D.2: Predicted Night-time Noise Levels from Road and Rail (Grid at 0m high)

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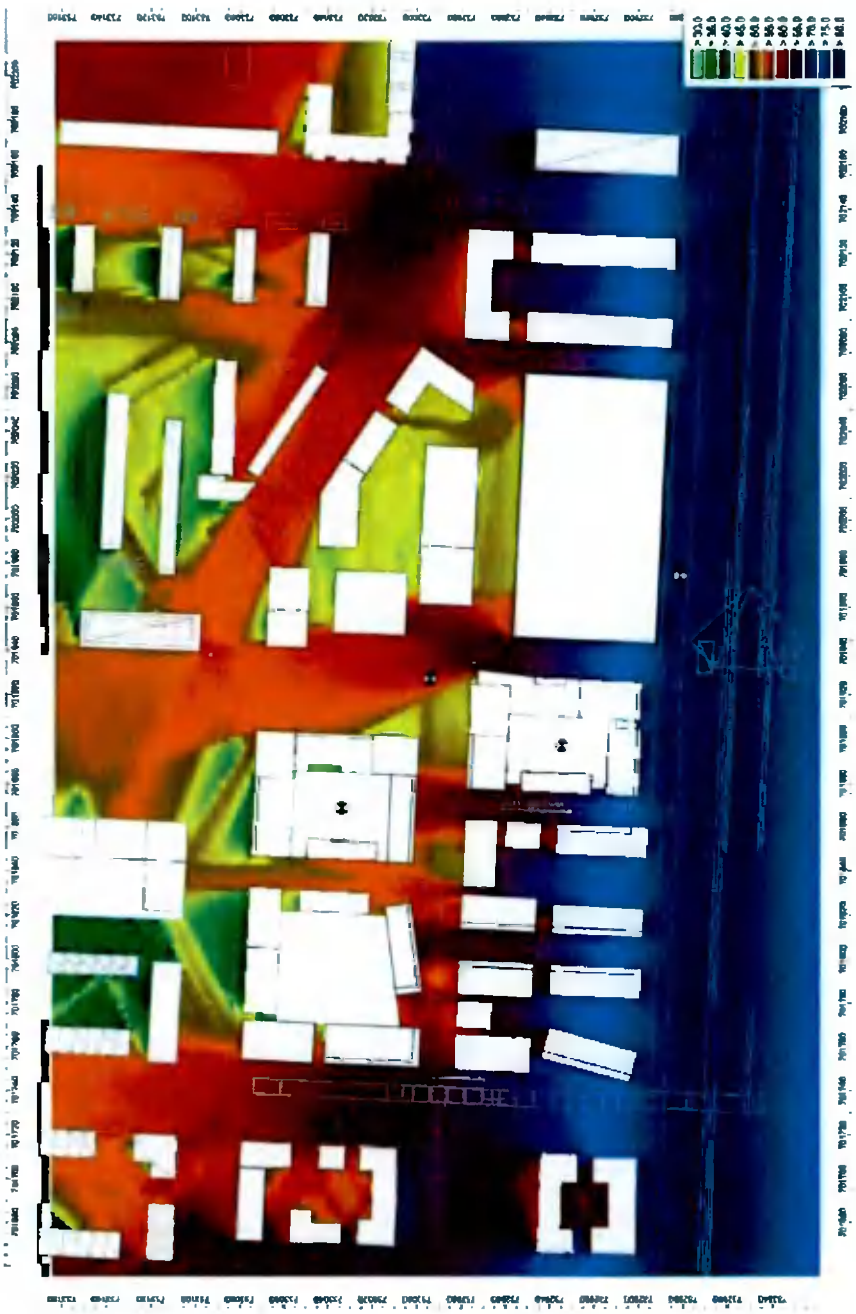

Figure D.3: Predicted Night-time LAmax Noise Levels from Rail (Grid at 0m high)

Adamstown District Centre Phase 1
Inward Impact Assessment

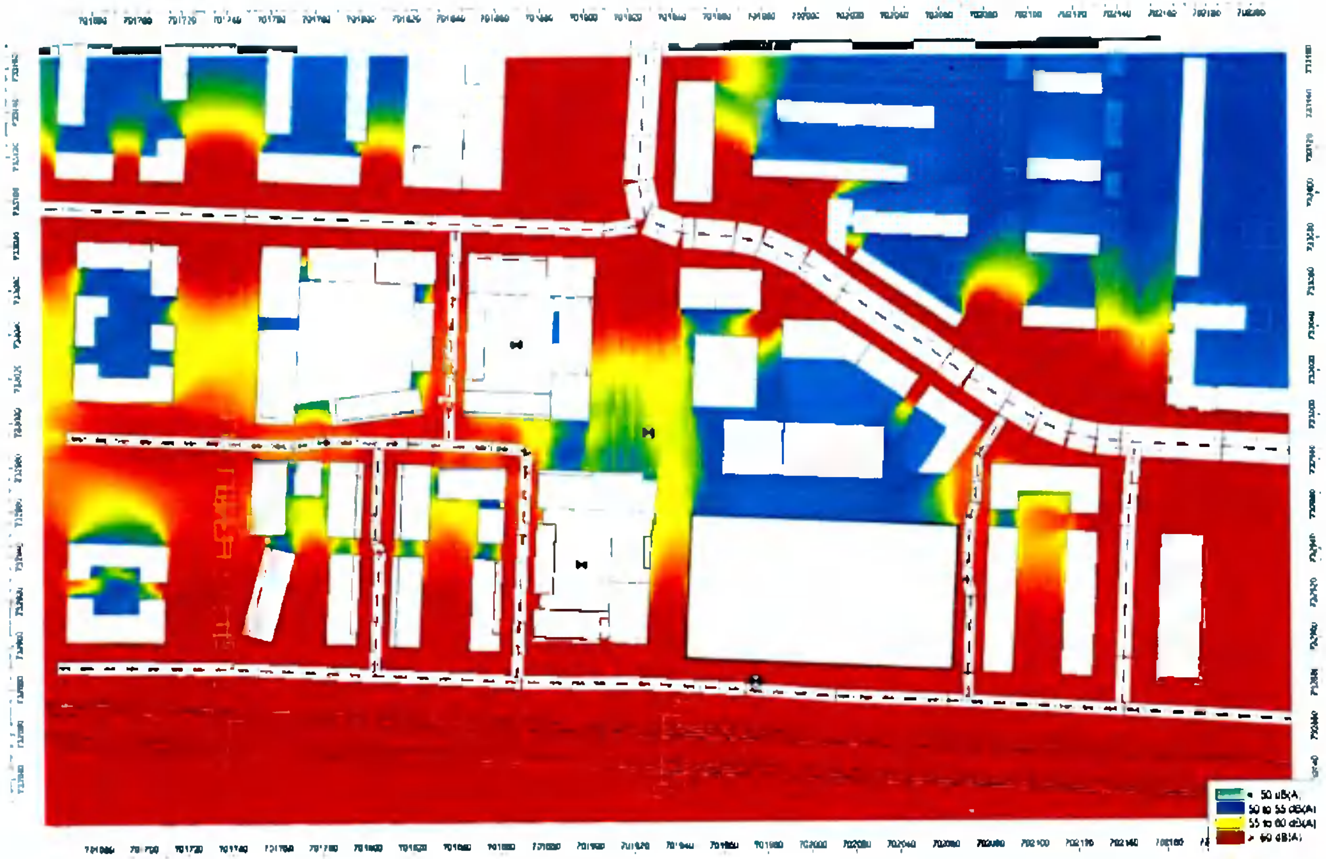

Figure D.4: Daytime BS8233 external amenity constraints

Appendix E - Façade Mitigation

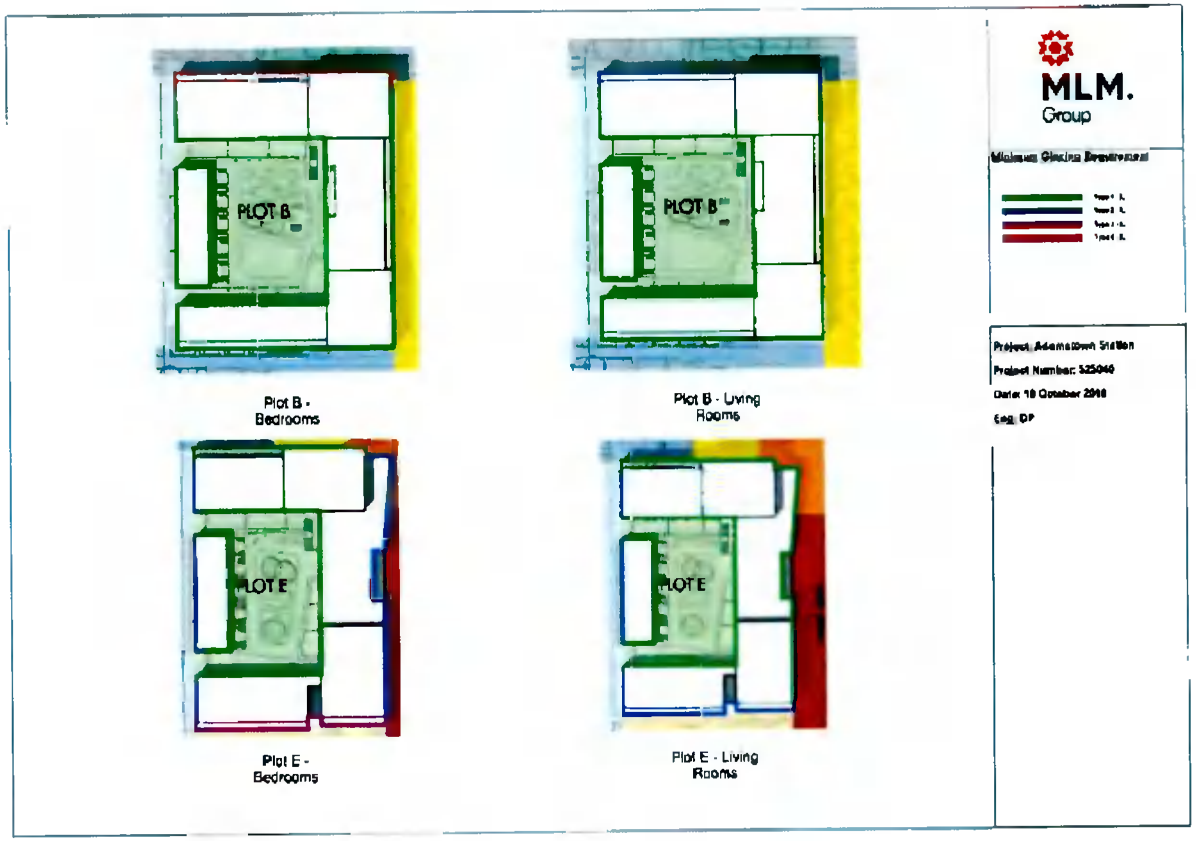

Figure D.5: Proposed Outline Façade Mitigation Measures

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Part of Sweco

T: +353 1 541 5870
A: 28-32 Upper Pembroke Street
Dublin 2

www.mlmgroup.com

Appendix B – BS 8233 Outside-to-Inside Calculation Sheets

iAcoustics
Integrated Acoustic Solutions

Adamstown District Station Blocks A, C & D

Calculation Sheet

65 dBA Traffic Spectra to Typical Bedroom

		Octave Band Centre Frequency (Hz)								
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Noise Source										
Noise Source - 65 dBA Traffic Spectra										
Noise Levels		**73.0**	**67.0**	**63.0**	**61.0**	**61.0**	**57.0**	**53.0**	**-**	**65.1 dBA**
Composite SRI										
Facade Width (m)	3.5									
Facade Height (m)	3.0									
Main Element - Block Wall										
SRI		44.0	45.0	50.0	60.0	69.0	79.0	89.0	99.0	Rw 62
Window Width (m)	1.5									
Window Height (m)	2.1									
No. of Windows (no)	1.0									
Glazed Element - Rw (Ctr) 41dB (-6)										
SRI		-	25.0	27.0	38.0	48.0	47.0	55.0	-	Rw 41
		-	*-30.13*	*-32.18*	*-43.17*	*-53.15*	*-52.22*	*-60.22*	-	
10 log (S/A)										
Internal Receiver - Typical Bedroom										
		-	*2.6*	*1.9*	*1.1*	*1.1*	*0.2*	*0.2*	-	
+3										
		-	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Bedroom										
Reverberant Field, LPrev		**-**	**42.5**	**35.7**	**22.0**	**12.0**	**7.9**	**-4.1**	**-**	**30.2 dBA**

iAcoustics
Integrated Acoustic Solutions

Adamstown District Station Blocks A, C & D

Calculation Sheet

65 dBA Traffic Spectra to Typical living room

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Noise Source										
Noise Source - 65 dBA Traffic Spectra										
Noise Levels		73.0	67.0	63.0	61.0	61.0	57.0	53.0	-	65.1 dBA
Composite SRI										
Facade Width (m)	6.0									
Facade Height (m)	3.0									
Main Element - Block Wall										
SRI		44.0	45.0	50.0	60.0	69.0	79.0	89.0	99.0	Rw 62
Window Width (m)	2.0									
Window Height (m)	2.1									
No. of Windows (no)	1.0									
Glazed Element - Rw (Ctr) 41dB (-6)										
SRI		-	25.0	27.0	38.0	48.0	47.0	55.0	-	Rw 41
		-	*-31.18*	*-33.25*	*-44.23*	*-54.21*	*-53.31*	*-61.31*	-	
10 log (S/A)										
Internal Receiver - Typical Living Room										
		-	*1.7*	*1.2*	*0.5*	*-0.3*	*-0.3*	*-0.3*	-	
+3										
		-	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Bedroom										
Reverberant Field, LPrev		-	40.6	33.9	20.3	9.5	6.4	-5.6	-	28.3 dBA

iAcoustics
Integrated Acoustic Solutions

Adamstown District Station Blocks A, C & D

Calculation Sheet

60 dBA Traffic Spectra to Typical Bedroom

		63	125	250	500	1k	2k	4k	8k	
		Octave Band Centre Frequency (Hz)								
Noise Source										
Noise Source - 60 dBA Traffic Spectra										
Noise Levels		**68.0**	**62.0**	**58.0**	**56.0**	**56.0**	**53.0**	**48.0**	**-**	**60.3 dBA**
Composite SRI										
Facade Width (m)	3.5									
Facade Height (m)	3.0									
Main Element - Block Wall										
SRI		44.0	45.0	50.0	60.0	69.0	79.0	89.0	99.0	Rw 62
Window Width (m)	1.5									
Window Height (m)	2.1									
No. of Windows (no)	1.0									
Glazed Element - Rw (Ctr) 35dB (-3)										
SRI		-	24.0	24.0	32.0	37.0	37.0	44.0	-	Rw 35
		-	*-29.15*	*-29.20*	*-37.21*	*-42.22*	*-42.23*	*-49.23*	-	
10 log (S/A)										
Internal Receiver - Typical Bedroom										
		-	*2.6*	*1.9*	*1.1*	*1.1*	*0.2*	*0.2*	-	
+3										
		-	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Bedroom										
Reverberant Field, LPrev		**-**	**38.4**	**33.7**	**22.9**	**17.9**	**13.9**	**1.9**	**-**	**28.4 dBA**

Calculation Sheet

60 dBA Traffic Spectra to Typical living room

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Noise Source										
Noise Source - 60 dBA Traffic Spectra										
Noise Levels		68.0	62.0	58.0	56.0	56.0	53.0	48.0	-	60.3 dBA
Composite SRI										
Facade Width (m)	6.0									
Facade Height (m)	3.0									
Main Element - Block Wall										
SRI		44.0	45.0	50.0	60.0	69.0	79.0	89.0	99.0	Rw 62
Window Width (m)	2.0									
Window Height (m)	2.1									
No. of Windows (no)	1.0									
Glazed Element - Rw (Ctr) 35dB (-3)										
SRI		-	24.0	24.0	32.0	37.0	37.0	44.0	-	Rw 35
		-	*-30.21*	*-30.28*	*-38.30*	*-43.31*	*-43.32*	*-50.32*	-	
10 log (S/A)										
Internal Receiver - Typical Living Room										
		-	*1.7*	*1.2*	*0.5*	*-0.3*	*-0.3*	*-0.3*	-	
+3										
		-	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Bedroom										
Reverberant Field, LPrev		-	36.5	31.9	21.2	15.4	12.4	0.4	-	26.5 dBA

Integrated Acoustic Solutions LTD. Ltd trading as iAcoustics
www.iacoustics.net info@iacoustics.net +353 (0)1 452 1133
Registered Office: Unit A16, Kingswood Business Park, Baldonnell, Dublin 22.

iAcoustics
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Adamstown District Station Blocks A, C & D

Calculation Sheet

55 dBA Traffic Spectra to Typical Bedroom

		Octave Band Centre Frequency (Hz)								
		63	125	250	500	1k	2k	4k	8k	
Noise Source										
Noise Source - 55 dBA Traffic Spectra										
Noise Levels		63.0	57.0	53.0	51.0	51.0	48.0	43.0	-	55.3 dBA
Composite SRI										
Facade Width (m)	3.5									
Facade Height (m)	3.0									
Main Element - Block Wall										
SRI		44.0	45.0	50.0	60.0	69.0	79.0	89.0	99.0	Rw 62
Window Width (m)	1.5									
Window Height (m)	2.1									
No. of Windows (no)	1.0									
Glazed Element - Rw (Ctr) 35dB (-6)										
SRI		-	20.0	21.0	33.0	40.0	36.0	48.0	-	Rw 34
		-	*-25.20*	*-26.22*	*-38.21*	*-45.22*	*-41.23*	*-53.23*	-	
10 log (S/A)										
Internal Receiver - Typical Bedroom										
		-	*2.6*	*1.9*	*1.1*	*1.1*	*0.2*	*0.2*	-	
+3										
		-	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Bedroom										
Reverberant Field, LPrev		-	37.4	31.7	16.9	9.9	9.9	-7.1	-	25.9 dBA

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Calculation Sheet

55 dBA Traffic Spectra to Typical living room

		Octave Band Centre Frequency (Hz)								
		63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**	
Noise Source										
Noise Source - 55 dBA Traffic Spectra										
Noise Levels		**63.0**	**57.0**	**53.0**	**51.0**	**51.0**	**48.0**	**43.0**	-	**55.3 dBA**
Composite SRI										
Facade Width (m)	6.0									
Facade Height (m)	3.0									
Main Element - Block Wall										
SRI		44.0	45.0	50.0	60.0	69.0	79.0	89.0	99.0	Rw 62
Window Width (m)	2.0									
Window Height (m)	2.1									
No. of Windows (no)	1.0									
Glazed Element - Rw (Ctr) 35dB (-6)										
SRI		-	20.0	21.0	33.0	40.0	36.0	48.0	-	Rw 34
		-	*-26.28*	*-27.30*	*-39.29*	*-46.30*	*-42.32*	*-54.32*	-	
10 log (S/A)										
Internal Receiver - Typical Living Room										
		-	*1.7*	*1.2*	*0.5*	*-0.3*	*-0.3*	*-0.3*	-	
+3										
		-	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	*3.0*	-	
Internal Receiver Noise										
Internal Receiver Noise - Typical Bedroom										
Reverberant Field, LPrev		-	**35.5**	**29.9**	**15.2**	**7.4**	**8.4**	**-8.6**	-	**24 dBA**

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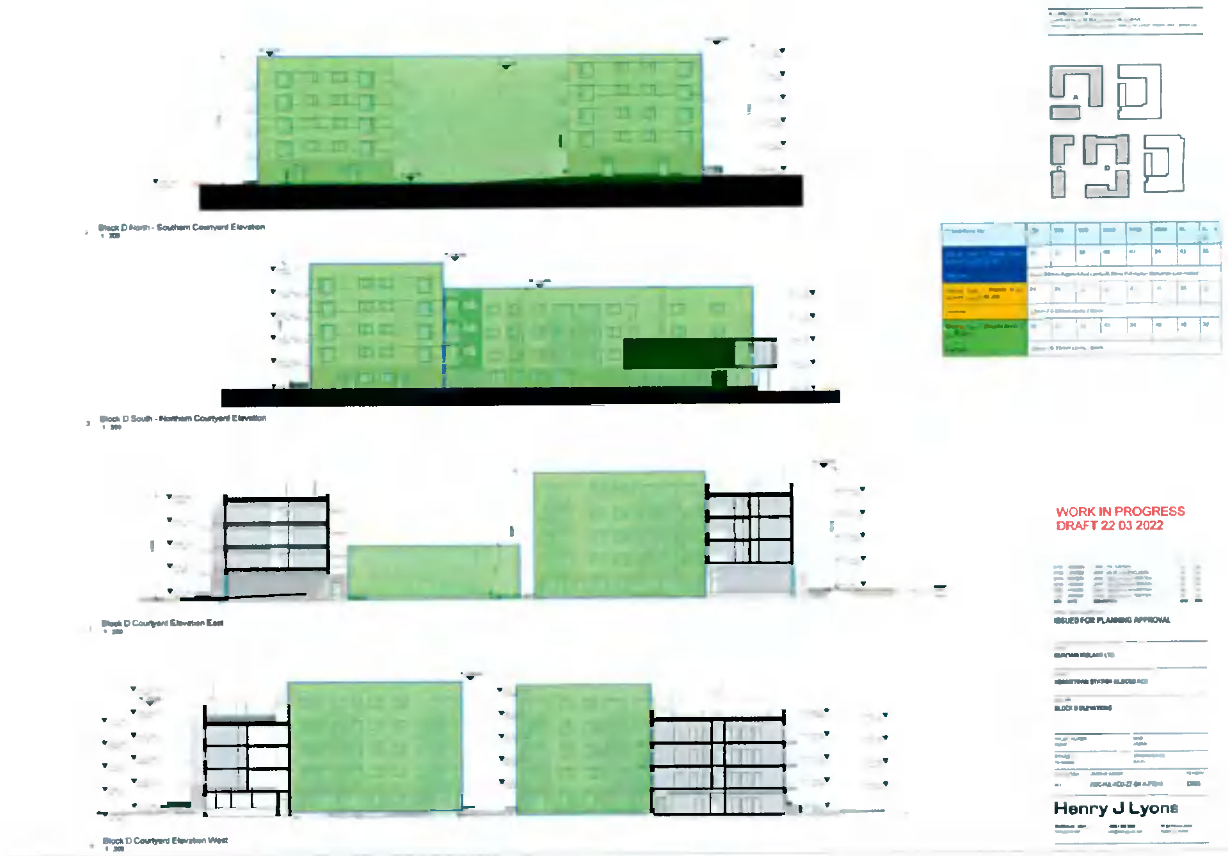
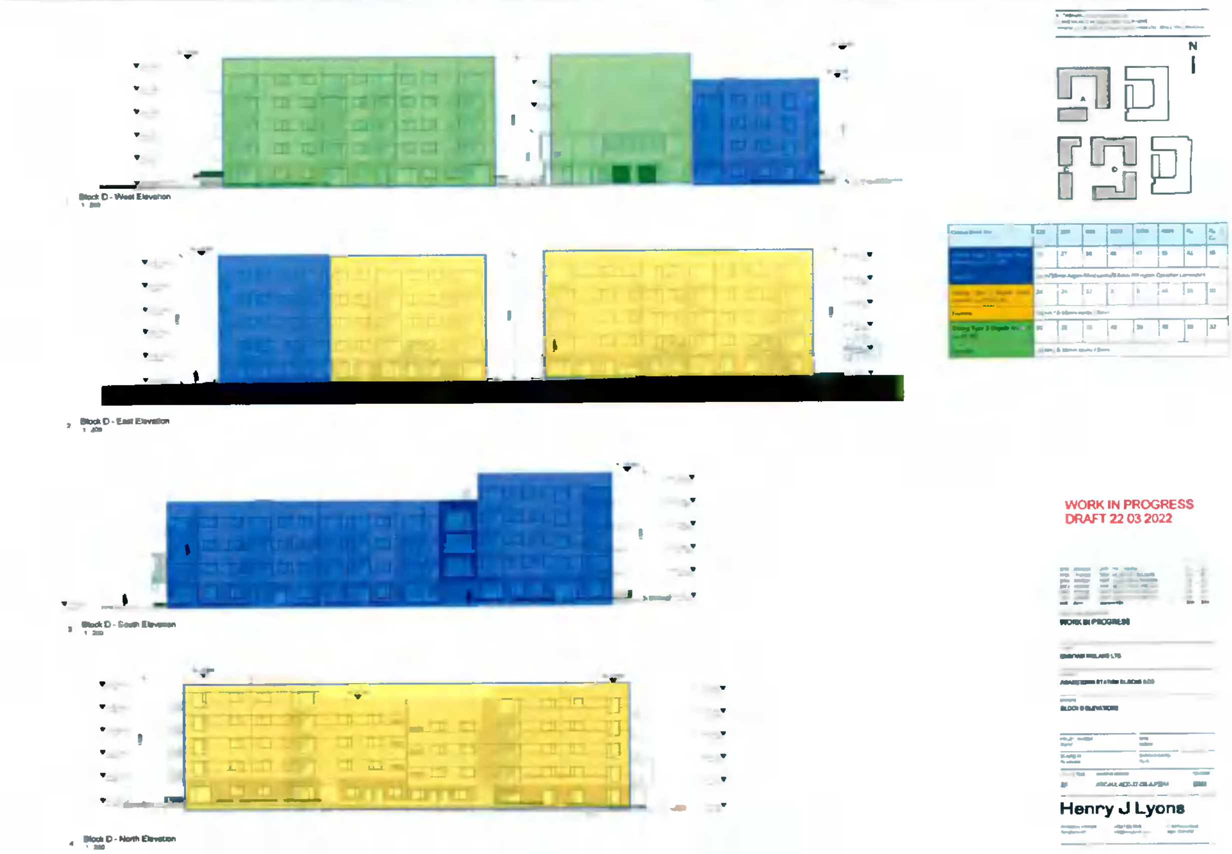
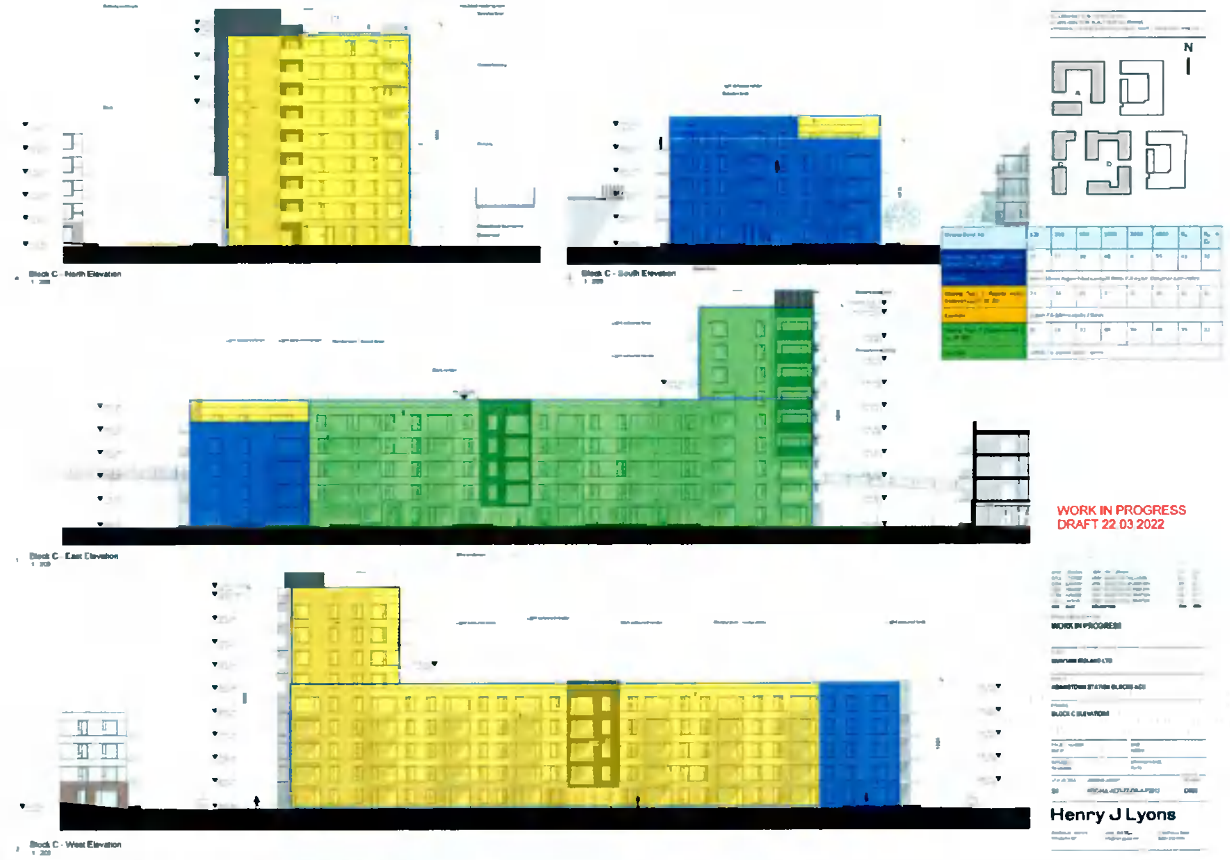
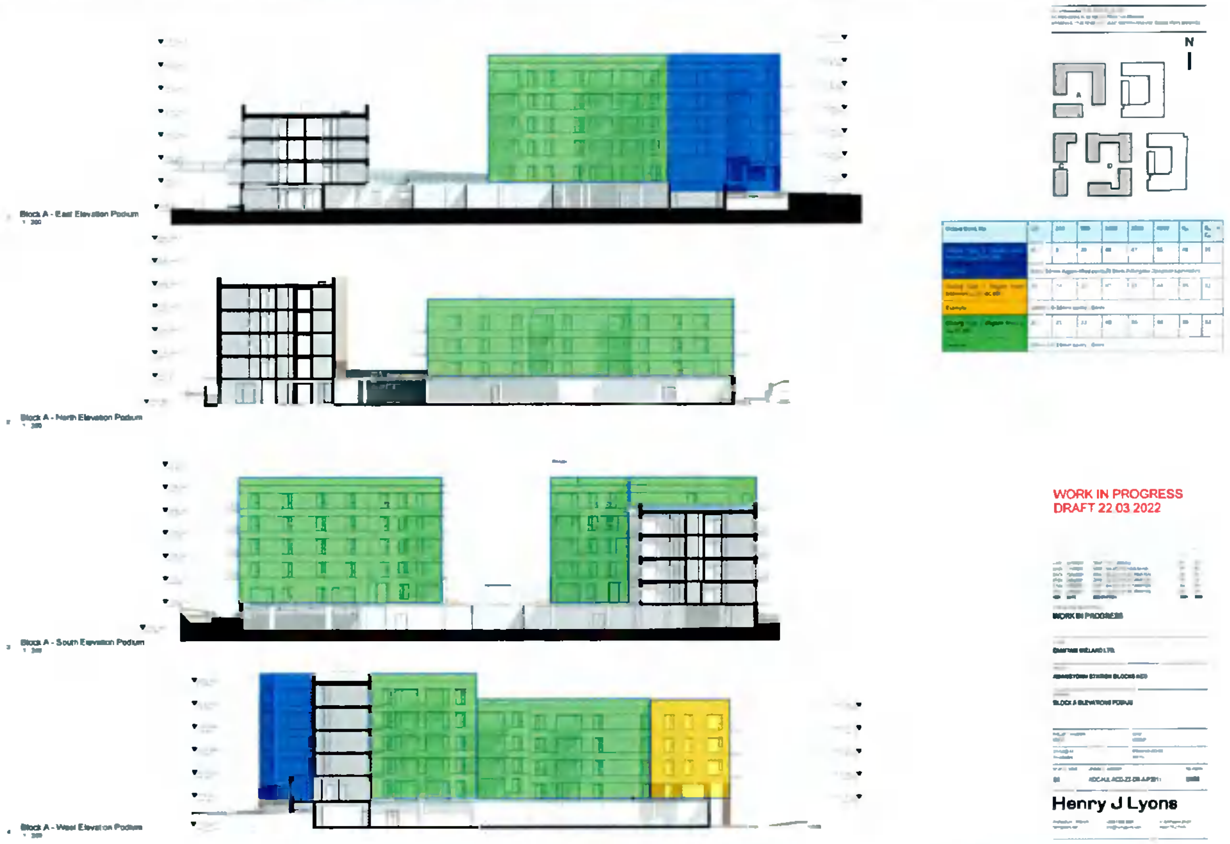
Appendix C – Glazing Markups


Block D North - Southern Courtyard Elevation
Block D South - Northern Courtyard Elevation
Block D Courtyard Elevation East
Block D Courtyard Elevation West
WORK IN PROGRESS
DRAFT 22 03 2022
ISSUED FOR PLANNING APPROVAL
Henry J Lyons


N
Block D - West Elevation
Block D - East Elevation
Block D - South Elevation
Block D - North Elevation
WORK IN PROGRESS
DRAFT 22 03 2022
WORK IN PROGRESS
Henry J Lyons


Block C - North Elevation
Block C - South Elevation
Block C - East Elevation
Block C - West Elevation
N
WORK IN PROGRESS
DRAFT 22 03 2022
Henry J Lyons


Block A - East Elevation Podium
Block A - North Elevation Podium
Block A - South Elevation Podium
Block A - West Elevation Podium
N
WORK IN PROGRESS
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Block A - South Elevation
Block A - East Elevation
Block A - North Elevation
Block A - West Elevation
N
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