Noise and Vibration Impact Survey at Infill Site- St Evins Park, Monasterevin, Co. Kildare.

Client: Architectural Services, Kildare County Council, Devoy Park, Naas, Co. Kildare.

Revision:	Rev 1.6
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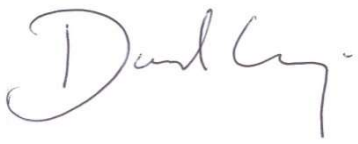

Diarmuid Keaney, ICAN Acoustics.

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1 Non-Technical Summary

ICAN Acoustics was engaged to prepare a noise and vibration assessment that considers rail traffic noise for a development site at a proposed residential development at an infill site at St Evins Park, Monasterevin, Co. Kildare.

This Report has been prepared to assess the effects of rail traffic noise on the proposed residential development. A comprehensive baseline noise and vibration survey has been undertaken at the development site to determine the existing rail noise and vibration levels at the proposed development site. This study aims to assess the site's suitability for residential development and to provide recommendations for noise mitigation measures, but only where necessary. This is further supported by the ProPG Stage 1 Risk Assessment findings that suggest that the proposed residential development would fall under the 'low/medium category' for the daytime period and a 'low/medium category' for the night period.

In addition, the study considers the impact of internal noise levels in the proposed properties, the ventilation strategy, fenestration details and the provision of outdoor amenity areas. We note that the Irish EPA, in their guidance document *'Ireland's Environment -An Integrated Assessment 2020',* advise that the UK's ProPG guidance is widely used in Ireland. They state that, importantly, ProPG guidance highlights that it encourages implementing good acoustic design from the earliest planning stages for new residential developments. As part of the ProPG assessment, we have prepared an Acoustic Design Statement (ADS) for the project and consideration of mitigation measures to be considered where appropriate. In addition, the Report considers the potential increase in rail noise in the general area due to additional rail use, likely in future years.

In addition to considering rail noise, vibration has been assessed using BS6472 to determine the inward impact of ground-borne vibrationon the existing and proposed properties. This study finds current vibration levels as well as further growth. It is expected that vibration levels may be perceptible at low levels during the passing train event. However, the overall vibration dose value estimates would indicate a low probability of adverse comment based on the measured specific rail pass-by data with allowance for future growth.

In summary, having completed a comprehensive study of the proposed development site, it is considered that the site is suitable for residential development.

2 Technical Report

2.1 Introduction

ICAN Acoustics, a noise and vibration consultancy, has been engaged by the Architectural Services Department at Kildare County Council to assess railway noise and vibration at a development site at a proposed residential development at an infill site at St Evins Park, Monasterevin, Co. Kildare. The specific work and site arrangements have been described in the sub-chapters below.

2.2 Project Brief

Kildare County Council requested a Noise Impact survey for the proposed works to the Infill site at St. Evins Park, Monasterevin. We were advised that the site is an open green space with access through the open space.

The objective of the noise impact and vibration survey was to establish the following items:

1. The assess if noise levels at the proposed residential units are likely to equal or exceed undesirable noise levels, as specified in the Local Authority's Noise Action Plan.
2. To report if the scheme in its current form needs to be modified to reduce likely noise and vibration impacts and to recommend mitigation measures where specified noise levels are exceeded.
3. The survey report includes a comprehensive technical report, and a non-technical summary outlining the main issues and making recommendations for noise mitigation proposals.

2.3 Site Arrangement

The proposed development will be located in St Evins Park, Monasterevin, Co. Kildare will be constructed close to the Dublin to Cork Intercity Rail line, which is located on the northern boundary of the development site. The proposed development site is circa 100m east of Monasterevin Railway Station. The layout is shown in Figure 1 below. Figure 1 includes a reference to existing residential properties and a rough outline of the development site area adjacent to the rail line.

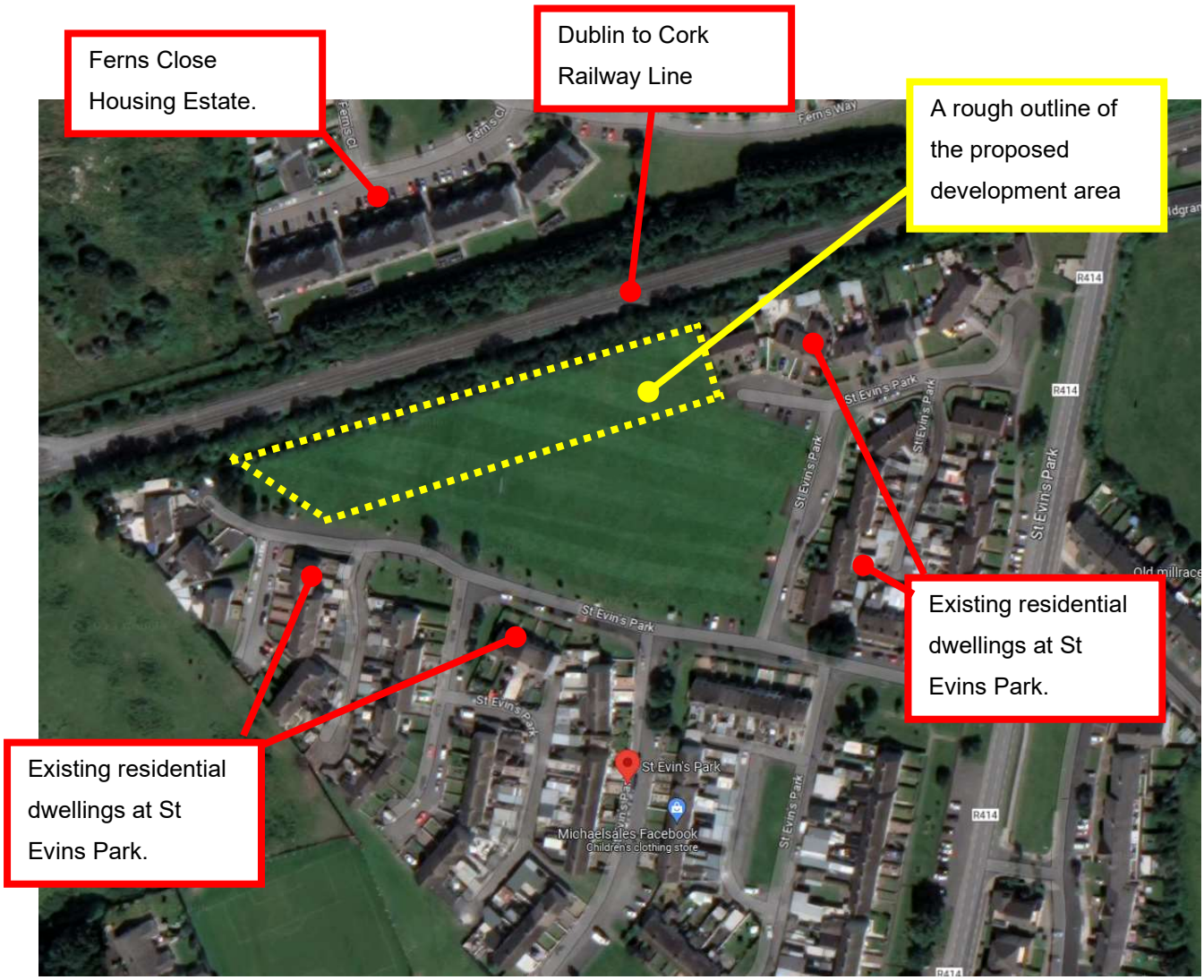

Figure 1: Aerial photograph of the general area surrounding St Evin's Park, Monasterevin, Co. Kildare. (Source: Google Maps).

2.4 Proposed Housing Scheme

The proposed housing scheme will comprise 15 houses in a housing scheme consisting of six house types (Type A~G) located on the northern side of St Evins Park, Monasterevin, Co. Kildare as shown in Figure 2 below. The house types proposed are listed below:

- 1no. Type A (1B2P)
- 1no. Type B (1B2P)
- 7no. Type C (2B4P)
- 3no. Type D (3B5P)
- 1no. Type E (3B6P)
- 1no. Type F (1B2P)
- 1no. Type G (1B2P)

The total site area will be 6420m2, with 15 houses and one parking space per dwelling.

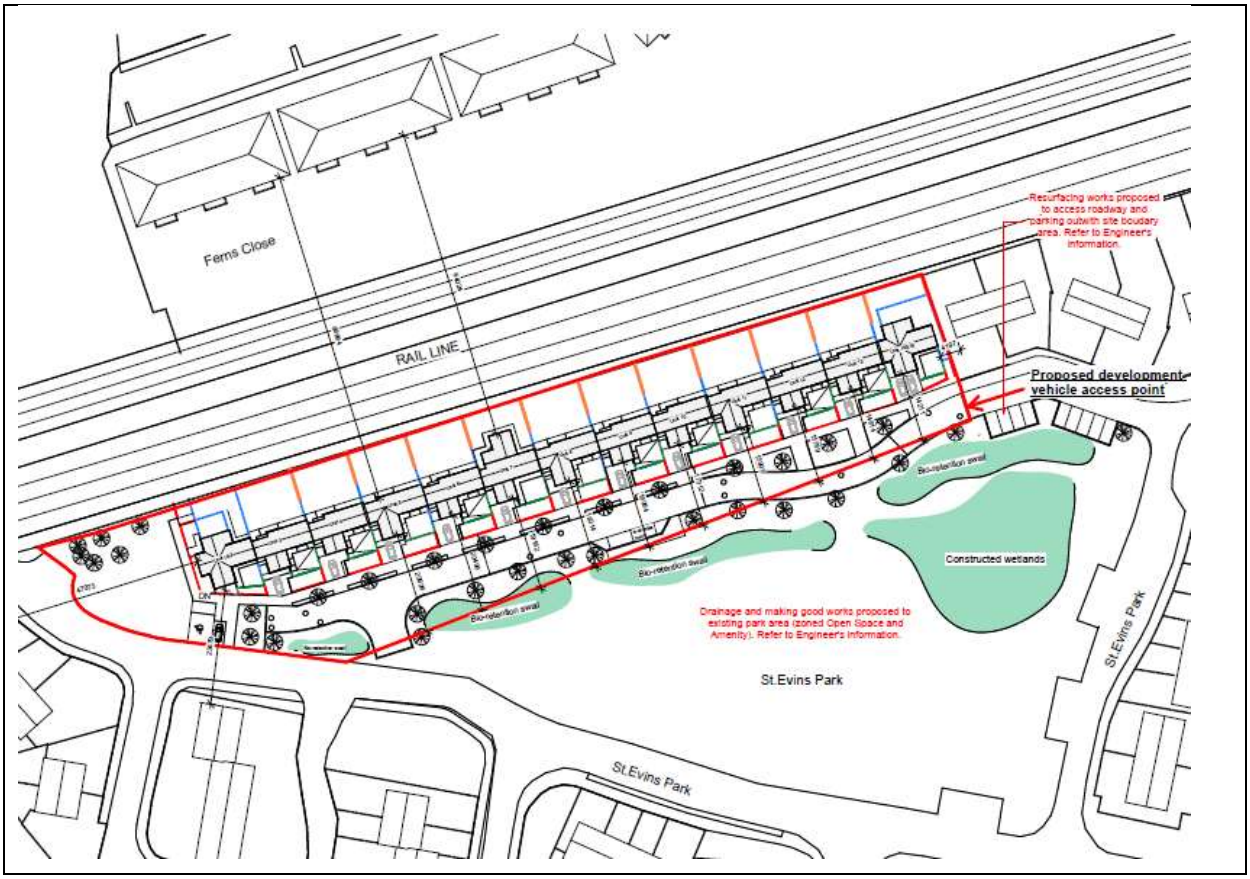

Figure 2: CAD Drawing showing the proposed housing scheme to be located at St Evins Park, Monasterevin, Co. Kildare, adjacent to the Rail Line.

2.5 Methodology to assess noise

The study has been undertaken using the following methodology:

- Baseline noise monitoring has been undertaken at the development site to determine noise levels at monitoring locations, allowing rail noise to be modelled.
- A review of the most applicable standards and guidelines has been conducted to set a range of acceptable noise and vibration criteria for the operational phases of the proposed development.
- Predictive calculations have been performed to assess the potential impacts of rail noise and the proposed residential receptors.;
- The inward impact of noise in the surrounding environment on the proposed buildings has also been assessed to determine the requirements for additional noise mitigation to provide suitable residential amenities.
- A schedule of noise mitigation measures has been proposed, which has been incorporated into the design of the proposed buildings.

2.6 Receiving Environment

The site is in an established residential location at St Evins Park, Monasterevin, Co. Kildare, near the Dublin to Cork Intercity Rail line. There are several residential properties in the area at similar setback distances to the rail line on both the northern and southern sides of the rail line.

2.7 Design Guidance

2.7.1 Irish EPA Guidance- Ireland's Environment – An Integrated Assessment 2020

Project Ireland 2040 includes a national policy objective to integrate noise management with health and planning. The roll-out of Policy Objective 65 in the Project Ireland 2040: National Planning Framework (DHPLG, 2018) is expected to be a significant driver of environmental noise policy in Ireland over the coming decades. Policy Objective 65 requires the following: *'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'*

The document suggests a need for national noise planning guidance for local authorities to ensure better consistency in assessing and conditioning noise issues in planning applications across the country. Planning guidance is of utmost importance in mitigating the current and future health impacts of noise pollution and helping to promote the government policy of improved building standards and 'ensuring that the right development takes place in the right locations.'

2.7.2 ProPG Guidance Referenced by the Irish EPA

The Institute of Acoustics is the UK's professional body for those working in acoustics, noise and vibration. It has some 3000 members worldwide, with approximately 150 members in the Irish branch. In 2017, the Institute co-published guidance to provide practitioners with a recommended approach to noise management within England's planning system. The *Professional Practice Guidance on Planning & Noise: New Residential Development* (ProPG) (IOA, 2017) is widely used, including in Ireland. Importantly, it encourages the implementation of good acoustic design from the earliest stages of planning for new residential developments, which should help reduce noise pollution levels for residents. The recommended approach provides opportunities to incorporate innovative and practical design interventions to enable residential development to proceed in acoustically challenging areas. In locations where it would not be appropriate to build new dwellings because of significant noise pollution, even with acoustic design considerations, the guidance encourages early identification of the risk of refusal. It supports early decision-making, thereby avoiding unnecessary development and design costs.

2.7.3 Kildare County Councils Noise Action Plan

This study considers Kildare County Council's Noise Action Plan (NAP) for 2019~2023, which was published by the requirements of the European Noise Directive (2002/49/EC). One of the key elements of the END is to assist in determining an estimate of the population's exposure to undesirable levels of noise that can potentially cause harmful health effects. In addition, the second purpose of noise mapping is to identify low-noise areas and areas that should be protected. The Kildare 2019 - 2023 Noise Action Plan proposes noise levels thresholds for this assessment of 70 dB (A) Lden, and 57 dB (A) Lnight for both "Major Roads" and "Major Railways" set in accordance with the Environmental Protection Agency (EPA) "Guidance Note for Noise Action Planning, July 2009". The NAP states that these limits are arbitrary at present as there is no existing legislation that limits environmental noise to a particular value. The limits are the same as those used in the previous two County Noise Action Plans.

The NAP advises these are consistent with those used by other Action Planning Authorities and with EPA guidance.

2.7.4 EPA Strategic Noise Contour Maps for the Area

Strategic noise contour maps show that the properties will fall under the band of 60~64dB, Lden based on published data from the Irish EPA.

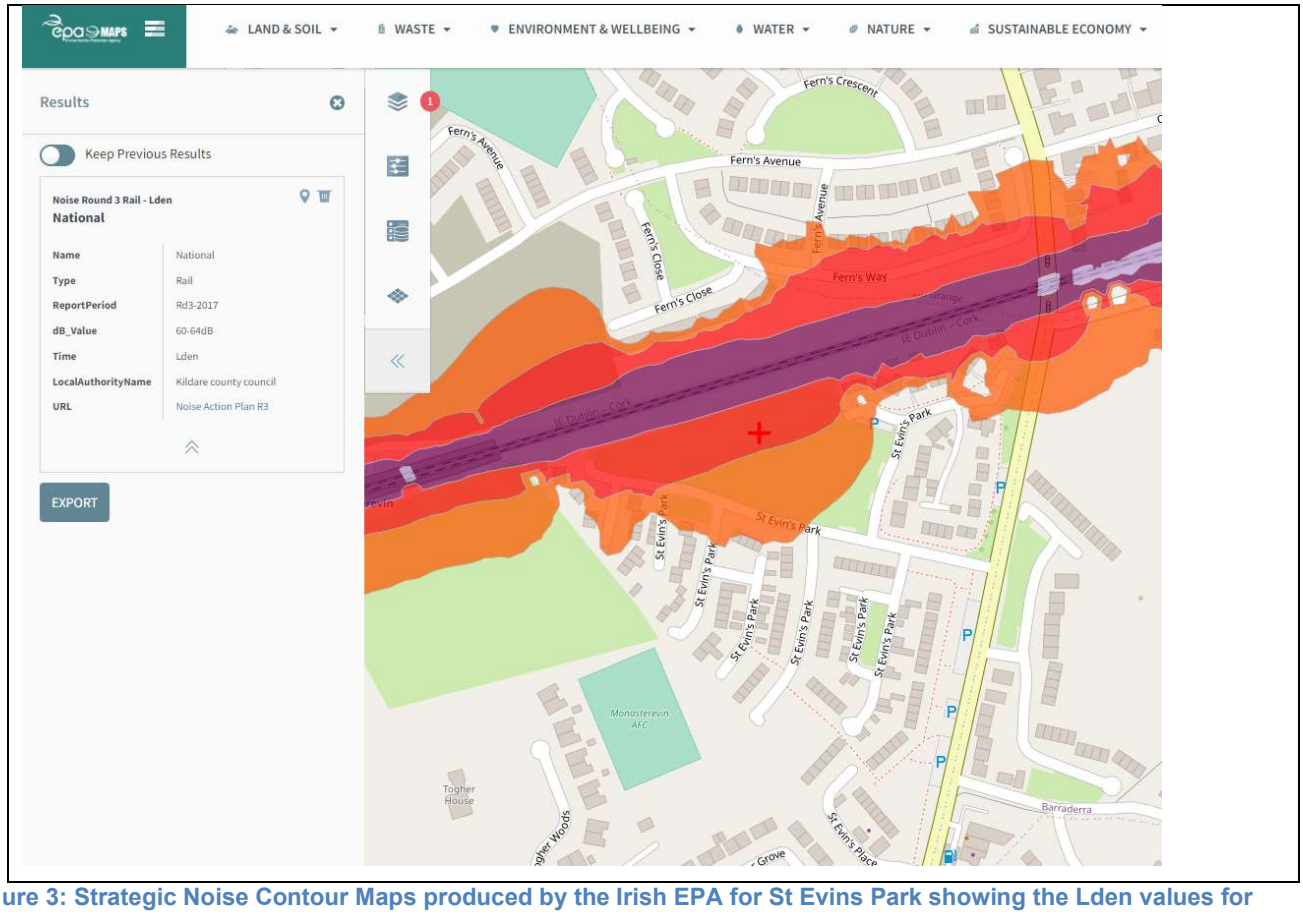

Figure 3: Strategic Noise Contour Maps produced by the Irish EPA for St Evins Park showing the Lden values for the area.

Strategic noise contour maps show that the properties will fall under the band of 50~54dB, Lnight based on published data from the Irish EPA.

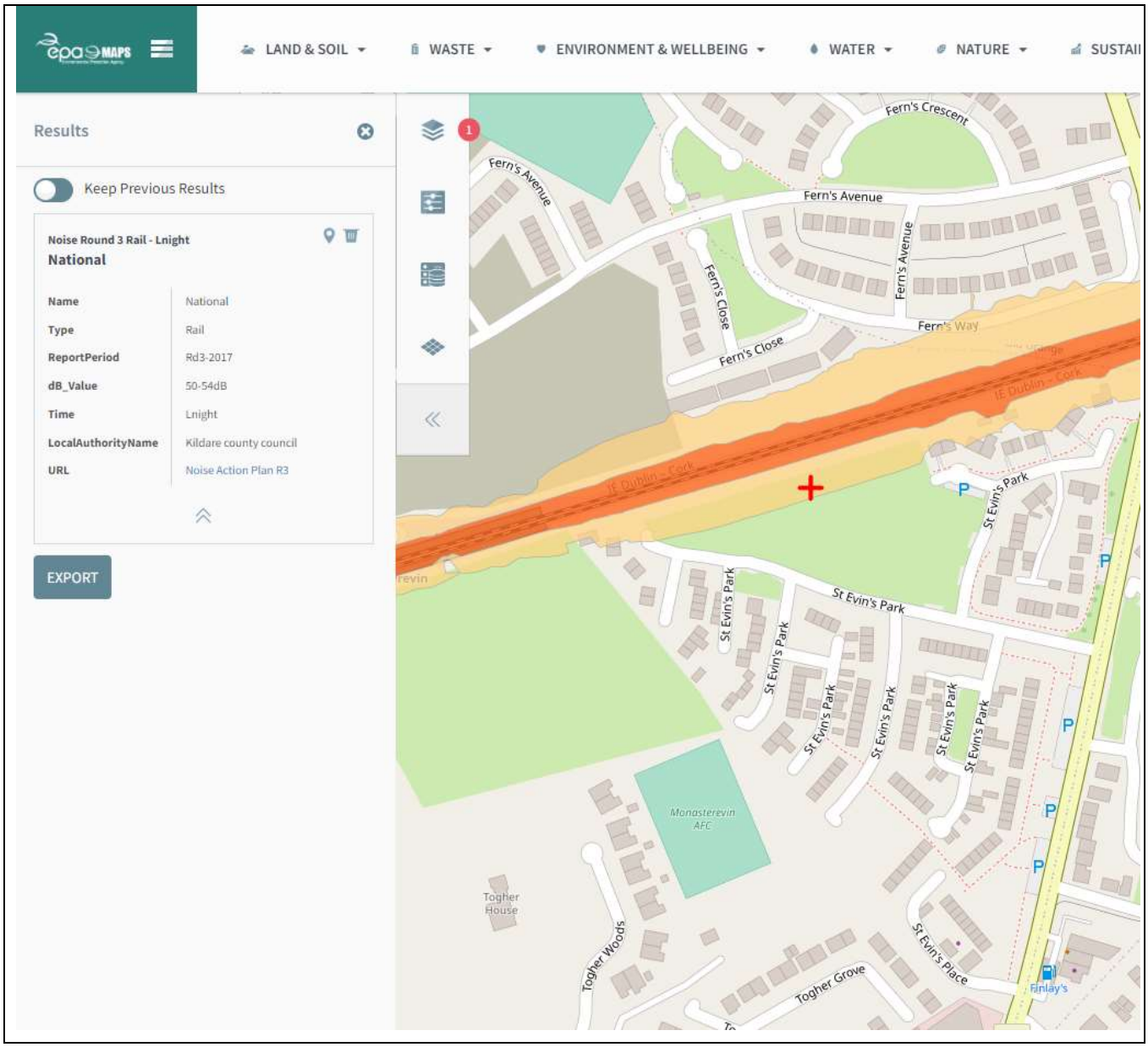

Figure 4: Strategic Noise Contour Maps produced by the Irish EPA for St Evins Park showing the Lnight values for the area.

It is evident from this that the railway line is NOTABLY below the thresholds of for assessment as a Major Railway.

2.7.5 Irish Planning Policy on Rail Noise

Ireland has no government planning policy or guidance on assessing rail noise. The Kildare County Council's Noise Action Plan for 2019~2023 confirms that no existing legislation limits environmental noise to a particular value.

3 ProPG: Planning & Noise

As referenced in the Irish EPA Guidance- Ireland's Environment – An Integrated Assessment 2020, The Professional Practice Guidance on Planning and Noise (ProPG) was published in May 2017 and produced jointly by the Association of Noise Consultants (ANC), the Institute of Acoustics (IOA), and the Chartered Institute of Environmental Health (CIEH) in the UK. The guidance adopts a two-stage approach in assessing potential residential developments that will be exposed predominately to airborne noise from transport. The ProPG outlines a systematic risk-based two-stage approach for evaluating noise exposure on prospective sites for residential development. The two primary stages of the approach can be summarised in subsequent chapters below.

3.1 Stage 1

Stage 1 is an initial noise risk assessment of the proposed development site. This should indicate whether the site poses a negligible, low, medium, or high noise risk based on noise levels measured during the day and night-time. The aim is to describe noise levels over a "typical worst-case" 24-hour day either now or in the foreseeable future. The Indicative Daytime (LAeq,16hr) and Indicative Night-time (LAeq,8hr) noise levels for each category have been calculated. These are combined free-field noise levels from all transport noise sources and may include industrial/commercial noise where this is present but is "not dominant". In this case, however, the Dublin to Cork Intercity Rail line remains the dominant noise source at the proposed development. Therefore, the levels should be assessed without including the acoustic effect of any scheme-specific noise mitigation measures. An indication that there may be more than ten noise events at night (23:00hrs – 07:00hrs) with LAF Max > 60 dB means the site should not be regarded as a negligible risk.

3.2 Stage 2

Stage 2 of the recommended approach contains four key elements to be undertaken in parallel, and each is considered in turn below in the following sub-sections.

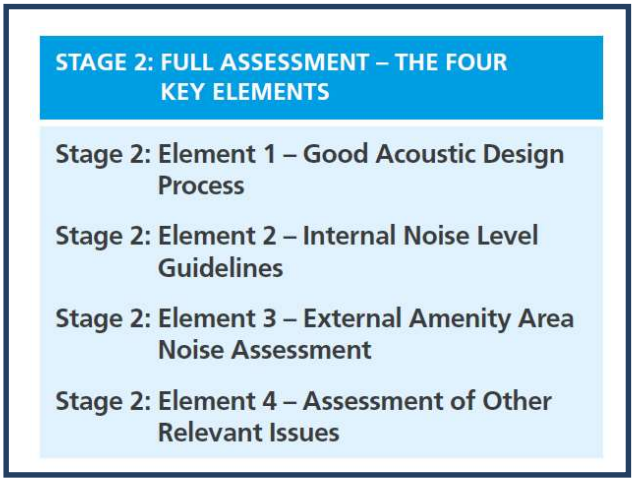

Figure 5– Stage 2 – Full assessment of the four key element

A major component of the evaluation process is the preparation and delivery of an Acoustic Design Statement (ADS) intended for submission to the planning authority as part of the Planning process. Our study on this project clearly outlines the methodology and findings of Stage 1 and Stage 2 assessments to allow the Planning Authority to make an informed decision on the permission.

ProPG outlines four possible recommendations concerning the findings of the ADS, which have been reproduced below:

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 to avoid significant adverse effects.
D. Planning consent should be refused on noise grounds to prevent unacceptable adverse effects.

3.2.1 A graphical representation of the ProPG approach.

A graphical representation of the ProPG approach is shown in Figure 4 below.

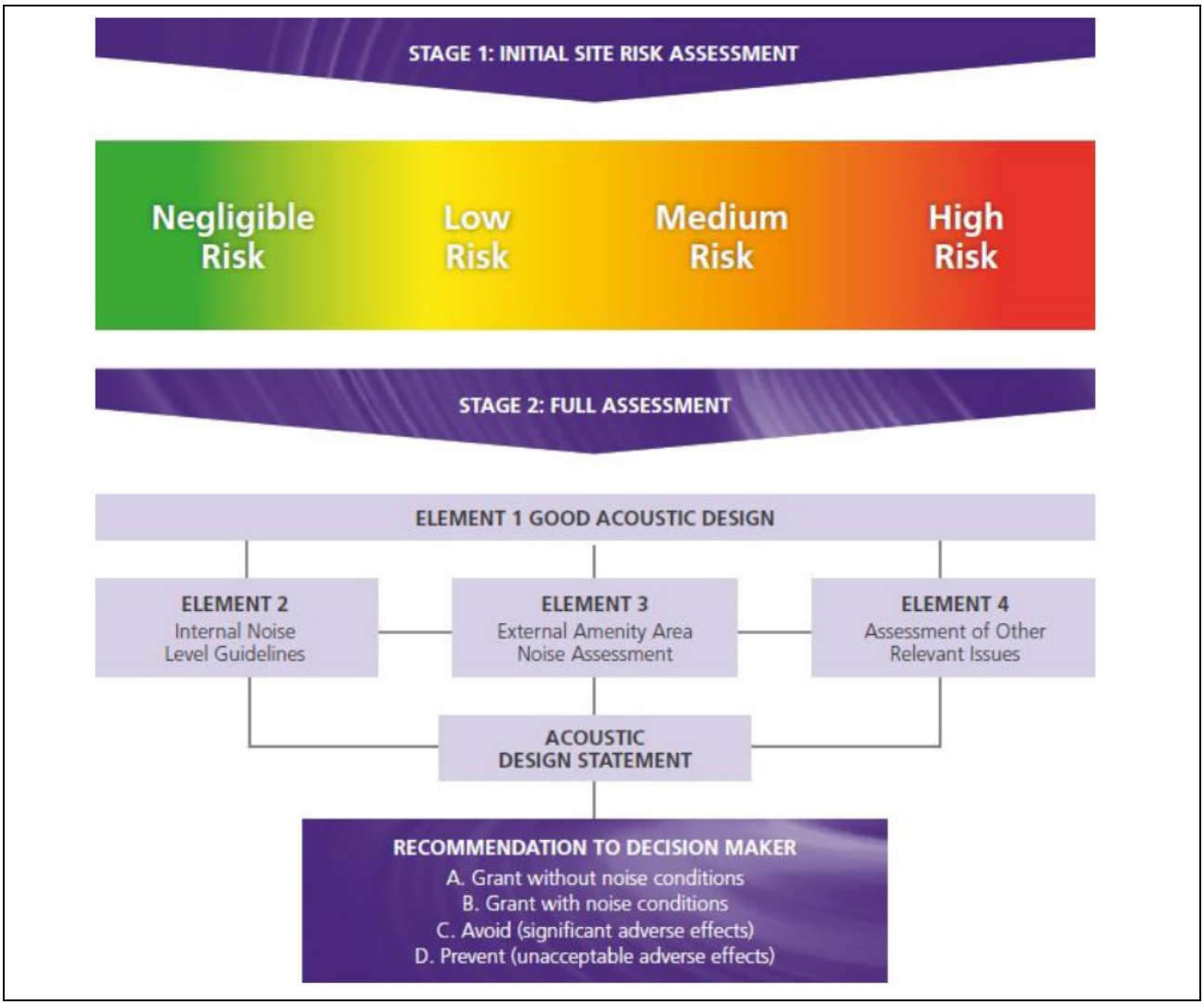

Figure 6: Summary of the ProPG Approach (Source: ProPG Document.

3.3 Stage 1- Noise Risk Assessment

3.3.1 Methodology

3.3.1.1 Stage 1 Risk Category

Figure 7 below shows the measured rail noise level where the instrumentation could be secured at an identical set back distance to the residential properties being proposed at St Evin's Park.

Period	Start Date	Measurement Duration	Weighting Duration	LAeq [dB]
Day	18 Nov	04:59:24	16:00:00	58.9
Night	18 Nov	08:00:00	08:00:00	48.5
Ldn	18 Nov			
Day	19 Nov	15:59:55	16:00:00	59.7
Night	19 Nov	08:00:00	08:00:00	48.1
Ldn	19 Nov			
Day	20 Nov	16:00:00	16:00:00	57.9
Night	20 Nov	08:00:00	08:00:00	37.8
Ldn	20 Nov			
Day	21 Nov	16:00:00	16:00:00	59.5
Night	21 Nov	08:00:00	08:00:00	49.1
Ldn	21 Nov			
Day	22 Nov	16:00:00	16:00:00	60.2
Night	22 Nov	08:00:00	08:00:00	48.6
Ldn	22 Nov			
Day	23 Nov	16:00:00	16:00:00	59.7
Night	23 Nov	08:00:00	08:00:00	50.3
Ldn	23 Nov			
Day	24 Nov	10:39:03	16:00:00	61.0

Figure 7: Measured Rail Traffic levels at Ferns Close at 34m from the rail line at a height of 4m above ground from 18 November to 24 November 2021

Rail traffic noise levels have been measured and determined to the indicative risk category defined in the Stage 1 assessment of ProPG. It should be noted that this preliminary review does not consider mitigation.

	Measured Level at Ferns Close	Façade Correction	Distance Correction for St Evins Park (derived from modelling)	Noise level at new Development at St Evin's Park
Daytime Noise Climate (Rail Dominated)	LAeq,16hr=60dB	-2.5dB	+1.6dB	LAeq,16hr=59dB
Night Noise Climate (Rail Dominated)	LAeq,8hour=50dB	-2.5dB	+1.6dB	LAeq,8hour=49dB

Table 1: Rail noise levels at the new development at St Evins Park, Monasterevin, Co. Kildare.

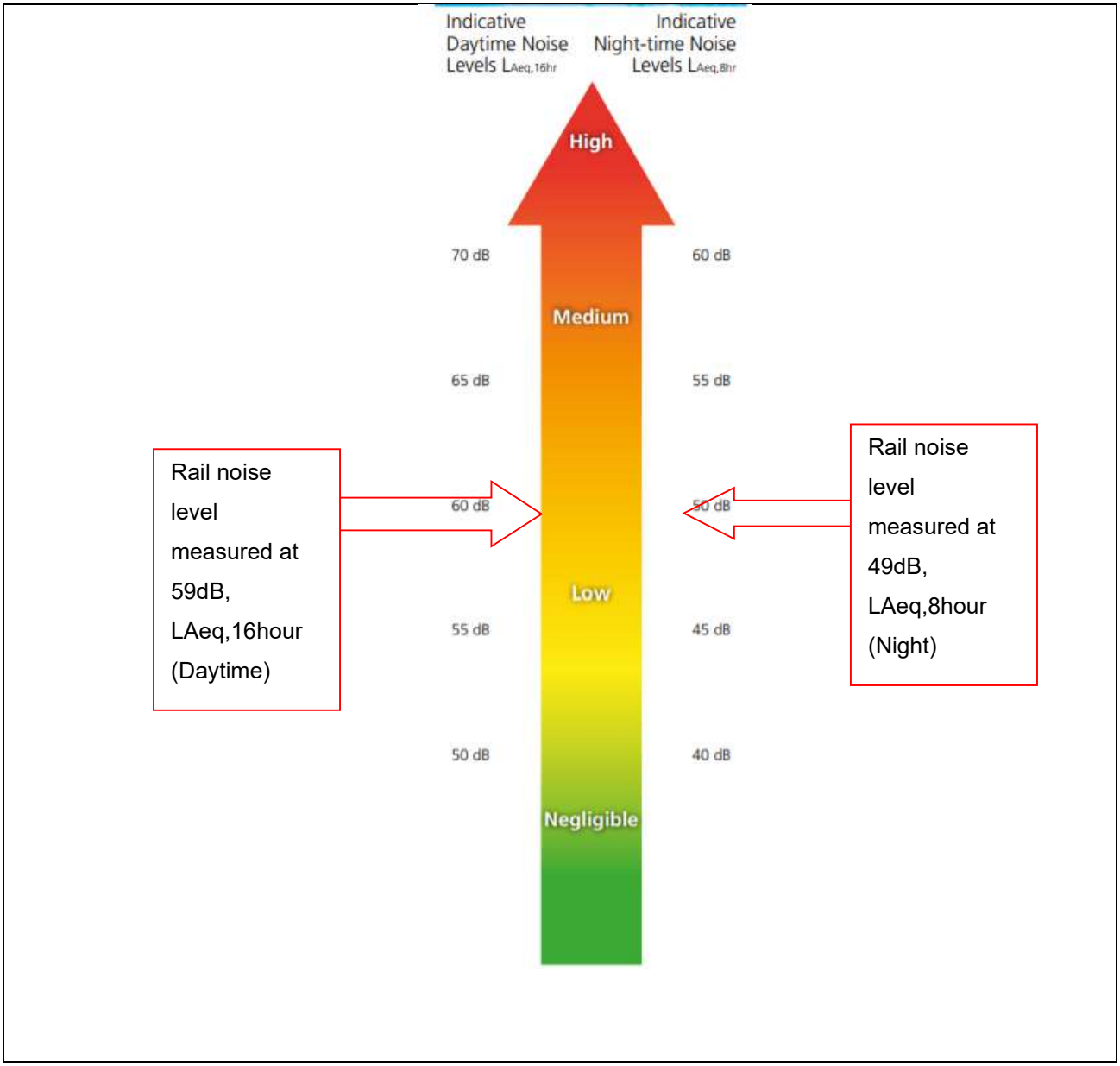

Figure 8: Indicative Risk Category defined in Stage 1 of the ProPG assessment process.

	Noise level at new Development at St Evins Park	**Risk Category**
Daytime Noise Climate (Rail Dominated)	LAeq,16hr=59dB	Low/Medium Risk Category.
Night Noise Climate (Rail Dominated)	LAeq,8hour=49dB	Low/Medium Risk Category.

Table 2: Rail noise level risk for the new development at St Evins Park, Monasterevin, Co. Kildare.

3.3.1.2 Measured LAFmax levels (night)

ProPG states that if there is an indication that there may be more than ten noise events between the hours 23:00-07:00 with an LAFmax in excess of 60 dB, the site should not be regarded as a 'negligible risk'. LAFmax values exceed 60dB, LAFmax when there are rail events and over an observation period from 23:00hrs to 07:00hrs, we noted just six rail events between that time. While there are not ten or more noise events from rail at night, if there were, then it would just mean that the site should not be considered as a 'negligible risk'. Our findings for the Daytime and Night climate, as shown in Table 2 above, would fall into the Low/Medium risk category.

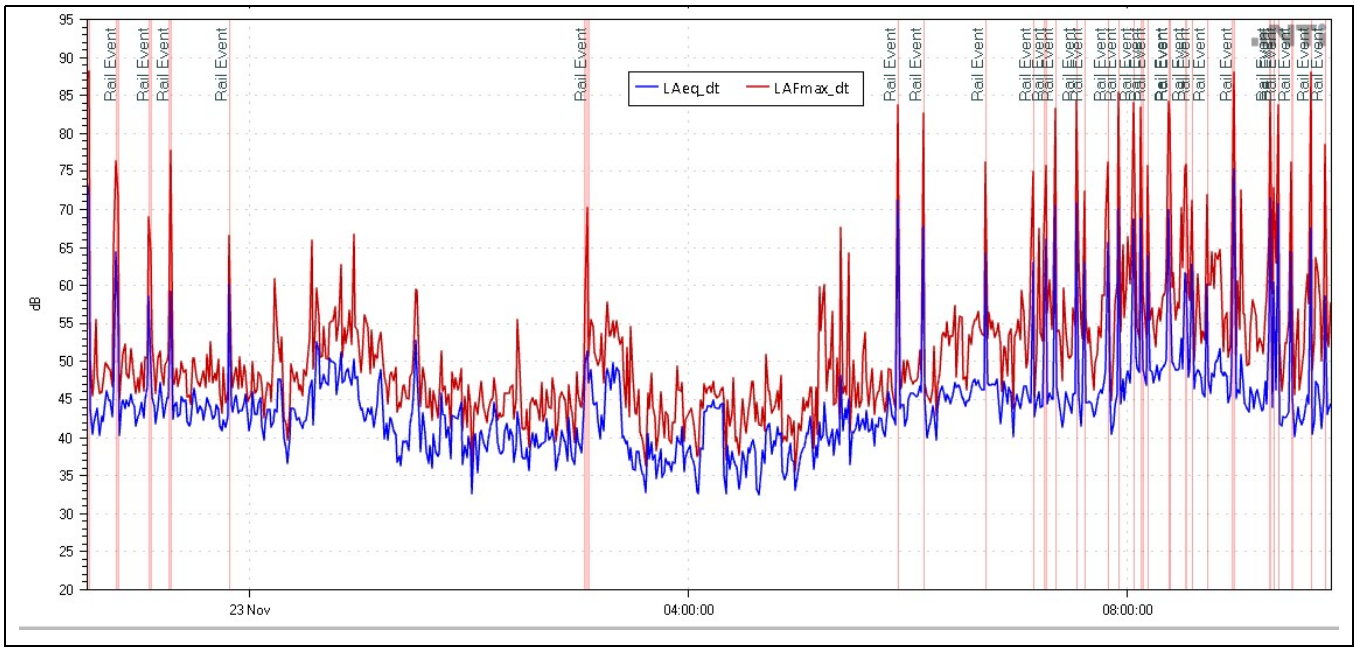

Figure 9: LAFmax values determined at measurement location A on-site at a reference height of 4m above ground level.

3.3.2 Conclusions from Stage 1 risk assessment

From the Stage 1 assessment, we can conclude that the development site has been risk-assessed, and the findings are as follows:

	Phase 1 conclusions	**Measurements**
Daytime Risk Category	LAeq,16hr=59dB	Low/Medium Risk Category.
Night time Risk Category	LAeq,8hour=49dB	Low/Medium Risk Category.

Table 3: Showing the Conclusions regarding the Stage 1 Risk Assessment for the site.

3.4 Baseline Study

A baseline noise monitoring has been undertaken across the development site to determine the range of noise levels at varying locations and establish the existing noise climate at the proposed residential development. The survey was conducted in general accordance with ISO 1996: 2017: Acoustics – Description, measurement and assessment of environmental noise.

3.4.1 Instrumentation

3.4.1.1 NTi Audio XL2 Sound Level Meter (SLM1)

Sound Level Meter, NTi Audio, Serial No: A2A-10976-E0
Calibration Certificate Dated: 20 October 2021 (2-year calibration)
Type 1 instrument.
Calibration certification has been provided in Appendix A of this Report.

3.4.1.2 NTi Audio XL2 Sound Level Meter (SLM3)

Sound Level Meter, NTi Audio, Serial No: A2A-11106-E0
Calibration Certificate Dated: 14 August 2020 (2-year calibration)
Type 1 instrument.
Calibration certification has been provided in Appendix A of this Report.

3.4.1.3 Field Calibration (Instrument A)

Using the Type 4231 Sound Level Calibrator, which produces a sound level of 93.8dB re.2x10-5 Pa, at a frequency of 1 kHz. The instrumentation used was calibrated before and after use of each measurement with a recorded maximum deviation of –0.02dB
Calibrator, Bruel & Kjaer Type: 4231 with Serial No 2499109
Date of Calibration: 19 October 2021 (annual calibration)

Calibration certification has been provided in Appendix A of this Report

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The measurement locations used to determine the rail noise climate at St Evins Park, Monasterevin, Co. Kildare are shown in Figure 10 below.

Figure 10: Aerial photo showing the site measurement locations (Source: Google Maps) in St Evins Park, Monasterevin, Co. Kildare and a proxy location on the northern side of the rail track at Ferns Close.

Location A: At 4m above ground where a 1st-floor bedroom would be located.

Type	Start	Duration	LAeq [dB]	LAFmax [dB]	L 10.0 % [dB]	L 90.0 % [dB]
60'	2021-11-18 10:00:00	00:56:02	54.3	80.7	48.0	42.2
60'	2021-11-18 11:00:00	01:00:00	58.6	94.0	48.3	42.4
60'	2021-11-18 12:00:00	01:00:00	57.0	86.9	50.6	42.2
60'	2021-11-18 13:00:00	01:00:00	57.2	85.6	49.4	42.8
60'	2021-11-18 14:00:00	01:00:00	56.0	84.7	48.8	43.0
60'	2021-11-18 15:00:00	01:00:00	56.9	81.2	50.0	42.9
60'	2021-11-18 16:00:00	01:00:00	64.0	100.6	48.0	42.5
60'	2021-11-18 17:00:00	00:11:07	56.4	80.0	48.8	43.6

Table 4: Measurements shown at 4m above ground at the rear of the proposed development.

Location B: At 1.6m above ground in a northern garden area.

Type	Start	Duration	LAeq [dB]	LAFmax [dB]	L 10.0 % [dB]	L 90.0 % [dB]
60'	2021-11-18 10:00:00	00:48:48	52.5	78.2	47.0	41.3
60'	2021-11-18 11:00:00	01:00:00	56.4	91.8	46.9	41.6
60'	2021-11-18 12:00:00	01:00:00	54.6	87.1	49.2	41.5
60'	2021-11-18 13:00:00	01:00:00	54.9	83.6	48.3	42.0
60'	2021-11-18 14:00:00	01:00:00	53.5	81.4	47.3	42.2
60'	2021-11-18 15:00:00	00:15:50	56.9	77.0	48.8	42.8

Table 5: Measurements shown at 1.6m above ground in the proposed rear garden of a development.

3.4.2 Determination of daytime and night-time noise levels.

A comprehensive noise survey was conducted over four days, from 18 November 2021 to 24 November 2021. Measurements were conducted at a measurement height of 4m above ground.

	Measured Level at Ferns Close	Façade Correction	Distance Correction for St Evins Park (derived from modelling)	The level at the new Development at St Evin's Park.
Daytime Noise Climate (Rail Dominated)	LAeq,16hr=60dB	-2.5dB	+1.6dB	LAeq,16hr=59dB
Night Noise Climate (Rail Dominated)	LAeq,8hour=50dB	-2.5dB	+1.6dB	LAeq,8hour=49dB

Table 6: Rail noise levels at the new development at St Evins Park, Monasterevin, Co. Kildare.

3.5 Noise Contour Model of Site

A sound propagation model of the site was prepared using a Cadna-A software package (computer-aided design prediction software). The sound sources in the model were calibrated and validated based on our baseline noise measurement survey. Daytime grids are calculated at 1.6m in height. Night-time noise contours are calculated at 1st-floor height (4m). The predicted sound levels across the site are then compared to the ProPG initial risk assessment values to determine the site's suitability for residential use. Existing Daytime Noise Contours for the existing site (16 hours).

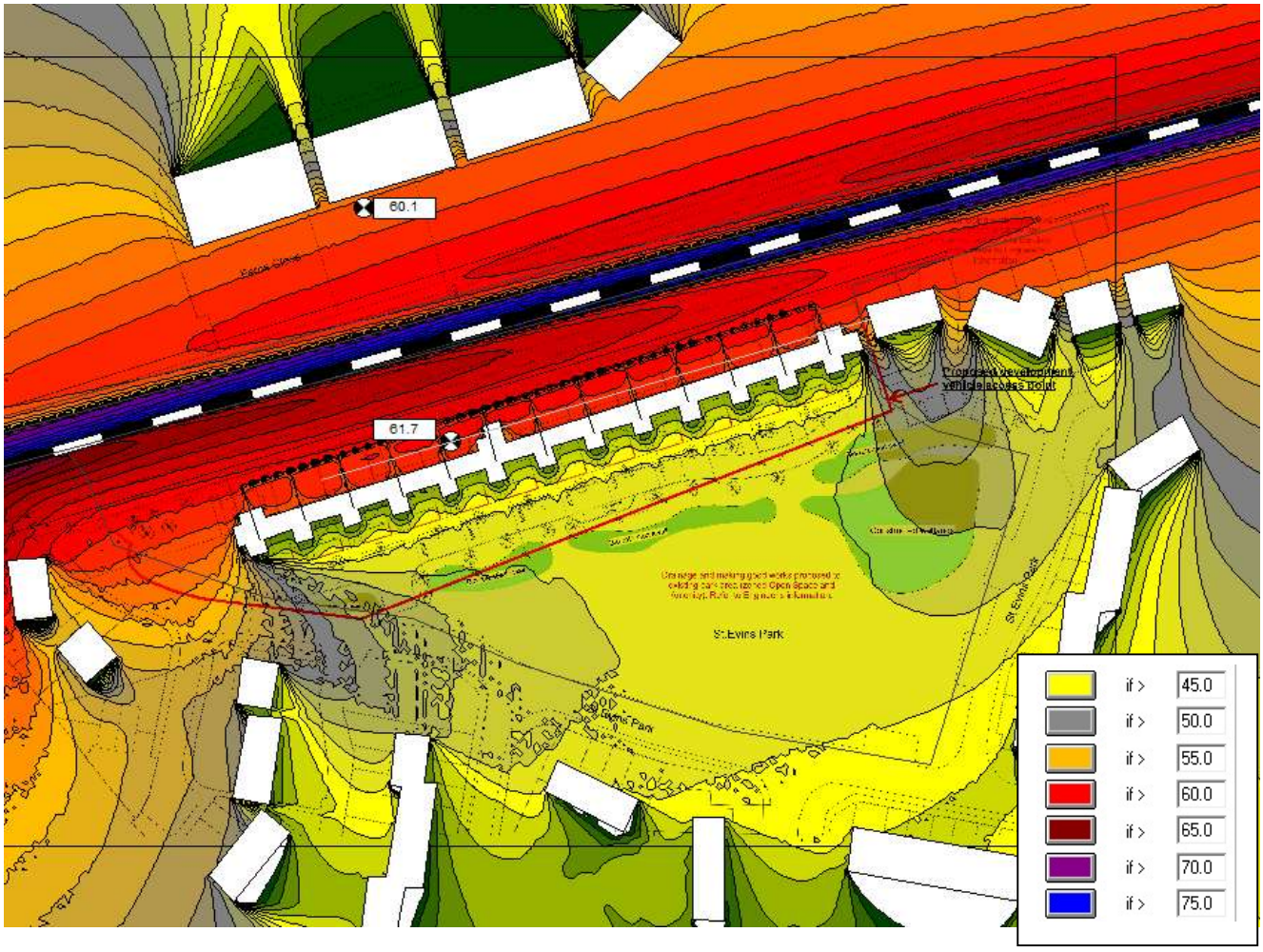

Figure 11: Showing a daytime noise contour map (LAeq,16hour) of the site for the daytime period at 1.6m above ground level for the proposed residential scheme at St Evins Park, Monasterevin, Co. Kildare.

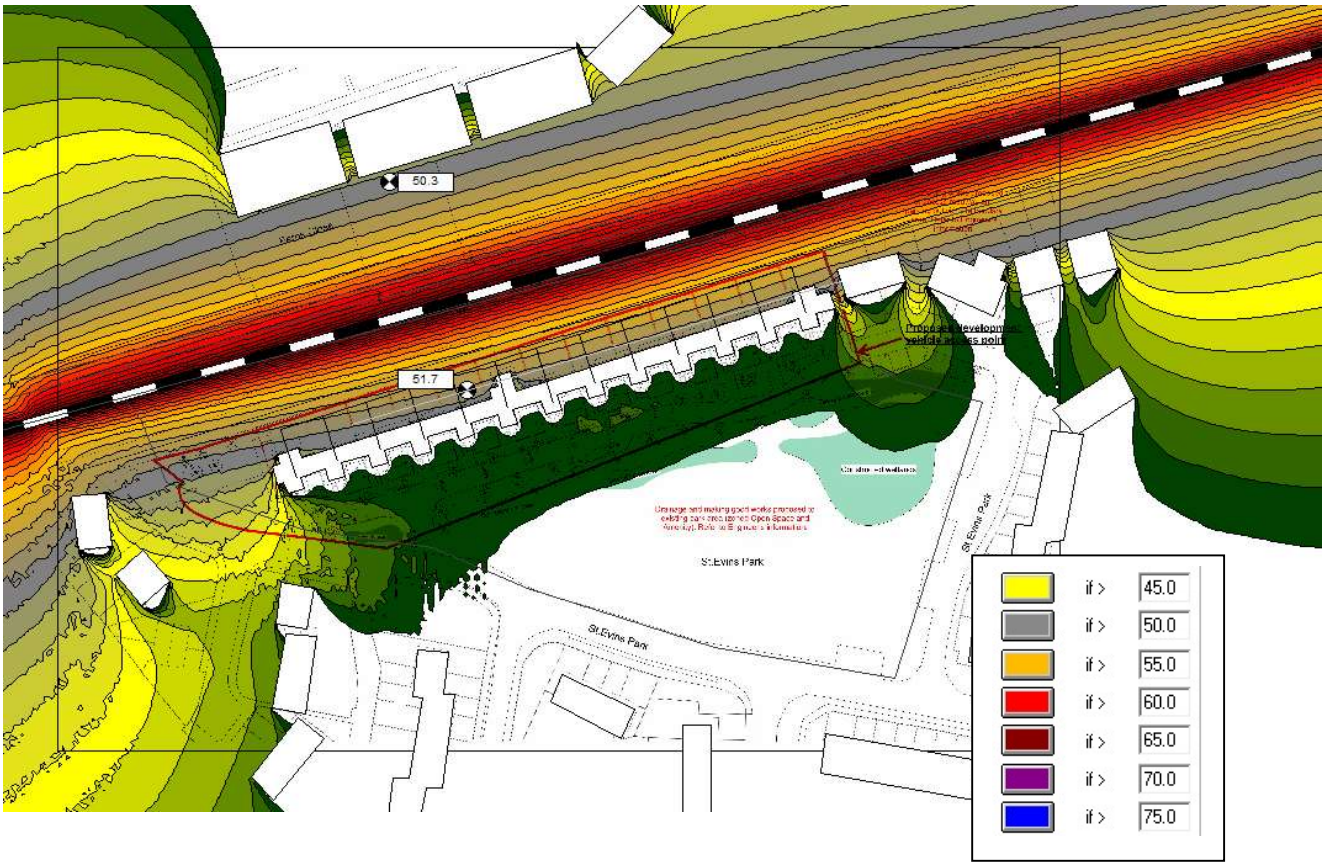

Figure 12: Showing a night noise contour map (LAeq,8hour) of the site for the night period at 1.6m above ground level proposed residential scheme at St Evins Park, Monasterevin, Co. Kildare.

3.6 Noise Risk Assessment Conclusion

From the Stage 1 assessment, we can conclude that the development site has been risk-assessed, and the findings are as follows:

	Phase 1 conclusions	**Likely levels at Residential Receptors (Corrected for façade reflections)**
Daytime Risk Category	Low/Medium Risk	56~ 57dB, LAeq,16hours
Night-time Risk Category	Low/Medium Risk	47~49dB, LAeq, 8hours

Table 7: Showing the Conclusions regarding the Stage 1 Risk Assessment for the proposed residential scheme at St Evins Park, Monasterevin, Co. Kildare.

4 Stage 2 Noise Risk Assessment

ProPG sets out four elements that form Stage 2 of the approach:

Element 1 – Good Acoustic Design Process

Element 2 – Internal Noise Level Guidelines

Element 3 – External Amenity Area Noise Assessment

Element 4 – Assessment of other relEvint issues

These four elements are considered in turn in the following sections.

4.1 Element 1 -Good Acoustics Design Process

This element addresses how noise can be mitigated at the site in general terms and indicates that noise can be factored into the overall design process for the scheme. The primary noise source across the site is from the Dublin to Cork Intercity Rail line, which runs on the northern side of the site. In the absence of rail noise, distant road traffic noise is audible, but rail noise remains the dominant source at the site.

In practice, the objective is to design the building envelope to sufficiently reduce internal noise from local rail traffic to meet the BS8233 guidelines using the 'in-principle' noise control measures discussed in subsequent chapters.

ProPG sets out a requirement for Good Acoustic Design (GAD) and should aim to deliver optimum acoustic design for a site without adversely affecting amenities or quality of life or compromising other sustainable design objectives ProPG. The guidance also suggests that good acoustic design is not equivalent to the overdesign of all new developments but that it seeks to deliver an optimum acoustic environment for a given site. ProPG outlines the following checklist for GAD:

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

Below we have prepared a narrative concerning each element to be considered using GAD.

Relocation or Reduction of Noise from Source

Our site survey shows that rail noise from the site is the dominant noise source impacting the site. This source is located on the northern side of the development site.

Planning, Layout and Orientation

The site is well-designed, whereby the residential buildings provide rail noise screening to amenities areas on the southern side of the proposed development. Property areas on the northern side of the residential properties will be used for ancillary residential use such as clothes drying, garage/shed area location and planting areas. The site has been designed to include property amenity areas on the southern side at locations that use residential buildings to screen and reduce rail noise.

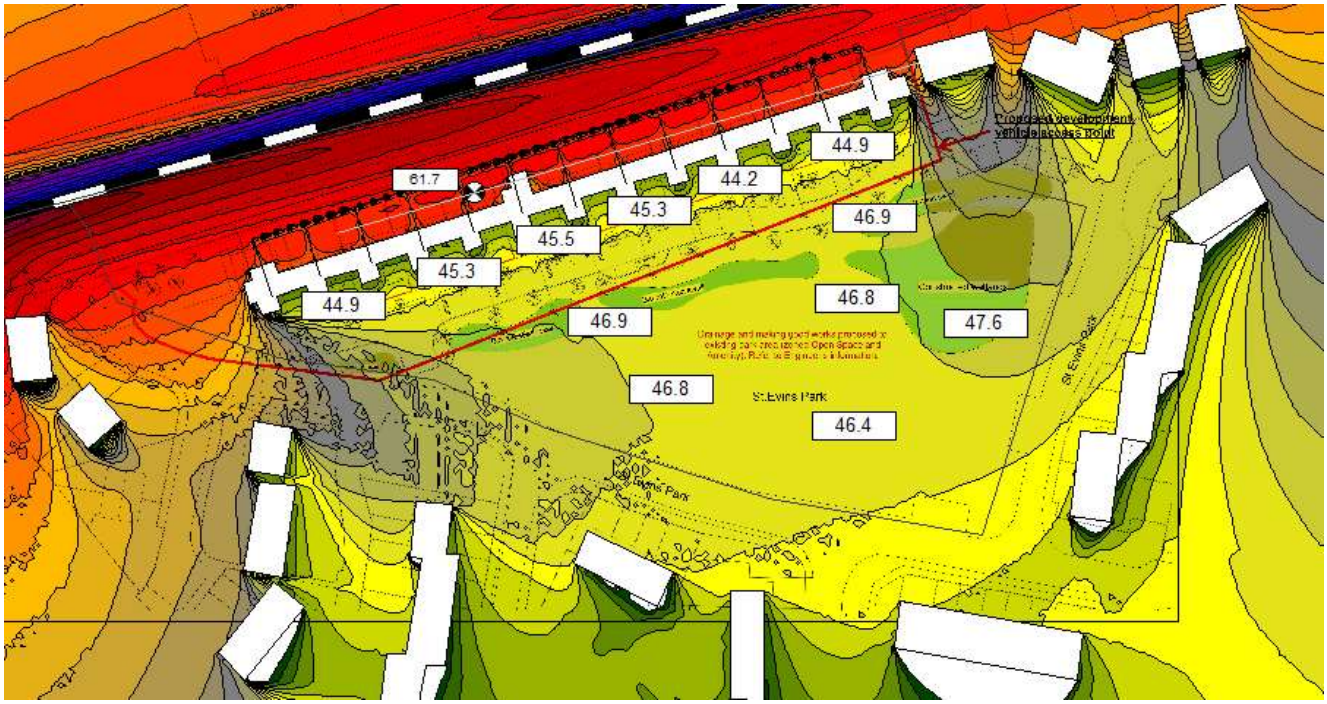

Figure 13: With amenity areas on the southern side of the proposed properties, we can see that the proposed residential buildings do provide building barrier effects. In addition, the housing will also have building barrier effects for the protection of the green space amenity area at St Evins Park, Monasterevin, Co. Kildare.

Building Envelope Details

The residential properties at this site will be masonry structures that typically offer high levels of sound attenuation. Laboratory and site tests always show that masonry elements of the structure will far exceed the likely performance offered by fenestration or natural ventilation. It is well-recognised and documented that glazing and ventilation openings in a building's envelope will likely dictate the façade's performance and resistance to inbound rail traffic noise.

In our design, it is proposed that glazing will be specified at facades that face the rail line will be specified to ensure internal noise levels meet the requirements stated in ProPG and BS8233:2014. It is proposed that ventilation in residential properties using a Demand Control Ventilation (DCV) system. With the benefit of DCV

systems, it is proposed that this will give rise to a desirable internal acoustic environment meeting the criteria defined in BS8233:2014.

Demand Control Ventilation

It is proposed that each property will be fitted with a demand-control ventilation system. It is proposed that there will be no demand control ventilation openings on the railway side of the properties or gable ends of the properties. Because a demand control ventilation system uses a centralised ventilation fan, it can ventilate the residential properties adequately without the need to provide openable windows on the railway sides of the properties. On non-railway sides of the properties, windows will be openable; however, this is not always a necessity given the ventilation needs of the property will be adequately addressed using the demand control ventilation system. It is understood that windows on the track side of the residential development and a Demand Control Ventilation system that is ported on the non-track side of the building.

Assess the external amenity areas.

ProPG provides the following advice concerning external amenity areas:

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 LAeq,16hr.

Figure 13 shows that garden amenity areas on the Southern side of the residential properties are well screened and that rail noise levels are some 5~10dB lower than the design range values proposed in ProPG for amenity areas. Additionally, we can see in that exact Figure that the amenity areas to the south of the property and on the non-rail side of the building will have daytime noise levels in the order of 45~48dB, LAeq,16hr.

Acoustic Design Summary

Our comprehensive study of the site, our validated noise modelling and prediction and our noise mitigation measures confirm that the principles of Good Acoustic Design have been applied to the development. Therefore, in the context of the requirements outlined in ProPG and BS8233:2014, we are satisfied that this site would fall under one that has had Good Acoustic Design applied.

4.2 Element 2- Internal Noise Guidelines

4.2.1 Guidance on Residential Accommodation

The target noise levels for residential use are shown in Table 8 below. They are based upon the noise levels contained in BS 8233:2014' guidance on sound insulation and noise reduction for buildings and are supported by the World Health Organisation's Community noise guidelines' (1999). Generally, the internal ambient noise level should be at most the guideline values shown in the Table below for steady external noise sources such as road traffic.

Indoor ambient noise levels for dwellings

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

Table 8: Extract of the target residential noise levels extracted from BS8233:2014.

Internal levels have been predicted using the criteria the World Health Organisation used, assuming that a window will be left partially open for ventilation.

4.2.2 Daytime Resting (4m above ground)

Table 9 below shows noise predictions at 4m above ground for assessing daytime resting in a bedroom across the entire site. It should be noted that the noise predictions are based on daytime periods at a level of 4m above ground to represent the likely noise level outside a bedroom during daytime hours.

Residential Property	Northern rail side LAeq,16hr.	Noise level drop across a partially open window (DLR: German Aerospace Centre)	Internal noise level with a natural ventilation strategy.
Units 1&2	61dB	18dB	43dB
Unit 7	63dB	18dB	45dB
Unit 8 &9	62dB	18dB	44dB
Unit 14&15	63dB	18dB	45dB

Table 9: Showing predicted noise levels at bedroom resting locations during daytime periods (LAeq,16hour) at a prediction height of 4m above ground without and with noise mitigation measures on the northern rail side of the properties.

Residential Property	Southern Non-rail side LAeq,16hr.	Noise level drop across a partially open window (DLR: German Aerospace Centre)	Internal noise level
Units 1&2	52dB	18dB	34dB
Unit 7	51dB	18dB	33dB
Unit 8 &9	51dB	18dB	33dB
Unit 14&15	50dB	18dB	32dB

Table 10: Showing predicted noise levels at bedroom resting locations during daytime periods (LAeq,16hour) at a prediction height of 4m above ground without noise mitigation measures on the southern non-rail side of the properties.

4.2.3 Night Period (4m above ground) for housing

Table 11 below shows noise predictions at 4m above ground for assessing night-time noise levels across the site. It should be noted that the predictions are based on daytime predictions at a level of 4m above ground to represent the likely noise level outside a bedroom during daytime hours.

House Type	**Northern side (rail side) LAeq,8hr**	**Noise level drop across a partially open window (DLR: German Aerospace Centre)**	**Internal noise level**
Units 1&2	51dB	18dB	33dB
Unit 7	53dB	18dB	35dB
Unit 8 &9	52dB	18dB	34dB
Unit 14&15	53dB	18dB	35dB

Table 11: Showing predicted noise levels outside bedrooms at night (LAeq,8hour) at a predicted height of 4m above ground without mitigation measures at bedrooms on the Northern side of the building (Railside)

House Type	**Southern side (non-rail side) LAeq,8hr**	**Level drop across a partially open window (DLR: German Aerospace Centre)**	**Internal noise level**
Units 1&2	42dB	18dB	24dB
Unit 7	41dB	18dB	23dB
Unit 8 &9	41dB	18dB	23dB
Unit 14&15	40dB	18dB	22dB

Table 12: Showing predicted noise levels outside bedrooms at night (LAeq,8hour) at a predicted height of 4m above ground without mitigation measures at bedrooms on the Southern side of the building (non-rail side)

4.3 With Window Mitigation Measures Implemented

Residential Property	Northern rail side LAeq,16hr.	Noise level drop across a closed window (DLR: German Aerospace Centre)	Internal noise level with Demand Control Ventilation strategy, LAeq,16hr	BS8233:2014 suggested indoor level.
Units 1&2	61dB	30dB	31dB	Day Resting: 35dB,LAeq16hr
Unit 7	63dB	30dB	33dB	Day Resting: 35dB,LAeq16hr
Unit 8 &9	62dB	30dB	32dB	Day Resting: 35dB,LAeq16hr
Unit 14&15	63dB	30dB	33dB	Day Resting: 35dB,LAeq16hr

Table 13: Showing predicted noise levels at bedroom resting locations during daytime periods (LAeq,16hour) at a prediction height of 4m above ground with noise mitigation measures on the northern rail side of the properties.

Residential Property	Southern Non-rail side LAeq,16hr.	Noise level drop across a partially open window (DLR: German Aerospace Centre) or closed window.	Internal noise level Windows Open or with Demand Control Ventilation strategy, LAeq,16hr	BS8233:2014 suggested indoor level.
Units 1&2	52dB	18dB/30dB	34dB/22dB	Day Resting: 35dB,LAeq16hr
Unit 7	51dB	18dB/30dB	33dB/21dB	Day Resting: 35dB,LAeq16hr
Unit 8 &9	51dB	18dB/30dB	33dB/21dB	Day Resting: 35dB,LAeq16hr
Unit 14&15	50dB	18dB/30dB	32dB/20dB	Day Resting: 35dB,LAeq16hr

Table 14: Showing predicted noise levels at bedroom resting locations during daytime periods (LAeq,16hour) at a prediction height of 4m above ground with noise mitigation measures on the southern non-rail side of the properties (openable windows or with the proposed Demand Control Ventilation system).

Residential Property	Northern rail side LAeq,16hr.	Noise level drop across a closed window (DLR: German Aerospace Centre)	Internal noise level with Demand Control Ventilation strategy, LAeq,16hr	BS8233:2014 suggested indoor level.
Units 1&2	51dB	30dB	21dB	Night 30dB,LAeq,8hr
Unit 7	53dB	30dB	23dB	Night 30dB,LAeq,8hr
Unit 8 &9	52dB	30dB	22dB	Night 30dB,LAeq,8hr
Unit 14&15	53dB	30dB	23dB	Night 30dB,LAeq,8hr

Table 15: Showing predicted noise levels at bedroom resting locations during night periods (LAeq,8hour) at a prediction height of 4m above ground with noise mitigation measures on the northern rail side of the properties.

Residential Property	Southern Non-rail side LAeq,16hr.	Noise level drop across a partially open window (DLR: German Aerospace Centre) or closed window.	Internal noise level Windows Open or with Demand Control Ventilation strategy, LAeq,16hr	BS8233:2014 suggested indoor level.
Units 1&2	42dB	18dB/30dB	24dB/12dB	Night 30dB,LAeq,8hr
Unit 7	41dB	18dB/30dB	23dB/11dB	Night 30dB,LAeq,8hr
Unit 8 &9	41dB	18dB/30dB	23dB/11dB	Night 30dB,LAeq,8hr
Unit 14&15	40dB	18dB/30dB	22dB/10dB	Night 30dB,LAeq,8hr

Table 16: Showing predicted noise levels at bedroom resting locations during daytime periods (LAeq,16hour) at a prediction height of 4m above ground with noise mitigation measures on the southern non-rail side of the properties (openable windows or with the proposed Demand Control Ventilation system).

Summary of Mitigation and Outcome Results

Residential Property	Noise Mitigation.	BS8233:2014 daytime criteria	BS8233:2014 night-time criteria
Units 1&2	DCV and Fenestration	Better/lower than guidance value	Better/lower than guidance value
Unit 7	DCV and Fenestration	Better/lower than guidance value	Better/lower than guidance value
Unit 8 &9	DCV and Fenestration	Better/lower than guidance value	Better/lower than guidance value
Unit 14&15	DCV and Fenestration	Better/lower than guidance value	Better/lower than guidance value

Table 17:Assessment of the noise levels with the mitigation measures in place.

4.3.1.1 Internal noise level guidelines

The second element of ASD is considering whether/how the ProPG internal noise criteria can be met. The monitoring and modelling have estimated Internal noise levels using the highest daytime and night-time LAeq. It will be necessary to ensure that to allow daytime rest and prevent sleep disturbance at night-time, internal noise levels in bedrooms and noise levels from rail noise in those rooms should not exceed 30 dB LAeq, 8 hour.

There is no requirement for specialist acoustic glass, and research by the German Aerospace Centre (DLR) suggests that a closed double-glazed window with air-tight seals will reduce inward passenger rail noise by 30dB(A). This will provide an adequate level of sound attenuation in a scenario where the properties are

ventilated from the non-rail side of the building and at a location close to the centre of the building where rail noise is likely to be at its lowest.

Modelling software indicates that double glazing (4mm/10mm/6mm) will provide a sound insulation value of 35dB, Rw. The modelling results calculated using Insul (9.7.22) show the likely laboratory performance of this build-up in Figure 14 below. Since this performance is a laboratory estimate, it offers a broadly similar level in line with the performance reported by the German Aerospace Centre (DLR). It is proposed to adopt the research data from the German Aerospace Centre (DLR).

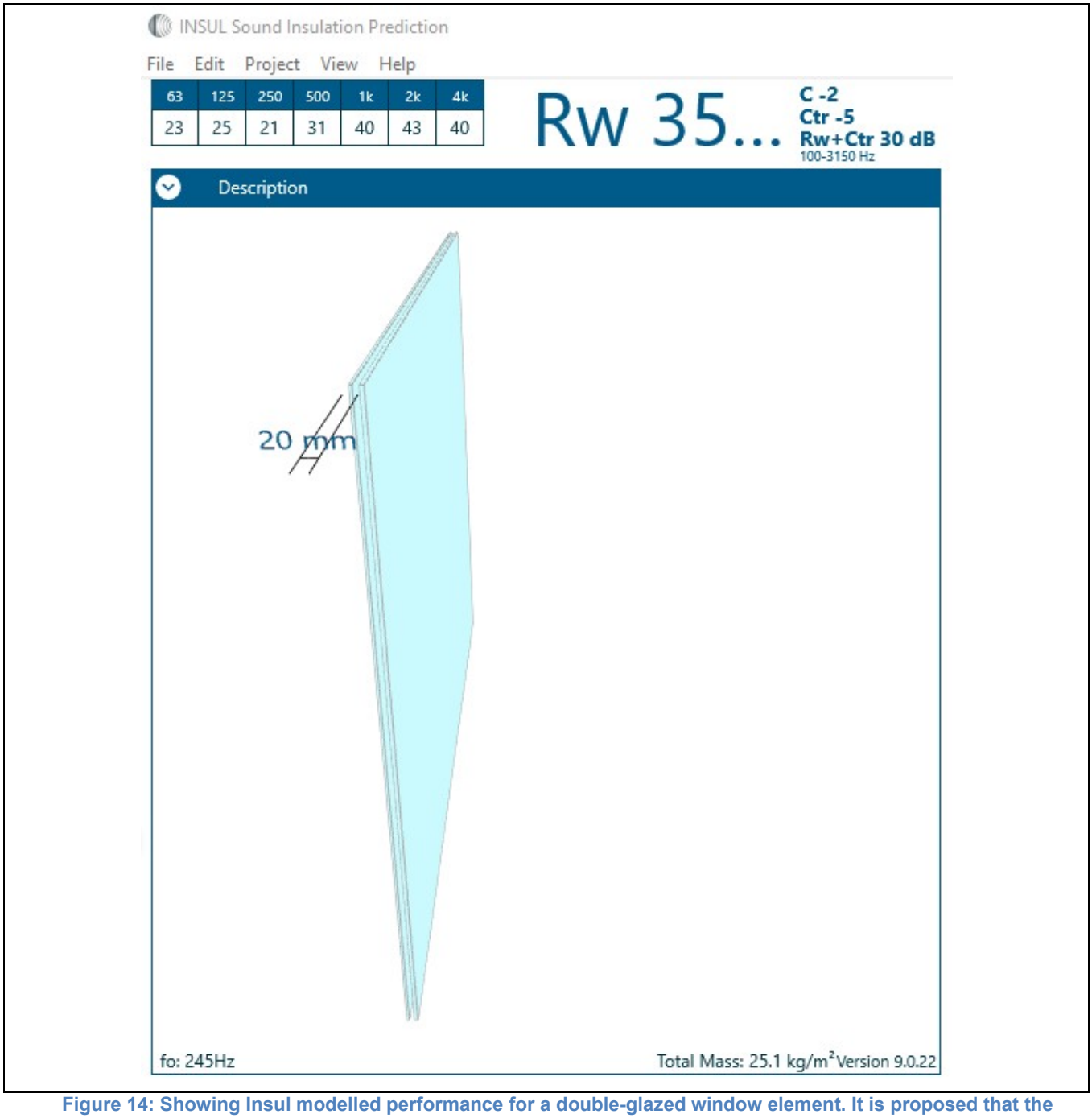

Figure 14: Showing Insul modelled performance for a double-glazed window element. It is proposed that the trackside windows will remain non-openable on the trackside (northern side) and openable on the non-track side of the rail line.

4.4 Element 3- External Amenity Area Noise Assessment

4.4.1 Garden Area & Amenity Area Predictions (1.6m above ground).

Table 18 below shows noise predictions for the front garden areas across the site. It should be noted that the predictions are based on a seated height of 1.6m above ground in the garden amenity areas on the southern side of the site.

Residential Unit	LAeq,16hr at 1.6m ABG (Daytime)
Unit 1&2 Front Garden	44dB
Units 3~Unit 6 Front Garden	45dB
Unit 7~Unit 10 Front Garden	45dB
Unit 11~ Unit 13 Front Garden	45dB
Unit 14 & Unit 15	45dB

Table 18: Showing predicted noise levels on the southern garden and amenity areas for daytime periods (LAeq,16hour)

Amenity Space	LAeq,16hr at 1.6m ABG (Daytime)
The green area in St Evin's Park, on the southern side of the proposed properties, is a designated amenity area.	44dB

Table 19: Showing predicted noise levels in the southern garden and amenity areas for daytime periods (LAeq,16hour)

ProPG provides the following advice concerning external noise levels for amenity areas in the development:

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

The values are primarily based on WHO guideline values. For this development, the good acoustic design principles ensure that the front garden amenity areas remain adequately protected by building barrier effects.

4.5 Element 4 Assessment of Other Related Issues

4.5.1 Future Rail Traffic Flows

It has been assumed that there will be circa 25% growth in rail traffic over the next 15 years. This increase is likely increase rail traffic noise levels of less than 1 dB and would have no appreciable additional impact on residents exposed to noise or the likely internal levels at houses in the proposed scheme.

Residential Unit	Future Year LAeq,16hr at 1.6m ABG (Daytime)
Unit 1&2 Front Garden	43dB
Units 3~Unit 6 Front Garden	44dB
Unit 7~Unit 10 Front Garden	44dB
Unit 11~ Unit 13 Front Garden	44dB
Unit 14 & Unit 15	44dB

Table 20: Showing predicted noise levels in the Southern Garden and amenity areas for daytime future periods (LAeq,16hour)

Future noise levels in garden areas would indicate that noise levels will remain comfortably < 55dB, LAeq,16hour and in line with the guidance provided in ProPG.

5 Vibration

It is noted that the Dublin to Cork Intercity rail line runs along the northern boundary of the proposed residential properties. This assessment uses a BS6472 to assess the inward impact of ground-borne vibrationon the existing and proposed properties. It should be noted that several established dwellings currently exist on the site at similar setback distances from the same rail line; however, these were not available for testing. Testing was conducted on-site, where a metal spike was driven into the ground to allow us to measure vibration in all three axes.

Figure 15: Photograph showing the vibration logging equipment used on a vibration spike at the northern façade location.

Trains will transmit vibrational energy from the train through the track into the ground and transmitted through the ground, depending on the nature of the ground, to a receiver or residential receptor. We have made measurements of vibration on-site at the location of the proposed residential properties as trains pass, and we did not detect a significant level of ground-borne vibration on site. There were a small number of short-term peaks in vibration level, but none of those was related to train/rail movements in the vicinity. It is worth noting that the rail line is located on a large berm of a substantial mass and that the rail line is circa 3~4m above the level in

Vibrations due to passing trains on the railway line would likely give rise to impact due to vibration, either on the buildings in terms of physical effect or on residents in terms of comfort. Guidance relating to human

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

In assessing vibration, BS 6472 uses the Vibration Dose Value (VDV), measured or forecasted over the day or night-time periods in terms of m/s1.75. In the standard the VDV parameter is used to approximate the likely response to vibration in terms of frequency and vibration magnitude and the number of vibration events during an assessment period.

Individual rail events were witnessed and measured using vibration measurement equipment at the site.

Rail Car Type	# of Ca	Passby Time	Direction	Pass speed
IR22000	5	10:12hrs	Dublin	Fast
IR22000	3	10:13hrs	Cork	Slow & Stop
IR22000	3	10:23hrs	Dublin	Fast
IR22000	6	10:33hrs	Cork	Slow & Stop
IR22000	3	10:43hrs	Dublin	Fast
Freight	20	10:54hrs	Cork	Slow
IR22000	3	10:54hrs	Dublin	Slow
IR22000	5	11:20hrs	Cork	Slow
IR22000	4	11:26hrs	Dublin	Fast
Mark 4 IR	9	11:31hrs	Dublin	Fast
201 Class	10	11:33hrs	Cork	Fast
IR22000	3	11:42hrs	Dublin	Slow
Maintenance Train	1	11:43hrs	Cork	Slow
IR22000	4	11:57hrs	Cork	Slow
Freight, 201 Class	19	12:01hrs	Dublin	Slow
IR22000	3	12:15hrs	Cork	Slow
IR22000		12:32hrs	Cork	Fast
Mark 4 IR	9	12:33hrs	Dublin	Fast
IR22000	4	12:47hrs	Dublin	Fast
IR22000	4	13:05hrs	Dublin	Fast
IR22000	5	13:07hrs	Cork	Slow
IR22000	7	13:18hrs	Cork	Slow
Mark 4 IR	9	13:33hrs	Dublin	Fast
Mark 4 IR	10	13:35hrs	Cork	Fast

Rail Car Type	# of Car	Passby Tir	Direction	Pass speed
IR22000	3	13:43hrs	Dublin	Slow
IR22000	7	14:00hrs	Cork	Slow
IR22000	3	14:15hrs	Cork	Slow
IR22000	5	14:32hrs	Cork	Slow
Mark 4 IR	9	14:33hrs	Dublin	Fast
Freight, 201 Class	13	14:43hrs	Cork	Slow
IR22000	5	14:51hrs	Dublin	Slow
Freight Mark 1	13	15:02hrs	Dublin	Slow
IR22000	3	15:11hrs	Cork	Slow
IR22000	6	15:13hrs	Dublin	Fast
IR22000	4	15:20hrs	Cork	Fast
IR22000	5	15:25hrs	Dublin	Fast
Mark 4 IR	9	15:37hrs	Cork	Slow
IR22000	6	15:46hrs	Dublin	Slow
IR22000	5	15:54hrs	Dublin	Slow
IR22000	6	16:09hrs	Cork	Slow
IR22000	4	16:15hrs	Cork	Slow
IR22000	5	16:23hrs	Cork	Fast
Mark 4 IR	9	16:30hrs	Dublin	Slow
Mark 4 IR	9	16:35hrs	Cork	Slow
IR22000	3	16:43hrs	Dublin	Fast
Test at 16:47hrs	Test	3axis		
IR22000	5	16:58hrs	Cork	Slow
IR22000	6	18:11hrs	Cork	Slow

Table 21: Witnessed rail events from 10:12hrs to 13:35hrs and 13:43hrs to 18:11hrs.

The vibration measurement instrumentation was placed at a location likely to represent the closest façade of the proposed development to the rail line. Figure 16 shows the location where vibration was measured in three axes using a vibration accelerometer attached to a metal spike installed in the ground.

Figure 16: Aerial photo showing where vibration measurement took place(Source: Google Maps).

5.1 Measurement Results on Site

Observation Period: 11:12hrs to 11:59hrs on 18th of November 2021

Highest VDV noted (and axis): 0.045 $m/s^{1.75}$

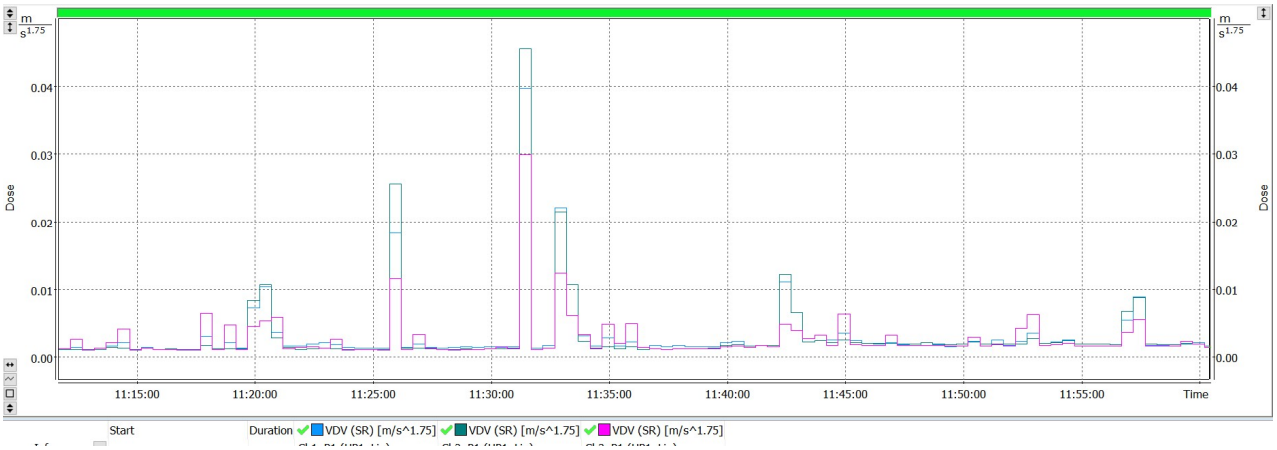

Figure 17: VDV measured in three axes from 11:12hrs to 11:59hrs on 18th/11/2021.

Observation Period: 12:00hrs to 12:10hrs on 18th of November 2021

Highest VDV noted (and axis): 0.055 **m/s$^{1.75}$**

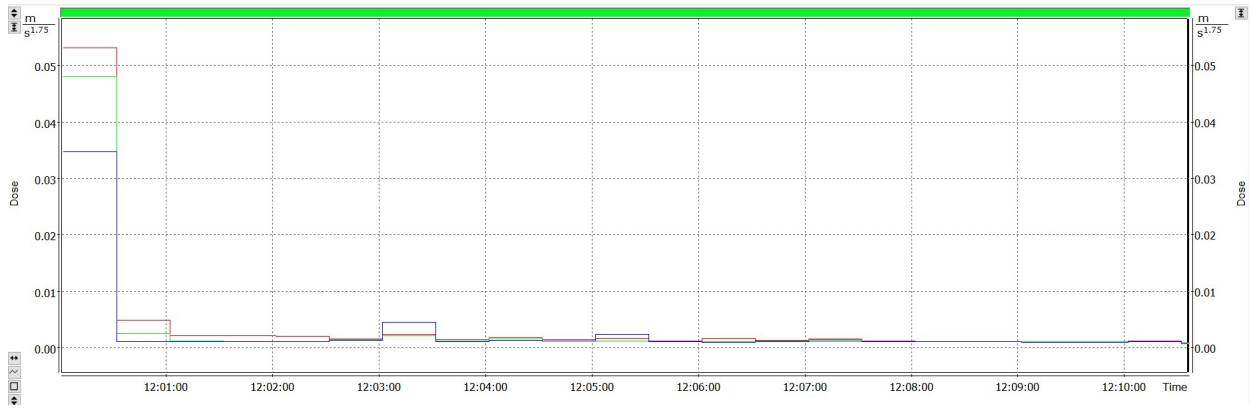

Figure 18:VDV measured in three axes from12:00hrs to 12:10hrs on 18th/11/2021.

Observation Period: 13:00hrs to 14:00hrs on 18 November 2021 (note includes sensor test at 13:08)

Highest VDV noted (and axis): 0.06 m/s$^{1.75}$

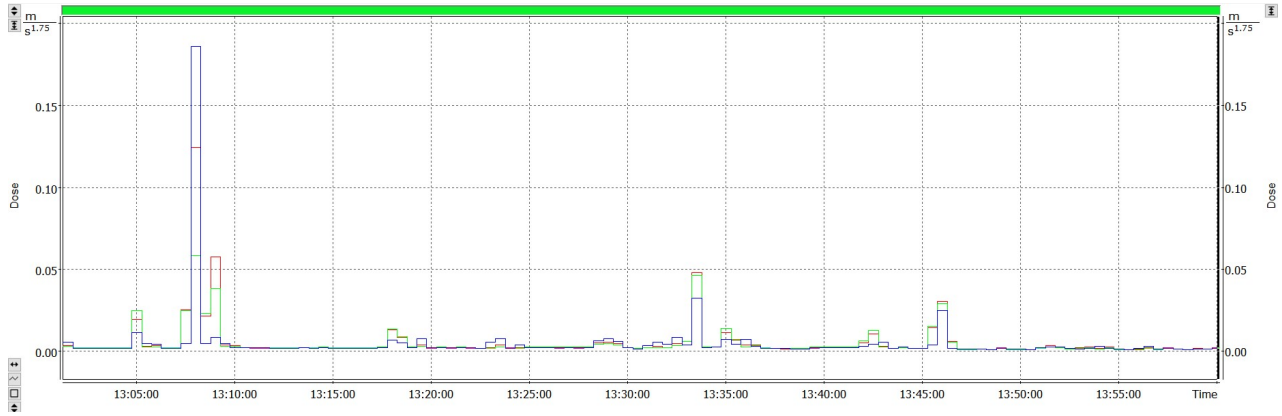

Figure 19: VDV measured in three axes from 13:00hrs to 14:00hrs on 18th/11/2021.

Observation Period: 14:00hrs to 15:00hrs on 18th of November 2021

Highest VDV noted (and axis): 0.04 m/s$^{1.75}$

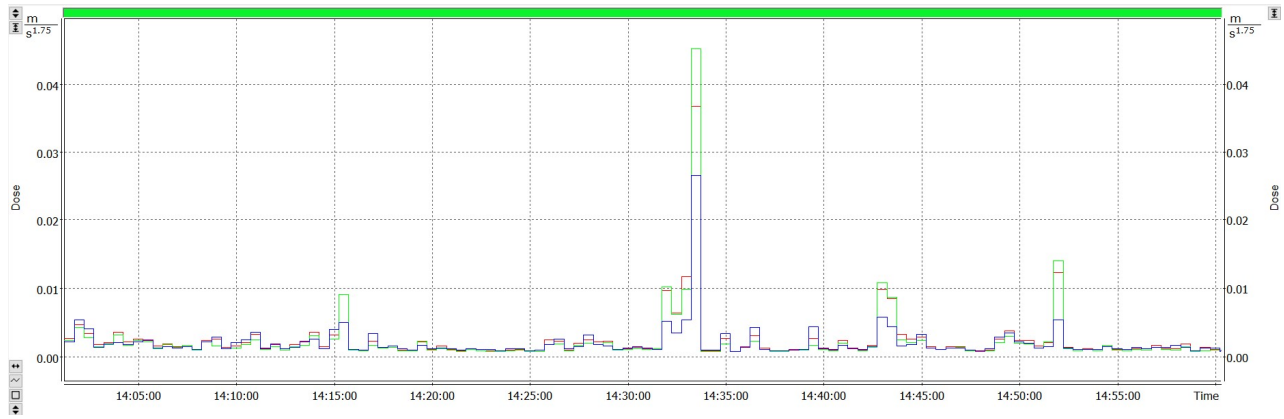

Figure 20:VDV measured in three axes from14:00hrs to 15:00hrs on 18th/11/2021.

Observation Period: 15:00hrs to 16:00hrs on 18th of November 2021

Highest VDV noted (and axis): 0.03 $m/s^{1.75}$

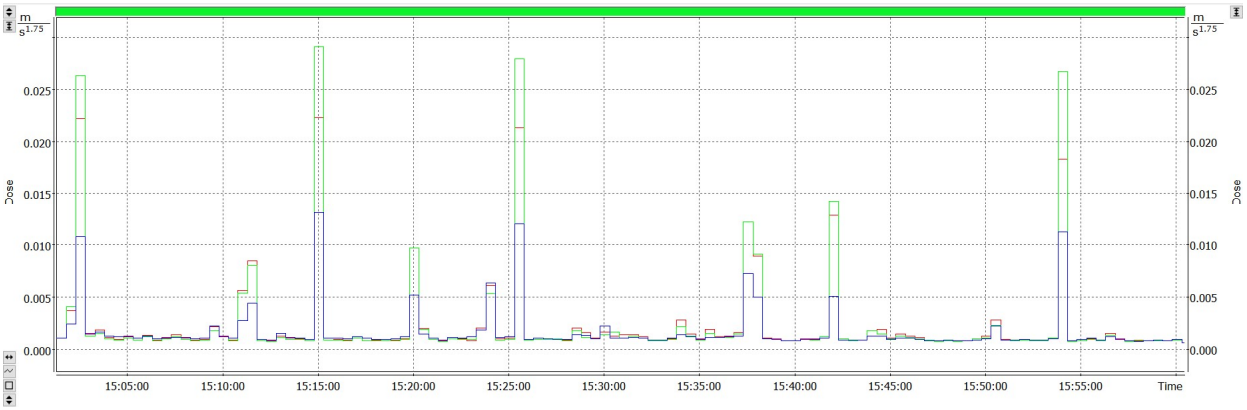

Figure 21:VDV measured in three axes from15:00hrs to 16:00hrs on 18th/11/2021.

Observation Period: 16:00hrs to 17:00hrs on 18th of November 2021(Sensor Test at 16:48hrs)

Highest VDV noted (and axis): 0.05 $m/s^{1.75}$

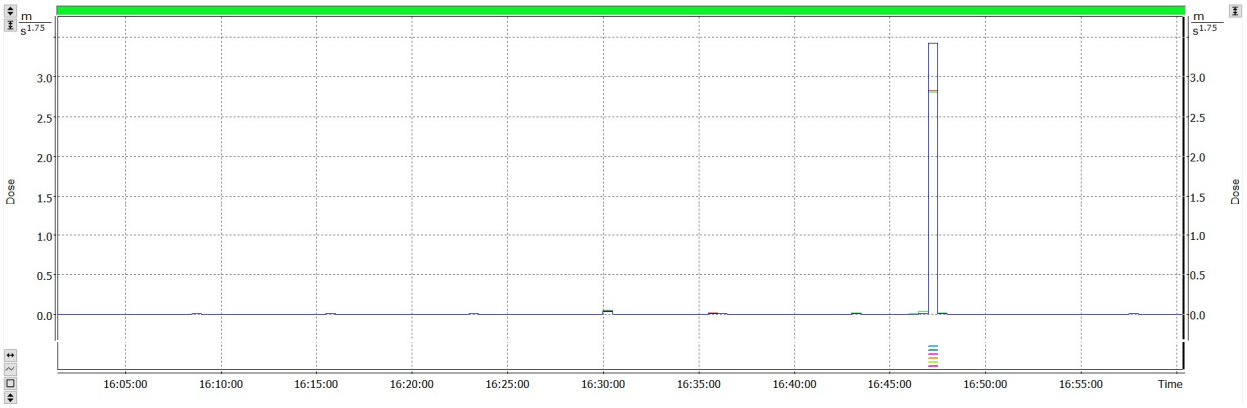

Figure 22:VDV measured in three axes from16:00hrs to 17:00hrs on 18th/11/2021, with sensor test at 16:47hrs.

5.2 Vibration Assessment using BS6472

An assessment of ground-borne vibration from rail traffic has been undertaken against the criteria provided in BS 6472-1:2008, "Guide to evaluation of human exposure to vibration in buildings – Part 1 Vibration sources other than blasting". This British Standard requires that such an assessment is undertaken by determining the Vibration Dose Value over a 16-hour day and 8-hour night period (taken to be 0700 to 2300 hours and 2300 to 0700 hours). The standard provides the following criteria for assessing vibration effects, as shown in Table 22 below—vibration dose value ranges, which might result in various probabilities of adverse comments within residential buildings.

Place	Low probability of adverse comment	Adverse comment possible	Adverse comment probable
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h night	0.13	0.26	0.51

Table 22: Extract from BS6472 Part 1, Table 7 –Vibration dose values ($m/s^{1.75}$) above which various degrees of adverse comment may be expected in residential buildings.

The provisions of BS 6472 have been used in this vibration assessment, and calculations of the Vibration Dose Value (VDV) have been set out for the daytime and night periods in Figure 23 below. As taken from Irish Rail timetable information, the day and night VDV values are calculated for the maximum VDV measured and the number of passing trains over the day and night time periods. It should be noted that the most significant vibration axis was the Z-axis (vertical), indicated throughout the noise survey. Measurements show that between period 13:00hrs to 14:00hrs on 18 November 2021, the highest VDV notes was 0.06 $m/s^{1.75}$ in the z-axis, created by seven rail events in that 1 hour.

The calculated eVDV day and night-time values measurement location, taking account of the number of train pass-by per day and assuming the maximum VDV value per train pass-by, are as follows:

	Existing Rail Traffic	**Rail Traffic Future Growth (15year)**	**BS 6472-1 (2008) Assessment**
Daytime eVDV	0.27 $m/s^{1.75}$	0.28 $m/s^{1.75}$	Low probability of adverse comment
Night-time eVDV	0.13 $m/s^{1.75}$	0.14 $m/s^{1.75}$	Low probability of adverse comment

Table 23: Estimated Vibration Dose Values for Daytime and Night Periods and assessed using BS6472-1.

These values are below a value where a low probability of adverse comment would be expected within the building as defined within BS 6472-1 (2008).

In summary, whilst vibration levels may be perceptible at low levels during the passing trains, the overall vibration dose value estimates would indicate a low probability of adverse comment based on the measured specific rail pass-by data with allowance for future growth. Having carried out vibration measurements and an assessment using BS 6472, measurements would indicate that the vibration levels are at a level where there would be a 'Low probability of adverse comment'. It should also be noted that this is a conservative approach where the highest VDV value measured was used in the calculation process when measurements frequently show levels considerably lower than the used VDV of 0.06 $m/s^{1.75}$.

6 CONCLUSIONS

6.1 Airborne Noise

We have assessed Rail Traffic noise using ProPG and BS8233:2014 at the proposed residential development site at St Evin's Park, Monasterevin, Co. Kildare. The study considers the impact of internal noise levels in the proposed properties and the garden amenity areas on the southern side of the residential development. We note that the Irish EPA, in their guidance document *'Ireland's Environment -An Integrated Assessment 2020',* advise that the UK's ProPG guidance is widely used in Ireland. They state that, importantly, ProPG guidance encourages implementing good acoustic design from the earliest planning stages for new residential developments. As part of the ProPG assessment, we have prepared an Acoustic Design Statement (ADS) for the project and considered mitigation measures where appropriate.

Our investigation indicates that the site's existing and future rail traffic noise impacts fall into the Low/Medium Risk Category for both the daytime and night periods.

In addition, we have provided an Acoustic Design Statement at an appropriate level of detail to demonstrate how design measures and other relevant matters can be applied to the proposed development. This site benefits from substantial building barrier effects to protect garden amenity areas.

Using noise modelling techniques, which have been validated using site noise measurements, it has been possible to identify locations where noise is likely to be at its highest during daytime and night. Using a natural ventilation strategy in isolation would result in an open window at the rear of the properties being higher than what is desirable in BS8233.

It is understood that each property would be fitted with a Demand Control Ventilation system in each dwelling, allowing the dwellings to be fully ventilated without the need to open windows at the rear of the property (on the rail side). In addition, windows to the rear of the properties (rail side) will not be openable.

The scheme layout is such that garden amenities are provided for in most properties on the non-rail side of the development. In some cases, too, while rail noise may be higher than levels that would be desirable, garden amenity areas for most properties are provided for on the non-rail side of the buildings, as well as an ample amenity space within St Evin's Park.

Based on our assessment of the current rail noise levels and the likely future noise climate, we consider no objection on noise grounds to granting planning consent. Planning consent may be given without any need for noise conditions once there is adherence to the Acoustic Design Statement provided in this Report.

6.2 Vibration

Vibration has been assessed using BS 6472 and the estimated Vibration Dose Values (eVDV) for the rail traffic servicing the line and considering the potential for future growth. Predictions are shown in Table 24 below along with the objective findings of BS 6472-1 (2008) , which has been used to assess the vibration at the proposed development site.

	Existing Rail Traffic	**Rail Traffic Future Growth (15year)**	**BS 6472-1 (2008)**
Daytime eVDV	0.27 $m/s^{1.75}$	0.28 $m/s^{1.75}$	Low probability of adverse comment
Night-time eVDV	0.13 $m/s^{1.75}$	0.14 $m/s^{1.75}$	Low probability of adverse comment

Table 24: Estimated Vibration Dose Values for Daytime and Night Periods and assessment using BS6472-1.

In summary, whilst vibration levels may be perceptible at low levels during the passing trains, the overall vibration dose value estimates would indicate a low probability of adverse comment based on the measured specific rail pass-by data with allowance for future growth.

Based on our assessment of rail vibration levels at the proposed development location and the likely future vibration climate, we consider no objection on vibration grounds to granting planning consent.

7 Limitations

Project: St Evins Park, Monasterevin, Co. Kildare.

Client: Architectural Department at Kildare County Council

ICAN Acoustics, St Mary's Road, Galway City, have prepared this Report for the sole use of Kildare County Council ("Client") in accordance with the Agreement under which our services were performed. No other warranty, expressed or implied, is made regarding the professional advice included in this Report or any other services ICAN Acoustics provides.

The conclusions and recommendations in this Report are based upon information provided by others and on the assumption that all relevant information has been provided by those parties from whom it has been requested and that such information is accurate. Information obtained by ICAN Acoustics has only been independently verified by ICAN Acoustics if otherwise stated in the Report.

The methodology adopted and the sources of information used by ICAN Acoustics in providing its services are outlined in this Report. The work described in this Report was undertaken between November 2021 and September 2023 and is based on the conditions encountered and the information available during the said period.

These circumstances accordingly limit the scope of this Report and the services. Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and, where appropriate, are subject to further investigations or information which may become available. Our work includes reliance on published third-party data from equipment suppliers and manufacturers and assumes that the data provided is correct and accurate in an assumed arrangement.

ICAN Acoustic disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to ICAN Acoustics' attention after the date of the Report.

Certain statements made in the Report that are not historical facts may constitute estimates, projections (modelling) or other forward-looking statements and even though they are based on reasonable assumptions as of the date of the Report, such forward-looking statements by their nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. ICAN Acoustics does not guarantee or warrant any estimate or projections in this Report.

British Standards, such as BS4142, suggest that 'Response to sound can be subjective and is affected by many factors, both acoustic and non-acoustic. The significance of its impact, for example, can depend on

such factors as the margin by which a sound exceeds the background sound level, its absolute level, time of day and change in the acoustic environment, as well as local attitudes to the source of the sound and the character of the neighbourhood. This edition of the standard recognises the importance of the context in which a sound occurs'. In that British Standard (BS4142) great care has been taken in using the words "sound" and "noise". Sound can be measured by a sound level meter or other measuring system. Noise is related to a human response and is routinely described as unwanted sound or sound that is considered undesirable or disruptive. Additionally, BS4142 highlights that *Adverse impacts include, but are not limited to, annoyance and sleep disturbance. Not all adverse impacts will lead to complaints, and not every complaint is proof of an adverse impact.*

It should be recognised that Standards and Guidance documents are typically based on what the law describes as 'the average man', but sensitivity to noise and vibration can vary greatly.

8 Appendix A: Instrument Calibration Certification

8.1 Logging Type Approved Measurement Instrument SLM1 (S/N: A2A-10976-EO)

NSAI
National Metrology Laboratory

Certificate of Calibration

Issued to: ICAN Acoustics, 9 St. Mary's Road, Galway City, Co. Galway

Attention of: Diarmuid Keaney

Certificate Number	214146
Item Calibrated	NTi Audio XL2-TA Sound Level Meter with NTi Audio MC230A Microphone
Serial Number	A2A-10976-E0 (SLM) and A14398 (Microphone)
ID Number	None
Order Number	Diarmuid Keaney
Date Received	11 Oct 2021
NML Procedure Number	AP-NM-09
Method	The above sound level meter was allowed to stabilise for a suitable period in laboratory conditions. It was then calibrated by carrying out the verification tests detailed in IEC 61672-3 (2006), *Periodic tests, specification for the verification of sound level meters.* This standard specifies a procedure for the periodic verification of conformance of a sound level meter or integrating-averaging meter to IEC 61672-1 (2003).
Calibration Standards	Norsonic 1504A Calibration System incorporating: SR DS360 Signal Generator, No. 0735 [Cal Due Date: 10 Jun 2022] Agilent 34401A Digital Multimeter, No. 0736 [Cal Due Date: 10 Jun 2022] B&K 4134 Measuring Microphone, No. 0744 [Cal Due Date: 03 Jun 2023] B&K 4228 Pistonphone, No. 0740 [Cal Due Date: 04 Jun 2023] B&K 4226 Acoustical Calibrator, No. 0150 [Cal Due Date: 07 Oct 2022]

Calibrated by: David Fleming — Approved by: Paul Hetherington

Date of Calibration: 20 Oct 2021 — Date of Issue: 20 Oct 2021

CIPM MRA

This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)

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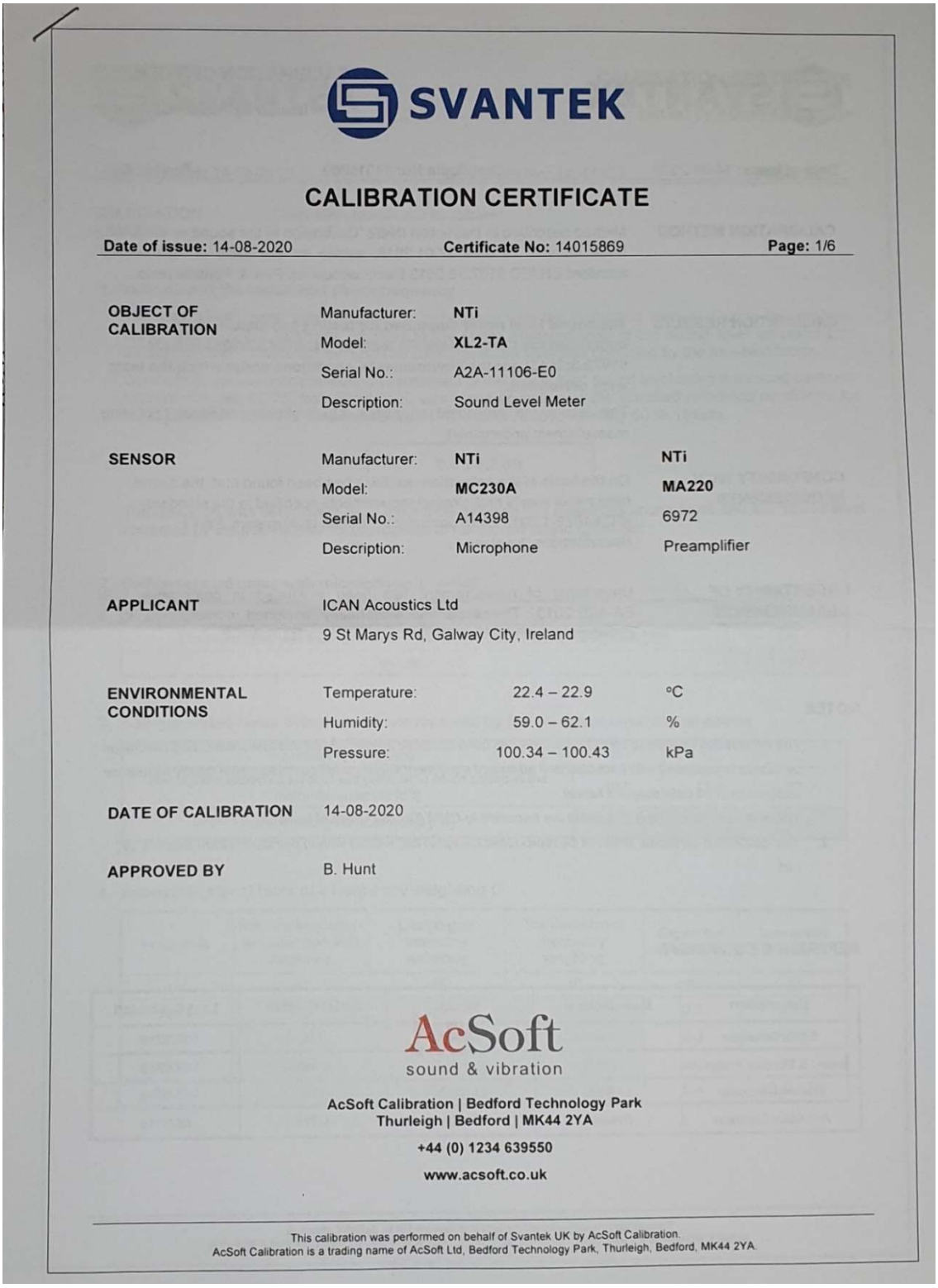
8.2 Logging Type Approved Measurement Instrument SLM3 (S/N A2A-11106-E0)



SVANTEK

CALIBRATION CERTIFICATE

Date of issue: 14-08-2020 **Certificate No:** 14015869 **Page:** 1/6

OBJECT OF CALIBRATION	Manufacturer:	**NTi**	
	Model:	**XL2-TA**	
	Serial No.:	A2A-11106-E0	
	Description:	Sound Level Meter	
SENSOR	Manufacturer:	**NTi**	**NTi**
	Model:	**MC230A**	**MA220**
	Serial No.:	A14398	6972
	Description:	Microphone	Preamplifier
APPLICANT	ICAN Acoustics Ltd		
	9 St Marys Rd, Galway City, Ireland		
ENVIRONMENTAL CONDITIONS	Temperature:	22.4 – 22.9	°C
	Humidity:	59.0 – 62.1	%
	Pressure:	100.34 – 100.43	kPa
DATE OF CALIBRATION	14-08-2020		
APPROVED BY	B. Hunt		

AcSoft
sound & vibration

AcSoft Calibration | Bedford Technology Park
Thurleigh | Bedford | MK44 2YA
+44 (0) 1234 639550
www.acsoft.co.uk

This calibration was performed on behalf of Svantek UK by AcSoft Calibration.
AcSoft Calibration is a trading name of AcSoft Ltd, Bedford Technology Park, Thurleigh, Bedford, MK44 2YA.

8.3 Field Calibration Unit

NSAI
National Metrology Laboratory

Certificate of Calibration

Issued to	ICAN Acoustics 9 St. Mary's Road Galway City Co. Galway
Attention of	Diarmuid Keaney

Certificate Number	214145
Item Calibrated	Bruel & Kjaer Type 4231 Sound Level Calibrator
Serial Number	2499109
ID Number	None
Order Number	Diarmuid Keaney
Date Received	11 Oct 2021
NML Procedure Number	AP-NM-13
Method	The above calibrator was allowed to stabilize for a suitable period in laboratory conditions. It was then calibrated by measuring the sound pressure level generated in its measuring cavity (half-inch configuration). The calibrator's operating frequency was also measured.
Calibration Standards	Norsonic 1504A Calibration System incorporating: Agilent 34401A Digital Multimeter, File No. 0736 [Cal due: 10 Jun 2022] B & K 4134 Measuring Microphone, File No. 0744 [Cal due: 03 Jun 2023] B & K 4228 Pistonphone, File No. 0740 [Cal due: 04 Jun 2023]

Calibrated by	David Fleming	Approved by	Paul Hetherington
Date of Calibration	19 Oct 2021	Date of Issue	19 Oct 2021

CIPM MRA

This certificate is consistent with Calibration and Measurement Capabilities (CMC's) that are included in Appendix C of the Mutual Recognition Arrangement (MRA) drawn up by the International Committee for Weights and Measures. Under the MRA, all participating institutes recognize the validity of each other's calibration certificates and measurement reports for quantities, ranges and measurement uncertainties specified in Appendix C (for details see www.bipm.org)

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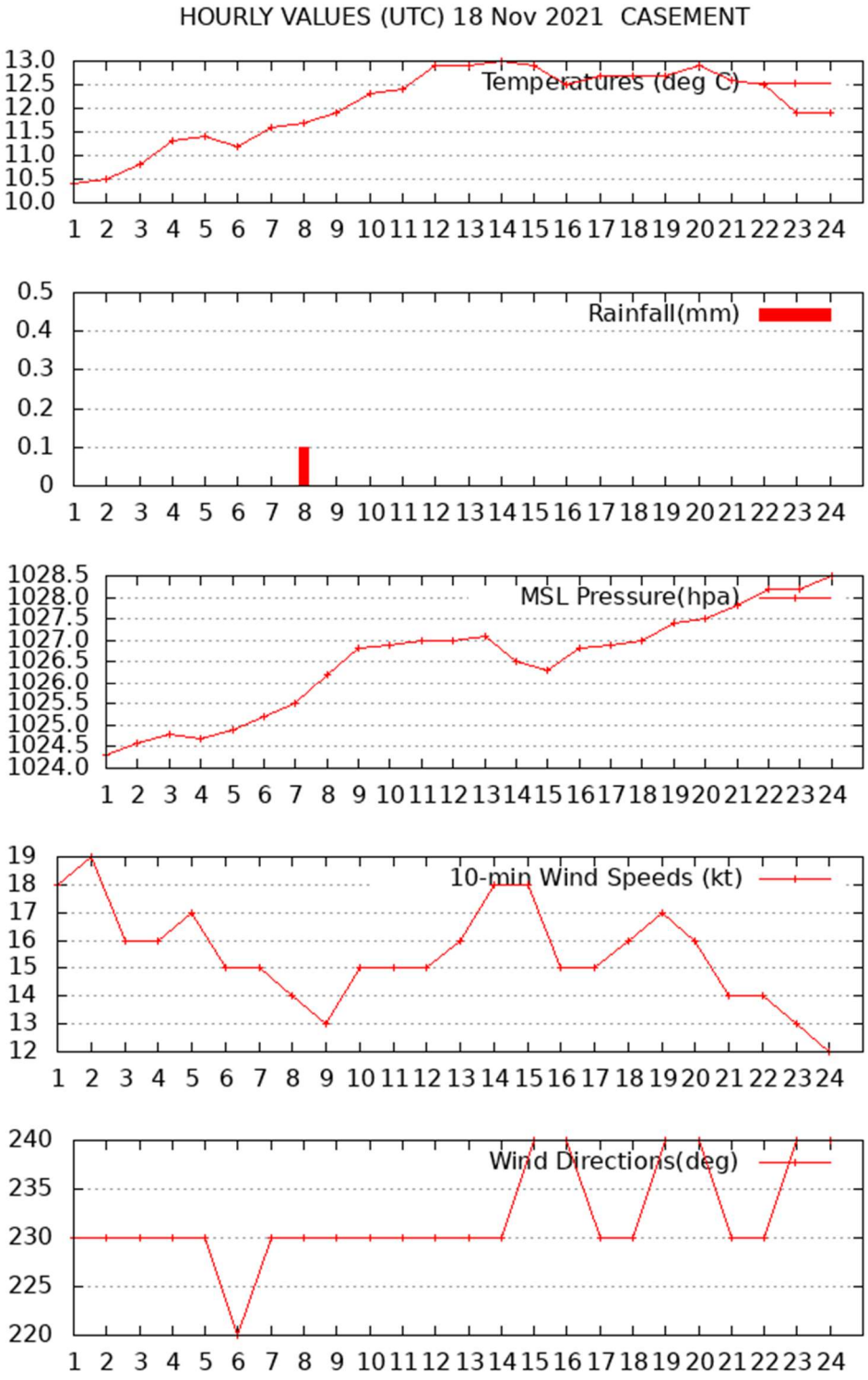
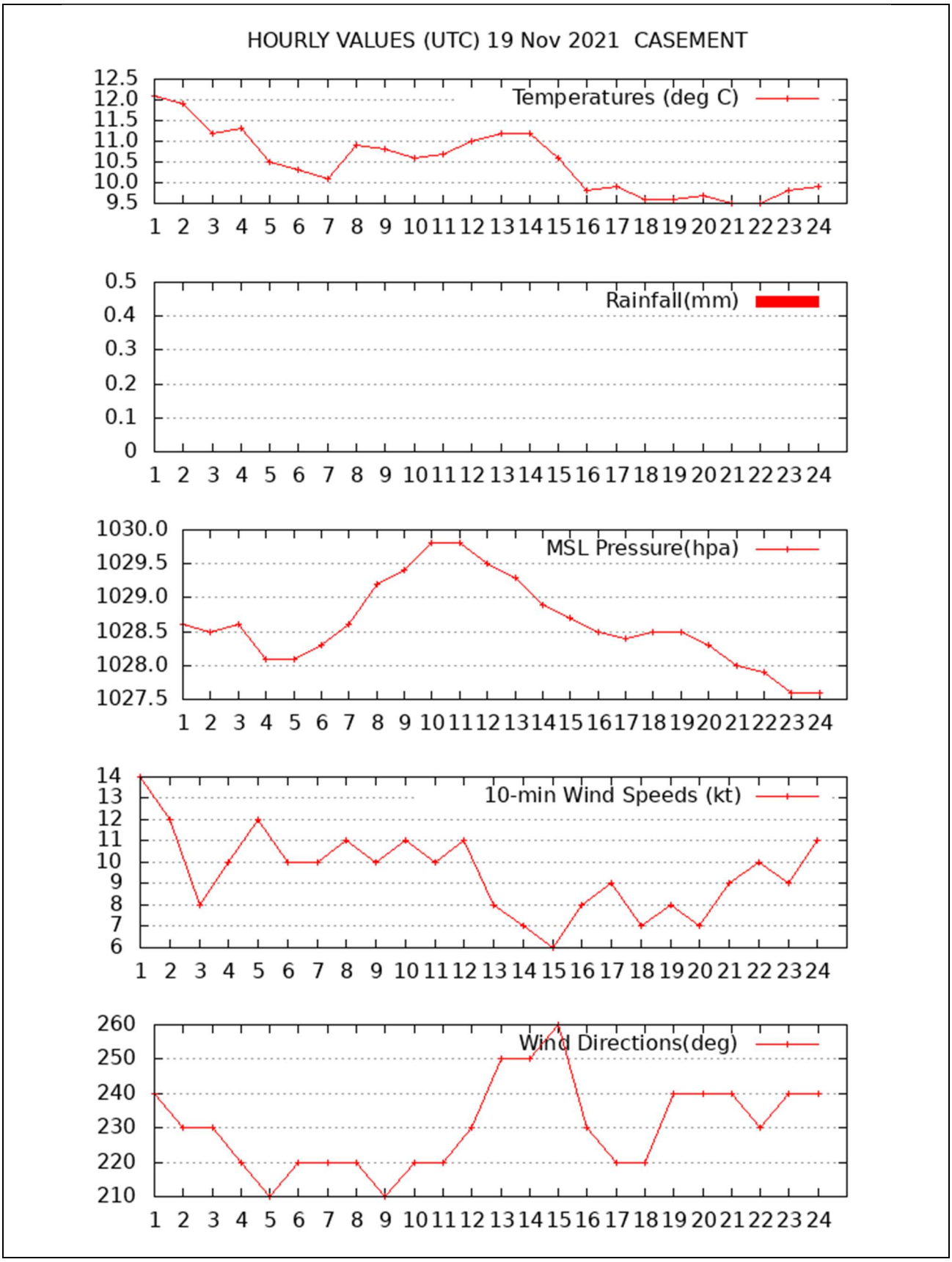
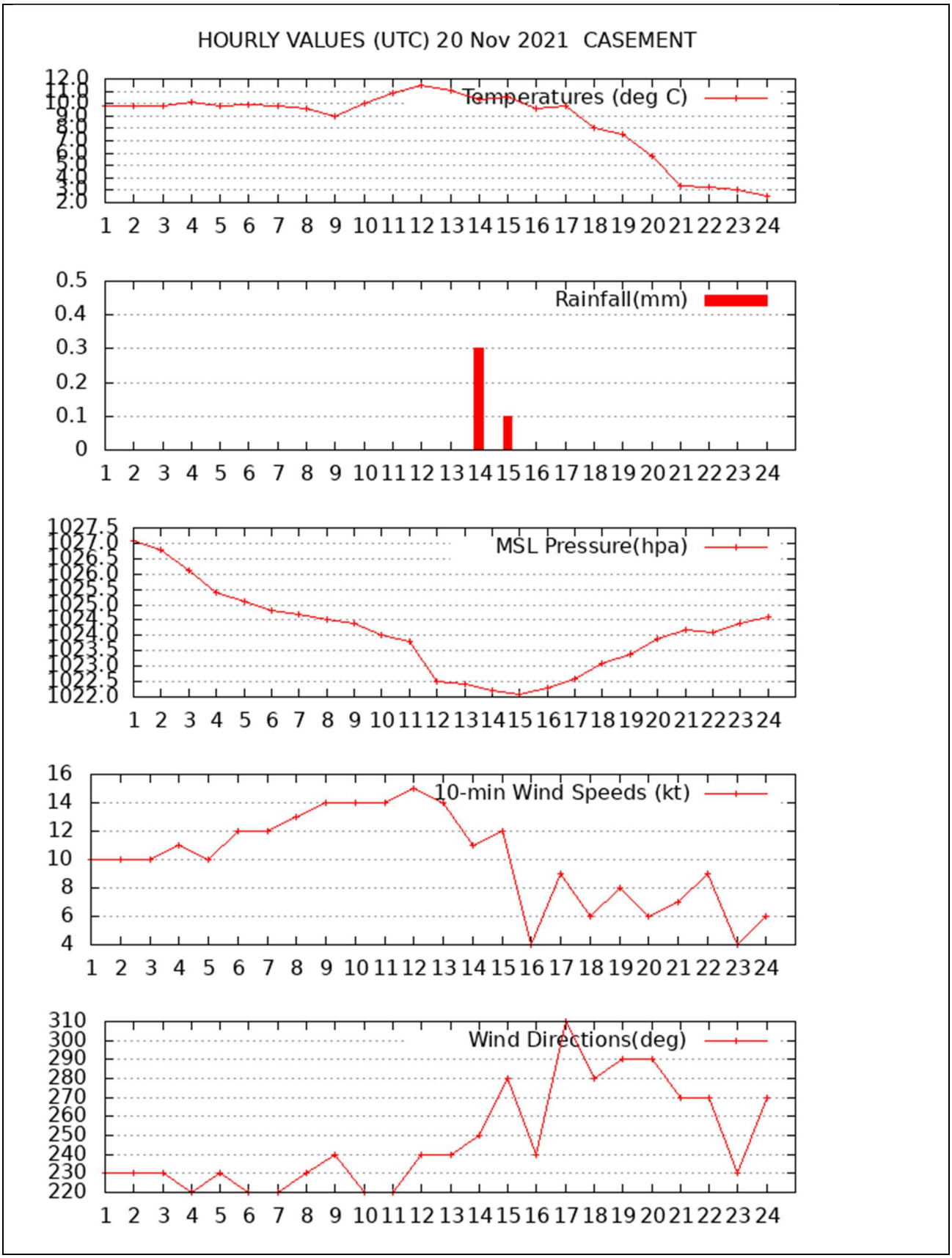
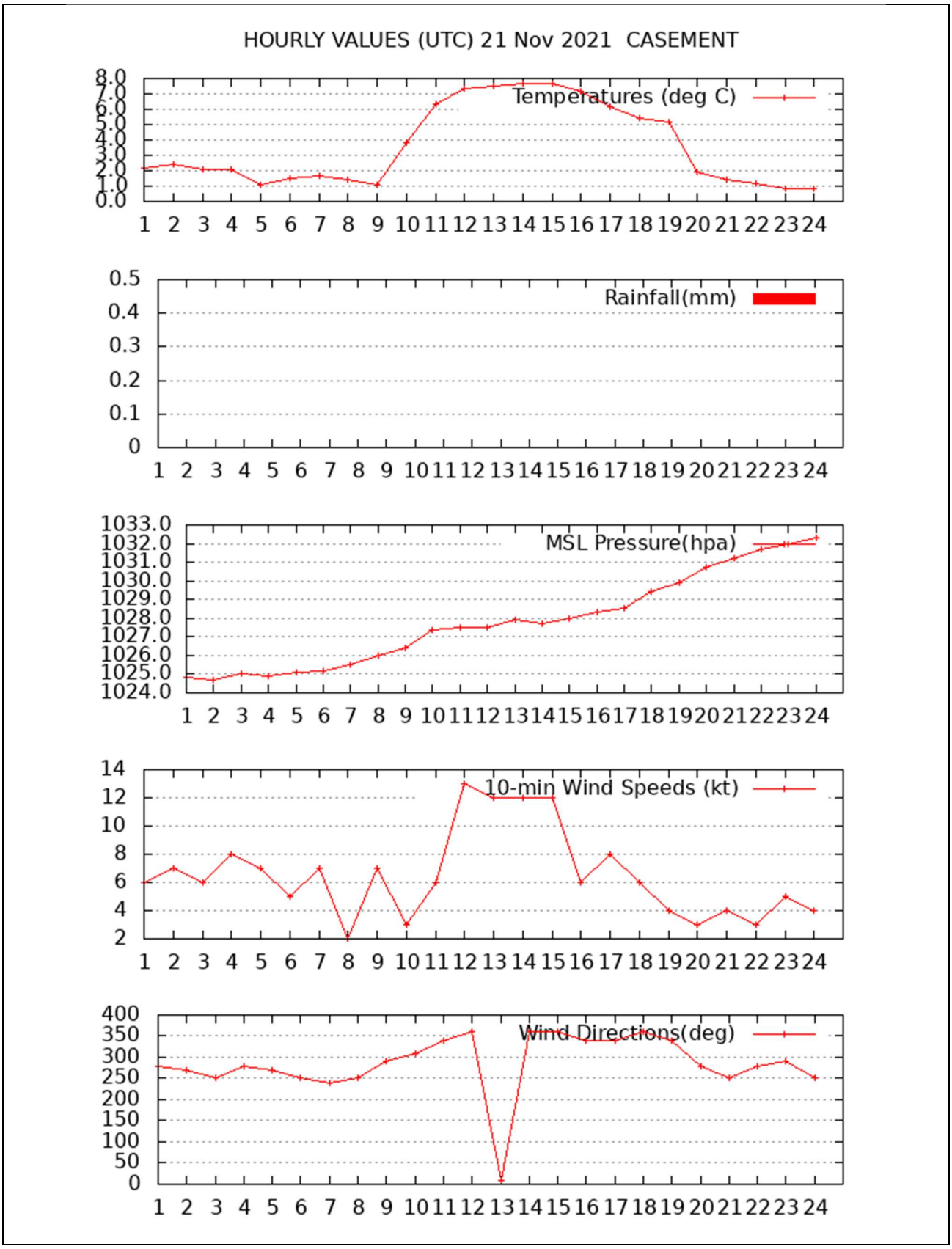
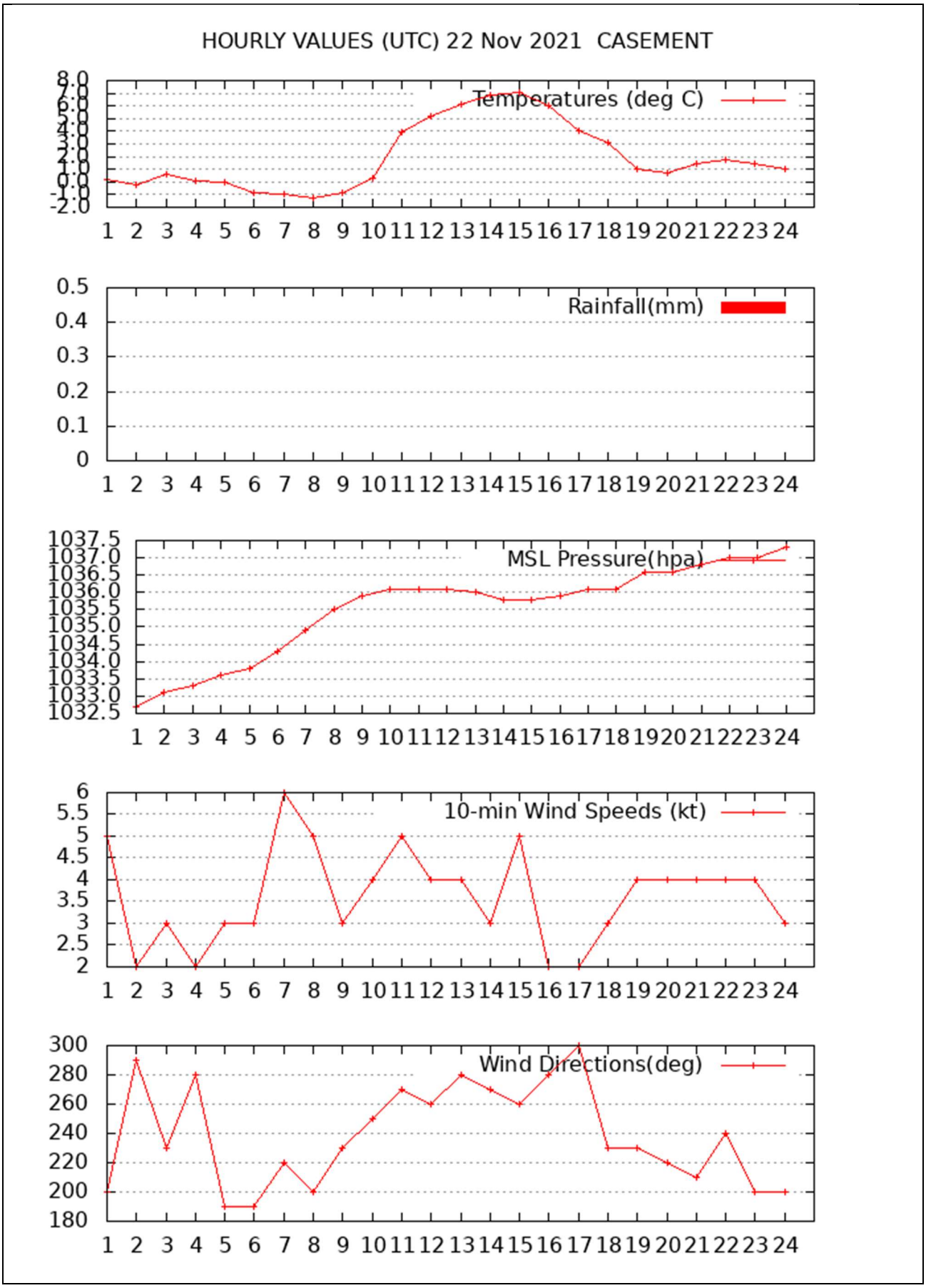
9 Appendix B: Weather Data (18~24th November 2021)

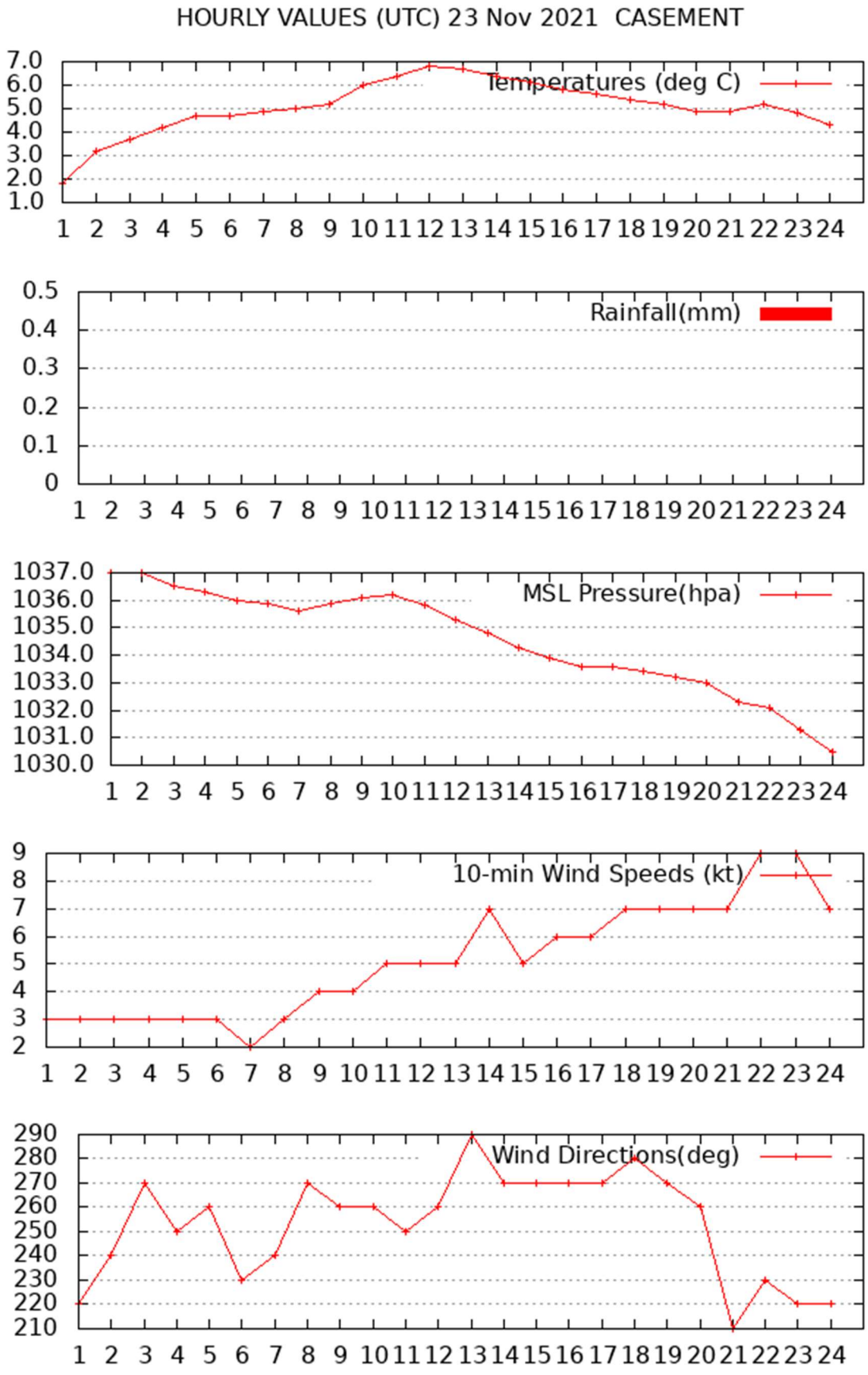


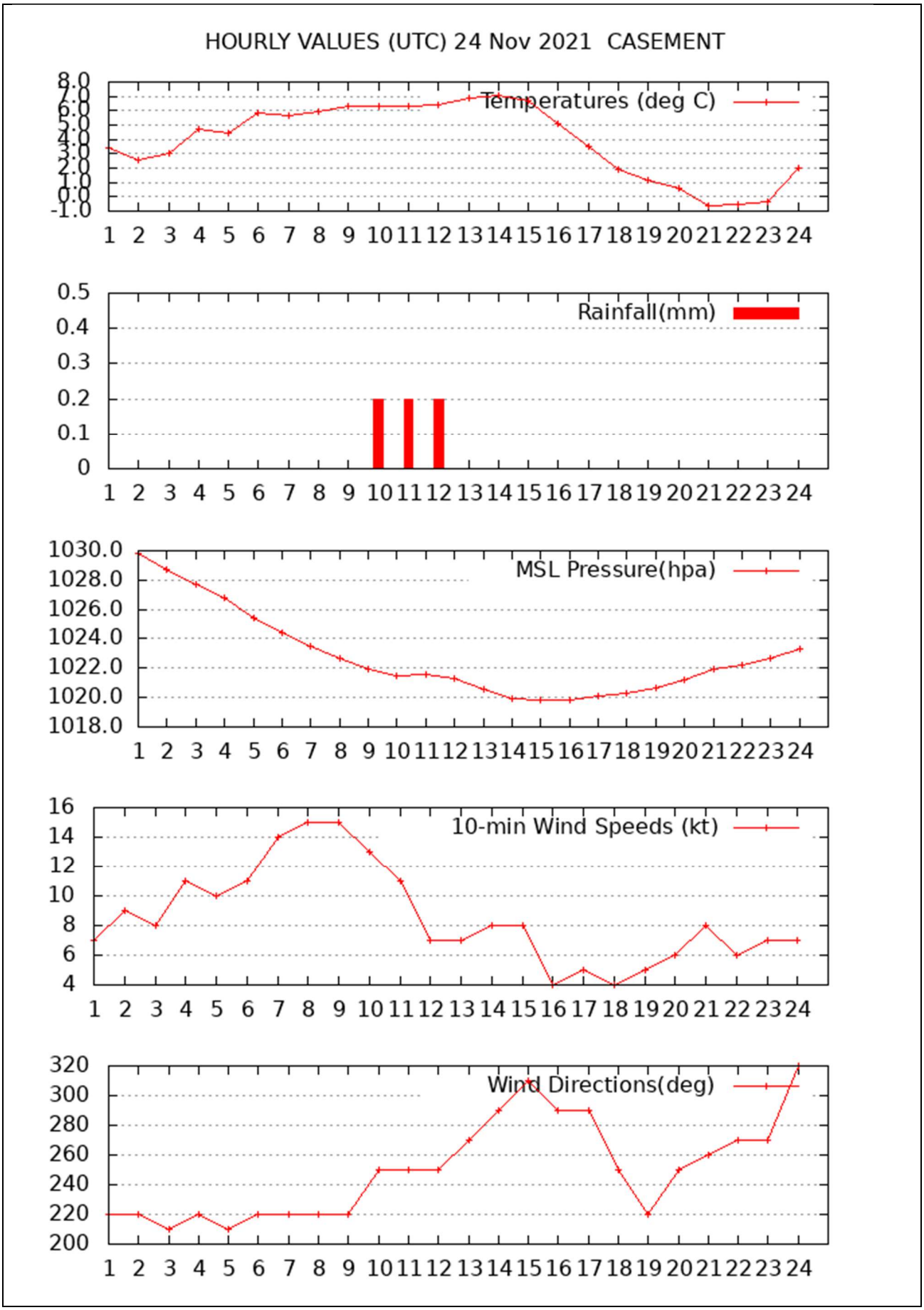












10 Appendix C: Terminology

Decibel (dB): A decibel is a unit of level, which denotes the ratio between two quantities that are proportional to the power; the number of decibels corresponding to the ratio of two powers is ten times the logarithm to the base 10 of this ratio.

dB(A): A weighted sound pressure level (SPL) approximately equivalent to the human ear frequency response to noise.
The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear frequency response of human hearing. All sound levels in this Report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

Equivalent Continuous (A) Weighted Sound Level [L_{AeqT}]:
This can be regarded as a notional level, which would, in the course of the measuring period (T), cause the same (A) weighted sound energy to be received as that due to the actual sound over the actual measuring period.

LAFMax
The maximum of the sound pressure levels recorded of a measurement period with 'A' frequency weighting. The 'F' denotes a fast sampling rate relating to the speed at which the instrument samples the noise being measured.

LA10
The percentile sound pressure level exceeded 10% of the measurement period, with 'A' frequency weighting calculated by statistical analysis.

LA90
The percentile sound pressure level exceeded 90% of the measurement period, with 'A' frequency weighting calculated by statistical analysis. This term is used to measure an area's background noise level.

Hertz (Hz): The unit of frequency equivalent to one cycle per second.

VDV: VDV is the vibration dose value in in $m/s^{1.75}$

eVDV: Estimated VDV is the vibration dose value in $m/s^{1.75}$