Independent Acoustic Consultancy Practice

Environmental Noise and Vibration Assessment

Former Tata Site
Swansea

6893/ENS1

Hunter Acoustics

Independent Acoustic Consultancy Practice

Henstaff Court Business Centre
Llantrisant Road, Cardiff
CF72 8NG

t: +44(0)2920 891020

e: enquiries@hunteracoustics.co.uk

w: www.hunteracoustics.co.uk

Environmental Noise and Vibration Assessment

Project:	**Former Tata Site**
Site Address:	Pontarddulais Swansea SA4 8RX
HA Reference:	6893/ENS1
Date:	13/10/2023
Client:	Walters Land Limited Hirwaun Industrial Estate Hirwaun House Hirwaun Aberdare CF44 9UL
Contact:	MerylLewis@walters-group.co.uk

ISSUE / REVISION

Rev	Date			
-	05 May 2023	**Filename**	23.6893_ENS1_DRAFT	
		Description	Draft for Client comment	
			Prepared by:	**Checked by:**
		Name	Matthew Hunter AMIOA	Meirion Townsend BSc(Hons) MIOA
		Signature		
0	13 October 2023	**Filename**	23.6893_ENS1	
		Description	Updated to include Illustrative Site Plan and preliminary EBF assessment	
			Prepared by:	**Checked by:**
		Name	Matthew Hunter AMIOA	Meirion Townsend BSc(Hons) MIOA
		Signature		

DOCUMENT CONTROL

Hunter Acoustics has prepared this report for Walters Land Limited (“the Client”), under the agreed terms of appointment for acoustic consultancy services. This report is for the sole and specific use of the Client, and Hunter Acoustics shall not be responsible for any use of this report or its contents for any purpose other than that for which it was prepared and provided.

Should the Client wish to distribute copies of this report to other parties for information, the whole report should be copied, however no professional liability or warranty shall be extended to other parties by Hunter Acoustics in this connection without the explicit written agreement thereto by Hunter Acoustics.

ACCESSIBILITY HELP

- Zoom in or out by holding down CTRL and turning the mouse wheel.
- CTRL and click on the table of contents or references to tables/figures/sections to navigate.
- Press CTRL and Home key to return to the top of the document.
- Press Alt-left arrow to return to your previous location.

TABLE OF CONTENTS

1. INTRODUCTION

We understand a residential development is proposed at Former Tata Site, Pontarddulais, Swansea, SA4 8RX.

The Client has requested a noise and vibration impact assessment is carried out to accompany the planning application.

This report has therefore been commissioned to assess existing ambient and background noise and vibration levels impinging on the site from local sources, namely High Street to the south, the rail line to the west and Glan Llwyd Industrial Estate to the north.

Survey results have been used for comparison with current planning guidance.

2. CRITERIA

2.1 Planning Policy Wales

The Welsh Government's Planning Policy Wales (Edition 11) dated February 2021, states the following;

"6.7.20 Where sensitive developments need to be located close to existing transportation infrastructure for sustainable movement and access they should be designed, as far as practicable, to limit harmful substances and noise levels within and around those developments both now and in the future. This may include employing the principles of good acoustic design and the inclusion of active travel or travel management measures as part of development proposals. Such development, however, should preferably be located away from existing sources of significant noise, which may include aircraft noise or roads, particularly new roads or those with programmed route improvements."

The document states *"For more information on the principles of good acoustic design, readers are referred to Professional Planning Guidance (ProPG) Supplementary Document 2, produced by the Association of Noise Consultants, the Institute of Acoustics and the Chartered Institute of Environmental Health (http://www.association-of-noise-consultants.co.uk/propg/). ProPG has been written principally to assist with the planning process in England, but the design principles put forward in Supplementary Document 2 may also be adopted in Wales.*

2.2 ProPG Supplementary Document 2

Professional Practice Guidance on Planning & Noise, New Residential Development 'Supplementary Document 2 – Good Acoustic Design' produced by the ANC, IOA and CIEH discusses the general principles of Good Acoustic Design, including the following hierarchy of noise management measures in descending order of preference;

i) Maximising the spatial separation of noise source(s) and receptor(s).
ii) Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.
iii) Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.
iv) Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.
v) Using the layout of the scheme to reduce noise propagation across the site.
vi) Using the orientation of the buildings to reduce the noise exposure of noise-sensitive rooms.
vii) Using the building envelope to mitigate noise to acceptable levels.

"It should be remembered that good acoustic design is a process that begins as soon as land is under consideration for development. The timeline for good acoustic design stretches from the conceptual design stage, through quality control during construction, and beyond to post construction performance testing.

Both internal and external spaces should be considered in the acoustic design process. Care should be taken to ensure that acoustic mitigation measures do not result in an otherwise unsatisfactory development. Good acoustic design must be regarded as an integrated part of the overall design process".

2.3 Technical Advice Note (Wales) 11

Noise bands defining categories A-D of TAN 11 are set in terms of $L_{Aeq,16hr}$ daytime and $L_{Aeq,8hr}$ night time levels for road traffic noise and mixed sources, free field 1.2-1.5m above ground level as follows;

Table 2.1 – TAN11 Noise Exposure Categories

Recommended noise exposure categories for new dwellings near existing noise sources (ref Table 2 of TAN 11 (Wales) October 1997)					
Noise Source	Time	Noise Exposure Categories			
		A	B	C	D
Road Traffic	07:00-23:00	<55	55-63	63-72	>72
	23:00-07:00	<45	45-57	57-66	>66
Rail Traffic	07:00-23:00	<55	55-66	66-74	>74
	23:00-07:00	<45	45-59	59-66	>66
Air Traffic	07:00-23:00	<57	57-66	66-72	>72
	23:00-07:00	<48	48-57	57-66	>66
Mixed Sources(4)	07:00-23:00	<55	55-63	63-72	>72
	23:00-07:00	<45	45-57	57-66	>66

Note: In addition, sites where individual noise events regularly exceed 82dB(A) L_{max}(slow), several times in any night time hour should be treated as being in NEC C, unless the L_{eq}(8 hour) already puts the site in NEC D.

(4) Mixed sources: this refers to any combination of road, rail, air and industrial noise sources. The "mixed source" values are based on the lowest numerical values of the single source limits in the table. The "mixed source" NECs should only be used where no individual noise source is dominant.

2.4 British Standard 8233:2014

British Standard 8233:2014 'Guidance on sound insulation and noise reduction for buildings' includes internal noise criteria of habitable rooms in residential dwellings, as shown below;

Table 2.2 – BS 8233:2014 Internal Ambient Noise Criteria for Habitable Rooms

Location	Desired		Reasonable *	
	07:00 to 23:00	23:00 to 07:00	07:00 to 23:00	23:00 to 07:00
Living room	35 dB $L_{Aeq,16hr}$	-	40 dB $L_{Aeq,16hr}$	-
Dining room/area	40 dB $L_{Aeq,16hr}$	-	45 dB $L_{Aeq,16hr}$	-
Bedroom	35 dB $L_{Aeq,16hr}$	30 dB $L_{Aeq,8hr}$	40 dB $L_{Aeq,16hr}$	35 dB $L_{Aeq,8hr}$

* *NOTE 7 states "Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal target levels may be relaxed by up to 5dB and reasonable internal conditions still achieved.*

In addition BS 8233:2014 states: *"Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax,F}$, depending on the character and number of events per night. Sporadic noise events could require separate values."*

Reference is therefore made to World Health Organisation (WHO) 'Guidelines for Community Noise, 1999' which states *"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45dB L_{Amax} more than 10-15 times per night (Vallet & Vernet 1991)".*

Section 7.7.3.2 of BS 8233:2014 entitled 'Design criteria for external noise' states;

"For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,T}$ with an upper guideline value of 55 dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also 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 to 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."

The above criteria in BS 8233:2014 apply for sources without specific character, previously termed “anonymous noise”. BS 8233:2014 7.7.1 advises:

“NOTE: Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate.”

2.5 Building Regulations Part O 2022 Edition - For use in Wales

Requirement O1 of Part O in Wales applies when a new residential building is erected and states,

“(1) Reasonable provision must be made to –

a) limit unwanted solar gains in summer;
b) provide an adequate means to remove heat from the indoor environment.

(2) In meeting the obligations in sub-paragraph(1) –

*a) **account must be taken of the safety of any occupant, and their reasonable enjoyment of the building; and***
b) mechanical cooling may only be used where insufficient heat is capable of being removed from the indoor environment without it.

Under the heading *“Intention”*, it states that requirement O1(2)(a) is met if the building’s overheating mitigation strategy takes account of all the following:

a. Noise at night
b. Pollution
c. Security
d. Protection from falling
e. Protection from entrapment

Noise at night is covered in paragraphs 2.2 to 2.4 as follows:

“2.2 High levels of external noise could limit the use of cross-ventilation to mitigate the risk of summer overheating. External noise is a material consideration considered when applying for Planning permission and mitigating measures may be required in the design in order to obtain Planning permission and controlled through a condition imposed on the consent. In exceptional cases, this could include non-openable windows. More commonly, windows will be openable in order to enable natural ventilation to occur at less sensitive times of day, when there is lower noise, when people are not present in the room, or when they are present but not engaged in noise-sensitive activities. But those windows may need to be kept closed at times to maintain acceptable indoor

acoustic conditions, for example when people are using the rooms for sleep or office work. A noise issue may be identified at the Planning stage but rely on occupants to close windows at noise-sensitive times rather than prevent them from ever opening them, and in those cases overheating strategies should assume windows will be closed during noise-sensitive periods even if they are not fixed closed.

2.3 When the removing excess heat as part of the overheating strategy, noise levels in bedrooms should be kept to a minimum during the sleeping hours of 23:00 – 07:00. Building control bodies may accept as evidence that this requirement is satisfied:

a. documentation to demonstrate that the local planning authority did not consider external noise to be an issue at the site at the planning stage or;

b. if the local planning authority did consider external noise to be an issue that should be controlled through a condition at planning stage, then documentation to demonstrate that the proposals for heat removal (during the sleeping hours of 23.00 – 07.00) are accommodated within or do not conflict with documentation provided to the local planning authority to satisfy any related planning permission condition(s). (For example any expectation that windows on one or more façade, or in certain rooms, will need to be kept closed during noise-sensitive periods.)

2.4 Where active measures (e.g. mechanical system) are used for removing excess heat within the overheating strategy, the noise generated by these measures, particularly within bedrooms and living rooms should be considered. Noise generated by ventilation/cooling systems (which may travel through ducts) and noise from the fan unit may disturb the occupants of the building and so discourage their use. Therefore, the designer should consider minimising noise by careful design and the specification of quieter products. Further guidance on mechanical ventilation systems can be found in Approved Document F.

There are no further criteria or guidance on internal noise levels within Building Regulations Part O in Wales and therefore guidance is sought from the Acoustics, Ventilation and Overheating Residential Design Guide (AVO Guide): 2020 prepared by the Association of Noise Consultants (ANC) and the Institute of Acoustics (IOA).

2.6 AVO Guide: 2020

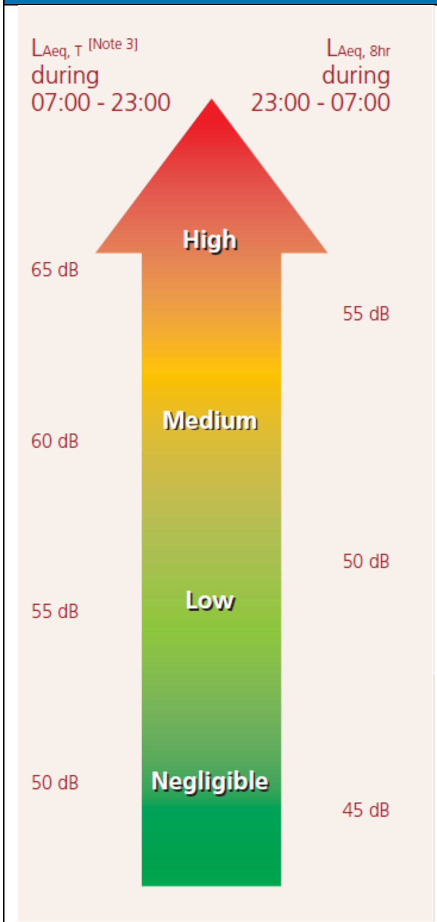
The Acoustics, Ventilation and Overheating – Residential Design Guide (AVO Guide) 2020 aims to assist designers to adopt an integrated approach to the acoustic design of residential dwellings within the context of ventilation and thermal comfort requirements.

The guidance outlines a two-level risk assessment procedure for estimating the potential adverse impact on occupants in overheating conditions.

The Level 1 site risk assessment is based on external free-field noise levels and the assumed scenario where a partially open window is used to mitigate overheating. The Level 1 assessment is sufficient for developments on 'Negligible' risk sites (as defined by Table 2.3 below).

The Level 2 assessment is recommended for 'High' risk sites. For 'Low' and 'Medium' risk sites, a Level 2 assessment can optionally be undertaken to give more confidence regarding the suitability of internal noise conditions. This may be particularly appropriate for sites in the 'Medium' risk category.

Table 2.3 – Guidance for Level 1 Assessment of Noise from Transport Noise Sources Relating to Overheating Condition

Risk Category for Level 1 Assessment [Note 5]	Potential Effect without Mitigation	Recommendation for Level 2 Assessment
	Increasing risk of adverse effect	Recommended Optional
	Use of opening windows as primary means of mitigating overheating is not likely to result in adverse effect	Not required

Note 1 *The noise levels suggested assume a steady road traffic noise source but may be adapted for other types of transport. All levels are external free-field noise levels.*

Note 2 *The values presented in this table should not be regarded as fixed thresholds and reference can also be made to relevant dose-response relationships.*

Note 3 *A decision must be made regarding the appropriate averaging period to use. The averaging period should reflect the nature of the noise source, the occupancy profile and times at which overheating might be likely to occur. Further guidance can be found within the 2014 IEMA Guidelines.*

Note 4 *Refer also to references [1,17,18,22] of the AVO Guide for further guidance regarding individual noise events. Where 78dB LAFmax is normally exceeded during the night-time period (23:00-07:00), a Level 2 assessment is recommended.*

Note 5 *The risk of an adverse effect occurring will also depend on how frequently and for what duration the overheating condition occurs. Refer to Figure 3-2 of the AVO Guide.*

Note 6 *To evaluate the risk category for a dwelling, all three aspects of external noise exposure (i.e. daytime, night-time and individual noise events) should be evaluated. The highest risk category for any of the three aspects applies.*

A Level 2 assessment to assess the potential for an adverse effect from noise exposure should include an estimate of how frequently, and for what duration the overheating condition occurs.

In order to undertake a Level 2 assessment, additional information is likely to be required from a suitably qualified thermal modelling engineer.

2.7 British Standard 4142:2014+A1:2019

British Standard 4142:2014+A1:2019 “Methods for rating and assessing industrial and commercial sound”, provides current guidance for the assessment of industrial noise affecting residential receivers.

This standard describes a rating method comparing L_{Aeq} noise levels from the industrial source with pre-existing background L_{A90} levels at the residential receiver. It advises at a difference (industrial noise - background) of:

- +10dB or higher, likely to be an indication of a significant adverse impact, depending on the context.
- A difference of + 5dB, likely to be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.

A sliding scale of penalties can be applied to industrial/commercial sound levels which have acoustically distinguishing characteristics, including tonality, impulsivity and intermittency.

Tonality – A penalty of 2dB for a tone which is just perceptible at the noise receptor, 4dB where it is clearly perceptible, and 6dB where it is highly perceptible.

Impulsivity – A penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6dB where it clearly perceptible, and 9dB where it is highly perceptible.

Other sound characteristics – Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied

Intermittency – If intermittency is readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied.

BS 4142:2014 states under section 11;

"Where the initial estimate of the impact needs to be modified due to the context, take all pertinent factors into consideration, including the following.

1) *The absolute level of sound. For a given difference between the rating level and the background sound level, the magnitude of the overall impact might be greater for an acoustic environment where the residual sound level is high than for an acoustic environment where the residual sound level is low.*

Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night.

Where residual sound levels are very high, the residual sound might itself result in adverse impacts or significant adverse impacts, and the margin by which the rating level exceeds the background might simply be an indication of the extent to which the specific sound source is likely to make those impacts worse."

2.8 British Standard 6472-1:2008

British Standard 6472-1:2008 "Guide to Evaluation of Human Exposure to Vibration in Buildings" gives guidance figures for vibration dose value (VDV) ranges which might result in various probabilities of adverse comment within residential buildings, as shown below;

Table 2.4 – BS 6472-1:2008 VDV Guidance Ranges

Place and Time	Low Probability of Adverse Comment $m/s^{1.75}$	Adverse Comment Possible $m/s^{1.75}$	Adverse Comment Probable $m/s^{1.75}$
Residential buildings 16 h day	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 h day	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

In our experience, Local Planning Authorities typically request that dwellings are designed and constructed to ensure that vibration dose values do not exceed $0.4 m/s^{1.75}$ 0700-2300hrs daytime, and $0.26 m/s^{1.75}$ 2300-0700hrs night-time, as calculated in accordance with BS 6472-1:2008 [1Hz to 80Hz].

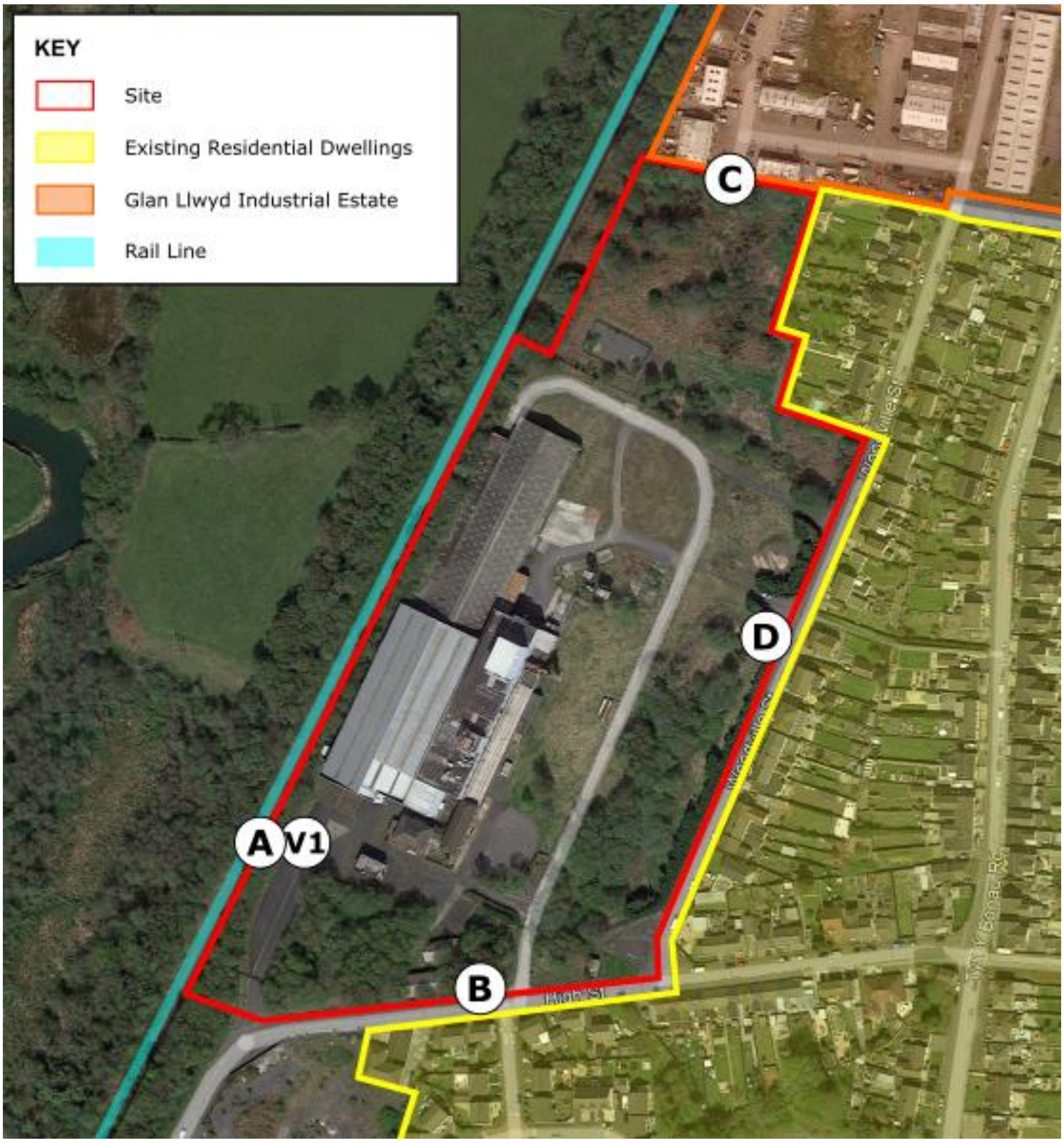
3. ENVIRONMENTAL NOISE SURVEY

3.1 Procedures

Continuous noise monitoring was carried out from 1200hrs on Tuesday, 18 April 2023 to 1030hrs on Thursday, 20 April 2023 at positions A-D.

Data including L_{Amax}, L_{Aeq} and background L_{A90} was logged at 1 minute intervals over the monitoring period, along with continuous audio and 100ms data to allow source identification and further detailed analysis of results if required.

Figure 3.1 – Site Plan Showing Monitoring Locations



Site plan in Figure 3.1 above shows the development site and continuous monitoring positions used, namely:

Table 3.1 – Continuous Monitoring Location Details

Position	Description
A	On fence along south-western boundary adjacent to railway line
B	On fence adjacent to 'High Street' along southern boundary
C	On fence along northern boundary with line of sight into the Glan Llwyd Industrial Estate
D	On fence along eastern boundary to Woodville Street

Note: All microphone positions approximately 1.5m above local ground level.

3.2 Meteorological Conditions

Approximate weather conditions are shown in time history graphs in Figure B.1, Figure B.2 and Figure B.3 of Appendix B.

To summarise, the weather conditions during the monitoring period were dry with winds generally around 5m/s.

3.3 Measurement Equipment

The following measurement equipment was used during the surveys:

Table 3.2 – Noise Monitoring Equipment List

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-08723-E0	29 October 2021	TCRT21/1759
	Preamplifier	MA220	1820	29 October 2021	TCRT21/1759
	Filters	XL2-TA	A2A-08723-E0	01 November 2021	TCRT21/1763
	Microphone Capsule	MC230	9381	29 October 2021	TCRT21/1759
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-10021-E0	17 August 2021	TCRT21/1568
	Preamplifier	MA220	5435	17 August 2021	TCRT21/1568
	Microphone Capsule	MC230	8547	17 August 2021	TCRT21/1568
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-14577-E0	23 June 2022	UK - 22 -051
	Preamplifier	MA220	7485	23 June 2022	UK - 22 -051
	Microphone Capsule	MC230	A15594	23 June 2022	UK - 22 -051
NTi	Type 1 - Sound Level Meter	XL2-TA	A2A-19813-E0	04 November 2021	UK-21-096
	Preamplifier	MA220	10302	04 November 2021	UK-21-096
	Microphone Capsule	MC230A	A21824	04 November 2021	UK-21-096
Larson Davis	Calibrator (94.00dB / 114.03dB @ 1kHz)	CAL200	19047	15 August 2022	44788-19047-CAL200

Measurement systems were calibrated before and after the surveys and no variation occurred.

Note: Copies of traceable calibration certificates for all equipment are available upon request.

3.4 Results

Time history graphs in Figure B.4, Figure B.5, Figure B.6 and Figure B.7 of Appendix B show L_{Amax}, L_{Aeq} and L_{A90} sound pressure levels measured at positions A, B, C and D respectively.

The following $L_{Aeq,16hr}$ daytime (0700-2300hrs) and $L_{Aeq,8hr}$ night-time (2300-0700hrs) noise levels were measured;

Table 3.3 – Summary of Daytime $L_{Aeq,16hr}$ and Night-time $L_{Aeq,8hr}$ Results

Period	Date	Position			
		A	B	C	D
Daytime $L_{Aeq, 11hr}$ (dB)	12/04/2023	49.1	60.5	53.3	58.2
Night-time $L_{Aeq,8hr}$ (dB)	12-13/04/2023	48.4	50.8	44.9	48.7
Daytime $L_{Aeq,16hr}$ (dB)	13/04/2023	50.1	58.9	52.1	58.3
Night-time $L_{Aeq,8hr}$ (dB)	13-14/04/2023	49.2	51.5	52.6	49.7
Daytime $L_{Aeq, 3.5hr}$ (dB)	14/04/2023	62.5	61.5	53.1	59.7

There were 2no $L_{Amax,F}$ events over 82dB measured during the first and second night-time periods (2300-0700hrs) at position A.

There was 1no $L_{Amax,F}$ event over 82dB measured during the second night-time period (2300-0700hrs) at position B.

There were 5no $L_{Amax,F}$ events over 82dB measured during the second night-time period (2300-0700hrs) at position C.

There were 2no $L_{Amax,F}$ events over 82dB measured during the first and 1no event on the second night-time period (2300-0700hrs) at position D.

Graphs in Figure B.8, Figure B.9, Figure B.10 & Figure B.11 of Appendix B show statistical analysis of background sound levels measured at positions A, B, C and D respectively.

The following minimum consistent daytime and night-time background L_{A90} sound levels have been determined;

Table 3.4 – Minimum Consistent Daytime and Night-time Background L_{A90} Results

Period	Position			
	A	B	C	D
Daytime (0700-2300hrs) L_{A90} (dB)	38	40	45	38
Night-time (2300-0700hrs) L_{A90} (dB)	29	27	40	26

Overall, the noise climate on site was controlled by road traffic noise. Additional noise events from trains at the western boundary and light industrial activities at the northern boundary were also identified.

The night-time background sound level at Position C appeared to be controlled by distant plant noise.

4. RAIL VIBRATION SURVEY

4.1 Procedure

Continuous vibration monitoring was carried out from 1200hrs on Tuesday, 18 April 2023 to 1030hrs on Thursday, 20 April 2023.

Vibration levels were monitored in three orthogonal axes:

- Radial (horizontal, perpendicular to line of tracks)
- Tangential (horizontal, parallel to line of tracks)
- Vertical

Consecutive 1-minute 1/3-octave RMS acceleration spectra (a_{rms}) were recorded as well as hourly VDVs.

Site plan in Figure 3.1 shows the development site and vibration monitoring positions used, namely:

Table 4.1 – Vibration Monitoring Location Details

Position	Description
V1	Attached to concrete block at 11m from Railway tracks

4.2 Equipment Used

The following measurement equipment was used during the surveys:

Table 4.2 – Vibration Monitoring Equipment List

Make	Description	Model	Serial Number	Last Calibrated	Certificate No.
Svantek	Type 1 - Sound & Vibration Data Logger	SVAN 948	6962	20 August 2019	TCRT19/1656 / TCRT19/1653
Dytran	Tri-axial Accelerometer	3233A	158	20 August 2019	TCRT19/1656
Dytran	Cable	6483A09	-	20 August 2019	TCRT19/1656

Note: Copies of traceable calibration certificates for all equipment are available upon request.

4.3 Results

Table B.1 and Table B.2 of Appendix B show hourly vibration dose value (VDV) results for continuous vibration monitoring at position V1.

Total daytime (0700-2300hrs) and night-time (2300-0700hrs) VDV results are summarised in the table below;

Table 4.3 – Summary of Continuous Vibration Monitoring Results (18-19/04/2023)

Axis	Position V1
Radial Totals VDV_d Day: 0700-2300hrs ($m/s^{1.75}$) VDV_d Night: 2300-0700hrs ($m/s^{1.75}$)	 0.003 0.002
Tangential Totals VDV_d Day: 0700-2300hrs ($m/s^{1.75}$) VDV_d Night: 2300-0700hrs ($m/s^{1.75}$)	 0.258 0.046
Vertical Totals VDV_b Day: 0700-2300hrs ($m/s^{1.75}$) VDV_b Night: 2300-0700hrs ($m/s^{1.75}$)	 0.060 0.024

Table 4.4 – Summary of Continuous Vibration Monitoring Results (19-20/04/2023)

Axis	Position V1
Radial Totals VDV_d Day: 0700-2300hrs ($m/s^{1.75}$) VDV_d Night: 2300-0700hrs ($m/s^{1.75}$)	 0.004 0.003
Tangential Totals VDV_d Day: 0700-2300hrs ($m/s^{1.75}$) VDV_d Night: 2300-0700hrs ($m/s^{1.75}$)	 0.277 0.021
Vertical Totals VDV_b Day: 0700-2300hrs ($m/s^{1.75}$) VDV_b Night: 2300-0700hrs ($m/s^{1.75}$)	 0.064 0.007

Vibration dose values do not therefore exceed $0.4m/s^{1.75}$ 0700-2300hrs daytime, and $0.26m/s^{1.75}$ 2300-0700hrs night-time, as calculated in accordance with BS 6472-1:2008 [1Hz to 80Hz].

5. INDUSTRIAL NOISE CONTRIBUTIONS

Light industrial activities were identified during the daytime at position C at the northern boundary during the monitoring period overlooking the Glan Llwyd Industrial Estate. No night-time activities were identified on the audio recordings.

From visiting the estate, units in proximity to the site boundary appear to be light industrial use with the main sources of noise appearing to be vehicles coming and going, with occasional deliveries.

A 1-hour period has been identified in the recordings during which a delivery takes place (1500-1600hrs on 19/04/2023).

Noise sources including an HGV movement (with reversing alarms) and impacts during the unloading were identified. An overall $L_{Aeq,10min}$ of 60dB was measured at Position C from the delivery (unscreened).

A detailed BS 4142:2014+A1:2019 assessment could be carried out at detailed design stage however at this outline stage we would refer to Section 11 of BS 4142 (quoted in 2.7 of this report) and outline the context:

BS4142 advises: "*whether dwellings will already incorporate design measures that secure good internal and/or outdoor acoustic conditions, such as:*

i. façade insulation treatment;
ii. ventilation and/or cooling that will reduce the need to have windows open so as to provide rapid or purge ventilation; and
iii. acoustic screening."

BS 4142:2014+A1:2019 therefore indicates sound insulation treatment of new residential façades can be used to reduce industrial noise impact. A scheme of noise mitigation measures could be included such as uprated glazing and ventilation to facades overlooking the industrial estate as well as close boarded fencing to screen gardens.

The units adjacent to the northern site boundary are also indicated to be light industrial use (electrical parts suppliers, cleaning contractors etc.), with daytime operating hours only (generally 0800-1800hrs).

6. NOISE MAP MODELLING

Three-dimensional noise map modelling of the road and rail noise has been undertaken using environmental noise mapping software package, which in turn uses calculation methods of Calculation of Road Traffic Noise (CRTN) and ISO 9613.

Models have been set up to predict daytime and night-time noise levels across the site from surrounding sources based on measured noise levels discussed in section 3.4 of this report.

The model takes into account distance and screening losses from existing and new structures, allowing garden noise levels to be assessed, as well as predicting noise levels at proposed residential facades.

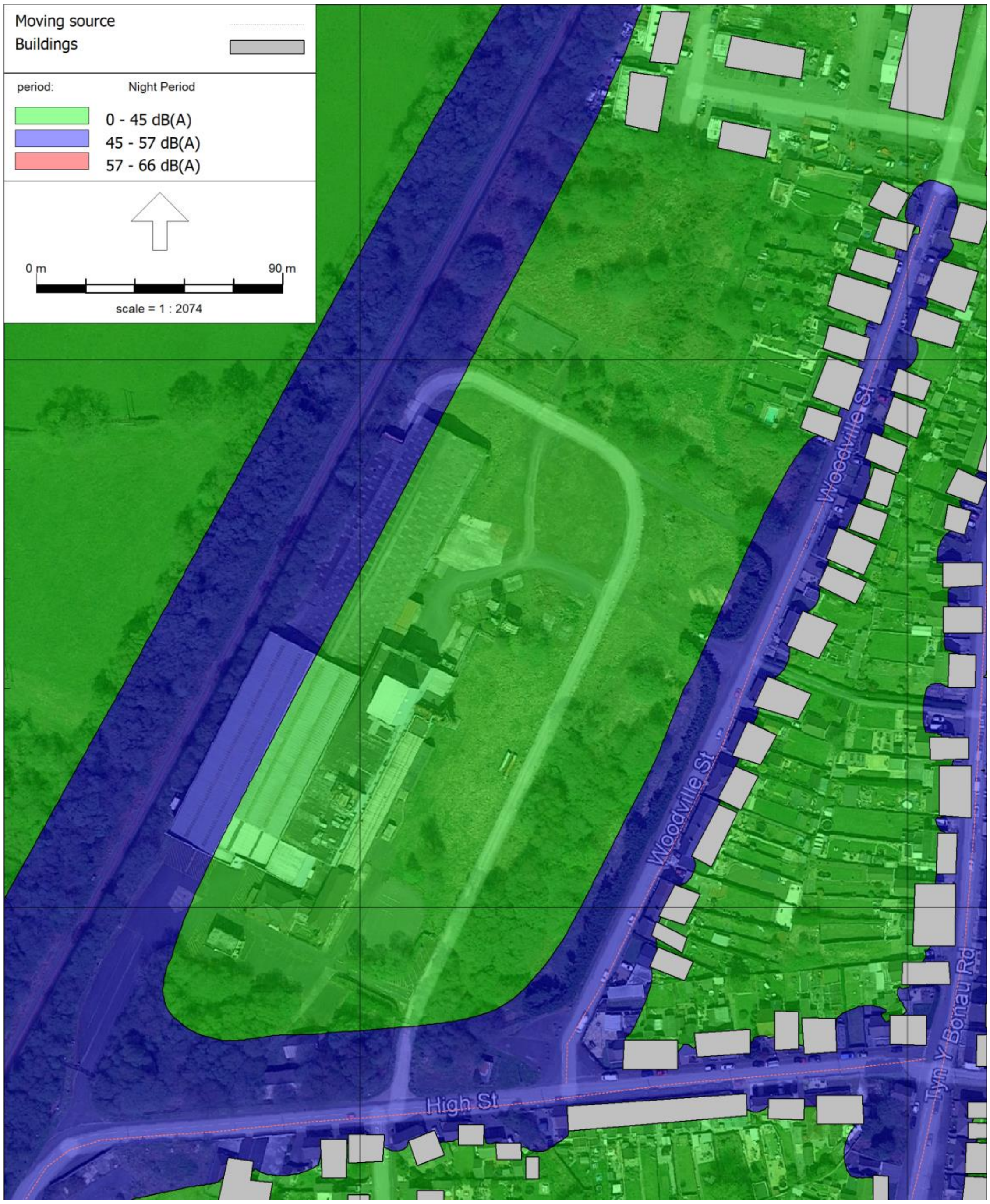
6.1 Undeveloped Model

The noise map model below shows predicted road and rail traffic noise levels during the daytime period (0700-2300hrs) at 1.5m above local ground level across the undeveloped site.

Figure 6.1 – Daytime Model (undeveloped Site) $L_{Aeq,16hr}$ Contours at 1.5m Height

Night-time noise levels are shown at first floor level (4.5m above local ground height).

Figure 6.2 – Night-time Model (undeveloped Site) $L_{Aeq,8hr}$ Contours at 4.5m Height



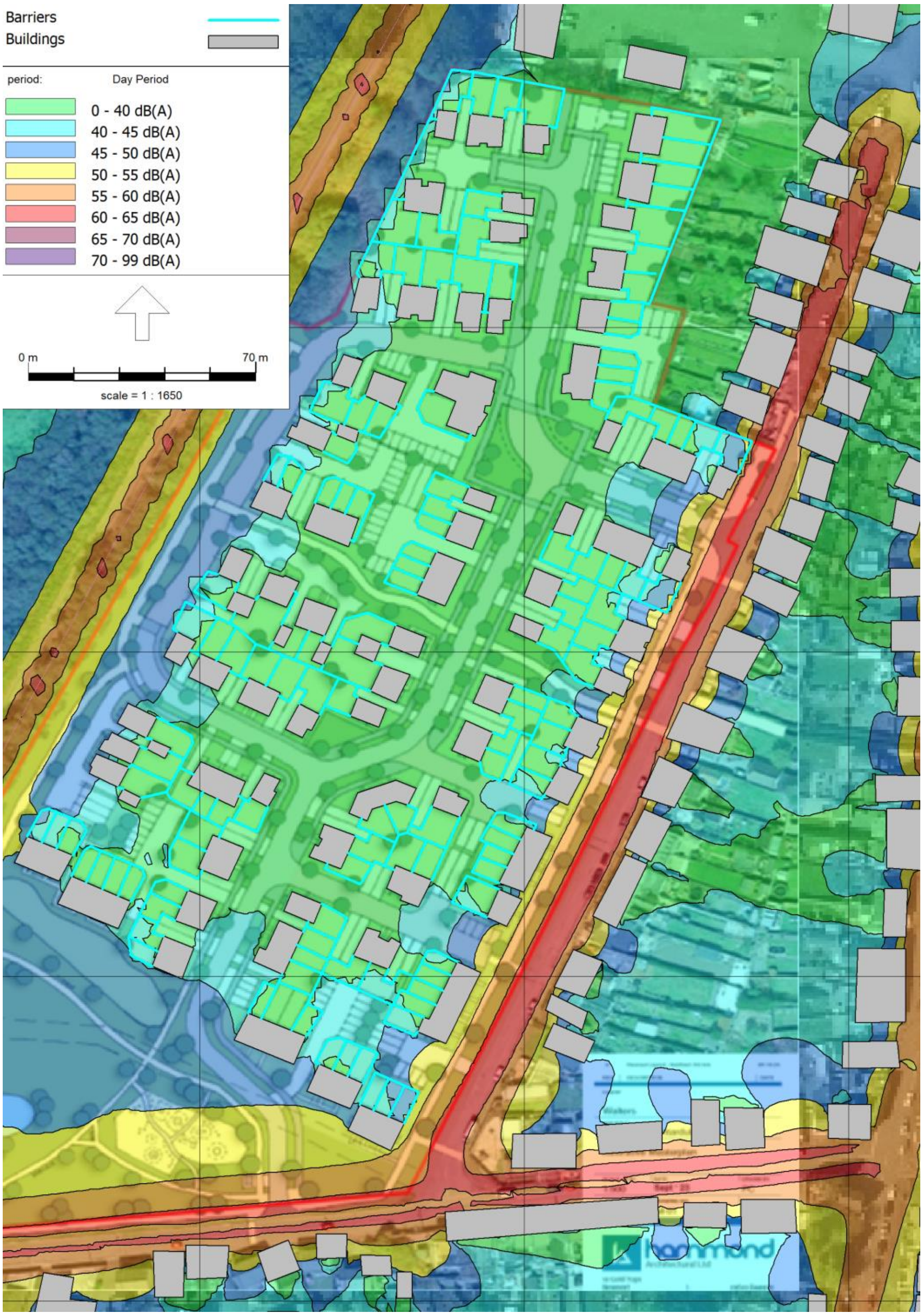
Overall, the majority of the site is indicated to fall under NEC A of TAN11, with exception of boundaries with the road/rail way which fall under NEC B.

6.2 Developed Site

The proposed housing layout plan referenced in Appendix C has been used for the developed model.

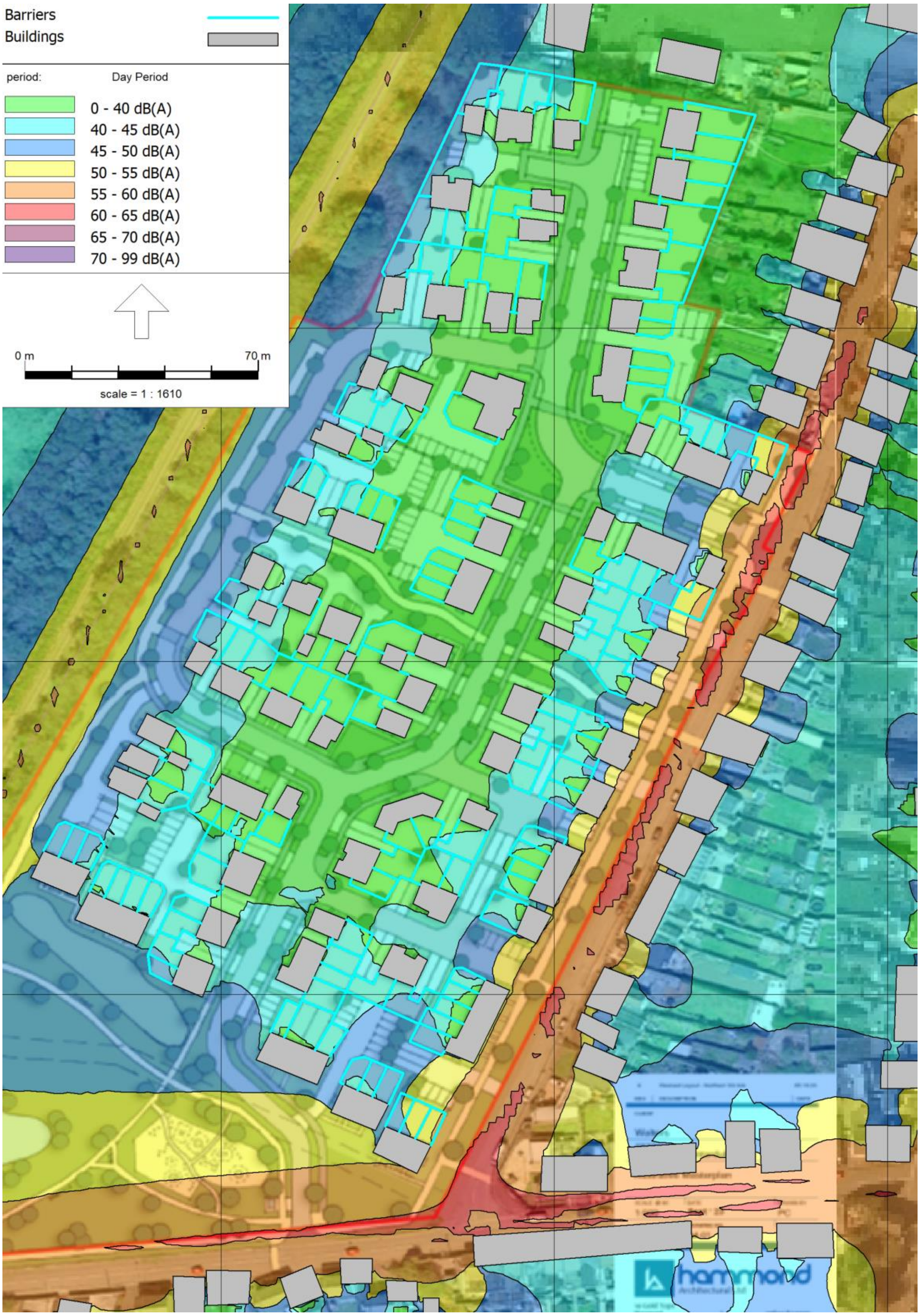
Noise map models in Figure 6.3 and Figure 6.4 below show predicted road and rail traffic noise levels during the daytime period (0700-2300hrs) at 1.5m and 4.5m above local ground level on the developed site respectively.

Figure 6.3 - Daytime Model (Developed Site) $L_{Aeq,16hr}$ Contours at 1.5m Height



Note: 1.8m high closed boarded fences have been modelled around gardens.

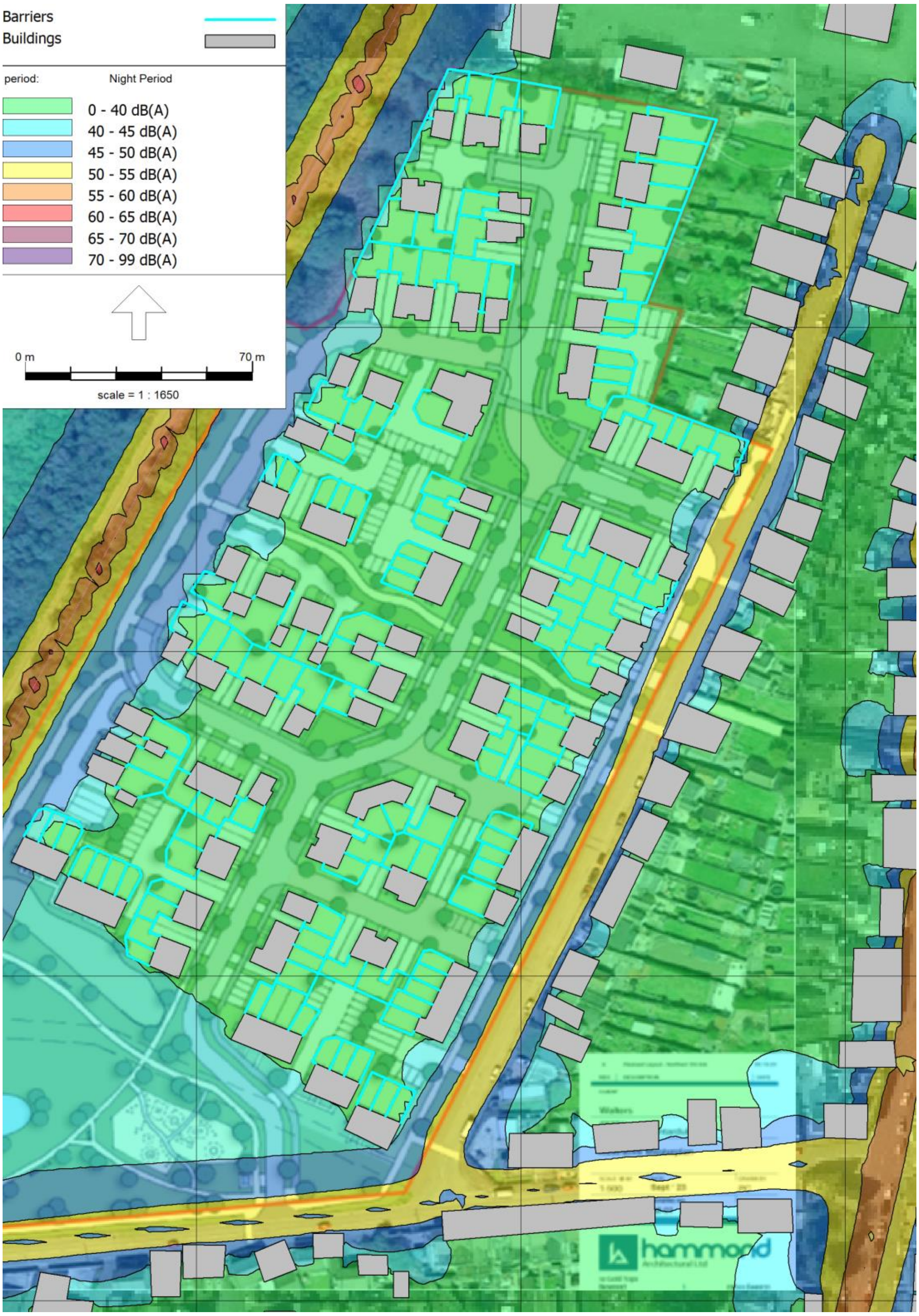
Figure 6.4 - Daytime Model (Developed Site) $L_{Aeq,16hr}$ Contours at 4.5m Height



Note: 1.8m high closed boarded fences have been modelled around gardens.

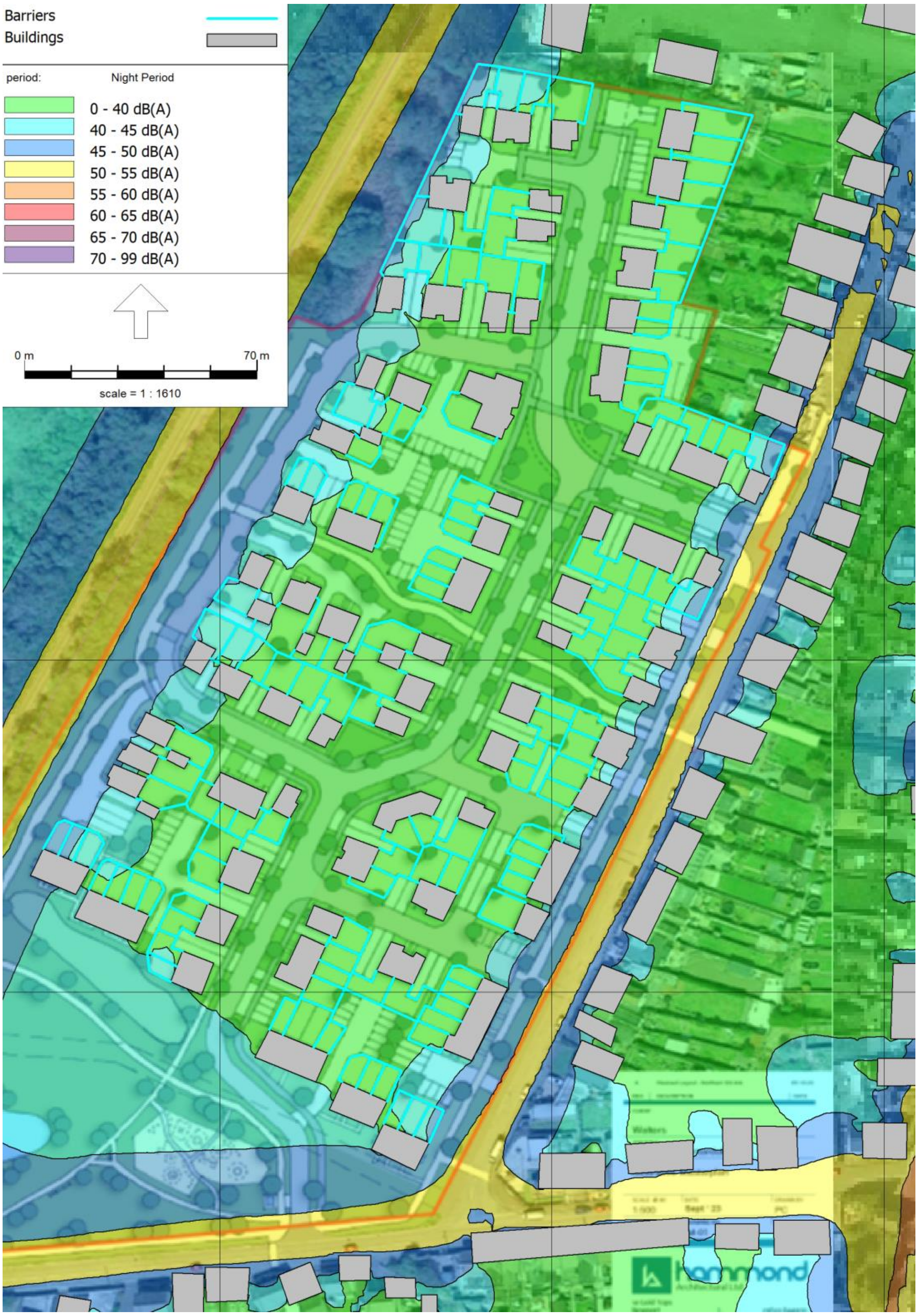
Noise map models in Figure 6.3 and Figure 6.4 below show predicted road and rail traffic noise levels during the night-time period (2300-0700hrs) at 1.5m and 4.5m above local ground level on the developed site respectively.

Figure 6.5 – Night-time Model (Developed Site) $L_{Aeq,\ 8hr}$ Contours at 1.5m Height



Note: 1.8m high closed boarded fences have been modelled around gardens.

Figure 6.6 – Night-time Model (Developed Site) $L_{Aeq,8hr}$ Contours at 4.5m Height



Note: 1.8m high closed boarded fences have been modelled around gardens.

7. PRELIMINARY EXTERNAL BUILDING FABRIC ASSESSMENT

Based on survey results and noise map models, we have carried out a preliminary external building fabric assessment with the aim of controlling noise intrusion to habitable rooms to meet 35dB $L_{Aeq,16hr}$ daytime and 30dB $L_{Aeq,8hr}$ night-time, in line with the desirable internal ambient noise values quoted in BS 8233:2014 (see section 2.4 of this report) under whole dwelling ventilation conditions..

This preliminary assessment is intended to provide an initial indication of the sound insulation measures required to control noise intrusion. Final design proposals should be confirmed acceptable with a suitably qualified acoustician at the detailed design stage.

This preliminary assessment has been carried out based on the following assumptions;

- Noise intrusion is calculated to a bedroom with dimensions of 4m (l) x 2.5m (w) x 2.4m (h)
- Façade area, exposed to road traffic of 10m^2 (l x h)
- Glazing area of 2m^2

The analysis is based on the noise spectra quoted in Figure B.12 & Figure B.13.

7.1 External Walls

The following external wall construction has been used in our analysis;

- Brick / cavity / Block *or* Brick / cavity / Timber Frame

The following SRI performance figures are taken from BS 8233:2014 for 'Brick and block external wall'. The proposed constructions should be capable of achieving these figures as a minimum;

Table 7.1 – External Wall Sound Reduction Index Figures

Element	Description	Sound Reduction Index dB *R* (BS EN ISO 10140-2:2010) @ Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
External Wall	Brick / Cavity / Block *or* Brick / Cavity / Timer frame	40	44	45	51	56

7.2 Roof

The following roof constructions have been used in our analysis;

• Pitched tiles on felt roof, 9mm plasterboard ceiling + 100mm insulation

The following minimum SRI performance figures are taken from BS 8233:2014: "tiles on felt roof with 100mm mineral wool on plasterboard ceiling";

Table 7.2 – Roof Sound Reduction Index Figures

Element	Description	Sound Reduction Index dB *R* (BS EN ISO 10140-2:2010) @ Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
Pitched Roof	Tiles on felt, 9mm plasterboard ceiling, 100mm mineral wool insulation	28	34	40	45	49

7.3 Glazing

The following sound reduction index figures shall be met for glazing:

Table 7.3 - Glazing Sound Reduction Index Figures

Element	Description	Sound Reduction Index dB *R* (BS EN ISO 10140-2:2010) @ Octave Band Centre Frequency (Hz)				
		125	250	500	1k	2k
Glazing	For budgetary guidance: based on Pilkington 6mm / 6 – 16mm / 4mm	21	20	25	38	37

A typical glazing system that should be capable of achieving the quoted SRI figures (based on Pilkington test data) is included in the table for initial budgetary guidance, however;

The successful glazing suppliers shall provide independent laboratory test data to BS EN ISO 10140-5 – 2010, confirming their proposed systems (including frames/seals) meet the quoted octave band sound reduction performance figures above.

7.4 Ventilation

A natural ventilation strategy utilising background ventilators and intermittent extract fans is indicated to be feasible on all plots, as specified in Building Regulations Part F, Regulation F1(1) 2010 *2022 Edition.*

> ***Natural Ventilation with background ventilators and intermittent extract fans (guidance suitable only for less airtight dwellings*).*** *Guidance on minimum provisions for intermittent extract and background ventilators is set out in Para 1.47 & 1.59 of Building Regulations Part F.*

The final proposed ventilation strategy should be confirmed acceptable with planners/ EHO and Building Control.

7.4.1 Natural Ventilation

This strategy relies on windows being closed; however, occupiers may still open windows for purge ventilation, or under normal ventilation conditions if they so choose.

Standard background (trickle) ventilators are indicated sufficient. The following minimum ventilator ($D_{n,e}$) performance has been used in our assessment

Table 7.4 – Acoustic Background Ventilator Specifications

Element	Description	Element-Normalised Level Difference dB $D_{n,e}$ (BS EN ISO 10140-2:2010)				
		125	250	500	1k	2k
Ventilator	RW Simon FrameVent (open)	36	33	33	31	29

The calculation has allowed for a maximum of 2no acoustic background ventilators per room, required to meeting the minimum 8000mm^2 equivalent area requirement of Part F.

The successful trickle ventilator suppliers shall provide independent laboratory test data to BS EN ISO 10140-5 – 2010, confirming their proposed ventilator meet the quoted octave band performance figures above.

7.4.2 Continuous Mechanical Extract Ventilation

Alternatively continuous mechanical ventilation may be provided where dwellings are less airtight. “Less airtight” dwellings are defined in Part F as:

a. A design air permeability higher than 5m^3/(h·m^2) at 50Pa.
b. An as-built air permeability higher than 3m^3/(h·m^2) at 50Pa.

Continuous mechanical extract. *Guidance on minimum provisions for extract and whole building ventilation is set out in Para 1.61 & 1.62 of Building Regulations Part F.*

The minimum ventilator ($D_{n,e}$) performance quoted in Table 7.4 above is indicated sufficient.

7.4.3 Mechanical Ventilation with Heat Recovery

Alternatively, a Mechanical Ventilation with Heat Recovery (MVHR) strategy could be utilised which does not require any background ventilators in the external façade.

7.4.4 Mechanical Ventilation System Noise

All mechanical ventilation systems should be designed to meet the noise criteria set out in Building Regulations Approved Document Part F, 2022 Edition – For use in Wales which states the following:

"Although there is no requirement to undertake noise testing, achieving the levels in the following guidance should ensure good acoustic conditions. The average A-weighted sound pressure level for a ventilator operating under normal conditions and not at boost rates should not exceed both of the following.

a) 30dB LAeq,T for noise-sensitive rooms (e.g. bedrooms and living rooms) when a continuous mechanical ventilation system is running on its minimum low rate.

b) 45dB LAeq,T in less noise-sensitive rooms (e.g. kitchens and bathrooms) when a continuous operation system is running at the minimum high rate or an intermittent operation system is running."

7.4.5 General

Final proposals should be confirmed with Building Control and Environmental Health prior to orders being placed.

7.5 Overheating

Based on overheating condition guidance in the AVO Guide (refer to Section 2.6), a 'Level 1 Site Risk Assessment' shows critical **bedroom** facades at 50dB $L_{Aeq,8h}$ and up to 73dB $L_{Amax,F}$ are at a 'Low-Medium Risk' of adverse effect in periods of overheating at night.

At this stage and for guidance, we would advise that the "geometric open area" of the **bedroom** windows on critical facades (not the "equivalent area") should not exceed 6.3% of the floor area at night, if the upper internal night-time AVO Guide values of 42dB $L_{Aeq,8h}$ and 65dB $L_{Amax,F}$ are to be met (providing approximately 8dB sound reduction).

This should be confirmed acceptable with a suitably qualified thermal modelling engineer. If this is not sufficient, an alternative means of controlling overheating is likely to be required.

Any detailed overheating assessment should be carried out to all plots within the development site.

Note: This assessment has been carried out to bedrooms of the most critical plots within the proposed development site, located closest to the road. It is likely that plots situated further back from the road, with lower external ambient noise levels, are at a reduced noise risk. This can be reviewed at a later stage, as part of a more detailed overheating assessment if required.

8. EXTERNAL NOISE ASSESSMENT (GARDENS)

The noise map model in Figure 6.3 indicates all garden areas meet the desirable 50dB(A) figure quoted in BS 8233.

The worst-case hour period of industrial noise measured at the northern boundary was 52dB(A) unscreened (-8dB correction from 60dB $L_{Aeq,10mins}$). Accounting for screening from 1.8m high garden fences it is indicated that industrial noise would also fall below 50dB(A).

9. CONCLUSION

An environmental noise and vibration assessment has been carried out for the proposed residential development at Former Tata Site, Pontarddulais, Swansea, SA4 8RX.

Road traffic is indicated to control the ambient noise climate day and night.

Noise map models have been generated to show noise propagation across the undeveloped site. The majority of the site falls under NEC A of TAN 11 and therefore overall, noise should not be a reason for concern for residential development.

Vibration levels are indicated to fall below thresholds typically applied in Local Planning Authority conditions.

Industrial noise was identified at the northern boundary of the site however an adverse impact is indicated less likely and residential development at the northern site boundary should not be restricted. Proposed external building fabric measures are indicated to be sufficient to control internal noise intrusion.

Garden noise levels are indicated to fall below the 50dB garden criteria of BS 8233:2014 with the inclusion of a 1.8m close boarded garden fence.

APPENDIX A - ACOUSTIC TERMINOLOGY

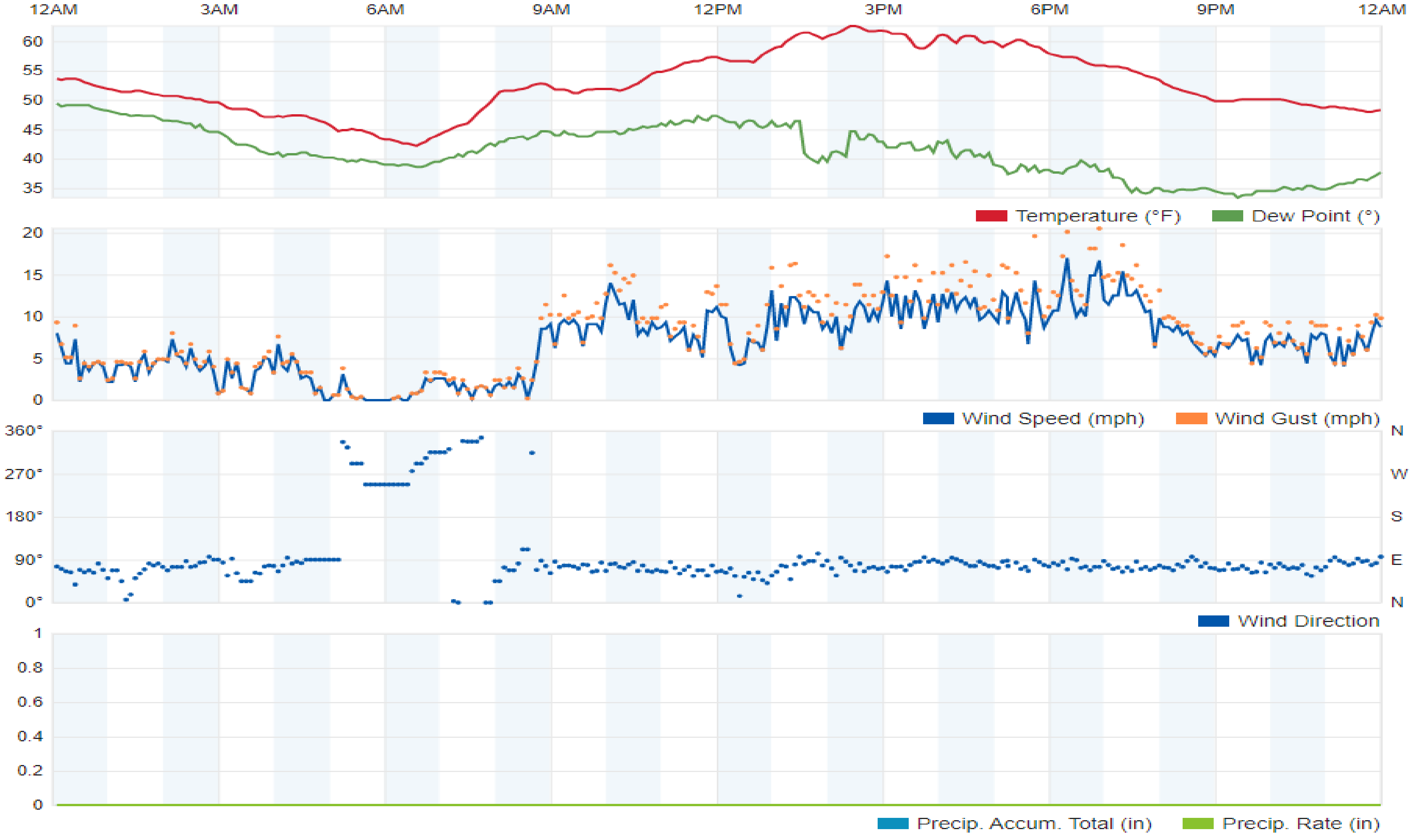
Human response to noise depends on a number of factors including loudness, frequency content and variations in level with time. Various frequency weightings and statistical indices have been developed in order to objectively quantify 'annoyance'.

The following units have been used in this report:

dB(A)	The sound pressure level A-weighted to correspond with the frequency response of the human ear and therefore a persons' subjective response to frequency content.
L_{eq}	The equivalent continuous sound level is a notional steady state level which over a quoted time period would have the same acoustic energy content as the actual fluctuating noise measured over that period.
L_{max}	The highest instantaneous sound level recorded during the measurement period.
L_{10}	The sound level which is exceeded for 10% of the measurement period. i.e. The level exceeded for 6 minutes of a 1 hour measurement - used as a measure of background noise.
L_{90}	The sound level which is exceeded for 90% of the measurement period. i.e. The level exceeded for 54 minutes of a 1 hour measurement - used as a measure of background noise.
$L_{Ar,Tr}$	The 'rating' level, as described in BS 4142:2014 – the specific noise plus any adjustment for the characteristic features of the noise.
SSR	Sound sensitive receiver
$VDV_{b/d,T}$	Vibration Dose Value – the measure of the total vibration experienced over a specified period. It is weighted using W_b and W_d as appropriate, over a given time period, T. The VDV defines a relationship that yields a consistent assessment of continuous, intermittent, occasional and impulsive vibration and correlates well with subjective response.

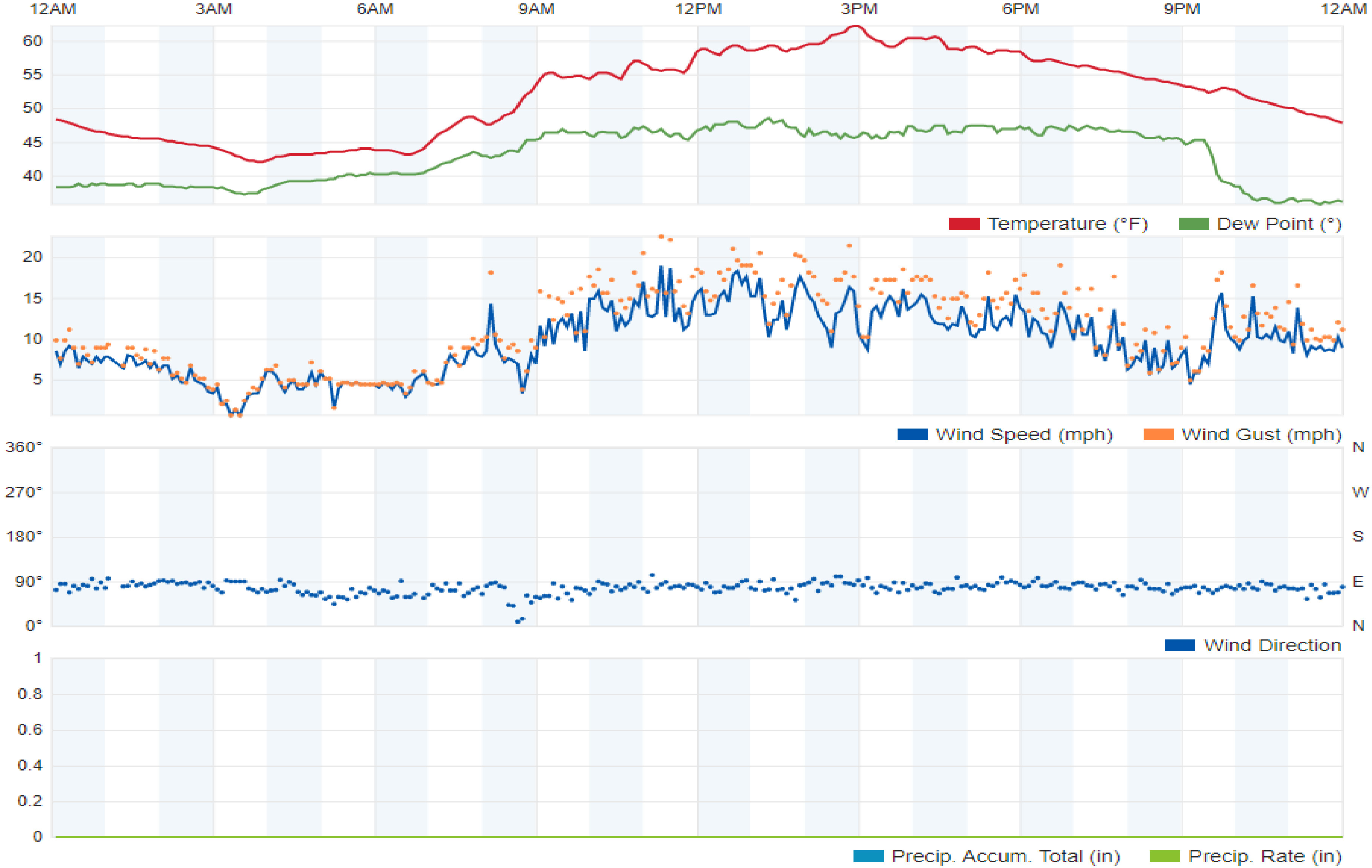
APPENDIX B - DIAGRAMS, GRAPHS AND TABLES

Figure B.1 – Approximate Weather History for Tuesday, 18 April 2023



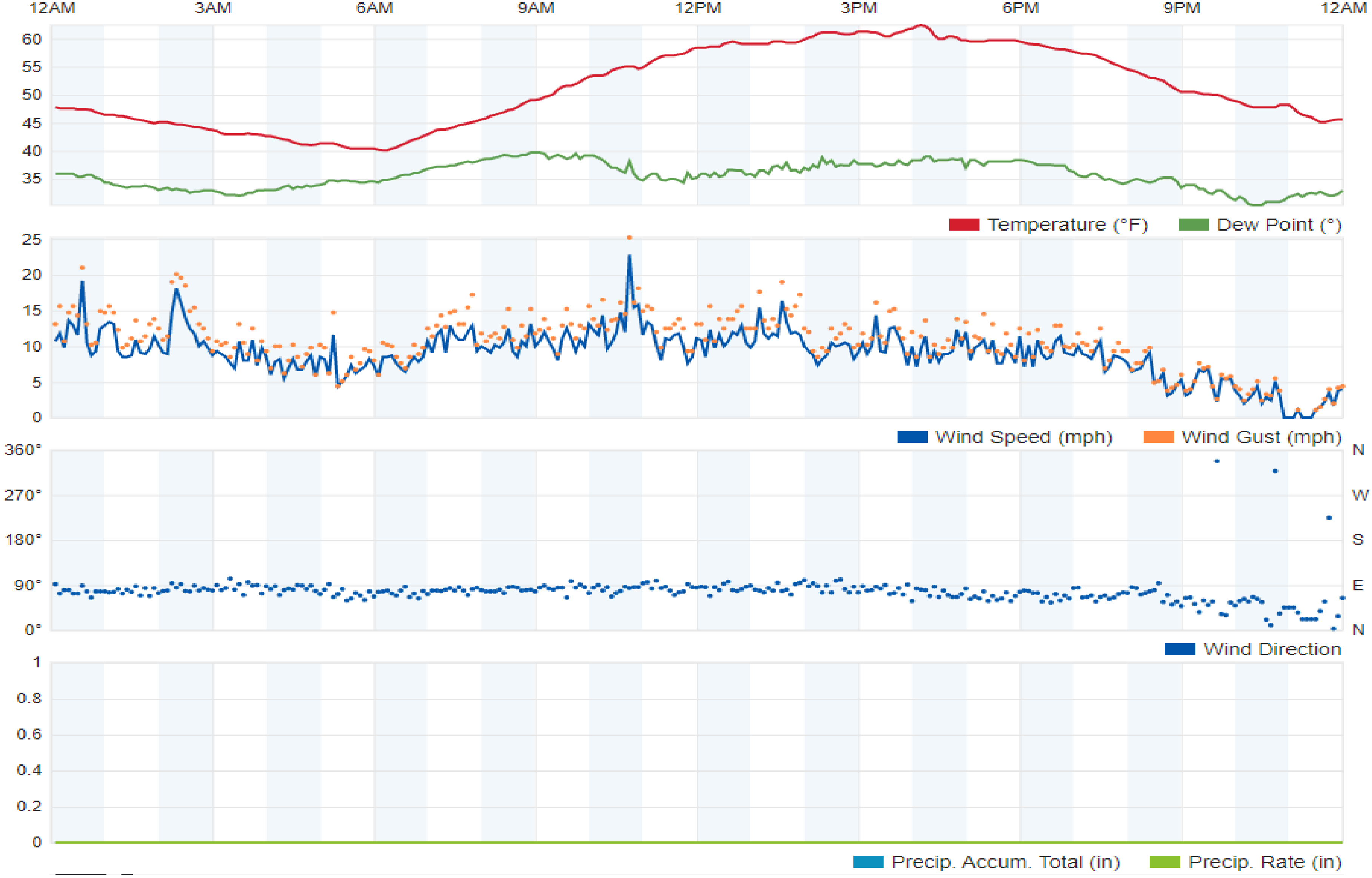
Note: Taken from www.wunderground.com - weather station ILLANE11 located in Llangennech [Elev 141 ft, 51.70 °N, 4.09 °W]

Figure B.2 – Approximate Weather History for Wednesday, 19 April 2023



Note: Taken from www.wunderground.com - weather station ILLANE11 located in Llangennech [Elev 141 ft, 51.70 °N, 4.09 °W]

Figure B.3 – Approximate Weather History for Thursday, 20 April 2023



Note: Taken from www.wunderground.com - weather station ILLANE11 located in Llangennech [Elev 141 ft, 51.70 °N, 4.09 °W]

Figure B.4 – Time History at Position A (Tuesday, 18 April 2023 to Thursday, 20 April 2023)

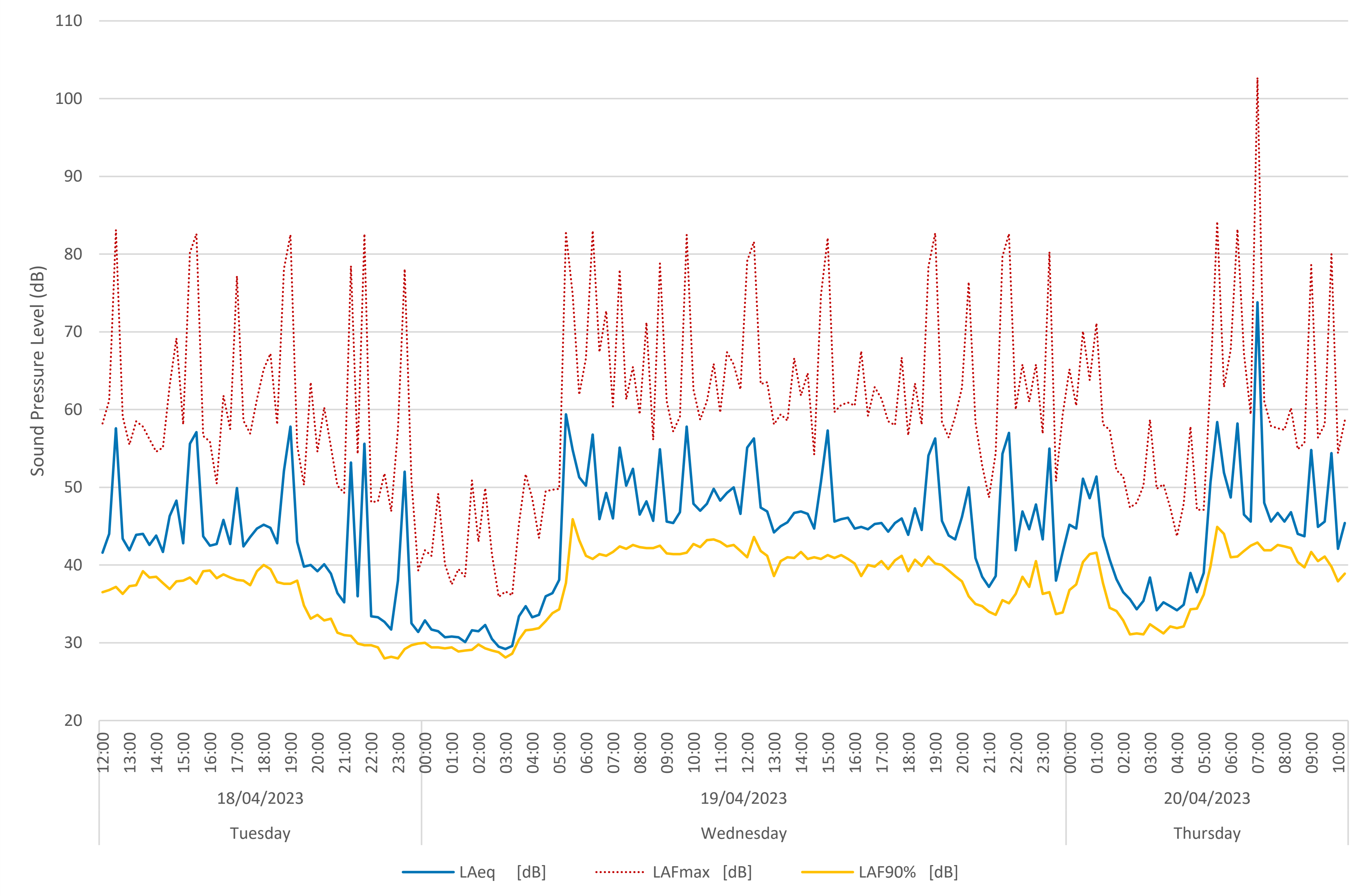


Figure B.5 – Time History at Position B (Tuesday, 18 April 2023 to Thursday, 20 April 2023)

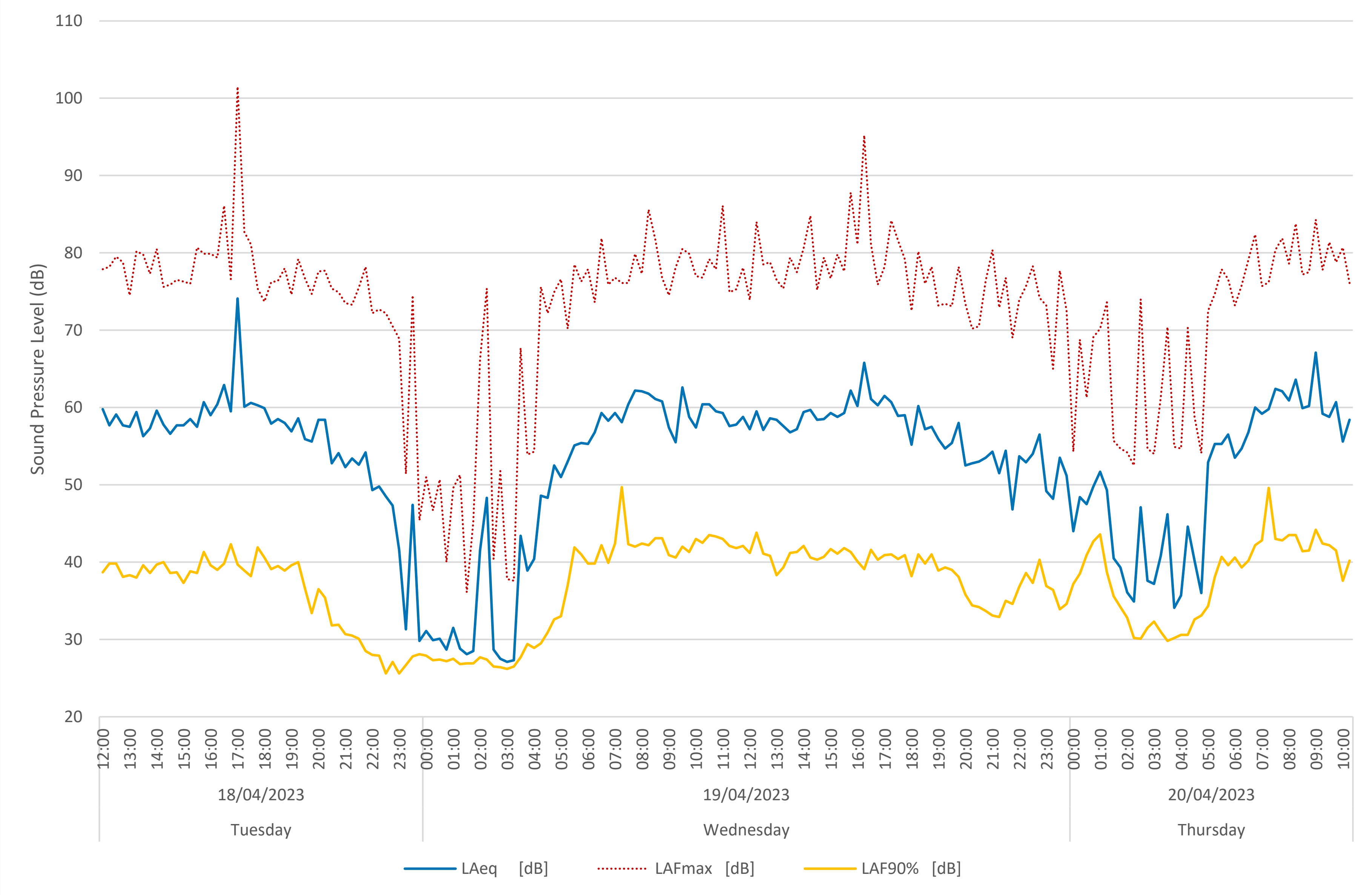


Figure B.6 – Time History at Position C (Tuesday, 18 April 2023 to Thursday, 20 April 2023)

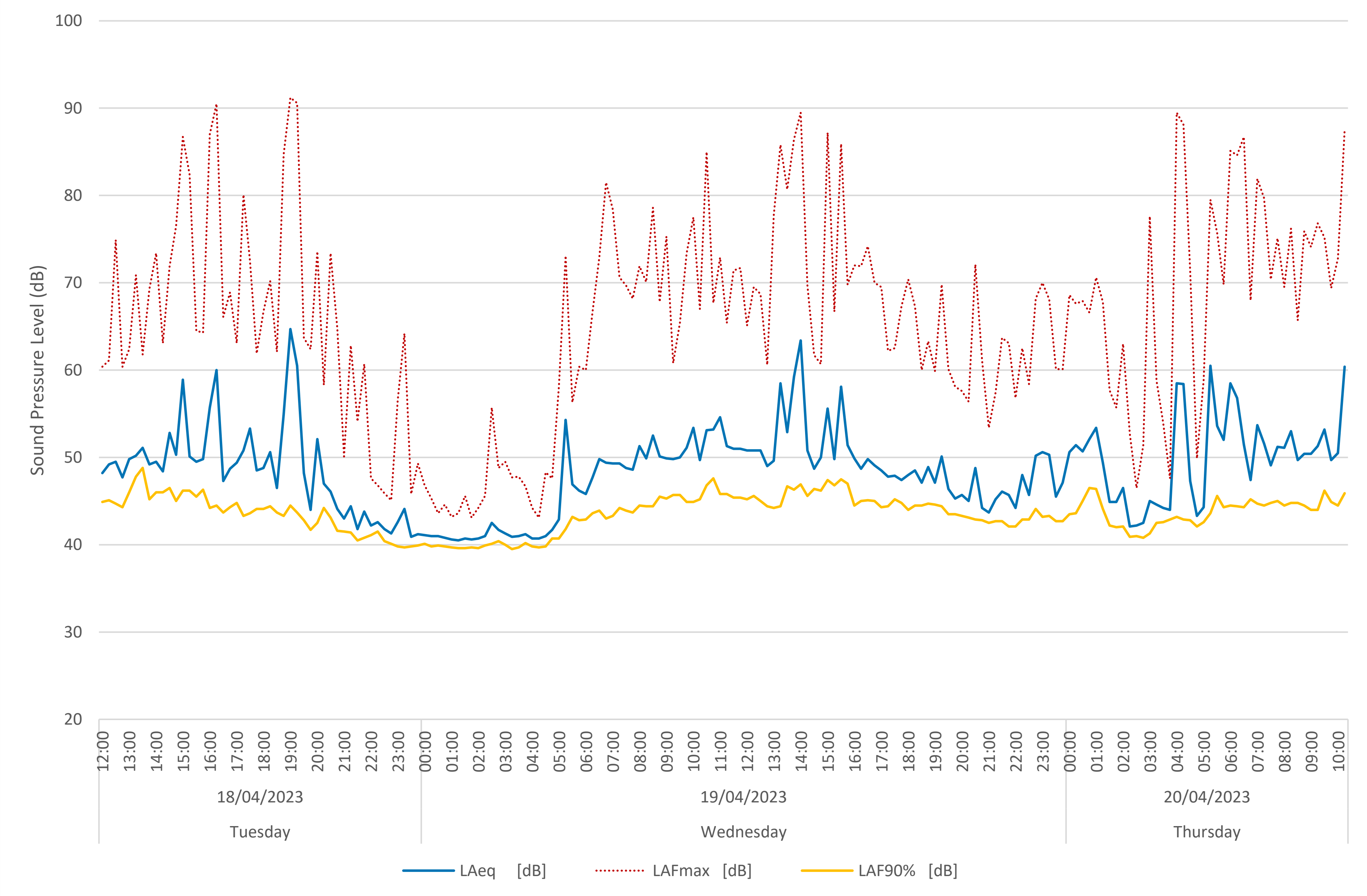


Figure B.7 – Time History at Position D (Tuesday, 18 April 2023 to Thursday, 20 April 2023)

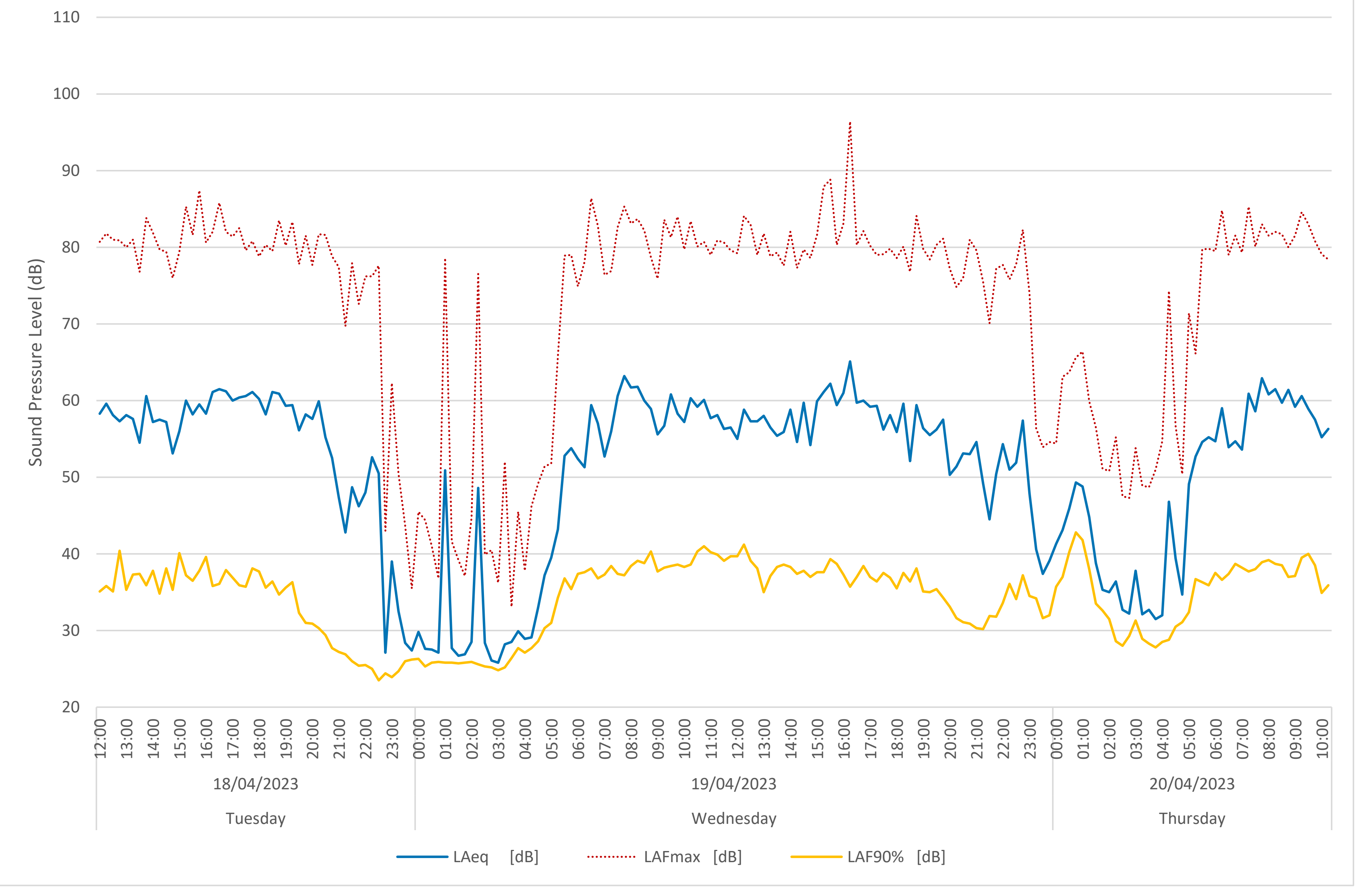


Figure B.8 – Statistical Analysis of Background Sound Levels Measured at Position A

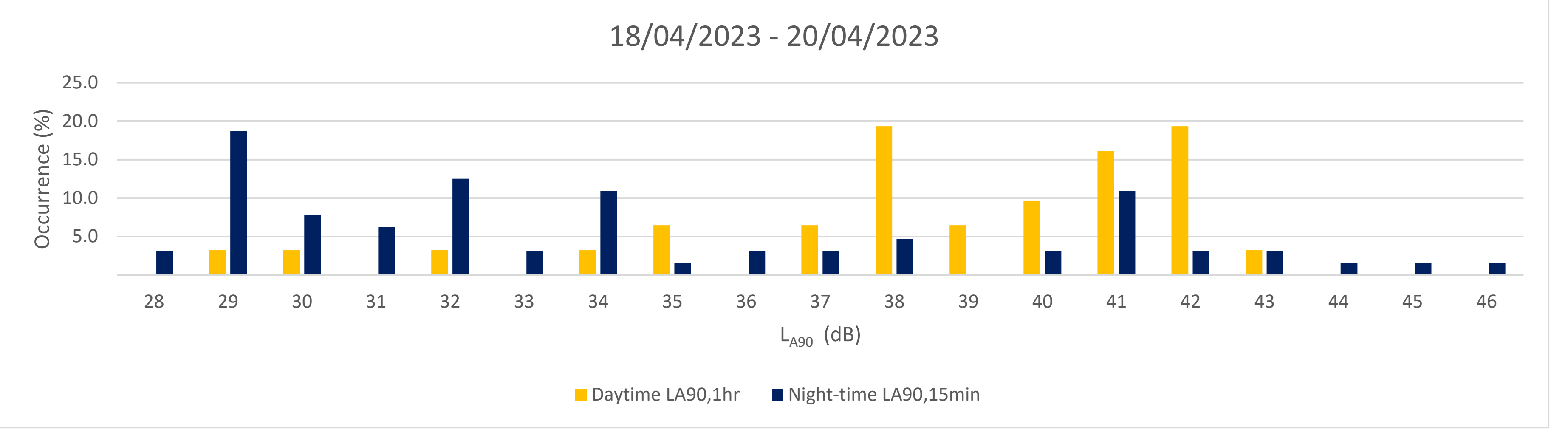


Figure B.9 – Statistical Analysis of Background Sound Levels Measured at Position B

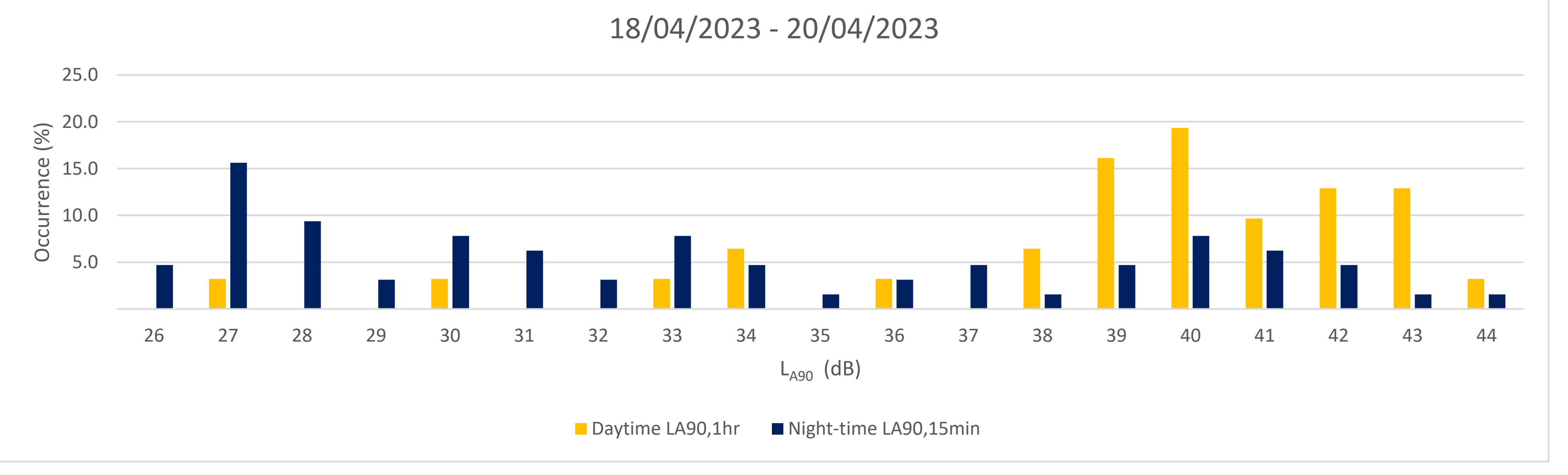


Figure B.10 – Statistical Analysis of Background Sound Levels Measured at Position C

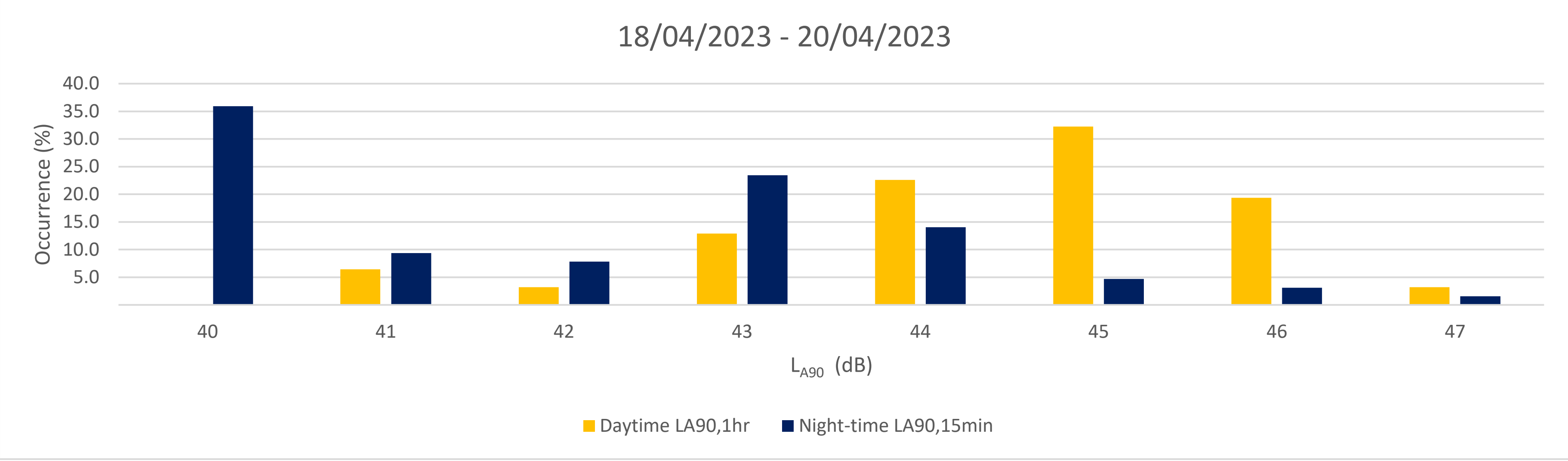


Figure B.11 – Statistical Analysis of Background Sound Levels Measured at Position D

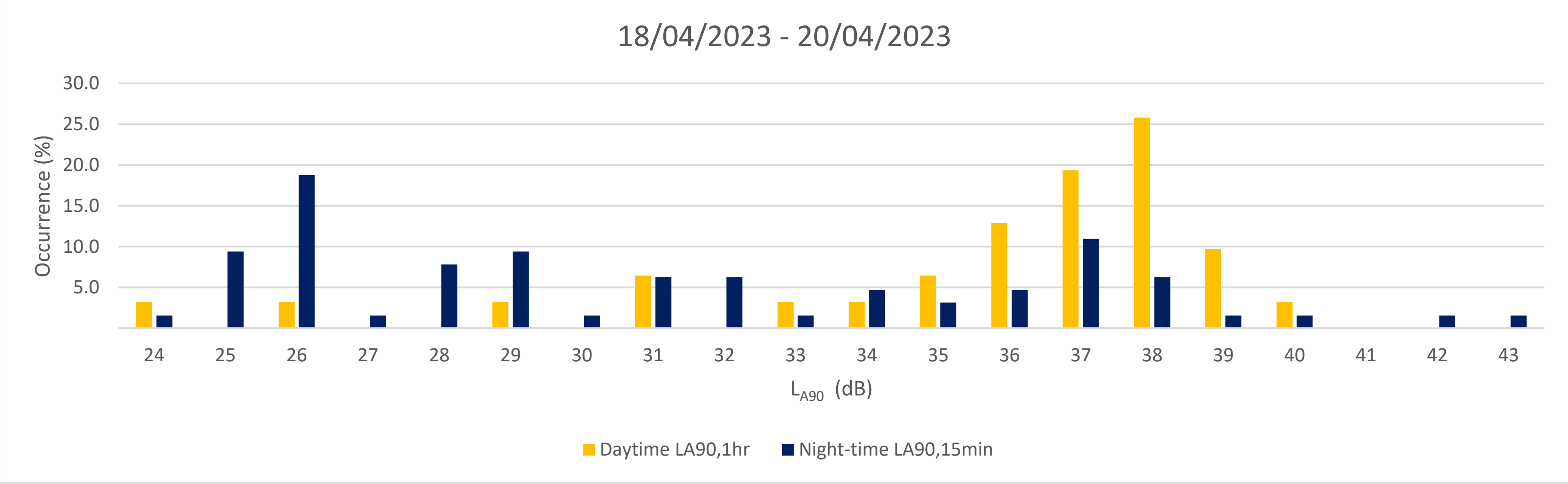


Figure B.12 – L_{eq} Octave Band Road Spectra Measured at Position B (Wednesday, 19 April 2023)

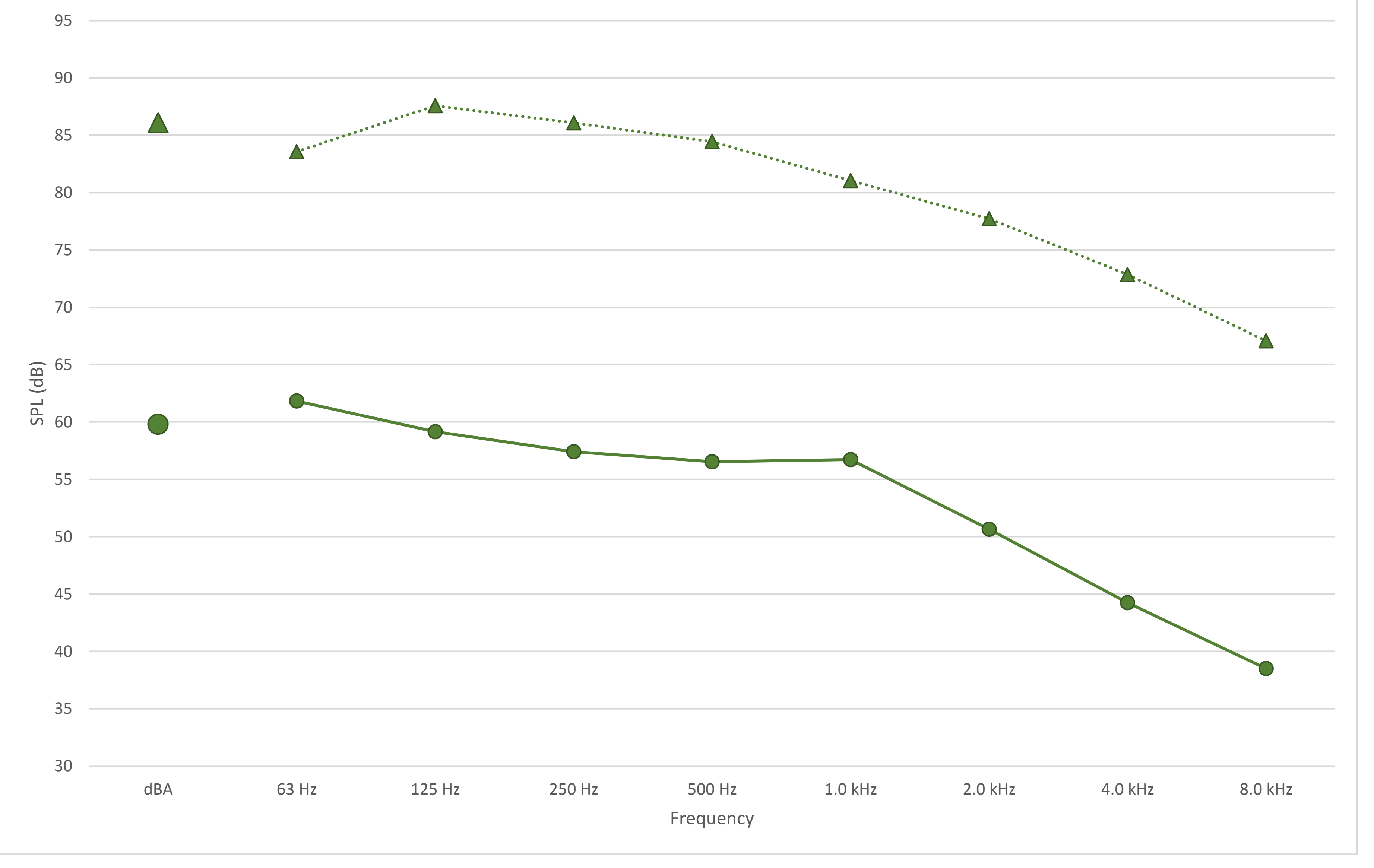


Figure B.13 – L_{eq} Octave Band Train Pass-by Spectra Measured at Position A (Wednesday, 19 April 2023)

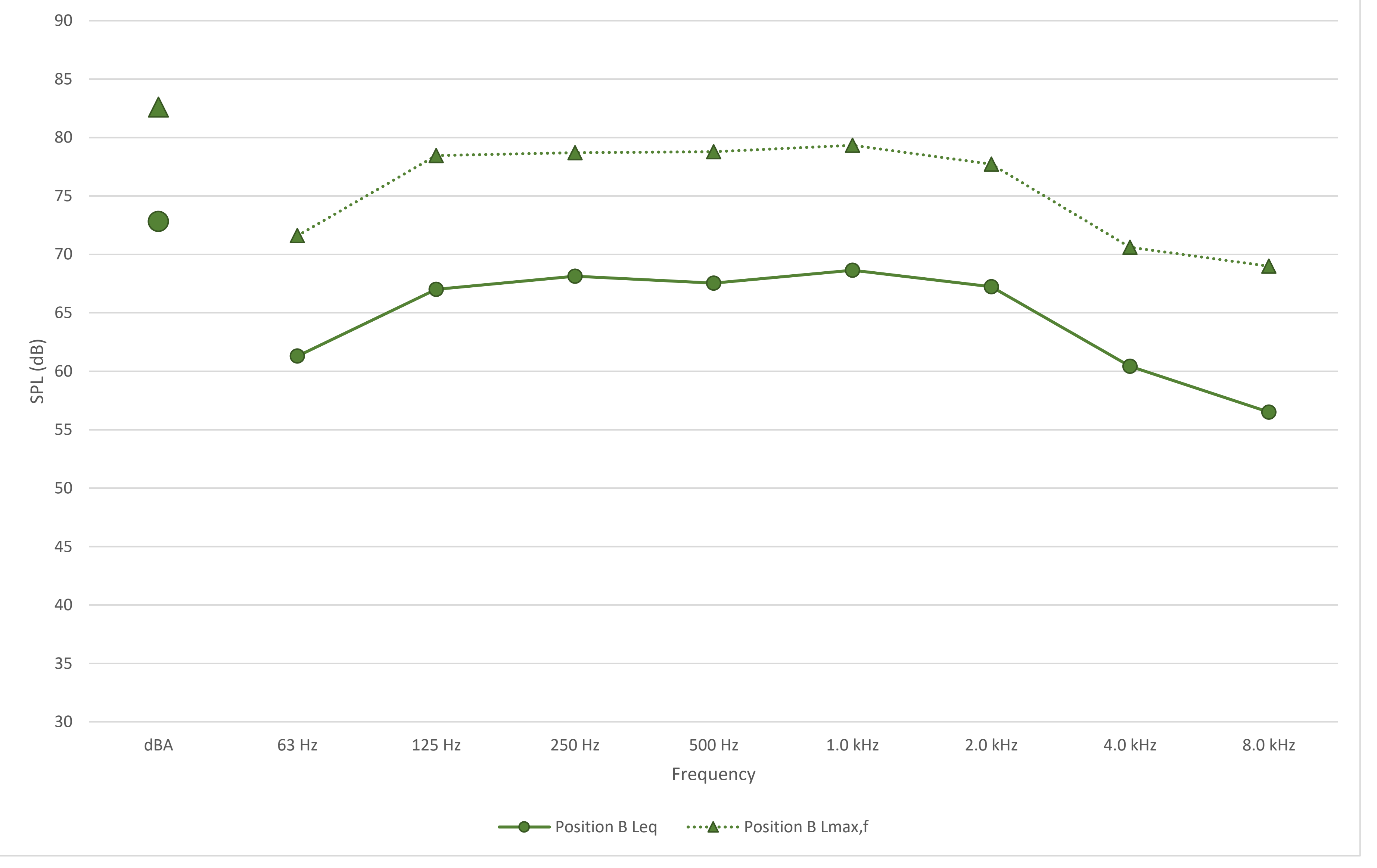


Table B.1 - Vibration Dose Values (VDVs) at Position V1 (Tuesday, 18 April 2023)

Date	Start	Channel	Weighting	VDV, $ms^{-1.75}$	Date	Start	Channel	Weighting	VDV, $ms^{-1.75}$
18/04/2023	12:00	Radial	W_d	2.86E-04	19/04/2023	00:00	Radial	W_d	1.40E-03
		Tangential	W_d	1.49E-01			Tangential	W_d	1.12E-02
		Vertical	W_b	3.21E-02			Vertical	W_b	2.27E-03
18/04/2023	13:00	Radial	W_d	4.82E-04	19/04/2023	01:00	Radial	W_d	1.37E-03
		Tangential	W_d	1.86E-01			Tangential	W_d	1.28E-02
		Vertical	W_b	4.61E-02			Vertical	W_b	2.15E-03
18/04/2023	14:00	Radial	W_d	9.13E-04	19/04/2023	02:00	Radial	W_d	1.33E-03
		Tangential	W_d	1.59E-01			Tangential	W_d	1.34E-02
		Vertical	W_b	3.81E-02			Vertical	W_b	2.14E-03
18/04/2023	15:00	Radial	W_d	1.39E-03	19/04/2023	03:00	Radial	W_d	1.24E-03
		Tangential	W_d	9.82E-02			Tangential	W_d	1.58E-02
		Vertical	W_b	2.27E-02			Vertical	W_b	2.29E-03
18/04/2023	16:00	Radial	W_d	1.44E-03	19/04/2023	04:00	Radial	W_d	1.22E-03
		Tangential	W_d	5.34E-02			Tangential	W_d	1.56E-02
		Vertical	W_b	1.30E-02			Vertical	W_b	2.58E-03
18/04/2023	17:00	Radial	W_d	1.40E-03	19/04/2023	05:00	Radial	W_d	1.16E-03
		Tangential	W_d	4.52E-02			Tangential	W_d	1.17E-02
		Vertical	W_b	1.02E-02			Vertical	W_b	4.13E-03
18/04/2023	18:00	Radial	W_d	1.30E-03	19/04/2023	06:00	Radial	W_d	1.20E-03
		Tangential	W_d	3.02E-02			Tangential	W_d	4.50E-02
		Vertical	W_b	7.42E-03			Vertical	W_b	2.40E-02
18/04/2023	19:00	Radial	W_d	1.47E-03	19/04/2023	07:00	Radial	W_d	1.19E-03
		Tangential	W_d	2.62E-02			Tangential	W_d	1.37E-02
		Vertical	W_b	7.09E-03			Vertical	W_b	2.87E-03
18/04/2023	20:00	Radial	W_d	1.62E-03	19/04/2023	08:00	Radial	W_d	1.40E-03
		Tangential	W_d	1.80E-02			Tangential	W_d	3.91E-02
		Vertical	W_b	3.35E-03			Vertical	W_b	8.30E-03
18/04/2023	21:00	Radial	W_d	1.61E-03	19/04/2023	09:00	Radial	W_d	1.63E-03
		Tangential	W_d	1.53E-02			Tangential	W_d	9.39E-02
		Vertical	W_b	2.64E-03			Vertical	W_b	1.88E-02
18/04/2023	22:00	Radial	W_d	1.44E-03	19/04/2023	10:00	Radial	W_d	1.58E-03
		Tangential	W_d	2.31E-02			Tangential	W_d	1.72E-01
		Vertical	W_b	2.28E-03			Vertical	W_b	3.69E-02
18/04/2023	23:00	Radial	W_d	1.51E-03	19/04/2023	11:00	Radial	W_d	1.75E-03
		Tangential	W_d	1.43E-02			Tangential	W_d	1.78E-01
		Vertical	W_b	2.58E-03			Vertical	W_b	4.15E-02
Radial Totals					VDV_d (Day : 0700-2300hrs)			0.003	$ms^{-1.75}$
					VDV_d (Night : 2300-0700hrs)			0.002	$ms^{-1.75}$
Tangential Totals					VDV_d (Day : 0700-2300hrs)			0.258	$ms^{-1.75}$
					VDV_d (Night : 2300-0700hrs)			0.046	$ms^{-1.75}$
Vertical Totals					VDV_b (Day : 0700-2300hrs)			0.060	$ms^{-1.75}$
					VDV_b (Night : 2300-0700hrs)			0.024	$ms^{-1.75}$

Table B.2 - Vibration Dose Values (VDVs) at Position V1 (Wednesday, 19 April 2023)

Date	Start	Channel	Weighting	VDV, $ms^{-1.75}$	Date	Start	Channel	Weighting	VDV, $ms^{-1.75}$
19/04/2023	12:00	Radial	W_d	2.16E-03	20/04/2023	00:00	Radial	W_d	1.86E-03
		Tangential	W_d	2.26E-01			Tangential	W_d	1.47E-02
		Vertical	W_b	5.29E-02			Vertical	W_b	5.97E-03
19/04/2023	13:00	Radial	W_d	2.37E-03	20/04/2023	01:00	Radial	W_d	1.94E-03
		Tangential	W_d	1.77E-01			Tangential	W_d	1.42E-02
		Vertical	W_b	4.19E-02			Vertical	W_b	4.89E-03
19/04/2023	14:00	Radial	W_d	2.52E-03	20/04/2023	02:00	Radial	W_d	1.98E-03
		Tangential	W_d	1.69E-01			Tangential	W_d	1.15E-02
		Vertical	W_b	3.81E-02			Vertical	W_b	2.55E-03
19/04/2023	15:00	Radial	W_d	2.53E-03	20/04/2023	03:00	Radial	W_d	2.07E-03
		Tangential	W_d	7.86E-02			Tangential	W_d	1.23E-02
		Vertical	W_b	1.85E-02			Vertical	W_b	2.77E-03
19/04/2023	16:00	Radial	W_d	2.26E-03	20/04/2023	04:00	Radial	W_d	2.10E-03
		Tangential	W_d	6.19E-02			Tangential	W_d	1.06E-02
		Vertical	W_b	1.46E-02			Vertical	W_b	2.41E-03
19/04/2023	17:00	Radial	W_d	2.25E-03	20/04/2023	05:00	Radial	W_d	2.12E-03
		Tangential	W_d	5.21E-02			Tangential	W_d	1.08E-02
		Vertical	W_b	1.22E-02			Vertical	W_b	4.08E-03
19/04/2023	18:00	Radial	W_d	2.24E-03	20/04/2023	06:00	Radial	W_d	1.97E-03
		Tangential	W_d	3.09E-02			Tangential	W_d	1.09E-02
		Vertical	W_b	7.17E-03			Vertical	W_b	2.41E-03
19/04/2023	19:00	Radial	W_d	2.11E-03	20/04/2023	07:00	Radial	W_d	1.89E-03
		Tangential	W_d	1.85E-02			Tangential	W_d	5.10E-02
		Vertical	W_b	5.06E-03			Vertical	W_b	1.09E-02
19/04/2023	20:00	Radial	W_d	2.14E-03	20/04/2023	08:00	Radial	W_d	2.17E-03
		Tangential	W_d	1.17E-02			Tangential	W_d	9.56E-02
		Vertical	W_b	2.80E-03			Vertical	W_b	1.95E-02
19/04/2023	21:00	Radial	W_d	1.99E-03	20/04/2023	09:00	Radial	W_d	2.25E-03
		Tangential	W_d	1.08E-02			Tangential	W_d	1.65E-01
		Vertical	W_b	3.70E-03			Vertical	W_b	3.48E-02
19/04/2023	22:00	Radial	W_d	1.92E-03	20/04/2023	10:00	Radial	W_d	2.08E-03
		Tangential	W_d	1.32E-02			Tangential	W_d	1.58E-01
		Vertical	W_b	4.63E-03			Vertical	W_b	3.61E-02
19/04/2023	23:00	Radial	W_d	1.94E-03	20/04/2023	11:00	Radial	W_d	0.00E+00
		Tangential	W_d	1.23E-02			Tangential	W_d	0.00E+00
		Vertical	W_b	3.34E-03			Vertical	W_b	0.00E+00

Radial Totals	VDV_d (Day : 0700-2300hrs)	0.004	$ms^{-1.75}$
	VDV_d (Night : 2300-0700hrs)	0.003	$ms^{-1.75}$
Tangential Totals	VDV_d (Day : 0700-2300hrs)	0.277	$ms^{-1.75}$
	VDV_d (Night : 2300-0700hrs)	0.021	$ms^{-1.75}$
Vertical Totals	VDV_b (Day : 0700-2300hrs)	0.064	$ms^{-1.75}$
	VDV_b (Night : 2300-0700hrs)	0.007	$ms^{-1.75}$

APPENDIX C - DRAWING LISTS

The following Hammond Architectural drawings and documents have been used in our assessment;

Table C.1 – Drawing List

Drawing Title	Drawing Number	Rev	Date
Capacity Sketch Plan	SK-01	1	March ‘23
Illustrative Masterplan	IM-01	A	05/10/2023