WH179 Mar 2022

Anglia Square, Norwich
Environmental Noise Assessment

Dated March 2022

Weston Homes

ENVIRONMENTAL NOISE ASSESSMENT
FOR
ANGLIA SQUARE, NORWICH

Project Reference:
ENV01-ANGL-049 – Anglia Square, Norwich

Site Address:
Anglia Square
Norwich
Norfolk, NR3 1DZ

Version Number:
Version 3

Report Date:
9th March 2018 (updated 4th March 2022)

Customer:
Weston Homes Plc
The Weston Group Business Centre
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CM22 6PU

Prepared By:
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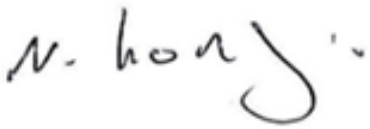
Document Control

24 Hour L_{Aeq} – Noise Monitoring Stations

Sound Level Meter	Norsonic 140
Serial Number	1402741
Date of Calibration	7th July 2015
Calibrator Type	Norsonic 1251
Serial Number	34436
Date of Calibration	7th July 2015
Date of Measurements	18th – 25th August 2016
Sound Level Meter	Sonitus EM2030
Serial Number	01486
Date of Calibration	December 2021
Calibrator Type	Rion-NC74
Serial Number	00410208
Date of Calibration	April 2021
Date of Measurements	11th – 31st January 2022
Spot Measurements	
Sound Level Meter	Brüel & Kjær 2250
Serial Number	3004740
Date of Calibration	4th September 2015
Calibrator Type	Brüel & Kjær 4231
Serial Number	2389219
Date of Calibration	22nd July 2016
Date of Measurements	25th August 2016

Remarks	Version 3
Date	9th March 2018 (updated 4th March 2022)
Prepared By	Nick Long MSc, BA(Hons), IEng MIOA.
Signature	
Approved By	Silvio Petrasso BSc(Hons) CMIOSH, MIOA, MIIRSM, IMaPS, ACIEH
Signature	
Project Number	ENV01
File Reference	ENV01-ANGL-049

Measurements taken by:	**Date**	**Time/Period**
Hugo Evans **Signature:** 	11th – 31st January 2022	Continuous monitoring for both day and night periods

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Professional Credentials

Stansted Environmental Services Limited (SES) is a standalone company within the Weston Group. SES provides a range of Health, Safety and Environmental Consultancy Services, specifically for the construction industry, working with developers, architects, planners and designers.

The consultants at Stansted Environmental Services specialise specifically in:-

- Site Investigation and Contaminated Land
- Acoustics and Noise Control
- Construction Safety
- Energy and Sustainability

Silvio Petrasso is the Associate Director (Environment) for Stansted Environmental Services Ltd and has over 13 years experience working in the construction industry.

Silvio is a Chartered Health and Safety Practitioner with the Institute of Occupational Safety and Health (IOSH), and a Corporate Member of the Institute of Acoustics (IOA), as well as an Incorporated Member of the Association for Project Safety (IMAPS).

Nick Long is a Senior Acoustic Consultant and has been working in acoustic consultancy and has experience in dealing with acoustic assessments for over seven years.

Nick holds a Master's degree (Merit) in Applied Acoustics from Derby University and is a Corporate Member of the Institute of Acoustics (IOA). He is also an Incorporated Engineer (IEng)

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1. Introduction

1.1 Stansted Environmental Services (SES) Ltd has been commissioned by Weston Homes Plc to carry out, an Environmental Noise Assessment for the proposed development known as Anglia Square, Norwich, Norfolk NR3 1DZ.

1.2 The survey was undertaken to measure the existing noise climate and to assess any potential noise impact that may affect the proposed development.

1.3 Furthermore the assessment was completed to provide evidence as part of a Hybrid Planning Application for a proposed development comprising up to 1250 dwellings with associated car parking, a hotel, a multi-storey car park, a cinema and varied commercial and retail spaces.

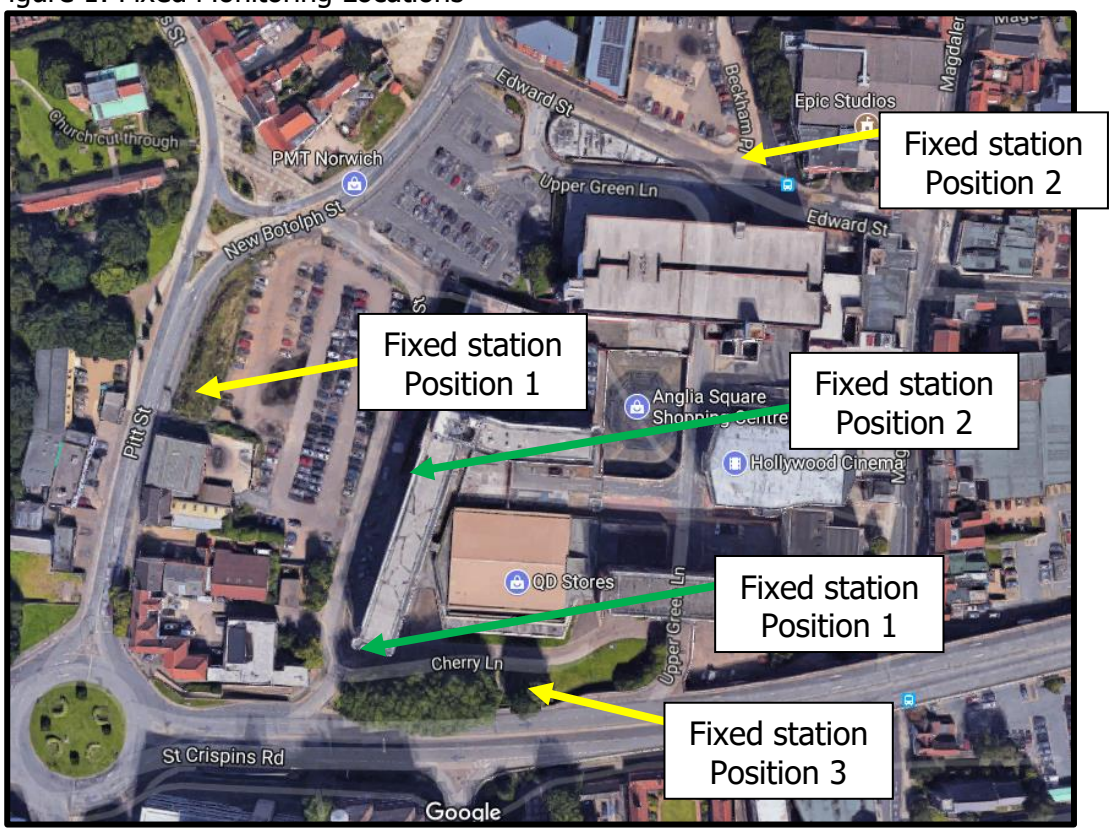
1.4 Two fixed monitoring locations were set up to the front of the site on Sovereign House facing Botolph Street. Continuous measurements were taken over a 7 day period. (Green: August 2016)

1.5 The monitoring exercise captured a total of 5 day time periods (16 hours between 07:00-23:00) and 7 night time periods (8 hours between 23:00-07:00) (Green: August 2016).

1.6 Additional continuous measurements were undertaken during early 2022 (Yellow) between 11th and 30th January.

1.7 The location of the fixed monitoring stations is shown in Figure 1.

Figure 1: Fixed Monitoring Locations



1.8 Seven 'spot' measurements were also undertaken (5x30min) as shown in Photographs 1 – 7 (August 2016).

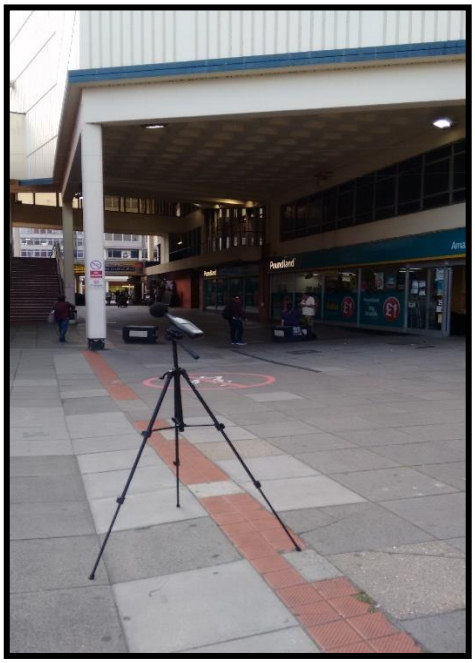
Position 1

Position 2

Position 3

Position 4

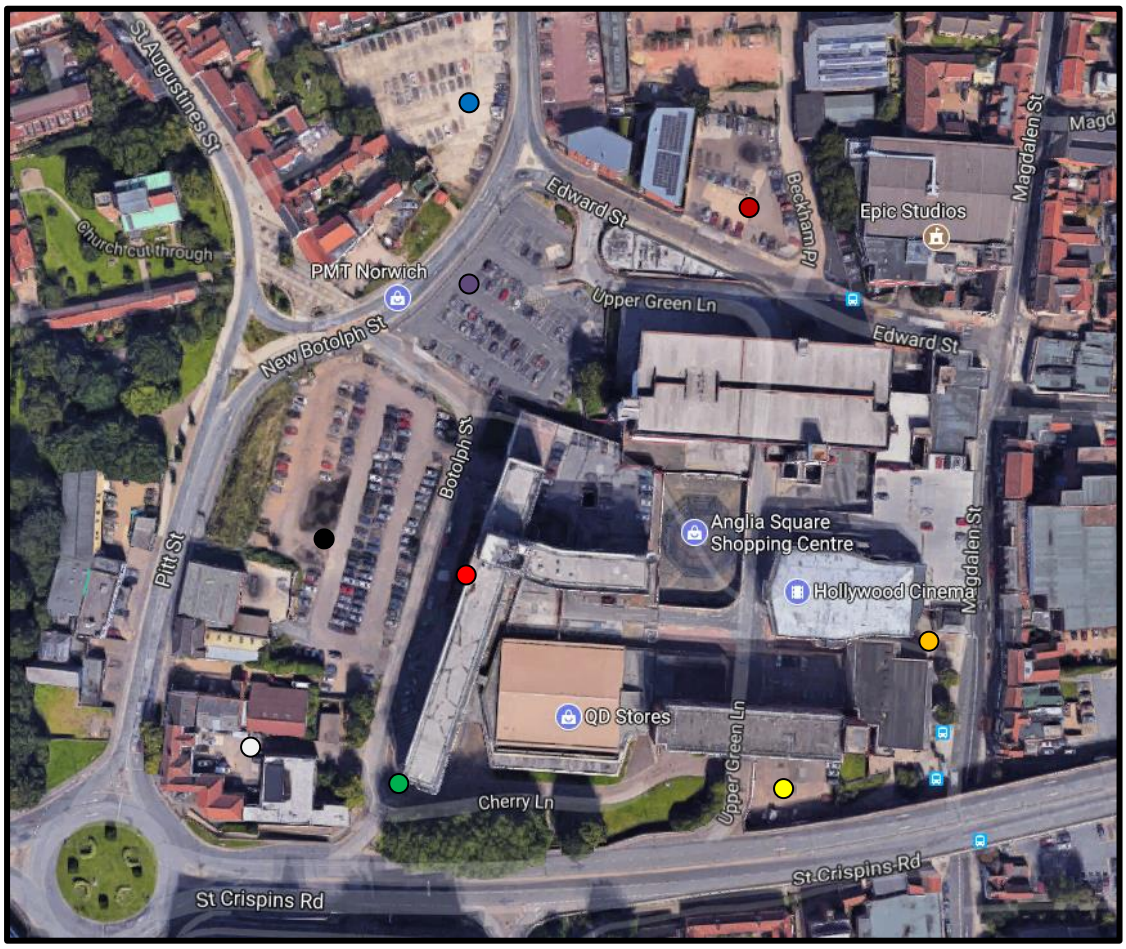
Position 5



Position 6

Position 7

Figure 2: Site Plan showing the spot measurement locations and fixed monitoring locations (August 2016).



● Fixed Noise Monitoring Station 1 ● Fixed Noise Monitoring Station 2
● Spot Position 1 ● Spot Position 2 ● Spot Position 3 ○ Spot Position 4
● Spot Position 5 ● Spot Position 6 ● Spot Position 7

1.9 On the 18th August 2016, a Type 1 Sound Level Meter was set up to monitor four 8 hour (night-time) periods and three 16 hour (day-time) periods at fixed monitoring location 2, located on the central third-floor staircase, on the external of Sovereign House, facing West onto Botolph Street.

1.10 On the 22nd August 2016, a Type 1 Sound Level Meter was set up to monitor three 8 hour (night-time) periods and two 16 hour (day-time) periods at fixed monitoring location 1, located on the Southern third-floor staircase, on the external of Sovereign House, facing South-West onto St Crispins Road.

1.11 A total of seven spot monitoring measurements were undertaken on the 25th August 2016 from Spot Positions 1-7 as shown in figure 2.

1.12 Noise recording sheets for the spot monitoring locations are attached as Appendix F.

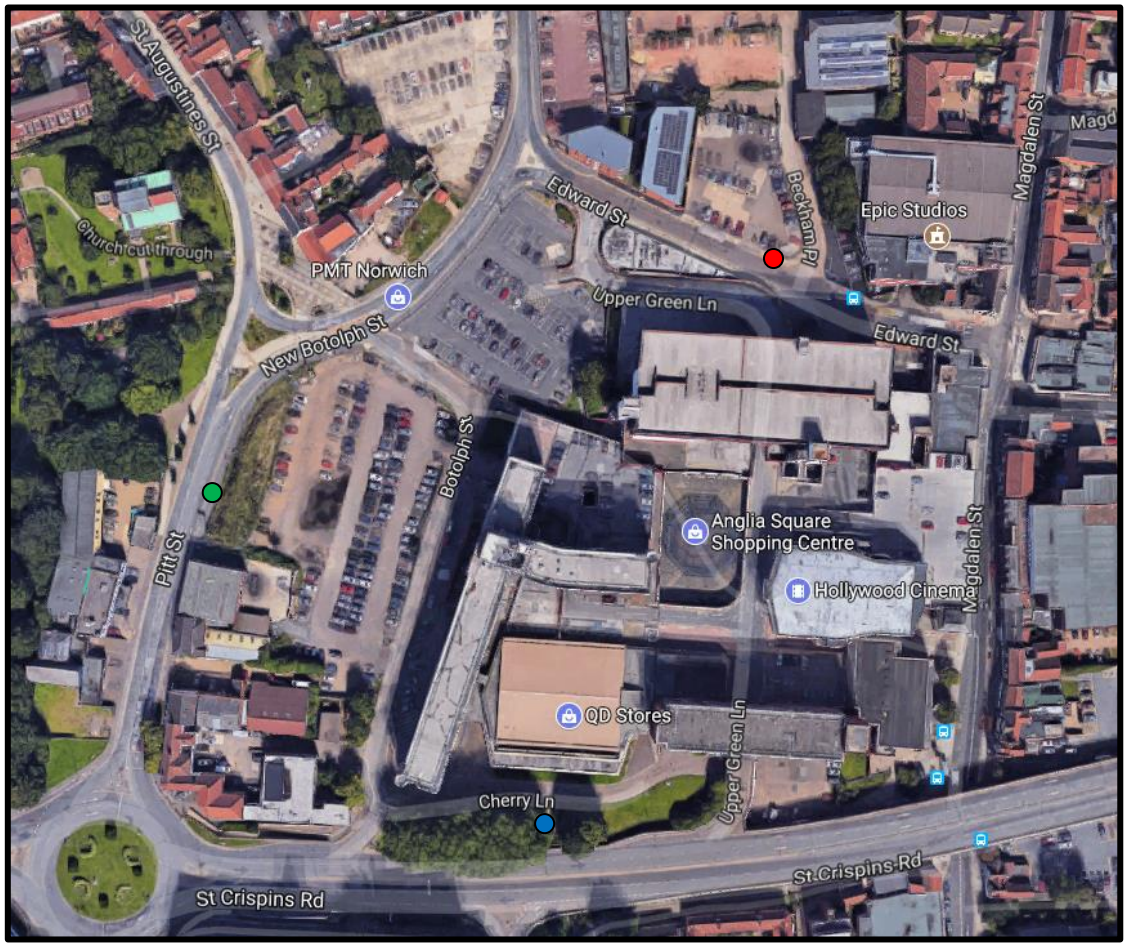
1.13 Since completion of the above survey, Weston Homes has prepared a revised hybrid planning application for the demolition and clearance of all existing

structures within the site in a phased manner and the construction of up to 1,100 residential units, comprising a mixture of typologies and tenures to be agreed through the pre-app process and up to 6,000 sqm of commercial retail space.

1.14 As such, SES were asked to undertake a further environmental noise assessment to support the revised planning application.

1.15 Between the 11th and 31st January 2022, additional continuous environmental noise measurements were undertaken at the following locations:

Figure 3: Additional long term monitoring (January 2022)



Fixed Noise Monitoring Station 1 Fixed Noise Monitoring Station 2

Fixed Noise Monitoring Station 3

1.16 The noise assessment has been undertaken in accordance with the most up-to-date planning guidance – in particular:

- The National Planning Policy Framework (NPPF),
- The WHO Guidelines for Community Noise and
- BS8233:2014 Guidance on sound insulation and noise reduction for buildings

1.17 The NPPF has revoked the previous guidance – "Planning Policy Guidance (PPG) 24: Planning and Noise". The Guidance used is discussed further in Section 3.

1.18 The results of the continuous noise monitoring have been analysed in order that a direct comparison with the Guideline values provided in BS8233 can be made. From this, it has been determined what, if any, mitigation and/or remedial measures are required to prevent noise from impacting on future users of the new building.

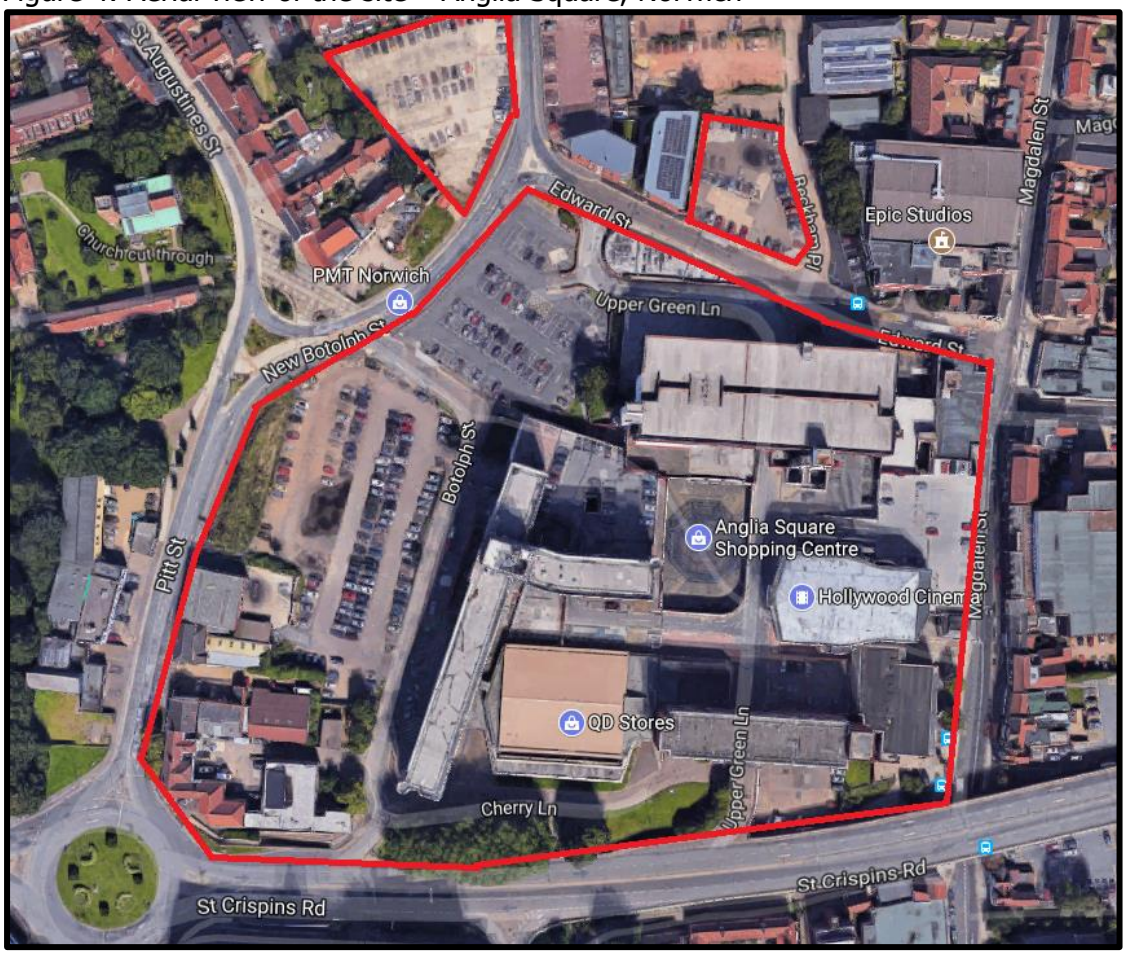
1.19 This report is necessarily technical in nature. Therefore to assist the reader, a glossary of terminology relating to noise is contained in Appendix A.

1.20 Limitations to this report are detailed in Appendix C.

2. Site Description

2.1 An aerial view of the site in its current use is shown in Figure 4.

Figure 4: Aerial view of the site – Anglia Square, Norwich



2.2 The site is in three portions. To the North-West is a triangular shaped area which covers an approximate area of 0.21 hectares. To the North is an area which covers an approximate area of 0.13 hectares. The main portion of the site is to the South, square in shape and covers an approximate area of 4.38 hectares.

2.3 The surrounding area is office and retail to the Western and Eastern boundary, residential housing to the Northern boundary, and the A147 (St Crispins Road) to the South.

3. Assessment Criteria

3.1 The National Planning Policy Framework (NPPF), 2021

The National Planning Policy Framework was published in 2021. In respect of noise, the document states, in section 15, paragraph 174 (subsection E) that:

"The planning system should contribute to and enhance the natural and local environment by… preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of … noise pollution".

3.2 It goes on to advise in section 15, paragraph 185 that:

"Planning policies and decisions should aim to:

- *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life,*

- *identify and protect areas of tranquillity which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason".*

3.3 The NPPF revokes Planning Policy Guidance 24 (PPG 24) which was previously used to assess noise impacts of planning applications. PPG 24:

- Outlined the considerations to be taken into account in determining planning applications both for noise-sensitive developments and for those activities that will generate noise

- Introduced the concept of "Noise Exposure Categories" for residential development, encouraged their use and recommended appropriate levels for exposure to different sources of noise and

- Advised on the use of planning conditions to minimise the impact of noise

3.4 The NPPF indicates that the Noise Policy Statement for England (NPSE) should be used to define "significant adverse impacts". A summary of the NPSE is provided below, and it is understood that the UK government is currently undertaking research to quantify the significant observed adverse effect levels for noise.

3.5 **Noise Policy Statement for England (NPSE)**

The NPSE was published in March 2010. The document seeks to clarify the underlying principles and aims in existing policy documents, legislation and guidance that relate to noise. It also sets out, in paragraph 1.6, the long term vision of Government noise policy:

"Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development".

3.6 The NPSE clarifies that noise should not be considered in isolation of the wider benefits of a scheme or development, and that the intention is to minimise noise and noise effects as far as is reasonably practicable having regard to the underlying principles of sustainable development.

3.7 The explanatory note of NPSE defines the terms used in the NPPF:

"There are two established concepts from toxicology that are currently being applied to noise impacts, for example, by the World Health Organisation.

They are:

NOEL – No Observed Effect Level: This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level: This is the level above which adverse effects on health and quality of life can be detected.

Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level: This is the level above which significant adverse effects on health and quality of life occur."

3.8 The NPSE does not provide a numerical value for the SOAEL, stating at paragraph 2.22:

"It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available."

3.9 The NPPF does not quote figures for action, however BS8233:2014 is the most appropriate guidance document in relation to identifying target noise level criteria. Achieving the LOAEL requires "all reasonable steps" to be taken in terms of mitigation.

3.10 **British Standard BS8233:2014: Sound Insulation and Noise Reduction for Buildings – Code of Practice**

The scope of this Standard is to provide recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

3.11 The Standard suggests suitable internal noise levels within different types of buildings, including dwellings, and these are repeated in Table 1.

3.12 Regarding transient noise sources, the standard provides the following advice:

> *"Regular individual noise events (for example, schedule aircraft or passing trains) can cause sleep disturbance. A guideline value may be set of SEL (Single Event Level) or $L_{Amax,f}$, depending on the character and number of events per night. Sporadic events could require separate values"*

3.13 Based upon historical guidance provided in the 1999 version of the standard, it is proposed a limit of 45dB$L_{Amax,f}$ is adopted.

Table 1: Recommended internal noise levels $L_{Aeq,T}$ dB

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35dB L_{Aeq}, 16 hour	---
Dining	Dining room area	40dB L_{Aeq}, 16 hour	---
Sleeping	Bedroom	35dB L_{Aeq}, 16 hour	30dB L_{Aeq}, 8 hour

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

3.15 WHO 2009: *Guidelines for Community Noise* has established guideline values for community noise in specific environments, which are summarised below:

- Outdoor Living Area – Serious Annoyance 55 dB(A), 16 hours between 07:00 and 23:00
- Outdoor Living Area – Moderate Annoyance 50 dB(A), 16 hours between 07:00 and 23:00
- Indoor Speech Intelligibility – Moderate Annoyance 35 dB(A), 16 hours between 07:00 and 23:00
- Inside bedrooms night time sleep disturbance 30dB(A), 8 hours between 23:00 and 07:00
- Outside bedrooms, window open (outdoor values), sleep disturbance 45dB(A)

3.16 The WHO have issued a further document. "Night Noise Guidelines for Europe (2009)" and the following table details the effects of different levels of night noise on health.

Table 2: Exposure –Effects Relationship

Average night noise levels over a year $L_{night,outside}$	Health Effects Observed in the Population
Up to 30dB	Although individual sensitivities exist, circumstances may differ, it appears that up to this level no substantial biological effects are observed. $L_{night,outside}$ of 30dB is equivalent to the no observed effect level (NOEL) for night noise.
30 to 40dB	A number of effects on sleep are observed from this range: body movements, awakening, self-reported sleep disturbances, arousals. The intensity of the effect depends on the nature of the source and the number of events. Vulnerable groups (for example, children, the chronically ill and the elderly) are more susceptible. However, even in the worst cases the effects seem modest. $L_{night,outside}$ of 40dB is equivalent to the lowest observed adverse effect level (LOAEL) for night noise.
40 to 55dB	Adverse health effects are observed among the exposed population. Many people have to adapt to their lives to cope with noise at night. Vulnerable groups are more severely affected.
Above 55dB	The situation is considered increasingly dangerous for public health. Adverse health effects occur frequently, a sizeable proportion of the population is highly annoyed and sleep-disturbed. There is evidence that the risk of cardiovascular disease increases.

3.17 Based on the exposure-effects relationship summarised in Table 2, the night noise guideline values are recommended for the protection of public health from night noise as follows:
Night Noise guideline – $L_{night,outside}$ = 40dB
Interim Target – $L_{night,outside}$ = 55dB

3.18 For the primary prevention of health effects related to night noise, the WHO (2009) recommends people should not be exposed to night time noise levels greater than 40dB of $L_{night,outside}$ during the part of the night when most people are in bed. The LOAEL of night noise, 40dB $L_{night,outside}$, should be considered a health based limit value to protect the public.

ProPG: Planning and Noise (May 2017): New Residential Development

3.19 This document has been produced to provide practitioners with guidance on a recommended approach to the management of noise within the planning system in England. The National Planning Policy Framework (NPPF) encourages improved standards of design.

3.20 The primary goal of this ProPG is to assist the delivery of sustainable development by promoting good health well-being through the effective management of noise.

3.21 ProPG promotes a 2-stage approach. This encourages early consideration of noise issues, facilitates straightforward accelerated decision making for low risk sites, and assists proper consideration of noise issues where the acoustic environment is challenging.

3.22 The two sequential stages of the approach are:

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

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

- Element 1 - demonstrating a "Good Acoustic Design Process";
- Element 2 - observing internal "Noise Level Guidelines";
- Element 3 - undertaking an "External Amenity Area Noise"; and
- Element 4 - consideration of "Other Relevant Issues"

3.24 Regarding noise level guidelines, ProPG follows guidance provided under BS8233:2014.

3.25 Regarding maximum (L_{Amax}) noise levels, ProPG provides the following guidance:

> "*In most circumstances in noise sensitive rooms at night (eg Bedrooms) good acoustic design can be used so that individual noise events* ***do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night.*** *However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events.* "

BS41412:2014+A1:2019 'Methods for rating and assessing an Industrial and Commercial Sound

3.26 BS4142:2014 is used to assess the likelihood of complaints from local residents, should a new industrial noise source be introduced to the vicinity.

3.27 The standard provides guidance on the assessment of the likelihood of complaints relating to noise from industrial sources and key aspects of the standard are summarised below;

3.28 The standard presents a method for assessing potential noise impact comparing the noise level due to industrial sources (the rating level) with that of the existing background noise level at the nearest noise sensitive receiver in the absence of the source (the background sound level).

3.29 This specific noise level produced by the source in question at the assessment location is determined and a correction applied for certain undesirable acoustic features such as tonality, impulsivity or intermittency. The corrected specific noise level is referred to as the rating level.

3.30 In order to assess the noise impact, the background sound level is arithmetically subtracted from the rating level and the standard states the following:

- Typically, the greater this difference, the greater the magnitude impact.
- The difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5dB is likely to be an indication of an adverse impact depending on the context.

3.31 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.

3.32 In addition to the margin by which the rating level of the specific sound source exceeds the background sound level, the standard places emphasis upon an appreciation of the context.

3.33 As noted above, BS4142:2014+A1:2019 introduced the concept of 'context' to the process of identifying noise impact. Section 11 of the standard explains "The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which

the sound occurs/will occur. When making assessments and arriving at decisions, therefore it is essential to place sound in context."

3.34 Context points to consider when undertaking an assessment of sound impact include the following;

- The absolute level of sound,
- The character and level of the specific sound in the context of the existing noise climate; for example is the sound to occur in a location already characterised by similar activities as those proposed?
- The sensitivity of the receptors,
- The time and duration that the specific sound is to occur,

3.35 The conclusions of assessments undertaken using alternative assessment methods, for example WHO guidelines noise values or change in noise level.

3.36 Whilst the 2014 edition of BS4142 introduced a requirement to consider and report the uncertainty in the data and associated calculations, the 2019 edition includes good practice for reducing uncertainty, it also clarifies the application of the standard in terms of measurement uncertainty.

4. Noise Survey

4.1 The Environmental Noise Assessment to assess noise conditions Anglia Square, Norwich, Norfolk NR3 1DZ was undertaken by Stansted Environmental Services Ltd. This survey was carried out to establish the prevailing noise levels resulting primarily from vehicle movements on the A147, and surrounding retail areas, which the site fronts onto and have been identified as the principal noise source in the area.

4.2 Continuous monitoring carried out between the 18th and 25th August 2016 involved the setting up of a fixed monitoring station in two locations on the West side of Sovereign House at 3rd floor level.

4.3 Additional environmental noise measurements were undertaken between 11th and 30th January 2022. Where unsuitable was forecast (high wind or rain) the relevant acoustic data was removed from the dataset.

4.4 At the time of set-up at Location 2, weather conditions were clear with some clouds and an average temperature of 22°C. (August 2016)

4.5 At the time of set-up at Location 1, weather conditions were overcast with light wind and an average temperature of 17°C.

4.6 Seven separate 30 minute L_{Aeq} measurements were taken on the 25th August 2016 to confirm the environmental noise conditions in other areas of the site.

4.7 During set-up and the spot measurements, it was confirmed that the predominant background noise level was associated with vehicle movements on the bordering highway and neighbouring retail area on the Eastern and Western boundaries.

4.8 The noise survey was carried out using the Type 1 specification noise measurement equipment detailed in Table 3.

Table 3: Noise Measurement Equipment

Equipment		Serial Number	Date of Calibration
Norsonic 140	Sound Level Meter	1402741	07/07/2015
Norsonic 1251	Calibrator	34436	07/07/2015
Brüel & Kjær 2250	Sound Level Meter	3004740	04/09/2015
Brüel & Kjær 4231	Calibrator	2389219	22/07/2016
Sonitus (January 2022 survey)	Sound Level Logger	01486	06/12/2021
Rion NC74 (January 2022 survey)	Calibrator	00410208	April 2021

4.9 As shown in Table 3, the sound level meters had been calibrated within 2 years and their associated calibrators had been calibrated within 1 year of the survey period.

4.10 The sound level meters was set up at a height of 9.0m and was secured to a window to prevent tampering, on both occasions (2016 survey).

4.11 Regarding the survey undertaken in January 2022, all meters were secured onto suitable lampposts at a height of around 7m to prevent tampering. Where rain and/or high winds were forecast during the survey period, these levels were discounted from the measurement data.

4.12 The 24 hour monitoring consisted of continuous 24-hour logging.

4.13 The seven spot measurements consisted of 7 x 30min L_{Aeq} periods.

4.14 Table 4 presents a summary of the measured noise levels.

Table 4: Summary of measured noise levels - (dB).

Time period - 24 hour fixed monitoring station	L_{Aeq}	L_{A90}
23:00 – 07:00 (8 hour) 18th/19th August 2016	51.7	40.5
23:00 – 07:00 (8 hour) 19th/20th August 2016	52.2	44.4
23:00 – 07:00 (8 hour) 20th/21st August 2016	54.0	47.9
23:00 – 07:00 (8 hour) 21st/22nd August 2016	55.2	40.9
23:00 – 07:00 (8 hour) 22nd/23rd August 2016	60.1	47.1
23:00 – 07:00 (8 hour) 23rd/24th August 2016	60.1	47.5
23:00 – 07:00 (8 hour) 24th/25th August 2016	60.6	47.3
07:00 – 23:00 (16 hour) 19th August 2016	58.2	54.4
07:00 – 23:00 (16 hour) 20th August 2016	59.8	55.0
07:00 – 23:00 (16 hour) 21st August 2016	58.1	54.1
07:00 – 23:00 (16 hour) 23rd August 2016	67.2	62.3
07:00 – 23:00 (16 hour) 24th August 2016	67.2	61.8
Time period – spot monitoring locations	**L_{Aeq}**	**L_{A90}**
SP1 – 25th August 2016 (30mins)(12:57-13:27)	59.5	52.6
SP2 – 25th August 2016 (30mins)(13:29-13:59)	66.2	56.4
SP3 – 25th August 2016 (30mins)(14:01-14:31)	58.9	50.2
SP4 – 25th August 2016 (30mins)(14:34-15:04)	57.3	52.5
SP5 – 25th August 2016 (30mins)(15:07-15:37)	65.6	63.5
SP6 – 25th August 2016 (30mins)(15:43-16:13)	68.2	62.5
SP7 – 25th August 2016 (30mins)(12:25-12:55)	64.0	49.3

4.15 Additional continuous measurements were undertaken in January 2022, as shown in the tables below:

Table 5: Summary of measured noise levels - (dB) New Botolph Street (Location 1)

Time period - 24 hour fixed monitoring station	L_{Aeq}	L_{A90}	L_{AMax}
23:00 - 07:00 (8 hour) 12th / 13th January 2022	62	41	81
23:00 - 07:00 (8 hour) 13th / 14th January 2022	62	42	80
23:00 - 07:00 (8 hour) 15th / 16th January 2022	61	42	79
23:00 - 07:00 (8 hour) 16th / 17th January 2022	60	40	78
07:00 – 23:00 (16 hour) 12th January 2022	68	58	N/A
07:00 – 23:00 (16 hour) 13th January 2022	68	58	N/A
07:00 – 23:00 (16 hour) 15th January 2022	67	56	N/A
07:00 – 23:00 (16 hour) 16th January 2022	66	53	N/A
07:00 – 23:00 (16 hour) 17th January 2022	68	59	N/A

* 14/01/22 (Day) Discounted due to unfavourable weather conditions.

Table 6: Summary of measured noise levels - (dB) Edward Street (Location 2)

Time period - 24 hour fixed monitoring station	L_{Aeq}	L_{A90}	L_{AMax}
23:00 - 07:00 (8 hour) 17th / 18th January 2022	55	40	73
23:00 - 07:00 (8 hour) 18th / 19th January 2022	52	35	71
23:00 - 07:00 (8 hour) 21st / 22nd January 2022	58	42	74
23:00 - 07:00 (8 hour) 22nd / 23rd January 2022	54	34	72
07:00 – 23:00 (16 hour) 17th January 2022	62	48	N/A
07:00 – 23:00 (16 hour) 18th January 2022	63	48	N/A
07:00 – 23:00 (16 hour) 19th January 2022	63	50	N/A
07:00 – 23:00 (16 hour) 21st January 2022	64	51	N/A
07:00 – 23:00 (16 hour) 22nd January 2022	64	50	N/A
07:00 – 23:00 (16 hour) 23rd January 2022	60	44	N/A
07:00 – 23:00 (16 hour) 24th January 2022	63	48	N/A

* 20/01/22 (Day and night) Discounted due to unfavourable weather conditions.
** 18/01/22 incomplete due unfavourable weather conditions

Table 7: Summary of measured noise levels - (dB) St Crispins Road (Location 3)

Time period - 24 hour fixed monitoring station	L_{Aeq}	L_{A90}	L_{AMax}
23:00 - 07:00 (8 hour) 26th/ 27th January 2022	60	52	72
23:00 - 07:00 (8 hour) 28th / 29th January 2022	60	52	72
23:00 - 07:00 (8 hour) 30th /31st January 2022	60	53	69
07:00 – 23:00 (16 hour) 26th January 2022	67	60	N/A
07:00 – 23:00 (16 hour) 28th January 2022	68	62	N/A
07:00 – 23:00 (16 hour) 30th January 2022	66	58	N/A

* 27/01/2022 and 29/01/2022 (Day) Discounted due to unfavourable weather conditions.
** 31/01/2022 Discounted due to unfavourable weather conditions.

Graphs 1-12 on the following pages show the results of the fixed monitoring exercise (August 2016)

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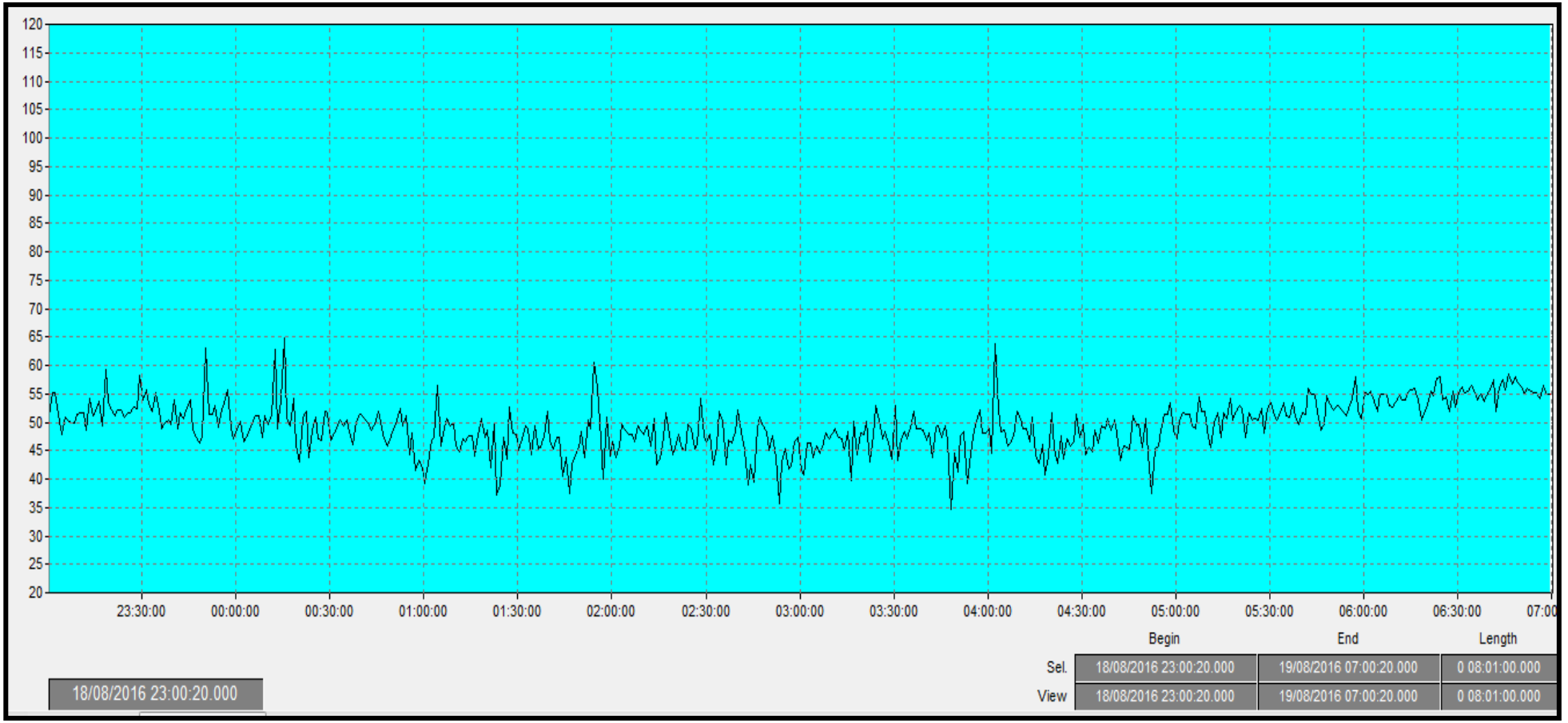
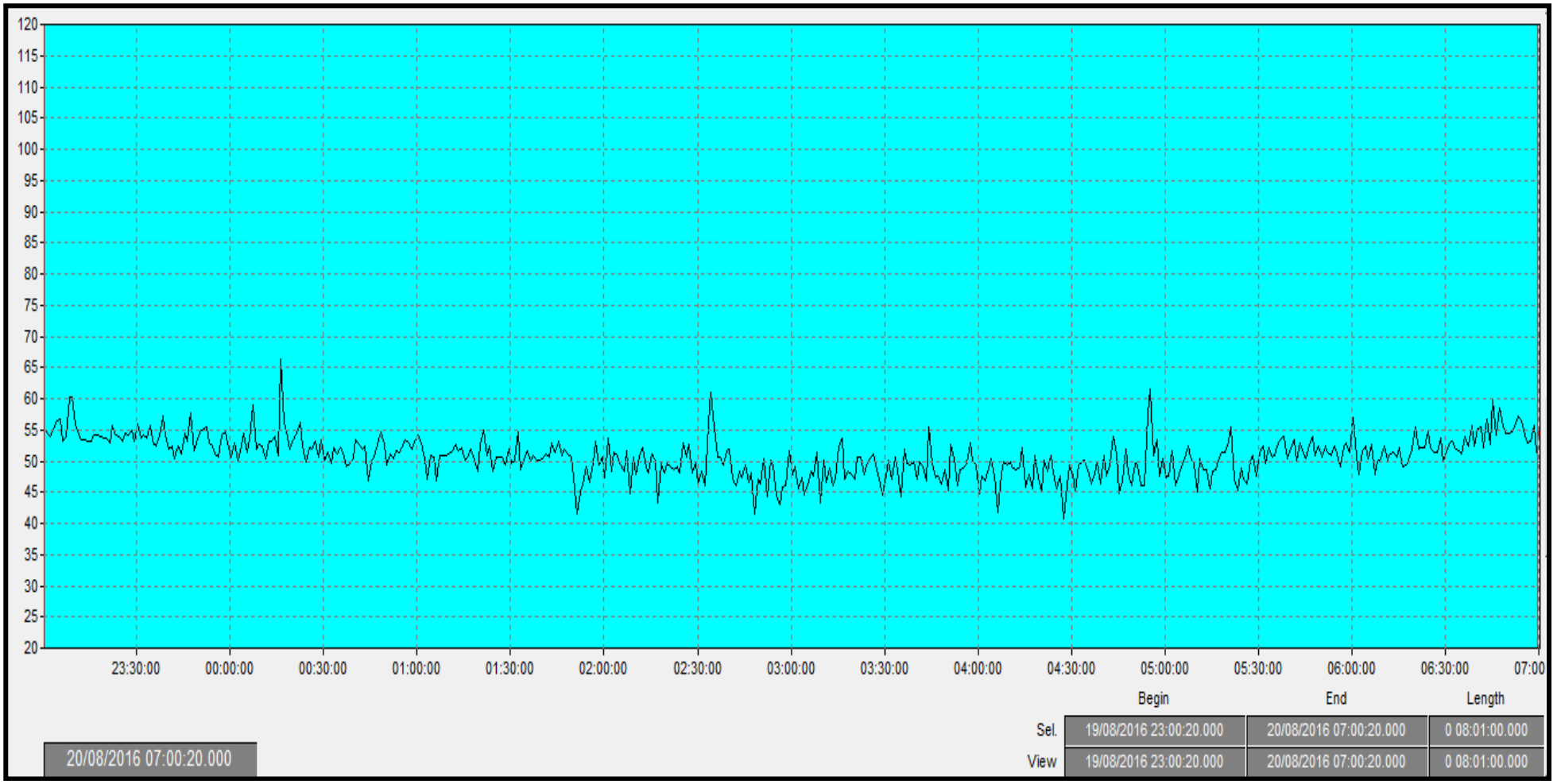
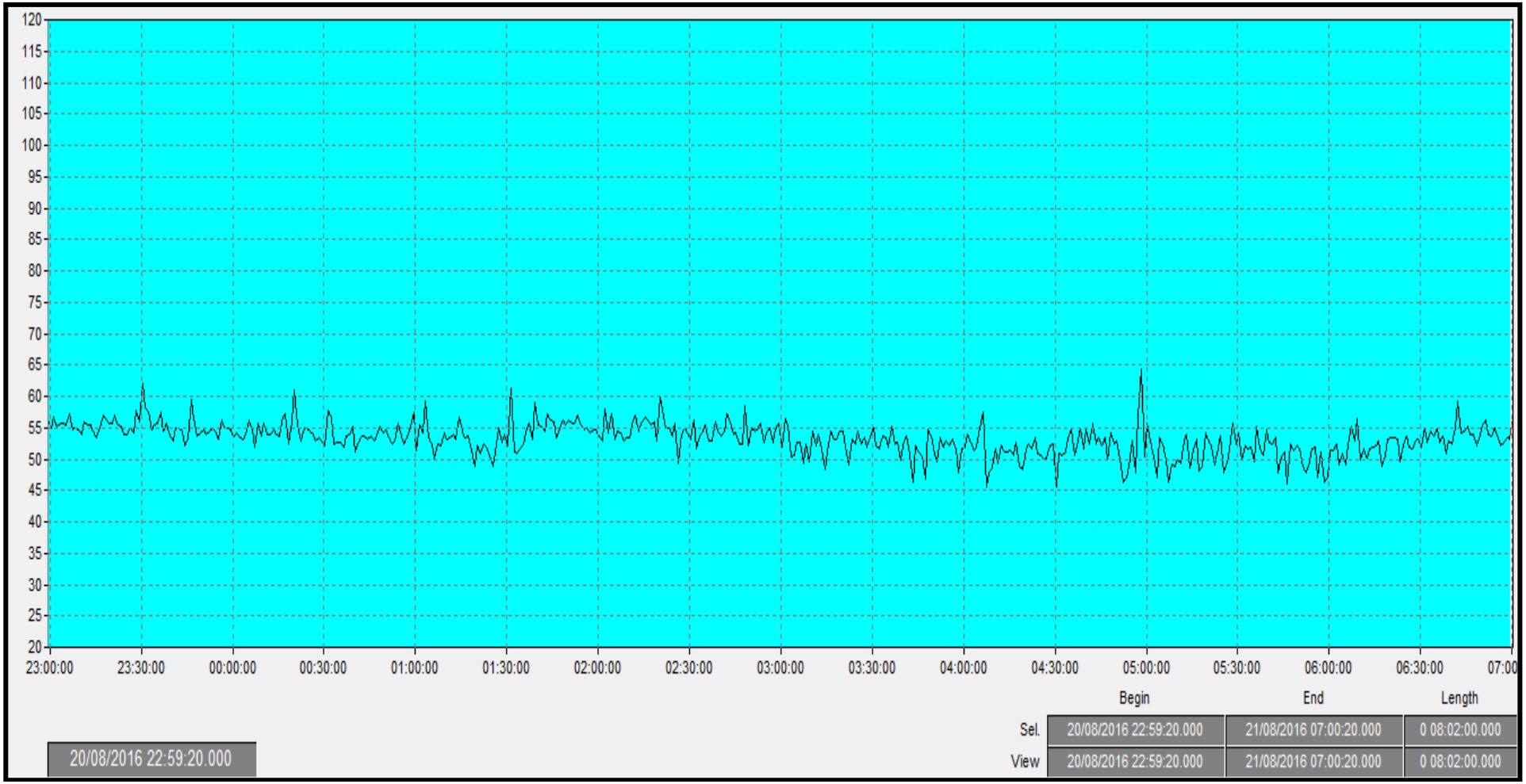
Graph 1: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 18th/19th August 2016



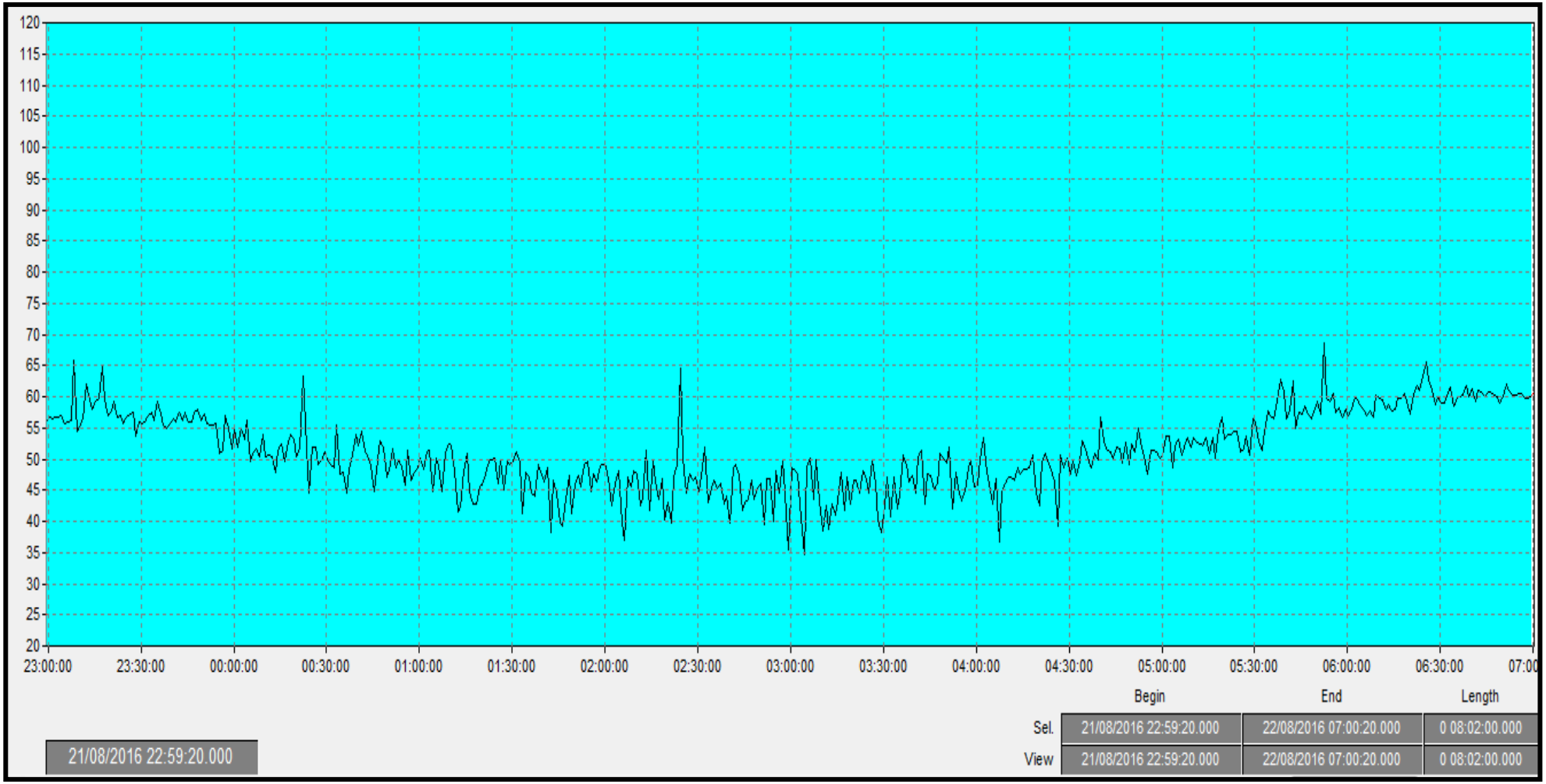
Graph 2: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 19th/20th August 2016



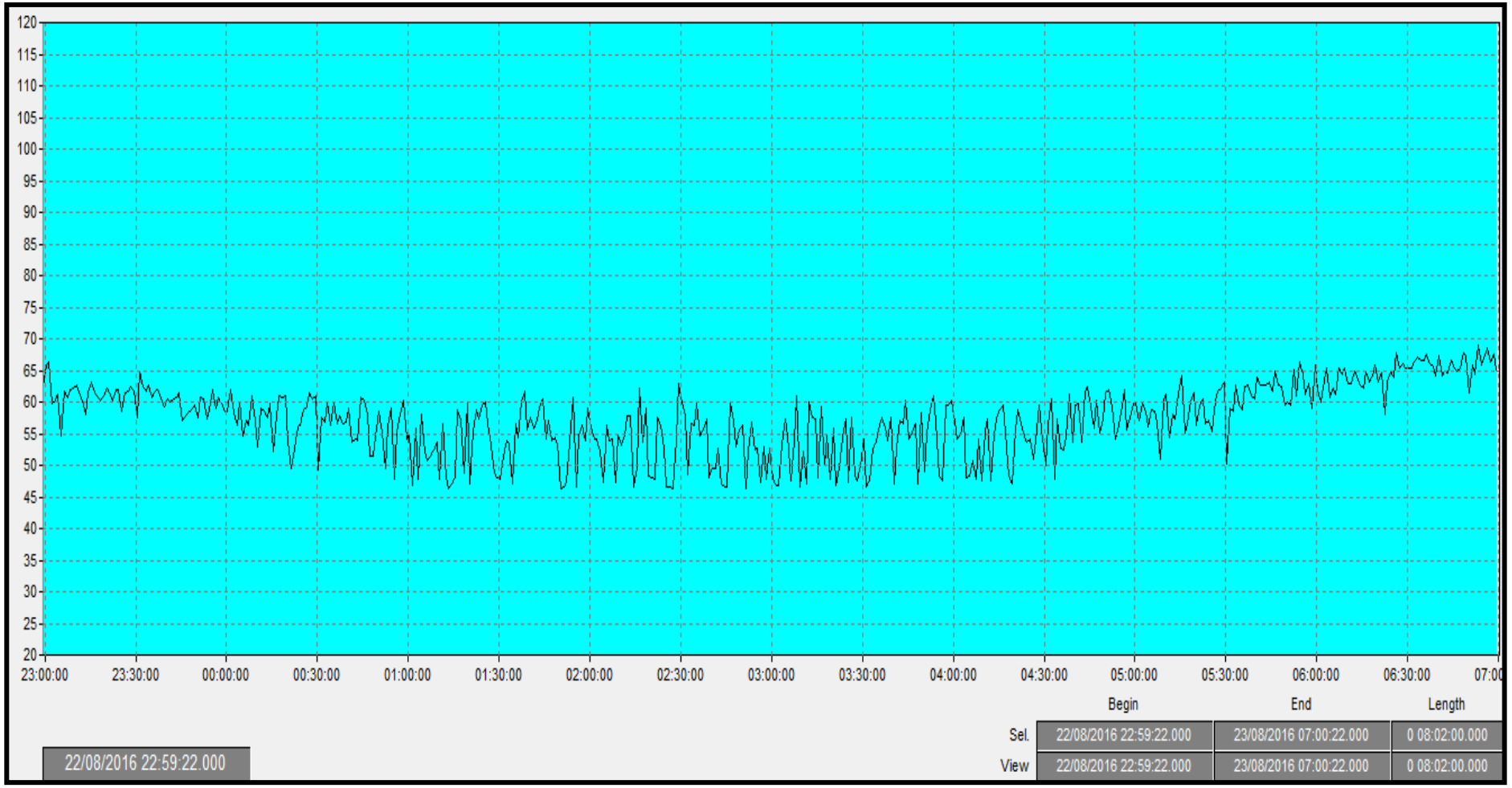
Graph 3: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 20th/21st August 2016



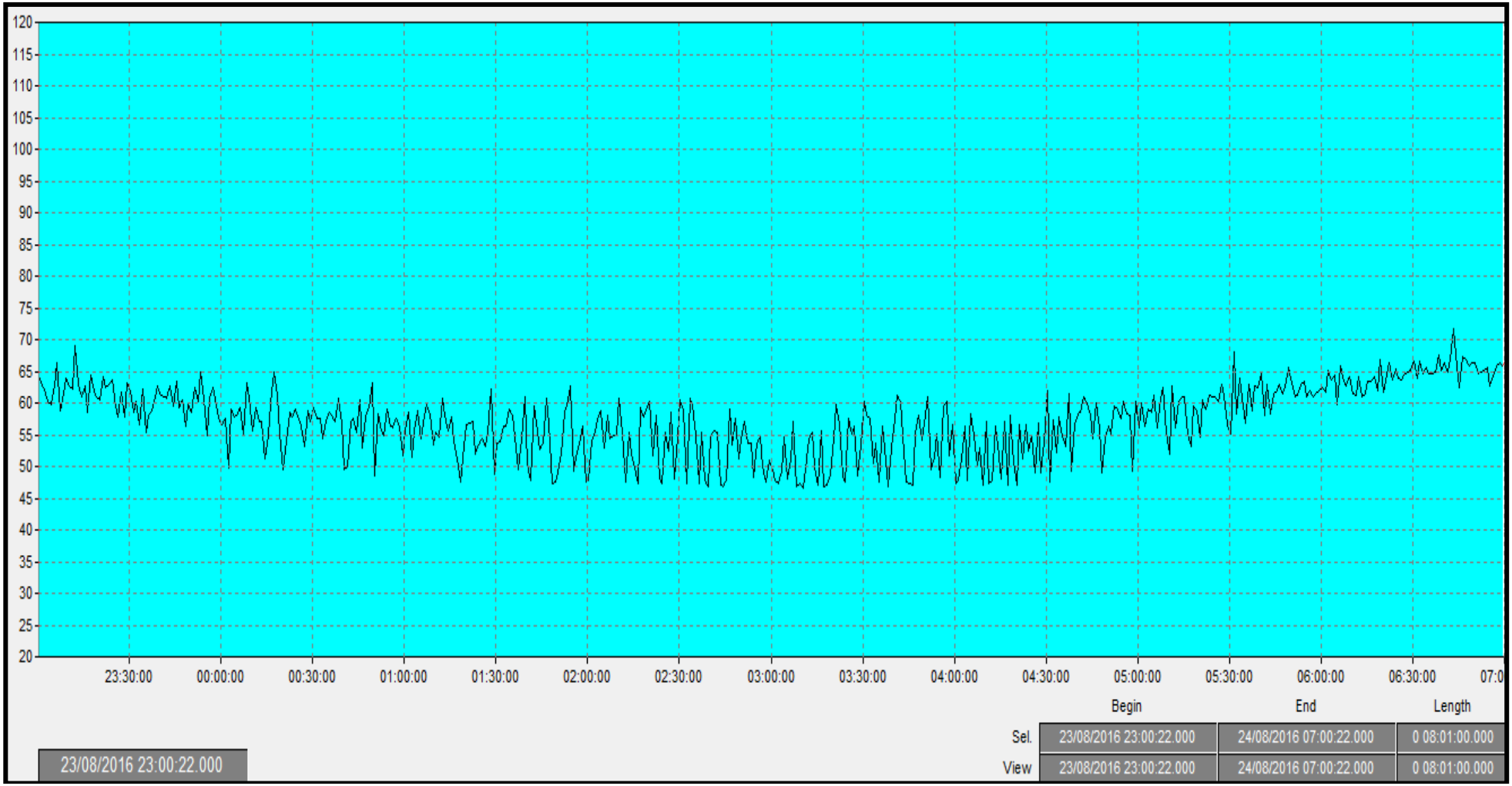
Graph 4: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 21st/22nd August 2016



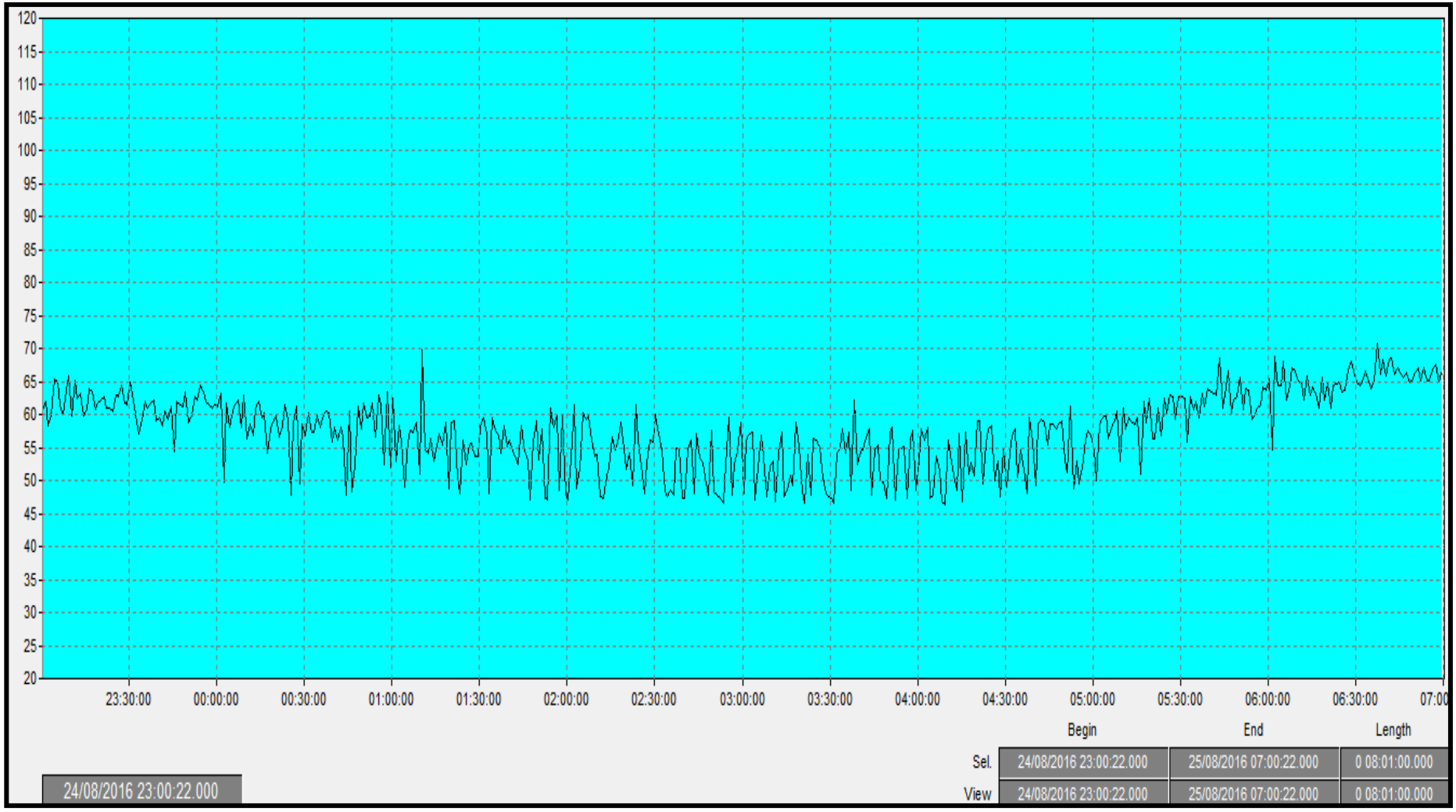
Graph 5: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 22nd/23rd August 2016



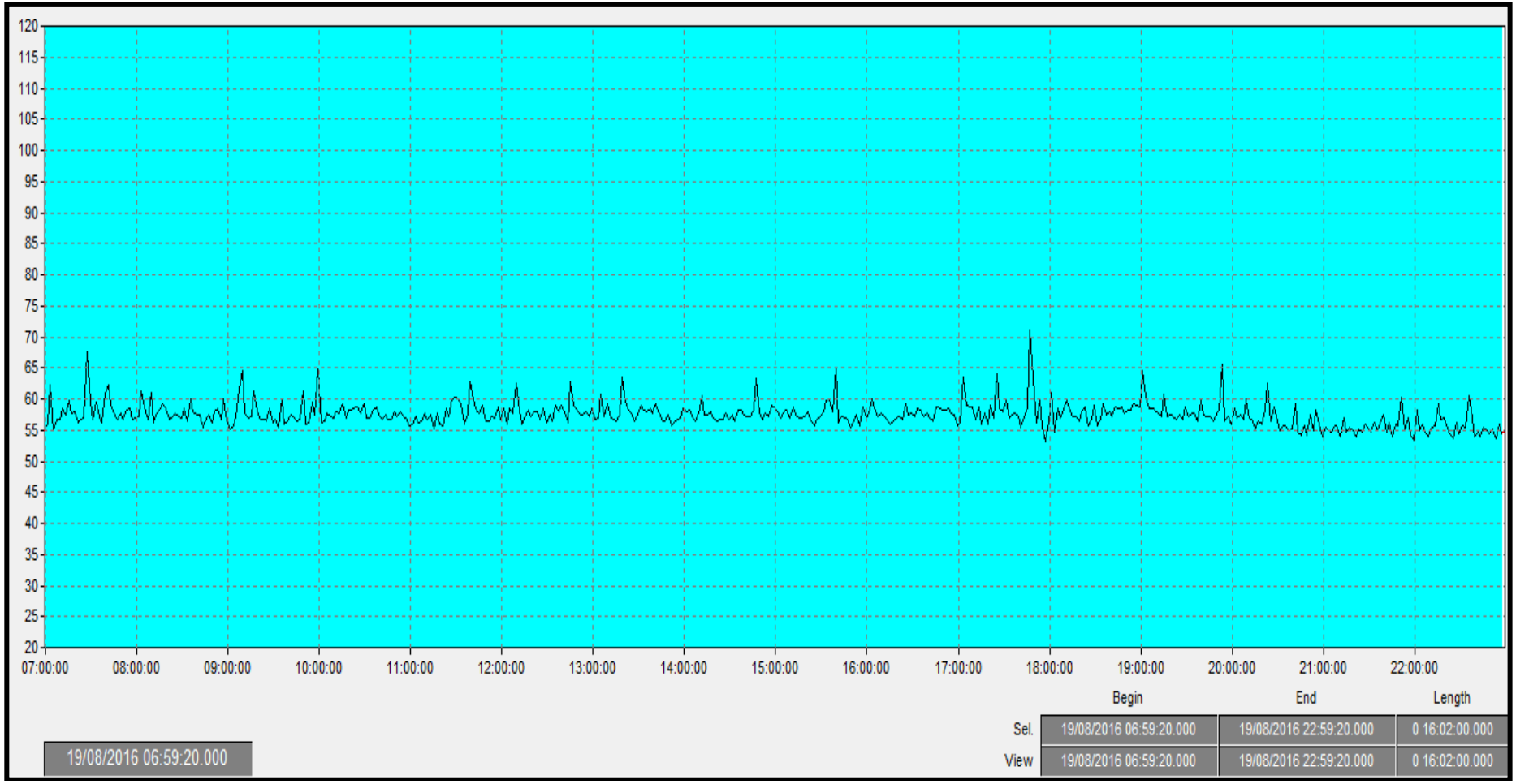
Graph 6: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 23rd/24th August 2016



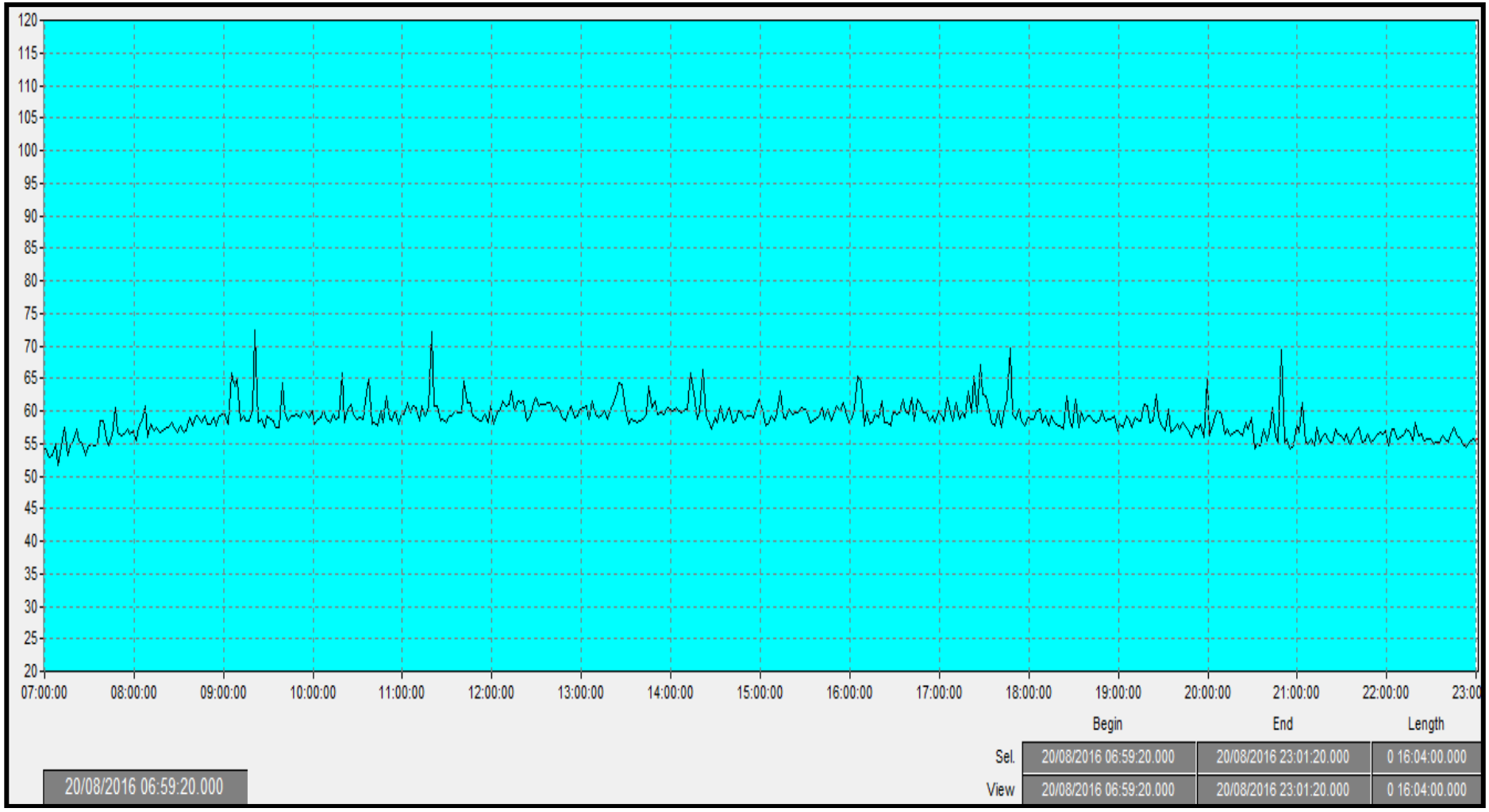
Graph 7: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 24th/25th August 2016



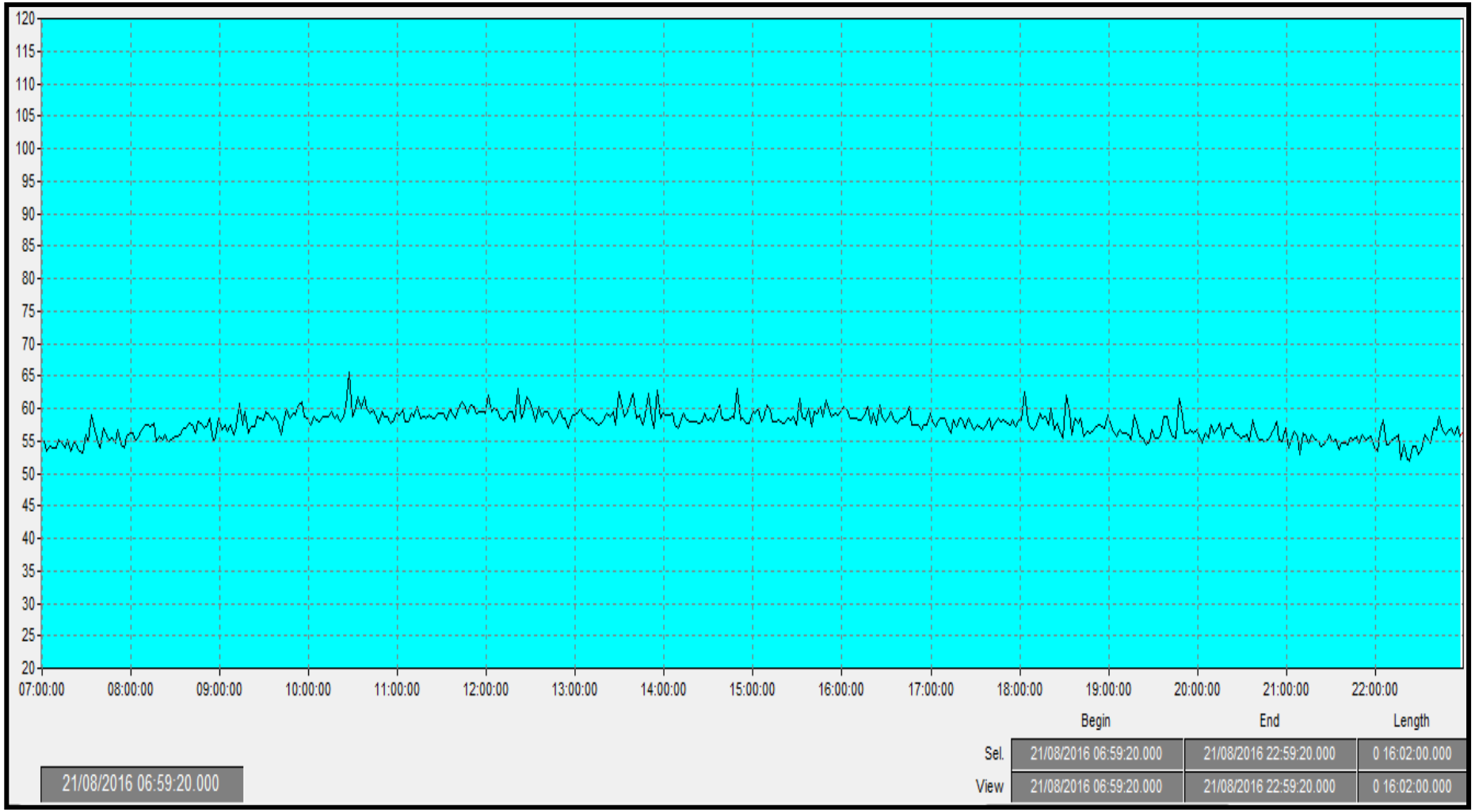
Graph 8: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 19th August 2016



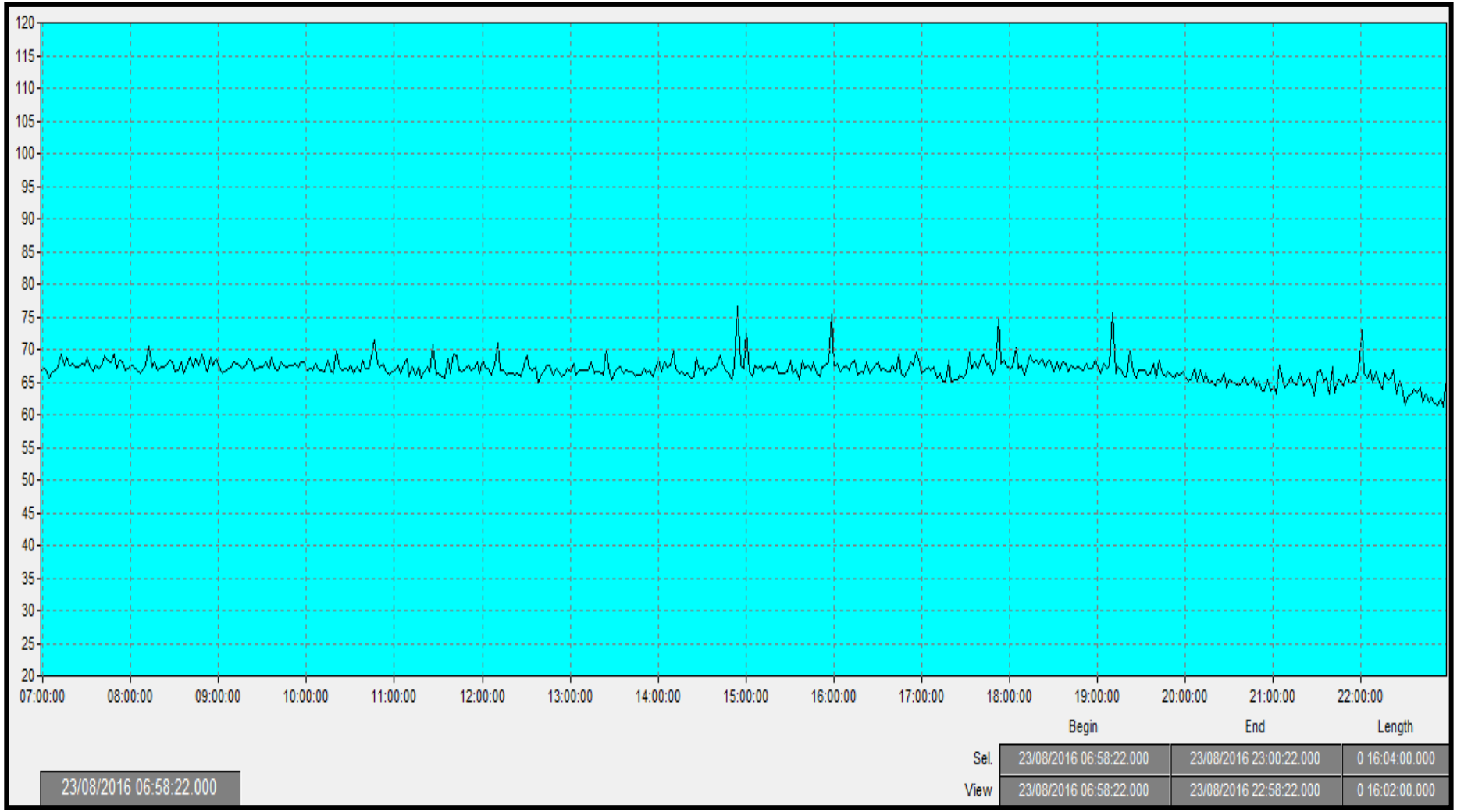
Graph 9: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 20th August 2016



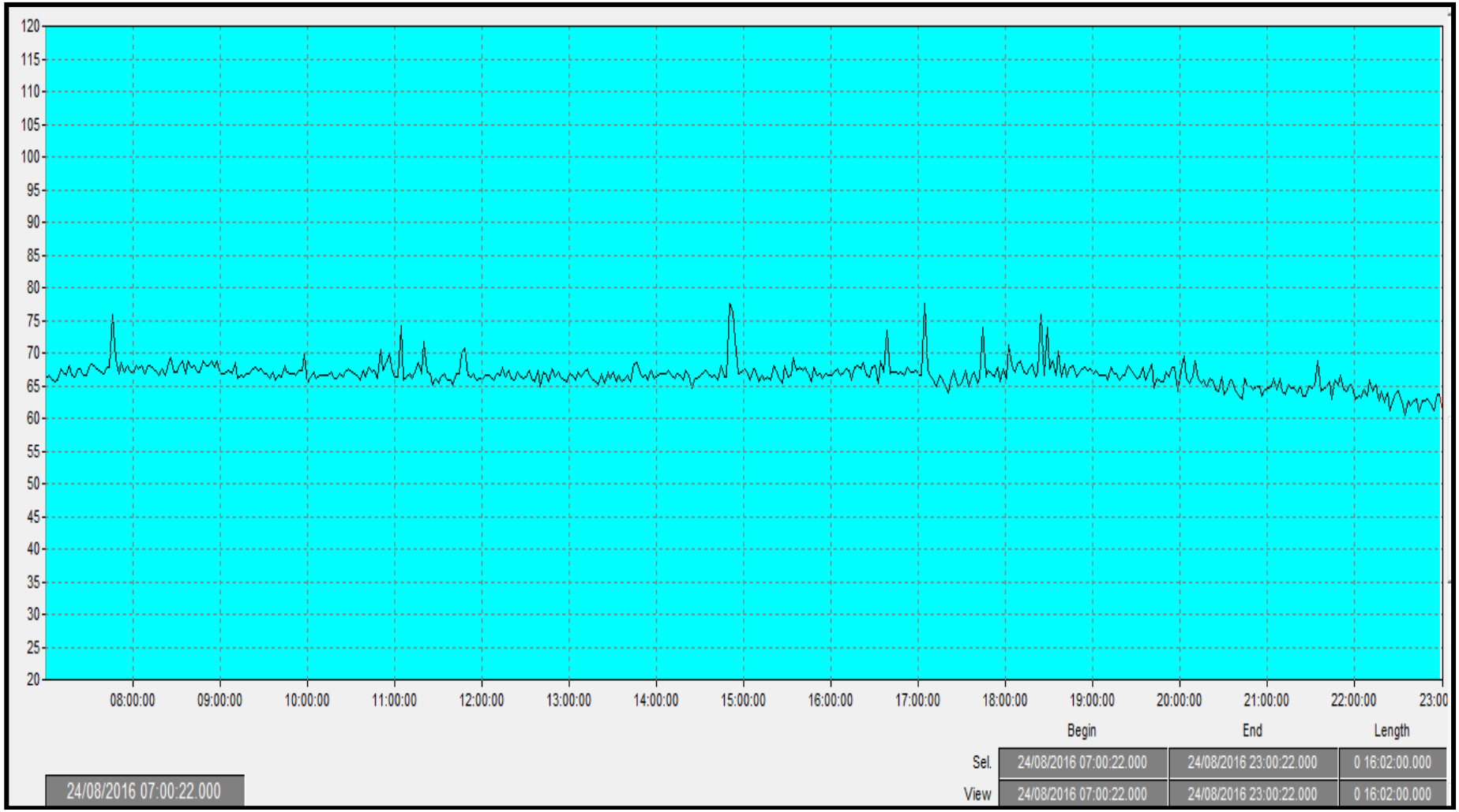
Graph 10: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 21st August 2016



Graph 11: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 23rd August 2016



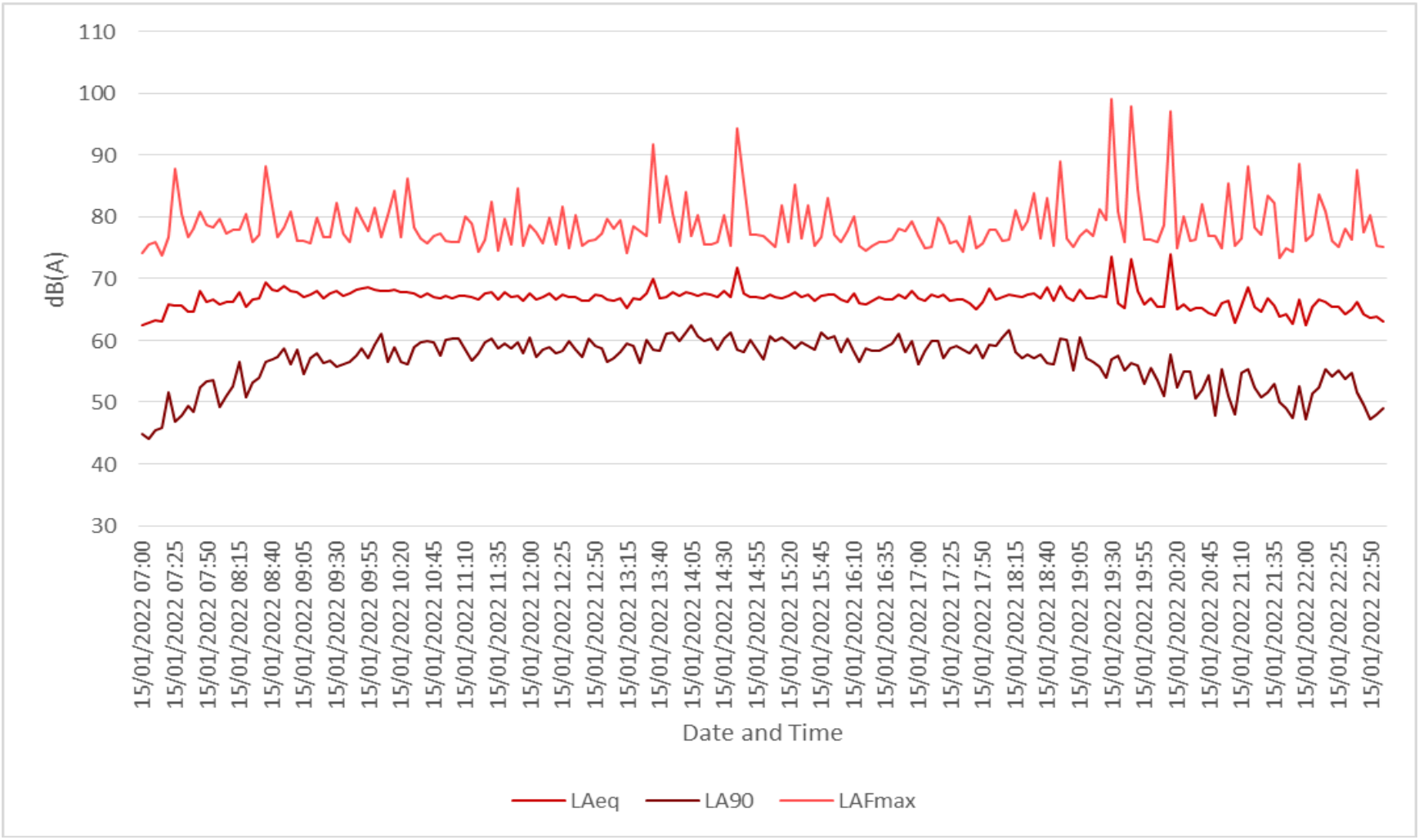
Graph 12: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 24th August 2016



Graph 13: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on 12th January 2022 (New Botolph Street)

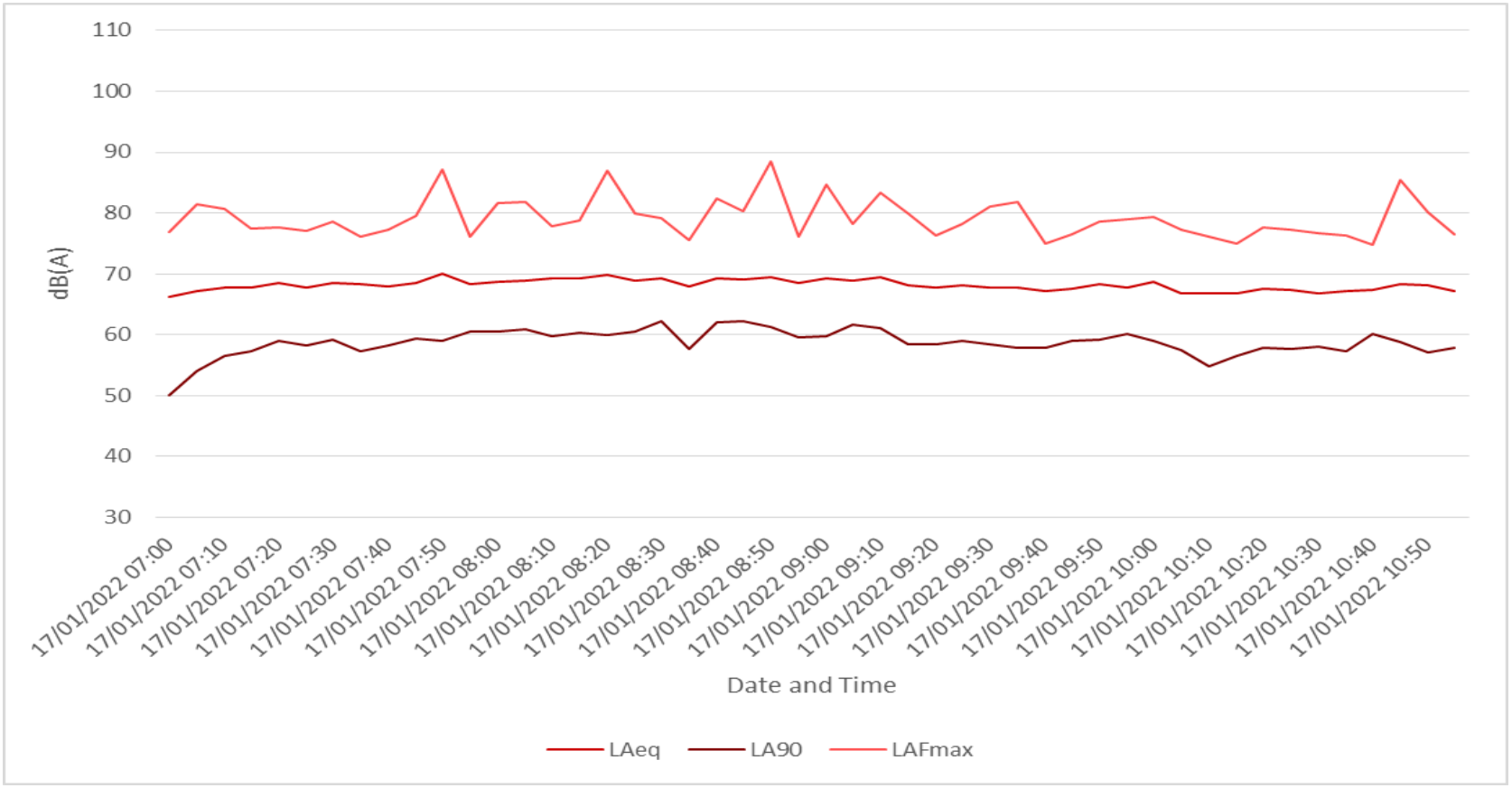
Graph 14: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on 13th January 2022 (New Botolph Street)

Graph 15: Graphical representation of the 16hour noise monitoring period (07:00-23:00) on 15th January 2022 (New Botolph Street)



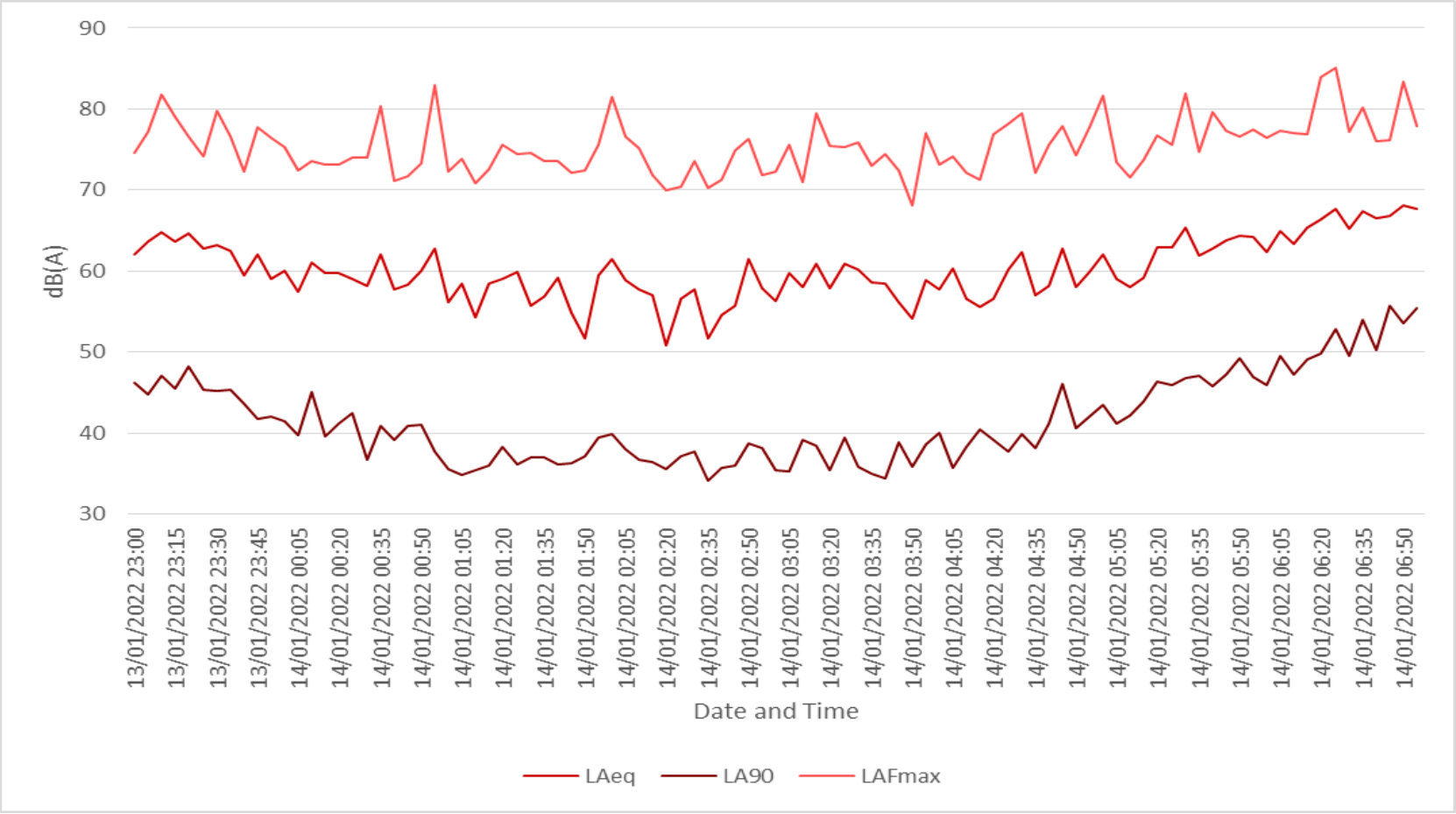
Graph 16: Graphical representation of the 16hour noise monitoring period (07:00-23:00) on 16th January 2022 (New Botolph Street)

Graph 17: Graphical representation of the day time noise monitoring period (incomplete measurement period) on 17th January 2022 (New Botolph Street)



Graph 18: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 12th /13th January 2022 (New Botolph Street)

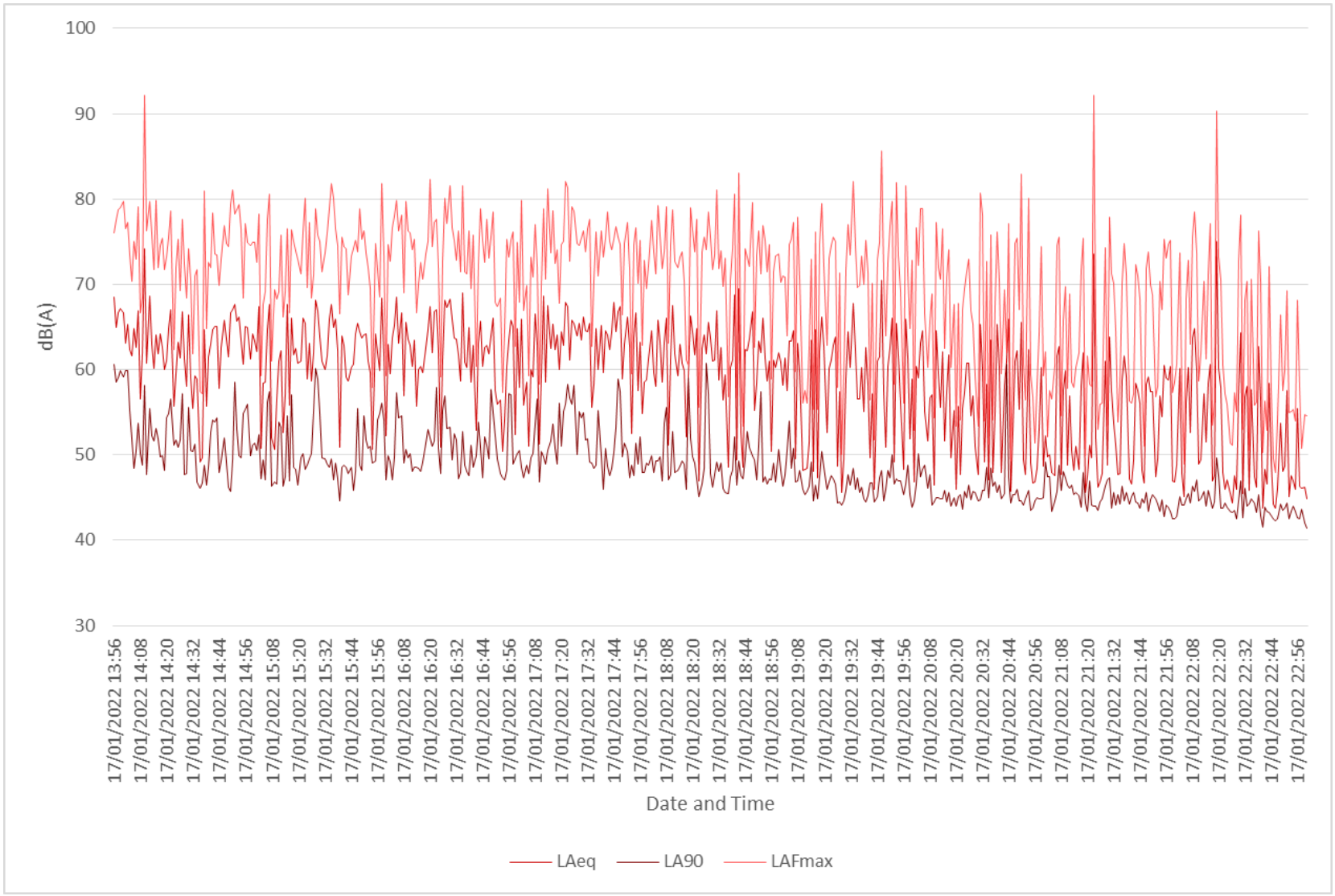
Graph 19: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 13th / 14th January 2022 (New Botolph Street)



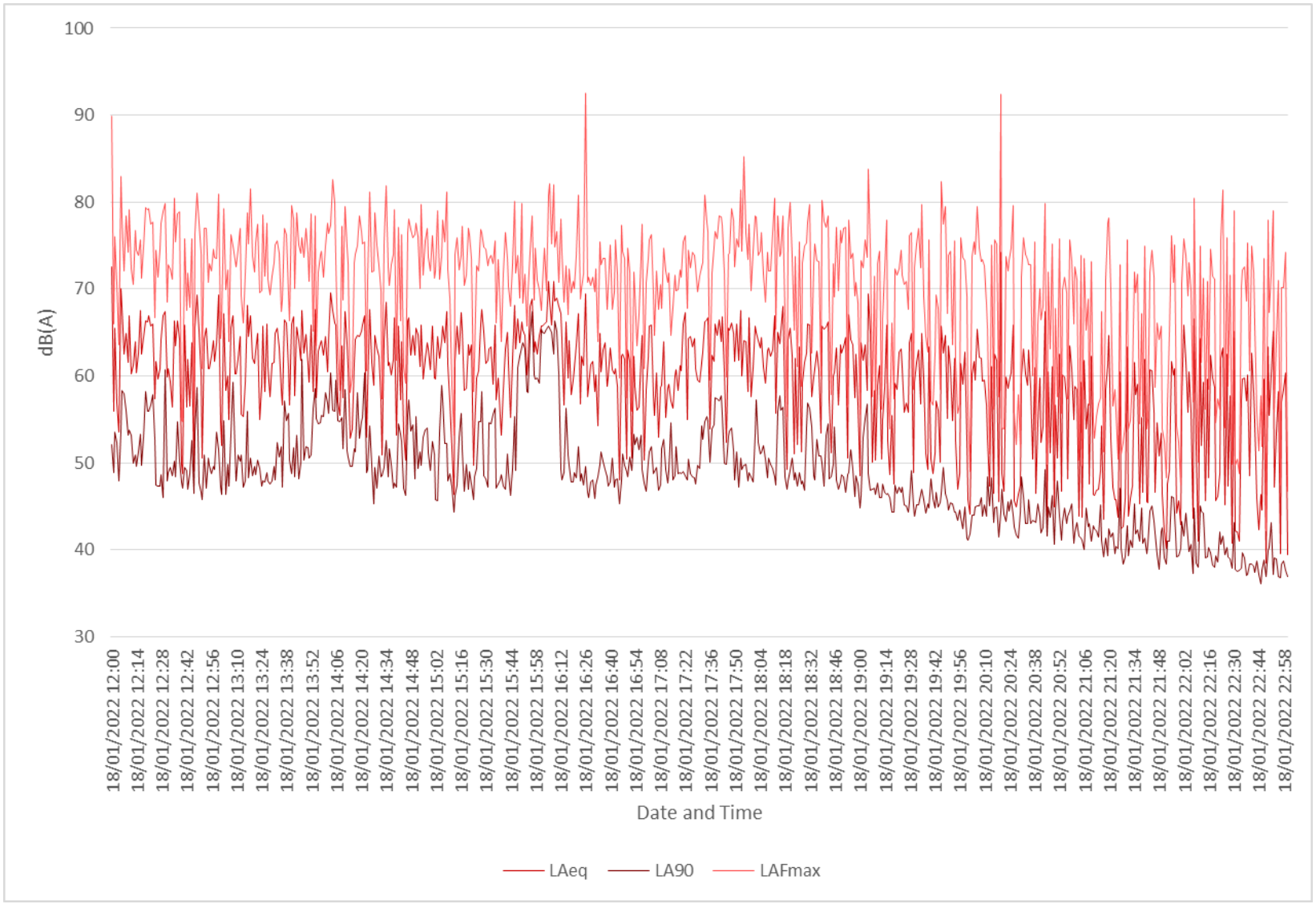
Graph 20: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 15th / 16th January 2022 (New Botolph Street)

Graph 21: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 16th /17th January 2022 (New Botolph Street)

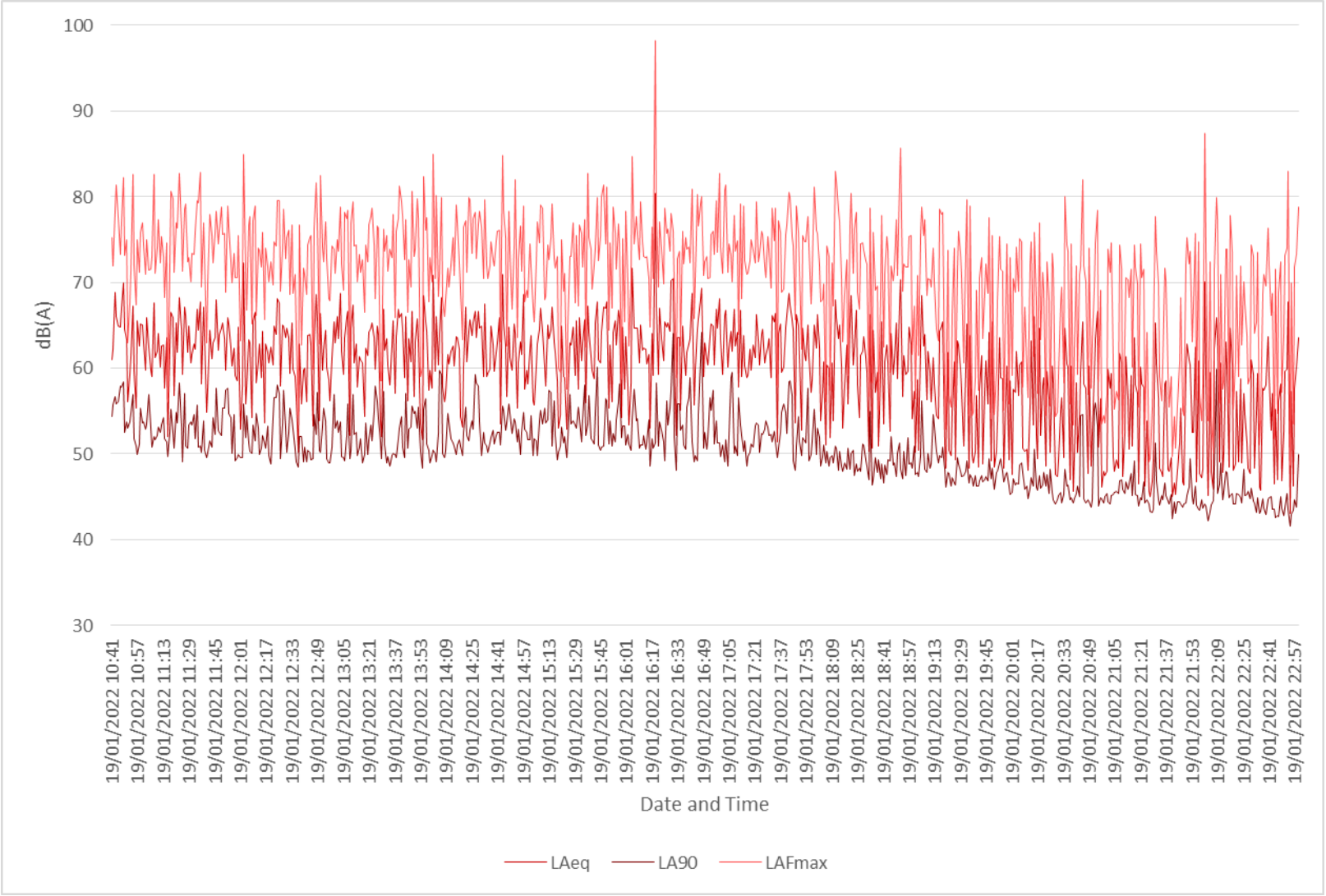
Graph 22: Graphical representation of the day monitoring period (incomplete) on the 17th January 2022 (Edward Street)



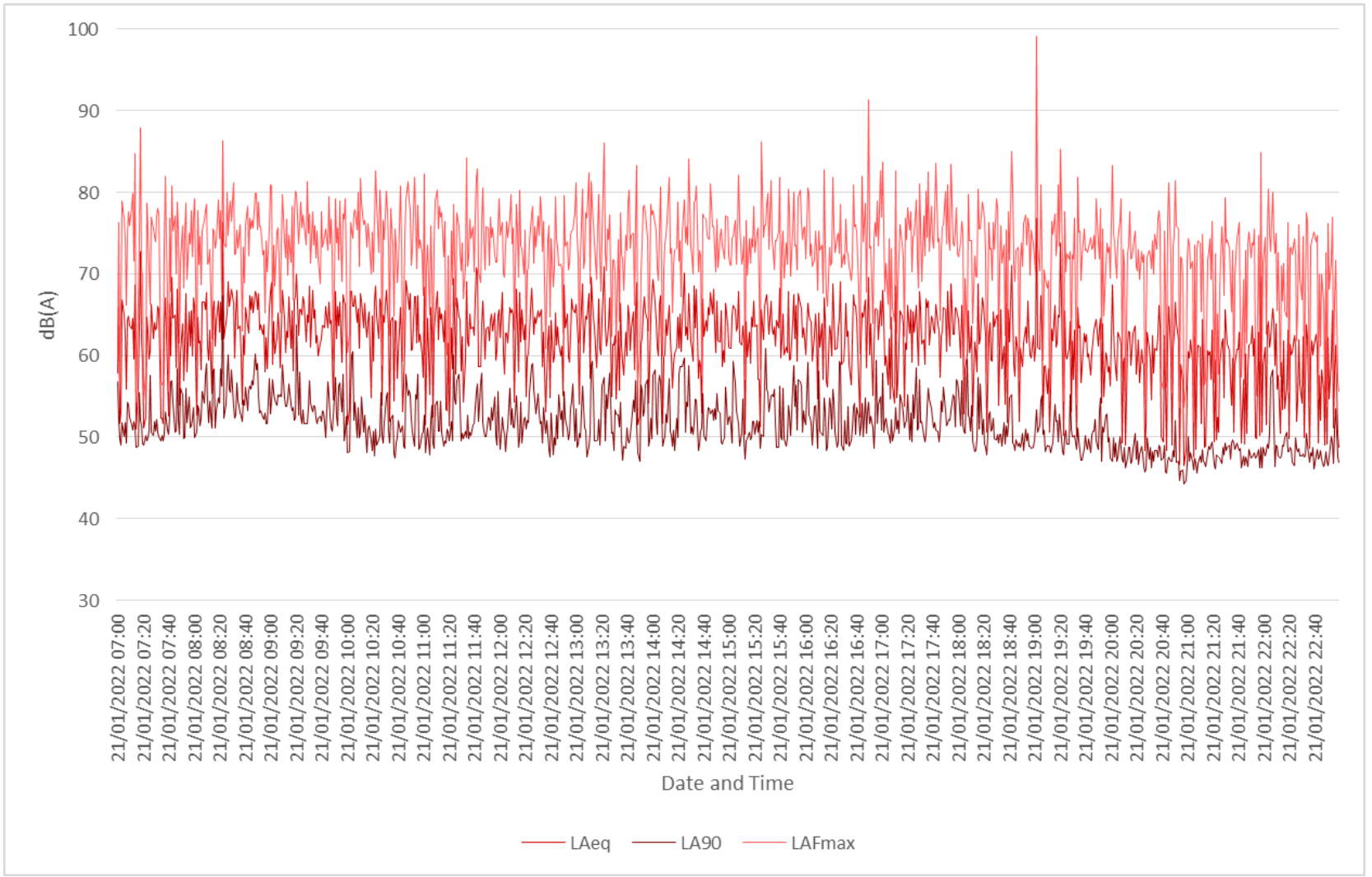
Graph 23: Graphical representation of the day monitoring period (incomplete) on the 18th January 2022 (Edward Street)



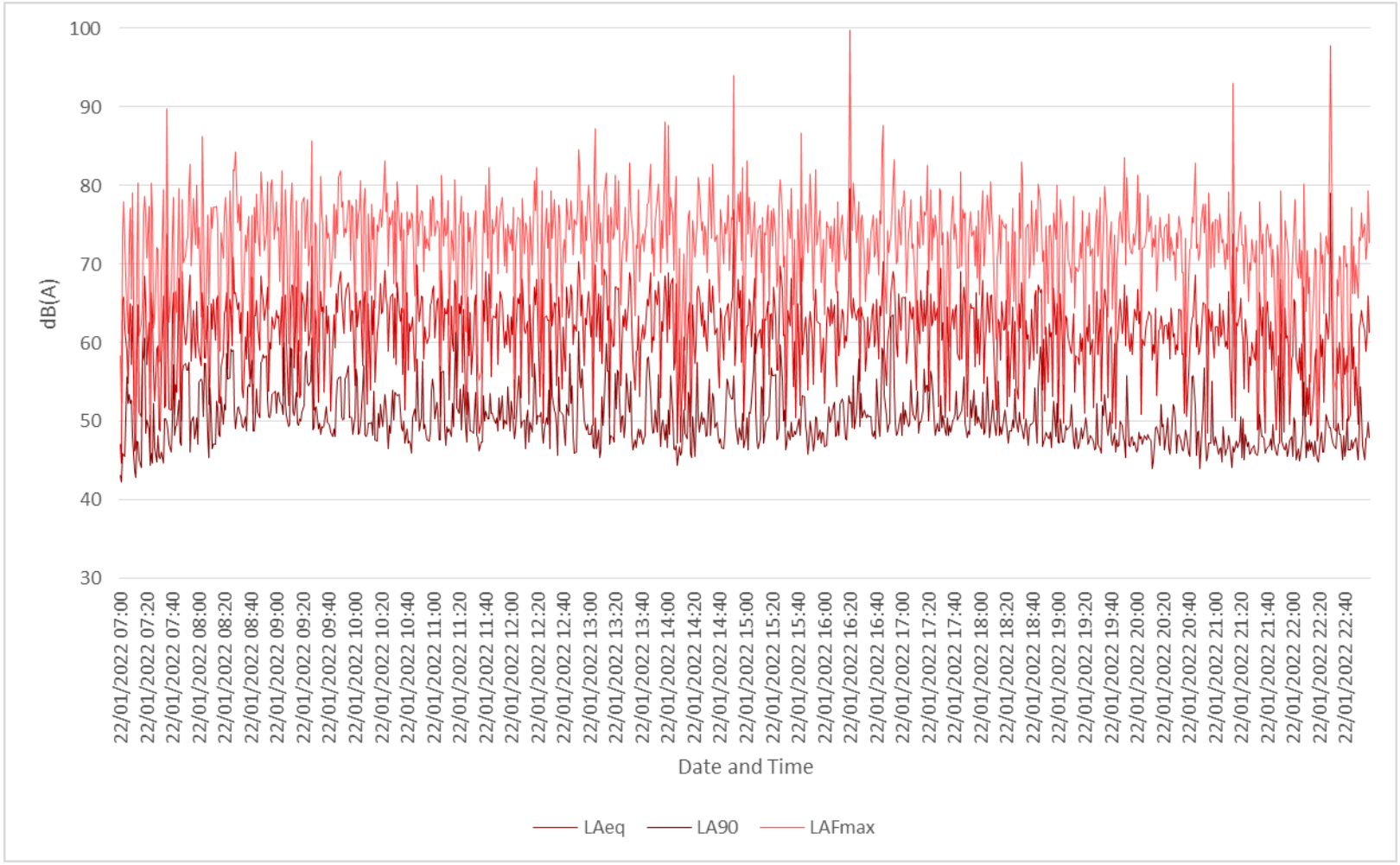
Graph 24: Graphical representation of the day monitoring period (incomplete) on the 19th January 2022 (Edward Street)



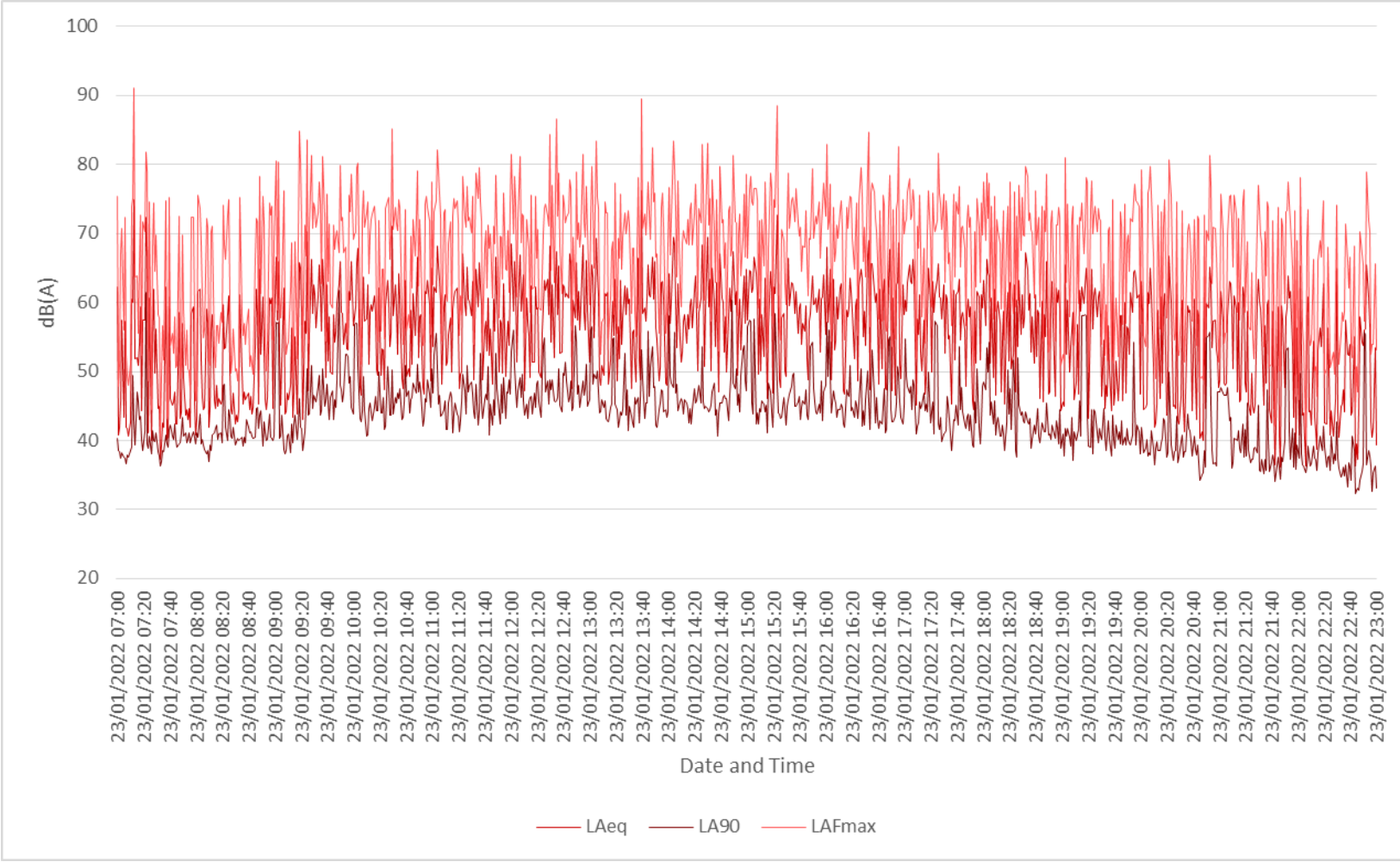
Graph 25: Graphical representation of the day monitoring period (16 hour) on the 21st January 2022 (Edward Street)



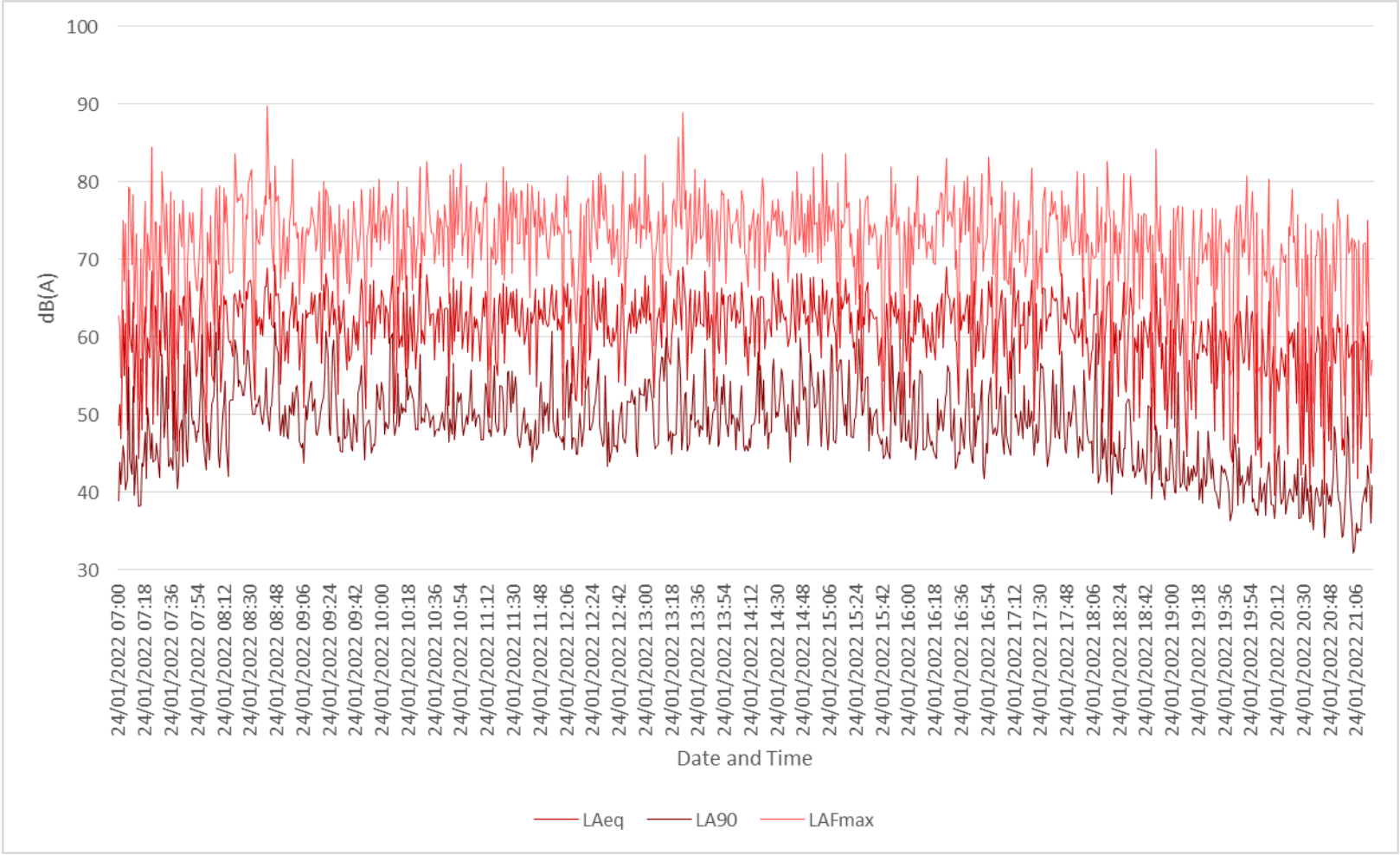
Graph 26: Graphical representation of the day monitoring period (16 hour) on the 22nd January 2022 (Edward Street)



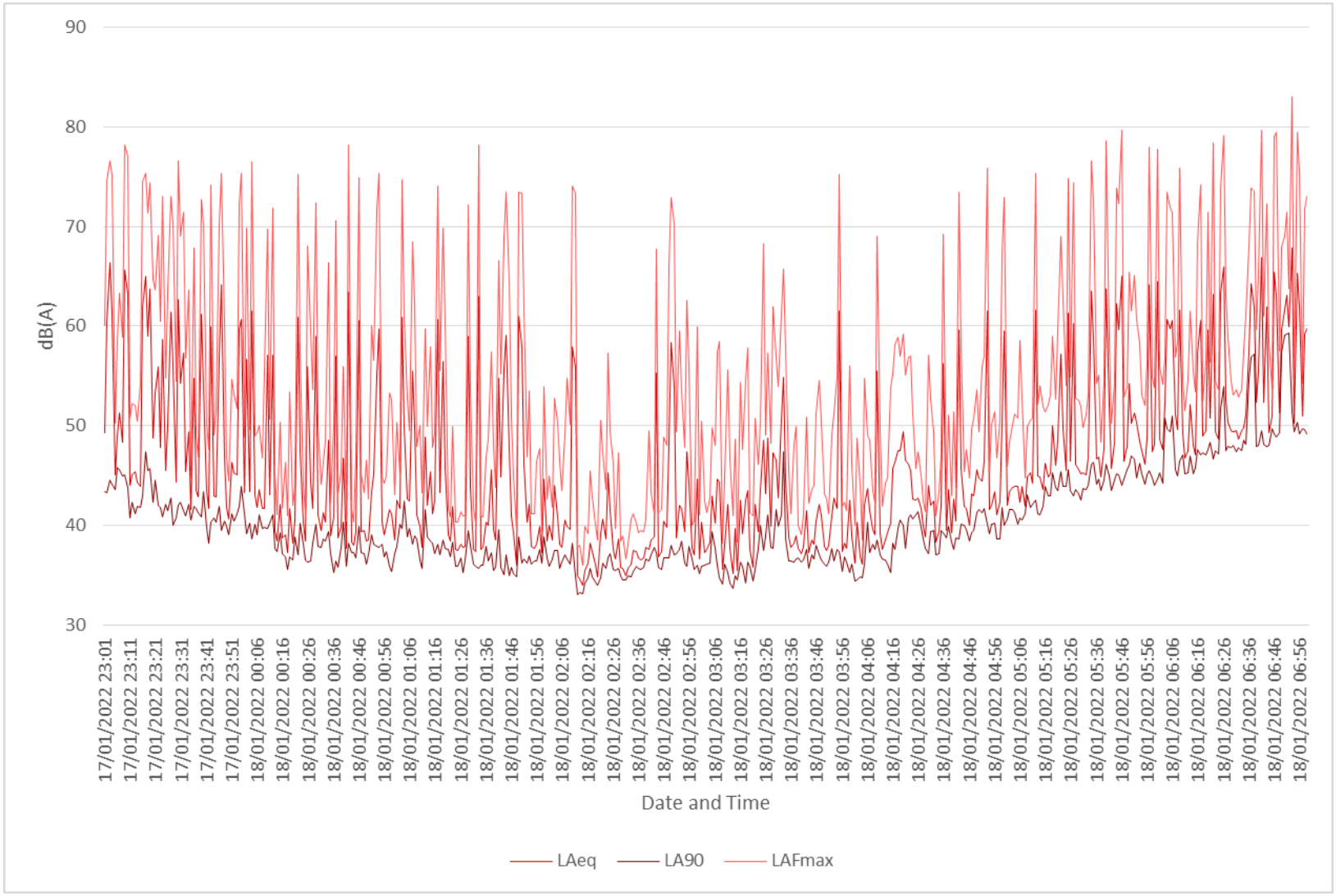
Graph 27: Graphical representation of the day monitoring period (16 hour) on the 23rd January 2022 (Edward Street)



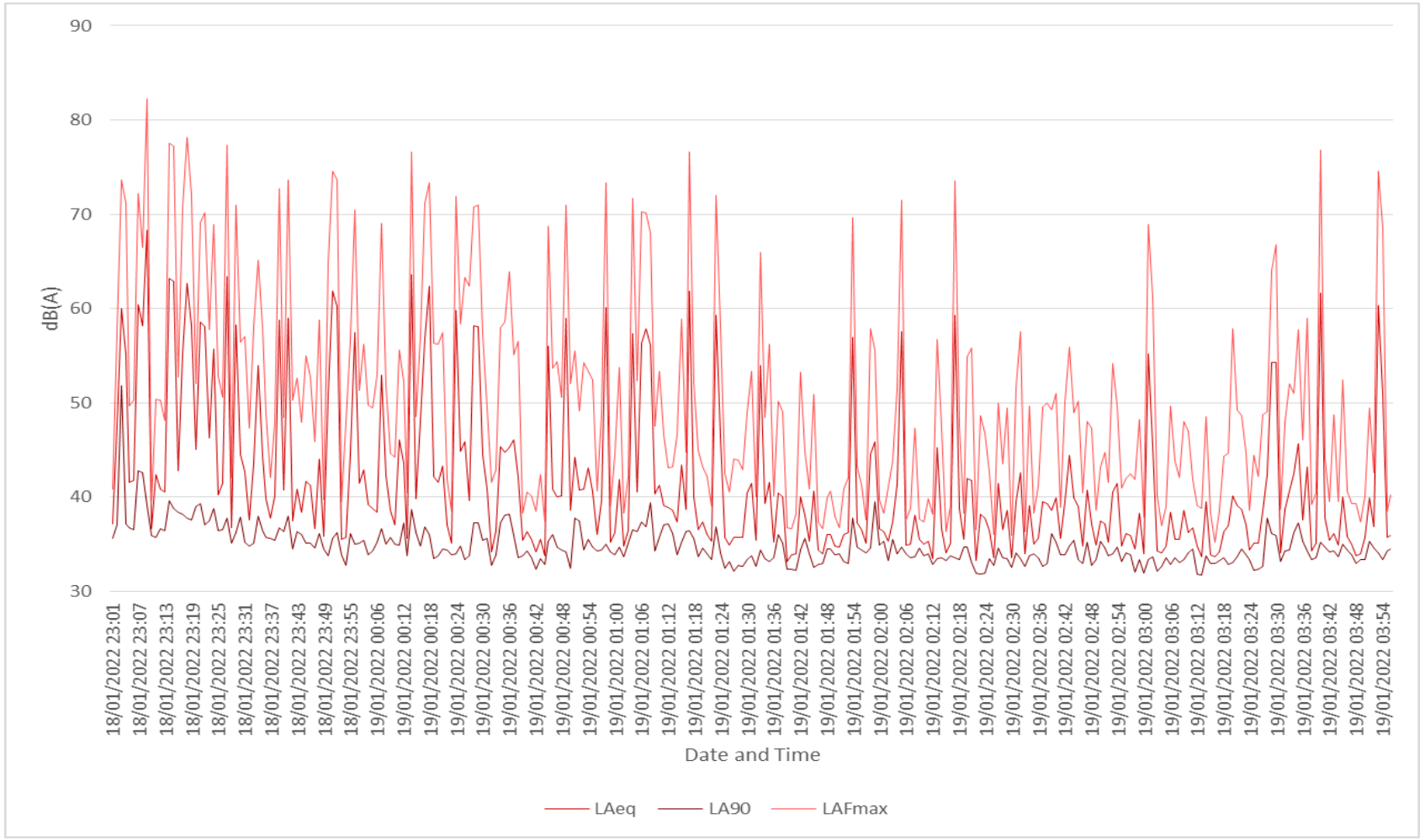
Graph 28: Graphical representation of the day monitoring period (incomplete) on the 24th January 2022 (Edward Street)



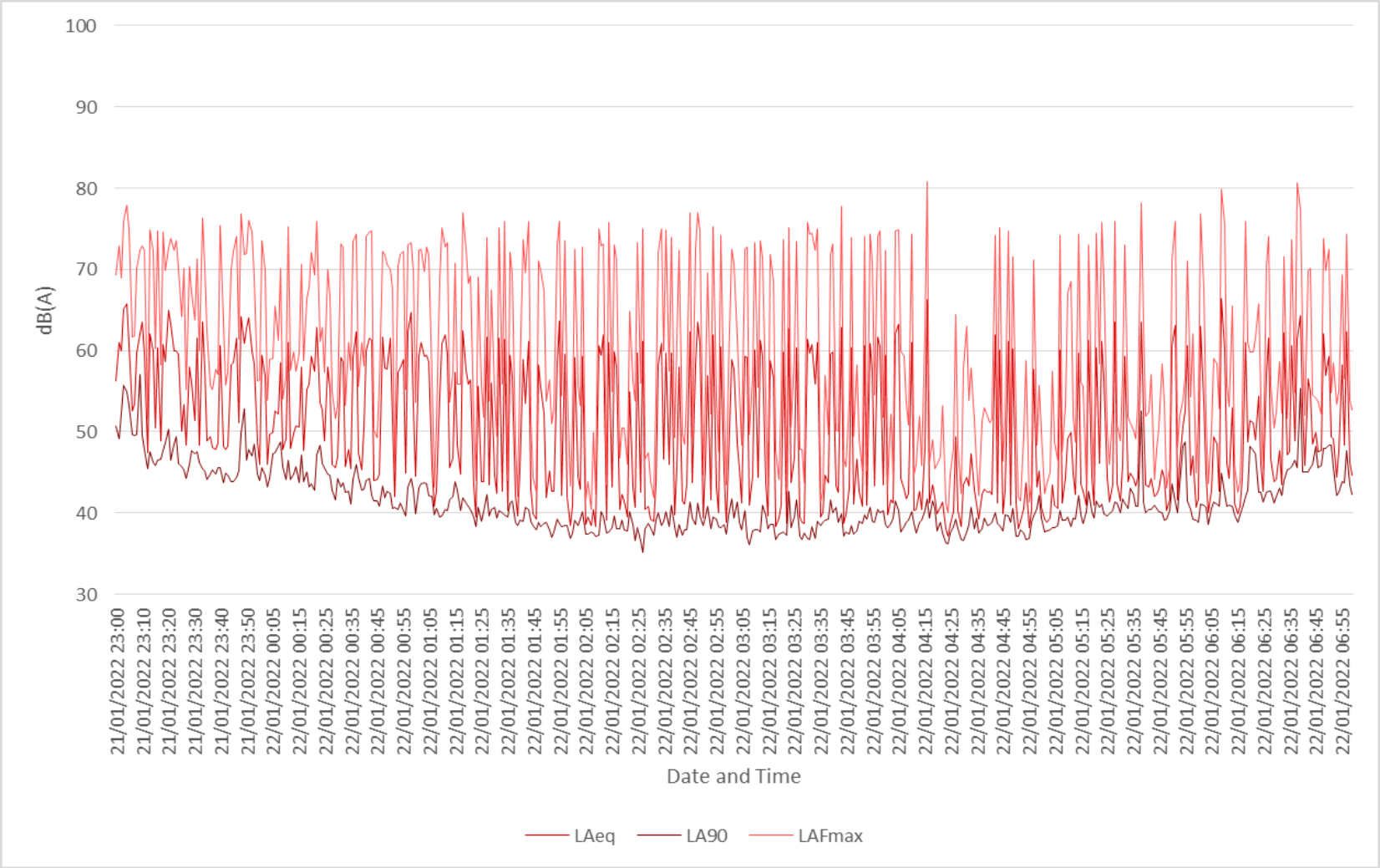
Graph 29: Graphical representation of the day monitoring period (8 hour) on the 17th / 18th January 2022 (Edward Street)



Graph 30: Graphical representation of the night monitoring period (incomplete) on the 18th / 19th January 2022 (Edward Street)

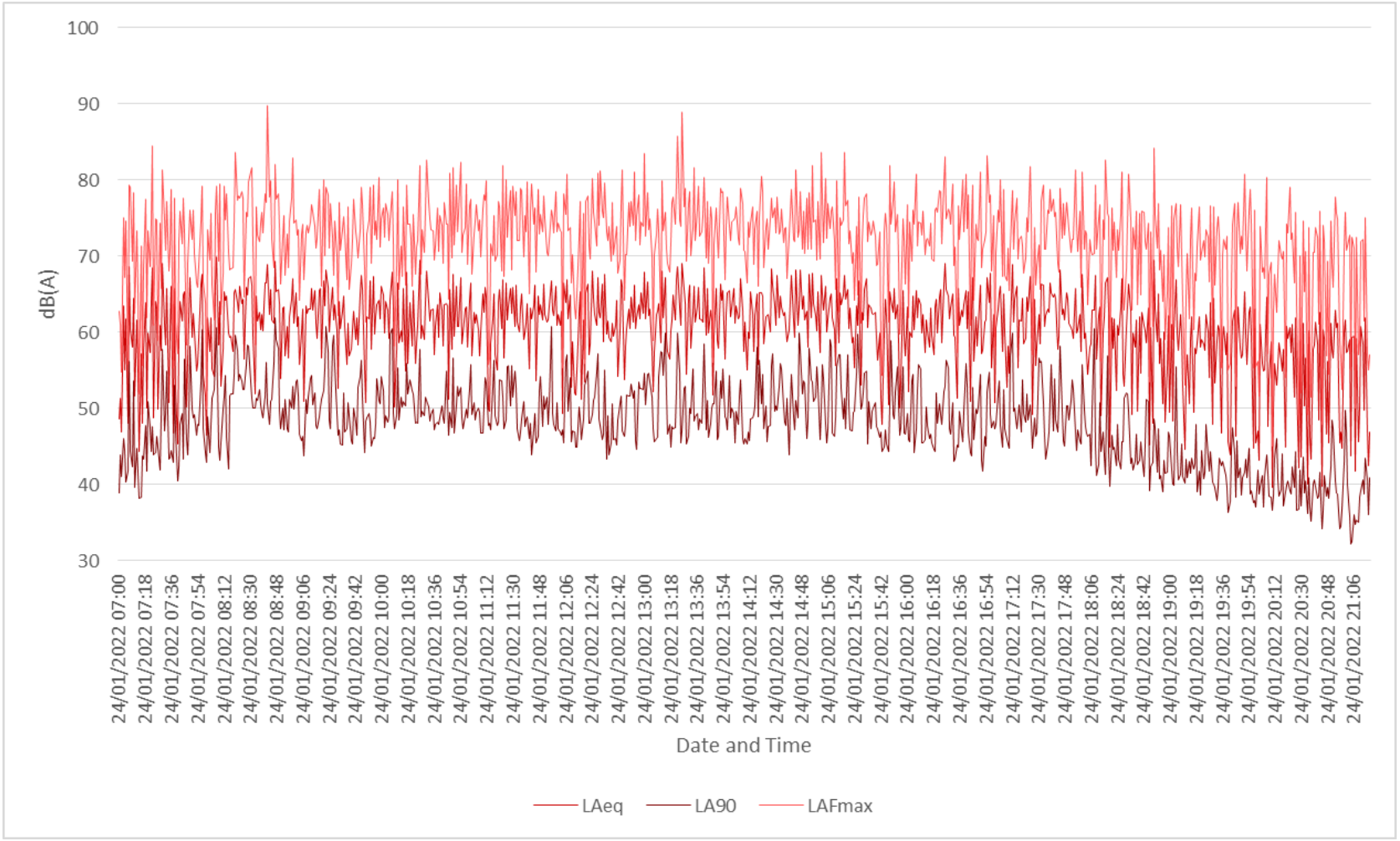


Graph 31: Graphical representation of the night monitoring period (8 hour) on the 21st / 22nd January 2022 (Edward Street)

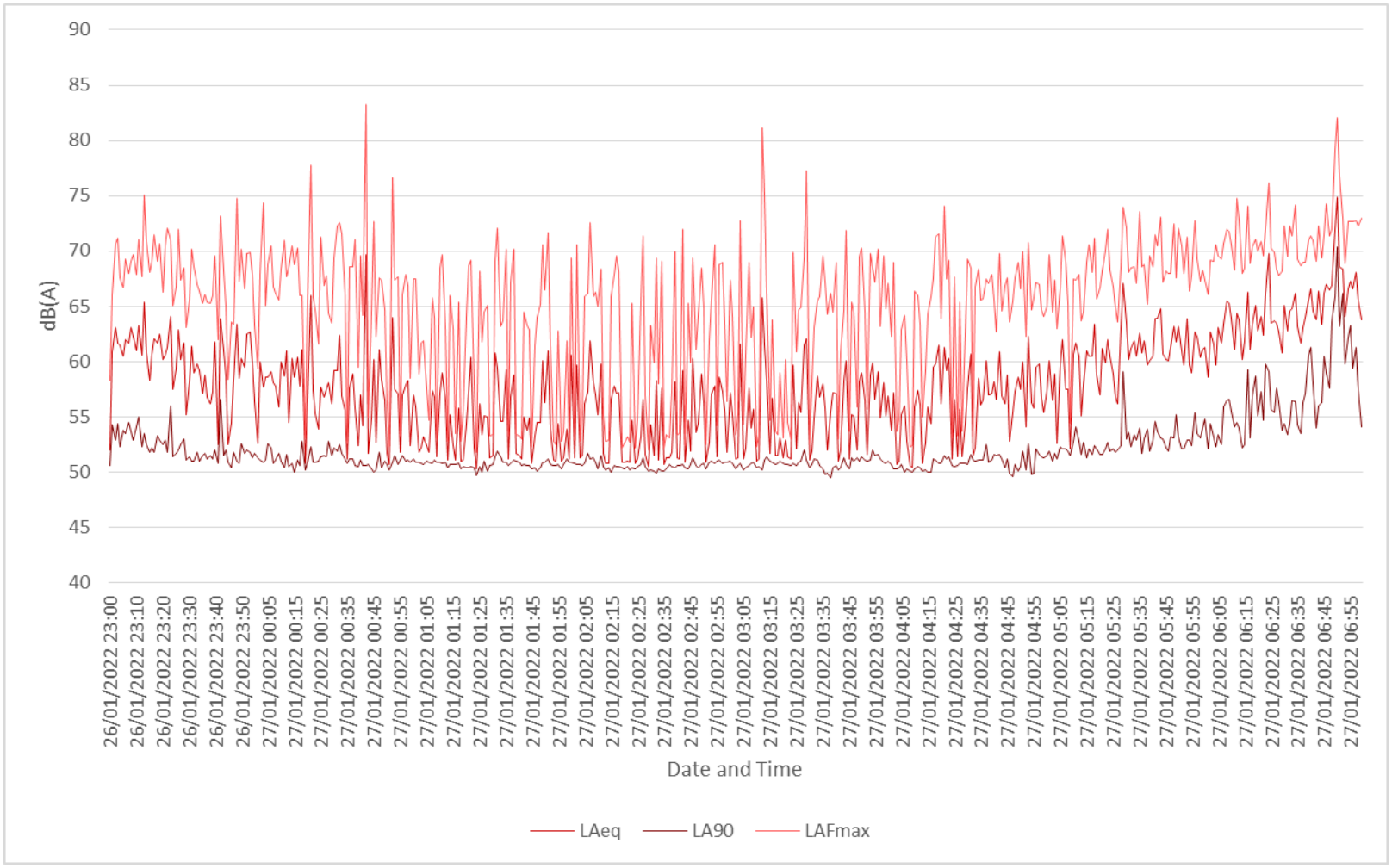


Graph 32: Graphical representation of the night monitoring period (8 hour) on the 22nd / 23rd January 2022 (Edward Street)

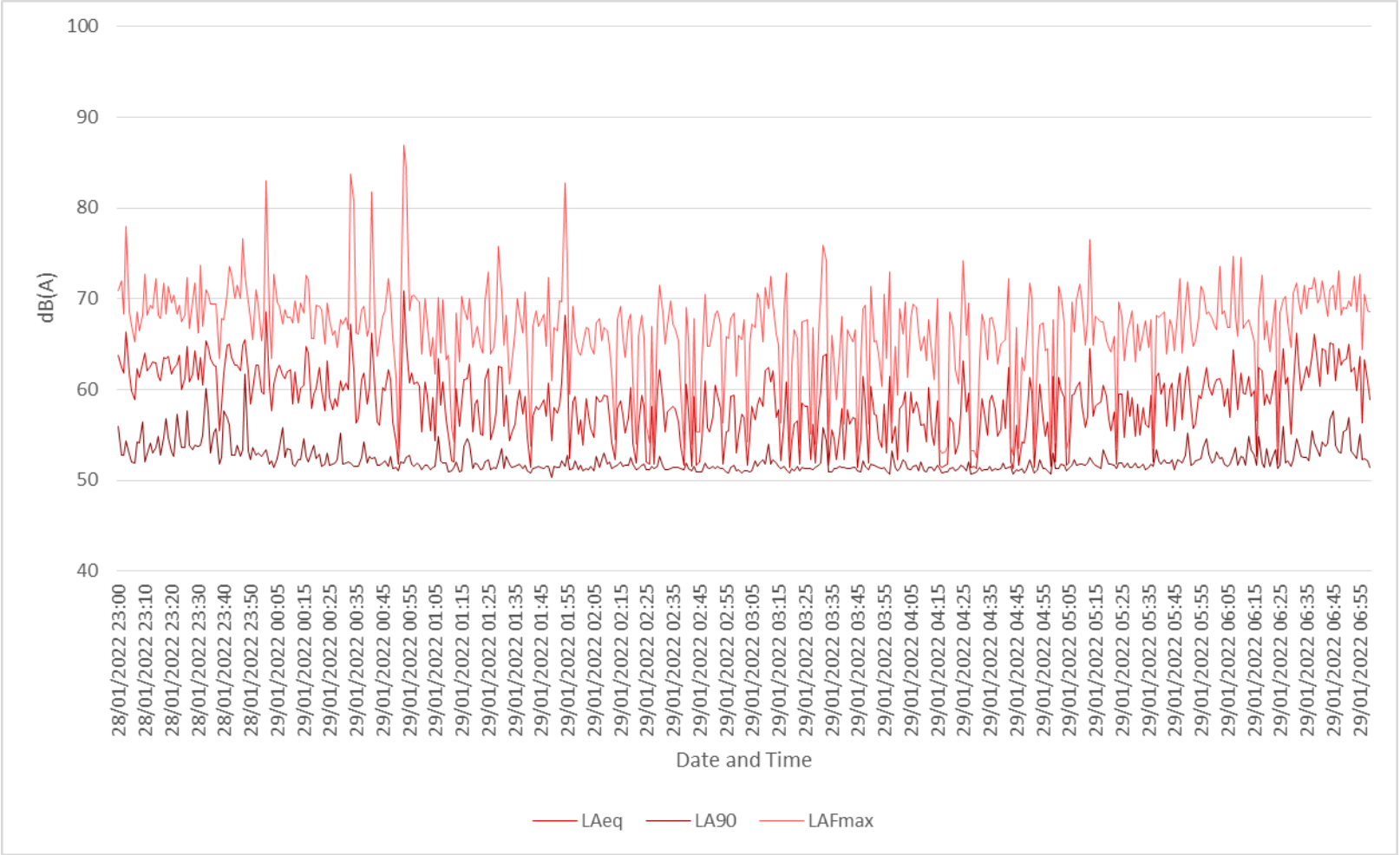
Graph 33: Graphical representation of the day monitoring period (incomplete) on the 24th January 2022 (Edward Street)



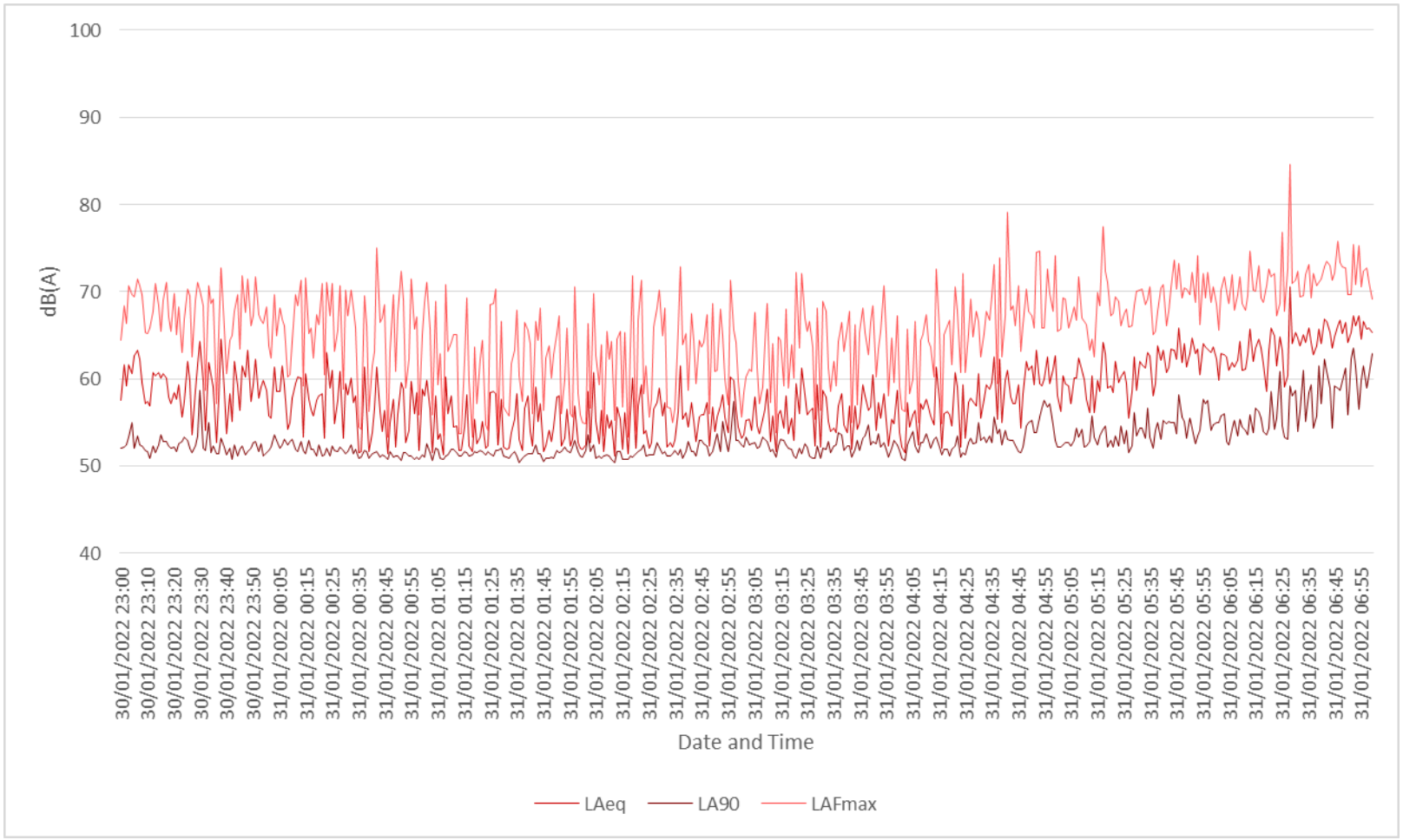
Graph 34: Graphical representation of the night monitoring period (8 hour) on the 26th / 27th January 2022 (St Crispins Road)



Graph 35: Graphical representation of the night monitoring period (8 hour) on the 28th / 29th January 2022 (St Crispins Road)

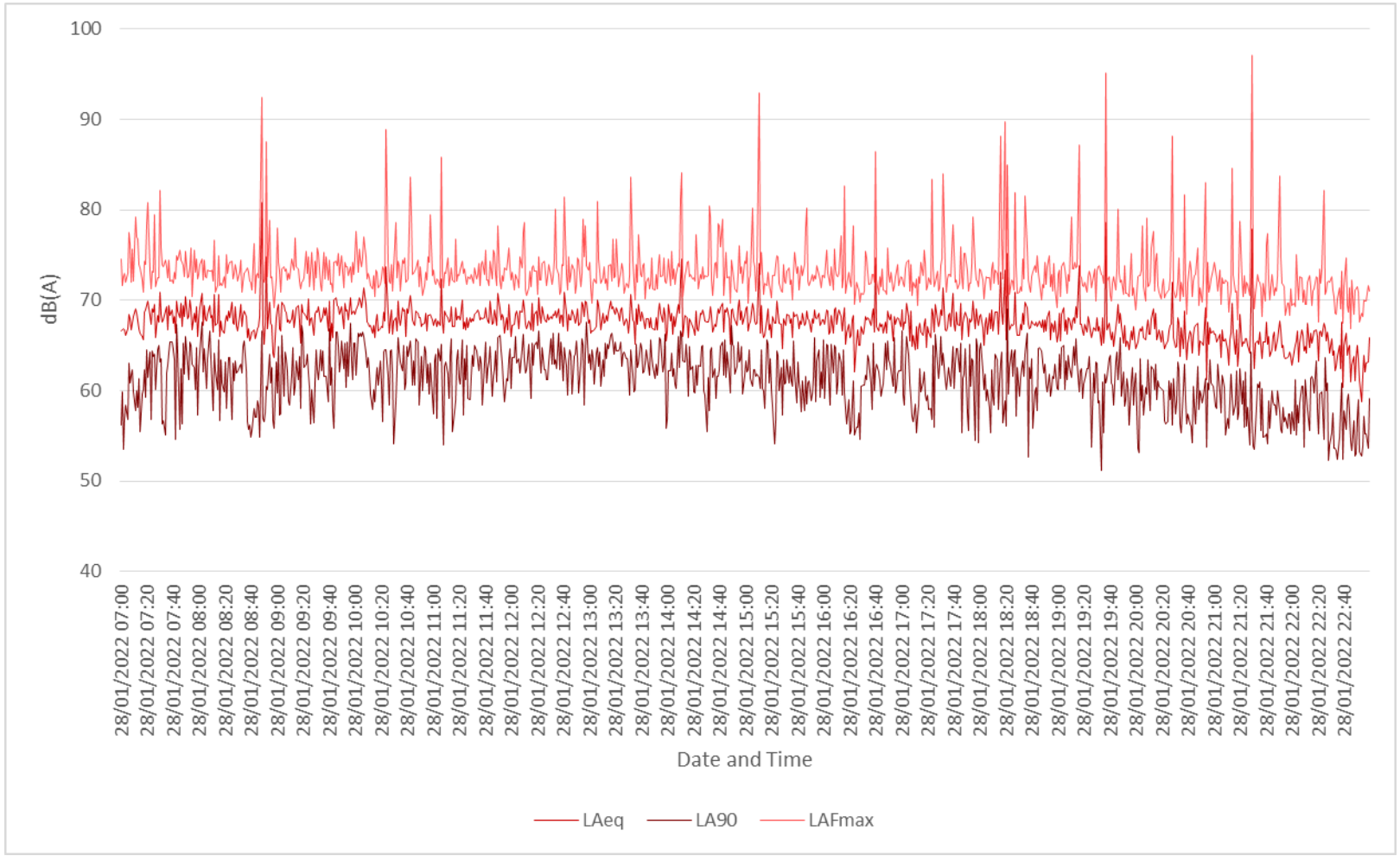


Graph 36: Graphical representation of the night monitoring period (8 hour) on the 30th / 31st January 2022 (St Crispins Road)

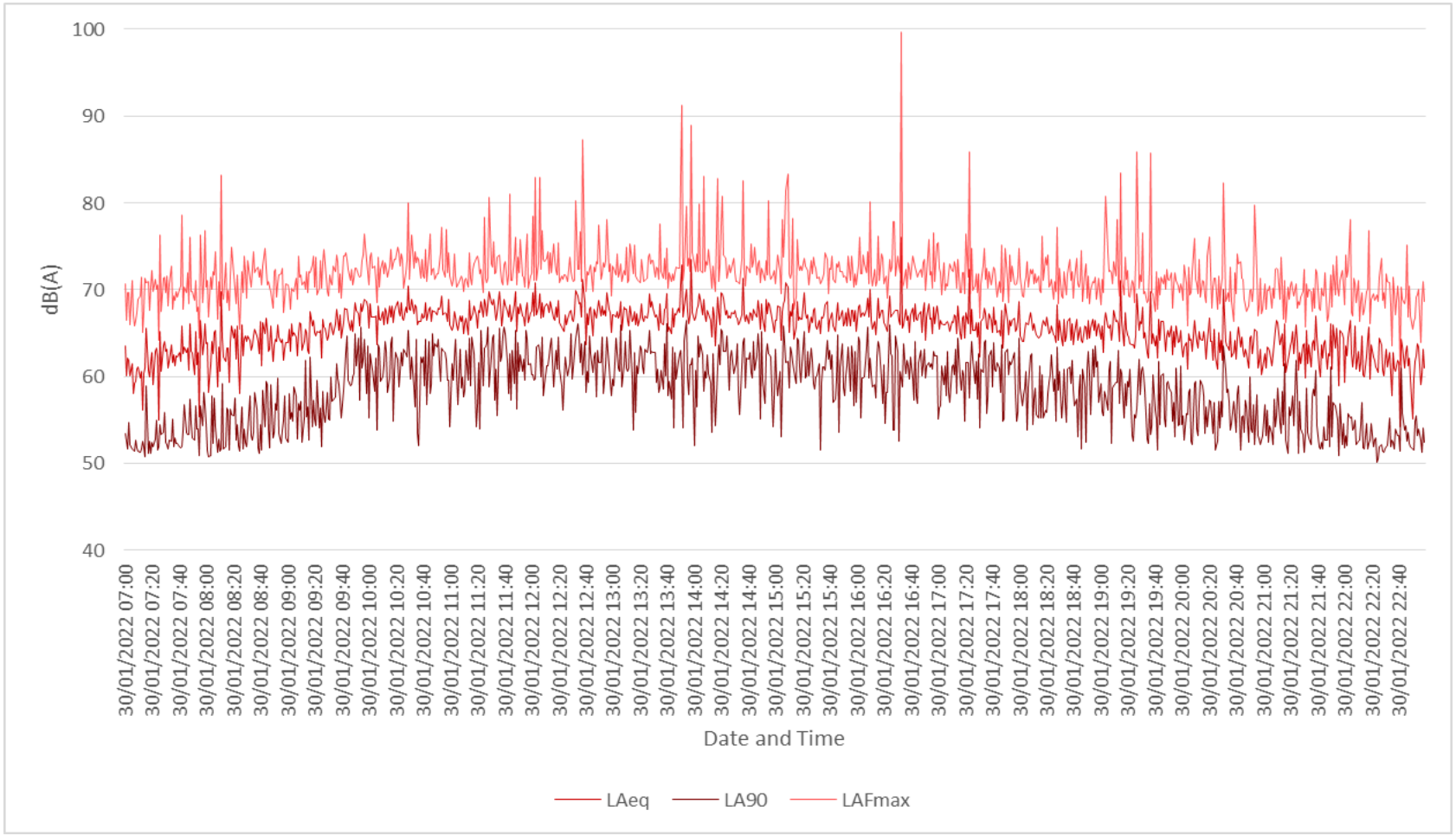


Graph 37: Graphical representation of the day monitoring period (incomplete) on the 26th January 2022 (St Crispins Road)

Graph 38: Graphical representation of the day monitoring period (16 hour) on the 28th January 2022 (St Crispins Road)



Graph 39: Graphical representation of the day monitoring period (16 hour) on the 30th January 2022 (St Crispins Road)



4.12 The daytime and night-time noise levels have been averaged for each fixed monitoring location as part of this assessment which provide the following levels;

Fixed Monitoring Location 1 (August 2016)

4.12.1	Daytime	16 hour L_{Aeq} =	67.2dB
4.12.2	Daytime	16 hour L_{A90} =	62.1dB
4.12.3	Night-time	8 hour L_{Aeq} =	60.3dB
4.12.4	Night-time	8 hour L_{A90} =	47.3dB

Fixed Monitoring Location 2 (August 2016)

4.12.5	Daytime	16 hour L_{Aeq} =	58.8dB
4.12.6	Daytime	16 hour L_{A90} =	54.5dB
4.12.7	Night-time	8 hour L_{Aeq} =	53.5dB
4.12.8	Night-time	8 hour L_{A90} =	44.5dB

4.13 Summarised in the sections below are the measurements undertaken in January 2022 at the 3 assessment locations as outlined in this report. Measurements undertaken during unfavourable weather conditions as defined in appropriate British Standard guidance have been removed from the data set. L_{Aeq} have been log averaged, whilst L_{A90} have been arithmetically averaged. The L_{Amax} data have been presented as the 90^{th} percentile for robustness of the assessment.

Fixed Monitoring Location 1: New Botolph Street (January 2022)

4.13.1	Daytime	16 hour L_{Aeq} =	68dB
4.13.2	Daytime	16 hour L_{A90} =	57dB
4.13.3	Night-time	8 hour L_{Aeq} =	61dB
4.13.4	Night-time	8 hour L_{A90} =	41dB
4.13.5	Night-time	8 hour L_{Amax} =	81dB

Fixed Monitoring Location 2: Edward Street (January 2022)

4.13.6	Daytime	16 hour L_{Aeq} =	63dB
4.13.7	Daytime	16 hour L_{A90} =	49dB
4.13.8	Night-time	8 hour L_{Aeq} =	55dB
4.13.9	Night-time	8 hour L_{A90} =	37dB
4.13.10	Night-time	8 hour L_{Amax} =	74dB

Fixed Monitoring Location 3: St Crispins Road (January 2022)

4.13.11	Daytime	16 hour L_{Aeq} =	65dB
4.13.12	Daytime	16 hour L_{A90} =	60dB
4.13.13	Night-time	8 hour L_{Aeq} =	56dB
4.13.14	Night-time	8 hour L_{A90} =	52dB
4.13.15	Night-time	8 hour L_{Amax} =	72dB

4.14 The results from the noise monitoring at fixed monitoring location 1(August 2016), demonstrate that there are increased noise levels along St Crispins Road which is an elevated dual carriageway located on the Southern boundary of the proposed development site.

4.15 Fixed monitoring location 2 (August 2016) was located in a more central area of the proposed development site away from St Crispins Road, which demonstrated that noise levels were up to 8dB lower in this location when compared against the levels recorded at fixed monitoring location 1.

4.16 Regarding the measurements undertaken during January 2022, commentary is provided as follows:

> Position 1: This was located along New Botolph Street. The measurement position was located along the pavement and fixed to appropriate road signage at around 3 metres elevation. It is noted this location produced the highest measured noise levels primarily from road traffic noise.
>
> Position 2: This was located along Edward Street. The measurement position was located along the pavement fixed to appropriate road signage at around 3 meters elevation. During the site visits, it was noted this road experienced lighter traffic flow than New Botolph Street.
>
> Position 3: This was located along St Crispins Road. The assessment location was set back from the main thoroughfare by around 9 metres, offering a degree of attenuation.

4.17 As such recommendations have been made with respect to noise control which will need to be considered as part of the scheme's design.

4.18 These are discussed in Section 5 of this report.

5. Design Criteria

Potential for Habitable Rooms

5.1 The noise monitoring has demonstrated that St Crispins Road is affecting the noise environment at the Southern boundary of the site. As such, units on this elevation will need some form of protection to avoid disturbance to future occupiers of the units.

5.2 With respect to other areas of the proposed development site, whilst protection will still be required, this will be lower as noise levels are currently lower away from St Crispins Road, and they will be afforded protection by the new buildings which will be on the St Crispins road elevation.

5.3 When reviewing environmental noise and residential properties, it is important to assess how external noise can enter dwellings and potentially cause a noise nuisance. The weakest element of any structure is the openings made within it, i.e. windows, doors or pipe-work (boiler flues, SVP's, etc.).

5.4 Approved Document L1A of the Building Regulations requires that air tightness testing is carried out to ensure that 'heat loss' is minimised thus reducing the carbon impact of a dwelling.

5.5 This has assisted greatly with potential noise intrusion as air gaps/penetrations are sealed so as to reduce air loss.

5.6 The thermal requirements of windows have also been increased so as to assist compliance with Approved Document L1A and consequently the acoustic performance of double glazed units has improved.

5.7 Table 5 identifies that to achieve the required internal noise levels as stated within BS8233, windows with an acoustic reduction value of 32dB.

5.8 Based upon L_{Amax} collected January 2022 it is recommended a glazing specification of 36dB Rw throughout the entire development is proposed. Should trickle ventilation be used, the vents will also need to achieve this level of attenuation in the open position.

Table 5: Required sound insulation performance

Period	Noise Level (dB)	Target Noise Levels L_{Aeq} (dB)	Standards Exceeded by (dB)
Night-time – 18th/19th Aug 16 Fixed position 2 $L_{Aeq,8hour}$	51.7 (52)	30	22
Night-time – 19th/20th Aug 16 Fixed position 2 $L_{Aeq,8hour}$	52.2	30	22
Night-time – 20th/21st Aug 16 Fixed position 2 $L_{Aeq,8hour}$	54.0	30	24
Night-time – 21st/22nd Aug 16 Fixed position 2 $L_{Aeq,8hour}$	55.2	30	25
Night-time – 22nd/23rd Aug 16 Fixed position 1 $L_{Aeq,8hour}$	60.1	30	30
Night-time – 23rd/24th Aug 16 Fixed position 1 $L_{Aeq,8hour}$	60.1	30	30
Night-time – 24th/25th Aug 16 Fixed position 1 $L_{Aeq,8hour}$	60.6 (61)	30	31
Daytime – 19th Aug 16 Fixed position 2 $L_{Aeq,16hour}$	58.2	35	23
Daytime – 20th Aug 16 Fixed position 2 $L_{Aeq,16hour}$	59.8 (60)	35	25
Daytime – 21st Aug 16 Fixed position 2 $L_{Aeq,16hour}$	58.1	35	23
Daytime – 23rd Aug 16 Fixed position 1 $L_{Aeq,16hour}$	67.2	35	32
Daytime – 24th Aug 16 Fixed position 1 $L_{Aeq,16hour}$	67.2	35	32
Spot Measurement SP1 25/08/2016 Daytime, $L_{Aeq,30min}$	59.5 (60)	35	25
Spot Measurement SP2 25/08/2016 Daytime, $L_{Aeq,30min}$	66.2	35	31
Spot Measurement SP3 25/08/2016 Daytime, $L_{Aeq,30min}$	58.9 (59)	35	24
Spot Measurement SP4 25/08/2016 Daytime, $L_{Aeq,30min}$	57.3	35	22
Spot Measurement SP5 25/08/2016 Daytime, $L_{Aeq,30min}$	65.6 (66)	35	31
Spot Measurement SP6 25/08/2016 Daytime, $L_{Aeq,30min}$	68.2	35	33
Spot Measurement SP7 25/08/2016 Daytime, $L_{Aeq,30min}$	64.0	35	29

5.9 A copy of the proposed site layout plan for the scheme is attached as Appendix E.

5.10 Weighted Sound Reduction is normally expressed as R_w which is the scale that allows for the response in the human ear and can be used to determine a suitable product to reduce noise such as voices.

5.11 The windows for the proposed dwellings will need to have an R_w value of 36dB.

5.12 An R_w value of 36dB can be achieved with a standard glazing configuration of 10mm/(6-16mm)/10mm as detailed in the Pilkington Octiphon windows brochure of which a copy is attached as Appendix D (or similar).

5.13 Table 6 below is taken from the Pilkington Octiphon brochure showing standard window sound insulation data.

Table 6 – Sound insulation data for standard products

Glass	Sound reduction index (dB)									
	Octaveband Centre Frequency (Hz)						$R_w(C;C_{tr})$	R_w	R_w+C	R_w+C_{tr}
	125	250	500	1000	2000	4000				
Single glazing										
4 mm Float Glass	17	20	26	32	33	26	29 (-2; -3)	29	27	26
6 mm Float Glass	18	23	30	35	27	32	31 (-2; -3)	31	29	28
8 mm Float Glass	20	24	29	34	29	37	32 (-2; -3)	32	30	29
10 mm Float Glass	23	26	32	31	32	39	33 (-2; -3)	33	31	30
12 mm Float Glass	27	29	31	32	38	47	34 (0; -2)	34	34	32
6 mm Laminated Glass	20	23	29	34	32	38	32 (-1; -3)	32	31	29
8 mm Laminated Glass	20	25	32	35	34	42	33 (-1; -3)	33	32	30
10 mm Laminated Glass	24	26	33	33	35	44	34 (-1; -3)	34	33	31
12 mm Laminated Glass	24	27	33	32	37	46	35 (-1; -3)	35	34	32
Insulating glass units										
4 mm / (6 - 16 mm) / 4 mm	21	17	25	35	37	31	29 (-1; -4)	29	28	25
6 mm / (6 - 16 mm) / 4 mm	21	20	26	38	37	39	32 (-2; -4)	32	30	28
6 mm / (6 - 16 mm) / 6 mm	20	18	28	38	34	38	31 (-1; -4)	31	30	27
8 mm / (6 - 16 mm) / 4 mm	22	21	28	38	40	47	33 (-1; -4)	33	32	29
8 mm / (6 - 16 mm) / 6 mm	20	21	33	40	36	48	35 (-2; -6)	35	33	29
10 mm / (6 - 16 mm) / 4 mm	24	21	32	37	42	43	35 (-2; -5)	35	33	30
10 mm / (6 - 16 mm) / 6 mm	24	24	32	37	37	44	35 (-1; -3)	35	34	32
6 mm / (6 - 16 mm) / 6 mm Laminated	20	19	30	39	37	46	33 (-2; -5)	33	31	28
6 mm / (6 - 16 mm) / 10 mm Laminated	24	25	33	39	40	49	37 (-1; -5)	37	36	32

Ventilation

5.14 Part F of the Building Regulations specifies required rates of background ventilation to domestic properties. These requirements must be achieved without compromising internal noise levels. When a window is opened for ventilation, it will only give 10-15dB reduction in noise.

5.15 As such some form of acoustic ventilation will be required to negate the need to open windows for fresh air.

5.16 Trickle ventilators or mechanical ventilation will need to be acoustically treated at the inlet point to afford a D_{new} attenuation level of 38dB in the open position.

Outdoor Amenity Areas

5.17 BS8233 includes design criteria for external noise.

5.18 The standard states that it is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$ with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments.

5.19 The proposed scheme does not include gardens or grassed areas at ground level, however there are upper level podium garden areas together with the provision private balconies to apartments.

5.20 Based upon the noise monitoring exercise, it can be seen that the upper noise limit of 55dB L_{Aeq} (16 hour) can achieved for central areas of the site, however the desirable limits are likely to be exceeded for those amenity spaces fronting the roadways.

5.21 Where outdoor amenity space backs on to noisier roads such as New Botolph Street, mitigation measures should be considered to attenuate daytime environmental noise levels.

5.22 Noise conditions will improve as the development progresses as there will be shielding from the new buildings on the St Crispins Road elevation.

6. Conclusions

6.1 Stansted Environmental Services Ltd (SES), has been appointed by Weston Homes Plc to undertake an environmental noise assessment at the proposed development at Anglia Square, Norwich, Norfolk NR3 1DZ.

6.2 The noise survey was undertaken to establish the prevailing noise conditions at the property in accordance with the National Planning Policy Framework and to determine how the proposed new dwellings will perform against current British Standards.

6.3 Two 24 hour fixed monitoring station ware set up on the West side of Sovereign House at 3rd floor level (August 2016).

6.4 Further measurements were undertaken in January 2022 at the 3 locations specified in this report. Measurement data affected by unfavourable weather conditions have removed from the survey dataset.

6.5 Consideration has been given to control L_{Amax} noise events during the night period.

6.6 Seven further spot measurements were also taken on the 25th August 2016 to confirm the noise environment.

6.7 The dominant noise source was found to be road traffic movements on St Crispins Road and surrounding commercial and retail spaces.

6.8 The spot measurements confirmed that noise levels reduced significantly further into the site away from St Crispins Road.

6.9 Based on the findings of the study, standard double glazing will address any potential noise concerns and achieve the internal standard as contained within BS8233.

6.10 To meet the required rates of background ventilation, the inclusion of trickle vents will need to be fitted to the habitable rooms to allow for suitable air changes in the dwellings in the open position.

6.11 The above vents will also need to have acoustic properties that afford a 38dB D_{new} reduction in noise.

6.12 With the implementation of the controls stated above, the required internal noise levels can be achieved as referred to in BS8233 and noise should not be a concern for the redevelopment of the site.

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7 Appendices

Appendix A – Glossary of Acoustics Terminology

Appendix B – Raw Noise Data and Noise Calculations can be provided upon request

Appendix C – Limitations to this Report

Appendix D – Pilkington Glazing Datasheets

Appendix E – Site Plans

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Appendix A – Glossary of Acoustics Terminology

Noise

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20Hz to 20,000Hz and over the audible range of 0dB (the threshold of perception) to 140dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features, such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the "A"-Weighting Scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc, according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a channel guide a 10dB(A) increase can be taken to represent a doubling of loudness, whilst an increase of 3dB(A) in generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the table.

Typical Sound Levels found in the Environment

Sound Level	Location
0dB(A)	Threshold Hearing
20-30dB(A)	Quiet Bedroom at night
30-40dB(A)	Living Room during the day
40-50dB(A)	Typical Office
50-60dB(A)	Inside a Car
60-70dB(A)	Typical High Street
70-90dB(A)	Inside a Factory
90-100dB(A)	Burglar Alarm at 1m away
100-110dB(A)	Jet Aircraft on Takeoff
140dB(A)	Threshold of Pain

Terminology

dB(Decibel)	The scale on which sound pressure level is expressed. It is defined as 20 x the logarithm of the ratio between the ratio route mean square pressure of the sound field and a reference pressure ($2x10^{-5}$Pa)
dB(A)	A-Weighted Decibel. This is measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. A-Weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
$L_{Aeq,T}$	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.
L_{Amax}	L_{Amax} is the maximum A-weighted sound pressure level recorded over the period stated. L_{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur which may have little effect on the overall L_{eq} noise level but will still effect the noise environment. Unless described otherwise, it is measured using the fast sound level meter response.
L_{Cpeak}	The absolute highest sound pressure of the noise signal of either the positive or negative part of the sound with a 'C' weighting. 'C' weighting is the frequency response often used to measure very high noise levels.
L_{10} and L_{90}	If a non-steady noise is to be described it is necessary to know both its level and degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the average maximum level. Similar L_{90} is the average minimum level and is often used to describe the background noise. It is common practice to use the L_{10} index to describe traffic noise.
Free Field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the route mean square section of a sound level meter with a 125milisecond time constraint.
Slow	A time weighting used in the route mean square section of a sound level meter with a 1000milisecond time constant.

Appendix B – RAW NOISE DATA and Noise Calculations can be provided upon request

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Appendix C – Limitations to this Report

Notes on limitations

This report has been prepared for the titled project or named part thereof and should not be used in whole or part and relied upon for any other project without the written authorisation of Stansted Environmental Services Ltd. Stansted Environmental Services Ltd, accept no responsibility or liability for the consequences of this document if it is used for a purpose other than that for which it was commissioned. Persons wishing to use or rely upon this report for other purposes must seek written authority to do so from the owner of this report and oblique all Stansted Environmental Services Ltd, and agree to indemnify Stansted Environment Services Ltd for any and all loss or damage resulting there from. Stansted Environment Services Ltd accepts no responsibility or liability for this document to any other party other than the person by whom it was commissioned.

The findings and opinions are relevant to the dates of the site works and should not be relied upon to represent conditions at substantially later dates. Opinions included therein are based on information gathered during the study and from our experience. If additional information becomes available which may affect our comments, conclusions or recommendations, Stansted Environment Services Ltd, reserve the right to review the information, reassess any new potential concerns and modify our opinions accordingly.

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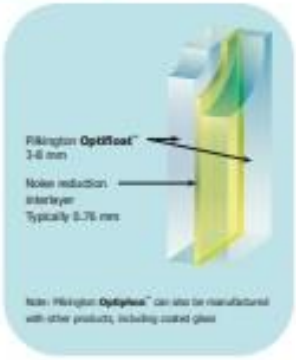
Appendix D – Pilkington Glazing Datasheet

Pilkington **Optiphon**™
Laminated glass for superior noise insulation

Pilkington **Optiphon**™ is the ideal choice of glass in situations where there is excess noise from road, rail or air traffic, or various other sources, such as factories, nightclubs or neighbours.

Pilkington **Optiphon**™ is a high quality acoustic laminated glass incorporating a special PVB (PolyVinyl Butyral) interlayer. It offers excellent noise reduction without compromising on light transmittance or impact performance.

The desired acoustic performance can be achieved through combining various thicknesses of glass with a PVB interlayer. With a large variety of product combinations, Pilkington **Optiphon**™ offers the opportunity to achieve specific noise reduction requirements.



Note: Pilkington **Optiphon**™ can also be manufactured with other products, including coated glass

Benefits

- Special PVB interlayer for enhanced sound insulation performance
- A thinner and lighter glass for the equivalent acoustic performance
- Available in jumbo and LES sizes
- All products achieve safety class 1(B)1 (EN 12600) and are available to meet security classes in accordance with EN 356
- A high acoustic performance can be achieved when used in Insulating Glass Units (IGUs)
- Can also be used to improve noise insulation in a triple glazing construction

As well as reducing intrusive noise, Pilkington **Optiphon**™ can be combined with other Pilkington products for a multi-functional glazing solution with additional benefits, such as:

- Thermal insulation with Pilkington **K Glass**™ / Pilkington **Optitherm**™ (coating in position 3 in IGU)
- Solar control with Pilkington **Suncool**™ (coating in position 2 in IGU)
- Self-cleaning with Pilkington **Activ**™ (coating in position 1 in IGU)

Technical Definitions

Sound Reduction Index

R_w is the weighted sound reduction, in decibels, which incorporates a correction for the ear's response.

C and C_{tr} are the spectrum adjustments, which are the values added to R_w to take account of the characteristics of particular sound spectra. Typical noise sources for each spectrum adaptation terms are given below.

Relevant spectrum adaptation term C

Type of noise source:

- Living activities (talking, music, radio, TV)
- Children playing
- Railway traffic at medium and high speed
- Jet aircraft, short distance away
- Motorway traffic >50 mph
- Factories emitting mainly medium and high frequency noise.

Relevant spectrum adaptation term C_{tr}

Type of noise source:

- Urban road traffic
- Railway traffic at low speeds
- Aircraft, propeller driven
- Jet aircraft, long distance away
- Music with low frequency bass sounds
- Factory emitting mainly low and medium frequency noise.

Sound insulation data for Pilkington **Optiphon™**

Glass	Sound reduction index (dB)									
	Octaveband Centre Frequency (Hz)						R_w (C; C_{tr})	R_w	R_w+C	R_w+C_{tr}
	125	250	500	1000	2000	4000				
Single glazing										
6.8 mm Pilkington **Optiphon™**	22	26	31	37	40	40	36 (-1; -4)	36	35	32
8.8 mm Pilkington **Optiphon™**	27	29	34	38	40	43	37 (0; -2)	37	37	35
10.8 mm Pilkington **Optiphon™**	26	30	35	39	40	46	38 (-1; -3)	38	37	35
12.8 mm Pilkington **Optiphon™**	29	32	36	41	42	51	40 (-1; -3)	40	39	37
16.8 mm Pilkington **Optiphon™**	31	33	38	41	43	54	41 (-1; -3)	41	40	38
Insulating glass units										
6 mm / 16 mm argon / 6.8 mm Pilkington **Optiphon™**	21	28	37	48	48	54	40 (-2; -6)	40	38	34
6 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	25	27	38	48	47	55	41 (-2; -6)	41	39	35
8 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	21	30	39	47	50	55	42 (-3; -8)	42	39	34
10 mm / 16 mm argon / 6.8 mm Pilkington **Optiphon™**	28	31	42	45	50	58	44 (-2; -6)	44	42	38
10 mm / 20 mm argon / 8.8 mm Pilkington **Optiphon™**	28	36	43	47	49	58	46 (-2; -6)	46	44	40
8.8 mm Pilkington **Optiphon™** / 16 mm argon / 12.8 mm Pilkington **Optiphon™**	28	36	45	53	56	64	48 (-2; -7)	48	46	41
10.8 mm Pilkington **Optiphon™** / 24 mm argon / 16.8 mm Pilkington **Optiphon™**	35	41	48	53	55	65	52 (-2; -6)	52	50	46
12.8 mm Pilkington **Optiphon™** / 20 mm argon / 16.8 mm Pilkington **Optiphon™**	35	45	49	50	54	65	51 (-1; -4)	51	50	47

Measurements undertaken in accordance with BS EN ISO 10140 and the (C; C_{tr}) determined in accordance with BS EN ISO 717-1.
For insulating glass units, there is little difference in the sound insulation for cavity widths in the range 6 to 16 mm.
To calculate performance data for Pilkington products, please use our Spectrum online calculator at https://spectrum.pilkington.com/
For glass combinations to achieve an R_w value higher than 52 dB, please contact us for more details.

Sound insulation data for standard products

Glass	Sound reduction index (dB)									
	Octaveband Centre Frequency (Hz)						R_w (C; C_{tr})	R_w	R_w+C	R_w+C_{tr}
	125	250	500	1000	2000	4000				
Single glazing										
4 mm Float Glass	17	20	26	32	33	26	29 (-2; -3)	29	27	26
6 mm Float Glass	18	23	30	35	27	32	31 (-2; -3)	31	29	28
8 mm Float Glass	20	24	29	34	29	37	32 (-2; -3)	33	30	29
10 mm Float Glass	23	26	32	31	32	39	33 (-2; -3)	33	31	30
12 mm Float Glass	27	29	31	32	38	47	33 (0; -2)	34	34	32
6 mm Laminated Glass	20	23	29	34	32	38	32 (-1; -3)	32	31	29
8 mm Laminated Glass	20	25	32	35	34	42	33 (-1; -3)	33	32	30
10 mm Laminated Glass	24	26	33	33	35	44	34 (-1; -3)	34	33	31
12 mm Laminated Glass	24	27	33	32	37	46	35 (-1; -3)	35	34	32
16 mm Laminated Glass	26	31	30	35	43	51	36 (-1; -3)	36	35	33
Insulating glass units										
4 mm / (6 - 16 mm) / 4 mm	21	17	25	35	37	31	29 (-1; -4)	29	28	25
6 mm / (6 - 16 mm) / 4 mm	21	20	26	38	37	39	32 (-2; -4)	32	30	28
6 mm / (6 - 16 mm) / 6 mm	20	18	28	38	34	38	31 (-1; -4)	31	30	27
8 mm / (6 - 16 mm) / 4 mm	22	21	28	38	40	47	33 (-1; -4)	33	32	29
8 mm / (6 - 16 mm) / 6 mm	20	21	33	40	36	48	35 (-2; -6)	35	33	29
10 mm / (6 - 16 mm) / 4 mm	24	21	32	37	42	43	35 (-2; -5)	35	33	30
10 mm / (6 - 16 mm) / 6 mm	24	24	32	37	37	44	35 (-1; -3)	35	34	32
6 mm / (6 - 16 mm) / 6 mm Laminated	20	19	30	39	37	46	33 (-2; -5)	33	31	28
6 mm / (6 - 16 mm) / 10 mm Laminated	24	25	33	39	40	49	37 (-1; -5)	37	36	32

The above are generally accepted values for generic products taken from EN 12758. They are conservative values that can be used in the absence of measured data.
Data for laminated glass is based on pvb interlayers (excluding acoustic pvb interlayers). Glass thickness for laminated glass excludes interlayer thickness.
Data can be adopted for air or argon gas-filled cavities

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Appendix E – Site Plan