ENVIRONMENTAL NOISE ASSESSMENT
FOR
ANGLIA SQUARE, NORWICH

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

Site Address:
Anglia Square
Norwich
Norfolk, NR13 1DZ

Version Number:
Version 2

Report Date:
9th March 2018

Customer:
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Document Control

24 Hour L_{Aeq} – Noise Monitoring Station

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
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 2
Date	9th March 2018
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Signature	
Project Number	ENV01
File Reference	ENV01-ANGL-049

Measurements taken by:	**Date**	**Time/Period**
George Booth **Signature:** 	18th – 22nd August 2016	Continuous monitoring capture 4 x 8-hour period at night and 3 x 16-hour period by day
	22nd – 25th August 2016	Continuous monitoring to capture 3 x 8-hour period at night and 2 x 16-hour period by day
	25th August 2016	7 x 30 minute spot measurements

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Appendix A – Glossary of Acoustics Terminology

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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

John Carpenter is the Managing Director for Stansted Environmental Services Limited and has experience in both the public and the private sector at Senior Management and Director level, overseeing a number of large projects, to ensure that the end product is suitable for its intended use.

John is a Chartered Environmental Health Practitioner, with the Chartered Institute of Environmental Health (CIEH), 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). John is also an incorporated member of the Association for Project Safety (IMAPS).

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).

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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.

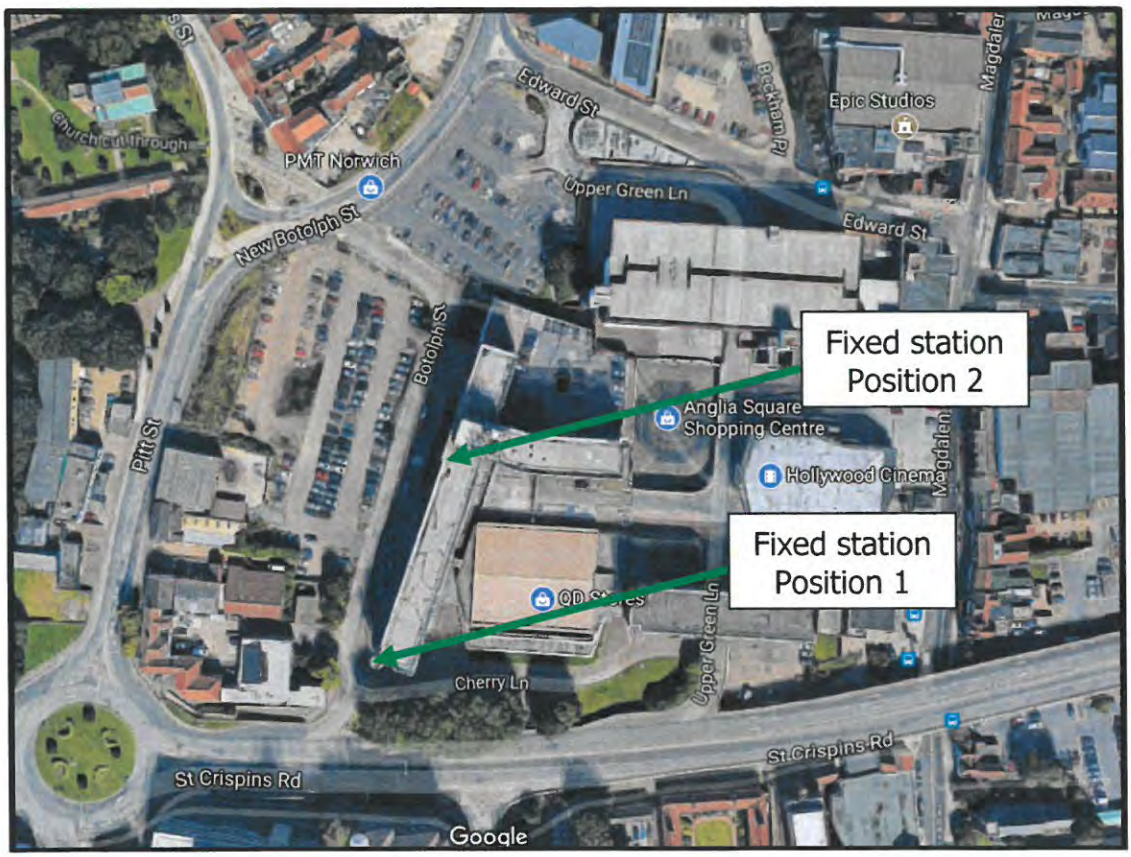
1.3 Furthermore the assessment was completed to provide evidence as part of a Hybrid Planning Application for a proposed development comprising up to 1250 dwellings with associated car parking, a hotel, a multi-storey car park, a cinema and varied commercial and retail spaces.

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.

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).

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

Figure 1: Fixed Monitoring Locations



1.7 Seven 'spot' measurements were also undertaken (5x30min) as shown in Photographs 1 - 7.

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.

● 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

1.8 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.

1.9 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.

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

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

1.12 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

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

1.14 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.

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

1.16 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 3.

Figure 3 – 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), 2012

The National Planning Policy Framework was published in March 2012. In respect of noise, the document states, in section 11, paragraph 109 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 11, paragraph 123 that:

"Planning policies and decisions should aim to:

- *Avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development*
- *Mitigate and reduce to a minimum other adverse impacts on health and quality of life arising from noise from new development, including through the use of conditions*
- *Recognise that development will often create some noise and existing businesses wanting to develop in continuance of their business should not have unreasonable restrictions put on them because of changes in nearby land uses since they were established;*
- *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.

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

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

3.13 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)

3.14 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 leavel (LOAEL) for night noise.
40 to 55dB	Adverse health effects are observed among the exposed population. Many people have to adapt to the 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.

3.15 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

3.16 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.

4. Noise Survey

4.1 The Environmental Noise Assessment to assess noise conditions Anglia Square, Norwich, Norfolk NR13 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 At the time of set-up at Location 2, weather conditions were clear with some clouds and an average temperature of 22°C.

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

4.5 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.

4.6 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.

4.7 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

4.8 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.

4.9 The sound level meter was set up at a height of 9.0m and was secured to a window to prevent tampering, on both occasions.

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

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

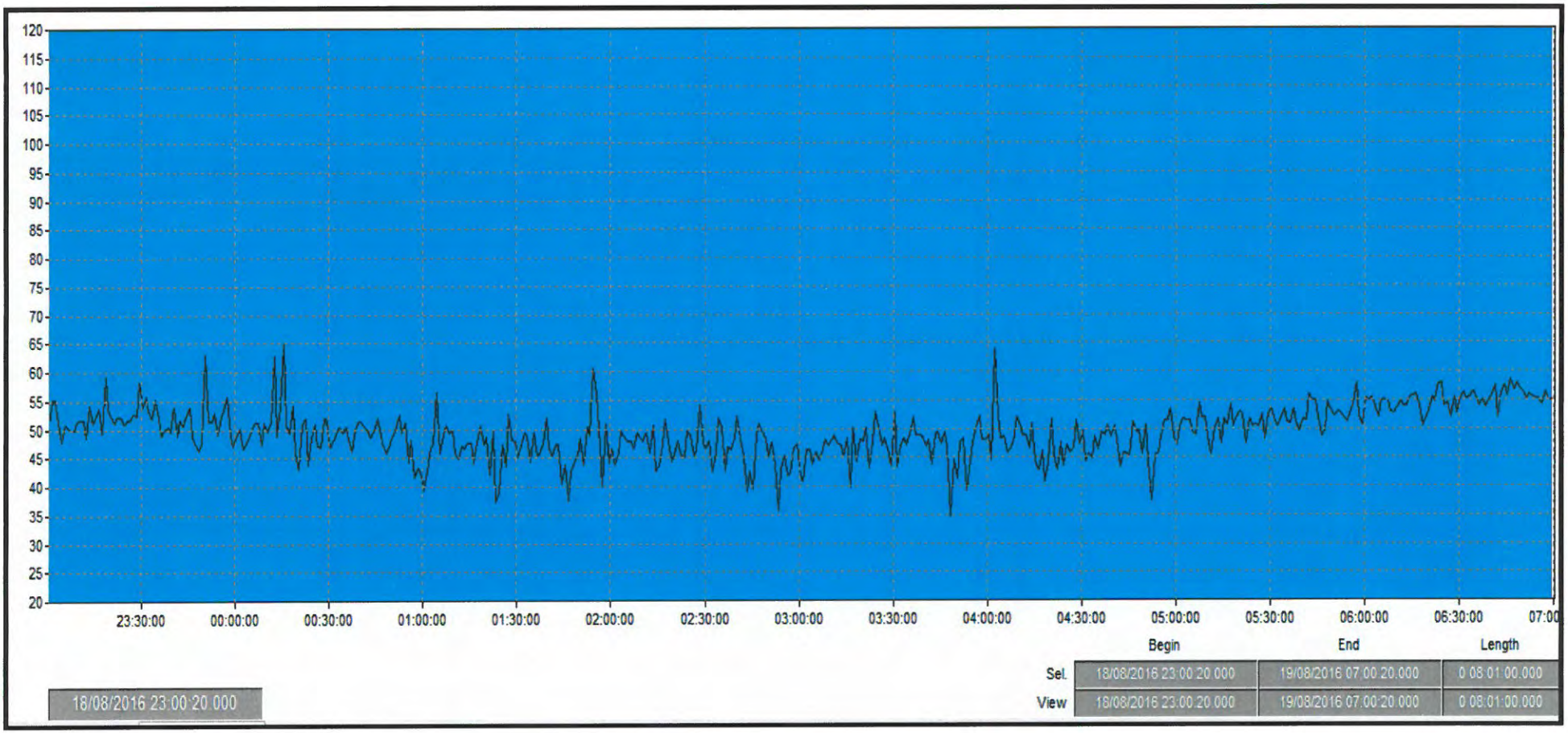
4.12 Table 4 presents a summary of the measured noise levels.

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

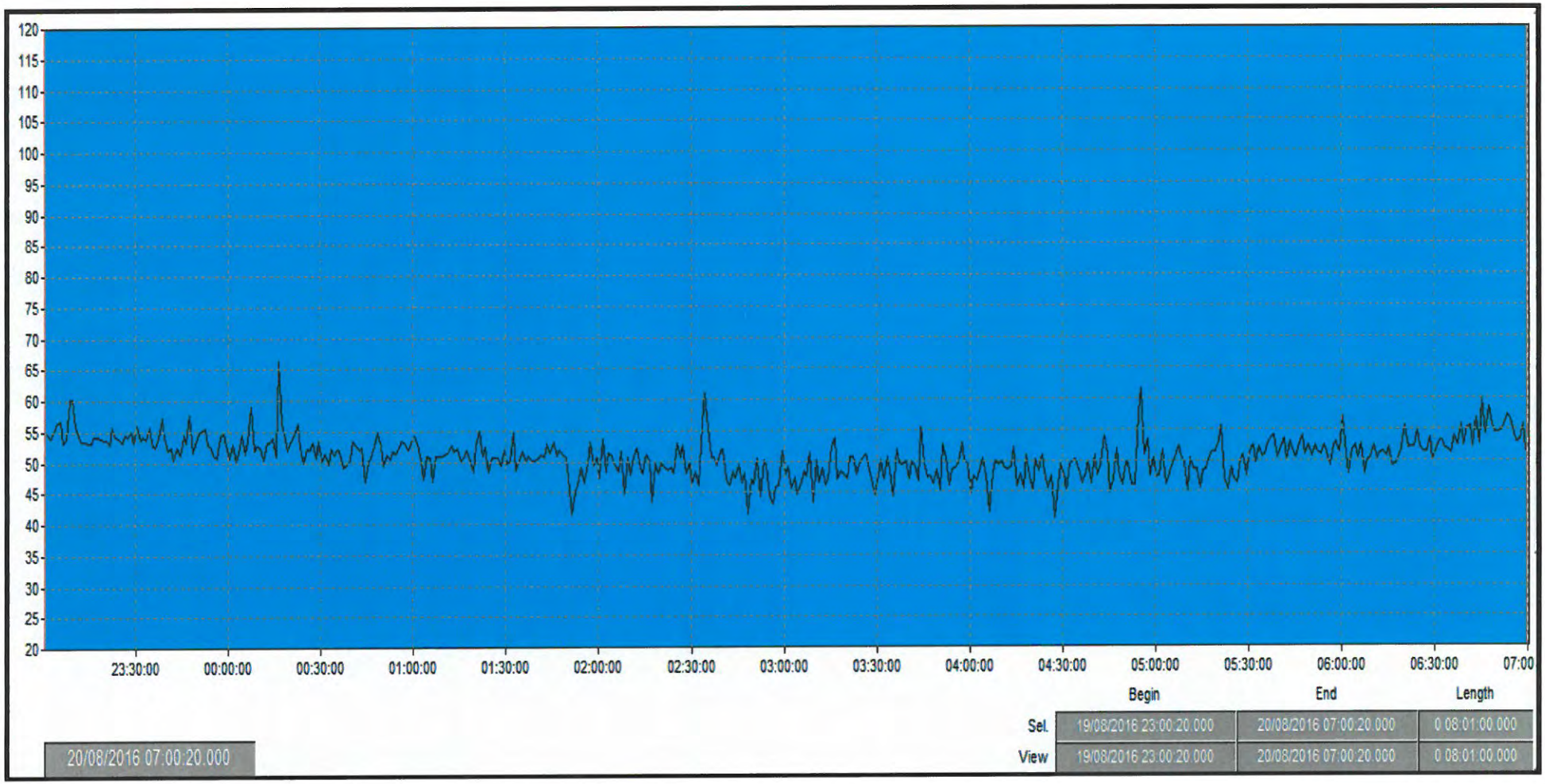
Time period - 24 hour fixed monitoring station	L_{Aeq}	L_{90}
23:00 – 07:00 (8 hour) 18th/19th August 2016	51.7	40.5
23:00 – 07:00 (8 hour) 19th/20th August 2016	52.2	44.4
23:00 – 07:00 (8 hour) 20th/21st August 2016	54.0	47.9
23:00 – 07:00 (8 hour) 21st/22nd August 2016	55.2	40.9
23:00 – 07:00 (8 hour) 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_{90}**
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

Graphs 1-12 on the following pages show the results of the fixed monitoring exercise.

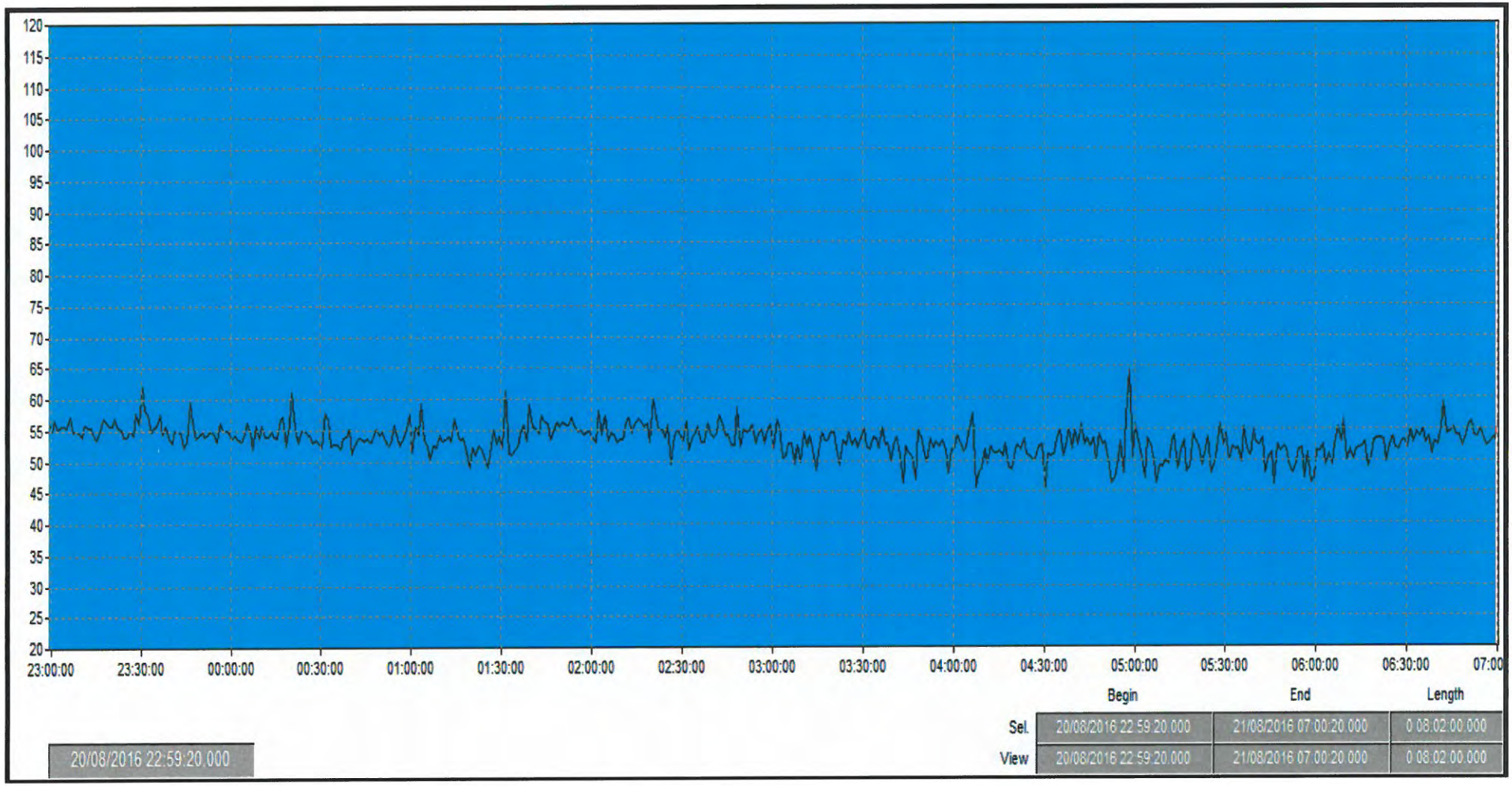
Graph 1: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 18th/19th August 2016



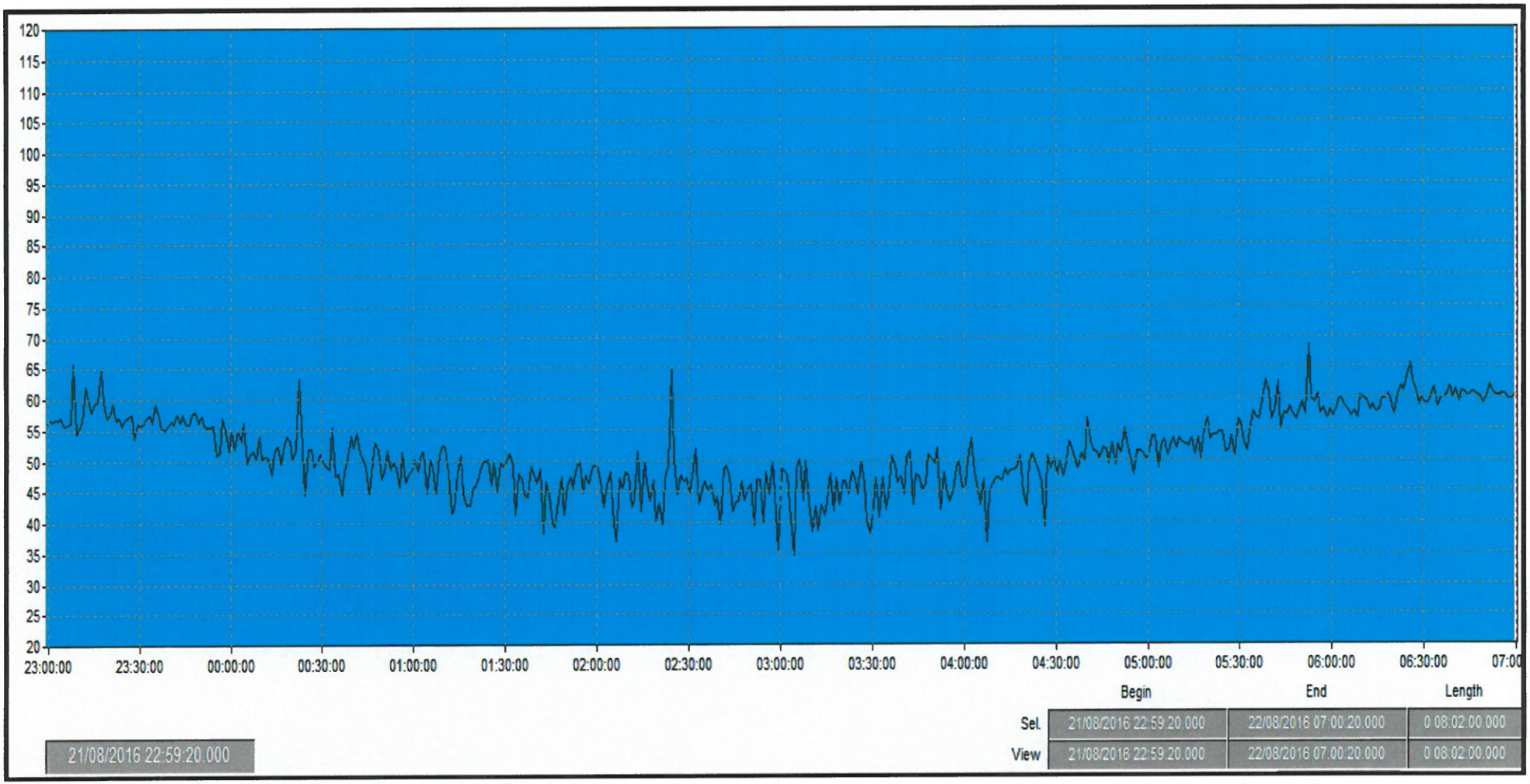
Graph 2: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 19th/20th August 2016



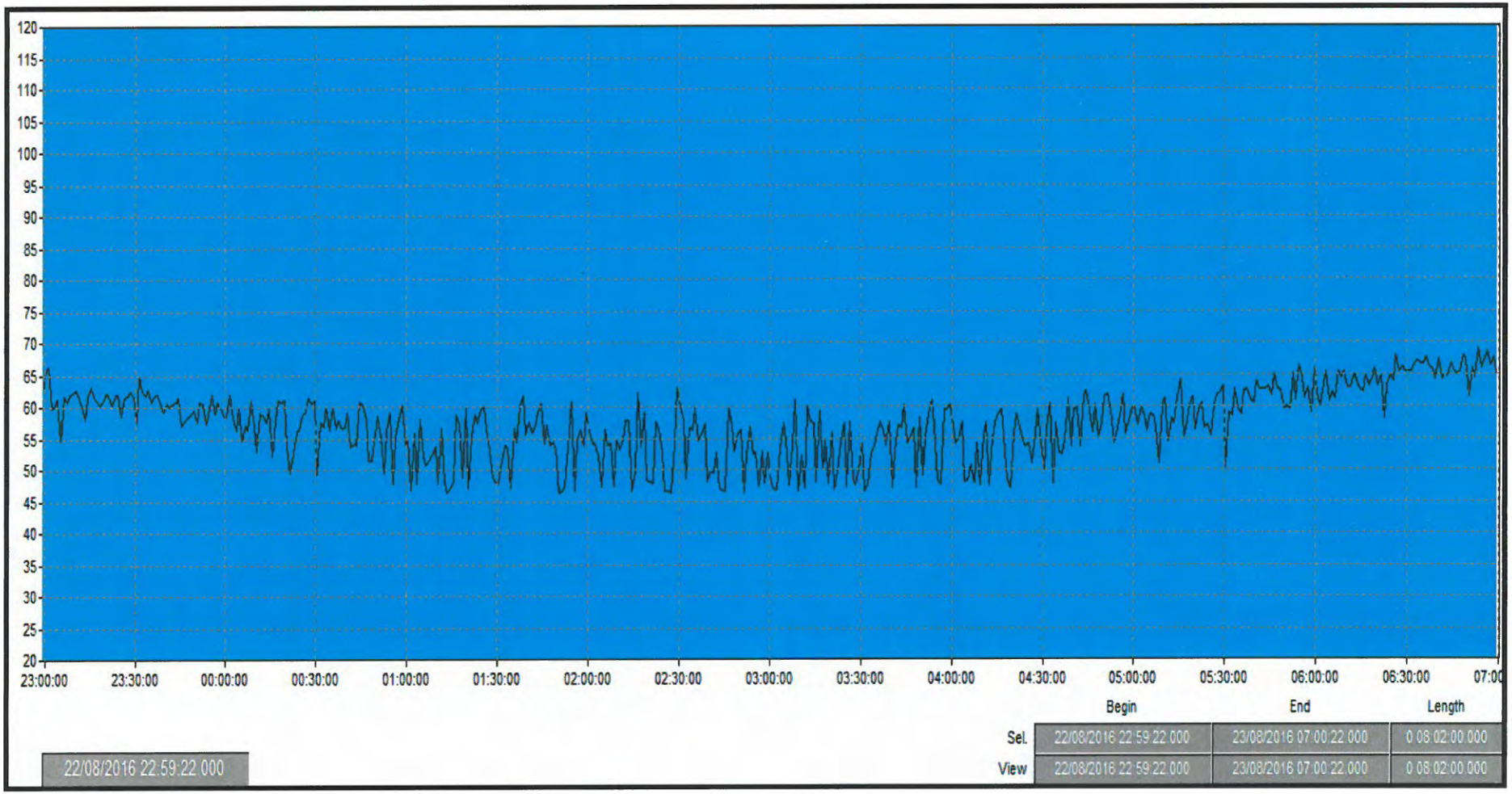
Graph 3: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 20th/21st August 2016



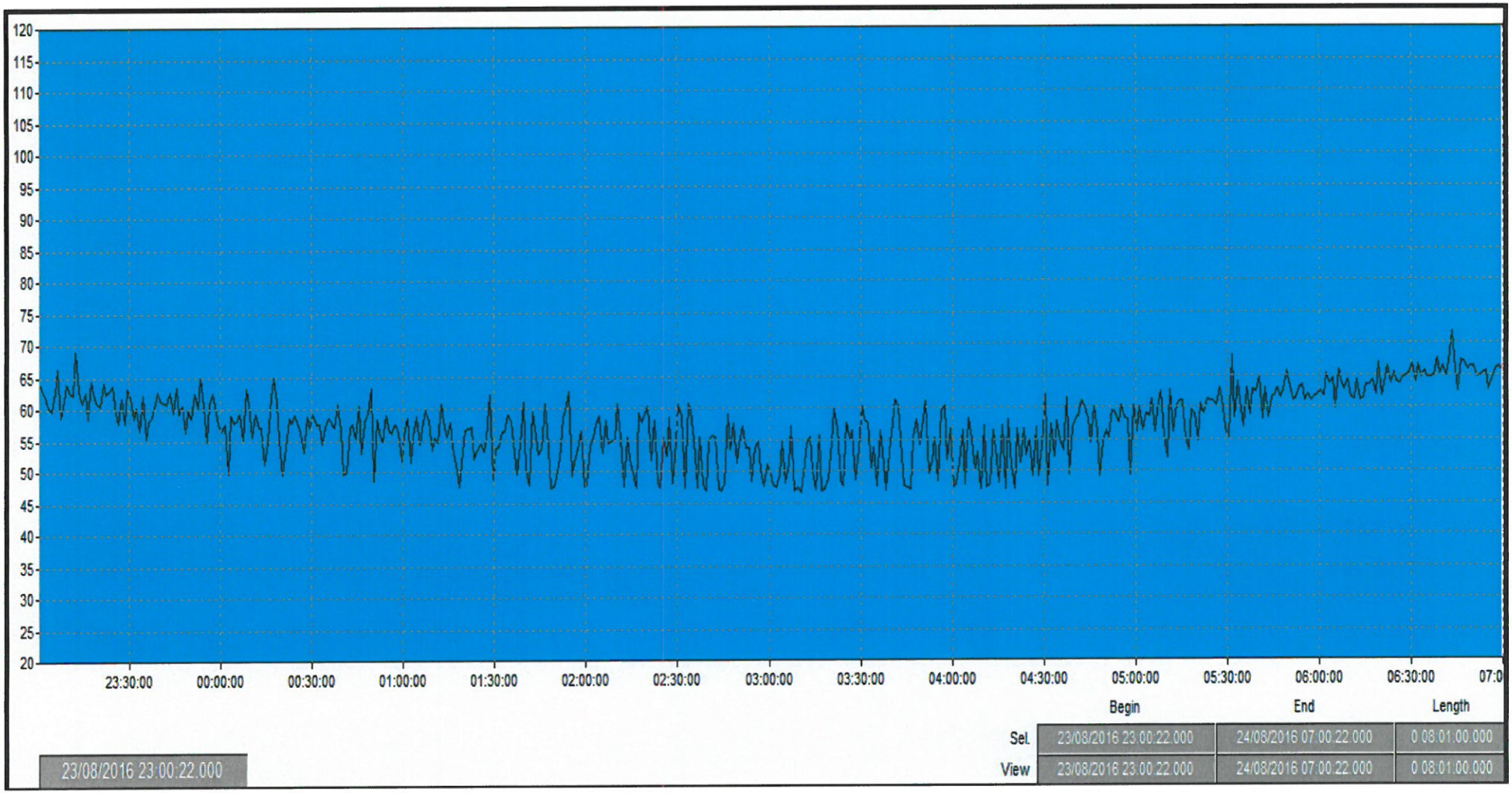
Graph 4: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 21st/22nd August 2016



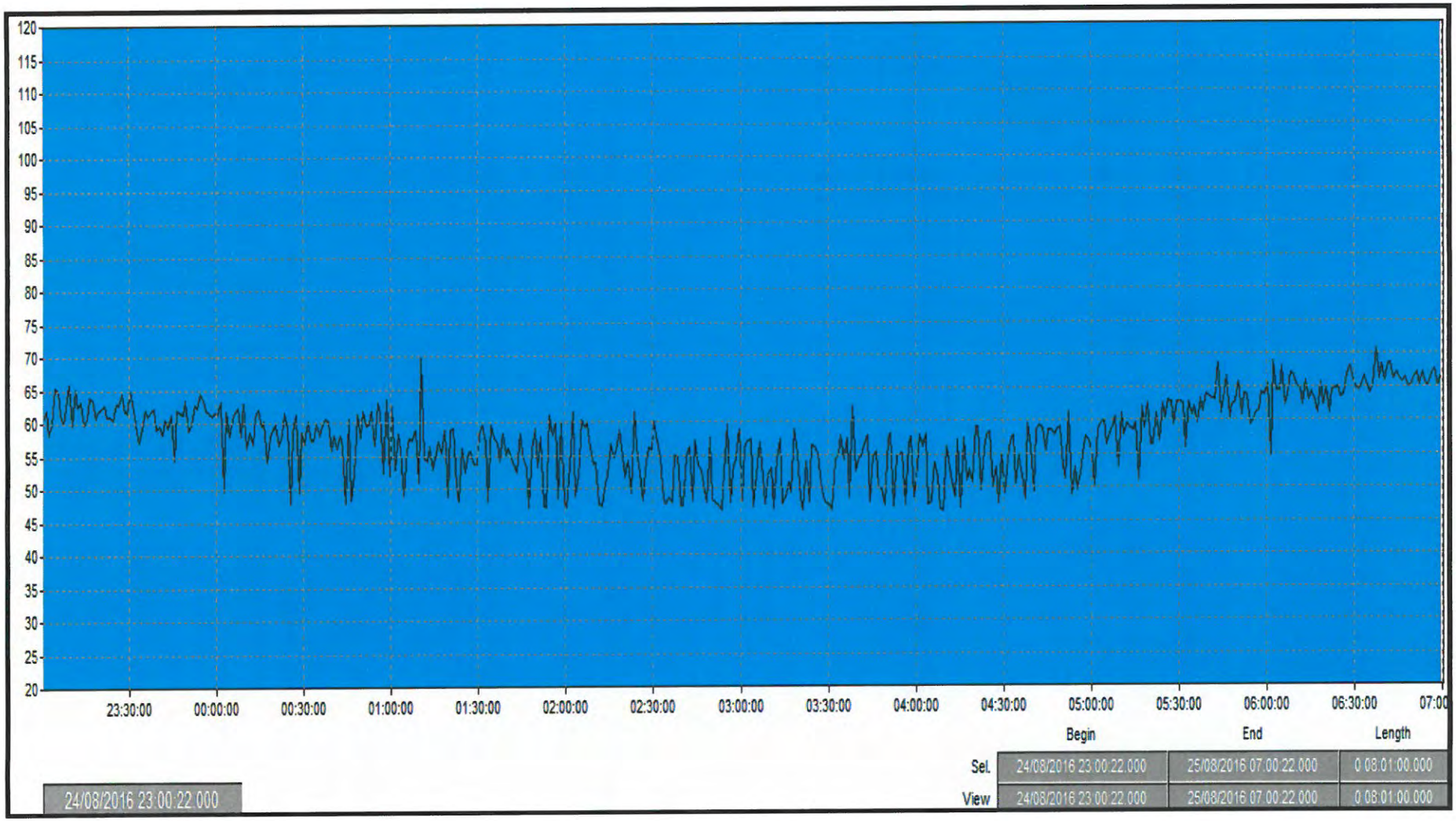
Graph 5: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 22nd/23rd August 2016



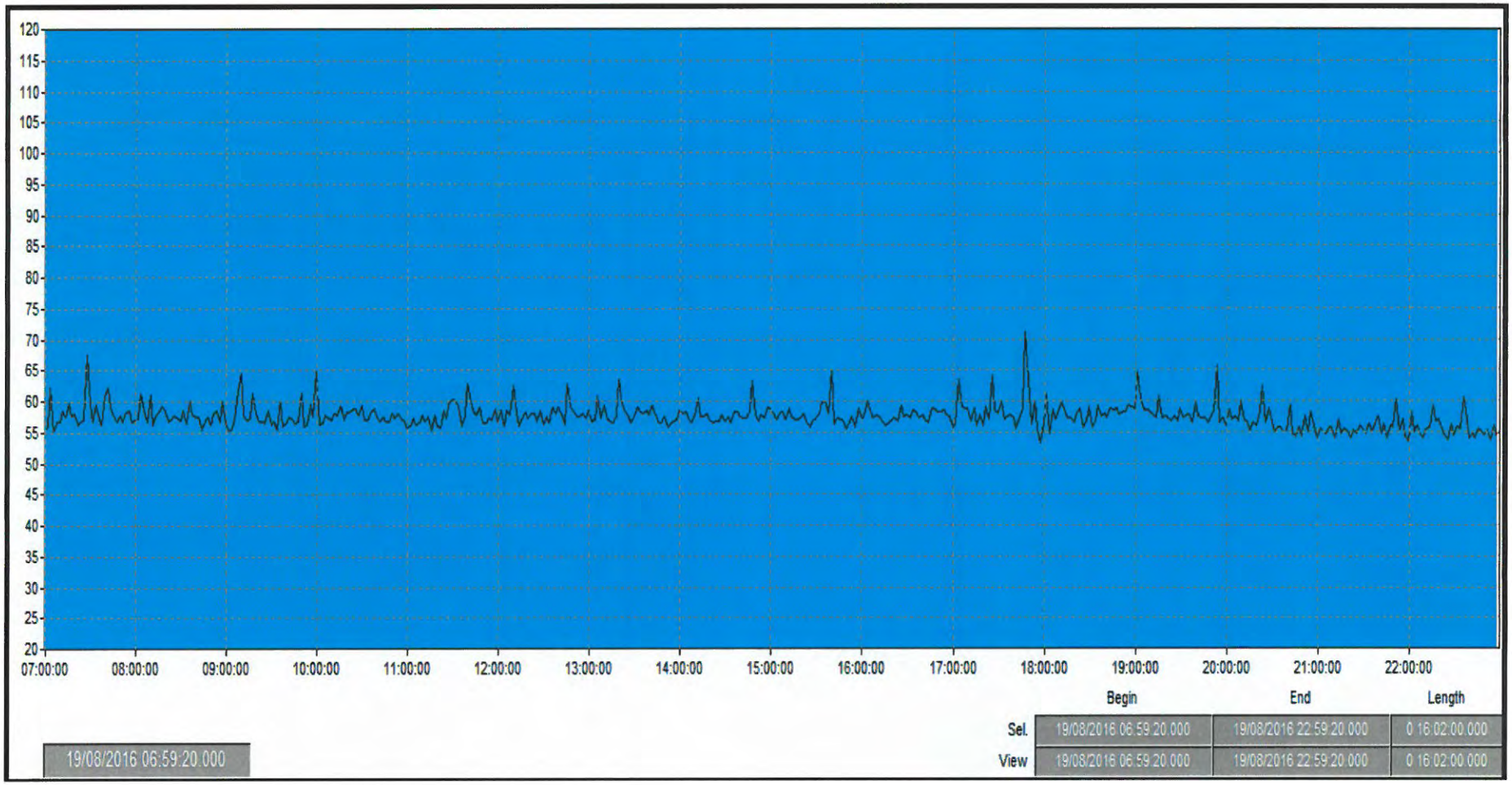
Graph 6: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 23rd/24th August 2016



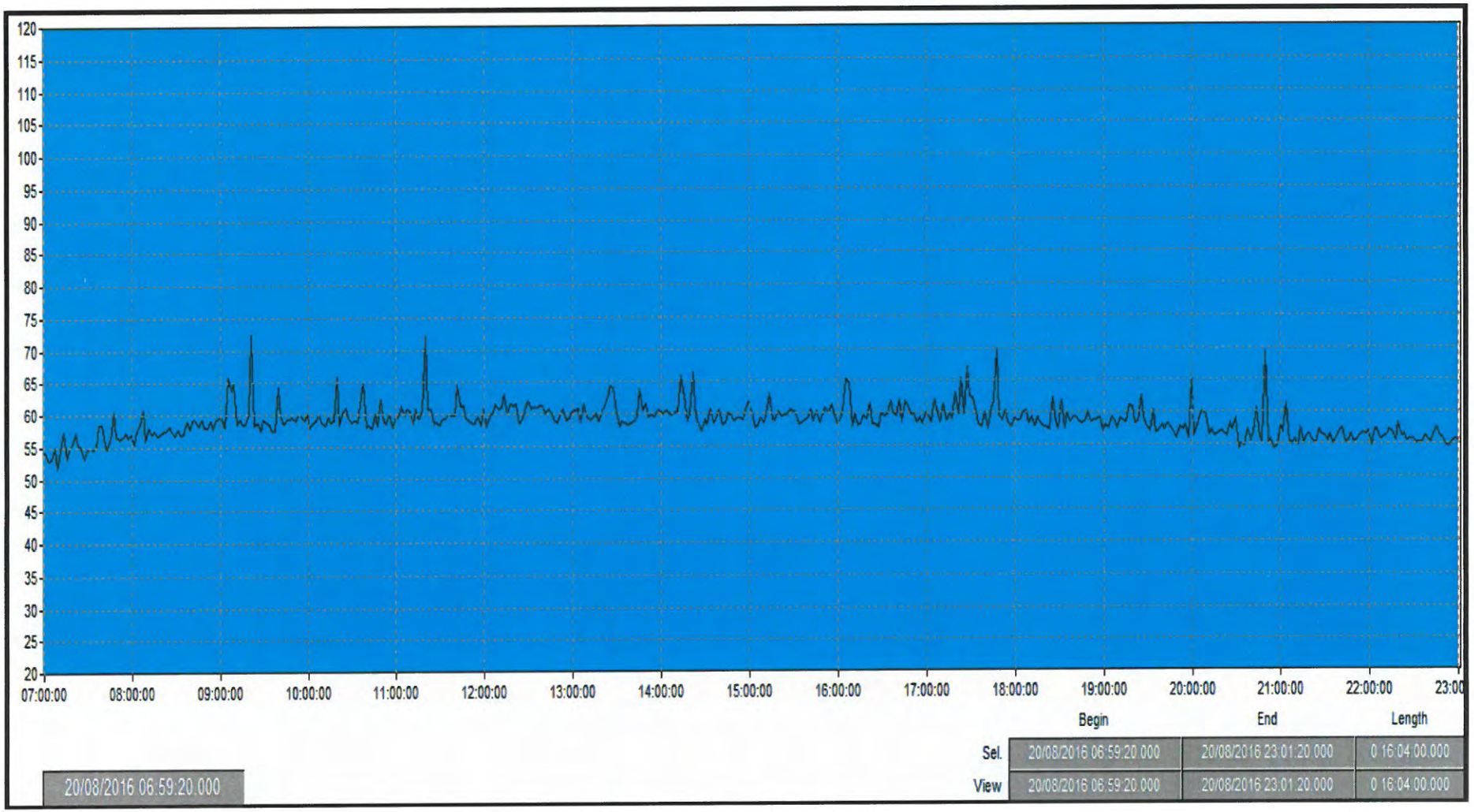
Graph 7: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 24th/25th August 2016



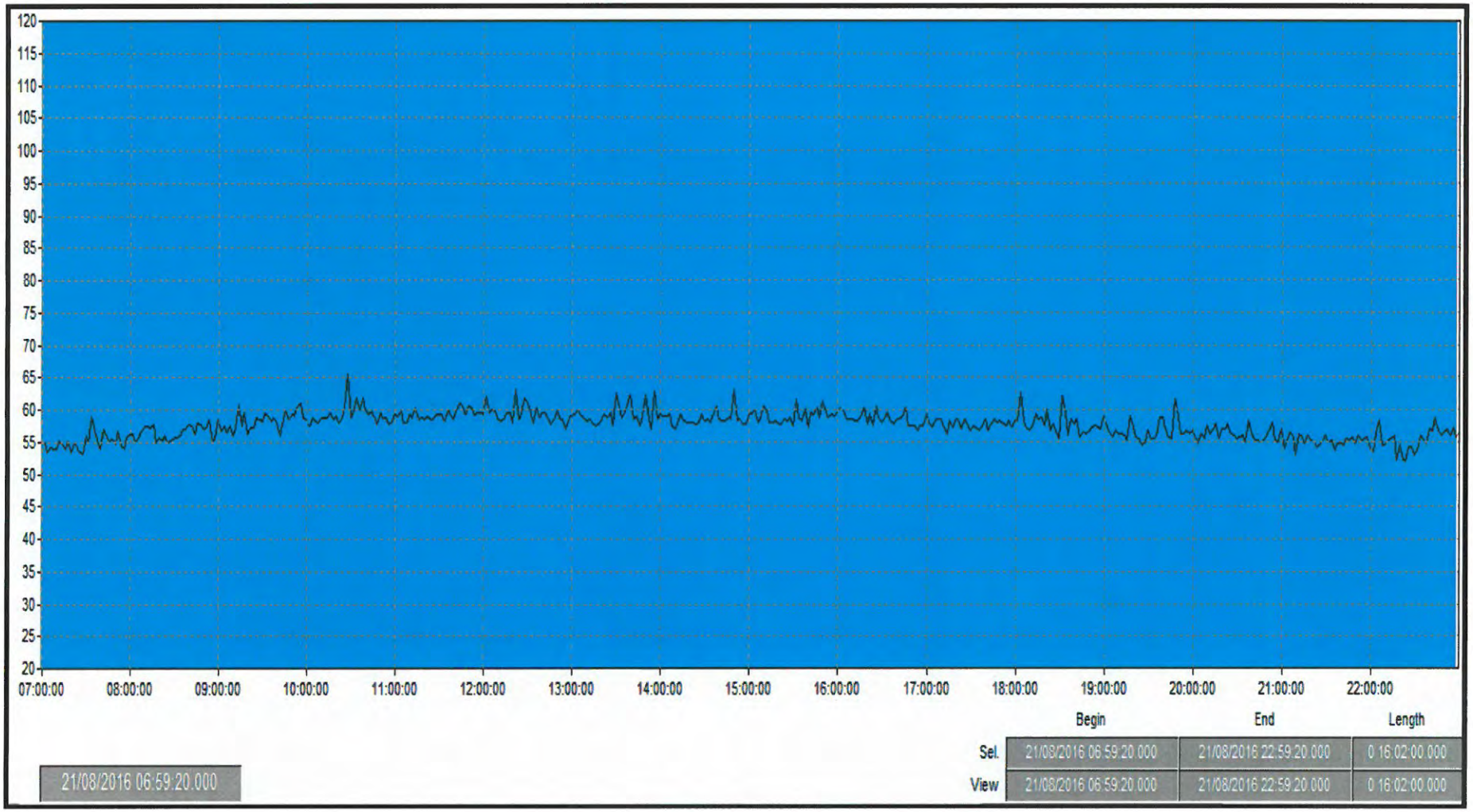
Graph 8: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 19th August 2016



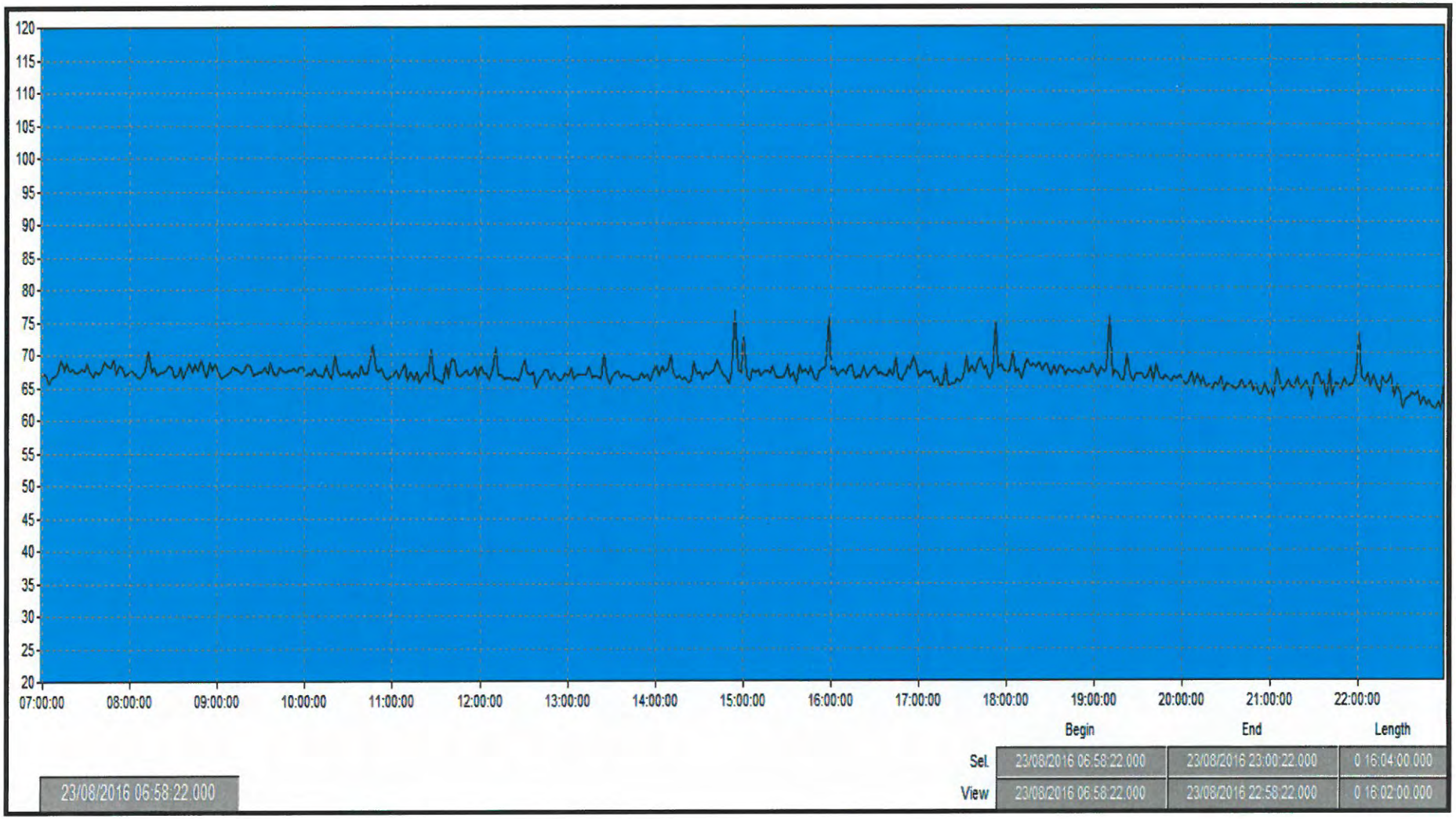
Graph 9: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 20th August 2016



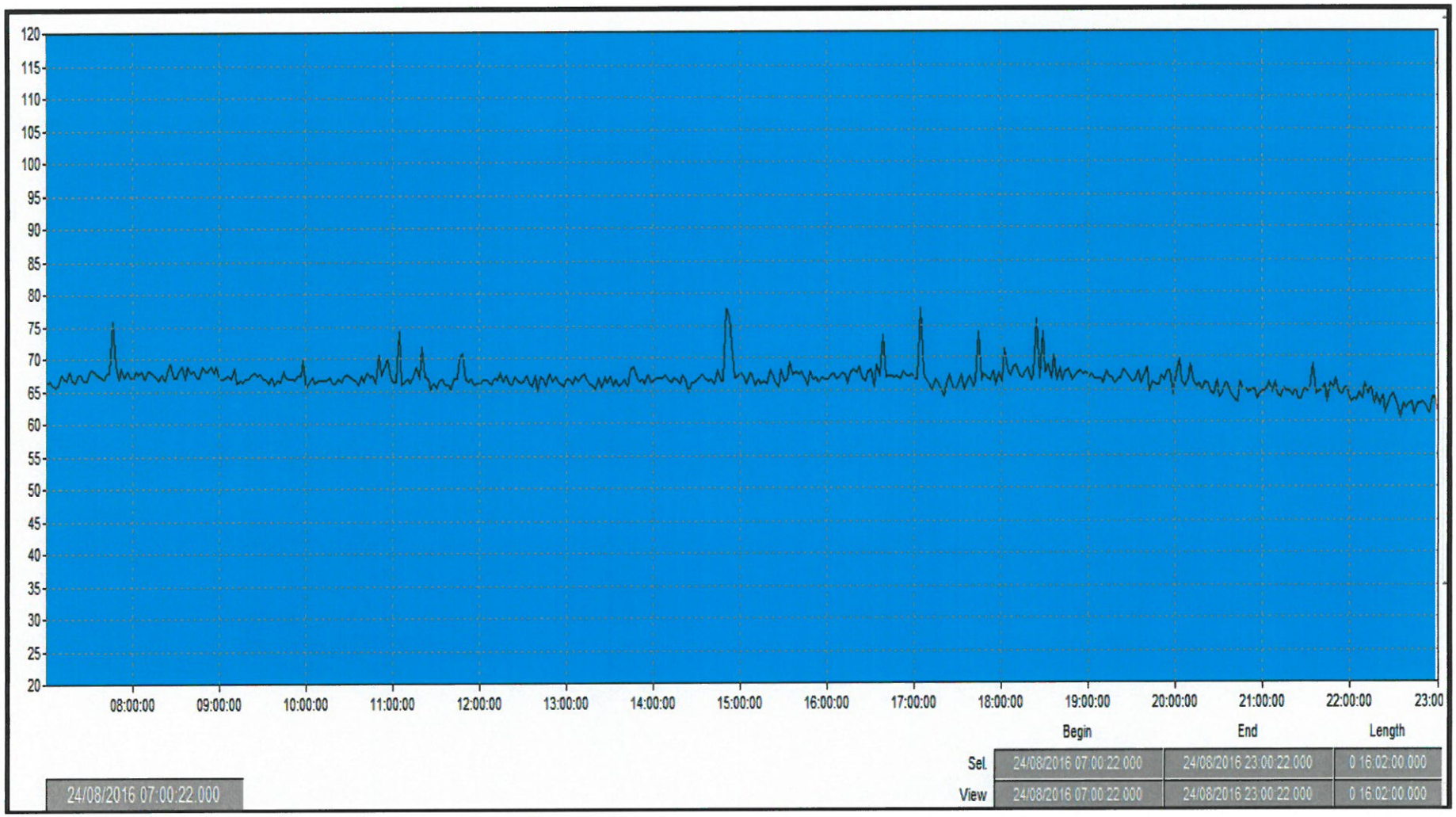
Graph 10: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 21st August 2016



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



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

4.12.1	Daytime	16 hour L_{Aeq} =	67.2dB
4.12.2	Daytime	16 hour L_{90} =	62.1dB
4.12.3	Night-time	8 hour L_{Aeq} =	60.3dB
4.12.4	Night-time	8 hour L_{90} =	47.3dB

Fixed Monitoring Location 2

4.12.5	Daytime	16 hour L_{Aeq} =	58.8dB
4.12.6	Daytime	16 hour L_{90} =	54.5dB
4.12.7	Night-time	8 hour L_{Aeq} =	53.5dB
4.12.8	Night-time	8 hour L_{90} =	44.5dB

4.13 The results from the noise monitoring at fixed monitoring location 1, 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.

4.14 Fixed monitoring location 2 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.

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

4.16 These are discussed in Section 5 of this report.

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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.

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

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

5.9 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.

5.10 R_w+C_{tr} is an adjustment to the R_w scale that could also be used for selecting a product to reduce noise from urban road traffic, disco music and other noises with a large component.

5.11 The windows for the proposed dwellings will need to have an R_w+C_{tr} value of 32dB.

5.12 An R_w+C_{tr} value of 32dB can be achieved with a standard glazing configuration of 10mm/(6-16mm)/6mm as detailed in the Pilkington Octiphon windows brochure of which a copy is attached as Appendix D.

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 an R_w+C_{tr} attenuation level of 32dB.

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 is achieved for the entire site bar the St Crispins Road elevation.

5.21 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 NR13 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.

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

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

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

6.7 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.

6.8 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.

6.9 The above vents will also need to have acoustic properties that afford a 32dB reduction in noise.

6.10 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

Appendix F – Noise Monitoring Recording Sheets

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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

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PILKINGTON

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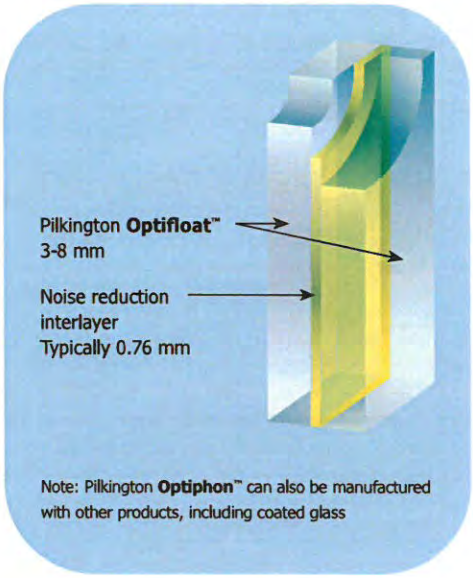
Pilkington **Optiphon**™
Laminated Glass for noise control

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

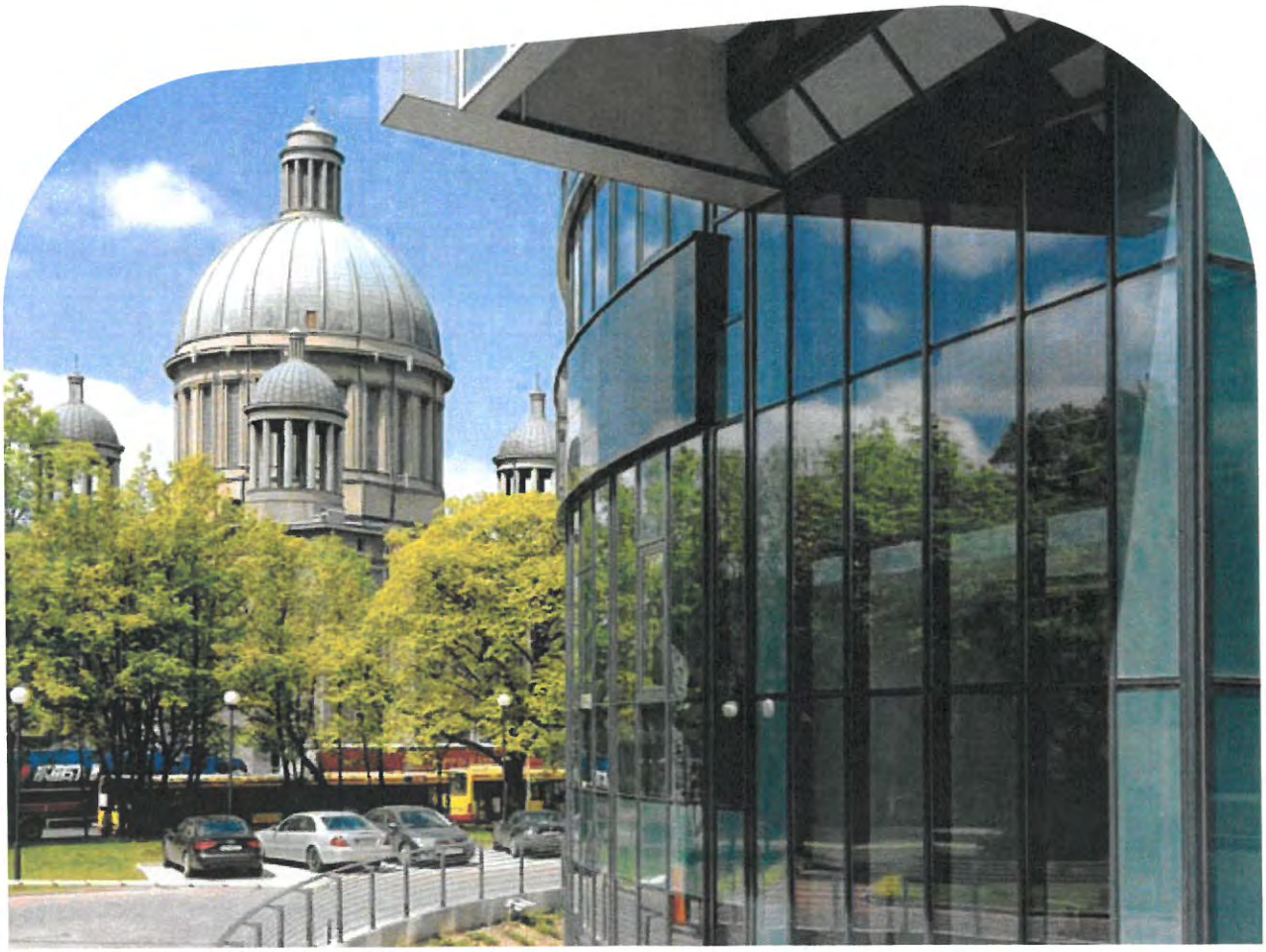
Type of noise source:

- 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 / 8.8 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 Rw (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)	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	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	38
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

Pilkington **Optiphon**™ has been awarded the Quietmark.

QUIET MARK

CE

CE marking confirms that a product complies with its relevant harmonised European Norm.
The Declaration of Performance for each product, including declared values, can be found at www.pilkington.com/CE

NSG GROUP

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pilkington@respond.uk.com
www.pilkington.co.uk

Appendix E – Site Plan

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Note
The footprint and layout of each building in the outline application, (outside the red line on drawing A02-P2-101) is illustrative only.

Block Location Plan

Scale Bar (1:500)

0 5 10 15 25 50m

No.	Description	Date

BroadwayMalyan BM
Architecture Urbanism Design

Riverside House
Southwark Bridge Road
London
SE1 9HA

T: +44 (0) 20 7261 4200
F: +44 (0) 20 7261 4300
E: t.orr@BroadwayMalyan.com

www.BroadwayMalyan.com

Client
Weston Homes

Project
Anglia Square
Norwich

Description
03-Plans
Architecture
Ground Floor - Masterplan

Status
ISSUED FOR PLANNING

Scale		Drawn	Date
1 : 500	@A1	BM	01.03.18
Job number	Drawing number		Revision
31467	A03-P2-000		

Original size 100mm@A1

Appendix F – Noise Monitoring Recording Sheets

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Position	SP1
Start Time	12:57:46

B&K Project Ref No	22
End Time	13:27:46

Weather Conditions	
Temperature	20.7 c
Wind Speed	6 mph
Wind Direction	NNE
Visibility	Good
Cloud Cover	5%
Humidity	83%
Pressure	1015.0 mbar

Ground Conditions
Hardstanding, concrete car park, some gravelled areas, flat with no vegetation within 5m radius, some obstrucrtion from nearby parked vehicles

Primary Noise	Road vehicle noise

Secondary Noise	Pedestrians and moving vehicles in

Observations & Comments	
Time	Noise type, dB and duration
23.19	LAeq peak 62.9 dB from loud music - passing vehicle

Pictures of Spot Position and Set-Up

SP1

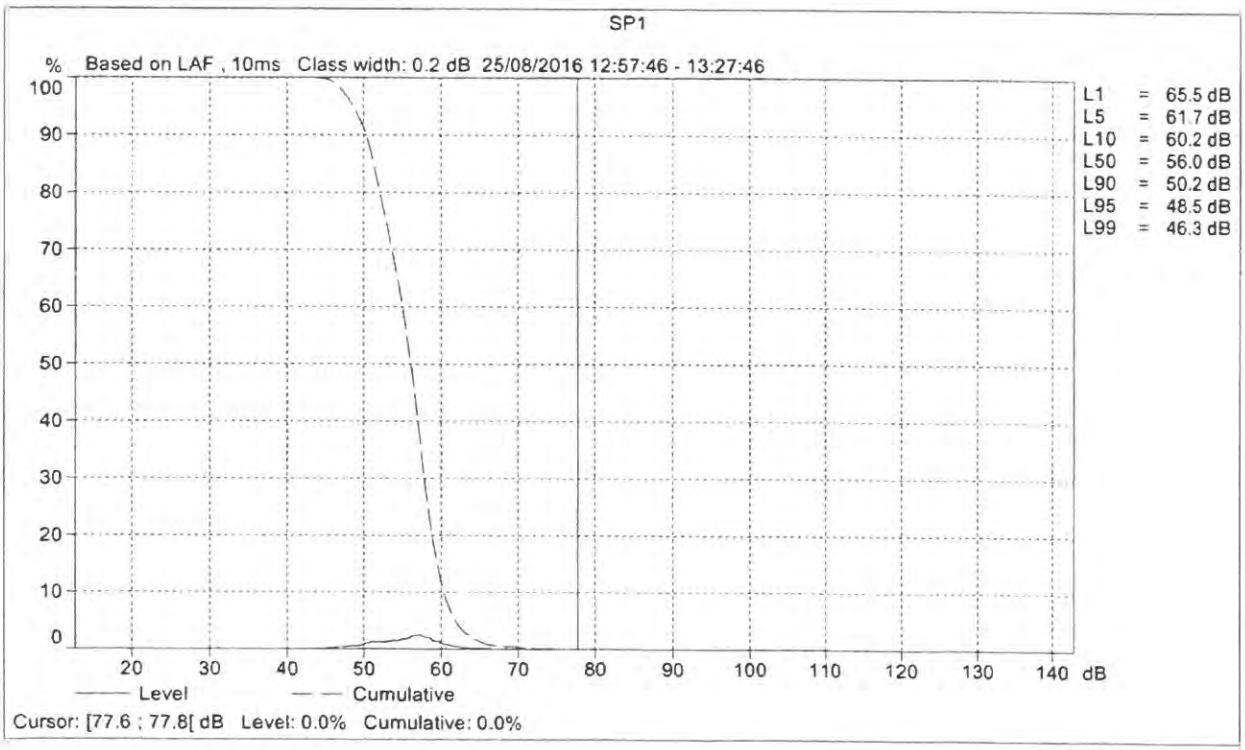
Instrument:		2250
Application:		BZ7224 Version 4.6.3
Start Time:		08/25/2016 12:57:46
End Time:		08/25/2016 13:27:46
Elapsed Time:		00:30:00
Bandwidth:		Broadband
Max Input Level:		141.66

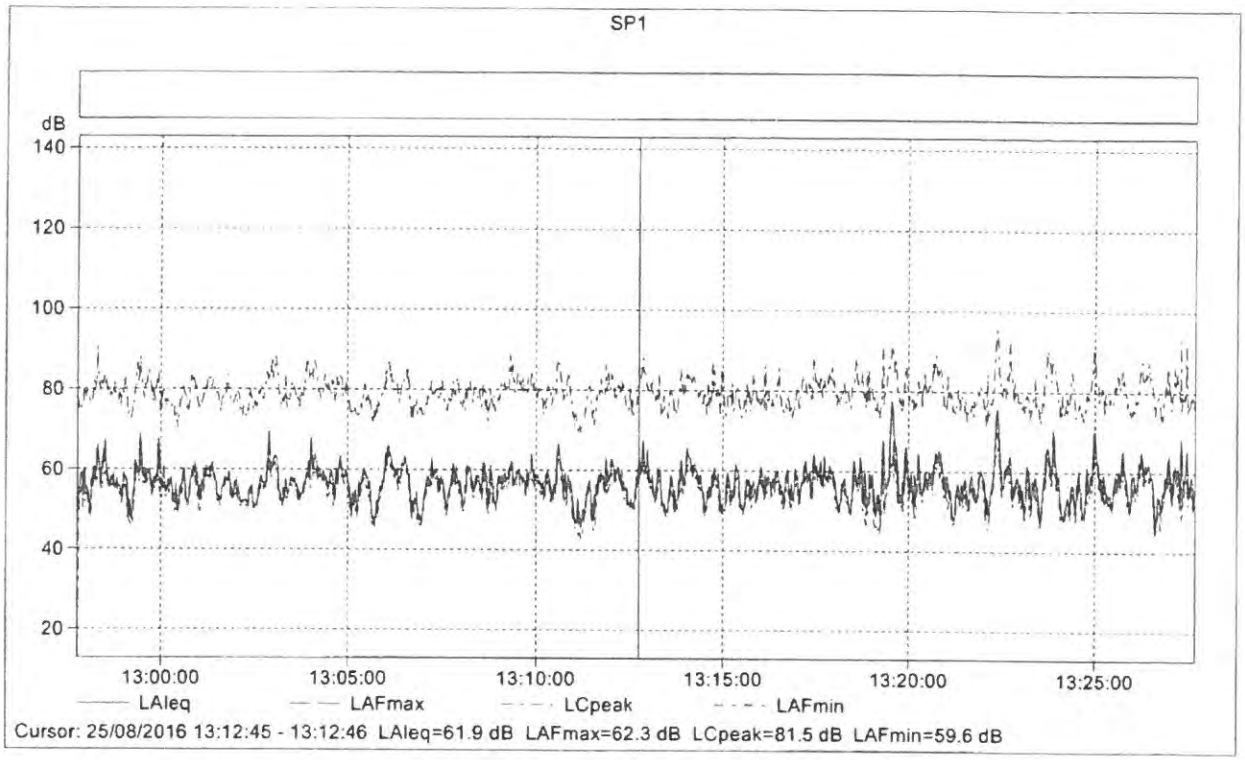
	Time	Frequency
Broadband (excl. Peak):	FSI	AC
Broadband Peak:		C
Instrument Serial Number:		3004740
Microphone Serial Number:		2983636
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field

Calibration Time:		08/25/2016 09:44:12
Calibration Type:		External reference
Sensitivity:		46.1227297782898 mV/Pa

SP1

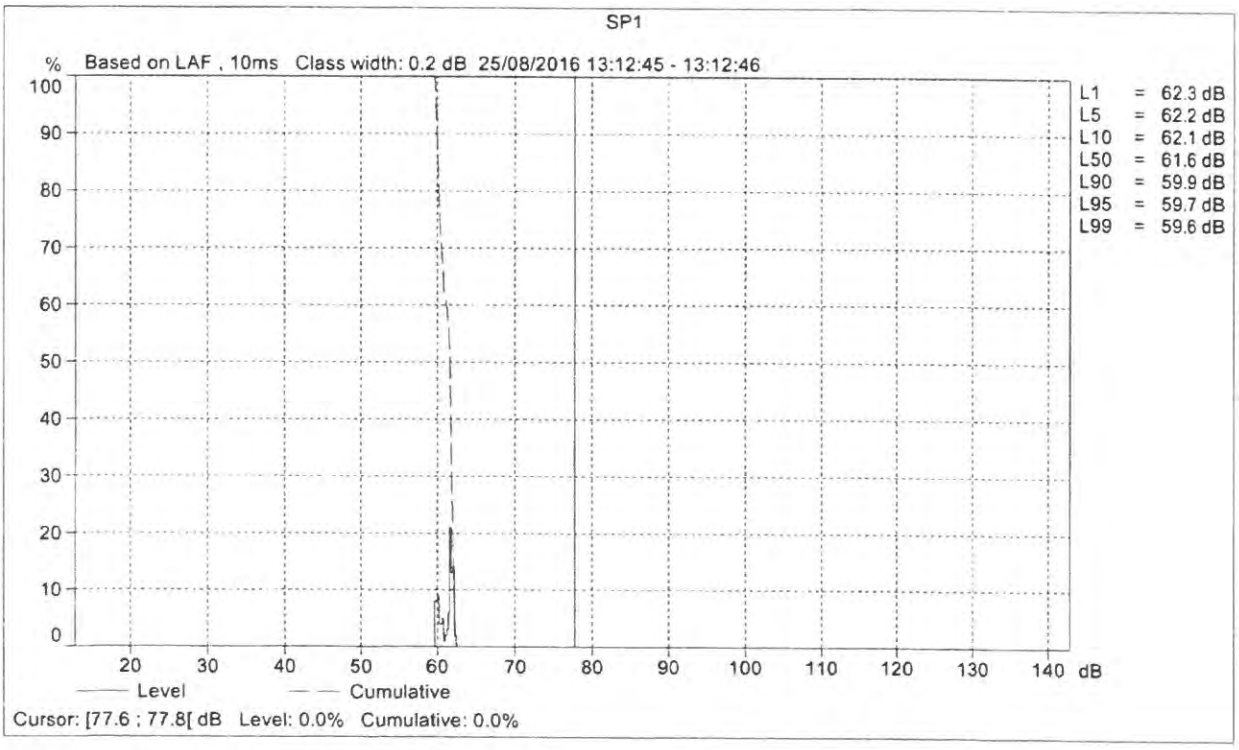
	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAFmax [dB]	LAFmin [dB]
Value				0.00	57.6	76.2	42.7
Time	12:57:46	13:27:46	0:30:00				
Date	25/08/2016	25/08/2016					

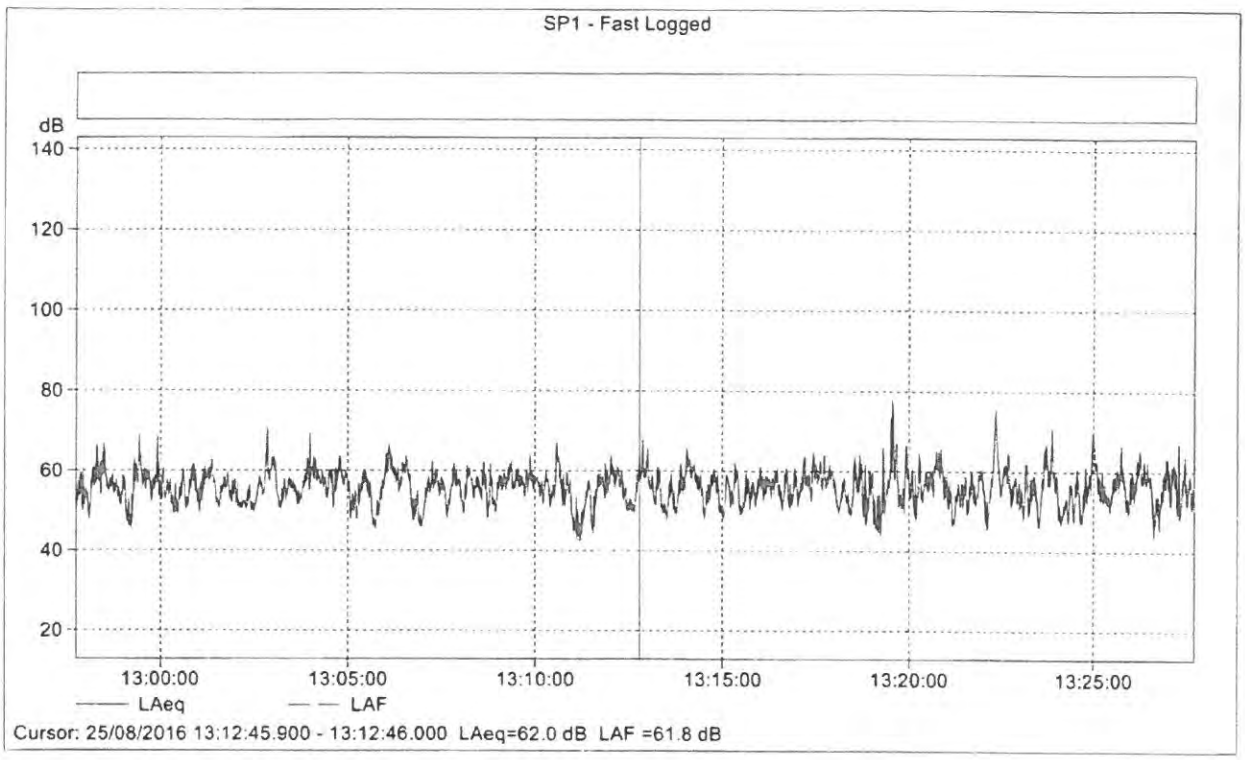




SP1

	Start time	Elapsed time	LAleq [dB]	LAFmax [dB]	LAFmin [dB]
Value			61.9	62.3	59.6
Time	13:12:45	0:00:01			
Date	25/08/2016				





SP1 - Fast Logged

	Start time	Elapsed time	LAeq [dB]
Value			62.0
Time	13:12:45.900	0:00:00.100	
Date	25/08/2016		

Position	SP2
Start Time	13:29:46

B&K Project Ref No	23
End Time	13:59:46

Weather Conditions	
Temperature	19.5 c
Wind Speed	6 mph
Wind Direction	NNW
Visibility	Good
Cloud Cover	15%
Humidity	86%
Pressure	1016.0 mbar

Ground Conditions
Tarmaced car park, flat, no vegetation within 5m radius, some obstruction from nearby parked vehicles

Primary Noise	Road vehicle noise

Secondary Noise	Noise from commercial/ shop

Observations & Comments	
Time	Noise type, dB and duration
5.15	LAeq peak 82.3 dB from close moving vehicle
20.24	People in car park talking approx 4m away from SLM

Pictures of Spot Position and Set-Up

SP2

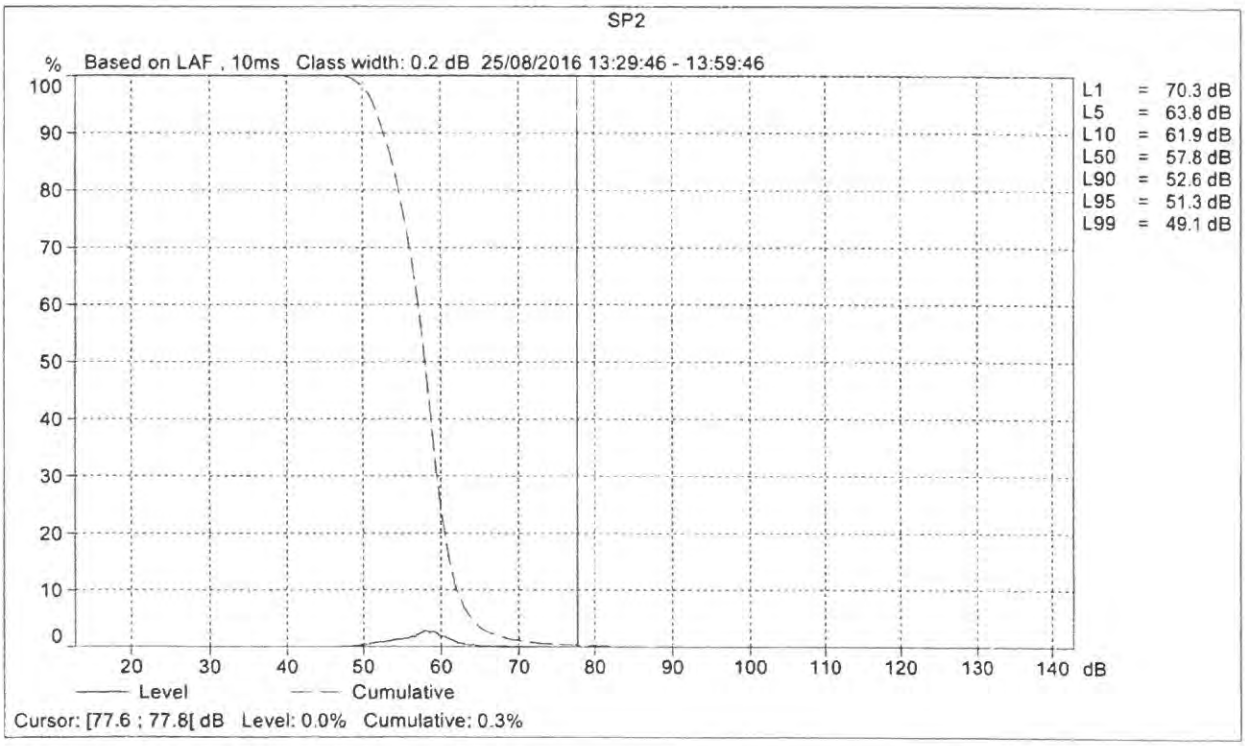
Instrument:		2250
Application:		BZ7224 Version 4.6.3
Start Time:		08/25/2016 13:29:46
End Time:		08/25/2016 13:59:46
Elapsed Time:		00:30:00
Bandwidth:		Broadband
Max Input Level:		141.66

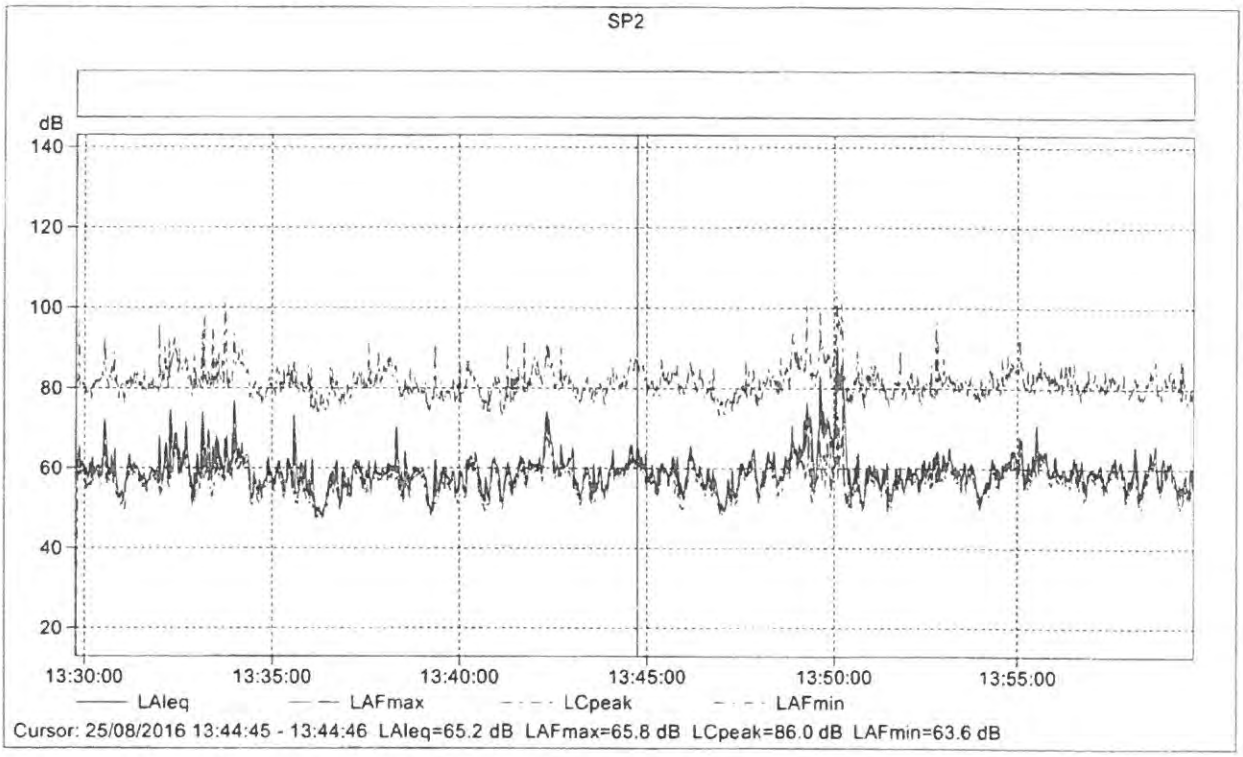
	Time	Frequency
Broadband (excl. Peak):	FSI	AC
Broadband Peak:		C
Instrument Serial Number:		3004740
Microphone Serial Number:		2983636
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field

Calibration Time:		08/25/2016 09:44:12
Calibration Type:		External reference
Sensitivity:		46.1227297782898 mV/Pa

SP2

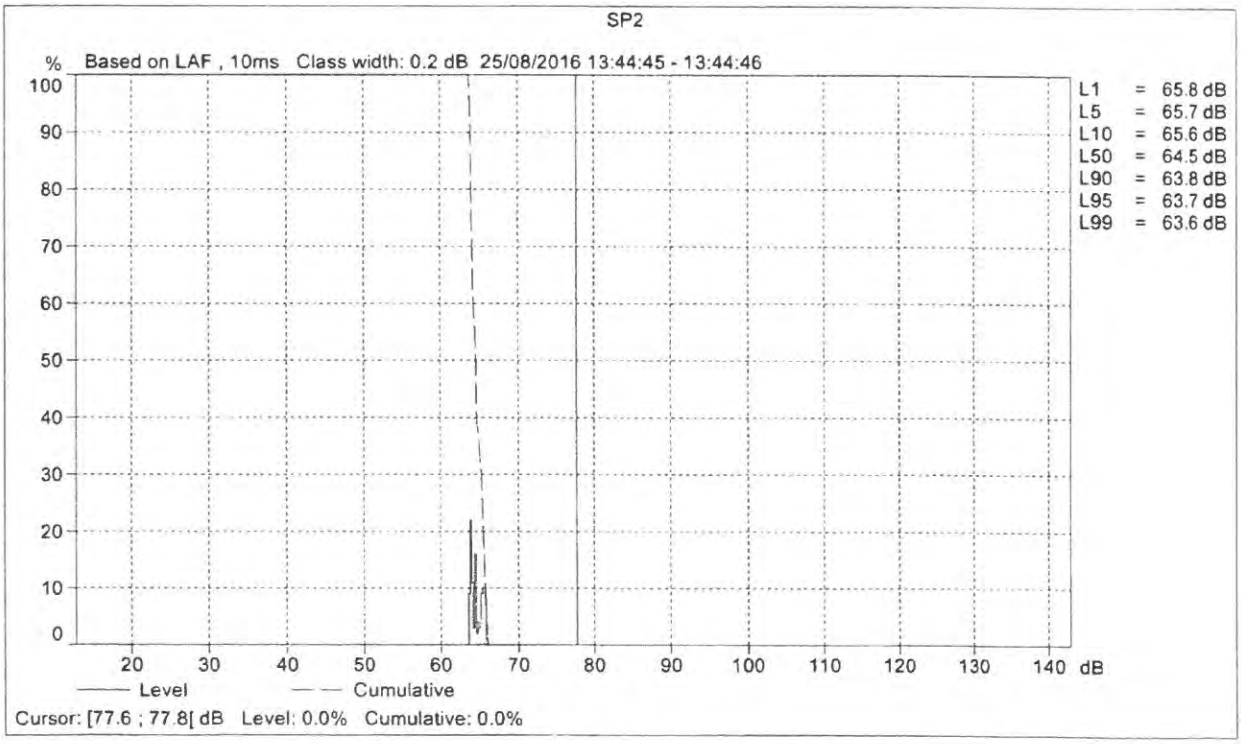
	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAFmax [dB]	LAFmin [dB]
Value				0.00	61.6	89.2	46.9
Time	13:29:46	13:59:46	0:30:00				
Date	25/08/2016	25/08/2016					

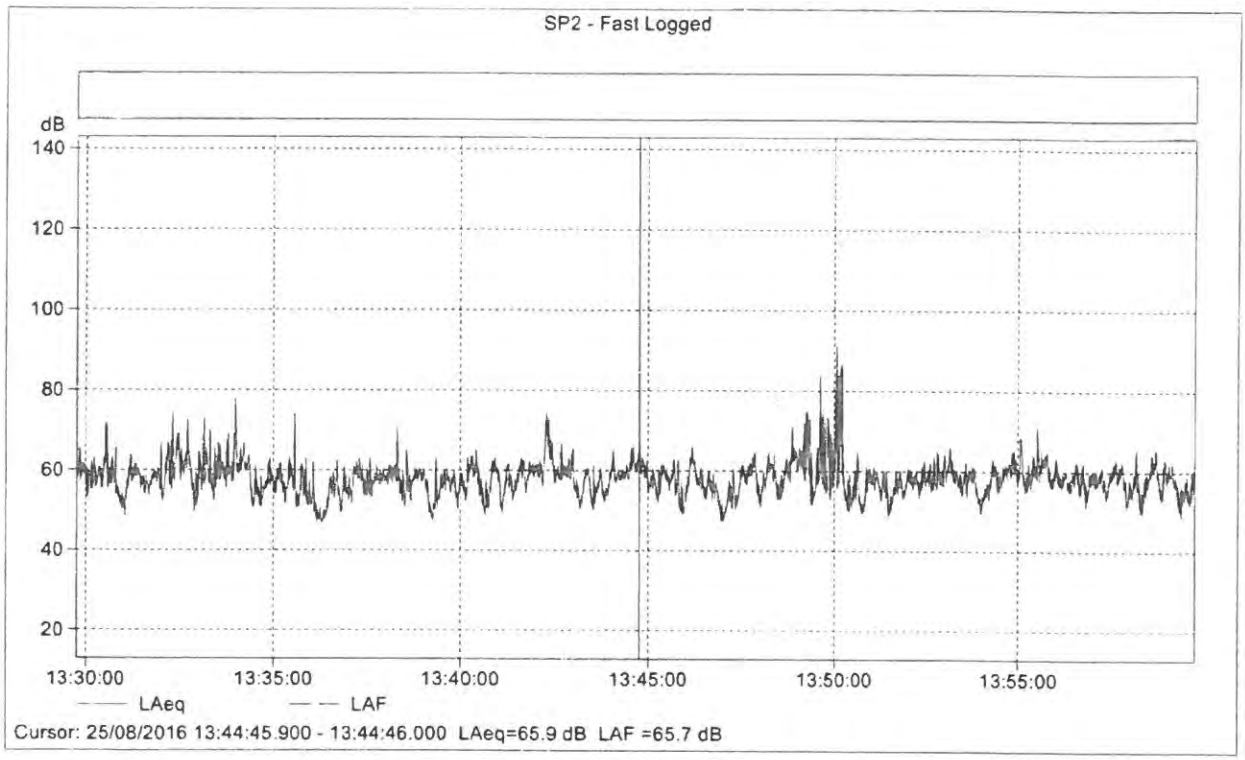




SP2

	Start time	Elapsed time	LAleq [dB]	LAFmax [dB]	LAFmin [dB]
Value			65.2	65.8	63.6
Time	13:44:45	0:00:01			
Date	25/08/2016				





SP2 - Fast Logged

	Start time	Elapsed time	LAeq [dB]
Value			65.9
Time	13:44:45.900	0:00:00.100	
Date	25/08/2016		

Position	SP3
Start Time	14:01:13

B&K Project Ref No	24
End Time	14:31:13

Weather Conditions	
Temperature	19.5 c
Wind Speed	6 mph
Wind Direction	NNW
Visibility	Good
Cloud Cover	15%
Humidity	86%
Pressure	1016.0 mbar

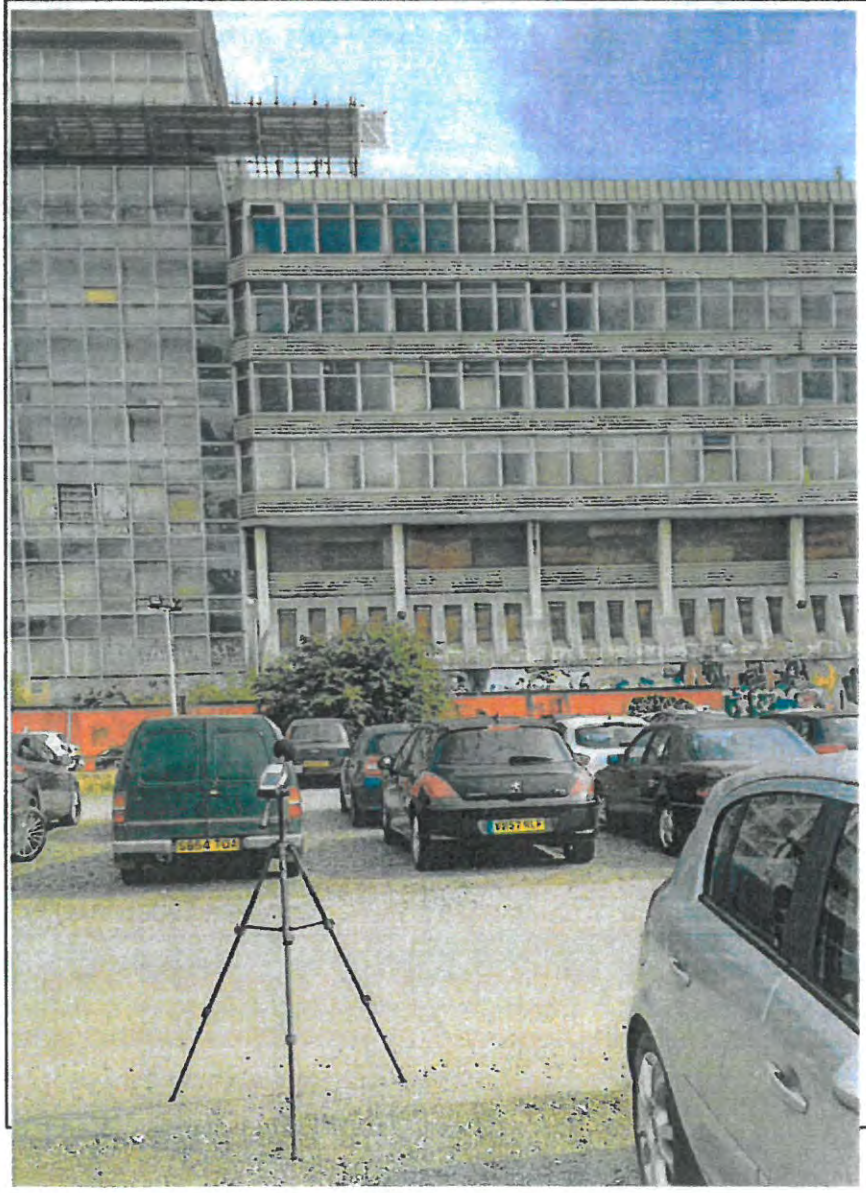
Ground Conditions
Gravel car park, no vegetation within 5m radius, some obstruction from nearby parked vehicles

Primary Noise	Road vehicle noise

Secondary Noise	Close moving vehicles/ talking

Observations & Comments	
Time	Noise type, dB and duration
10.26	LAeq peak 64.2 dB from close moving vehicle
Intermittant	People in car park talking approx 4m away from SLM

Pictures of Spot Position and Set-Up



SP3

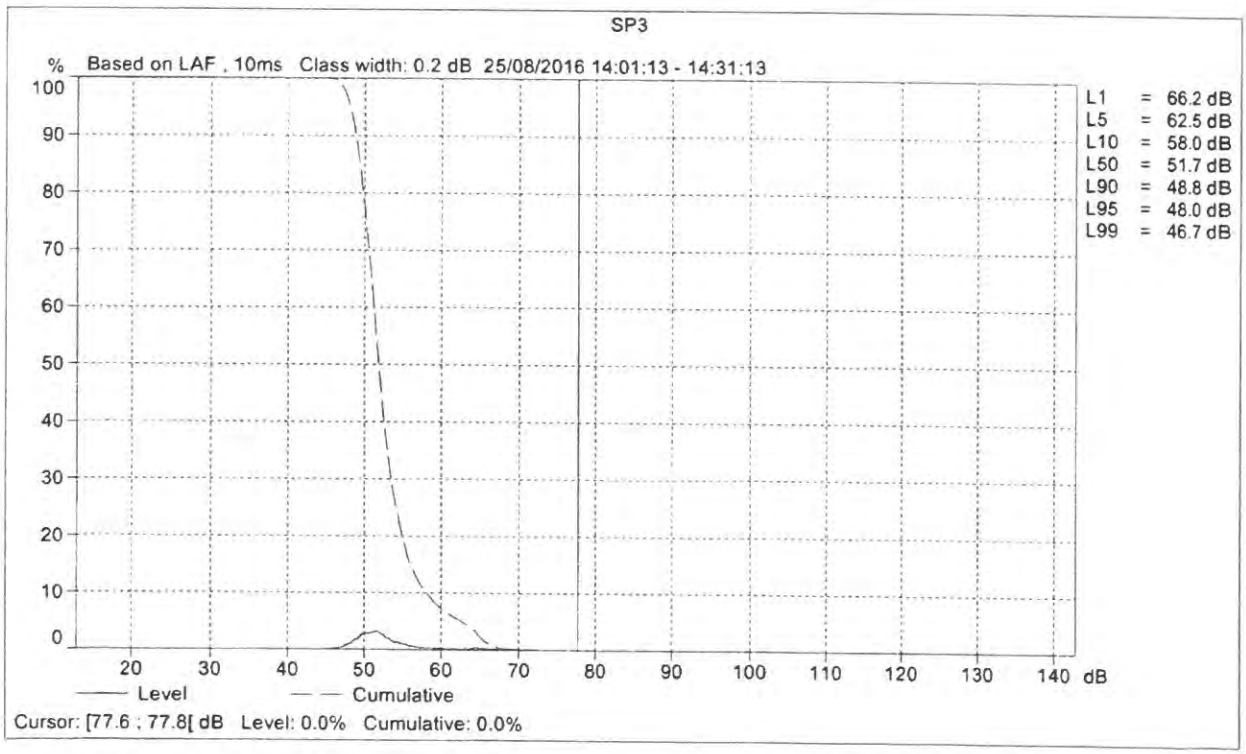
Instrument:		2250
Application:		BZ7224 Version 4.6.3
Start Time:		08/25/2016 14:01:13
End Time:		08/25/2016 14:31:13
Elapsed Time:		00:30:00
Bandwidth:		Broadband
Max Input Level:		141.66

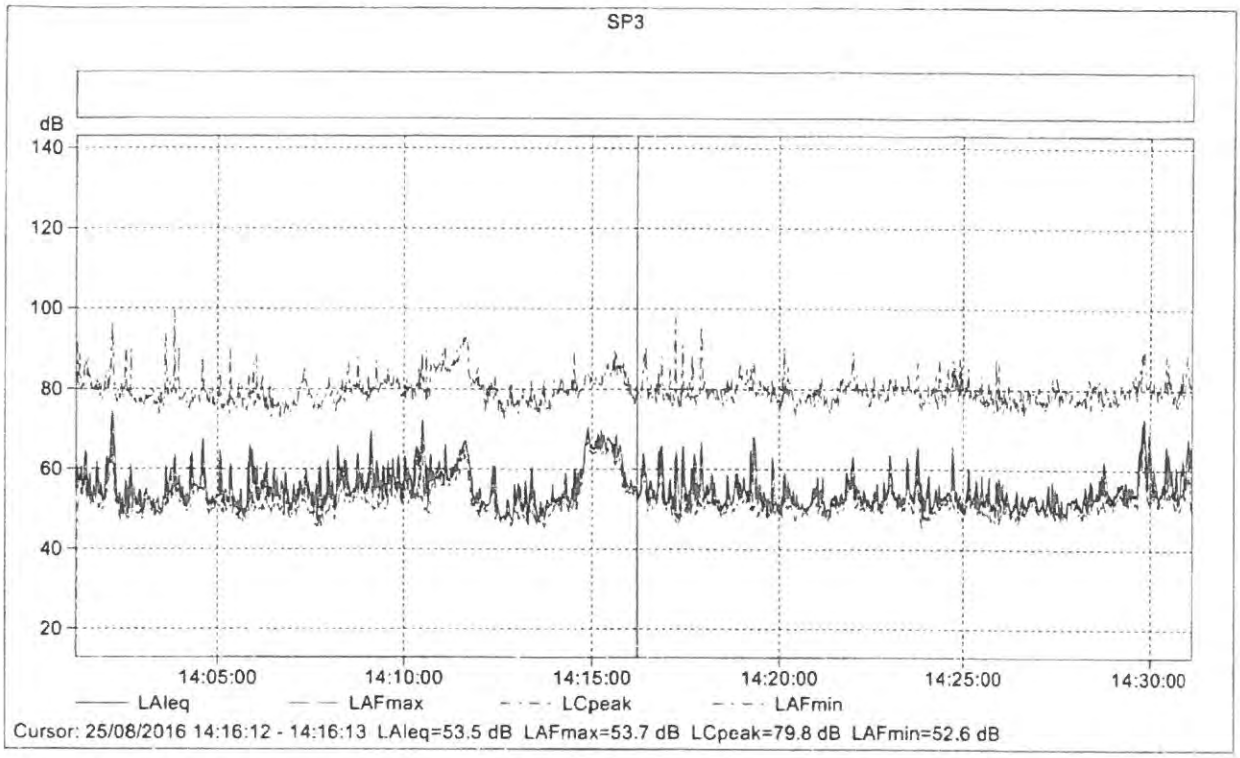
	Time	Frequency
Broadband (excl. Peak):	FSI	AC
Broadband Peak:		C
Instrument Serial Number:		3004740
Microphone Serial Number:		2983636
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field

Calibration Time:		08/25/2016 09:44:12
Calibration Type:		External reference
Sensitivity:		46.1227297782898 mV/Pa

SP3

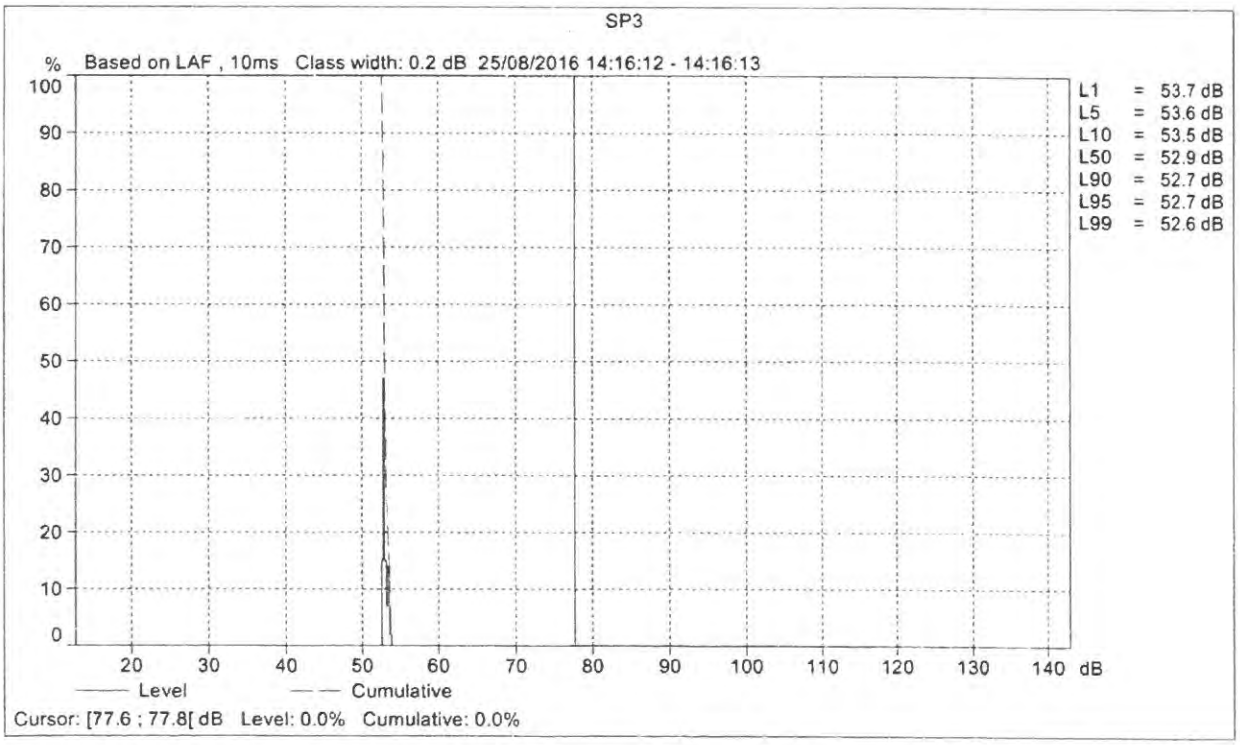
	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAFmax [dB]	LAFmin [dB]
Value				0.00	55.8	72.7	44.8
Time	14:01:13	14:31:13	0:30:00				
Date	25/08/2016	25/08/2016					

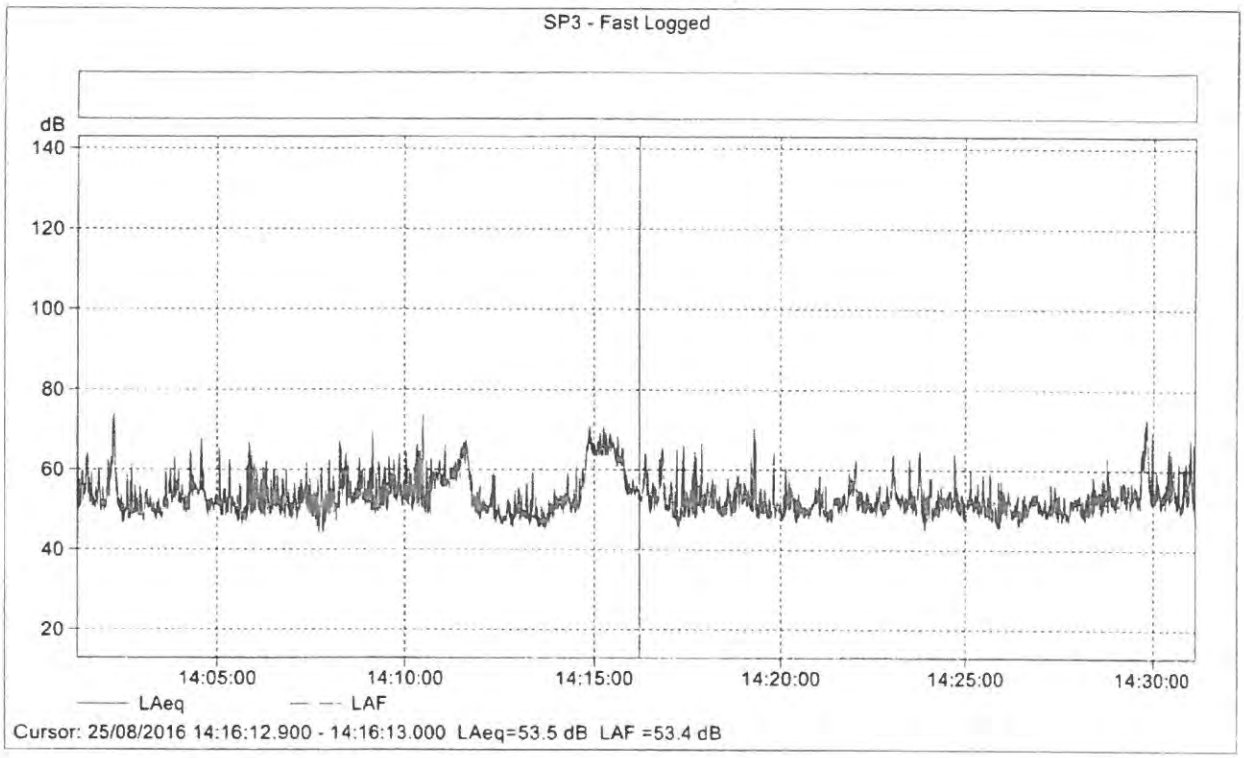




SP3

	Start time	Elapsed time	LAleq [dB]	LAFmax [dB]	LAFmin [dB]
Value			53.5	53.7	52.6
Time	14:16:12	0:00:01			
Date	25/08/2016				





SP3 - Fast Logged

	Start time	Elapsed time	LAeq [dB]
Value			53.5
Time	14:16:12.900	0:00:00.100	
Date	25/08/2016		

Position	SP4
Start Time	14:34:16

B&K Project Ref No	25
End Time	15:04:15

Weather Conditions	
Temperature	18.9 c
Wind Speed	3 mph
Wind Direction	N
Visibility	Good
Cloud Cover	20%
Humidity	86%
Pressure	1015.0 mbar

Ground Conditions
Gravel car park, no vegetation within 5m radius, some obstruction from nearby parked vehicles

Primary Noise	Road vehicle noise

Secondary Noise	Shop noise

Observations & Comments	
Time	Noise type, dB and duration
9.35	LAeq peak 72.2 dB from close moving vehicle
Intermittant	Shop noise

Pictures of Spot Position and Set-Up

SP4

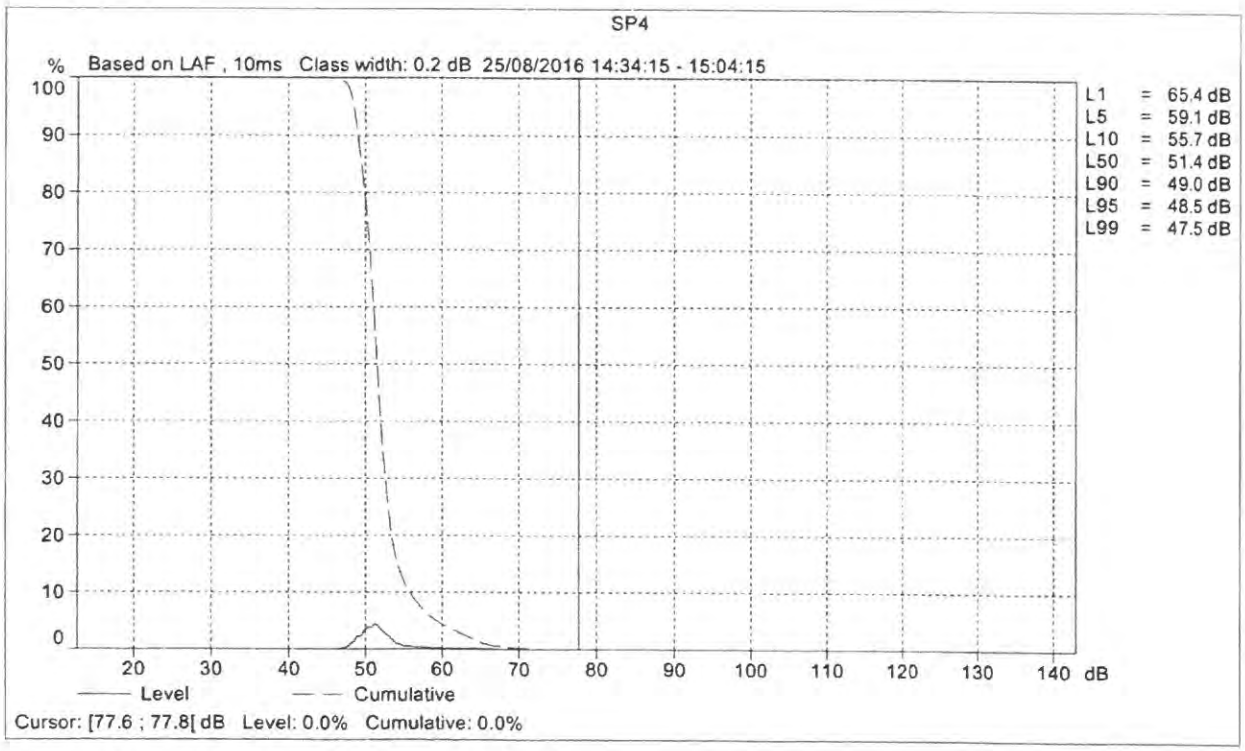
Instrument:		2250
Application:		BZ7224 Version 4.6.3
Start Time:		08/25/2016 14:34:15
End Time:		08/25/2016 15:04:15
Elapsed Time:		00:30:00
Bandwidth:		Broadband
Max Input Level:		141.66

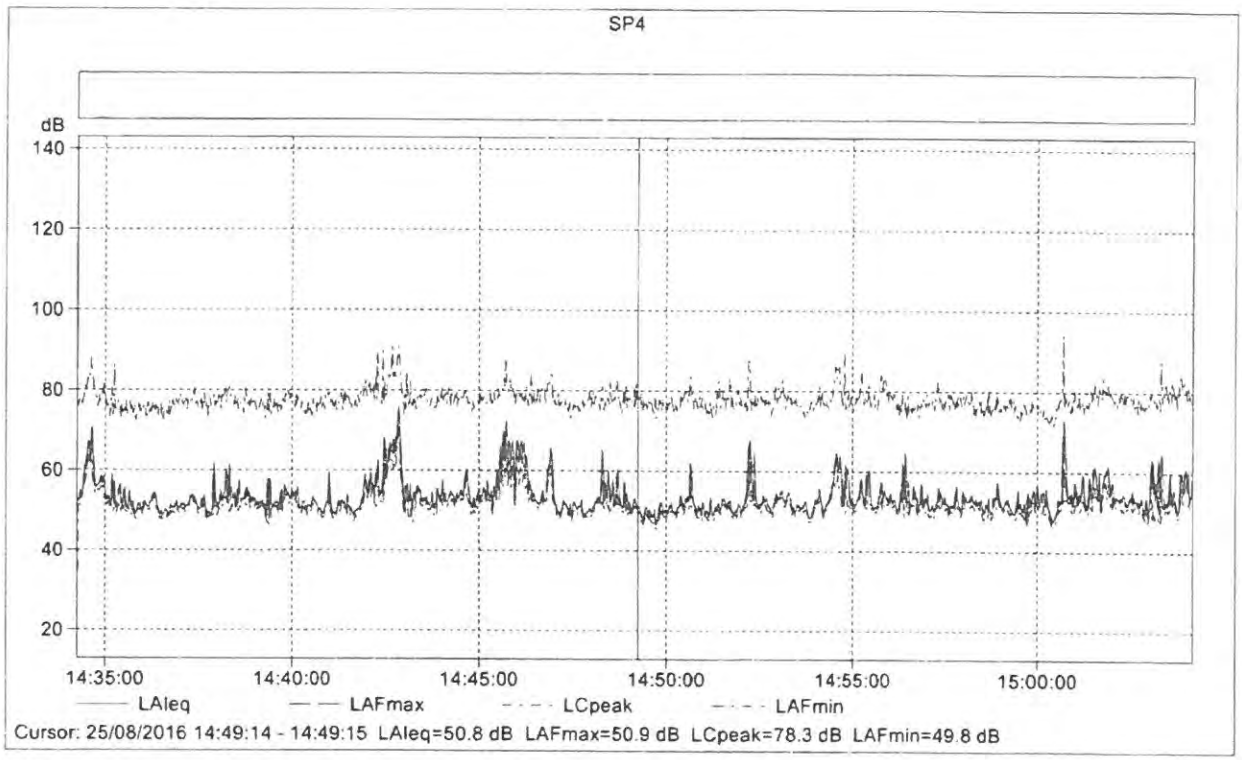
	Time	Frequency
Broadband (excl. Peak):	FSI	AC
Broadband Peak:		C
Instrument Serial Number:		3004740
Microphone Serial Number:		2983636
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field

Calibration Time:		08/25/2016 09:44:12
Calibration Type:		External reference
Sensitivity:		46.1227297782898 mV/Pa

SP4

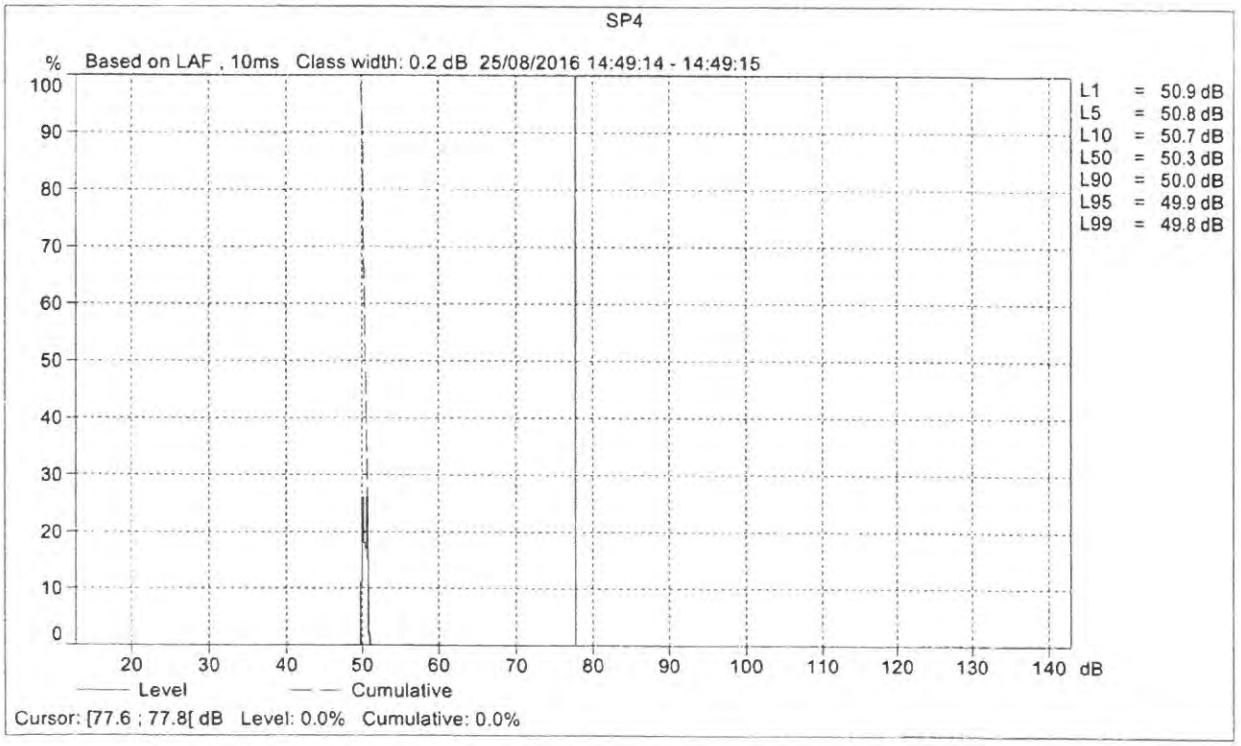
	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAFmax [dB]	LAFmin [dB]
Value				0.00	54.7	74.9	45.4
Time	14:34:15	15:04:15	0:30:00				
Date	25/08/2016	25/08/2016					

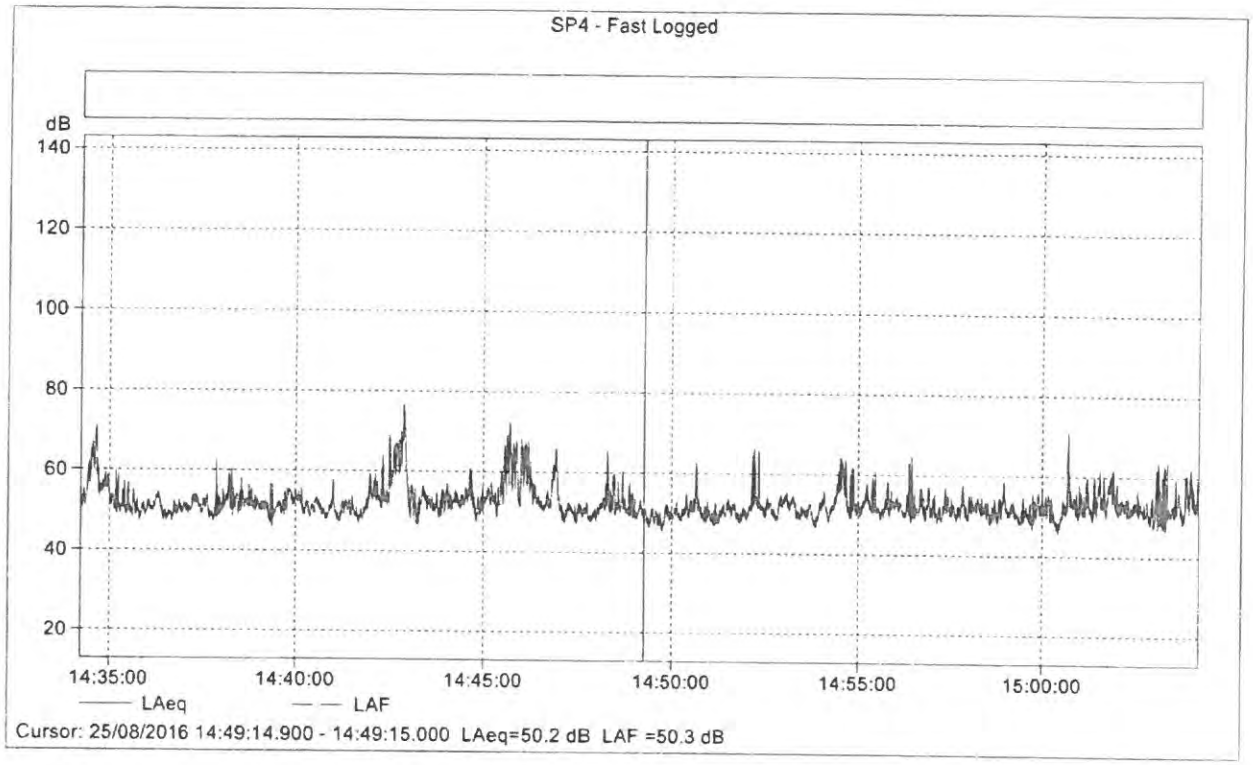




SP4

	Start time	Elapsed time	LAleq [dB]	LAFmax [dB]	LAFmin [dB]
Value			50.8	50.9	49.8
Time	14:49:14	0:00:01			
Date	25/08/2016				





SP4 - Fast Logged

	Start time	Elapsed time	LAeq [dB]
Value			50.2
Time	14:49:14.900	0:00:00.100	
Date	25/08/2016		

Position	SP5
Start Time	15:07:12

B&K Project Ref No	26
End Time	15:37:12

Weather Conditions	
Temperature	18.9 c
Wind Speed	3 mph
Wind Direction	N
Visibility	Good
Cloud Cover	20%
Humidity	86%
Pressure	1015.0 mbar

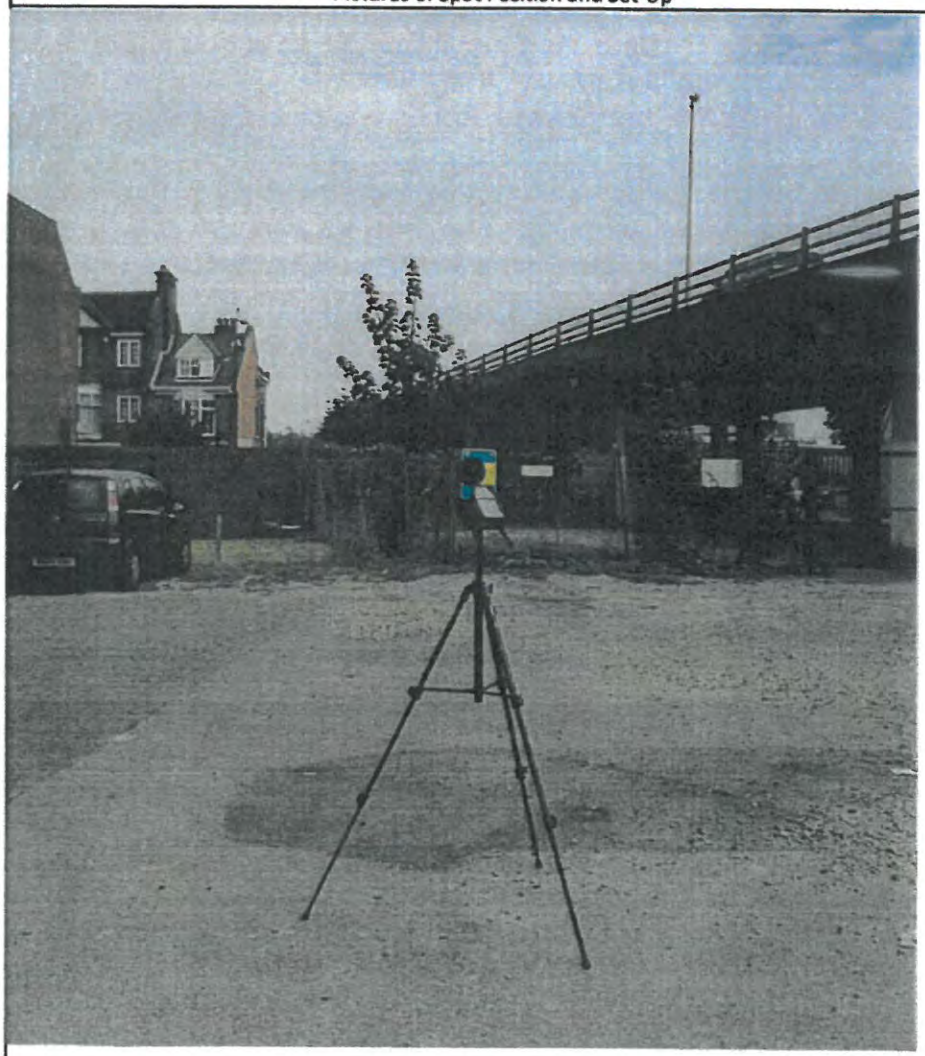
Ground Conditions
Tarmaced area, no vegetation, surrounding by commercial units and roadway flyover

Primary Noise	Flyover road traffic

Secondary Noise	commercial building exhaust

Observations & Comments	
Time	Noise type, dB and duration
Constant	Commercial unit HIU exhaust vent
Intermittant	Higher than average road noise/ emergency vehicles ete

Pictures of Spot Position and Set-Up



SP5

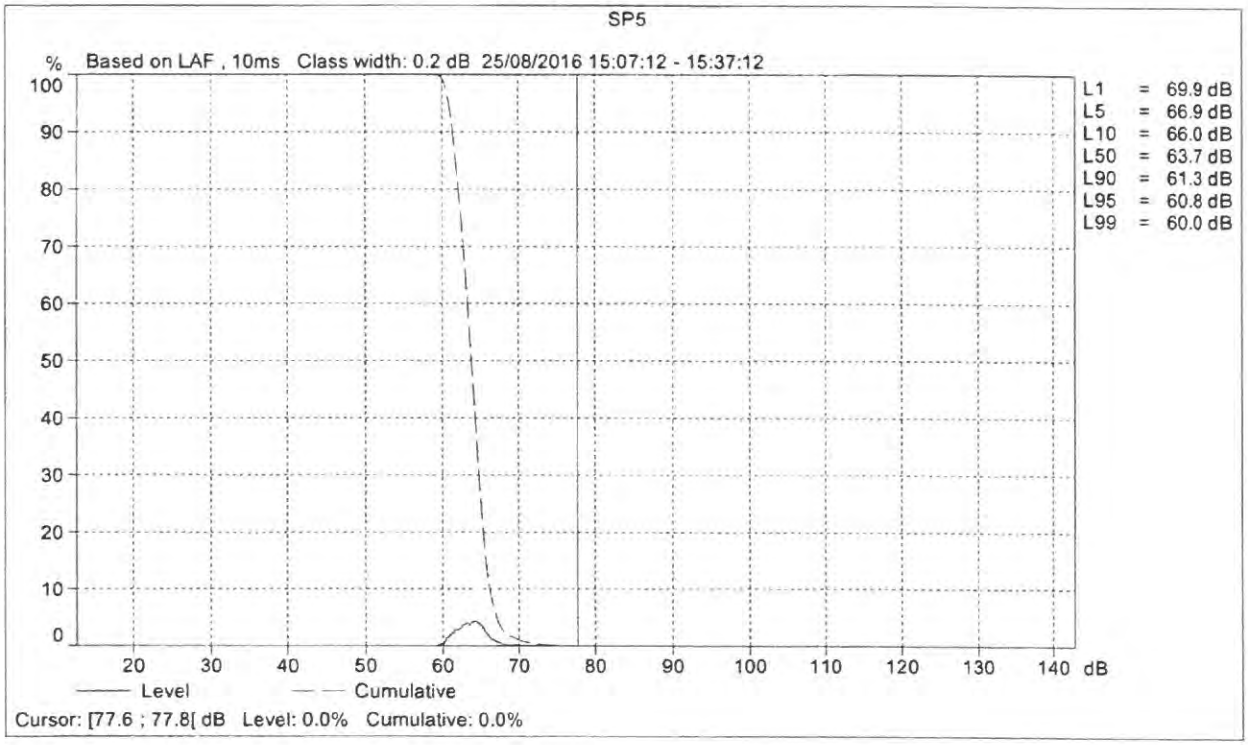
Instrument:		2250
Application:		BZ7224 Version 4.6.3
Start Time:		08/25/2016 15:07:12
End Time:		08/25/2016 15:37:12
Elapsed Time:		00:30:00
Bandwidth:		Broadband
Max Input Level:		141.66

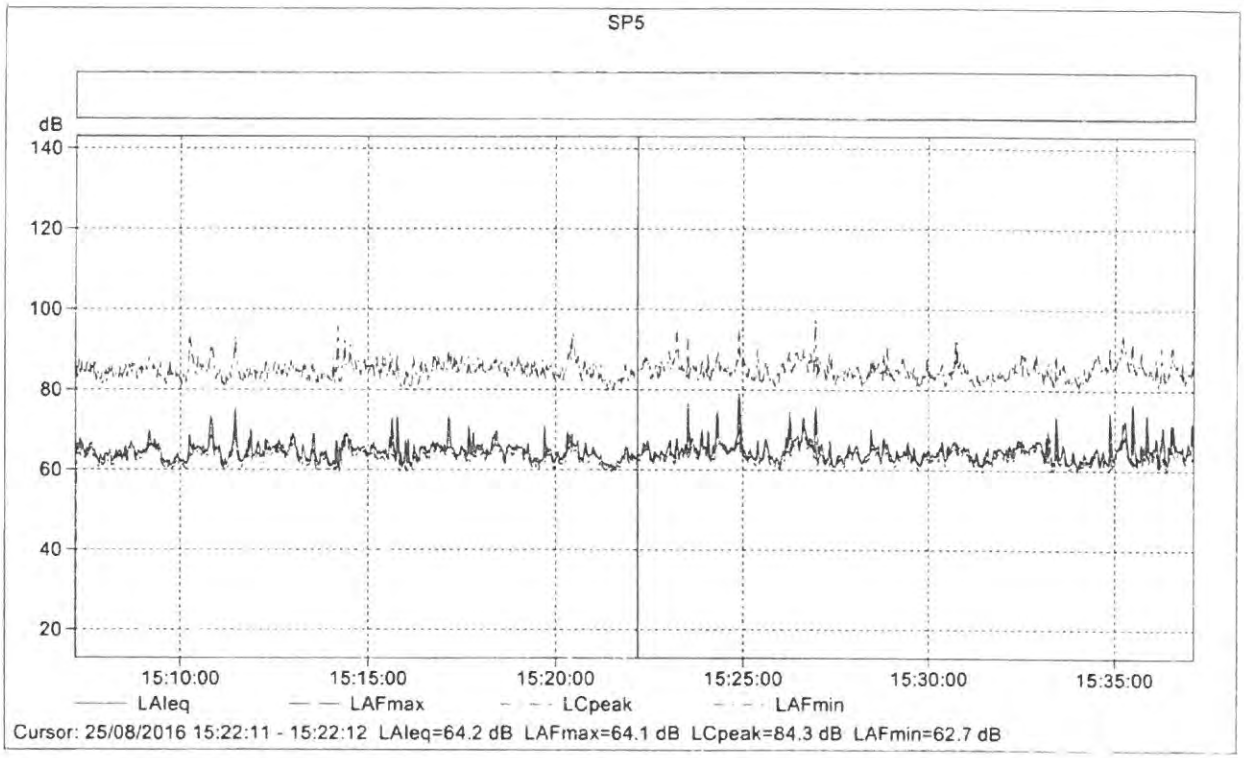
	Time	Frequency
Broadband (excl. Peak):	FSI	AC
Broadband Peak:		C
Instrument Serial Number:		3004740
Microphone Serial Number:		2983636
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field

Calibration Time:		08/25/2016 09:44:12
Calibration Type:		External reference
Sensitivity:		46.1227297782898 mV/Pa

SP5

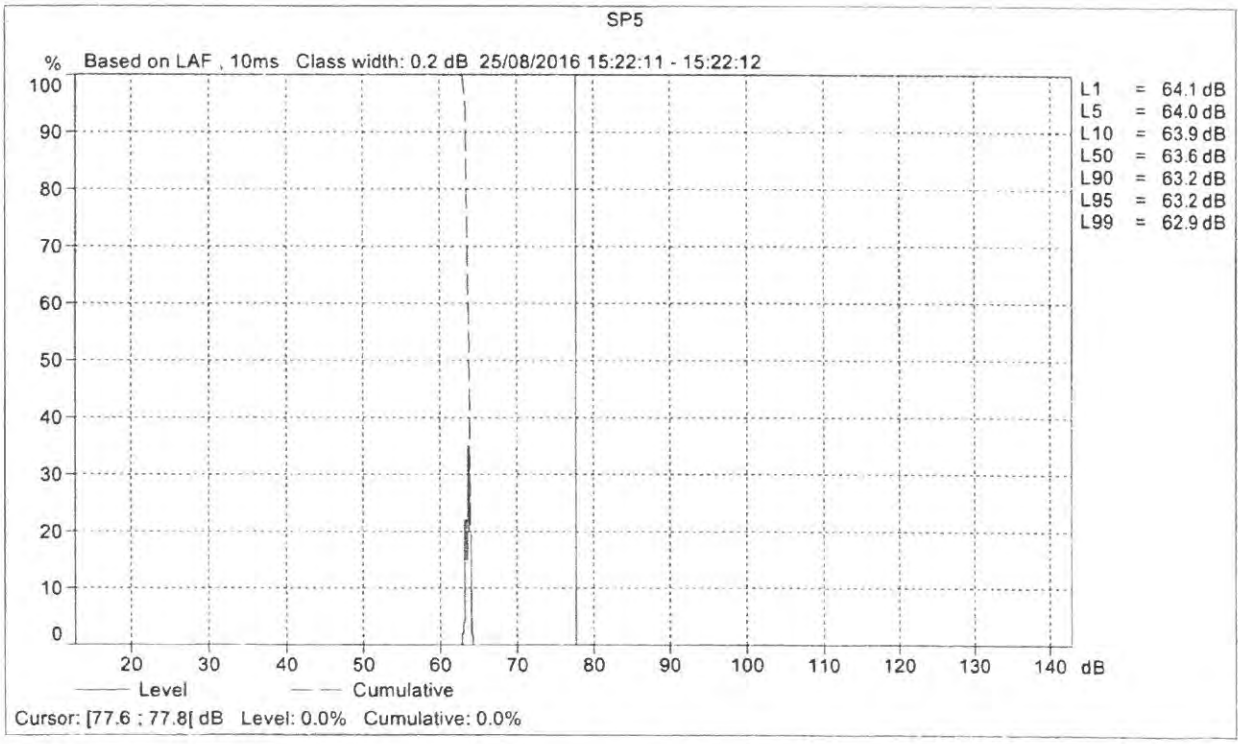
	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAFmax [dB]	LAFmin [dB]
Value				0.00	64.3	78.3	58.8
Time	15:07:12	15:37:12	0:30:00				
Date	25/08/2016	25/08/2016					

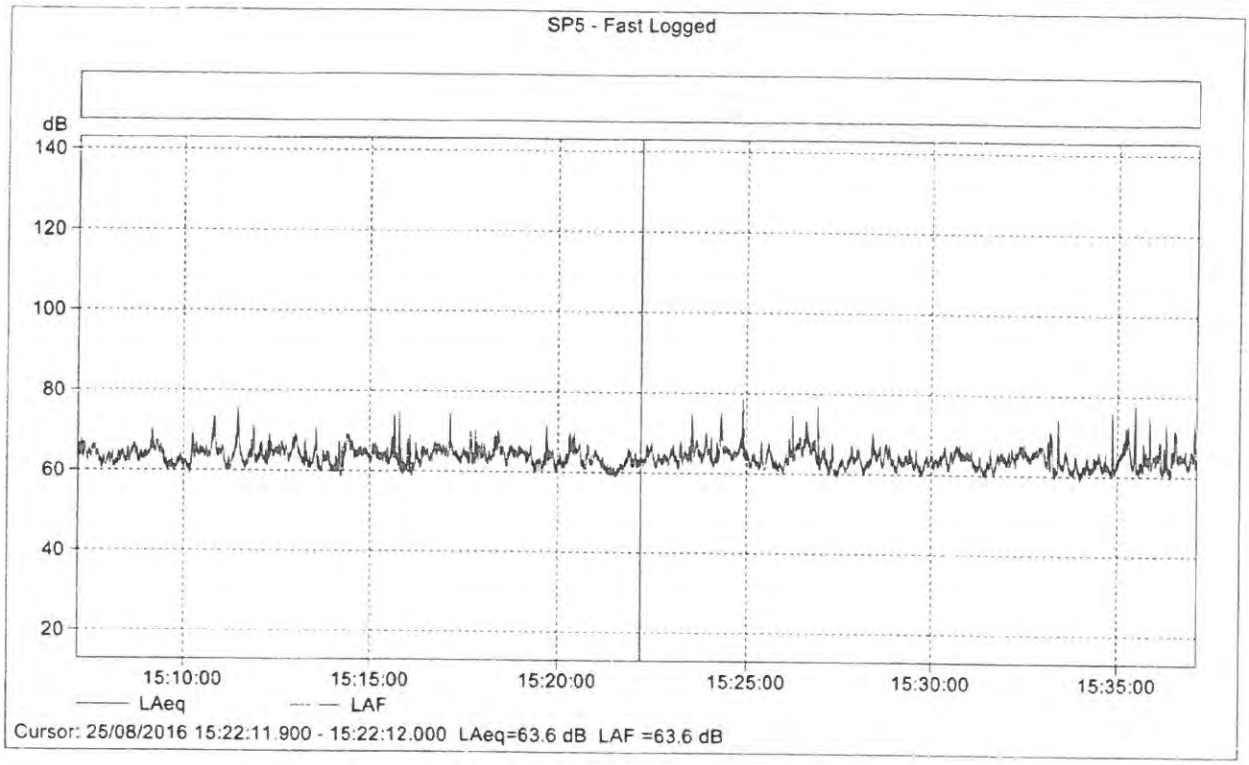




SP5

	Start time	Elapsed time	LAleq [dB]	LAFmax [dB]	LAFmin [dB]
Value			64.2	64.1	62.7
Time	15:22:11	0:00:01			
Date	25/08/2016				





SP5 - Fast Logged

	Start time	Elapsed time	LAeq [dB]
Value			63.6
Time	15:22:11.900	0:00:00.100	
Date	25/08/2016		

Position	SP6
Start Time	15:43:47

B&K Project Ref No	27
End Time	16:13:47

Weather Conditions	
Temperature	19.2 c
Wind Speed	5 mph
Wind Direction	ENE
Visibility	Good
Cloud Cover	25%
Humidity	86%
Pressure	1015.0 mbar

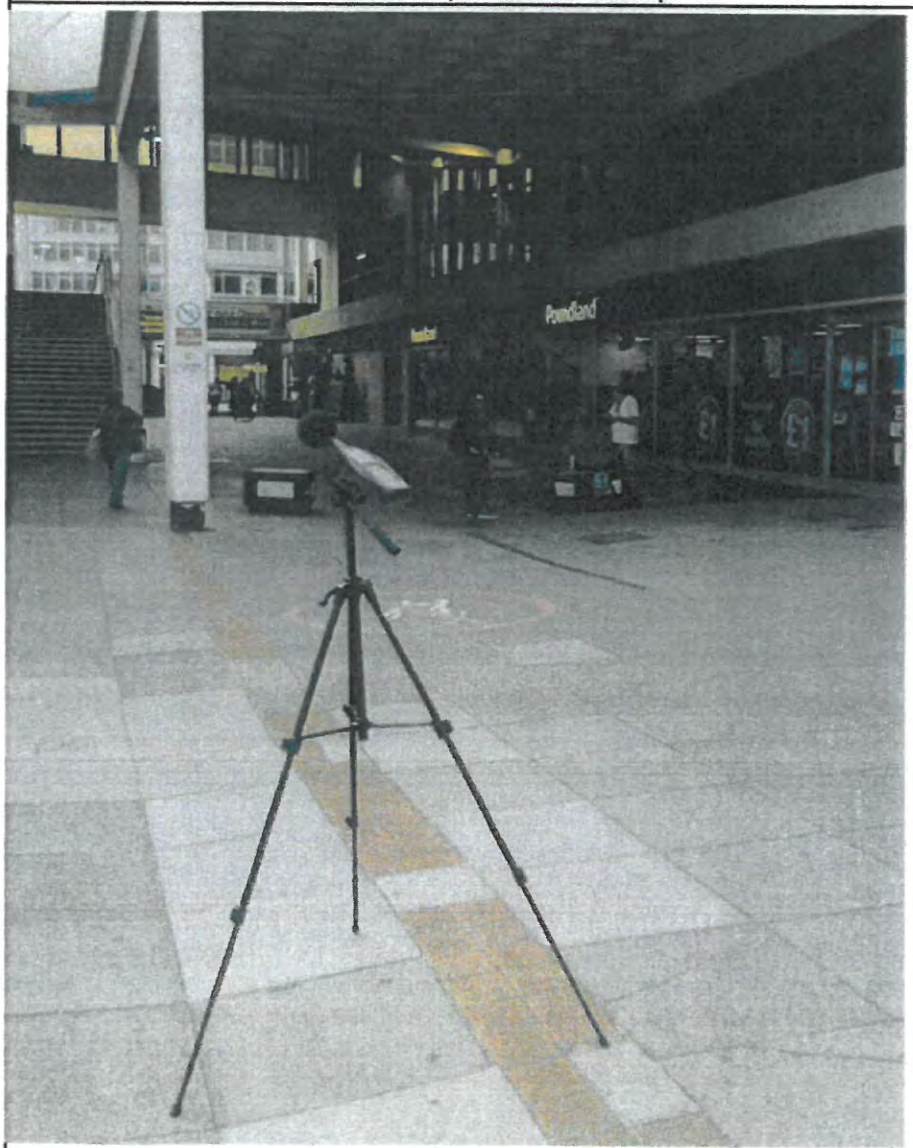
Ground Conditions
Paved area, Heavy people traffic, buildings either side approx 5m away

Primary Noise	Road traffic

Secondary Noise	Pedestrians

Observations & Comments	
Time	Noise type, dB and duration
Constant	Pedestrians in close proximity to SLM
Intermittant	Road noise, passing vehicles - approx 3 metres away

Pictures of Spot Position and Set-Up



SP6

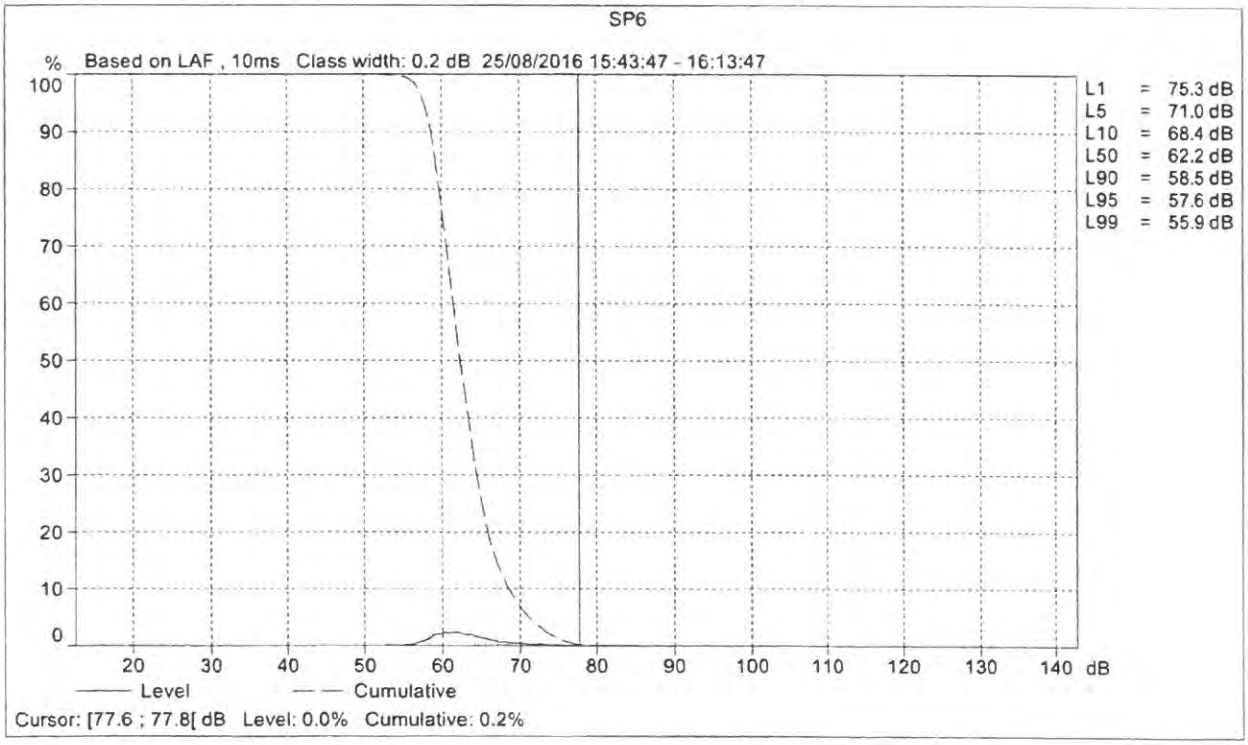
Instrument:		2250
Application:		BZ7224 Version 4.6.3
Start Time:		08/25/2016 15:43:47
End Time:		08/25/2016 16:13:47
Elapsed Time:		00:30:00
Bandwidth:		Broadband
Max Input Level:		141.66

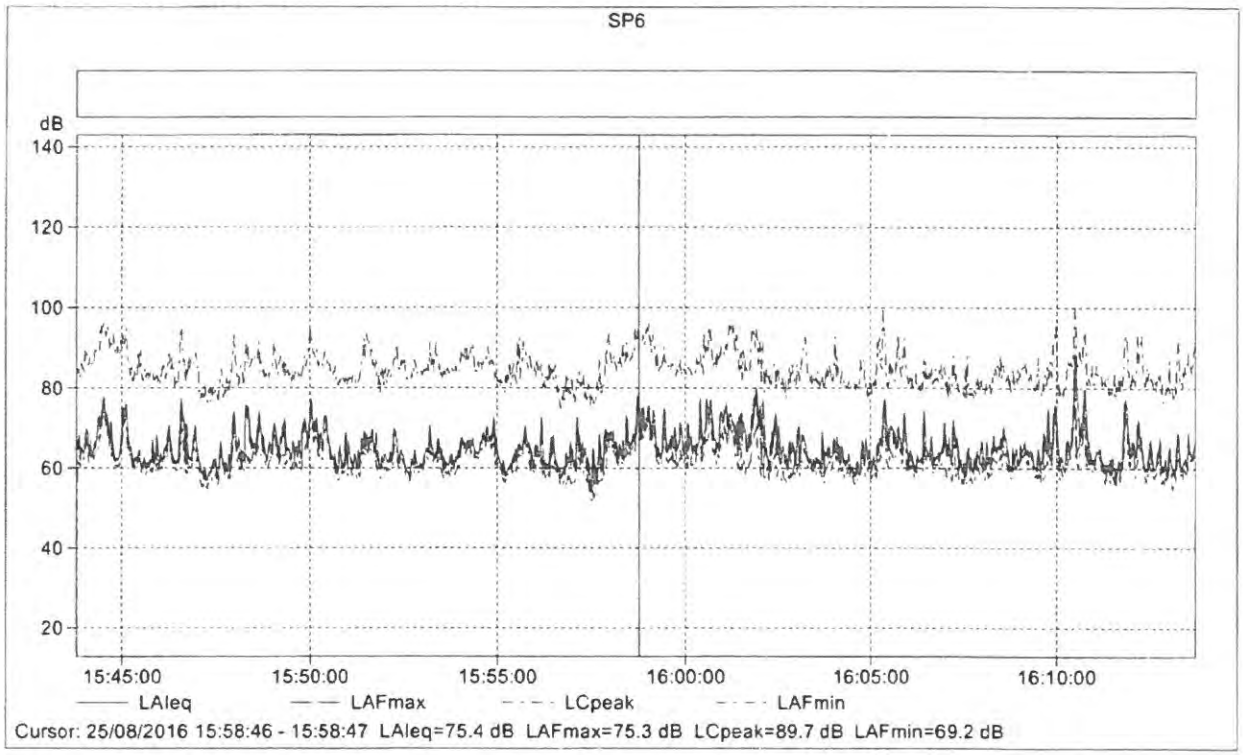
	Time	Frequency
Broadband (excl. Peak):	FSI	AC
Broadband Peak:		C
Instrument Serial Number:		3004740
Microphone Serial Number:		2983636
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field

Calibration Time:		08/25/2016 09:44:12
Calibration Type:		External reference
Sensitivity:		46.1227297782898 mV/Pa

SP6

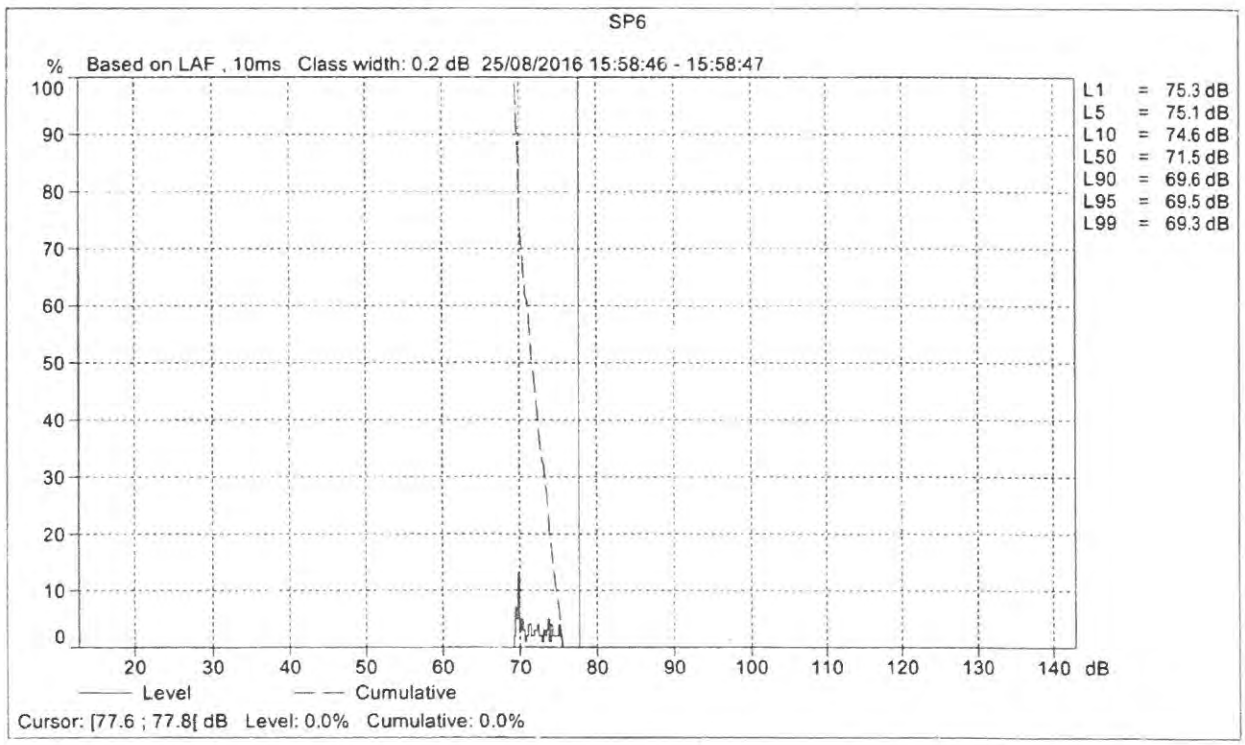
	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAFmax [dB]	LAFmin [dB]
Value				0.00	65.6	88.2	51.8
Time	15:43:47	16:13:47	0:30:00				
Date	25/08/2016	25/08/2016					

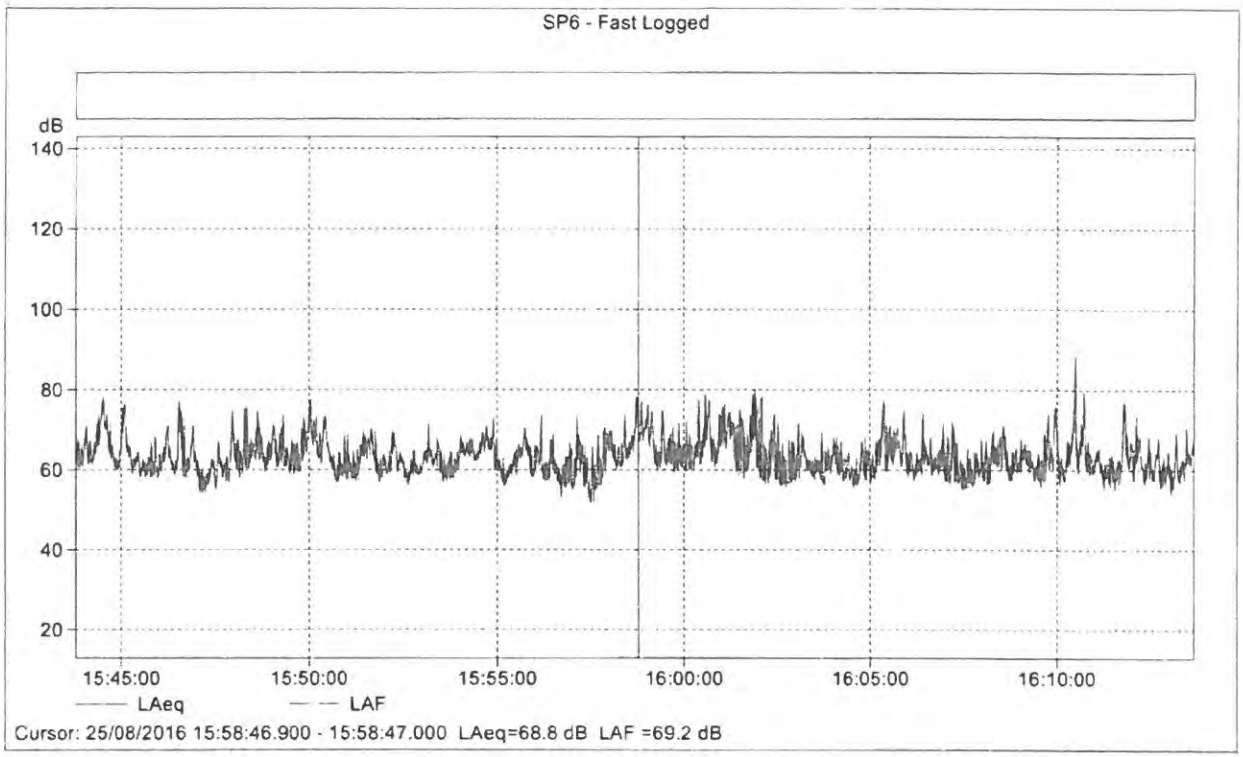




SP6

	Start time	Elapsed time	LAleq [dB]	LAFmax [dB]	LAFmin [dB]
Value			75.4	75.3	69.2
Time	15:58:46	0:00:01			
Date	25/08/2016				





SP6 - Fast Logged

	Start time	Elapsed time	LAeq [dB]
Value			68.8
Time	15:58:46.900	0:00:00.100	
Date	25/08/2016		

Position	SP7
Start Time	12:25:10

B&K Project Ref No	21
End Time	12:55:10

Weather Conditions	
Temperature	19.9 c
Wind Speed	7 mph
Wind Direction	NE
Visibility	Good
Cloud Cover	0%
Humidity	89%
Pressure	1016.0 mbar

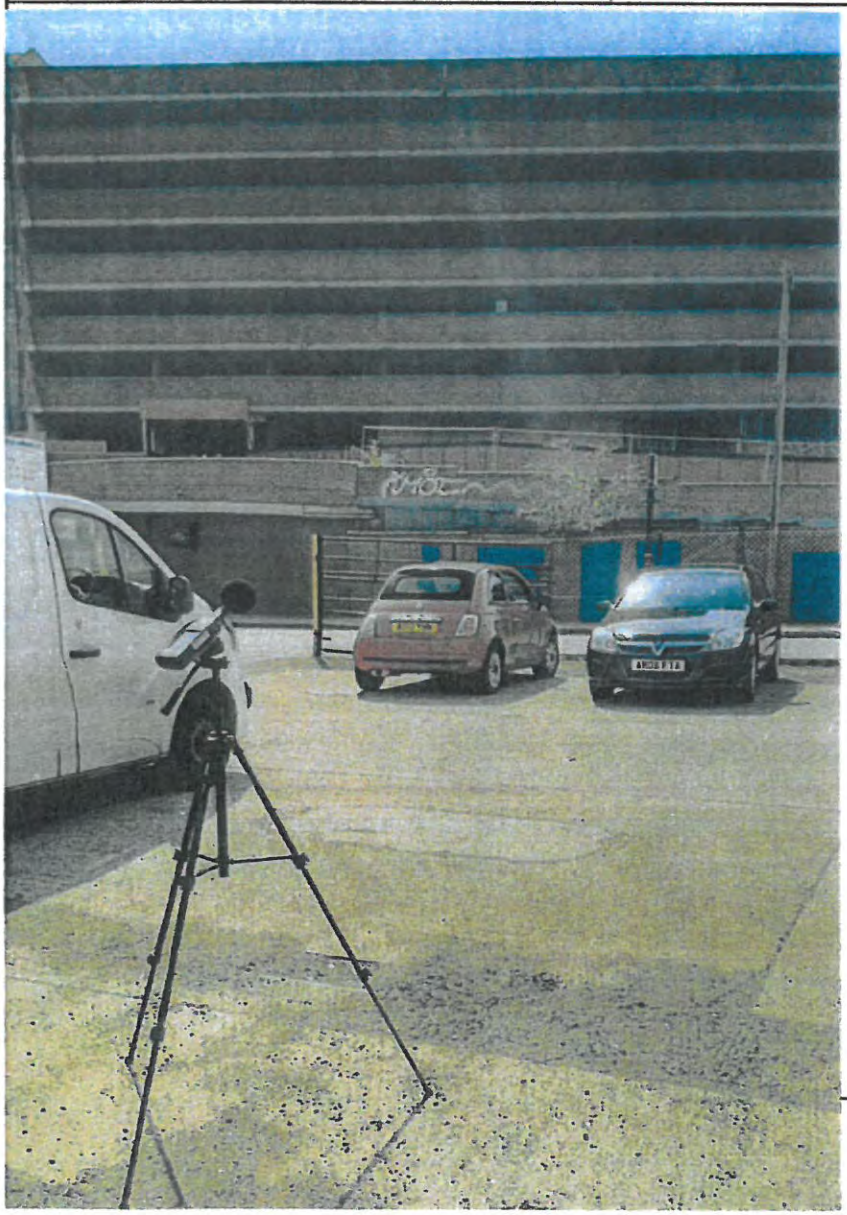
Ground Conditions
Gravel car park, buildings surrounding carpark and roadway, parked vehicles within 3m of SLM

Primary Noise	Road traffic

Secondary Noise	Bus Stop Activity

Observations & Comments	
Time	Noise type, dB and duration
Constant	Road Noise
Intermittant	Bus Activity, Pedestrian movements and close proximity car movement

Pictures of Spot Position and Set-Up



SP7

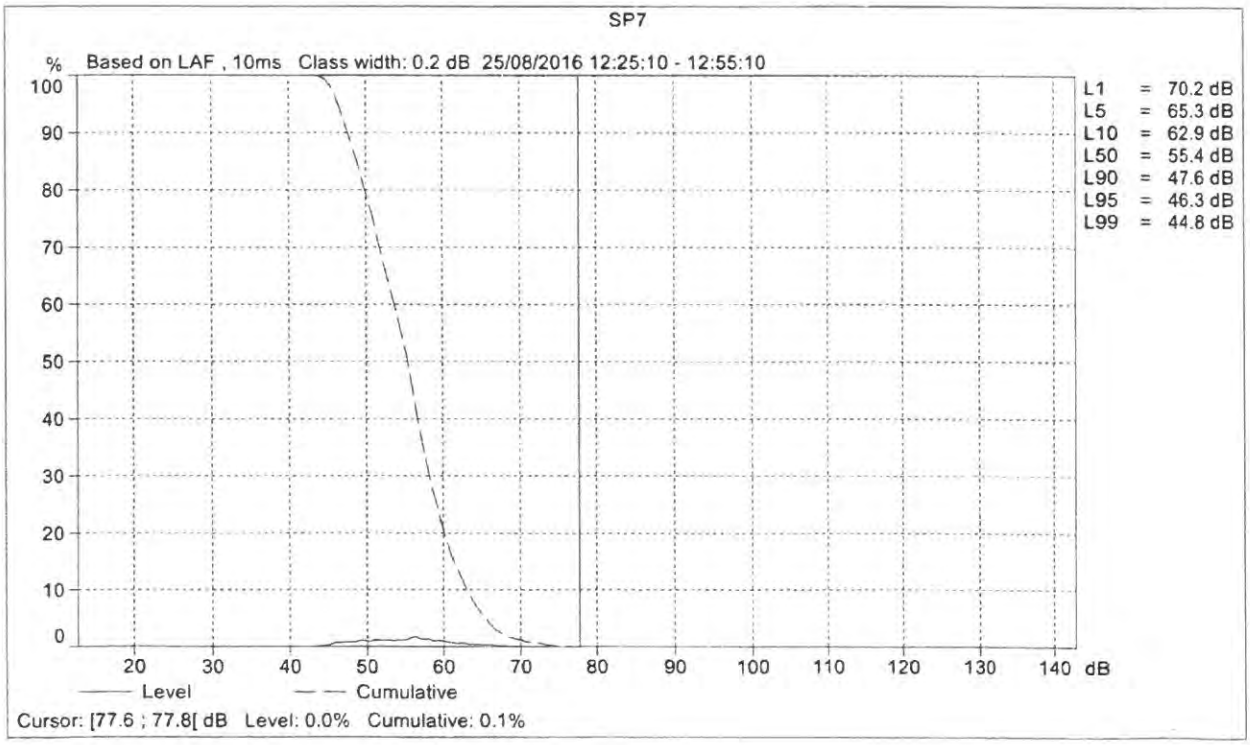
Instrument:		2250
Application:		BZ7224 Version 4.6.3
Start Time:		08/25/2016 12:25:10
End Time:		08/25/2016 12:55:10
Elapsed Time:		00:30:00
Bandwidth:		Broadband
Max Input Level:		141.66

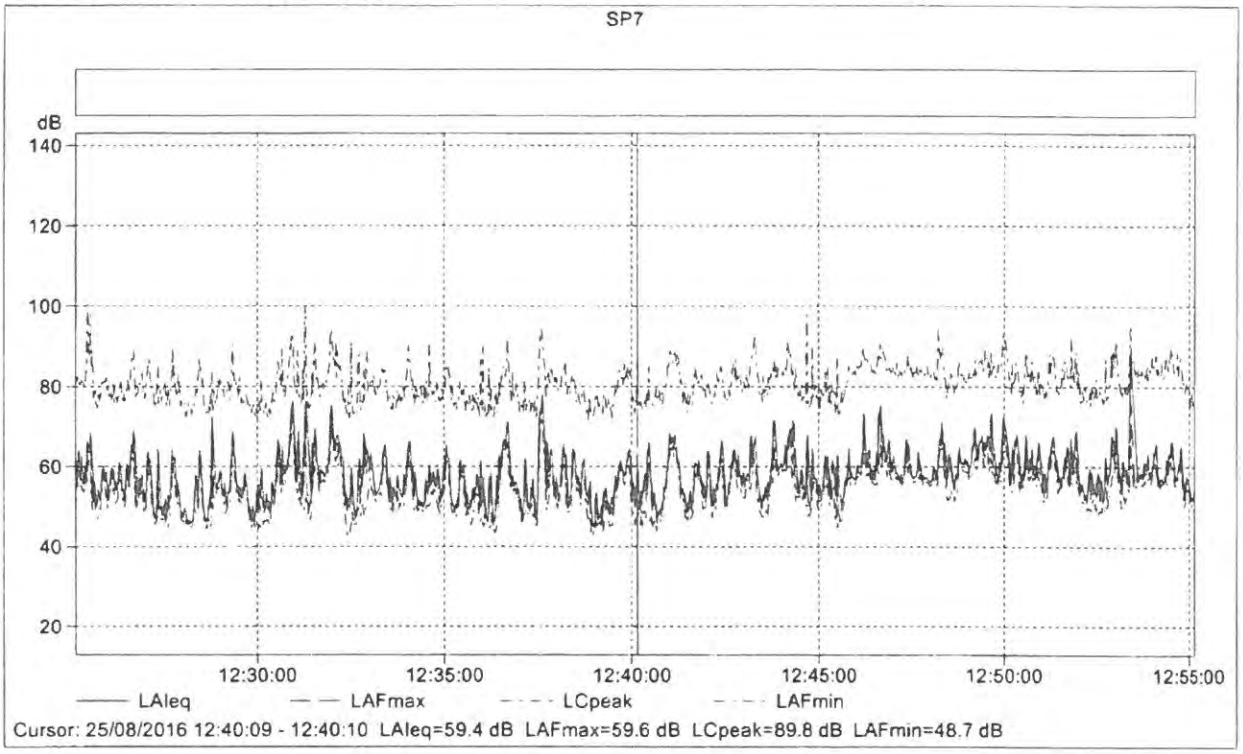
	Time	Frequency
Broadband (excl. Peak):	FSI	AC
Broadband Peak:		C
Instrument Serial Number:		3004740
Microphone Serial Number:		2983636
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field

Calibration Time:		08/25/2016 09:44:12
Calibration Type:		External reference
Sensitivity:		46.1227297782898 mV/Pa

SP7

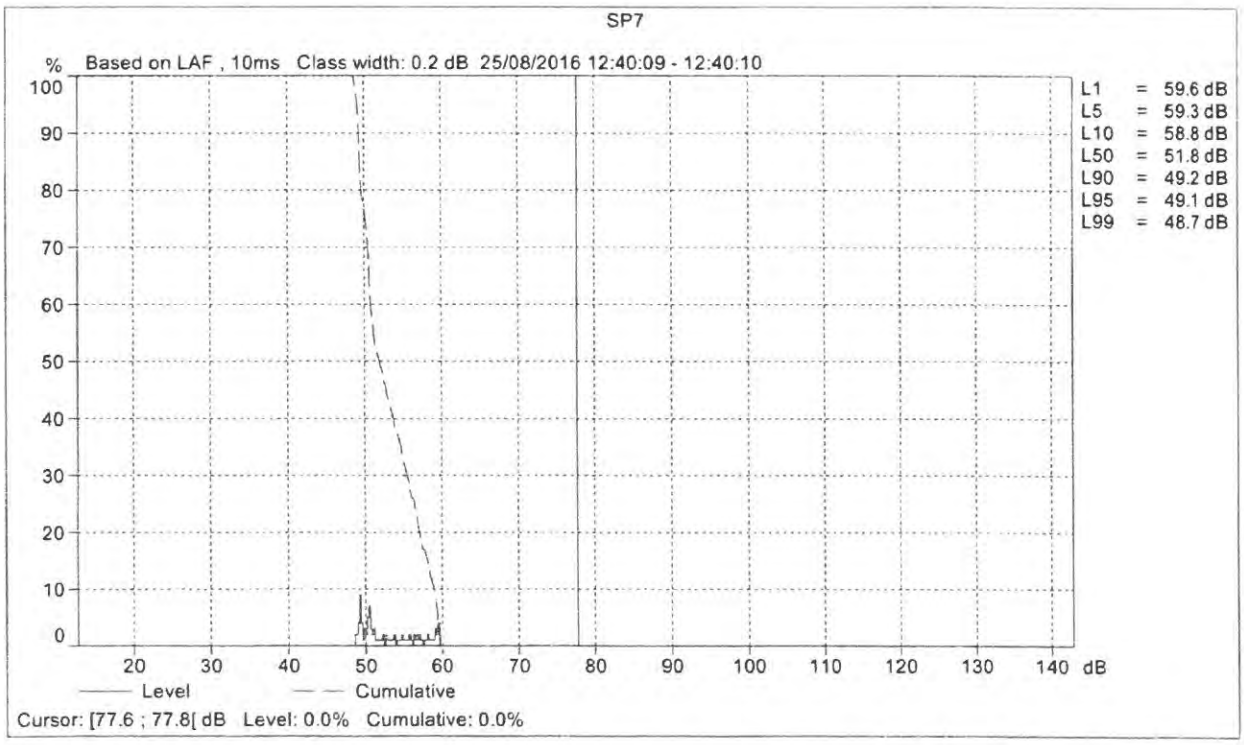
	Start time	End time	Elapsed time	Overload [%]	LAeq [dB]	LAFmax [dB]	LAFmin [dB]
Value				0.00	60.2	87.5	42.3
Time	12:25:10	12:55:10	0:30:00				
Date	25/08/2016	25/08/2016					

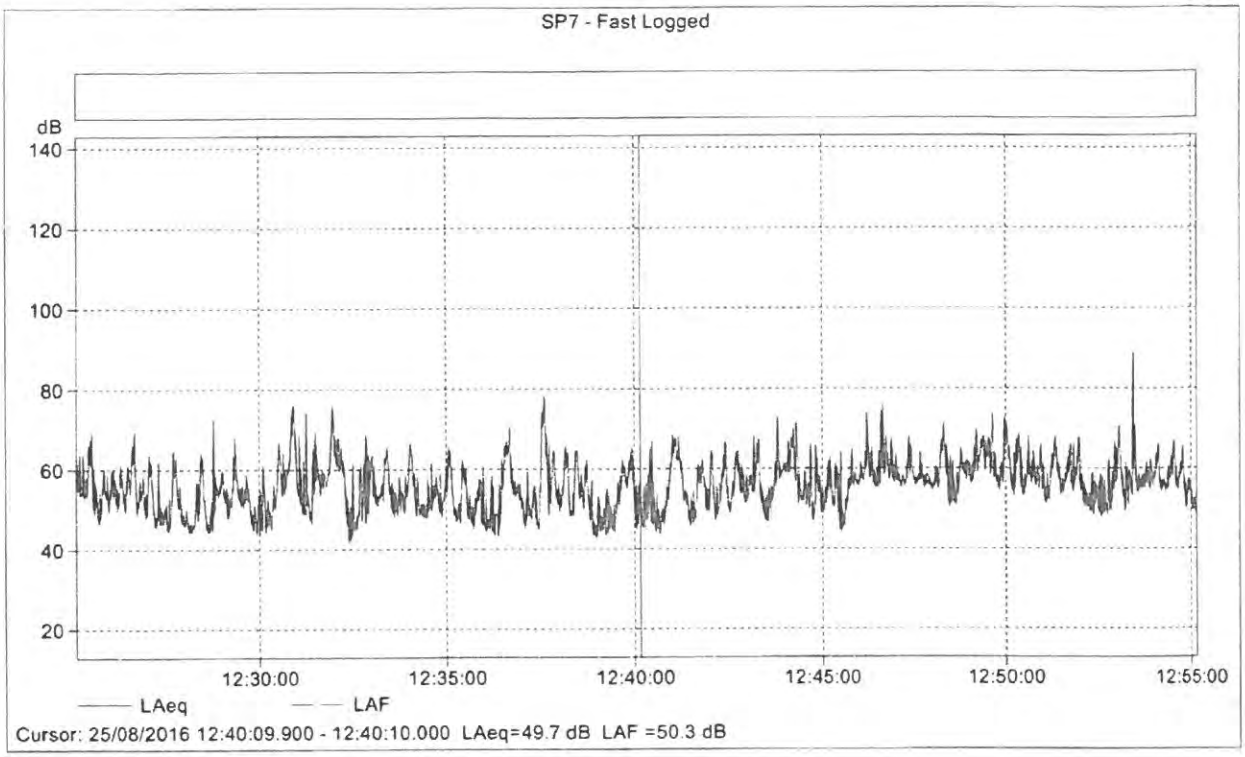




SP7

	Start time	Elapsed time	LAleq [dB]	LAFmax [dB]	LAFmin [dB]
Value			59.4	59.6	48.7
Time	12:40:09	0:00:01			
Date	25/08/2016				





SP7 - Fast Logged

	Start time	Elapsed time	LAeq [dB]
Value			49.7
Time	12:40:09.900	0:00:00.100	
Date	25/08/2016		

ENVIRONMENTAL NOISE ASSESSMENT ADDENDUM

FOR

ANGLIA SQUARE, NORWICH

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

Site Address:
Anglia Square
Norwich
Norfolk, NR13 1DZ

Version Number:
Version 1

Report Date:
August 2018

Customer:
Weston Homes Plc
The Weston Group Business Centre
Parsonage Road
Takeley
Essex, CM22 6PU

Prepared By:
Stansted Environmental Services Ltd
The Stansted Centre
Parsonage Road
Takeley
Essex, CM22 6PU

Environmental Noise Assessment Addendum: Comments on Norwich City Council Environmental Protection Team Response on ENA (NCC Ref: 18/00330/F)

A hybrid planning application by Weston Homes and Columbia Threadneedle, to comprehensively redevelop Anglia Square, Norwich (LPA ref: 18/00330/F), was submitted to Norwich City Council on 2nd March 2018. The application comprised a full set of technical documents to assess the potential impacts of the proposals, including an EIA which covered a number of topics. Please refer to the original application documents for further details.

Following submission of the application, and the statutory consultation exercise, the applicant has worked closely with the Council to review the consultation responses received from the local community, statutory consultees and other key stakeholders, and to identify an appropriate response where considered necessary. As a result of on-going discussions with Norwich City Council, a number of changes to the originally submitted scheme are now proposed, including the reduction in height of the proposed landmark building by 5 storeys; amendments to the elevation design of Block A; the inclusion of public conveniences in Block A, resultant amendments to the proposed dwelling mix between the outline and detailed phases; changes to the landscape strategy; additional highways improvements; and greater flexibility for B1 use within the proposed commercial floor space. The application continues to seek consent for up to 1,250 dwellings. These changes comprise the Amended Scheme submitted in August 2018.

This document sets out where necessary a response to the relevant comments received on the originally submitted application proposals, and describes and considers the implications of the changes to the scheme now proposed. It should be noted that where relevant, this document also refers to any updates to national planning policy as set out within the recently published revised National Planning Policy Framework (July 2018).

Stansted Environmental Services (SES) had prepared an Environmental Noise Chapter within the Environmental Statement (ES) forming part of the application, which included in Appendix 9.1 an Environmental Noise Assessment (ENA).

Accordingly, SES has been instructed to prepare this Note to address the consultation comments received in relation to noise, from the Environmental Protection Team at NCC following submission of the Planning Application and its associated documentation.

The NPPF July 2018 Paragraph 180 requires, new development to, inter alia, “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”. Reference is made to the Noise Policy Statement for England 2010, to which NPPF 2012 also referred, and this is addressed in the Environmental Statement Chapter 9 Paragraphs 9.6-9.8.

In preparing this Note, SES has reviewed the two documents forwarded from NCC via email on the 31st May 2018 titled;

- Anglia Square – EP Consultation Response NOISE draft
- EH Noise and contaminated land

The EP Consultation Response has identified a number of “Deficiencies and uncertainties in the ENA that will need clarification and which are worthy of further consideration. Further work will need to be carried out so that all relevant information can be provided, so that the Council can make a properly informed representation as part of the planning application”.

Prior to responding to the points raised in the consultation response, SES note, that no reference is made by the Environmental Planning team to the Environmental Statement Chapter 9: Noise, which formed part of the planning application documentation. This is relevant, because the majority of points raised by the Environmental Planning team have been addressed within the Chapter and reference is made to the appropriate sections of the Chapter as part of this response.

For ease, the same numbering format as used in the EP consultation response has been used and the points have been reproduced in bold italics.

1. ***No consideration was given to the noise climate during the construction phases for the application site which may significantly and adversely impact the occupiers of residential units. For example, the occupiers of residential units in the first phases of the development will effectively living within or adjacent to a considerable sized construction site that will generate significant levels of noise.***

   The construction phase impact on the site was identified in Paragraphs 9.23 -9.25 (including Tables 9.3 and 9.4) of the Noise Chapter. In essence, whilst it was too early to detail the exact construction techniques and types of plant to be used, a worst-case scenario was considered.

   Construction effects were then discussed in paragraphs 9.31 – 9.34 and a summary of the significance criteria based on the values stated within BS5228 was provided in table 9.6.

   Mitigation measures were discussed in paragraphs 9.36 – 9.38, which included;

   - Application of controlled working hours for noisy activities, which are typically; Monday – Friday 08.00 to 18.00 hours and Saturday 08.00 to 13.00 hours, with no work on Sundays or Bank Holidays.
   - Provision of site boundary barriers as needed.
   - Adoption of the principles of "Best Practicable Means".
   - Use of compressors that have silencers or are sound reduced models.
   - Fitting of silencers or mufflers to pneumatic tools, when necessary.
   - Programming deliveries to arrive only during daylight hours, and acting carefully when unloading vehicles to minimise disturbance to local residents.
   - Prohibiting delivery vehicles from waiting within the Site with their engines running.
   - Ensuring all plant items will be properly maintained and operated according to the manufacturer's instructions.
   - Siting plant as far as possible, away from noise sensitive receptors. (Plant and machinery noise will be controlled via condition to mitigate impact on the surrounding area).

   In addition, confirmation was given in paragraph 9.38 of the Construction Environmental Management Plan implement the above controls for approval by NCC, which would then be implemented by Weston Homes, in order to ensure that noise and vibration limits during construction were monitored and kept to acceptable levels.

2. ***Furthermore, no consideration was given to the cumulative noise impact of the application site on the occupiers of the residential units once the construction phase has been completed. No information has been submitted detailing the installation of plant and machinery including; air handling units, refrigeration etc. which could impact internal and external noise receptors.***

   With respect to installed permanent plant, it is intended that this will be addressed at the detailed design stage of the development, via use of planning conditions attached to the current Hybrid and future Reserved Matters consents. Nevertheless, for assurance at the Hybrid application determination stage, reference was made in Environmental Statement paragraph 9.48 to installed plant being designed/selected (or attenuated) to be 5dB below the existing background level.

3. ***The current suggested mitigation measures are not considered to be sufficient because the glazing elements have been considered in isolation rather than taking into account any losses in the sound reduction index due to the fitting of the glazed unit in the window opening which may introduce air gaps and the installation of passive ventilation such as trickle vents etc. resulting an overall reduction in the sound insulation and protection of the occupiers of the properties to external noise sources.***

   The mitigation measures refer to the required comprehensive attenuation needed to meet the desired internal noise levels as stated within BS8233:2014. Whilst reference to a standard glazing

window was noted in the ENA and the Noise Chapter (Paragraph 9.39), this is for the whole unit including any trickle ventilators or mechanical ventilation as noted in paragraph 9.42. Furthermore, current Building Regulation requirements for insulation do not allow for "air gaps" between windows and walls, the avoidance of which is guaranteed by required air testing. Accordingly, a planning condition which requires attenuation to an internal level of 30dB at night, 35dB during daytime, can be achieved via specification of appropriate products, and via construction which satisfies Building Regulations.

4. ***The application site will affect the noise climate for the area and there are needs to be some detailed modelling of impact of vehicle movements, changes to traffic flow and the contribution of plant and machinery and other noise sources to the noise climate so that appropriate mitigation measures can be properly considered. It is possible that the changes might not significantly affect the noise climate for the area but any potential changes must be properly considered.***

   Environmental Statement Paragraph 9.51-9.53 refer to the Transport Assessment prepared as part of the planning application to identify if there were any cumulative effects during the operational phase of the development. The Transport Assessment Model took account of the agreed modelling of the Norwich Northern Distribution Road (NDR) which will significantly reduce traffic flow within the city centre. The NDR is expected to be fully operational in 2018 and traffic flow in the city centre is forecast to be almost half of that in 2012 which was the base year for the traffic assessment model.

   On this basis it was concluded that vehicle movements on St. Crispins Road would be lower from 2018, even with the development. Only Edward Street would experience a material increase in traffic, but this is by comparison with the current situation with the multi-storey car park closed. It is contended that the proposed car club vehicles, the ample cycle storage and the proposed improvements to cycling and walking connectivity between the site and its surroundings, all of which will assist in limiting car usage associated with the site, no other mitigation to the noise climate of the area is needed.

   It should also be noted that the parking numbers that have been stated are based on maximum figures and as such the parking allowance on the development may reduce further.

5. ***A number of the proposed residential apartment blocks will have building facades located close to the highway on Pitt Street, New Botolph Street, and St Crispins Road. The noise levels at the facades of these buildings are likely to be significantly higher than those suggested by SES in their submitted ENA. The fixed and spot noise measurements that have been used during the noise survey could have been expanded to include positions much closer to the highway giving more representative building façade noise levels.***

   The measurement positions were deemed satisfactory as the fixed noise monitoring positions targeted (Position 1) the St Crispins Road elevation of the proposed development (identified as the primary noise source affecting the site) with Position 2 being a more central position. Seven spot monitoring measurements were also take for thirty minute periods around the boundary of the site which correlated well with the data collected by the fixed monitoring stations.

   CadnaA modelling has now been carried out to assess the noise levels at the building facades. Copies of the models have been attached.

   As can be seen from the models, the highest daytime level of noise at the facades are within the >65dB banding which correlates with the 67.2dB level referred to in the ENA. This is further broken down as follows;

   - Maximum façade levels on the Pitt Street/New Botolph Street elevation elevation = >60dB
   - Maximum façade levels on the Edward Street = >65dB
   - Maximum façade levels on the St Crispins Road elevation = >65dB
   - Maximum façade levels on the Magdalen Street elevation = <60dB

   As such, the level of attenuation required remains 32dB as stated within the ENA at the noisiest elevations.

6. ***There does not seem to be a distance correction calculation for the expected increased noise levels at the proposed building facades which front onto the highway. As a consequence, the façade noise levels suggested by SES appear to be significantly lower than would be expected. Previous noise surveys indicate considerably greater levels of noise at the boundary and it is essential that SES confirm whether or not any distance correction has been applied or not. As a consequence, it would appear that the proposed sound insulation i.e. the glazing elements are insufficient unless SES can demonstrate otherwise.***

   Please refer to the CadnaA models. It is correct to base these on SES's recent noise surveys rather than previous historic surveys.

7. ***The road traffic noise especially on the southern elevation of the site is particularly challenging. As a consequence some of the proposed residential dwellings will require additional glazing and supplementary ventilation in order to achieve the recommended internal sound levels. An ENA for a previous planning application suggested the sound insulation performance of the facades and windows on the facades of properties located on the St. Crispins elevation will require a maximum SRI rating of 42dB. These proposals are acceptable to provide occupiers of the residential accommodation with adequate protection from road traffic noise. We will require the specification of the glazing and ventilator units to be installed, to include the manufacturers stated sound reduction rating.***

   ES Chapter 9 – Noise Operational Phase paragraphs 9.40-9.42 already notes that all dwellings will be provided with acoustically treated trickle vents or mechanical ventilation where external noise survey results dictate that such arrangements are necessary. Further noise surveys can be required by condition prior to the submission of Reserved Matters applications for each phase.

   Window specification details will be provided to the developer by the glazing subcontractor once appointed as will the ventilation details once the detailed design of the scheme has been completed.

   Planning conditions can be used to enable NCC to consider and approve the specifications of these elements to ensure adequate noise attenuation.

8. ***As a consequence, the building envelope including glazing elements for the block facing the St. Crispins Road will need to be carefully selected to ensure there is sufficient protection from road traffic noise for the occupiers of the proposed residences or otherwise consider alternative uses for this block such as office, leisure etc.***

   The southern end of Block F, fronting St Crispins Road between the roundabout and the new St George's Street is already proposed as a hotel. It is proposed that this building will be served by an air source heat pump heating/cooling ventilation system, so windows can be sealed, and specified with appropriate attenuation Blocks G and J, facing St Crispins Road are set further back and as the CadnaA models demonstrate, noise levels at their respective facades can be adequately attenuated by standard double glazing with acoustic trickle vents. The specification can be approved by NCC via planning conditions.

9. ***No details have been submitted of noise and dust mitigation during the construction phases for the application site. Details of mitigation measures include noise minimisation and dust suppression will need to be submitted as well as operating times for particularly noisy activities.***

   As noted in point 1, details of how noise and dust mitigation during construction will be achieved have been provided. Thus a Construction Environmental Management Plan will be prepared for the development which will address construction dust and noise. This will be submitted to NCC for approval via a planning condition.

10. ***No details relating to the type, number and location of on-site plant and machinery has been submitted yet. Detailed plans for the site show a number of roof garden spaces and green or living roof with some of the drawings showing what appears to be small plant rooms on the top of some of the buildings. The contribution of plant and machinery noise to the noise climate of the area needs to be taken into account before the details of the sound insulation for the residential blocks are finalised.***

As noted in point 2, details of plant have yet to be designed, however all plant will be designed/selected (or attenuated) to be 5dB below background levels. The drawings for the Amended Scheme clarify the actual/illustrative locations and scale of roof plant enclosures for the detailed/outline application areas respectively.

11. ***No details for the ventilation of the three on-site multi-story car parks have been submitted and the contribution of these ventilation systems must also be taken into account before the details of the sound insulation for the residential blocks are finalised.***

    All three multi-storey car parks will indeed require mechanical ventilation. Of these only Block A is within the detailed element of the application, but as noted in response 10, the details of plant have yet to be designed. Noise limits from plant can be specified by planning condition, as noted, and the details of noise attenuation for the residential units in the scheme can also be considered and controlled by the Local Planning Authority via planning conditions. It is anticipated that plant noise limits, and the specification of suitable insulation can together ensure that appropriate internal residential noise targets are not exceeded.

12. ***The ENA does state that the podium outdoor amenity areas should be able to meet the WHO guideline level of 55dB. However, this doesn't seem to take into account the potential contribution from plant and machinery located on the roof spaces of the buildings. The buildings located on the southern elevation i.e. facing onto St. Crispins Road do not meet the guideline levels regardless of the contribution of nearby plant and machinery. No mitigation measures have been suggested by SES in reducing noise levels on the St Crispins Road elevation such that the WHO guideline for the outdoor amenity areas can be met.***

    The CadnaA models demonstrate that the inner areas of the scheme will be afforded attenuation by the buildings themselves with levels not exceeding 50dB, which confirms the findings of the ENA. Within those communal amenity areas, any plant, eg ventilating the car parks, will be controlled by the planning condition suggested in response 10, to ensure that appropriate noise targets are not exceeded. With respect to the amenity spaces on the St Crispins Road elevation, consideration should be given to the following;

    - There is no strict planning policy that requires private balcony amenity to all residential units.
    - Residential dwellings are benefitted by extensive communal courtyards, offering high levels of amenity that is accessible.
    - In line with the above, St Crispins facing balconies can be considered 'additional' not primary amenity.
    - Through detailed design, noise levels could be reduced through careful positioning of balconies and material selection to provide screening and enhanced attenuation.

13. ***No details have been supplied relating to how background ventilation will be provided to the residential properties. For example, details have not been provided of trickle vents or other means of passive ventilation design and installation and how these will affect the internal noise levels in the bedrooms and living rooms of the proposed residential properties. The installation and operation of background ventilators will affect the internal noise levels inside the proposed residential properties and to mitigate this, care should be taken in the selection and installation of background ventilators.***

    The scheme of ventilation will be drawn up as part of the detailed design and will be in accordance with the requirements of Part F of the Building Regulations. However, the ENA has specifically noted at Paragraph 5.16 that inlets will need to be acoustically treated to ensure that noise does not affect the internal noise levels. Ventilation can be either via trickle ventilators or mechanical ventilation. This can be controlled by a planning condition.

14. ***No details of purge ventilation have been provided to allow rapid air changes in rooms especially in warmer weather when additional ventilation is required. It is assumed that the method of purge ventilation will be via openable windows which will compromise the internal noise levels especially bedrooms. However, it is likely purge ventilation will generally only be used intermittently reducing the need for active or mechanical ventilation.***

This is addressed in the Environmental Statement Noise Chapter at Paragraphs 9.40-9.42. Purge ventilation can be via open-able windows. However, to satisfy BS8233 standards, apartments located on the elevations where high noise levels have been identified will have a ventilation system incorporated that will achieve two air changes per hour, thus negating the need to open windows, and thereby ensuring that the noise attenuation measures can operate continuously, without compromising internal noise levels achieved.

15. ***The commercial use of the public spaces within the proposed development site will need to be controlled to ensure the occupier of the residential properties are not adversely affected by excessive noise such as amplified music, human noise etc. No details have yet been supplied by the applicant but this will need to be taken into account and must be appropriately conditioned if planning permission is granted. This will include suitable and sufficient sound insulation between commercial units and any adjoining / neighbouring residential properties.***

    Noted and should be dealt with by condition controlling the future occupiers of the commercial units, and the details of sound attenuation between commercial spaces and adjoining dwellings.

16. ***There should also be some consideration of the use of external areas such as the proposed St George's Square which has been suggested by the applicant may be used by customers of the restaurant and bars. This will generate additional noise which may change the to take into account additional noise sources such as human noise from diners, street entertainment, breakout of amplified music from restaurants / bars. Any permission must be appropriately conditioned to ensure adequate mitigation is provided to reduce the impact of commercial activities described above.***

    As above.

17. ***Conditions might include the restrictions on external amplification, the setting of internal sound levels for PA/sound systems by the Environmental Protection team, the provision of sound limiting devices, internal lobbies to reduce the break-out of internal noise from restaurants, bars and other commercial units as well as other means of preventing sound transmission and break-out.***

    Noted.

18. ***The ENA is unclear whether all of the proposed balconies meet the WHO guideline for the outdoor amenity areas. It would be very useful if SES could confirm whether or not they meet the WHO guideline level. If they do not then further mitigation measures will be necessary unless this requirement is relaxed.***

    The CadnaA model identifies that not all of the elevations will achieve the WHO guideline level, however as noted in point 12, the proposed scheme provides sufficient alternative amenity space, and the Council's planning team have acknowledged that such balconies represent extra amenity space which can be used when traffic levels are low.

19. ***Taking into account the above points, additional sound insulation such as improved glazing / material specification may be required. This may provide the occupiers with the necessary acoustic protection in achieving the internal noise levels recommended by WHO 1999 Guidelines for Community Noise although this may be difficult to achieve for some balconies.***

    Please refer to the CadnaA model and the response to 18 above.

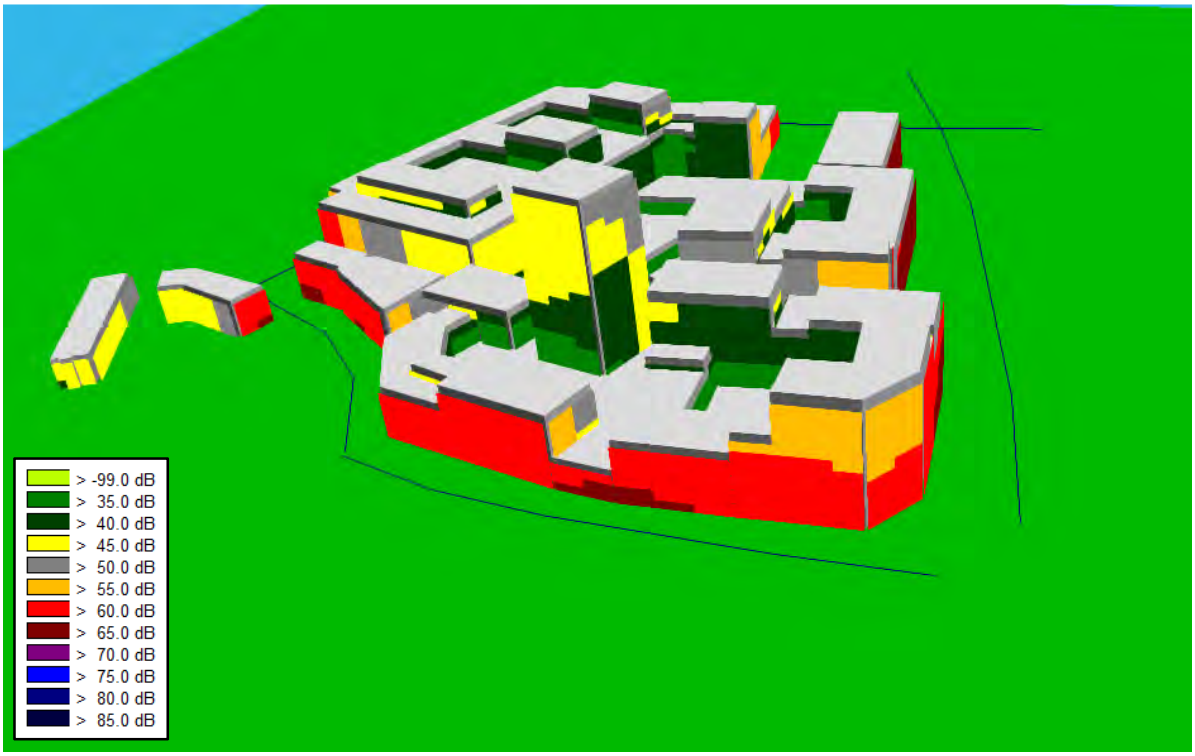
Points 20-26 are conclusions derived from the above points which have now been addressed, e.g for point 20, point 5 confirms that CadnaA modelling has now been carried out, and is attached.

The above information addresses each of the points raised by the NCC Environmental Protection, including confirming where planning conditions are anticipated by the applicants in order to properly mitigate and control noise impact. Accordingly, it is contended that the Environmental Statement Chapter 9 and Environmental Noise Assessment, together with this Note, jointly demonstrate that the Hybrid Application Scheme is acceptable in terms of its construction and operational noise/dust impact, and that a satisfactory

noise environment will be produced both within the proposed dwellings, and in their communal amenity space and private balconies, when the latter are likely to be used.

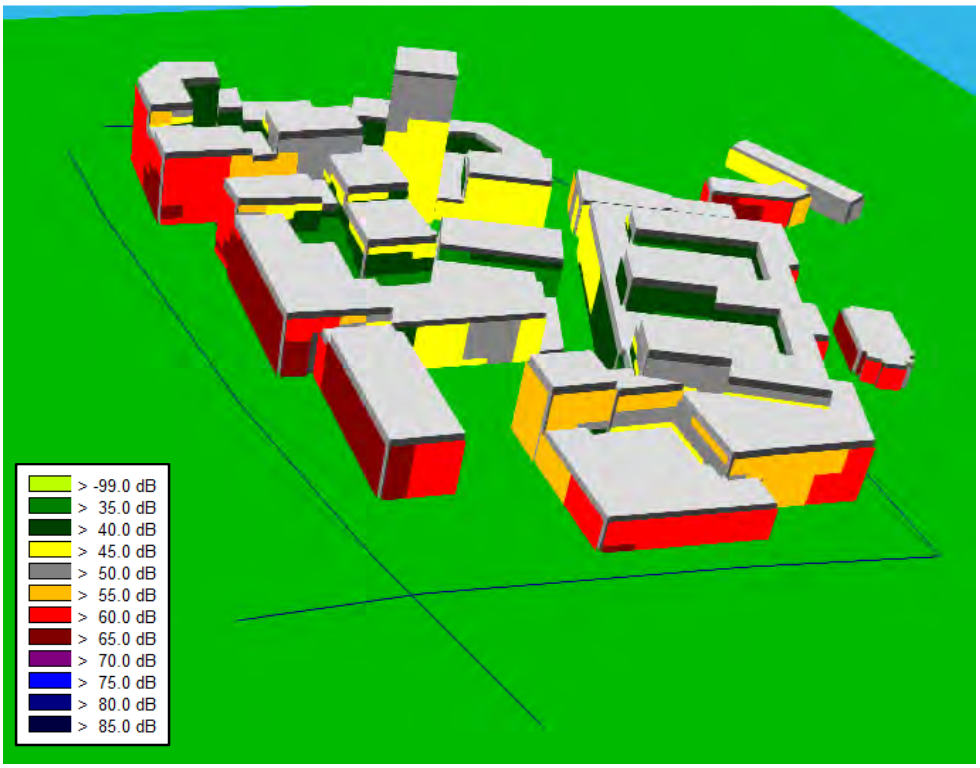
Prepared by:

Silvio Petrasso BSc (Hons)
CMIOSH, MIIRSM, MIOA, IMAPS, ACIEH
Associate Director (Environment)

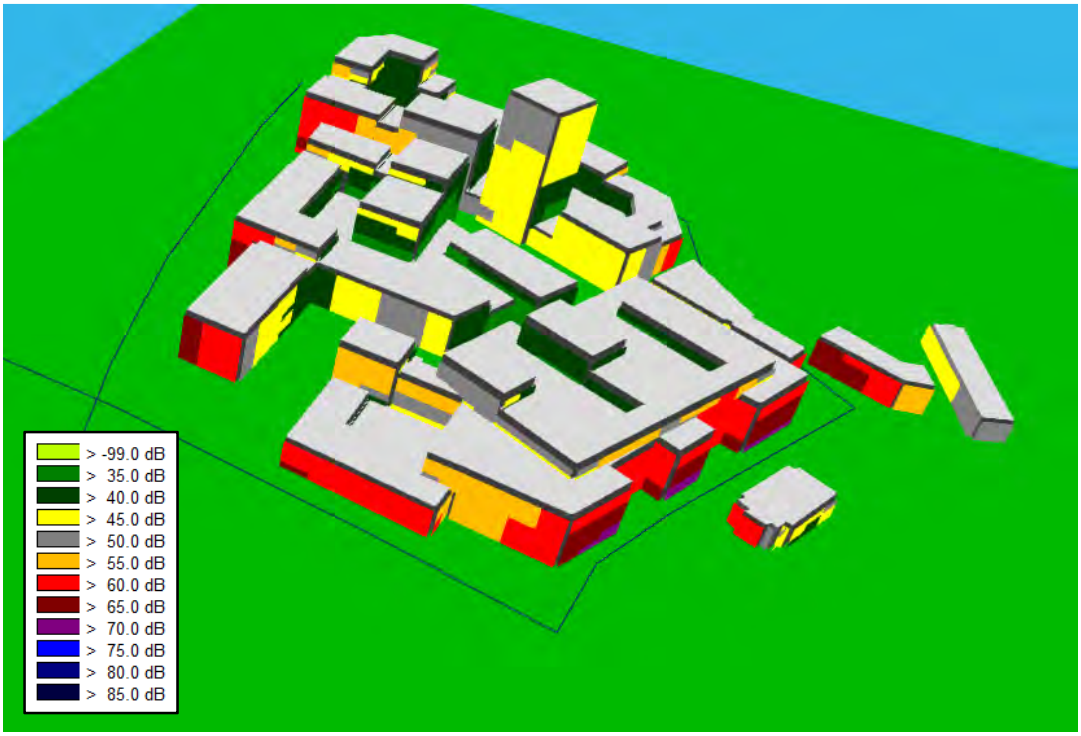


Pitt Street elevation

St Crispins Road elevation



Magdalen Street elevation



Edward Street elevation

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
Parsonage Road
Takeley
Essex
CM22 6PU

Prepared By:
Stansted Environmental Services Ltd
The Stansted Centre
Parsonage Road
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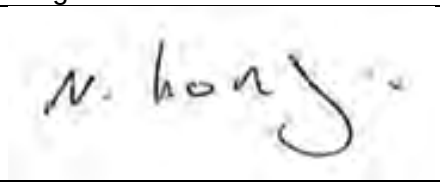
CM22 6PU

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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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 Datasheet

Appendix E – Site Plan

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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.

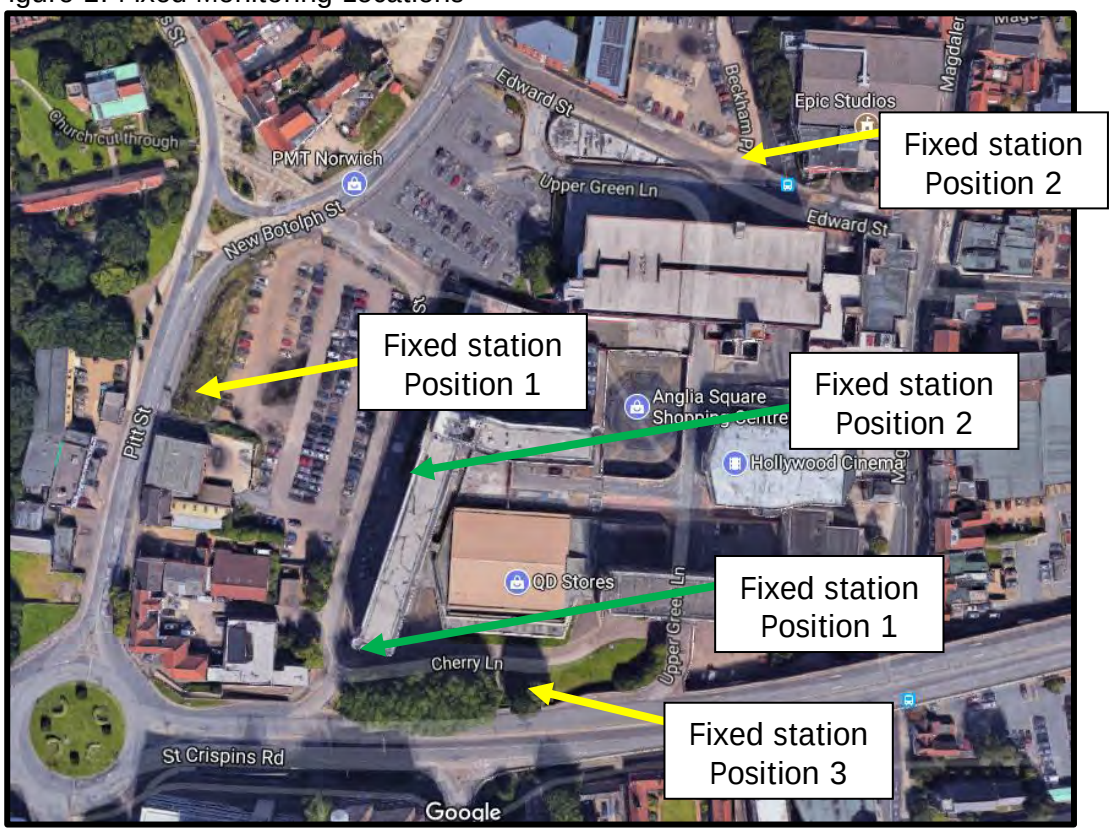
1.4 Two fixed monitoring locations were set up to the front of the site on Sovereign House facing Botolph Street. Continuous measurements were taken over a 7 day period. (Green: August 2016)

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).

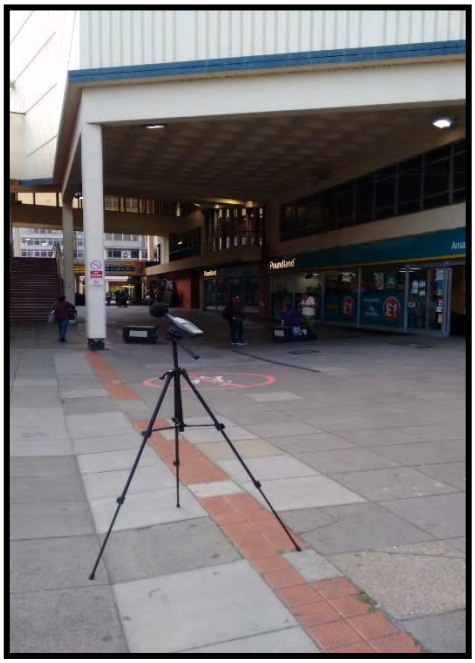
Position 1

Position 2

Position 3

Position 4

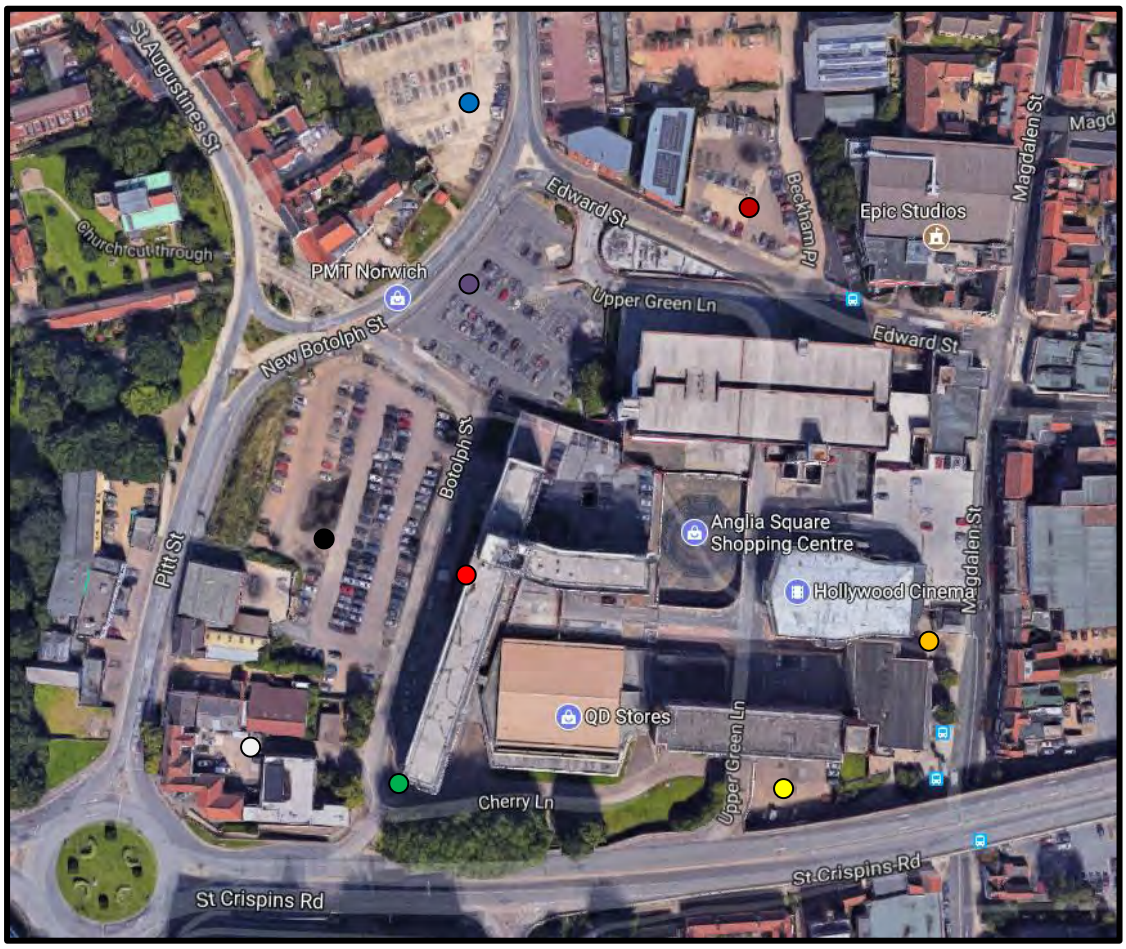
Position 5



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.

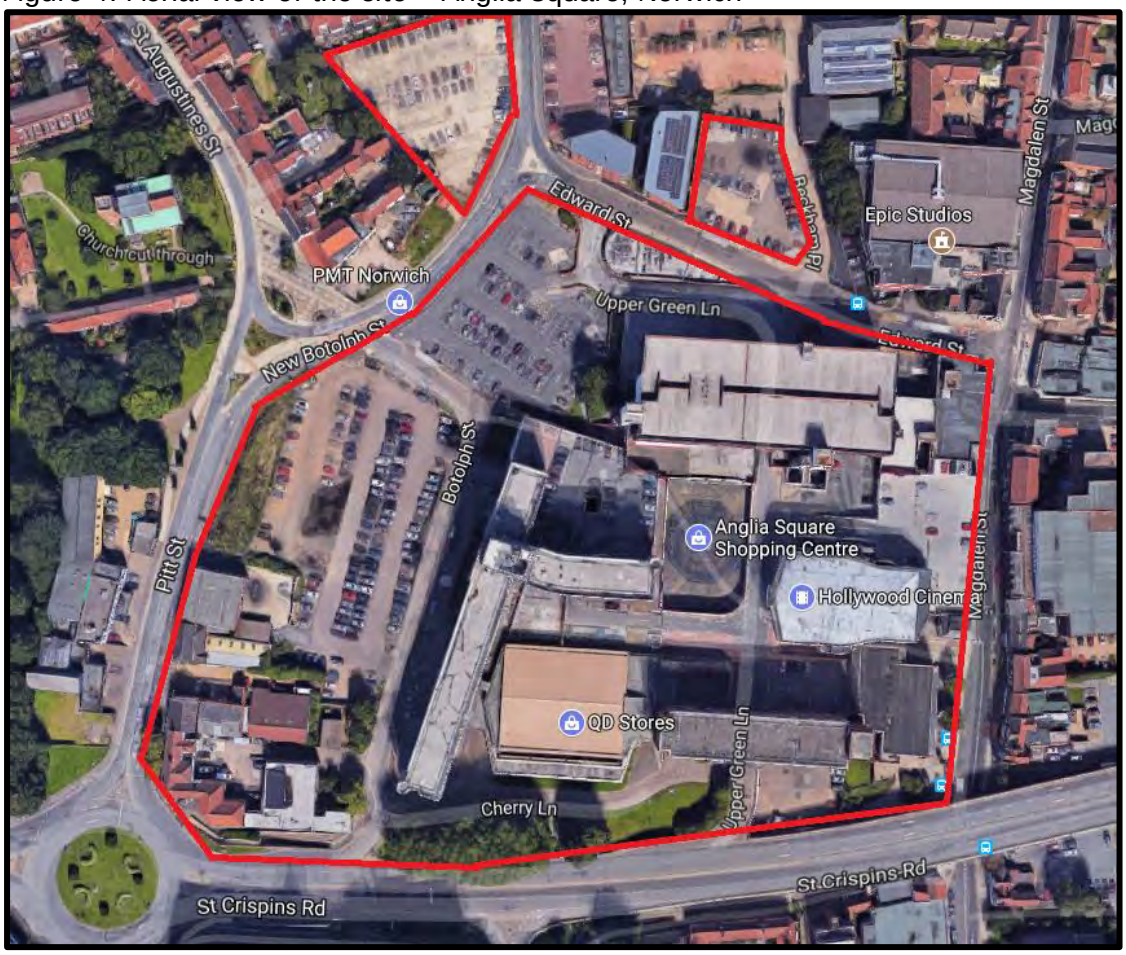
1.19 This report is necessarily technical in nature. Therefore to assist the reader, a glossary of terminology relating to noise is contained in Appendix A.

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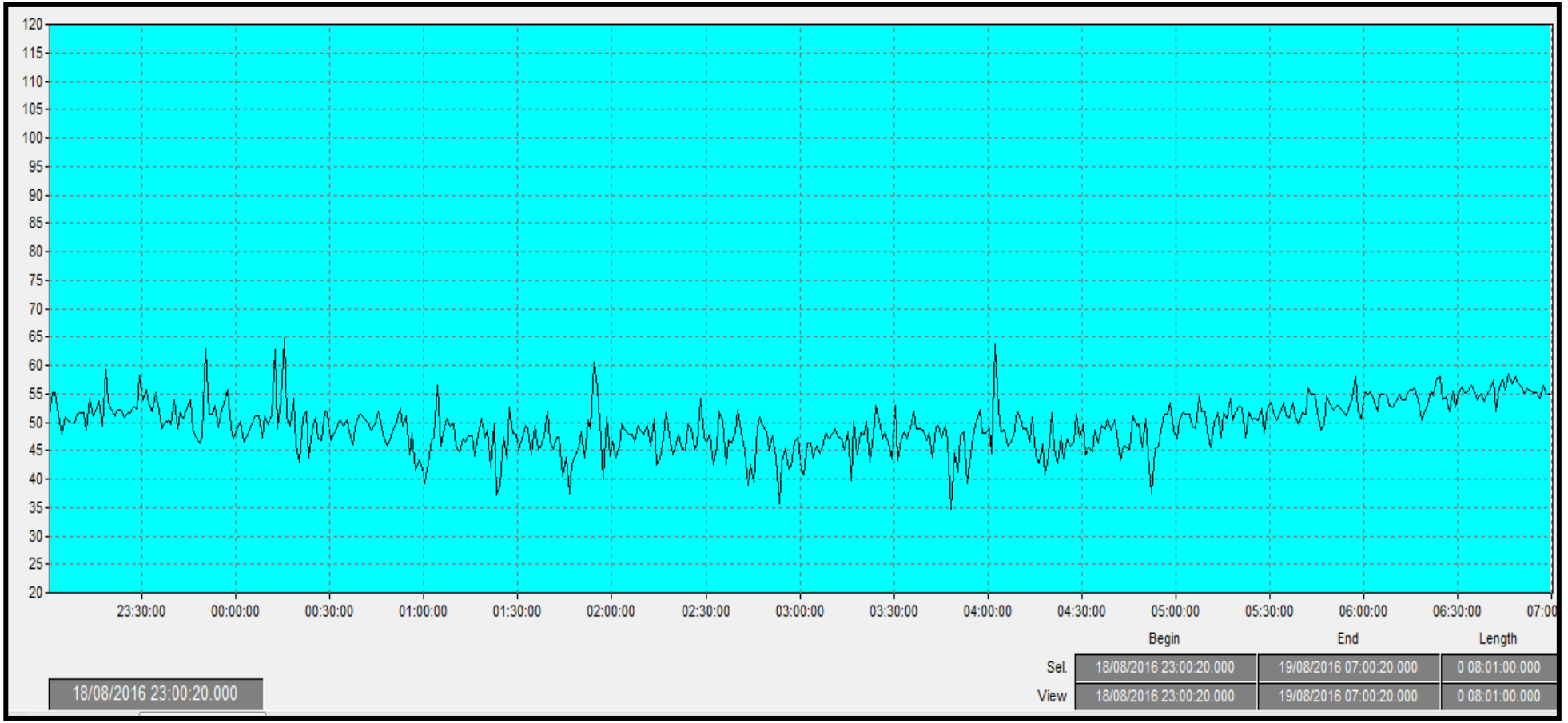
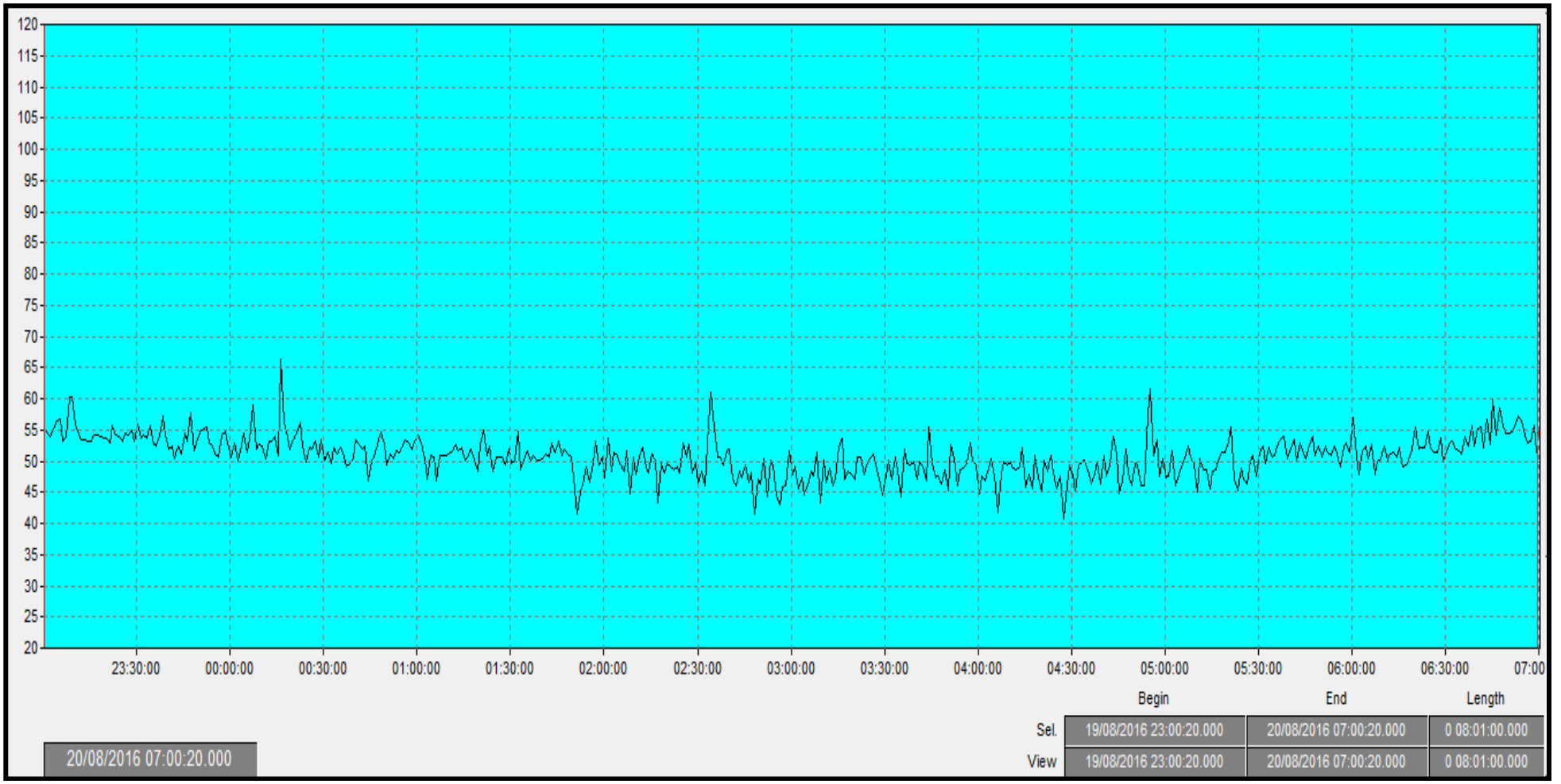
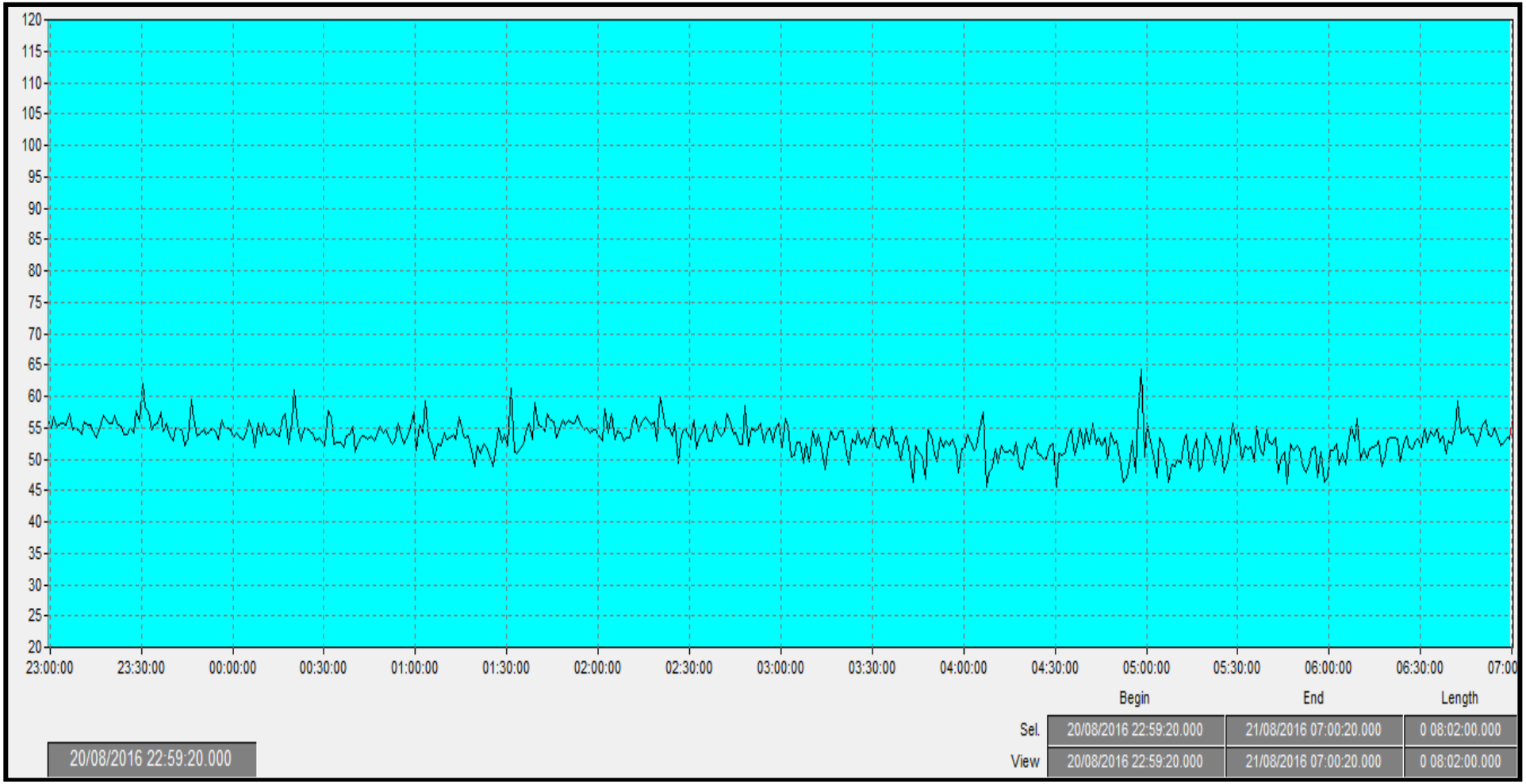
Graph 1: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 18th/19th August 2016



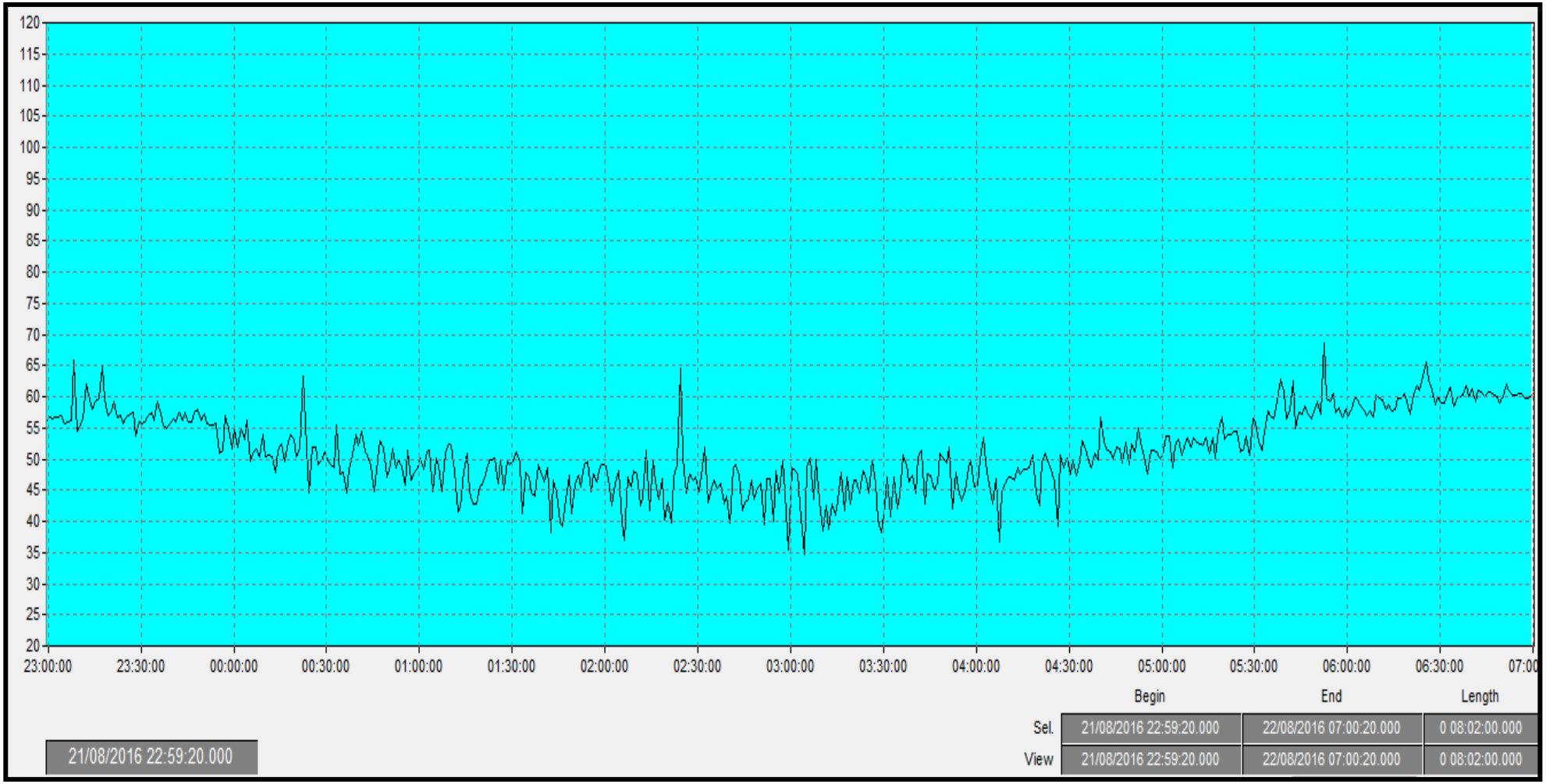
Graph 2: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 19th/20th August 2016



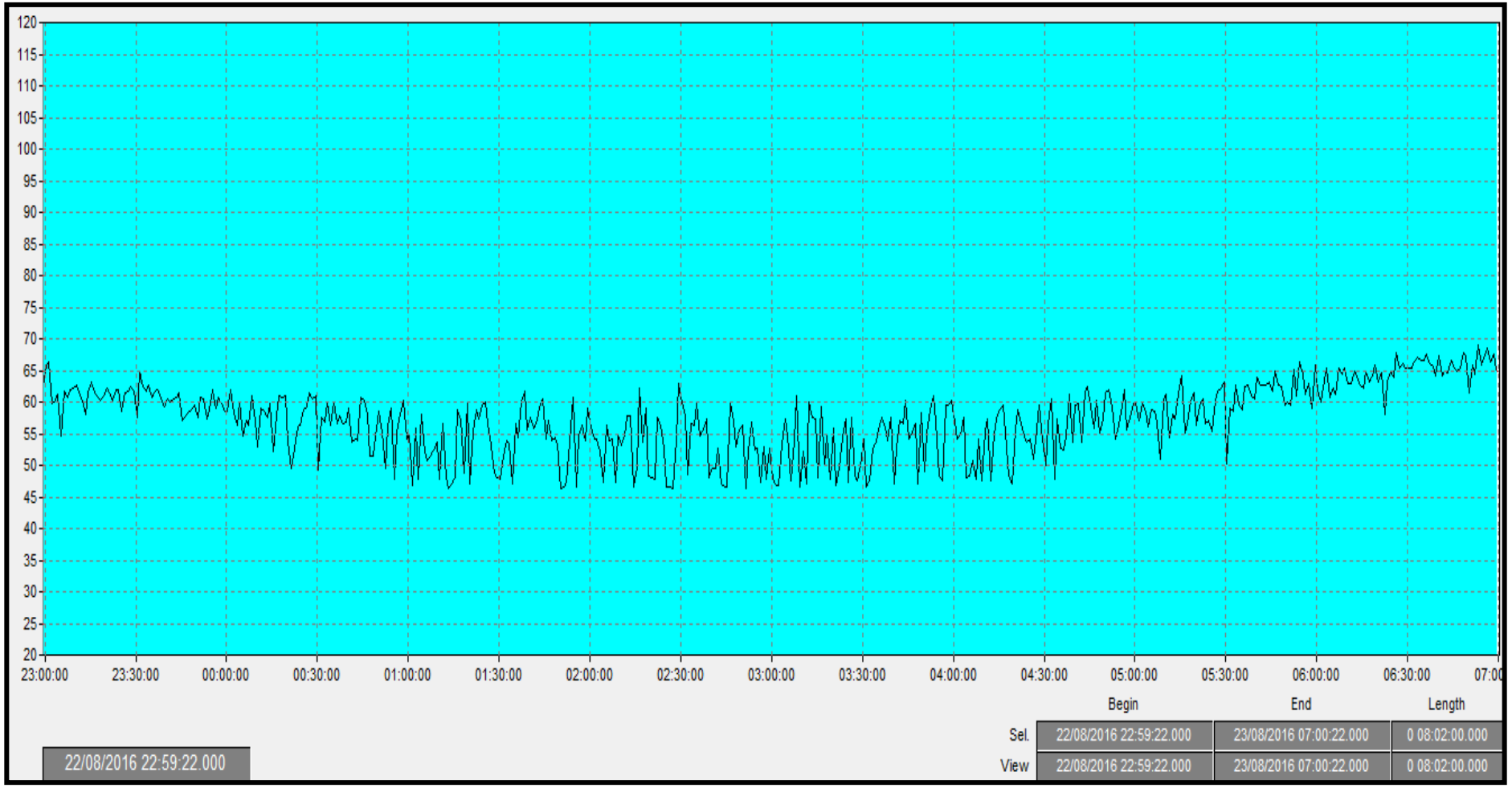
Graph 3: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 20th/21st August 2016



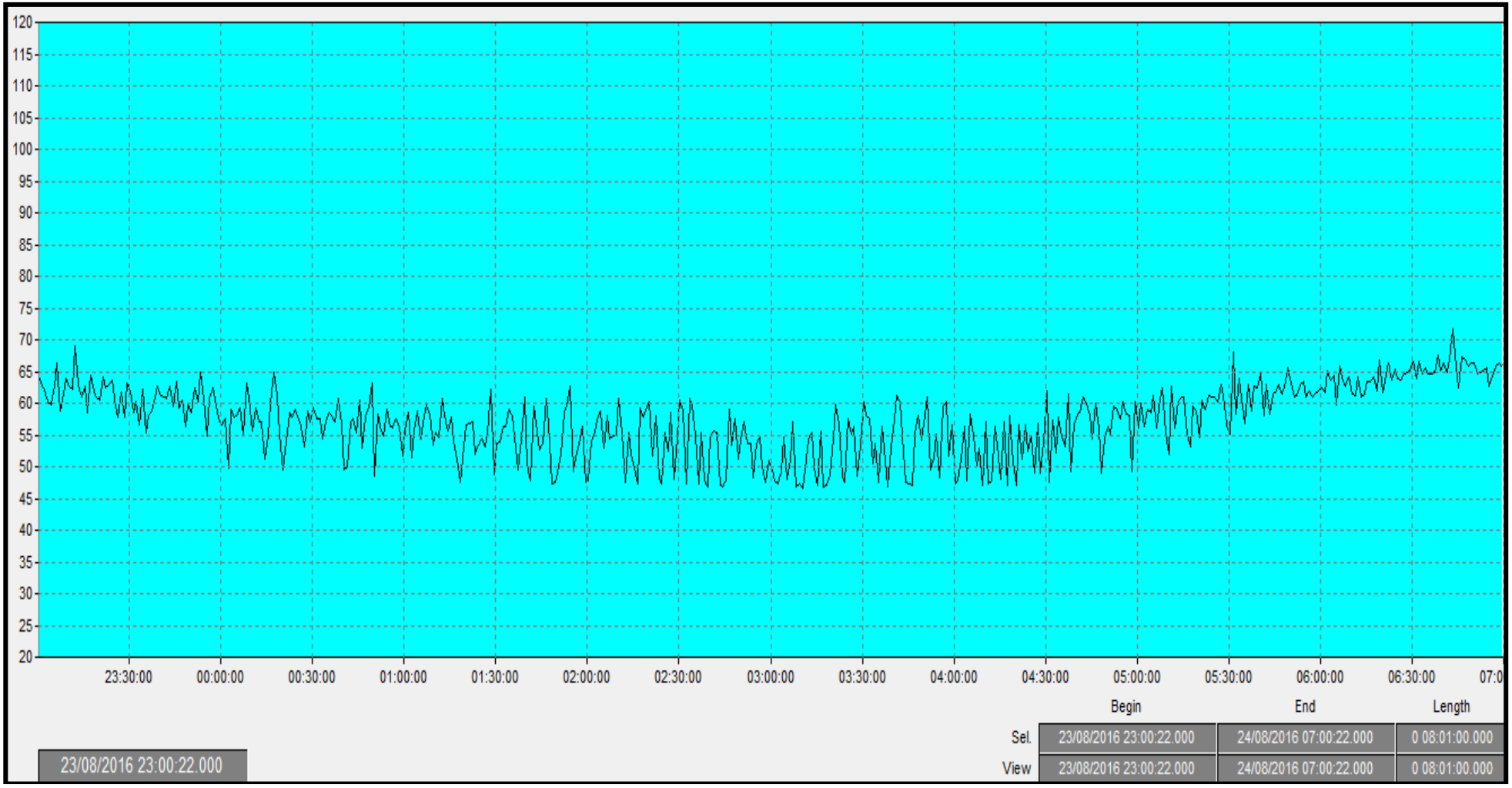
Graph 4: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 21st/22nd August 2016



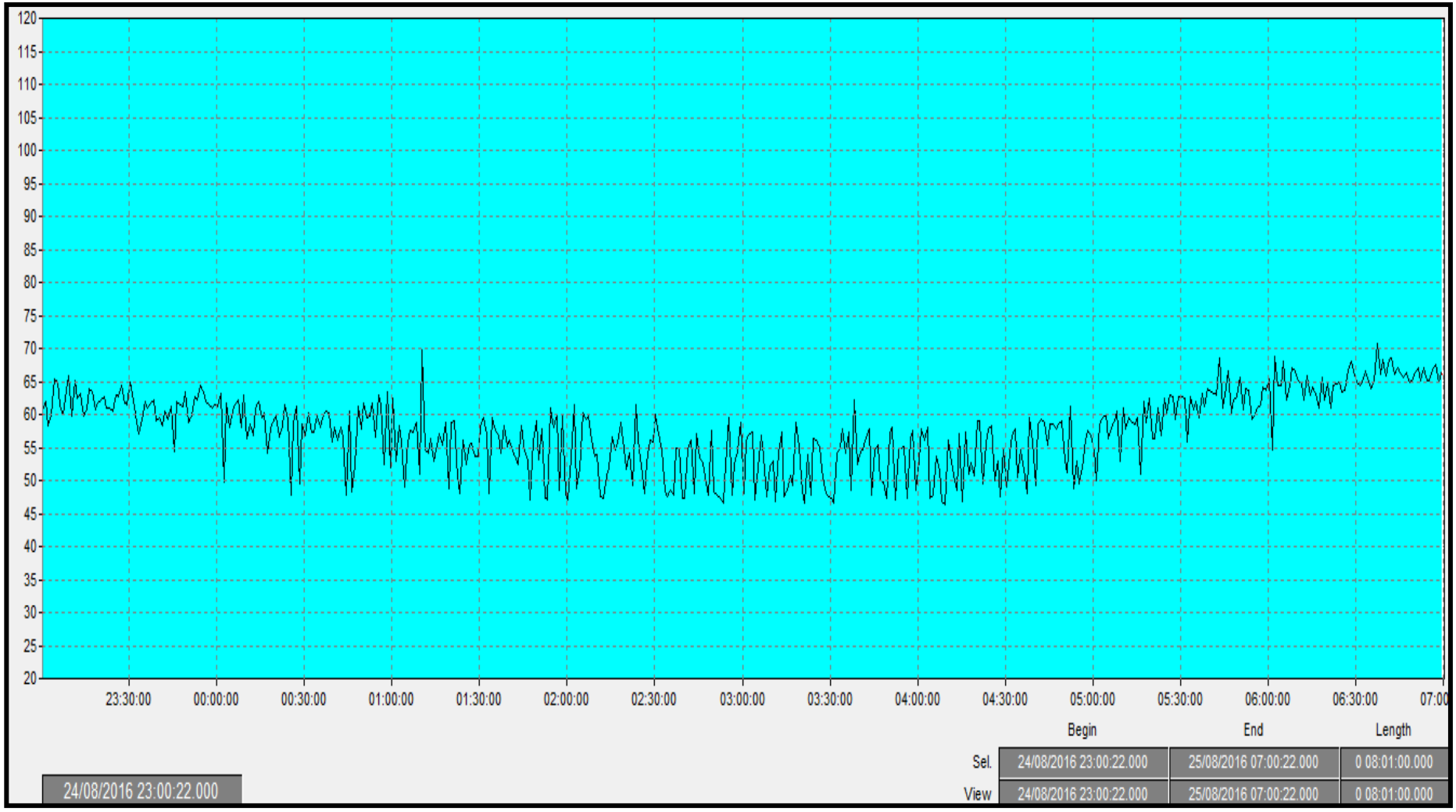
Graph 5: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 22nd/23rd August 2016



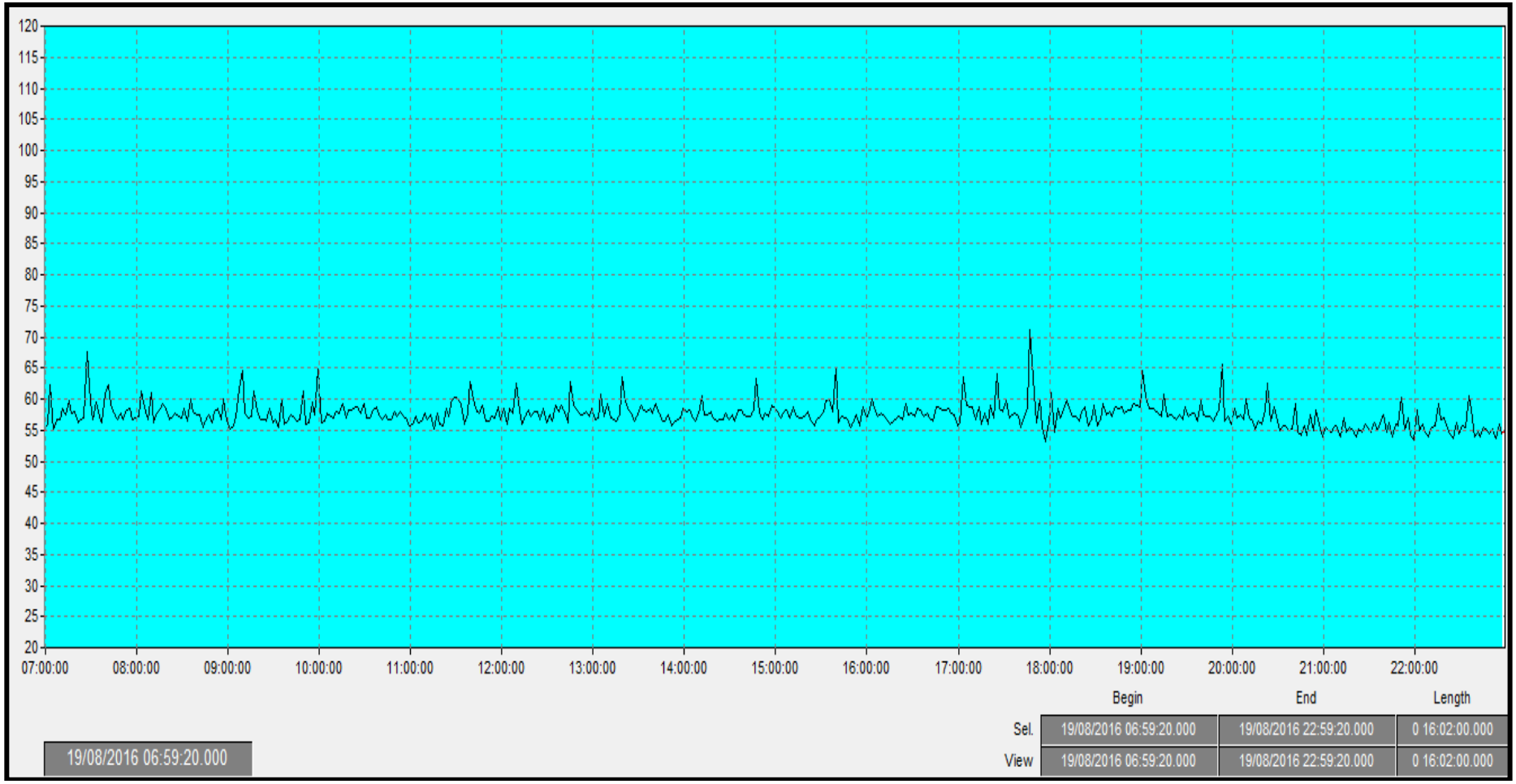
Graph 6: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 23rd/24th August 2016



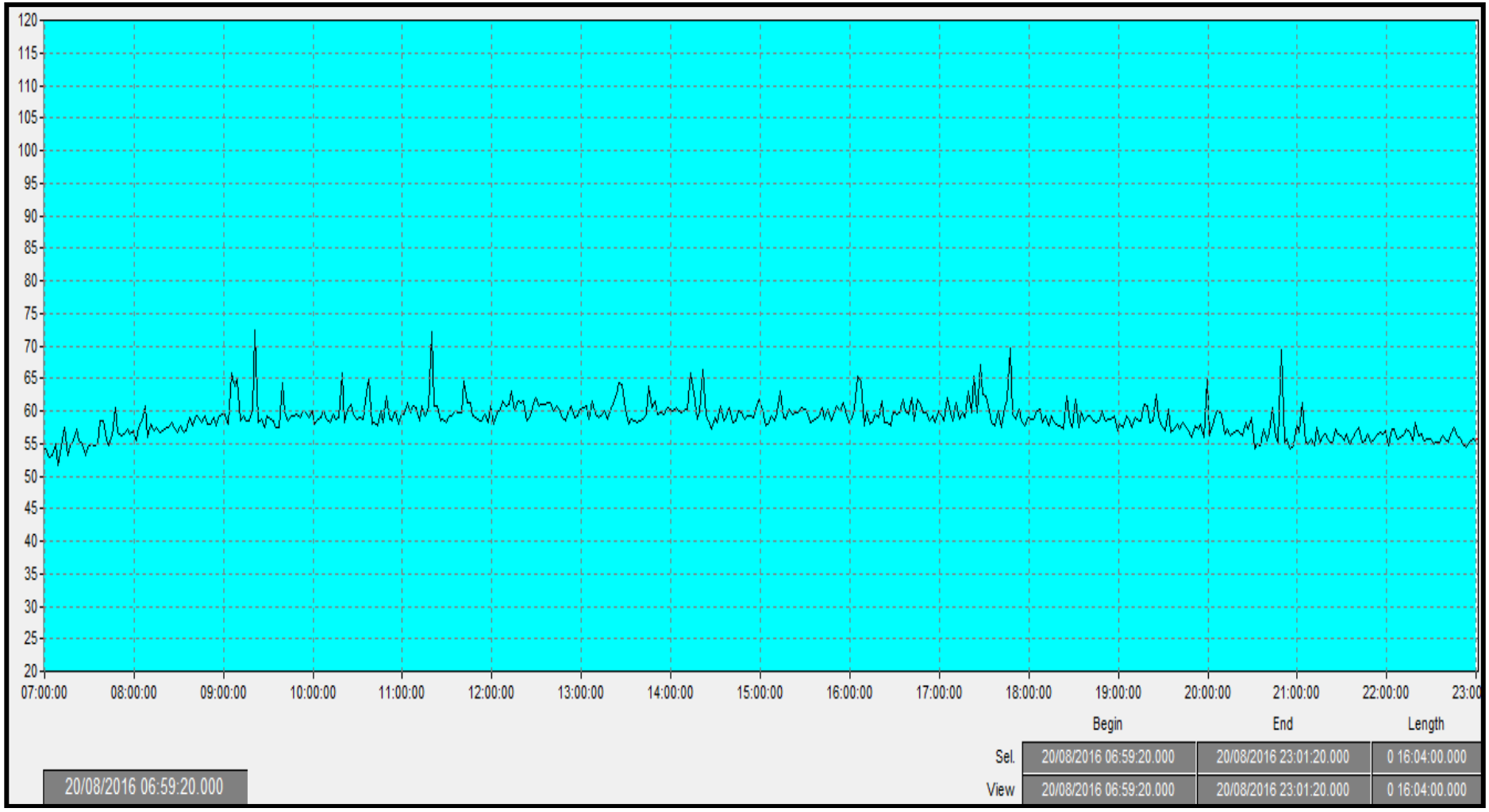
Graph 7: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 24th/25th August 2016



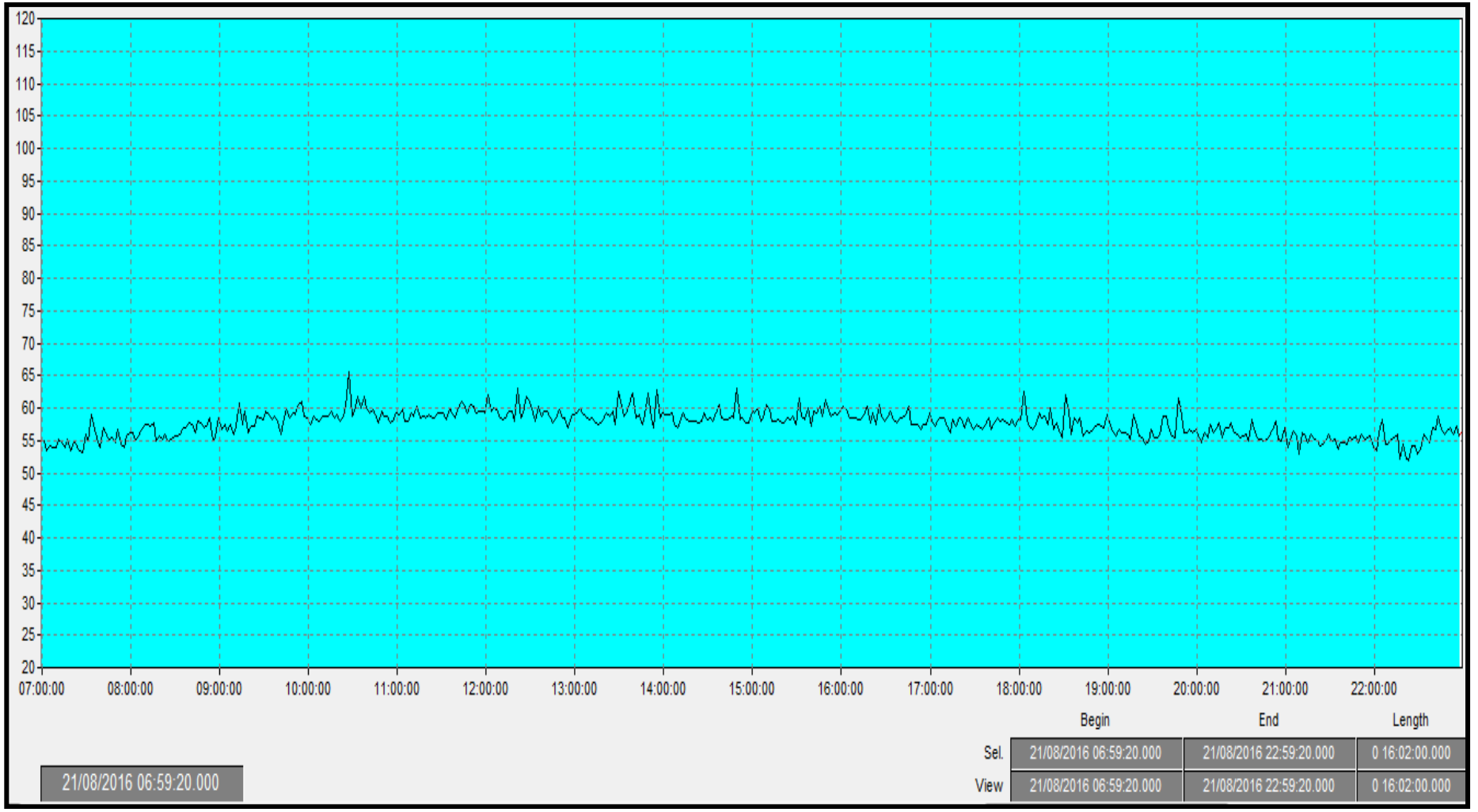
Graph 8: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 19th August 2016



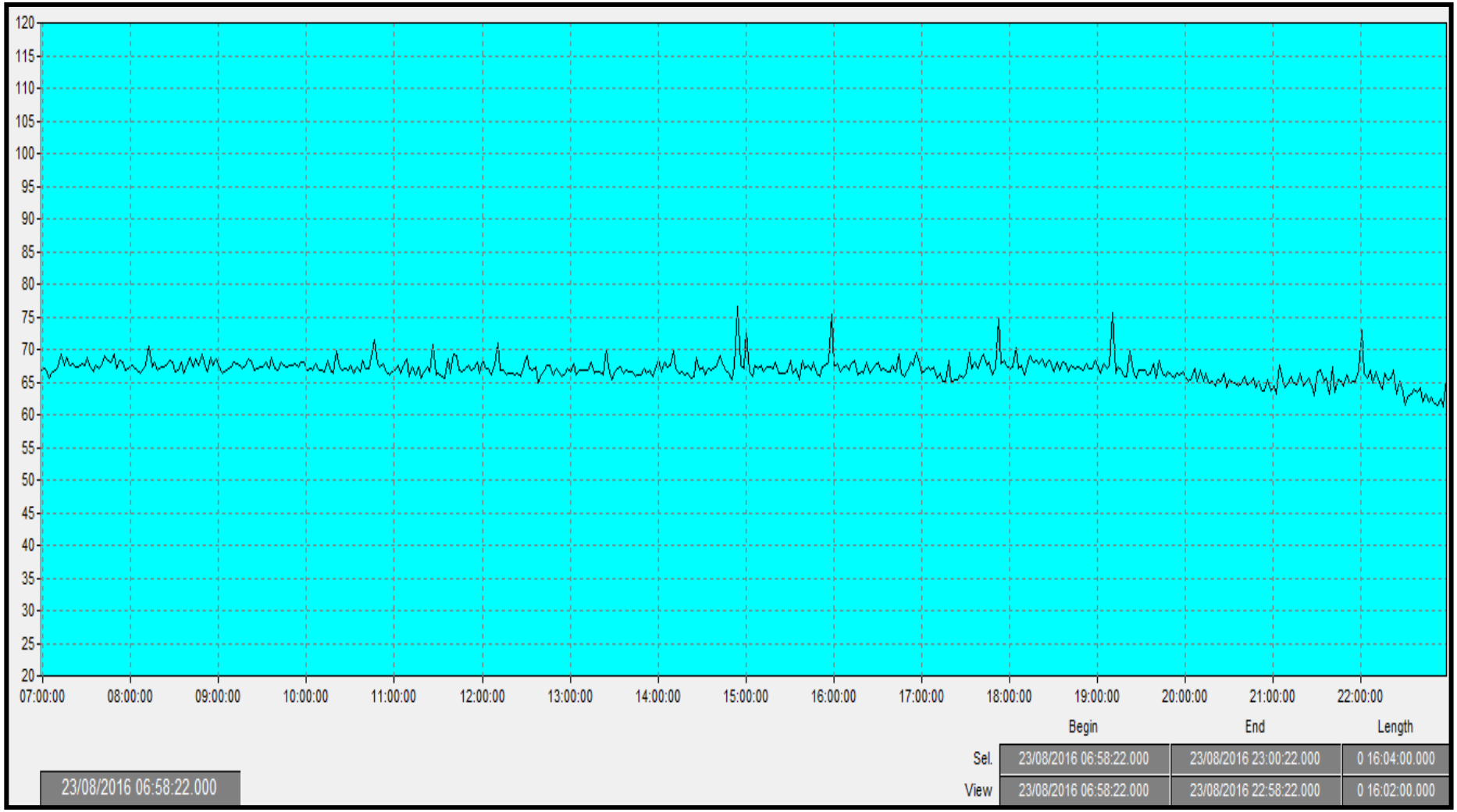
Graph 9: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 20th August 2016



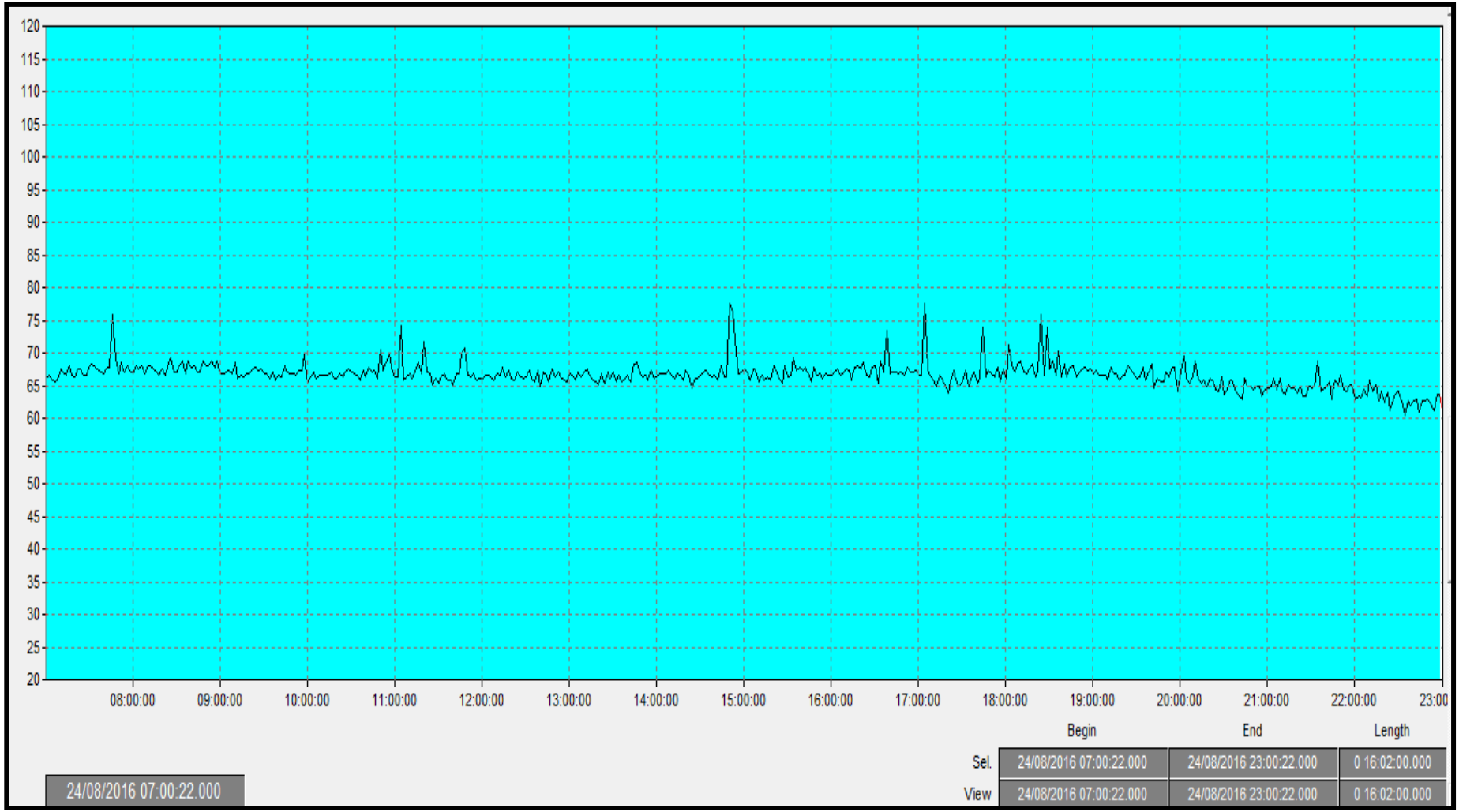
Graph 10: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 21st August 2016



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



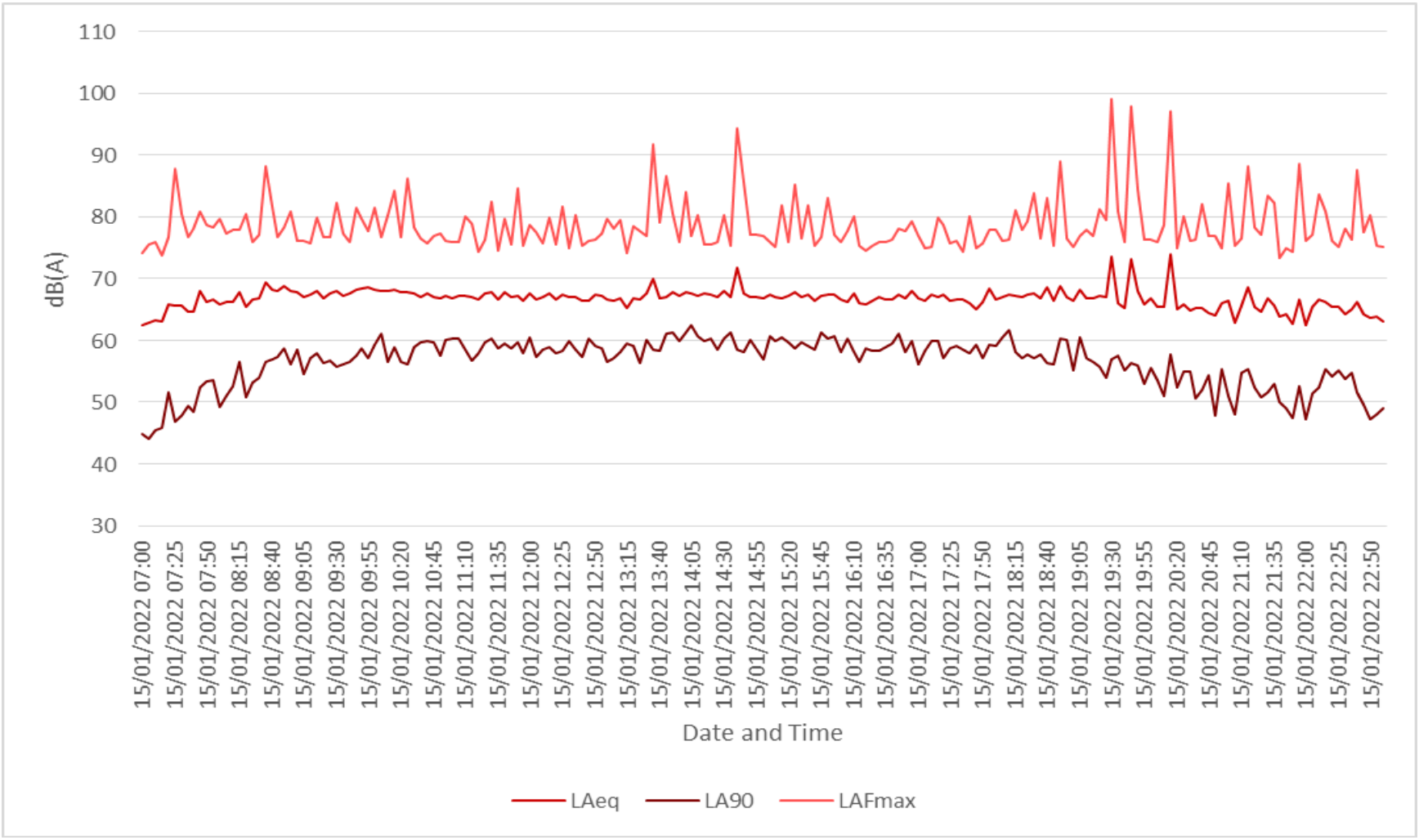
Graph 12: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on the 24th August 2016



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

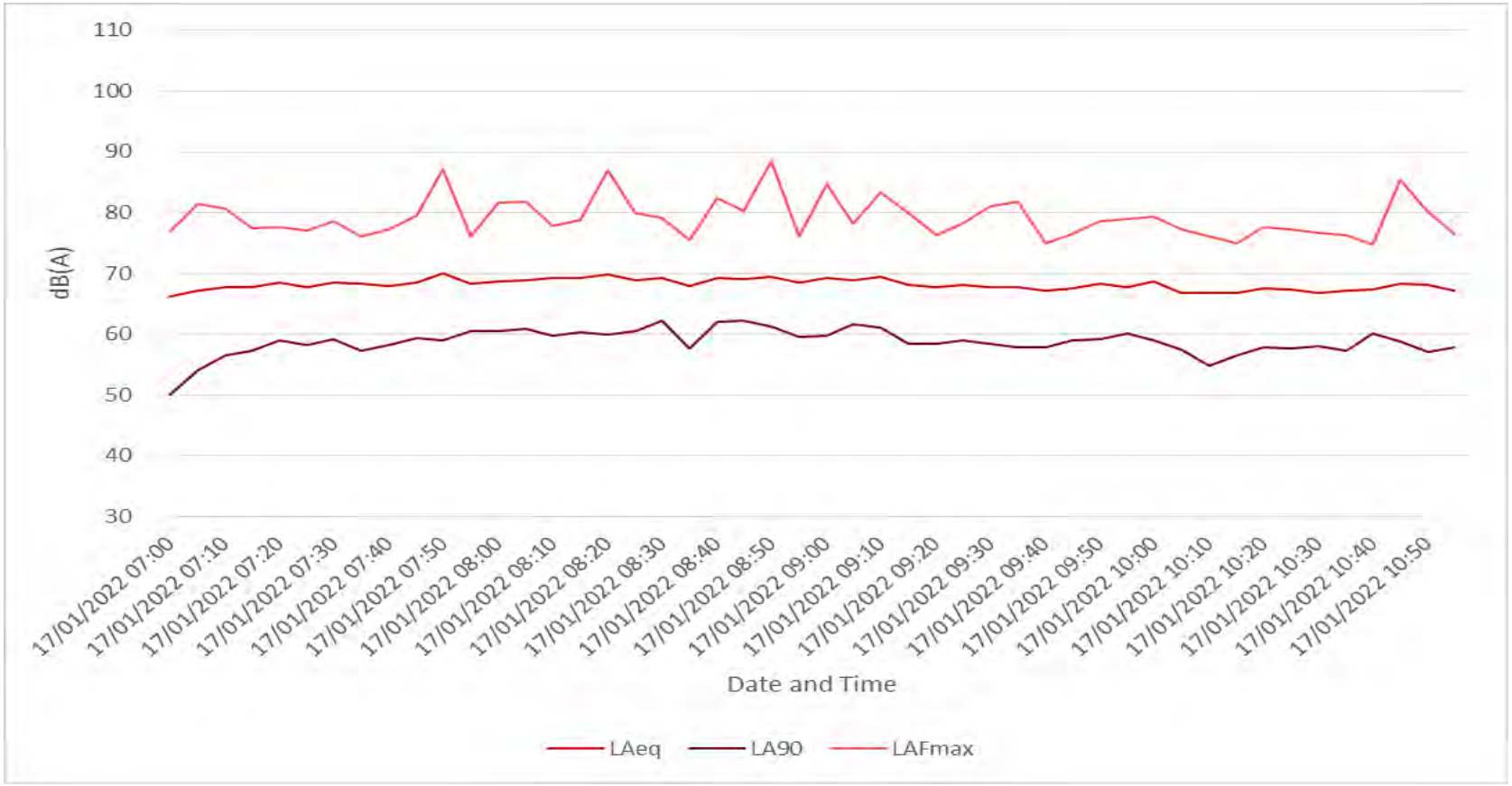
Graph 14: Graphical representation of the 16 hour noise monitoring period (07:00-23:00) on 13th January 2022 (New Botolph Street)

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



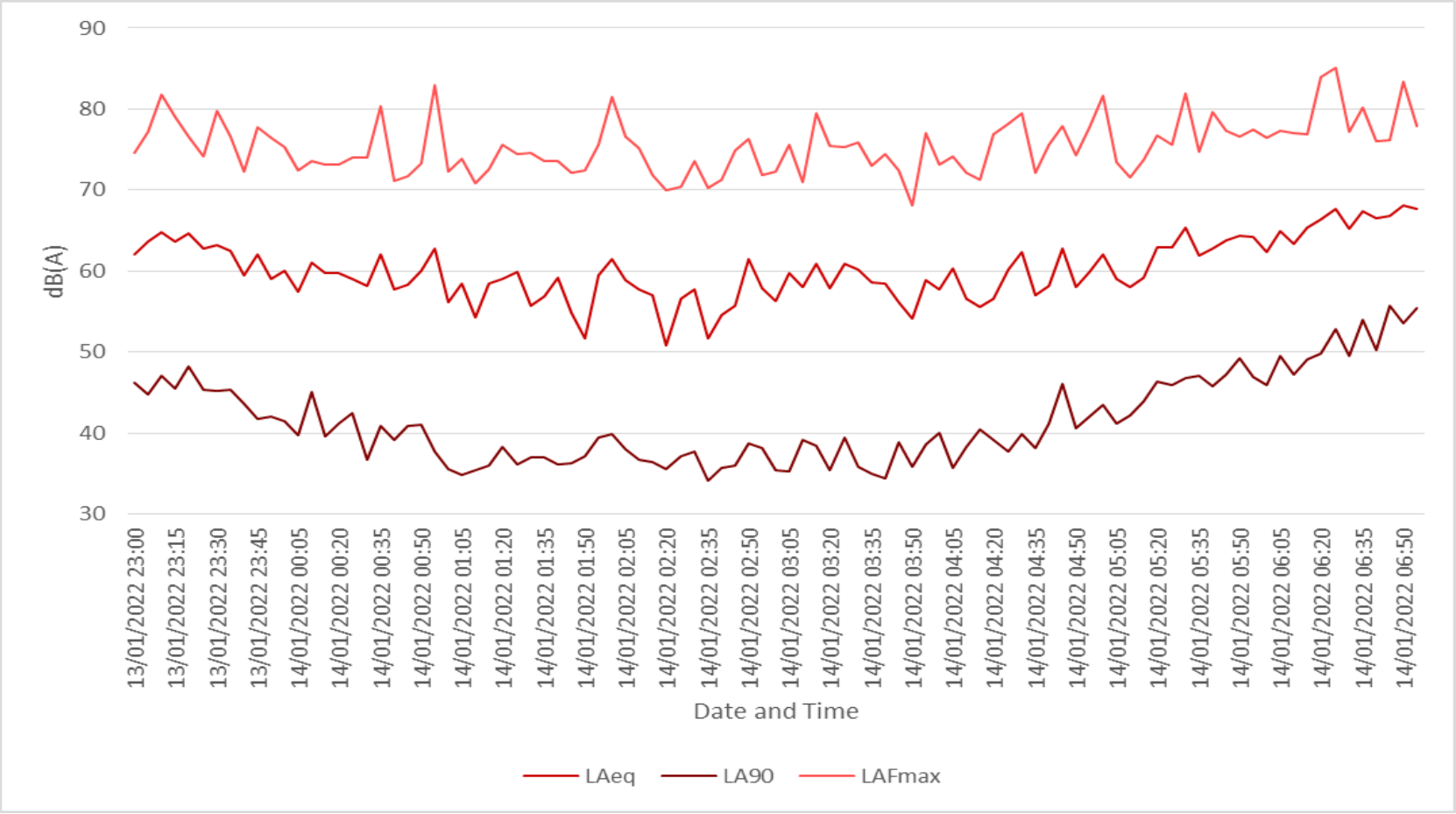
Graph 16: Graphical representation of the 16hour noise monitoring period (07:00-23:00) on 16th January 2022 (New Botolph Street)

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)

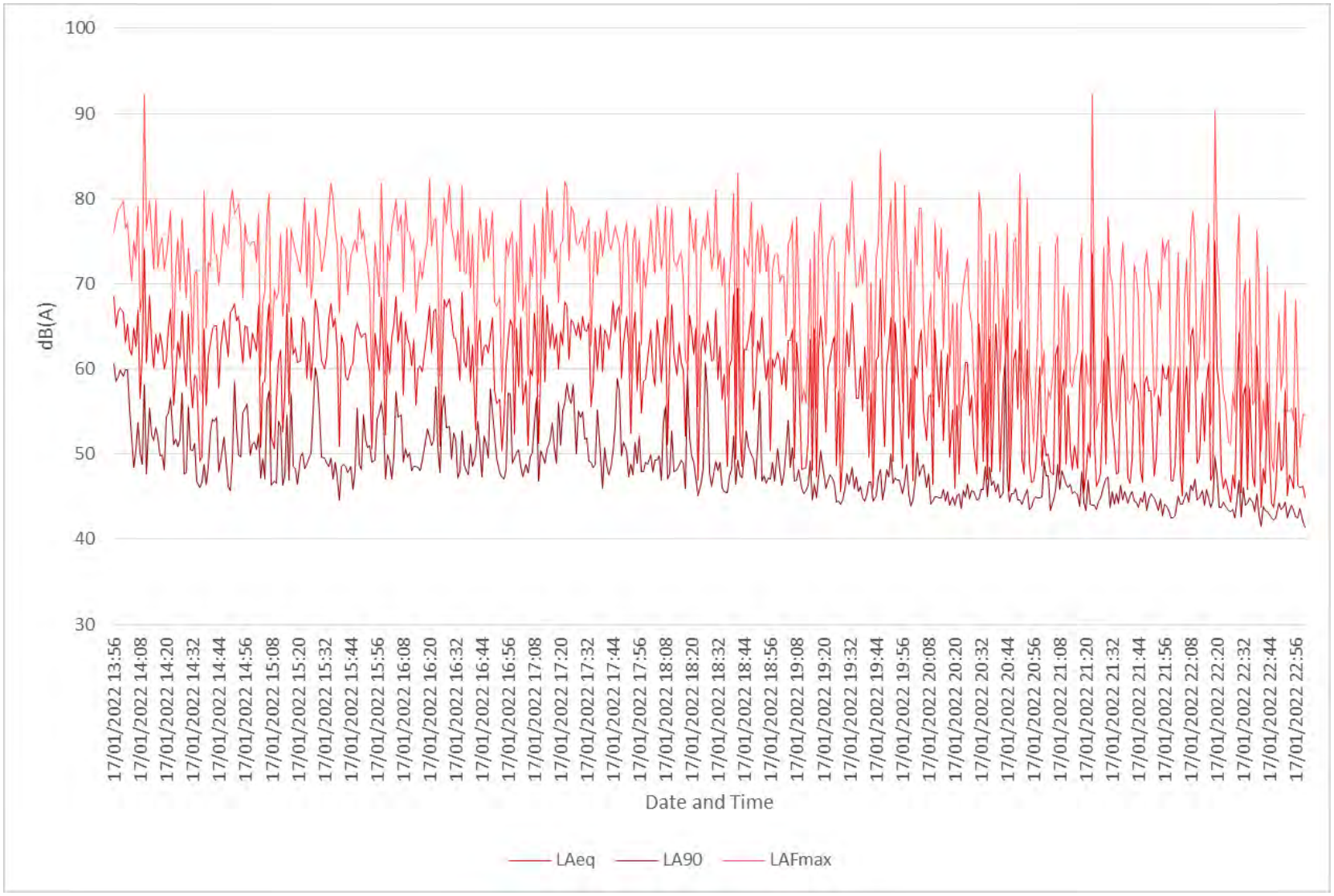
Graph 19: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 13th / 14th January 2022 (New Botolph Street)



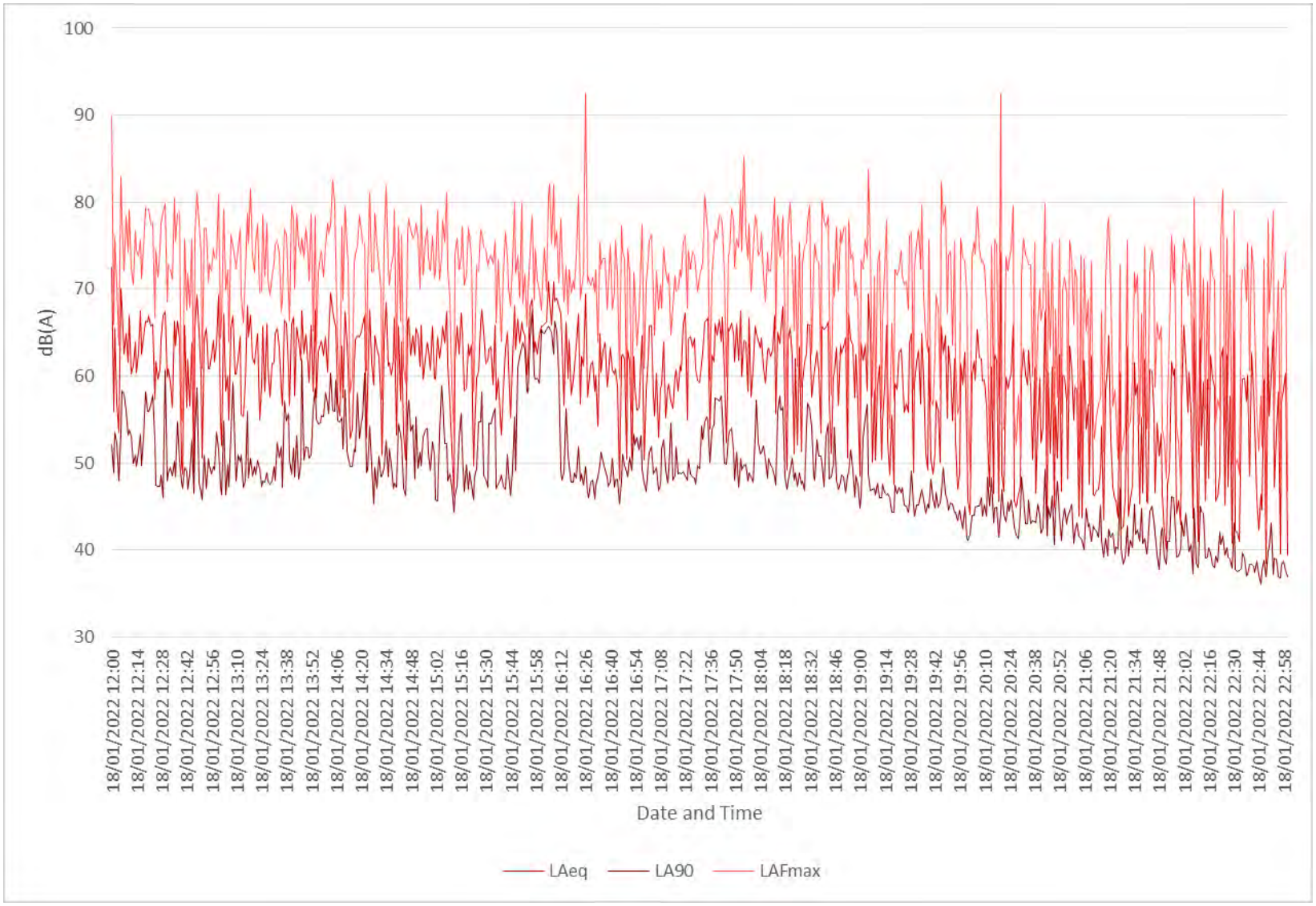
Graph 20: Graphical representation of the 8 hour noise monitoring period (23:00-07:00) on the 15th / 16th January 2022 (New Botolph Street)

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

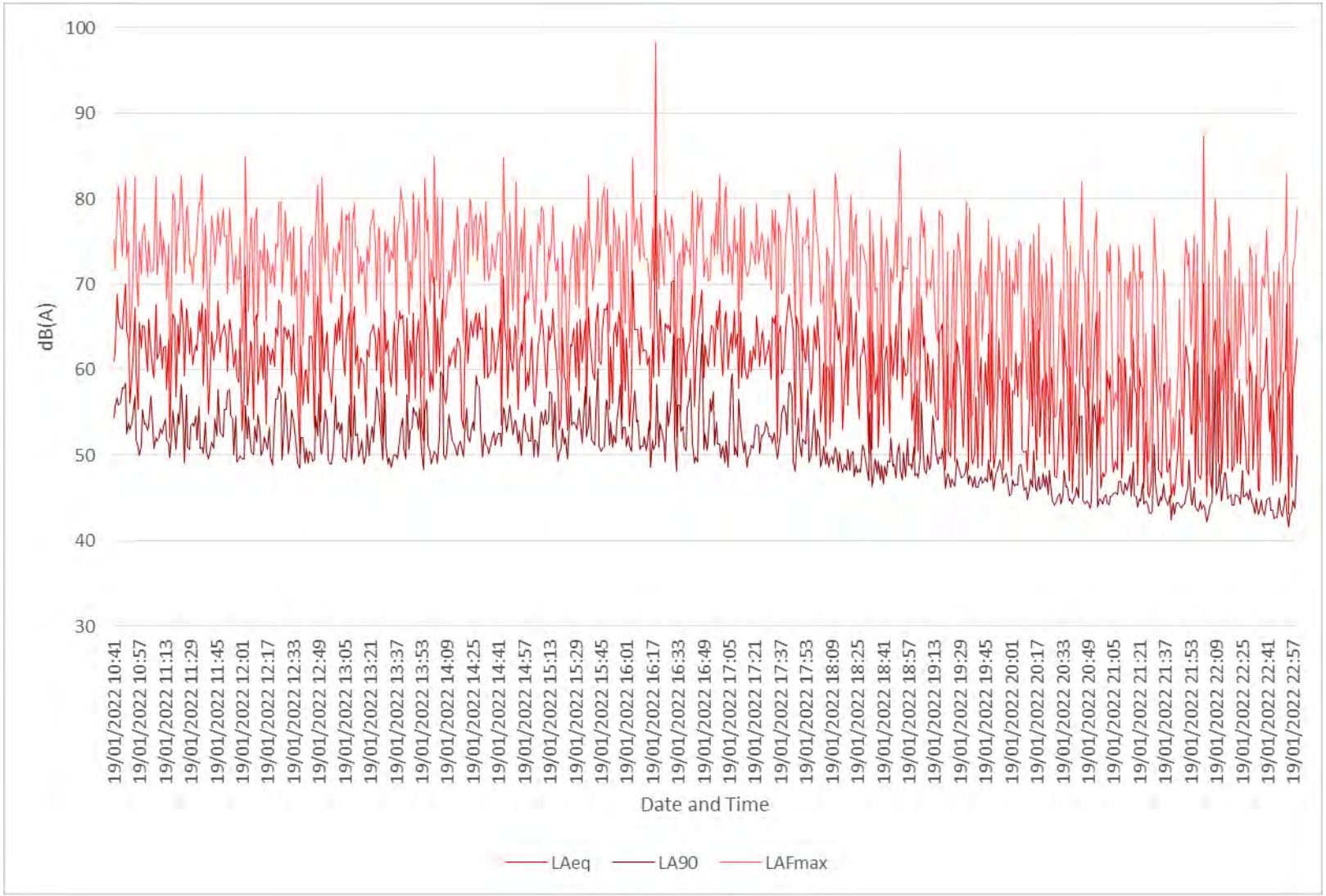
Graph 22: Graphical representation of the day monitoring period (incomplete) on the 17th January 2022 (Edward Street)



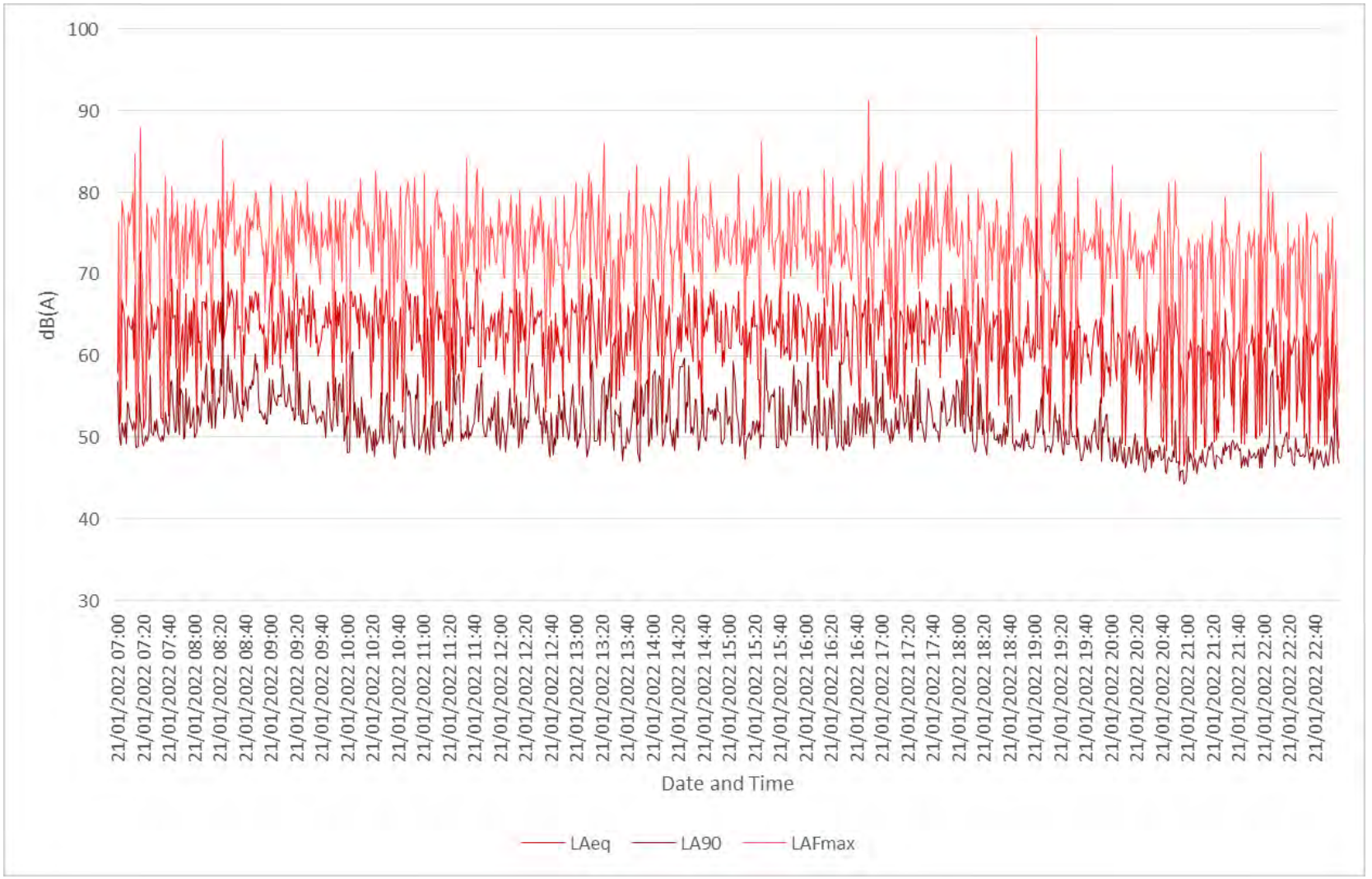
Graph 23: Graphical representation of the day monitoring period (incomplete) on the 18th January 2022 (Edward Street)



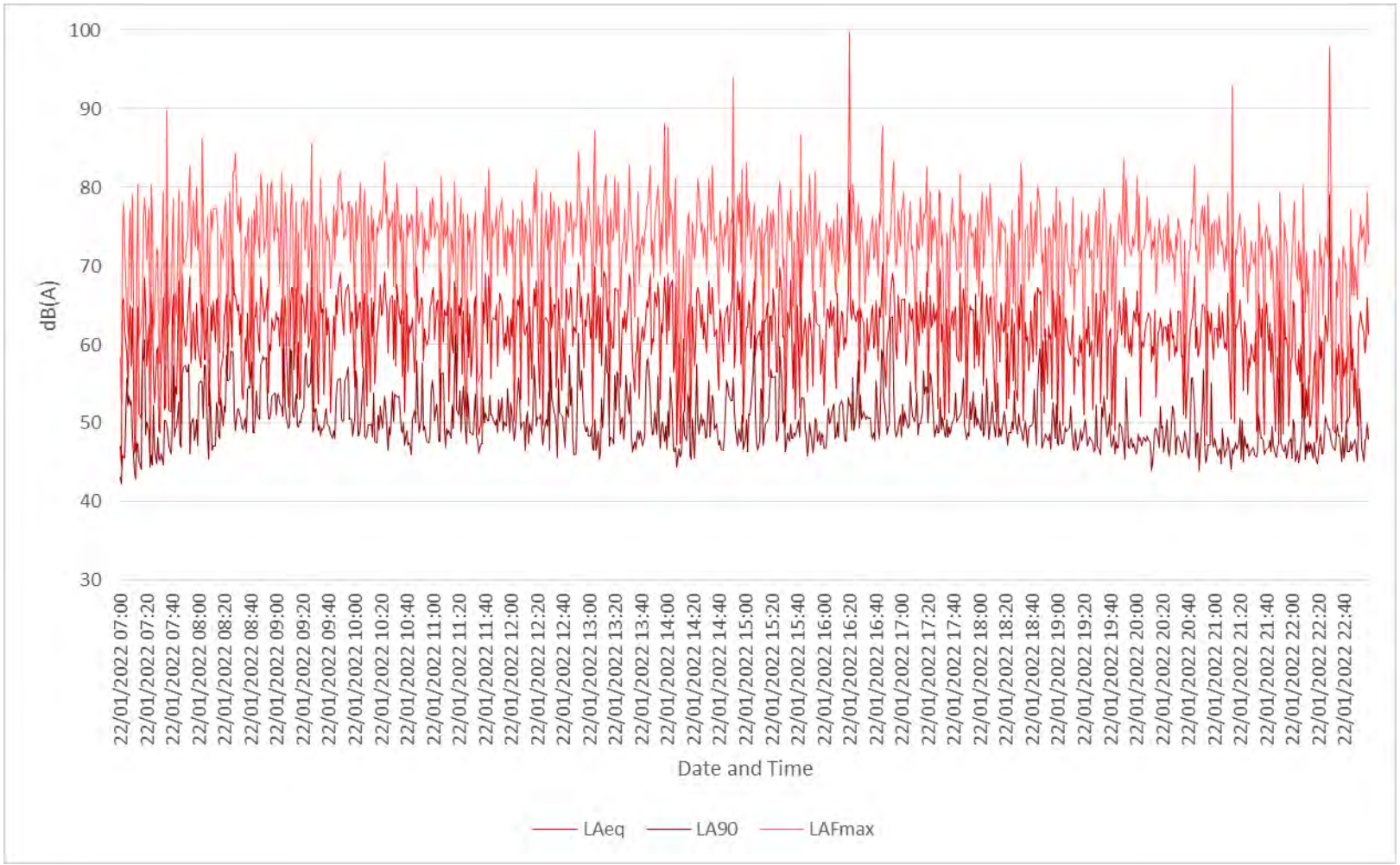
Graph 24: Graphical representation of the day monitoring period (incomplete) on the 19th January 2022 (Edward Street)



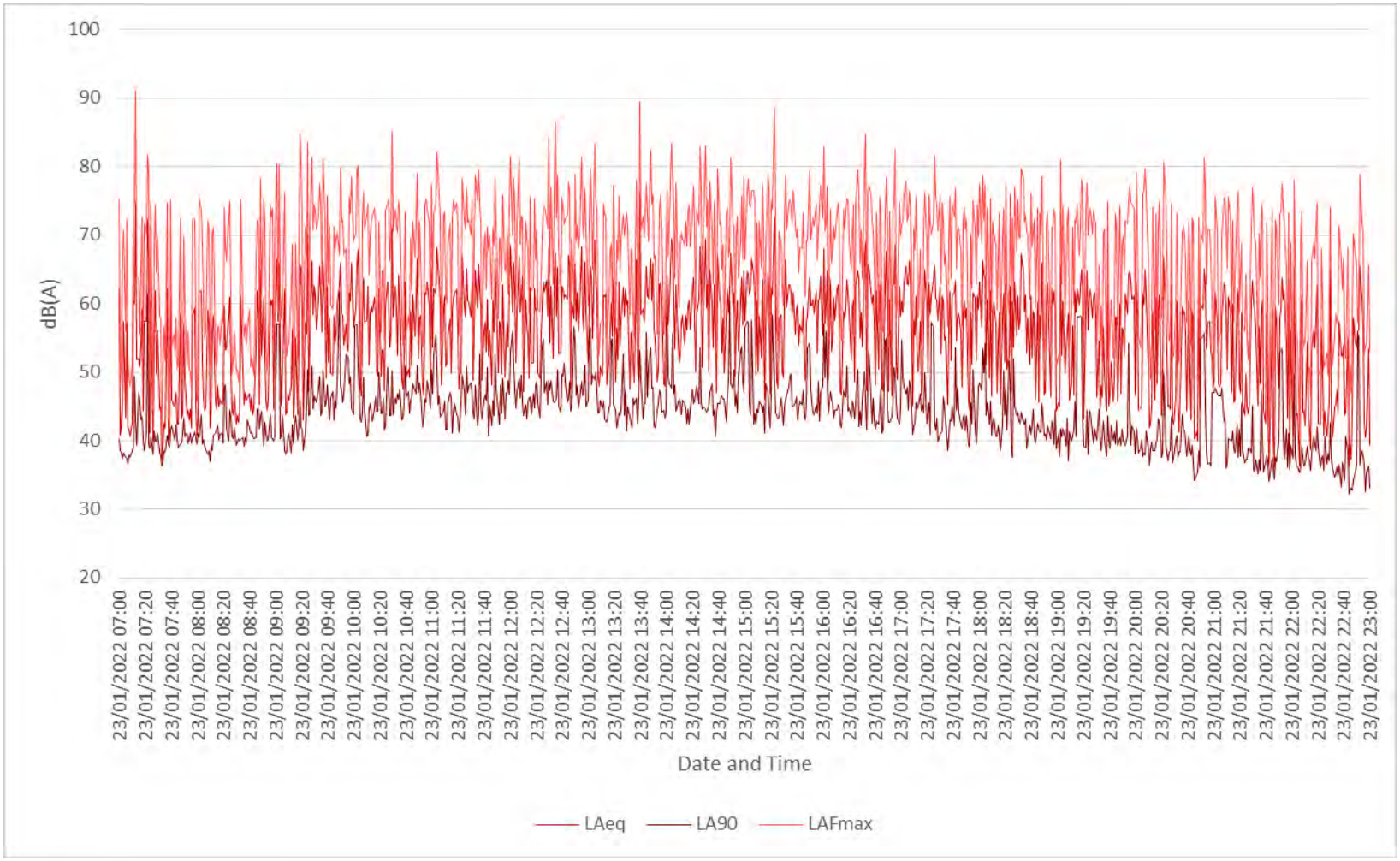
Graph 25: Graphical representation of the day monitoring period (16 hour) on the 21st January 2022 (Edward Street)



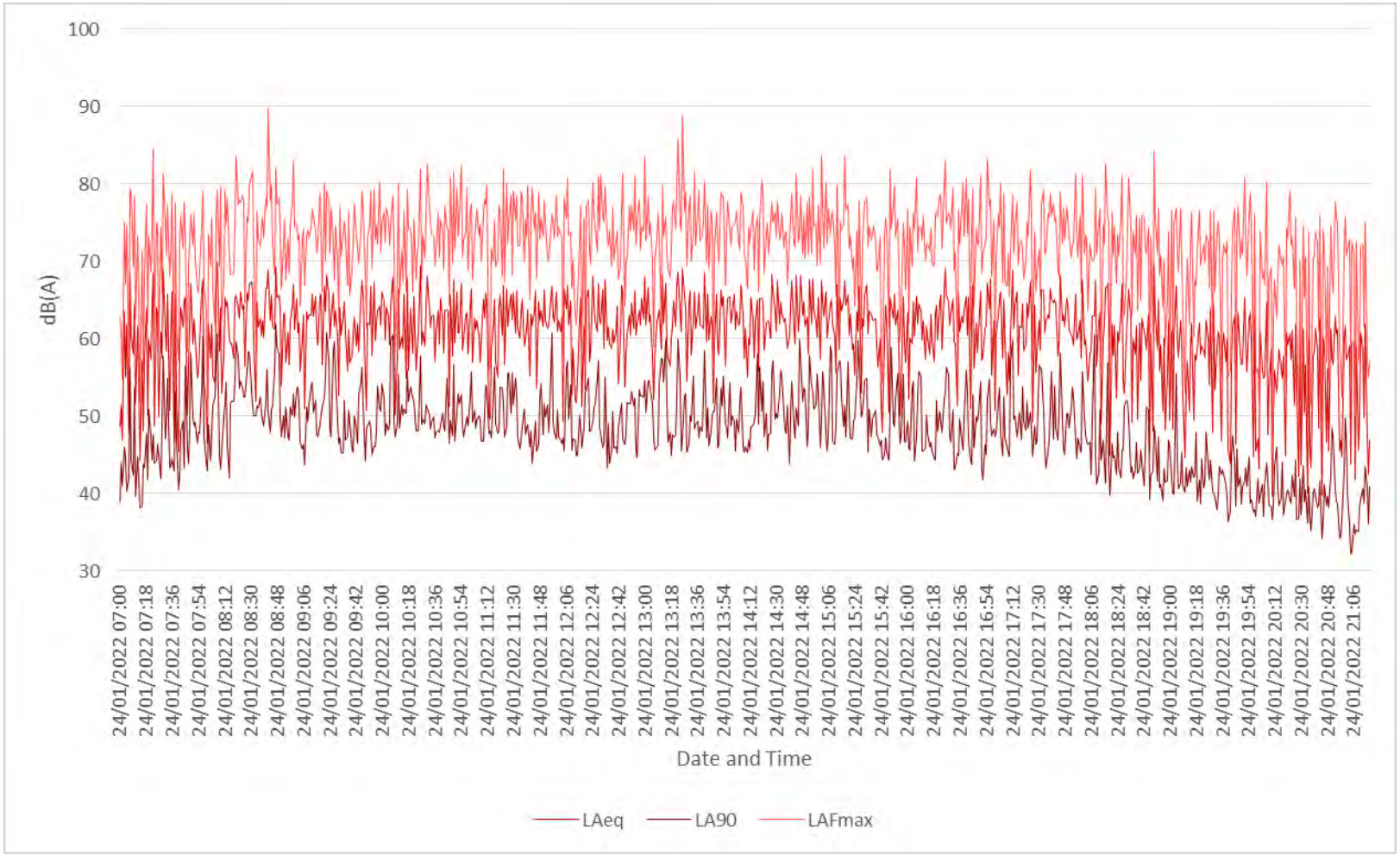
Graph 26: Graphical representation of the day monitoring period (16 hour) on the 22nd January 2022 (Edward Street)



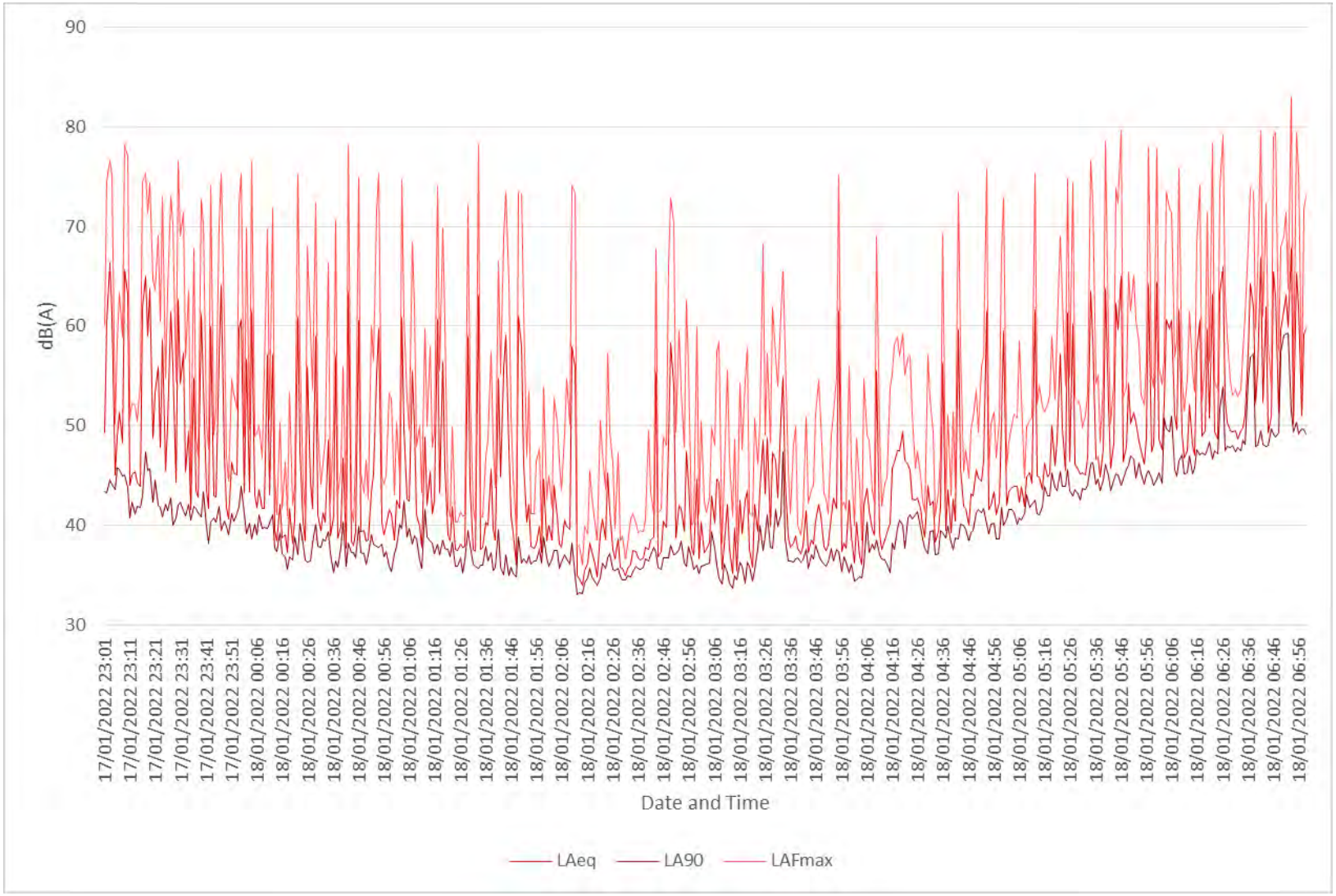
Graph 27: Graphical representation of the day monitoring period (16 hour) on the 23rd January 2022 (Edward Street)



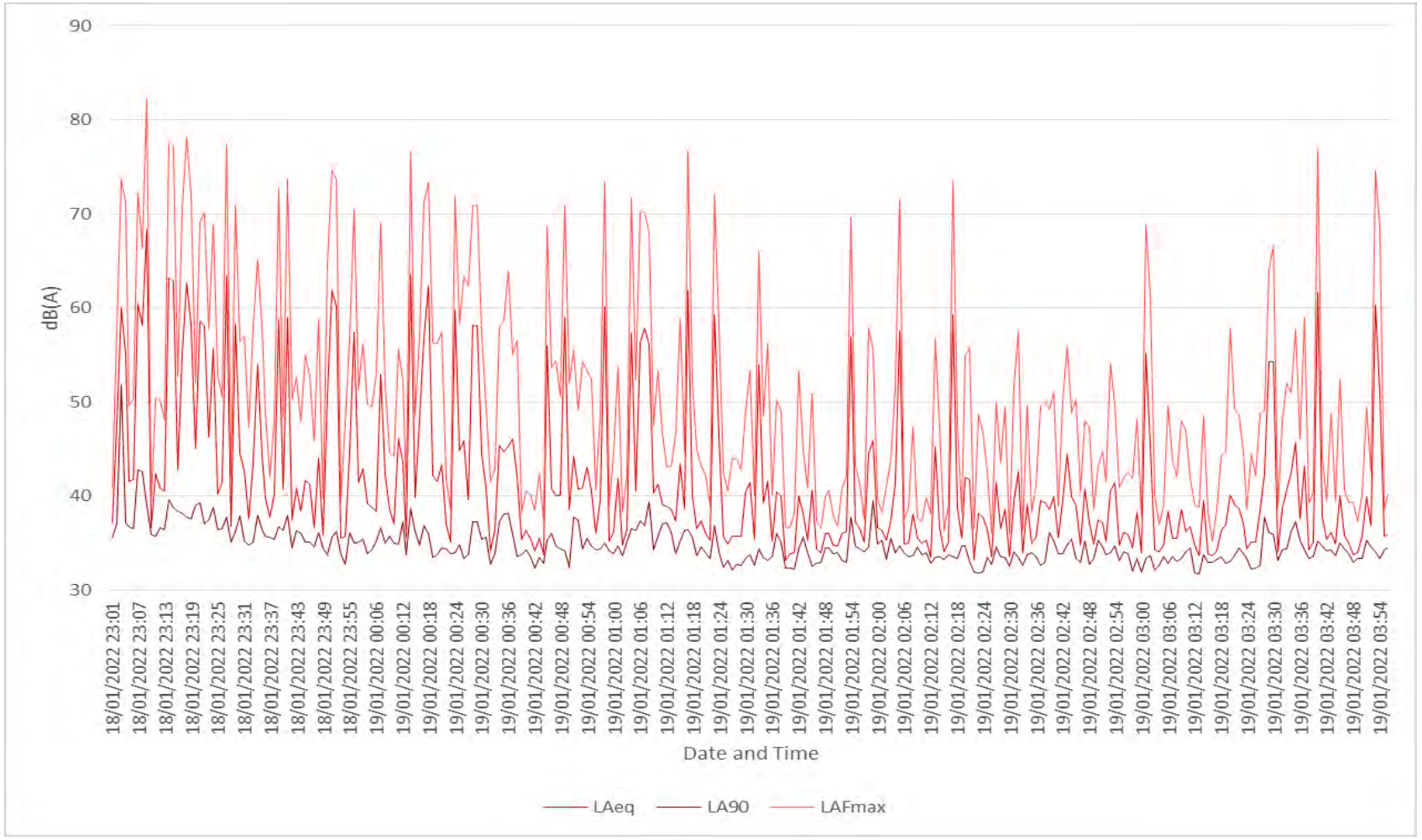
Graph 28: Graphical representation of the day monitoring period (incomplete) on the 24th January 2022 (Edward Street)



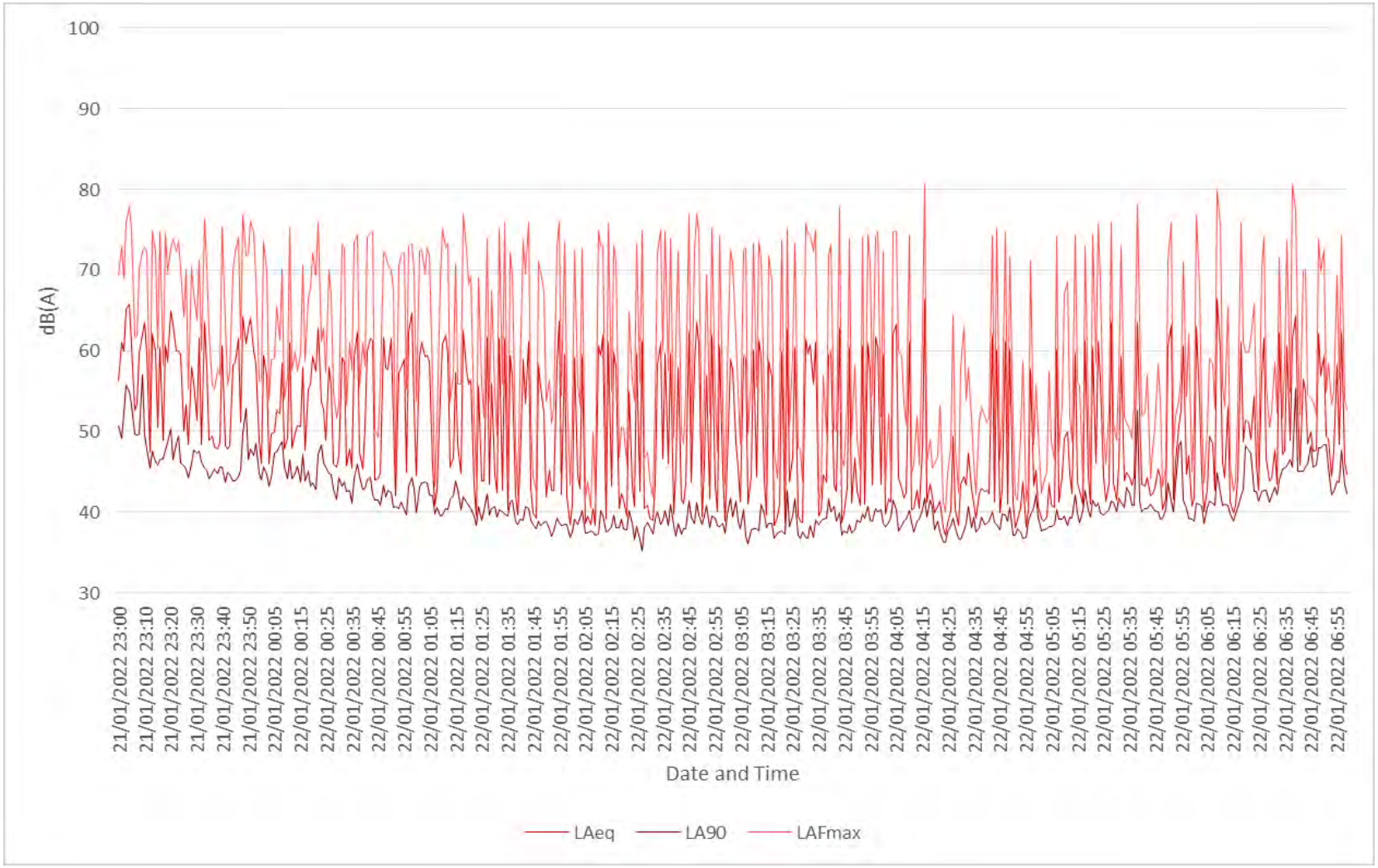
Graph 29: Graphical representation of the day monitoring period (8 hour) on the 17th / 18th January 2022 (Edward Street)



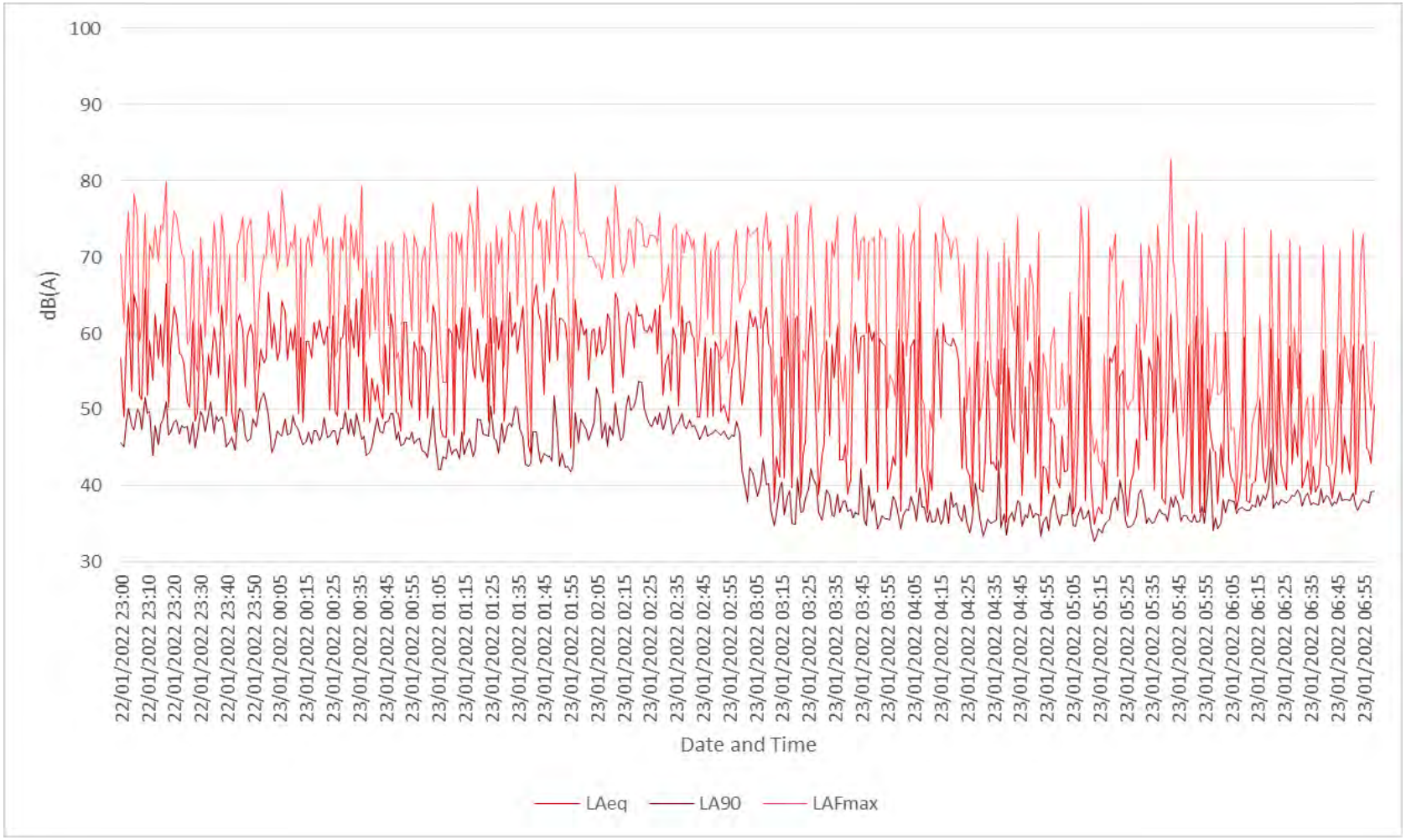
Graph 30: Graphical representation of the night monitoring period (incomplete) on the 18th / 19th January 2022 (Edward Street)



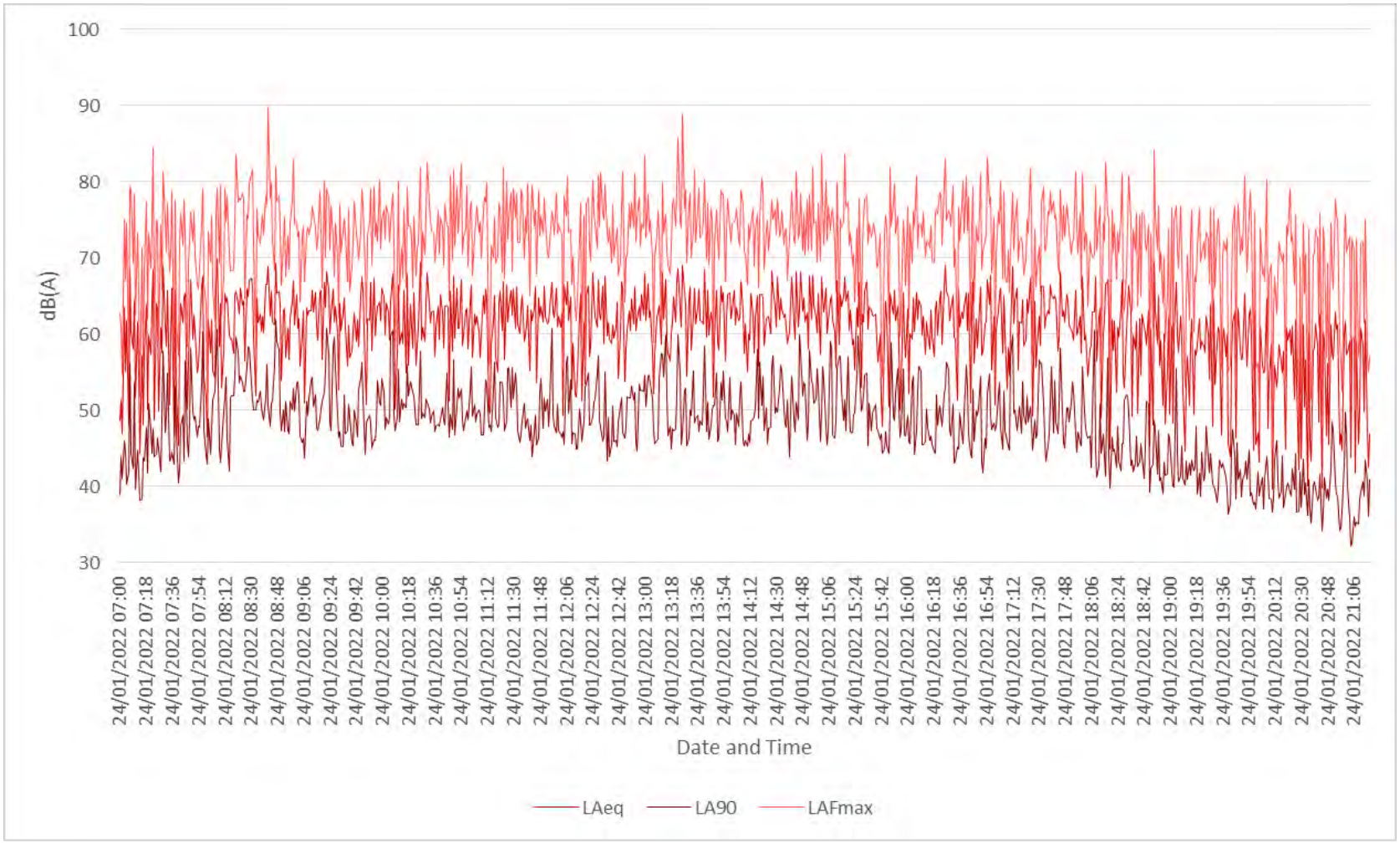
Graph 31: Graphical representation of the night monitoring period (8 hour) on the 21st / 22nd January 2022 (Edward Street)



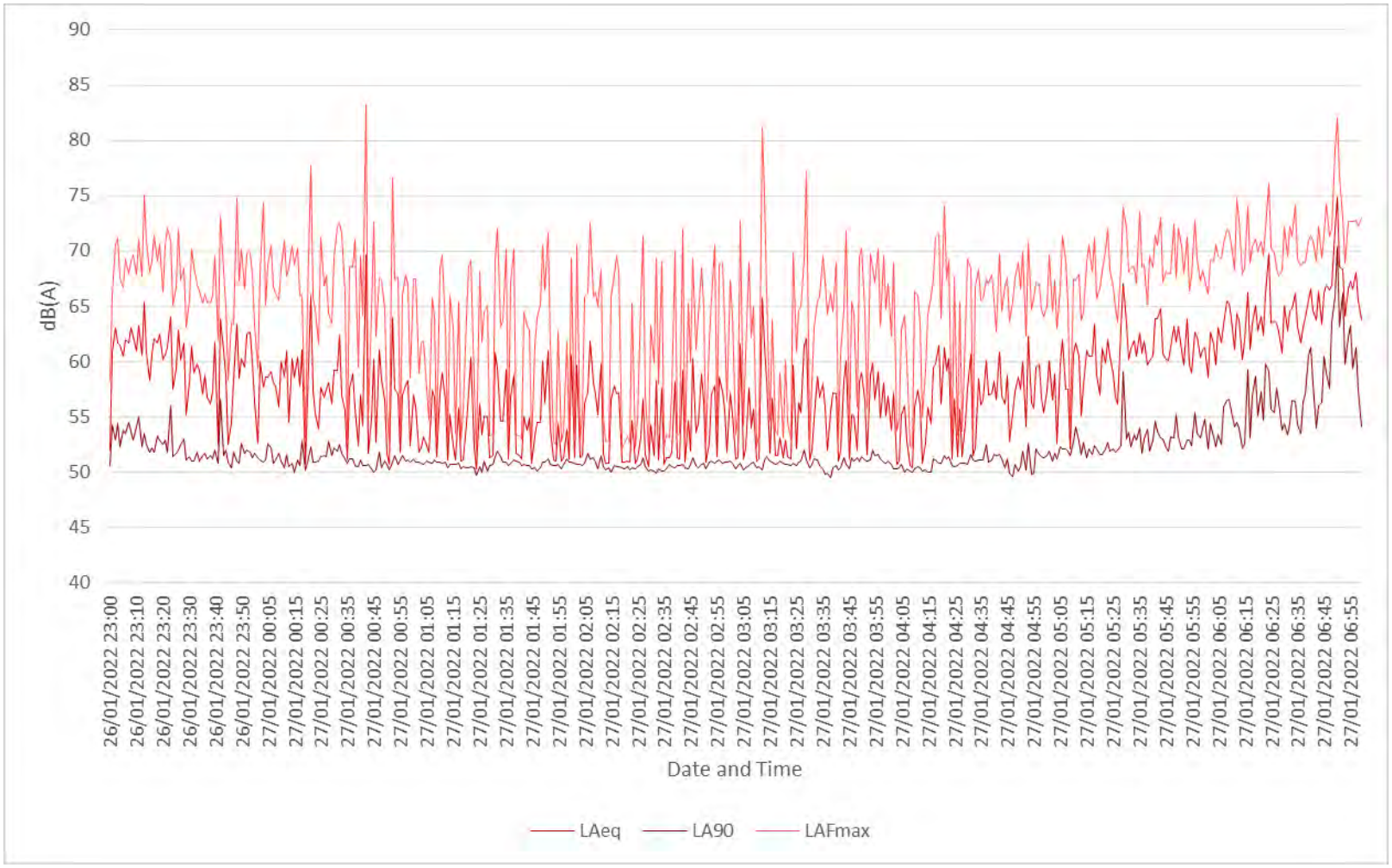
Graph 32: Graphical representation of the night monitoring period (8 hour) on the 22nd / 23rd January 2022 (Edward Street)



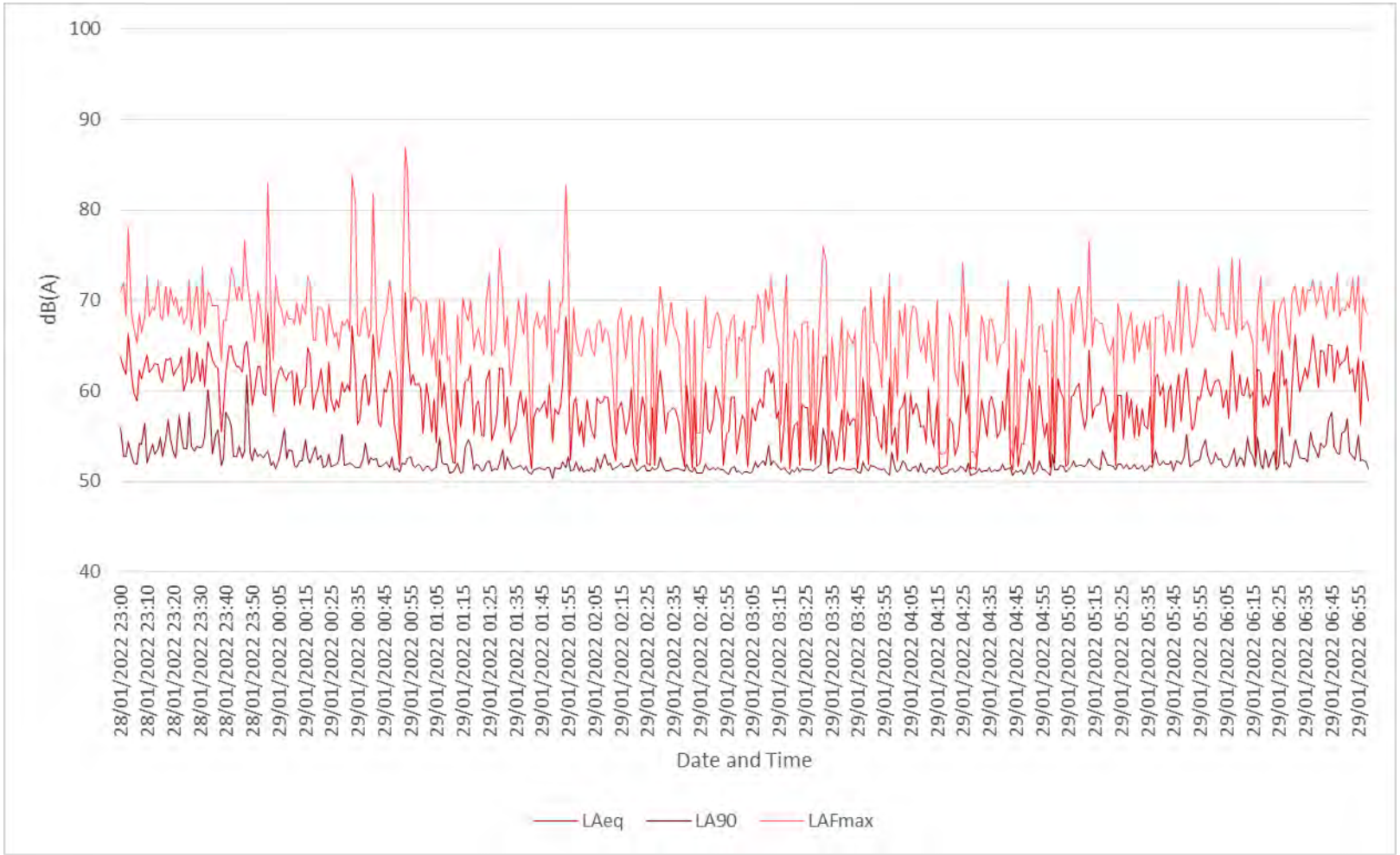
Graph 33: Graphical representation of the day monitoring period (incomplete) on the 24th January 2022 (Edward Street)



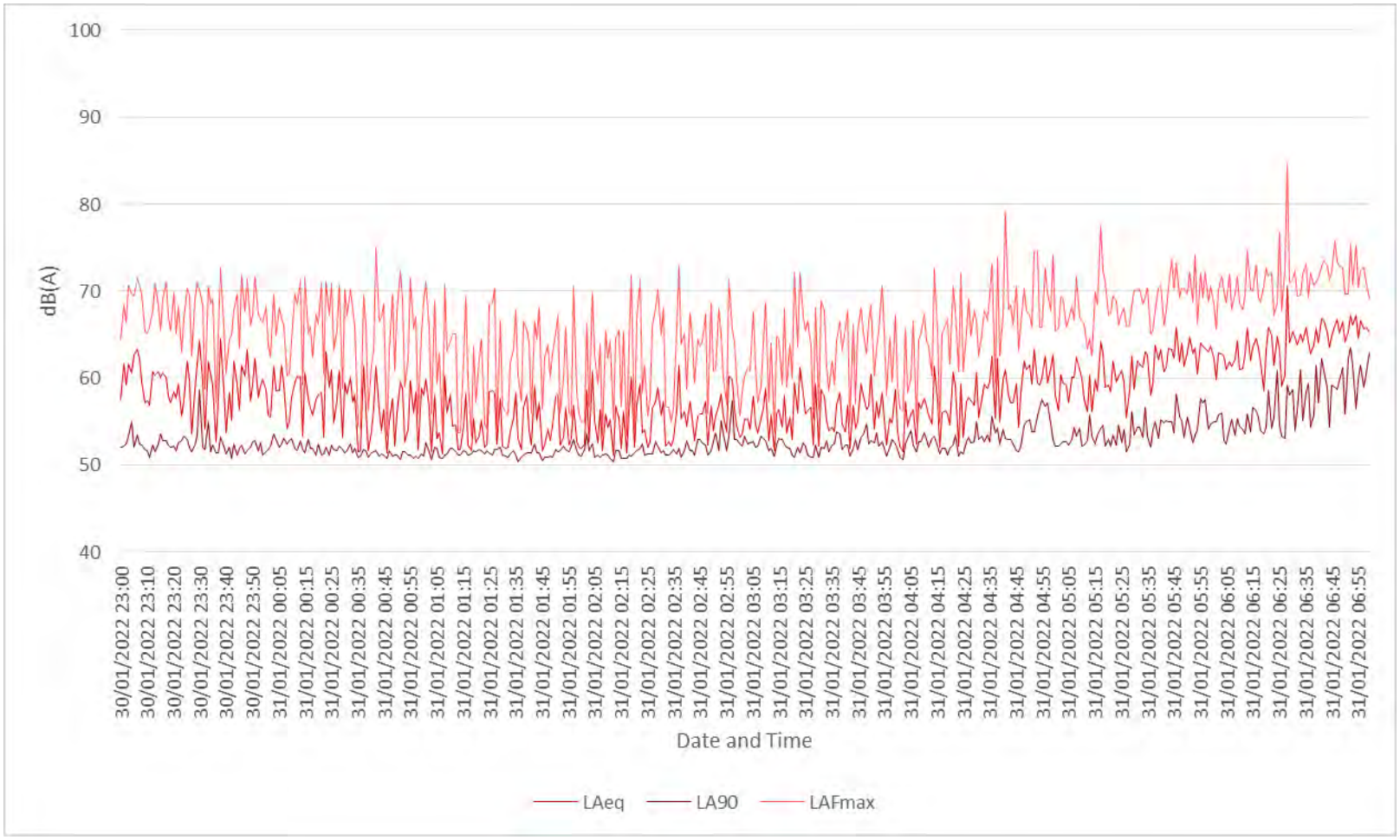
Graph 34: Graphical representation of the night monitoring period (8 hour) on the 26th / 27th January 2022 (St Crispins Road)



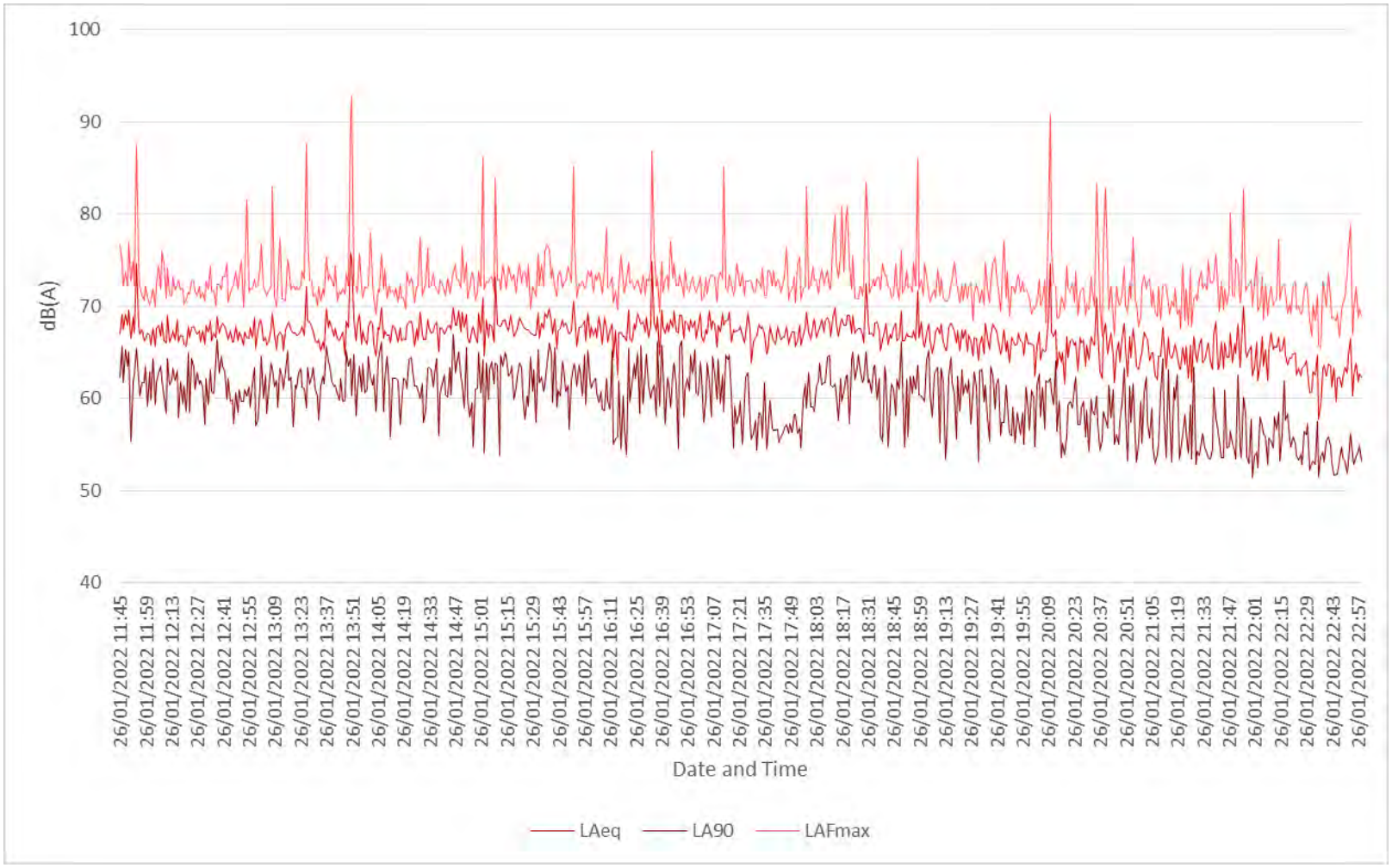
Graph 35: Graphical representation of the night monitoring period (8 hour) on the 28th / 29th January 2022 (St Crispins Road)



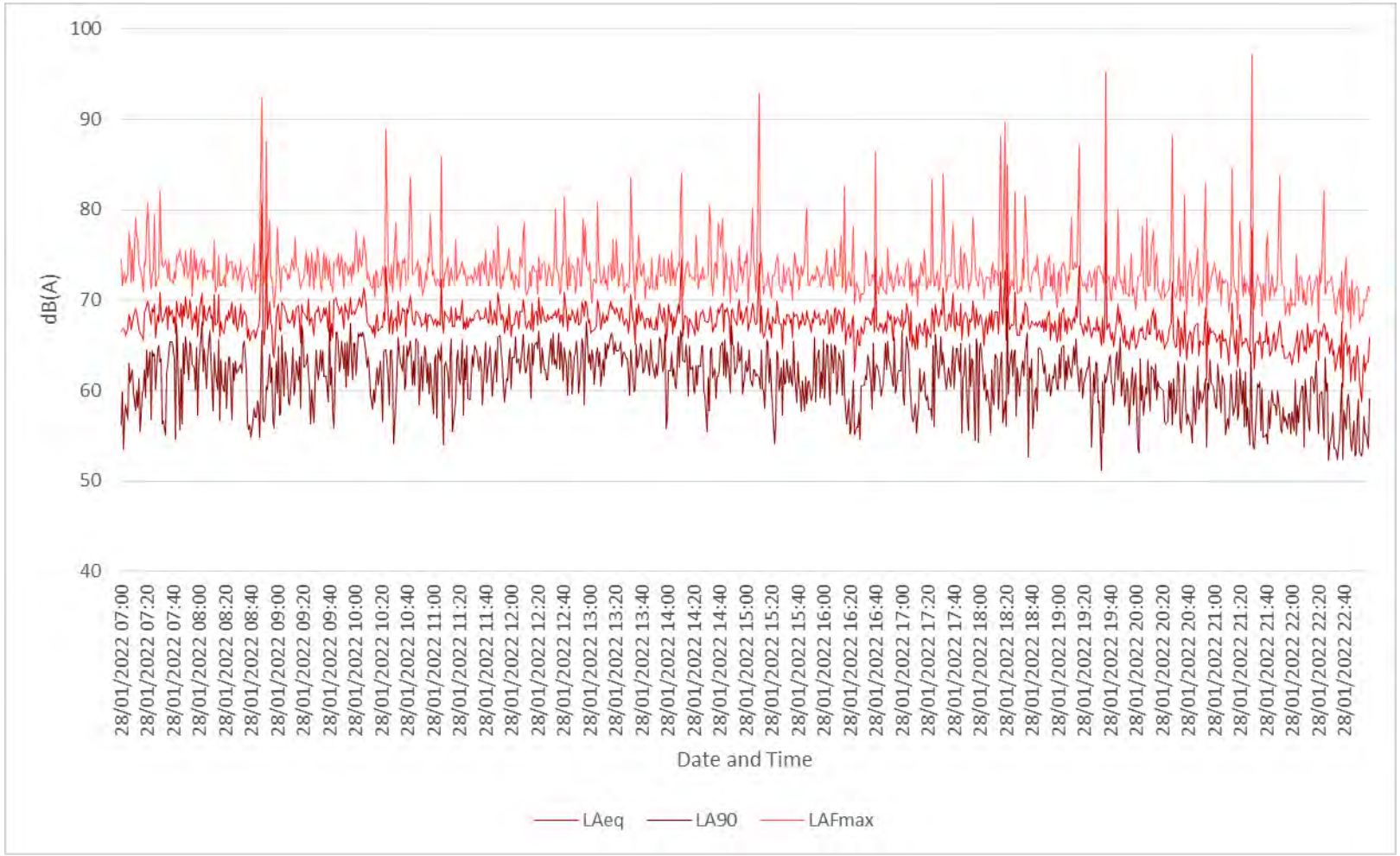
Graph 36: Graphical representation of the night monitoring period (8 hour) on the 30th / 31st January 2022 (St Crispins Road)



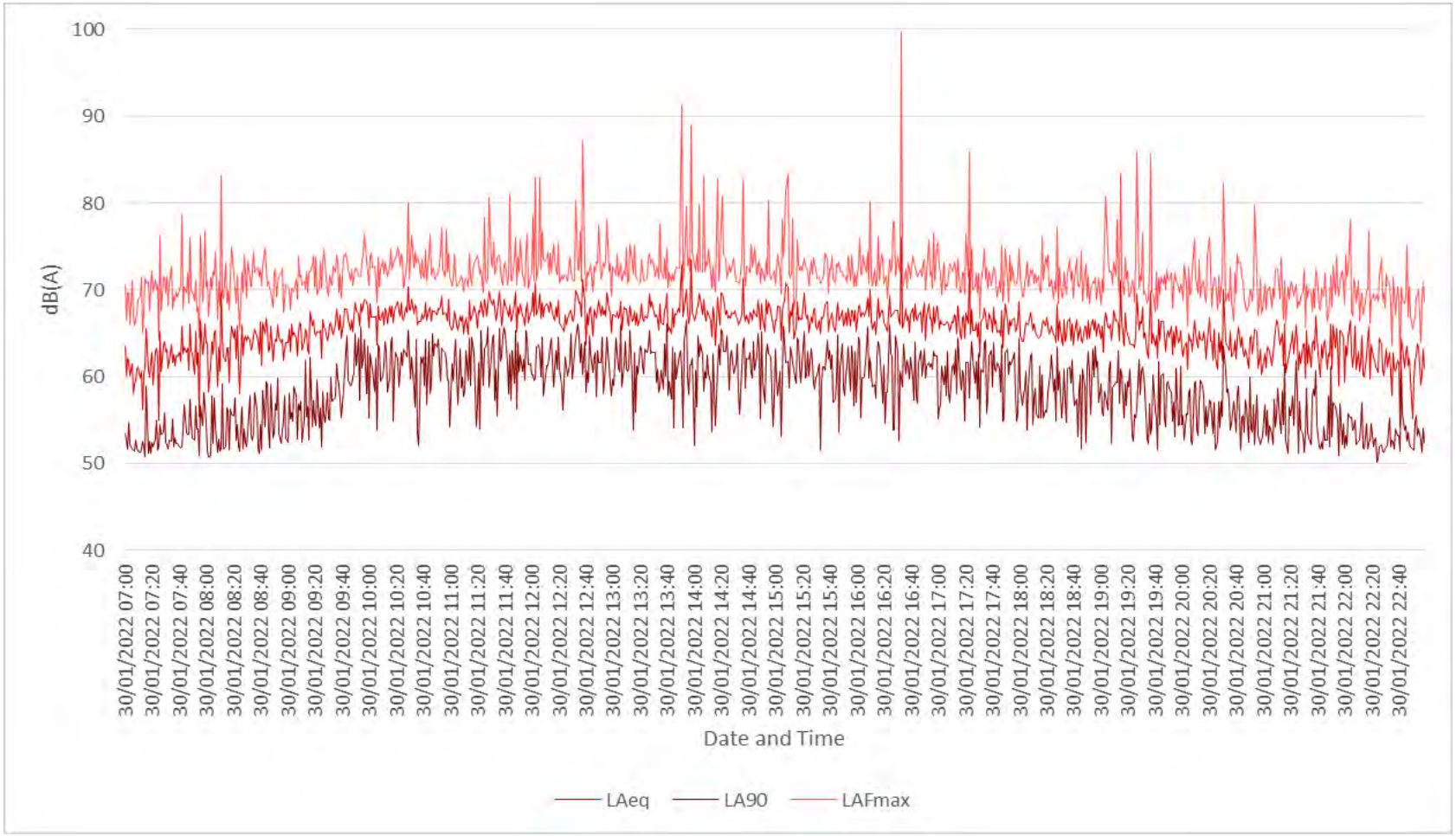
Graph 37: Graphical representation of the day monitoring period (incomplete) on the 26th January 2022 (St Crispins Road)



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 90th 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.

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:

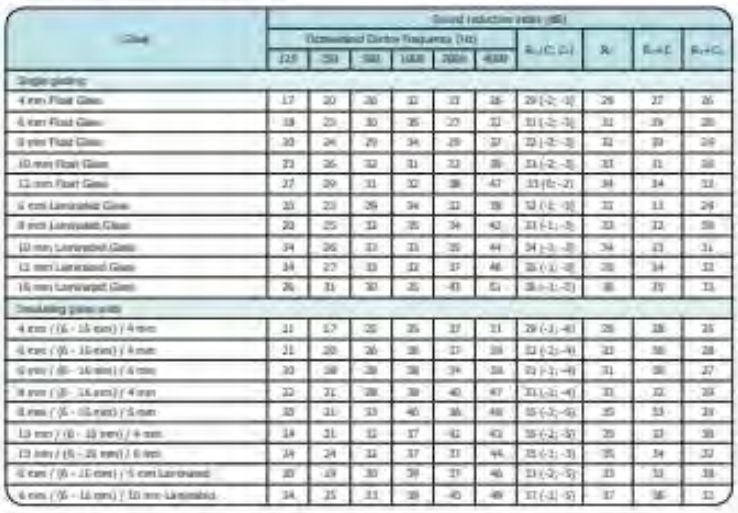
- Urban road traffic
- Railway traffic at low speeds
- Aircraft, propeller driven
- Jet aircraft, long distance away
- Music with low frequency bass sounds
- Factory emitting mainly low and medium frequency noise.

Sound insulation data for Pilkington **Optiphon™**

Glass	Sound reduction index (dB)									
	Octaveband Centre Frequency (Hz)						R_w (C; C_{tr})	R_A	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	42	36 (-1; -4)	36	35	32
8.8 mm Pilkington **Optiphon™**	27	29	34	38	40	42	37 (0; -2)	37	37	35
10.8 mm Pilkington **Optiphon™**	26	30	35	39	40	44	38 (-1; -3)	38	37	35
12.8 mm Pilkington **Optiphon™**	28	32	36	41	42	51	40 (-1; -2)	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™**	31	36	37	48	48	54	43 (-2; -6)	43	38	34
6 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	35	37	38	48	47	55	44 (-2; -6)	44	39	35
8 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	31	36	39	47	50	55	45 (-3; -8)	42	39	34
10 mm / 16 mm argon / 8.8 mm Pilkington **Optiphon™**	28	31	42	46	50	58	44 (-2; -6)	44	42	38
10 mm / 20 mm argon / 8.8 mm Pilkington **Optiphon™**	28	38	43	47	49	58	46 (-2; -6)	46	44	40
8.8 mm Pilkington **Optiphon™** / 16 mm argon / 12.8 mm Pilkington **Optiphon™**	38	36	45	53	53	64	49 (-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; -8)	52	50	46
12.8 mm Pilkington **Optiphon™** / 20 mm argon / 16.8 mm Pilkington **Optiphon™**	35	45	49	55	54	65	51 (-1; -4)	51	50	47

Measurements undertaken in accordance with BS EN ISO 10140 and the R_w (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)									
	Octave band 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	35	29 (-2; -5)	29	27	24
6 mm Float Glass	18	23	30	35	27	32	31 (-2; -5)	31	29	26
8 mm Float Glass	20	24	29	34	29	37	32 (-2; -5)	32	30	26
10 mm Float Glass	23	26	32	31	32	35	31 (-2; -5)	33	31	28
12 mm Float Glass	27	29	31	32	38	47	33 (0; -2)	34	34	32
6 mm Laminate Glass	20	23	29	34	32	39	32 (-1; -5)	32	33	29
8 mm Laminate Glass	20	25	32	35	34	42	33 (-1; -5)	33	32	30
10 mm Laminate Glass	24	26	33	33	35	44	34 (-3; -7)	34	33	31
12 mm Laminate Glass	24	27	33	32	37	46	35 (-1; -5)	35	34	33
16 mm Laminate Glass	26	31	30	35	43	51	36 (-1; -7)	36	35	33
Insulating glass units										
4 mm / (6 - 15 mm) / 4 mm	21	17	25	35	37	31	29 (-1; -6)	29	28	25
6 mm / (6 - 15 mm) / 4 mm	21	20	26	36	37	33	32 (-2; -9)	33	30	28
6 mm / (8 - 16 mm) / 4 mm	23	18	28	38	34	36	31 (-1; -6)	31	30	27
8 mm / (8 - 16 mm) / 4 mm	22	21	28	39	40	47	33 (-1; -4)	33	32	29
8 mm / (6 - 15 mm) / 6 mm	20	21	33	40	36	48	35 (-2; -6)	35	33	29
10 mm / (6 - 15 mm) / 4 mm	24	21	32	37	42	43	35 (-2; -5)	35	33	30
10 mm / (6 - 20 mm) / 6 mm	24	24	32	37	37	46	35 (-2; -3)	35	34	32
6 mm / (6 - 15 mm) / 6 mm Laminate	20	19	30	39	37	46	33 (-2; -5)	33	33	30
6 mm / (6 - 16 mm) / 10 mm Laminate	24	25	33	39	45	49	37 (-2; -5)	37	36	33

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Appendix E – Site Plan

Appendix 9.4: Legislation and Policy Context

National Planning Policy

9.1 The key legislation relevant to the Proposed Development is:

National Planning Policy Framework (2021)

9.2 The National Planning Policy Framework was published in March 2012 and revised in July 2018, February 2019, July 2019 and July 2021. In respect of noise, the document states, in section 15, paragraph 174 that:

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

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

9.5 "Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- 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 life65;
- Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; and
- Limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

9.6 Paragraph 187 states "Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed.

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

9.8 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

9.9 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

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

9.11 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.

9.12 British Standard BS8233: Sound Insulation and Noise Reduction for Buildings – Code of Practice (2014)

9.13 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.

9.14 The Standard suggests suitable internal noise levels within different types of buildings, including dwellings, and these are repeated in Table 9.4.

Table 9.4 Recommended internal noise levels LAeq,T Db

Activity	Location	07:00-23:00	23:00-07:00
Resting	Living Room	35dB $LA_{eq,16\ hour}$	----
Dining	Dining Room Area	40dB $LA_{eq,16\ hour}$	----
Sleeping	Bedroom	35dB $LA_{eq,16\ hour}$	30dB $LA_{eq,8\ hour}$

9.15 These internal levels are based on annual average data and do not have to be achieved in all circumstances. It is normal to exclude occasional events, such as fireworks night or New Year’s Eve.

9.16 The standard states that where development is considered necessary or desirable, the internal target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

9.17 For external amenity areas, such as gardens and patios, the standard states:

9.18 ‘it is desirable that the external noise level does not exceed 50 dB LAeq,T with an upper guideline value of 55 dB LAeq,T which would be acceptable in noisier environments. However, it is also recognized that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors, such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited.’

BS41412: ‘Methods for rating and assessing an Industrial and Commercial Sound (2014 + A1:2019)

9.19 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;

9.20 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).

9.21 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.

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

9.23 Typically, the greater this difference, the greater the magnitude impact.

9.24 The difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.

9.25 A difference of around +5dB is likely to be an indication of an adverse impact depending on the context.

9.26 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.

9.27 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.

9.28 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."

9.29 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,
- The conclusions of assessments undertaken using alternative assessment methods, for example WHO guidelines noise values or change in noise level.

9.30 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.

Local Planning Policy

NCC New Local Plan (2014)

9.31 The Local Plan was adopted/ amended by NCC in 2014 and comprises three documents. That relevant to noise assessment is titled - Norwich Local Plan – Development Management Policies Plan, Adopted December 2014.

9.32 Policy DM2 Amenity – the supporting text states that for the purpose of this policy, "amenity" is defined as 'the desirable features of a place that ought to be protected or enhanced in the public interest'. This includes factors such as achieving and maintaining acceptable levels of privacy, safeguarding occupiers from excessive noise or light pollution and ensuring sufficient internal and external space and light. Consideration should not only be given to the impact of individual developments, but also to cumulative impacts. The policy will consider both the use, or activity itself and its direct and indirect impacts (e.g. increases in traffic).

9.33 Policy DM2 – Amenity is reproduced below;

Policy DM2 – Amenity

Existing occupiers
Development will be permitted where it would not result in an unacceptable impact on the amenity of the area or the living or working conditions or operations of neighbouring occupants. Particular regard will be given to:
a) the prevention of overlooking and the loss of privacy;
b) the prevention of overshadowing and loss of light and outlook; and
c) the prevention of disturbance from noise, odour, vibration, air or artificial light pollution.

Future occupiers
Development will only be permitted where:
a) it provides for a high standard of amenity, satisfactory living and working conditions, adequate protection from noise and pollution and adequate levels of light and outlook for future occupiers; and
b) such a standard can be achieved and maintained without preventing or unreasonably restricting the continued operation of established authorised uses and activities on adjacent sites.

9.34 Policy DM11 Environmental Hazards – the supporting text states that the policy should be read alongside other relevant policies of the plan seeking to manage particular forms of development (in particular late night activities subject to policy DM23 and hot food takeaways subject to policy DM24). It seeks to apply a precautionary principle, recognising that it will be necessary in certain circumstances to limit the impacts of noise generating uses in the interests of amenity, albeit not to the extent where it would impact unreasonably on the operating conditions of business (see policy DM22). The acceptability and the precise impact of noise will vary according to where the proposed development is located, but the expectation is that in the City Centre the intensity of commercial uses and activities, particularly those relating to the evening and late night economy, will typically generate higher levels of neighbourhood noise than would characterise a quiet suburban area, and that some noise in these areas is inevitable. Accordingly, relative noise sensitivity and the level at which noise becomes significantly harmful to health and quality of life (the “significant observed adverse effect level” or SOAEL) will vary from place to place, and this will have a bearing on the scope and nature of any conditions or mitigating measures required.

9.35 In forming conditions necessary to manage and mitigate the impact of noise either by means of insulation, limits on amplified sound or mechanical noise or the restriction of hours of operation, account will be taken of the technical advice from Environmental Health Officers on what is appropriate in individual cases. Such conditions will be proportionate and reasonable to the circumstances of the case. It should be noted however that the Development does not propose any Use Class A5 Take Away food premises, and that the proposed Use Class A3 and A4 restaurants and bars are intended to contribute to the evening, rather than late night economy of the area.

9.36 Policy DM11 Environmental Hazards - noise, has been reproduced below;