Report VA5551.250514.NIA3

Broadway Farm, Broad Oak, Botley

Noise Impact Assessment

15 May 2025

Paris Smith Solicitors
1 London Road
Southampton
SO15 2AE

VENTA ACOUSTICS

01962 461016
0203 8650332
mail@ventaacoustics.com

registered company no. 10139494

Contents

1. Introduction 1
2. Site Description 1
3. Design Criterion and Assessment Methodology 1
   3.1 BS4142:2014+A1:2019 1
   3.2 The National Planning Policy Framework (2024) 3
   3.3 Noise Policy Statement for England (2010) 3
   3.4 Planning Practice Guidance 4
   3.5 BS8233:2014 5
   3.6 WHO Guidelines for Community Noise (1999) 6
4. Environmental Noise Survey 6
   4.1 Survey Procedure & Equipment 6
5. Results 7
6. BS4142 Noise Impact Assessment 7
   6.1 Source Noise Levels 7
   6.2 Acoustic Character Correction 8
   6.3 Rating Level and Assessment 8
   6.4 Context 9
   6.5 Uncertainty 9
   6.6 NPPF, NPSE, PPG and WHO 10
7. Potential Mitigation 10
8. Conclusion 11

Attachments

VA5551/SP1	Indicative Site Plan
VA5551/TH1-TH10	Environmental Noise Time Histories
Appendix A	Acoustic Terminology

Report Version	Author	Approved	Changes	Date
NIA3	Jamie Duncan	Ben Alexander	-	15/5/25

The interpretations and conclusions summarised in this report represent Venta Acoustics' best technical interpretation of the data available to us at the time of assessment. Any information provided by third parties and referred to in this report has not been checked or verified by Venta Acoustics, unless otherwise expressly stated in the document. Venta Acoustics cannot accept any liability for the correctness or validity of the information provided. Due to a degree of uncertainty inherent in the prediction of all parameters, we cannot, and do not guarantee the accuracy or correctness of any interpretation and we shall not, except in the case of gross or wilful negligence on our part, be liable for any loss, cost, damages or expenses incurred or sustained by anyone resulting from any interpretations, predictions of conclusions made by the company or employees. The findings and conclusions are relevant to the period of the site survey works, and should not be relied upon to represent site conditions at later dates. Where additional information becomes available which may affect the findings of our assessment, the author reserves the right to review the information, reassess the findings and modify the conclusions accordingly.

1. Introduction

Botley houses CCW Services operates a warehouse, storage and transport service, with fleet of 25 HGVs that service the site at Broadway Farm, Broad Oak 24/7, and have done so for a number of years. A new trailer storage area is to be constructed to the north-west of the existing site to allow for the relocation of the existing trailer parking area, which is located to the northeast of the site.

Venta Acoustics has been commissioned by Paris Smith Solicitors to undertake an assessment of the potential noise impact of these changes on the nearby noise sensitive receivers.

An environmental noise survey was undertaken to determine the background noise levels at the site, as well as the sound levels generated by the surrounding premises. These levels were then used to undertake an assessment of the likely impact with reference to the methodology in BS4142:2014 *Methods for rating and assessing industrial and commercial sound.* This report also compares the measured levels with the aims and intents of the National Planning Policy Framework (2024), Noise Policy Statement for England (2010), Planning Policy Guidance, BS8233: 2014 *Guidance on sound Insulation and noise reduction for buildings* and the World Health Organisation Guidelines for Community Noise (1999).

All staff at Venta Acoustics are fully qualified and members of the Institute of Acoustics, the recognised UK professional body for acoustics, noise and vibration professionals and are fully competent to undertake BS4142 assessments.

2. Site Description

As illustrated on attached site plan VA5551/SP1, the site is located to the north of Broad Oak, a main access road running between Hedge End and Botley. The site is bordered by agricultural land to the west, north and east.

The most affected noise sensitive receiver is expected to be located at Poplar Cottage to the southwest of the site. The rear of the house is located approximately 110m from the nearest point of the proposed new trailer storage area.

3. Design Criterion and Assessment Methodology

3.1 BS4142:2014+A1:2019

British Standard BS4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* describes a method for rating and assessing sound of an industrial and/or commercial nature, which includes:

- Sound from industrial and manufacturing processes;
- Sound from fixed installations which comprise mechanical and electrical plant and equipment;

- Sound from the loading and unloading of goods and materials at industrial and/or commercial premises, and;
- Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes.

The Standard is therefore suited to this assessment.

The assessment methodology considers the Specific Sound Level, as measured or calculated at a potential noise sensitive receptor, due to the source under investigation in terms of a L_{Aeq} value over a one-hour period during daytime operation (07:00-23:00 hours) and a fifteen-minute period during night-time operation (23:00-07:00 hours).

A correction factor is added to this level to account for the acoustic character of the sound. This is determined as follows when using the subjective assessment methodology:

Tonality - For sound ranging from not tonal to prominently tonal, the Joint Nordic Method gives a correction of between 0 dB and +6 dB for tonality. Subjectively, this can be allocated as a penalty of 2 dB for a tone which is just perceptible at the noise receptor, 4 dB where it is clearly perceptible and 6 dB where it is highly perceptible.

Impulsivity - A correction of up to +9dB can be applied for sound that is highly impulsive considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be allocated as a penalty of 3 dB for impulsivity which is just perceptible at the receiver, 6 dB where it is clearly perceptible and 9 dB where it is highly perceptible.

Other sound characteristics - Where the specific sound contains characteristics that are neither tonal nor impulsive, but are otherwise startling, disturbing or incongruous with the residual acoustic environment, a penalty of +3 dB can be applied.

Intermittency - When the specific sound has identifiable on/off conditions, if the intermittency is readily distinctive against the residual acoustic environment, a penalty of +3 dB can be applied.

An initial estimate of the impact of the source is then obtained by subtracting the typical background noise level, in terms of a LA90 value over the relevant period of operation, from the corrected Specific Sound Level.

- Typically, the greater this difference, the greater the magnitude of the impact.
- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- A difference of around +5 dB could be an indication of an adverse impact, depending on the context.
- The lower the rating level is relative to the measured background sound level, the less likely it is that there will be an adverse impact. Where the rating level does not exceed the

background sound level, this is an indication of the specific sound having a low impact, depending on the context.

The initial estimate of the impact may then be modified by taking consideration of the context in which the sound occurs.

3.2 The National Planning Policy Framework (2024)

The revised *National Planning Policy Framework* (NPPF), published in December 2024 (amended in February 2025), sets out the Government's planning polices for England, superseding all previous planning policy statements and guidance.

In respect of noise, the NPPF states that the planning system should contribute to and enhance the natural and local environment by preventing both new and existing developments from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of noise pollution.

Hence, Paragraph 198 states that *planning policies and decisions should also ensure 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:*

a) *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*
b) *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason*

In regards to the term adverse impact, reference is made to the Noise Policy for England:

3.3 Noise Policy Statement for England (2010)

The Noise Policy Statement for England (NPSE) sets out the long term vision of Government noise policy: to promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

This vision is supported by the following aims:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life.*

The terms "significant adverse" and "adverse" are related to the following concepts:

No Observed Effect Level (NOEL) - *the level below which no effect on health and quality of life can be detected*.

Lowest Observed Adverse Effect Level (LOAEL) - *the level above which adverse effects on health and quality of life can be detected*.

Significant Observed Adverse Effect Level (SOAEL) - *the level above which significant adverse effects on health and quality of life occur*.

The guidance acknowledges that 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, but will be different for different noise sources, receptors and times.

In order to enable assessment of impacts in line with these requirements, reference should be made to other currently available guidance.

3.4 Planning Practice Guidance

This document advises on how planning can be used to manage potential noise impacts on communities.

The document has some overlap with the NPSE in its guidance although it does introduce new concepts regarding amenity.

Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- *whether or not a significant adverse effect is occurring or likely to occur;*
- *whether or not an adverse effect is occurring or likely to occur; and*
- *whether or not a good standard of amenity can be achieved.*

The document includes a table, reproduced in Table 3.1, regarding perception of noise in relation to the effect on residents, which is summarised below. This provides a qualitative description of noise and how it affects people and their behaviour.

Perception	Examples of outcomes	Increasing effect level	Action
Not noticeable	No Effect	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard, but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
		Lowest Observed Adverse Effect Level	
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
		Significant Observed Adverse Effect Level	
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

Table 3.1 – Noise exposure hierarchy

3.5 BS8233:2014

BS8233 *Guidance on sound insulation and noise reduction for buildings* provides guidance as to suitable internal noise levels for different areas within residential buildings.

The relevant section of the standard is shown below in Table 3.2.

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

Table 3.2 - Excerpt from BS8233: 2014 **[dB ref. 20µPa]**

3.6 WHO Guidelines for Community Noise (1999)

The guidance in this document details suitable noise levels for various activities within residential and commercial buildings.

The relevant sections of this document are shown in Table 3.3.

Criterion	Environment	Design range $L_{Aeq,T}$ dB
Maintain speech intelligibility and avoid moderate annoyance, daytime and evening	Living Room	35 dB
Prevent sleep disturbance, night time	Bedrooms	30 dB

Table 3.3 – Excerpt from WHO **[dB ref. 20µPa]**

For outdoor living areas, it is stated that:

> *To protect the majority of people from being seriously annoyed during the daytime, the outdoor sound level from steady, continuous noise should not exceed 55dB LAeq on balconies, terraces and in outdoor living areas. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound level should not exceed 50dB LAeq. Where it is practical and feasible, the lower outdoor sound level should be considered the maximum desirable sound level for new development.*

4. Environmental Noise Survey

4.1 Survey Procedure & Equipment

In order to establish the existing background noise levels at the site, a noise survey was carried out between Thursday 19th and Monday 23rd September 2024 at the locations shown in site plan VA5551/SP1. These locations were chosen to be representative of the background noise level at the most affected noise sensitive receivers.

Continuous 5-minute samples of the L_{Aeq}, L_{Amax}, L_{A10} and L_{A90} sound pressure levels were undertaken at each of the measurement locations.

The weather during the survey period was generally dry with light winds, with some periods of rain, that have been excluded from the analysis.

Measurements were made generally in accordance with ISO 1996 2:2017 *Acoustics - Description, measurement and assessment of environmental noise – Part 2: Determination of sound pressure levels*.

The following equipment was used in the course of the survey:

Manufacturer	Model Type	Serial No	Calibration	
			Certificate No.	Date
NTi Class 1 Integrating SLM	XL2	A2A-11461-E0	1509201-1	19/7/24
NTi Class 1 Integrating SLM	XL2	A2A-11586-E0	1509201-2	19/7/24
Svantek Class 1 SLM	971	143568	1508506-1	22/4/24
Larson Davis calibrator	CAL200	19816	1509201-5	19/7/24

Table 4.1 – Equipment used for the survey

The calibration of the sound level meters was verified before and after use with no significant calibration drift observed.

5. Results

The measured sound levels are shown as time-history plots on the attached charts VA5551/TH1-4 for position 1, VA5551/TH5-6 for position 2 and VA5551/TH7-10 for position 3.

The background noise level is determined by traffic on the roads in the local area.

The typical background noise levels measured were:

Monitoring Period	Typical[1] $L_{A90,5min}$		
	Position 1 (West)	Position 2 (East)	Position 3 (Entrance)
07:00 – 23:00 hours	39 dB	39 dB	44 dB
23:00 – 07:00 hours	25 dB	26 dB	32 dB

Table 5.1 – Typical background noise levels

[1] The typical L_{A90} value is taken as the 10th percentile of all L_{A90} values measured during the relevant period.

6. BS4142 Noise Impact Assessment

6.1 Source Noise Levels

Although the business does not always operate 24/7, there are occasions when there may be HGV movements during the night-time, and so a comparison of the noise from each of the trailer storage areas has been undertaken to the most affected dwelling.

Noise from HGVs entering and leaving site along the access road would be unchanged from the current situation, and so this has not been evaluated.

The following source noise level has been used for the purpose of the assessment.

Noise Source	Measurement Distance	Measured L_{Aeq}
HGV manoeuvring	8m	73dB

Table 6.1 – Measured and library data noise sources used for assessment

6.2 Acoustic Character Correction

The subjective method of allocating corrections to the sound source has been used following the methodology provided in BS4142:2014 and summarised in section 3.1.

Noise Source	Subjective Description	Allocated Corrections
HGV Manoeuvring	Intermittent deliveries, diesel engine broadband, tonal and impulsive reversing alarm	Tonality: +2dB Impulsivity: +3dB Intermittency: +3dB

Table 6.2 – Acoustic character corrections

These penalties are applied to the specific noise level in section 6.3 to obtain the rating level.

6.3 Rating Level and Assessment

The rating levels at the assessment locations are compared against the relevant background noise levels to assess the notional significance of the noise impact as follows. Operations are adjusted to the appropriate on times.

Table 6.3 and Table 6.4 show the assessments for the current and proposed situation, respectively, on the most affected façade of the house.

Results		Relevant Clause	Commentary
Source Sound Levels	73dB @ 8m	7.3.4	HGV Manoeuvring – east
Distance Loss (170m)	-27dB	7.3.5	Assumed a point source
Screening	-10dB		From existing buildings
Specific Sound Level	L_{Aeq} 36dB		
Time correction	-12dB	7.2	1 minute per 15 minute period
Acoustic feature correction	+8 dB	9.2	+2 dB for tonality, +3dB for impulsivity, +3dB for intermittency
Rating level	L_{Ar} 32 dB	9.2	
Night-time background sound level	L_{A90} 25 dB	8	
Excess of rating over background sound level	+7 dB	11	
Assessment indicates adverse impact		11	Depending on context

Table 6.3 – BS4142 Assessment - existing

The existing assessment shows a +7dB rating above the background.

Results		Relevant Clause	Commentary
Source Sound Levels	73dB @ 8m	7.3.4	HGV Manoeuvring - west
Distance Loss (140m)	-25dB	7.3.5	Assumed a point source
Screening	-10 dB		Boundary fencing
Specific Sound Level	L_{Aeq} 38 dB		
Time correction	-12dB	7.2	1 minute per 15 minute period
Acoustic feature correction	+8 dB	9.2	+2 dB for tonality, +3dB for impulsivity, +3dB for intermittency
Rating level	L_{Ar} 34 dB	9.2	
Night-time background sound level	L_{A90} 25 dB	8	
Excess of rating over background sound level	+9 dB	11	
Assessment indicates adverse impact		11	Depending on context

Table 6.4 – BS4142 Assessment – proposed

The proposed scenario shows a marginal increase of 2dB in the potential impact at the receiver from the new location.

6.4 Context

The site has a long history of use as a 24 hour business with regular HGV movements, and is not understood to have generated any complaints. Due to the predicted absolute noise levels externally being relatively low, and the busy nature of the main road, this may support the lack of complaints.

At a greater distance, there is the busy main road, and various businesses, including a fuel station and a septic tank company to the west, and vehicle sales premises to the east.

Within this context, the estimated impact of the sound sources is expected to remain valid or be slightly reduced.

6.5 Uncertainty

This section considers the variable in the assessment that may cause variations within the final results and describes how these have been addressed.

- Use of a Class 1 sound level meter is considered to reduce instrument error to insignificant levels as compared with environmental variations. The calibration of the instrumentation was confirmed before and after the noise surveys.
- The background measurements were undertaken under suitable weather conditions over a period designed to include reasonable temporal variations in background noise levels, including a weekend period. Multiple monitoring locations were selected to minimise local acoustic phenomenon that may affect a single measurement location, including the noise from the nearby road site. These measurement locations were selected to be representative of the background noise levels expected to be experienced by the nearby dwellings without being unduly influenced by extraneous noise sources.
- Propagation calculations have been used to correct noise levels to the relevant distance at the receiver.

Overall, the uncertainty is considered to have been minimised to a suitable range so as not to risk significant variations in the impact assessment of typical operations.

6.6 NPPF, NPSE, PPG and WHO

The NPPF highlights that consideration should be taken for a location taking into account the likely effects of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site. It goes on to state, as is echoed in the NPSE and the PPG, that where possible, measures should be taken to mitigate and reduce to a minimum potential adverse impacts.

As previously discussed, the site has a long history of commercial use throughout the day and night.

The BS4142 assessment suggests the potential for adverse impact on the dwelling during the night-time. However, this is based against the quietest periods of the night when noise levels are at their lowest. At this time, it is considered unlikely that the residents would experience the noise in their rear gardens, and instead be more likely to be inside the house. Allowing for a partially open window loss of 15dB, as per BS8233, internal noise levels resulting from the noise of HGVs manoeuvring (38dB(A) externally) would be expected to be 23dB(A) for the proposed new trailer park area. This is lower than the corresponding BS8233 guideline level detailed in Table 3.2 (although it is noted that this guidance is intended for consideration of anonymous noise), and is also slightly lower than the existing average noise levels measured during the quieter night time periods without any activity, (i.e., the residual noise climate).

Considering the relatively small change in noise level of 2dB from the existing to proposed use, this would suggest that the level of impact derived using the noise hierarchy would lie between *lowest observed adverse effect level* and *observed adverse effect*.

Although the WHO Guidelines are intended for the assessment of what is often referred to 'anonymous' noise, such as distant traffic, the levels on site from activity at 38dB(A) are considerably below the 50dB level suggested at which the onset of annoyance may begin, which would suggest that there would be limited impact on amenity during the daytime.

7. Potential Mitigation

The current proposal shows the potential for an adverse impact on the areas to the rear of the most affected receivers. As highlighted in Table 6.2, the HGVs are fitted with tonal and impulsive reversing alarms. Following discussion with the operator of the site, it is understood that the tonal reversing alarms can be turned off and instead a visual flashing alert utilised during the night-time periods on site. This would remove both the penalties for both tonality and impulsivity from the assessment. A new BS4142 assessment has been undertaken on this basis and is shown in Table 7.1.

Results		Relevant Clause	Commentary
Source Sound Levels	73dB @ 8m	7.3.4	HGV Manoeuvring - west
Distance Loss (140m)	-25dB	7.3.5	Assumed a point source
Screening	-10dB		Boundary fencing
Specific Sound Level	L_{Aeq} 38dB		
Time correction	-12dB	7.2	1 minute per 15 minute period
Acoustic feature correction	+3 dB	9.2	+3dB for intermittency
Rating level	L_{Ar} 29 dB	9.2	
Night-time background sound level	L_{A90} 25 dB	8	
Excess of rating over background sound level	+4 dB	11	
Assessment indicates marginal impact		11	Depending on context

Table 7.1 – BS4142 Assessment – proposed, mitigated

With the tonal reversing alarms turned off, the night-time assessment shows the same level of impact as the current situation with the HGVs parking to the east of the site.

Contextually therefore, this is likely to be perceived as a low impact.

8. Conclusion

A baseline noise survey has been undertaken by Venta Acoustics to establish the background noise climate in the locality of Broadway Farm, Broad Oak, Botley.

The noise levels associated with the new trailer storage area have been assessed against BS4142:2014 *Methods for rating and assessing industrial and commercial sound* and show a small increase in potential impact of 2dB from the current situation. Although both assessments would suggest an adverse impact during the night-time, this is based upon external noise. Residents are not likely to experience the noise externally during the quietest part of the night, and so a discussion of internal noise levels has been included.

When considered against the guidance provide in the NPPF, NPSE, PPG and WHO, noise levels would be audible at the nearby residences, although at a level which would be considered of low impact, and the level of change from the current situation is expected to be between LOAEL and OAEL.

Discussion with the site operator has resulted in a solution to reduce noise in the form of visual rather than auditory reversing alarms on the units. This would result in the level of impact from the proposals reduced from the the existing use, with the trailers being parked to the east of the site.

Considering the above, with the reduction in impact on nearby residents externally, and subsequent lower levels of impact on the residents internally in their houses, the actual impact on residents during the night would be low.

Jamie Duncan MIOA

Noise monitoring location 2
Proposed new trailer area
Noise monitoring location 1
Noise monitoring location 3
Most affected receiver
Google Earth

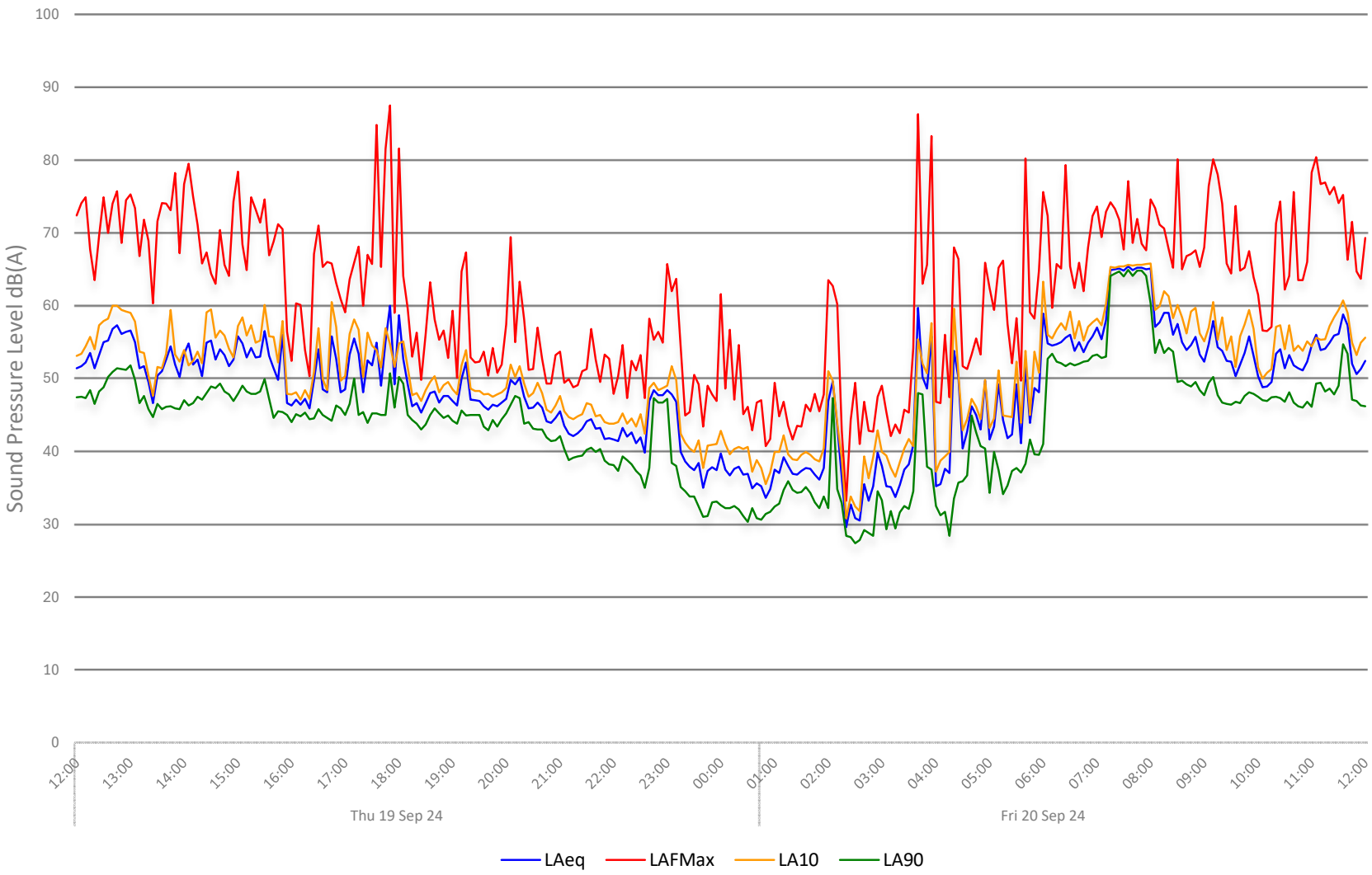
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 1

Position 1 - West

VENTA ACOUSTICS

Figure VA5551/TH1



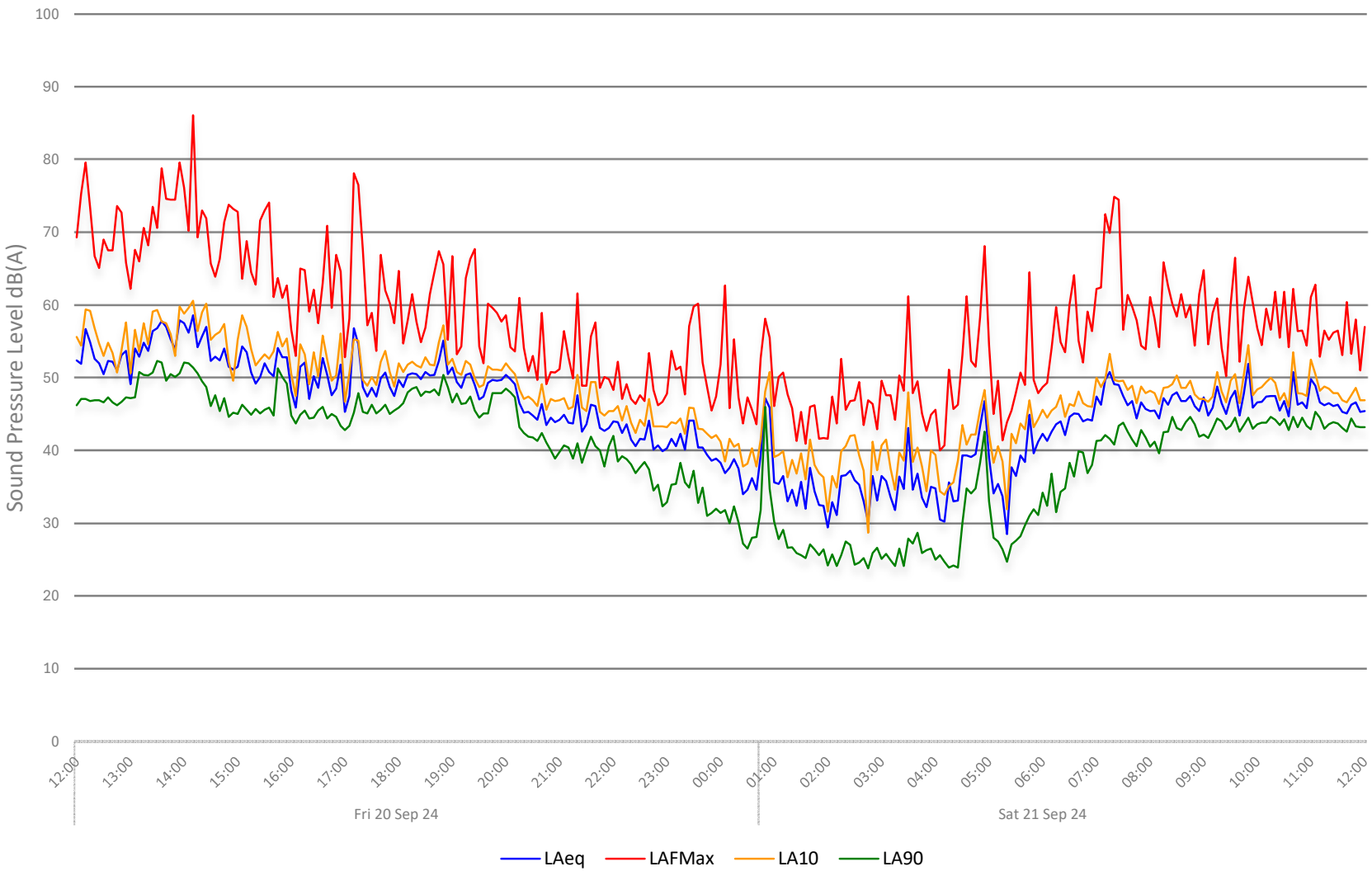
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 2

Position 1 - West

VENTA ACOUSTICS

Figure VA5551/TH2



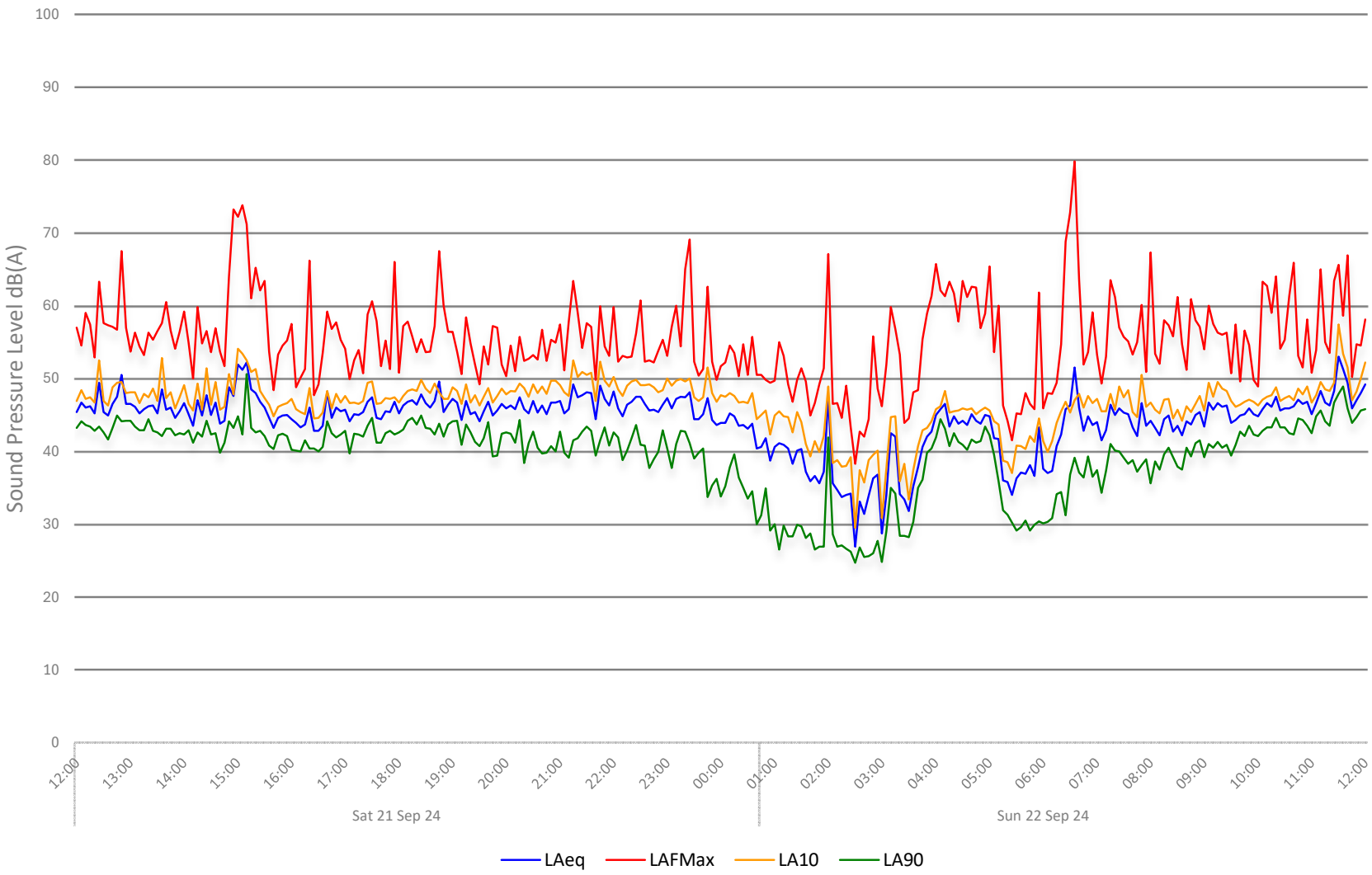
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 3

Position 1 - West

VENTA ACOUSTICS

Figure VA5551/TH3



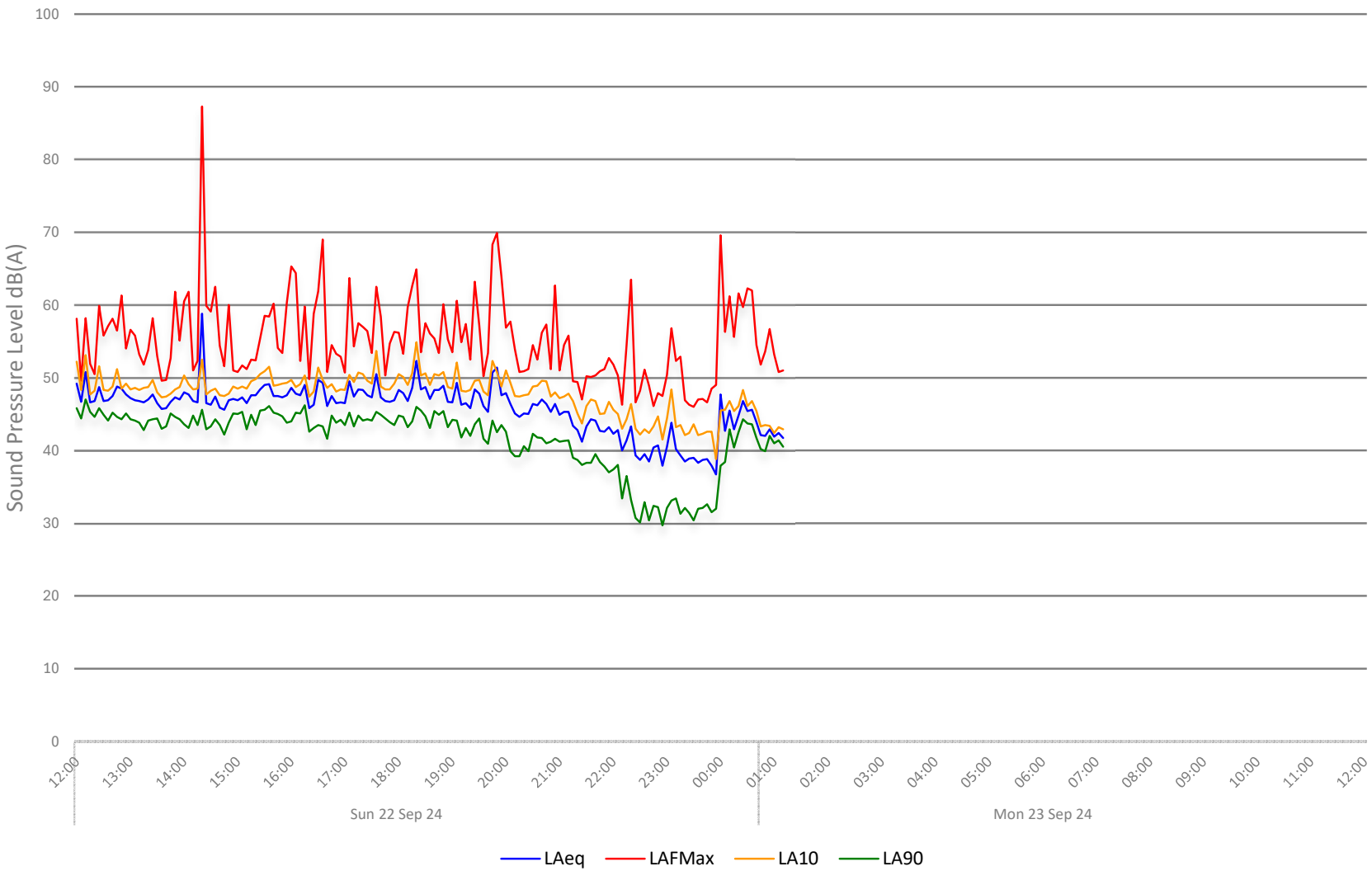
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 4

Position 1 - West

VENTA ACOUSTICS

Figure VA5551/TH4



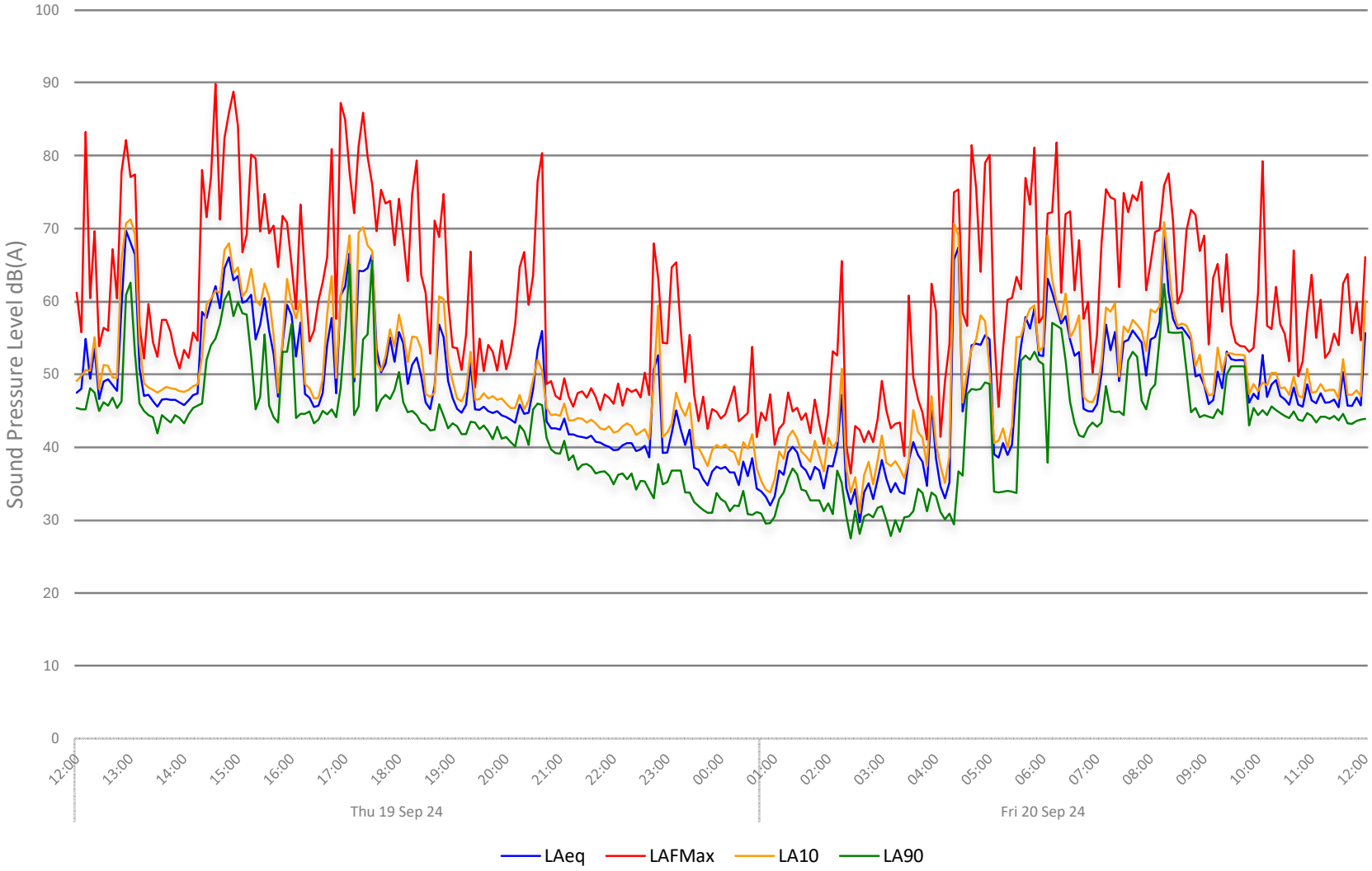
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 5

Position 2 - West

VENTA ACOUSTICS

Figure VA5551/TH5



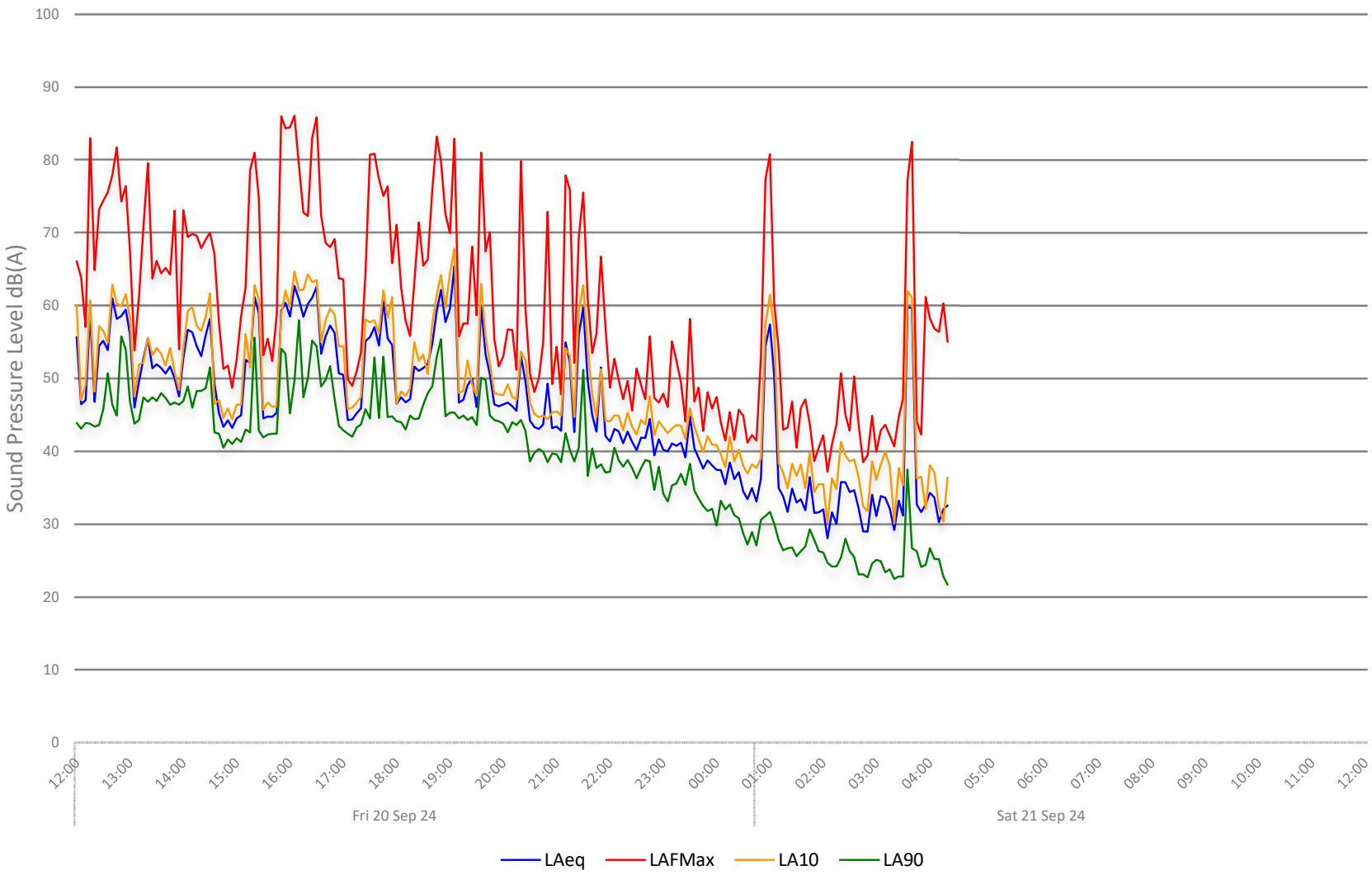
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 6

Position 2 - West

VENTA ACOUSTICS

Figure VA5551/TH6



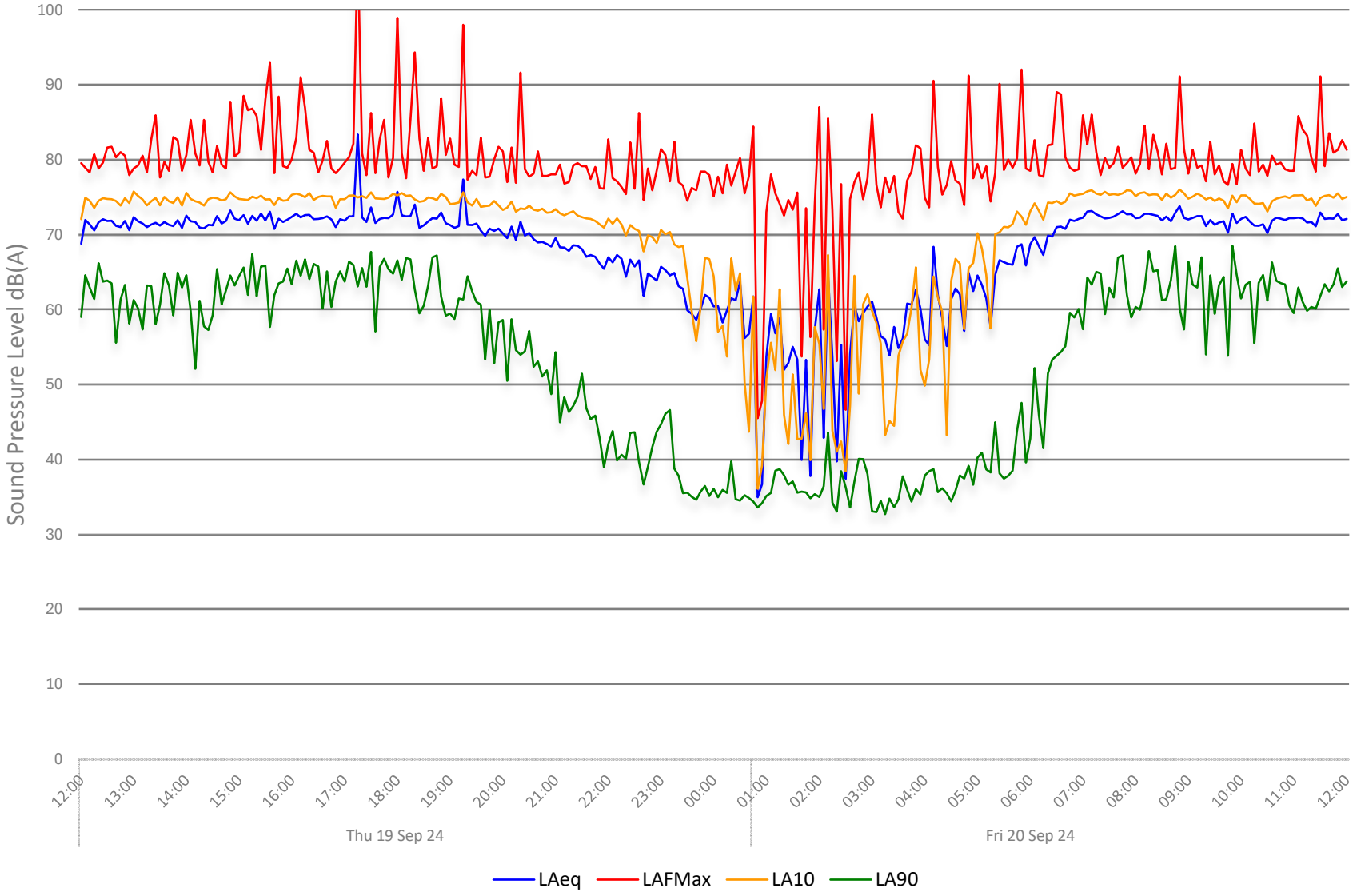
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 7

Position 3 - Front Gate

VENTA ACOUSTICS

Figure VA5551/TH7



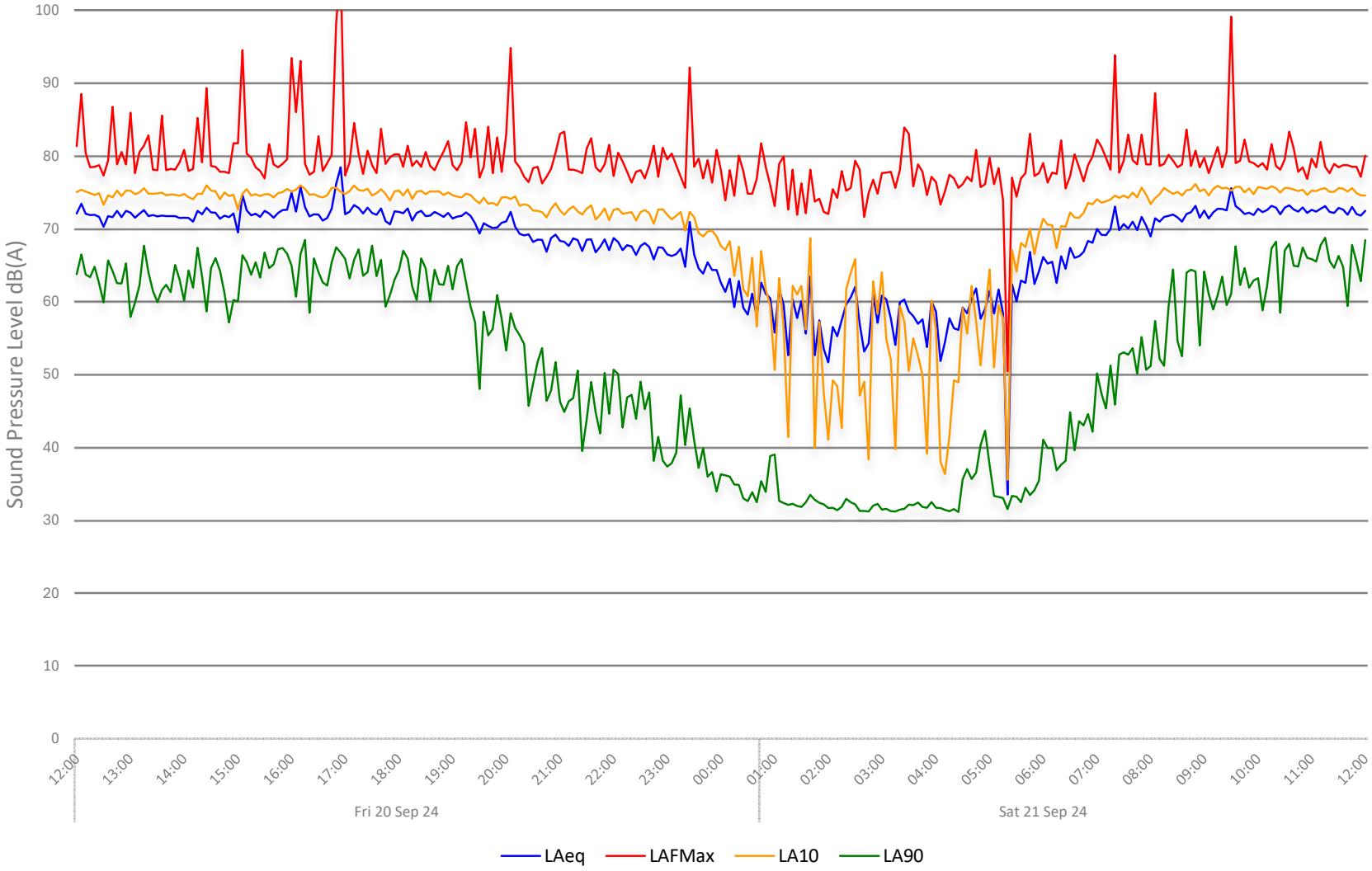
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 8

Position 3 - Front Gate

VENTA ACOUSTICS

Figure VA5551/TH8



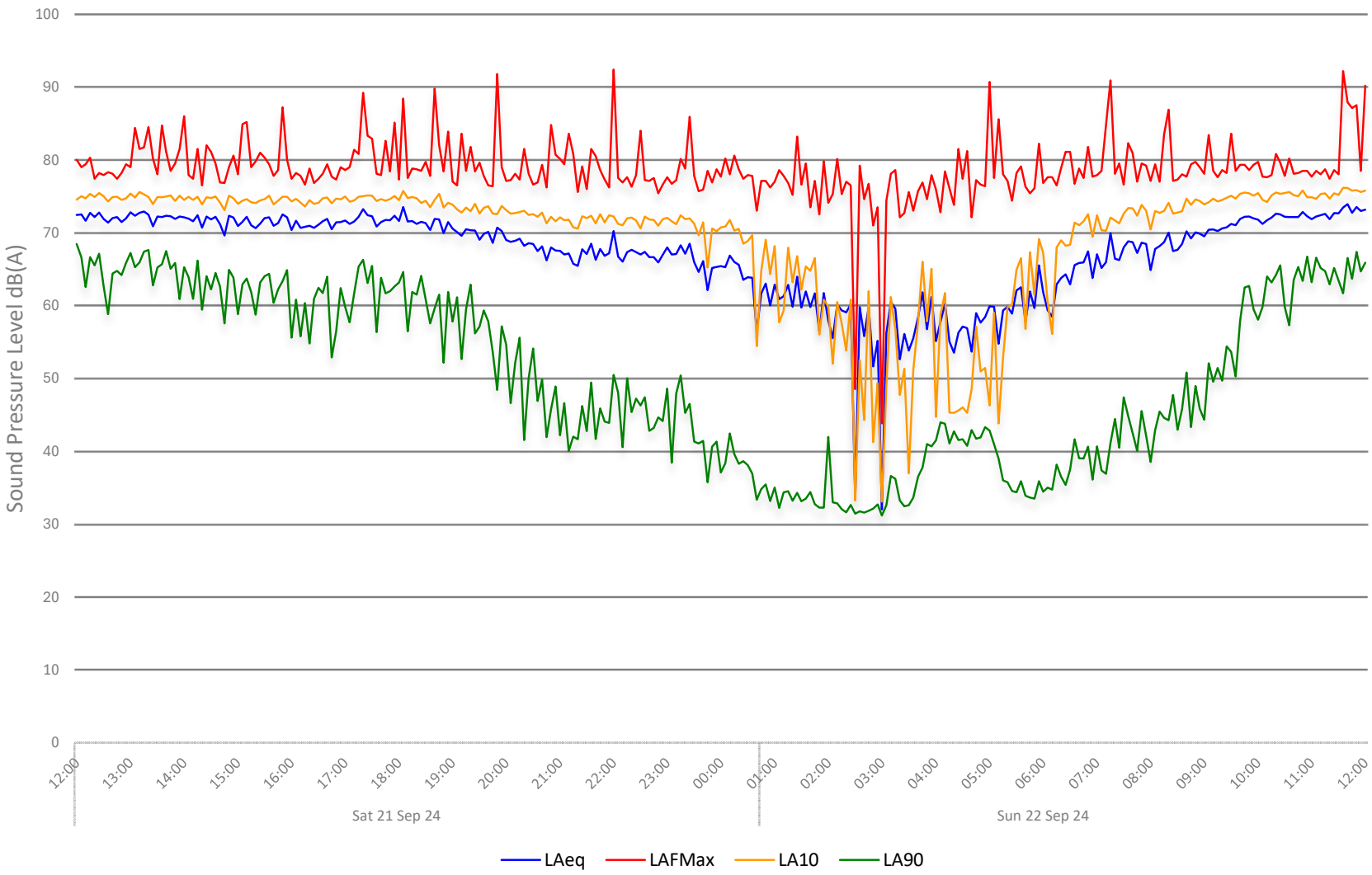
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 9

Position 3 - Front Gate

VENTA ACOUSTICS

Figure VA5551/TH9



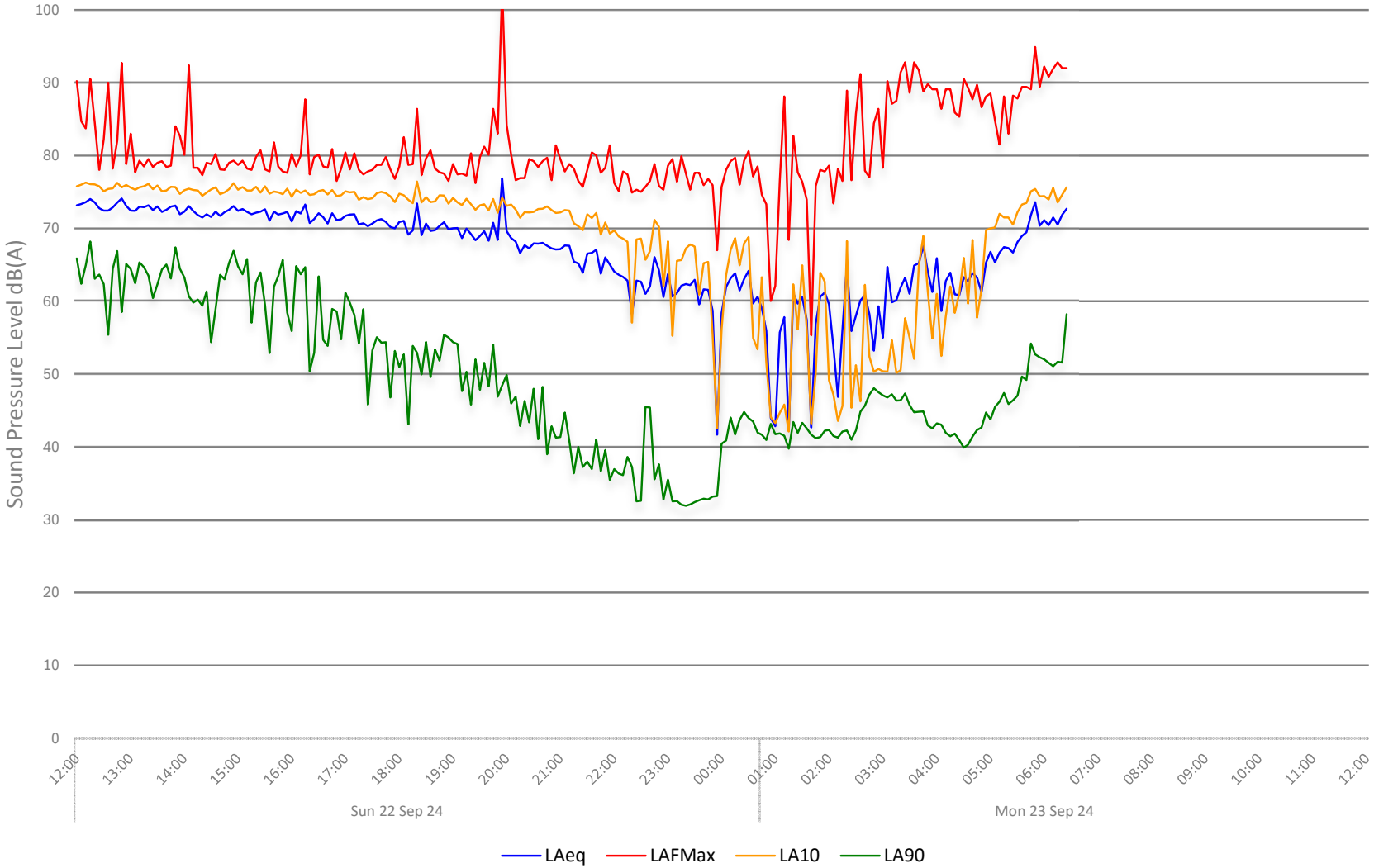
Broadway Farm, Broad Oak, Botley

Environmental Noise Time History: 10

Position 3 - Front Gate

VENTA ACOUSTICS

Figure VA5551/TH10



APPENDIX A

Acoustic Terminology & Human Response to Broadband Sound

1.1 Acoustic Terminology

The human impact of sounds is dependent upon many complex interrelated factors such as 'loudness', its frequency (or pitch) and variation in level. In order to have some objective measure of the annoyance, scales have been derived to allow for these subjective factors.

Sound	Vibrations propagating through a medium (air, water, etc.) that are detectable by the auditory system.
Noise	Sound that is unwanted by or disturbing to the perceiver.
Frequency	The rate per second of vibration constituting a wave, measured in Hertz (Hz), where 1Hz = 1 vibration cycle per second. The human hearing can generally detect sound having frequencies in the range 20Hz to 20kHz. Frequency corresponds to the perception of 'pitch', with low frequencies producing low 'notes' and higher frequencies producing high 'notes'.
dB(A):	Human hearing is more susceptible to mid-frequency sounds than those at high and low frequencies. To take account of this in measurements and predictions, the 'A' weighting scale is used so that the level of sound corresponds roughly to the level as it is typically discerned by humans. The measured or calculated 'A' weighted sound level is designated as dB(A) or L_A.
L_{eq} :	A notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the actual, fluctuating sound measured over that period (e.g. 8 hour, 1 hour, etc). The concept of L_{eq} (equivalent continuous sound level) has primarily been used in assessing noise from industry, although its use is becoming more widespread in defining many other types of sounds, such as from amplified music and environmental sources such as aircraft and construction. Because L_{eq} is effectively a summation of a number of events, it does not in itself limit the magnitude of any individual event, and this is frequently used in conjunction with an absolute sound limit.
L_{10} & L_{90} :	Statistical L_n indices are used to describe the level and the degree of fluctuation of non-steady sound. 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 a typical maximum level. Similarly, L_{90} is the typical minimum level and is often used to describe background noise. It is common practice to use the L_{10} index to describe noise from traffic as, being a high average, it takes into account the increased annoyance that results from the non-steady nature of traffic flow.
L_{max} :	The maximum sound pressure level recorded over a given period. L_{max} is sometimes used in assessing environmental noise, where occasional loud events occur which might not be adequately represented by a time-averaged L_{eq} value.

1.2 Octave Band Frequencies

In order to determine the way in which the energy of sound is distributed across the frequency range, the International Standards Organisation has agreed on "preferred" bands of frequency for sound measurement and analysis. The widest and most commonly used band for frequency measurement and analysis is the Octave Band. In these bands, the upper frequency limit is twice the lower frequency limit, with the band being described by its "centre frequency" which is the average (geometric mean) of the upper and lower limits, e.g. 250 Hz octave band extends from 176 Hz to 353 Hz. The most commonly used octave bands are:

Octave Band Centre Frequency Hz	63	125	250	500	1000	2000	4000	8000

1.3 Human Perception of Broadband Noise

Because of the logarithmic nature of the decibel scale, it should be borne in mind that sound levels in dB(A) do not have a simple linear relationship. For example, 100dB(A) sound level is not twice as loud as 50dB(A). It has been found experimentally that changes in the average level of fluctuating sound, such as from traffic, need to be of the order of 3dB before becoming definitely perceptible to the human ear. Data from other experiments have indicated that a change in sound level of 10dB is perceived by the average listener as a doubling or halving of loudness. Using this information, a guide to the subjective interpretation of changes in environmental sound level can be given.

Change in Sound Level dB	Subjective Impression	Human Response
0 to 2	Imperceptible change in loudness	Marginal
3 to 5	Perceptible change in loudness	Noticeable
6 to 10	Up to a doubling or halving of loudness	Significant
11 to 15	More than a doubling or halving of loudness	Substantial
16 to 20	Up to a quadrupling or quartering of loudness	Substantial
21 or more	More than a quadrupling or quartering of loudness	Very Substantial