

ACOUSTIC DESIGN TECHNOLOGY
Noise and Vibration Consultants

ADT 3267

24 September 2021

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PILGRIM HOSPITAL, BOSTON
ENVIRONMENTAL NOISE IMPACT ASSESSMENT
ACOUSTIC CONSULTANCY REPORT ADT 3267/ENIA

Revision	Date	Issued By	Revision Notes
-	24 September 2021	Chris Middleton	first issue

1.0 SUMMARY

The proposal is to refurbish and extend the existing accident and emergency department at the Pilgrim Hospital, Boston.

This report describes the environmental noise impact of the development for the purposes of the planning application as and preliminary design information for the BREEAM Hea 05 second credit and the Pol 05 credit (in accordance with the 2018 'Non Domestic Buildings' scheme document, version 3.0).

An environmental noise survey has been undertaken to determine the currently prevailing noise levels incident on the proposed development, and background sound levels representative of surrounding noise sensitive properties.

The development is both *noise generating* and *noise sensitive*. There will be new fixed plant with a potential impact on existing noise sensitive properties, while the noise from existing environmental noise sources (primarily road traffic) has a potential impact on the proposed hospital accommodation.

In terms of environmental noise emissions from new fixed plant, the widely accepted standard assessment method is BS 4142:2014+A1:2019 (hereafter referred to as BS 4142). It is normal practice in most areas to control plant noise to a BS 4142 rating level at or below the otherwise prevailing background sound level at noise sensitive properties, while BREEAM Pol 05 goes beyond this by setting the rating level limit 5 dB below the background level. Noise limits for fixed plant have therefore been set in accordance with the BREEAM Pol 05 requirements, which should equate to 'no observed effect' using the Planning Practice Guidance.

Preliminary analysis indicates that it should be possible to control external noise intrusion to the indoor levels recommended in HTM-08-01 (as required for compliance with the BREEAM Hea 05 second credit) using standard thermal double glazing and mechanical ventilation.

2.0 BASIS OF ASSESSMENT

2.1 BREEAM Authorship

Suitably qualified acoustician status for this assessment is as follows:

Author	Professional Status	Qualifications	Consultancy experience
Chris Middleton	Corporate member of the Institute of Acoustics	Degree in Engineering Diploma in Acoustics and Noise Control	from 1997

2.2 Site Location

The site is located at the south-east end of the Pilgrim Hospital site in Boston and is an operational Accident and Emergency centre.

To the north-east, north and west are other hospital buildings, with car parks immediately to the east and south.

There are two storey houses on the new Blue Cedar Drive estate approximately 135 metres away to the east, and more houses on Burton Close around 80 metres away to the south. Boston High School is approximately 190 metres away to the south west.

The A16 Sibsey Road is the nearest major road, about 100 metres away to the east. Sibsey Road joins the A52 at a roundabout junction some 200 metres away to the south-east.

2.3 Proposed Development

The proposal is to refurbish and extend the accident and emergency department as shown on the architectural drawings.

2.4 Planning Guidance

The National Planning Policy Framework (NPPF) sets out the general terms of reference for sustainable development, including noise. Section 180 of the February 2019 edition states that:

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:

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; and

c) limit the impact of light pollution from artificial light on local amenity, intrinsically dark landscapes and nature conservation.

For this development the key principles to be applied from the NPPF are to protect existing noise sensitive properties from noise generated by the development, and to ensure that the proposed development has sufficient protection against existing external noise sources.

The Noise Policy Statement for England (NPSE) published in March 2010 establishes the No Observed Effect Level (NOEL), Lowest Observed Adverse Effect Level (LOAEL) and Significant Observed Adverse Effect Level (SOAEL), although these are not linked to objective criteria, as Section 2.22 of the NPSE states:

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.

The Ministry of Housing, Communities and Local Government guidance on planning and noise as of July 2019 includes a noise exposure hierarchy table to help determine the NOEL, NOAEL and SOAEL. This is provided in Appendix A.

2.5 Assessment Criteria

The proposed development is both noise generating and noise sensitive.

In respect of environmental noise emissions from new fixed plant, the widely accepted assessment method is BS 4142:2014+A1:2019 (hereafter referred to as BS 4142).

It is normal practice in most areas to control plant noise to a BS 4142 rating level at or below the otherwise prevailing background sound level at noise sensitive properties, and BREEAM Pol 05 (2018) goes beyond this by setting the rating level limit 5 dB below the background level. Noise limits for fixed plant haven therefore been set in accordance with the BREEAM Pol 05 requirements, which should equate to 'no observed effect' using the Planning Practice Guidance.

Noise intrusion to hospitals from external sources is covered by the requirements of Health Technical Memorandum HTM 08-01. Compliance with the HTM 08-01 criteria for external noise intrusion is required for compliance with the BREEAM Hea 05 second credit.

For brevity the full set of HTM 08-01 criteria are not duplicated in this report, although the criteria for the typical room types at this development are summarised in the following table:

	Maximum $L_{Aeq, 1 \text{ hour}}$ dB from external sources
Individual treatment rooms	40
Open Clinical Areas	45
Circulation Spaces	55
Offices	40

2.6 Nearest Noise Sensitive Areas

The noise sensitive properties in the surrounding area have been grouped into 3 noise sensitive areas (NSA), as described below and as indicated on the attached site plan 3267/SP1.

NSA	Location	Direction	Approximate distance from proposed building (metres)
1	Blue Cedar Drive	east	135
2	Burton Close	south	80
3	Other hospital buildings	north and west	various

The above noise sensitive areas represent the closest noise sensitive properties, with others located further from the site and in some cases screened by the intervening buildings. A satisfactory noise impact at the identified noise sensitive areas should therefore ensure a satisfactory noise impact at other noise sensitive areas.

2.7 Strategy for Noise Impact Assessment

Based on the information in Sections 2.1 to 2.6 above, the strategy for the noise impact assessment has been broken down into the following stages:

- i. undertake an environmental noise survey to obtain baseline noise data, as described in Section 3.0 below.
- ii. set environmental noise limits for new fixed plant installations, as described in Section 4.0 below.
- iii. assess the acoustic suitability of the site for the proposed hospital accommodation and determine the scope of sound insulation measures required, as described in Section 5.0 below.

3.0 ENVIRONMENTAL NOISE SURVEY

3.1 Introduction

An environmental noise survey was undertaken between 11:00 hours on Thursday 16 September 2021 and 14:00 hours on Monday 20 September 2021.

3.2 Instrumentation

The instrumentation used, and the field calibration values before and after the survey are detailed in Appendix B of this report. There were no significant drifts.

3.3 Procedure

Four measurement positions were selected as described below and indicated on the attached site plan 3267/SP1:

- i. at 1st floor level on the east elevation of East Skirbeck House
- ii. at 3rd floor level on the south elevation of the Maternity Block
- iii. on the site, at the south elevation of the existing A&E building
- iv. on the site, at the east elevation of the existing A&E building

At measurement positions 1 and 2 the microphones were projected approximately 1 metre out from the existing building facade.

At measurement positions 3 and 4, the microphone was mounted on a tripod approximately 1.2 metres above the ground and at least 3.5 metres from any other acoustically reflective surface.

At positions 1 and 2 the noise levels were logged continuously for the duration of the survey period, using the 01dB Black and Blue Solo sound level meters respectively, set to store the octave band and 'A' weighted 100ms short-term L_{eq} for subsequent post processing.

At positions 3 and 4, measurements were taken at each position over a 15 minute sample at both the beginning and end of the survey using the Svantek 971 sound level meter set to store the octave band and A-weighted 100ms short-term L_{eq} levels for subsequent post processing.

3.4 Results

The logged data from measurement positions 1 and 2 has been post processed to determine $L_{Aeq,T}$, $L_{A90,T}$ and L_{Amax} levels for each 15 minute period, and these have been plotted on the attached time history graphs 3267/TH1 and 3267/TH2.

The logged data from measurement positions 3 and 4 has been post processed to determine $L_{Aeq,T}$, $L_{A90,T}$ and L_{Amax} levels for each 15 minute period, and these are listed in the attached table 3267/T1.

Typical day-time and night-time background noise levels have been processed as follows, based on statistical analysis of the measured levels according to the method described in Section 8.1.4 of BS 4142:2014:

Location	Typical L_{A90} by period dB	
	Day time 07:00 – 23:00	Night time 23:00 – 07:00
	$L_{A90, 1 \text{ hour}}$	$L_{A90, 15 \text{ mins}}$
Position 1	51	37
Position 2	45	40

Please refer to Appendix C for an explanation of the various noise descriptors used in this report.

3.5 Weather Conditions

As the survey was primarily unattended it is not possible to provide a detailed description of the weather conditions throughout the entire survey period. However, at the start and end of the survey conditions were clear and dry with no more than a light breeze, with similar conditions forecast for the intervening period.

3.6 Existing Noise Climate

As the survey was primarily unattended it is not possible to provide a detailed description of the noise throughout the entire survey period. The following description is therefore based on observations during site visits, the pattern of the time history and analysis of periodic audio samples.

At position 1 the measured levels are typical of diurnal road traffic conditions, and this is consistent with site observations.

At position 2, the noise climate was controlled by a combination of road traffic and hospital plant noise. This explains the higher night time background sound levels than those measured at position 1.

At positions 3 and 4, the noise climate was controlled entirely by passing vehicles on the various access roads surrounding the existing A&E department building, as well as idling vehicles including ambulances, maintenance vehicles and buses.

4.0 NOISE IMPACT ASSESSMENT (NEW FIXED PLANT)

4.1 Introduction

At this stage the schedule of fixed plant has not been finalised, so it is not possible to undertake a noise impact assessment of specific equipment.

Environmental noise limits have therefore been proposed, which can then be used in the future selection of plant and any associated attenuation.

4.2 Noise Limits

As described in Section 2.5 above, it is proposed that plant noise is assessed using the BS 4142 method, with the rating levels set 5 dB below the otherwise prevailing background sound level for compliance with BREEAM Pol 05, and well within the BS 4142 definition of 'low impact'.

Proposed noise limits for fixed plant are therefore as follows, based on the measured background levels most representative of each noise sensitive area:

Location	Recommend BS 4142:2014 rating level limits for fixed plant L _{Ar} dB	
	Day (07:00 - 23:00)	Night (23:00 - 07:00)
NSA1 Blue Cedar Drive	46	32
NSA2 Burton Close	40	32*
NSA3 Pilgrim Hospital wards	40	35

*Note:- the night time measurement at position 1 has been used for NSA1 and NSA2, as the night time data from position 2 was influenced by plant noise at the hospital.

Following selection of the new plant, cumulative noise levels will be calculated at the various noise sensitive areas and checked against the above limits, taking into account any penalties required for acoustic character as defined in the standard.

The majority of the plant will be located in the 1st floor plant room, and as a rough guide, the noise level at 1 metre from the plant room louvres would need to be controlled to $L_{Aeq, 1 \text{ hour}} \leq 60$ dB in order to achieve compliance with the proposed BS 4142 rating level limits.

It should be noted that while compliance with the above noise limits would provide sufficient protection for surrounding noise sensitive areas, it is important to ensure that the noise levels in external public areas are not excessive. Thus, in addition to the rating level limits defined above, it is recommended that the noise emissions from fixed plant do not exceed $L_{Aeq, 1 \text{ hour}}$ 55 dB at 1 metre from the building in publically accessible areas, i.e. the footpaths surrounding the building.

In summary, the implementation of the proposed environmental noise limits should equate to 'no observed effect' according to the Planning Practice Guidance, and would fulfil the requirements of BREEAM Pol 05.

5.0 NOISE INTRUSION TO HOSPITAL

5.1 Incident Noise Levels

Reference to the survey results in the attached table 3267/T1 reveals a typical worst case incident noise level of $L_{Aeq,1 \text{ hour}}$ 63 dB.

5.2 Indoor Ambient Noise Criteria

The HTM 08-01 indoor ambient noise criteria for the main room types at this development are provided in Section 2.5 above and replicated here for quick reference:

	Maximum $L_{Aeq, 1 \text{ hour}}$ dB from external sources
Individual treatment rooms	40
Open Clinical Areas	45
Circulation Spaces	55
Offices	40

5.3 External Noise Intrusion – Windows Open

A building facade with windows open for ventilation typically provides up to 15 dB reduction of a traffic controlled incident $L_{Aeq,T}$. Applying that noise reduction to the typical incident noise level in Section 5.1 above would yield $L_{Aeq, 1 \text{ hour}}$ 48 dB internally, which is above the HTM 08-01 criteria for most room types listed in Section 5.2 above.

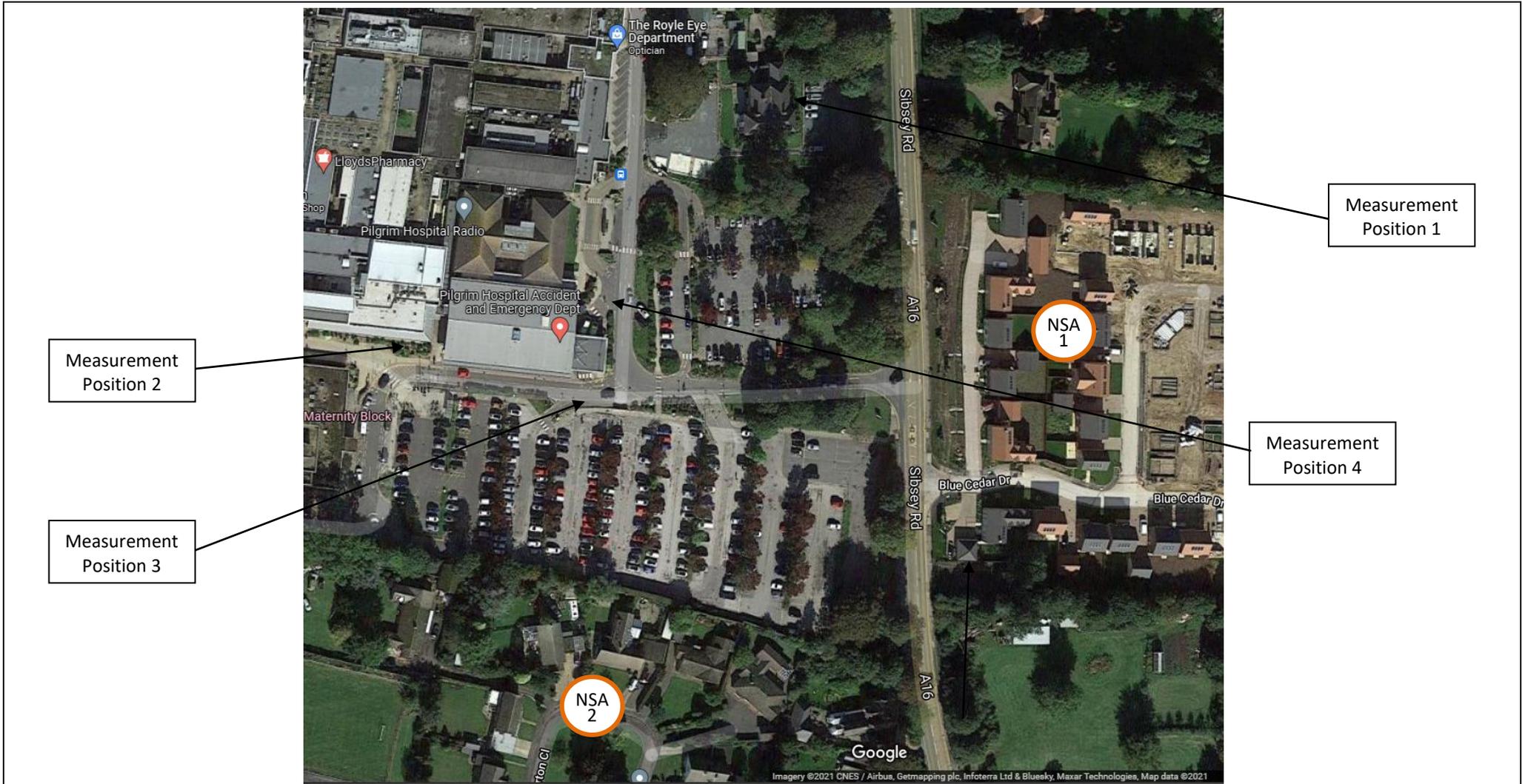
Natural ventilation is therefore not expected to be acoustically viable vis a vis the HTM and BREEAM Hea 05 requirements.

5.4 External Noise Intrusion – Windows Closed

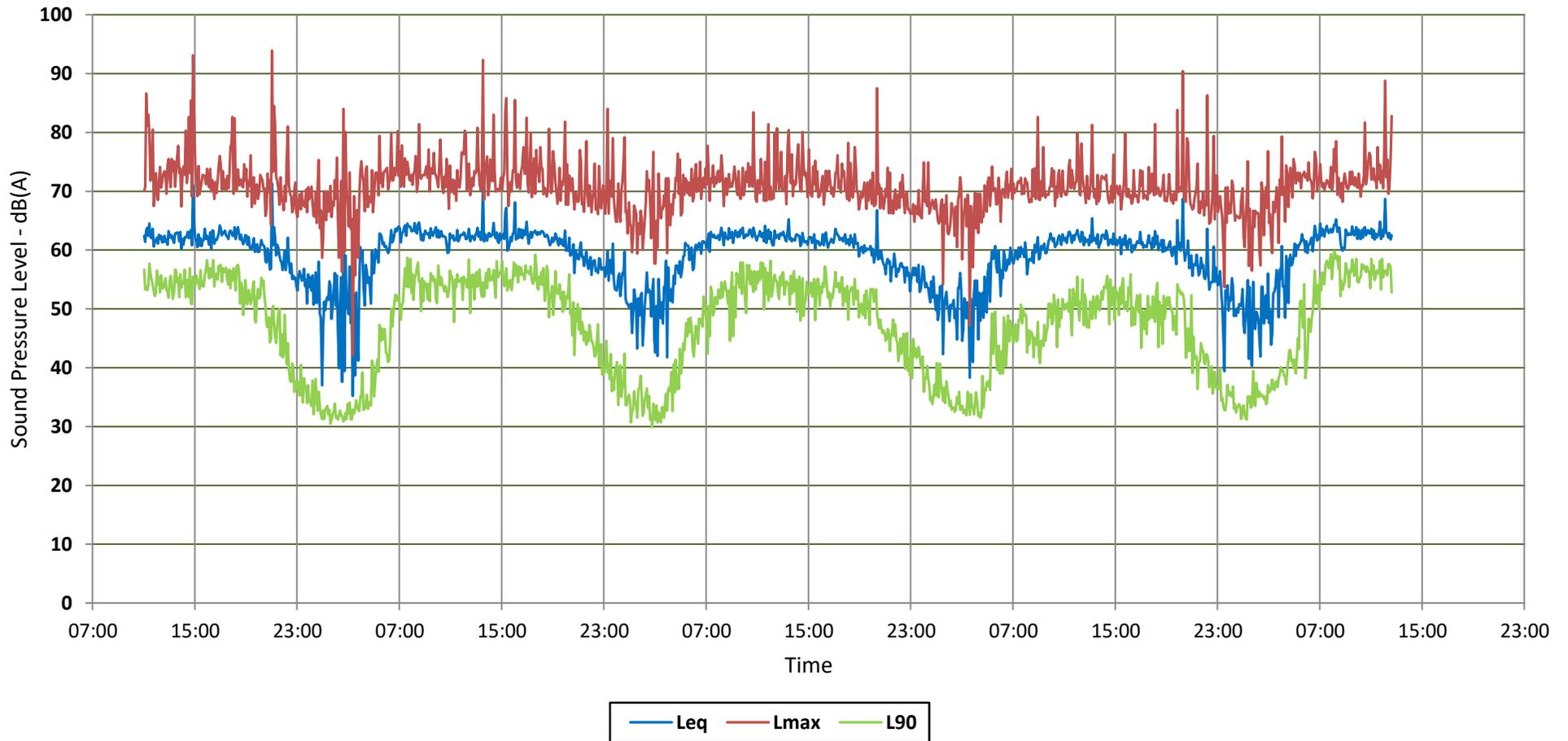
With windows closed the building envelope would need to provide up to 23 dB overall noise reduction of the incident $L_{Aeq, 1 \text{ hour}}$ in order to achieve the required indoor ambient noise levels. This should be readily achievable using most modern forms of wall construction, such as cavity masonry or an insulated lightweight cladding system, and standard thermal double glazing (which generally achieves at least R_w 30).

The HTM 08-01 indoor ambient noise criteria and therefore the associated BREEAM Hea 05 second credit would therefore be achievable with standard wall constructions and standard thermal double glazing, provided there is mechanical ventilation.

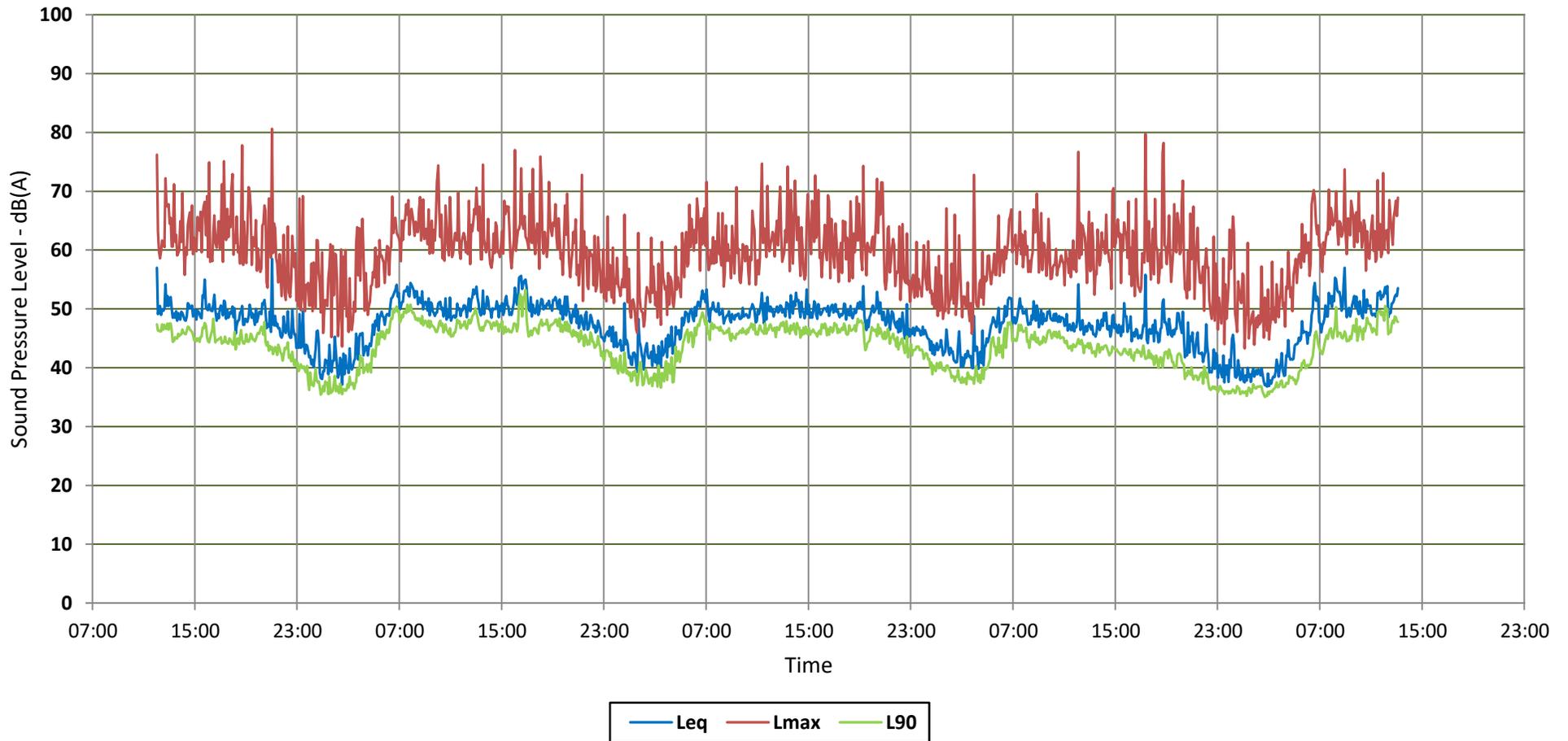
FOR ACOUSTIC DESIGN TECHNOLOGY



Notes	Description Site Plan to show noise monitoring locations and noise sensitive areas		 ADT Acoustic Design Technology Noise and Vibration Consultants
	Project Pilgrim Hospital, Boston		
	Date 24 September 2021	Drawing No. 3267/SP1	



Notes	Description Time History Graph - Measurement Position 1		 ACOUSTIC DESIGN TECHNOLOGY Noise and Vibration Consultants
	Project Pilgrim Hospital, Boston		
	Date 24/09/2021	Drawing No. 3267/TH1	



Notes

Description

Time History Graph - Measurement Position 2

Project

Pilgrim Hospital, Boston

Date

24/09/2021

Drawing No.

3267/TH2



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SURVEY RESULTS (A WEIGHTED TIME HISTORY)

Measurement Position	Survey date	L _{Aeq, 15mins} dB	L _{Amax} dB	L _{A90} dB
3	16 September	58	77	48
	20 September	63	78	61*
4	16 September	63	92	50
	20 September	61	80	53

*Note:- an ambulance was standing idling close by for the duration of this measurement

Table 3267/T1

APPENDIX A

NOISE EXPOSURE HIERARCHY TABLE

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
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

APPENDIX B - INSTRUMENTATION

Manufacturer	Type and / or Model	Serial Number	Last Laboratory Calibration	Calibrator Output (dB)	Free Field Correction (dB)	Initial reading (dB)	Final reading (dB)
01dB	(Black) Solo Class 1 Sound Level Meter	65201	October 2019	114.16 (initial)	-0.10	114.1	
01dB	PRE 21 S Pre-Amplifier	15619		113.98 (final)			113.9
01dB	MCE 212 ½ inch Microphone	101204					
01dB	(Blue) Solo Class 1 Sound Level Meter	60320	July 2021	114.16 (initial)	-0.10	114.1	
01dB	PRE 21 S Pre-Amplifier	16866		113.98 (final)			113.9
01dB	MCE 212 ½ inch Microphone	90549					
Svantek	Svan 971 Class 1 Sound Level Meter	34392	October 2019	113.98	-0.13	113.85	113.79
ACO	7052E ½ inch Microphone	54655					
Svantek	SV18 Preamplifier	32179					
Norsonic	Nor1251 Calibrator (Cal 4)	33453	February 2021	114.16			
Norsonic	Nor1251 Calibrator (Cal 5)	34220	February 2021	113.98			

APPENDIX C

Acoustic Terminology

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

A-weighting The human ear is more susceptible to mid-frequency noise than the high and low frequencies. To take account of this when measuring noise, the A-weighting scale is used so that the measured noise corresponds roughly to the overall level of noise that is discerned by the average person. It is also possible to calculate the A-weighted noise level by applying certain corrections to an un-weighted spectrum.

When the noise being measured has variable amplitude, such as traffic noise, it is necessary to qualify the basic dB unit. This may be done using a statistical index L_n dB, where n is any value between 0 and 100, and is the percentage of the sample time for which the stated level is exceeded. In defining the use of the index, both the value of n and the length of the sample period must be stated.

L_{10} L_{10} , being the level exceeded for 10% of the time, has been shown to be a good indicator for traffic noise intrusion, and is used in assessing the effect of traffic noise on residential or commercial premises.

L_{90} L_{90} is the level exceeded for 90% of the time, and is used as a measure of background noise level, as it excludes the effects of occasional transient levels, such as individual passing cars or aircraft.

In addition to the statistical noise indices defined above, the following noise units are also used to define variable amplitude noise sources:

$L_{eq,T}$ $L_{eq,T}$ is defined as the notional steady sound pressure level which, over a stated period of time, would contain the same amount of acoustical energy as the actual fluctuating sound measured over the same period. In other words, it is a measure of the "average" noise level

L_{max} L_{max} is the maximum time-weighted sound pressure level recorded over the stated time period.