Guild Living
Epsom Hospital

Environmental Noise Survey and Plant Noise Assessment Report

26691/PNA1/Rev4

20 January 2021

For:
Cast Real Estate
Black Bull Yard
24-28 Hatton Wall
London
EC1N 8JH

Hann Tucker Associates
Consultants in Acoustics Noise & Vibration

Head Office: Duke House, 1-2 Duke Street, Woking, Surrey, GU21 5BA (t) +44 (0) 1483 770 595
Manchester Office: First Floor, 346 Deansgate, Manchester, M3 4LY (t) +44 (0) 161 832 7041
(w) hanntucker.co.uk (e) enquiries@hanntucker.co.uk

Hann Tucker Associates

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Document Control

Rev	Date	Comment	Prepared by	Authorised by
4	20/01/2021	Updated as request		
			Xiaoyi Li Consultant MSc, BA(Hons), TechIOA	Andrew Fermer Director BSc(Hons), MIOA
3	12/01/2021	Project scheme updated for planning re-submission	Xiaoyi Li Consultant MSc, BA(Hons), TechIOA	Andrew Fermer Director BSc(Hons), MIOA
2	19/12/2019	Project proposal description and drawing reference updated	Xiaoyi Li Assistant Consultant MSc, BA(Hons), TechIOA	Andrew Fermer Director BSc(Hons), MIOA
1	18/12/2019	Noise impact assessment updated	Xiaoyi Li Assistant Consultant MSc, BA(Hons), TechIOA	Andrew Fermer Director BSc(Hons), MIOA
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Contents

Attachments

1.0 Introduction

It is proposed to redevelop the south part of the site of Epsom General Hospital. We understand the updated project scheme is as follows:

Demolition of the existing hospital buildings, accommodation block and associated structures and redevelopment of the site to provide a new care community for older people arranged in two buildings, comprising 267 care residences, 10 care apartments and 28 care suites proving transitional care, together with ancillary communal and support services Use Class C2, 24 key worker units Use Class C3, children's nursery Use Class E, as well as associated back of house and service areas, car and cycle parking, altered vehicular and pedestrian access, landscaping, private amenity space and public open space.

Hann Tucker Associates has therefore been commissioned to undertake an environmental noise survey to determine the currently prevailing noise climate around the site, the results of which will be used to inform various aspects of the acoustic design and to support the planning re-submission.

This report presents the methodology and findings. This report will need to be revised once the planning conditions become available.

2.0 Objectives

To inspect the site to familiarise ourselves with its layout and surroundings in order to identify suitable accessible locations for environmental noise measurements.

To establish by means of a detailed survey the existing L_{Amax}, L_{Aeq} and L_{A90} environmental road, rail and air traffic noise levels at selected "secure" on-site positions, using fully computerised unmanned monitoring equipment.

The environmental noise data will be presented in a combined report, with recommendations made for daytime and night-time plant noise emission limits, following liaison with the Local Authority.

To assess the noise emissions from the proposed plant, based upon data with which we are provided, and comment upon the acceptability.

To advise on noise control measures if required with reference to the requirements of the Local Authority.

3.0 Site Description

3.1 Location

The site is located at 40 Woodcote Green Road and extends deeper into the southwest. The location is shown in the Location Map below.

Location Map (Map Data © 2019 Google)

The site falls within the jurisdiction of Epsom & Ewell Borough Council.

3.2 Description

The site is located within a mixed residential and commercial area. The site is bound by Woodcote Green Road on the southeast, and surrounded by a park to the south, suburban housing to the east and west and hospital buildings to the north. Subjectively, the dominant noise sources on site were considered to be nearby road traffic.

The site is shown in the Site Plan overleaf.

Site Plan (Map Data © 2019 Google)

4.0 Acoustic Terminology

For an explanation of the acoustic terminology used in this report please refer to Appendix A enclosed.

5.0 Project Proposals

5.1 Proposed Plant

We understand the proposed plant are as detailed in Section 11 of this report.

5.2 Operating Hours

We understand that the operating hours of the proposed plant are as detailed in Section 11 of this report.

5.3 Drawings

Our acoustic analyses is based on the following drawings by Marchese Partners and commented by Hoare Lea.

Reference	Title	Date
18120_A2.07 (Rev K)	Roof Level	Reviewed by Hoare Lea on 12/12/2019
-	Ground Level Plan Showing Generator Plantroom	Provided by Hoare Lea on 27/11/2020
EPS001-MPI-ZZ-00-DR-A-010100	Level 00 Master Plan	23/12/2020

Reference	Title	Date
EPS001-MPI-ZZ-00-DR-A-010101	Level 01 Master Plan	23/12/2020
EPS001-MPI-ZZ-00-DR-A-010102	Level 02 Master Plan	23/12/2020
EPS001-MPI-ZZ-00-DR-A-010103	Level 03 Master Plan	23/12/2020
EPS001-MPI-ZZ-00-DR-A-010104	Level 04 Master Plan	23/12/2020
EPS001-MPI-ZZ-00-DR-A-010105	Level 05-08 Master Plan	23/12/2020
EPS001-MPI-ZZ-00-DR-A-010106	Level Roof Master Plan	23/12/2020
EPS001-20-200	Site Sections	23/12/2020
EPS001-20-202	Building Section CC-DD	23/12/2020

6.0 Acoustic Standards and Guidelines

6.1 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) was published in March 2010 (i.e. before the NPPF). The NPSE is the overarching statement of noise policy for England and applies to all forms of noise other than occupational noise, setting out the long term vision of Government noise policy which is 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."

That vision is supported by the following NPSE noise policy aims which are reflected in three of the four aims of planning policies and decisions in paragraph 123 of the NPPF (see paragraph 8.2 (b) below):

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *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 Explanatory Note to the NPSE has three concepts for the assessment of noise in this country:

NOEL – No Observed Effect Level

This is the level below which no effect can be detected and below which there is no detectable effect on health and quality of life due to noise.

LOAEL – Lowest Observable Adverse Effect Level

This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

This is the level above which significant adverse effects on health and quality of life occur.

None of these three levels are defined numerically and for the SOAEL the NPSE makes it clear that the noise level is likely to vary depending upon the noise source, the receptor and the time of day/day of the week, etc. The need for more research to investigate what may represent an SOAEL for noise is acknowledged in the NPSE and the NPSE asserts that not stating specific SOAEL levels provides policy flexibility in the period until there is further evidence and guidance.

The NPSE concludes by explaining in a little more detail how the LOAEL and SOAEL relate to the three NPSE noise policy aims listed above. It starts with the aim of avoiding significant adverse effects on health and quality of life, then addresses the situation where the noise impact falls between the LOAEL and the SOAEL when *"all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development."* The final aim envisages pro-active management of noise to improve health and quality of life, again taking into account the guiding principles of sustainable development which include the need to minimise travel distance between housing and employment uses in an area.

6.2 National Planning Policy Framework (NPPF)

The following paragraphs are from the NPPF (revised February 2019):

"180. 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.

182. 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."

Paragraph 180 also references the Noise Policy Statement for England. This document does not refer to specific noise levels but instead sets out three aims:

"Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development.

Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."

6.3 Planning Practice Guidance on Noise

Planning Practice Guidance (PPG) under the NPPF has been published by the Government as a web based resource at http://planningguidance.planningportal.gov.uk/blog/guidance/. This includes specific guidance on Noise although, like the NPPF and NPSE the PPG does not provide any quantitative advice. It seeks to illustrate a range of effect levels in terms of examples of outcomes as set out in the following table:

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	

Perception	Examples of Outcomes	Increasing effect level	Action
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.	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 hard, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

6.4 Local Authority Requirements

The site lies within the jurisdiction of Epsom & Ewell Borough Council. We have requested their advice concerning their requirements for setting atmospheric noise emission criteria for building service plant, but have not received a reply at the time of writing.

There does not appear to be any quantitative criteria regarding controlling plant noise emissions in the Epsom & Ewell's local planning documents; however, relevant policies are extracted from local planning documents and presented as below:

Core Strategy Policy CS 6 – Local Plan Core Strategy 2007

"Proposals for development should result in a sustainable environment and reduce, or have a neutral impact upon, pollution and climate change. The Council will expect proposals to demonstrate how sustainable construction and design can be incorporated to improve the energy efficiency of development - both new build and conversion.

In order to conserve natural resources, minimise waste and encourage recycling, the Council will ensure that new development … minimises the emission of pollutants, including noise, water and light pollution, into the wider environment …"

Section 5. Air Quality, Noise and Light Pollution – Revised Sustainable Design Supplementary Planning Document (adopted February 2016)

"An acoustic study will be required from development proposals / new uses that will generate noise with the potential to cause nuisance / harm, or are located in proximity to sources of significant noise. Examples of the former could include proposals for large retail uses located in proximity to residential properties, and the latter, proposals in proximity to a railway line. Residential developments in the town centres should be designed to comply with the standards in BS8233.

5.7 Under Section 79 of the Environmental Protection Act 1990, local authorities have a duty to take reasonably practicable steps to investigate complaints of statutory nuisance, including: "Noise emitted from premises so as to be prejudicial to health or a nuisance."

5.8 Minimising the adverse impacts of noise is a significant issue for the Borough Council. This is because most new development takes place within the existing urban area. This is particularly relevant in locations where there are a combination of different uses, such as residential accommodation, retail, employment and leisure uses. Recent developments in Epsom Town Centre provide good examples of how of how this issue could be considered.

5.9 In that respect applicants are encouraged to enter into pre-application discussions with the Council to identify whether acoustic studies are required to support a proposal. The Council's Development Management team will work closely with the Environmental Health service to ensure that the impact/potential impact of noise pollution is mitigated."

6.5 BS 4142:2014

When setting plant noise emission criteria reference is commonly made to BS 4142: 2014 "*Methods for rating and assessing industrial and commercial sound".*

The procedure contained in BS 4142:2014 provides an assessment of the likely effects of sound on people when comparing the specific noise levels from the source with representative background noise levels. Where the noise contains "a tone, impulse or other characteristic" then various corrections can be added to the specific (source) noise level to obtain the "rating level".

BS 4142 states that: *"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 estimation of the impact of the specific noise can be obtained by the difference of the rating noise level and the background noise level and considering the following:*

• *"Typically, the greater this difference, the greater the magnitude of the impact."*

• *"A 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."*

• *"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."*

The determination of the "rating level" and the "background level" are both open to interpretation, depending on the context.

In summary it is not possible to set plant noise emission criteria purely on the basis of BS 4142:2014. It is reasonable to infer from the above, however, that a difference of around -5dB corresponds to "No Observed Effect Level" as defined in the Noise Policy Statement for England. It is also reasonable to infer from the above that if the plant noise rating level does not exceed the existing background noise level outside any noise sensitive residential window then the plant noise is of "low impact".

6.6 World Health Organisation Guidelines on Community Noise

BS8233:2014 is based upon the current World Health Organisation (WHO) guidance "*Guidelines on Community Noise".* A summary of the noise guidelines relevant to the proposed scheme is presented in the table overleaf.

Residential Environment	Critical Health Effect(s)	L_{Aeq}	L_{AFmax}	Time Base
Outdoor living area	Serious annoyance, daytime and evening	55	-	07:00-23:00
	Moderate annoyance, daytime and evening	50	-	07:00-23:00
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	-	07:00-23:00
Inside bedrooms	Sleep disturbance, night-time	30	45	23:00-07:00
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	60	23:00-07:00

These WHO guidelines are based, in almost all cases, on the lower threshold below which the occurrence rates of any particular effect can be assumed to be negligible.

6.7 British Standard BS8233: 2014

British Standard 8233: 2014 “Guidance on sound insulation and noise reduction for buildings” provides guidance for the control of noise in and around buildings.

BS8233:2014 Section 7.7.2 titled “Internal ambient noise levels for dwellings” states:

“In general for steady external noise sources, it is desirable that internal ambient noise levels do not exceed the following guideline values:

Activity	***Location***	***Desirable Internal Ambient Criteria***	
		07:00 - 23:00	***23:00 - 07:00***
Resting	*Living Rooms*	*35 dB $L_{Aeq,16hour}$*	-
Dining	*Dining Room/Area*	*40 dB $L_{Aeq,16hour}$*	-
Sleeping (Daytime Resting)	*Bedroom*	*35 dB $L_{Aeq,16hour}$*	*30 dB $L_{Aeq,8hour}$*

6.8 Statutory Noise Nuisance

There is no quantitative definition of statutory noise nuisance. It is generally accepted however, that if the plant noise level is at least 5dB (or 10dB if tonal) below the minimum background $L_{90(15minutes)}$ at 1m from the nearest noise sensitive window, then the risk of a statutory noise nuisance is avoided. By adopting this as a design criterion the guidance contained in BS 4142:2014 should also be complied with.

7.0 Methodology

The survey was undertaken by Xiaoyi Li MSc BA(Hons) TechIOA, and assisted by Bo Ding PhD MSc BSc(Hons) AMIOA.

7.1 Unmanned Survey

7.1.1 Procedure

Fully automated environmental noise monitoring was undertaken from approximately 12:00 hours on Tuesday 11 June 2019 to 12:00 hours on Thursday 13 June 2019.

During the periods we were on site the wind conditions were calm. The sky was generally clear. We understand that generally throughout the survey period the weather conditions were cloudy and rainy. These conditions are considered suitable for obtaining representative measurement results.

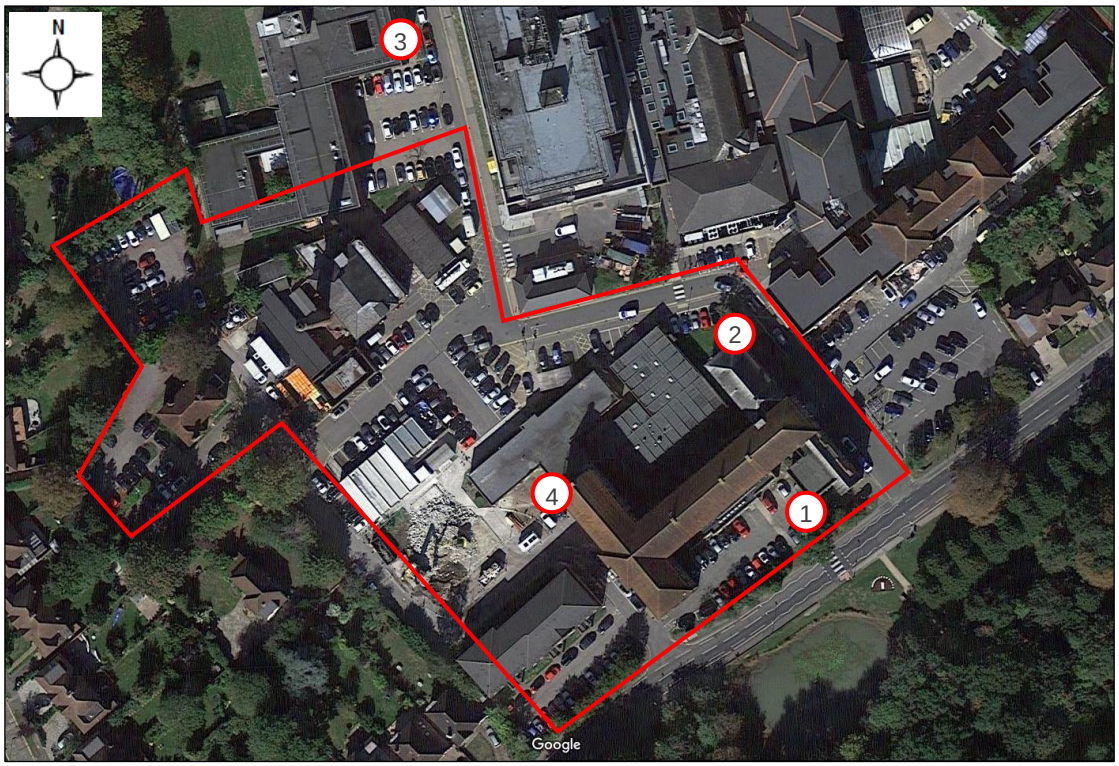
Measurements were taken continuously of the A-weighted (dBA) L_{90}, L_{eq} and L_{max} sound pressure levels over 15 minute periods.

7.1.2 Measurement Positions

The noise level measurements were undertaken at 4No. positions as described in the table below.

Position No	Description
1	The sound level meter was placed on the fire escape landing. The microphone was attached to a pole fixed on the fire escape handrail of Rowan House, approximately 1.8 metres from the wall, 6.5 metres above ground level and 12 metres from Woodcote Road. It overlooked Woodcote Green Road.
2	The sound level meter was placed on the fire escape landing. The microphone was attached to a pole fixed on the fire escape handrail of Rowan House, approximately 1.8 metres from the wall, 6.5 metres above ground level and 7 metres from road side. It overlooked the road junction on the northeast.
3	The sound level meter was placed on the roof of Epsom Hospital Langley Wing. The microphone was attached to a pole fixed on the roof handrail, approximately 1.5 metres above roof level, 12 metres above ground level and 7 metres from road side. It overlooked the road on the east.
4	The sound level meter was placed on the fire escape landing. The microphone was attached to a pole fixed on fire escape handrail of Rowan House, approximately 1.8 metres from the wall and 11 metres above ground level overlooking the car park.

The positions are shown on the plan below.



Site Plan Showing Unmanned Measurement Positions (Map Data © 2019 Google)

7.1.3 Instrumentation

The instrumentation used during the survey is presented in the table below:

Description	Manufacturer	Type	Serial Number	Calibration
Position 1 Type 1 ½" Condenser Microphone	ACO Pacific	7052E	67983	Calibration on 06/02/2019
Position 1 Preamp	Svantek	SV18	71464	Calibration on 06/02/2019
Position 1 Type 1 Data Logging Sound Level Meter	Svantek	971	80233	Calibration on 06/02/2019
Position 2 Type 1 ½" Condenser Microphone	ACO Pacific	7052E	68293	Calibration on 15/11/2018
Position 2 Preamp	Svantek	SV18	72276	Calibration on 15/11/2018
Position 2 Type 1 Data Logging Sound Level Meter	Svantek	971	72538	Calibration on 15/11/2018

Description	Manufacturer	Type	Serial Number	Calibration
Position 3 Type 1 ½" Condenser Microphone	PCB	377B02	135744	Calibration on 17/09/2018
Position 3 Preamp	Larson Davis	PRM902	4812	Calibration on 17/09/2018
Position 3 Type 1 Data Logging Sound Level Meter	Larson Davis	824	3839	Calibration on 17/09/2018
Position 4 Type 1 ½" Condenser Microphone	PCB	377A02	101926	Calibration on 09/07/2018
Position 4 Preamp	Larson Davis	PRM902	3691	Calibration on 09/07/2018
Position 4 Type 1 Data Logging Sound Level Meter	Larson Davis	824	3841	Calibration on 09/07/2018
Type 1 Calibrator	Larson Davis	CAL200	3082	Calibration on 08/08/2018

Each sound level meter, including the extension cable, was calibrated prior to and on completion of the surveys. No significant changes were found to have occurred (no more than 0.1 dB).

Each sound level meter was located in an environmental case with the microphone connected to the sound level meter via an extension cable. Each microphone was fitted with a windshield.

7.2 Manned Survey

7.2.1 Procedure

Fully manned environmental noise monitoring was undertaken from approximately 13:30 hours to 15:15 hours on 11 June 2019.

During the survey period the wind conditions were calm. The sky was generally clear. There was no rain and road surfaces were dry throughout the survey period.

Measurements were taken of the A-weighted (dBA) L_{90}, L_{eq} and L_{max} sound pressure levels over periods of not less than 13 minutes in each hour. Atypical noises were excluded as far as reasonably possible. The noise levels measured are therefore assumed to be representative of the noise climate during the hour in which the measurements were taken.

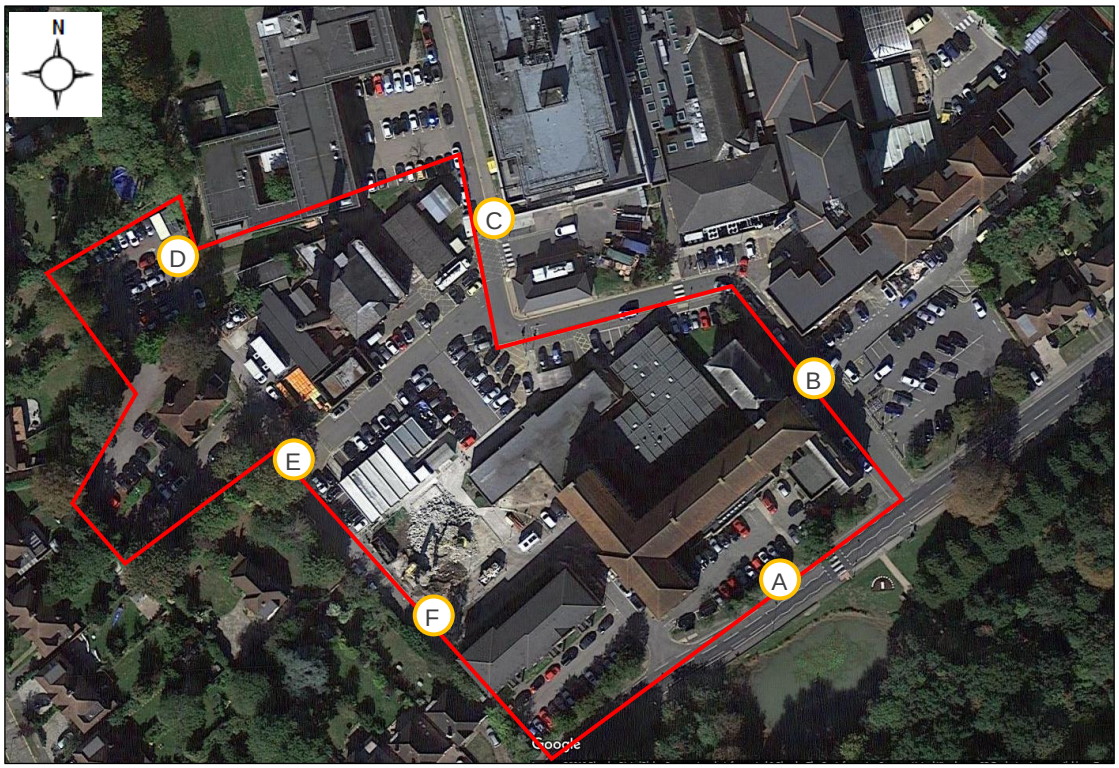
In addition, at each position typical L_{90}, L_{eq} and L_{max} octave band spectra (from 63Hz to 8kHz) were taken during the measurement period in order to gain a more detailed description of the prevailing noise climate.

7.2.2 Measurement Positions

The noise level measurements were undertaken at 6No. positions around the development site. The measurement position***s*** are described in the table below.

Position No	Description
A	The microphone was positioned on Woodcote Green Road at street level and fixed on a tripod approximately 1m above ground level and 1m from road side.
B	The microphone was positioned on the northeast boundary of the site at street level and fixed on a tripod approximately 1m above ground level and 1m from road side.
C	The microphone was positioned on the east boundary of the site at street level and fixed on a tripod approximately 1m above ground level and 1m from road side.
D	The microphone was positioned at the northwest corner of the site at street level and fixed on a tripod approximately 1m above ground level and 1m from road side.
E	The microphone was positioned on the southwest boundary of the site at street level and fixed on a tripod approximately 1m above ground level and 1m from road side.
F	The microphone was positioned at the south corner of the site at street level and fixed on a tripod approximately 1m above ground level and 1m from road side.

The positions are shown on the plan overleaf.



Site Plan Showing Manned Measurement Positions (Map Data © 2019 Google)

7.2.3 Instrumentation

The instrumentation used during the manned survey is presented in the table below:

Description	Manufacturer	Type	Serial Number	Calibration
Type 1 ½" Condenser Microphone	Bruel & Kjaer	4189	2650666	Calibration on 08/01/2019
Preamp	Bruel & Kjaer	ZC0026	-	Calibration on 08/01/2019
Type 1 Data Logging Sound Level Meter	Bruel & Kjaer	2260	2370433	Calibration on 08/01/2019
Type 1 ½" Condenser Microphone	Bruel & Kjaer	4189	3004879	Calibration on 19/09/2018
Preamp	Bruel & Kjaer	ZC0032	23396	Calibration on 19/09/2018
Type 1 Data Logging Sound Level Meter	Bruel & Kjaer	2250	3007292	Calibration on 19/09/2018
Type 1 Calibrator	Bruel & Kjaer	4231	2205779	Calibration on 13/09/2018

Each sound level meter was mounted on a tripod and was fitted with a Brüel and Kjær microphone windshield.

Each sound level meter was calibrated prior to and on completion of the surveys. No significant changes were found to have occurred (no more than 0.1 dB).

8.0 Results

8.1 Results of Unmanned Survey

The results have been plotted on Time History Graphs 26691/TH1 to 26691/TH4 enclosed presenting the 15 minute A-weighted (dBA) L_{90}, L_{eq} and L_{max} levels at each measurement position throughout the duration of the survey.

The following table presents the lowest measured L_{A90} background noise levels during the survey:

Position	Lowest Measured L_{A90} Background Noise Level (dB re 2 x 10^{-5} Pa)		
	Daytime (07:00 – 23:00) Hours	Night-Time (23:00 – 07:00) Hours	24 Hours
1	32	28	28
2*	49	47	47
3	53	52	52
4	45	44	44

* Affected by existing plant serving neighbouring buildings, and do not represent true background levels

The following table presents the modal average of the measured L_{A90} background noise levels during the survey:

Position	Modal Average Measured L_{A90} Background Noise Level (dB re 2 x 10^{-5} Pa)		
	Daytime (07:00 – 23:00) Hours	Night-Time (23:00 – 07:00) Hours	24 Hours
1	49	28	28
2*	54	49	49
3	55	52	52
4	49	45	45

*Affected by existing plant serving neighbouring buildings, and do not represent true background levels

The following table presents the measured $L_{Aeq,T}$ noise levels during the survey:

Position	Measured $L_{Aeq,T}$ Noise Level (dB re 2 x 10^{-5} Pa)	
	Daytime (07:00 – 23:00) Hours, $L_{Aeq,16hr}$	Night-Time (23:00 – 07:00) Hours, $L_{Aeq,8hr}$
1	63	54
2*	61	56
3	58	55
4	55	49

* Affected by existing plant serving neighbouring buildings

8.2 Results of Manned Survey

The fully manned survey A-weighted (dBA) L_{90}, L_{eq} and L_{max} sound level measurements are recorded below.

Position	Time	Sound Levels dBA		
		L_{90}	L_{eq}	L_{max}
A	13:58 – 14:12 hours	50	68	86
	14:45 – 14:59 hours	51	68	84
B	14:14 – 14:27 hours	48	57	79
	15:02 – 15:15 hours	52	58	76
C	13:27 – 13:40 hours	46	59	82
	14:18 – 14:30 hours	46	60	88
D	14:02 – 14:16 hours	39	52	78
	14:45 – 14:59 hours	40	54	83
E	13:43 – 13:57 hours	43	52	73
	14:31 – 14:45 hours	44	51	67
F	13:30 – 13:44 hours	39	46	65
	14:30 – 14:43 hours	40	47	62

The following table presents the typical free-field worst case incident traffic noise levels for each façade / measurement position. The data may be used in subsequent analysis to establish sound performance specifications for each of the external building fabric elements.

Position	L_{eq} Sound Pressure Level (dB) @ Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
A	68	63	62	62	65	60	52	45	68
	70	64	64	63	65	61	54	51	68
B	64	59	57	54	52	49	42	38	57
	68	59	57	54	54	50	44	42	58
C	63	61	58	54	53	52	48	42	59
	63	61	59	59	52	51	48	44	60
D	56	53	49	46	47	44	43	36	52
	54	50	47	50	48	47	43	38	54
E	60	55	49	47	47	44	42	36	52
	66	54	49	47	46	41	37	32	51
F	55	49	45	43	41	39	35	29	46
	59	55	49	41	41	37	33	27	47

9.0 Discussion Of Noise Climate

During the periods we were on site the dominant noise source at Position 1 was noted to be frequent and high-speed traffic on Woodcote Green Road; the dominant noise sources at Position 2 were noted to be nearby road traffic and operating plant opposite the road; the dominant noise source at Position 3 was noted to be traffic on the road to the east; the dominant noise source at Position 4 was noted to be nearby road traffic.

10.0 Plant Noise Emission Criteria

Building services plant external noise emission levels will need to comply with local planning requirements and statutory noise nuisance legislation.

On the basis of the aforementioned guidance or policies and the results of the environmental noise survey, we propose that the following plant noise emission criteria be achieved at 1 metre from the nearest noise sensitive residential window.

Position	Noise Emission Limit (dBA)		
	Daytime (07:00 – 23:00 hours)	Night-time (23:00 – 07:00 hours)	24 hours
1	27	23	23
2*	44*	42*	42*
3	48	47	47
4	40	39	39

*Affected by existing plant serving neighbouring buildings, should be excluded in plant noise assessment

The above criteria are to be achieved with all of the proposed plant operating simultaneously.

If plant contains tonal or impulsive characteristics the external design criteria should be reduced by 5dBA.

It should be noted that the above are subject to the final approval of the Local Authority.

For life safety standby plant, only used in emergencies and occasional testing - e.g. smoke extract fans and life safety generators - relaxations of the internal and external criteria are normally acceptable but should comply with local authority and occupational requirements and must not interfere with internal audible emergency alarms.

We would recommend a 10dB relaxation to the external plant noise emission criteria for life safety standby generators. This is subject to the final approval of the Local Authority.

11.0 Plant Noise Impact Assessment

Building services plant information for the updated scheme is not available at the time of writing. However, we have been advised by the mechanical engineers that "we should assume the acoustics remain as previously". We have undertaken plant noise impact assessment based upon the original plant proposal as below.

We understand the proposed plant comprises the following:

Plant Description	Location	Qty	Plant Make	Model Number
ASHP's	Roof	2	Blue Box	Omicron Rev S4 HE LN 52.6
Restaurant Kitchen Extract Fan	Roof	1	Halton	PEU-05
Environmental Ventilation Extract Fans	Roof	8	Nuaire	AM43ES
Smoke Extract Fans	Roof	8	Colt	Non-standard
Life Safety Standby Generator	Ground Floor Plantroom	1	Perkins	4008TAG2A

11.1 Plant Noise Data

We understand the manufacturer's noise data for the equipment to be as follows:

Plant Description	Sound Power Level (dB re 10^{-12} Watts) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
ASHP	91	81	81	86	85	84	79	77
Restaurant Kitchen Extract Fan (Induct Outlet)	-	90	88	89	87	84	79	73
Restaurant Kitchen Extract Fan (Breakout)	-	80	75	72	56	52	46	37
Environmental Ventilation Extract Fan – 100% speed (Induct Outlet)	80	84	79	82	76	75	75	60
Environmental Ventilation Extract Fan – 86.84% speed (Induct Outlet)	79	82	77	79	72	71	71	56
Environmental Ventilation Extract Fan – 100% speed (Breakout)	72	71	69	59	45	45	52	38
Environmental Ventilation Extract Fan – 86.84% speed (Breakout)	71	69	67	56	41	41	48	34
Smoke Extract Fan (Induct Outlet)	94	95	93	90	93	92	91	84

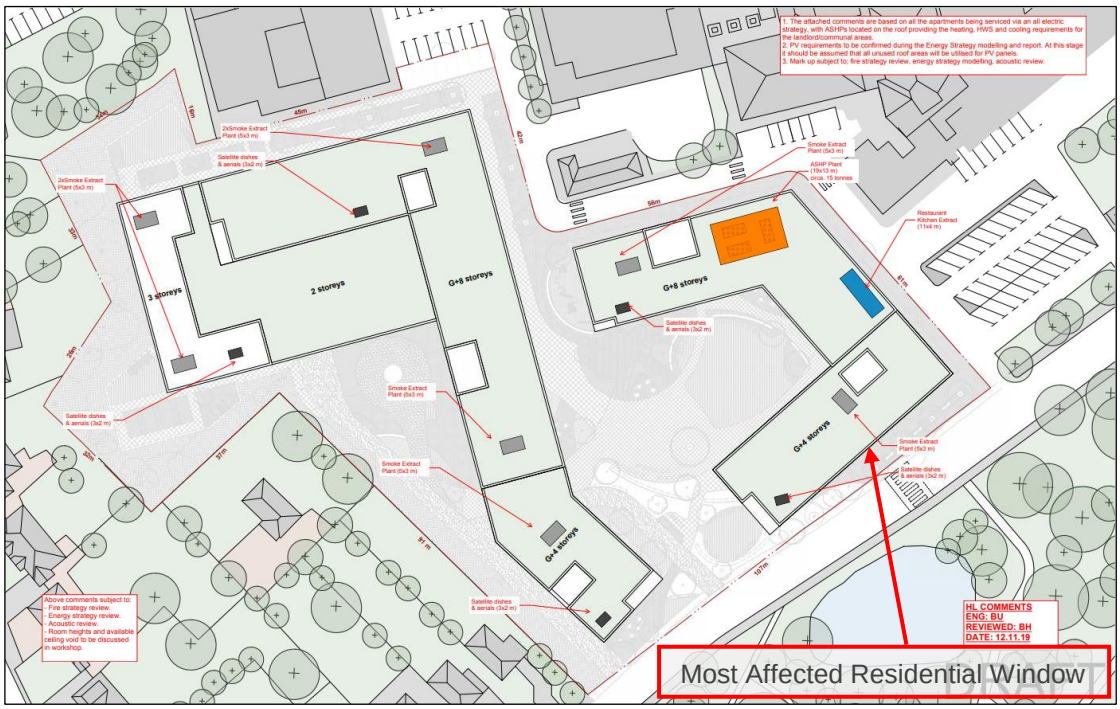
We also understand that the maximum noise level measured at 1 metre from the life safety standby generator engine is approximately 110dBA.

Halton have also provided the following built-in attenuator insertion losses for all air paths of the proposed restaurant kitchen extract fan.

Plant Description	Manufacturer's Built-in Attenuator Insertion Losses (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Restaurant Kitchen Extract Fan Built-in Attenuator	-	14	17	28	38	30	23	18

11.2 Location of Plant

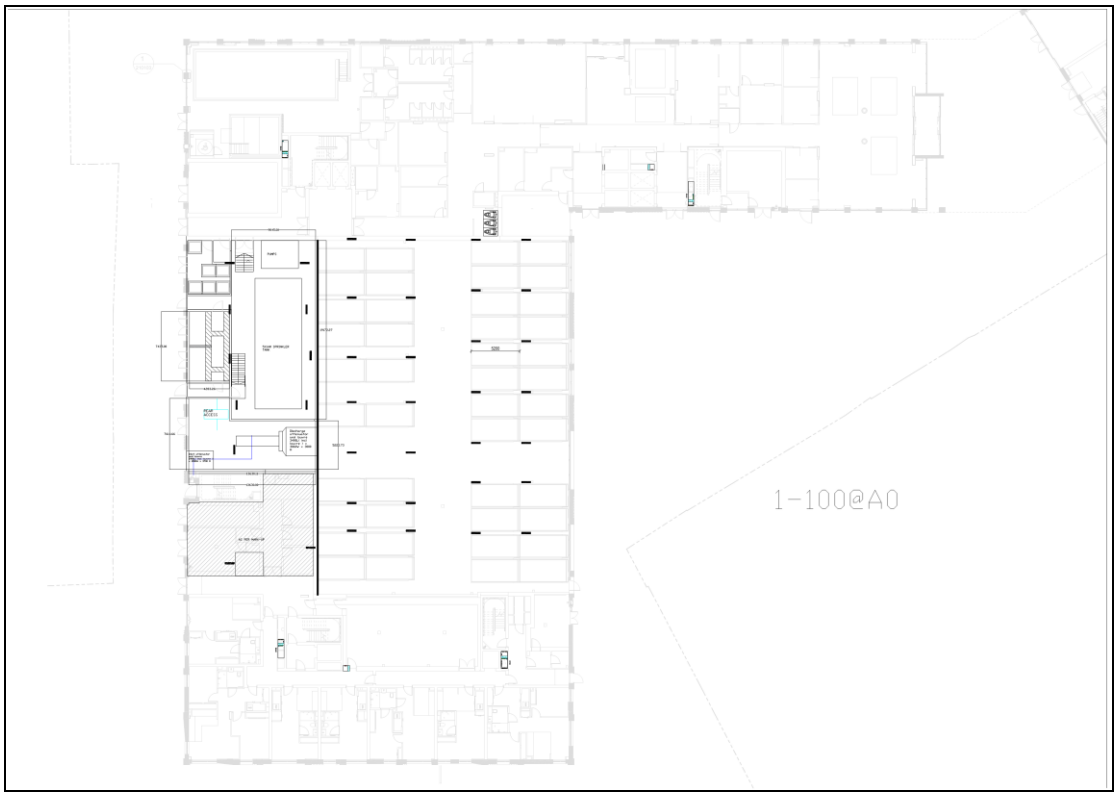
We understand all new external plant units will be located on the roof as illustrated in the drawing overleaf.



Roof Plan Showing Roof Plant Arrangement and Most Affected Residential Window
(Ref. 18120_A2.07_Rev.K © Marchese Partners commented by Hoare Lea)

During our site visits, we identified a number of nearest and potentially most affected noise sensitive windows located at the residential part of the proposed development itself and surrounding residential and hospital building. According to results of the noise survey along with our calculations, the worst affected residential window is located on the 3rd floor of the southeast façade of the proposed development, approximately 8 metres from the closest roof plant item.

In addition ,a life safety standby generator is proposed within a plantroom at ground floor level, as illustrated below. We understand the generator takes air from external and discharges towards the ground floor car park. The nearest noise sensitive receptor is identified to be a residential window at second floor of this development, approximately 5 metres above the generator plantroom intake louvre.



Ground Floor Plan Showing Life Safety Standby Generator Within Plantroom (© Hoare Lea)

11.3 Mitigation Measures

In order to control plant noise emissions in line with the proposed criteria, we recommend building acoustic louvre screening around the ASHP's plant area, as specified below and at the end of this report.

In addition, we recommend the following mitigation measures for the proposed environmental ventilation extract fans:

- controlling fan speed to required duty (86.84%); and
- incorporating acoustic attenuators to the outlets (as specified below); and
- positioning the environmental ventilation extract fans at least 5.5 metres from any roof edge parapet walls.

We would also recommend the following mitigation measures for the proposed restaurant kitchen extract fan:

- upgrading the manufacturer's built-in attenuator to the attenuator specified below; and
- building acoustic louvre screening around the restaurant kitchen extract fan plant area, as specified below and at the end of this report.

Description	Minimum Required Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Acoustic Louvre Screening around ASHP's	7	7	10	17	29	30	27	21
Acoustic Louvre Screening around Restaurant Kitchen Extract Fan	7	8	13	23	37	33	29	29

The specifications for the acoustic louvre screens are enclosed at the end of this report.

Description	Minimum Required Insertion Loss (dB) at Octave Band Centre Frequency (Hz)							
	63	125	250	500	1k	2k	4k	8k
Environmental Ventilation Extract Fan Outlet Attenuator	10	20	35	48	50	50	50	37
Restaurant Kitchen Extract Fan Outlet Attenuator	14	25	39	50	50	50	50	49

11.4 Plant Noise Impact Assessment

We understand that all proposed normal plant units will potentially be operational 24 hours. The proposed smoke extract fans will only operate in the event of a fire and during routine testing.

11.4.1 Normal Plant Noise Impact Assessment

The following tables summarise our predictions of atmospheric noise emissions from the proposed normal roof plant to 1m from the nearest and most affected noise sensitive residential window.

ASHP's	Sound Pressure Level (dB re $2x10^{-5}$ Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Sound Power Level	91	81	81	86	85	84	79	77	90
Correction for 3No.	+5	+5	+5	+5	+5	+5	+5	+5	

ASHP's	Sound Pressure Level (dB re 2x10^{-5} Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Barrier Correction	-14	-16	-19	-20	-20	-20	-20	-20	
Distance Correction (52m)	-46	-46	-46	-46	-46	-46	-46	-46	
Specified Acoustic Louvre Screening SRI	-7	-7	-10	-17	-29	-30	-27	-21	
Calculated Noise Level at 1m from Receptor	29	17	11	8	-5	-7	-9	-5	9

Restaurant Kitchen Extract Fan	Sound Pressure Level (dB re 2x10^{-5} Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Induct Outlet Sound Power Level	-	90	88	89	87	84	79	73	90
Specified Attenuator Insertion Loss	-14	-25	-39	-50	-50	-50	-50	-49	
Directionality	+3	+4	+5	+6	+6	+6	+6	+6	
Distance Correction (0m to 1m)	-11	-11	-11	-11	-11	-11	-11	-11	
Outlet Sound Pressure Level at 1m from Plant	-	58	43	34	32	29	24	19	44
Breakout Sound Power Level	-	80	75	72	56	52	46	37	72
Distance Correction (0m to 1m)	-11	-11	-11	-11	-11	-11	-11	-11	
Specified Acoustic Louvre Screening SRI	-7	-8	-13	-23	-37	-33	-29	-29	
Breakout Sound Pressure Level at 1m from Plant	-	61	51	38	8	8	6	-3	47
Cumulative Sound Pressure Level at 1m from Plant	-	63	52	39	32	29	24	19	49
Barrier Correction	-17	-20	-20	-20	-20	-20	-20	-20	
Distance Correction (1m to 31m)	-19	-19	-19	-19	-19	-19	-19	-19	
Calculated Noise Level at 1m from Receptor	-	24	13	0	-7	-10	-15	-20	10

Environmental Ventilation Extract Fans (86.84% speed)	Sound Pressure Level (dB re 2x10^{-5} Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
Induct Outlet Sound Power Level	79	82	77	79	72	71	71	56	80
Specified Attenuator Insertion Loss	-10	-20	-35	-48	-50	-50	-50	-37	
Directionality	+2	+3	+4	+5	+6	+6	+6	+6	
Distance Correction (0m to 1m)	-11	-11	-11	-11	-11	-11	-11	-11	
Outlet Sound Pressure Level at 1m from Plant	60	54	35	25	17	16	16	14	40
Breakout Sound Power Level	71	69	67	56	41	41	48	34	61
Distance Correction (0m to 1m)	-11	-11	-11	-11	-11	-11	-11	-11	
Breakout Sound Pressure Level at 1m from Plant	60	58	56	45	30	30	37	23	50
Cumulative Sound Pressure Level at 1m from Plant	63	59	56	45	30	30	37	24	50

Environmental Ventilation Extract Fans (86.84% speed)		Sound Pressure Level (dB re 2x10^{-5} Pa) at Octave Band Centre Frequency (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
#1	Barrier Correction	-10	-12	-14	-17	-20	-20	-20	-20	
	Distance Correction (1m to 9m)	-14	-14	-14	-14	-14	-14	-14	-14	
	Calculated Noise Level at 1m from Receptor	39	33	28	14	-4	-4	3	-10	22
#2	Barrier Correction	-9	-12	-16	-20	-23	-25	-25	-25	
	Distance Correction (1m to 67m)	-30	-30	-30	-30	-30	-30	-30	-30	
	Calculated Noise Level at 1m from Receptor	24	17	10	-5	-23	-25	-18	-31	5
#3	Barrier Correction	-10	-12	-15	-18	-20	-20	-20	-20	
	Distance Correction (1m to 71m)	-31	-31	-31	-31	-31	-31	-31	-31	
	Calculated Noise Level at 1m from Receptor	22	16	10	-4	-21	-21	-14	-27	5
#4	Barrier Correction	-10	-12	-15	-18	-20	-20	-20	-20	
	Distance Correction (1m to 81m)	-32	-32	-32	-32	-32	-32	-32	-32	
	Calculated Noise Level at 1m from Receptor	21	15	9	-5	-22	-22	-15	-28	4
Cumulative Noise Level at 1m from Receptor		39	33	28	14	-4	-4	3	-10	22

The following table summarises our predictions of the cumulative atmospheric noise emissions from the proposed normal roof plant to 1m from the nearest and most affected noise sensitive residential window.

Plant Description	Sound Pressure Level (dB re 2x10^{-5} Pa) at Octave Band Centre Frequency (Hz)								dBA
	63	125	250	500	1k	2k	4k	8k	
ASHP's	29	17	11	8	-5	-7	-9	-5	9
Restaurant Kitchen Extract Fan	-	24	13	0	-7	-10	-15	-20	10
Environmental Ventilation Extract Fans (86.84% speed)	39	33	28	14	-4	-4	3	-10	22
Cumulative Normal Roof Plant Noise Emission Levels at 1m from Receptor	40	34	28	15	0	-1	4	-4	23

Our calculations indicate that the proposed normal plant, in conjunction with the propose mitigation measures, should be capable of satisfying the policies of the Local Authority outlined in Section 9.0.

11.4.2 Smoke Extract System Noise Impact Assessment

The following tables summarise our predictions of atmospheric noise emissions from the proposed smoke extract fans to 1m from the nearest noise sensitive residential window.

Smoke Extract Fans		Sound Pressure Level (dB re $2x10^{-5}$ Pa) at Octave Band Centre Frequency (Hz)								dBA
		63	125	250	500	1k	2k	4k	8k	
Induct Outlet Sound Power Level		94	95	93	90	93	92	91	84	98
Grille End Reflection		-7	0	-1	0	0	0	0	0	
Directionality		+1	+2	+3	+4	+5	+6	+6	+6	
Distance Correction (0m to 1m)		-11	-11	-11	-11	-11	-11	-11	-11	
Outlet Sound Pressure Level at 1m from Plant		77	86	85	83	87	87	86	79	93
Breakout Sound Pressure Level at 1m from Plant		83	82	79	72	70	65	64	57	76
Cumulative Sound Pressure Level at 1m from Plant		84	87	86	83	87	87	86	79	93
#1	Barrier Correction	-10	-12	-14	-17	-20	-20	-20	-20	
	Distance Correction (1m to 9m)	-14	-14	-14	-14	-14	-14	-14	-14	
	Calculated Noise Level at 1m from Receptor	60	61	58	52	53	53	52	45	59
#2	Barrier Correction	-9	-12	-16	-20	-23	-25	-25	-25	
	Distance Correction (1m to 67m)	-30	-30	-30	-30	-30	-30	-30	-30	
	Calculated Noise Level at 1m from Receptor	45	45	40	33	34	32	31	24	40
#3	Barrier Correction	-10	-12	-15	-18	-20	-20	-20	-20	
	Distance Correction (1m to 71m)	-31	-31	-31	-31	-31	-31	-31	-31	
	Calculated Noise Level at 1m from Receptor	43	44	40	34	36	36	35	28	42
#4	Barrier Correction	-10	-12	-15	-18	-20	-20	-20	-20	
	Distance Correction (1m to 81m)	-32	-32	-32	-32	-32	-32	-32	-32	
	Calculated Noise Level at 1m from Receptor	42	43	39	33	35	35	34	27	41
Cumulative Noise Level at 1m from Receptor		60	61	58	52	53	53	52	45	59

Our calculations indicate that the noise emissions of the proposed smoke extract fans at the nearest and most affected residential window are approximately 27dB above the lowest measured daytime background $L_{A90,15mins}$ (32dBA), and 4dB lower than the measured daytime $L_{Aeq,16hour}$ (63dBA). According to the PPG guidance, it is likely that the noise impact of the proposed smoke extract fans would fall under the category of 'Observed Adverse Effect'. We understand, however, incorporating attenuators to the outlets of smoke extract fans would generally reduce the fan efficiency. Therefore, no mitigation measures have been recommended. This is, however, subject to the approval of the Local Authority.

11.4.3 Life Safety Standby Generator Noise Impact Assessment

We have determined the limiting sound pressure levels at 1m from the generator plantroom intake louvre as follows:

Generator Plantroom Intake System	Sound Pressure Level (dBA)
Noise Level at Nearest Receptor	57 @ 1m
Conformal Area Distance Correction (approx. 5m)	+9
Plant Noise Emission Limit for Generator Plantroom Intake Louvre	66 @ 1m

The proposed life safety standby generator intake system shall be appropriately attenuated such that the above limiting levels are met. Please see the Acoustic Specification for Generator Installation enclosed.

Our calculation indicate that provided the above limiting noise level and the acoustic specification enclosed are complied with, our recommended criteria for life safety standby generator should be achieved. This is subject to final approval of the Local Authority.

12.0 Conclusions

An environmental noise survey has been undertaken in order to establish the currently prevailing noise levels.

Critical period L_{Amax}, L_{Aeq} and L_{A90} noise measurements along with relevant octave band sound spectra have been established by means of detailed fully manned daytime environmental noise survey at suitable street level locations around the site.

Plant noise emission criteria have been recommended based on the results of the noise survey and with reference to the Local Authority's policies and statutory noise nuisance.

An assessment has been carried out to determine the plant noise emissions at the nearest and most affected noise sensitive residential window.

The assessment indicates that the proposed normal plant, in conjunction with the proposed attenuation, should be capable of achieving the proposed environmental noise criteria at the nearest noise sensitive residential window, should therefore be acceptable to the Local Authority.

The assessment indicates that the noise emissions of the proposed smoke extract fans at the nearest and most affected residential window are approximately 27dB above the lowest measured daytime background $L_{A90,15mins}$ (32dBA), and 4dB lower than the measured daytime $L_{Aeq,16hour}$ (63dBA). According to the PPG guidance, it is likely that the noise impact of the proposed smoke extract fans would fall under the category of 'Observed Adverse Effect'. We also understand incorporating attenuators to the outlets of smoke extract fans would generally reduce the fan efficiency. Therefore, no mitigation measures have been recommended. This is, however, subject to the approval of the Local Authority.

An assessment has also been undertaken to determine the limiting sound pressure level from the life safety generator plantroom louvre, based on our recommended plant noise emission criteria for emergency generators. This is, however, subject to the approval of the Local Authority.

Appendix A

The acoustic terms used in this report are defined as follows:

dB — Decibel - Used as a measurement of sound level. Decibels are not an absolute unit of measurement but an expression of ratio between two quantities expressed in logarithmic form. The relationships between Decibel levels do not work in the same way that non-logarithmic (linear) numbers work (e.g. 30dB + 30dB = 33dB, not 60dB).

dBA — The human ear is more susceptible to mid-frequency noise than the high and low frequencies. The 'A'-weighting scale approximates this response and allows sound levels to be expressed as an overall single figure value in dBA. The $_A$ subscript is applied to an acoustical parameter to indicate the stated noise level is A-weighted

It should be noted that levels in dBA do not have a linear relationship to each other; for similar noises, a change in noise level of 10dBA represents a doubling or halving of subjective loudness. A change of 3dBA is just perceptible.

$L_{90,T}$ — L_{90} is the noise level exceeded for 90% of the period *T* (i.e. the quietest 10% of the measurement) and is often used to describe the background noise level.

$L_{eq,T}$ — $L_{eq,T}$ is the equivalent continuous sound pressure level. It is an average of the total sound energy measured over a specified time period, *T*.

L_{max} — L_{max} is the maximum sound pressure level recorded over the period stated. L_{max} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the L_{eq} noise level.

L_p — Sound Pressure Level (SPL) is the sound pressure relative to a standard reference pressure of 2×10^{-5} Pa. This level varies for a given source according to a number of factors (including but not limited to: distance from the source; positioning; screening and meteorological effects).

L_w — Sound Power Level (SWL) is the total amount of sound energy inherent in a particular sound source, independent of its environment. It is a logarithmic measure of the sound power in comparison to a specified reference level (usually 10^{-12} W).

GUILD LIVING, EPSOM HOSPITAL

ACOUSTIC SPECIFICATION FOR

ACOUSTIC LOUVRE SCREENING

Acoustic louvre screening shall extend:

- continuously around all four sides of the proposed ASHP's plant area.

- from the roof up to a minimum height of 2000 mm above roof level, or equal to the highest part of the plant, whichever is the higher.

The louvre blades shall face in the direction opposite to that which would be conventional for weather louvers, such that the plant is not visible between the louvre blades when viewed from the noise sensitive receptor below.

Performance

The acoustic louvres shall be at least 300mm deep and provide, in their as-installed condition, the following minimum combined sound reduction indices (SRI's) when tested in accordance with BS 2750 Part 3 – 1980 (ISO 140 Part 3 – 1995).

Minimum Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)							
63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
7	7	10	17	29	30	27	21

Construction

The louvre frame shall be constructed from a suitable gauge of galvanised mild steel, or aluminium, supporting louvre blades of like material. The acoustic material in the blades shall be packed to a density of not less than 45kg/m^3 and be inert, rot and vermin proof, non-hygroscopic incombustible mineral fibre. This shall be faced with glass fibre cloth, or other approved infill protection membrane, and retained on the lower blade face by perforated galvanised mild steel or aluminium (not "expamet" or similar derivative) having a minimum thickness of 0.5mm fixed at 200mm (max) centres.

All junctions between the acoustic screen and adjacent structures shall be made good and sealed with a heavy grout and/or non-hardening dense mastic.

The supplier shall ensure that the assembled enclosure is designed and constructed to withstand site operating conditions such as wind and snow loads, etc., as appropriate, and is suitably weatherproofed.

The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to ensure that fibre migration is prevented.

Any deviations from the above specification must be agreed by, and confirmed in writing to, Hann Tucker Associates.

GUILD LIVING, EPSOM HOSPITAL

ACOUSTIC SPECIFICATION FOR

ACOUSTIC LOUVRE SCREENING

Acoustic louvre screening shall extend:

- continuously around all four sides of the proposed restaurant kitchen extract fan plant area.
- from the roof up to a minimum height of 2000 mm above roof level, or equal to the highest part of the plant, whichever is the higher.

The louvre blades shall face in the direction opposite to that which would be conventional for weather louvers, such that the plant is not visible between the louvre blades when viewed from the noise sensitive receptor below.

Performance

The acoustic louvres shall be at least 600mm deep and provide, in their as-installed condition, the following minimum combined sound reduction indices (SRI's) when tested in accordance with BS 2750 Part 3 – 1980 (ISO 140 Part 3 – 1995).

Minimum Sound Reduction Index (dB) at Octave Band Centre Frequency (Hz)							
63	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
7	8	13	23	37	33	29	29

Construction

The louvre frame shall be constructed from a suitable gauge of galvanised mild steel, or aluminium, supporting louvre blades of like material. The acoustic material in the blades shall be packed to a density of not less than 45kg/m^3 and be inert, rot and vermin proof, non-hygroscopic incombustible mineral fibre. This shall be faced with glass fibre cloth, or other approved infill protection membrane, and retained on the lower blade face by perforated galvanised mild steel or aluminium (not "expamet" or similar derivative) having a minimum thickness of 0.5mm fixed at 200mm (max) centres.

All junctions between the acoustic screen and adjacent structures shall be made good and sealed with a heavy grout and/or non-hardening dense mastic.

The supplier shall ensure that the assembled enclosure is designed and constructed to withstand site operating conditions such as wind and snow loads, etc., as appropriate, and is suitably weatherproofed.

The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to ensure that fibre migration is prevented.

Any deviations from the above specification must be agreed by, and confirmed in writing to, Hann Tucker Associates.

GUILD LIVING, EPSOM HOSPITAL

ACOUSTIC SPECIFICATION FOR

GENERATOR INSTALLATION

1.0 GENERATOR

1.1 Noise Control

1.1.1 Noise Limits

Limiting noise levels within the generator plantroom are to be confirmed. These limits apply at any position in the plantroom 1m (or more) in any direction from any part of the generator installation.

Noise levels external to the generator plantroom shall not exceed 66dBA. This limit applies at any plantroom/position externally 1m in any direction from any part of the generator installations.

The above criteria are to be achieved with the maximum number of generators installed and operating simultaneously at maximum load, and at all intermediate load conditions.

N.B. Compliance with the above does not alter the requirement to comply with Section 1.1.2.

1.1.2 Data Required

The supplier shall submit:

- expected octave band noise data for the generator.
- expected octave band levels of atmospheric noise emissions from ventilation inlet/outlet openings and exhaust systems.
- expected octave band levels of atmospheric noise breakout from external ducts, silencers and exhaust systems.
- the insertion losses expected from the silencers offered (under the operating conditions) and the silencer pressure losses expected at the design flow and temperature derived from tests carried out in accordance with BS EN ISO 7235:2009 “Acoustics - laboratory measurement procedures for ducted silencers and air terminal

units-insertion loss, flow noise and total pressure loss" together with the expected effect of turbulence due to adjacent duct elements on the quoted pressure losses.

- silencer generated octave band sound power levels (125-8kHz) at the operating conditions derived from tests carried out in accordance with Bs EN ISO 7235:2009.

1.1.3 Silencer Construction

The outer casing of all duct silencers shall be constructed in accordance with the current relevant ductwork specification in terms of thickness and seams.

All silencers shall be fitted with drilled angle flange connections, unless alternative connections are specified in the schedule or by the Mechanical Services Consultant or Contractor. Flanges should also conform to the relevant code or its equivalent.

Acoustic elements in rectangular silencers of length equal to or greater than 900mm shall incorporate faired leading and trailing edges (not square ends). Silencers having a length of less than 900mm should have a faired leading edge, unless otherwise specified.

The inert, rot and vermin proof, non-hygroscopic and non-combustible mineral wool or glass fibre acoustic medium shall be packed to a density of not less than 48kg/m^3. This shall be faced with a glass fibre cloth, or other approved infill protection membrane, retained by a perforated galvanized sheet steel facing (not "expamet"" or similar derivative) having a minimum thickness of 0.5mm fixed at 200mm (max) centres. Splitters shall be constructed so that no egress of acoustic medium will occur into the gas stream under the operating conditions.

The manufacturer will also note any particular requirements, e.g. painting, special materials, etc., indicated in the schedules or on the drawings.

Where acoustic elements form splitters within the silencer, the arrangement shall be with a half-width splitter fixed to each side wall of the casing and preferably with the splitters vertical. The configuration should have a regular splitter/airway dimension across the full width of the silencer. However, it is the responsibility of the supplier to ensure that the parallel splitter elements in the silencer are correctly orientated for the adjacent duct geometry, particularly when silencers are located near bends, bifurcations, etc. Horizontal splitters should be suitably stiffened to prevent flexing and restriction of the airways and will normally be limited to silencers having a module width of 900mm or less.

In the case of circular silencers, all internal acoustic elements shall comprise mineral or glass fibre as the acoustic medium, as specified above for rectangular silencers, retained by a

perforated galvanised sheet steel facing (or other approved infill protection membrane, but not “expamet” or similar derivative).

When silencers are manufactured in modules each unit shall be shop assembled (unless the Mechanical Services Contractor instructs to the contrary) and this specification, together with the manufacturer's own guarantee and performance ratings, shall apply to the unit as a whole.

Silencer units shall be delivered to site with blocked ends to prevent ingress of rubble, etc., while on site and to reduce the risk of damage. The direction of airflow through the silencer shall be clearly marked on the casing.

Silencers for high temperature applications (e.g. diesel exhausts, boiler flues, etc.) should have casings manufactured from a suitable gauge steel, with adequate precautions taken to cater for expansion and thermal shock. The internal elements shall be packed with an inert, rot and vermin proof, non-hygroscopic and non-combustible mineral or glass fibre acoustic medium of at least 96kg/m^3 density. This shall be faced with glass fibre cloth retained by perforated galvanised sheet steel facing (not “expamet” or similar derivative) having a minimum thickness of 0.7mm fixed at 200mm (max) centres. For very high temperatures, steel wool or equivalent approved materials may be used as the acoustic medium.

The silencer cross-sectional sizes shown in the schedules are to be followed exactly, since they often relate to duct sizes and thus avoid the unnecessary use of transition sections. However, subject to agreement with the Mechanical Services Consultant or Contractor, the supplier may propose alternative dimensions in line with his own standard sizes, provided the acoustic and aerodynamic requirements are met.

The use of Melinex or other plastic film between the perforated sheet steel facing and the infill medium may be required for certain applications. It should be noted that such materials may reduce the acoustic performance of the silencer significantly and this must be taken into account when interpreting the schedules. Film thicknesses greater than 0.05mm will not be permitted, and use of very thin films (0.008-0.010mm) is preferred.

Where corrosive or toxic gases or substances are being handled, special constructions and materials may be specified as an addendum to this specification.

The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to ensure fibre migration is prevented.

1.1.4 Site Testing

The contractor shall allow for a full programme of testing to demonstrate that the specified noise emission limits are being met when the complete generator system is operating at full design duty.

Measurements will be made externally at 1m from each source (i.e. inlet, discharge and exhaust) and also internally in general accordance with ANC Guidelines – Noise Measurements in Buildings.

It is therefore preferable to measure each generator individually, or in garage pairs, which should also make it easier to simulate maximum load.

Measurements of noise levels shall be undertaken with sound level measuring equipment conforming to BS EN 61672-2:2003, with an octave band filter set complying with BS EN 61260:1996. The sound measuring system shall be calibrated prior to the commencement of any series of tests using a piston phone or dynamic calibrator. Calibration shall be rechecked on completion of the test sequence.

1.2 Vibration Isolation

1.2.1 Isolation Performance

The generator shall be isolated via high deflection caged steel spring type anti-vibration mounts having minimum static deflections of 75mm.

The vibration isolation shall provide an isolation efficiency at the engines rotational speed (or firing frequency if this is lower) of at least 95%.

The base channels shall be separated from the floor by neoprene pads having minimum static deflection of 3mm.

Isolation systems shall restrict the vibration and structure borne noise to the levels specified.

Vibration isolation systems shall be designed on the recommendations of the ASHRAE Handbook 1991 Applications Volume, Chapter 42, Table 34, and the accompanying text, for type of base, mounting, active material and static deflection, except where indicated otherwise.

The method of mounting machinery and the size, type and active material of the mountings shall be agreed between machinery and isolator suppliers.

The generator supplier shall advise the structural engineer of the forcing frequencies (i.e. rotational speed, firing frequency) and harmonics, and shall liaise closely with him to ensure these lie away from the natural frequency response of the supporting structure and that the supporting structure is dynamically stable.

1.2.2 Asymmetrical Loading of Anti-vibration Mounts in a Vibration Isolation System

Mounting selections should allow for any eccentric load distribution or torque reaction, so that the design deflection is achieved on all mountings under operating conditions.

The vibration isolation system shall have levelling screws and locking nuts to allow the deflection of each mounting to be adjusted to the design value at the operating condition of the supported equipment.

The maximum difference between resonant frequencies of any two mountings of a set when the supported equipment is operating shall not differ by more than 15%.

1.2.3 Lateral Stiffness of Isolators

The lateral stiffness of vibration isolators shall be selected to suit the lateral isolation efficiency required without causing instability. For rotating machines with horizontal shafts, the horizontal stiffness perpendicular to the shaft shall not be less than vertical, if ‘floor’ mounted, and vice versa if ‘side’ mounted.

1.2.4 Levelling and Height Adjustment of Vibration Isolators

Vibration isolators shall be provided with means of adjustment of deflections to allow for unevenness in bases, etc., unless they are located between prefabricated accurately parallel frames. The amount of adjustments for floor mounted isolators shall not be less than twice the permitted tolerance in the levelling of the floor. Levelling bolts or studs shall be provided with lock nuts.

Alternatively, the means of adjustment of deflections’ may be located between the supported machine and the isolators, or between the isolators and the basic supporting structure.

1.2.5 Anti-Vibration Mounts

Each mounting shall consist of cast or fabricated telescopic top and bottom housings enclosing one or more helical steel springs as the principle isolation elements and shall incorporate a built-in levelling device. The housing should be designed to permit visual inspection of the springs after installation, i.e. the spring must not be totally enclosed.

The springs shall have an outside diameter of not less than 75% of the operating height, and be selected to have at least 50% overload capacity before becoming coil-bound.

Isolators shall have auxiliary dampers or adjustable ‘snubber’ type restraints which prevent excessive movement as the machine speed passes through the resonant frequency of the mounting system.

Mountings incorporating snubbers or restraining devices shall be designed so that the snubbing, damping or restraining mechanism is capable of being adjusted to have no significant effect during the normal running of the isolated machine.

All nuts, bolts or other elements used for adjustment of a mounting shall incorporate locking mechanisms to prevent the isolator going out of adjustment as a result of vibration or accidental or unauthorised tampering.

The bottom plate of each mounting shall have bonded to it a rubber/neoprene pad designed to attenuate any high frequency energy transmitted by the springs.

Holes shall be provided for fixing both to the supported machine and the supporting structure.

It is the supplier's responsibility to ensure that all mountings offered are suitable for the loads, operating and environmental conditions which will prevail. Particular attention should be paid to mountings which will be exposed to atmospheric conditions to prevent corrosion.

All mountings shall be colour coded, or otherwise marked, to indicate their load capacity to facilitate identification during installation.

1.2.6 Pad’ or ‘Mat’ Mountings

The material used for ‘pad’ or ‘mat’ type mountings may be cellular, ribbed or studded. Pads and mats shall normally be bonded both to supported and to supporting surfaces. All components shall be suitable for the environment in which they will operate.

1.2.7 Acceptable Levels of Vibration Of Building Structure Due To Building Services

The vibration velocity of the surfaces of the building due to vibrations from the operation of the generators installation within this contract shall not exceed 0.1mm/s RMS for occupied/switch floors and 0.3mm/s RMS for unoccupied and non-switch floors.

1.2.8 Site Testing

The contractor shall allow for a full programme of testing on site to demonstrate that the specified vibration limits are being met, when the full generators installation within the contract is operating at maximum load.

2.0 EXHAUST SYSTEMS

2.1 Noise Control

2.1.1 Noise Limits

The generator exhaust installations shall be attenuated such that noise levels 1m in any direction from the discharges or any other external component of the installations shall not exceed a sound pressure level of TBC dBA at maximum duty or at any intermediate load condition. This criterion assumes one exhaust discharge for each set. If there are two (or more) discharges per set a more stringent criterion will apply, and advice should be sought.

N.B. Compliance with the above does not alter the requirement to comply with Section 2.1.2.

2.1.2 Data Required

The supplier shall submit:

- expected octave band levels of atmospheric noise emissions from exhaust discharge.
- expected octave band levels of atmospheric noise break out from externally located exhaust components.

Unless any relaxation is demonstrated to the satisfaction of the acoustic consultant as being acoustically acceptable, the exhaust systems shall incorporate two stage exhaust silencers with both primary and secondary silencers accommodated within the generator plant enclosure. Tertiary silencers (if required) may be located externally if other non-acoustic considerations permit.

The peak attenuation of the primary silencer shall be at the firing frequency of the associated manifold, with a drop in attenuation 1 octave each side of this frequency not exceeding 5dB, and shall be as close to the manifold as possible.

The attenuation characteristics of the secondary silencers (and tertiary if fitted) shall be complimentary to the primary. In combination the silencers shall ensure the atmospheric noise emissions do not contain significant tonal characteristics.

The pressure loss through the exhaust system shall not exceed the value recommended by the engine manufacturer.

The exhaust system shall be separated from the engine exhaust manifold by corrugated bellows. The bellows shall be positioned, after a bend if necessary, with the axis perpendicular to the direction of the vibration.

Where an exhaust system runs with less than two bends between the flexible bellows connection at the manifold and the point of exit from the plantroom, a second bellows connection, similar to the first, shall be located just before the point of exit.

The outer casings of all silencers shall be constructed from a suitably heavy gauge steel with all seems and joints continuously welded. Acoustic elements within the silencer shall be designed and constructed with due allowance for differential expansion and thermal shock.

All silencers shall also be fitted with suitable flanges and drain plugs and shall be manufactured and finished with due allowance made for the operating temperatures and environmental conditions.

Silencers shall be delivered to site with blocked ends to prevent ingress of rubble, etc., during installation, and to reduce the risk of damage. The direction of gas flow through the silencer shall be clearly marked on the casing.

The acoustic media shall not comprise materials which are generally composed of mineral fibres, either man-made or naturally occurring, which have a diameter of 3 microns or less and a length of 200 microns or less or which contain any fibres not sealed or otherwise stabilised to ensure that fibre migration is prevented.

2.2 Vibration Control

The complete exhaust systems shall be suspended via high deflection steel spring type anti-vibration hangers. These AV hangers should have the same minimum static deflections as that specified for the generator sets (see above) and shall provide an isolation efficiency at the engine’s rotational speed (or firing speed if this is lower) of at least 95% - whichever is more onerous.

The supports shall allow unstressed expansion of the exhaust system with significant changes in vibration isolator loads or excessive deflections of the flexible connections.

Support locations shall be selected to give adequate structural support without causing resonance of the supported length at the manifold firing frequency or the engine's rotational frequency.

Vertical sections of pipes shall be supported at floor slabs, and be guided between as necessary to avoid resonance. Horizontal sections shall avoid mid-span supports.

AV hangers shall incorporate a helical steel spring and with a rubber/neoprene element in series securely located in a steel cage. The vibration isolating elements shall be used in compression.

The clearance hold in the bottom of the cage should allow a lateral movement of the lower hanger rod of at least 30^{o} included angle without metal to metal contact.

Where AV hangers incorporate a positioning device, the adjustment system should incorporate a locking mechanism to prevent the hanger going out of adjustment as a result of vibration, or accidental or unauthorised tampering.

It is the supplier's responsibility to ensure that all products offered are suitable for the loads, operating and environmental conditions which will prevail. Particular attention should be paid to products which will be exposed to atmospheric conditions to prevent corrosion.

Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. No permanent deformation shall be caused by full compression.

Neoprene/rubber isolators shall be protected from overloading by metal to metal restraints or lateral containment.

The hanger cage shall be capable of carrying five times the maximum rated normal service load without permanent distortion.

3.0 GENERAL

3.1 Isolator Adjustment

When raising equipment to its final position on vibration isolators, the isolators must be adjusted progressively.

Each isolator should be adjusted several turns at a time in sequence. The continued adjustment of a single mount will result only in the unit becoming coil bound and failure to lift the equipment.

3.2 Flexible Connections

All ductwork connections to fans should be flexible and at least 75mm long. These should be constructed from sound barrier mat having a minimum superficial density of at least 5kg/m^2. These connections should be straight but not rigid, with no offset, in order to prevent turbulence.

3.3 Electrical Connections

It is important that isolated equipment is not mechanically shorted by the installation of conduit or cable trays, etc, which are rigidly connected to the structure. Electrical connections to plant should, therefore, be made via a looped flexible conduit. The loop should form a diameter of 300mm or more.

4.0 LIABILITY

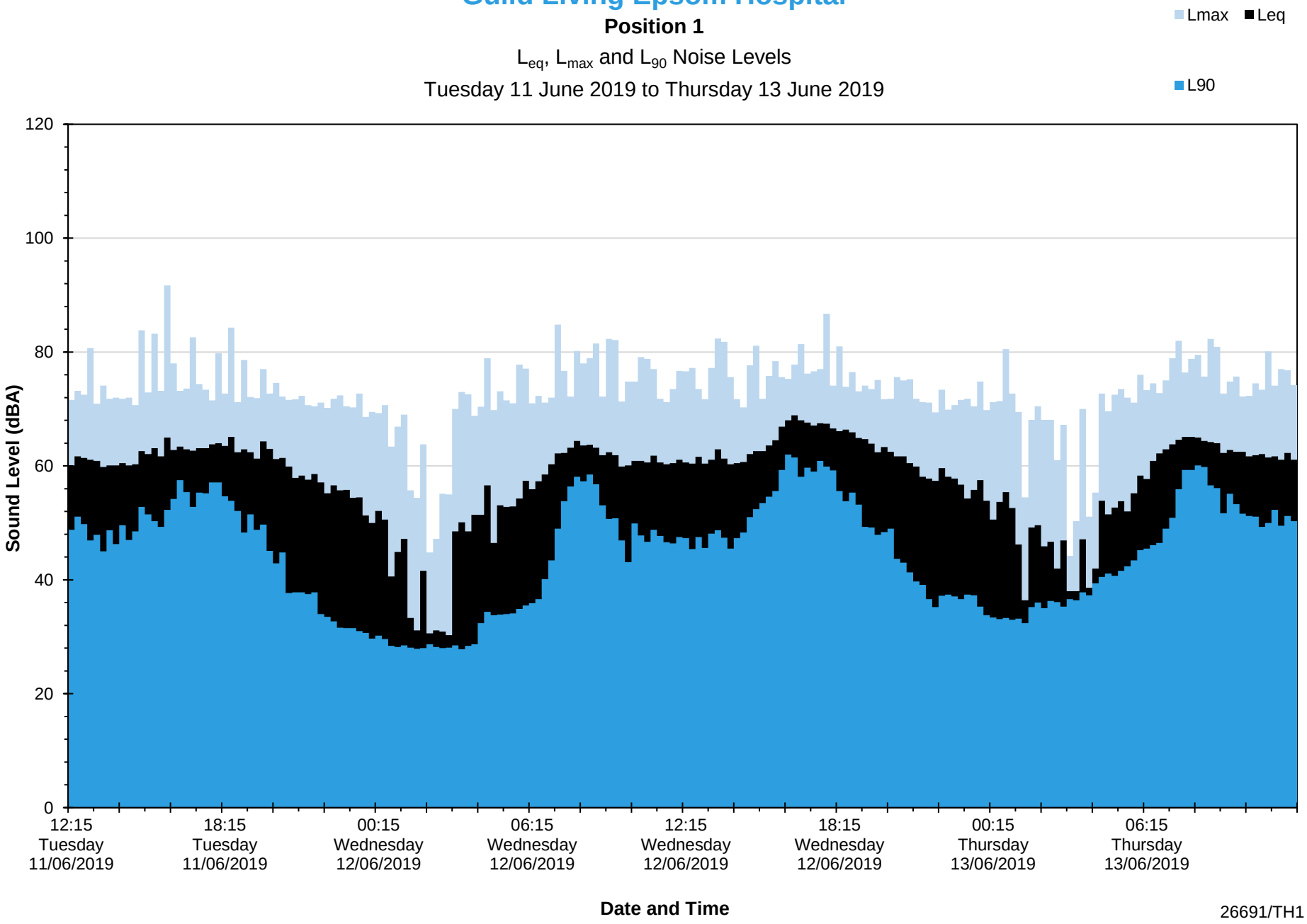
The supplier is advised that failure to comply with any part of the above specification may result in liability for any resulting remedial or replacement costs on site, including consequential liability, unless variations are accepted in writing by their client and/or the Acoustic Consultant.

Guild Living Epsom Hospital

Position 1

L_{eq}, L_{max} and L_{90} Noise Levels

Tuesday 11 June 2019 to Thursday 13 June 2019



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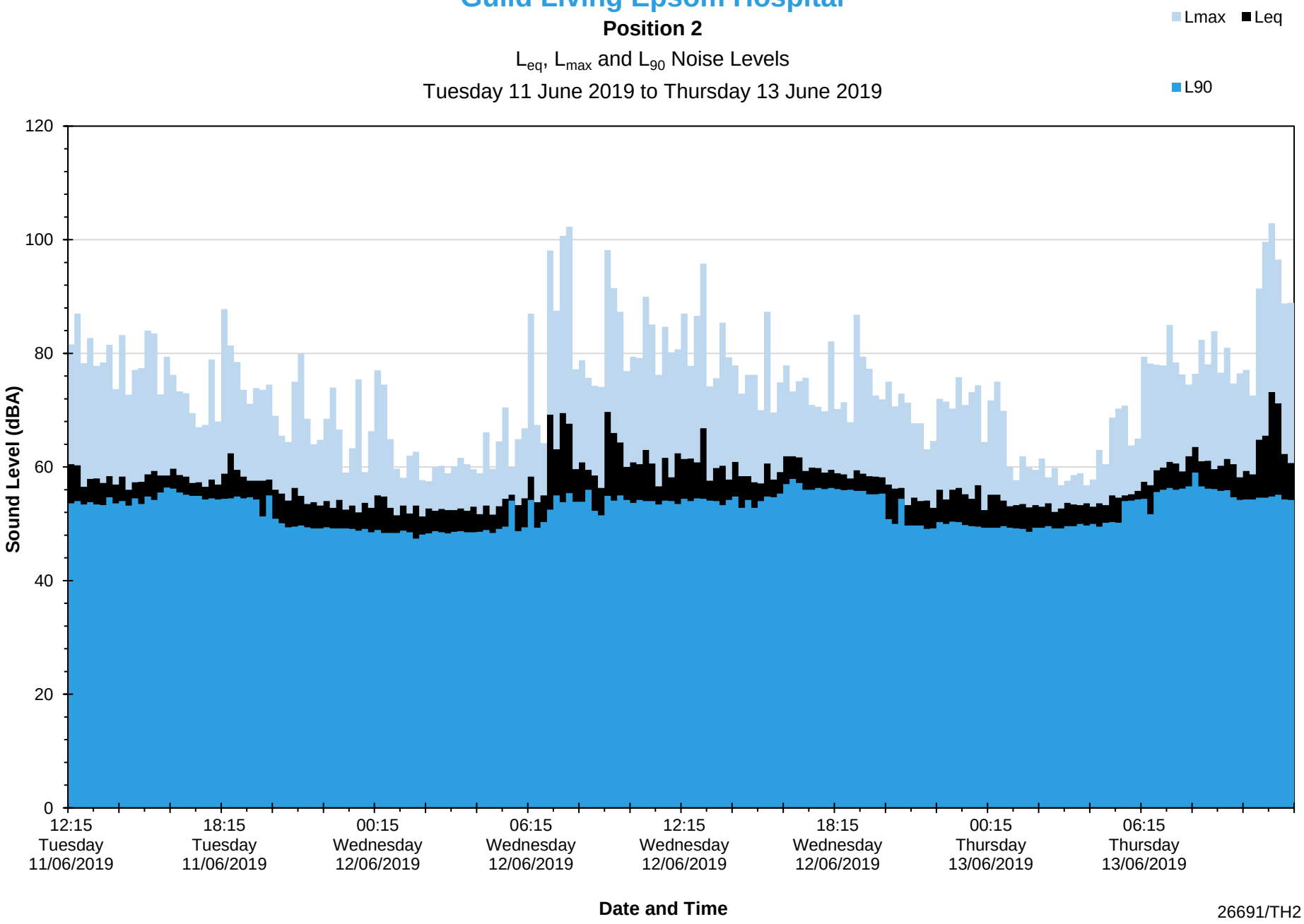
Position 2

L_{eq}, L_{max} and L_{90} Noise Levels

Tuesday 11 June 2019 to Thursday 13 June 2019



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Position 3

L_{eq}, L_{max} and L_{90} Noise Levels

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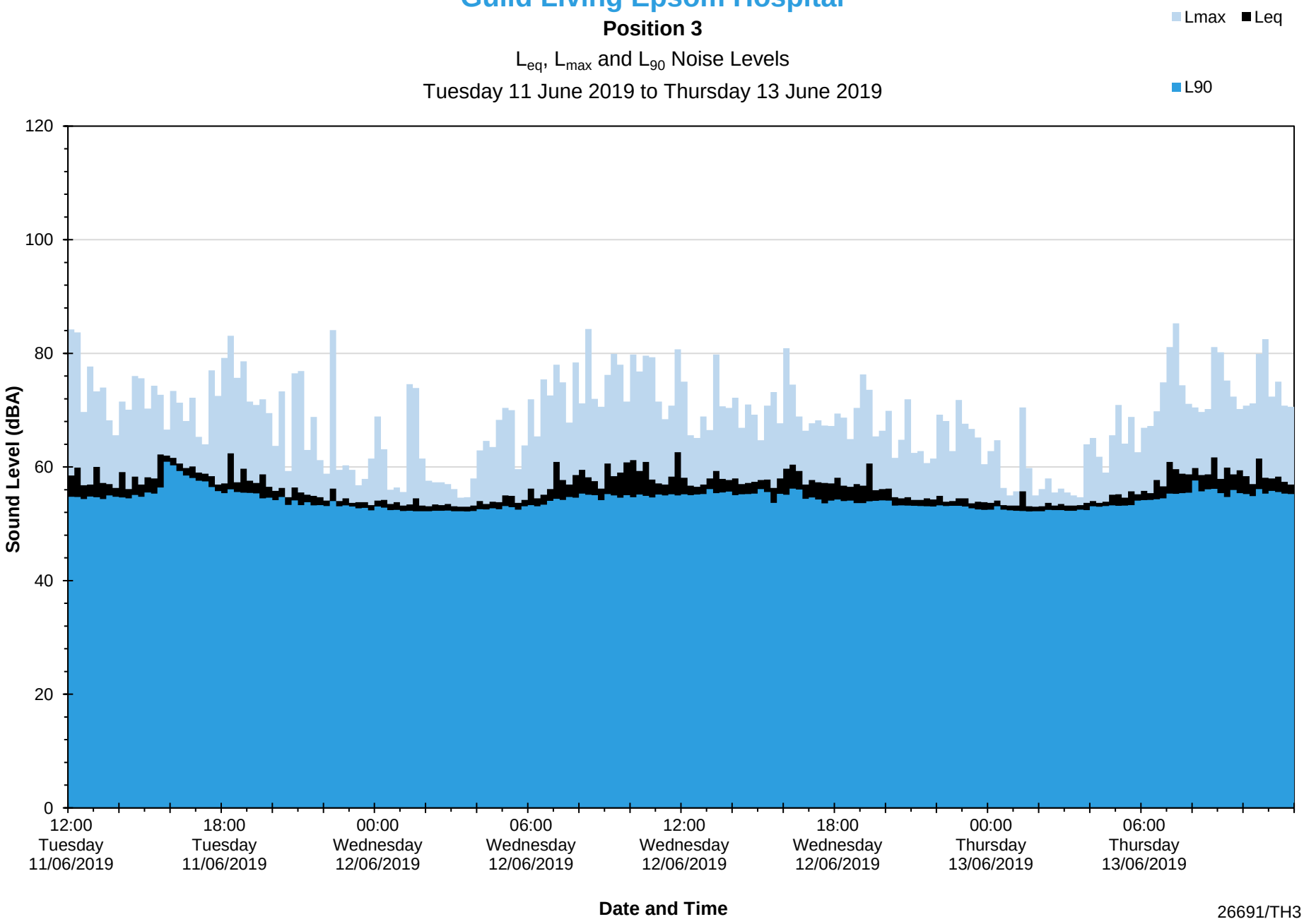

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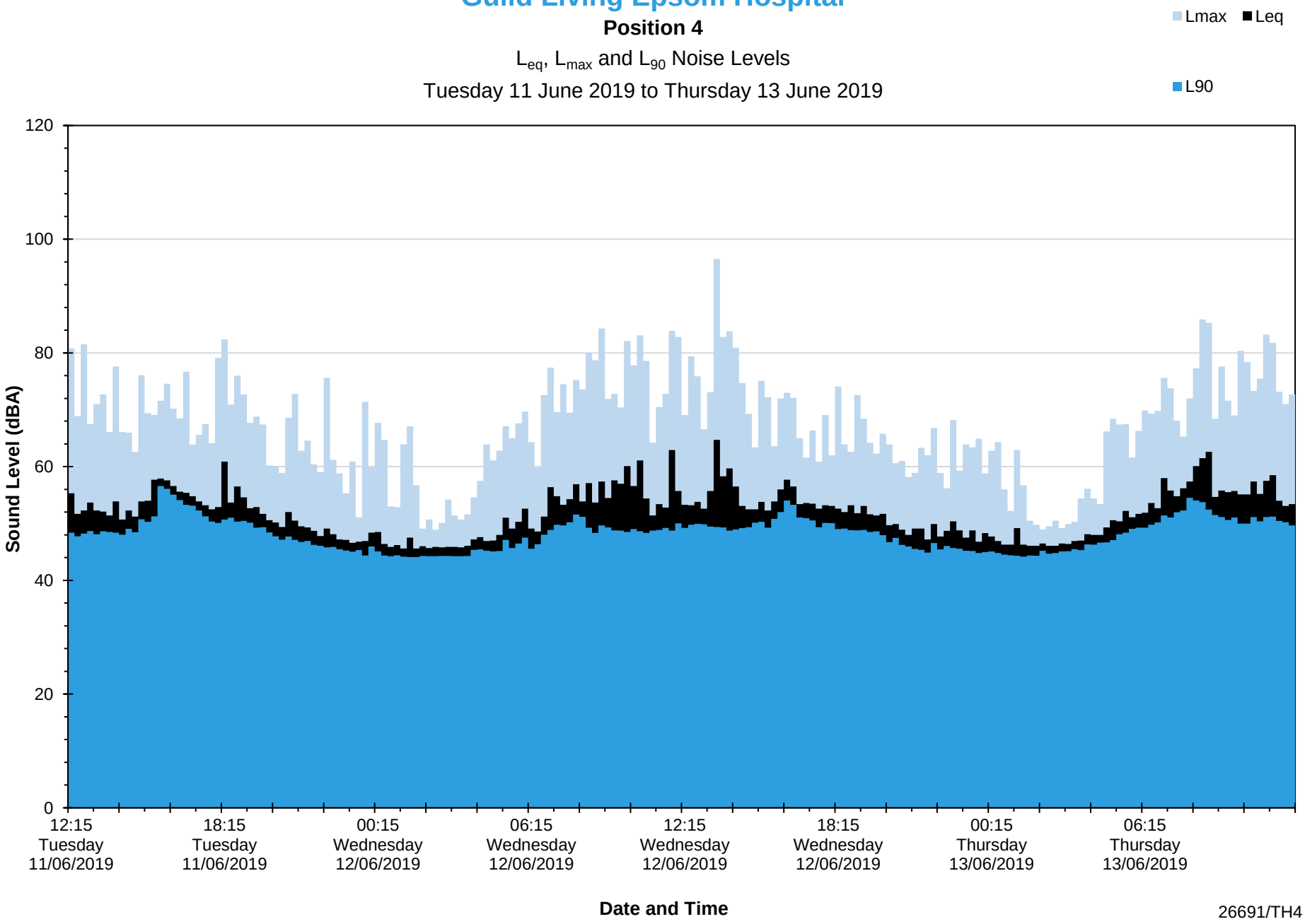
Position 4

L_{eq}, L_{max} and L_{90} Noise Levels

Tuesday 11 June 2019 to Thursday 13 June 2019



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