Report No:
Warburg Institute - BS4142 Plant Noise Impact Assessment for Exhibition Space

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For: Warburg Institute

WARBURG INSTITUTE

BS4142 – PLANT NOISE IMPACT ASSESSMENT REPORT FOR EXHIBITION SPACE

By:
Gillieron Scott Acoustic Design
130 Brixton Hill
London SW2 1RS

t - 020 8671 2223
e - info@gsacoustics.org
w - www.gsacoustics.org

REVISION SCHEDULE

Document Revision	Date	Document Title	Details	Prepared by	Approved by
00	24/04/2023	Warburg Institute Exhibition Space – BS4142 Plant Noise Impact Assessment	DRAFT FOR COMMENTS	Hugo Bell 	Lucie Zalberg 
01	07/07/2023	Warburg Institute Exhibition Space – BS4142 Plant Noise Impact Assessment	FINAL	Hugo Bell 	Lucie Zalberg 

TABLE OF CONTENTS

INTRODUCTION

Gillieron Scott Acoustic Design (GSAD) have been commissioned to carry out a noise impact assessment of a proposed air source heat pump (ASHP) to be installed in the courtyard to provide cooling for the Exhibition Space at the Warburg Institute, Woburn Square, London WC1H 0AB.

A noise survey was carried out by GSAD at two fixed monitoring locations from 11:00 Thursday 5th July to 14:00 Wednesday 11th July 2018. The results of the survey have been used in this report.

It is understood that the plant will have the facility to operate during daytime only (07:00-23:00) Monday to Sunday.

Another ASHP unit will be installed in the same area and a previous planning report was submitted by GSAD ''Warburg Institute – BS4142 Planning Report for new ASHP unit'' dated 19/01/2022.

1.0 SUMMARY

- Identify noise sensitive dwellings located close to the site and assess the topography of the intervening ground.
- Analyse the site-acquired data and determine the appropriate criteria to adopt from the London Borough of Camden's noise policy.
- Using representative measured data from the survey, undertake a plant noise impact assessment according to the methodology contained within British Standard 4142: 2014+A1:2019 and the London Borough of Camden's noise policy.

2.0 CONTEXT

The site is in a located on Byng Place - Gordon Square and between Torrington Square and Woburn Square.

The nearest primary roads with fairly constant traffic are Gower Street A400 to the west and Euston Road A501 to the north. The building is approximately 400m from three Underground stations, Euston, Goodge Street and Russell Square. Bloomsbury Farmer's Market happens every Thursday 9am-2pm on Torrington Square/Byng Place.

Other sound sources noted were due to moderate air traffic with aeroplanes and occasional helicopter passes being the most distinct noise events above background.

The proposed plant is to be located inside the courtyard. The intervening ground between the expected plant location and nearest noise sensitive windows are acoustically hard ground.

3.0 SUMMARY AND SURVEY DETAILS

A background noise survey was undertaken at two fixed monitoring locations from 11:00 Thursday 5th July to 14:00 Wednesday 11th July 2018.

Both positions were deemed to be representative to produce and calibrate a noise map for the closest residential receptors, Appendix F. Additional spot measurements were taken in the courtyard on deployment and correlated to the measurements from the fixed locations to calibrate the noise map. A picture of the measurement positions is shown in Appendix B.

The levels were recorded as A-weighted and octave band L_{eq}, L_{max} and L_{90}. The clocks on the sound level meters were synchronised during deployment. The meters were then set to integrate sound levels over 15-minute periods in synchronisation mode. A list of the equipment is reported in Appendix G.

The equipment was calibrated at the beginning and end of the survey period and no drift in calibration was noted.

An automatic logging weather station was deployed as part of the assessment to ensure all data used in the determination of the representative background sound level occurred during conditions that are considered conducive to acoustic measurement. Weather data are available upon request.

A 3D environmental noise model has been constructed using CADNA-A to establish environmental noise levels at each noise sensitive façade and within the courtyard.

4.0 PLANT NOISE ASSESSMENT CRITERIA

4.1 BS4142:2014+A1:2019 "Methods for rating and assessing industrial and commercial sound"

The London Borough of Camden's noise policy requires new plant machinery installations to be in accordance with BS4142: 2014+A1:2019.

BS4142:2014+A1:2019 provides methods for rating and assessing industrial and commercial sound. The standard is used to rate sound from fixed installations. The standard requires a "Specific Sound Level", in terms of L_{Aeq}, is determined either by measurement or calculation at a receptor location. This Specific Sound Level may then be corrected for the character of sound and is then termed the "Rating Level".

Once the Rating Level has been determined, the background sound level is subtracted from it and the greater the difference, the greater the likelihood of an '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. The standard advocates that each site and situation should take the context of the scenario into consideration and that "not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact".

•A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.
•A difference of around +5 dB 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 standard provides reference periods over which the assessment should take place which have been reproduced in the table below.

Table 1 – Reference Periods

Period	Hours
Typical Daytime	07:00 – 23:00
Typical Night-time	23:00 – 07:00

4.2 Local Authority Noise Policy

The London Borough of Camden Local Plan (2017) on Noise states the following on industrial and commercial noise:

Noise levels applicable to proposed industrial and commercial developments (including plant and machinery)

Existing Noise sensitive receptor	Assessment Location	Design Period	LOAEL (Green)	LOAEL to SOAEL (Amber)	SOAL (Red)
Dwellings**	Garden used for main amenity (free field) and Outside living or dining or bedroom window (façade)	Day	'Rating level' 10dB* below background	'Rating level' between 9dB below and 5dB above background	'Rating level' greater than 5dB above background
Dwellings**	Outside bedroom window (façade)	Night	'Rating level' 10dB* below background and no events exceeding 57dBL_{Amax}	'Rating level' between 9dB below and 5dB above background or noise events between 57dB and 88dB L_{Amax}	'Rating level' greater than 5dB above background and/or events exceeding 88dBL_{Amax}

"*Industrial and Commercial Noise Sources*

A relevant standard or guidance document should be referenced when determining values for LOAEL and SOAEL for non-anonymous noise. Where appropriate and within the scope of the document it is expected that British Standard 4142:2014 'Methods for rating and assessing industrial and commercial sound' (BS 4142) will be used. ***For such cases a 'Rating Level' of 10 dB below background (15dB if tonal components are present) should be considered as the design criterion****".*

5.0 SURVEY RESULTS

A summary of the results is presented in the Table 2 below according to the BS4142:2014 standard.

Table 2 – Summary of long-term noise monitoring results

Measurement Position	**Typical Background L_{A90} (dB)** Day / Night	**Average $L_{Aeq,15min}$ (dB)** Day / Night
Position 1 – West (Torrington Sq/Byng Pl)	53 / 44	62 / 53
Position 2 – East (Woburn Sq)	55 / 48	63 / 56

Refer to Appendices B and C for an aerial view showing the measurement locations and time series data. Noise results consider façade reflections from the existing building.

The 3D environmental noise model (CADNA-A) shows noise levels at the nearest noise sensitive building facing the courtyard of 40dB $L_{A90,15min}$ during daytime.

6.0 PLANT NOISE ASSESSMENT

It is proposed that 1x ASHP Mitsubishi i-BX- 020T is to be installed and will operate during daytime only (0700-2300hrs). Manufacturer supplied noise data is provided in Appendix I.

It is understood the unit will be installed in the courtyard of the building as shown in Appendix E, next to the other ASHP unit (Mitsubishi i-BX 035T - details are presented in previously submitted planning report ''Warburg Institute – BS4142 Planning Report for new ASHP unit'' dated 19/01/2022).

The nearest noise sensitive receptor has been identified as a residential window at the back of the building, about 14m away from the proposed plant area. Refer to Appendix B. The plant noise impact assessment for the nearest/most affected residential window has been carried out in the following Table 3.

Table 3 – **Noise Impact Assessment – Daytime (07:00-23:00hrs)**

Element	Level			Comments
	New unit Mitsubishi i-BX- 020T	Other unit Mitsubishi i-BX 035T (previous planning report)		
Sound Power Level SWL	74		dB(A)	Sound Power Level SWL, from manufacturer's datasheet
Conversion to SPL	-11		dB	Conversion from SWL to SPL
Sound Pressure Level	63		dB	SPL at 1m, calculated from manufacturer datasheet
Reflections	+3		dB	1 additional acoustically hard reflective surface near the unit
Distance losses	-23		dB	Point source distance attenuation over 14m.
Specific Sound Level	43	45*	dB	Specific sound level before acoustic feature corrections *details are presented in previously submitted planning report ''Warburg Institute – BS4142 Planning Report for new ASHP unit'' dated 19/01/2022
Cumulative Specific Sound Level	47		dB	Cumulative Specific Sound Level from all plant units at 1m from the receptor
Acoustic Feature Correction	+2		dB	2dB for Tonality (tone just perceptible at the noise receptor)
Specific Sound Level	49		dB	
Mitigation Measures Proposed: Acoustic Enclosure	-19		dB	Acoustic enclosure supplied by e.g. NOICO/ENVIRON
Cumulative rating level for both units	**30**		**dB(A)**	**At the closest receptor**
Representative background	40		dB(A)	Representative $L_{A90,15min}$ during daytime reference period as shown on the CadnaA model
Difference (Rating Level – Background)	-10		dB(A)	The rating level is 10 dB below representative background noise level; therefore, it is an indication of low adverse impact and demonstrates compliance with the Local Authority Policy

As per Table 3 above, the assessment of noise breakout from the ASHP with the proposed acoustic enclosure (minimum 19dB of attenuation) results in a rating level at the nearest residential receptor of 30dB L_{Aeq}, 10 dB below the minimum background sound level during operating hours. This demonstrates compliance to London Borough of Camden's adopted noise policy.

7.0 UNCERTAINTY

The sound level meter was checked at the beginning and end of the survey and the field calibration, and no drift was noted.

Weather conditions during the noise survey were recorded and all within limits. Overall, the weather conditions are considered conducive to acoustic measurements.

Overall, the uncertainty within the survey procedure is deemed not to have significant influence on the outcome of the assessment.

8.0 CONCLUSION

GSAD has undertaken a background noise survey at the site and the survey results are presented within this report, together with BS4142:2014+A1:2019 and London Borough of Camden's noise policy for the proposed unit.

A representative background sound level of 40 dB $L_{A90,15min}$ has been determined at the nearest noise sensitive residential receptor over the proposed operational hours of the plant items (daytime 07:00-23:00, Monday to Sunday).

The plant noise impact assessment has determined that the rating level from the newly proposed plant with both units being housed in an acoustic enclosure providing minimum 19dB attenuation will be 10dB below the representative background sound level during proposed hours of operation, which demonstrates compliance with London Borough of Camden's adopted noise policy.

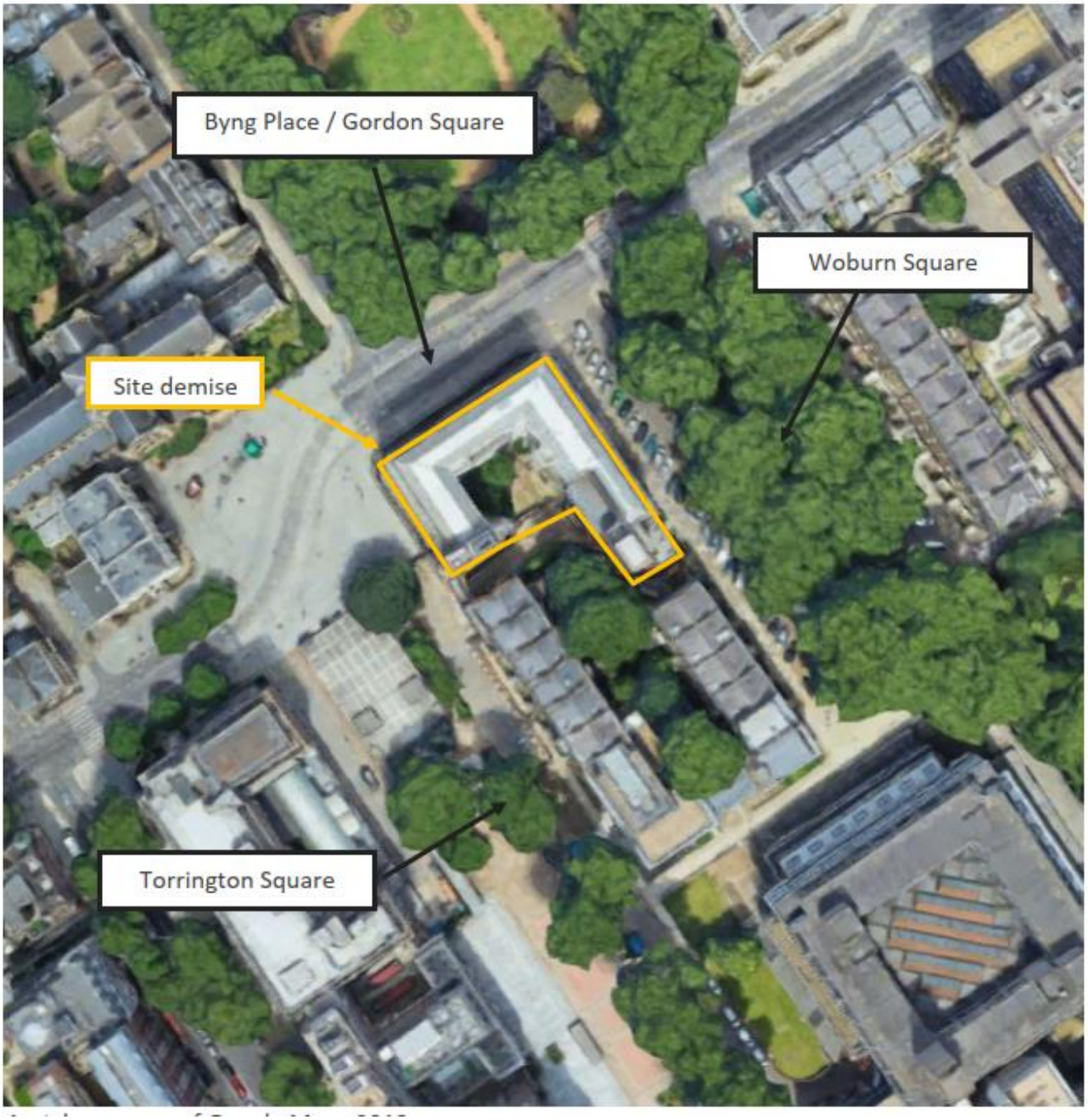
9.0 STATEMENT OF COMPETENCE

The assessment has been undertaken by the author of this report: Hugo Bell, AMIOA, BEng (Electronic Engineering w/ Music Technology Systems), MSc (Cognitive Science). Hugo is a Graduate Acoustic Consultant at Gillieron Scott Acoustic Design with experience across a diverse range of acoustic, psychoacoustic and audio technology projects gained during a Bachelors' degree at the University of York and a Masters' degree from the University of Edinburgh.

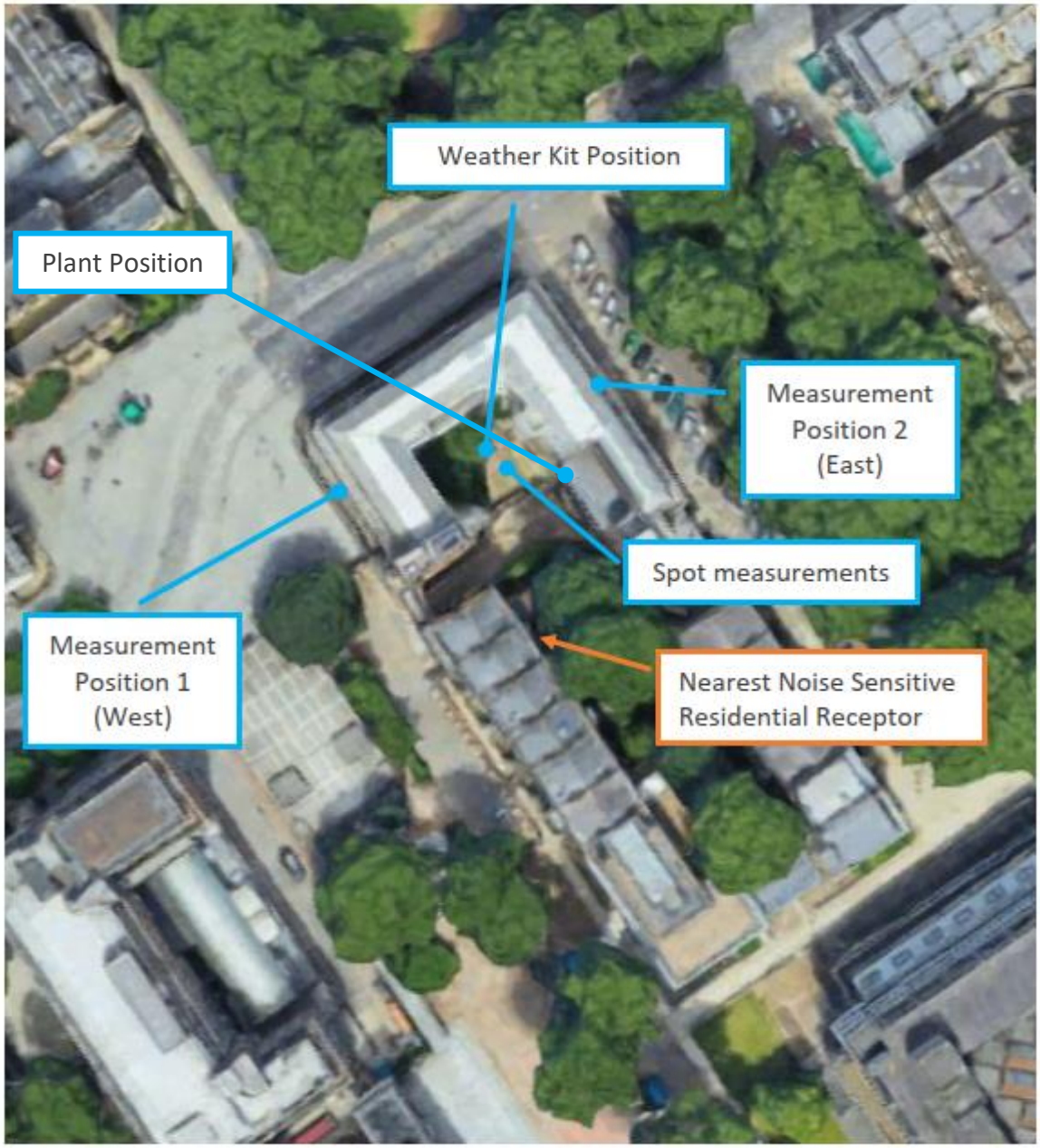
The assessment has been checked by: Lucie Zalberg, BSc(Physics) MSc(Architectural Acoustics) MIOA. The author is a Director of Gillieron Scott Acoustic Design with 15+ years' experience since completing a degree at Pierre et Marie University in Paris and Bath University. The author has undertaken numerous noise assessments according to the 1997 revision of the British Standard and the most recent 2014 revision of the standard.

APPENDICES

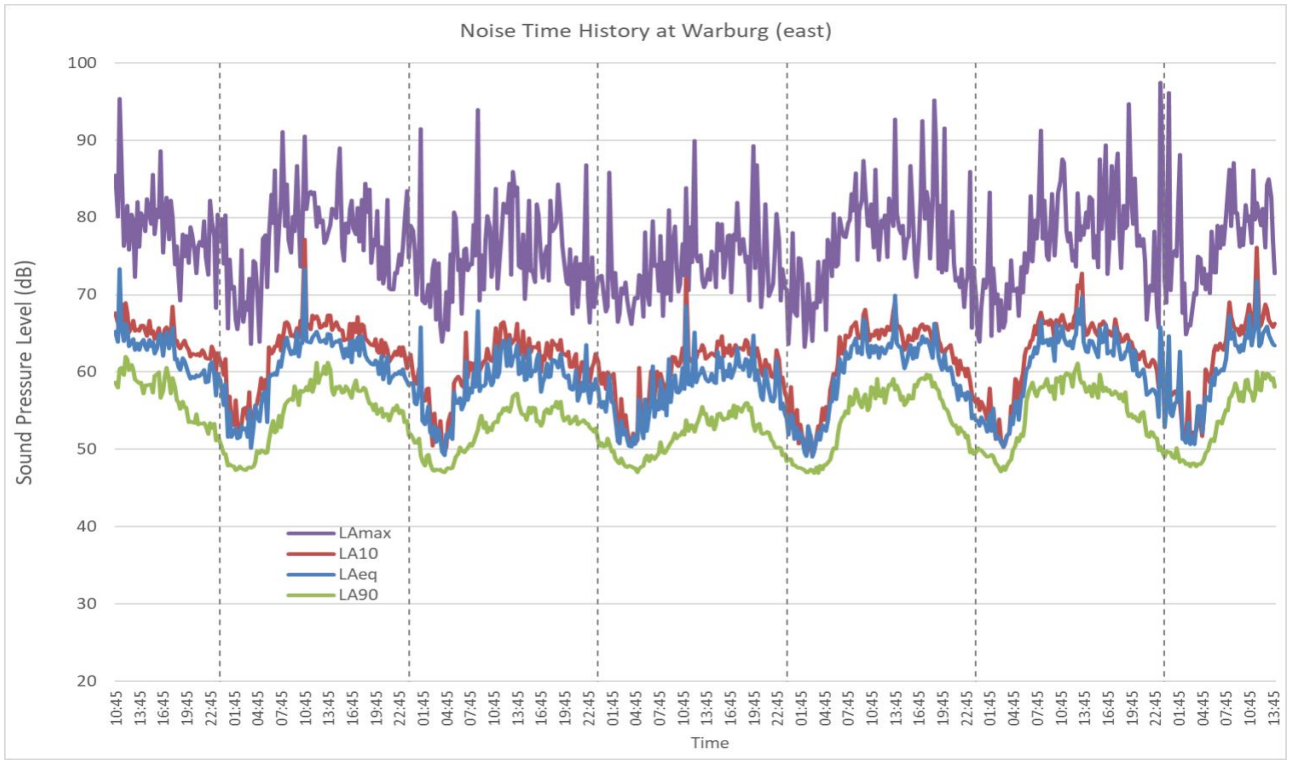
APPENDIX A: SITE OVERVIEW

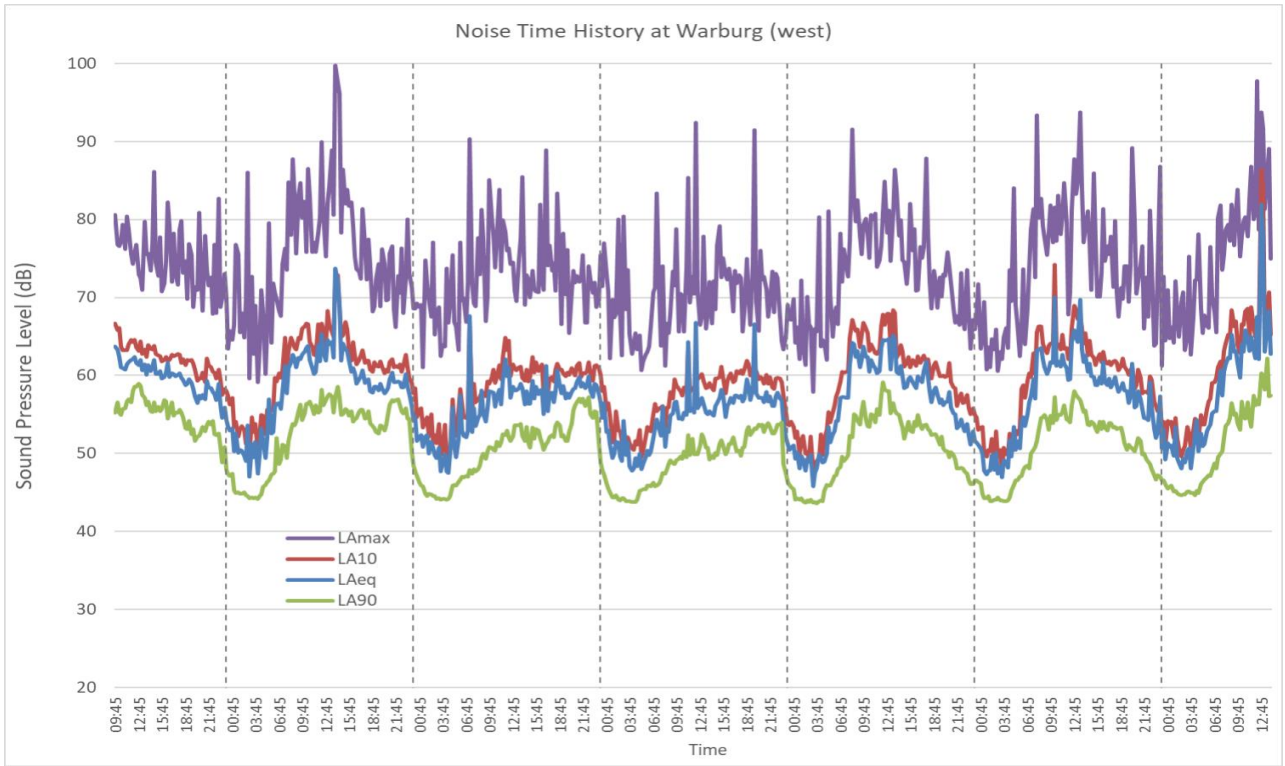


APPENDIX B: MEASUREMENT POSITIONS



APPENDIX C: TIME SERIES GRAPH

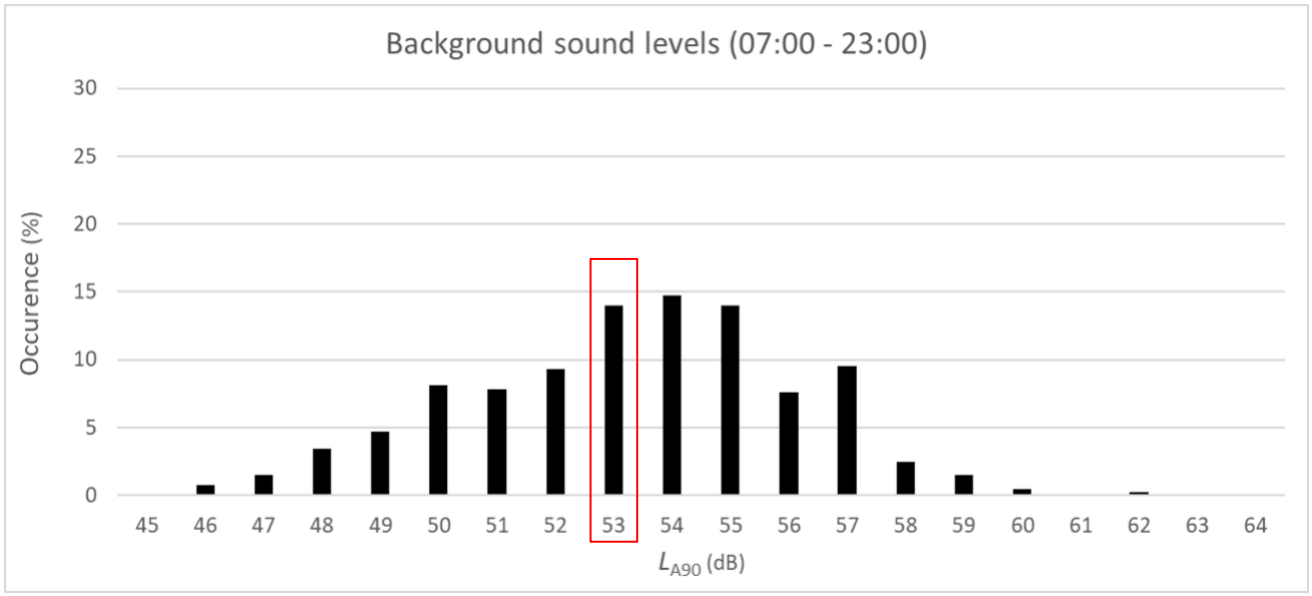


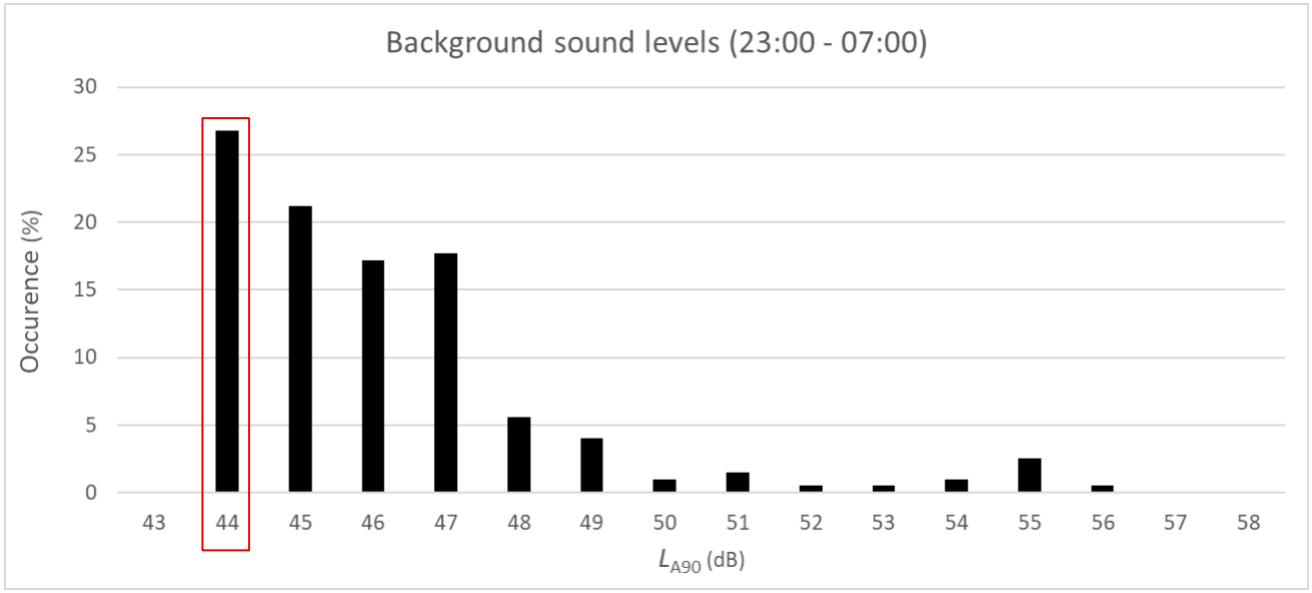


APPENDIX D: HISTOGRAM PLOT

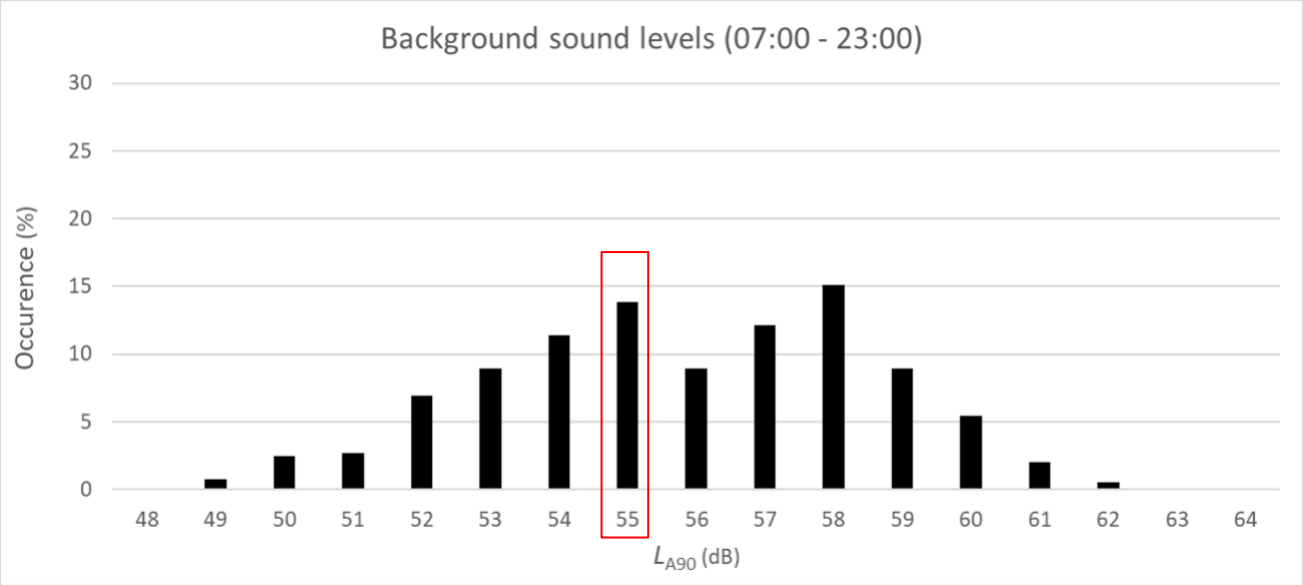
Representative Background Noise Level

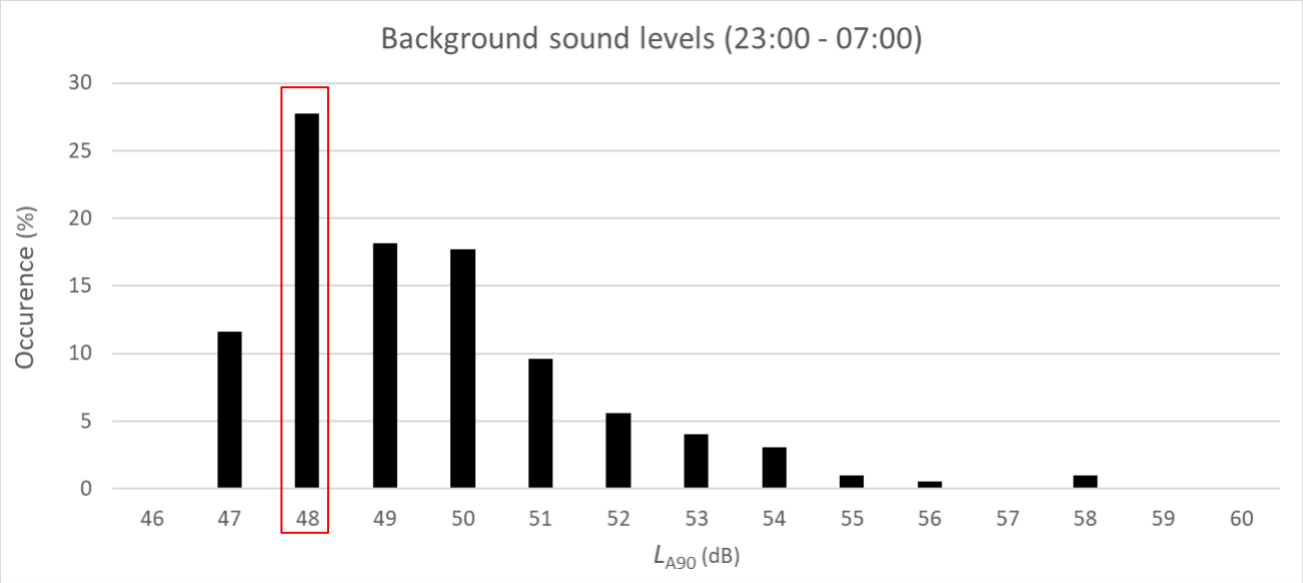
WEST



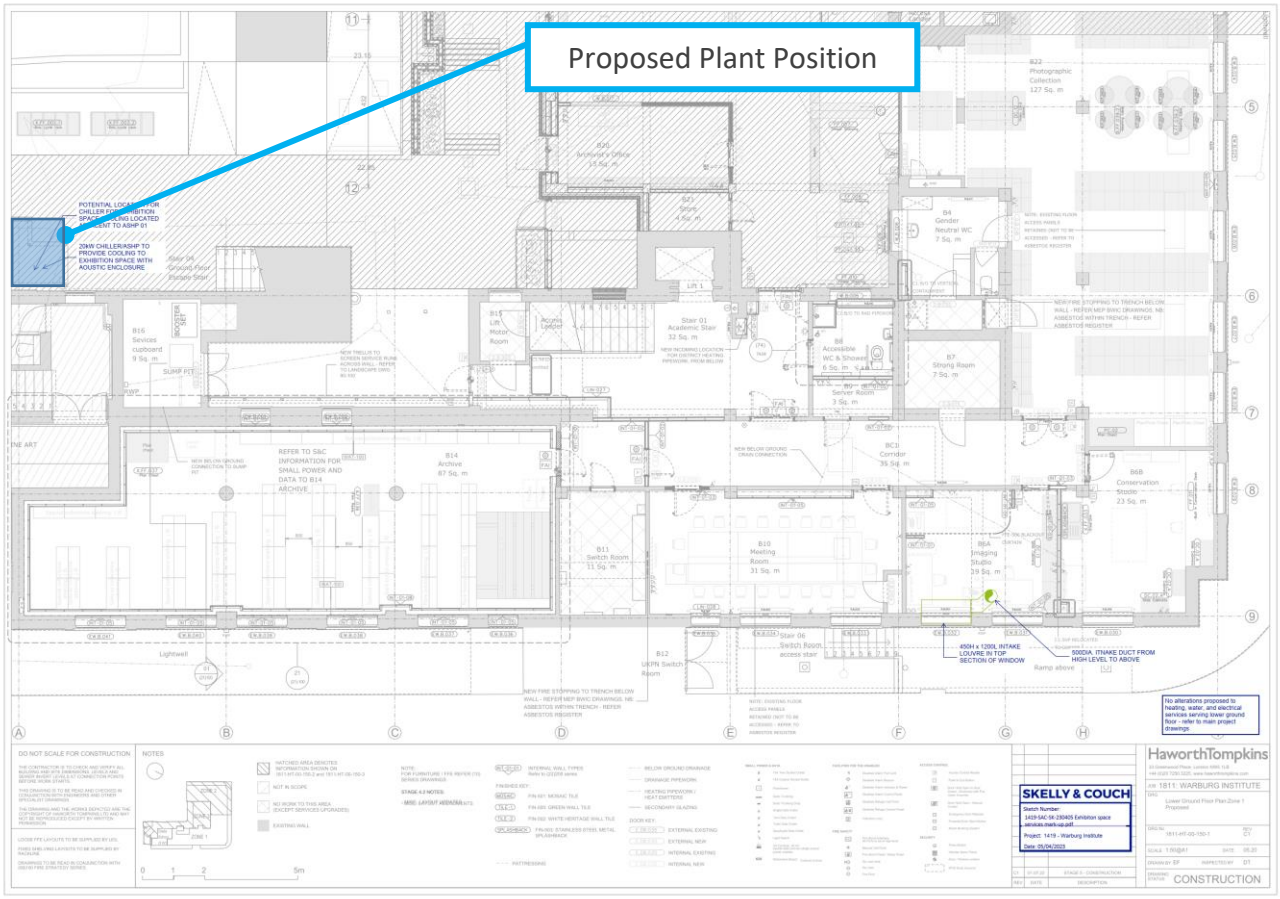


EAST


Background sound levels (07:00 - 23:00)
Occurence (%)
30
25
20
15
10
5
0
48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64
L_{A90} (dB)


Background sound levels (23:00 - 07:00)
Occurence (%)
30
25
20
15
10
5
0
46 47 48 49 50 51 52 53 54 55 56 57 58 59 60
L_{A90} (dB)

APPENDIX E: PROPOSED LOCATION OF ASHP UNIT



APPENDIX F: NOISE MAPPING MODEL

DAY L_{A90}

NIGHT L_{A90}


280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
120
110
410
420
430
440
450
460
470
480
490
500
510
520
530
540

APPENDIX G: EQUIPMENT

Position 1:

- NTi XL2-TA Real Time Analyser
- NTi Outdoor Microphone kit
- Tripod

Position 2:

- NTi XL2-TA Real Time Analyser
- NTi Outdoor Microphone kit
- Tripod

General:

- B&K 4231 Calibrator
- Weather Station Davis Vantage Vue.

Calibration certificates are available on request.

APPENDIX H: ACOUSTIC FEATURE CORRECTION

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

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

Intermittency
When the specific sound has identifiable on/off conditions, the specific sound level should be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. This can necessitate measuring the specific sound over a number of shorter sampling periods that are in combination less than the reference time interval in total, and then calculating the specific sound level for the reference time interval allowing for time when the specific sound is not present. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.

Other sound characteristics
Where the specific sound features characteristics that are neither tonal nor impulsive, nor intermittent, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied.

A total rating penalty of 2 dB has been applied.

2 dB penalty for slight anticipated tonality: typical mechanical units can have tonal components that are perceptible. Tonal components may or may not be audible at the nearest receptors located at about 14m, however, a small correction has been applied to adopt a cautious approach.

APPENDIX I: MANUFACTURER NOISE DATA

Mitsubishi i-BX- 020T Sound Power Level

17. FULL LOAD SOUND LEVEL

SOUND POWER LEVEL IN COOLING									
SIZE	Octave band [Hz]								Total sound level dB(A)
	63	125	250	500	1000	2000	4000	8000	
	Sound power level dB								
004	64	65	63	62	57	56	52	41	**64**
006	64	65	64	62	58	59	53	42	**65**
008	67	68	65	66	59	56	52	48	**66**
010	70	71	68	69	62	59	55	49	**69**
013	71	72	69	70	63	60	56	50	**70**
010	70	71	68	69	62	59	55	49	**69**
013	71	72	69	70	63	60	56	50	**70**
015	73	74	63	74	67	65	64	52	**74**
020	73	74	63	74	67	65	64	52	**74**
025	73	74	65	75	68	66	65	52	**75**
030	74	75	66	76	69	67	66	53	**76**
035	75	76	67	77	70	68	67	54	**77**

Working conditions

Plant (side) cooling exchanger water (in/out) 12,0°C/7,0°C; Source (side) heat exchanger air (in) 35,0°C.

Sound power on the basis of measurements made in compliance with ISO 9614.

Such certification refers specifically to the sound Power Level in dB(A). This is therefore the only acoustic data to be considered as binding.

Sound power level in cooling, outdoors.

APPENDIX J: GLOSSARY OF ACOUSTIC TERMS

DECIBEL (dB) - A unit of sound pressure measurement
Sound Pressure Level in dB (*L*p) = 20 log (Measured sound pressure/Reference sound pressure = 20 µPa)

dB(A) - The A -weighted sound pressure level, the weighting network reduces low frequency sound in a similar way to the human ear.

REVERBERATION TIME (RT or *T*) – decay of sound in rooms
The time taken for a sound, once terminated, to fall through 60dB i.e. to one millionth of its original sound intensity. *T*30 – RT for first 30dB of decay. RT_{500} - Mid frequency RT.
HERTZ (Hz) - a unit of frequency measurement. The normal range of hearing is from 20Hz to about 15kHz.

ABSORPTION COEFFICIENT – degree to which a material absorbs sound.
The ratio of absorbed to incident sound energy (perfect absorber = 1)

SOUND REDUCTION INDEX *R* – quantity which describes a material's ability to reduce the sound pressure level across it (e.g. a wall or floor)

$R = L1 - L2 + 10\log (S/A)$

*L*1 - Average sound pressure level in source room (averaged from 100 Hz – 3150 Hz)
*L*2 - Average sound pressure level in receiving room (averaged from 100 Hz – 3150 Hz)
S – Wall Area (m^2)
A – Total absorption in receiving room (m^2 units)

*R*w – weighted sound reduction index

AVERAGE ROOM TO ROOM LEVEL DIFFERENCE – *D*, dB = *L*1 – *L*2, averaged 1/3 octave bands from 100Hz – 3150kHz.

*D*w – weighted value of D (usually 2 - 3dB higher)

*D*nT, w – *D*w corrected for reverberation time of receiving room

NOISE RATING CURVES (NR CURVES) – set of curves used to describe optimum background noise levels for different tasks.

*L*10/90 LEVEL (dB) - The level in dB of a time varying sound pressured level (e.g. traffic) exceeded for 10%/90% of the time of measurement.
*L*90 is usually called the BACKGROUND NOISE LEVEL.

*L*eq AVERAGE SOUND PRESSURE LEVEL – level dB of a time varying sound pressure level with equal amounts of energy above and below it, for the time of measurement.

TONAL NOISE – noise of a single frequency (or a narrow band of frequencies that can be perceived as a tone), audible above the broad band noise background. Noise which is at least 5dB above the average of the 1/3 octave band sound pressure levels immediately on either side of it.