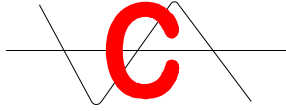


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ACOUSTICS

ENVIRONMENTAL ACOUSTIC IMPACT ASSESSMENT

**The Royal Free NHS Trust
Pond Street
Hampstead
London
NW3 2QG**

Proposed Air Source Heat Pumps

Reference : CS8574-01

Revision : Revision A

Status : Planning Issue

Issue Date: 21st November 2022

Prepared By:

Stuart Metcalfe

Stuart Metcalfe MIOA

CLIENT:

ROYAL FREE LONDON NHS FOUNDATION TRUST

Pond Street

Hampstead

London

NW3 2QG



Royal Free London
NHS Foundation Trust

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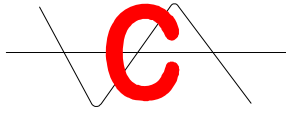
Revision & Changes Log

Revision	Date	Comments/Summary of changes	Amended By:
A	21-11-2022	Plant and Plant Locations Changed	SJM

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Glossary of Terms

Calculations

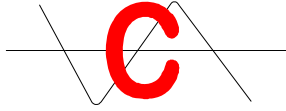
Calibration Certificates

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1 Introduction

Conabeare Acoustics Limited have been commissioned by The Royal Free NHS Trust to undertake an Acoustic Survey and BS4142:2014 assessment in relation to noise emissions of proposed plant at The Royal Free London Hospital, Pond Street, Hampstead, London NW3 2QG for planning purposes.

The Survey was undertaken by Stuart Metcalfe MIOA who has been practicing in Building Services Acoustics and Noise Control Engineering for in excess of 30 years, is a Member of the Institute of Acoustics (MIOA) and is a Director at Conabeare Acoustics Ltd.

2 Acoustic Criteria

BS4142:2014 Methods for rating and assessing industrial and commercial sound.

BS4142:2014 gives a method for rating sound from industrial and commercial sources affecting people inside or outside dwellings or premises used for residential purposes.

An initial estimate of the significance of the sound from the industrial/commercial nature can be assessed by subtracting the measured background noise level from the rating level (this is the specific sound level of the source with any corrections or penalties for distinctive acoustic characteristics).

Typically, the greater the difference, the greater the magnitude of the impact.

The site is located within the London Borough of Camden demise which has adopted the National Planning Policy Guidelines and as such References and evaluations are to be made to the National Planning Policy Framework 2012 (NPPF) and the Noise Policy Statement for England 2010 (NPSE).

There are several key phrases within the NPSE aims and these are discussed below. “Significant adverse” and “adverse”

NOEL – No Observed Effect Level - This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

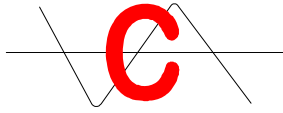
LOAEL – Lowest Observed Adverse Effect Level - This is the level above which adverse effects on health and quality of life can be detected. Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.

SOAEL – Significant Observed Adverse Effect Level - This is the level above which significant adverse effects on health and quality of life occur.

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This Camden requirement for noise exposure are detailed in the Local Plan Appendix 3: Noise thresholds which is reproduced thus;

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).

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

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

**10dB should be increased to 15dB if the noise contains audible tonal elements. (day and night). However, if it can be demonstrated that there is no significant difference in the character of the residual background noise and the specific noise from the proposed development then this reduction may not be required. In addition, a frequency analysis (to include, the use of Noise Rating (NR) curves or other criteria curves) for the assessment of tonal or low frequency noise may be required.*

***levels given are for dwellings, however, levels are use specific and different levels will apply dependent on the use of the premises.*

The periods in Table C correspond to 0700 hours to 2300 hours for the day and 2300 hours to 0700 hours for the night. The Council will take into account the likely times of occupation for types of development and will be amended according to the times of operation of the establishment under consideration.

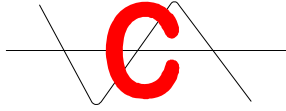
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There are certain smaller pieces of equipment on commercial premises, such as extract ventilation, air conditioning units and condensers, where achievement of the rating levels (ordinarily determined by a BS:4142 assessment) may not afford the necessary protection. In these cases, the Council will generally also require a NR curve specification of NR35 or below, dependant on the room (based upon measured or predicted Leq,5mins noise levels in octave bands) 1 metre from the façade of affected premises, where the noise sensitive premise is located in a quiet background area.

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3 Plant Location and Measurement Position

The site is located on Pond Street in the Hampstead District in North West London.

The site is bordered by Pond Street to the North, Fleet Road to the East, Aspern Grove to the South and the A502 Haverstock Hill to the West.

The closest sound sensitive façades are as below;

1. The Hospital Accommodation in Anne Bryans House to the South which will be at a distance of approximately 8 to 14 metres from the proposed plant location.
2. The properties to Fleet Road to the East which are approximately 30-35 metres from the proposed plant location.

Fig. 1 - View of Property Looking West



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Fig 2 –Proposed Plant Location and Sound Sensitive Facade

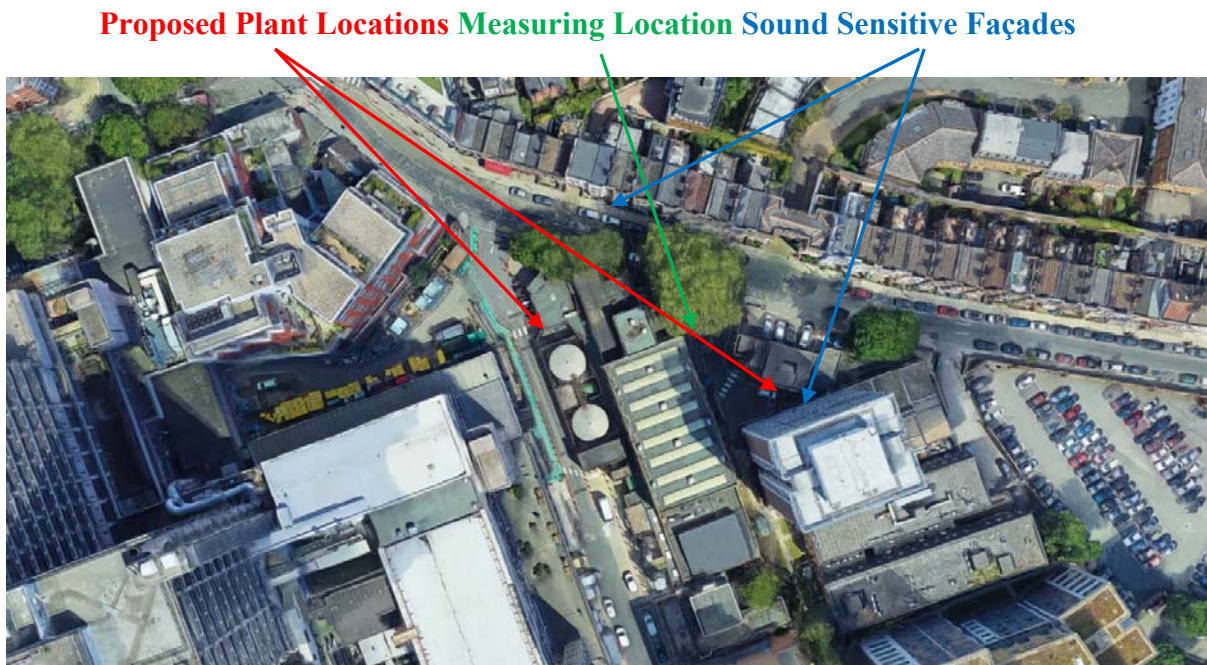
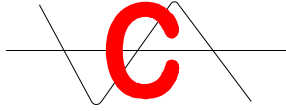


Fig 3 – Measuring Location looking towards Sound Sensitive Facade





4 Existing Noise Climate

The area is generally a mixture of commercial, healthcare and residential premises with transportation and plant noise from the area being adjudged to be the dominant background noise source during the survey period.

5 Noise Survey

5.1 Measurements

The Survey commenced at approximately 09:20 hours on Tuesday 20th September 2022 until approximately 08:30 hours on Wednesday 21st September 2022.

The Analyser was programmed to record 15 minute sampling periods over the survey duration.

The microphone was located on a tripod at approximately 1.2 metres above a reflecting plane.

The measurements and their interpretation are in accordance with BS 7445: Parts 1 and 2. All readings are Sound Pressure Levels (Lp) in dB (re 20µPa).

5.2 Weather during Survey Period

The weather was warm and dry throughout the measuring period. The weather did not, in our opinion, adversely influence the readings obtained.

5.3 Instrumentation

The instrumentation used was a Type 1 Larson Davis LxT Sound Expert Sound Level Analyser confirming to IEC 651-1979 Type 1, EN60651 Type 1 and IEC 804-1985 Type 1, EN60804 Type 1.

- **Larson Davis LxT Sound Level Analyser, Serial Number 05588.**
- **Larson Davis PRMLxT1L Preamplifier, Serial Number 055664.**

The Sound Analyser and Preamplifier were calibrated on 9th March 2022, Certificate Number 16013.

The additional following equipment was also used

- **Larson Davis type CAL200 Calibrator, Serial Number 17720 calibrated on 9th March 2022, Certificate Number 16011.**
- **Extension Cable**

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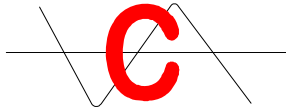
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Field calibration checks were made using the Calibrator and no significant drift was noted against the Calibration level of $114.0\text{dB} \pm 0.2\text{dB}$ at $1000\text{Hz} \pm 0.2\%$.

5.4 Survey Results

The following is a summary of the Background Noise Levels (L_{A90}) levels recorded in Daytime, Evening and Night-time Periods

- $L_{A90,15\text{min}}$ 52.2dB(A) between 07:00 hours to 19:00 hours.
- $L_{A90,15\text{min}}$ 51.2dB(A) between 19:00 hours to 23:00 hours.
- $L_{A90,15\text{min}}$ 50.5dB(A) between 23:00 hours to 07:00 hours.



6 Assessment Methodology: BS4142:2014

A revision of British Standard BS 4142 was published at the end of October 2014 and replaces the previous 1997 edition. The main aim of the standard is to provide an assessment and rating method that is proportionate, sufficiently flexible and suitable for use by practitioners to inform professional judgement. The foreword to the standard clearly states that:

“The execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.”

It does this by providing a method for the determination of:

- rating levels for sources of an industrial and/or commercial nature; and
- ambient, background and residual sound levels.

An assessment framework is provided to allow the practitioner to use the rating, ambient, background and residual sound levels determined using the standard for the purposes of:

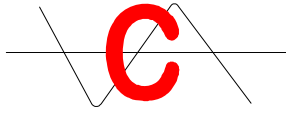
- 1) *investigating complaints;*
- 2) *assessing sound from proposed, new, modified or additional source(s) of sound of an industrial and/or commercial nature; and*
- 3) *assessing sound at proposed new dwellings or premises used for residential purposes.*

The scope of the standard has now been widened to rating and assessing:

- a) *sound from industrial and manufacturing processes;*
- b) *sound from fixed installations which comprise mechanical and electrical plant and equipment;*
- c) *sound from the loading and unloading of goods and materials at industrial and/or commercial premises; and*
- d) *sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from premises or processes, such as that from forklift trucks, or that from train or ship movements on or around an industrial and/or commercial site.”*

It can also be seen from above that the standard explicitly states that it can be used to investigate complaints and has been significantly widened to cover not only new, modified or additional sources of sound, but also the assessment of sound affecting new dwellings or premises to be used for residential purposes.

Like the 1997 edition, the standard provides a method for correcting the specific sound levels so as to account for acoustic features that are present at the assessment location.



The approach in the 1997 edition was purely subjective and allowed for a +5 dB correction irrespective of how prominent the feature was or whether there was one feature only or a combination of tones, impulses or other features irregular enough to attract attention. The 2014 edition provides for scaled corrections up to +6 dB for tones and up to +9 dB for impulses, depending upon the prominence of the tones or impulses, as well as +3 dB corrections for:

- other sound characteristics that are neither tonal nor impulsive; and/or
- intermittent features when the sound has identifiable on/off conditions.

The corrections for tones and impulses can be assessed using subjective or reference methods. There is also an objective method for tones, which is based upon the prominence of sound pressure levels in the one-third-octave-band containing a tone in comparison to the sound pressure levels in the adjacent one-third-octave-bands.

The objective method however, does not allow for different corrections to be applied for tones differing in prominence as it only allows for a single correction of +6 dB for clearly prominent tones.

The 1997 edition assessed the likelihood of complaints using the difference between the rating level and the background sound level. A difference of around +10 dB or more indicated complaints are likely, a difference of around +5 dB was of marginal significance and a difference of more than 10 dB below the background was considered to provide a positive indication that complaints were unlikely.

The 2014 edition no longer assesses the likelihood of complaints. Instead, it can be used to assess adverse impacts.

This change was introduced because the likelihood of complaints is not a particularly appropriate benchmark, especially when it is used in a planning context, and it also aligns the standard more closely with the type of language and benchmarks that are suitable for the assessment of sound at the planning stage for new proposed development.

It continues to use the difference between the rating level and the background sound level, though it also introduces the requirement to consider the context and states that:

a) Typically, the greater this difference, the greater the magnitude of the impact.

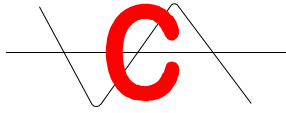
b) A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context.

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

d) 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 context includes consideration of pertinent factors, such as:

- the absolute level of sound;
- the character and level of the residual sound compared to the character and level of the specific sound;
- the sensitivity of the receptor and whether dwellings or other premises used for residential purposes will already incorporate design measures that secure good internal and/or outdoor acoustic conditions.

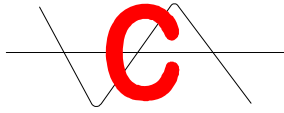
It is also considered appropriate to consider other pertinent sources of guidance. The following sections consider absolute criteria advocated by both the World Health Organisation: 1999: "Guidelines for Community Noise" and BS 8233:2014: "Guidance on Sound insulation and noise reduction for buildings".

World Health Organisation: 1999: "Guidelines for Community Noise"

This document provides a review of the effects of noise and a description of the principles of the WHO health criteria and guidelines for Community Noise.

The effects of noise in dwellings are identified as sleep disturbance, annoyance and speech interference. For bedrooms, the critical effect is sleep disturbance. The indoor guideline value for continuous noise in bedrooms is 30 dB LAeq. To enable casual conversation indoors during the daytime, the sound level of the interfering noise should not exceed 35 dB LAeq.

Table 1 of the document summarises the guideline values for community noise in specific environments and includes the noise indices to be adopted. Significantly, the corresponding time base to be used for the assessment is also included.



The relevant extracts of Table 1 are reproduced thus:

Specific environment	Critical health effect(s)	LAeq [dB]	Time base [hours]	LAmx fast [dB]
Dwelling, indoors	Speech intelligibility & moderate annoyance daytime & evening	35	16	45
	Sleep disturbance, night-time	30	8	

This level should be a cumulative level from all plant running normally and makes allowance for any tonal or intermittent noise from the plant.

BS8233:2014

BS 8233: 2014 – “Guidance on sound insulation and noise reduction for buildings” provides information on achieving internal acoustic environments appropriate to their functions.

As part of this document, recommendations are given to the internal noise levels which are commensurate with achieving acceptable resting, dining and sleeping conditions within residential properties. The values given are generally in terms of an LAeq level although reference is also made with regards to maximum noise levels, although no criterion is specified in this recently revised version of the standard.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living Room	35dB LAeq 16 hours	-
Dining	Dining Room	40dB LAeq 16 hours	-
Sleeping	Bedroom	35dB LAeq 16 hours	30dB LAeq 8 hours

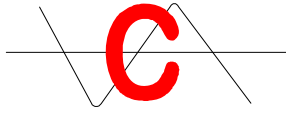
It is generally accepted that a partially open window will provide a level difference of 15dB and therefore the guideline levels to achieve 30dBA within a bedroom would indicate a level of 45dBA directly outside a bedroom window would be acceptable.

Noise Change (dBA)	Category
0	No Impact
0.1 to 2.9	Slight Impact
3.0 to 4.9	Moderate Impact
5.0 to 9.9	Substantial Impact
10.0 and above	Severe Impact

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7 Noise Assessment

The objective of any specification limiting new noises should therefore be to ensure that sound emission from the new building services plant and any other new sources, in particular, should not materially add to the existing sound climate.

We understand that the operating hours for the plant will be potentially on a 24 hour basis and would therefore recommend setting the Plant Noise Emissions as below.

7.1 Plant Noise Emissions Criteria

- Air Source Heat Pumps - $L_{Aeq,15min}$ 40.0dB – 24 hours.

This level is 10dB(A) below the lowest background noise level.

7.2 Proposed Plant

Anne Bryans House

ASHP01 – LG ARUM500LTE5 – 1 number

ASHP02 – LG ARUM500LTE5 – 1 number

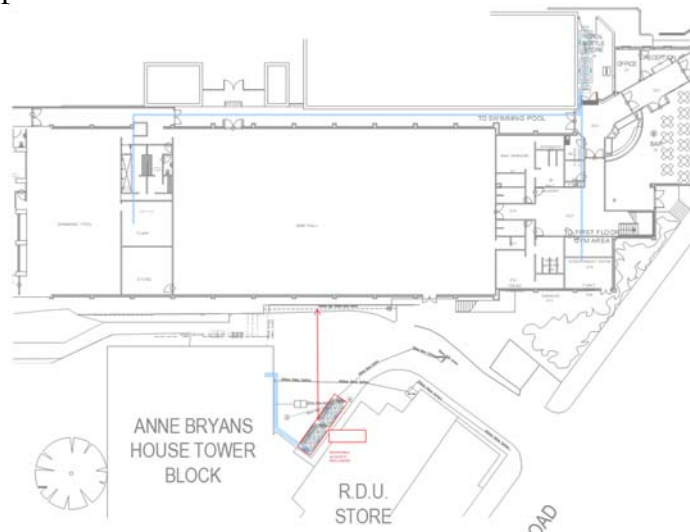
Bottle Store

ASHP03 – LG ARUM500LTE5 – 1 number

ASHP04 – LG ARUM400LTE5 – 1 number

7.3 Plant Locations

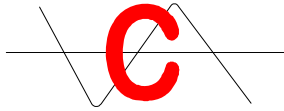
The plant is proposed to be located at the locations shown below



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7.4 Plant Noise Levels

The manufacturers sound spectrum/information is reproduced below.

Item	Model	Parameter	Sound Level (dB) at Octave Band Centre Frequency (Hz)								
			63	125	250	500	1k	2k	4k	8k	dBA
ASHP01	ARUM500LTE5	L _w	--	98	92	89	86	81	77	70	91
ASHP02	ARUM500LTE5	L _w	--	98	92	89	86	81	77	70	91
ASHP03	ARUM500LTE5	L _w	--	98	92	89	86	81	77	70	91
ASHP04	ARUM400LTE5	L _w	--	96	91	88	84	79	75	66	90

Note: The intention is to have the ASHP units oversized and run at reduced speed to provide a 15dB reduction to the quoted noise levels. This is detailed within our calculation sheets.

We have detailed the noise levels for the above equipment, to the nearest sound sensitive façade, as well as the proposed mitigating measures, within our calculation sheets as below.

Acoustic Feature Correction

We have allowed for a 3dB Acoustic Correction Feature for the sound sensitive façades.

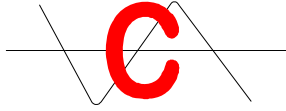
No allowance has been made for tonal or intermittent noise as no items of plant are considered to be tonal or intermittent in nature.

Distance Attenuation

The distance loss to the sound sensitive façades is detailed in our calculation sheets.

Barrier Attenuation

Screening between the proposed plant and the sound sensitive facades is detailed within our calculation sheets.



Un-mitigated Noise Levels

The noise level for all items of plant with no mitigating measures, and with all suitable allowances made, will be as below;

Location 1 – Anne Bryan’s House Facade – 51dB_{LAeq}

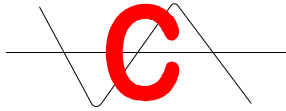
These combined noise levels are 1dBA **above** the measured Background Level at the nearest noise sensitive façade and will provide *LOAEL – Lowest Observed Adverse Effect Level* and is therefore an AMBER rating in line with Camden Council guidelines.

It will therefore be necessary to reduce the noise levels from the plant by 11dBA by means of acoustic mitigation.

Location 2 – Fleet Road – 33dB_{LAeq}

The combined noise levels are 17dBA below the measured Background Level at the nearest noise sensitive façade and will provide *NOEL – No Observed Effect Level* - and is therefore a GREEN rating in line with Camden Council guidelines.

It will therefore not be necessary to carry out any mitigation measures for plant within this location.



8 Recommendations

Anne Bryan's House Plant

Air Source Heat Pumps

We would recommend that the units are enclosed within a bespoke, acoustic housing which will have the following minimum acoustic performance.

Intake and Discharge Air Acoustic Louvres

The acoustic housing should have an intake and discharge acoustic louvres fitted to allow air to the units which will require the following minimum acoustic performance.

Sound Reduction Index (dB) at Octave Band Centre Frequencies (Hz)

63	125	250	500	1k	2k	4k	8k
5	5	7	12	16	18	15	15

The acoustic louvres will be 300mm thick and would need to be sized so as to give maximum pressure loss of 10Pa.

Our calculations as below indicate that if the proposed mitigating measures are introduced then the resulting noise level at the nearest sound sensitive façades will be 41dBA. This level is 9/10dBA below the measured background level.

This would then give *NOEL – No Observed Effect Level* - and is therefore a GREEN rating in line with Camden Council guidelines.

Bottle Store

Air Source Heat Pumps

We have calculated that no additional mitigating measures will be required for the units within this area due to the high level of screening and distance to the sound sensitive façade.

9 Conclusion

A background Noise Survey was carried during a typical day and night-time period at a location representative of the nearest sound sensitive receivers.

An assessment in line with BS4142:2014 has been carried out.

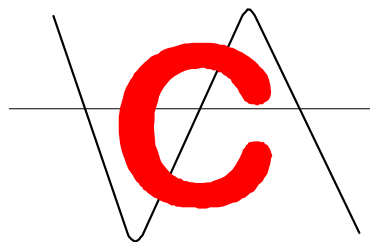
The assessment would indicate that the plant with the proposed mitigating measures will have a GREEN rating as it 10dBA below the measured background level.

In our opinion, the scheme should be acceptable to the Local Authority.

CS8574 - Air Source Heat Pumps, Royal Free Hospital, Pond Street, London NW3 2QG

- Period result profile -

Overload occurred	No
Low battery occurred	No
Pause was used	No
Frequency weighting	A
Band	Broadband
Period time	15 min
Periods too short for LNs	No
First period listed	1 : 94
Measurement Description	
Start	20/09/2022 9:22:49
Stop	21/09/2022 8:33:26
Duration	23:10:37.6
Run Time	23:10:37.6
Pause	0:00:00.0
Pre Calibration	20/09/2022 9:21:15

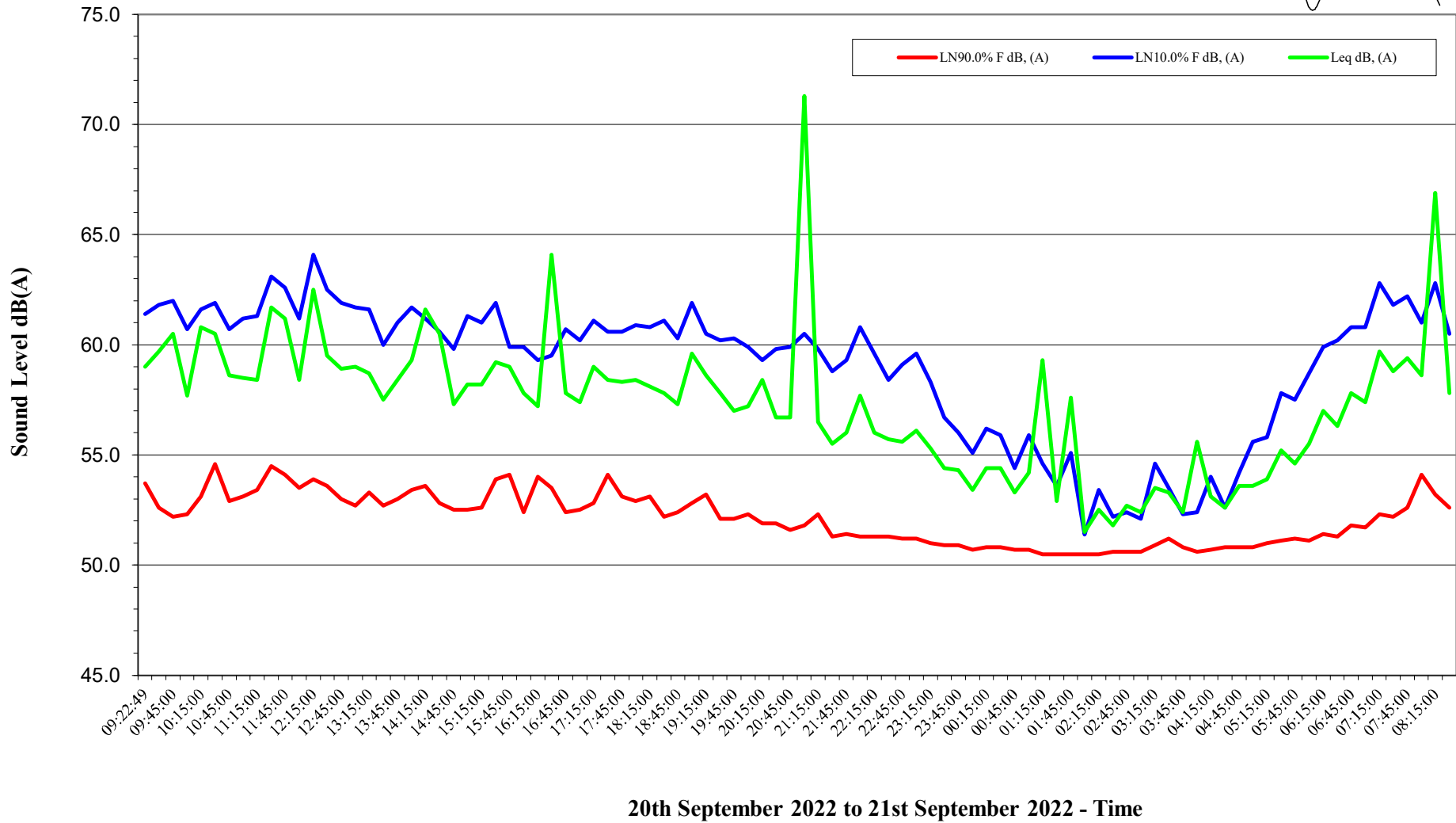
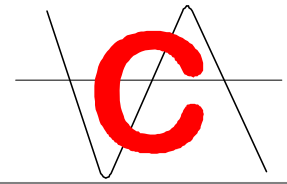


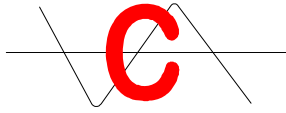
Period number	Date	Time	LN90.0% F	LN10.0% F	Leq
			dB, (A)	dB, (A)	dB, (A)
1	20/09/2022	09:22:49	53.7	61.4	59.0
2	20/09/2022	09:30:00	52.6	61.8	59.7
3	20/09/2022	09:45:00	52.2	62.0	60.5
4	20/09/2022	10:00:00	52.3	60.7	57.7
5	20/09/2022	10:15:00	53.1	61.6	60.8
6	20/09/2022	10:30:00	54.6	61.9	60.5
7	20/09/2022	10:45:00	52.9	60.7	58.6
8	20/09/2022	11:00:00	53.1	61.2	58.5
9	20/09/2022	11:15:00	53.4	61.3	58.4
10	20/09/2022	11:30:00	54.5	63.1	61.7
11	20/09/2022	11:45:00	54.1	62.6	61.2
12	20/09/2022	12:00:00	53.5	61.2	58.4
13	20/09/2022	12:15:00	53.9	64.1	62.5
14	20/09/2022	12:30:00	53.6	62.5	59.5
15	20/09/2022	12:45:00	53.0	61.9	58.9
16	20/09/2022	13:00:00	52.7	61.7	59.0
17	20/09/2022	13:15:00	53.3	61.6	58.7
18	20/09/2022	13:30:00	52.7	60.0	57.5
19	20/09/2022	13:45:00	53.0	61.0	58.4
20	20/09/2022	14:00:00	53.4	61.7	59.3
21	20/09/2022	14:15:00	53.6	61.2	61.6
22	20/09/2022	14:30:00	52.8	60.6	60.5
23	20/09/2022	14:45:00	52.5	59.8	57.3
24	20/09/2022	15:00:00	52.5	61.3	58.2
25	20/09/2022	15:15:00	52.6	61.0	58.2
26	20/09/2022	15:30:00	53.9	61.9	59.2
27	20/09/2022	15:45:00	54.1	59.9	59.0
28	20/09/2022	16:00:00	52.4	59.9	57.8
29	20/09/2022	16:15:00	54.0	59.3	57.2
30	20/09/2022	16:30:00	53.5	59.5	64.1
31	20/09/2022	16:45:00	52.4	60.7	57.8
32	20/09/2022	17:00:00	52.5	60.2	57.4
33	20/09/2022	17:15:00	52.8	61.1	59.0
34	20/09/2022	17:30:00	54.1	60.6	58.4

Period number	Date	Time	LN90.0% F	LN10.0% F	Leq
			dB, (A)	dB, (A)	dB, (A)
35	20/09/2022	17:45:00	53.1	60.6	58.3
36	20/09/2022	18:00:00	52.9	60.9	58.4
37	20/09/2022	18:15:00	53.1	60.8	58.1
38	20/09/2022	18:30:00	52.2	61.1	57.8
39	20/09/2022	18:45:00	52.4	60.3	57.3
40	20/09/2022	19:00:00	52.8	61.9	59.6
41	20/09/2022	19:15:00	53.2	60.5	58.6
42	20/09/2022	19:30:00	52.1	60.2	57.8
43	20/09/2022	19:45:00	52.1	60.3	57.0
44	20/09/2022	20:00:00	52.3	59.9	57.2
45	20/09/2022	20:15:00	51.9	59.3	58.4
46	20/09/2022	20:30:00	51.9	59.8	56.7
47	20/09/2022	20:45:00	51.6	59.9	56.7
48	20/09/2022	21:00:00	51.8	60.5	71.3
49	20/09/2022	21:15:00	52.3	59.8	56.5
50	20/09/2022	21:30:00	51.3	58.8	55.5
51	20/09/2022	21:45:00	51.4	59.3	56.0
52	20/09/2022	22:00:00	51.3	60.8	57.7
53	20/09/2022	22:15:00	51.3	59.6	56.0
54	20/09/2022	22:30:00	51.3	58.4	55.7
55	20/09/2022	22:45:00	51.2	59.1	55.6
56	20/09/2022	23:00:00	51.2	59.6	56.1
57	20/09/2022	23:15:00	51.0	58.3	55.3
58	20/09/2022	23:30:00	50.9	56.7	54.4
59	20/09/2022	23:45:00	50.9	56.0	54.3
60	21/09/2022	00:00:00	50.7	55.1	53.4
61	21/09/2022	00:15:00	50.8	56.2	54.4
62	21/09/2022	00:30:00	50.8	55.9	54.4
63	21/09/2022	00:45:00	50.7	54.4	53.3
64	21/09/2022	01:00:00	50.7	55.9	54.2
65	21/09/2022	01:15:00	50.5	54.6	59.3
66	21/09/2022	01:30:00	50.5	53.6	52.9
67	21/09/2022	01:45:00	50.5	55.1	57.6
68	21/09/2022	02:00:00	50.5	51.4	51.5
69	21/09/2022	02:15:00	50.5	53.4	52.5
70	21/09/2022	02:30:00	50.6	52.2	51.8
71	21/09/2022	02:45:00	50.6	52.4	52.7
72	21/09/2022	03:00:00	50.6	52.1	52.4
73	21/09/2022	03:15:00	50.9	54.6	53.5
74	21/09/2022	03:30:00	51.2	53.5	53.3
75	21/09/2022	03:45:00	50.8	52.3	52.4
76	21/09/2022	04:00:00	50.6	52.4	55.6
77	21/09/2022	04:15:00	50.7	54.0	53.1
78	21/09/2022	04:30:00	50.8	52.6	52.6
79	21/09/2022	04:45:00	50.8	54.2	53.6
80	21/09/2022	05:00:00	50.8	55.6	53.6
81	21/09/2022	05:15:00	51.0	55.8	53.9
82	21/09/2022	05:30:00	51.1	57.8	55.2
83	21/09/2022	05:45:00	51.2	57.5	54.6
84	21/09/2022	06:00:00	51.1	58.7	55.5
85	21/09/2022	06:15:00	51.4	59.9	57.0
86	21/09/2022	06:30:00	51.3	60.2	56.3
87	21/09/2022	06:45:00	51.8	60.8	57.8
88	21/09/2022	07:00:00	51.7	60.8	57.4
89	21/09/2022	07:15:00	52.3	62.8	59.7

[illegible]

CS8574 - Air Source Heat Pumps, Royal Free Hospital, Pond Street, London NW3 2QG





Glossary of Terms

L_{A90}	The sound pressure level in dB(A) which is exceeded for 90% of the time and is taken to be the effective lowest background sound level for the period by such methods of sound rating as that recommended in BS4142:2014. It will also be used as a basis for selecting limiting sound levels from new plant by Local Planning Authorities when setting Planning Consent Conditions.
L_{Aeq}	The “equivalent continuous sound level” for the measuring period, defined as the level in dBA which, if held constant over the measuring period, would produce the same amount of sound energy as does the actual varying ambient sound level. It is a measure of the amount of sound energy affecting the site from sources other than new plant or operations.
L_{A10}	The sound level exceeded for 10% of the time over the sample period. Originally used as a measure of subjective reaction to traffic noise in particular, it can also be taken as an indication of the practical maximum sound level that the building envelope will have to protect against.
dBA	Describes measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dBA broadly agree with people’s assessment of loudness. A change of 3dBA is the minimum perceptible under normal conditions, and a change of 10dBA corresponds roughly to halving or doubling the loudness of a sound.

Conabeare Acoustics Limited

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Project: CS8574 - Royal Free Hospital - ASHP Project
Client : Royal Free NHS Trust
Revision: Revision C
Date : 21st November 2022

Item **Calculation 01 - Noise To Anne Bryans House - Proposed Plant - Location C - Target Level - 40dBA**

ASHP01	Air Source Heat Pump 01 - Atmospheric Noise		63	125	250	500	1k	2k	4k	8k	dBA
	Unit Lw - LG ARUM500LTE5 - Manufacturers Data - Heating - 63Hz Estimated		98	98	92	89	86	81	77	70	91
	Low Noise Set Back		-15	-15	-15	-15	-15	-15	-15	-15	
	Resultant Low Noise		83	83	77	74	71	66	62	55	76
	Distance to Listener	8 m	-31	-31	-31	-31	-31	-31	-31	-31	
	Façade Effect		3	3	3	3	3	3	3	3	
	Estimated Lp at Listener ASHP01 Only		55	55	49	46	43	38	34	27	48
ASHP02	Air Source Heat Pump 02 - Atmospheric Noise		63	125	250	500	1k	2k	4k	8k	dBA
	Unit Lw - LG ARUM500LTE5 - Manufacturers Data - Heating - 63Hz Estimated		98	98	92	89	86	81	77	70	91
	Low Noise Set Back		-15	-15	-15	-15	-15	-15	-15	-15	
	Resultant Low Noise		83	83	77	74	71	66	62	55	76
	Distance to Listener	10 m	-32	-32	-32	-32	-32	-32	-32	-32	
	Façade Effect		3	3	3	3	3	3	3	3	
	Estimated Lp at Listener ASHP02 Only		54	54	48	45	42	37	33	26	47
	Cumulative Noise Level - Plant Noise only		58	58	52	49	46	41	37	30	51
	Proposed Mitigation - 300mm deep Acoustic Louvre Sound Reduction Index		-5	-5	-7	-12	-16	-19	-15	-15	
	Resultant Noise Level with Mitigation		53	53	45	37	30	22	22	15	41



Project: CS8574 - Royal Free Hospital - ASHP Project
Client : Royal Free NHS Trust
Revision: Revision C
Date : 21st November 2022

Item **Calculation 02 - Noise To Fleet Road - Proposed Plant - Location A - Target Level - 40dBA**

ASHP03	Air Source Heat Pump 03 - Atmospheric Noise			63	125	250	500	1k	2k	4k	8k	dBA
	Unit Lw - LG ARUM500LTE5 - Manufacturers Data - Heating - 63Hz Estimated			98	98	92	89	86	81	77	70	91
	Low Noise Set Back			-15	-15	-15	-15	-15	-15	-15	-15	
	Resultant Low Noise			83	83	77	74	71	66	62	55	76
	Distance to Listener	28	m	-41	-41	-41	-41	-41	-41	-41	-41	
	Additional Surfaces	3		9	9	9	9	9	9	9	9	
	Screening from Building Edge			-10	-13	-15	-18	-18	-18	-18	-18	
	Facade Effect			3	3	3	3	3	3	3	3	
	Estimated Lp at Listener ASHP03 Only			44	41	33	27	24	19	15	8	31
ASHP04	Air Source Heat Pump 04 - Atmospheric Noise			63	125	250	500	1k	2k	4k	8k	dBA
	Unit Lw - LG ARUM400LTE5 - Manufacturers Data - Heating - 63Hz Estimated			96	96	91	88	84	79	75	66	90
	Low Noise Set Back			-15	-15	-15	-15	-15	-15	-15	-15	
	Resultant Low Noise			81	81	76	73	69	64	60	51	75
	Distance to Listener	28	m	-41	-41	-41	-41	-41	-41	-41	-41	
	Additional Surfaces	3		9	9	9	9	9	9	9	9	
	Screening from Building Edge			-10	-13	-15	-18	-18	-18	-18	-18	
	Facade Effect			3	3	3	3	3	3	3	3	
	Estimated Lp at Listener ASHP04 Only			42	39	32	26	22	17	13	4	29
	Cumulative Noise Level - Location A Plant Noise only			46	43	36	30	26	21	17	9	33

Acoustic Calibration Services Limited
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Works Road Letchworth Garden City
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CERTIFICATE OF CALIBRATION

Model: LD LxT1L

Serial Number: 0005588

Organisation: Conabeare Acoustics Limited, 11 Chilton Enterprise Centre
Station, Road, Theale, Berkshire RG7 4AA

Job Number: 2890

Customer Order Reference: 11027

The Sound Level Meter was assessed for conformance with International Standard BS EN 61672-3:2006 as modified by TPS 49 Edition 1. The manufacturer claims Class 1 accuracy conformance and it was against these requirements that all the results were evaluated.

The sound level meter was fitted with a **PCB 377B02** Serial No. **304334** measurement microphone, a **LD PRMLxT1L** preamplifier Serial No. **055664** and an unmarked 12 ft microphone extension cable. The microphone was replaced with a suitable input device in order to apply electrical signals to the preamplifier.

A **LD CAL200** Acoustic Calibrator Serial No: **17720** was supplied with the meter and utilised in establishing the initial acoustic calibration setting.

The sound level meter passed all tests carried out with no deviations from Class 1 specification, in accordance with the modified BS EN 61672-3:2006.

The sound level meter should be set to read **113.7dB** when used with the associated acoustic calibrator, microphone, preamplifier and 12 ft microphone extension cable, as detailed above at reference atmospheric pressure.

All ACSL's calibration instrumentation is fully traceable to National Standards. The acoustic references are calibrated by laboratories which are UKAS accredited for the purpose.

Certificate No: 16013

Date of Issue: 9th March 2022

Signature:

Print Name:

A handwritten signature in black ink, appearing to read 'Trevor Lewis', is written over a large, stylized circular flourish.

Trevor Lewis

Robert Lewis Accountants, Head Office: 4 Capricorn Centre Cranes Farm Road Basildon SS14 3JJ
Registered No: 4143457 VAT No: GB 770505441 Directors: Trevor J Lewis, G Parry BSc CPhys MInstP AMIOA, O R Clingan MIOA

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Works Road Letchworth Garden City
Hertfordshire SG6 1LW
Tel: 01462-677 197 Mobile: 0771 886 4944
Email: trevjohnlewis@aol.com



CERTIFICATE OF CALIBRATION

Model: LD CAL200

Serial Number: 17720

Organisation: Conabeare Acoustics Ltd, 11 Chilton Enterprise Centre
Station Road, Theale, Berkshire RG7 4AA

Job Number: 2890

Customer Order Reference: 11027

The acoustic calibrator was run for a period of time until a stable level was achieved. The output level was compared to the certified level of the laboratory measurement references. The calibrator was applied to the meter, removed, then reapplied to provide five separate readings, with the average value of these measurements recorded and certified.

The ambient temperature during calibration was **23.7** \pm 1°C.
The barometric pressure was **100.8** to **100.9** kPa.
The relative humidity was **28** to **38** %

The sound pressure level output from the Acoustic Calibrator was measured in its half inch configuration using a B&K 4134 microphone. The mean level output of the acoustic calibrator was 113.9 dB at the reference setting and 93.9 dB at the -20dB setting.

The output frequency signal of the acoustic calibrator is 1000Hz.

All ACSL's calibration instrumentation is fully traceable to National Standards. The acoustic references are calibrated by laboratories which are UKAS accredited for the purpose.

Certificate No: 16011
Date of Issue: 8th March 2022

Signature: 
Print Name: Trevor Lewis

Robert Lewis Accountants, Head Office: 4 Capricorn Centre Cranes Farm Road Basildon SS14 3JJ
Registered No: 4143457 VAT No: GB 770505441 Directors: Trevor J Lewis, G Parry BSc CPhys MInstP AMIOA, O R Clingan MIOA