

## ACOUSTIC REPORT CS7277A-1

**Royal Free Hospital  
Temporary Theatres**

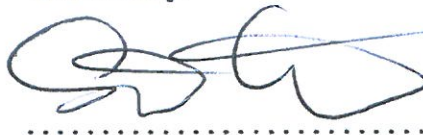
7<sup>th</sup> December 2012

**Prepared By:**



**John E Redknap MBA, MIOA, MCMI**

**Checked By:**



**Stuart Metcalfe MIOA**

**Client:** Property Services  
Royal Free Hampstead NHS Trust  
Pond Street  
London NW3 2QG

## **FORWARD**

There is a requirement for two temporary modular theatres over the Oaks Garden Terrace, which is above the HAAS and radiotherapy entrance at the Royal Free Hospital. The hospital has established the current Background Sound Level before any work commences by commissioning an Environmental Sound Survey of the area – see the Conabeare Acoustics Limited report CS7277 dated 5<sup>th</sup> November 2012.

Using the results of the above survey allows us to now undertake the acoustic assessment of the proposed plant, to check the likely impact that noise from any plant will have on the Background Sound Level at the nearest sound sensitive locations. Advising on any required mitigation measures to ensure the proposed new plant complies with the planning requirements of the local authority.

## **SUMMARY**

In the original survey mentioned above the lowest measured Background Sound Levels  $L_{A90.15MIN}$  were as follows:

$L_{A90-15min}$	51.7dB(A) between 07:00 hours to 19:00 hours (Day Time)
$L_{A90-15min}$	51.2dB(A) between 19:00 hours to 23:00 hours (Evening)
$L_{A90-15min}$	50.0dB(A) between 23:00 hours to 07:00 hours (Night Time)

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**1. Author**

John E Redknap MBA, MIOA, MCMI

The author has been practising in noise control engineering since 1985. He has gained a wide range of experience over this period and is a Sales Engineer for **Conabeare Acoustics Ltd.**

**2. Client**

The survey and report has been undertaken on behalf of:

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

**3. Introduction**

There is a requirement for two temporary modular theatres over the Oaks Garden Terrace, which is above the HAAS and radiotherapy entrance at the Royal Free Hospital. The hospital has established the current Background Sound Level before any work commences by commissioning an Environmental Sound Survey of the area – see the Conabeare Acoustics Limited report CS7277 dated 5<sup>th</sup> November 2012.

The results of the above survey established the Background Sound Level to enable future checks to be made on the new plant in order that they comply with planning requirements.

We understand that the proposed plant has now been selected and so this report makes the acoustic assessment of the proposed plant with regard to the planning requirements.

**4. Assessment**

The objective of any specification limiting sound should be to ensure that sound emissions from the proposed plant should not materially add to the existing ambient noise climate when measured 1m from the nearest effected property window.

The level at which the target should be set is normally specified by the planning authority in their planning consent conditions.

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In the absence of any such specification, we would recommend setting a limit on the proposed plant sound level as follows, with the proviso that any sound produced by this plant must be quite free of any audibly evident tonality or similar characteristics.

In our original Acoustic Report CS7277 dated 5<sup>th</sup> November 2012, the lowest measured Background Sound Levels  $L_{A90,15\text{MIN}}$  were as follows:

$L_{A90-15\text{min}}$	51.7dB(A) between 07:00 hours to 19:00 hours (Day Time)
$L_{A90-15\text{min}}$	51.2dB(A) between 19:00 hours to 23:00 hours (Evening)
$L_{A90-15\text{min}}$	50.0dB(A) between 23:00 hours to 07:00 hours (Night Time)

The current design policy of council planners is that noise produced by mechanical plant should be at least 10dB(A) below the background sound level at the nearest sound sensitive window. The combined sound level of all new plant when measured at the closest residential window should therefore not exceed:

$L_{A90-15\text{min}}$	41.7dB(A) between 07:00 hours to 19:00 hours (Day Time)
$L_{A90-15\text{min}}$	41.2dB(A) between 19:00 hours to 23:00 hours (Evening)
$L_{A90-15\text{min}}$	40.0dB(A) between 23:00 hours to 07:00 hours (Night Time)

The above limits should be achieved with all plant operating normally, any plant exhibiting characteristics which are tonal or intermittent in nature should be designed to criteria 5dB(A) more stringent than those levels shown above. Allowances should also be made for the additional effect of multiple noise sources.

From the frequency analysis the plant does not exhibit any distinct tonal characteristics and so the additional 5dB(A) penalty is not required. The condenser units will be intermittent in operation, however at the receptor locations these would not be audible as they would be more than 15dB(A) below the back ground level and therefore we have discounted these element.

The new plant can potentially operate 24hours a day and so we would recommend that the equipment is designed to achieve a level of 40dB(A) at the nearest noise sensitive windows.

Any hospital windows that may over look the plant area are assumed to have sealed double glazed units and do not form part of our assessment. In this respect, to achieve an NR35 level within the hospital, and based upon glazing performance of 20dB, the level 1m outside of such windows can be 60dB(A). The residential windows are therefore the more stringent application.

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The proposed new plant consists of three new AHU's, six new condensers and three Condenser Area Prop Fans positioned as illustrated on the attached Plant Level Plan. The South end of this proposed plant room is to be louvred and it looks out on to Rowland Hill Street and straight towards Bartram's Residential Hostel. The North end of the proposed plant room looks out towards Pond Street, but with windows of an adjacent School approximately at 45 degrees to the louvre face of the plant room.

Following our original survey and receipt of information on the plant and its proposed positioning, we have established the location of "the nearest sound sensitive windows" in two locations. The first position to be considered relates to those windows level with the plant room in Bartram's Residential Hostel. This is referenced as Assessment Location "A" in our acoustic calculations. The second position are those windows in the adjacent School, nominally at 45 degrees to the North end of the plant room. This is referenced as Assessment Location "B" in our acoustic calculations.

The attached Site Layout illustrates these two positions and the distances to each.

#### **Assessment Location A**

The attached calculation sheet 'Calc1A' is for Assessment Location A and this sheet illustrates that at the louvre face of the plant room Specific Sound Level from the Fresh Air side of AHU-A alone would be 58dB(A).

The attached calculation sheet 'Calc2A' is for Assessment Location A and this sheet illustrates that at the louvre face of the plant room Specific Sound Level from the Exhaust side of AHU-A alone would be 30dB(A).

The attached calculation sheet 'Calc3A' is for Assessment Location A and this sheet illustrates that at the louvre face of the plant room the combined Specific Sound Level from AHU-A alone would be 58dB(A). This sheet then goes on to calculate the Specific Sound Level at 1m from the receivers façade for AHU-A alone, which equals 43dB(A).

Since AHU-B is in the same general location as AHU-A we have used the figures from 'Calc1A' for this plant. Consequently, at the louvre face of the plant room the combined Specific Sound Level from AHU-B alone would also be 58dB(A) and the Specific Sound Level at 1m from the receivers façade for AHU-B alone, would also equal 43dB(A).

The attached calculation sheet 'Calc4A' is for Assessment Location A and this sheet illustrates that at the louvre face of the plant room Specific Sound Level from the Fresh Air side of AHU-C alone would be 39dB(A).

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The attached calculation sheet 'Calc5A' is for Assessment Location A and this sheet illustrates that at the louvre face of the plant room Specific Sound Level from the Exhaust side of AHU-C alone would be 31dB(A).

The attached calculation sheet 'Calc6A' is for Assessment Location A and this sheet illustrates that at the louvre face of the plant room the combined Specific Sound Level from AHU-C alone would be 39dB(A). This sheet then goes on to calculate the Specific Sound Level at 1m from the receivers façade for AHU-C alone, which equals 25dB(A).

All of the above results need to be added together to create a combined Specific Sound Level 1 metre from the receivers façade – Assessment Location 'A'. The combined figures are therefore totalled on 'Calc7A'. This sheet illustrates that at the louvre face of the plant room the combined Specific Sound Level from all three AHU's would be 61dB(A). This sheet then goes on to calculate the Specific Sound Level at 1m from the receivers façade for all AHU's, which equals 46dB(A).

The combined figure of 46dB(A) is above the proposed 24hour design target of 40dB(A) and so mitigation measures are required to reduce the level down to the design target or below.

By introducing an acoustic louvre with the following minimum acoustic performance the combined figure is reduced down to 37dB(A).

**Insertion Loss (dB) at Octave Band Centre Frequencies (Hz)**

<b>63</b>	<b>125</b>	<b>250</b>	<b>500</b>	<b>1000</b>	<b>2000</b>	<b>4000</b>	<b>8000</b>
5	5	7	12	16	19	15	15

The combined figure of 37dB(A) is below the proposed 24hour design target of 40dB(A) and should therefore meet the planning requirements of the local authority.

In our opinion the above would generally be acceptable to the local authority for this area, but all design targets should as a matter of course be verified with the local Environmental Health or Planning Departments.

**Assessment Location B**

The attached calculation sheet 'Calc10A' is for Assessment Location B and this sheet illustrates that at the louvre face of the plant room Specific Sound Level from the first set of three Condensers alone would be 76dB(A).

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The attached calculation sheet 'Calc11A' is for Assessment Location B and this sheet illustrates that at the louvre face of the plant room Specific Sound Level from the second set of three Condensers alone would be 74dB(A).

The attached calculation sheet 'Calc12A' is for Assessment Location B and this sheet illustrates that at the louvre face of the plant room Specific Sound Level from the three Prop Fans alone would be 79dB(A).

All of the above results need to be added together to create a combined Specific Sound Level 1 metre from the receivers façade – Assessment Location 'B'. The combined figures are therefore totalled on 'Calc13A'. This sheet illustrates that at the louvre face of the plant room the combined Specific Sound Level from all six Condensers and the three Prop Fans would be 81dB(A).

The attached calculation sheet 'Calc14A' is for Assessment Location B and this sheet illustrates that by using the combined figures as the starting point, it then goes on to calculate the Specific Sound Level at 1m from the receivers façade for all plant, which equals 46dB(A).

The combined figure of 46dB(A) is above the proposed 24hour design target of 40dB(A) and so mitigation measures are required to reduce the level down to the design target or below.

By introducing an acoustic louvre with the following minimum acoustic performance the combined figure is reduced down to 35dB(A).

**Insertion Loss (dB) at Octave Band Centre Frequencies (Hz)**

63	125	250	500	1000	2000	4000	8000
5	5	7	12	16	19	15	15

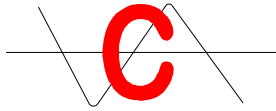
The combined figure of 35dB(A) is below the proposed 24hour design target of 40dB(A) and should therefore meet the planning requirements of the local authority.

In our opinion the above would generally be acceptable to the local authority for this area, but all design targets should as a matter of course be verified with the local Environmental Health or Planning Departments.

For completeness, we had a preliminary look at whether the sound from the two louvred ends of the plant room, if combined, would increase the Specific Sound Level at 1m from the receivers façade at either Assessment Locations. Due to the distances involved they do not increase either level and so no additional treatment will be required.

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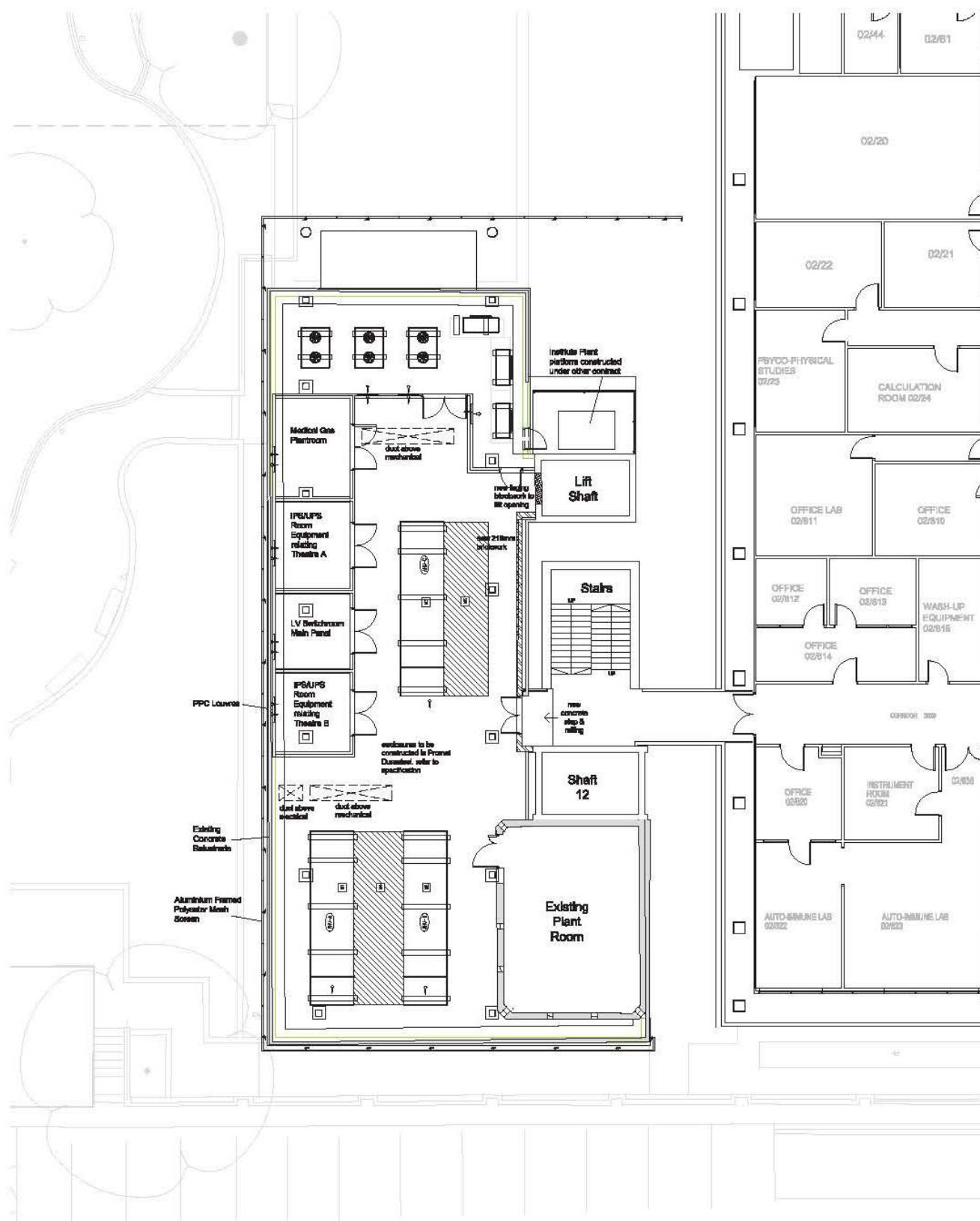


## 5. Glossary of Terms

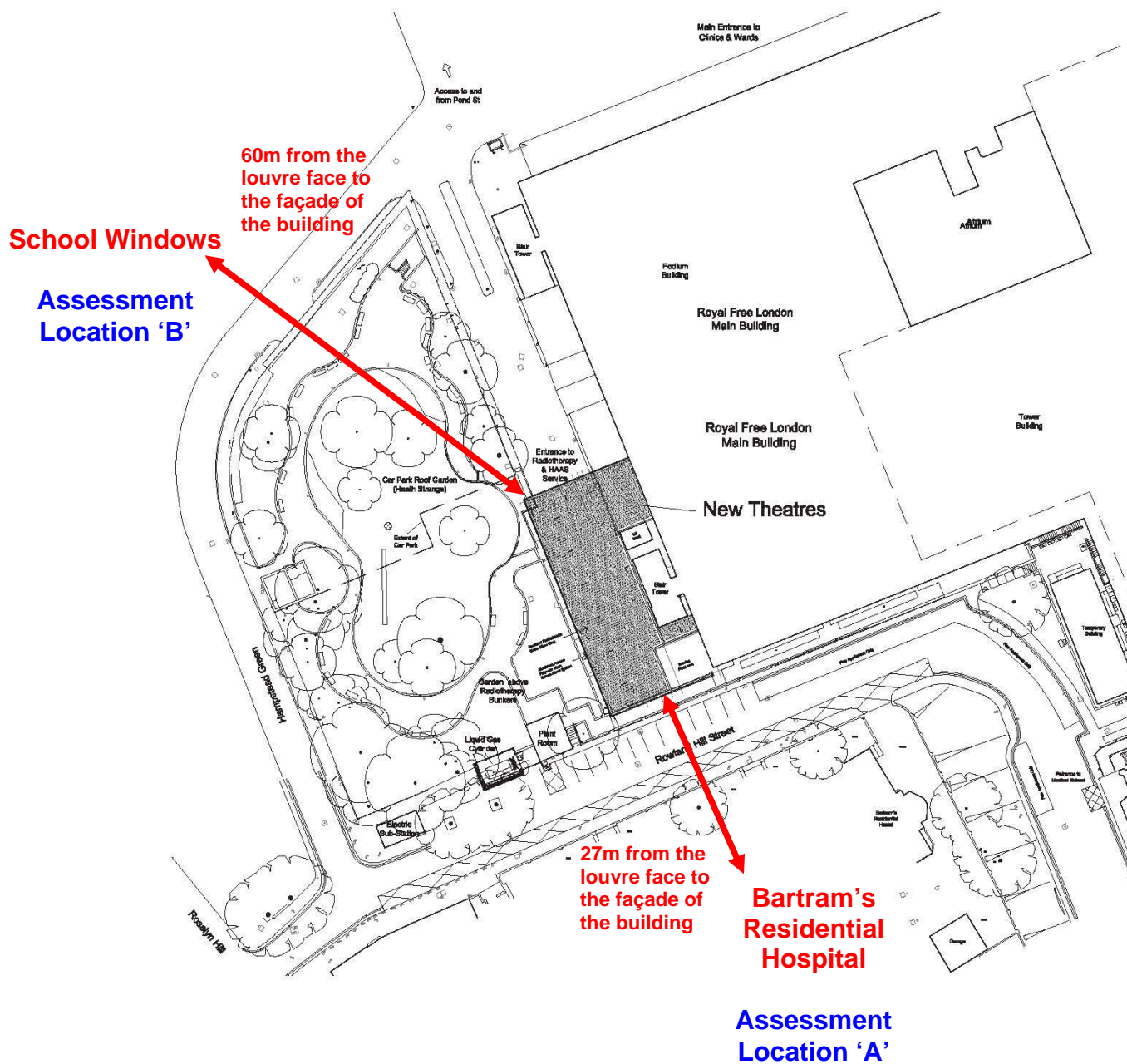
$L_{A90}$	The sound pressure level in dB(A) which is exceeded for 90% of the time and is taken to be the effective lowest background sound level for the period by such methods of sound rating as that recommended in British Standard 4142. It will also be used as a basis for selecting limiting sound levels from new plant by Local Planning Authorities when setting Planning Consent Conditions.
$L_{eq}$	The “equivalent continuous sound level” for the measuring period, defined as the level in dB(A) 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.
dB(A)	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 dB(A) broadly agree with people’s assessment of loudness. A change of 3dB(A) is the minimum perceptible under normal conditions, and a change of 10dB(A) corresponds roughly to halving or doubling the loudness of a sound.

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**Plant Level Plan**



## Proposed Site Layout

## CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc1A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres								
	DATE: 4th December 2012								
AHU-A Fresh Air	Conabeare Acoustics ref: CS7277A								
	Octave Band Centre Frequency (Hz)								
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
<b>LOCATION 'A' ASSESSMENT</b> Break Out									
FlaktWoods ACON-01166618 Lw	57	61	62	48	43	42	36	34	
Additional Surface Reflections Three	9	9	9	9	9	9	9	9	
Distance to face of louvre = 5.5m	-26	-26	-26	-26	-26	-26	-26	-26	
<b>Lp @ louvre face</b>	<b>40</b>	<b>44</b>	<b>45</b>	<b>31</b>	<b>26</b>	<b>25</b>	<b>19</b>	<b>17</b>	<b>38</b>
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
<b>LOCATION 'A' ASSESSMENT</b> Fresh Air In									
FlaktWoods ACON-01166618 Lw	64	60	70	58	54	54	47	49	
Additional Surface Reflections Three	9	9	9	9	9	9	9	9	
Distance to face of louvre = 1.5m	-15	-15	-15	-15	-15	-15	-15	-15	
<b>Lp @ louvre face</b>	<b>58</b>	<b>54</b>	<b>64</b>	<b>52</b>	<b>48</b>	<b>48</b>	<b>41</b>	<b>43</b>	<b>58</b>
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
Breakout Noise	40	44	45	31	26	25	19	17	
Fresh Air In	58	54	64	52	48	48	41	43	
<b>Combined Lp @ louvre face</b>	<b>58</b>	<b>54</b>	<b>64</b>	<b>52</b>	<b>48</b>	<b>48</b>	<b>41</b>	<b>43</b>	<b>58</b>

### Notes

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the louvres

## CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc2A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres								
	DATE: 4th December 2012								
AHU-A Exhaust	Conabeare Acoustics ref: CS7277A								
	Octave Band Centre Frequency (Hz)								
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
<b>LOCATION 'A' ASSESSMENT</b> Break Out									
FlaktWoods ACON-01166618 Lw	57	61	62	48	43	42	36	34	
Additional Surface Reflections Three	9	9	9	9	9	9	9	9	
Distance to face of louvre = 5.5m	-26	-26	-26	-26	-26	-26	-26	-26	
<b>Lp @ louvre face</b>	<b>40</b>	<b>44</b>	<b>45</b>	<b>31</b>	<b>26</b>	<b>25</b>	<b>19</b>	<b>17</b>	<b>38</b>
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
<b>LOCATION 'A' ASSESSMENT</b> Exhaust Side Ductwork Breakout									
FlaktWoods ACON-01166618 Lw	60	64	58	54	52	50	48	46	
Estimated Duct Transmission Loss	-9	-12	-17	-20	-22	-22	-22	-22	
Additional Surface Reflections Three	9	9	9	9	9	9	9	9	
Distance to face of louvre = 3.5m	-22	-22	-22	-22	-22	-22	-22	-22	
<b>Lp @ louvre face</b>	<b>38</b>	<b>39</b>	<b>28</b>	<b>21</b>	<b>17</b>	<b>15</b>	<b>13</b>	<b>11</b>	<b>27</b>
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
Breakout Noise	40	44	45	31	26	25	19	17	
Exhaust Side Ductwork Breakout	38	39	28	21	17	15	13	11	
<b>Combined Lp @ louvre face</b>	<b>42</b>	<b>45</b>	<b>45</b>	<b>31</b>	<b>27</b>	<b>25</b>	<b>20</b>	<b>18</b>	<b>38</b>

### Notes

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the louvres

# CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc3A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres								
	DATE: 4th December 2012								
AHU-A Summary	Conabeare Acoustics ref: CS7277A								
	Octave Band Centre Frequency (Hz)								
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
Fresh Air Calculation	58	54	64	52	48	48	41	43	
Exhaust Calculation	42	45	45	31	27	25	20	18	
<b>Combined Lp @ louvre face</b>	<b>58</b>	<b>55</b>	<b>64</b>	<b>52</b>	<b>48</b>	<b>48</b>	<b>41</b>	<b>43</b>	<b>58</b>
Source location	3	3	3	3	3	3	3	3	
Large source direction	2	2	2	2	2	2	2	2	
Directivity factor (0 degrees)	4	4	4	5	5	5	5	5	
Screening via building None	0	0	0	0	0	0	0	0	
Distance: 26m to 1m in front of nearest window	-27	-27	-27	-27	-27	-27	-27	-27	
Façade Correction	3	3	3	3	3	3	3	3	
<b>Lp @1m from receivers façade</b>	<b>43</b>	<b>40</b>	<b>49</b>	<b>38</b>	<b>34</b>	<b>34</b>	<b>27</b>	<b>29</b>	<b>43</b>

Design Target = 40

Excess = 3

## Notes

Calculations to the nearest windows (level with the plant) in Bartram's Residential Hostel in Rowland Hill Street

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the intake louvres

## CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc4A

CLIENT: Royal Free Hospital		PROJECT: Temporary Theatres								
		DATE: 4th December 2012								
AHU-C Fresh Air		Conabeare Acoustics ref: CS7277A								
		Octave Band Centre Frequency (Hz)								
Description		63	125	250	500	1K	2K	4K	8K	dB(A)
<b>LOCATION 'A' ASSESSMENT</b>	Break Out									
FlaktWoods ACON-01166618	Lw	57	61	62	48	43	42	36	34	
Additional Surface Reflections	Three	9	9	9	9	9	9	9	9	
Distance to face of louvre = 19m		-37	-37	-37	-37	-37	-37	-37	-37	
<b>Lp @ louvre face</b>		<b>29</b>	<b>33</b>	<b>34</b>	<b>20</b>	<b>15</b>	<b>14</b>	<b>8</b>	<b>6</b>	<b>27</b>
Description		63	125	250	500	1K	2K	4K	8K	dB(A)
<b>LOCATION 'A' ASSESSMENT</b>	Fresh Air In									
FlaktWoods ACON-01166618	Lw	64	60	70	58	54	54	47	49	
Additional Surface Reflections	Three	9	9	9	9	9	9	9	9	
Distance to face of louvre = 15m		-34	-34	-34	-34	-34	-34	-34	-34	
<b>Lp @ louvre face</b>		<b>39</b>	<b>35</b>	<b>45</b>	<b>33</b>	<b>29</b>	<b>29</b>	<b>22</b>	<b>24</b>	<b>39</b>
Description		63	125	250	500	1K	2K	4K	8K	dB(A)
Breakout Noise		29	33	34	20	15	14	8	6	
Fresh Air In		39	35	45	33	29	29	22	24	
<b>Combined Lp @ louvre face</b>		<b>39</b>	<b>37</b>	<b>45</b>	<b>33</b>	<b>29</b>	<b>29</b>	<b>22</b>	<b>24</b>	<b>39</b>

### Notes

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the louvres

## CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc5A

CLIENT: Royal Free Hospital		PROJECT: Temporary Theatres								
		DATE: 4th December 2012								
AHU-C Exhaust		Conabeare Acoustics ref: CS7277A								
		Octave Band Centre Frequency (Hz)								
Description		63	125	250	500	1K	2K	4K	8K	dB(A)
<b>LOCATION 'A' ASSESSMENT</b>	Break Out									
FlaktWoods ACON-01166618	Lw	57	61	62	48	43	42	36	34	
Additional Surface Reflections	Three	9	9	9	9	9	9	9	9	
Distance to face of louvre = 19m		-37	-37	-37	-37	-37	-37	-37	-37	
<b>Lp @ louvre face</b>		29	33	34	20	15	14	8	6	27
Description		63	125	250	500	1K	2K	4K	8K	dB(A)
<b>LOCATION 'A' ASSESSMENT</b>	Exhaust Side Ductwork Breakout									
FlaktWoods ACON-01166618	Lw	60	64	58	54	52	50	48	46	
Additional Surface Reflections	Three	9	9	9	9	9	9	9	9	
Distance to face of louvre = 17m		-36	-36	-36	-36	-36	-36	-36	-36	
<b>Lp @ louvre face</b>		33	37	31	27	25	23	21	19	31
Description		63	125	250	500	1K	2K	4K	8K	dB(A)
Breakout Noise		29	33	34	20	15	14	8	6	
Exhaust Side Ductwork Breakout		33	37	31	27	25	23	21	19	
<b>Combined Lp @ louvre face</b>		34	38	36	28	25	24	21	19	33

### Notes

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the louvres

# CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc6A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres								
	DATE: 4th December 2012								
AHU-C Summary	Conabeare Acoustics ref: CS7277A								
	Octave Band Centre Frequency (Hz)								
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
Fresh Air Calculation	39	37	45	33	29	29	22	24	
Exhaust Calculation	34	38	36	28	25	24	21	19	
<b>Combined Lp @ louvre face</b>	<b>40</b>	<b>41</b>	<b>46</b>	<b>34</b>	<b>30</b>	<b>30</b>	<b>25</b>	<b>25</b>	<b>40</b>
Source location	3	3	3	3	3	3	3	3	
Large source direction	2	2	2	2	2	2	2	2	
Directivity factor (0 degrees)	4	4	4	5	5	5	5	5	
Screening via building None	0	0	0	0	0	0	0	0	
Distance: 26m to 1m in front of nearest window	-27	-27	-27	-27	-27	-27	-27	-27	
Façade Correction	3	3	3	3	3	3	3	3	
<b>Lp @1m from receivers façade</b>	<b>25</b>	<b>26</b>	<b>31</b>	<b>20</b>	<b>16</b>	<b>16</b>	<b>11</b>	<b>11</b>	<b>25</b>

Design Target = 40

Excess = -15

## Notes

Calculations to the nearest windows (level with the plant) in Bartram's Residential Hostel in Rowland Hill Street

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the intake louvres

## CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc7A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres								
	DATE: 4th December 2012								
AHU-C Summary	Conabeare Acoustics ref: CS7277A								
	Octave Band Centre Frequency (Hz)								
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
AHU-A	58	55	64	52	48	48	41	43	
AHU-B	58	55	64	52	48	48	41	43	
AHU-C	40	41	46	34	30	30	25	25	
<b>Combined Lp @ louvre face</b>	<b>61</b>	<b>58</b>	<b>67</b>	<b>55</b>	<b>51</b>	<b>51</b>	<b>44</b>	<b>46</b>	<b>61</b>
Source location	3	3	3	3	3	3	3	3	
Large source direction	2	2	2	2	2	2	2	2	
Directivity factor (0 degrees)	4	4	4	5	5	5	5	5	
Screening via building None	0	0	0	0	0	0	0	0	
Distance: 26m to 1m in front of nearest window	-27	-27	-27	-27	-27	-27	-27	-27	
Façade Correction	3	3	3	3	3	3	3	3	
<b>Lp @1m from receivers façade</b>	<b>46</b>	<b>43</b>	<b>52</b>	<b>41</b>	<b>37</b>	<b>37</b>	<b>30</b>	<b>32</b>	<b>46</b>

Design Target = 40

Excess = 6

### Notes

Calculations to the nearest windows (level with the plant) in Bartram's Residential Hostel in Rowland Hill Street

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the intake louvres

## CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc10A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres									
	DATE: 4th December 2012									
Condenser Calculation	Conabeare Acoustics ref: CS7277A									
North Louvre Face	Octave Band Centre Frequency (Hz)									
Description	63	125	250	500	1K	2K	4K	8K	dB(A)	
<b>LOCATION 'B' ASSESSMENT</b>										
FlaktWoods KCTB-182 Lw	84	78	78	74	69	70	62	55		
Additional identical units Two	5	5	5	5	5	5	5	5		
Combined Total	89	83	83	79	74	75	67	60	82	
Additional Surface Reflections Three	9	9	9	9	9	9	9	9		
Screening None	0	0	0	0	0	0	0	0		
Distance to face of louvre = 1.5m	-15	-15	-15	-15	-15	-15	-15	-15		
Lp @ face of louvre	83	77	77	73	68	69	61	54	76	

### Notes

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the louvres

### CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc11A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres									
	DATE: 4th December 2012									
Condenser Calculation	Conabeare Acoustics ref: CS7277A									
North Louvre Face	Octave Band Centre Frequency (Hz)									
Description	63	125	250	500	1K	2K	4K	8K	dB(A)	
<b>LOCATION 'B' ASSESSMENT</b>										
FlaktWoods KCTB-081 Lw	84	80	76	72	69	67	63	60		
Additional identical units Two	5	5	5	5	5	5	5	5		
Combined Total	89	85	81	77	74	72	68	65	80	
Additional Surface Reflections Three	9	9	9	9	9	9	9	9		
Screening None	0	0	0	0	0	0	0	0		
Distance to louvre face = 1.5m	-15	-15	-15	-15	-15	-15	-15	-15		
Lp @ louvre face	83	79	75	71	68	66	62	59	74	

#### Notes

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the intake louvres

## CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc12A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres									
	DATE: 4th December 2012									
Prop fans calculation	Conabeare Acoustics ref: CS7277A									
North Louvre Face	Octave Band Centre Frequency (Hz)									
Description	63	125	250	500	1K	2K	4K	8K	dB(A)	
<b>LOCATION 'A' ASSESSMENT</b>										
Condenser Area prop fans Lw	90	90	88	86	82	79	73	64		
Additional identical units Two	5	5	5	5	5	5	5	5		
Combined Total	95	95	93	91	87	84	78	69	93	
Additional Surface Reflections Three	9	9	9	9	9	9	9	9		
Screening None	0	0	0	0	0	0	0	0		
Distance to louvre face = 4m	-23	-23	-23	-23	-23	-23	-23	-23		
Lp @ louvre face	81	81	79	77	73	70	64	55	79	

### Notes

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the intake louvres

## CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc13A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres								
	DATE: 4th December 2012								
Condenser Summary	Conabeare Acoustics ref: CS7277A								
Assessment Location B	Octave Band Centre Frequency (Hz)								
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
Calc 10A Lp @ louvre face	83	77	77	73	68	69	61	54	
Calc 11A Lp @ louvre face	83	79	75	71	68	66	62	59	
Calc 12A Lp @ louvre face	81	81	79	77	73	70	64	55	
Combined Lp @ louvre face	87	84	82	79	75	73	67	61	81

### Notes

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the intake louvres

## CONABEARE ACOUSTICS LTD CALCULATION SHEET - Calc14A

CLIENT: Royal Free Hospital	PROJECT: Temporary Theatres								
	DATE: 4th December 2012								
Condenser Summary	Conabeare Acoustics ref: CS7277A								
Assessment Location 'B'	Octave Band Centre Frequency (Hz)								
Description	63	125	250	500	1K	2K	4K	8K	dB(A)
Combined Lp @ louvre face	87	84	82	79	75	73	67	61	81
Source location	3	3	3	3	3	3	3	3	
Large source direction	2	2	2	2	2	2	2	2	
Directivity factor (45 degrees)	4	3	3	3	2	2	2	1	
Screening via building None	0	0	0	0	0	0	0	0	
Distance: 59m to 1m in front of nearest window	-46	-46	-46	-46	-46	-46	-46	-46	
Façade Correction	3	3	3	3	3	3	3	3	
Lp @1m from receivers façade	53	49	47	44	39	37	31	24	46

Design Target = 40

Excess = 6

### Notes

Calculations to the nearest windows (with line of site to the louvre) from the School in Rowland Hill Street

No allowance has been made in the above calculations for any noise/vibration transfer through the structure

Vibration isolation will be required for the new plant

No allowance has been made for any acoustic reduction through the intake louvres