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# GREAT ORMOND STREET HOSPITAL

## Planning Condition 8 Discharge Acoustic Report

03/02/2016



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# Quality Management

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# Great Ormond Street Hospital

## Planning Condition 8 Discharge Acoustic Report

03/02/2016

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# 1 Introduction

- 1.1.1 WSP | Parsons Brinckerhoff (WSP | PB) has been appointed by Skanska to provide acoustic consultancy services in relation to the Phase 2B development at Great Ormond Street Hospital (GOSH2B). This report is intended to fulfil the requirements of Planning Condition 8 of planning application reference 2007/4116/P, as issued by the London Borough of Camden Council (LBCC) in November 2007. This condition relates to the control of noise from fixed plant.
- 1.1.2 The purpose of this report is to provide sufficient information to LBCC to discharge the planning condition.
- 1.1.3 This revision of this planning condition discharge report contains further information following correspondence with the Local Authority Environmental Health Officer, Joanne Stowell, dated 19 October 2015.
- 1.1.4 The following reports, guidance and standards are referred to throughout this report:
- The London Borough of Camden (LBC) '*Replacement Unitary Development Plan, Adopted June 2006*' (UDP 2006)
  - The LBC '*Camden Development Policies 2010-2025: Local Development Framework*' (LDF),
  - The WSP '*Great Ormond Street Hospital: Acoustic Survey Report*' (ref 12102153.mrc.rp1-Rev1, 2 November 2006, referred to as the '2006 WSP Acoustic Survey Report')
  - BS 4142:1997 'Method for rating industrial noise affecting mixed residential and industrial areas'
  - ISO 9613-2:1996, '*Acoustics -- Attenuation of sound during propagation outdoors -- Part 2: General method of calculation*'.
  - BS EN 12354-4:2000: '*Building acoustics – Estimation of acoustic performance of building from the performance of elements – Part 4: Transmission of indoor sound to the outside*'.
  - BS EN 12354-5:2009, '*Building acoustics – Estimation of acoustic performance of building from the performance of elements – Part 5: Sounds level dues to the service equipment*'.
- 1.1.5 This report is necessarily technical in nature. A glossary of technical terms used in this report is provided in Appendix A.

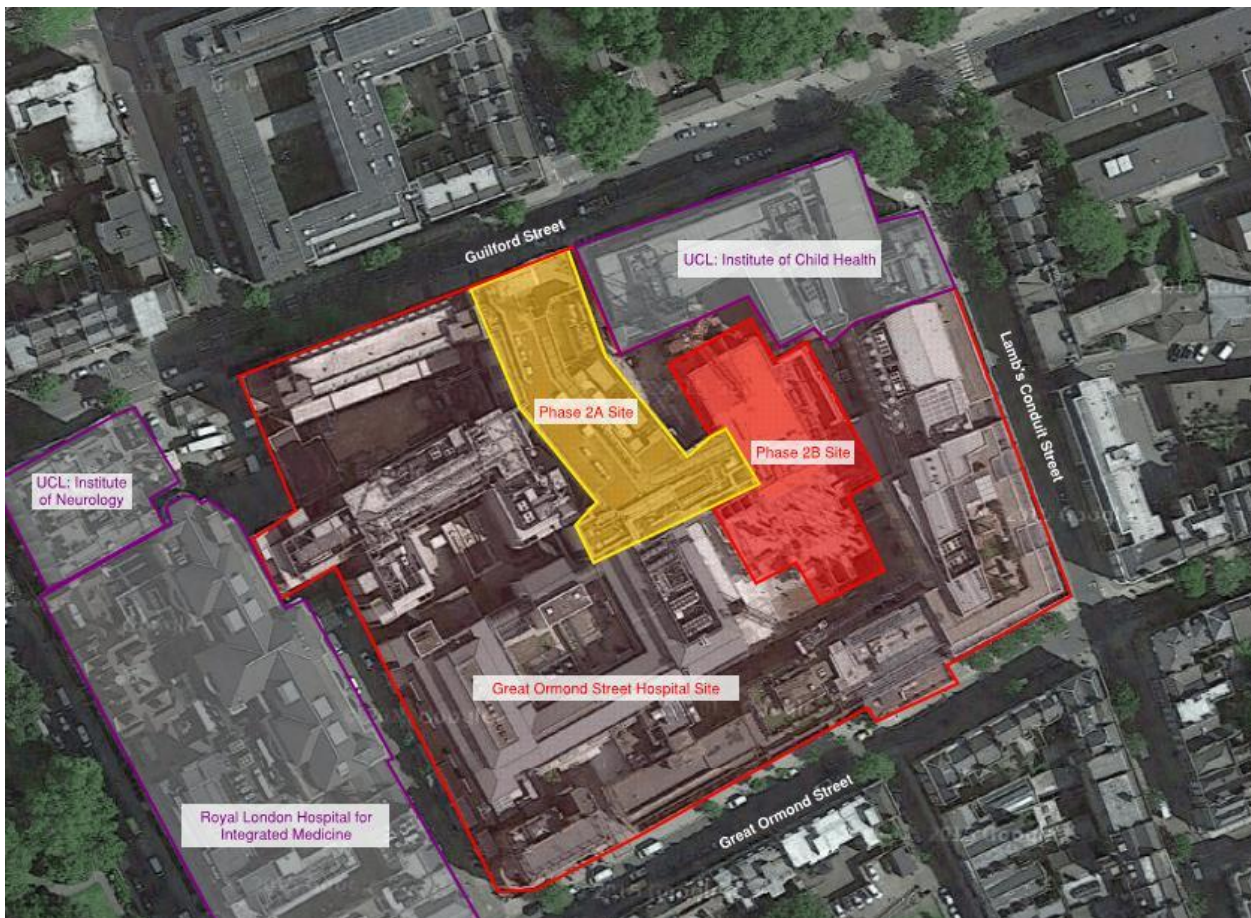


## 2 The Proposed Development

### 2.1 Site Description

- 2.1.1 The site of Great Ormond Street Hospital is bounded to the north by Guilford Road, to the east by Lambs Conduit Street, to the south by Great Ormond Street, and to the west by Queen Square. The Phase 2B development is located on the eastern portion of the GOSH site
- 2.1.2 The area contains a mix of uses including housing, retail, health and educational facilities.
- 2.1.3 Of the three roads bounding the site, Guilford Road was found to be relatively busy with Great Ormond Street and Lambs Conduit Street generally less busy.
- 2.1.4 The main entrance to the hospital and access for ambulances is via Great Ormond St.
- 2.1.5 The nearest noise-sensitive receptors to the site are identified below:
- The dwellings on the south side of Great Ormond St.
  - The dwellings on the east side of Lambs Conduit.
  - The dwellings on to north side of Guilford St.
- 2.1.6 A map of the GOSH2B development and the surrounding area is shown in Figure 1.

**Figure 2-1: Map of the development site**



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## 2.2 The Development Proposals

- 2.2.1 The development consists of a new building on the site of the old Cardiac Wing for which four floors of the old building will be retained and refurbished and four additional upper floors.
- 2.2.2 The proposed plant areas mainly located on the eighth floor of the development and a fourth floor roof area, with some additional plant within risers and a ground floor loading bay.
- 2.2.3 The proposed plant and machinery that will emit noise which could affect the surrounding area includes air handling units, supply and extract fans, pumps, a pressurisation unit, transformers, chillers, a CHP unit and an generator that would be used under emergency circumstances only (i.e. power failure).
- 2.2.4 Further information about the proposed plant and machinery is presented in Section 7.

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## 3 Planning Context

### 3.1 GOSH2B Planning Application

- 3.1.1 A planning application for the GOSH2B was submitted to Camden London Borough Council (CLBC) in August 2007. The 2006 WSP Acoustic Survey Report was submitted as part of the application.
- 3.1.2 The 2006 WSP Acoustic Survey Report presented the relevant planning policies relevant to the control of noise that were current at the time of the application submission and the results of a noise measurement survey carried out in November 2005. Maximum permissible plant noise emission limits were derived based on the measurement data. No assessment of noise from mechanical plant was carried out at this stage as the development was at an early stage in the design process.
- 3.1.3 The GOSH2B development was granted planning approval in November 2007 (application ref: 2007/4116/P), with one condition relating to acoustics and noise (Planning Condition 8):
- 'Details of plant (including an acoustic report, sound attenuation and acoustic isolation from the structure) to be installed as part of the development shall be submitted to and approved by the local planning authority prior to commencement of each part of the development. The development shall only be carried out in accordance with such approved details, including specified maximum noise levels, and thereafter maintained.'*
- REASON: To ensure that the appearance of any external plant is compatible with the appearance of the building and the area and to ensure that residential amenities are protected in accordance with the requirements of policy SD7 of the Camden Replacement Unitary Development Plan 2006.'*
- 3.1.4 The planning condition refers to the 2006 UDP, Policy SD7, the relevant sections of which are reproduced below:
- 'SD7 - Light, noise and vibration pollution***
- B - Noise/vibration pollution*
- Unless appropriate attenuation measures are available and are included, the Council will not grant planning permission for:*
- a) development likely to generate noise/vibration pollution; or*
- b) development sensitive to noise/vibration in locations with noise/vibration pollution.*
- In assessing applications against these criteria, the Council will have regard to the levels set out in Appendix 1 to this Plan.'*
- 3.1.5 Appendix 1 of the 2006 UDP contains three tables presenting acceptable levels of noise and vibration for residential development and one table relating to noise from places of entertainment. A further table (Table E) presents limits on noise from plant and machinery which is considered more relevant to the discharge of this planning condition, and is referenced in the 2006 UDP 'Policy SD8 – Disturbance'. This policy, along with Table E of the 2006 UDP are reproduced as follows:



## **'SD8 - Disturbance**

### *A - Disturbance from plant and machinery*

*The Council will only grant planning permission for plant or machinery, including ventilation or air handling equipment, if it can be operated without causing a loss to local amenity and does not exceed the thresholds set out in Appendix 1 - Noise and Vibration (Table E).'*

*'Appendix 1 – Noise and Vibration Thresholds: Table E: Noise levels from plant and machinery at which planning permission will not be granted'*

| Noise description and location of measurement  | Period               | Time        | Noise level                 |
|--|----------------------|-------------|-----------------------------|
| <b>Noise at 1 metre external of a sensitive façade</b>   | Day, evening & night | 00:00-24:00 | 5 dB(A) < L <sub>A90</sub>  |
| <b>Noise that has a distinguishable discrete continuous note (whine, hiss, screech, hum) at 1 metre external to a sensitive façade</b> | Day, evening & night | 00:00-24:00 | 10 dB(A) < L <sub>A90</sub> |
| <b>Noise that has distinct impulses (bangs, clicks, clatters, thumps) at 1 metre external to a sensitive façade</b>                    | Day, evening & night | 00:00-24:00 | 10 dB(A) < L <sub>A90</sub> |
| <b>Noise at 1 metre external L<sub>Aeq</sub> to sensitive façade where L<sub>A90</sub> &gt; 60dB</b>                                   | Day, evening & night | 00:00-24:00 | 55 dB L <sub>Aeq</sub>      |

## **3.2 Planning Condition 8 Discharge Application**

- 3.2.1 Applications have been submitted to LBCC to discharge condition 8 (ref 2015/3935/P, dated 8 July 2015, and ref: 2015/4089/P, dated 9 July 2015). Information submitted includes an earlier revision to this report (WSP report reference: 7003167/C05)
- 3.2.2 WSP | PB has since received correspondence from the local authority Environmental Health Officer, Joanne Stowell, dated 19 October 2015. This correspondence includes a request for further information before the planning condition can be discharged.
- 3.2.3 In summary, the following supplementary information was requested:
- Additional information regarding the proposed plant and the assessment assumptions and caveats, particularly more plant noise source information (in relation to the proposed extract and supply fans, chillers, boilers and pumps).
  - The results of an additional noise survey due to the length of time that has passed since the survey presented in the 2006 WSP Survey Report.
  - An update of the UDP policies referenced in the report.
  - Clarification on plant that would operate during emergency conditions and the assessment criteria.
- 3.2.4 It is the intention of this report to provide the requested information and provide the LBCC with sufficient information to discharge the planning condition.

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## 4 Establishing the Assessment Criteria

### 4.1 UDP Revision

4.1.1 Planning Condition 8 refers to policies within the 2006 UDP, as presented in Section 2. It is noted that the UDP has since been updated.

4.1.2 Reference has since been made to the 'Camden Development Policies 2010-2025: Local Development Framework' (LDF), as published on the LBCC internet site.

4.1.3 The current LDF contains policy 'DP28 Noise and Vibration' which presents current noise and vibration policy for the LBCC. Policy DP28 is reproduced below:

*'The Council will seek to ensure that noise and vibration is controlled and managed and will not grant planning permission for:*

*a) development likely to generate noise pollution; or*

*b) development sensitive to noise in locations with noise pollution, unless appropriate attenuation measures are provided.*

*Development that exceeds Camden's Noise and Vibration Thresholds will not be permitted.*

*The Council will only grant permission for plant or machinery if it can be operated without cause harm to amenity and does not exceed our noise thresholds.*

*The Council will seek to minimise the impact on local amenity from the demolition and construction phases of development. Where these phases are likely to cause harm, conditions and planning obligations may be used to minimise the impact.'*

4.1.4 Policy DP28 refers to the 'Camden Noise and Vibration Thresholds' which are presented in five tables within the LDF. It is noted that the thresholds for noise from plant and machinery are identical to those in the 2006 UDP, as shown in Table E in Section 2.1 of this report.

4.1.5 Assessment criteria established in accordance with the 2006 UDP will therefore satisfy current policy within the LDF.

### 4.2 Establishing the Background Noise Level

4.2.1 It is noted that both the 2006 UDP policy SD8 and LDF policy DP28, as well as the supporting guidance, do not provide information on obtaining the background noise level (dB L<sub>A90</sub>). In particular, the duration of the measurement is not stated, and it is not clear whether the noise limits apply to the lowest measured background noise level or a more representative typical value. For this reason reference is made to BS 4142:1997: *Method for rating industrial noise affecting mixed residential and industrial areas*, which was the relevant standard to the control of noise from plant at the time of the GOSH2B planning application. This document presents guidance on determining the background noise level and is summarised below.

4.2.2 BS 4142:1997 provides a method of rating noise of an industrial nature affecting areas of mixed residential and industrial use, and a method of assessing the likelihood of complaint regarding industrial noise. The assessment process can be summarised as follows, for each assessment location:

- The 'specific noise level' from the development is determined by measurement or calculation;

- The 'rating level' of noise is determined by correcting the specific sound level for any acoustic features (such as tones or impulses) if appropriate;
- The background noise level is determined by measurement; and
- The impact of the specific sound is estimated by subtracting the measured background noise level from the rating level. The greater the rating level is compared to the background noise level, the greater the likelihood of complaint.

- 4.2.3 The background noise level is measured in the absence of the source under investigation, either at the assessment location or at a suitable alternative location, in terms of the  $L_{A90,T}$  noise parameter. The period 'T' for the assessment of the specific noise level is 5 minutes during night-time hours or 1 hour during the day-time period. The assessment period for the background noise measurements should be sufficient to obtain a representative value of the background noise level.
- 4.2.4 Measurements of background noise should be carried out during periods when the background noise level is typical of the background noise level when the specific source would operate but is not actually operating at the time of the measurement.
- 4.2.5 It is acknowledged that BS 4142:1997 has since been superseded by BS4142:2014 and that guidance on both obtaining the background noise level and rating sources of industrial sound has since changed. However due to the legacy nature of the GOSH2B development this standard was not available during the detailed design of the project and has therefore not been applied and is not discussed further.

## 4.3 Adopted Assessment Criteria

- 4.3.1 On the basis of the above the adopted assessment criteria are as shown in Table 4-1 below.

**Table 4-1: Maximum noise levels from plant or machinery at the nearest sensitive properties**

| Position  | Type of noise  | Period        | Time        | Noise level   |
|---|--|---------------|-------------|---|
| <b>1 metre from any sensitive façade that could be affected by noise from plant and machinery</b> | Noise that has distinct impulses (bangs, clicks, clatters, thumps) or distinguishable discrete continuous note (whine, hiss, screech, hum) | Day & Evening | 07:00-23:00 | $L_{A90,1hr}$ (lowest) minus 10 dB(A), with an upper limit of 55 dB $L_{Aeq,1hr}$   |
|   |  | Night         | 23:00-07:00 | $L_{A90,5min}$ (lowest) minus 10 dB(A), with an upper limit of 55 dB $L_{Aeq,5min}$ |
|   | Noise without these characteristics  | Day & Evening | 07:00-23:00 | $L_{A90,1hr}$ (lowest) minus 5 dB(A), with an upper limit of 55 dB $L_{Aeq,1hr}$    |
|   |  | Night         | 23:00-07:00 | $L_{A90,5min}$ (lowest) minus 5 dB(A), with an upper limit of 55 dB $L_{Aeq,5min}$  |

- 4.3.2 The maximum noise plant noise level at each receptor location is dependent upon the background noise level measured at the façade of that sensitive receptor (or at a representative position).
- 4.3.3 At the request of the LBCC, further noise measurements have been carried out at the adjacent sensitive receptors. The results of this survey are presented in Section 4 and are used in determining the maximum noise level from plant or machinery at each location.
- 4.3.4 The lowest measured background noise levels will be used for the purposes of this assessment, as a conservative approach.

## 5 Acoustic Surveys

### 5.1 Introduction

- 5.1.1 Noise measurements were taken in 2005 as part of the original planning application. These measurements previously formed the basis of the acoustic design.
- 5.1.2 Following correspondence with the LBCC it was requested that the survey was repeated, due to the length of time that has passed since the submission of the original planning application. For this reason a noise survey was carried out in December 2015 to obtain more recent noise measurements of the background noise level.
- 5.1.3 For reference the noise measurement results obtained during the 2005 acoustic survey are summarised in Appendix B.
- 5.1.4 Details of the 2015 acoustic survey are presented in Appendix C. Noise measurements were taken at positions as close as possible to those used in the 2005 survey, to represent the adjacent noise-sensitive properties. The noise monitoring positions are shown in Figure 5-1.
- 5.1.5 Background noise levels measured in both surveys are summarised in the section 5.2.

**Figure 5-1: Noise monitoring positions**



## 5.2 Measured Background Noise Levels

5.2.1 The lowest measured background noise level has been determined for each period of interest using the measurement data obtained both 2005 and 2015.

5.2.2 The results for each acoustic survey are summarised and compared in Table 5-1 below.

**Table 5-1: Measured background noise levels from both acoustic surveys, corrected to façade conditions**

| Position   | Period | Time      | T     | Lowest Measured Background Noise Level [dB L <sub>A90,T</sub> ] |                       |
|--|--------|-----------|-------|---|-----------------------|
|  |        |           |       | 2005 Acoustic Survey  | 2015 Acoustic Survey  |
| <b>1 (Great Ormond Street façade conditions)</b>   | Day    | 0700-2300 | 1 hr  | 47  | 52 (49 dB free-field) |
|  | Night  | 2300-0700 | 5 min | 44  | 46 (43 dB free-field) |
| <b>2 (Lambs Conduit Street, façade conditions)</b> | Day    | 0700-2300 | 1 hr  | 52 (49 dB free-field)   | 54 (51 dB free-field) |
|  | Night  | 2300-0700 | 5 min | 45  | 50 (47 dB free-field) |
| <b>3 (Guildford Street façade conditions)</b>      | Day    | 0700-2300 | 1 hr  | 50  | 56                    |
|  | Night  | 2300-0700 | 5 min | 41  | 47                    |

5.2.3 It can be seen from the above table that background noise levels at Positions 1 and 2 remain the same to within 5 dB L<sub>A90,T</sub> for both the daytime and night-time, with an apparent increase in background noise level in the vicinity of the development since 2005. The apparent greater increase in background noise level at Position 3 is likely to be due to the position of the microphone, which was closer to Guildford Street in 2015 and in a more exposed location. Access to the position used in 2005 was not possible. The acoustic assessment will be based on the lowest of either measured background noise levels, as a conservative approach.

5.2.4 Further information about each survey is presented in Appendix B and Appendix C.



## 6 Plant Noise Emission Limits

### 6.1 Airborne Noise

- 6.1.1 Maximum noise levels from plant or machinery at each noise-sensitive receptor have been established based on the adopted assessment criteria presented in Table 4-1 in Section 4 and using the background noise levels measured in 2015, as presented in Section 5. These noise limits are presented at each receptor in Table 6-1 below.

**Table 6-1: Maximum noise levels from plant or machinery at the each adjacent sensitive receptor**

| Position   | Period        | Time        | Plant noise limit, normal conditions |
|--|---------------|-------------|--------------------------------------|
| 1 metre from any noise sensitive property on Great Ormond Street   | Day & Evening | 07:00-23:00 | 42 dB $L_{Aeq,1hr}$ , façade         |
|  | Night         | 23:00-07:00 | 39 dB $L_{Aeq,5min}$ , façade        |
| 1 metre from any noise sensitive property on Lamb's Conduit Street | Day & Evening | 07:00-23:00 | 47 dB $L_{Aeq,1hr}$ , façade         |
|  | Night         | 23:00-07:00 | 40 dB $L_{Aeq,5min}$ , façade        |
| 1 metre from any noise sensitive property on Guilford Street       | Day & Evening | 07:00-23:00 | 45 dB $L_{Aeq,1hr}$ , façade         |
|  | Night         | 23:00-07:00 | 36 dB $L_{Aeq,5min}$ , façade        |

- 6.1.2 It is assumed that discrete tones and distinct impulses can be eliminated from plant noise experienced at the adjacent sensitive properties through sensitive selection of plant and appropriate acoustic design of ventilation systems. Where these acoustic features are present the maximum noise levels shown in Table 6-1 are to be reduced by 5 dB(A).

### 6.2 Structure-borne Noise

- 6.2.1 Planning Condition 8 requires that details of the acoustic isolation between the plant items and roof structure are to be provided to ensure that residential amenities are protected. However, whilst all plant will be mounted on anti-vibration treatment where necessary to protect the occupants of the hospital, the hospital is a detached building and negligible structural borne noise or vibration will be transmitted from the plant to the residential amenity in the surrounding area. Consequently this report does not include a review of the acoustic isolation i.e. anti-vibration mounts.

### 6.3 Airborne Noise from Emergency Plant

- 6.3.1 As the generator will not be expected to operate continuously, it is common to impose a less onerous noise limit, as the likelihood that it will be generating noise is less.
- 6.3.2 Health Technical Memorandum 08-01: 'Acoustic', produced by the Department of Health, presents information on acoustic criteria for healthcare development. In section 2.30 it is stated that:
- 'An increase in internal and external noise levels of up to 10 dB(A) over the noise criteria is normally considered acceptable, provided that regular testing only takes place during the daytime on a weekday'.*
- 6.3.3 On this basis it is proposed that an acceptable limit, given the limited use of the proposed emergency plant should be 10 dB greater than those limits shown in Table 6-1. Therefore the limits shown in Table 6-2 below will apply to emergency plant.

**Table 6-2: Maximum noise levels from plant or machinery at the each adjacent sensitive receptor during emergency conditions**

| Position   | Period        | Time        | Plant noise limit, emergency conditions |
|--|---------------|-------------|---|
| 1 metre from any noise sensitive property on Great Ormond Street   | Day & Evening | 07:00-23:00 | 52 dB $L_{Aeq,1hr}$ , façade            |
|  | Night         | 23:00-07:00 | 49 dB $L_{Aeq,5min}$ , façade           |
| 1 metre from any noise sensitive property on Lamb's Conduit Street | Day & Evening | 07:00-23:00 | 57 dB $L_{Aeq,1hr}$ , façade            |
|  | Night         | 23:00-07:00 | 50 dB $L_{Aeq,5min}$ , façade           |
| 1 metre from any noise sensitive property on Guilford Street       | Day & Evening | 07:00-23:00 | 55 dB $L_{Aeq,1hr}$ , façade            |
|  | Night         | 23:00-07:00 | 46 dB $L_{Aeq,5min}$ , façade           |

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## 7 Building Services Plant

### 7.1 Proposed Plant

7.1.1 The GOSH2B development is served by various items of plant and machinery as follows:

- 5 no. supply fans
- 7 no. extract fans;
- 21 no. air handling units;
- 14 no. pumps;
- 1 no. pressurisation set;
- 2 no. transformers;
- 2 no. chillers;
- 27 no. fan coil units in various rooms and risers within the development;
- CHP on the roof of the Phase 2A development; and
- A generator to be used in emergency circumstances (i.e. power failure).

7.1.2 These proposed items of plant and machinery have the potential to influence external noise levels in the area. Possible sources of noise are as follows:

- Duct-borne fan noise from various fans and air handling units;
- Case-radiated noise and fan noise break-out from externally located fans and air handling units and associated ductwork;
- Noise from other externally located plant such as the CHP unit, various pumps, and emergency generator;
- Noise break-out from rooms containing items of plant through acoustically weak points in the building envelope (e.g. louvres or doors).

7.1.3 Most items of plant are located on the Level 8 rooftop of the Phase 2B building, either located externally or within plant rooms.

7.1.4 The following items are enclosed within rooms on Level 8:

- Chiller rooms: This room contains AHU discharge louvres, two chillers units; and various pumps associated with the chillers.
- Boiler room: This room contains the pressurisation unit is located within the Level 8 Boiler Room along with the boilers and various pumps.
- Transformer rooms: These rooms contain the transformers.

7.1.5 In addition, two AHU's serving the operating theatre (AHU 06 & 07) will be located in a separate plant area on the fourth floor flat rooftop area on the east of the building. These two air handling units will be located within a partial enclosure.

7.1.6 AHU 08 and AHU ISO 12 & 13 will be located within ventilation risers at the southern and northern extents of the building respectively. These plant items will be ducted to the main roof level where they will discharge exhaust air.

7.1.7 Additional extract and supply fans and their associated terminals are located at lower levels, for example near the loading bay.

7.1.8 The CHP unit will be located on the roof of the Phase 2A part of the GOSH development.

- 
- 7.1.9 The emergency generator will be located on the southwest corner of the main rooftop and comes with a manufacturer supplied noise control kit. This generator will operate in emergency circumstances only (e.g. during a power failure).

## 7.2 Sound Level Information

- 7.2.1 All information regarding plant noise data has been provided by the design team and the contractor.
- 7.2.2 Source level information, in the form of either sound power levels or sound pressure levels at a specified distance, has been supplied by the relevant manufacturers.
- 7.2.3 The source levels provided are reproduced in the plant noise schedule in Appendix D.

## 7.3 Incorporated Mitigation

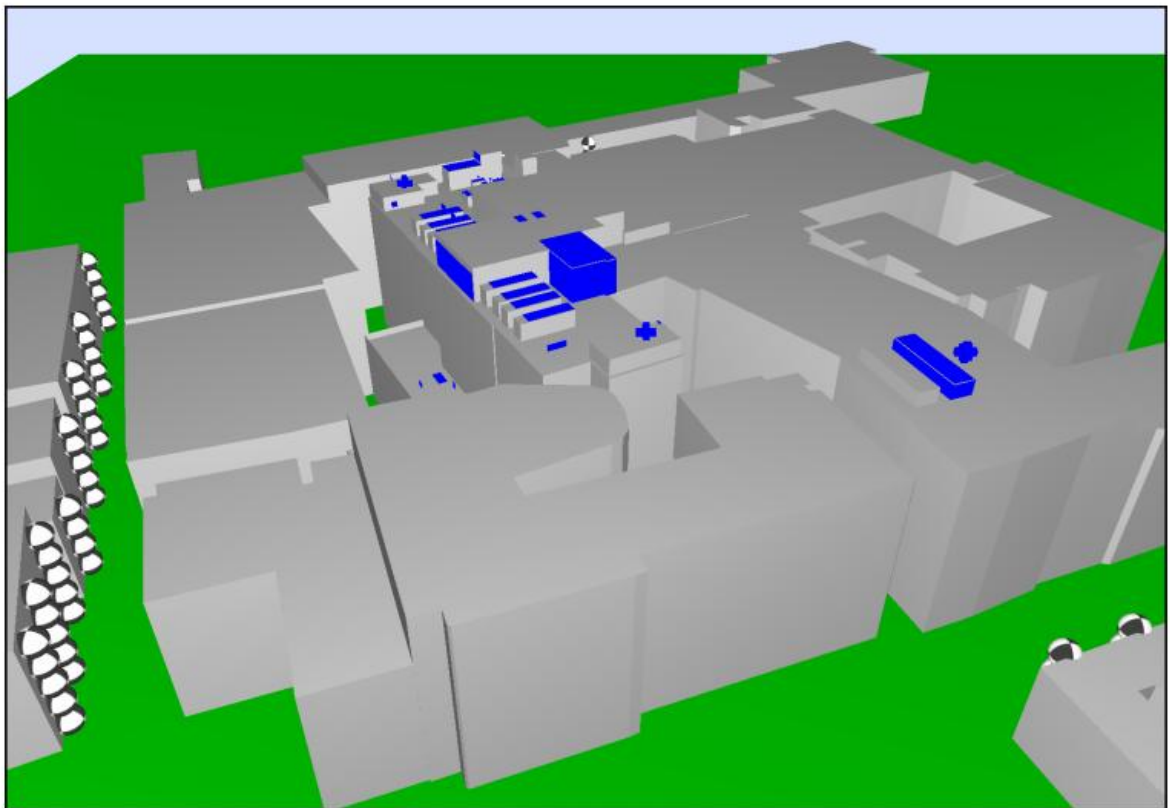
- 7.3.1 Various attenuation measures have been incorporated into the design in order to control noise emissions from the Phase 2B development. These measures have been incorporated into the assessment.
- 7.3.2 The ventilation system has been designed to include attenuators, the specification of which was carried out previously by another consultant. The minimum required insertion loss of each of the proposed attenuators has been supplied by the design team. Further information regarding the proposed attenuators is given in Appendix E.

## 8 Building Services Plant Noise Assessment

### 8.1 Methodology

- 8.1.1 The assessment of building services plant has been based on information provided by the design team and contractor in November and December 2015, as described in Section 7. This information was used to create a three dimensional acoustic model of the hospital and the surrounding area.
- 8.1.2 The acoustic model was created in the Datakustik Cadna/A software package which implements the ISO9613-2 '*Acoustics -- Attenuation of sound during propagation outdoors – Part 2: General method of calculation*' procedure. A screenshot of the three dimensional acoustic model is shown in Figure 8-1.

**Figure 8-1: Screenshot of three-dimensional acoustic model (viewed from the north)**



- 8.1.3 Where extract or supply grilles are located externally, the sound power level of duct-borne fan noise at the grille has been determined using the methodology within BS EN 12354-5:2009, '*Building acoustics – Estimation of acoustic performance of building from the performance of elements – Part 5: Sounds level dues to the service equipment*'. The grille sound power levels incorporate the effect of the attenuators shown in Appendix E.
- 8.1.4 Large noise sources were represented by area sources, the dimensions of which were consistent with those supplied by the manufacturer. Smaller sources were represented by point sources.
- 8.1.5 Where sources of noise were located in rooms with acoustically weak elements (for example louvres), the reverberant sound pressure level in the room due to these sources were determined. This calculation takes into account the dimensions of the room and the sound absorption properties



of the internal surfaces of the room materials (which were assumed to be highly reflective to sound). Noise break-out from these rooms was predicted using the methodology within BS EN 12354-4:2000, 'Building acoustics – Estimation of acoustic performance of building from the performance of elements – Part 4: Transmission of indoor sound to the outside'.

- 8.1.6 External plant noise levels were predicted outside the nearest noise sensitive properties; those located on Great Ormond Street, Guilford Street and Lambs Conduit Street, to the south, north and east of the hospital respectively.
- 8.1.7 Two scenarios have been considered, and noise levels have been predicted for each:
- Normal operation: All plant apart from the emergency generator operating simultaneously.
  - Emergency operation: As above, with emergency generator operating.
- 8.1.8 It is assumed that either of these scenarios could occur at any time of day, and the effects of noise during both the daytime and night-time periods has been assessed.
- 8.1.9 Noise levels were predicted at 1 m from the closest façade of the nearest noise sensitive properties, and include the effect of façade reflections. The range of predicted noise levels at each location is reported in the following section.
- 8.1.10 Other residential receptors located further from the development will be subject to lower levels of noise than those predicted at the above locations and are not considered in detail.

## 8.2 Noise Predictions

- 8.2.1 Predicted noise levels at the adjacent noise sensitive receptors are shown in Table 8-1 and Table 8-2 for normal and emergency operation respectively. The predicted range of noise levels is shown and corresponds to varying positions across the façade (both horizontally and at the different floors of each building). The worst affected location is also described.

**Table 8-1: Predicted noise levels from plant or machinery associated with the development**

| Location  | Normal Operation  |                                  | Emergency Operation   |                                  |
|---|---|----------------------------------|---|----------------------------------|
|   | Predicted noise levels across the façade [dB L <sub>Aeq,T</sub> ] | Worst affected location          | Predicted noise levels across the façade [dB L <sub>Aeq,T</sub> ] | Worst affected location          |
| <b>89-92 Guilford Street</b>                                      | 31 - 40   | 1st floor, eastern end of façade | 31 - 40   | 1st floor, eastern end of façade |
| <b>International Hall (University of London), Guilford Street</b> | 27 - 36   | 4th floor, eastern end of façade | 27 - 36   | 4th floor, eastern end of façade |
| <b>19-27 Great Ormond Street</b>                                  | 26 - 29   | 3rd floor, eastern end of façade | 28 - 31   | 3rd floor, eastern end of façade |
| <b>29-41 Great Ormond Street</b>                                  | 25 - 28   | 3rd floor, western end of façade | 28 - 33   | 3rd floor, middle of façade      |
| <b>3-6 Guilford Place / 86-94 Lamb's Conduit Street</b>           | 29 - 37   | 4th floor, north end of façade   | 29 - 37   | 4th floor, north end of façade   |
| <b>Spens House / 70 Lamb's Conduit Street</b>                     | 29 - 32   | 4th floor, north end of façade   | 29 - 33   | 4th floor, north end of façade   |
| <b>The Lamb PH</b>  | 31  | 3rd floor                        | 31 - 32   | 3rd floor                        |

- 8.2.2 In general, the highest noise level due to the development is predicted at the top floor of the sensitive properties. This is due to the fact that the roof top plant will be screened by the surrounding buildings.

This effect is most pronounced for the ground floor of the adjacent noise sensitive properties and will reduce as the receptor height increases up to the top floors of the sensitive building

- 8.2.3 At 89-92 Guilford Street, the highest noise level is predicted at the first floor and is predominantly due case-radiated noise from an extract fan located near the ground floor canopy on the north side of the development (EF07).
- 8.2.4 Further detailed information is provided in Appendix F. Table F.1 shows the contribution of each item of plant to the total noise level at the worst affected locations.

## 8.3 Assessment

- 8.3.1 The highest predicted noise levels are compared to the established assessment criteria in Table 8-2 and Table 8-3 for normal and emergency conditions respectively.

**Table 8-2: Assessment of plant noise: normal conditions**

| Location (worst affected receptor)                         | Predicted Propagated Sound Pressure Level, dBA | Criteria, dB $L_{Aeq,T}$ , facade |            | Exceedance of Criteria, dB |            |
|--|--|-----------------------------------|------------|----------------------------|------------|
|  |  | Daytime                           | Night-time | Daytime                    | Night-time |
| 89-92 Guilford Street                                      | 40   | 45                                | 36         | -5                         | +4         |
| International Hall (University of London), Guilford Street | 36   | 45                                | 36         | -9                         | 0          |
| 19-27 Great Ormond Street                                  | 29   | 42                                | 39         | -13                        | -10        |
| 29-41 Great Ormond Street                                  | 28   | 42                                | 39         | -14                        | -11        |
| 3-6 Guilford Place / 86-94 Lamb's Conduit Street           | 37   | 47                                | 40         | -10                        | -3         |
| Spens House / 70 Lamb's Conduit Street                     | 32   | 47                                | 40         | -15                        | -8         |
| The Lamb PH  | 31   | 47                                | 40         | -16                        | -9         |

**Table 8-3: Assessment of plant noise: emergency conditions**

| Location (worst affected receptor)                         | Predicted Propagated Sound Pressure Level, dBA | Criteria, dB $L_{Aeq,T}$ |            | Exceedance of Criteria, dB |            |
|--|--|--------------------------|------------|----------------------------|------------|
|  |  | Daytime                  | Night-time | Daytime                    | Night-time |
| 89-92 Guilford Street                                      | 40   | 55                       | 46         | -15                        | -6         |
| International Hall (University of London), Guilford Street | 36   | 55                       | 46         | -19                        | -10        |
| 19-27 Great Ormond Street                                  | 31   | 52                       | 49         | -21                        | -18        |
| 29-41 Great Ormond Street                                  | 33   | 52                       | 49         | -19                        | -16        |
| 3-6 Guilford Place / 86-94 Lamb's Conduit Street           | 37   | 57                       | 50         | -20                        | -13        |
| Spens House / 70 Lamb's Conduit Street                     | 33   | 57                       | 50         | -24                        | -17        |
| The Lamb PH  | 32   | 57                       | 50         | -25                        | -18        |

- 8.3.2 Table 8-2 demonstrates that the noise emission limits will be achieved at the worst affected part of all receptors, apart from at 89-92 Guilford Street during the night-time, during normal conditions.
- 8.3.3 Table 8-3 demonstrates that, during emergency conditions, the noise emission limits will be achieved at the worst affected part of all receptors.

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- 8.3.4 At 89-92 Guilford Street, the highest noise level is predominantly due case-radiated noise from an extract fan located near the ground floor canopy (EF07). Figure F.1 shows a noise level contour and demonstrates that the effect of noise from this fan is relatively localised.
- 8.3.5 In order to achieve the night-time criteria at 89-92 Guilford Street it will be necessary to reduce case-radiated noise from fan EF07 by at least 10 dB. This would be achieved by placing the fan in an enclosure, or by lagging the fan with a composite material comprising a heavy polymeric barrier (with minimum weight 10 kg/m<sup>2</sup>) and a sewn glassfibre quilt on the inner face (with minimum density 24 kg/m<sup>3</sup>) and with minimum overall thickness 15 mm (an example product for which would be MuftiLag P 15/10). Provided this is implemented, noise levels at all positions and at all times of day will be below the established plant noise emission limits.
- 8.3.6 Table 8-2 and Table 8-3 incorporate the assumption that that discrete tones and distinct impulses will not be present at the receiver positions. It is considered that this assumption is valid since the received noise level will be a contribution from a large number of different sources, and the items of plant will operate continuously, generating a steady level of noise.
- 8.3.7 It is noted that, even with a tonality correction of 5 dB(A), all day-time criteria will be achieved at the worst affected locations, and the night-time criteria would be achieved at the majority of the worst
- 8.3.8 On the basis of this assessment, and assuming the minor amendment to fan EF07 is carried out, noise from the proposed plant and machinery will meet the requirements of Camden Council.

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## 9 Conclusions

- 9.1.1 WSP | PB has been commissioned to undertake a noise impact assessment of the proposed building services in relation to Phase 2B of the redevelopment of Great Ormond Street Hospital.
- 9.1.2 Conditional planning permission has been granted for the redevelopment works at the hospital. Condition 8 of the permission requires that an acoustic report and assessment be submitted to and approved by the local planning authority prior to commencement of the works on site.
- 9.1.3 As part of the assessment, an additional noise survey has been taken at locations representing the nearest noise-sensitive properties. The results of the surveys have been compared against those obtained during the environmental noise survey undertaken as part of the Phase 2A development. Background noise levels measured in 2015 were within 2 dB  $L_{A90,T}$  of those measured in 2005 at two of the three positions.
- 9.1.4 Measured noise levels have been compared against the noise criteria within the London Borough of Camden Unitary Development Plan to determine maximum permissible noise limits for the proposed plant. These were based on the lowest measured background noise level from either survey. The plant noise limits were set to meet the requirements of Camden Council.
- 9.1.5 An assessment of noise from building services plant has been carried out based on information provided by the design team and equipment manufacturers. Plant noise levels have been predicted at the most nearest noise sensitive receptors for normal and emergency plant.
- 9.1.6 Predicted plant noise levels have been compared with the established plant noise limits:
- During normal conditions, noise emission limits will be achieved at all receptors, except for 89-92 Guilford Street during the night-time. At this receptor localised noise emissions from fan EF07 result in a noise level 4 dB above the night-time criteria. Noise emission limits will be achieved at all receptors during normal conditions if fan EF07 can be placed in an enclosure or lagged with an appropriate specification acoustic lagging product.
  - During emergency conditions, the noise emission limits will be achieved at all receptors.
- 9.1.7 On the basis of this assessment, and assuming the minor amendment to fan EF07 is carried out, noise from the proposed plant and machinery will meet the requirements of Camden Council.

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## Appendix A – Glossary of Acoustic Terminology

**A-Weighting:** The human ear is not equally sensitive to all frequencies of sound. It is relatively much less sensitive to very low frequencies such as 'mains hum', and to very high frequencies such as the call of a bat, than to the 'mid-frequencies' important for human voice communication. In order to make sound level meters, which would otherwise be indiscriminate in registering sound pressures, respond in a way which reflects human perception of sound, they usually are fitted with a set of filters to progressively filter out the high and low frequency energy. The filters are made to an internationally standardised specification and the filtered noise level is said to be 'A-weighted'. Sometimes A-weighted decibel levels are denoted 'dB(A)', but the correct, internationally standardised format for reporting requires the 'A' to be appended to the noise descriptor e.g.  $L_{Aeq,T}$ ,  $L_{Amax}$ , etc.

**Airborne Sound:** Sound transmitted through the air rather than through the structure of a building or the ground.

**Ambient Noise:** This is the totally encompassing sound at the measurement position over a specified time interval and usually comprises sound from many different sources both near and far. Usually this is measured as an  $L_{Aeq,T}$  where  $T$  is the time interval.

**Attenuation:** A general term used to indicate the reduction of noise or vibration, or the amount (in decibels) by which it is reduced.

**Averaging:** In the absence of a dominant steady source, the sound level at a point, indoors or outdoors, varies continuously. For example, the variation may be over a few dB about an average value in a quiet room, or over 10 dB or more in a noisy outdoor environment. In order to define a level to represent the noisiness of the space it is necessary to define that average value. The most common averaging methods are energy averaging ( $L_{Aeq}$ ) and statistical averaging ( $L_{AN}$  where  $N$  is a percentage between 1 and 100).

**Background Noise Level,  $L_{A90,T}$ :** Background noise level is a term used to describe that level to which the noise falls during quiet spells, when there is a lull in passing traffic for example. It is quantified by the  $L_{A90,T}$  which is the noise level that is exceeded for 90% of the measurement time interval,  $T$ . It is typically measured using the fast time weighting (see below), whereby the levels is denoted  $L_{AF90,T}$  or  $L_{A90,T,fast}$ .

**Decibels:** Noise conventionally is measured in decibels (dB). The decibel is a logarithmic unit and decibel levels do not add and subtract arithmetically. An increase or decrease of 3 dB in the level of a steady noise is about the smallest that is noticeable. It represents a doubling or halving of noise energy. An increase or decrease of 10 dB represents a ten-fold change in noise energy, and is perceived as a doubling or halving of loudness.

The threshold of hearing for a typical young, healthy adult is 0 dB A-weighted sound pressure level. A noise level of 140 dB(A) can cause physical pain. Most people listen to their televisions at about 60 dB(A) to 65 dB(A). Alongside a busy main road the ambient noise level may be in the 70 dB(A) to 80 dB(A) range; on a quiet day in the country it might be as low as 30 dB(A), in town 40 dB(A) to 50 dB(A).

**Decibel Addition:** If two similar noise sources operate together their combined noise level at an observer's position some distance away is 3 dB higher than the noise level generated by just one of them. If two further machines are switched on the noise level generated by all four at the observer's position is 3 dB higher than the level generated by the two. If the number of machines is again doubled, to eight, the noise level increases by another 3 dB, and so on.

**Equivalent Continuous A-Weighted Sound Pressure Level,  $L_{Aeq,T}$ :** The 'equivalent continuous A-weighted sound pressure level' is an average of the fluctuating sound energy in a space. It is the value of the



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A-weighted sound pressure level of a continuous, steady sound that, over the specified time period,  $T$  seconds, has the same root mean square sound pressure as the varying sound. It can be likened to the mean petrol consumption of a car over a specific journey during which the instantaneous consumption peaked during periods of acceleration and fell during periods of coasting or braking.

**Façade Sound Level:** Road and railway traffic noise levels often are specified in terms of the sound level at a position 1 m in front of the most exposed façade of potentially noise sensitive premises. Such levels are assumed to be 3 dB(A) higher than sound levels measured at an equivalent position away from the reflections from the building and any other surfaces (excluding the ground).

**Fast Time Weighting:** An averaging time used in sound level meters, corresponding to a 125 ms time constant.

**Free-field Sound Level:** The free-field refers to sound level measurement positions in an open area well away from any buildings or other sound reflecting surfaces other than the ground. Generally the minimum distance from building façades for free-field measurements is taken to be 3.5 m.

**Maximum Sound Level,  $L_{Amax}$ :** This is the maximum instantaneous sound level occurring during the measurement period. It is typically measured using the fast time weighting (see above), whereby the levels is denoted  $L_{AFmax}$  or  $L_{Amax,fast}$ .

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## Appendix B – Summary of the 2005 Noise Survey

### Introduction

An environmental noise survey was carried out at the site in November 2005, and was reported in a previous 2006 WSP Survey Report. These noise levels formed the basis on which the noise control design was based.

### Survey Methodology

WSP conducted a series of noise measurement surveys to establish the prevailing ambient noise and background noise levels at key locations around the site. The surveys comprised 24 hour unattended noise surveys at three positions and attended short term measurements at an additional three locations.

The unattended noise surveys were undertaken at the following positions and times:

- Position 1 – 1 metre from the southern façade of level 1 of the hospital facing Great Ormond Street. This survey was undertaken between 13:00 hrs on 7 November and 14:00 hrs on 8 November 2005. This position was adjacent the main hospital entrance on top of the first floor balcony.
- Position 2 – in line with the façade on the roof of The Lamb public house located on the eastern side of Lambs Conduit Street. This survey was undertaken between 14:00 hrs on 4 November and 01:00 hrs on 6 November 2005. The meter on this survey stopped recording prematurely, however this has not affected the survey significantly.
- Position 3 – 1 metre from the northern façade of level 1 of the hospital facing Guilford Street. This survey was undertaken between 13:00 hrs on 7<sup>th</sup> November and 14:00 hrs on 8 November 2005.

The attended noise surveys were undertaken at the following positions and times:

- Position 4 – 1 metre from the southern façade of the hospital facing Great Ormond Street. This position was exposed to similar noise levels as to position 1 described above.
- Position 5 – 1 metre from the eastern façade of the hospital facing Lambs Conduit Street. This position was exposed to similar noise levels as to position 2 described above.
- Position 6 – 1 metre from the northern façade of the hospital facing Guilford Street. This position was exposed to similar noise levels as to position 3 described above.

All attended measurements were undertaken at 1 metre from the façade of the GOSH and at 1.5 metres above the ground.

Each of the attended measurements lasted for a period of between 20 and 30 minutes during the day and night, which apart from some low level construction noise audible at positions 4 and 6 during the day, no atypical noise sources were observed.

It should be noted however, that the construction noise was infrequent and at such a low level as not to be dominant and unlikely to significantly affect the reported background noise levels. It is possible the construction noise levels had a small effect on the ambient levels.

The weather during all surveys was conducive to the measurement of noise, it being fine and dry with only a little wind.

Details of the equipment used to take the measurements are presented in Table B-1.

**Table B-1: Noise measurement equipment used for the survey**

| Equipment         | Item              | Make & Model                           | Serial No. |
|-------------------|-------------------|--|------------|
| <b>Solo A</b>     | Sound Level Meter | 01dB-Stell Solo Master                 | 10330      |
|                   | Pre-amplifier     | 01dB-Stell PRE 21 S                    | 10423      |
|                   | Microphone        | Microtech Gefell GmbH MCE212 Condenser | 37991      |
| <b>Solo B</b>     | Sound Level Meter | 01dB-Stell Solo Master                 | 10712      |
|                   | Pre-amplifier     | 01dB-Stell PRE 21 S                    | 11349      |
|                   | Microphone        | Microtech Gefell GmbH MCE212 Condenser | 39755      |
| <b>Solo C</b>     | Sound Level Meter | 01dB-Stell Solo Master                 | 10706      |
|                   | Pre-amplifier     | 01dB-Stell PRE 21 S                    | 11464      |
|                   | Microphone        | Microtech Gefell GmbH MCE212 Condenser | 39648      |
| <b>Calibrator</b> | Calibrator        | 01dB-Stell Cal 21                      | 51031216   |

Each meter was calibrated by a UKAS accredited laboratory within the previous 24 months to the date of the survey. The equipment was also field calibrated at the commencement and conclusion of the survey using the above calibrators, which had themselves been calibrated by a UKAS accredited laboratory within the previous twelve months. Each meter was found to have no significant drift in calibration ( $< 0.5$  dB) across the measurement period.

## Survey Results

Table B-2 below presents a summary of the ambient noise levels, in terms of the equivalent continuous sound pressure level, measured during the unattended noise surveys.

**Table B-2: Unattended ambient noise level measurement results**

| Position   | Period  | Time      | T   | Measured Equivalent Continuous Noise Level<br>[dB L <sub>Aeq,T</sub> ] |
|--|---------|-----------|-----|--|
| <b>1 (Great Ormond Street, façade conditions)</b>      | Day     | 0700-1900 | 12h | 65   |
|  | Evening | 1900-2300 | 4h  | 60   |
|  | Night   | 2300-0700 | 8h  | 56   |
| <b>2 (Lambs Conduit Street, free-field conditions)</b> | Day     | 0700-1900 | 12h | 65   |
|  | Evening | 1900-2300 | 4h  | 65   |
|  | Night   | 2300-0700 | 8h  | 55   |
| <b>3 (Guilford Street, façade conditions)</b>          | Day     | 0700-1900 | 12h | 71   |
|  | Evening | 1900-2300 | 4h  | 65   |
|  | Night   | 2300-0700 | 8h  | 65   |

The background noise level has been measured and determined for a time period of 1 hour during the day (07:00-23:00) and 5 minutes during the night (23:00-07:00), as required by BS4142:1997. The lowest measured background noise levels during the day and night at each receptor position is shown in Table B-3.

**Table B-3: Unattended background noise level measurement results**

| Position   | Period | Time      | T     | Lowest Measured Background Noise Level [dB L <sub>A90,T</sub> ] |
|--|--------|-----------|-------|---|
| <b>1 (Great Ormond Street, façade conditions)</b>      | Day    | 0700-2300 | 1 hr  | 47  |
|  | Night  | 2300-0700 | 5 min | 44  |
| <b>2 (Lambs Conduit Street, free-field conditions)</b> | Day    | 0700-2300 | 1 hr  | 49  |
|  | Night  | 2300-0700 | 5 min | 47  |
| <b>3 (Guilford Street, façade conditions)</b>          | Day    | 0700-2300 | 1 hr  | 50  |
|  | Night  | 2300-0700 | 5 min | 41  |

In addition to the unattended measurements, attended measurements were made at positions 4, 5 and 6. These positions were located at street level (microphone height of 1.5 metres). The results of these attended measurements are presented in Table B-4.

**Table B-4: Attended noise level measurement results**

| Position   | Time  | Duration, T | Measured Equivalent Continuous Noise Level [dB L <sub>Aeq,T</sub> ] | Lowest Measured Background Noise Level [dB L <sub>A90,T</sub> ] |
|--|-------|-------------|---|---|
| <b>4 (Great Ormond Street, ground floor level, façade conditions)</b>  | 10:07 | 45 min      | 68  | 58  |
|  | 01:38 | 20 min      | 50  | 45  |
| <b>5 (Lambs Conduit Street, ground floor level, façade conditions)</b> | 11:35 | 25 min      | 67  | 57  |
|  | 02:01 | 20 min      | 52  | 45  |
| <b>6 (Guilford Street, ground floor level, façade conditions)</b>      | 10:56 | 35 min      | 70  | 58  |
|  | 02:01 | 20 min      | 62  | 48  |

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# Appendix C – 2015 Acoustic Survey Details

## Introduction

A further environmental noise survey was carried out at the site in December 2015. This section describes the survey method and the noise measurement results.

## Survey Methodology

A baseline sound survey was undertaken by Daniel Doherty MIOA and Jon Jones MIOA of WSP | Parsons Brinckerhoff to determine the prevailing sound levels on and around the site. This survey consisted of long-term unattended monitoring as follows:

- Long-term unattended monitoring was carried out at three positions between the afternoon of Wednesday 9 December 2015 and the afternoon of Friday 11 December 2015.
- Due to an equipment fault at one position, further long-term unattended monitoring was carried out at one position between the afternoon of Tuesday 15 December 2015 and the afternoon of Thursday 17 December 2015.

Measurements were taken at positions representing the nearest noise-sensitive receptors.

The sound monitoring equipment was configured to record the various acoustic parameters including the equivalent continuous sound level, dB  $L_{Aeq,15min}$ , the maximum event sound level, dB  $L_{AFmax,15min}$ , and the background sound level, dB  $L_{A90,15min}$ .

The unattended monitoring equipment also gathered sound level data that was used to determine long-term parameters such as the daytime (07:00-23:00) and night-time (23:00-07:00) equivalent continuous sound level, dB  $L_{Aeq,16hr}$  and dB  $L_{Aeq,8hr}$ . This parameter are presented for information only and do not affect the outcome of this assessment.

The sources of ambient sound, both distant and local, that contributed to measured sound levels were noted upon installation and collection of the equipment.

Prevailing weather conditions were observed during the installation and collection of the equipment. These observations were supplemented with historical data from local weather stations.

The monitoring positions used during the survey were as close as possible to the monitoring positions used in 2005, and were as follows:

- Position 1 – on the first floor balcony area south of the GOSH Frontage Building, overlooking Great Ormond Street. The microphone was positioned in free-field conditions, roughly 6 m above street level. This position represents the nearest noise-sensitive properties to the development on Great Ormond Street.
- Position 2 – in line with the south-west façade on the roof of The Lamb public house (a four storey building) located on the eastern side of Lamb's Conduit Street. The microphone was positioned in free-field conditions, roughly 15 m above street level. This position represents the nearest noise-sensitive properties to the development on Lamb's Conduit Street.
- Position 3 – on temporary site compound scaffolding located on Guilford St, approximately 5 m from the façade of the new Phase 2A building, facing Guilford Street. The microphone was positioned in façade conditions, roughly 9 m above street level, representing second floor level. This position represents the nearest noise-sensitive properties to the development on Guilford Street.

Photographs of the monitoring positions are shown in Figures C.1 to C.3.

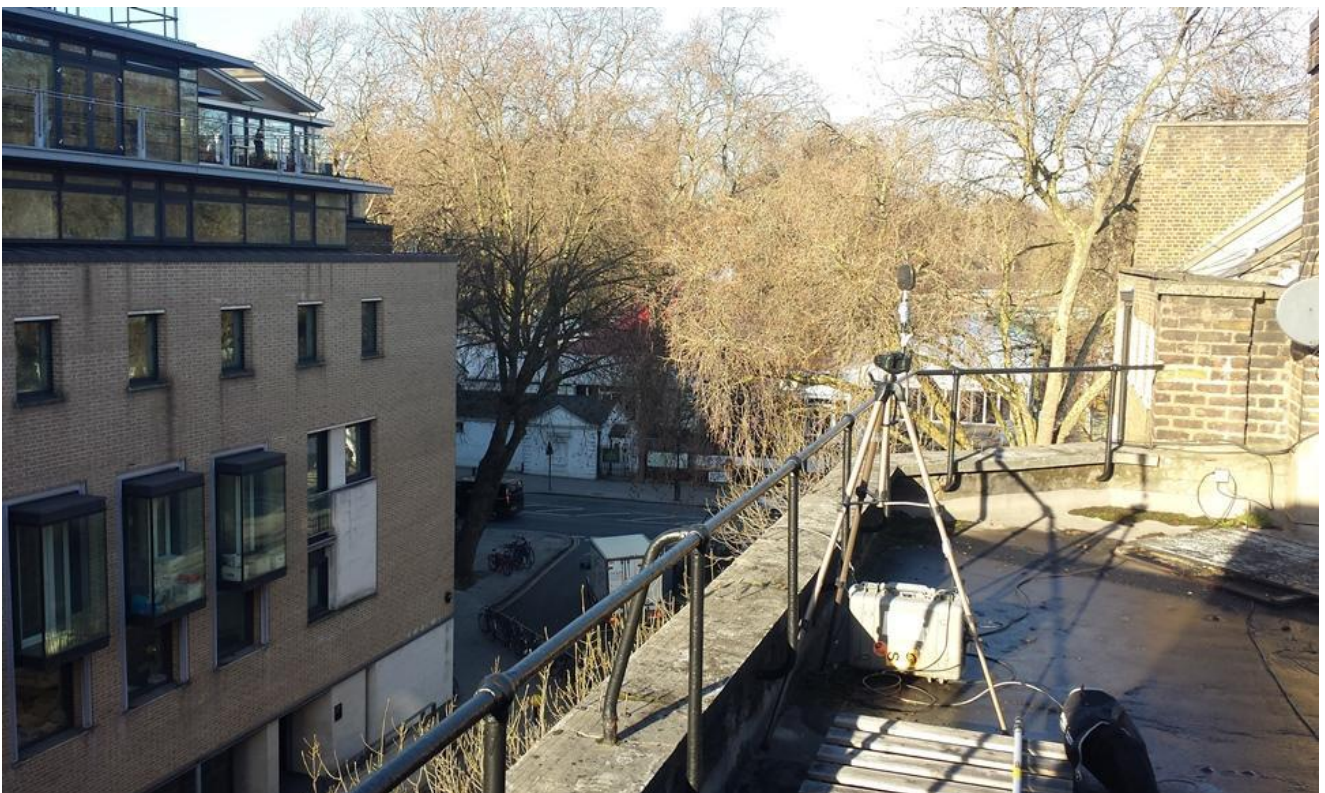


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Figure C-1: Photograph of Position 1



Figure C-2: Photograph of Position 2





**Figure C-3: Photograph of Position 3**



The sound monitoring equipment used during the survey is shown in Table C-1.

**Table C-1: Noise measurement equipment used for the survey**

| Equipment      | Item              | Make & Model                 | Serial No. | Calibration due date |
|----------------|-------------------|------------------------------|------------|----------------------|
| <b>Duo 6</b>   | Sound Level Meter | 01 dB-Metravib DUO           | 10328      | 12 August 2016       |
|                | Pre-amplifier     | 01 dB Metravib PRE 22        | 10233      |                      |
|                | Microphone        | GRAS 40CD                    | 154531     | 09 January 2016      |
|                | Calibrator        | 01 dB-Stell CAL 21           | 34134166   |                      |
| <b>Solo 13</b> | Sound Level Meter | 01dB-METRAVIB Solo Master    | 65303      | 16 August 2017       |
|                | Pre-amplifier     | 01dB-Stell PRE 21 S          | 15976      |                      |
|                | Microphone        | Microtech Gefell GmbH MCE212 | 142812     | 16 August 2016       |
|                | Calibrator        | 01dB-Stell Cal 21            | 34213780   |                      |
| <b>Solo 20</b> | Sound Level Meter | 01dB-METRAVIB Solo Master    | 65811      | 1 November 2017      |
|                | Pre-amplifier     | 01dB-Stell PRE 21 S          | 16485      |                      |
|                | Microphone        | Microtech Gefell GmbH MCE212 | 166394     | 09 January 2016      |
|                | Calibrator        | 01dB-Metravib Cal 21         | 34634224   |                      |

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Each meter has been calibrated by a UKAS accredited laboratory within the previous 24 months. The equipment was also field calibrated at the start and end of the survey using calibrators that were, themselves, calibrated by a UKAS accredited laboratory within the previous 12 months.

Before and after the use of any sound level meter, the calibration level was checked with a field calibrator. The field calibrator had a reference level of 94.0 dB at 1 kHz. No significant drift in calibration was observed (maximum of 0.1 dB).

## Observations and Meteorological Conditions

Upon set up and collection of the unattended sound level meters the following sources were observed:

- Road traffic noise from the adjacent road network, including occasional heavy vehicles, and vehicles idling on Great Ormond Street;
- Intermittent clattering sounds and noise from earth-moving plant on a site to the east of the pub (20 Guilford Street). This was on the opposite side of the building to the noise monitoring position. It is considered that although it may have influenced the background sound levels during day-time, the evening or night-time background sound levels, on which this assessment is based, would not have been affected.
- Occasional clattering sounds were observed at Position 1 due to people using the lightweight temporary staircase to access the Frontage House site office.
- Construction noise from the GOSH2B development itself was not significant at the monitoring positions due to the screening effect of the adjacent buildings.
- At position 2, there was some rooftop plant visible on the building on the opposite side of Lamb's Conduit Street. No noise from this plant was audible during the day-time.

The weather upon set up and collection of the measurement equipment was conducive to the measurement of environmental sound, being dry and with wind speeds within acceptable magnitudes (below 5 m/s). There was some very light rain on the 11 December (during equipment collection) but this did not affect the noise measurements.

The weather during the remainder of the survey has been reviewed based on weather station data at University College London and was as follows:

- The temperature was between 10 to 13 °C between 9 and 11 December, mostly with a high proportion of cloud cover. The temperature was between 13 to 16 °C between 15 and 17 December.
- The average wind speed was no more than 5 m/s except for brief periods during the night of the 9 December and morning of the 10 December where the maximum average speed was 6 m/s. The wind speed was no more than 5 m/s for all measurements between 15 and 17 December.
- The wind was consistently from the south or south-west between 9 and 11 December. Between 15 and 17 December the wind was consistently from the south.
- On the evening and night of 10 December and a brief period at 01:00 on 11 December there was some light rain. The data does not show any notable change in background sound level during this period.
- On the evening of 15 December there was rain between 16:00 and 20:00, with further light rain in the early hours of 16 December before 03:00. During the remainder of the measurements on 16 December and 17 December the conditions were dry. Background noise levels were higher during the rain on the 15 December; however, the assessment is not based on measurements taken during these periods.

## Survey Results

Overall long-term values are summarised in Table C-2 and Table C-3 for the equivalent continuous sound pressure level and the background noise level respectively.

The long-term noise measurement results are presented in Figures C-4 to C-6.

**Table C-2: Unattended ambient noise level measurement results**

| Position  | Period | Time      | T   | Average Measured Equivalent Continuous Noise Level<br>[dB L <sub>Aeq,T</sub> ] |
|---|--------|-----------|-----|--|
| 1 (Great Ormond Street, free-field conditions)  | Day    | 0700-2300 | 16h | 62   |
|   | Night  | 2300-0700 | 8h  | 56   |
| 2 (Lambs Conduit Street, free-field conditions) | Day    | 0700-2300 | 16h | 63   |
|   | Night  | 2300-0700 | 8h  | 56   |
| 3 (Guilford Street, façade conditions)          | Day    | 0700-2300 | 16h | 68   |
|   | Night  | 2300-0700 | 8h  | 62   |

The background noise level has been measured and determined for a time period of 1 hour during the day (07:00-23:00) and 5 minutes during the night (23:00-07:00). The lowest measured background noise levels during the day and night at each receptor position is shown in Table C-3.

**Table C-3: Unattended background noise level measurement results**

| Position  | Period | Time      | T     | Lowest Measured Background Noise Level<br>[dB L <sub>A90,T</sub> ] |
|---|--------|-----------|-------|--|
| 1 (Great Ormond Street, free-field conditions)  | Day    | 0700-2300 | 1 hr  | 49   |
|   | Night  | 2300-0700 | 5 min | 43   |
| 2 (Lambs Conduit Street, free-field conditions) | Day    | 0700-2300 | 1 hr  | 51   |
|   | Night  | 2300-0700 | 5 min | 47   |
| 3 (Guilford Street, façade conditions)          | Day    | 0700-2300 | 1 hr  | 56   |
|   | Night  | 2300-0700 | 5 min | 47   |

**Figure C-4: Noise measurement results at Position 1 (free-field conditions)**

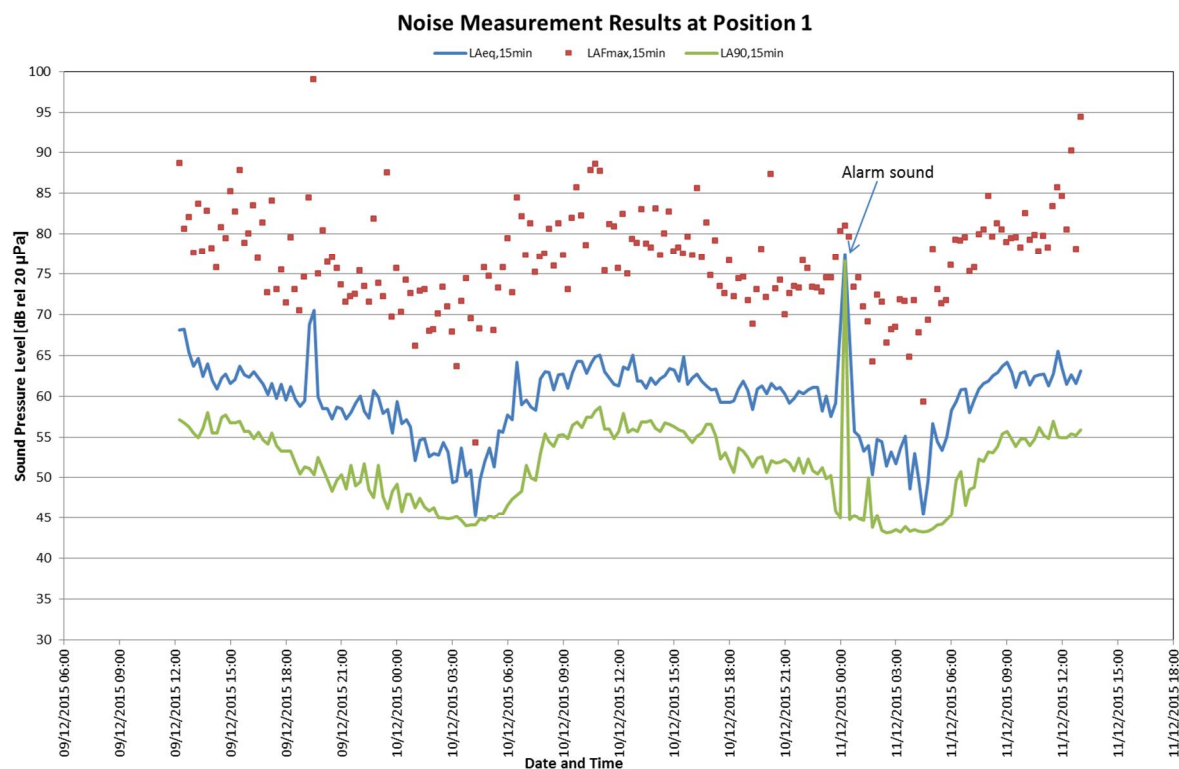


Figure C-5: Noise measurement results at Position 2 (free-field conditions)

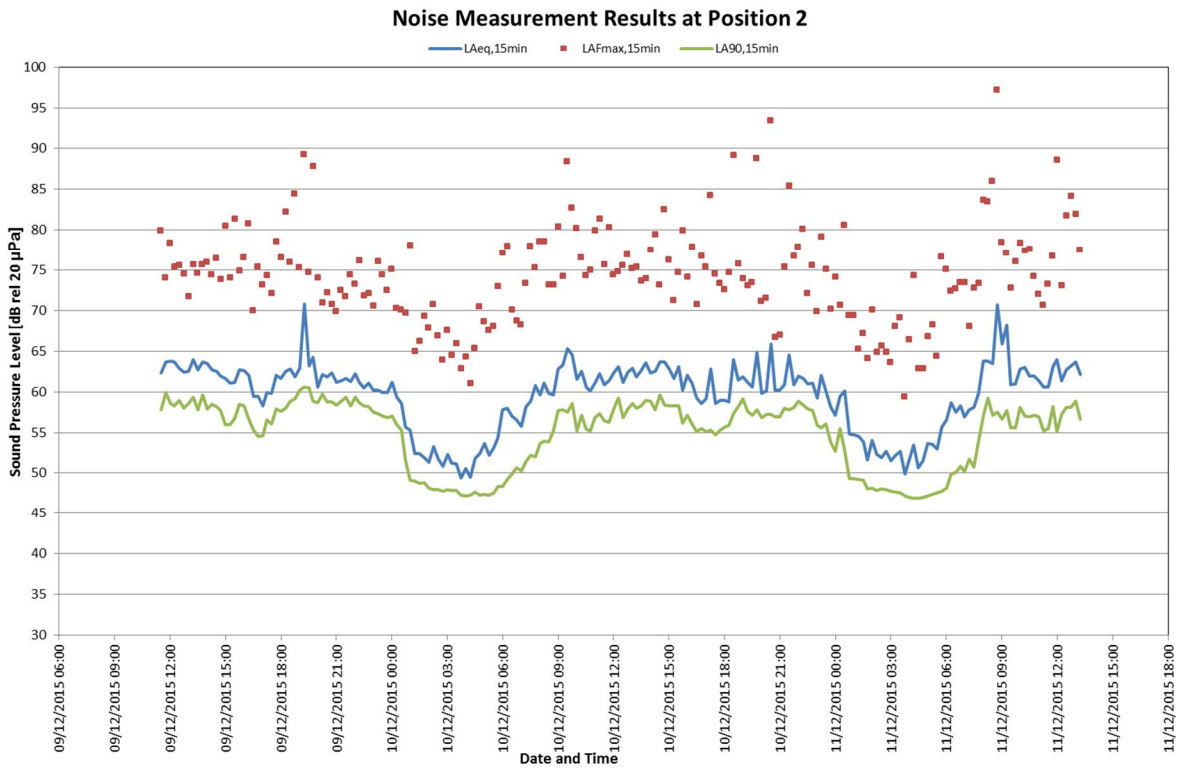
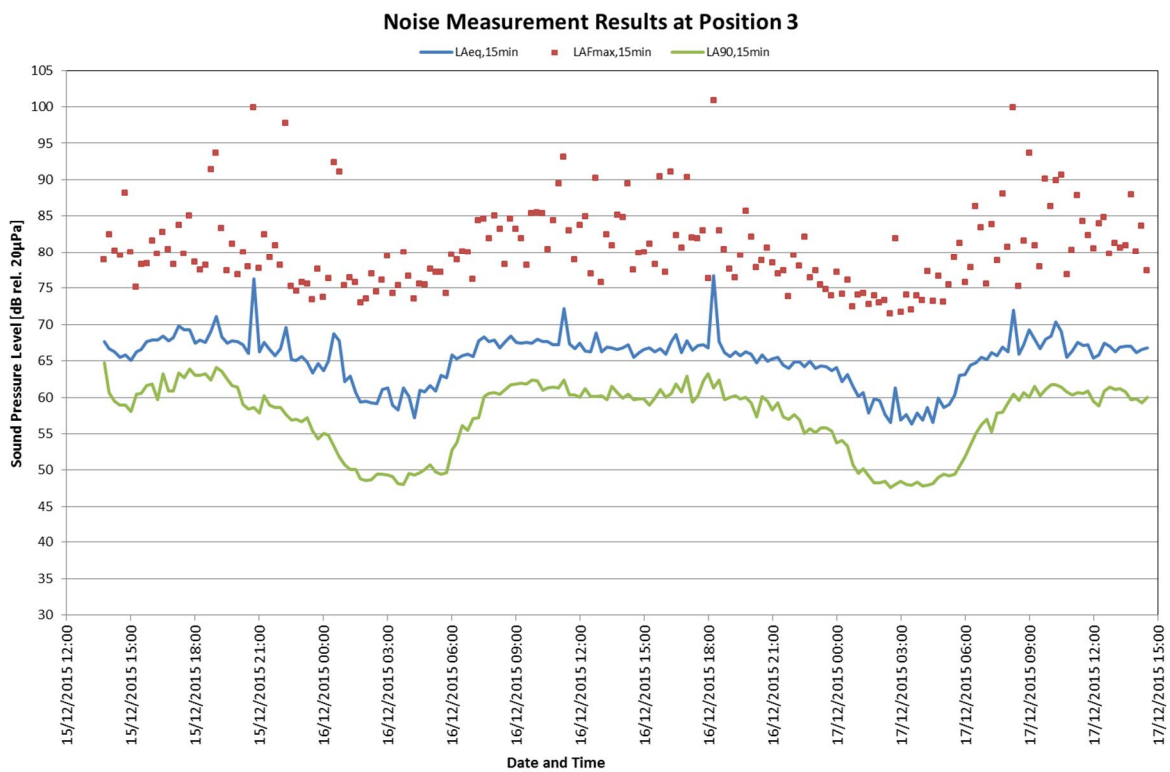


Figure C-6: Noise measurement results at Position 3 (façade conditions)



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## Appendix D – Plant Noise Schedule

See overleaf.



## GOSH 2B Plant Noise Schedule



| Plant Description |                    | Details                       |              |           |            |                         |           | Octave Band Noise Level (dB) |     |     |     |    |    |    |    | dBA |
|-------------------|--------------------|-------------------------------|--------------|-----------|------------|-------------------------|-----------|------------------------------|-----|-----|-----|----|----|----|----|-----|
| Plant Ref.        | Description        | Space Served / Location       | Mfr/Emp Data | SWL / SPL | Power (kW) | Vol (m <sup>3</sup> /s) | ESP (Pa.) | 63                           | 125 | 250 | 500 | 1K | 2K | 4K | 8K |     |
| AHU01-04          | Supply fan inlet   | Various zones L01 to L07      | Mfr          | SWL       | TBC        | 8.0                     | 515       | 88                           | 88  | 87  | 82  | 81 | 77 | 71 | 66 | 86  |
| AHU01-04          | Supply fan outlet  | Various zones L01 to L07      | Mfr          | SWL       | TBC        | 8.0                     | 515       | 89                           | 85  | 91  | 89  | 84 | 79 | 76 | 73 | 90  |
| AHU01-04          | Extract fan inlet  | Various zones L01 to L07      | Mfr          | SWL       | TBC        | 8.0                     | 380       | 85                           | 87  | 81  | 77  | 77 | 72 | 67 | 62 | 81  |
| AHU01-04          | Extract fan outlet | Various zones L01 to L07      | Mfr          | SWL       | TBC        | 8.0                     | 380       | 88                           | 89  | 87  | 86  | 80 | 76 | 77 | 71 | 87  |
| AHU01-04          | Case-radiated      | L08 Plantroom                 | Mfr          | SWL       | TBC        | -                       | -         | 84                           | 84  | 75  | 62  | 56 | 55 | 48 | 43 | 71  |
| AHU05             | Supply fan inlet   | L03 PACU area                 | Mfr          | SWL       | TBC        | 5.6                     | 353       | 89                           | 80  | 79  | 76  | 76 | 70 | 68 | 64 | 80  |
| AHU05             | Supply fan outlet  | L03 PACU area                 | Mfr          | SWL       | TBC        | 5.6                     | 353       | 86                           | 80  | 90  | 88  | 85 | 78 | 77 | 77 | 90  |
| AHU05             | Extract fan inlet  | L03 PACU area                 | Mfr          | SWL       | TBC        | 5.6                     | 262       | 88                           | 79  | 86  | 75  | 75 | 69 | 67 | 63 | 81  |
| AHU05             | Extract fan outlet | L03 PACU area                 | Mfr          | SWL       | TBC        | 5.6                     | 262       | 85                           | 79  | 89  | 87  | 84 | 77 | 76 | 76 | 89  |
| AHU05             | Case-radiated      | L08 Plantroom                 | Mfr          | SWL       | TBC        | -                       | -         | 83                           | 76  | 75  | 62  | 57 | 53 | 48 | 47 | 69  |
| AHU06-07          | Supply fan inlet   | L03 Op. Theatre Suite 11      | Mfr          | SWL       | TBC        | 2.1                     | 510       | 87                           | 84  | 92  | 98  | 95 | 91 | 85 | 81 | 99  |
| AHU06-07          | Supply fan outlet  | L03 Op. Theatre Suite 11      | Mfr          | SWL       | TBC        | 2.1                     | 510       | 77                           | 80  | 98  | 97  | 92 | 87 | 82 | 79 | 98  |
| AHU06-07          | Extract fan inlet  | L03 Op. Theatre Suite 11      | Mfr          | SWL       | TBC        | 2.1                     | 195       | 84                           | 89  | 98  | 96  | 94 | 92 | 86 | 84 | 99  |
| AHU06-07          | Extract fan outlet | L03 Op. Theatre Suite 11      | Mfr          | SWL       | TBC        | 2.1                     | 195       | 77                           | 81  | 93  | 91  | 87 | 83 | 81 | 78 | 93  |
| AHU06-07          | Case-radiated      | L04 Plantroom                 | Mfr          | SWL       | TBC        | -                       | -         | 66                           | 67  | 75  | 75  | 71 | 59 | 34 | 29 | 75  |
| AHU08             | Supply fan inlet   | L03 Op. Theatre Suite 12      | Mfr          | SWL       | TBC        | 2.1                     | 303       | 90                           | 91  | 99  | 97  | 94 | 92 | 86 | 84 | 99  |
| AHU08             | Supply fan outlet  | L03 Op. Theatre Suite 12      | Mfr          | SWL       | TBC        | 2.1                     | 303       | 78                           | 81  | 99  | 93  | 89 | 85 | 83 | 80 | 96  |
| AHU08             | Extract fan inlet  | L03 Op. Theatre Suite 12      | Mfr          | SWL       | TBC        | 2.1                     | 245       | 84                           | 89  | 98  | 96  | 94 | 92 | 86 | 84 | 99  |
| AHU08             | Extract fan outlet | L03 Op. Theatre Suite 12      | Mfr          | SWL       | TBC        | 2.1                     | 245       | 77                           | 81  | 93  | 91  | 87 | 83 | 81 | 78 | 93  |
| AHU08             | Case-radiated      | S. Riser Shaft                | Mfr          | SWL       | TBC        | -                       | -         | 68                           | 70  | 77  | 74  | 70 | 60 | 34 | 30 | 75  |
| ISO AHU01-13      | Supply fan inlet   | Various Isolation Suites      | Mfr          | SWL       | TBC        | 0.5                     | 590       | 74                           | 74  | 75  | 82  | 80 | 81 | 77 | 73 | 86  |
| ISO AHU01-13      | Supply fan outlet  | Various Isolation Suites      | Mfr          | SWL       | TBC        | 0.5                     | 590       | 67                           | 66  | 70  | 77  | 74 | 71 | 72 | 68 | 80  |
| ISO AHU01-13      | Extract fan inlet  | Various Isolation Suites      | Mfr          | SWL       | TBC        | 0.5                     | 858       | 74                           | 74  | 75  | 82  | 80 | 81 | 77 | 73 | 86  |
| ISO AHU01-13      | Extract fan outlet | Various Isolation Suites      | Mfr          | SWL       | TBC        | 0.5                     | 858       | 67                           | 66  | 70  | 77  | 74 | 71 | 72 | 68 | 80  |
| ISO AHU01-13      | Case-radiated      | L08 Plantroom/N. Riser(12/13) | Mfr          | SWL       | TBC        | -                       | -         | 55                           | 54  | 52  | 59  | 56 | 48 | 25 | 19 | 59  |

**Comments:** Mfr: Manufacturer

Emp: Empirical

SWL: Sound Power Level

SPL: Sound Pressure Level

ESP: Extenal Static Pressure

SWL\*: Sound Power Level estimated from manufacturers' sound pressure level data

# GOSH 2B Plant Noise Schedule



| Plant Description |  | Details                 |              |            |            |                         |           | Octave Band Noise Level (dB) |     |     |     |    |    |    |    | dBA |
|-------------------|--|-------------------------|--------------|------------|------------|-------------------------|-----------|------------------------------|-----|-----|-----|----|----|----|----|-----|
| Plant Ref.        | Description                            | Space Served / Location | Mfr/Emp Data | SWL / SPL  | Power (kW) | Vol (m <sup>3</sup> /s) | ESP (Pa.) | 63                           | 125 | 250 | 500 | 1K | 2K | 4K | 8K |     |
| SF02              | Supply fan: inlet                      | North riser vent supply | Mfr          | SWL        | TBC        | 0.29                    | 236       | 76                           | 80  | 82  | 82  | 80 | 72 | 65 | 59 | 84  |
| SF02              | Supply fan: outlet                     | North riser vent supply | Mfr          | SWL        | TBC        | 0.29                    | 236       | 77                           | 80  | 86  | 83  | 81 | 73 | 65 | 60 | 85  |
| SF02              | Case-radiated                          | L07 N. Riser shaft      | Mfr          | SWL        | TBC        | -                       | -         | 77                           | 80  | 86  | 83  | 81 | 73 | 65 | 60 | 85  |
| SF03              | Supply fan: inlet                      | South riser vent supply | Mfr          | SWL        | TBC        | 0.22                    | 210       | 80                           | 85  | 87  | 93  | 89 | 84 | 76 | 68 | 93  |
| SF03              | Supply fan: outlet                     | South riser vent supply | Mfr          | SWL        | TBC        | 0.22                    | 210       | 81                           | 86  | 87  | 93  | 89 | 84 | 76 | 70 | 93  |
| SF03              | Case-radiated                          | L07 S. Riser shaft      | Mfr          | SWL        | TBC        | -                       | -         | 81                           | 86  | 87  | 93  | 89 | 84 | 76 | 70 | 93  |
| SF04              | Supply fan: inlet                      | L08 Elect Plant rooms   | Mfr          | SWL        | TBC        | 3.76                    | 183       | 86                           | 82  | 85  | 84  | 80 | 79 | 74 | 68 | 86  |
| SF04              | Supply fan: outlet                     | L08 Elect Plant rooms   | Mfr          | SWL        | TBC        | 3.76                    | 183       | 88                           | 82  | 86  | 84  | 81 | 80 | 76 | 72 | 87  |
| SF04              | Case-radiated                          | L08 Plant room          | Mfr          | SWL        | TBC        | -                       | -         | 78                           | 61  | 60  | 59  | 56 | 52 | 56 | 49 | 63  |
| SF05              | Supply fan: inlet                      | Loading Bay FA supply   | Mfr          | SWL        | TBC        | 0.33                    | 102       | 67                           | 69  | 69  | 69  | 61 | 59 | 53 | 47 | 69  |
| SF05              | Supply fan: outlet                     | Loading Bay FA supply   | Mfr          | SWL        | TBC        | 0.33                    | 102       | 69                           | 71  | 69  | 69  | 63 | 59 | 54 | 49 | 69  |
| SF05              | Case-radiated                          | L01 Loading Bay canopy  | Mfr          | SWL        | TBC        | -                       | -         | 69                           | 71  | 69  | 69  | 63 | 59 | 54 | 49 | 69  |
| EF02              | Extract fan: inlet                     | N. Riser Vent. Extract  | Mfr          | SWL        | TBC        | 0.27                    | 83        | 51                           | 60  | 62  | 56  | 53 | 50 | 47 | 37 | 59  |
| EF02              | Roof extract fan: outlet+case-radiated | L07 N. Riser shaft      | Mfr          | SWL        | TBC        | 0.27                    | 83        | 55                           | 58  | 64  | 60  | 57 | 52 | 46 | 36 | 62  |
| EF03              | Extract fan: inlet                     | S. Riser Vent. Extract  | Mfr          | SWL        | TBC        | 0.22                    | 75        | 61                           | 60  | 66  | 58  | 59 | 58 | 53 | 49 | 64  |
| EF03              | Roof extract fan: outlet+case-radiated | L07 S. Riser shaft      | Mfr          | SWL        | TBC        | 0.22                    | 75        | 58                           | 59  | 63  | 64  | 61 | 64 | 55 | 53 | 68  |
| EF04              | Wall mounted fan                       | L03 Bottle Store        | Mfr          | SPL at 3 m | TBC        | 0.03                    | 25        | Not available                |     |     |     |    |    |    |    | 43  |
| EF05              | Extract fan: inlet                     | L01 Nuclear Med         | Mfr          | SWL        | TBC        | 0.51                    | 201       | 68                           | 71  | 78  | 73  | 77 | 68 | 62 | 55 | 79  |
| EF05              | Extract fan: outlet                    | L01 Nuclear Med         | Mfr          | SWL        | TBC        | 0.51                    | 201       | 69                           | 71  | 81  | 74  | 77 | 69 | 62 | 55 | 80  |
| EF05              | Case-radiated                          | L07 N. Riser shaft      | Mfr          | SWL        | TBC        | -                       | -         | 69                           | 71  | 81  | 74  | 77 | 69 | 62 | 55 | 80  |
| EF06              | Extract fan: inlet                     | L01 Nuclear Med         | Mfr          | SWL        | TBC        | 0.51                    | 201       | 68                           | 71  | 78  | 73  | 77 | 68 | 62 | 55 | 79  |
| EF06              | Extract fan: outlet                    | L01 Nuclear Med         | Mfr          | SWL        | TBC        | 0.51                    | 201       | 69                           | 71  | 81  | 74  | 77 | 69 | 62 | 55 | 80  |
| EF06              | Case-radiated                          | L07 N. Riser shaft      | Mfr          | SWL        | TBC        | -                       | -         | 69                           | 71  | 81  | 74  | 77 | 69 | 62 | 55 | 80  |
|                   |  |                         |              |            |            |                         |           |                              |     |     |     |    |    |    |    |     |
|                   |  |                         |              |            |            |                         |           |                              |     |     |     |    |    |    |    |     |

**Comments:** Mfr: Manufacturer

Emp: Empirical

SWL: Sound Power Level

SPL: Sound Pressure Level

ESP: Extenal Static Pressure

SWL\*: Sound Power Level estimated from manufacturers' sound pressure level data

## GOSH 2B Plant Noise Schedule



| Plant Description |   | Details                   |              |                |            |                         |           | Octave Band Noise Level (dB) |     |     |     |     |     |     |     | dBA |
|-------------------|---|---------------------------|--------------|----------------|------------|-------------------------|-----------|------------------------------|-----|-----|-----|-----|-----|-----|-----|-----|
| Plant Ref.        | Description                                     | Space Served / Location   | Mfr/Emp Data | SWL / SPL      | Power (kW) | Vol (m <sup>3</sup> /s) | ESP (Pa.) | 63                           | 125 | 250 | 500 | 1K  | 2K  | 4K  | 8K  |     |
| EF07              | Extract fan: inlet                              | Loading Bay extract       | Mfr          | SWL            | TBC        | 0.60                    | 138       | 81                           | 72  | 75  | 73  | 73  | 72  | 71  | 66  | 79  |
| EF07              | Extract fan: outlet                             | Loading Bay extract       | Mfr          | SWL            | TBC        | 0.60                    | 138       | 82                           | 73  | 76  | 74  | 74  | 73  | 71  | 66  | 80  |
| EF07              | Case-radiated                                   | L01 Loading Bay canopy    | Mfr          | SWL            | TBC        | -                       | -         | 82                           | 73  | 76  | 74  | 74  | 73  | 71  | 66  | 80  |
| EF08              | Extract fan: inlet                              | Cooling air circulation   | Mfr          | SWL            | TBC        | 1.35                    | 120       | 76                           | 75  | 71  | 69  | 65  | 64  | 60  | 56  | 72  |
| EF08              | Extract fan: outlet                             | Cooling air circulation   | Mfr          | SWL            | TBC        | 1.35                    | 120       | 77                           | 75  | 71  | 69  | 65  | 64  | 61  | 57  | 72  |
| EF08              | Case-radiated                                   | L01 Medical Air Plantroom | Mfr          | SWL            | TBC        | -                       | -         | 77                           | 75  | 71  | 69  | 65  | 64  | 61  | 57  | 72  |
| Pressure burner   | Overall sound power (high-fired)                | L08 Plantroom             | Mfr          | SWL*           | TBC        | -                       | -         | 70                           | 86  | 86  | 88  | 88  | 86  | 84  | 85  | 93  |
| ABS2/L08          | Chiller   | Level 8 Chiller Room      | Mfr          | SWL*           | TBC        | TBC                     | N/A       | 84                           | 83  | 83  | 84  | 83  | 82  | 77  | 75  | 88  |
| ABS4/L08          | Chiller   | Level 8 Chiller Room      | Mfr          | SWL*           | TBC        | TBC                     | N/A       | 84                           | 83  | 83  | 84  | 83  | 82  | 77  | 75  | 88  |
| CHP               | CHP (aggregate, no casing)                      | Phase 2A roof             | Mfr          | SPL at 1m      | TBC        | TBC                     | N/A       | 84                           | 98  | 95  | 91  | 86  | 88  | 92  | 89  | 97  |
| CHP               | CHP (aggregate, with casing)                    | Phase 2A roof             | Mfr          | SPL(est) at 1m | TBC        | TBC                     | N/A       | 84                           | 67  | 74  | 68  | 55  | 59  | 60  | 63  | 70  |
| CHP               | CHP (exhaust, no silencing)                     | Phase 2A roof             | Mfr          | SPL at 1m      | TBC        | TBC                     | N/A       | 117                          | 115 | 113 | 108 | 105 | 108 | 109 | 107 | 115 |
| CHP               | CHP (exhaust, no silenced)                      | Phase 2A roof             | Mfr          | SPL(est) at 1m | TBC        | TBC                     | N/A       | 91                           | 64  | 24  | <20 | <20 | <20 | <20 | <20 | 65  |
| Transformer       | Transformer                                     | Transformer Room          | Mfr          | SWL            | TBC        | TBC                     | N/A       | Not available                |     |     |     |     |     |     |     | 70  |
| Emerg. Gen.       | Emergency Generator (walls)                     | L08 Plant room            | Mfr          | SPL at 1m      | TBC        | TBC                     | N/A       | 70                           | 79  | 71  | 65  | 59  | 52  | 47  | 43  | 68  |
| Emerg. Gen.       | Emergency Generator (inlet)                     | L08 Plant room            | Mfr          | SPL at 1m      | TBC        | TBC                     | N/A       | 84                           | 82  | 67  | 49  | 49  | 48  | 47  | 60  | 67  |
| Emerg. Gen.       | Emergency Generator (outlet)                    | L08 Plant room            | Mfr          | SPL at 1m      | TBC        | TBC                     | N/A       | 90                           | 66  | 67  | 62  | 58  | 57  | 48  | 26  | 68  |
| Pump 4/L08        | MTHW / Boiler Pump 4                            | L08 Plant room            | Mfr          | SPL at 1m      | 2 x 11     | TBC                     | N/A       | Not available                |     |     |     |     |     |     |     | 53  |
| Pump 7/L08        | MTHW / Absorption Chiller 2 & 4 Heating         | L08 Plant room            | Mfr          | SPL at 1m      | 2 x 7.5    | TBC                     | N/A       | Not available                |     |     |     |     |     |     |     | 51  |
| Pump 11/L08       | MTHW to EnPOD 1 / DHWS Calrs / L08 AHUs Heating | L08 Plant room            | Mfr          | SPL at 1m      | 2 x 18.5   | TBC                     | N/A       | Not available                |     |     |     |     |     |     |     | 60  |
| Pump 12/L08       | MTHW to LG-LTHW PHE's                           | L08 Plant room            | Mfr          | SPL at 1m      | 2 x 2.2    | TBC                     | N/A       | Not available                |     |     |     |     |     |     |     | 51  |
| Pump 5/L08        | Secondary LG-LTHW                               | L08 Plant room            | Mfr          | SPL at 1m      | 2 x 15     | TBC                     | N/A       | Not available                |     |     |     |     |     |     |     | 54  |
| Pump 2/L08        | CHW / Absorption Chiller 2 & 4 Heating          | L08 Plant room            | Mfr          | SPL at 1m      | 2 x 11     | TBC                     | N/A       | Not available                |     |     |     |     |     |     |     | 53  |
| Pump 6/L08        | HG-CHW to OT AHU's + HUBs + Kitchens            | L08 Plant room            | Mfr          | SPL at 1m      | 2 x 7.5    | TBC                     | N/A       | Not available                |     |     |     |     |     |     |     | 51  |
| Pump 7/L08        | HG-CHW to L08 AHU's                             | L08 Plant room            | Mfr          | SPL at 1m      | 2 x 15     | TBC                     | N/A       | Not available                |     |     |     |     |     |     |     | 54  |

**Comments:** Mfr: Manufacturer

Emp: Empirical

SWL: Sound Power Level

SWL\*: Sound Power Level estimated from manufacturers' sound pressure level data

SPL: Sound Pressure Level

ESP: Extenal Static Pressure

[illegible]

**Comments:** Mfr: Manufacturer  
Emp: Empirical  
SWL: Sound Power Level  
SPL: Sound Pressure Level  
ESP: Extenal Static Pressure

SWL\*: Sound Power Level estimated from manufacturers' sound pressure level data

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## Appendix E – Attenuator Schedule

See overleaf.

# Technical Submittal



|  |  |
|--|--|
| <b>Project:</b> Great Ormond Street Hospital |  |
| <b>From:</b> Chris Tancock                   | <b>Ref:</b> TS-016                         |
| <b>To:</b> Kesh Jehanathan                   | <b>Date:</b> 25 <sup>th</sup> October 2015 |

|  |  |
|--|--|
| <b>Equipment:</b> Attenuators  | <b>Manufacturer:</b> Allaway Acoustics Ltd |
| IDSL to propose to use Attenuators manufactured by Allaway Acoustics Ltd on the Great Ormond Street Hospital Phase 2B Project. |  |
| <b>Specification Ref:</b> WSP Specification – Volume 2, Part 3 – Section 11.2<br>Skanska Volume 2 – July 2015                  |  |

| Supporting Documentation Issued |                               |   |        |                                 |  |
|---------------------------------|-------------------------------|---|--------|---------------------------------|--|
| (i)                             | Equipment Specifying Schedule |   | (vii)  | Builders Work Requirements      |  |
| (ii)                            | Manufacturers Data            | ✓ | (viii) | Assembly & Installation Details |  |
| (iii)                           | Design Check Calculations     | ✓ | (ix)   | O&M Instructions                |  |
| (iv)                            | Certified Performance Levels  |   | (x)    | List of Recommended Spares      |  |
| (v)                             | QA /QC Documents              |   | (xi)   | Deviation Schedule              |  |
| (vi)                            | Sample Enclosed               |   | (xii)  | Other                           |  |

| Additional Information |
|------------------------|
|                        |

|                                    |              |              |              |
|------------------------------------|--------------|--------------|--------------|
|                                    |              |              |              |
| <b>M&amp;E Contractor:</b> Skanska | <b>Name:</b> | <b>Sign:</b> | <b>Date:</b> |
|                                    |              |              |              |
| <b>Main Contractor:</b> Skanska    | <b>Name:</b> | <b>Sign:</b> | <b>Date:</b> |
|                                    |              |              |              |
| <b>Services Consultant:</b> WSP    | <b>Name:</b> | <b>Sign:</b> | <b>Date:</b> |
|                                    |              |              |              |





EQUIPMENT SCHEDULE

| Item | System Reference                     | Suffix | DWG  | L1   | L2/ID | W    | H/Dia | Vol               | PD | Wt  |    | Performance, dB |     |     |     |    |    |    |    |
|------|--------------------------------------|--------|------|------|-------|------|-------|-------------------|----|-----|----|-----------------|-----|-----|-----|----|----|----|----|
|      |                                      |        |      | mm   | mm    | mm   | mm    | m <sup>3</sup> /s | Pa | kg  |    | 63              | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| 1    | ATT01 - AHU01 & 02 COMMON FAI*       | GM2    | A02E | 1800 |       | 3000 | 1200  | 12.938            | 50 | 613 | IL | 7               | 18  | 25  | 43  | 55 | 51 | 42 | 27 |
| 2    | ATT02 - AHU01 & 02 EXHAUST*          | G      | A02E | 1800 |       | 3000 | 1200  | 12.938            | 50 | 578 | IL | 13              | 23  | 37  | 53  | 55 | 55 | 47 | 31 |
| 3    | ATT03 - DELETED                      |        |      |      |       |      |       |                   |    |     |    |                 |     |     |     |    |    |    |    |
| 4    | ATT04 - DELETED                      |        |      |      |       |      |       |                   |    |     |    |                 |     |     |     |    |    |    |    |
| 5    | ATT05 - NORTH COMMON SUPPLY DUCTWK*  | GM2    | A02E | 1800 |       | 2100 | 1400  | 12.938            | 39 | 443 | IL | 9               | 18  | 26  | 42  | 52 | 38 | 33 | 21 |
| 6    | ATT06 - NORTH COMMON EXTRACT DUCTWK* | GM2    | A02E | 1800 |       | 2100 | 1400  | 12.938            | 39 | 443 | IL | 9               | 18  | 26  | 42  | 52 | 38 | 33 | 21 |
| 7    | ATT07 - AHU03 FAI                    | GM2    | A02E | 1800 |       | 2000 | 1000  | 8                 | 50 | 374 | IL | 7               | 18  | 25  | 43  | 55 | 51 | 42 | 27 |
| 8    | ATT08 - AHU03 & 04 COMMON EXHAUST    | G      | A02E | 1800 |       | 3000 | 1200  | 13.824            | 50 | 578 | IL | 13              | 23  | 37  | 53  | 55 | 55 | 47 | 31 |
| 9    | ATT09 - AHU04 FAI                    | GM2    | A02E | 1800 |       | 2000 | 1000  | 8                 | 50 | 374 | IL | 7               | 18  | 25  | 43  | 55 | 51 | 42 | 27 |
| 10   | ATT10 - DELETED                      |        |      |      |       |      |       |                   |    |     |    |                 |     |     |     |    |    |    |    |
| 11   | ATT11 - SOUTH COMMON SUPPLY DUCTWK*  | GM2    | A02E | 1800 |       | 1925 | 1600  | 13.824            | 45 | 476 | IL | 6               | 15  | 23  | 41  | 52 | 42 | 35 | 23 |
| 12   | ATT12 - SOUTH COMMON EXTRACT DUCTWK* | GM2    | A02E | 1800 |       | 1925 | 1600  | 13.824            | 45 | 476 | IL | 6               | 15  | 23  | 41  | 52 | 42 | 35 | 23 |
| 13   | ATT13 - AHU05 SUPPLY*                | GM2    | A02E | 900  |       | 3000 | 1400  | 5.526             | 35 | 431 | IL | 9               | 19  | 22  | 34  | 46 | 39 | 32 | 28 |
| 14   | ATT14 - AHU05 EXTRACT*               | GM2    | A02E | 900  |       | 3000 | 1400  | 5.526             | 35 | 431 | IL | 9               | 19  | 22  | 34  | 46 | 39 | 32 | 28 |
| 15   | ATT15 - AHU05 FAI*                   | GM2    | A02E | 900  |       | 3000 | 1400  | 5.526             | 35 | 431 | IL | 9               | 19  | 22  | 34  | 46 | 39 | 32 | 28 |
| 16   | ATT16 - AHU05 EXHAUST*               | G      | A02E | 900  |       | 2500 | 1000  | 5.526             | 35 | 274 | IL | 6               | 13  | 22  | 34  | 55 | 52 | 48 | 33 |
| 17   | ATT17 - ISO 01 AHU SUPPLY            | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 18   | ATT18 - ISO 01 AHU EXTRACT           | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 19   | ATT19 - ISO 01 AHU FAI               | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 20   | ATT20 - ISO 01 AHU EXHAUST           | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 21   | ATT21 - ISO 02 AHU SUPPLY            | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 22   | ATT22 - ISO 02 AHU EXTRACT           | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 23   | ATT23 - ISO 02 AHU FAI               | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 24   | ATT24 - ISO 02 AHU EXHAUST           | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 25   | ATT25 - ISO 03 AHU SUPPLY            | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 26   | ATT26 - ISO 03 AHU EXTRACT           | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 27   | ATT27 - ISO 03 AHU FAI               | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |
| 28   | ATT28 - ISO 03 AHU EXHAUST           | GM2J   | A02E | 1500 |       | 800  | 400   | 0.5               | 34 | 74  | IL | 17              | 28  | 32  | 45  | 55 | 42 | 31 | 25 |



## EQUIPMENT SCHEDULE

| Item | System                     | Suffix | DWG  | L1   | L2/ID | W   | H/Dia | Vol | PD | Wt |    | Performance, dB |    |    |    |    |    |    |    |
|------|----------------------------|--------|------|------|-------|-----|-------|-----|----|----|----|-----------------|----|----|----|----|----|----|----|
|      |                            |        |      |      |       |     |       |     |    |    |    | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 29   | ATT29 - ISO 04 AHU SUPPLY  | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 30   | ATT30 - ISO 04 AHU EXTRACT | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 31   | ATT31 - ISO 04 AHU FAI     | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 32   | ATT32 - ISO 04 AHU EXHAUST | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 33   | ATT33 - ISO 05 AHU SUPPLY  | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 34   | ATT34 - ISO 05 AHU EXTRACT | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 35   | ATT35 - ISO 05 AHU FAI     | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 36   | ATT36 - ISO 05 AHU EXHAUST | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 37   | ATT37 - ISO 06 AHU SUPPLY  | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 38   | ATT38 - ISO 06 AHU EXTRACT | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 39   | ATT39 - ISO 06 AHU FAI     | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 40   | ATT40 - ISO 06 AHU EXHAUST | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 41   | ATT41 - ISO 07 AHU SUPPLY  | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 42   | ATT42 - ISO 07 AHU EXTRACT | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 43   | ATT43 - ISO 07 AHU FAI     | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 44   | ATT44 - ISO 07 AHU EXHAUST | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 45   | ATT45 - ISO 08 AHU SUPPLY  | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 46   | ATT46 - ISO 08 AHU EXTRACT | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 47   | ATT47 - ISO 08 AHU FAI     | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 48   | ATT48 - ISO 08 AHU EXHAUST | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 49   | ATT49 - ISO 09 AHU SUPPLY  | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 50   | ATT50 - ISO 09 AHU EXTRACT | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 51   | ATT51 - ISO 09 AHU FAI     | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 52   | ATT52 - ISO 09 AHU EXHAUST | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 53   | ATT53 - ISO 10 AHU SUPPLY  | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 54   | ATT54 - ISO 10 AHU EXTRACT | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 55   | ATT55 - ISO 10 AHU FAI     | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 56   | ATT56 - ISO 10 AHU EXHAUST | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 57   | ATT57 - ISO 11 AHU SUPPLY  | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 58   | ATT58 - ISO 11 AHU RETURN  | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 59   | ATT59 - ISO 11 AHU FAI     | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 60   | ATT60 - ISO 11 AHU EXHAUST | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5 | 34 | 74 | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |



EQUIPMENT SCHEDULE

| Item | System                                 | Suffix | DWG  | L1   | L2/ID | W   | H/Dia | Vol   | PD | Wt  |    | Performance, dB |    |    |    |    |    |    |    |
|------|--|--------|------|------|-------|-----|-------|-------|----|-----|----|-----------------|----|----|----|----|----|----|----|
| 61   | ATT61 - ISO 12/13 COMMON AHU'S SUPPLY* | GM2J   | A02E | 1800 |       | 950 | 650   | 1     | 25 | 142 | IL | 19              | 32 | 37 | 55 | 55 | 44 | 37 |    |
| 62   | ATT62 - ISO 12 AHU EXTRACT             | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5   | 34 | 74  | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 63   | ATT63 - ISO 12 AHU FAI                 | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5   | 34 | 74  | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 64   | ATT64 - ISO 12 AHU EXHAUST             | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5   | 34 | 74  | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 65   | ATT65 - DELETED                        |        |      |      |       |     |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 66   | ATT66 - ISO 13 AHU EXTRACT             | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5   | 34 | 74  | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 67   | ATT67 - ISO 13 AHU FAI                 | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5   | 34 | 74  | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 68   | ATT68 - ISO 13 AHU EXHAUST             | GM2J   | A02E | 1500 |       | 800 | 400   | 0.5   | 34 | 74  | IL | 17              | 28 | 32 | 45 | 55 | 42 | 31 | 25 |
| 69   | ATT69 - DELETED                        |        |      |      |       |     |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 70   | ATT70 - DELETED                        |        |      |      |       |     |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 71   | ATT71 - DELETED                        |        |      |      |       |     |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 72   | ATT72 - DELETED                        |        |      |      |       |     |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 73   | ATT73 - SHAFT VENT FA FAN INLET*       | GM2    | A02E | 1200 |       | 450 | 450   | 0.182 | 35 | 48  | IL | 7               | 16 | 24 | 41 | 55 | 47 | 40 | 29 |
| 74   | ATT77 - OT AHU06 SUPPLY*               | GM2    | A02E | 1500 |       | 900 | 750   | 2.037 | 35 | 128 | IL | 9               | 19 | 29 | 42 | 55 | 44 | 34 | 25 |
| 75   | ATT78 - OT3 AHU06 EXTRACT*             | GM2    | A02E | 1500 |       | 900 | 750   | 2.037 | 35 | 128 | IL | 9               | 19 | 29 | 42 | 55 | 44 | 34 | 25 |
| 76   | ATT79 - OT AHU06 FAI*                  | GM2    | A02E | 1500 |       | 900 | 750   | 2.037 | 35 | 128 | IL | 9               | 19 | 29 | 42 | 55 | 44 | 34 | 25 |
| 77   | ATT80 - OT AHU06 EXHAUST*              | G      | A02E | 1500 |       | 900 | 750   | 2.037 | 35 | 128 | IL | 8               | 17 | 33 | 47 | 55 | 55 | 55 | 36 |
| 78   | ATT81 - OT AHU07 SUPPLY*               | GM2    | A02E | 1500 |       | 900 | 750   | 2.037 | 35 | 128 | IL | 9               | 19 | 29 | 42 | 55 | 44 | 34 | 25 |
| 79   | ATT82 - OT AHU07 EXTRACT*              | GM2    | A02E | 1500 |       | 900 | 750   | 2.037 | 35 | 128 | IL | 9               | 19 | 29 | 42 | 55 | 44 | 34 | 25 |
| 80   | ATT83 - OT AHU07 FAI*                  | GM2    | A02E | 1500 |       | 900 | 750   | 2.037 | 35 | 128 | IL | 9               | 19 | 29 | 42 | 55 | 44 | 34 | 25 |
| 81   | ATT84 - OT AHU07 EXHAUST*              | G      | A02E | 1500 |       | 900 | 750   | 2.037 | 35 | 128 | IL | 8               | 17 | 33 | 47 | 55 | 55 | 55 | 36 |
| 82   | ATT85 - ON-FLOOR SUPPLY L01*           | GM2    | A02E | 2700 |       | 900 | 750   | 2.42  | 50 | 199 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 83   | ATT86 - ON-FLOOR EXTRACT L01*          | GM2    | A02E | 2700 |       | 900 | 750   | 2.2   | 50 | 199 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 84   | ATT87 - ON-FLOOR SUPPLY L02*           | GM2    | A02E | 2700 |       | 900 | 750   | 1.819 | 50 | 199 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 85   | ATT88 - ON-FLOOR EXTRACT L02*          | GM2    | A02E | 2700 |       | 900 | 750   | 1.8   | 50 | 199 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 86   | ATT89 - ON-FLOOR SUPPLY L03*           | GM2J   | A02E | 2100 |       | 900 | 600   | 0.719 | 50 | 148 | IL | 18              | 33 | 44 | 55 | 55 | 55 | 50 | 41 |
| 87   | ATT90 - ON-FLOOR EXTRACT L03*          | GM2J   | A02E | 2100 |       | 900 | 600   | 0.703 | 50 | 148 | IL | 18              | 33 | 44 | 55 | 55 | 55 | 50 | 41 |
| 88   | ATT91 - ON-FLOOR SUPPLY L04*           | GM2J   | A02E | 2400 |       | 900 | 750   | 1.677 | 50 | 188 | IL | 22              | 37 | 44 | 55 | 55 | 55 | 42 | 34 |



EQUIPMENT SCHEDULE

| Item | System   | Suffix | DWG  | L1   | L2/ID | W    | H/Dia | Vol   | PD | Wt  |    | Performance, dB |    |    |    |    |    |    |    |
|------|--|--------|------|------|-------|------|-------|-------|----|-----|----|-----------------|----|----|----|----|----|----|----|
| 89   | ATT92 - ON-FLOOR EXTRACT L04*                    | GM2J   | A02E | 2400 |       | 900  | 750   | 1.682 | 50 | 188 | IL | 22              | 37 | 44 | 55 | 55 | 55 | 42 | 34 |
| 90   | ATT93 - ON-FLOOR SUPPLY L05*                     | GM2J   | A02E | 2100 |       | 900  | 750   | 1.137 | 50 | 174 | IL | 22              | 36 | 44 | 55 | 55 | 55 | 46 | 40 |
| 91   | ATT94 - ON-FLOOR EXTRACT L05*                    | GM2J   | A02E | 2100 |       | 900  | 750   | 1.137 | 50 | 174 | IL | 22              | 36 | 44 | 55 | 55 | 55 | 46 | 40 |
| 92   | ATT95 - ON-FLOOR SUPPLY L06*                     | GM2    | A02E | 2700 |       | 900  | 750   | 1.92  | 50 | 199 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 93   | ATT96 - ON-FLOOR EXTRACT L06*                    | GM2J   | A02E | 2400 |       | 900  | 750   | 1.751 | 50 | 188 | IL | 22              | 37 | 44 | 55 | 55 | 55 | 42 | 34 |
| 94   | ATT97 - ON-FLOOR SUPPLY L07*                     | GM2    | A02E | 2700 |       | 900  | 750   | 2.492 | 50 | 199 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 95   | ATT98 - ON-FLOOR EXTRACT L07*                    | GM2    | A02E | 2700 |       | 900  | 750   | 2.207 | 50 | 199 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 96   | ATT99 - ON-FLOOR SUPPLY L08*                     | GM2    | A02E | 2700 |       | 900  | 750   | 2.2   | 50 | 199 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 97   | ATT100 - ON-FLOOR EXTRACT L01*                   | GM2    | A02E | 2700 |       | 900  | 750   | 2.2   | 50 | 199 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 98   | ATT101 - ON-FLOOR SUPPLY L02*                    | GM2    | A02E | 2700 |       | 900  | 800   | 2.759 | 50 | 208 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 99   | ATT102 - ON-FLOOR- EXTRACT L02*                  | GM2    | A02E | 2700 |       | 900  | 800   | 2.708 | 50 | 208 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 100  | ATT103 - DELETED                                 |        |      |      |       |      |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 101  | ATT104 - DELETED                                 |        |      |      |       |      |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 102  | ATT105 - DELETED                                 |        |      |      |       |      |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 103  | ATT106 - DELETED                                 |        |      |      |       |      |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 104  | ATT107 - ON-FLOOR SUPPLY L04*                    | GM2    | A02E | 2700 |       | 900  | 800   | 2.775 | 50 | 208 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 105  | ATT108 - ON-FLOOR EXTRACT L04*                   | GM2    | A02E | 2700 |       | 900  | 800   | 2.574 | 50 | 208 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 106  | ATT109 - ON-FLOOR SUPPLY L05*                    | GM2    | A02E | 2700 |       | 900  | 800   | 2.608 | 50 | 208 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 107  | ATT110 - ON-FLOOR EXTRACT L05*                   | GM2    | A02E | 2700 |       | 900  | 800   | 2.621 | 50 | 208 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 108  | ATT111 - ON-FLOOR SUPPLY L06*                    | GM2    | A02E | 2700 |       | 900  | 800   | 2.547 | 50 | 208 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 109  | ATT112 - ON-FLOOR SUPPLY L06*                    | GM2    | A02E | 2700 |       | 900  | 800   | 2.514 | 50 | 208 | IL | 21              | 35 | 44 | 55 | 55 | 46 | 37 | 25 |
| 110  | ATT113 - ON-FLOOR SUPPLY L07*                    | GM2    | A02E | 2400 |       | 800  | 600   | 0.825 | 50 | 152 | IL | 23              | 38 | 44 | 55 | 55 | 55 | 41 | 34 |
| 111  | ATT114 - ELECT PLANT ROOMS VENT FAN SUCTION L08* | GJ     | A02E | 600  |       | 1300 | 1200  | 3.757 | 35 | 125 | IL | 7               | 12 | 17 | 23 | 34 | 30 | 25 | 19 |
| 112  | ATT115 - ELECT PLANT ROOMS VENT FAN              | GJ     | A02E | 600  |       | 1300 | 1200  | 3.757 | 35 | 125 | IL | 7               | 12 | 17 | 23 | 34 | 30 | 25 | 19 |



EQUIPMENT SCHEDULE

| Item | System  | Suffix | DWG  | L1   | L2/ID | W    | H/Dia | Vol   | PD | Wt  |    | Performance, dB |    |    |    |    |    |    |    |
|------|---|--------|------|------|-------|------|-------|-------|----|-----|----|-----------------|----|----|----|----|----|----|----|
|      | DISCHARGE L08*  |        |      |      |       |      |       |       |    |     |    |                 |    |    |    |    |    |    |    |
| 113  | ATT116 - L01<br>NUCLEAR MED<br>EXT FAN EF05<br>INLET  | G      | A02E | 1200 |       | 600  | 500   | 0.5   | 30 | 63  | IL | 12              | 23 | 32 | 46 | 55 | 55 | 55 | 45 |
| 114  | ATT117 - L01<br>NUCLEAR MED<br>EXT FAN EF06<br>OUTLET | G      | A02E | 1200 |       | 600  | 500   | 0.5   | 30 | 63  | IL | 12              | 23 | 32 | 46 | 55 | 55 | 55 | 45 |
| 115  | ATT118 - L01<br>NUCLEAR MED<br>EXT FAN EF07<br>INTLET | G      | A02E | 1200 |       | 600  | 500   | 0.5   | 30 | 63  | IL | 12              | 23 | 32 | 46 | 55 | 55 | 55 | 45 |
| 116  | ATT119 - L01<br>NUCLEAR MED<br>EXT FAN EF07<br>OUTLET | G      | A02E | 1200 |       | 600  | 500   | 0.5   | 30 | 63  | IL | 12              | 23 | 32 | 46 | 55 | 55 | 55 | 45 |
| 117  | ATT120 - ON-<br>FLOOR EXTRACT<br>L07                  | GM2    | A02E | 2100 |       | 800  | 600   | 0.851 | 50 | 135 | IL | 21              | 36 | 44 | 55 | 55 | 52 | 39 | 31 |
| 118  | ATT121 - AHU08<br>SUPPLY                              | GM2    | A02E | 1500 |       | 900  | 750   | 1.825 | 35 | 128 | IL | 9               | 19 | 29 | 42 | 55 | 44 | 34 | 25 |
| 119  | ATT122 - AHU08<br>EXTRACT                             | GM2J   | A02E | 1200 |       | 1000 | 600   | 1.8   | 35 | 96  | IL | 9               | 17 | 29 | 42 | 55 | 44 | 34 | 25 |
| 120  | ATT123 - AHU08<br>FAI                                 | GM2J   | A02E | 1200 |       | 1000 | 600   | 1.825 | 35 | 96  | IL | 9               | 17 | 29 | 42 | 55 | 44 | 34 | 25 |
| 121  | ATT124 - AHU08<br>EXHAUST                             | GM2    | A02E | 1500 |       | 900  | 750   | 1.8   | 35 | 128 | IL | 9               | 19 | 29 | 42 | 55 | 44 | 34 | 25 |
| 122  | ATT125 - OMITTED                                      |        |      |      |       |      |       |       |    |     |    |                 |    |    |    |    |    |    |    |

**NOTES**

LABEL WITH ITEM NO. & SYSTEM REF.

IL = INSERTION LOSS (dB)

REFER TO DATA SHEET NO. A02E FOR ATTENUATOR CONSTRUCTIONAL DETAILS.

ATTENUATORS TO BE DELIVERED WITH HEAVY DUTY POLYTHENE BLOCKED ENDS.

SUFFIX M2: ATTENUATORS TO HAVE THE ACOUSTIC INFILL BAGGED/SEALED IN MELINEX FOR HOSPITAL APPLICATION.

\*REQUESTED LENGTHS/DIMENSIONS HAVE BEEN AMENDED (AS NECESSARY) TO SUIT PERFORMANCE REQUIREMENTS.

# DATA SHEET **A02e**

## RECTANGULAR ATTENUATOR

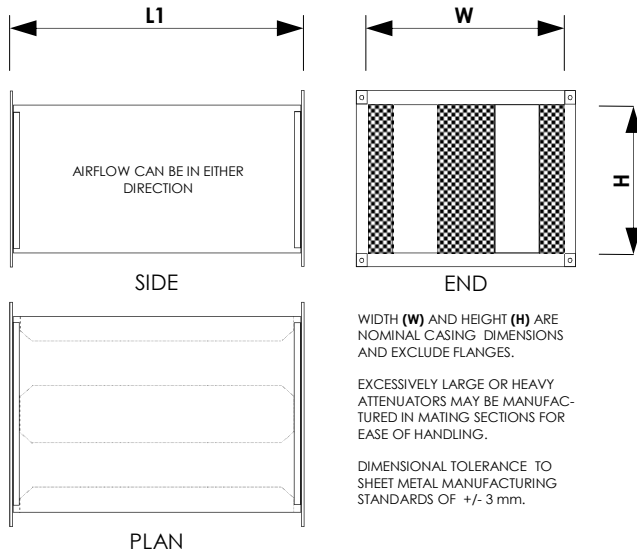
### MODEL **SP**

THIS IS NOT A STAND ALONE DOCUMENT AND UNLESS REFERRED TO IN A DATED EQUIPMENT SCHEDULE IS SUBJECT TO REVISION WITHOUT NOTICE.



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## DIMENSIONS



## SPECIFICATION

ATTENUATORS ARE CONSTRUCTED TO DW144 SPECIFICATION FOR MEDIUM PRESSURE DUCTWORK.

CASES ARE FORMED FROM PRE-GALVANISED STEEL OF THE SPECIFIED GAUGE, BUT IN NO INSTANCE LESS THAN 0.8 mm. CASE SEAMS ARE LOCK FORMED AND MASTIC SEALED.

CASES ARE STIFFENED AND FITTED WITH PROPRIETARY FLANGES.

SOUND ABSORBENT ELEMENTS ARE ARRANGED WITHIN THE CASING TO FORM A SERIES OF CENTRAL SPLITTERS AND SIDE LININGS. SPLITTER FRAMES ARE FORMED FROM PRE-GALVANISED STEEL, AND CONTAIN A FIBROUS INFILL THAT IS NON-SHEDDING, NON-COMBUSTIBLE, NON-HYGROSCOPIC AND CHEMICALLY INERT. THE INFILL IS FACED WITH GLASS CLOTH AND PRE-GALVANISED PERFORATED STEEL.

SPLITTER ELEMENTS HAVE AERODYNAMIC FAIRINGS ON AIR ENTRY AND AIR EXIT END OF ATTENUATOR.

## NOTES

THIS DATA SHEET IS TO BE READ IN CONJUNCTION WITH THE EQUIPMENT SCHEDULE.

EXCESSIVELY LARGE OR HEAVY ATTENUATORS MAY BE MANUFACTURED IN MATING SECTIONS FOR EASE OF HANDLING.

ATTENUATORS WILL BE SUPPLIED WITHOUT SUPPORT STEELWORK, BRACKETS, FIXINGS, GASKET, MASTIC OR OTHER SUCH ITEMS, UNLESS OTHERWISE STATED.

ATTENUATOR SEAMS AND JOINTS WILL BE FACTORY SEALED, HOWEVER, THE FLANGE CONNECTION SEAL, INCLUDING THE FLANGE CORNERS, IS THE RESPONSIBILITY OF THE INSTALLER.

THE PRESSURE LOSS STATED ON THE EQUIPMENT SCHEDULE IS DERIVED FROM TESTS CARRIED OUT IN ACCORDANCE WITH ISO 7235.

DIMENSIONAL TOLERANCE TO SHEET METAL MANUFACTURING STANDARDS OF +/- 3 mm.

## WEIGHT

WEIGHTS ARE GIVEN ON THE EQUIPMENT SCHEDULE.

## CODE

THE ATTENUATOR CODE DEFINES THE SPLITTER AND AIRWAY DIMENSIONS AND IS GIVEN ON THE EQUIPMENT SCHEDULE.

## SUFFIX

THE SUFFIX DEFINES ADDITIONAL FEATURES OR SPECIAL CONSTRUCTIONAL DETAILS.

**G** - GALVANISED STEEL CONSTRUCTION.

**S** - STAINLESS STEEL CONSTRUCTION.

**U** - UPVC/GRP CONSTRUCTION TO DW154 SPECIFICATION (SEPARATE DRAWING)

**H1** - 2 HOUR/300°C CONSTRUCTION.

**H2** - FIRE DUCT CONSTRUCTION (FINAL TREATMENT BY SPECIALIST CONTRACTOR)

**C** - CHLORINATED RUBBER PAINT TO INSIDE SURFACES.

**J** - SPLITTERS ARRANGED HORIZONTALLY.

**L** - SPLITTERS ONLY (REFER TO DATA SHEET A10 FOR DETAILS).

**D** - DOUBLE SKIN CASING.

**M1** - MELINEX LINED INFILL.

**M2** - MELINEX ENCAPSULATED INFILL.

**X** - SPECIAL CONSTRUCTION, REFER TO EQUIPMENT SCHEDULE FOR DETAILS.

## FLANGE DETAILS

ATTENUATORS ARE FITTED WITH PROPRIETARY FLANGES AS FOLLOWS:

| GREATEST DIMENSION (W or H) | FLANGE  |
|-----------------------------|---------|
| 0 - 1000 mm                 | DOBY 20 |
| 1001 - 1250 mm              | DOBY 30 |
| 1251 and above              | DOBY 40 |

NOTE: IT IS THE INSTALLERS RESPONSIBILITY TO PROVIDE THE FLANGE SEAL TO THE CONNECTING DUCT, INCLUDING THE FLANGE CORNERS.

## STANDARD SIZES

THERE ARE NO STANDARD SIZES. ALL ATTENUATORS ARE MADE TO ORDER.



## Appendix F – Detailed Calculation Results

**Table F-1: Contribution from each item of plant or machinery at the worst affected position: normal conditions**

| Item of Plant              | Predicted Façade Noise Level due to Item of Plant at Specified Location [dB L <sub>Aeq</sub> ] |                                     |                           |                           |  |  |             |
|----------------------------|--|-------------------------------------|---------------------------|---------------------------|--|--|-------------|
|                            | 89-92 Guilford Street  | International Hall, Guilford Street | 19-27 Great Ormond Street | 29-41 Great Ormond Street | 3-6 Guilford Place / 86-94 Lamb's Conduit Street | Spens House / 70 Lamb's Conduit Street | The Lamb PH |
| L8 AHUs                    | 13   | 14                                  | 19                        | 16                        | 23   | 19                                     | 17          |
| L4 AHUs                    | 10   | <10                                 | 12                        | 10                        | 17   | 18                                     | 18          |
| L1 Extract Fans            | <b>38</b>  | 27                                  | <10                       | <b>22</b>                 | 22   | 23                                     | 21          |
| L8 Extract Fans            | <10  | <10                                 | <10                       | <10                       | <10  | <10                                    | <10         |
| Phase 2A CHP               | 30   | <b>35</b>                           | 16                        | 21                        | 23   | 19                                     | 18          |
| Chiller Room Break-out     | 22   | 21                                  | <b>28</b>                 | 21                        | <b>36</b>  | <b>31</b>                              | <b>30</b>   |
| Break-out from other rooms | 11   | <10                                 | <10                       | 10                        | <10  | <10                                    | <10         |
| Riser Break-out            | 14   | 14                                  | 17                        | 19                        | 20   | 17                                     | 13          |
| L1 Supply Fans             | 31   | 15                                  | <10                       | <10                       | <10  | <10                                    | <10         |
| L8 Supply Fans             | <10  | <10                                 | <10                       | 12                        | <10  | <10                                    | <10         |
| Emergency Generator        | N/A  | N/A                                 | N/A                       | N/A                       | N/A  | N/A                                    | N/A         |
| <b>Total</b>               | <b>40</b>  | <b>36</b>                           | <b>29</b>                 | <b>28</b>                 | <b>37</b>  | <b>32</b>                              | <b>31</b>   |

**Table F-2: Contribution from each item of plant or machinery at the worst affected position: emergency conditions**

| Item of Plant              | Predicted Façade Noise Level due to Item of Plant at Specified Location [dB L <sub>Aeq</sub> ] |                                     |                           |                           |  |  |             |
|----------------------------|--|-------------------------------------|---------------------------|---------------------------|--|--|-------------|
|                            | 89-92 Guilford Street  | International Hall, Guilford Street | 19-27 Great Ormond Street | 29-41 Great Ormond Street | 3-6 Guilford Place / 86-94 Lamb's Conduit Street | Spens House / 70 Lamb's Conduit Street | The Lamb PH |
| L8 AHUs                    | 13   | 14                                  | 19                        | 17                        | 23   | 19                                     | 17          |
| L4 AHUs                    | 10   | <10                                 | 12                        | 10                        | 17   | 18                                     | 18          |
| L1 Extract Fans            | <b>38</b>  | 27                                  | <10                       | 14                        | 22   | 23                                     | 21          |
| L8 Extract Fans            | <10  | <10                                 | <10                       | <10                       | <10  | <10                                    | <10         |
| Phase 2A CHP               | 30   | <b>35</b>                           | 16                        | 22                        | 23   | 19                                     | 18          |
| Chiller Room Break-out     | 22   | 21                                  | <b>28</b>                 | 23                        | <b>36</b>  | <b>31</b>                              | <b>30</b>   |
| Break-out from other rooms | 11   | <10                                 | <10                       | 10                        | <10  | <10                                    | <10         |
| Riser Break-out            | 14   | 14                                  | 17                        | 20                        | 20   | 17                                     | 13          |
| L1 Supply Fans             | 31   | 15                                  | <10                       | 14                        | <10  | <10                                    | <10         |
| L8 Supply Fans             | <10  | <10                                 | <10                       | <10                       | <10  | <10                                    | <10         |
| Emergency Generator        | 13   | 18                                  | 27                        | <b>31</b>                 | 21   | 24                                     | 19          |
| <b>Total</b>               | <b>40</b>  | <b>36</b>                           | <b>31</b>                 | <b>33</b>                 | <b>37</b>  | <b>33</b>                              | <b>32</b>   |

Figure F-1: Noise level contour: normal conditions

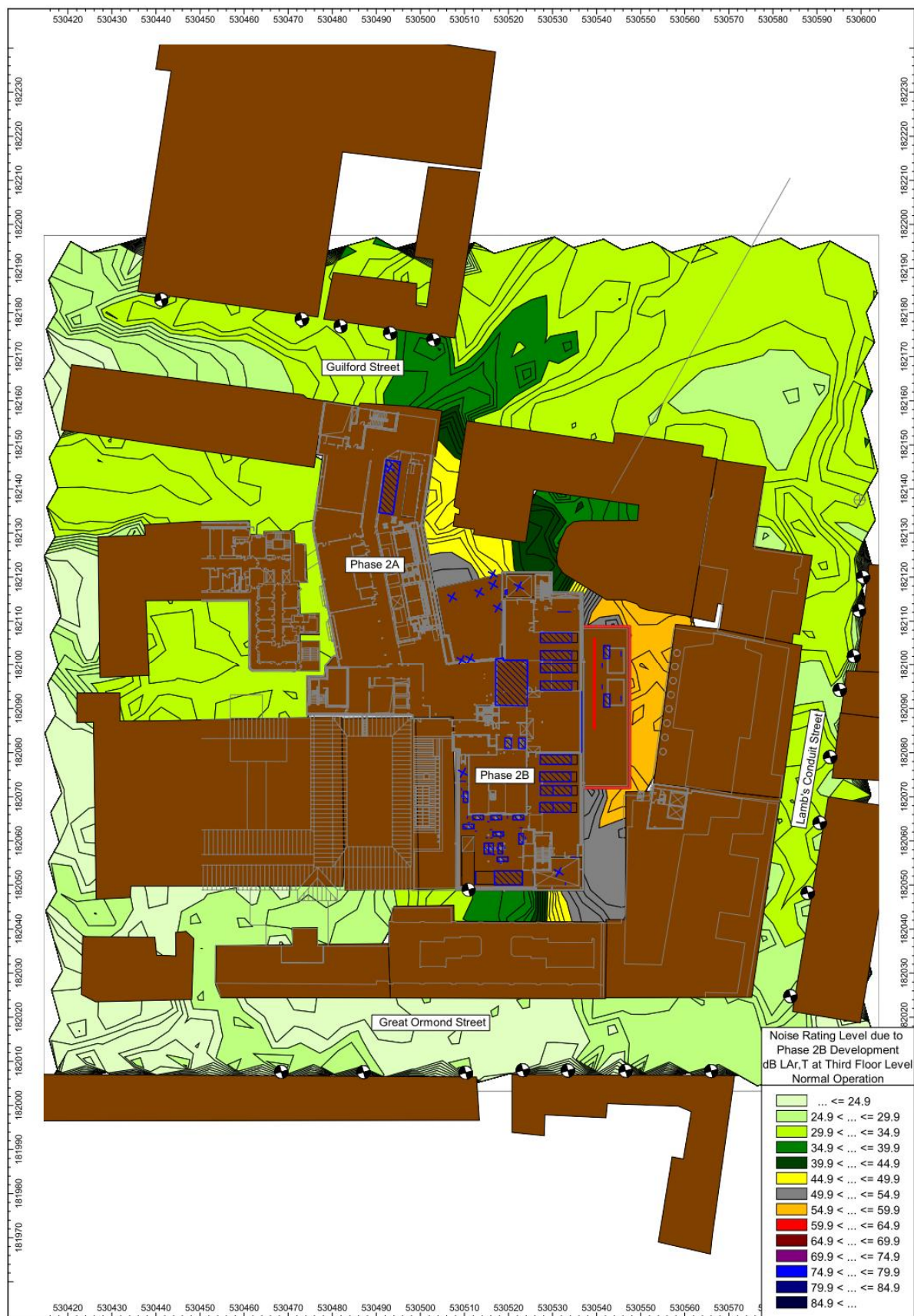


Figure F-2: Noise level contour: emergency conditions





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## Appendix G – Limitations of this Report

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