# THE HOPE PROJECT

## NOISE EMISSION ASSESSMENT

HOPE LEASE LIMITED

OCTOBER 2017

REVISION 04

# CONTENTS



| Revision History | | Date | Prepared by | Checked by |
|---|---|---|---|---|
| R01 | Initial issue | June 2017 | Jacob Perry BMus AMIOA | Jason Clouston BEng MSc MIOA |
| R02 | | July 2017 | Jacob Perry BMus AMIOA | Jason Clouston BEng MSc MIOA |
| R03 | | Oct 2017 | Jacob Perry BMus AMIOA | Jason Clouston BEng MSc MIOA |
| R04 | Update for planning | Oct 2017 | Jacob Perry BMus AMIOA | Jason Clouston BEng MSc MIOA |

# 1 INTRODUCTION

1.1 Proposals are in place for the redevelopment of the Hope and Anchor pub and associated buildings to the rear of KOKO nightclub. The formal description of the development is as follows:

> *Demolition of 65 Bayham Place, 1 Bayham Street (retention of façade) and rebuilding to provide private members club (sui generis) with extension to the rear and basement; retention and refurbishment of the ground floor of the Hope & Anchor Public House (Use Class A4) with 1st/2nd floor demolition and replacement to provide restaurant and bar, minor reconfiguration to circulation space within KOKO. Use of the Flytower by the private members club with retention of original theatre equipment. Installation of fourth floor extension to provide amenity space with terrace restaurant and bar. The proposals also include for the conversion of the KOKO dome to a private bar and general refurbishment and restoration to the building, along with the installation new plant.*

1.2 In order to assess the noise impact associated with the proposed development, an external noise survey has been undertaken. The measurement data from the survey have been used to assess the level of noise emission from proposed building services plant. Chapter 2 of this report describes the external noise survey, and the assessment of noise emission is presented in Chapter 3.

1.3 A selection of data from the external noise survey is presented in Appendix A, and a glossary of terminology used in this report is included in Appendix B.

# 2 EXTERNAL NOISE SURVEY

## 2.1 SITE DESCRIPTION

2.1.1 KOKO and the adjoining Hope & Anchor are located on Crowndale Road, Camden, near to Mornington Crescent Underground station. A satellite image of the site is presented as Figure 2.1.

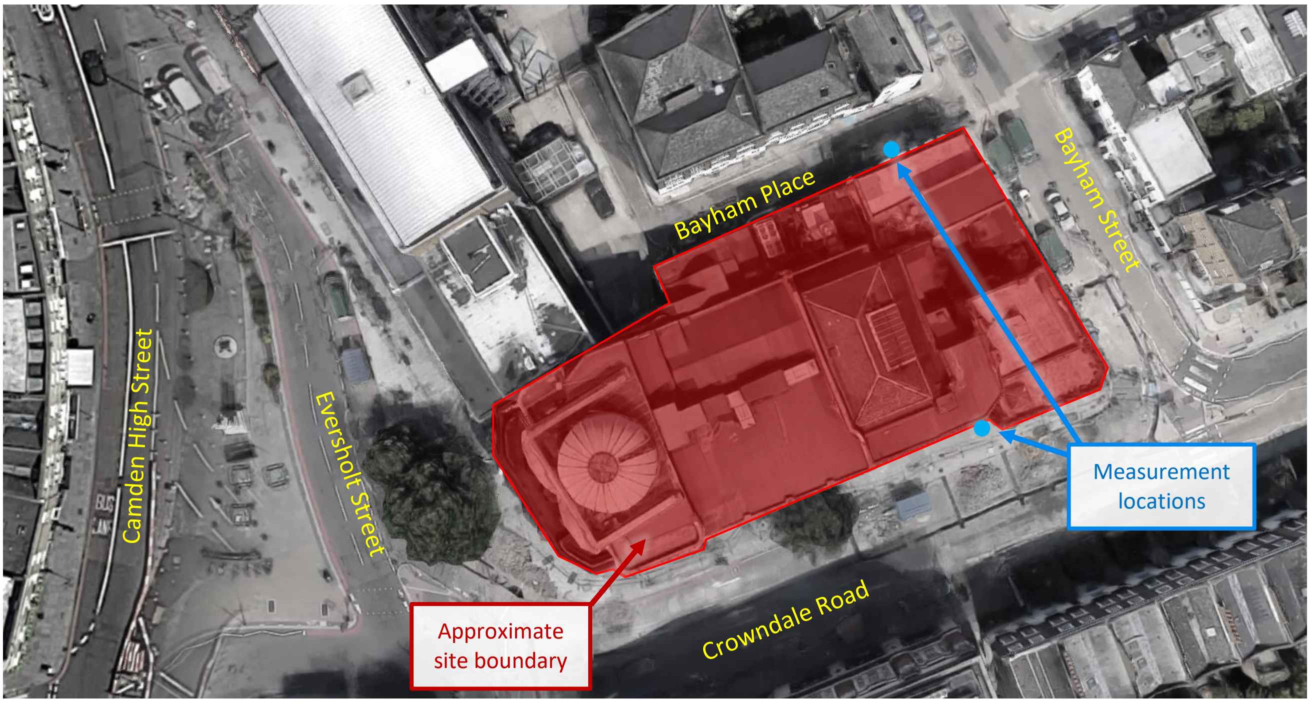



**Figure 2.1 Satellite image of the site (courtesy of Google) with measurement locations highlighted**

2.1.2 The primary noise source in both measurement locations was traffic along Camden High Street, Eversholt Street, and Crowndale Road. This traffic was observed to include heavy goods vehicles and regular emergency vehicles. Traffic was also fairly regular along Bayham Street and occasional delivery lorries are understood to use Bayham Place.

## 2.2 MEASUREMENT METHODOLOGY

2.2.1 Continuous unattended noise level measurements were conducted at two locations at the site boundary:

1. Out of a first floor window overlooking Bayham Place. Measurements made at this location are believed to be representative of the maximum noise levels that would be experienced at the façade of the proposed building facing into Bayham Place, as well as the lowest background noise levels experienced at the new residential building opposite Bayham Place.

2. Out of a first floor windows overlooking the Koko box office on Crowndale road. Measurements made at this location are believed to be representative of the maximum noise levels that would be experienced at the façade of the proposed building facing Crowndale Road and Bayham Street.

2.2.2 The measurement locations are shown in Figure 2.1.

2.2.3 Statistical and spectral data were recorded continuously between 17/03/2017 (Friday) and 22/03/2017 (Wednesday), in 10-minute samples.

2.2.4 The following equipment was used for the noise survey:

| Equipment | Type | Serial No. | Location |
| --- | --- | --- | --- |
| Norsonic 131 | Precision sound analyser | 1313605 | Crowndale Road |
| Norsonic 1207 | Associated preamplifier | 20032 | |
| Norsonic 1227 | Associated microphone | 170634 | |
| Norsonic 1218 | Microphone protection kit | 12182517 | |
| Norsonic 131 | Precision sound analyser | 1312766 | Bayham Place |
| Norsonic 1207 | Associated preamplifier | 12160 | |
| Norsonic 1227 | Associated microphone | 170606 | |
| Norsonic 1218 | Microphone protection kit | 12182559 | |
| Brüel & Kjær 4231 | Portable calibrator | 2291098 | Both |

**Table 2.1 Noise measurement equipment**

2.2.5 The calibration of the sound level meter and associated microphone were checked prior to and on completion of both measurement periods in accordance with recommended practice. No significant drift in calibration occurred during the measurement period. The accuracy of the calibrator can be traced to National Physical Laboratory Standards.

2.2.6 The weather conditions were generally dry with wind not in excess of 5 $ms^{-1}$, and are not expected to have affected the findings of the assessment.

2.2.7 Construction work was being undertaken on the residences opposite Bayham Place during the weekdays; this has been taken into account in the assessments.

## 2.3 MEASUREMENT RESULTS

2.3.1 The full measurement data are available upon request. Level-history graphs from both sets of measurements are presented in Figure 2.2 and 2.3.

## 2.4 COMMENTARY ON RESULTS

2.4.1 Evening and overnight noise levels measured in Bayham place were influenced by the existing KOKO plant. This is evident in the increased $L_{A90}$ measurements when this plant was in operation. The noise emission assessment presented in this report has therefore assumed a *background sound level* outside of these times.

2.4.2 Noise levels in both locations generally followed a consistent diurnal pattern, reaching a maximum during the daytime and a minimum overnight. The exception was on the Friday and Saturday nights, where measurements above the KOKO box office were influenced by KOKO patrons.


**Figure 2.2** **Measurement results overlooking Bayham Place 17/03/2017 – 22/03/2017**

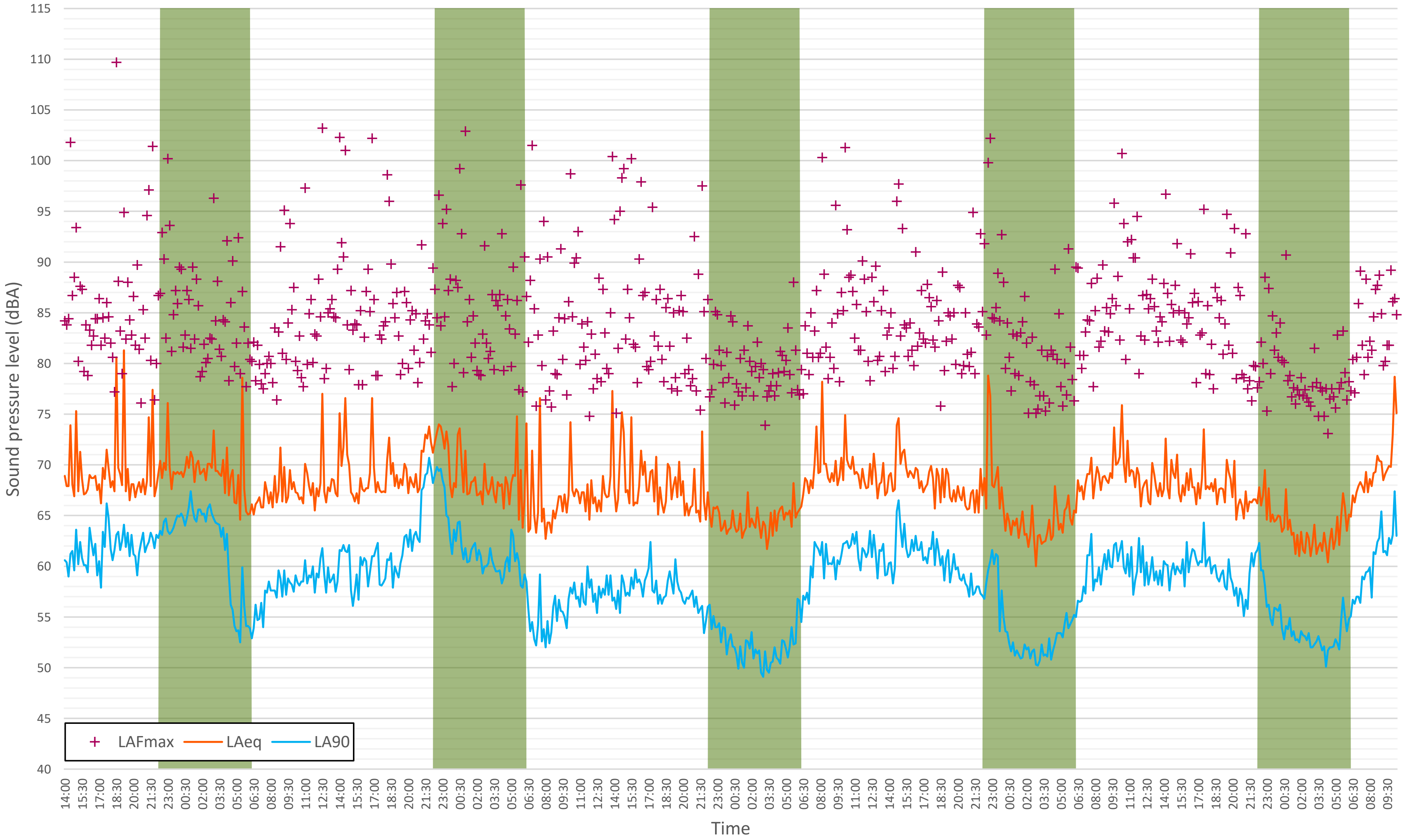



**Figure 2.3 Measurement results overlooking KOKO box office 17/03/2017 – 22/03/2017**

# 3 BUILDING SERVICES NOISE EMISSION ASSESSMENT

## 3.1 CRITERIA

3.1.1 The objective is to control noise emission from proposed building services plant to the nearest noise-sensitive receivers. The local authority have provided guidance on what they expect in this regard, but it must also be considered that there is always the potential that neighbours may take direct noise nuisance action under the provisions of the Environmental Protection Act 1990 if they believe they have been subjected to noise nuisance. It is therefore in Koko's best interest to ensure that they do not subject neighbours to unacceptable levels of noise emission.

3.1.2 Camden Council have now adopted a new version of their Local Plan (July 2017), which contains a policy relating to noise emission. This is replicated below:

> ***Policy A4 Noise and vibration***
>
> *The Council will seek to ensure that noise and vibration is controlled and managed.*
>
> *Development should have regard to Camden's Noise and Vibration Thresholds (Appendix 3). We will not grant planning permission for:*
>
> *a. development likely to generate unacceptable noise and vibration impacts; or*
>
> *b. development sensitive to noise in locations which experience high levels of noise, unless appropriate attenuation measures can be provided and will not harm the continued operation of existing uses.*
>
> *We will only grant permission for noise generating development, including any plant and machinery, if it can be operated without causing harm to amenity. We will also seek to minimise the impact on local amenity from deliveries and from the demolition and construction phases of development.*

3.1.3 Table C of the aforementioned appendix 3 of Camden Council's Local Plan contains noise limits for a *low observed adverse effect level* (LOAEL) and *significant observed adverse effect level* (SOAEL). The criteria relevant to building services noise from industrial and commercial developments are reproduced below:

| | LOAEL (Green) | LOEAL to SOEAL (Amber) | SOEAL (Red) |
|---|---|---|---|
| BS 4142:2014 "Rating level" | At least 10 dB below background noise level | - 9 dB to + 5 dB relative to background noise level | More than 5 dB above the background noise level |
| $L_{Amax}$ at noise-sensitive receivers | Less than 57 dB | Between 57 and 88 dB | Greater than 88 dB |

**Table 3.1 Camden Council noise thresholds for industrial/commercial development**

3.1.4 All of the proposed plant will operate at a steady noise level, as such the $L_{Amax}$ are not expected to be significantly greater than the $L_{Aeq}$. The criteria regarding the $L_{Amax}$ has therefore not been considered further in this assessment.

3.1.5 The local authority have confirmed (via phone call to Edward Davis) that the following approach would be considered acceptable:

- Plant that is to be replaced like-for-like should be designed to be no noisier than the current plant in operation
- New items of plant shall be assessed according to the noise thresholds detailed in Table 3.1. If it is found that achieving a "green" rating is impractical an "amber" rating may be considered satisfactory.

## 3.2 BS 4142 ASSESSMENT METHODOLOGY

3.2.1 BS 4142: 2014 *Method for rating and assessing industrial and commercial sound* provides guidance on the assessment of the impact of a noise source. The standard presents a methodology for comparing the noise level of the new source (the *specific sound level*) with that of the existing background noise level in the area in the absence of the new source (the *background sound level*).

3.2.2 The methodology requires consideration to be given to all aspects of the assessment process and also accounts for unusual acoustic features such as tonal, impulsive, or intermittency characteristics of the noise by the addition of various decibel corrections to the *specific sound level*. The corrected *specific sound level* is known as the *rating level*.

3.2.3 The *rating level* is then arithmetically subtracted from the *background sound level*. The greater the positive difference between the *rating level* and the *background sound level*, the greater the magnitude of the impact.

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending upon the context.
- A difference of around +5 dB or more is likely to be an indication of an adverse impact, depending upon the context.
- Where the *rating level* does not exceed the *background sound level*, this is an indication of a low impact, depending upon the context.

## 3.3 PROPOSALS FOR EXISTING AND REPLACEMENT PLANT

3.3.1 The existing KOKO chiller is to be relocated to the third floor open air plant area. This would not be expected to affect the noise emission level of the chiller itself. Historical manufacturers' noise data states a sound power level for this unit of 87 dB $L_{wA}$.

3.3.2 The auditorium intake AHU will be replaced and relocated. A selection has been made that does not exceed the noise emission of the AHU currently installed at KOKO. The selection has a sound power level at the inlet termination of 98 dB $L_{wA}$, and a casing breakout sound power level of 76 dB $L_{wA}$.

3.3.3 Both the chiller and the AHU will be located in a new, lidded enclosure formed of acoustically-rated 150mm thick louvres for the walls, and 270mm thick louvres for the roof. The louvres acoustic performance has been selected to match or better the attenuative performance thought to be provided by the existing solid screen to the neighbours.

3.3.4 The auditorium extract fans will be replaced and relocated. Selections have been made to ensure the noise emission of the new equipment does not exceed the noise emission of the existing equipment. The units selected have a sound power level of 99 dB $L_{wA}$ from the exhaust termination, and 77 dB $L_{wA}$ as casing breakout.

## 3.4 PROPOSALS FOR NEW PLANT

3.4.1 The following items are new plant servicing the development, with no existing analogue. The noise levels used in the assessment have also been provided as sound pressure levels at a distance of 1m in the worst-case direction.

| Equipment | dB $L_{pA}$ at 1m (per unit) |
|---|---|
| 4 No. AC condensers to be located behind the parapet surrounding the dome | 66 |
| 1 No. DX cooling unit to be located atop on the roof above the recording studio | 64 |
| 1 No. intake termination for internally located kitchen ventilation unit, at second floor level | 52 |
| 1 No. exhaust termination for internally located kitchen ventilation unit, at fourth floor level | 52 |
| 1 No. ventilation unit located atop the existing dome above KOKO | 60 |
| 1 No. smaller condenser behind the parapet surrounding the dome | 65 |

**Table 3.2 Proposed building services plant**

3.4.2 There are other items of proposed ventilation plant associated with this development, but these are significantly quieter than the units presented above and are either well-screened to the nearest noise-sensitive receivers or internally located. As such they have not been given further consideration within this assessment, but will be designed to not alter the findings.

3.4.3 The 4 new AC condensers will be arranged around the dome, behind the parapet (the height of which exceeds the top of the units). An additional, imperforate screen with a surface density of at least 10 kgm$^{-2}$ will be installed to extend the parapet around the rear of the dome; this will ensure acoustic screening to the neighbours.

3.4.4 The approximate locations of the plant proposals listed in sections 3.3 and 3.4 are highlighted in Figure 3.1. These will be finalised as the design develops, and care will be taken to ensure that the results of this noise emission assessment does not change.

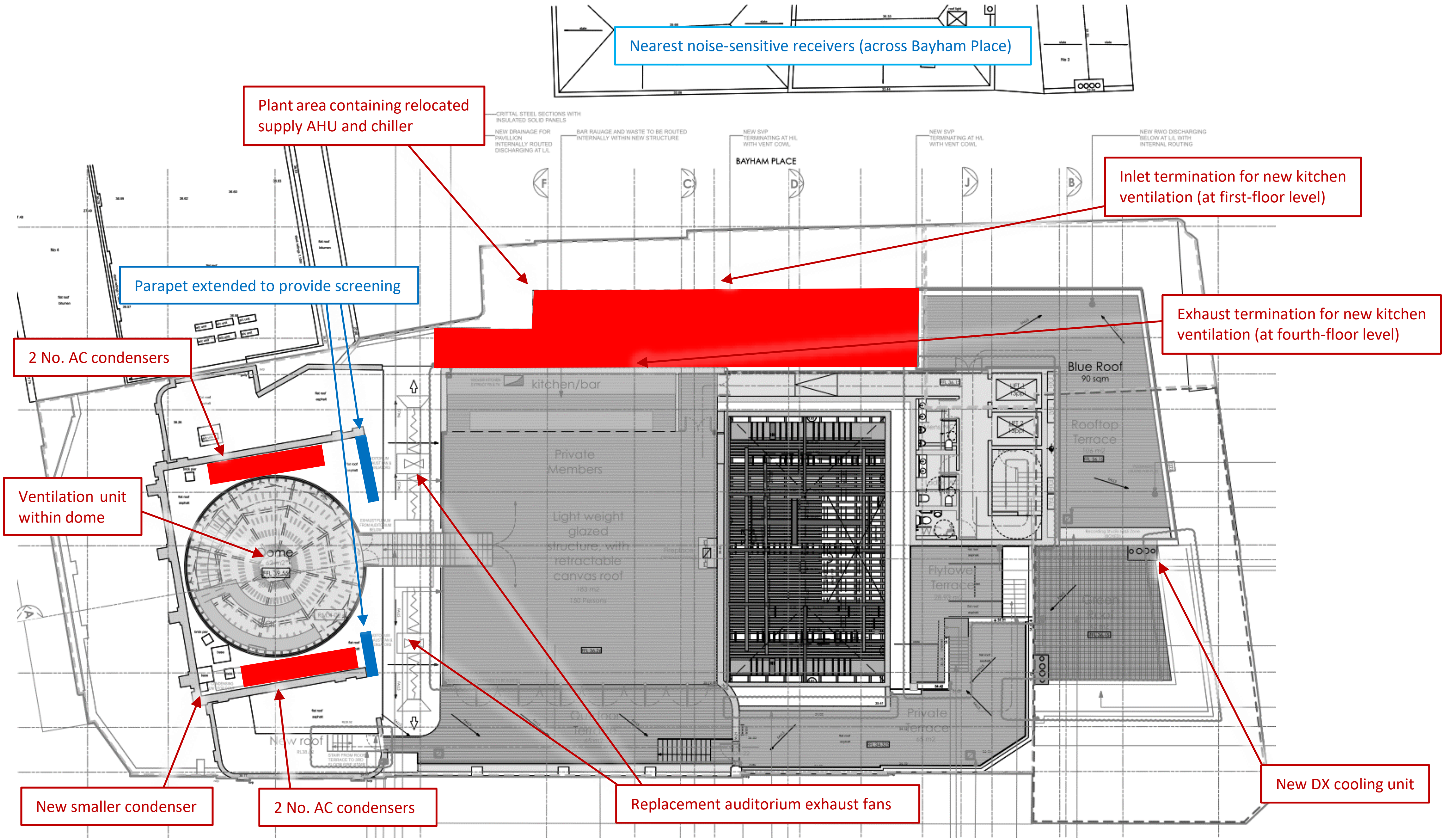
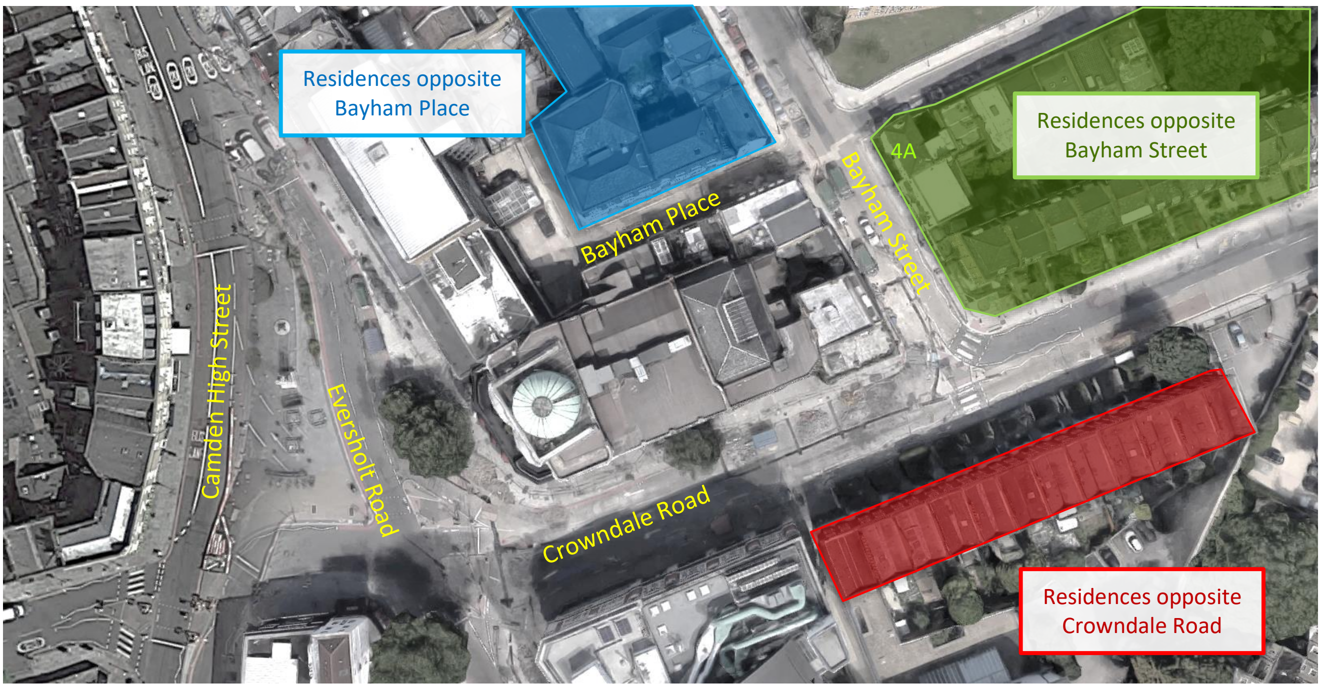



**Figure 3.1** **Approximate proposed locations of assessed plant items**

## 3.5 NEAREST NOISE-SENSITIVE RECEIVERS

3.5.1 Figure 3.2 shows the locations of the nearest noise-sensitive receivers that have been considered in this assessment. They are as follows:

- The *Residences opposite Bayham Place* have windows facing onto Bayham Place. These are the nearest noise-sensitive receivers to many of the plant proposals.
- The *Residences opposite Bayham Street* consist of a number of terraced houses. 4A Bayham Street is on the corner of Bayham Street and Bayham Place, and is a two-storey house with windows facing Bayham Street
- The *Residences opposite Crowndale Road* consist of a line of three-storey terraced houses with windows facing onto Crowndale Road




Satellite image courtesy of Google

**Figure 3.2 Locations of nearest noise sensitive receivers**

3.5.2 Other noise-sensitive receivers further away than those presented in Figure 4.2 are expected to benefit from greater noise propagation loss and increased screening, as such the level of noise from the proposed plant at these more distant receivers can be expected to be lower.

## 3.6 BACKGROUND SOUND LEVELS

3.6.1 The *background sound levels* at the noise-sensitive receivers have been established for **when the existing KOKO plant is operational**, with a correction of -3 dB applied to account for the influence of façade reflections:

- Neighbouring properties facing Bayham Place: 54 dB $L_{A90,10min}$
- Neighbouring properties facing Crowndale Road: 55 dB $L_{A90,10min}$

3.6.2 It is believed that demonstrating the noise emission to the neighbours from the relocated/replaced plant does not exceed the lowest $L_{A90,10min}$ measured during this time, will be sufficient evidence that the noise from KOKO plant has not become any noisier with the new development.

3.6.3 *Background sound levels* for each noise-sensitive receiver have been evaluated for **when existing KOKO plant is not operational**, in order to establish a suitable limit for the new plant. A correction of -3 dB has been applied to the measured *background sound levels* to account for the influence of façade reflections.

| Receiver | Assumed *background sound level* when existing KOKO plant is not in operation |
|---|---|
| Opposite Bayham Place | 43 dB $L_{A90}$ |
| Opposite Bayham Street | |
| Opposite Crowndale Road | 46 dB $L_{A90}$ |

**Table 3.3 Assumed background noise levels for use in the noise emission assessments**

## 3.7 NOISE EMISSION ASSESSMENT OF RELOCATED PLANT

3.7.1 The noise level as it would be measured at the nearest noise-sensitive receiver (*specific sound level)* has been calculated in accordance with the methodology presented in ISO 9613-2. This methodology has been used to predict the various attenuation effects that will apply to each noise source, which can be combined with the noise emission levels of the equipment to give the noise contribution from that source at the receiver. The noise contribution from each source is then summed for each receiver to give a *specific sound level*.

3.7.2 Octave-band noise levels for each item of plant are provided in Table 3.4, along with octave band sound reduction indices for the louvres. Indicative attenuator selections are also provided although these are subject to change as the design develops.

| Frequency (Hz) | 63 | 125 | 250 | 500 | 1000 | 2000 | 4000 |
|---|---|---|---|---|---|---|---|
| Existing chiller: total dB $L_w$ | 94 | 92 | 87 | 82 | 85 | 77 | 67 |
| Replacement AHU: in-duct dB $L_w$ | 86 | 94 | 94 | 98 | 92 | 88 | 84 |
| Indicative AHU attenuator (insertion loss dB) | 3 | 4 | 9 | 14 | 12 | 8 | 7 |
| Replacement AHU: casing dB $L_w$ | 78 | 84 | 82 | 72 | 63 | 61 | 57 |
| Sound reduction index of 150mm wall louvre (dB) | 5 | 5 | 7 | 9 | 13 | 13 | 13 |
| Sound reduction index of 270mm roof louvre (dB)( | | | | | | | |
| Replacement Extract fan (each): in-duct dB $L_w$ | 83 | 80 | 89 | 91 | 95 | 93 | 88 |
| Indicative extract fan attenuator (insertion loss dB) | 6 | 8 | 12 | 19 | 15 | 11 | 10 |
| Replacement Extract fan (each): casing dB $L_w$ | 74 | 61 | 66 | 69 | 73 | 69 | 71 |

**Table 3.4 Octave-band calculation data for assessment of relocated and replacement plant**

3.7.3 The attenuation due to geometrical divergence is calculated using the Euclidean distance between the source (item of plant being assessed) and the receiver. Receivers opposite Bayham Street are far away and well screened from the replaced and relocated plant proposals, and so have not been assessed. Table 3.5 shows the distances used for this assessment:

| Plant item | Opposite Bayham Place | Opposite Crowndale Road |
|---|---|---|
| Chiller and intake AHU | 8m | * |
| Exhaust fan (nearest) | 18m | 25m |

*transmission path not included in assessment, as it is expected to provide attenuation far in excess of other paths

**Table 3.5 Assumed source to receiver distances used in assessment**

3.7.4 Attenuation due to atmospheric absorption and ground effect would not provide meaningful attenuation over such short distances, and have therefore not been calculated in this assessment.

3.7.5 Assuming all existing plant is operating simultaneously, the total noise level at the nearest noise-sensitive receivers have been established as the following:

- 54 dB $L_{pA}$ at 1 metre from the nearest neighbouring window facing Bayham Place
- 48 dB $L_{pA}$ at 1 metre from the nearest neighbouring window facing Crowndale Road

These values are below the established *background sound level* while KOKO plant is in operation

## 3.8 NOISE EMISSION ASSESSMENT OF NEW PLANT

3.8.1 The noise level as it would be measured at the nearest noise-sensitive receiver (*specific sound level)* has been calculated in accordance with the methodology presented in ISO 9613-2. This methodology has been used to predict the various attenuation effects that will apply to each noise source, which can be combined with the noise levels specified in Section 4.3 to give the noise contribution from that source at the receiver. The noise contribution from each source is then summed for each receiver to give a *specific sound level*.

3.8.2 The attenuation due to geometrical divergence is calculated using the Euclidean distance between the source (item of plant being assessed) and the receiver. Table 3.6 shows the distances used for this assessment:

| Plant item | Opposite Bayham Place | Opposite Bayham Street | Opposite Crowndale Road |
|---|---|---|---|
| 4 No. AC condensers surrounding the dome | 25 – 35 m | * | 39 – 51 m |
| DX cooler above the recording studio | * | 15 m | 30 m |
| Intake of internal kitchen ventilation | 8 m | * | * |
| Exhaust of internal kitchen ventilation | 8 m | 35 m | * |
| Ventilation unit atop KOKO dome | 30 m | 64 m | 30 m |
| Condenser next to KOKO dome | * | 64 m | 28 m |

*transmission path not included in assessment, as it is expected to provide attenuation far in excess of other paths

**Table 3.6 Assumed source to receiver distances used in assessment**

3.8.3 Attenuation due to atmospheric absorption and ground effect would not provide meaningful attenuation over such short distances, and have therefore not been calculated in this assessment.

3.8.4 Attenuation due to screening has been calculated individually for each of the 4 No. AC condensers screened by the dome parapet, using the calculation methodology presented in ISO 9613-2. The calculated attenuation values vary between 6 and 20 dB, depending on frequency.

3.8.5 As noted in section 4.2, corrections should be applied to the *specific sound level* to give a *rating level*.

- **Tonality**: A + 2dB correction has been applied to noise from the condensers and coolers, based on previous experience these units may provide a *just perceptible* hum in certain modes of operation
- **Impulsivity**: No corrections have been applied. Properly maintained ventilation and heating/cooling equipment should never exhibit banging or other impulsive qualities in their noise emission
- **Intermittency**: All condensers/coolers are expected to operate in some capacity 24 hours a day. When changing between capacities they are expected to slowly ramp up/down in duty, in order to avoid an intermittent characteristic being readily audible. However, a precautionary + 3 dB correction has been applied to cover the possibility of an intermittent characteristic being distinguishable. The same correction has also been applied to the kitchen extract plant to allow for the possibility of a short term boost mode.
- **Other**: The site is not considered to be particularly tranquil, and building services noise is not considered to be out of character for the area. Therefore, no other corrections have been applied.

3.8.6 Assuming all plant is operating at full duty, and the attenuation effects detailed above, the worst-case *specific sound levels* as would be experienced at the nearest noise-sensitive receivers have been calculated and presented with the *rating level* in Table 3.7.

| Receiver | *Specific sound level* | BS 4142: 2014 *rating level* | Relationship to *background sound level* |
|---|---|---|---|
| Opposite Bayham Place | 39 dB $L_{\mathrm{Aeq},T}$ | 43 dB $L_{\mathrm{Ar}Tr}$ | Equal |
| Opposite Bayham Street | 41 dB $L_{\mathrm{Aeq},T}$ | 46 dB $L_{\mathrm{Ar}Tr}$ | Equal |
| Opposite Crowndale Road | 41 dB $L_{\mathrm{Aeq},T}$ | 46 dB $L_{\mathrm{Ar}Tr}$ | Equal |

**Table 3.7 Results of noise emission assessment for new plant**

3.8.7 The noise levels emitted from the assessed plant are based on the load requirements of the building. It is believed to be unlikely full load will be required during the quietest period of night, but as this is a possibility it has been assumed for the assessment. This should therefore be considered as a *worst-case scenario*.

## 3.9 ASSESSMENT OF IMPACT

3.9.1 The proposals for the relocation and replacement of the existing KOKO plant have been selected to ensure that they do not exceed the current background noise level while KOKO is in operation. It is believed that this is compliant with the agreed requirement from the local authority that this plant *should be no noisier than the current plant in operation*.

3.9.2 The new building services plant has been designed so that, even with the plant operating at maximum duty at the quietest period of night, the BS 4142 *rating level* will not exceed the *background sound level*. The guidance in BS 4142:2014 states that where the *rating level* does not exceed the *background sound level*, this is an indication of a **low impact**, depending upon the context.

3.9.3 Noise emission from the new plant would meet the "amber" rating according to the Camden Council noise thresholds. Attempts have been made to revise the design so that the "green" threshold can be met. However, this is not believed to be possible without the use of large louvred or attenuated enclosures around the new plant items, which will have visual and height implications. The location and acoustic measures for the equipment as presented in the current design are believed to represent the optimal acoustic solution for this development given the constraints.

3.9.4 When considering this assessment, Scotch would like to point out the following:

- The noise emission to these neighbours has been assessed as being indicative of a low impact according to BS 4142:2014, the recognised industry guidance for assessing the impact of industrial noise to neighbouring properties
- The assessment has assumed all equipment operating simultaneously during the quietest period of night, a scenario that is unlikely to ever occur. As such the noise emission from the new proposals would be expected to be less than the *specific sound level* presented in this assessment, and therefore more likely to fall within, or close to, the "green" threshold.
- The nearest noise-sensitive receivers are already subject to high levels of traffic and building services noise overnight, and so should have a façade design capable of attenuating this noise to an acceptable level. Assuming a relatively modest façade performance of 20 dB, it can be expected that the noise from this development will be attenuated to a level that is comfortably within the recommendations of BS 8233:2014 for internal noise levels in dwellings.

# APPENDIX A – MEASUREMENT DATA

A selection of the measured noise level data are presented in the tables in this appendix. The full set of data are available in electronic form on request.

All values are sound pressure levels in dB re: $2x10^{-5}$Pa

**Table A1: Statistical noise level data measured in Bayham Place between 17/03/2017 and 18/03/2017**

| Date | Time | $L_{AFmax}$ | $L_{A10}$ | $L_{Aeq}$ | $L_{A90}$ | $L_{AFMin}$ |
|---|---|---|---|---|---|---|
| 17/03/2017 | 17:00 | 87.1 | 67.0 | 65.3 | 58.2 | 55.6 |
| 17/03/2017 | 17:10 | 80.3 | 65.4 | 62.7 | 57.1 | 54.7 |
| 17/03/2017 | 17:20 | 82.4 | 65.3 | 62.7 | 57.1 | 54.9 |
| 17/03/2017 | 17:30 | 78.8 | 64.4 | 61.8 | 56.5 | 55.0 |
| 17/03/2017 | 17:40 | 80.5 | 67.4 | 64.4 | 58.2 | 55.4 |
| 17/03/2017 | 17:50 | 78.5 | 66.3 | 63.4 | 58.2 | 55.9 |
| 17/03/2017 | 18:00 | 80.7 | 64.0 | 62.3 | 57.8 | 55.8 |
| 17/03/2017 | 18:10 | 86.6 | 63.6 | 61.4 | 57.2 | 54.9 |
| 17/03/2017 | 18:20 | 92.6 | 65.3 | 64.2 | 57.4 | 55.4 |
| 17/03/2017 | 18:30 | 100.2 | 66.5 | 73.7 | 57.8 | 55.5 |
| 17/03/2017 | 18:40 | 78.8 | 70.1 | 66.5 | 59.3 | 56.3 |
| 17/03/2017 | 18:50 | 81.7 | 67.3 | 63.9 | 58.2 | 56.1 |
| 17/03/2017 | 19:00 | 77.4 | 64.8 | 62.4 | 57.4 | 55.8 |
| 17/03/2017 | 19:10 | 97.4 | 66.5 | 69.7 | 57.9 | 55.4 |
| 17/03/2017 | 19:20 | 71.0 | 63.3 | 60.8 | 57.2 | 55.6 |
| 17/03/2017 | 19:30 | 76.2 | 64.9 | 62.3 | 58.0 | 56.5 |
| 17/03/2017 | 19:40 | 73.6 | 63.5 | 61.0 | 57.3 | 55.7 |
| 17/03/2017 | 19:50 | 76.2 | 64.0 | 61.4 | 57.0 | 55.3 |
| 17/03/2017 | 20:00 | 81.0 | 63.5 | 61.5 | 57.0 | 55.5 |
| 17/03/2017 | 20:10 | 77.3 | 64.9 | 62.0 | 57.3 | 55.6 |
| 17/03/2017 | 20:20 | 83.8 | 64.0 | 62.3 | 56.9 | 54.9 |
| 17/03/2017 | 20:30 | 75.7 | 64.2 | 61.5 | 57.9 | 56.5 |
| 17/03/2017 | 20:40 | 84.9 | 62.9 | 60.7 | 57.0 | 55.5 |
| 17/03/2017 | 20:50 | 76.7 | 64.8 | 62.2 | 57.1 | 55.6 |
| 17/03/2017 | 21:00 | 72.6 | 62.9 | 60.5 | 57.3 | 55.6 |
| 17/03/2017 | 21:10 | 73.5 | 63.6 | 61.2 | 57.6 | 55.8 |
| 17/03/2017 | 21:20 | 93.2 | 64.3 | 68.3 | 57.6 | 55.8 |
| 17/03/2017 | 21:30 | 73.9 | 62.4 | 60.3 | 57.1 | 55.3 |
| 17/03/2017 | 21:40 | 99.4 | 64.3 | 72.2 | 57.6 | 56.2 |
| 17/03/2017 | 21:50 | 75.3 | 63.0 | 60.8 | 57.8 | 55.7 |
| 17/03/2017 | 22:00 | 70.7 | 62.7 | 60.4 | 57.0 | 55.4 |
| 17/03/2017 | 22:10 | 77.0 | 62.9 | 61.0 | 57.4 | 55.5 |
| 17/03/2017 | 22:20 | 76.7 | 64.3 | 61.9 | 57.9 | 56.1 |
| 17/03/2017 | 22:30 | 79.3 | 64.1 | 61.6 | 57.6 | 56.3 |
| 17/03/2017 | 22:40 | 72.1 | 63.8 | 61.3 | 58.1 | 55.7 |
| 17/03/2017 | 22:50 | 76.7 | 63.2 | 61.2 | 58.0 | 55.9 |
| 17/03/2017 | 23:00 | 82.8 | 63.6 | 62.3 | 57.0 | 55.1 |
| 17/03/2017 | 23:10 | 70.3 | 63.0 | 60.4 | 56.9 | 55.3 |
| 17/03/2017 | 23:20 | 79.6 | 63.8 | 61.6 | 57.6 | 56.3 |
| 17/03/2017 | 23:30 | 73.1 | 62.6 | 60.3 | 57.4 | 55.9 |
| 17/03/2017 | 23:40 | 79.2 | 62.4 | 60.2 | 57.0 | 55.4 |
| 17/03/2017 | 23:50 | 77.3 | 64.3 | 61.4 | 57.5 | 56.1 |
| 18/03/2017 | 00:00 | 81.3 | 64.8 | 62.3 | 57.9 | 55.8 |
| 18/03/2017 | 00:10 | 71.4 | 62.8 | 60.5 | 57.6 | 55.6 |
| 18/03/2017 | 00:20 | 78.6 | 63.5 | 61.0 | 57.5 | 55.5 |
| 18/03/2017 | 00:30 | 77.4 | 63.2 | 61.0 | 57.2 | 55.4 |
| 18/03/2017 | 00:40 | 81.6 | 66.3 | 64.1 | 56.9 | 55.3 |
| 18/03/2017 | 00:50 | 86.9 | 65.2 | 63.5 | 57.6 | 55.9 |
| 18/03/2017 | 01:00 | 71.5 | 63.5 | 60.8 | 57.4 | 55.8 |
| 18/03/2017 | 01:10 | 81.1 | 67.2 | 64.2 | 58.2 | 56.5 |
| 18/03/2017 | 01:20 | 71.2 | 62.8 | 60.5 | 57.2 | 55.2 |
| 18/03/2017 | 01:30 | 77.6 | 64.3 | 61.7 | 57.3 | 55.5 |
| 18/03/2017 | 01:40 | 74.0 | 62.9 | 60.7 | 57.4 | 55.6 |
| 18/03/2017 | 01:50 | 70.8 | 62.8 | 60.4 | 57.3 | 55.6 |
| 18/03/2017 | 02:00 | 76.3 | 63.1 | 61.0 | 57.5 | 55.9 |
| 18/03/2017 | 02:10 | 78.1 | 63.7 | 61.7 | 57.5 | 55.4 |
| 18/03/2017 | 02:20 | 73.4 | 64.3 | 61.6 | 57.5 | 55.7 |
| 18/03/2017 | 02:30 | 72.1 | 64.4 | 61.6 | 57.0 | 55.4 |
| 18/03/2017 | 02:40 | 72.4 | 64.3 | 62.0 | 58.1 | 56.2 |
| 18/03/2017 | 02:50 | 73.4 | 64.1 | 61.7 | 57.8 | 56.1 |
| 18/03/2017 | 03:00 | 91.5 | 65.6 | 66.2 | 57.4 | 55.9 |
| 18/03/2017 | 03:10 | 80.3 | 63.9 | 62.1 | 57.4 | 55.8 |
| 18/03/2017 | 03:20 | 73.4 | 65.0 | 62.3 | 57.6 | 55.8 |
| 18/03/2017 | 03:30 | 80.9 | 66.0 | 62.9 | 57.4 | 55.6 |
| 18/03/2017 | 03:40 | 74.6 | 65.1 | 61.8 | 56.7 | 55.4 |
| 18/03/2017 | 03:50 | 79.8 | 65.4 | 62.3 | 57.0 | 55.3 |
| 18/03/2017 | 04:00 | 74.0 | 63.5 | 61.2 | 56.3 | 54.8 |
| 18/03/2017 | 04:10 | 77.0 | 65.8 | 62.6 | 57.0 | 54.7 |
| 18/03/2017 | 04:20 | 75.6 | 64.6 | 61.8 | 56.7 | 55.3 |
| 18/03/2017 | 04:30 | 77.4 | 65.2 | 61.9 | 53.1 | 48.3 |
| 18/03/2017 | 04:40 | 76.4 | 64.8 | 60.9 | 47.7 | 46.1 |
| 18/03/2017 | 04:50 | 77.3 | 63.5 | 60.3 | 47.7 | 45.3 |
| 18/03/2017 | 05:00 | 79.2 | 64.1 | 60.2 | 47.7 | 46.0 |
| 18/03/2017 | 05:10 | 73.5 | 63.4 | 59.7 | 47.5 | 45.4 |
| 18/03/2017 | 05:20 | 83.3 | 60.1 | 58.3 | 46.2 | 44.8 |
| 18/03/2017 | 05:30 | 73.2 | 64.6 | 61.2 | 48.8 | 46.9 |
| 18/03/2017 | 05:40 | 75.5 | 63.7 | 60.5 | 48.8 | 46.6 |
| 18/03/2017 | 05:50 | 73.4 | 62.0 | 59.1 | 47.9 | 46.3 |
| 18/03/2017 | 06:00 | 73.5 | 62.6 | 59.4 | 48.9 | 46.7 |
| 18/03/2017 | 06:10 | 72.7 | 61.4 | 58.6 | 48.2 | 46.6 |
| 18/03/2017 | 06:20 | 72.4 | 62.7 | 59.0 | 47.6 | 45.5 |
| 18/03/2017 | 06:30 | 73.8 | 62.1 | 59.1 | 49.5 | 46.4 |
| 18/03/2017 | 06:40 | 74.4 | 64.1 | 60.1 | 49.3 | 46.8 |
| 18/03/2017 | 06:50 | 76.6 | 63.0 | 59.5 | 48.5 | 46.8 |
| 18/03/2017 | 07:00 | 77.1 | 64.3 | 60.7 | 49.3 | 47.6 |
| 18/03/2017 | 07:10 | 77.3 | 63.5 | 60.2 | 49.2 | 47.0 |
| 18/03/2017 | 07:20 | 73.4 | 62.9 | 59.4 | 48.9 | 47.2 |
| 18/03/2017 | 07:30 | 76.6 | 64.4 | 61.1 | 49.7 | 48.0 |
| 18/03/2017 | 07:40 | 81.4 | 64.8 | 62.1 | 49.8 | 47.5 |
| 18/03/2017 | 07:50 | 77.9 | 63.1 | 59.4 | 49.7 | 48.0 |
| 18/03/2017 | 08:00 | 74.0 | 63.6 | 60.2 | 49.0 | 47.4 |
| 18/03/2017 | 08:10 | 73.2 | 64.2 | 60.3 | 50.7 | 48.2 |
| 18/03/2017 | 08:20 | 83.0 | 64.9 | 61.4 | 50.1 | 47.6 |
| 18/03/2017 | 08:30 | 74.4 | 64.2 | 60.1 | 49.8 | 47.9 |
| 18/03/2017 | 08:40 | 85.8 | 70.6 | 67.0 | 53.2 | 49.7 |
| 18/03/2017 | 08:50 | 88.4 | 73.7 | 69.5 | 56.3 | 49.7 |
| 18/03/2017 | 09:00 | 81.6 | 76.4 | 71.9 | 56.5 | 52.5 |
| 18/03/2017 | 09:10 | 90.5 | 70.9 | 69.3 | 55.5 | 52.5 |
| 18/03/2017 | 09:20 | 80.0 | 67.9 | 63.8 | 55.0 | 52.7 |
| 18/03/2017 | 09:30 | 94.1 | 68.2 | 68.2 | 55.8 | 52.1 |
| 18/03/2017 | 09:40 | 86.0 | 69.1 | 66.0 | 56.0 | 52.4 |
| 18/03/2017 | 09:50 | 79.5 | 64.7 | 61.7 | 54.0 | 52.2 |
| 18/03/2017 | 10:00 | 78.7 | 65.3 | 61.5 | 53.9 | 51.7 |
| 18/03/2017 | 10:10 | 92.4 | 71.9 | 71.0 | 54.2 | 51.9 |
| 18/03/2017 | 10:20 | 91.2 | 72.8 | 69.6 | 57.5 | 53.3 |
| 18/03/2017 | 10:30 | 93.4 | 73.0 | 70.4 | 57.4 | 53.3 |
| 18/03/2017 | 10:40 | 91.4 | 75.6 | 73.1 | 67.3 | 65.7 |
| 18/03/2017 | 10:50 | 99.7 | 74.3 | 72.9 | 61.6 | 55.4 |
| 18/03/2017 | 11:00 | 88.9 | 72.1 | 68.3 | 54.1 | 51.9 |
| 18/03/2017 | 11:10 | 89.5 | 71.4 | 70.8 | 53.8 | 51.6 |
| 18/03/2017 | 11:20 | 78.9 | 64.1 | 61.3 | 53.9 | 51.8 |
| 18/03/2017 | 11:30 | 73.9 | 63.4 | 59.9 | 51.8 | 48.2 |
| 18/03/2017 | 11:40 | 78.7 | 71.8 | 66.6 | 55.6 | 53.1 |
| 18/03/2017 | 11:50 | 84.9 | 72.1 | 68.1 | 56.6 | 51.1 |
| 18/03/2017 | 12:00 | 84.9 | 69.4 | 65.8 | 56.5 | 52.7 |
| 18/03/2017 | 12:10 | 83.8 | 73.3 | 67.9 | 57.6 | 51.4 |
| 18/03/2017 | 12:20 | 82.5 | 71.1 | 65.8 | 55.6 | 51.2 |
| 18/03/2017 | 12:30 | 84.7 | 66.8 | 65.2 | 55.4 | 52.0 |
| 18/03/2017 | 12:40 | 95.3 | 67.5 | 67.2 | 55.8 | 50.1 |
| 18/03/2017 | 12:50 | 85.6 | 65.7 | 63.7 | 54.0 | 49.0 |
| 18/03/2017 | 13:00 | 72.7 | 64.5 | 60.8 | 53.6 | 48.6 |
| 18/03/2017 | 13:10 | 92.3 | 65.0 | 64.0 | 53.3 | 50.4 |
| 18/03/2017 | 13:20 | 86.8 | 65.9 | 64.2 | 53.6 | 50.3 |
| 18/03/2017 | 13:30 | 73.5 | 62.7 | 59.1 | 51.5 | 49.9 |
| 18/03/2017 | 13:40 | 78.2 | 63.3 | 60.4 | 51.7 | 49.8 |
| 18/03/2017 | 13:50 | 80.3 | 64.0 | 60.9 | 52.3 | 49.5 |
| 18/03/2017 | 14:00 | 94.6 | 65.5 | 67.6 | 55.7 | 51.8 |
| 18/03/2017 | 14:10 | 77.4 | 65.3 | 62.4 | 55.6 | 51.3 |
| 18/03/2017 | 14:20 | 72.7 | 64.2 | 61.3 | 56.3 | 51.5 |
| 18/03/2017 | 14:30 | 81.8 | 66.1 | 63.0 | 54.3 | 50.9 |
| 18/03/2017 | 14:40 | 80.7 | 63.9 | 61.0 | 55.3 | 51.9 |
| 18/03/2017 | 14:50 | 78.3 | 67.0 | 64.6 | 58.1 | 52.7 |
| 18/03/2017 | 15:00 | 71.2 | 64.2 | 60.7 | 54.2 | 50.7 |
| 18/03/2017 | 15:10 | 71.7 | 63.5 | 60.2 | 55.2 | 51.9 |
| 18/03/2017 | 15:20 | 70.3 | 63.0 | 59.9 | 55.4 | 51.9 |
| 18/03/2017 | 15:30 | 77.7 | 63.2 | 60.3 | 54.3 | 49.8 |
| 18/03/2017 | 15:40 | 72.9 | 63.2 | 59.9 | 53.5 | 50.7 |
| 18/03/2017 | 15:50 | 74.2 | 65.0 | 61.6 | 55.5 | 51.6 |
| 18/03/2017 | 16:00 | 77.2 | 63.8 | 61.3 | 55.8 | 51.8 |
| 18/03/2017 | 16:10 | 69.9 | 63.7 | 60.7 | 56.1 | 51.7 |
| 18/03/2017 | 16:20 | 73.7 | 63.2 | 60.2 | 54.8 | 51.0 |
| 18/03/2017 | 16:30 | 76.6 | 63.6 | 60.3 | 53.7 | 50.7 |
| 18/03/2017 | 16:40 | 73.7 | 64.5 | 60.8 | 54.1 | 51.3 |
| 18/03/2017 | 16:50 | 83.1 | 64.3 | 62.6 | 54.7 | 51.4 |
| 18/03/2017 | 17:00 | 74.8 | 64.7 | 61.3 | 52.7 | 50.0 |
| 18/03/2017 | 17:10 | 71.0 | 63.3 | 59.6 | 52.8 | 49.4 |
| 18/03/2017 | 17:20 | 79.5 | 63.7 | 60.5 | 52.7 | 49.5 |
| 18/03/2017 | 17:30 | 80.3 | 63.3 | 60.1 | 52.6 | 50.3 |

## Table A2: Statistical noise level data measured on Crowndale Road between 17/03/2017 and 18/03/2017

| Date | Time | $L_{AFmax}$ | $L_{A10}$ | $L_{Aeq}$ | $L_{A90}$ | $L_{AFMin}$ |
|---|---|---|---|---|---|---|
| 17/03/2017 | 17:00 | 86.4 | 70.7 | 68.1 | 60.5 | 55.0 |
| 17/03/2017 | 17:10 | 81.8 | 68.7 | 66.2 | 57.9 | 54.7 |
| 17/03/2017 | 17:20 | 84.5 | 72.3 | 69.7 | 63.4 | 57.1 |
| 17/03/2017 | 17:30 | 82.5 | 71.4 | 68.6 | 61.9 | 57.7 |
| 17/03/2017 | 17:40 | 86.0 | 73.9 | 71.5 | 66.2 | 59.7 |
| 17/03/2017 | 17:50 | 84.6 | 72.0 | 69.7 | 64.8 | 59.9 |
| 17/03/2017 | 18:00 | 82.0 | 71.4 | 67.8 | 61.7 | 58.0 |
| 17/03/2017 | 18:10 | 80.6 | 72.0 | 68.4 | 60.6 | 56.9 |
| 17/03/2017 | 18:20 | 77.2 | 70.5 | 67.4 | 61.6 | 56.5 |
| 17/03/2017 | 18:30 | 109.7 | 72.9 | 80.6 | 63.1 | 57.6 |
| 17/03/2017 | 18:40 | 88.1 | 72.1 | 69.7 | 63.4 | 60.1 |
| 17/03/2017 | 18:50 | 83.2 | 71.9 | 69.1 | 61.6 | 56.9 |
| 17/03/2017 | 19:00 | 79.0 | 70.6 | 68.0 | 62.5 | 58.8 |
| 17/03/2017 | 19:10 | 94.9 | 86.6 | 81.3 | 64.1 | 59.5 |
| 17/03/2017 | 19:20 | 82.4 | 70.3 | 67.4 | 61.9 | 58.4 |
| 17/03/2017 | 19:30 | 88.0 | 71.8 | 69.6 | 63.3 | 57.8 |
| 17/03/2017 | 19:40 | 84.3 | 69.1 | 66.5 | 61.0 | 57.1 |
| 17/03/2017 | 19:50 | 82.8 | 70.6 | 68.1 | 63.1 | 58.0 |
| 17/03/2017 | 20:00 | 86.6 | 70.5 | 68.1 | 61.2 | 56.3 |
| 17/03/2017 | 20:10 | 81.8 | 69.7 | 66.8 | 61.0 | 54.4 |
| 17/03/2017 | 20:20 | 89.7 | 70.2 | 67.7 | 59.1 | 54.0 |
| 17/03/2017 | 20:30 | 81.4 | 71.6 | 68.3 | 61.3 | 56.9 |
| 17/03/2017 | 20:40 | 76.1 | 70.8 | 67.3 | 62.3 | 58.1 |
| 17/03/2017 | 20:50 | 85.3 | 71.3 | 68.6 | 63.3 | 58.4 |
| 17/03/2017 | 21:00 | 82.5 | 69.9 | 67.1 | 61.4 | 57.3 |
| 17/03/2017 | 21:10 | 94.6 | 70.6 | 68.4 | 62.0 | 57.2 |
| 17/03/2017 | 21:20 | 97.1 | 71.7 | 74.7 | 62.4 | 56.4 |
| 17/03/2017 | 21:30 | 80.3 | 70.5 | 67.9 | 63.3 | 55.9 |
| 17/03/2017 | 21:40 | 101.4 | 72.0 | 77.4 | 62.8 | 58.7 |
| 17/03/2017 | 21:50 | 76.4 | 69.7 | 66.9 | 61.8 | 56.0 |
| 17/03/2017 | 22:00 | 80.0 | 70.5 | 67.8 | 63.1 | 56.8 |
| 17/03/2017 | 22:10 | 86.7 | 71.2 | 69.1 | 62.8 | 59.3 |
| 17/03/2017 | 22:20 | 86.9 | 73.5 | 70.4 | 63.5 | 60.1 |
| 17/03/2017 | 22:30 | 92.9 | 70.9 | 68.7 | 63.1 | 59.2 |
| 17/03/2017 | 22:40 | 90.3 | 71.8 | 70.2 | 64.4 | 60.6 |
| 17/03/2017 | 22:50 | 82.5 | 72.2 | 69.5 | 64.7 | 59.6 |
| 17/03/2017 | 23:00 | 100.2 | 72.3 | 76.1 | 63.5 | 59.9 |
| 17/03/2017 | 23:10 | 93.6 | 71.1 | 69.8 | 63.2 | 59.6 |
| 17/03/2017 | 23:20 | 81.2 | 70.0 | 67.6 | 63.4 | 59.2 |
| 17/03/2017 | 23:30 | 84.8 | 72.2 | 69.3 | 63.8 | 60.3 |
| 17/03/2017 | 23:40 | 87.2 | 71.4 | 69.1 | 64.5 | 61.2 |
| 17/03/2017 | 23:50 | 85.9 | 71.6 | 69.3 | 65.0 | 59.5 |
| 18/03/2017 | 00:00 | 89.5 | 71.3 | 69.1 | 64.9 | 61.1 |
| 18/03/2017 | 00:10 | 89.3 | 71.4 | 69.3 | 65.2 | 60.4 |
| 18/03/2017 | 00:20 | 81.6 | 71.2 | 68.8 | 64.8 | 61.9 |
| 18/03/2017 | 00:30 | 82.8 | 72.2 | 69.5 | 64.0 | 60.5 |
| 18/03/2017 | 00:40 | 87.2 | 73.0 | 70.8 | 64.8 | 61.5 |
| 18/03/2017 | 00:50 | 86.3 | 71.8 | 69.7 | 65.8 | 61.8 |
| 18/03/2017 | 01:00 | 81.5 | 73.9 | 71.3 | 67.4 | 63.5 |
| 18/03/2017 | 01:10 | 89.5 | 73.2 | 70.7 | 65.7 | 61.8 |
| 18/03/2017 | 01:20 | 82.4 | 70.5 | 68.3 | 64.7 | 61.2 |
| 18/03/2017 | 01:30 | 88.3 | 72.1 | 70.0 | 64.4 | 60.8 |
| 18/03/2017 | 01:40 | 85.7 | 72.3 | 70.4 | 65.6 | 60.5 |
| 18/03/2017 | 01:50 | 78.7 | 71.5 | 69.1 | 65.6 | 61.1 |
| 18/03/2017 | 02:00 | 79.2 | 71.9 | 69.3 | 65.1 | 60.9 |
| 18/03/2017 | 02:10 | 81.9 | 72.2 | 69.6 | 65.2 | 61.7 |
| 18/03/2017 | 02:20 | 80.1 | 71.0 | 68.5 | 64.4 | 60.8 |
| 18/03/2017 | 02:30 | 80.5 | 72.7 | 70.1 | 65.7 | 61.2 |
| 18/03/2017 | 02:40 | 82.5 | 72.5 | 70.1 | 66.1 | 63.0 |
| 18/03/2017 | 02:50 | 82.4 | 72.6 | 69.7 | 65.2 | 60.9 |
| 18/03/2017 | 03:00 | 96.3 | 73.9 | 73.4 | 64.7 | 60.6 |
| 18/03/2017 | 03:10 | 84.2 | 72.1 | 69.4 | 64.3 | 59.4 |
| 18/03/2017 | 03:20 | 88.1 | 71.9 | 69.4 | 64.2 | 59.8 |
| 18/03/2017 | 03:30 | 81.4 | 72.1 | 69.1 | 64.1 | 60.4 |
| 18/03/2017 | 03:40 | 80.7 | 72.1 | 68.9 | 62.9 | 59.5 |
| 18/03/2017 | 03:50 | 84.3 | 73.7 | 70.5 | 63.8 | 59.9 |
| 18/03/2017 | 04:00 | 84.1 | 70.7 | 67.2 | 61.6 | 56.4 |
| 18/03/2017 | 04:10 | 92.1 | 73.6 | 71.7 | 63.2 | 59.2 |
| 18/03/2017 | 04:20 | 78.3 | 70.1 | 67.0 | 59.2 | 55.3 |
| 18/03/2017 | 04:30 | 86.0 | 71.5 | 68.8 | 56.2 | 53.2 |
| 18/03/2017 | 04:40 | 90.1 | 71.9 | 69.5 | 55.7 | 51.3 |
| 18/03/2017 | 04:50 | 79.7 | 70.3 | 66.3 | 54.1 | 49.4 |
| 18/03/2017 | 05:00 | 82.0 | 70.3 | 66.2 | 53.6 | 50.0 |
| 18/03/2017 | 05:10 | 92.4 | 70.5 | 69.0 | 53.7 | 50.9 |
| 18/03/2017 | 05:20 | 79.0 | 69.0 | 64.6 | 52.5 | 49.1 |
| 18/03/2017 | 05:30 | 87.1 | 83.6 | 78.6 | 59.9 | 55.0 |
| 18/03/2017 | 05:40 | 83.6 | 70.8 | 67.6 | 56.1 | 54.2 |
| 18/03/2017 | 05:50 | 77.7 | 69.6 | 65.4 | 54.1 | 51.4 |
| 18/03/2017 | 06:00 | 82.0 | 69.2 | 65.1 | 54.1 | 51.1 |
| 18/03/2017 | 06:10 | 80.4 | 69.8 | 65.2 | 53.9 | 49.3 |
| 18/03/2017 | 06:20 | 80.2 | 70.4 | 66.1 | 52.9 | 49.9 |
| 18/03/2017 | 06:30 | 82.1 | 69.4 | 65.1 | 53.9 | 50.3 |
| 18/03/2017 | 06:40 | 78.3 | 70.5 | 66.1 | 56.2 | 51.5 |
| 18/03/2017 | 06:50 | 81.8 | 70.9 | 66.4 | 54.7 | 50.3 |
| 18/03/2017 | 07:00 | 79.9 | 71.2 | 66.8 | 54.8 | 51.4 |
| 18/03/2017 | 07:10 | 78.0 | 69.2 | 65.8 | 56.4 | 51.9 |
| 18/03/2017 | 07:20 | 77.5 | 69.8 | 65.8 | 54.0 | 50.7 |
| 18/03/2017 | 07:30 | 79.0 | 72.2 | 68.3 | 57.6 | 54.4 |
| 18/03/2017 | 07:40 | 80.0 | 71.1 | 67.4 | 57.4 | 54.4 |
| 18/03/2017 | 07:50 | 80.7 | 70.1 | 66.2 | 58.5 | 53.0 |
| 18/03/2017 | 08:00 | 80.0 | 70.8 | 67.3 | 57.6 | 51.7 |
| 18/03/2017 | 08:10 | 78.1 | 69.3 | 65.8 | 57.6 | 54.5 |
| 18/03/2017 | 08:20 | 83.5 | 72.1 | 68.9 | 57.6 | 52.9 |
| 18/03/2017 | 08:30 | 76.4 | 70.1 | 66.3 | 56.9 | 51.2 |
| 18/03/2017 | 08:40 | 83.1 | 70.3 | 67.4 | 59.6 | 53.4 |
| 18/03/2017 | 08:50 | 91.5 | 72.4 | 71.7 | 58.8 | 53.7 |
| 18/03/2017 | 09:00 | 81.0 | 70.4 | 66.4 | 57.0 | 53.7 |
| 18/03/2017 | 09:10 | 95.1 | 70.8 | 69.8 | 59.6 | 55.2 |
| 18/03/2017 | 09:20 | 80.4 | 69.7 | 66.3 | 57.2 | 52.4 |
| 18/03/2017 | 09:30 | 84.0 | 70.7 | 66.8 | 58.8 | 55.1 |
| 18/03/2017 | 09:40 | 93.8 | 72.1 | 69.5 | 58.4 | 54.2 |
| 18/03/2017 | 09:50 | 85.3 | 69.8 | 67.6 | 58.2 | 53.7 |
| 18/03/2017 | 10:00 | 87.5 | 70.9 | 68.3 | 57.5 | 53.7 |
| 18/03/2017 | 10:10 | 80.2 | 70.4 | 67.3 | 59.1 | 53.6 |
| 18/03/2017 | 10:20 | 79.3 | 71.0 | 67.2 | 58.4 | 53.6 |
| 18/03/2017 | 10:30 | 82.7 | 69.8 | 66.6 | 58.1 | 54.4 |
| 18/03/2017 | 10:40 | 78.6 | 70.1 | 66.8 | 58.5 | 53.3 |
| 18/03/2017 | 10:50 | 77.7 | 69.6 | 66.2 | 58.5 | 53.0 |
| 18/03/2017 | 11:00 | 97.3 | 71.9 | 70.1 | 60.6 | 56.6 |
| 18/03/2017 | 11:10 | 79.9 | 73.4 | 69.2 | 58.3 | 52.4 |
| 18/03/2017 | 11:20 | 84.9 | 70.6 | 67.9 | 59.1 | 53.6 |
| 18/03/2017 | 11:30 | 86.3 | 70.1 | 67.0 | 58.9 | 52.9 |
| 18/03/2017 | 11:40 | 80.1 | 71.6 | 68.2 | 60.0 | 56.1 |
| 18/03/2017 | 11:50 | 82.9 | 69.1 | 65.5 | 57.4 | 54.1 |
| 18/03/2017 | 12:00 | 82.7 | 71.3 | 67.7 | 59.3 | 54.9 |
| 18/03/2017 | 12:10 | 88.3 | 70.1 | 66.9 | 58.9 | 54.7 |
| 18/03/2017 | 12:20 | 84.6 | 71.5 | 68.2 | 60.8 | 55.5 |
| 18/03/2017 | 12:30 | 103.2 | 71.9 | 77.0 | 61.8 | 56.6 |
| 18/03/2017 | 12:40 | 78.5 | 70.9 | 67.4 | 59.2 | 55.5 |
| 18/03/2017 | 12:50 | 79.5 | 70.0 | 66.3 | 57.4 | 51.7 |
| 18/03/2017 | 13:00 | 85.0 | 70.7 | 67.8 | 59.9 | 54.1 |
| 18/03/2017 | 13:10 | 85.4 | 70.3 | 67.4 | 58.4 | 52.2 |
| 18/03/2017 | 13:20 | 86.3 | 71.3 | 68.6 | 58.7 | 53.2 |
| 18/03/2017 | 13:30 | 84.6 | 70.8 | 68.5 | 59.2 | 53.5 |
| 18/03/2017 | 13:40 | 84.5 | 70.5 | 67.2 | 57.5 | 52.3 |
| 18/03/2017 | 13:50 | 89.3 | 69.4 | 66.9 | 58.5 | 54.5 |
| 18/03/2017 | 14:00 | 102.3 | 71.4 | 75.1 | 61.6 | 58.0 |
| 18/03/2017 | 14:10 | 91.9 | 71.6 | 69.9 | 61.5 | 56.3 |
| 18/03/2017 | 14:20 | 90.5 | 73.1 | 71.7 | 62.1 | 58.8 |
| 18/03/2017 | 14:30 | 101.0 | 77.9 | 76.6 | 61.5 | 54.4 |
| 18/03/2017 | 14:40 | 83.8 | 75.6 | 71.0 | 61.4 | 53.6 |
| 18/03/2017 | 14:50 | 79.4 | 73.9 | 70.0 | 62.1 | 57.6 |
| 18/03/2017 | 15:00 | 87.2 | 70.0 | 67.3 | 57.6 | 52.9 |
| 18/03/2017 | 15:10 | 83.3 | 70.2 | 67.0 | 56.1 | 52.2 |
| 18/03/2017 | 15:20 | 83.9 | 70.1 | 66.4 | 57.5 | 52.0 |
| 18/03/2017 | 15:30 | 83.8 | 70.3 | 67.2 | 59.2 | 52.7 |
| 18/03/2017 | 15:40 | 77.9 | 69.9 | 66.2 | 56.7 | 53.8 |
| 18/03/2017 | 15:50 | 85.2 | 72.1 | 68.7 | 60.9 | 57.7 |
| 18/03/2017 | 16:00 | 77.9 | 70.9 | 67.6 | 60.1 | 56.6 |
| 18/03/2017 | 16:10 | 82.6 | 70.7 | 67.4 | 60.8 | 55.0 |
| 18/03/2017 | 16:20 | 87.1 | 70.6 | 67.7 | 60.5 | 54.2 |
| 18/03/2017 | 16:30 | 89.3 | 69.9 | 67.7 | 58.0 | 55.4 |
| 18/03/2017 | 16:40 | 85.1 | 71.8 | 69.2 | 59.4 | 53.6 |
| 18/03/2017 | 16:50 | 102.2 | 72.3 | 76.6 | 61.0 | 53.8 |
| 18/03/2017 | 17:00 | 86.3 | 72.5 | 69.7 | 61.0 | 56.1 |
| 18/03/2017 | 17:10 | 78.8 | 70.4 | 67.3 | 61.7 | 57.6 |
| 18/03/2017 | 17:20 | 78.8 | 71.2 | 68.3 | 62.3 | 54.9 |
| 18/03/2017 | 17:30 | 82.8 | 70.6 | 67.5 | 58.2 | 52.9 |

# APPENDIX B - TERMINOLOGY

This appendix provides an explanation of some of the acoustics terms used in this report.

| | |
|---|---|
| | The human ear does not sense all frequencies of sound equally. Our sensitivity is at a maximum at around 2 kHz and steadily decreases above and below. Below 20 Hz and above about 20 kHz we can't hear at all. |
| A-weighting<br>$L_A$ or $L_{pA}$, $L_{WA}$, | Within its operating limits a precision measurement microphone measures all frequencies the same so the output it produces does not reflect what we would actually hear. The A-weighting is an electronic filter that matches the response of a sound level meter to that of the human ear. When A-weighted the Sound Pressure Level $L_p$ becomes $L_{pA}$ (or $L_A$) and the Sound Power Level $L_W$ becomes $L_{WA}$. |
| $L_p$ | *The instantaneous sound pressure level* ($L_p$) |
| $L_{pA}$ (or $L_A$) | *The A-weighted instantaneous sound pressure level* ($L_{pA}$ or $L_A$) |
| | This is the root mean square size of the pressure fluctuations in the air. This level can fluctuate wildly even for seemingly steady sounds. To make sound level meters easier to read the values on the display are smoothed or damped out. This is effectively done by taking a rolling average of the previous 0.125 s (FAST time constant) or the previous 1 s (SLOW time constant). |
| $L_{AF}$, $L_{AS}$ | The letters F or S are added to the subscripts in the notation to indicate when the FAST or SLOW time constant has been used. These are often omitted but it is good practice to include them. |
| $L_{max}$ | *The maximum instantaneous sound pressure level* ($L_{max}$), |
| $L_{Amax}$ | *The A-weighted maximum instantaneous sound pressure level* ($L_{Amax}$) |
| $L_{AFmax}$ | *The A-weighted maximum instantaneous sound pressure level with a FAST time constant* ($L_{AFmax}$). |
| $L_{min}$ , $L_{Fmin}$ | The opposite of the $L_{max}$ is the *minimum instantaneous sound pressure level* or $L_{min}$ etc.<br>It is good practice to include the letter which identifies the time constant used as this can make a significant difference to the value. |
| $L_{N,T}$ | *The percentage exceedence sound pressure level* ($L_{N,T}$), |
| $L_{AN,T}$ $L_{AFN,T}$<br>$_N$ = %age value, 0-100<br>$_T$ = measurement time<br>eg. $L_{A90}$, $L_{A10}$, $L_{AF90, 5 min}$ | *The A-weighted percentage exceedence sound pressure level* ($L_{AN,T}$)*, the A-weighted percentage exceedence sound pressure level with a FAST time constant* ($L_{AFN,T}$).<br>This is the sound pressure level exceeded for *N*% of time period *T*. eg. If an A-weighted level of x dB is exceeded for a total of 6 minutes within one hour, the level will have been above x dB for 10% of the measurement period. This is written as $L_{A10,1hr}$ = x dB.<br>$L_{A0}$ (the level exceeded for 0 % of the time) is equivalent to the $L_{Amax}$ and $L_{A100}$ (the level exceeded for 100 % of the time) is equivalent to the $L_{Amin}$.<br>It is good practice to include the letter which identifies the time constant used as this can make a significant difference to the value. |
| $L_{eq,T}$ | The *equivalent continuous sound pressure level over period T* ($L_{eq,T}$), |
| $L_{Aeq,T}$<br>$_T$ = measurement time<br>eg. $L_{Aeq,5min}$ | *The A-weighted equivalent continuous sound pressure level over period T* ($L_{Aeq,T}$).<br>This is effectively the average sound pressure level over a given period. As the decibel is a logarithmic quantity the $L_{eq}$ is not a simple arithmetic mean value.<br>The $L_{eq}$ is calculated from the raw sound pressure data. It is not appropriate to include a reference to the FAST and SLOW time constants in the notation |

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