N I C K

HITAKER

electro-acoustics

ACOUSTIC REPORT

Analysis of the potential noise impact caused to local residents by the replacement of air conditioning system compressor units on roof of:
Wedlake Bell Solicitors - 52 Bedford Row, London,WC1R 4LR

Client: United Facility Management Ltd/ Wedlake Bell Solicitors
c/o Suite 4 - The Sanctuary
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Report prepared by Nick Whitaker MIOA

Contents:

Confidential

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1. Summary

1.1 A study has been completed to assess the noise output & potential impact of the existing air conditioning system mounted on the roof of Wedlake Bell Solicitors, 52 Bedford Row, London WC1R 4LR.

1.2 The 6 system compressor units are due to be replaced. The purpose of this study is to
a) establish the required (maximum) noise output specifications of replacement units - so that appropriate units can be specified, and the total noise emission levels from the system will not be increased as a result.
b) ensure that the current (and potential future) noise emissions from the system do not provide any cause for complaint from local residents in the vicinity.

1.3 A continuous logged noise survey was conducted over a 48 hour period, 7th May until Thursday 9th May 2013. The measurement position was on the roof of 52, Bedford Row, so that the dominant noise sources were the air handling & compressor units, when switched on.

1.4 The system was ON from 5am until 8pm. During this period the air handling unit is on continuously & the compressors intermittently switch on (depending on demand).

1.4 It is shown that the noise emissions from the existing system, located in the roof plant room area; considering the distance to the closest noise sensitive (residential) properties & the barrier attenuation provided by the location of the units within the roof of 52, Bedford Row, will be at least 10dB below the prevailing background noise levels - at all times of the day & week. This should be sufficient to satisfy Camden Local Authority planning requirements.

1.5 The maximum noise output of the replacement compressor units has been determined to ensure that the above condition will continue to be met after the compressor units have been replaced. The specifications of the proposed Weatherite WRC WRC2-350 units indicate that this requirement will be fulfilled.

2. Introduction:

2.1 52, Bedford Row is an office block located to the side of Grays Inn Gardens, London.

2.2 The majority of the other buildings in the vicinity are offices or the Inns of Court & Legal chambers. The closest residential property (which is currently being developed) appears to be at the corner of Eagle St & Bedford Row - approximately 70m from 52, Bedford Row.

2.3 The air conditioning machinery is operational during normal office hours during the week, and also occasionally later in the evening and over weekends.

2.5 The criteria required by the local authority is that that the level of noise emitted from any new plant shall be lower than the existing background level by at least 10 LpA. Noise levels shall be determined at one metre from the window of the nearest noise sensitive premises. The measurements and assessments made in accordance with B.S. 4142.

3 Methodology of assessment:

3.1 Measurements of the ambient sound levels in the vicinity were made and logged in 5 minute intervals over a 2 day period – 1500 Tuesday 7th May until 1500 Thursday 9th May. The measurements included L_{Aeq} & L_{A90} (background noise indicator) percentile. Octave band frequency analysis was also measured and logged. The octave band spectra of the lowest measured periods were analysed and compared with the measured frequency octave band noise emissions from the machinery when air handling & compressor components were operational.

3.2 Measurement equipment employed:

A RION NA-28 type 1 integrating sound level analyser (S/N 00991178), calibration was checked before & after the measurement period with Cirrus CR513A acoustic calibrator (S/N 031520), both calibrated to traceable national standards – no significant drift in the calibration was noted.
Appropriate weather protection was provided for the microphone, although for the first 24 hours of the measurement period the weather conditions were dry, with a low wind speed. There were occasional short rain showers over the second 24 hours, and increased wind speeds.

3.3 The position of the measurement microphone was on the roof area of 52, Bedford Row (a 6 storey block), ~1.5m above the plant control room roof in clear line of sight to both the air handling output vent & the compressor units (see photo & map in appendix).
Due to the restricted space available & the general difficulty of access to other positions, this position was approximately 2.5m to the closest compressor unit & approximately 5m to the air handling unit output vent. This position is considered a "free-field" measurement position.

4. Measurement results: - see attached graphical results in Appendix 1.

4.1 L_{A90} levels in the 5 minute periods were found to be between 60dBA to 66dBA during the hours (5am - 8pm) when the system was operational. At 2000 hrs the levels fall to around 52dBA, gradually reducing after this to a lowest value of 44dB at 0225. From around 0400 the levels rose back to 52dBA, then around 0500 they increased back to 60dBA when the system switched on.

4.2 During the operational period of the system the noise levels can be seen to be generally around 60-61dBA. There are regular, periodic increases in noise level - up to 66dBA - which appear to correlate with periods when the compressor units (as well as the air handling unit) were operational.

4.4 Local noise environment/ Dominant local noise sources:
Local road traffic is the most dominant noise source (excluding the ac system noise as measured in this survey location) The area is undoubtedly busy, and the night time background noise levels (~44dBA) are reasonably typical of those found in the centre of London.

5. Discussion of the potential noise impact of noise from the ac system.

The overall noise output of the system with both air handling and compressor units operational is 66dBA. This noise level is dominated by the noise from the compressor units located at 2.5m from the measurement position. Given that the air handling units were located at ~5m distance from measurement position, it can be estimated that both components have approximately the same noise output (6dB/ doubling of distance).
If the dominant noise sources of the ac system were in direct, unobstructed line of sight to the upper floors of the closest residential building, the attenuation of sound by distance travelled (~70m), compared to the measurement position (2.5m distance) would be of the order of 25-28dB. This would imply that the noise emissions from the ac system would be marginally lower than the lowest night time background noise levels at the closest residential building.

The system is also effectively recessed within an area surrounded by an upper mansard type roof structure (of over 2m height) above the 6th floor of 52, Bedford Row. The structure of the mansard roof is reasonably substantial, therefore provides an effective noise barrier. Due to the height of this barrier, and it's relative height compared to the height of the upper floors of the residential block on corner of Bedford Row (44) & Eagle St, the effective angle of noise shadow from the main noise sources in the equipment is greater than 90 degrees.
From calculation, the mansard roof barrier should provide greater than 20dB attenuation in the mid frequency bands (1kHz), and approximately 12dB at low frequencies (63Hz).

The overall attenuation of the noise emissions - by distance travelled to the the closest residential building & by the barrier attenuation offered by the mansard roof surround - should therefore be at least 45dB in the mid frequencies (and overall dBA rating), and 37dB at low frequencies.
The resulting overall level of noise emissions from the units the closest residential building would be 21dBA, which is 23dBA lower than the prevailing background noise levels, even during the quietest period during the night. This should ensure a very minimal likelihood of any complaint related to the noise emissions.

Operation of the units over weekend periods was considered & it appears unlikely that weekend daytime background noise levels in the vicinity are any lower than weekday

lowest night time levels - which implies that operation of the system over weekend periods would also be be very unlikely to cause any reason for complaint due to noise emissions.

6. Recommended maximum noise output levels of 6 replacement units

The replacement compressor units should ideally have equal or lower noise emissions than the current units. Although the current emissions appear to be well within acceptable limits, and there would appear to be a reasonable margin to increase the potential emissions, I would suggest that a 10dB design/safety margin would be advisable, if possible. The resulting maximum requirements are not particularly onerous, & I expect that newer high quality units would easily meet them - and be quieter than the current units.

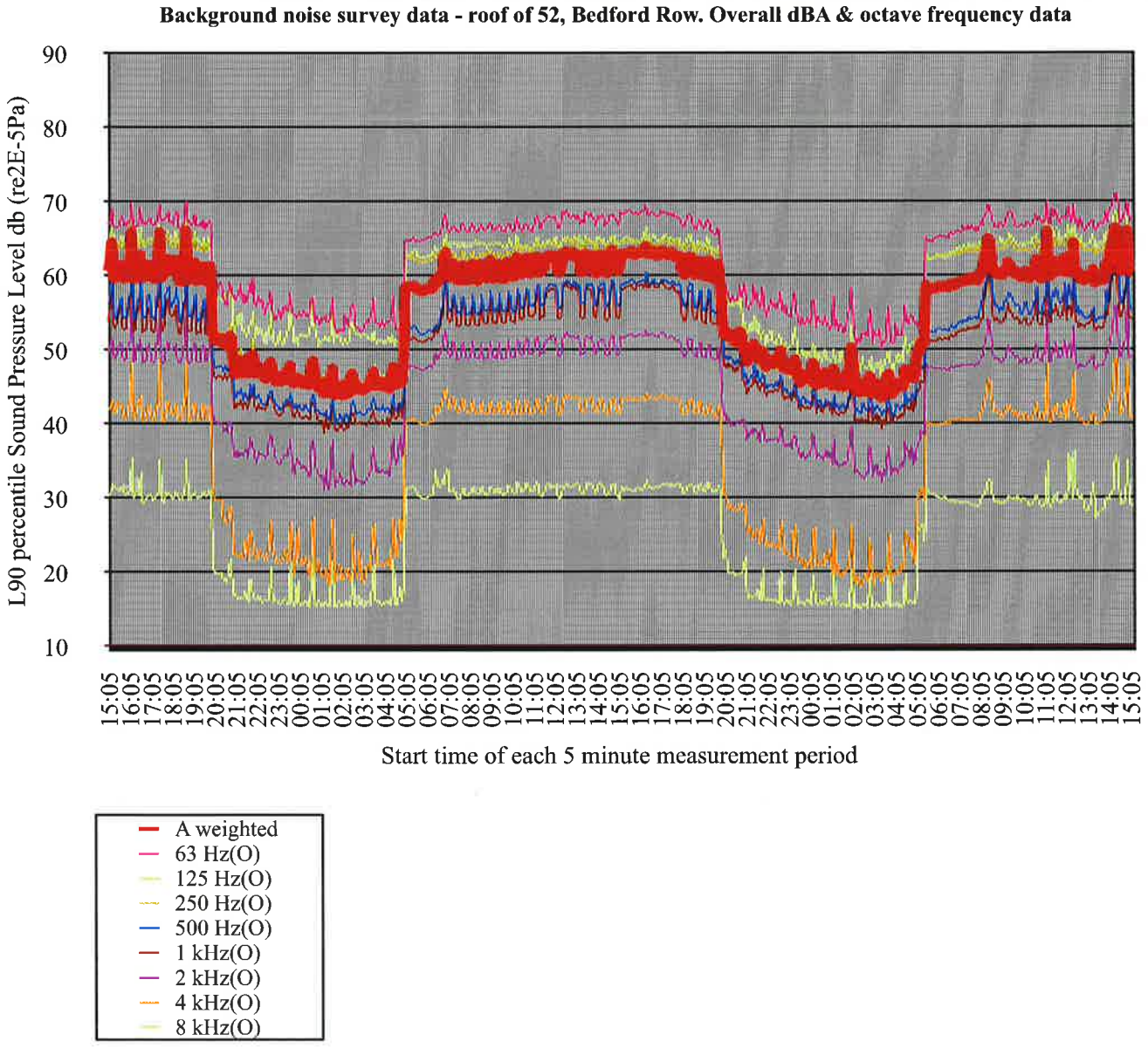
Compressor noise levels only (extrapolated from data) - at 3m to closest compressor unit.

	- present units at measurement position	recommended estimate / per unit at 3m distance	**Weatherite WRC WRC2-350 10 fan unit (full output)**
A weighted	64.9dBA	61.9dBA	62dBA
63 Hz(O)	66.7dB	63.7dB	63.5dB
125 Hz(O)	64dB	61.0dB	56.5dB
250 Hz(O)	62.8dB	59.8dB	56.5dB
500 Hz(O)	61.8dB	58.8dB	56.5dB
1 kHz(O)	62dB	59.0dB	55.5dB
2 kHz(O)	55.3dB	52.3	56.5dB*
4 kHz(O)	48.3dB	45.3	51.5dB*
8 kHz(O)	33.7dB	30.7	N/A

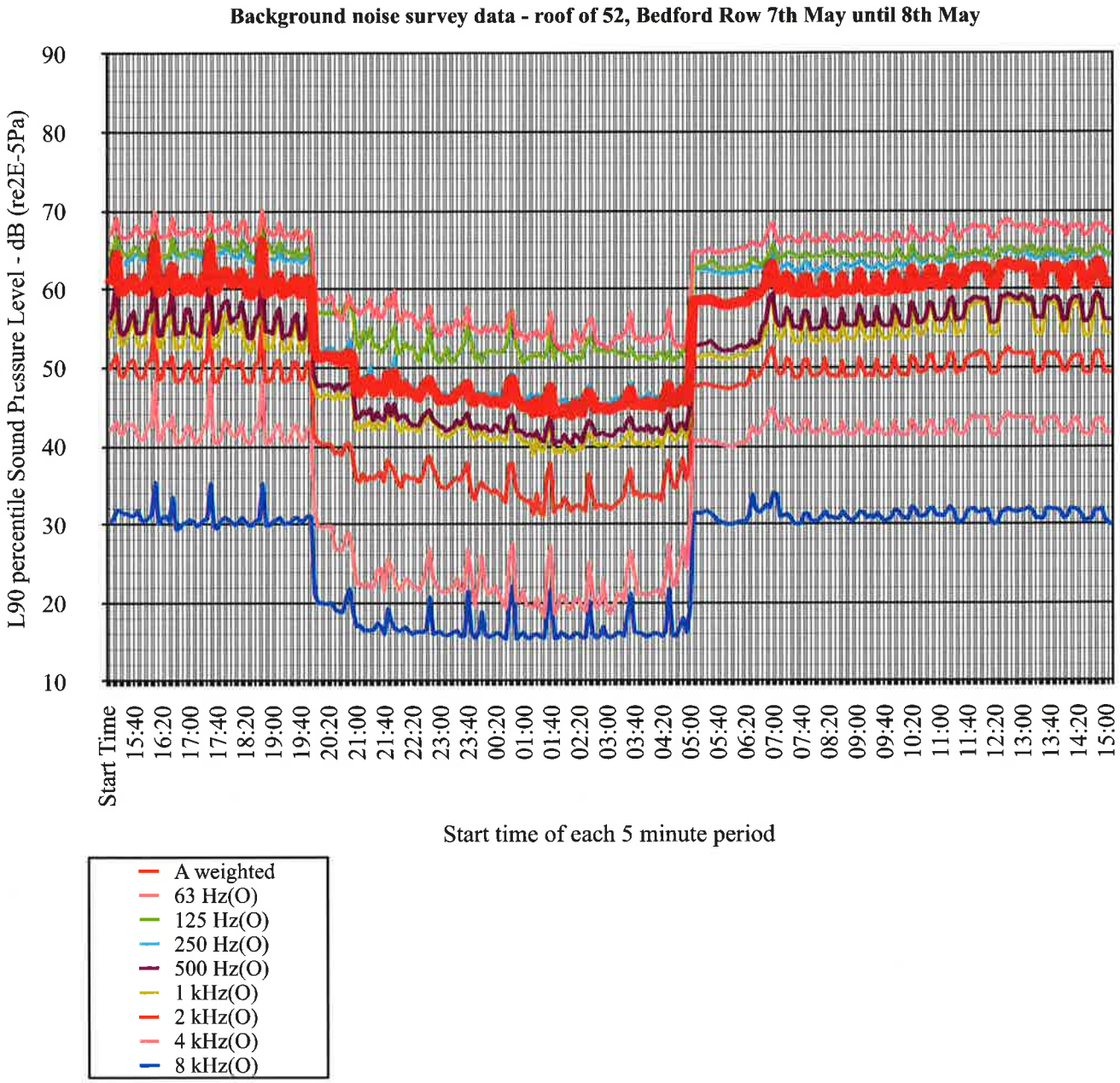
* note that attenuation by the barrier effect of mansard roof structure around the plant will be most effective at these higher frequencies - therefore the emissions at these frequencies will be more than adequately attenuated at the closest noise sensitive premises.

Appendix 1: Measurement data

48 hour survey (7th May 1505 hrs to 9th May 1505 hrs)



1st 24 hour period in detail:

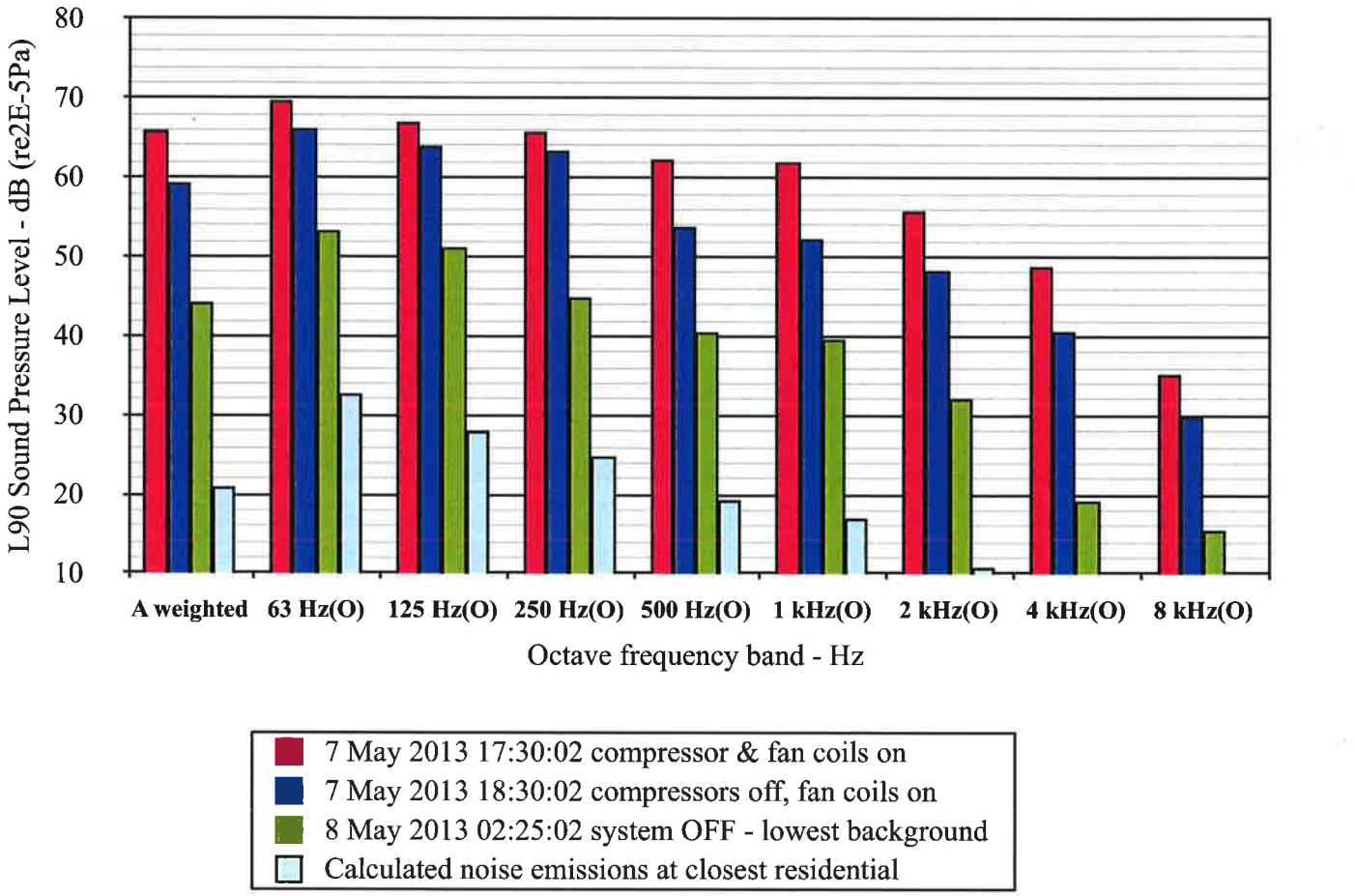


Frequency data:

- maximum levels

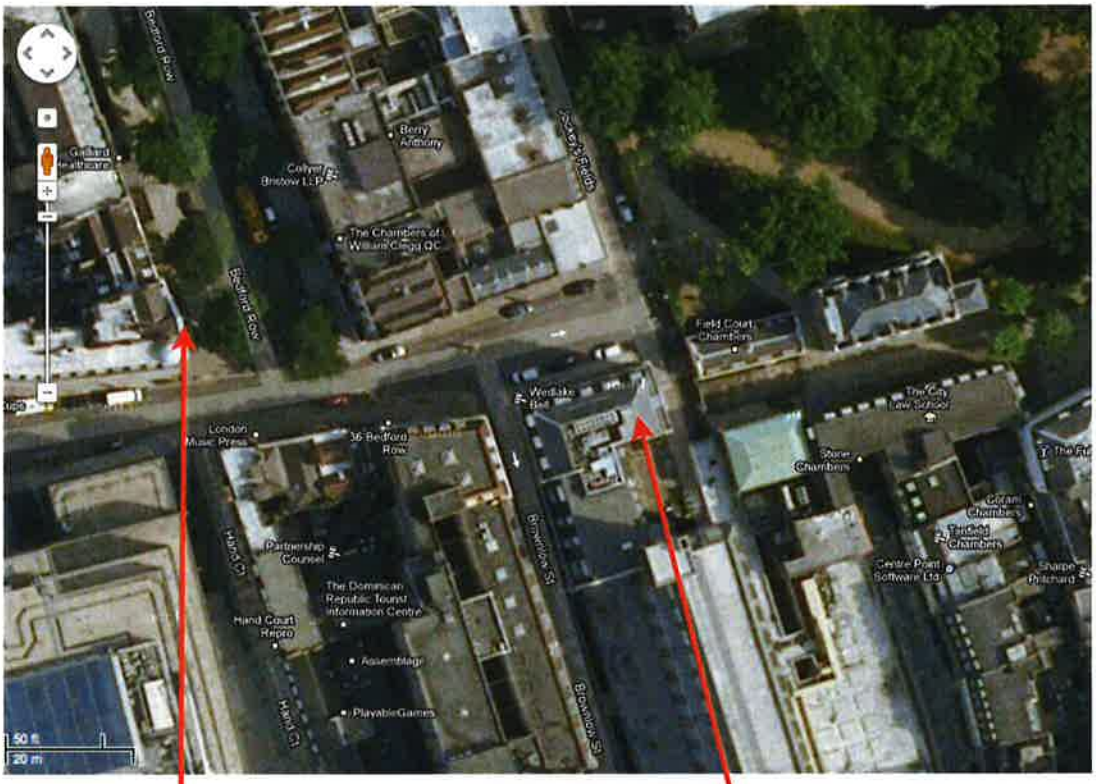
1) compressors & air handling unit on
2) air handling unit on
3) background noise - ac system OFF
4) calculated noise emissions of units (maximum) at closest noise sensitive property.

Overall noise levels of lowest background compared to system emissions at maximum operational levels



Appendix 2: Location

courtesy Google Maps



Closest noise sensitive properties

Measurement position

dome above closest residential property

mansard roof structure surrounding plant

measurement microphone position

compressor units

air handling unit vent out

Proposed chiller unit noise specifications:

PROJECT REFERENCE: Wedlake Bell Chiller

MODEL: WRC2-350

SOUND POWER LEVELS

Reference: 10^{-12} Watts at fan outlet

Octave Band Frequency	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
Condenser fan (Per fan):	76	66	65	64	66	64	59	54

Operating Noise Level: 55.0 dB(A) at 10.0 metres, 0° directivity to airflow under free field conditions, all fans operating at full speed.

Description of results & statistical analysis used to describe time-varying noise sources:

Instantaneous A-weighted sound pressure level is not generally considered as an adequate indicator of subjective response to noise because levels of noise usually vary with time.

For many types of noise the Equivalent Continuous A-Weighted Sound Pressure Level ($L_{Aeq,T}$) is used as the basis of determining community response. The $\mathbf{L_{Aeq,T}}$ is defined as the A-weighted sound pressure level of the steady sound which contains the same acoustic energy as the noise being assessed over a specific time period (in these measurements, 15 minutes).

Statistical descriptors:

$\mathbf{L_{A90}}$ describes the sound level which is exceeded for 90% of the time period & is normally taken as a description of the ambient background noise levels – this is the underlying noise level, largely ignoring transient events during the time period. This descriptor is most useful to evaluate the underlying prevailing background noise levels & also noise emissions which are of a reasonable consistent level over the measurement period - for example, operating ac equipment.

$\mathbf{L_{A10}}$ describes the sound level which is exceeded for 10% of the time period & is normally taken as a descriptor of the road traffic noise.

$\mathbf{L_{Amax}}$ describes the maximum sound level recorded during the time period.