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LONDON CITY AIRPORT

AIRCRAFT NOISE SURVEY

EAST DULWICH

Report to

Lewis Chenery
Environmental Compliance Executive
City Aviation House
London City Airport
The Royal Docks
London E16 2PB

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Bickerdike Allen Partners LLP is an integrated practice of Architects, Acousticians, and Construction Technologists, celebrating over 50 years of continuous practice.

Architects: Design and project management services which cover all stages of design, from feasibility and planning through to construction on site and completion.

Acoustic Consultants: Expertise in planning and noise, the control of noise and vibration and the sound insulation and acoustic treatment of buildings.

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This report has been redacted to remove identifiable details of the survey location to comply with GDPR.

1.0 INTRODUCTION

Bickerdike Allen Partners LLP (BAP) have been commissioned by London City Airport (LCA) to carry out a survey to monitor aircraft noise at a location on Lordship Lane in East Dulwich. The purpose of the survey is to measure the noise level under the flight path of LCA arrivals and also to assess the effect of aircraft using London Heathrow Airport (LHA).

This measurement location is around 11 km to the south west of LCA, between Dulwich and Forest Hill. It is typically overflown by aircraft on an easterly approach to LCA, when the aircraft are travelling west before carrying out a 180° turn to line up with the runway for their final approach. Some aircraft using LHA also pass close to this area, either on westerly approaches or easterly departures. This report provides a summary of the noise measurements. A glossary of acoustic terminology is provided in Appendix 1.

2.0 SURVEY DETAILS

2.1 Methodology

Environmental noise measurements were carried out in accordance with BS 7445[1].

BAP visited the property and set up a noise monitor in the rear garden of the property, which faces to the south west. This recorded noise data continuously for 14 days between approximately 12:15 pm on 11th September and 6:30 pm on 24th September.

This period was chosen as a mixture of easterly and westerly winds was forecast, meaning measurements could be taken for both runway 09 and runway 27 aircraft operations at LHA, as well as the runway 09 aircraft operations at LCA. In practice easterly winds occurred for around 2 days of the measurement period.

2.2 Equipment

The equipment used for the long term survey was an 01dB DUO Smart Noise Monitor, mounted on a tripod approximately 3 m above the ground, in a free field position in the garden of the property. Attended measurements were made using a Norsonic 140 next to the long term monitor on a tripod approximately 1m above the ground. The unattended monitor location is shown in Figure 1. The monitors were calibrated at the start and end of the measurements, and no significant drift was observed.

[1] BS 7445-1:2003 *Description and measurement of environmental noise*

[redacted]

Figure 1: Noise monitor location, facing south west

3.0 SURVEY RESULTS AND DISCUSSION

3.1 Background Noise Levels

Other than aircraft noise, the main noise source was road traffic. During the daytime (07:00 to 23:00), the average noise level over the survey period (total from all sources) was 52 dB $L_{Aeq,16h}$ and the average background noise level was 46 dB L_{A90}.

3.2 Flight Tracks – London City Airport

LCA have provided BAP with the aircraft movement data and flight track data for the monitoring period. Figure 2 shows the runway 09 arrival radar tracks during the monitoring period, with the property location marked by a green spot. The radar feed was not operational for part of the period and therefore not all flights are displayed. It can be clearly seen that arrivals using runway 09 pass very close to directly above the property. Aircraft approaching LCA are typically at around 2,000 ft at this location.

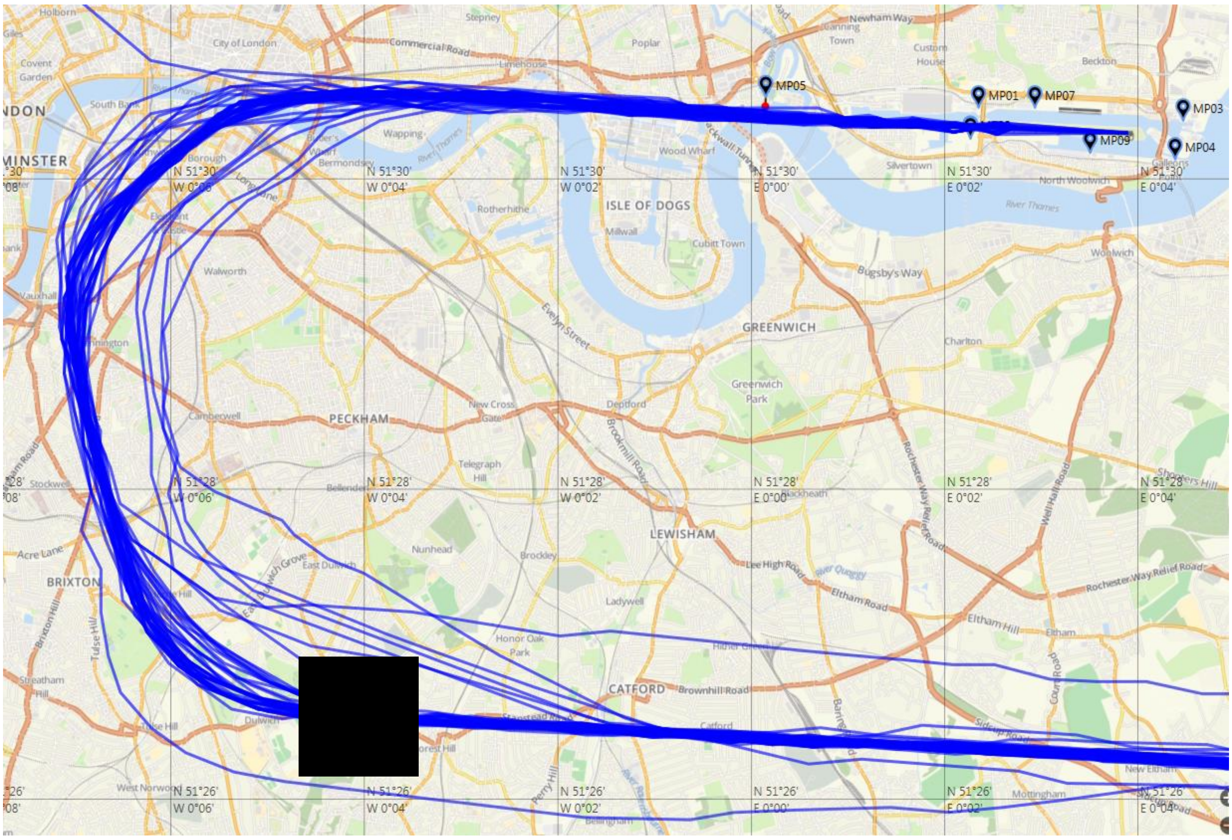

Figure 2: Runway 09 Arrivals During Measurement Period

3.3 Flight Tracks – London Heathrow Airport

The property is also overflown by some aircraft using LHA, either on approach in westerly operations (runway 27) or on departure in easterly operations (runway 09). The majority of LHA aircraft do not pass particularly close to the property, when following one of the arrival tracks before joining the extended centreline of the runway, they do pass close to the property. A typical example of this is shown in Figure 3, which shows an arrival track passing around 300-400m from the property, at a height of around 4,600 ft.

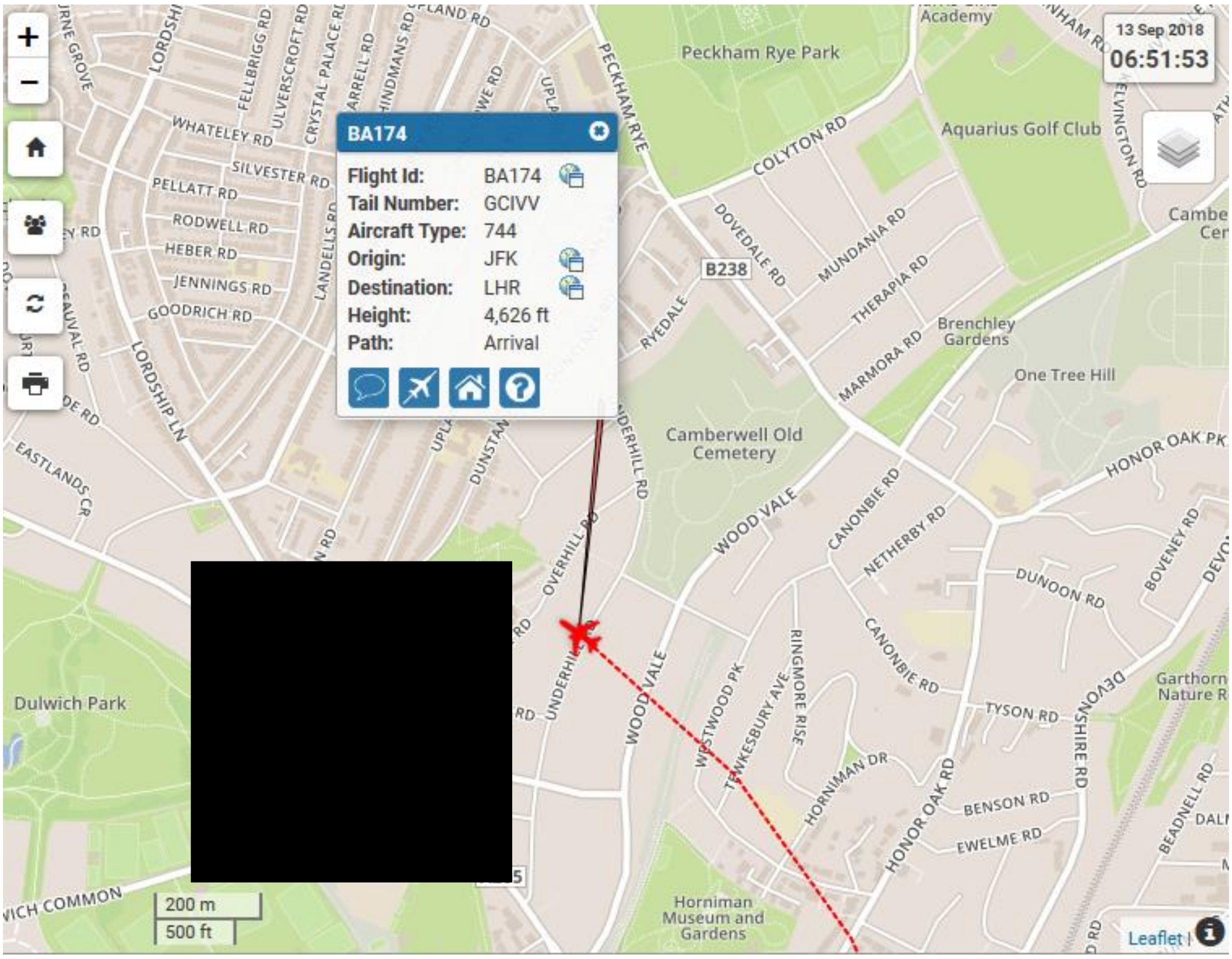

Figure 3: Example of Runway 27 Heathrow Arrival Track

3.4 Noise Measurements – LCA aircraft

The unattended noise monitoring data was processed by BAP to correlate the measured noise levels with the LCA aircraft movement data, provided by LCA.

The LCA aircraft events were caused by aircraft approaching LCA using runway 09. Other aircraft using LCA do not pass close to this location and would therefore unlikely be audible.

During the measurement period there were 110 arrivals at LCA using runway 09. Of these, 104 (95%) were correlated with a noise event. This is considered to be sufficient to give broadly representative noise levels for the most common aircraft operations. The correlated aircraft noise events are summarised in Table 1.

Aircraft	No. Correlated	Average L_{ASmax} (dB)
De Havilland Dash 8-400	15	64
Embraer E170	16	68
Embraer E190	59	69
Others	14	66
Total	104	68

Table 1: Summary of Noise Results – LCA Aircraft

3.5 Noise Measurements – LHA aircraft

The unattended noise monitoring data was processed by BAP to correlate the measured noise levels with the LHA aircraft movement data, provided by LHA.

The LHA aircraft events were cause by aircraft approaching runway 27L or 27R. Some of these aircraft approach from the south and pass close to the measurement location when turning onto the extended centreline of the runway they are approaching. As the aircraft were significantly higher than the LCA aircraft, some of the smaller aircraft did not produce high enough noise levels to register a reliable noise event.

Aircraft departing LHA using runway 09L or 09R typically turn to the north or south before reaching the measurement location. Those that pass close to the measurement location are higher again than the LHA arrivals using runway 27L or 27R. Therefore aircraft departing LHA did not register reliable noise events (at least 60 dB L_{ASmax}) at the measurement location.

During the measurement period there were a total of 8,238 arrivals at LHA using runway 27L or 27R. Of these, 246 (3%) were correlated with a noise event. This low correlation rate is due to the fact that the majority of LHA arrivals did not pass close enough to the measurement location to register a reliable noise event. This is considered to be sufficient to give broadly representative noise levels for the most common aircraft operations.

Aircraft	No. Correlated	Average L_{ASmax} (dB)
Airbus A319	31	65
Airbus A320	66	65
Airbus A321	16	64
Airbus A330	21	65
Airbus A380	18	65
Boeing 747	34	66
Boeing 777	38	64
Boeing 787	21	65
Others	40	65
Total	246	65

Table 2: Summary of Noise Results – LHA Aircraft

4.0 ANALYSIS OF RESULTS

Aircraft noise in the UK is commonly assessed in terms of the $L_{Aeq,16h}$ metric for the average "summer" day, which is the average noise level produced by aircraft over the 16-hour daytime period (07:00 to 23:00) for the 92-day "summer", defined as 16th June to 15th September inclusive. This is consistent with LCA's sound insulation eligibility criteria.

As LCA operates from 06:30 to 22:30, the full extent of operations is deemed as daytime for this purpose.

The noise level of the aircraft movements averaged over the measurement period was 39 dB $L_{Aeq,16h}$ for LCA aircraft and 41 dB $L_{Aeq,16h}$ for LHA aircraft.

During the measurement period, 7% of the aircraft at LCA used runway 09 and 91% of the airport at LHA used runway 27L or 27R. Over the last 5 summer periods, 33% of the aircraft at LCA have used runway 09. Therefore the measurement period would be considered to be quieter for LCA aircraft and louder for LHA aircraft than is typical. If the measurements are extrapolated to typical runway usage, this would result in a noise level of 46 dB $L_{Aeq,16h}$ for LCA aircraft and 40 dB $L_{Aeq,16h}$ for LHA aircraft. This gives a combined noise exposure level of 47 dB $L_{Aeq,16h}$ and is the value that relates to a typical summer day of operations. This is the value used to rate community response to air noise in the UK, as recommended by the Government.

On rare occasions, it is possible that runway 09 is used for LCA and runway 27 is used for LHA. In this worst case situation, the noise level would be 51 dB $L_{Aeq,16h}$ for LCA aircraft and 42 dB $L_{Aeq,16h}$ for LHA aircraft, for a total noise level of 51 dB $L_{Aeq,16h}$.

This means that the aircraft noise level at the property is significantly below LCA's sound insulation First Tier Scheme eligibility criterion of 57 dB $L_{Aeq,16h}$ average daytime aircraft noise level. It is however recognised that some people will be annoyed by levels lower than this (and conversely others may find higher noise levels acceptable). As found in the results of the 2000/1 National Noise Incidence Survey, 90% of the UK are exposed to noise levels of 50 dB $L_{Aeq,16h}$ or higher (from all sources rather than only aircraft). The typical L_{A90} background noise level during a 16 hour day was between 44 and 49 dB, therefore the noise level at the property from both aircraft and other sources is considered to be a relatively modest level of daytime noise exposure, particularly for a large urban conurbation such as London.

5.0 SUMMARY

BAP have measured the noise levels at a location in East Dulwich that is overflown by aircraft using both London City Airport (LCA) and London Heathrow Airport (LHA) over a 14 day period. The average aircraft noise level measured was 44 dB $L_{Aeq,16h}$.

When taking account of conditions over a typical summer day, as is used to rate community response in the UK, the combined noise level from LCA and LHA flights is 47 dB $L_{Aeq,16h}$.

This is quieter than typical as there were fewer easterly operations than average. On the worst case assumption for this location that all LCA aircraft operate in an easterly direction, this equates to a noise level of 51 dB dB $L_{Aeq,16h}$.

Under westerly operations, some aircraft arriving at LHA pass close to the property. Using a similar worst case assumption that all LHA aircraft operate in a westerly direction, this equates to a noise level of 42 dB dB $L_{Aeq,16h}$ due to LHA aircraft.

Under easterly operations, some aircraft departing from LHA pass close to the property. However, these were at a sufficiently high altitude to not register a noise event.

Therefore the worst case situations for this location are on the rare occasions that LCA is operating under easterly conditions and LHA is operating under westerly conditions. In these situations, the noise contribution of the LHA flights is relatively insignificant, increasing the overall noise level by less than 1 dB.

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for Bickerdike Allen Partners LLP

Peter Henson
Partner

APPENDIX 1

GLOSSARY OF ACOUSTIC TERMINOLOGY

Sound

This is a physical vibration in the air, propagating away from a source, whether heard or not.

The Decibel, dB

The unit used to describe the magnitude of sound is the decibel (dB) and the quantity measured is the sound pressure level. The decibel scale is logarithmic and it ascribes equal values to proportional changes in sound pressure, which is a characteristic of the ear. Use of a logarithmic scale has the added advantage that it compresses the very wide range of sound pressures to which the ear may typically be exposed to a more manageable range of numbers. The threshold of hearing occurs at approximately 0 dB (which corresponds to a reference sound pressure of 2 x 10^{-5} Pascals) and the threshold of pain is around 120 dB.

The sound energy radiated by a source can also be expressed in decibels. The sound power is a measure of the total sound energy radiated by a source per second, in watts. The sound power level, L_w is expressed in decibels, referenced to 10^{-12} watts.

Frequency, Hz

Frequency is analogous to musical pitch. It depends upon the rate of vibration of the air molecules that transmit the sound and is measure as the number of cycles per second or Hertz (Hz). The human ear is sensitive to sound in the range 20 Hz to 20,000 Hz (20 kHz). For acoustic engineering purposes, the frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, in which each octave band is divided into three. The bands are described by their centre frequency value and the ranges which are typically used for building acoustics purposes are 63 Hz to 4 kHz (octave bands) and 100 Hz to 3150 Hz (one-third octave bands).

A-weighting

The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

Sound Transmission in the Open Air

Most sources of sound can be characterised as a single point in space. The sound energy radiated is proportional to the surface area of a sphere centred on the point. The area of a sphere is proportional to the square of the radius, so the sound energy is inversely proportional to the square of the radius. This is the inverse square law. In decibel terms, every time the distance from a point source is doubled, the sound pressure level is reduced by 6 dB.

Road traffic noise is a notable exception to this rule, as it approximates to a line source, which is represented by the line of the road. The sound energy radiated is inversely proportional to the area of a cylinder centred on the line. In decibel terms, every time the distance from a line source is doubled, the sound pressure level is reduced by 3 dB.

Factors Affecting Sound Transmission in the Open Air

Reflection

When sound waves encounter a hard surface, such as concrete, brickwork, glass, timber or plasterboard, it is reflected from it. As a result, the sound pressure level measured immediately in front of a building façade is approximately 3 dB higher than it would be in the absence of the façade.

Screening and Diffraction

If a solid screen is introduced between a source and receiver, interrupting the sound path, a reduction in sound level is experienced. This reduction is limited, however, by diffraction of the sound energy at the edges of the screen. Screens can provide valuable noise attenuation, however. For example, a timber boarded fence built next to a motorway can reduce noise levels on the land beyond, typically by around 10 dB(A). The best results are obtained when a screen is situated close to the source or close to the receiver.

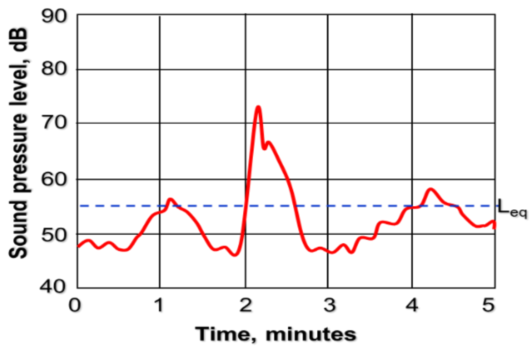
Meteorological Effects

Temperature and wind gradients affect noise transmission, especially over large distances. The wind effects range from increasing the level by typically 2 dB downwind, to reducing it by typically 10 dB upwind – or even more in extreme conditions. Temperature and wind gradients are variable and difficult to predict.

Environmental Noise Descriptors

Where noise levels vary with time, it is necessary to express the results of a measurement over a period of time in statistical terms. Some commonly used descriptors follow.

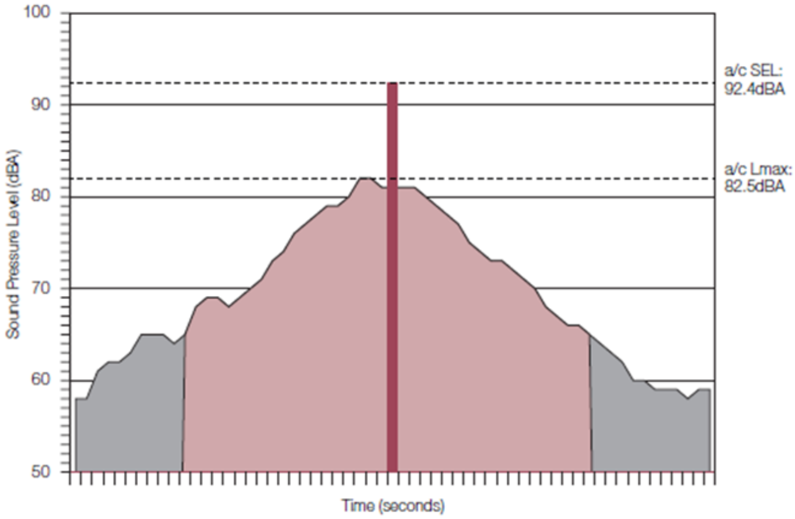
Statistical Term	Description
$L_{Aeq,T}$	The most widely applicable unit is the equivalent continuous A-weighted sound pressure level ($L_{Aeq,T}$). It is an energy average and is defined as the level of a notional sound which (over a defined period of time, T) would deliver the same A-weighted sound energy as the actual fluctuating sound. This is shown in the graph below:



L_{A90}	The level exceeded for 90% of the time is normally used to describe background noise.
$L_{Amax,T}$	The maximum A-weighted sound pressure level, normally associated with a time weighting, F (fast), or S (slow)

Sound Exposure Level (SEL)	An SEL is a measure the total noise from an aircraft movement. The SEL noise level for an aircraft movement is the sum of all the noise energy for the event expressed as an average noise level for 1 second. This is shown in the graph below:

Figure 3.1: Aircraft time history, showing maximum level L_{Amax} and associated Sound Exposure Level (SEL)[41]



Source: CAA data