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LONDON CITY AIRPORT

AIRCRAFT NOISE SURVEY

[redacted] WINSOR TERRACE

Report to

Lewis Chenery
Environmental Compliance Executive
City Aviation House
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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.

Construction Technology Consultants: Expertise in building cladding, technical appraisals and defect investigation and provision of construction expert witness services.

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Appendix 1: Glossary of Acoustic Terminology

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 outside [redacted] Winsor Terrace, E6 [redacted]. This property is located just over 1 kilometre to the north of the eastern end of the runway. 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 east. This recorded noise data for 19 days between approximately 12:00 pm on 12th July and 3:00 pm on 30th July. Data was not saved on 22nd July due to a fault with the equipment. This did not affect the data on any other days.

This period included a mixture of westerly and easterly winds, meaning measurements could be taken for both runway 09 and runway 27 aircraft operations at LCA. Departures using runway 09 and arrivals using runway 27 are the primary sources of aircraft noise at the property.

A small number of attended measurements were also taken on the 12th July.

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 monitor locations are 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*

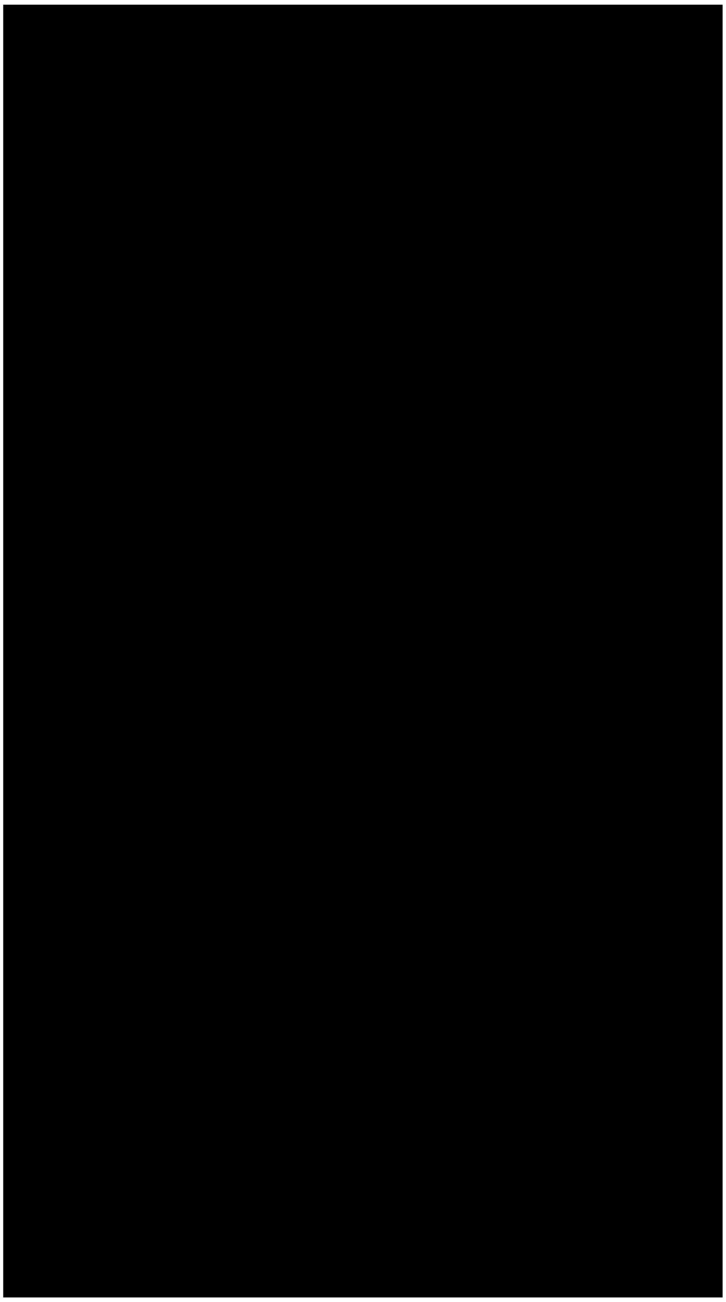

Figure 1: Noise monitor location, facing north

3.0 SURVEY RESULTS AND DISCUSSION

3.1 Flight Tracks

The airport have provided BAP with the aircraft movement data and flight track data for the monitoring period. Figure 2 shows the flight tracks during the monitoring period. Runway 09 departures are shown in red and runway 27 arrivals are in blue, with the property location marked by a green spot. It can be clearly seen that arrivals using runway 09 do not routinely pass close to the property and due to the distance from the airport the property is largely screened from start of roll noise from departures on runway 27.

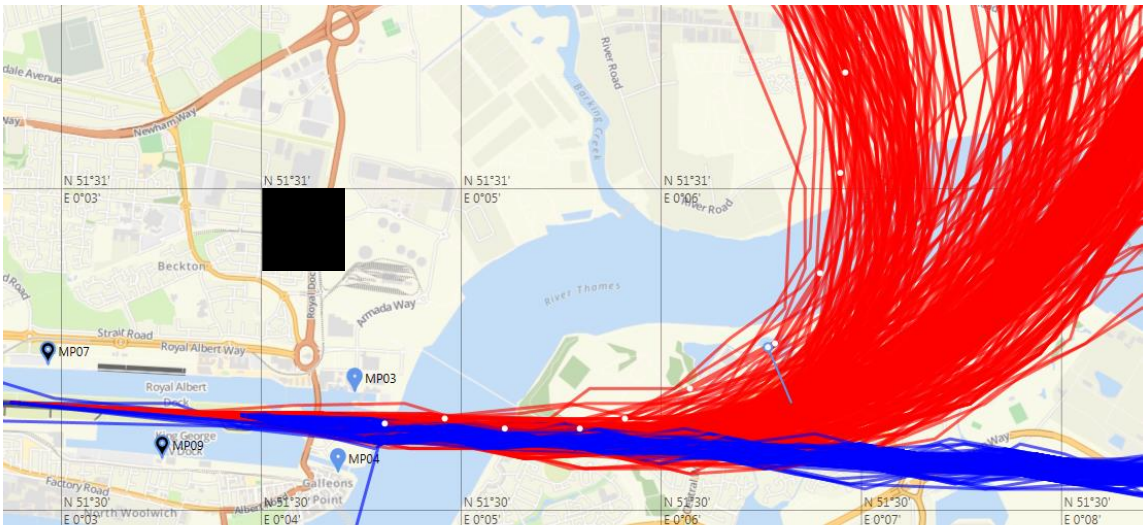

Figure 2: Runway 09 Departures and Runway 27 Arrivals During Measurement Period

3.2 Noise Measurements

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

The loudest aircraft events were caused by aircraft departing LCA using runway 09. Arrivals using runway 27 were audible, but produce a significantly lower noise level such that it was not generally possible to distinguish these from non-aircraft noise events in the unattended measurement data.

During the measurement period there were 751 departures using runway 09. Of these, 490 (65%) were correlated with a noise event. The majority of departures that were not correlated were turboprops and business jets, which typically produce lower noise levels than the larger passenger jets. 99% of departures by the loudest departing aircraft, the Embraer E190, were correlated. The correlated aircraft noise events are summarised in Table 1.

Aircraft	No. Correlated	Average L_{Amax} (dB)
Airbus A318	5	67
Embraer E170	108	68
Embraer E190	346	70
Avro RJ85	10	65
Other	21	66
Total	490	69

Table 1: Summary of Noise Results

A small number of attended noise measurements of departures on runway 09 were also taken and the results were broadly in line with the unattended data.

Aircraft noise in the UK, and at LCA, 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 the airport’s sound insulation First Tier Scheme eligibility criterion.

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

The measurement period is considered broadly representative of an average summer day, as 38% of the operations used runway 09 during this period, which is marginally higher than the typical average (the average over the last 5 summer periods is 33%).

The noise level of the aircraft movements averaged over the measurement period was 43 dB $L_{Aeq,16h}$. The highest measured daily aircraft noise level over the survey duration, which occurred on a day when 100% of operations used runway 09, was 49 dB $L_{Aeq,16h}$.

This means that the aircraft noise level at the property is significantly below the airport’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 41 and 44 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.

4.0 SUMMARY

BAP have measured the noise levels at [redacted] Winsor Terrace, E6 [redacted] over a 19 day period. The average aircraft noise level measured was 43 dB $L_{Aeq,16h}$. This level is well below 57 dB $L_{Aeq,16h}$ average daytime aircraft noise level used as the criterion in determining eligibility for the airport's sound insulation First Tier Scheme.

Duncan Rogers
for Bickerdike Allen Partners LLP

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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.

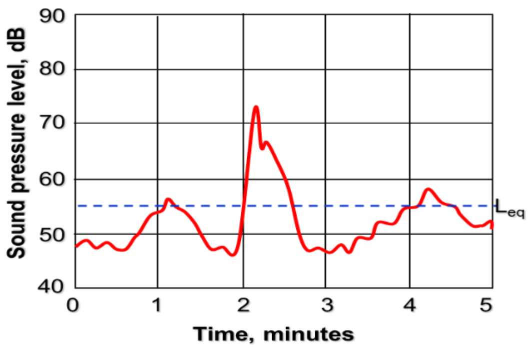
Meteorological Effects

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:



Statistical Term	Description
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)

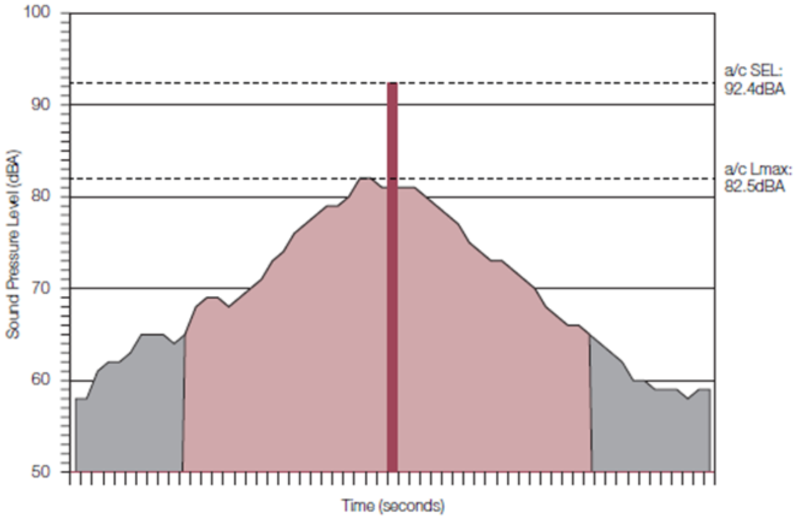
Sound Exposure Level (SEL)

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