Bickerdike
Allen
Partners
Architecture
Acoustics
Technology

# AIRCRAFT NOISE SURVEY

# LAMBETH

Report to

London City Airport
City Aviation House
London City Airport
The Royal Docks
London E16 2PB

A11327_12_RP064_1.0
17 June 2024

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

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## 1.0 INTRODUCTION

Bickerdike Allen Partners LLP (BAP) were commissioned by London City Airport (LCA) to carry out a survey of the noise from aircraft while in level flight. The survey measured aircraft noise in August, September and October 2023 in Lambeth under the level section of the flight path used by Runway 09 arrivals. The location is shown on a map in Figure A11327_12_DR002, along with the locations of the airport's six permanent noise monitoring terminals (NMTs). The results of this survey have previously been reported as part of an analysis of new generation aircraft in BAP report A11327_12_RP056 dated 24 November 2023.

This report provides a summary of the noise measurements by aircraft type and compares these with the noise levels measured at the airport's Noise Monitoring Terminals (NMTs). A glossary of acoustic terminology is provided in Appendix 1.

## 2.0 SURVEY DETAILS

### 2.1 Location

The measurement location in Lambeth was at Roots and Shoots, Walnut Tree Walk, Lambeth SE11 6DN. This location is around 11 km west and 1.5 km south of LCA. It is typically overflown by aircraft on an easterly approach to LCA, as they turn to line up with Runway 09 for their final approach. Some aircraft using London Heathrow Airport also pass close to this location when arriving during periods of westerly operations. The monitor was installed on a roof terrace, approximately 10m above the ground.

### 2.2 Methodology

A long-term unattended noise monitor was set up and environmental noise measurements were carried out in general accordance with BS 7445-1:2003[1].

The monitor recorded noise data continuously while it was operational. There were some periods during which the monitor was not operational, for example while batteries were changed.

[1] British Standards Institute, BS 7445-1:2003 Description and measurement of environmental noise, 2003

## 2.3 Equipment

The equipment used for the long-term survey was a Norsonic Type 140 sound level meter, with a microphone mounted on a pole so it was approximately 3 m above the roof terrace, and clear of reflecting surfaces. The monitor installation is shown in Figure 1. The monitor was checked for correct calibration at the start and end of the measurements, and no significant drift was observed.

**Figure 1: Noise Monitor Location, Lambeth**

## 2.4 Flight Tracks

LCA has provided BAP with the aircraft movement data and flight track data for the monitoring period. BAP have reviewed the flight tracks to determine only those flights which passed close to the monitor location.

## 3.0 RESULTS

The noise monitoring data was processed by BAP to correlate the measured noise levels with the aircraft movement data, provided by the airport. Measurements of the same aircraft operations were also extracted from the noise monitoring system at the airport. All noise levels presented in the tables in this section have been rounded to 1 decimal place.

During the measurement period there were 1,198 arrivals which used Runway 09 and passed close to the monitor. Of these 1,190 (99%) were correlated with a noise event at the monitor. The correlated aircraft noise events are summarised in Table 1. Aircraft types with at least ten measurements are shown individually. Aircraft types with fewer than 10 measurements are grouped in “Other”, these are mostly business jets.

| Aircraft Type | No. Correlated | Average $L_{Amax}$ (dB) | Average SEL (dB(A)) |
|---|---|---|---|
| Airbus A220-100 | 33 | 68.3 | 78.4 |
| Bombardier Dash 8-Q400 | 66 | 66.8 | 76.6 |
| Cessna Citation Excel | 14 | 67.3 | 76.2 |
| Cessna Citation Latitude | 14 | 63.7 | 73.2 |
| Embraer E190 | 944 | 71.8 | 81.6 |
| Embraer E190-E2 | 47 | 69.9 | 80.3 |
| Embraer Phenom 300 | 11 | 66.0 | 75.0 |
| Other | 61 | 66.7 | 75.8 |

**Table 1: Summary of Arrival Noise Results**

Aircraft noise in the UK is typically assessed using the $L_{Aeq}$ metric, which averages the noise energy over a specified period (e.g. 16 hours for daytime). The SEL metric is most directly related to such assessments, when measuring individual aircraft. However, the $L_{Amax}$ metric is easier to understand, simply being the highest noise level measured during an aircraft overflight.

The most common aircraft was the Embraer E190, this was also the nosiest aircraft measured. The Embraer E190 is gradually being replaced by a new generation of quieter modernised passenger jets, specifically the Embraer E190-E2 and Airbus A220-100. On average the $L_{ASmax}$ arrival noise levels for these aircraft are around 2-3 dB quieter compared to the current generation E190. The other aircraft that operated regularly were the Bombardier Dash 8-Q400 turboprop and a variety of business jets, these are all quieter than the passenger jets due to their smaller size.

The results of the similar analysis undertaken for the fixed Noise Monitoring Terminals (NMTs) for the same flights is summarised in Table 2.

| **Aircraft Type** | **NMT1/2 average** | | | **NMT5** | | |
|---|---|---|---|---|---|---|
| | **No. Correlated** | **Avg $L_{Amax}$ (dB)** | **Avg SEL (dB(A))** | **No. Correlated** | **Avg $L_{Amax}$ (dB)** | **Avg SEL (dB(A))** |
| Airbus A220-100 | 33 | 75.9 | 84.3 | 32 | 70.9 | 80.8 |
| Bombardier Dash 8-Q400 | 65 | 76.6 | 84.8 | 65 | 72.3 | 82.3 |
| Cessna Citation Excel | 14 | 73.3 | 81.3 | 14 | 70.1 | 78.6 |
| Cessna Citation Latitude | 10 | 70.8 | 79.2 | 14 | 67.0 | 76.2 |
| Embraer E190 | 937 | 79.0 | 86.9 | 937 | 74.5 | 83.8 |
| Embraer E190-E2 | 47 | 75.8 | 84.4 | 46 | 71.3 | 81.2 |
| Embraer Phenom 300 | 11 | 73.4 | 80.3 | 11 | 69.0 | 77.3 |

**Table 2: Summary of Arrival Noise Results – NMTs**

The NMT results broadly mirror those for the survey in Lambeth. The Embraer E190 is the loudest. The maximum noise levels for arrivals by the new generation passenger jet aircraft are between 3.1 and 3.6 dB quieter than those for the current generation E190. The noise levels for the Bombardier Dash 8-Q400 are quieter than the E190, but slightly louder than the new generation passenger jets. The various business jets are quieter than the other aircraft due to their smaller size.

As activity at the airport has yet to fully recover following the pandemic, 2019 is the loudest year at the airport to date, as measured by the size of the average summer day $L_{Aeq,16h}$ noise contours. The survey location in Lambeth is well outside of the airport's published noise contours. In 2019 NMT5 was exposed to around 59 dB $L_{Aeq,16h}$. However, this was mainly due to departures, as they are both louder and more common at that location. In 2019, the average summer day noise level at NMT5 from arrivals was around 51 dB $L_{Aeq,16h}$. 51 dB is defined as the Lowest Adverse Effect Level (LOAEL) for aircraft noise in government guidance[2]. The results show that all of the aircraft measured quieter under the arrival level section in Lambeth than at NMT5. As the area near the level flight path is not affected by noise from LCY departures which turn north, this demonstrates that LCY noise levels in Lambeth are below the LOAEL.

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[2] UK air navigation guidance 2017, https://www.gov.uk/government/publications/uk-air-navigation-guidance-2017

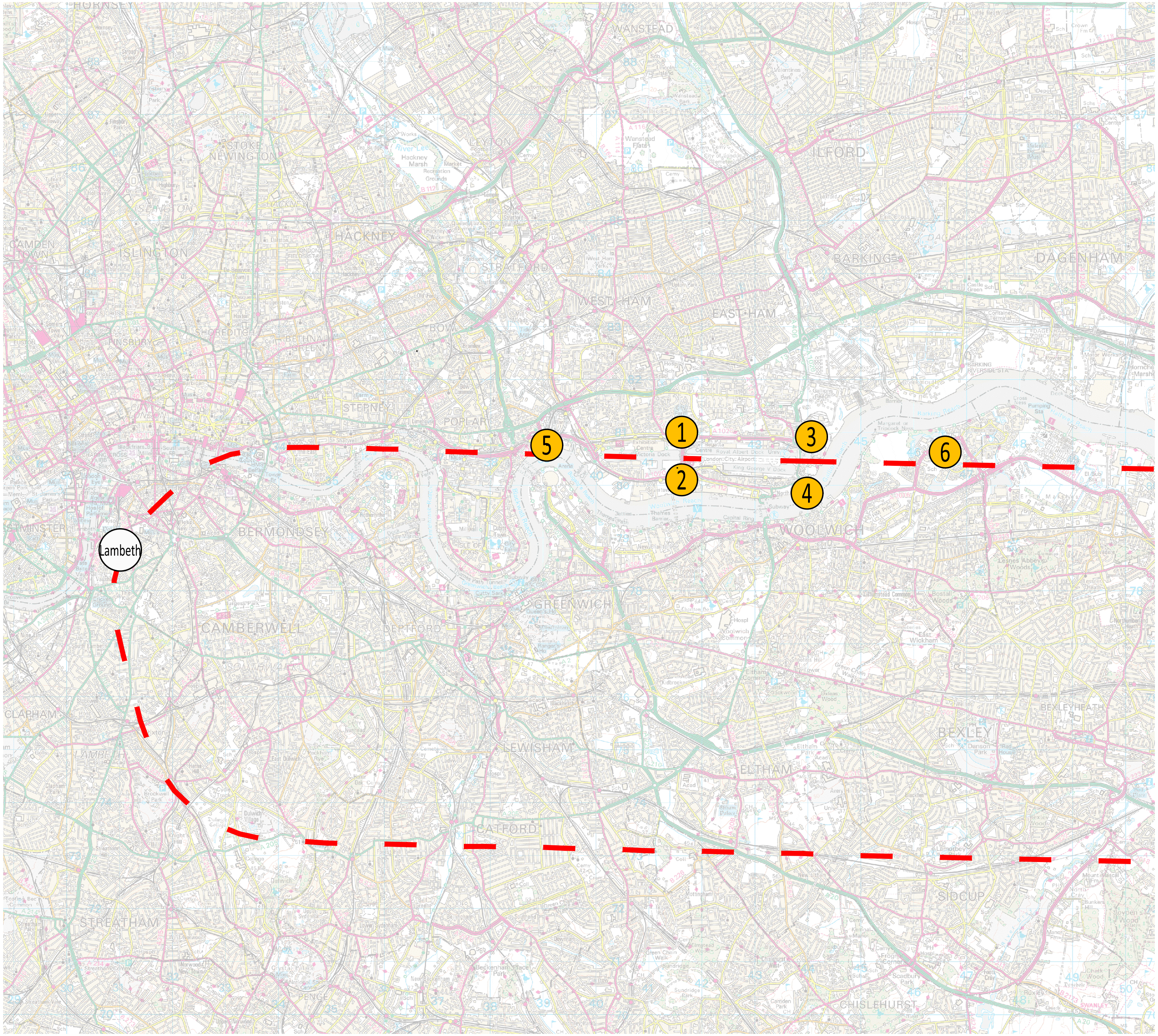
While the noise level under the level flight path for Runway 09 arrivals is relatively low being below the LOAEL, this does not mean that the aircraft are not audible, nor that nobody will be disturbed or annoyed by aircraft noise.

## 4.0 SUMMARY

BAP have carried out a long-term noise survey in Lambeth to measure the aircraft noise levels and have reported the results. The absolute noise levels for all of the aircraft types are lower in Lambeth under the Runway 09 arrival flight path compared to the levels measured at the airport's NMTs.

The results confirm that the average summer day noise levels under the arrival level flight path in Lambeth are below 51 dB $L_{Aeq,16h}$, which is defined by the government[2] as the Lowest Observed Adverse Effect Level (LOAEL).

| | |
|---|---|
| **Duncan Rogers** | **David Charles** |
| **for Bickerdike Allen Partners LLP** | **Partner** |






LEGEND:

X Survey Location

X Permanent Noise Monitors

Typical Arrival Tracks

REVISIONS

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London City Airport

Survey Location
Lambeth

DRAWN: DR CHECKED: DC

DATE: June 2024 SCALE: 1:100,000@A4

FIGURE No:

A11327_12_DR002_1.0

# APPENDIX 1
# GLOSSARY OF ACOUSTIC TERMINOLOGY

**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**

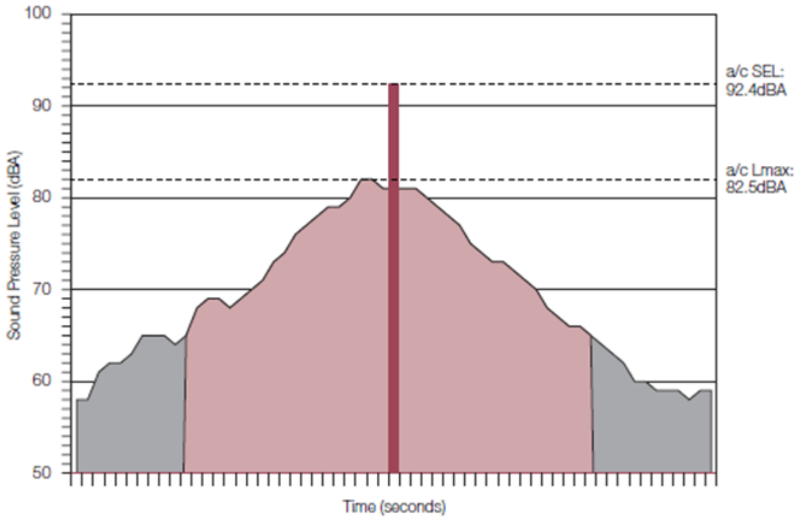
The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

**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 (LAeq, 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. |
| $L_{Amax,T}$ | 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.<br>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.<br>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*

**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.