Bickerdike
Allen
Partners
Architecture
Acoustics
Technology

AIRCRAFT NOISE SURVEY

ILFORD

Report to

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

A11327_12_RP065_1.0
17 June 2024

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Bickerdike Allen Partners LLP is an integrated practice of Architects, Acousticians, and Construction Technologists, celebrating over 60 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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1.0 INTRODUCTION

Bickerdike Allen Partners LLP (BAP) have been commissioned by London City Airport (LCA) to carry out a survey of the noise of aircraft while in level flight. The survey measured aircraft noise in August, September and October 2023 in Ilford under the level section of the flight path used by some Runway 27 departures. The location is shown on a map in Figure A11327_12_DR003, 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 Ilford was at Avanti Court Primary School, Carlton Drive, Ilford IG6 1LU. This location is around 9 km north and 2 km east of LCA. It is typically overflown by a proportion of aircraft which depart LCY on Runway 27 during westerly operations.

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.

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 3m above the ground, 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.

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

Figure 1: Noise Monitor Location, Ilford

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 773 departures which used Runway 27 and passed close to the monitor. Of these 725 (94%) 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	30	61.3	71.1
Bombardier Dash 8-Q400	64	62.1	71.7
Cessna Citation Excel	11	61.8	71.1
Dornier 328Jet	12	63.6	73.7
Embraer E190	534	64.9	74.7
Embraer E190-E2	34	61.8	71.5
Embraer Phenom 300	13	60.5	70.3
Other	27	62.4	71.1

Table 1: Summary of Departure 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} departure noise levels for these aircraft are around 3-3.5 dB quieter compared to the current generation E190. The other aircraft that operated regularly were the Bombardier Dash 8-Q400 turboprop, the Dornier 328Jet and various business jets. These were all quieter than the current generation E190, but similar to the new generation passenger jets, despite 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	30	84.0	92.0	30	71.8	81.6
Bombardier Dash 8-Q400	64	79.9	87.5	59	67.6	77.6
Cessna Citation Excel	11	81.3	88.7	10	67.7	76.1
Dornier 328Jet	12	82.2	90.2	12	71.9	81.1
Embraer E190	524	89.4	97.8	524	76.0	86.2
Embraer E190-E2	33	84.2	91.7	33	70.9	81.2
Embraer Phenom 300	13	84.4	92.5	12	68.4	78.0

Table 2: Summary of Departure Noise Results – NMTs

Comparing the various aircraft types, the NMT results broadly mirror those for the survey in Ilford. The Embraer E190 is the loudest. The maximum noise levels for departures by the new generation passenger jet aircraft are between 4 and 6 dB quieter than those for the current generation E190, with the reduction at NMTs 1 and 2 slightly greater than that measured at NMT5. The noise levels for the Bombardier Dash 8-Q400, Dornier 328Jet, and the various business jets are quieter than the E190, and typically similar to or slightly quieter than the new generation passenger jets, 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 Ilford is well outside of the airport's published noise contours. In 2019 NMT5 was exposed to around 59 dB $L_{Aeq,16h}$. This was mainly due to the noise from Runway 27 departures, with some contribution from Runway 09 arrivals. In 2019, the average summer day noise level at NMT5 from departures was around 58.5 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 much quieter under the departure level section in Ilford than at NMT5. The difference varied by aircraft type. For the key Embraer E190 type the noise levels measured at the survey location were around 11 dB lower than those measured at NMT5. The results suggest that the average summer day noise levels in Ilford are approximately 48 dB $L_{Aeq,16h}$ which is below the LOAEL.

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

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While the noise level under the level flight path for Runway 27 departures 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.

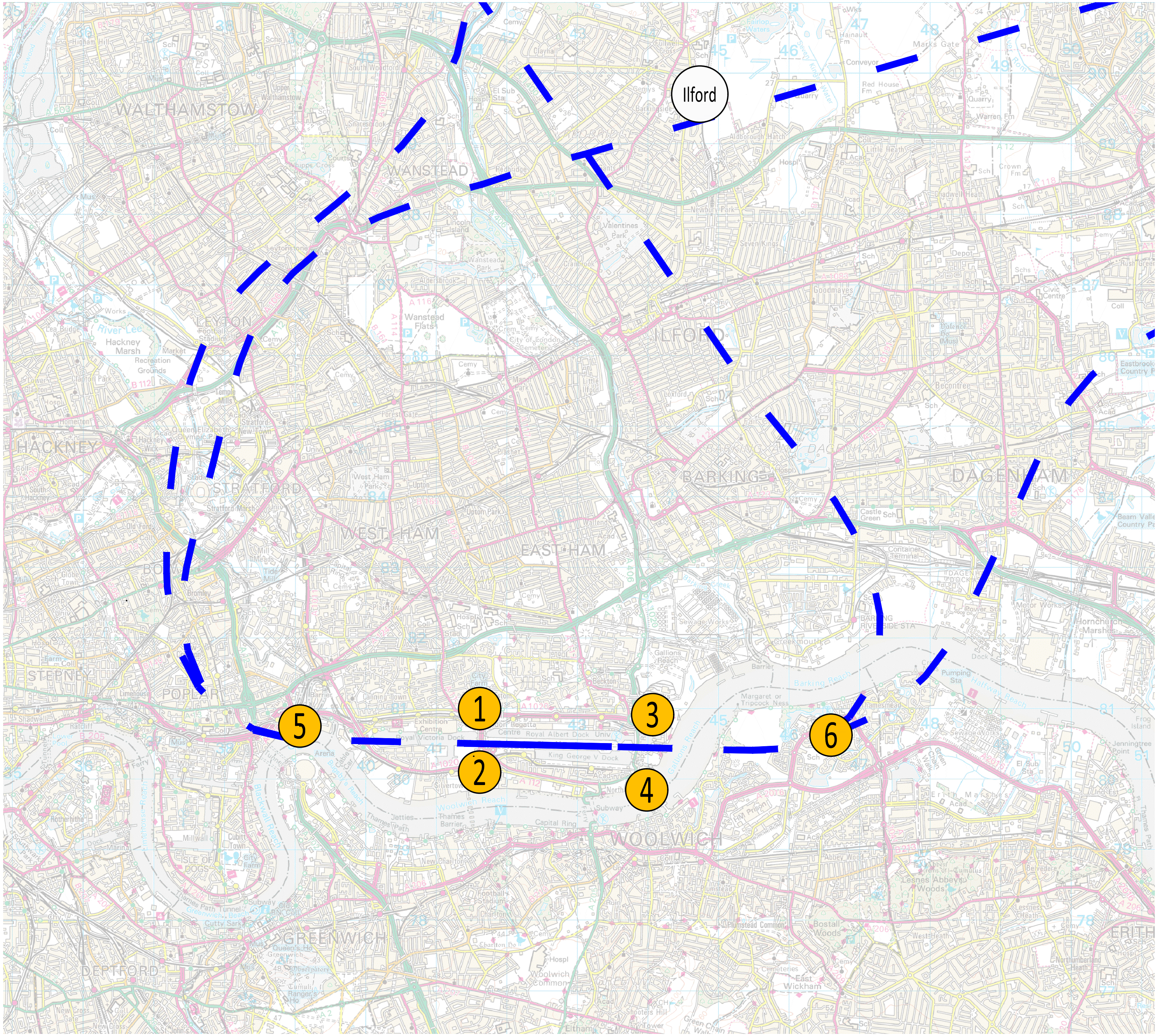
4.0 SUMMARY

BAP have carried out a long-term noise survey in Ilford to measure the aircraft noise levels and have reported the results. The absolute noise levels for all of the aircraft types are much lower in Ilford under the Runway 27 departure flight path compared to the levels measured at the airport's NMTs.

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

Duncan Rogers
for Bickerdike Allen Partners LLP

David Charles
Partner



LEGEND:

- X Survey Location
- X Permanent Noise Monitors
- Typical Departure Tracks

REVISIONS

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London City Airport

Survey Location
Ilford

DRAWN: DR	CHECKED: DC
DATE: June 2024	SCALE: 1:75,000@A4

FIGURE No:
A11327_12_DR003_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

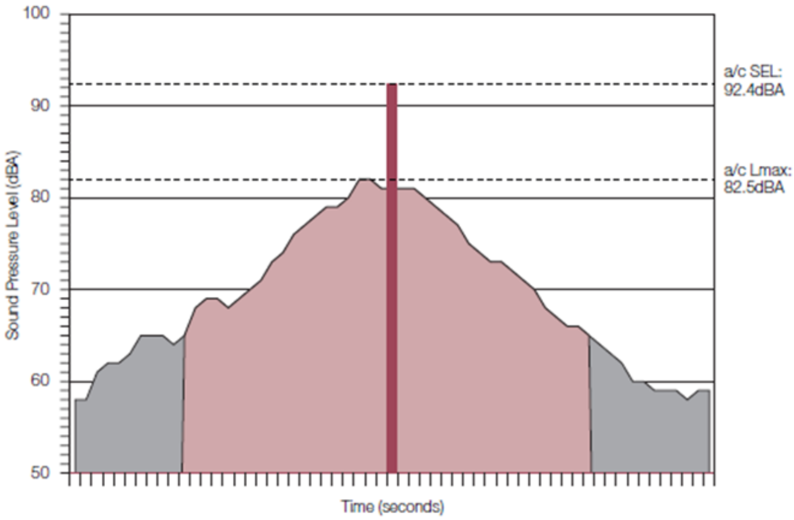
The sensitivity of the ear is frequency dependent. Sound level meters are fitted with a weighting network which approximates to this response and allows sound levels to be expressed as an overall single figure value, in dB(A).

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. 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

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.