Bickerdike
Allen
Partners
Architecture
Acoustics
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LONDON CITY AIRPORT

AIRCRAFT NOISE SURVEY

WANSTEAD

Report to

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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.

Sustainability Consultants: Energy Conservation and Environmental Specialists and registered assessors for the Code for Sustainable Homes.

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1.0 INTRODUCTION

Bickerdike Allen Partners LLP (BAP) have been commissioned by London City Airport (LCA) to carry out a noise monitoring survey at a property in the Wanstead area in response to complaints from a resident. BAP have also been asked to investigate the flight tracks as the resident has reported differing results to the airport's Noise and Track Keeping (NTK) system, in addition to reporting an increase in overflying aircraft since the introduction of RNAV tracks in early 2016.

A glossary of acoustic terminology is provided in Appendix 1.

2.0 SURVEY DETAILS

2.1 Methodology

BAP visited the property on 31 March 2016 to set up a noise monitor in the garden of the property which recorded continuously between the hours of 06:50 and 09:50. This represents a period of the day when activity at LCA is normally at its busiest on a weekday.

This date was chosen as westerly winds were forecast, meaning runway 27 was in use at LCA. This is the worst case location for this property with respect to noise, as when runway 09 is in use the aircraft from LCA do not pass as closely to the property.

An operative was situated in a room on the third (top) storey of the property which had a view of the garden and also a skylight, facing southwest, which enabled a good view of passing aircraft.

2.2 Equipment

The equipment used for this survey was an 01dB Duo Smart Noise Monitor, mounted on a tripod approximately 1.2m off the ground. The monitor was calibrated at the start and end of the measurements, and no significant drift was observed.

2.3 Weather Conditions

The weather was clear and dry, with a light wind coming from the south.

3.0 SURVEY RESULTS AND DISCUSSION

3.1 Noise Measurements

The noise monitoring data was processed to highlight all those aircraft events which were significantly above the background level. These largely fell into 2 categories; around 60% of the aircraft were those departing LCA using runway 27 and other aircraft, and the remaining 40% were those assumed to be turning towards Heathrow before starting their final approach. The aircraft in the latter category are not associated with LCA and therefore detailed flight information is not available for all these aircraft. The aircraft from LCA departed over the measurement position at varying intervals over the 3-hour measurement period, with time intervals between flights ranging from around 2 to 15 minutes.

Aircraft height data has been provided by the airport, given to the nearest 100 ft. The heights of the LCA aircraft when passing over the property ranged from 2,900 to 3,100 ft.

Movement data has been supplied by the airport to enable correlation with departing LCA aircraft. All aircraft that departed LCA during the measurement period resulted in a correlated noise measurement, while some of the Heathrow aircraft were not loud enough to register a noise event at the microphone location. The detailed results are presented in Appendix 2 and are summarised in Table 1 below.

Description	No. Correlated	Average L_{Amax}	Maximum L_{Amax}
LCA Runway 27 Departures	32	65 dB	71 dB
Heathrow approaches	20	60 dB	64 dB

Table 1: Summary of Noise Results

The noise level of the aircraft departures averaged over the measurement period was 49.7 dB $_{LAeq,3h}$. Even assuming that this level of LCA activity, and resulting noise level, continues throughout the whole day (which would be an over-estimate of the true situation), this is significantly below the 57 dB $L_{Aeq,16h}$ average daytime aircraft noise level that is widely considered in the UK to mark the approximate onset of significant community annoyance. However, it is noted 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). Therefore this is considered to be a relatively low level of daytime noise exposure for a large urban conurbation such as London.

3.2 Flight Tracks

3.2.1 Comparison of Observations with Radar Tracks

Observations were made of LCA flight tracks from the property in question. The viewing point, as described in section 2 above, was from a room on the third storey with a skylight facing southwest and a window to the garden facing northeast. The observations are given for each flight in Appendix 2 and are summarised in Table 2 below.

Subjective Location Relative to Property	No. Observed	Percentage
Overhead	12	38%
North	12	38%
South	6	19%
Not Noted	2	6%
Total	**32**	**100%**

Table 2: Summary of Observed Flight Tracks

Figure 1 shows the radar tracks supplied by LCA, with the property in the area marked by a black circle. Due to the viewing position, the aircraft would not have been visible when within a distance of around 1 km of the property. After this point, but before reaching the property, the majority of aircraft turned either to the north or to the south, despite subjectively appearing to fly directly overhead.

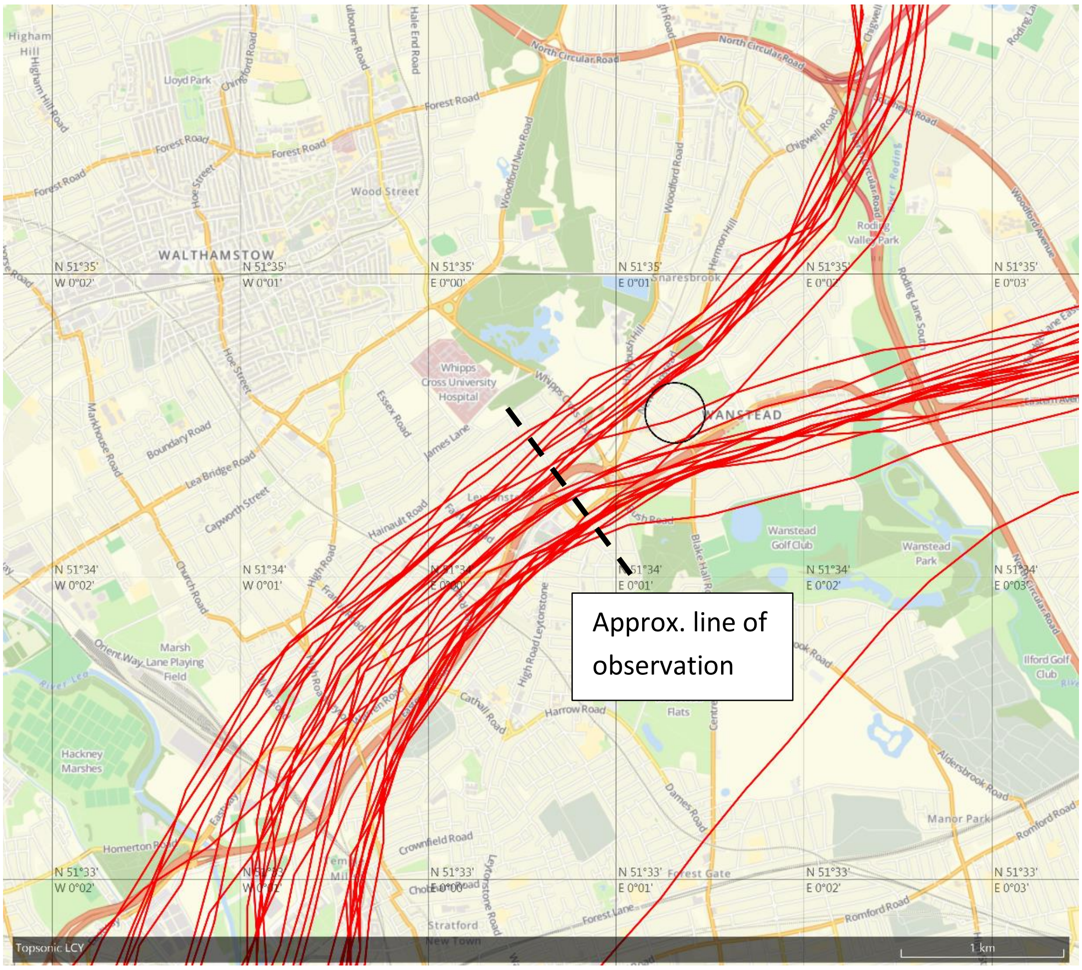

Figure 1: Radar Tracks During Survey (06:45 - 09:45 Departures, 31st March 2016)

3.2.2 Effect of Introduction of RNAV Tracks

In early 2016, following a consultation period, departure routes at LCA were upgraded to take advantage of the improved navigational capabilities of RNAV (aRea NAVigation). The intention of this change was to replicate the existing routes as closely as possible with RNAV routes. The expected effect was that aircraft would on average follow very similar tracks, but that they would be more concentrated around the centre track as the RNAV technology allows more accurate navigation.

To show a comparison of the effect, track density plots of runway 27 departures have been produced for two periods; one before the change (1 March 2015 to 7 May 2015) and one after the change (1 March 2016 to 30 April 2016). These periods have been chosen so that they contain the same number of runway 27 departures (4611), and are approximately the same time of year. These are displayed in Figure 2 and Figure 3 below. The property in question is again marked by a black circle.

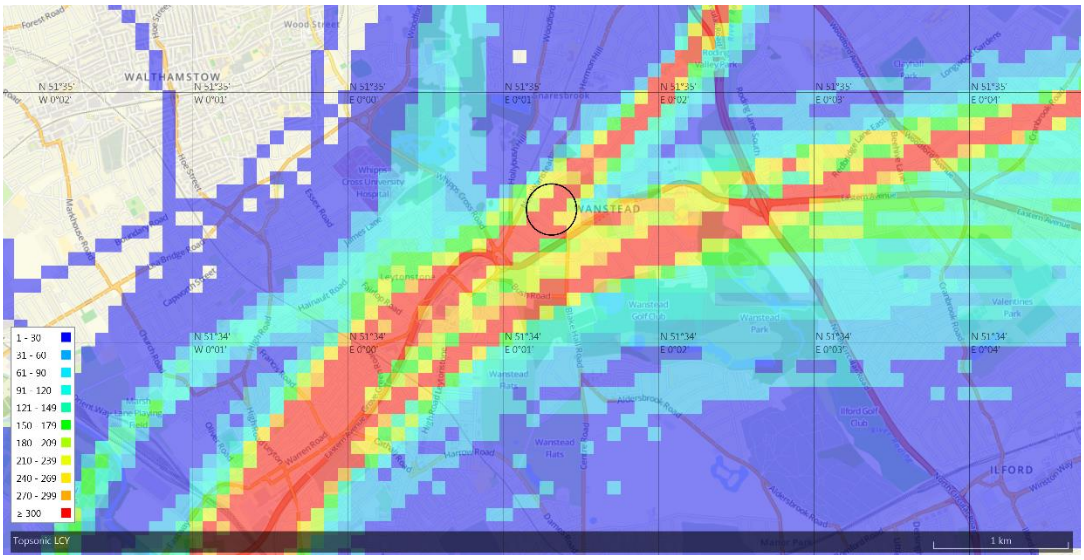

Figure 2: Track Density Plot - Pre RNAV (1 Mar 2015 to 7 May 2015)

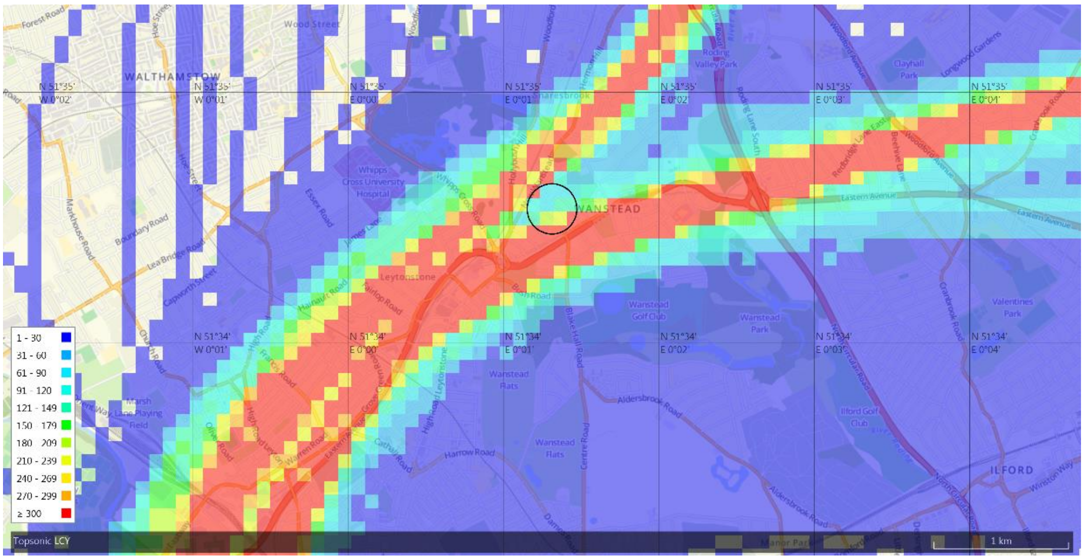

Figure 3: Track Density Plot - Post-RNAV (1 Mar 2016 to 30 Apr 2016)

As can be seen from the figures above, the aircraft are flying in a similar location in 2016 to 2015. The tracks in 2016 are generally slightly further north, which means the northern branch that in 2015 flew directly over the property now does not, although the southern branch is closer than before. This means that a similar number of aircraft are passing directly over the property in 2016 compared to before the RNAV routes were introduced, however the aircraft are now more concentrated and so there are slightly more that pass close to the property.

4.0 SUMMARY

BAP have measured the noise levels and observed the flight tracks at a property in the Wanstead area following complaints from a resident.

The average noise level measured during the early hours of the day from aircraft departing London City Airport on runway 27 were found to be well below the average daytime aircraft noise level used by the government as marking the approximate onset of significant community annoyance.

A number of flights did subjectively appear to pass directly over the property, although this is due to the viewing angle. Inspection of the radar data shows that all but one of the flights turned to either the north or the south before reaching the property.

A comparison has been carried out of flight tracks before and after the RNAV routes were introduced. This shows that a similar number of aircraft are flying directly over the property now, compared to before the RNAV routes were in operation. However the aircraft are now more concentrated and so there are slightly more that pass close to the property.

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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_{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 Transmission in Rooms

Sound energy is reflected from the room surfaces and this gives rise to reverberation. At short distances from a sound source, the sound level will fall off at a rate of 6 dB per doubling of distance, as it would in the open air – this is known as the direct field. Beyond a certain distance, the effect of reverberation takes over and the level ceases to fall off significantly with distance from the source. This is known as the reverberant field. For receiver positions in this part of the room, sound levels can be reduced by applying sound absorbing finishes to the surfaces of the room. A 3 dB reduction can normally be obtained by doubling the absorption present, which corresponds to halving the reverberation time (see below).

APPENDIX 2

DETAILED SURVEY RESULTS

L_{max} Time	Aircraft Source	Subjective Location	Aircraft Type	Dur, s	L_{max}, dB(A)	SEL, dB(A)
06:58:05	Heathrow	Overhead	Unknown	32	60.1	71.8
07:02:39	LCY	Slight north	RJ85	29	61.1	71.9
07:05:11	LCY	Slight north	E190	30.5	63.8	74.2
07:10:59	LCY	Slight north	E190	31	65.6	75.1
07:12:09	Heathrow		2 engine jet	30	60.2	70.3
07:20:32	LCY	Overhead	E170	32	68.2	77.0
07:23:26	LCY	Overhead	E190	35	66.2	75.8
07:29:31	Heathrow		4 engine jet	21	59.8	68.4
07:32:40	Heathrow		4 engine jet	52.5	60	73.5
07:34:36	LCY	Overhead	RJ85	29	63.9	74.2
07:35:18	Heathrow		2 engine jet	33.5	63.5	71.9
07:37:13	Heathrow	West	2 engine jet	12	57.8	63.8
07:39:37	LCY	Slight south	E170	29	64.7	74.1
07:43:19	LCY	Slight south	DH8D	27.5	66.9	74.7
07:46:33	LCY	Slight south	SB20	28.5	68.0	75.9
07:48:39	Heathrow		2 engine jet	24	58.4	68.6
07:51:49	LCY	South	F50	19.5	57.9	67.4
08:04:29	Heathrow		Unknown	13	56.8	64.5
08:05:41	LCY	Slight south	RJ85	27.5	65.1	73.8
08:11:32	Heathrow		2 engine jet	15	57.1	64.7
08:12:54	LCY	Slight south	E190	36.5	70.5	78.7
08:14:26	Heathrow		2 engine jet	38.5	63.2	72.7
08:19:30	LCY	Slight north	DH8D	29.5	65.7	74.3
08:23:06	LCY	Overhead	E190	30	65.5	75.6
08:28:24	LCY	Overhead	E170	31	65.9	74.5
08:29:58	LCY	North	DH8D	26.5	62.3	72.0
08:34:42	Heathrow		2 engine jet	23.5	62.5	70.0
08:36:21	Heathrow		2 engine jet	24.5	63.5	70.5

L_{max} Time	Aircraft Source	Subjective Location	Aircraft Type	Dur, s	$L_{max,}$ dB(A)	SEL, dB(A)
08:45:20	LCY	North	DH8D	28	65.3	74.7
08:46:56	Heathrow		Unknown	19	58.9	67.6
08:47:52	LCY	North	DH8D	28.5	62.7	72.2
08:54:30	LCY		RJ85	27.5	61.2	71.0
08:59:25	LCY	Overhead	E190	30	65.2	75.0
09:02:53	LCY	Overhead	RJ1H	35	68.9	77.4
09:07:03	Heathrow		Unknown	13	57.8	65.2
09:07:38	LCY	North	E170	28.5	62.7	72.6
09:08:38	Heathrow		Unknown	14.5	59.7	66.2
09:12:07	LCY	Slight north	SB20	31	62.3	71.7
09:15:25	LCY	North	E170	25.5	63.1	72.3
09:24:30	Heathrow		Unknown	18	60.0	67.7
09:27:00	Heathrow		Unknown	19.5	56.7	65.2
09:27:28	LCY	Overhead	E190	34.5	70.8	78.9
09:32:00	LCY	Overhead	E190	32.5	68.1	77.7
09:33:50	LCY	North	E170	27	62.9	71.8
09:36:24	LCY	Overhead	AT42	28.5	70.7	77.6
09:40:25	LCY	North	E190	28.5	64.7	73.4
09:41:49	Heathrow		Unknown	33	64.0	72.6
09:42:13	Heathrow		Unknown	11	58.1	64.3
09:42:54	LCY	Overhead	AT42	29	70.5	77.7
09:45:43	Heathrow		Unknown	20	58.1	67.4
09:47:11	LCY	Overhead	RJ85	29	64.0	72.8
09:48:37	LCY		DH8D	24	63.7	71.2