Environmental Research and Consultancy Department
Directorate of Airspace Policy
Civil Aviation Authority

ERCD Report 0501

Noise Exposure Contours for Heathrow Airport 2004

D J Monkman
D P Rhodes
J Deeley

Prepared by the Civil Aviation Authority on behalf of the Department for Transport, London, August 2005

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SUMMARY

This report describes the calculations of the aircraft noise exposure around London Heathrow Airport for the year 2004 and compares both the input data and the resulting contours, together with the areas and populations within the contours, with those for 2003.

Prepared by the CAA on behalf of the Department for Transport, August 2005

The authors of this report are employed by the Civil Aviation Authority. The work reported herein was carried out on behalf of the Department for Transport.

EXECUTIVE SUMMARY

For every year, the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority estimates the noise exposures around the London Airports (Heathrow, Gatwick and Stansted) on behalf of the Department for Transport (DfT). The magnitude and extent of the aircraft noise around these airports are depicted on maps by *contours* of constant aircraft noise index (Leq) values. The contours are generated by a computer model validated with noise measurements, which calculates the emissions and propagation of noise from arriving and departing air traffic.

This report presents the results for London Heathrow Airport for the year 2004 and compares both the air traffic information and the noise contours with those for 2003. As for 2003, the 2004 contours shown in this report take into account the topography around Heathrow by accounting for terrain height in the modelling process.

Estimates of the populations within the 2003 contours are based on the 2001 census updated by CACI in 2002, populations within the 2004 contours are also based on the 2001 census but updated by CACI in 2003.

The average daily aircraft movement rate was 2.5% higher in 2004 than in 2003. The actual modal split of runway direction in 2004 was 81% west - 19% east compared with 70% west – 30% east in 2003. The standard modal split (20 year average) in 2004 was 77% west – 23% east.

The total area within the 2004 terrain adjusted 57 dBA Leq (16-hour) decreased by 7.5% and the population within this contour decreased by 9.1%.

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1 INTRODUCTION

1.1 The amount of aircraft noise experienced by people living around London (Heathrow) Airport during the summer (mid June – mid September) of each year is estimated by the Environmental Research and Consultancy Department of the Civil Aviation Authority on behalf of the Department for Transport (DfT). The noise exposure measure is the Equivalent Continuous Sound Level, Leq (16-hour) in dBA. The background to the use of this index is explained in DORA Report 9023 (Ref 1). The method by which noise maps, or contours of Leq, are prepared using the ANCON Noise Model is described in DORA Report 9120, R&D Report 9842 and ERCD Report 0104[1] (Refs 2, 3 and 4 respectively). Technical terms used here are described in those references.

1.2 This document contains small scale (1:200,000) diagrams of the 2004 Heathrow Leq contours. Contours overlaid on OS digital maps to scale 1:50,000, or in AutoCad DXF format on CD-ROM, are available for purchase from the Department for Transport, Aviation Environmental Division, Zone 1/33, Great Minster House, 76 Marsham Street, London SW1P 4DR, telephone 020-7944-5494, e-mail address aed@dft.gsi.gov.uk. The previous practice of producing translucent acetate overlays to scale 1:50,000 has now been discontinued.

1.3 This report provides supporting information and compares both the aircraft operations and the resulting noise contours with those for 2003 (Ref 5).

1.4 New analyses of radar and noise data were undertaken in 2004, and the calculations incorporate revised mean tracks and associated dispersions for departing aircraft, together with revised 'spurs' to model the arrival flight track dispersion. Height/speed departure and arrival profiles have also been updated for each aircraft type where the data has shown this to be necessary.

1.5 To remove the effect of year-on-year weather fluctuations on aircraft operations in order to clarify underlying trends, two sets of contours for 2004 have been generated; (i) the *actual* modal split and (ii) the "*standard"* modal split. In 2004 the actual modal split was 81% west - 19% east compared to 70% west – 30% east in 2003. For 2003 the standard modal split was 77% west - 23% east (based on the 20 year Leq period average 1984 to 2003 inclusive); for 2004 the standard modal split remained unchanged at 77% west – 23% east (based on the 20 year Leq period average 1985 to 2004 inclusive). This report compares actual and standard contours for 2003 and 2004.

1.6 As in 2003, the 2004 contours shown in this report take into account the topography around Heathrow by accounting for terrain height in the modelling process. This was achieved by geometrical corrections for source-receiver distance and elevation angles, other more complex effects such as lateral attenuation from uneven ground surfaces and noise screening/reflection effects due to topographical features were not taken into account. ERCD holds terrain height data[2] obtained from Ordnance Survey on a 200m by 200m grid for England and Wales. Interpolation was performed to generate height data at each of the calculation points on the 100m by 100m receiver grid for use by the ANCON noise model.

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[1] Work on this Report has, for some time, been integrated into updating European Noise Modelling Guidance, which will culminate in an updated ECAC.CEAC Document 29, 'Methodology for Computing Noise Contours around Civil Airports'. A proposal from the AIRMOD Technical Subgroup was considered by Directors General in Summer 2004 and a draft report Volumes 1 and 2 has been published on the ECAC web site (www.ecac-ceac.org). ERCD played a major role in the production of the proposal, in particular the formulation and implementation of revised algorithms for an improved lateral attenuation adjustment.

[2] Meridian® 2 data revised 2003.

2 AIRCRAFT OPERATIONS

2.1 Flight Tracks

2.1.1 The 2004 calculations were based on updated mean tracks and track dispersions for all outbound routes from Runways 27L, 27R, 09R and 09L (see Figure 1 for route designations). These were determined from radar data (extracted from the airport's Noise and Track Keeping (NTK) monitoring system) for the summer of 2004. Following the withdrawal of Concorde from service in October 2003, the previous practice of generating separate mean tracks and dispersions for departures by Concorde on the Compton (CPT) routes from Runways 27L, 27R, 09R and 09L is now no longer required. As in 2003, there were some departures from Runway 09L during the 2004 Leq period (0.93% of the total easterly departures) and mean tracks and track dispersions were defined for these operations.

2.1.2 Radar measurements of arrival tracks between the stacks and Runways 27L, 27R, 09L and 09R confirmed that the continued use of evenly spaced 'spurs' remained a realistic method for modelling the dispersion of arrival tracks about the extended runway centre lines. All these spur route segments joined the centre lines at distances greater than 12 kilometres from threshold – only a small number of aircraft joined at the shorter distances.

2.2 Flight Profiles and Noise Emissions

2.2.1 For 2004, the average flight profiles of height and speed versus track distance for each aircraft type were reviewed, and updated where necessary, for both departures and arrivals. For the 2004 calculations one additional aircraft type (the Airbus A318) was added to the database. Noise event levels were then determined from a database expressing SEL[3] as a function of engine power setting and slant distance to the receiver – the so-called 'noise-power-distance (NPD)' relationship. The engine power settings required for the aircraft to follow the measured average height and speed profiles were calculated from data describing aircraft performance characteristics within each of the different aircraft type categories.

2.2.2 Following the withdrawal of Concorde from service in October 2003, the previous practice of generating separate 'west' and 'east' climb profiles for Concorde departures on the CPT routes is now no longer required. However, as in previous years, the climb profiles for other aircraft types, which operate on *both* straight and curved departure routes from either end of the airport, are averaged across *all* departure routes. For these types, the 2004 departure radar data showed that, on average, climb profiles for easterly and westerly departures were not significantly different.

2.3 Traffic Distribution by Aircraft Type and Route

2.3.1 The aircraft movements conventionally used to determine Leq are the daily averages of those which take place in the 16-hour day, 0700-2300 local time, during the 92-day period 16 June to 15 September inclusive. Table 1, which displays the distribution of movements by aircraft type, shows that the 2004 average Leq (16-hour) day movement rate was 2.5% higher than in 2003.

[3] Sound Exposure Level in dBA; a measure of noise event level which accounts for both the duration and intensity of noise.

2.3.2 Table 2 compares the distribution of aircraft departures by route for 2003 and 2004. The percentages of use of each runway direction - the "modal split" - for 2004 were 81% west - 19% east compared to 70% west – 30% east in 2003.

2.3.3 The table below lists the 'average summer day' movements by eight noise classes of aircraft (ranked in ascending order of noise emission, i.e. from least to most noisy) during 2003 and 2004. Table 1 and Figure 2 (at the end of the Report) state which specific aircraft types fall into which categories.

NOISE CLASS	AIRCRAFT	AVERAGE NUMBER 2003	AVERAGE NUMBER 2004	PERCENTAGE OF TOTAL 2004 MOVEMENTS	CHANGE AS PERCENTAGE OF TOTAL 2003 MOVEMENTS
	PROPELLER AIRCRAFT				
1	Small props	0.8	0.3	0.0	0.0
2	Large props	9.5	9.8	0.8	0.0
	CHAPTER 3 JETS				
3	Short-haul	849.9	852.2	67.5	+0.2
4	Wide-body twins	203.4	230.8	18.3	+2.2
5	2nd gen wide body multis*	151.1	161.7	12.8	+0.9
	LARGE CHAPTER 2/3 JETS				
6	1st gen wide-body multis*	10.4	7.6	0.6	-0.2
	2 nd GENERATION TWIN JETS				
7	Narrow body twins (including Chapter 2 and hushkitted versions)	4.1	0.0	0.0	-0.3
	1 st GENERATION JETS AND CONCORDE				
8	Narrow body multis (including hushkitted versions)	3.0	0.6	0.0	-0.2
	TOTAL MOVEMENTS	1232.2	1263.0	100.0**	+2.5**

* Multi-engined (3 or 4) aircraft
** May not sum exactly due to rounding

2.3.4 It can be seen from the above table that the average number of movements of aircraft types in noise classes 3, 4 and 5 all showed a slight increase in 2004. The largest increase was in movements of the Chapter 3 Jets Wide-body twins category (noise class 4) which rose from 203.4 movements per average day in 2003 to 230.8 movements per average day in 2004. The largest percentage decrease was in movements of the 2nd generation narrow-body twins (noise class 7) which fell from 4.1 movements per average day in 2003 to zero movements per average day in 2004. Movements by aircraft types in noise classes 6 and 8 also fell in 2004.

2.3.5 Figure 2 illustrates the changing distribution of traffic among these noise classes over the twenty one years from 1984 to 2004[4] inclusive.

[4] The 1990 to 2004 percentages shown in Figure 2 relate to the average 16 hour Leq-day; before 1990 the percentages relate to the average 12 hour NNI-day (0700-1900 Local Time). Also, the percentages before 1992 are based on departures only, from 1992 they relate to total movements.

3 NOISE CONTOURS

3.1 'Actual' contours

3.1.1 The actual Leq contours for 2004 (i.e. those depicting actual terrain adjusted average mode Leq exposures), from 57 to 72 dBA in steps of 3dB, are overlaid on a background map in Figure 3. In Figure 4, three of these, for 57, 63 and 69 dBA Leq, are compared with the actual contours for 2003. Immediately apparent from Figure 4 is the effect on the 2004 contours of the withdrawal of Concorde operations. Contours associated with departures on the westerly and easterly Compton (CPT) routes have greatly diminished.

3.1.2 Less apparent from Figure 4 is the effect on the contours due to the change in modal split. However, the 2004 contours on westerly departure routes not associated with Concorde have elongated slightly reflecting the 11% increase in westerly operations in 2004. The 2004 contours associated with easterly departure routes have decreased.

3.1.3 The total areas and populations[5] enclosed by each of the contours are listed below:

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE	POPULATION 000's		PERCENTAGE CHANGE
	2003 ACTUAL	2004 ACTUAL		2003 ACTUAL (2002 CACI data)	2004 ACTUAL (2003 CACI data)	
>57	126.9	117.4	-7.5	263.7	239.7	-9.1
>60	71.1	66.7	-6.2	128.6	105.3	-18.1
>63	43.8	40.3	-8.0	64.6	55.9	-13.5
>66	28.1	24.4	-13.2	28.8	21.0	-27.1
>69	15.6	13.3	-14.7	8.0	5.7	-28.8
>72	8.3	6.5	-21.7	2.5	1.5	-40.0

Percentage changes in contour areas and populations are not necessarily the same because the contours differ in shape as well as size.

Relative to 2003, the areas within all the actual 2004 Leq contours decreased ranging from 21.7% at 72 dBA Leq to 6.2% at 60 dBA Leq. Based on the updated 2003 CACI data, the population enclosed within the actual 2004 57 dBA Leq contour decreased by 9.1% (using the earlier 2002 CACI data would have yielded a decrease of 6.3%).

[5] The population estimates shown in this Report are based on 2001 census data (updated by CACI Ltd in 2002 and 2003). Note also that area and population figures presented in this Report are cumulative.

3.2 '**Standard' contours**

3.2.1 In Figure 5 the standard terrain adjusted 2004 contours (57, 63 and 69 dBA Leq) are compared with those for 2003. This shows what the noise exposures would have been if the 2003 and 2004 modal splits had mirrored the 20-year rolling average. The 2003 standard contours were based on the 20 year average modal split from 1984 to 2003 inclusive of 77% west - 23% east; those for 2004 were based on the 20 year average modal split from 1985 to 2004 inclusive which remained unchanged at 77% west - 23% east. The associated contour areas and populations are displayed below:

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE	POPULATION 000's		PERCENTAGE CHANGE
	2003 STANDARD	2004 STANDARD		2003 STANDARD (2002 CACI data)	2004 STANDARD (2003 CACI data)	
>57	129.3	116.3	-10.1	269.2	240.1	-10.8
>60	72.2	66.1	-8.4	122.6	107.3	-12.5
>63	44.1	40.3	-8.6	63.8	57.6	-9.7
>66	27.5	24.4	-11.3	27.0	20.8	-23.0
>69	15.8	13.1	-17.1	8.4	5.3	-36.9
>72	8.4	6.5	-22.6	2.6	1.4	-46.2

3.2.2 The standard contours normally provide a clearer indication than the actual contours of 'fleet noise level' changes because they minimise the effect of any difference between the ratios of westerly to easterly operations for the two years**.** Figure 5 clearly shows the effect on the 2004 contours of the withdrawal of Concorde operations. In 2004 contours associated with departures on the westerly and easterly CPT routes have greatly diminished. Contours associated with arrivals on Runway 27R have also decreased slightly in 2004 although this reflects both the withdrawal of Concorde and the uneven usage of the runways in 2003 due to re-surfacing work

3.2.3 Relative to 2003, the area within the standard 2004 57 dBA Leq contour decreased by 10.1% and the population by 10.8% (using the earlier 2002 CACI population data would have yielded a decrease of 8.1%).

3.3 **Comparison of 2004 contours with 2003 contours that excluded Concorde movements**

3.3.1 In October 2003 Concorde retired from service so the contours for 2003 were the last to include any Concorde movements. To enable further comparisons, additional terrain adjusted contours were generated for 2003 that excluded movements by Concorde.

3.3.2 Figures 6 and 7 compare these 2003 contours that excluded Concorde movements with those for 2004 for both the actual and standard modal splits.

3.3.3 The contour areas and populations for these two scenarios are listed below:

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE	POPULATION 000's		PERCENTAGE CHANGE
	2003 excluding Concorde movements ACTUAL	2004 ACTUAL		2003 excluding Concorde movements ACTUAL (2002 CACI data)	2004 ACTUAL (2003 CACI data)	
>57	110.2	117.4	+6.5	226.3	239.7	+5.9
>60	62.8	66.7	+6.2	106.6	105.3	-1.2
>63	38.9	40.3	+3.6	52.6	55.9	+6.3
>66	23.4	24.4	+4.3	18.3	21.0	+14.8
>69	12.2	13.3	+9.0	4.9	5.7	+16.3
>72	6.2	6.5	+4.8	1.4	1.5	+7.1

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE	POPULATION 000's		PERCENTAGE CHANGE
	2003 excluding Concorde movements STANDARD	2004 STANDARD		2003 excluding Concorde movements STANDARD (2002 CACI data)	2004 STANDARD (2003 CACI data)	
>57	111.5	116.3	+4.3	224.5	240.1	+6.9
>60	63.8	66.1	+3.6	101.3	107.3	+5.9
>63	38.9	40.3	+3.6	53.4	57.6	+7.9
>66	23.5	24.4	+3.8	19.1	20.8	+8.9
>69	12.4	13.1	+5.6	5.1	5.3	+3.9
>72	6.2	6.5	+4.8	1.5	1.4	-6.7

3.3.4 It can be seen from the above Tables that had Concorde not operated in 2003 then the areas within the 2004 contours would have actually increased ranging from 3.6 to 9%. These increases reflect the overall increase in traffic (+2.5%) and the general shift to larger aircraft especially wide body twins in noise class 4 which increased from 203.4 per average day in 2003 to 230.8 per average day in 2004 (13.5% increase).

4 HEATHROW TRAFFIC AND NOISE: HISTORICAL TRENDS

4.1 Figure 8 shows how the average mode 57 dBA Leq contours, based on actual modal splits, have changed since 1988 by comparison with the *total annual* aircraft movements.

4.2 The area figures give a better indication of the actual noise than the population figures because the latter are more susceptible to the 'modal split' between easterly and westerly operations[6]. This is particularly noticeable in 1995 which had an atypical modal split of 54% west – 46% east (compared with the 20-year average of 77% west – 23% east for that year). The recorded increase in enclosed population between 1998 and 1999 reflected demographic changes that occurred between the 1991 census and the subsequent update.

4.3 The sharp rate of decline in contour area recorded in the late eighties and early nineties has diminished. The area reductions in 2000 and 2001 reflect reduced numbers of Concorde movements in those years (2.5 per day in 2000 and 0.1 per day in 2001). This followed the grounding of Concorde following the crash at Paris,

[6] Actual modal split data are used in this figure because contours based on standard modal split are a relatively recent innovation and data prior to 1995 are not available.

Charles de Gaulle airport in July 2000. Concorde movements in 2002 and 2003 never reached the level of 1999. The dashed line on the figure shows what the 2003 areas and populations would have been had there been no movements by Concorde in the Leq period for that year. In October 2003 Concorde was retired from service so there were no movements by Concorde in 2004.

4.4 Against the trend of a general decrease in contour area, the number of aircraft movements has risen steadily each year, the only trough occurring in 1991, the year of the Gulf War. The annual movement figure for 2001 was slightly lower than the preceding year and reflects the disruption to traffic following the events of September 11th. The total annual movement figure for 2004 was about 2.7% higher than that for 2003 compared with the 2.5% increase for the 16 hour average summer day.

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ERCD Report 0401

Table 1:

DISTRIBUTION OF HEATHROW AVERAGE DAILY AIRCRAFT MOVEMENTS BY TYPE (0700-2300 LOCAL TIME, 16 JUNE - 15 SEPTEMBER)

AIRCRAFT TYPE(S)	NOISE CLASS	AVERAGE NUMBER 2003	AVERAGE NUMBER 2004	PERCENTAGE OF TOTAL 2004 MOVEMENTS	CHANGE AS PERCENTAGE OF TOTAL 2003 MOVEMENTS
Small Props	1	0.8	0.3	0.0	0.0
Large Props	2	9.5	9.8	0.8	0.0
B737-300,400,500	3	67.9	42.2	3.3	-2.1
B737-600,700	3	1.7	15.4	1.2	+1.1
B737-800,900	3	14.8	22.0	1.7	+0.6
B757E(RB211-535E4, E4B)	3	58.2	58.3	4.6	0.0
B757C(RB211-535C)	3	0.6	1.5	0.1	+0.1
B757P (Pratt and Whitney)	3	1.8	2.1	0.2	0.0
BAe146	3	19.1	6.9	0.5	-1.0
A318**	3	0.0	1.9	0.2	+0.2
A319C (CFM-56)	3	16.6	15.9	1.3	-0.1
A319V (IAE-V2500)	3	163.2	184.9	14.6	+1.8
A320C (CFM-56)	3	122.7	135.5	10.7	+1.0
A320V (IAE-V2500)	3	150.6	153.5	12.2	+0.2
A321C (CFM-56)	3	65.3	64.1	5.1	-0.1
A321V (IAE-V2500)	3	68.1	80.0	6.3	+1.0
Business Jet (Ch 3)	3	7.7	4.9	0.4	-0.2
CRJ Canadair Regional Jet	3	6.0	15.3	1.2	+0.8
CRJ700	3	0.3	4.1	0.3	+0.3
ERJ Embraer EMB 135/145	3	5.7	5.5	0.4	0.0
F100	3	36.9	8.7	0.7	-2.3
MD80	3	31.1	25.2	2.0	-0.5
MD90	3	11.6	4.3	0.3	-0.6
B767-200	4	1.4	0.8	0.1	0.0
B767-300G (General Electric)	4	12.8	14.6	1.2	+0.1
B767-300P (Pratt and Whitney)	4	14.4	14.2	1.1	0.0
B767-300R (Rolls Royce)	4	43.6	48.1	3.8	+0.4
B777-200G (General Electric)	4	27.4	30.9	2.4	+0.3
B777-200P (Pratt and Whitney)	4	18.3	14.2	1.1	-0.3
B777-200R (Rolls Royce)	4	41.9	54.2	4.3	+1.0
B777-300R (Rolls Royce)	4	5.3	5.1	0.4	0.0
A300	4	9.2	15.9	1.3	+0.5
A310	4	9.6	8.4	0.7	-0.1
A330	4	19.5	24.4	1.9	+0.4
B747-400G (General Electric)	5	22.7	26.8	2.1	+0.3
B747-400P (Pratt and Whitney)	5	19.8	24.2	1.9	+0.4
B747-400R (Rolls Royce)	5	65.7	64.5	5.1	-0.1
B747SP	5	1.4	1.6	0.1	0.0
A340	5	33.2	32.5	2.6	-0.1
A340S	5	4.4	8.5	0.7	+0.3
MD11	5	3.9	3.6	0.3	0.0
B747-100*	6	0.2	0.3	0.0	0.0
B747-200,-300 (Ch 3)	6	7.1	5.8	0.5	-0.1
DC10	6	2.4	1.3	0.1	-0.1
Tristar	6	0.7	0.2	0.0	0.0
B737-200 (Ch3)	7	4.0	0.0	0.0	-0.3
Business Jet (Ch 2)	7	0.1	0.0	0.0	0.0
B707, DC8*	8	0.1	0.0	0.0	0.0
B727 (Ch 3)	8	0.2	0.3	0.0	0.0
Concorde	8	2.1	0.0	0.0	-0.2
Tu154M*	8	0.4	0.3	0.0	0.0
VC10, IL62*	8	0.2	0.0	0.0	0.0
TOTAL MOVEMENTS		1232.2	1263.0	100.0***	+2.5***

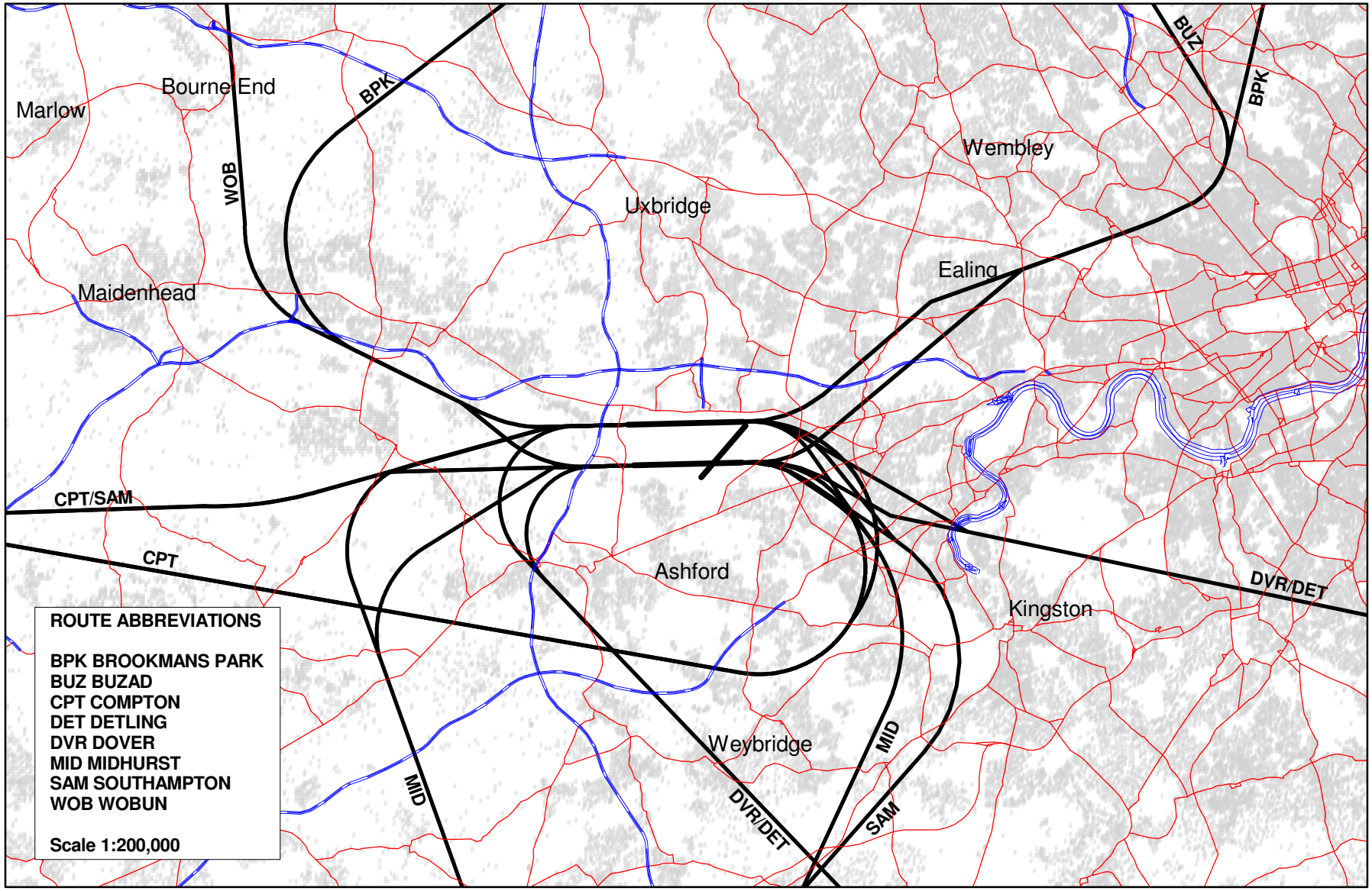
* In 2003 and 2004 all Chapter 3 versions.
** New type for 2004
*** May not sum exactly due to rounding

Table 2:

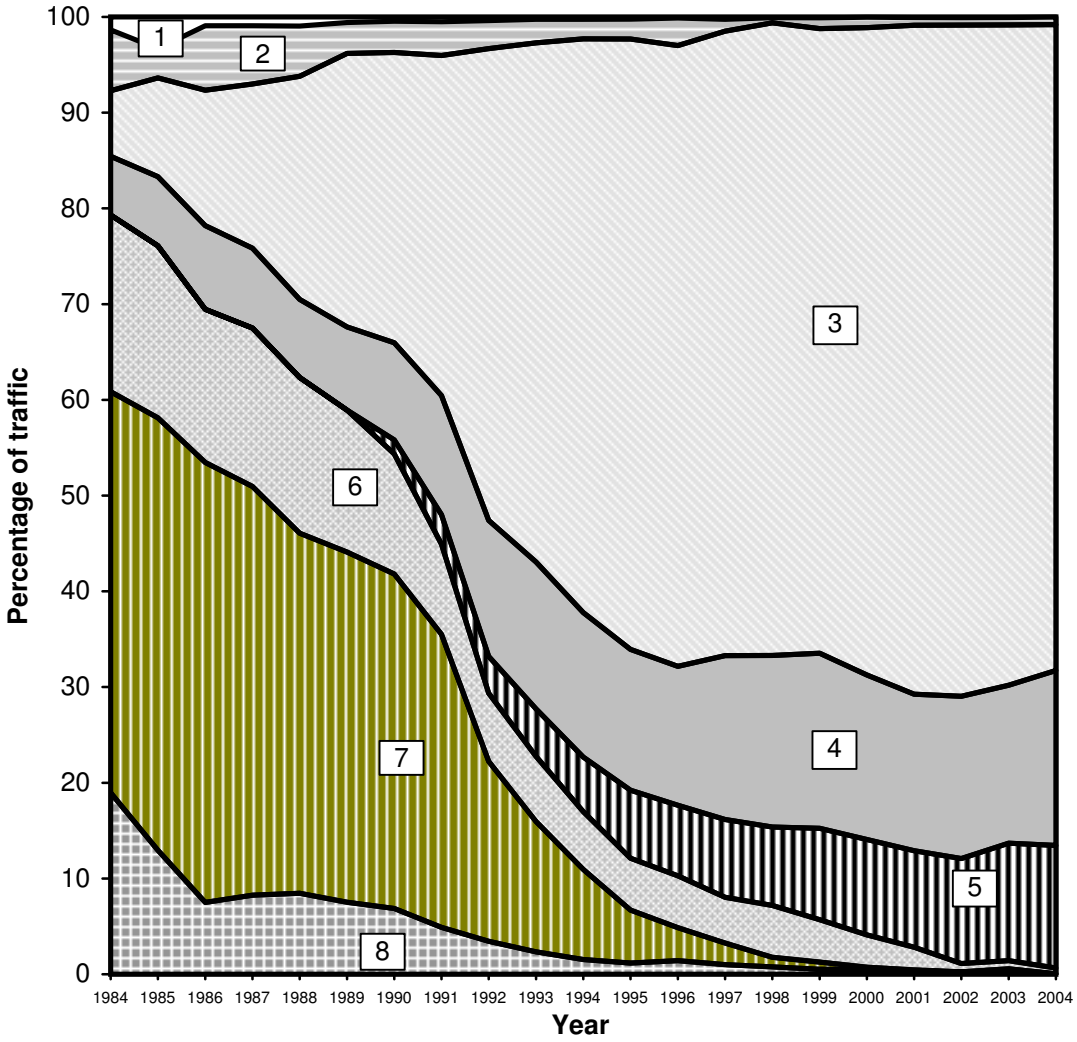
PERCENTAGE OF HEATHROW AVERAGE DAILY AIRCRAFT DEPARTURES BY ROUTE*
(0700-2300 LOCAL TIME, 16 JUNE - 15 SEPTEMBER)

WESTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES 2003	PERCENTAGE OF TOTAL DEPARTURES 2004	CHANGE (% OF TOTAL)
WOB/BPK	30.5	34.7	+4.2
DVR/DET	11.9	17.3	+5.4
MID	14.8	15.5	+0.7
CPT/SAM	12.8	13.5	+0.7
PERCENTAGE WEST	70.0	81.0	+11.0
EASTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES 2003	PERCENTAGE OF TOTAL DEPARTURES 2004	CHANGE (% OF TOTAL)
BUZ/BPK	12.9	8.5	-4.4
DVR/DET	5.0	3.8	-1.2
MID/SAM	8.0	4.6	-3.4
CPT	4.1	2.1	-2.0
PERCENTAGE EAST	30.0	19.0	-11.0

* See Figure 1.



Fligure 1: London Heathrow Airport Standard Instrument Departure Routes



Propeller aircraft:

1 Small props: Single and twin pistons and turboprop light, business and commuter aircraft

2 Large props: 2- & 4-propeller transports; eg SF340 BAe-ATP, ATR42, F50, HS748, Saab 2000, Electra, Hercules, Viscount, Vanguard

Chapter 3 jets:

3 Short-haul: eg A320, BAe146, B717, B737-300, B757, F100, MD80, RJ50, re-engined narrow-bodies, some business jets

4 Wide-body twins: A300, A310, A330, B767, B777

5 2nd gen. wide-body multis*: A340, MD11, B747-400

Large Chapter 2/3 jets:

6 1st gen. wide-body multis* (Chapter 2 & 3): 'Classic' 747, Tristar, DC-10, An124, IL76, IL86

2nd generation twin jets:

7 Narrow body twins (including hushkitted versions): eg F28,, BAC 1-11, DC-9, B737-200 other business jets

1st generation jets & Concorde: (including hushkitted versions)

8 eg Trident, 707, DC-8, B727, IL62, Tu154

* Multi = 3- or 4- engined aircraft

Figure 2: Noise Class of Heathrow aircraft 1984 - 2004

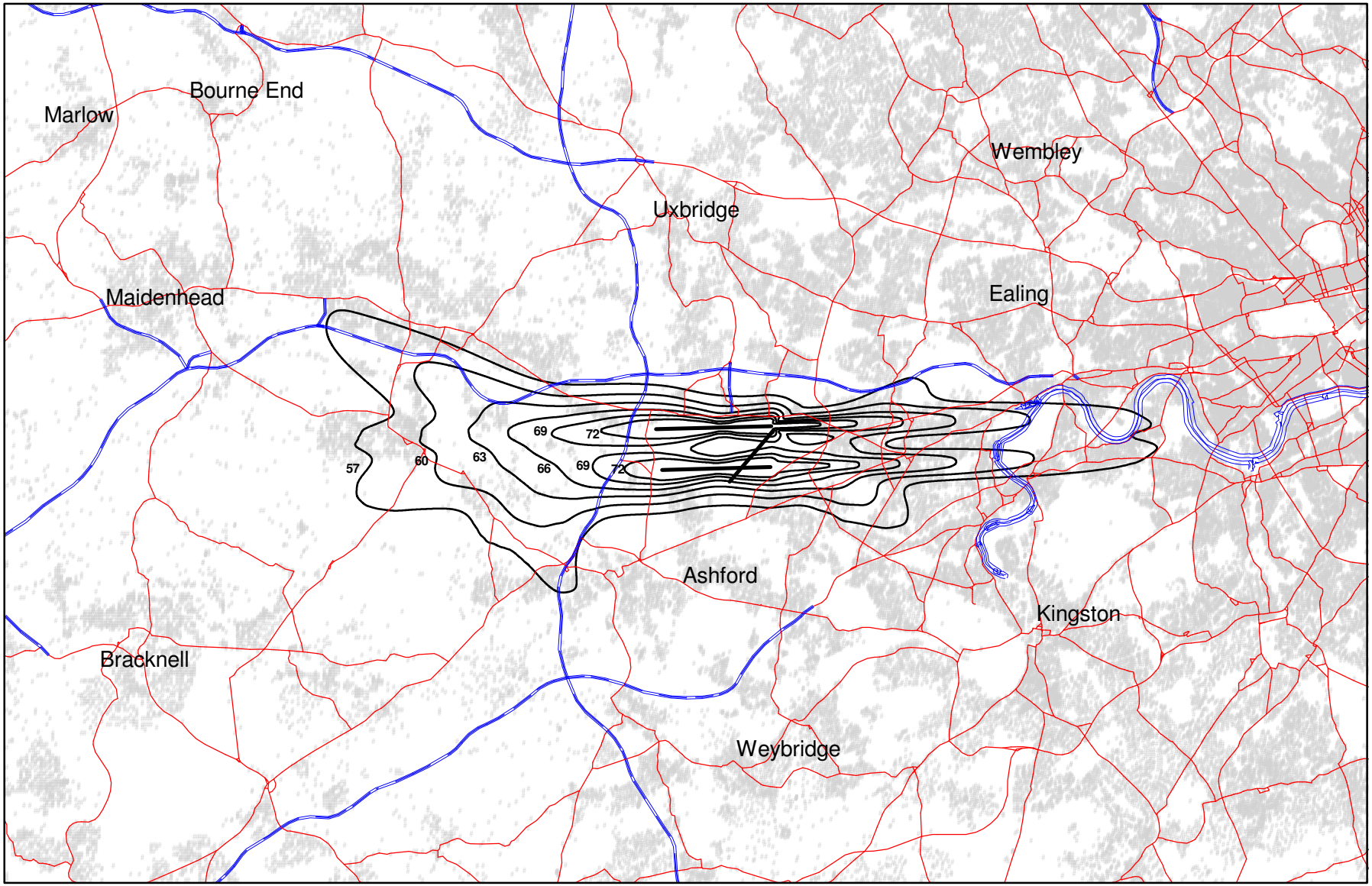


Figure 3: Heathrow actual 2004 average mode (81% west-19% east) terrain adjusted 16hr Leq on population map

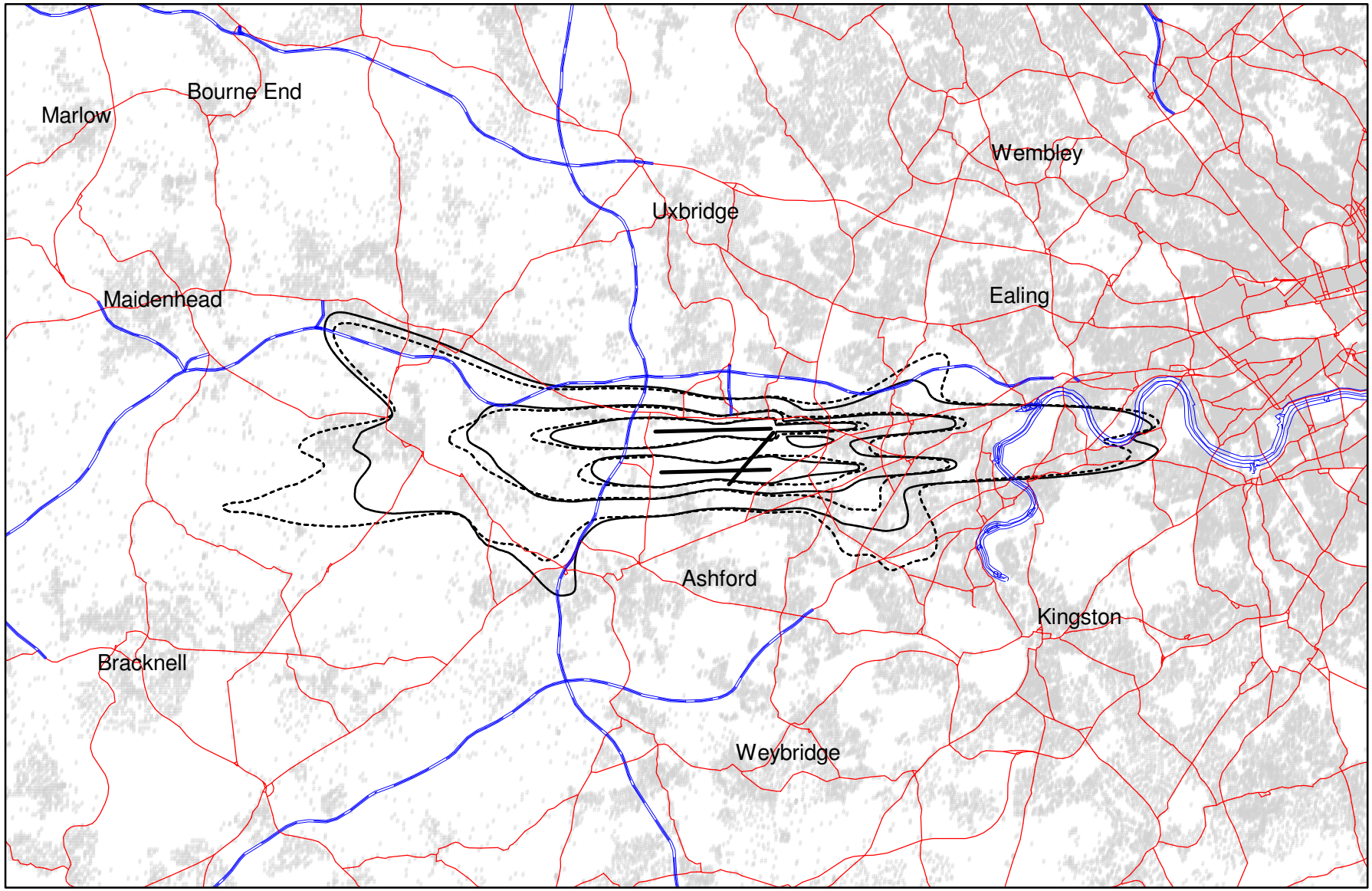


Figure 4: Heathrow actual 57, 63 and 69 Leq contours - 2003 dotted (70% west-30% east) - 2004 solid (81% west-19% east)

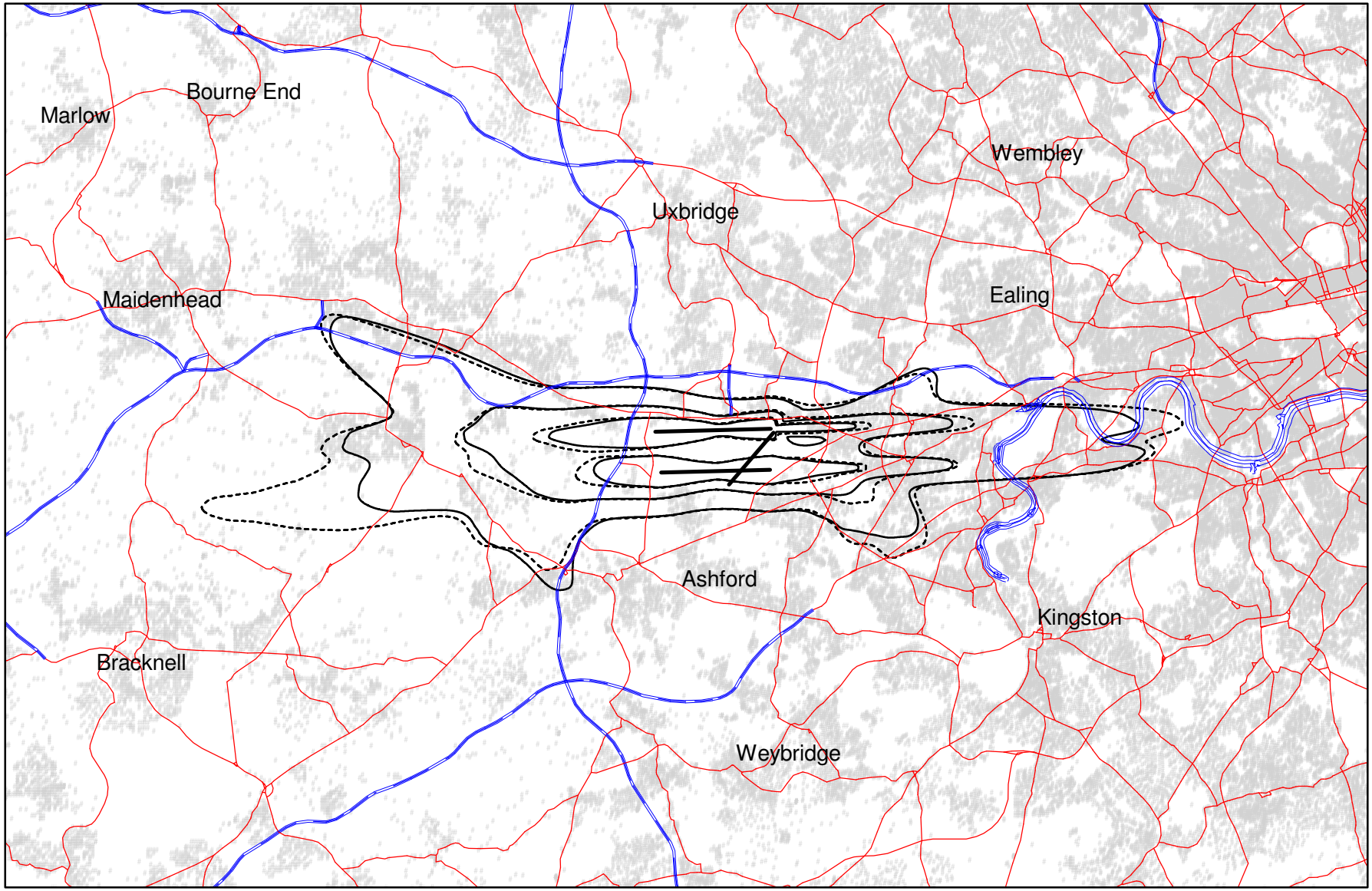


Figure 5: Heathrow standard 57, 63 and 69 Leq contours - 2003 dotted (77% west-23% east) - 2004 solid (77% west-23% east)

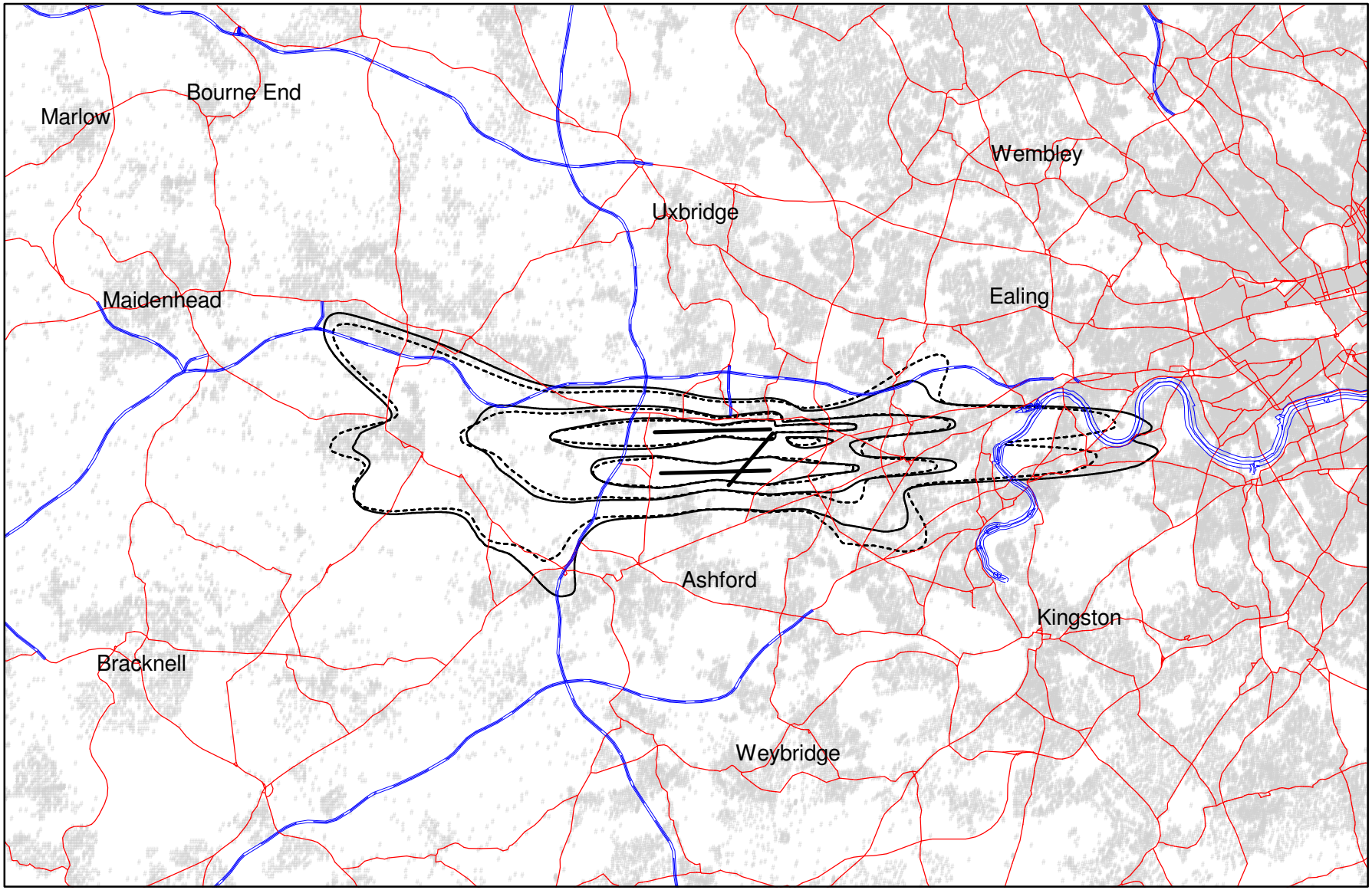


Figure 6: Heathrow actual 57, 63 and 69 Leq contours - 2003 excl. Concorde movements dotted (70% west-30% east) - 2004 solid (81% west-19% east)

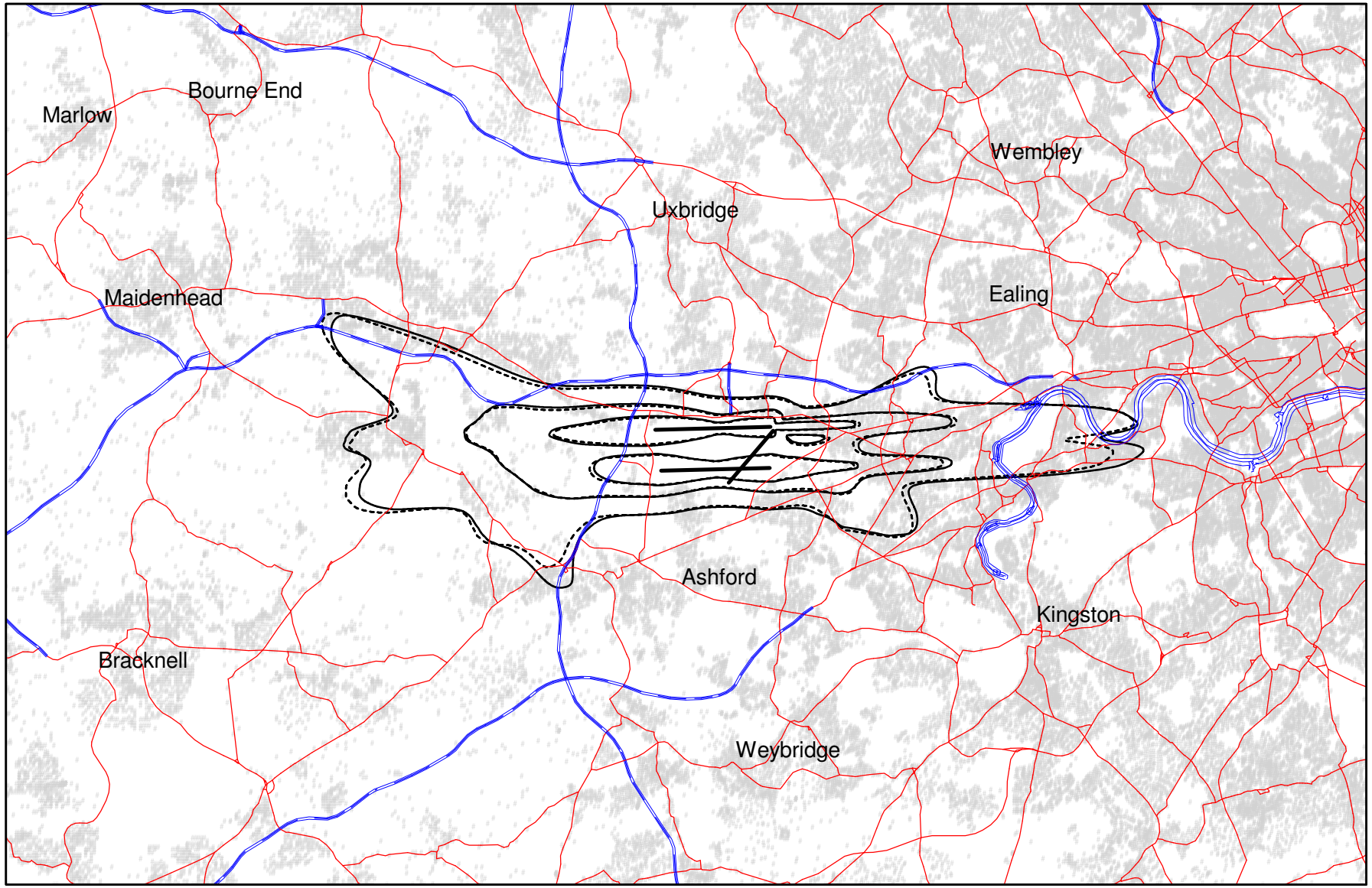


Figure 7: Heathrow standard 57, 63 and 69 Leq contours - 2003 excl. Concorde movements dotted (77% west-23% east) - 2004 solid (77% west-23% east)

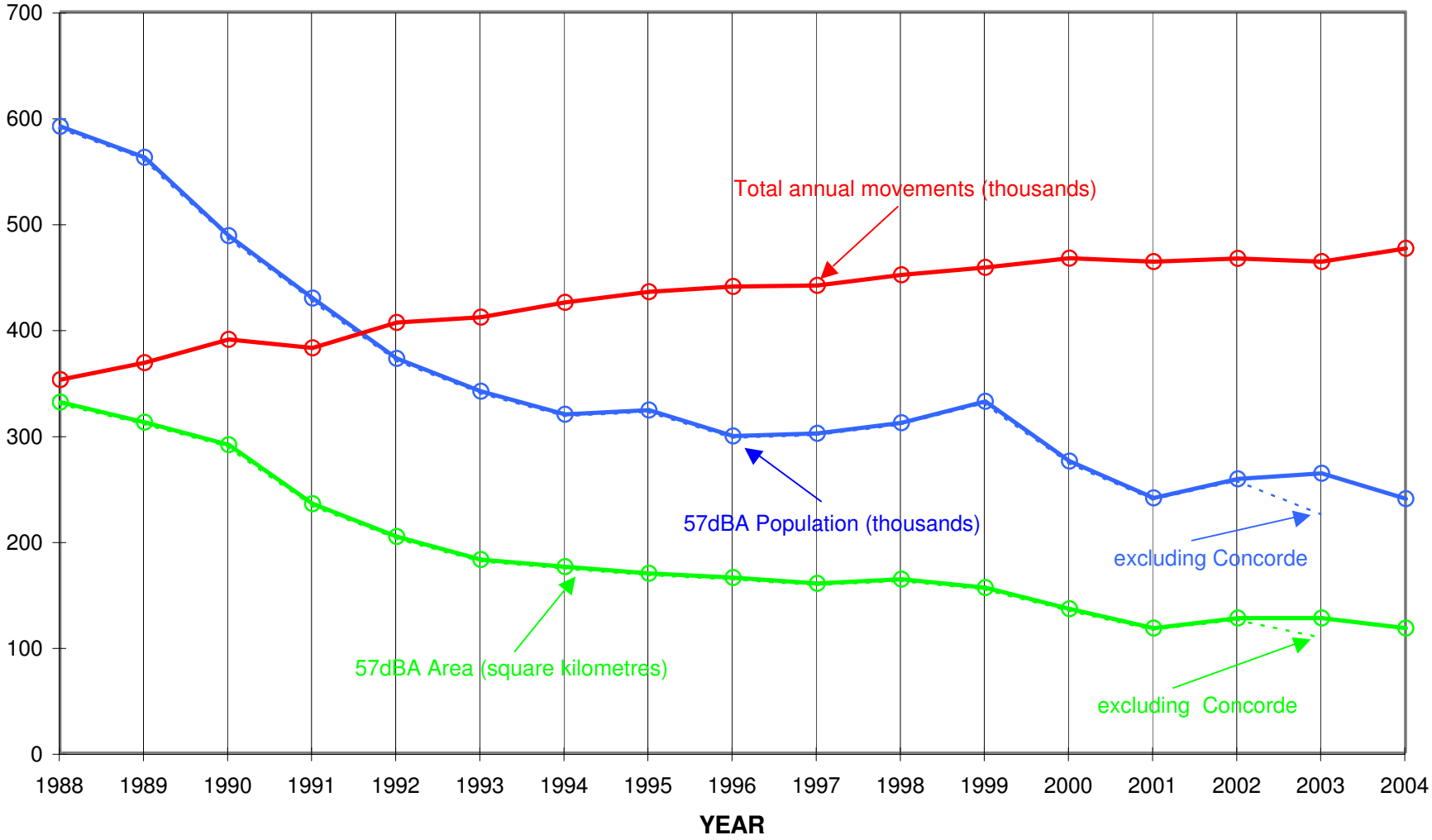


Figure 8: Heathrow traffic and noise 1988 - 2004