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

ERCD Report 0502

Noise Exposure Contours for Gatwick 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 Gatwick 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.

Population data used in this report are based on 2001 Census data (updated in 2002 and 2003) supplied by CACI Information Services.

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 Gatwick 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 Gatwick 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 2.6% higher in 2004 than in 2003. The modal split in 2004 was 77% west - 23% east compared with 62% west - 38% east in 2003. The standard modal split (20 year average) in 2004 was 73% west – 27% east.

Relative to 2003, the total area within the 2004 terrain adjusted 57 dBA Leq (16-hour) contour increased by 4.1% and the population within this contour increased by 7.1%.

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1 INTRODUCTION

1.1 The amount of aircraft noise experienced by people living around London (Gatwick) 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 (1:150,000) diagrams of the 2003 Gatwick Leq contours. Contours overlaid on OS 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 77% west - 23% east compared to 62% west - 38% east in 2003. For 2003 the standard modal split was 73% west - 27% east (based on the 20 year Leq period average 1984 to 2003 inclusive); for 2004 the standard modal split remained unchanged at 73% west - 27% east (based on the 20 year Leq period average 1985 to 2004 inclusive). This report compares both 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 Gatwick 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

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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.

50m receiver grid for use by the ANCON noise model. This is of particular relevance on the western side of the airport around the high ground in the vicinity of Russ Hill.

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 26L and 08R (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. The 2004 radar data indicated that, as in preceding years, a small proportion of departures by some propeller aircraft deviated from the Standard Instrument Departure (SID) routeings and special routes and dispersions were defined for these operations. Such deviations are consistent with the rules laid down in the UK Aeronautical Information Publication (AIP) which states that certain propeller aircraft may be permitted to depart from the Noise Preferential Routes (NPRs) by Air Traffic Control.

2.1.2 Radar measurements of arrival tracks between the stacks and Runways 26L and 08R 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. The 2004 measurements showed that, within the area of interest, 96.7% of (westerly) arrivals on Runway 26L joined the extended runway centre-line from the south and 0.3% from the north. The remaining 3% were aligned with the extended runway centre-line itself. The comparable percentages for (easterly) arrivals on Runway 08R were 97.1% from the south, 2.3% from the north and 0.6% along the extended runway centre-line. The majority of aircraft joined the centre lines at distances greater than 11 kilometres from threshold – only a very small number of aircraft joined at 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. 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.

2.3 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 2.6% higher than in 2003.

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 77% west - 23% east compared to 62% west – 38% east in 2003.

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

2.3.3 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	0.2	0.2	0.0	0.0
2	Large props	30.7	20.2	2.9	-1.6
	CHAPTER 3 JETS				
3	Short-haul	529.7	546.5	79.8	+2.5
4	Wide-body twins	81.6	84.4	12.3	+0.4
5	2nd gen wide body multis*	7.9	8.9	1.3	+0.1
	LARGE CHAPTER 2/3 JETS				
6	1st gen wide-body multis*	10.4	10.4	1.5	0.0
	2 nd GENERATION TWIN JETS				
7	Narrow body twins (including Chapter 2 and hushkitted versions)	5.1	12.9	1.9	+1.2
	1 st GENERATION JETS				
8	Narrow body multis (including hushkitted versions)	1.9	1.3	0.2	-0.1
	TOTAL MOVEMENTS	667.5	684.8	100.0**	+2.6**

* 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 largest percentage increase occurred in noise class 3 (short haul Chapter 3 Jets) which rose from 529.7 movements per day in 2003 to 546.5 per day in 2004. Of more relevance for noise was the increase in movements by 2nd generation twin-jets (mainly B737-200 Ch3 – see Table 1) which rose from 5.1 per average day in 2003 to 12.9 per average day in 2004.

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

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 population 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. Examination of Figure 4 shows that the 2004 contours associated with westerly arrivals to Runway 26L have elongated reflecting the 15% increase in westerly operations and, to a lesser extent, the small increase in traffic in 2004. The 2004 57 dBA Leq contour associated with westerly departures on the Lambourne, Biggin, Clacton and Dover (LAM/BIG/CLN/DVR) routes has also increased in size, again reflecting the increase in traffic and the higher proportion of westerly operations.

[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.

3.1.2 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	46.1	48.0	+4.1	4.2	4.5	+7.1
>60	27.8	28.6	+2.9	1.3	1.5	+15.4
>63	16.5	16.7	+1.2	0.6	0.6	*
>66	9.2	9.2	0.0	0.2	0.3	*
>69	4.8	4.8	0.0	0.1	0.1	*
>72	2.5	2.5	0.0	<0.1	<0.1	*

* Percentage changes not shown because of the relatively low numbers and limited resolution of the estimates.

Relative to 2003, the areas within the 2004 57, 60 and 63 dBA Leq contours increased ranging from 1.2% at 63 dBA Leq to 4.1% at 57 dBA Leq**.** At levels 66 to 72 dBA Leq, the areas within 2004 contours remained unchanged from those for 2003. These increases in area between 57 to 63 dBA Leq are attributable to the overall increase in traffic and the increase in the number of operations by 2nd generation twin jets (noise class 7) which rose from 5.1 per average day in 2003 to 12.9 per average day in 2004. Examination of Table 1 shows that specifically movements by the B737-200 (Chapter 3) more than doubled in 2004. Percentage changes in contour areas are not necessarily accompanied by similar changes in enclosed populations because the contours may be different in shape as well as size and slight movement of contour line(s) from year to year, especially in or around relatively highly populated areas, can cause a disproportionate change in enclosed population. Based on the updated 2003 CACI data the population enclosed within the 57dBA Leq contour increased by 7.1% (using the earlier 2002 CACI data would have yielded an increase of 8.7%). This is mainly because the 2004 57dBA Leq contour to the north east of the airport (associated with westerly arrivals to Runway 26L) elongated slightly and encroached into Lingfield to a greater extent than it did in 2003.

[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 the standard 2003 contours. These show what the noise exposures would have been if the 2003 and 2004 modal splits had mirrored the 20-year rolling average. The average modal split for the years 1985 to 2004 inclusive (used for the 2004 terrain adjusted standard contours) was 73% west - 27% east, the average modal split for the years 1984 to 2003 (used for the terrain corrected 2003 standard contours) was also 73% west 27% east. The associated 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	46.0	48.0	+4.3	4.3	4.6	+7.0
>60	27.7	28.6	+3.2	1.4	1.5	+7.1
>63	16.4	16.7	+1.8	0.6	0.6	*
>66	9.2	9.2	0.0	0.2	0.3	*
>69	4.8	4.8	0.0	0.1	0.1	*
>72	2.5	2.5	0.0	<0.1	<0.1	*

* Percentage changes not shown because of the relatively low numbers and limited resolution of the estimates.

The areas within the standardised 2004 terrain adjusted 57, 60 and 63 dBA Leq contours are very slightly higher than those for the standardised 2003 contours. At levels 66, 69 and 72 dBA Leq the areas within the 2004 contours remain unchanged from those for 2003. Based on the 2003 CACI data the population within the 57 dBA Leq contour increased by 7% (using the earlier 2002 CACI data would have yielded an increase of 9.3%). This is mainly because the extremities of the 2004 standardised 57dBA Leq contour elongated slightly and extended into Lingfield (to the north east of the airport) to a slightly greater extent than in 2003.

3.2.2 The standard contours generally 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. It can be seen from Figure 5 that the 2004 contours are generally very similar to those for 2003, the only noticeable difference being a slight elongation of the extremities of the 2004 57 dBA Leq contour.

4 GATWICK TRAFFIC AND NOISE: HISTORICAL TRENDS

4.1 Figure 6 shows how the average mode 57 dBA Leq contours, based on actual modal splits[6], have changed since 1988 by comparison with the *total annual* aircraft movements.

4.2 From 1988 to 1993, the areas within the 57 dBA Leq contours diminished markedly and then increased slightly until 1996. From 1996 onwards the areas decreased slightly each year but levelled off between 1999 and 2000. In 2001 the area decreased by 22% relative to the previous year and in 2002 the contour area decreased by 19% relative to 2001. In 2003 the area increased by 2% relative to 2002 and this continued in 2004 when the area increased by 4.1% over that for 2003.

4.3 The population numbers within the contours generally move in line with the areas.

4.4 Aircraft movements bottomed out in 1991 (the year of the Gulf War) and did not return to 1990 levels until 1995. From 1995 to 2000 they increased steadily. From 2000 to 2002 movements decreased, possibly as a consequence of 11th September 2001. There was little change in the total annual number of movements from 2002 to 2003. The total annual movement figure for 2004 was about 3.4% higher than that for 2003 compared with the 2.6% increase for the 16 hour average summer day.

[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.

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The CAA Aircraft Noise Contour Model: ANCON Version 1
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3 Ollerhead J B, Rhodes D P, Viinikainen M S, Monkman D J, Woodley A C
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Improvements in Version 2
R&D Report 9842

4 Smith M J T, Ollerhead J B, Rhodes D P, White S, Woodley A C
Development of an Improved Lateral Attenuation Adjustment
for the UK Aircraft Noise Contour Model, ANCON
ERCD Report 0104 (to be superseded by an updated ERCD Report)

5 Monkman D J, Rhodes D P, Deeley J
Noise Exposure Contours for Gatwick Airport 2003
ERCD Report 0402

Table 1:

DISTRIBUTION OF GATWICK 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	0.2	0.2	0.0	0.0
Large Props	2	30.7	20.2	2.9	-1.6
B717	3	1.5	0.0	0.0	-0.2
B737-300,400,500	3	246.1	221.0	32.3	-3.8
B737-600,700	3	46.2	21.0	3.1	-3.8
B737-800,900	3	20.7	18.1	2.6	-0.4
B757E (RB211-535E4, E4B)	3	70.2	77.3	11.3	+1.1
B757P (Pratt and Whitney)	3	0.2	0.0	0.0	0.0
BAe146	3	42.0	35.9	5.2	-0.9
A319C (CFM-56)	3	3.0	66.4	9.7	+9.5
A319V (IAE-V2500)	3	0.1	0.5	0.1	+0.1
A320C (CFM-56)	3	29.4	23.6	3.4	-0.9
A320V (IAE-V2500)	3	30.7	39.3	5.7	+1.3
A321C (CFM56)	3	6.9	4.7	0.7	-0.3
A321V (IAE-V2500)	3	13.1	19.8	2.9	+1.0
Business Jet (Ch 3)	3	2.4	4.0	0.6	+0.2
CRJ Canadair Regional Jet	3	5.9	5.5	0.8	-0.1
ERJ Embraer EMB 135/145	3	5.5	5.1	0.7	-0.1
F100	3	2.1	2.0	0.3	0.0
MD80	3	3.7	2.3	0.3	-0.2
B767-200	4	9.9	9.1	1.3	-0.1
B767-300G (General Electric)	4	15.6	14.2	2.1	-0.2
B767-300P (Pratt and Whitney)	4	3.6	8.2	1.2	+0.7
B767-400	4	0.3	0.2	0.0	0.0
B777-200G (General Electric)	4	18.5	18.8	2.7	0.0
B777-200R (Rolls Royce)	4	6.9	8.4	1.2	+0.2
B777-300R (Rolls Royce)	4	2.1	0.0	0.0	-0.3
A300	4	7.0	6.6	1.0	-0.1
A310	4	2.6	2.3	0.3	0.0
A330	4	15.1	16.6	2.4	+0.2
B747-400G (General Electric)	5	7.1	8.0	1.2	+0.1
A340	5	0.8	0.9	0.1	0.0
B747-200, -300 (Ch 3)	6	2.7	3.4	0.5	+0.1
DC10	6	6.9	7.0	1.0	0.0
Tristar	6	0.8	0.0	0.0	-0.1
B737-200 (Ch3)	7	5.1	12.8	1.9	+1.2
Business Jet (Ch 2)	7	0.0	0.1	0.0	0.0
Tu154M*	8	1.9	1.3	0.2	-0.1
TOTAL MOVEMENTS		667.5	684.8	100.0**	+2.6**

* In 2003 and 2004 all Chapter 3 versions.

** May not sum exactly due to rounding

Table 2:

PERCENTAGE OF GATWICK 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)
LAM/CLN/BIG/DVR	30.6	30.7	+0.1
HAR/BOG	8.6	21.3	+12.7
KEN/SAM	22.4	24.7	+2.3
SFD	0.0	0.0	0.0
WIZ/TIG	0.4	0.3	-0.1
PERCENTAGE WEST	62.0	77.0	+15.0
EASTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES 2003	PERCENTAGE OF TOTAL DEPARTURES 2004	CHANGE (% OF TOTAL)
LAM	3.6	2.6	-1.0
CLN/BIG/DVR	3.7	6.5	+2.8
KEN/SAM	14.7	6.6	-8.1
SFD	16.0	7.3	-8.7
PERCENTAGE EAST	38.0	23.0	-15.0

* See Figure 1.

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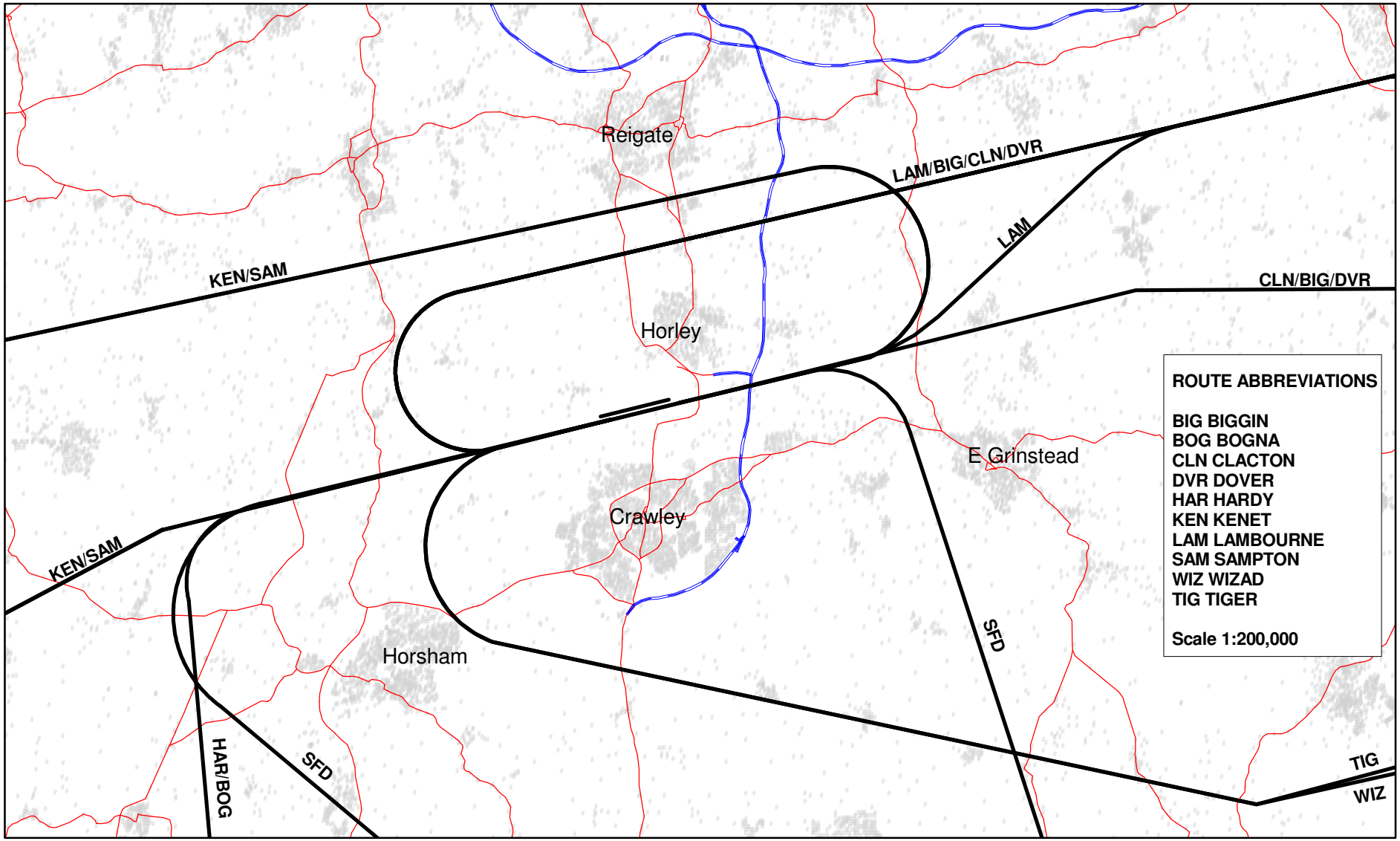
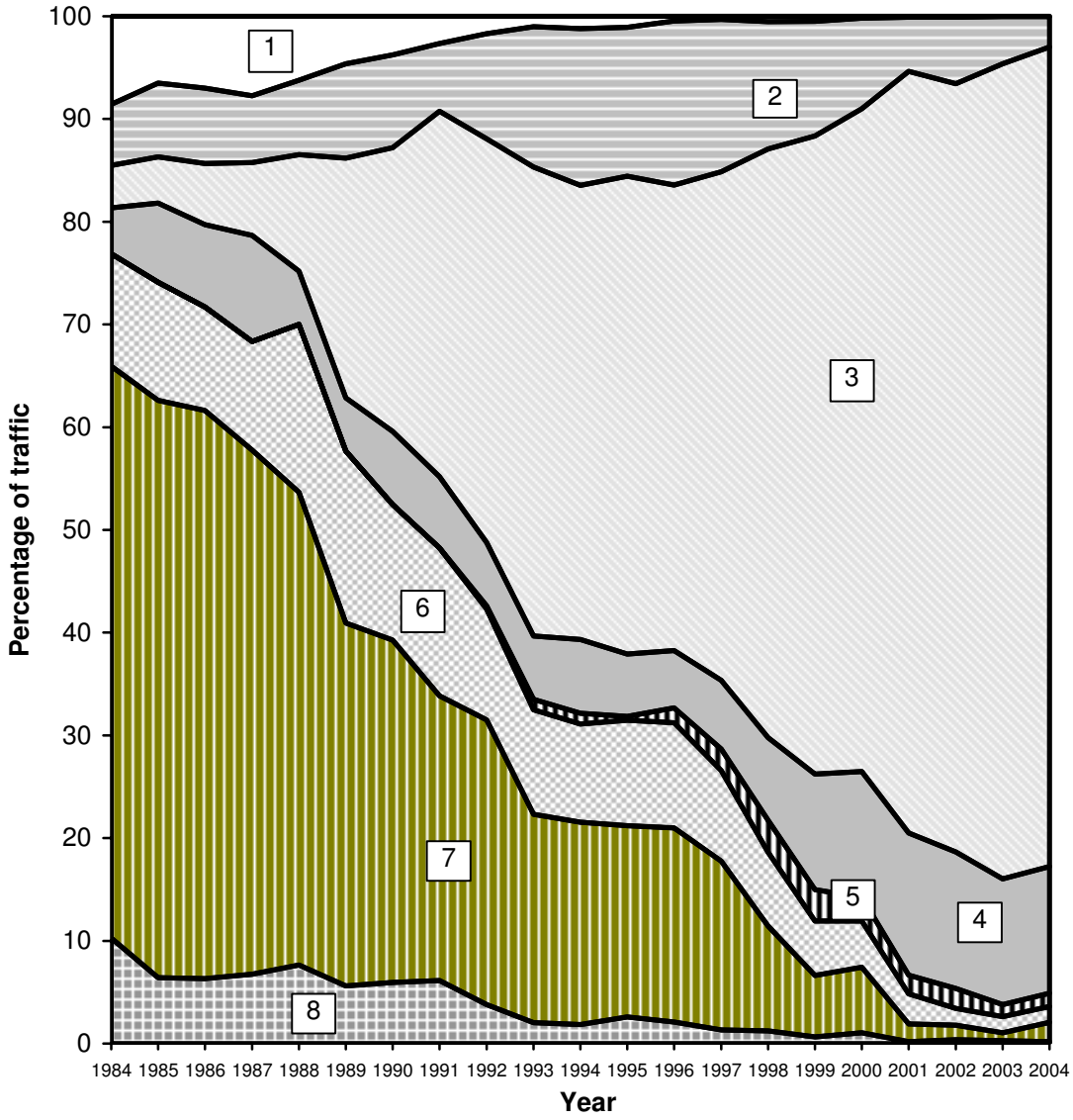


Figure 1: London Gatwick Airport Standard Instrument Departure Routes



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, BAC1-11, DC-9, B737-200, Tu134, other business jets

1st generation jets: (including hushkitted versions)

8 eg Trident, B707, DC-8, B727, IL62, Tu154

* Multi = 3- or 4- engined aircraft

Figure 2: Noise Class of Gatwick aircraft 1984 - 2004

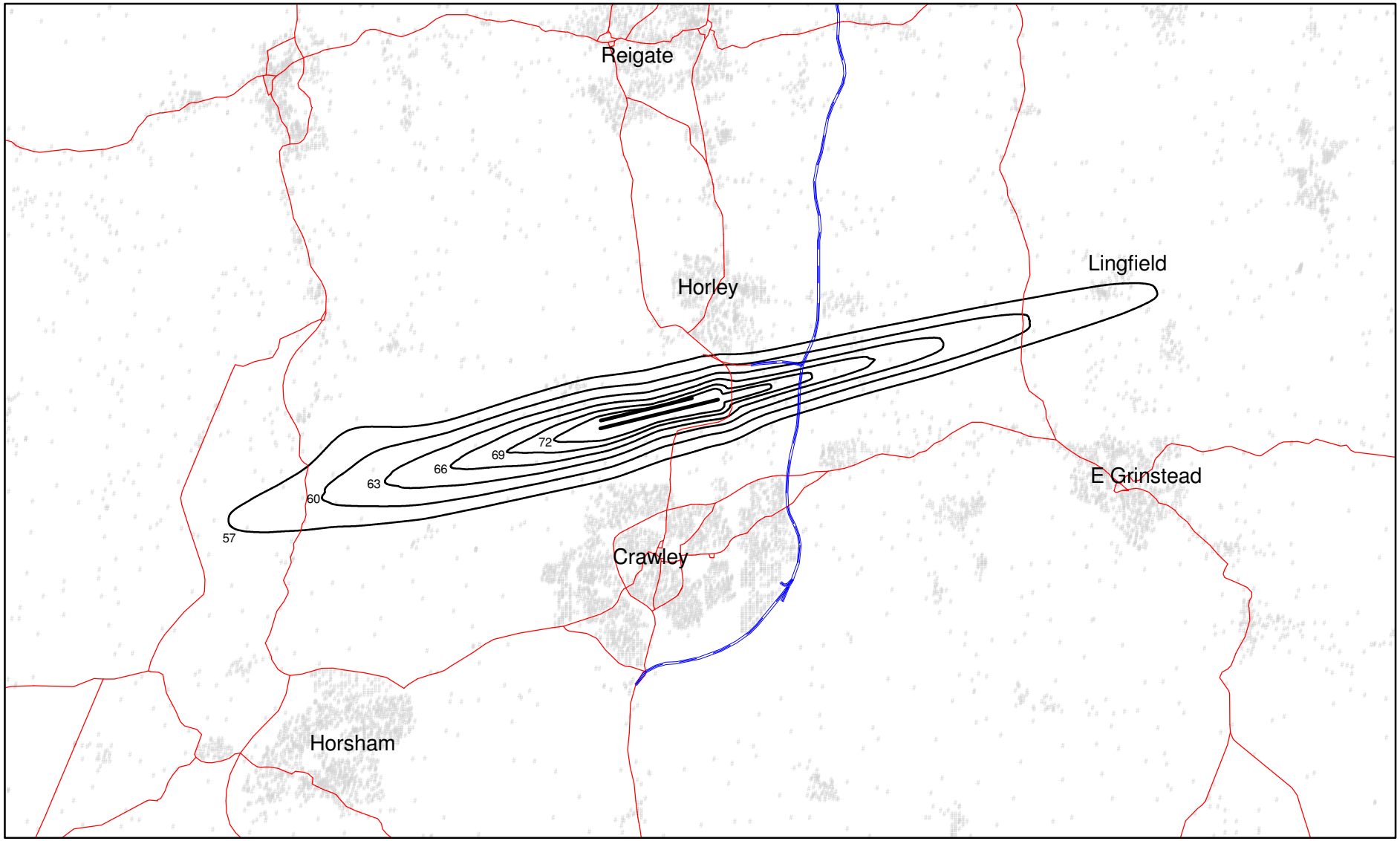


Figure 3: Gatwick actual 2004 average mode (77% west - 23% east) terrain adjusted 16hr Leq on population map

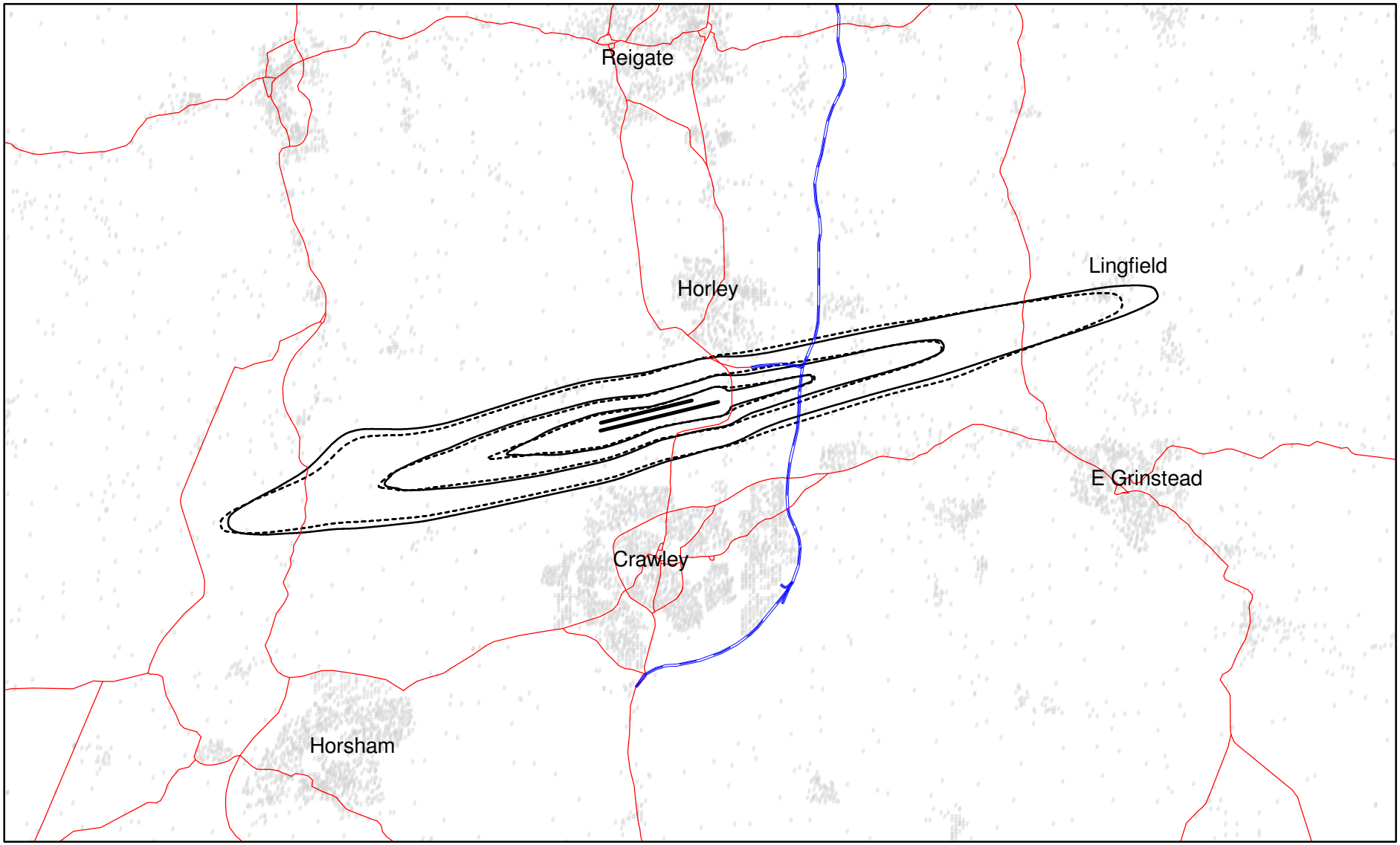


Figure 4: Gatwick actual 57, 63 and 69 Leq contours - 2003 dotted (62% west - 38% east) - 2004 solid (77% west - 23% east)

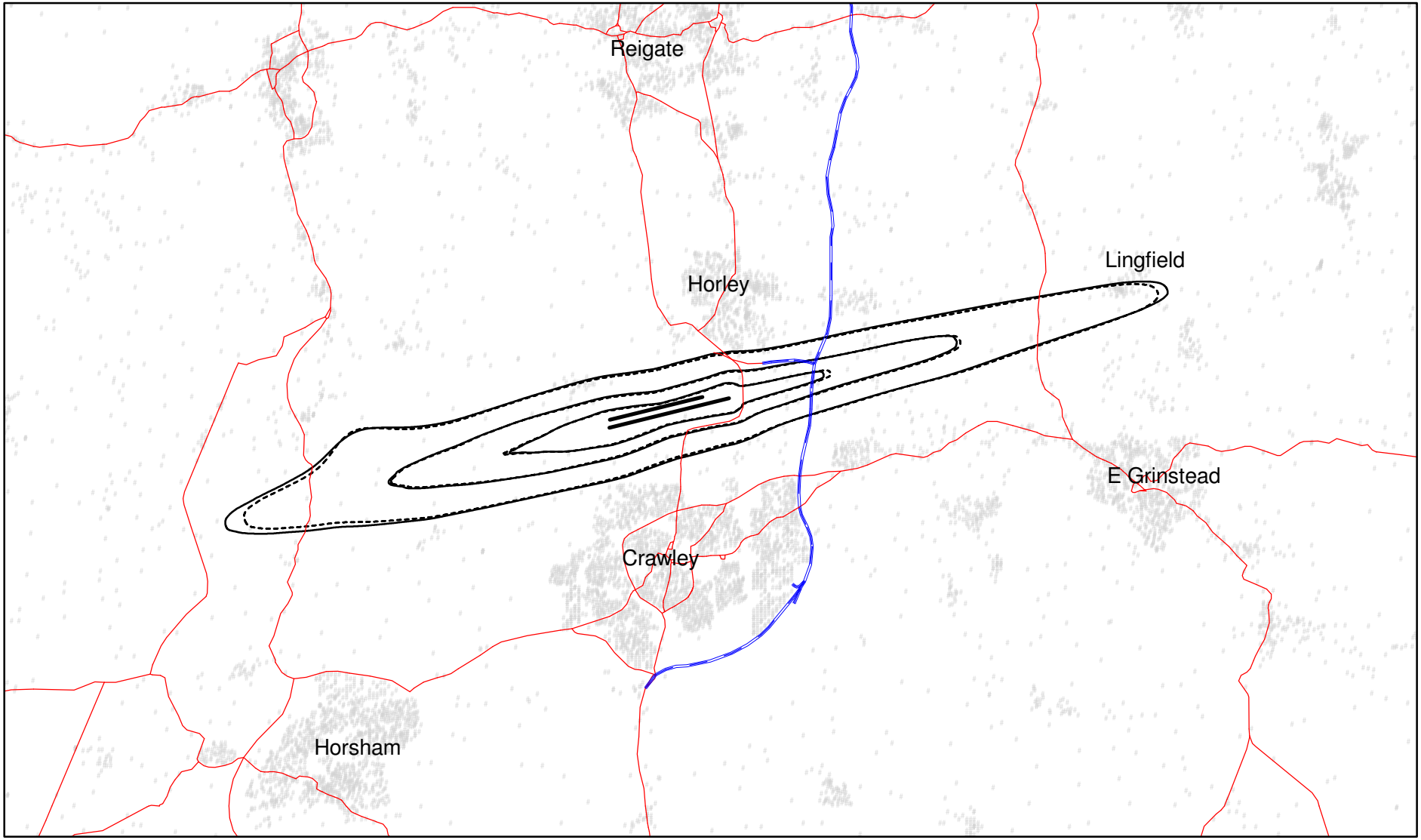


Figure 5: Gatwick standard 57, 63 and 69 Leq contours - 2003 dotted (73% west - 27% east) - 2004 solid (73% west - 27% east)

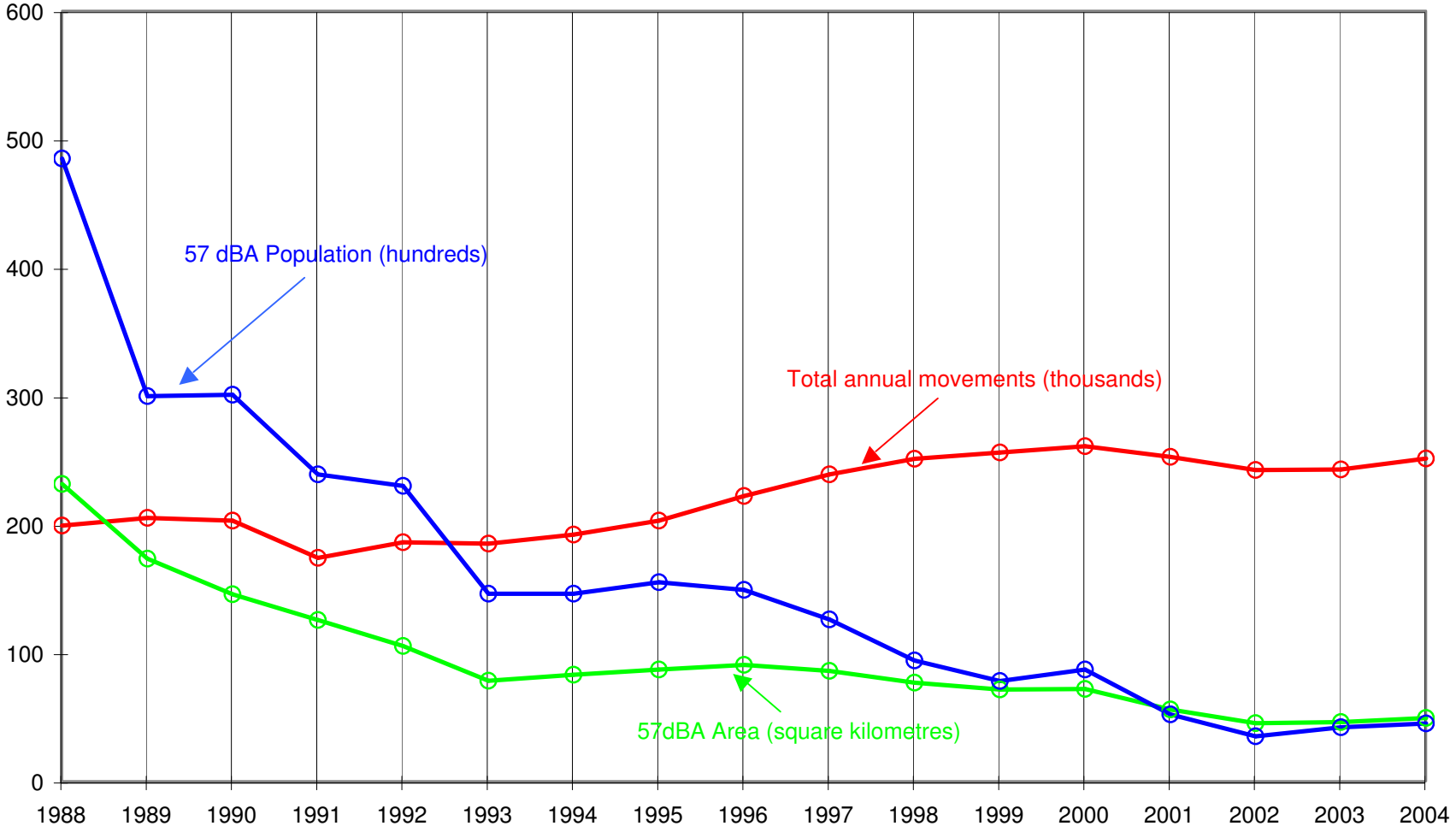


Figure 6: Gatwick traffic and noise 1988 - 2004