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

ERCD Report 0402

Noise Exposure Contours for Gatwick Airport 2003

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D P Rhodes
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Prepared by the Civil Aviation Authority on behalf of the Department for Transport, London, July 2004

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SUMMARY

This report describes the calculations of the aircraft noise exposure around London Gatwick Airport for the year 2003 and compares both the input data and the resulting contours, together with the areas and populations within the contours, with those for 2002.

Prepared by the CAA on behalf of the Department for Transport, July 2004

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 1991 and 2001 Census data (updated in 1999 and 2002) 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 2003 and compares both the air traffic information and the noise contours with those for 2002. The 2003 contours shown in this report take into account the topography around Gatwick by accounting for terrain height in the modelling process. This is discussed in more detail in Section 1.6.

Estimates of the populations within the 2003 contours are based on the 2001 census (updated by CACI in 2002). Comparisons with the earlier 1991 census dated (updated in 1999) are also shown in this report.

The average daily aircraft movement rate was 0.6% lower in 2003 than in 2002. The modal split in 2003 was 62% west - 38% east compared with 71% west - 29% east in 2002. The standard modal split (20 year average) in 2003 was 73% west – 27% east.

The total area within the 2003 terrain adjusted 57 dBA Leq (16-hour) contour increased by 2%. The population within this contour increased by 20%.

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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 3½ inch diskettes, 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 2002 (Ref 5).

1.4 New analyses of radar and noise data were undertaken in 2003, 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 2003 have been generated; (i) the *actual* modal split and (ii) the "*standard"* modal split. In 2003 the actual modal split was 62% west - 38% east compared to 71% west - 29% east in 2002. For 2002 the standard modal split was 73% west - 27% east (based on the 20 year Leq period average 1983 to 2002 inclusive); for 2003 the standard modal split remained unchanged at 73% west - 27% east (based on the 20 year Leq period average 1984 to 2003 inclusive). This report compares both actual and standard contours for 2002 and 2003.

[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 is to be considered by Directors General in Summer 2004. 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.

1.6 The 2003 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 50m receiver grid for use by the ANCON noise model.

2 AIRCRAFT OPERATIONS

2.1 Flight Tracks

2.1.1 The 2003 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 2003. The 2003 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 2003 measurements showed that, within the area of interest, 96.3% of (westerly) arrivals on Runway 26L joined the extended runway centre-line from the south and 0.4% from the north. The remaining 3.3% were aligned with the extended runway centre-line itself. The comparable percentages for (easterly) arrivals on Runway 08R were 96.9% from the south, 2.4% from the north and 0.7% along the extended runway centre-line. All the spur route segments joined the centre lines at distances greater than 11 kilometres from threshold.

2.2 Flight Profiles and Noise Emissions

2.2.1 For 2003, 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

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2 Meridian® 2 data revised 2003.

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

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 2003 average Leq (16-hour) day movement rate was 0.6% lower than in 2002.

2.3.2 Table 2 compares the distribution of aircraft departures by route for 2002 and 2003. The percentages of use of each runway direction - the "modal split" - for 2003 were 62% west - 38% east compared to 71% west – 29% east in 2002.

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 2002 and 2003. 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 2002	AVERAGE NUMBER 2003	PERCENTAGE OF TOTAL 2003 MOVEMENTS	CHANGE AS PERCENTAGE OF TOTAL 2002 MOVEMENTS
	PROPELLER AIRCRAFT				
1	Small props	0.6	0.2	0.0	-0.1
2	Large props	43.5	30.7	4.6	-1.9
	CHAPTER 3 JETS				
3	Short-haul	502.1	529.7	79.4	+4.1
4	Wide-body twins	89.1	81.6	12.2	-1.1
5	2nd gen wide body multis*	13.1	7.9	1.2	-0.8
	LARGE CHAPTER 2/3 JETS				
6	1st gen wide-body multis*	11.0	10.4	1.6	-0.1
	2 nd GENERATION TWIN JETS				
7	Narrow body twins (including Chapter 2 and hushkitted versions)	9.5	5.1	0.8	-0.7
	1 st GENERATION JETS				
8	Narrow body multis (including hushkitted versions)	2.4	1.9	0.3	-0.1
	TOTAL MOVEMENTS	671.3	667.5	100.0**	-0.6

* 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 502.1 movements

per day in 2002 to 529.7 per day in 2003 (4.1% increase). Relative to 2002, the number of movements per day in all other noise classes decreased.

2.3.5 Figure 2 illustrates the changing distribution of traffic among these classes over the twenty years from 1984 to 2003[4] inclusive.

3 NOISE CONTOURS

3.1 'Actual' contours

3.1.1 The actual Leq contours for 2003 (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 non-adjusted contours for 2002. Despite the change in modal split, the 2002 and terrain adjusted 2003 contours are generally very similar in both shape and size; this is because where departure and arrival routes follow the same (or similar) ground tracks any potential differences caused by a change in modal split tend to be self-cancelling.

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
	2002 ACTUAL	2003 ACTUAL Terrain adj		2002 ACTUAL (1999 CACI data)	2003 ACTUAL (2002 CACI data) Terrain adj	
>57	45.2	46.1	+2.0	3.5	4.2	+20.0
>60	27.1	27.8	+2.6	1.4	1.3	-7.1
>63	15.8	16.5	+4.4	0.5	0.6	*
>66	8.8	9.2	+4.5	0.2	0.2	*
>69	4.6	4.8	+4.3	0.1	0.1	*
>72	2.4	2.5	+4.2	<0.1	<0.1	*

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

Despite a reduction in movements from 2002 to 2003, the areas within all the Leq contours increased slightly ranging from 2% at 57 dBA Leq to 4.2% at 72 dBA Leq**.** These increases in area are attributable, in part, to the change in fleet mix within noise class 3. Operations by B737-300, -400 and -500 aircraft types

[4] The 1990 to 2003 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.

[5] The population estimates shown in this Report are based on 1991 census data (updated by CACI Ltd in 1999) and 2001 census data (updated by CACI Ltd in 2002). Note also that area and population figures presented in this Report are cumulative.

(relatively noisy types) rose from 175.7 movements per day in 2002 to 246.1 movements per day in 2003 whilst operations by BAe 146 aircraft (a quieter type than the B737-300, -400, -500) decreased from 125.7 in 2002 to 42.0 in 2003 (see Table 1). 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. The population enclosed within the 57dBA Leq contour increased by 20%. This is mainly because the terrain adjusted 2003 57dBA Leq contour to the north east of the airport expanded slightly and encroached into Horley to a greater extent than it did in 2002.

3.1.3 The table below compares the areas enclosed by each of the 2003 contours for both terrain and non-terrain adjusted scenarios. It can be seen that the inclusion of the terrain adjustment in the 2003 Gatwick contours has had a slightly larger effect on the 63 to 69 dBA Leq contours. The "tips" of these particular contours have elongated slightly on the western side of the airport due to the relatively high ground around the Russ Hill area. The area within the 57 dBA Leq contour has increased slightly by 0.9% whilst the area within the 72 dBA Leq contour remained unchanged.

Leq LEVEL dBA	AREA SQ KM		PERCENTAGE CHANGE
	2003 ACTUAL Non-Terrain adj	2003 ACTUAL Terrain adj	
>57	45.7	46.1	+0.9
>60	27.3	27.8	+1.8
>63	16.0	16.5	+3.1
>66	8.9	9.2	+3.4
>69	4.7	4.8	+2.1
>72	2.5	2.5	0.0

3.1.4 The next table compares the populations enclosed by each of the 2003 terrain adjusted contours using the earlier 1991 census data (updated in 1999) and the latest 2001 census data (updated in 2002).

Leq LEVEL dBA	POPULATION (000's)		PERCENTAGE CHANGE
	2003 (Terrain adj) ACTUAL	2003 (Terrain adj) ACTUAL	
>57	4.1	4.2	+2.4
>60	1.3	1.3	0.0
>63	0.7	0.6	*
>66	0.3	0.2	*
>69	0.1	0.1	*
>72	<0.1	<0.1	*

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

The 2001 Census data (as updated by CACI in 2002) has barely affected the populations enclosed by each of the 2003 terrain adjusted contours.

3.2 'Standard' contours

3.2.1 In Figure 5 the standard terrain adjusted 2003 contours (57, 63 and 69 dBA Leq) are compared with the standard non-adjusted 2002 contours. These show what the noise exposures would have been if the 2002 and 2003 modal splits had mirrored the 20-year rolling average. The average modal split for the years 1984 to 2003 inclusive (used for the 2003 terrain adjusted standard contours) was 73% west - 27% east, the average modal split for the years 1983 to 2002 (used for the non adjusted 2002 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
	2002 STANDARD	2003 STANDARD Terrain adj		2002 STANDARD (1999CACI data)	2003 STANDARD (2002 CACI data) Terrain adj	
>57	45.1	46.0	+2.0	3.6	4.3	+19.4
>60	27.1	27.7	+2.2	1.4	1.4	0.0
>63	15.8	16.4	+3.8	0.5	0.6	*
>66	8.8	9.2	+4.5	0.2	0.2	*
>69	4.6	4.8	+4.3	0.1	0.1	*
>72	2.4	2.5	+4.2	<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 2003 terrain adjusted contours are all slightly higher than for the standardised non-adjusted 2002 contours. With the exception of the 57 dBA Leq contour, the populations within the 2003 contours are very similar to those for 2002. The population within the 57 dBA Leq contour increased by 19.4%; this is mainly because the "tip" of the 2003 standardised 57dBA Leq contour elongated slightly to the east of the airport and extended into Lingfield to a greater extent than in 2002.

3.2.2 Normally the standard contours 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. However, at Gatwick, the change in modal split between 2002 and 2003 has tended to be self-cancelling because both departure and arrival routes followed the same (or very similar) ground tracks.

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.

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.

[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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Development of an Improved Lateral Attenuation Adjustment
for the UK Aircraft Noise Contour Model, ANCON
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Noise Exposure Contours for Gatwick Airport 2002
ERCD Report 0302

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 2002	AVERAGE NUMBER 2003	PERCENTAGE OF TOTAL 2003 MOVEMENTS	CHANGE AS PERCENTAGE OF TOTAL 2002 MOVEMENTS
Small Props	1	0.6	0.2	0.0	-0.1
Large Props	2	43.5	30.7	4.6	-1.9
B717	3	1.7	1.5	0.2	0.0
B737-300,400,500	3	175.7	246.1	36.9	+10.5
B737-600,700	3	24.3	46.2	6.9	+3.3
B737-800,900	3	14.4	20.7	3.1	+0.9
B757E (RB211-535E4, E4B)	3	63.0	70.2	10.5	+1.1
B757P (Pratt and Whitney)	3	0.0	0.2	0.0	0.0
BAe146	3	125.7	42.0	6.3	-12.5
A319C (CFM-56)	3	3.7	3.0	0.4	-0.1
A319V (IAE-V2500)	3	0.2	0.1	0.0	0.0
A320C (CFM-56)	3	29.1	29.4	4.4	+0.0
A320V (IAE-V2500)	3	20.1	30.7	4.6	+1.6
A321C (CFM56)	3	6.6	6.9	1.0	+0.0
A321V (IAE-V2500)	3	6.2	13.1	2.0	+1.0
Business Jet (Ch 3)	3	3.3	2.4	0.4	-0.1
CRJ Canadair Regional Jet	3	10.7	5.9	0.9	-0.7
ERJ Embraer EMB 135/145	3	8.9	5.5	0.8	-0.5
F100	3	2.0	2.1	0.3	0.0
MD80	3	6.5	3.7	0.6	-0.4
B767-200	4	10.7	9.9	1.5	-0.1
B767-300G (General Electric)	4	15.7	15.6	2.3	0.0
B767-300P (Pratt and Whitney))	4	2.7	3.6	0.5	+0.1
B767-400	4	0.0	0.3	0.0	0.0
B777-200G (General Electric)	4	20.0	18.5	2.8	-0.2
B777-200R (Rolls Royce)	4	13.8	6.9	1.0	-1.0
B777-300R (Rolls Royce)	4	1.6	2.1	0.3	+0.1
A300	4	8.2	7.0	1.0	-0.2
A310	4	3.1	2.6	0.4	-0.1
A330	4	13.3	15.1	2.3	+0.3
B747-400G (General Electric)	5	8.2	7.1	1.1	-0.2
B747-400R (Rolls Royce)	5	0.2	0.0	0.0	0.0
A340	5	0.0	0.8	0.1	+0.1
MD11	5	4.7	0.0	0.0	-0.7
B747-200, -300 (Ch 3)	6	1.5	2.7	0.4	+0.2
DC10	6	9.0	6.9	1.0	-0.3
Tristar	6	0.5	0.8	0.1	0.0
B737-200 (Ch3)	7	9.4	5.1	0.8	-0.6
Business Jet (Ch 2)	7	0.1	0.0	0.0	0.0
B707, DC8*	8	0.3	0.0	0.0	0.0
B727 (Ch 3)	8	0.1	0.0	0.0	0.0
Tu154M*	8	2.0	1.9	0.3	0.0
TOTAL MOVEMENTS		671.3	667.5	100.0**	-0.6

* In 2002 and 2003 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 2002	PERCENTAGE OF TOTAL DEPARTURES 2003	CHANGE (% OF TOTAL)
LAM/CLN/BIG/DVR	34.5	30.6	-3.9
HAR/BOG	14.8	8.6	-6.2
KEN/SAM	21.2	22.4	+1.2
SFD	0.0	0.0	0.0
WIZ/TIG	0.5	0.4	-0.1
PERCENTAGE WEST	71.0	62.0	-9.0
EASTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES 2002	PERCENTAGE OF TOTAL DEPARTURES 2003	CHANGE (% OF TOTAL)
LAM	3.6	3.6	0.0
CLN/BIG/DVR	4.1	3.7	-0.4
KEN/SAM	10.1	14.7	+4.6
SFD	11.2	16.0	+4.8
PERCENTAGE EAST	29.0	38.0	+9.0

* See Figure 1.

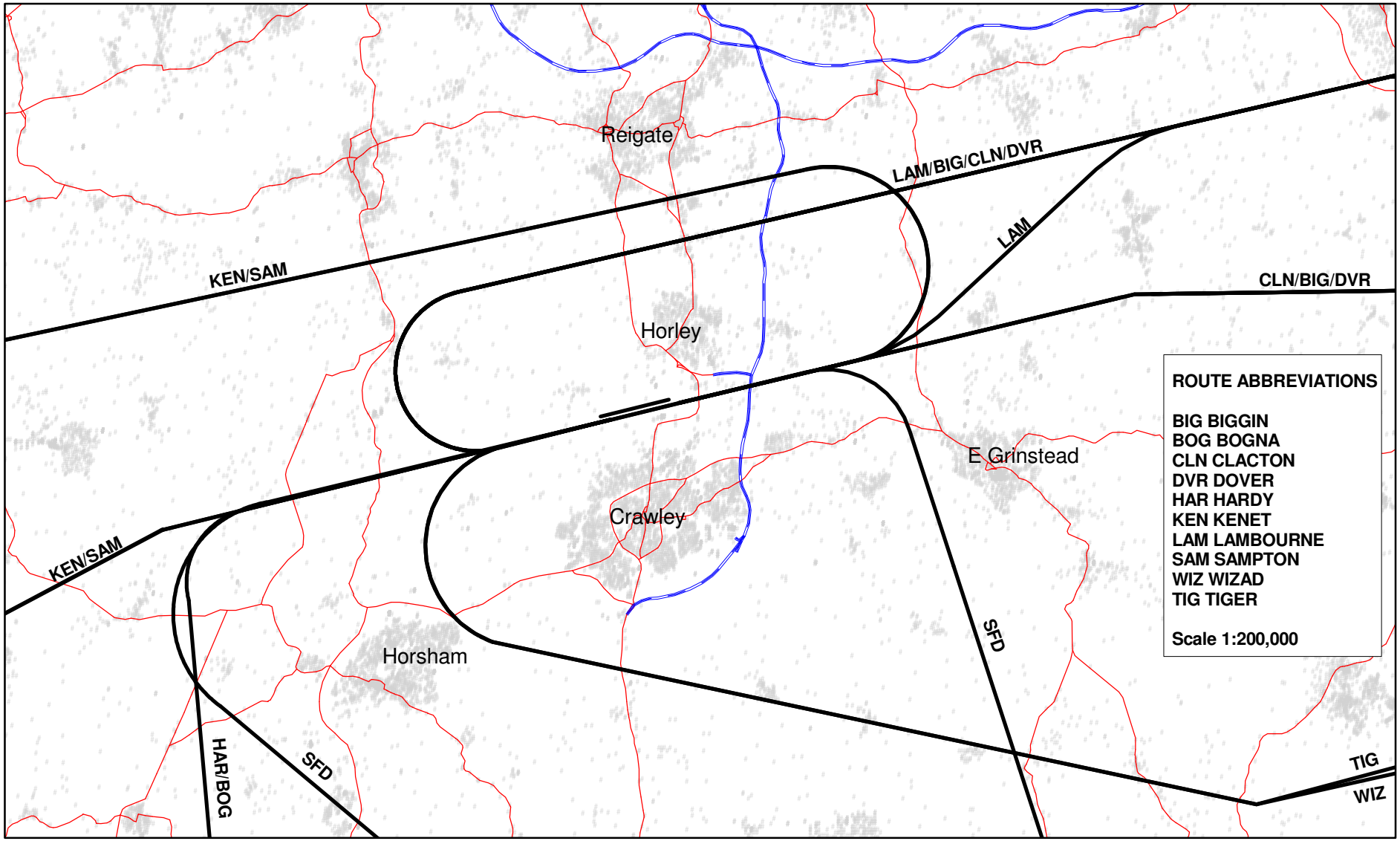

Figure 1: London Gatwick Airport Standard Instrument Departure Routes

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 - 2003

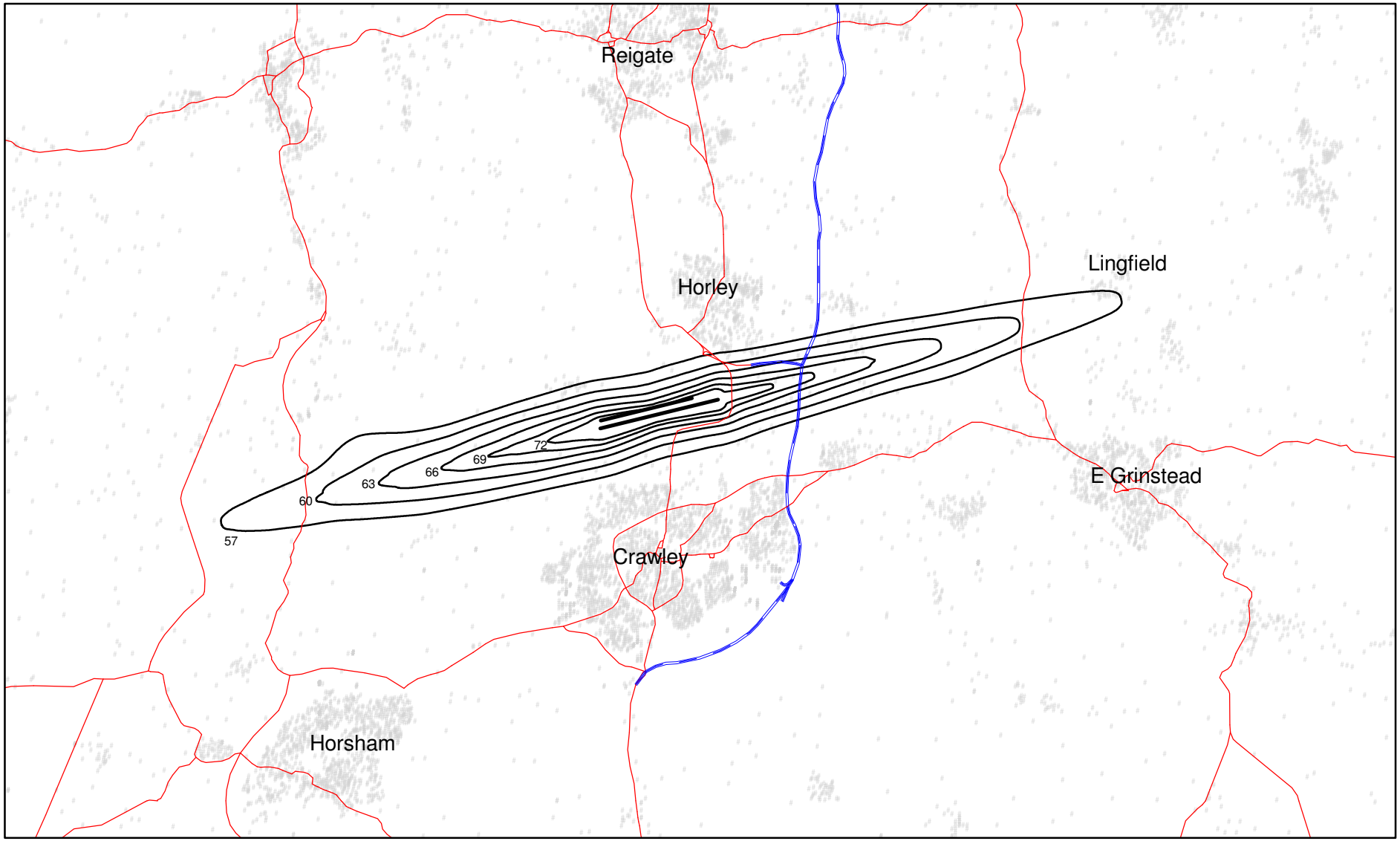

Figure 3: Gatwick actual 2003 average mode (62% west - 38% east) terrain adjusted 16hr Leq on population map

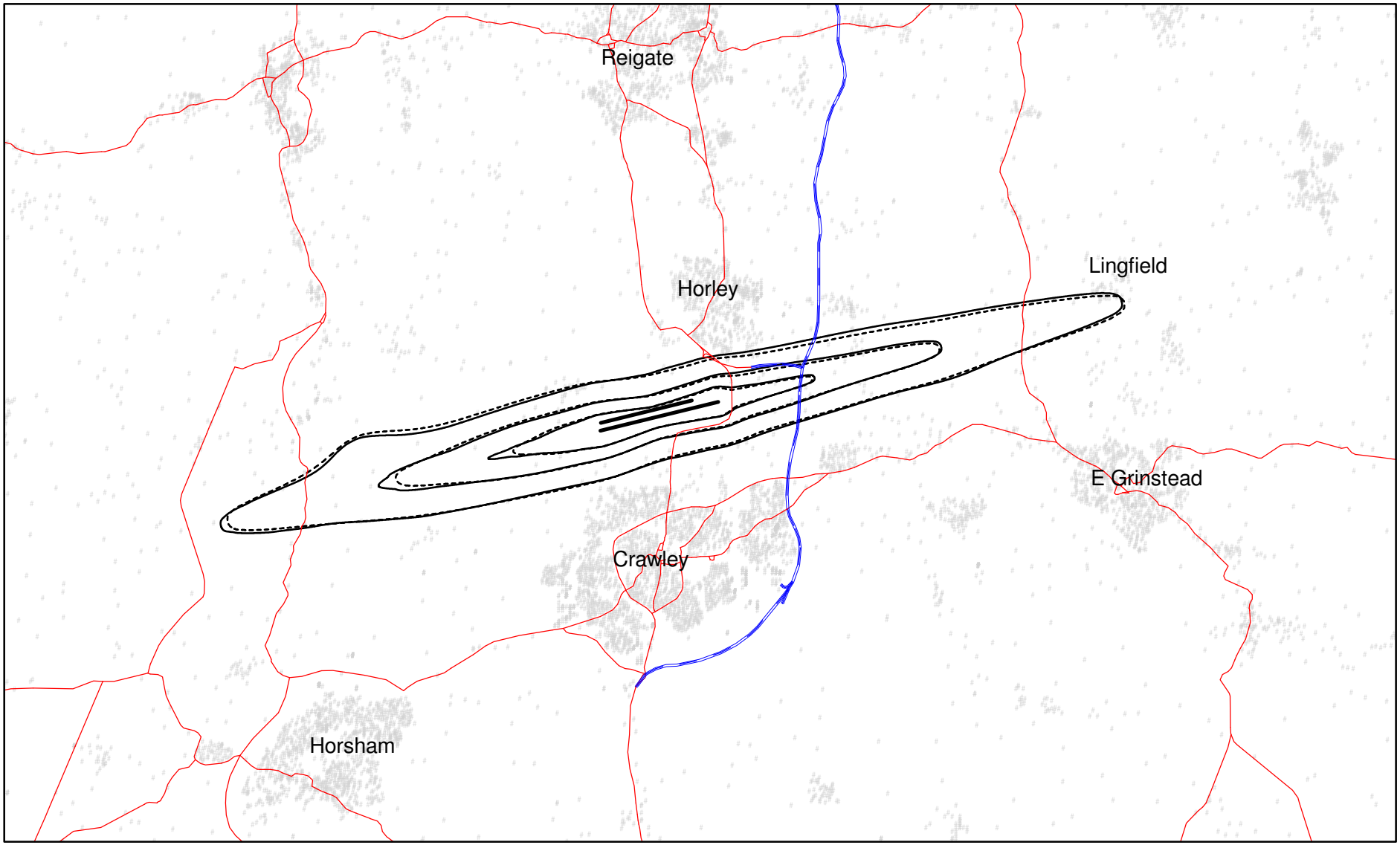

Figure 4: Gatwick actual 57, 63 and 69 Leq contours - 2002 dotted (71% west - 29% east) - 2003 solid (62% west - 38% east) (2003 contours include terrain adjustment)

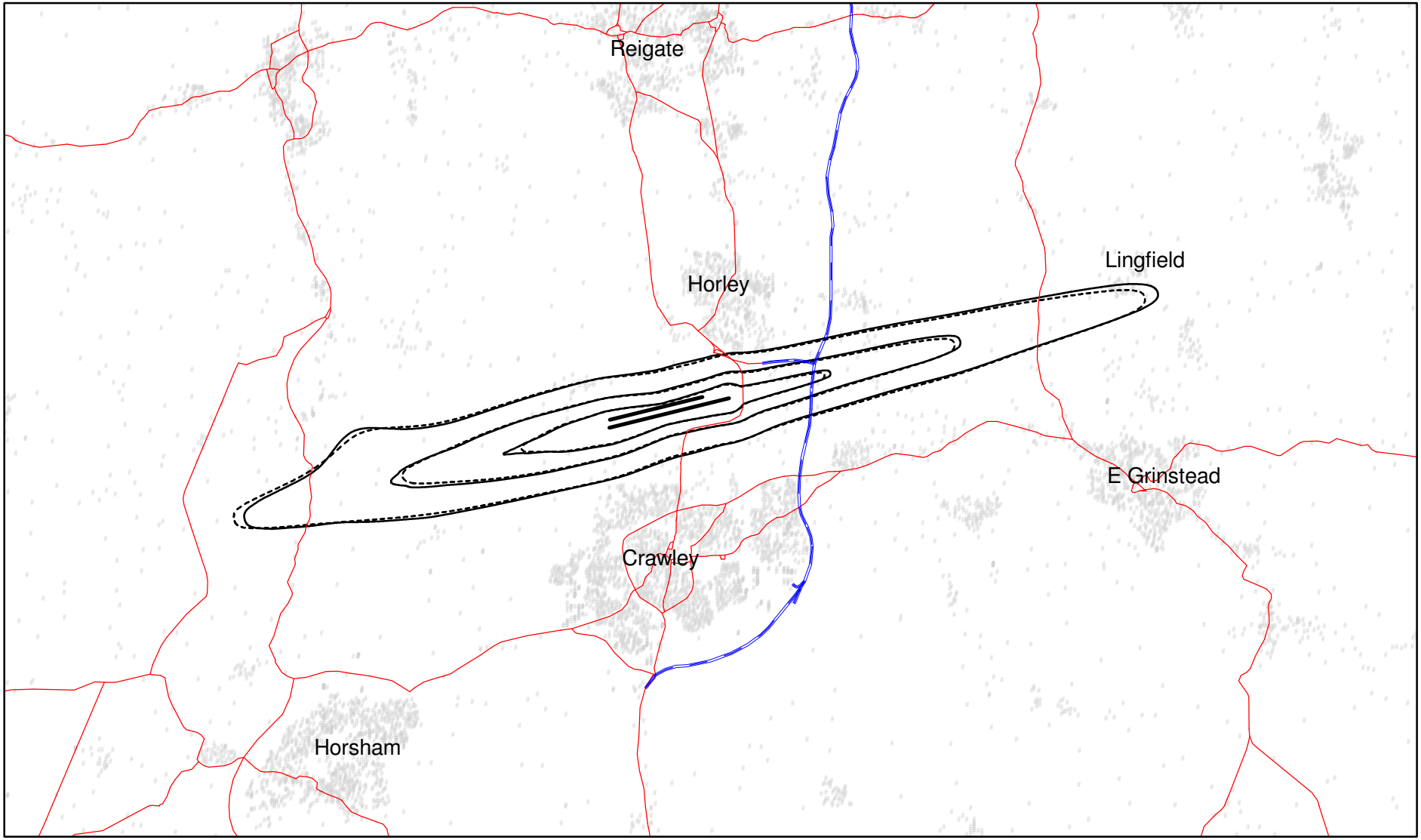

Figure 5: Gatwick standard 57, 63 and 69 Leq contours - 2002 dotted (73% west - 27% east) - 2003 solid (73% west - 27% east) (2003 contours include terrain adjustment)

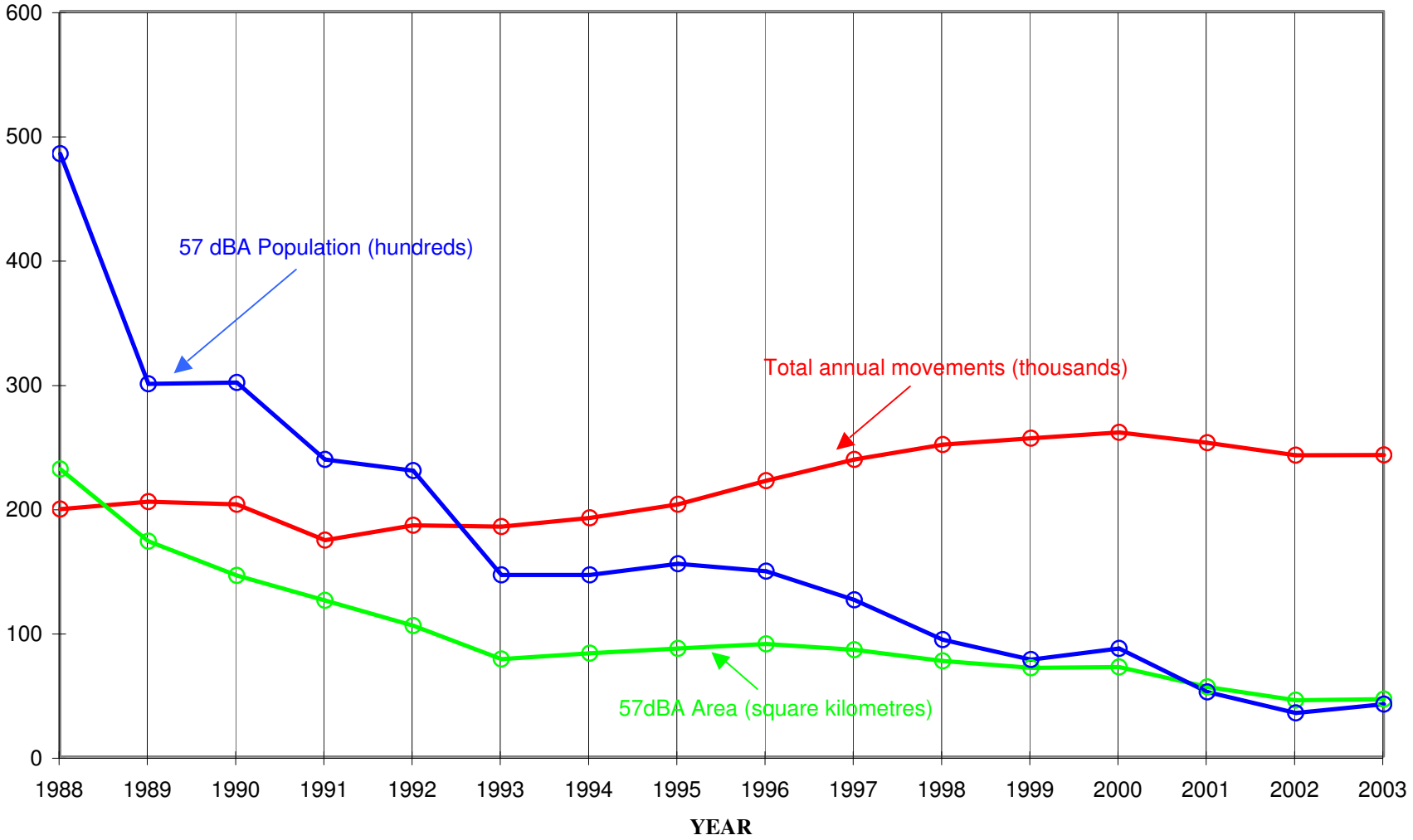

Figure 6: Gatwick traffic and noise 1988 - 2003