ERCD REPORT 0901

Noise Exposure Contours for Heathrow Airport 2008

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Summary

This report presents the year 2008 noise exposure contours for London Heathrow Airport. The 57 dBA contour area based on the actual runway modal split was calculated to be 123.1 km², an increase of 2.9% from 2007. Populations enclosed within the actual 57 dBA contour increased by 6.6% compared to 2007.

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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.

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Glossary

**AIP**
Aeronautical Information Publication.

**ANCON**
The UK civil aircraft noise contour model, developed and maintained by ERCD.

**ATC**
Air Traffic Control.

**CAA**
Civil Aviation Authority – the UK’s independent specialist aviation regulator.

**dB**
Decibel units describing sound level or changes of sound level.

**dBA**
Units of sound level on the A-weighted scale, which incorporates a frequency weighting approximating the characteristics of human hearing.

**DfT**
Department for Transport (UK Government).

**ERCD**
Environmental Research and Consultancy Department of the Civil Aviation Authority.

**ISO**
International Organization for Standardization.

**Leq**
Equivalent sound level of aircraft noise in dBA, often called ‘equivalent continuous sound level’. For conventional historical contours this is based on the daily average movements that take place within the 16-hour period (0700-2300 local time) over the 92-day summer period from 16 June to 15 September inclusive.

**NPD**
Noise-Power-Distance.

**NPR**
Noise Preferential Route.

**NTK**
Noise and Track Keeping monitoring system. The NTK system associates radar data from air traffic control radar with related data from both fixed (permanent) and mobile noise monitors at prescribed positions on the ground.

**OS**
Ordnance Survey®, Great Britain’s national mapping agency.

**SEL**
The Sound Exposure Level generated by a single aircraft at the measurement point, measured in dBA. This metric accounts for the duration of the sound as well as its intensity.

**SID**
Standard Instrument Departure.
Executive Summary

This report presents noise exposure contours generated for Heathrow Airport for the year 2008. The noise modelling used radar and noise data from the Heathrow Noise and Track Keeping System. Mean flight tracks and dispersions for each route, and average flight profiles of aircraft height, speed and thrust for each aircraft type, were calculated.

Average summer daily traffic movements increased by 0.5% compared to 2007. The results show that the area of the 'actual' modal split (86% west / 14% east) 57 dBA contour increased by 2.9% to 123.1 km² in 2008. This can be attributed primarily to the adjustment in the predicted departure noise level values used in modelling – as part of the continuous review of the noise database - of the noise dominant ANCON type (see Table 2) at Heathrow, the B744R, by about 1 dB at distances greater than 14 kilometres from start-of-roll (see paragraphs 2.5.3 – 2.5.4); and also, the use of a zero 'run-speed threshold' (to improve modelling accuracy) as explained in section 2.10. The population count within the 2008 actual 57 dBA contour increased by 6.6%.

Similarly, the area of the 2008 'standard' modal split (76% west / 24% east) 57 dBA contour increased by 3.4% to 120.2 km² and the corresponding population count also increased, by 5.1%.
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1 Introduction

1.1 Background

1.1.1 Each year the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority (CAA) calculates the noise exposure around London Heathrow Airport on behalf of the Department for Transport (DfT). A computer model, ANCON, validated with noise measurements, is used to estimate the noise exposure. The model calculates the emission and propagation of noise from arriving and departing air traffic.

1.1.2 The noise exposure metric used is the Equivalent Continuous Sound Level, or Leq 16-hour (0700-2300 local time), which is calculated over the 92-day summer period from 16 June to 15 September. The background to the use of this index is explained in DORA Report 9023 (Ref 1).

1.1.3 Noise exposure is depicted in the form of noise contours, i.e. lines joining places of constant Leq, akin to the height contours shown on geographical maps or isobars on a weather chart. In the UK, Leq noise contours are normally plotted at levels from 57 to 72 dBA, in 3 dB steps. The 57 dBA level denotes the approximate onset of significant community annoyance.

1.1.4 This report contains small-scale diagrams of the year 2008 Heathrow Leq contours overlaid onto Ordnance Survey® (OS) base maps. Diagrams in Adobe® PDF and AutoCAD DXF format are also available for download from the DfT website1. Additionally, printed contours overlaid on OS maps to scale 1:50,000 are available for purchase from:

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1.1.5 The objectives of this report are to explain the noise modelling methodology used to produce the year 2008 Leq contours for Heathrow Airport, to present the calculated noise contours and to assess the changes to the contours relative to the previous year (Ref 2).

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1 www.dft.gov.uk
1.2 **Heathrow Airport**

1.2.1 Heathrow Airport is situated approximately 13 miles (21 kilometres) west of the city of London. It is surrounded by suburban housing, business premises and mixed-use open land to the north and south, suburban housing and business premises to the east, and three large reservoirs, mixed-use open land, housing and business premises to the west (*Figure 1*).

1.2.2 Heathrow Airport has two runways: Runway 09L/27R to the north, which is 3,901 metres long, and Runway 09R/27L to the south, which is 3,660 metres long. The landing threshold for Runway 09L is displaced by 306 metres. The landing threshold for Runway 09R is also displaced, by 307 metres. There are five passenger terminals. The layout of the runways, taxiways and passenger terminals is shown in *Figure 2*.²

1.2.3 In the 2008 calendar year, there were 478,700³ aircraft movements at Heathrow, handling approximately 67.1 million passengers⁴.

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² UK AIP (5 Jun 08) AD 2- EGLL
³ To the nearest hundred.
⁴ Source: CAA Economic Regulation Group statistics, www.caa.co.uk
2 Noise contour modelling methodology

2.1 ANCON noise model

2.1.1 Leq noise contours were calculated with the UK civil aircraft noise model ANCON (version 2.3), which is developed and maintained by ERCD on behalf of the DfT. A technical description of ANCON is provided in DORA Report 9120 (Ref 3) and R&D Report 9842 (Ref 4), both of which are available from the CAA website\(^5\). The ANCON model is also used for the production of annual contours for Gatwick and Stansted airports, and a number of regional airports in the UK.

2.1.2 ANCON is fully compliant with the latest European guidance on noise modelling, ECAC CEAC Doc 29 (3rd edition), published in December 2005 (Ref 5). This guidance document represents internationally agreed best practice as implemented in modern aircraft noise models.

2.2 Radar data

2.2.1 The noise modelling carried out by ERCD made extensive use of radar data extracted from Heathrow Airport's Noise and Track Keeping (NTK) system. Most large airports have NTK systems, which take data from Air Traffic Control (ATC) radars and combine them with flight information such as callsign, tail number, type and destination. Analyses of departure and arrival flight tracks, and flight profiles, were based on Heathrow 2008 summer radar data.

2.3 Flight tracks

2.3.1 Aircraft departing Heathrow are required to follow specific flight paths called Noise Preferential Routes (NPRs) unless directed otherwise by ATC. NPRs were designed to avoid the overflight of built-up areas where possible. They lead from the take-off runway to the main UK air traffic routes and form the first part of the Standard Instrument Departure routes (SIDs). The Heathrow SIDs are indicated in Figure 3.

2.3.2 Associated with each NPR is a lateral swathe, which is defined by a pair of lines that diverge at 10 degrees from a point 2,000 metres from start-of-roll, leading to a corridor extending 1.5 kilometres either side of the nominal NPR centreline. Within this swathe the aircraft are considered to be flying on-track. The swathe takes account of various factors that affect track-keeping, including tolerances in

\(^{5}\) www.caa.co.uk
navigational equipment, type and weight of aircraft, and weather conditions – particularly winds that may cause drifting when aircraft are turning. Aircraft reaching an altitude of 4,000 feet at any point along an NPR may be turned off the route by ATC onto more direct headings to their destinations – a practice known as ‘vectoring’. ATC may also vector aircraft from NPRs below this altitude for safety reasons, including in certain weather conditions (for example, to avoid storms).

2.3.3 Departure and arrival flight tracks were modelled using radar data extracted from the Heathrow NTK system for the 92-day summer period, 16 June to 15 September 2008. ERCD used in-house radar analysis software to calculate mean departure flight tracks and associated lateral dispersions for each NPR/SID. As in the previous two years, there were insufficient departures from Runway 09L in 2008 to define statistically adequate tracks and dispersions, so the Runway 09L mean departure tracks/dispersions from 2005 were used for modelling. Arrival tracks for Runways 27L, 27R, 09L and 09R were modelled using evenly spaced ‘spurs’ about the extended runway centrelines. The majority of arriving aircraft joined the centrelines at distances between 14 and 35 kilometres from threshold when in westerly mode, and at distances between 12 and 30 kilometres in easterly mode.

2.4 Flight profiles

2.4.1 For each ANCON aircraft type, average flight profiles of height, speed and thrust versus track distance (for departures and arrivals separately) were reviewed and updated where necessary, using 2008 summer radar data. The engine power settings required for the aircraft to follow the average height and speed profiles were calculated from data describing aircraft performance characteristics within each of the different aircraft type categories.

2.4.2 The application of reverse thrust following touchdown was modelled for all types where applicable.

2.5 Noise emissions

2.5.1 At Heathrow the NTK system captures data from both fixed and mobile noise monitors around the airport, which are then matched to operational data. The Heathrow NTK system comprises ten fixed monitors (positioned approximately 6.5 kilometres from start-of-roll), together with a number of mobile monitors that are shared amongst the three designated London Airports and the CAA. These can be deployed anywhere within the NTK radar coverage area.

2.5.2 The noise data collected are screened by ERCD with reference to several criteria so that only high quality data are used in the analysis. First of all, noise data that
lie outside a ‘weather window’ as specified by an ISO standard\textsuperscript{6} are discarded. This ensures that the data used are not affected by adverse meteorological conditions such as precipitation and strong winds. Secondly, the maximum noise level of the aircraft event must exceed the noise monitor threshold by at least 10 dB to avoid underestimates of the Sound Exposure Level (SEL)\textsuperscript{7}. Thirdly, only measurements obtained from aircraft events that pass through a 60-degree inverted cone, centred at the noise monitor, are retained in order to minimise the effects of lateral attenuation\textsuperscript{8} and lateral directivity\textsuperscript{9}.

2.5.3 Noise event levels are determined from a noise database expressing SEL as a function of engine power setting and slant distance to the receiver – the so-called ‘Noise-Power-Distance’ (NPD) relationship. The ANCON noise database is continuously reviewed and updated with adjustments made when, and where, measurements show this to be necessary. Further information on the validation of the ANCON noise model can be found on the ERCD website\textsuperscript{10}.

2.5.4 The most notable update to the noise database concerns the noise dominant ANCON type at Heathrow, the B744R. In the light of extensive noise measurements undertaken in 2008, departure noise levels for the B744R have been increased by about 1 dB at distances greater than 14 kilometres from start-of-roll. A similar adjustment was also made to the B744P ANCON type at distances greater than 15 kilometres from start-of-roll.

2.5.5 For 2008, two new aircraft types, the Airbus A380 and Bombardier Regional Jet 900, were added to the Heathrow noise database.

2.6 Traffic distributions

2.6.1 The Leq contours are based on the daily average movements that take place during the 16-hour day (0700-2300 local time) over the 92-day period from 16 June to 15 September inclusive. The source of this information is the NTK system, which comprises radar data supplemented by daily flight plans. Traffic statistics from NTK data were crosschecked with runway logs supplied by NATS\textsuperscript{11} and very close agreement was found.

\textsuperscript{6} ISO 3891:1978 Acoustics – Procedure for Describing Aircraft Noise Heard on the Ground
\textsuperscript{7} The Sound Exposure Level of an aircraft noise event is the steady noise level, which over a period of one second contains the same sound energy as the whole event. It is equivalent to the Leq of the noise event normalised to one second.
\textsuperscript{8} Lateral attenuation is the excess sound attenuation caused by the ground surface, which can be significant at low angles of elevation.
\textsuperscript{9} Lateral directivity is the non-uniform directionality of sound radiated laterally about the roll axis of the aircraft – this is influenced to a large extent by the positioning of the engines.
\textsuperscript{10} http://www.caa.co.uk/docs/68/Valid_ANCON.pdf
\textsuperscript{11} NATS is the provider of air traffic control services to Heathrow Airport.
Traffic distribution by noise class

2.6.2 Table 1 lists the average summer day movements\(^{12}\) by eight noise classes of aircraft, ranked in ascending order of noise emission, i.e. from least to most noisy, in 2007 and 2008. It can be seen that short-haul ‘Chapter 3’\(^{13}\) jet aircraft (Noise Class 3) formed the highest proportion of movements (65%) in 2008. Relative to 2007, their number fell by 16 movements per day, a 2% decrease. In contrast, the number of wide-body twin-engined aircraft (Noise Class 4) increased by 27 movements per day (+11%). The 2008 daily total movement rate for all aircraft types over the summer period was 0.5% higher than in 2007.

2.6.3 Figure 4 illustrates the changing distribution of traffic among the eight noise classes over the period 1984 to 2008 inclusive.

Traffic distribution by ANCON aircraft type

2.6.4 A more detailed breakdown of the 2008 average summer day movements, indicating the ANCON types that fall into each noise class, is provided in Table 2. Within Noise Class 3, there were reductions in movements of types such as the B733, EA319C and EA320C; these were offset by increases in the numbers of EA320V and EA321V aircraft. It may be seen that the increase in the proportion of aircraft in Noise Class 4 was due mainly to the higher movement rates of the B763P, B772G, B773G and EA33 types.

2.6.5 Figure 5 illustrates the frequency of movements by ANCON aircraft type for the average summer day. It may be seen that the EA319V was the most frequent ANCON aircraft type at Heathrow, with 214 movements per day. Other types in the Airbus family such as the EA320C, EA320V, EA321C and EA321V were also among the most frequent aircraft. There were, on average, 74 daily movements of the noise dominant ANCON type, B744R. The B744R was the noise dominant ANCON type at Heathrow because it was responsible for the highest contribution of ‘noise energy’, a function of both aircraft noise level and number of movements.

Traffic distribution by SID route

2.6.6 Figure 6 shows the distribution of aircraft departures by SID route for 2008. The percentage loadings on the SIDs were similar to 2007, with the westerly WOB/BPK SIDs taking the highest proportion of traffic over the summer period (38%), followed by the westerly DVR/DET SIDs (22%).

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\(^{12}\) Includes departures and arrivals.

\(^{13}\) Aircraft whose certificated noise levels are classified by the ICAO Standards and Recommended Practices – Aircraft Noise: Annex 16 to the Convention on International Civil Aviation into ‘Chapter 3’ types - these are typically characterised by modern, quieter, high-bypass turbofan aircraft.
2.7 Runway modal splits

2.7.1 In general, aircraft will take-off and land into a headwind to maximise lift during take-off and maximise deceleration upon landing. The wind direction, which varies over the course of a year, will therefore have an important influence on the usage of runways. The ratio of westerly (27L/27R) and easterly (09L/09R) operations is referred to as the runway modal split.

2.7.2 To remove the effect of year-on-year weather fluctuations on aircraft operations and to clarify underlying trends, two sets of contours for 2008 have been produced:

(i) Contours using the ‘actual’ modal split over the Leq period; and

(ii) Contours assuming the ‘standard’ modal split over the Leq period, i.e. the long-term modal split calculated from the 20-year rolling average; for 2008, this is the 20-year period from 1989 to 2008. Use of the standard modal split enables year-on-year comparison of contours without the runway usage affecting the contour shape.

2.7.3 The actual and standard modal splits for 2008, together with the previous year, are summarised in the following table:

<table>
<thead>
<tr>
<th>Modal split scenario</th>
<th>% west (Runway 27L/27R)</th>
<th>% east (Runway 09L/09R)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual 2008</td>
<td>86%</td>
<td>14%</td>
</tr>
<tr>
<td>Actual 2007</td>
<td>87%</td>
<td>13%</td>
</tr>
<tr>
<td>Standard 2008</td>
<td>76%</td>
<td>24%</td>
</tr>
<tr>
<td>Standard 2007</td>
<td>76%</td>
<td>24%</td>
</tr>
</tbody>
</table>

2.7.4 It can be seen that the 2008 actual modal split was similar to that for 2007. The standardised modal splits for 2007 and 2008 were identical. Historical runway modal splits at Heathrow for the past 20 years are illustrated in Figure 7.

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14 It should be noted that at Heathrow, a ‘westerly preference’ for aircraft operations is employed, which means that the airport will operate in westerly mode even if there is a light tailwind. This is done to reduce the use of easterly SIDs which tend to overfly more populated areas compared to the westerly SIDs.
2.8 Topography

2.8.1 The topography around Heathrow Airport was modelled by accounting for terrain height. 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.

2.8.2 ERCD holds OS terrain height data\(^{15}\) on a 200-metre by 200-metre grid for the whole of England. Interpolation was performed to generate height data at each of the calculation points on the receiver grid used by the ANCON noise model.

2.9 Population database

2.9.1 ERCD estimated the numbers of people enclosed within the noise contours that were produced. The population data used in this report are a 2008 update of the 2001 Census supplied by CACI Limited\(^{16}\). The CACI population database contains data referenced at the postcode level. Population numbers associated with each postcode are assigned to a single co-ordinate located at the postcode’s centroid.

2.10 Modelling improvements

2.10.1 The ANCON model allows for a ‘run-speed threshold’ to be set for each modelling run. This feature is used to eliminate time-consuming calculations for flight path segments that have little contribution to the noise exposure at a given location. The threshold chosen is generally a compromise between achieving manageable run times and retaining modelling accuracy.

2.10.2 Whilst the time-savings from setting an appropriate threshold can be substantial (especially where complex modelling scenarios are involved), with today’s high-performance computers, lower thresholds can be realistically set. For the 2008 contours, the calculations have been carried out for the first time with the run-speed threshold set to zero, thus the noise contributions from all flight segments have been included. This will help to improve the accuracy of the contours produced, especially at lower contour levels.

\(^{15}\) Meridian™ 2

\(^{16}\) www.caci.co.uk
3 Noise contour results

3.1 Actual modal split contours

3.1.1 The Heathrow 2008 Leq noise contours generated with the actual 2008 summer period modal split (86% west / 14% east) are shown in Figure 8. The contours are plotted from 57 to 72 dBA at 3 dB intervals.

3.1.2 The cumulative areas and populations within the actual modal split contours are listed in the table below:

Heathrow 2008 actual modal split contour areas and populations

<table>
<thead>
<tr>
<th>Leq contour level (dBA)</th>
<th>Area (km²)</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 57</td>
<td>123.1</td>
<td>268,450</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>66.2</td>
<td>103,650</td>
</tr>
<tr>
<td>&gt; 63</td>
<td>37.7</td>
<td>47,100</td>
</tr>
<tr>
<td>&gt; 66</td>
<td>22.8</td>
<td>15,950</td>
</tr>
<tr>
<td>&gt; 69</td>
<td>11.8</td>
<td>3,900</td>
</tr>
<tr>
<td>&gt; 72</td>
<td>6.1</td>
<td>650</td>
</tr>
</tbody>
</table>

Note: Areas are given to the nearest 0.1 km² and populations to the nearest 50.

3.2 Standard modal split contours

3.2.1 The Heathrow 2008 Leq noise contours generated with the standard 2008 summer period modal split (76% west / 24% east) are shown in Figure 9. The contours are plotted from 57 to 72 dBA at 3 dB intervals.

3.2.2 The cumulative areas and populations within the standard modal split contours are listed in the table below:

Heathrow 2008 standard modal split contour areas and populations

<table>
<thead>
<tr>
<th>Leq contour level (dBA)</th>
<th>Area (km²)</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 57</td>
<td>120.2</td>
<td>264,550</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>64.2</td>
<td>105,750</td>
</tr>
<tr>
<td>&gt; 63</td>
<td>38.0</td>
<td>50,100</td>
</tr>
<tr>
<td>&gt; 66</td>
<td>22.8</td>
<td>15,300</td>
</tr>
<tr>
<td>&gt; 69</td>
<td>11.4</td>
<td>3,500</td>
</tr>
<tr>
<td>&gt; 72</td>
<td>6.0</td>
<td>400</td>
</tr>
</tbody>
</table>

Note: Areas are given to the nearest 0.1 km² and populations to the nearest 50.
4 Analysis of results

4.1 Actual modal split contours – comparison with 2007 contours

4.1.1 The Heathrow 2008 actual modal split Leq contours are compared against the 2007 actual Leq contours in Figure 10 at levels 57, 63 and 69 dBA (the other levels have been omitted for clarity). The table below summarises the areas, populations and percentage changes from 2007 to 2008 for all contour levels:

Heathrow actual modal split contour areas and populations for 2007 and 2008

<table>
<thead>
<tr>
<th>Leq contour level (dBA)</th>
<th>2007 Area (km²)</th>
<th>2008 Area (km²)</th>
<th>2007 Population</th>
<th>2008 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 57</td>
<td>119.6</td>
<td>123.1 (+2.9%)</td>
<td>251,900</td>
<td>268,450 (+6.6%)</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>65.3</td>
<td>66.2 (+1.4%)</td>
<td>100,400</td>
<td>103,650 (+3.2%)</td>
</tr>
<tr>
<td>&gt; 63</td>
<td>37.6</td>
<td>37.7 (+0.3%)</td>
<td>45,100</td>
<td>47,100 (+4.4%)</td>
</tr>
<tr>
<td>&gt; 66</td>
<td>23.1</td>
<td>22.8 (-1.3%)</td>
<td>16,150</td>
<td>15,950 (-1.2%)</td>
</tr>
<tr>
<td>&gt; 69</td>
<td>12.2</td>
<td>11.8 (-3.3%)</td>
<td>3,650</td>
<td>3,900 (+6.8%)</td>
</tr>
<tr>
<td>&gt; 72</td>
<td>6.4</td>
<td>6.1 (-4.7%)</td>
<td>700</td>
<td>650 (-7.1%)</td>
</tr>
</tbody>
</table>

Note: 2007 actual modal split was 87% W / 13% E; 2008 actual modal split was 86% W / 14% E.

4.1.2 Relative to 2007, the areas of the 57, 60 and 63 dBA contours increased, by up to 3%. This is largely due to: (a) the adjustment of the B744R departure noise levels in 2008 at distances greater than 14 km from start-of-roll (see paragraph 2.5.4) and (b) the use of a zero ‘run-speed threshold’ (see section 2.10).

4.1.3 Increases in the 2008 population counts may also be seen at the 57, 60 and 63 and 69 dBA contour levels. It should be noted that percentage changes in contour areas are not necessarily accompanied by similar changes in enclosed population because populations are unevenly distributed around the airport.

4.1.4 The 2008 actual modal split (86% west / 14% east) was similar to that for 2007 (87% west / 13% east), thus the modal split does not have a large effect on the contour shapes in 2008 when compared with the 2007 actual contours.

4.1.5 Figure 10 shows that the 57 dBA contour lobe associated with departures on the 27L/27R WOB/BPK SIDs has extended in 2008; this may be explained by the fact that there were approximately 11% more movements by the B747-400 fleet (the noise dominant aircraft at Heathrow) on these SIDs in 2008. Also, as mentioned previously, the B744R and B744P have had their noise levels increased by about 1 dB at distances greater than about 14-15 kilometres from start-of-roll.

4.1.6 It can be seen that the 57 dBA contour lobe associated with easterly BUZ/BPK departures has extended in 2008. Examination of the movements by the B747-400 fleet reveals that they increased by 25% in 2008 along these routes.
4.1.7 There is a southward shift to the 57 dBA contour tip associated with arrivals to Runways 27L/27R. This is a consequence of the higher proportion of arrivals to Runway 27L in 2008. In 2007, 52% of arrivals used Runway 27R and 48% used Runway 27L, whereas in 2008, 48% used Runway 27R and 52% used Runway 27L.

4.2 Standard modal split contours – comparison with 2007 contours

4.2.1 The Heathrow 2008 standard modal split Leq contours are compared against the 2007 standard Leq contours in Figure 11 at levels 57, 63 and 69 dBA (the other levels have been omitted for clarity). The table below summarises the areas, populations and percentage changes from 2007 to 2008 for all contour levels:

<table>
<thead>
<tr>
<th>Leq contour level (dBA)</th>
<th>2007 Area (km²)</th>
<th>2008 Area (km²)</th>
<th>2007 Population</th>
<th>2008 Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 57</td>
<td>116.3</td>
<td>120.2 (+3.4%)</td>
<td>251,600</td>
<td>264,550 (+5.1%)</td>
</tr>
<tr>
<td>&gt; 60</td>
<td>63.3</td>
<td>64.2 (+1.4%)</td>
<td>103,850</td>
<td>105,750 (+1.8%)</td>
</tr>
<tr>
<td>&gt; 63</td>
<td>37.9</td>
<td>38.0 (+0.3%)</td>
<td>47,100</td>
<td>50,100 (+6.4%)</td>
</tr>
<tr>
<td>&gt; 66</td>
<td>23.0</td>
<td>22.8 (-0.9%)</td>
<td>15,100</td>
<td>15,300 (+1.3%)</td>
</tr>
<tr>
<td>&gt; 69</td>
<td>11.9</td>
<td>11.4 (-4.2%)</td>
<td>3,500</td>
<td>3,500 (0.0%)</td>
</tr>
<tr>
<td>&gt; 72</td>
<td>6.3</td>
<td>6.0 (-4.8%)</td>
<td>550</td>
<td>400 (-27.3%)</td>
</tr>
</tbody>
</table>

Note: 2007 and 2008 standard modal splits were both 76% W / 24% E.

4.2.2 Relative to 2007, the areas of the 57, 60 and 63 dBA contours have increased. The populations enclosed within these contour levels have also increased.

4.2.3 The standard contours normally provide a clearer indication than the actual contours of ‘fleet noise level’ changes from year to year because they minimise the effect of any difference between the ratios of westerly to easterly operations. For 2008, the actual modal split was similar to 2007, thus the changes in standard contour shapes from 2007 to 2008 are in line with the results for the actual contours. The earlier comments on changes in actual contour shapes in paragraphs 4.1.4 to 4.1.7 are therefore also applicable to the standard contours.

4.2.4 However, it can be seen from the above results for the actual and standard contours that the modal split can affect the area enclosed by the contours. At 57 dBA Leq the actual 2008 contour (modal split 86% west / 14% east) encloses an area of 123.1 km², whereas the 57 dBA Leq standard 2008 contour (modal split 76% west / 24% east) has an area some 2.9 km² less at 120.2 km².
4.3 Noise contours trend

4.3.1 Figure 12 shows how the 57 dBA actual modal split contour has changed in area and population terms since 1988 by comparison with the total annual aircraft movements. (Actual modal split data are used in this figure because standard modal split contours were not produced prior to 1995).

Areas & populations

4.3.2 The contour area figures give a better indication of the actual noise than the population figures because the latter are more susceptible to the runway modal split. 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). Also, percentage changes in contour areas are not necessarily accompanied by similar changes in enclosed population because the contours may be different in shape as well as size, and movement of contour lines from year to year, especially in or around relatively highly populated areas, can cause a disproportionate change in enclosed population. The recorded increase in enclosed population between 1998 and 1999 reflected demographic changes that occurred between the 1991 census and the subsequent update.

4.3.3 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 after the crash at Paris, 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.

4.3.4 Since 2004, the 57 dBA contour area at Heathrow has been relatively steady, in the range from 117 to 123 km².

Movements

4.3.5 Against the trend of a general decrease in contour area, the number of aircraft movements has risen steadily most years, the only major trough occurring in 1991, the year of the First Gulf War. The annual movement figure for 2001 was slightly lower than the preceding year and reflected the disruption to traffic following the terrorist attacks on 11 September 2001. The total annual movement figure for 2005 was 2% higher than that for 2004 compared with the 1% decrease for the 16-hour average summer Leq day. Movements during the summer 2005 period were affected by three days of industrial action in August and possibly by the terrorist attacks in central London on 7 July 2005. A separate analysis showed that total movements in July and August of 2005 were less than those for the same months in 2004.

4.3.6 The total annual movements in 2006 were 0.2% lower than in 2005. Traffic levels during the summer 2006 Leq period were affected by new tighter security
restrictions, which were introduced in mid-August 2006. Flights at Heathrow were also disrupted in December 2006 by heavy fog.

4.3.7 Annual traffic levels rose by 1% in 2007, but have since fallen in 2008 by 0.6% – this may be attributed to the economic downturn and fluctuating oil price. (Note: over the summer period only, traffic levels increased by 0.5%).
5 Conclusions

5.1 Year 2008 average summer 16-hour day Leq noise exposure contours have been generated for Heathrow Airport using the ANCON noise model.

5.2 The results indicate that the actual modal split 57 dBA contour area increased from 119.6 km² in 2007 to 123.1 km² in 2008. This 2.9% increase in area can be attributed primarily to the increase in departure noise levels of the B744R ANCON type at distances greater than 14 kilometres from start-of-roll, and also the use of a zero ‘run-speed threshold’ (to improve modelling accuracy). The population count within the 2008 actual 57 dBA contour increased by 6.6%.

5.3 The standard modal split 57 dBA contour area also increased, from 116.3 km² in 2007 to 120.2 km² in 2008, a change of 3.4%. The population count within the 2008 standard 57 dBA contour increased by 5.1%.
References

1. Critchley J B, Ollerhead J B
   *The Use of Leq as an Aircraft Noise Index*
   DORA Report 9023, September 1990

   *Noise Exposure Contours for Heathrow Airport 2007*
   ERCD Report 0801, July 2008

3. Ollerhead J B
   *The CAA Aircraft Noise Contour Model: ANCON Version 1*
   DORA Report 9120, November 1992

   *The UK Civil Aircraft Noise Contour Model ANCON: Improvements in Version 2*
   R&D Report 9842, June 1999

5. European Civil Aviation Conference
   *Report on Standard Method of Computing Noise Contours around Civil Airports*
   ECAC.CEAC Doc 29, 3rd edition, Volumes 1 & 2, December 2005
Table 1  
Heathrow 2007 and 2008 average summer day movements by noise class

<table>
<thead>
<tr>
<th>Noise Class</th>
<th>Description</th>
<th>2007</th>
<th>2008</th>
<th>Percentage of total 2008 movements</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
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<td>PROPELLER AIRCRAFT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Small propeller aircraft</td>
<td>0.2</td>
<td>&lt; 0.1</td>
<td>&lt; 0.1%</td>
<td>-0.1 (%)</td>
</tr>
<tr>
<td>2</td>
<td>Large propeller aircraft</td>
<td>7.5</td>
<td>3.5</td>
<td>0.3%</td>
<td>-4.0 (%) -53%</td>
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<td></td>
<td>CHAPTER 3 JETS</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Short-haul aircraft</td>
<td>843.9</td>
<td>827.6</td>
<td>65.4%</td>
<td>-16.3 (-2%)</td>
</tr>
<tr>
<td>4</td>
<td>Wide-body twin-engined aircraft</td>
<td>235.4</td>
<td>261.9</td>
<td>20.7%</td>
<td>+26.5 (+11%)</td>
</tr>
<tr>
<td>5</td>
<td>2nd generation wide-body 3,4-engined aircraft</td>
<td>169.7</td>
<td>169.7</td>
<td>13.4%</td>
<td>0.0 (0%)</td>
</tr>
<tr>
<td></td>
<td>LARGE CHAPTER 2/3 JETS</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1st generation wide-body 3,4-engined aircraft</td>
<td>1.0</td>
<td>1.9</td>
<td>0.2%</td>
<td>+0.9 (%)</td>
</tr>
<tr>
<td></td>
<td>2nd GENERATION TWIN JETS</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Narrow-body twin-engined aircraft (including Ch.2 and hushkitted versions)</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0%</td>
<td>-0.1 (%)</td>
</tr>
<tr>
<td></td>
<td>1st GENERATION JETS</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Narrow-body 3,4-engined aircraft</td>
<td>0.4</td>
<td>0.2</td>
<td>&lt; 0.1%</td>
<td>-0.2 (%)</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td>1258.2</td>
<td>1264.8</td>
<td>100%</td>
<td>+6.6 (+0.5%)</td>
</tr>
</tbody>
</table>

* Percentages changes not shown due to low numbers and limited data resolution.
Table 2  
Heathrow 2007 and 2008 average summer day movements by noise class and ANCON aircraft type

<table>
<thead>
<tr>
<th>Aircraft type</th>
<th>Noise class</th>
<th>ANCON type</th>
<th>2007</th>
<th>2008</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small twin-piston propeller</td>
<td>1</td>
<td>STP</td>
<td>0.2</td>
<td>0.1</td>
<td>-0.1</td>
</tr>
<tr>
<td>Large twin-turboprop</td>
<td>2</td>
<td>LTT</td>
<td>7.5</td>
<td>3.5</td>
<td>-4.0</td>
</tr>
<tr>
<td>Boeing 737-300/400/500</td>
<td>3</td>
<td>B733</td>
<td>55.3</td>
<td>49.8</td>
<td>-5.5</td>
</tr>
<tr>
<td>Boeing 737-600/700</td>
<td>3</td>
<td>B736</td>
<td>9.3</td>
<td>9.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Boeing 737-800/900</td>
<td>3</td>
<td>B738</td>
<td>13.6</td>
<td>15.8</td>
<td>+2.2</td>
</tr>
<tr>
<td>Boeing 757-200 (RB211-535C engines)</td>
<td>3</td>
<td>B757C</td>
<td>0.6</td>
<td>0.7</td>
<td>+0.1</td>
</tr>
<tr>
<td>Boeing 757-200 (RB211-535E4/E4B engines)</td>
<td>3</td>
<td>B757E</td>
<td>55.4</td>
<td>50.7</td>
<td>-4.7</td>
</tr>
<tr>
<td>Boeing 757-200 (PW2037/2040 engines)</td>
<td>3</td>
<td>B757P</td>
<td>1.6</td>
<td>1.4</td>
<td>-0.2</td>
</tr>
<tr>
<td>BAe 146/Avro RJ</td>
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<td>BA46</td>
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<td>0.7</td>
<td>+0.1</td>
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<td>Airbus A318</td>
<td>3</td>
<td>EA318</td>
<td>3.4</td>
<td>0.2</td>
<td>-3.2</td>
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<tr>
<td>Airbus A319 (CFM-56 engines)</td>
<td>3</td>
<td>EA319C</td>
<td>18.5</td>
<td>13.6</td>
<td>-4.9</td>
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<tr>
<td>Airbus A319 (IAE-V2500 engines)</td>
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<td>EA319V</td>
<td>222.1</td>
<td>213.9</td>
<td>-8.2</td>
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<td>Airbus A320 (CFM-56 engines)</td>
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<td>EA320C</td>
<td>122.7</td>
<td>102.4</td>
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<td>128.0</td>
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<td>Airbus A321 (CFM56 engines)</td>
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<td>70.7</td>
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<tr>
<td>Airbus A321 (IAE-V2500 engines)</td>
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<td>72.0</td>
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<td>+14.1</td>
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<td>Executive Business Jet (Chapter 3)</td>
<td>3</td>
<td>EXE3</td>
<td>3.8</td>
<td>5.5</td>
<td>+1.7</td>
</tr>
<tr>
<td>Bombardier Regional Jet 100/200</td>
<td>3</td>
<td>CRJ</td>
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<td>0.7</td>
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<tr>
<td>Bombardier Regional Jet 700</td>
<td>3</td>
<td>CRJ700</td>
<td>1.8</td>
<td>4.1</td>
<td>+2.3</td>
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<tr>
<td>Bombardier Regional Jet 900</td>
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<td>CRJ900</td>
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<td>0.6</td>
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<tr>
<td>Embraer ERJ 135/145</td>
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<td>ERJ</td>
<td>31.9</td>
<td>29.8</td>
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<tr>
<td>Embraer ERJ 170</td>
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<td>0.0</td>
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<tr>
<td>Fokker 100</td>
<td>3</td>
<td>FK10</td>
<td>3.3</td>
<td>4.6</td>
<td>+1.3</td>
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<tr>
<td>McDonnell Douglas MD80 series</td>
<td>3</td>
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<td>28.3</td>
<td>25.6</td>
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</tr>
<tr>
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</tr>
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<td>Boeing 767-200</td>
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<td>B762</td>
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</tr>
<tr>
<td>Boeing 767-300 (GE CF6-80 engines)</td>
<td>4</td>
<td>B763G</td>
<td>12.6</td>
<td>13.8</td>
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</tr>
<tr>
<td>Boeing 767-300 (PW4000 engines)</td>
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<td>B763P</td>
<td>10.1</td>
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<td>+4.8</td>
</tr>
<tr>
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<td>Boeing 777-200 (GE GE90 engines)</td>
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<td>Boeing 777-200 (PW PW4000 engines)</td>
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<td>14.4</td>
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<tr>
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<td>+6.0</td>
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<td>Airbus A340-200/300</td>
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<tr>
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<td>B741</td>
<td>0.0</td>
<td>0.5</td>
<td>+0.5</td>
</tr>
</tbody>
</table>
Aircraft type | Noise class | ANCON type | 2007 | 2008 | Change
--- | --- | --- | --- | --- | ---
Boeing 747-200/300 (Chapter 3) | 6 | B742C3 | 0.9 | 0.7 | -0.2
McDonnell Douglas DC-10 | 6 | DC10 | 0.1 | 0.7 | +0.6
Executive Business Jet (Chapter 2) | 7 | EXE2 | 0.1 | 0.0 | -0.1
Boeing 727 (Chapter 3) | 8 | B727C3 | 0.2 | 0.2 | 0.0
Tupolev Tu-154 | 8 | TU54 | 0.2 | 0.0 | -0.2
**TOTAL** | | | **1258.2** | **1264.8** | **+6.6**

Note: Totals may not sum exactly due to rounding of individual aircraft type numbers.
Figures

ERCD Report 0901 Noise Exposure Contours for Heathrow Airport 2008

Figure 1
Heathrow Airport and the surrounding area

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Heathrow Airport
Figure 2
Heathrow Airport layout
Figure 3
Heathrow Standard Instrument Departure routes
Figure 4  Heathrow noise class trend 1984-2008

Note: The percentages from 1990 onwards 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.

Key to noise classes

Propeller aircraft
1  Small props, e.g. single/twin piston and turboprop light aircraft
2  Large props, e.g. 2- and 4-propeller transports, e.g. ATR-42, BAe ATP

Chapter 3 jets
3  Short-haul, e.g. Airbus A320, Boeing 737-300
4  Wide-body twins, e.g. Airbus A300, Boeing 767
5  2nd generation wide-body 3,4-engined aircraft, e.g. Airbus A340, Boeing 747-400

Large Chapter 2/3 jets
6  1st generation wide-body 3,4-engined aircraft, e.g. Boeing 747-200

2nd generation twin jets
7  Narrow body twins (including hushkitted versions), e.g. Boeing 737-200, Fokker 28

1st generation jets (including hushkitted versions)
8  Narrow body 3,4-engined aircraft, e.g. Boeing 707, Tupolev Tu-154
Figure 5  Heathrow 2008 average summer day movements by ANCON type

Note: ANCON types are listed in the same order as in Table 2.
Figure 6

Heathrow 2007 and 2008 departure traffic distributions by SID route.
Figure 7  Heathrow average summer day runway modal splits 1989-2008

<table>
<thead>
<tr>
<th>Year</th>
<th>Westerly operations (%)</th>
<th>Easterly operations (%)</th>
</tr>
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<td>1989</td>
<td>77</td>
<td>23</td>
</tr>
<tr>
<td>1990</td>
<td>77</td>
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<td>1991</td>
<td>72</td>
<td>28</td>
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<td>79</td>
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</tr>
<tr>
<td>2008</td>
<td>86</td>
<td>14</td>
</tr>
</tbody>
</table>

20-year average: 76% W, 24% E
Figure 8
Heathrow 2008 actual modal split (86% W / 14% E) Leq contours
Figure 10
Heathrow 2008 actual (86% W / 14% E) and 2007 actual (87% W / 13% E) Leq contours
Figure 11

Heathrow 2008 standard (76% W / 24% E) and 2007 standard (76% W / 24% E) Leq contours.
Figure 12
Heathrow traffic and noise contour area/population trend 1988-2008