Environmental Research and Consultancy Department

Civil Aviation Authority

ERCD REPORT 0706

London Heathrow Airport

Strategic Noise Maps 2006

D J Monkman
J McMahon

www.caa.co.uk

Environmental Research and Consultancy Department

Civil Aviation Authority

ERCD REPORT 0706

London Heathrow Airport

Strategic Noise Maps 2006

D J Monkman
J McMahon

Summary

This report presents the strategic noise mapping contours for Heathrow Airport 2006 as detailed in Statutory Instrument 2006 No 2238 The Environmental Noise (England) Regulations 2006.

December 2007

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.

Any views expressed are not necessarily those of the Secretary of State for Transport.

Population data used in this report are based on 2001 Census data (updated in 2005) supplied by CACI Information Services.

ISBN 978 0 11790 970 0

Enquiries regarding the content of this publication should be addressed to:
Environmental Research and Consultancy Department, Directorate of Airspace Policy, Civil Aviation Authority, CAA House, 45-59 Kingsway, London, WC2B 6TE.

The latest version of this document is available in electronic format at www.caa.co.uk, where you may also register for e-mail notification of amendments.

Published by TSO (The Stationery Office) on behalf of the UK Civil Aviation Authority.

Printed copy available from:
TSO, PO Box 29, Norwich NR3 1GN
Telephone orders/General enquiries: 0870 600 5522
Fax orders: 0870 600 5533
www.tso.co.uk/bookshop
E-mail: book.orders@tso.co.uk
Textphone: 0870 240 3701

Contents

Appendices

Intentionally Blank

Glossary of Terms and Abbreviations

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

ANMAC Aircraft Noise Monitoring Advisory Committee. The committee is chaired by the Department for Transport and comprises, among others, representatives of the airlines, Heathrow, Gatwick and Stansted airports and airport consultative committees.

ATC Air Traffic Control.

BAA BAA plc, the company which own and runs Heathrow, Gatwick and Stansted airports amongst others, and is responsible for the operation of the NTK system.

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

dBA Units of sound level on the A-weighted scale.

DfT Department for Transport (UK Government).

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

ICAO International Civil Aviation Organization.

ILS Instrument Landing System.

L_{Amax} The maximum A-weighted sound level (in dBA) measured during an aircraft fly-by.

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 in the 16 hour period (0700-2300 LT) during the 92 day period 16 June to 15 September inclusive.

L_{day} Equivalent sound level of aircraft noise in dBA for the 12 hour ***annual*** day.

$L_{evening}$ Equivalent sound level of aircraft noise in dBA for the 4 hour ***annual*** evening.

L_{night} Equivalent sound level of aircraft noise in dBA for the 8 hour ***annual*** night.

$L_{Aeq,16h}$ For this report, equivalent sound level of aircraft noise in dBA for the 16 hour ***annual*** day.

L_{den} 24 hour day, evening, night sound level in dBA based on annual traffic and the evening movements are weighted by 5 dB and night movements are weighted by 10 dB.

NATS Formerly known as National Air Traffic Services Ltd. NATS provides air traffic control services at several major UK airports, including Heathrow, Gatwick and Stansted.

NNI Noise and Number Index. The noise exposure measure that preceded Leq.

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.

PNdB Perceived Noise Level, measured in PNdB. Its measurement involves analyses of the frequency spectra of noise events as well as the maximum level.

QC Quota Count – the basis of the London airports Night Restrictions regime.

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

SOR Start-of-roll: The position on a runway where aircraft commence their take-off runs.

Intentionally Blank

1 Introduction

1.1 Background

1.1.1 For every year, the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority estimates the amount of aircraft noise experienced by people living around London Heathrow Airport during the **summer months (mid June – mid September)**. The noise exposure measure is the Equivalent Continuous Sound Level, Leq (**16-hour 0700 – 2300 Local Time**) 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 0606[1] (Refs 2, 3 and 4). 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.

1.1.2 The latest summer 16-hour Leq contours for Heathrow 2006 are described in ERCD Report 0701 (Ref 5) which is available for download from the Department for Transport (DfT) website at www.dft.gov.uk. Contours for the summer 16-hour period are presented from 57 to 72 dBA Leq in steps of 3 dB.

1.2 Strategic Noise Mapping

1.2.1 ERCD were commissioned by the DfT to carry out the Strategic Noise Mapping for Heathrow Airport as outlined in Statutory Instrument 2006 No 2238 The Environmental Noise (England) Regulations 2006.

1.2.2 Unlike the conventional summer 16-hour Leq contours, the Environmental Noise Regulations requires the following parameters, L_{day}, $L_{evening}$, L_{night}, $L_{Aeq,16hr}$, and L_{den}. All these parameters are based on air traffic movements over the entire year (unlike conventional contours that are based on the air traffic data during the summer months mid June to mid September). L_{den} is the 24 hour day, evening, night sound level in dBA with the evening movements weighted by 5 dB and the night movements weighted by 10 dB. Also, air noise contours for strategic noise mapping are presented in 5 dB steps from 55 dBA to 75 dBA except for L_{night} where the contours are presented between 50 dBA and 70 dBA.

1.2.3 This report sets out the methodologies used in the computation of the strategic noise mapping contours and includes the resulting contours for each of the required parameters.

1.2.4 The 2006 strategic noise mapping contours shown in this report take into account the topography around Heathrow by accounting for terrain height in the modelling process. This was achieved by geometrical corrections for source-receiver distance and elevation angles, other more complex effects such as lateral attenuation from uneven ground surfaces and noise screening/reflection effects due to topographical features were not taken into account. ERCD holds terrain height data[2] obtained from Ordnance Survey on a 200 m by 200 m grid for England and Wales.

[1] ERCD Report 0606 will be published shortly.

[2] Meridian® 2 data revised 2006.

Interpolation was performed to generate height data at each of the calculation points on the 200 m by 100 m receiver grid for use by the ANCON noise model.

1.2.5 Numerical results for a 10 m by 10 m grid for each of the required parameters have also been provided. Although not shown on the contour figures, this grid is large enough to cover the extent of a theoretical 50 dBA contours for L_{day}, $L_{evening}$, $L_{Aeq,16hr}$ and L_{den} and a theoretical 45 dBA contour for L_{night}.

2 London Heathrow Airport

2.1 Location

2.1.1 The airport has two runways, four passenger terminals and one cargo terminal with two aprons. A fifth terminal is under construction. The airport is located approximately 13 miles (21 km) west of the city of London and is surrounded by suburban housing, business premises and mixed use open land to the north and south, surburban housing and business premises to the east and three large reservoirs, mixed use open land, housing and business premises to the west. In 2006, there were just over 477,000 movements handling around 67.5 million passengers.

2.1.2 The layout of the runways and taxiways is displayed in Figure 1.

3 Measures To Reduce Aircraft Noise Currently in Place

3.1 Land use planning

3.1.1 The Government's policies are set out in planning policy guidance (PPG) notes. Local authorities must take their content into account in preparing their development plans. PPG24[3] gives advice on how the planning system can be used to minimise the adverse effects of noise. When assessing a proposal for residential development near a source of noise, local planning authorities should determine into which of the four noise exposure categories (NECs) the proposed site falls, taking account of both day and night-time noise. The NEC categories are as follows:

NEC

A Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.

B Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.

C Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no quieter alternative sites available, conditions should be imposed to ensure a commensurate level of protection against noise.

[3] Planning Policy Guidance 24: Planning and Noise published September 1994

D Planning permission should normally be refused.

3.1.2 The recommended Noise Exposure Categories for new dwellings near existing noise sources are given below:

Noise levels[1] corresponding to the noise exposure categories for new dwellings Leq dB

	Noise exposure category			
Noise source	A	B	C	D
Road traffic				
0700 – 2300	<55	55 – 63	63 – 72	>72
2300 – 0700 [2]	<45	45 – 57	57 – 66	>66
Rail traffic				
0700 – 2300	<55	55 – 66	66 – 74	>74
2300 – 0700	<45	45 – 59	59 – 66	>66
Air traffic [3]				
0700 – 2300	<57	57 – 66	66 – 72	>72
2300 – 0700	<48	48 – 57	57 – 66	>66
Mixed sources [4]				
0700 – 2300	<55	55 – 63	63 – 72	>72
2300 – 0700	<45	45 – 57	57 – 66	>66

[1] Noise levels: the noise level(s) ($L_{Aeq,T}$) used when deciding the NEC of a site should be representative of typical conditions.

[2] Night time noise levels (2300 – 0700): sites where individual noise events regularly exceed 82 dB L_{max} (S time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq,8hr}$ (except where the $L_{Aeq,8hr}$ already puts the site in NEC D).

[3] Aircraft noise: daytime values accord with the contour values adopted by the Department for Transport which relate to levels measured 1.2 metres above open ground. For the same amount of noise energy, contour values can be up to 2 dBA higher than those of other sources because of ground reflection effects.

[4] Mixed sources: this refers to any combination of road, rail, air and industrial noise sources. The 'mixed source' values are based on the lowest numerical values of the single source limits in the table. The 'mixed source' NECs should only be used where no individual noise source is dominant.

3.2 Noise Insulation and Compensation

3.2.1 The Air Transport White Paper[4] stated that in addition to controlling and reducing aircraft noise impacts, a proportion of the large economic benefits provided by airport development should be used to mitigate their local impacts. The principal mitigation measure for aircraft noise impacts is the provision of acoustic insulation and can be required on a statutory basis under section 79 of the Civil Aviation Act 1982 at Heathrow. In practice, however, all current noise insulation schemes are provided on a voluntary basis by airport operators, often supported by local planning agreements. Accordingly, airport operators are expected to:

- offer households subject to high levels of noise (69 dBA Leq or more) assistance with the costs of relocating; and
- offer acoustic insulation (applied to residential properties) to other noise-sensitive buildings, such as schools and hospitals, exposed to medium to high levels of noise (63 dBA Leq or more).

3.2.2 To address the impacts of *future* airport growth Government also expects the airport operators to:

- offer to purchase those properties suffering from both a high level of noise (69 dBA Leq or more) and a large increase in noise (3 dBA Leq or more); and
- offer acoustic insulation to any residential property which suffers from both a medium to high level of noise (63 dBA Leq or more) and a large increase in noise (3 dBA Leq or more).

3.2.3 In 2005, after separate consultations, BAA launched a number of schemes at Heathrow, including: its voluntary blight mitigation arrangements in respect of potential development at Heathrow Airport; a Community Buildings Noise Insulation Scheme; a Home Relocation Assistance Scheme; a Home Owner Support Scheme; and a Property Market Support Bond. Following the introduction of the current night restrictions regime, BAA launched the Night Noise Insulation Scheme in 2007.

3.3 Operational procedures and operating restrictions

3.3.1 Full details are set out in statutory notices and published in the UK AIP (Aeronautical Information Package) [5] and elsewhere as appropriate. The following extracts contain provisions which apply at night.

3.3.2 *General (Heathrow, Gatwick and Stansted)*

After take-off the aircraft shall be operated in such a way that it is at a height of not less than 1000 ft aal (above aerodrome level) at 6.5 km from the start of roll as measured along the departure track of that aircraft. To minimise disturbance in areas adjacent to the aerodrome, commanders of aircraft are requested to avoid the use of reverse thrust after landing, consistent with the safe operation of the aircraft, between 2330 and 0600 (local time).

[4] DfT, The Future of Air Transport, December 2003, Cm 6046

[5] Section AD2-EGLL-1-16 to 19.

3.3.3 *Heathrow specific*

Between 0600 and 2330 hours (local time) where the aircraft is approaching runway 27L or 27R (0700 and 2300 hours when approaching runway 09L or 09R) and is using the Instrument Landing System (ILS) it shall not descend on the glidepath below an altitude of 2500 ft before being established on the localiser, nor thereafter fly below the glidepath. Between 2330 and 0600 hours (local time) where the aircraft is approaching runway 27L or 27R (0700 and 2300 hours when approaching runway 09L or 09R) and is using the ILS it shall not descend below an altitude of 3000 ft before being established on the localiser, nor thereafter fly below the glidepath.

3.3.4 *Continuous descent approach (CDA)*

A voluntary code of practice is in place which was compiled by a group representing airlines, NATS, Civil Aviation Authority, airports and the Department for Transport, Local Government and the Regions (DTLR) (now DfT), and is primarily concerned with Heathrow, Gatwick and Stansted airports.

The code encourages air traffic controllers and pilots to seek to facilitate a continuous descent approach in the descent from 6000 ft. This is an effective technique for reducing arrivals noise. The following is an extract from the UK AIP instructing pilots to use CDA wherever possible. The full text can be found in the AIP and in the arrivals code of practice on the DfT website[6].

"Where the aircraft is approaching the aerodrome to land (runway 23 only at Stansted) it shall commensurate with its ATC clearance minimise noise disturbance by the use of continuous descent and low power, low drag operating procedures (referred to in Detailed Procedures for descent clearance in AD 2-EGSS-1-13 of the UK AIP). Where the use of the procedures is not practicable, the aircraft shall maintain as high an altitude as possible."

Heathrow, along with Gatwick and Stansted airports have developed a common working definition for monitoring CDAs as follows:

'For monitoring purposes, a descent will be deemed to have been continuous provided that no segment of level flight longer than 2.5 nm occurs below 6000 ft QNH and 'level flight' is interpreted as any segment of flight having a height change of not more than 50 ft over a track distance of 2 nm or more, as recorded in the airport Noise and Track-keeping system.'

The CDA compliance levels are regularly reported back to the airports' noise and track keeping working groups and consultative committees as well as the Flight Operations Performance Committee (FLOPC), which includes airline and ATC representatives.

3.3.5 *Westerly Preference, Runway Alternation and Cranford Agreement at Heathrow*

For safety and aeronautical technical reasons aircraft normally take-off and land into the wind. In the UK the prevailing winds are south - westerly, so at Heathrow aircraft land from the east and depart to the west ('westerly operations') about 70-80% of the time, during a typical year.

6 http://www.dft.gov.uk/pgr/aviation/environmentalissues/arrivalscodeofpractice/

A ***Westerly Preference*** is operated at Heathrow. This means that during periods of light easterly winds, aircraft will often continue to land in a westerly direction making their final approach over London. The westerly preference was introduced in the 1960s to reduce numbers of aircraft taking off in an easterly direction over London i.e. over the most heavily populated side of the airport. In 2000, following consultation, the westerly preference was replaced at night by a weekly rotation between westerly and easterly operations. However, the rotation is only operated in certain weather conditions and the airport maintains the westerly preference when there are delayed departures.

A system of ***Runway Alternation*** was introduced in 1972-73 for aircraft landing during westerly operations (i.e. when arriving aircraft make their final approach over London) to provide predictable periods of relief from the noise of landing aircraft for communities under the final approach tracks to the east of the airport.

The pattern of alternation has been modified several times since the 1970s and in 1999 was extended to the night period. The present pattern provides for one runway to be used by landing aircraft from 0600 hours until 1500 hours and the other runway to be used from 1500 hours until after the last departure (therefore normally starting with the midnight hour), after which landing aircraft use the first runway again until 0600 hours. However, on Sunday each week the runway used before midnight continues to be used for landings until 0600 hours. This means early morning arrivals before 0600 hours use a different runway on successive weeks and that the runways used by landing aircraft before and after 1500 hours also alternate on a weekly basis. Aircraft taking off during westerly operations can use either runway, but most use the runway that is not in use for arrivals.

When the runway alternation scheme was extended to the night period in 1999 it was also introduced – at night only – for easterly operations; i.e. when arriving aircraft make their final approach over Windsor in an easterly direction. Runway alternation does not operate in the daytime during easterly operations due to the Cranford Agreement.

The 0600 to 0700 hour was specifically excluded when runway alternation was introduced at night because concerns were raised that the use of one runway only in this hour for arrivals could lead to delays. These delays could lead to the suspension of runway alternation for a time in order to avoid the problems of delays persisting through the day. However, soon afterwards a trial of alternation in the 0600 to 0700 period was introduced and is still in place.

The overall pattern of alternation results in a four week schedule which provides for one runway to be used for arrivals on westerly operations during the day with the rotation of the use of an easterly/westerly preference at night.

The pattern of runway alternation may be suspended by Air Traffic Control if there are sound operational or safety reasons for doing so. One of the exemptions is to accommodate peak traffic build-up. This temporary suspension of alternation is known as Tactically Enhanced Arrival Measures (TEAM). Runway alternation may also be suspended to allow essential maintenance of the runways, lighting and the instrument landing systems, although most maintenance carried out at night is synchronised with the alternation pattern.

The ***Cranford Agreement*** is a verbal undertaking dating from the 1950s to avoid use of the northern runway for take-offs in an easterly direction over Cranford unless necessary (e.g. when the southern runway is closed). In order to observe the

agreement, there is no runway alternation on easterly operations during the day; most aircraft departing to the east use the southern runway and most easterly arrivals use the northern runway.

3.4 Night restrictions

3.4.1 *Current night restrictions regime*

The current night restrictions regime was introduced in 2006[7] following extensive consultation. The restrictions are set by the DfT and detailed in a statutory notice, published each season in the supplement to the UK AIP.

3.4.2 *Night Period and Night Quota Period*

The 'night period' is 2300 – 0700 hours (local time) during which period the noisiest types of aircraft classified QC/8 and QC/16 may not be scheduled to land or take-off. From 2330 to 0600, the 'night quota period', aircraft movements are restricted by movements limits with noise quotas as a supplementary measure. These are set for each season.

3.4.3. *The Quota Count System*

Aircraft are assigned quota count (QC) classifications as follows:

Certified noise level (EPNdB)	**Quota count**
More than 101.9	QC/16
99 – 101.9	QC/8
96 – 98.9	QC/4
93 – 95.9	QC/2
90 – 92.9	QC/1
87 – 89.9	QC/0.5
84 – 86.9	QC/0.25

and are classified separately for take-off and landing. Schedules showing the QC classification of individual aircraft are published as part of the statutory notice.

Exempt aircraft

Jet aircraft and propeller aircraft are exempt from the movements limits and noise quotas if their noise certification data are less than 84 EPNdB.

[7] House of Commons *Official Report* 6 June 2006 cols 25WS.

3.4.4. *Movements limits and Noise Quotas at Heathrow*

The movements limits and noise quotas for current and future years/seasons are:

	Winter						
	2005/06	**2006/07**	**2007/08**	**2008/09**	**2009/10**	**2010/11**	**2011/12**
Movement limit	2550	2550	2550	2550	2550	2550	2550
Noise quota	4140	4140	4140	4110	4110	4110	4080

	Summer						
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Movement limit	3250	3250	3250	3250	3250	3250	3250
Noise quota	5610	5610	5460	5460	5340	5220	5100

Seasons

The summer season is the period of British Summer Time in any one year as fixed by or under the Summer Time Act 1972 as amended by S.I. 2002/262; the winter season is the period between the end of British Summer Time in one year and the start of British Summer Time in the next. The change to British Summer Time occurs at 0100 Greenwich Mean Time (Universal Co-ordinated Time).

3.4.5. *End of season flexibility*

The flexibility margin is 10%; i.e. up to 10% of the current season's movements limit may be carried over if sufficient amount of the limit is unused, and up to 10% of the next season's movements limit may be anticipated in the event of an overrun. Any excess overrun is penalised in the following season at double the amount of the excess. The same arrangements apply to the noise quotas.

3.4.6. *Permitted operations*

(1) any aircraft which has a quota count of 4, 8, or 16 may not be scheduled to take off or land during the night quota period;

(2) any aircraft which has a quota count of 8 or 16 may not be scheduled to take off or land during the night period;

(3) any aircraft which has a quota count of 8 or 16 may not take off in the night period, except in the period 2300 hours to 2330 hours in circumstances where:

(a) it was scheduled to take off prior to 2300 hours;

(b) the take-off was delayed for reasons beyond the control of the aircraft operator; and

(c) the airport authority has not given notice to the aircraft operator precluding take-off.

3.4.7 *Dispensations*

The Secretary of State has the power to specify circumstances in which movements may be disregarded from the night restrictions by the airport managers and the power to authorise that specific flights should be disregarded. The airport companies may disregard night movements in the following exceptional circumstances:

- delays to aircraft which are likely to lead to serious congestion at the aerodrome or serious hardship or suffering to passengers or animals
- delays to aircraft resulting from widespread and prolonged disruption of air traffic.

3.4.8 *Monitoring*

Heathrow airport provides to its Airport Consultative Committee, and to the Department, regular reports in a format advised by The Aircraft Noise Monitoring Advisory Committee (ANMAC) on usage of the movements limits and the noise quotas, details of any dispensations or exemptions granted, and reports on any movements by QC/8 and QC/16 aircraft during the night period. In addition, under section 78(4) of the Civil Aviation Act 1982 all dispensations granted by the airports have to be reported to the Department in writing within a maximum of one week from when the dispensed flight took place.

3.5 Noise preferential routeing

3.5.1 Aircraft departing Heathrow are required to follow specific paths called noise preferential routes (NPRs) up to an altitude of 4000 ft, unless directed otherwise by air traffic control (ATC). NPRs were designed to avoid 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). Associated with each NPR is a swathe extending 1.5 km each side of the nominal NPR centre line, within which aircraft are considered to be flying on track. This takes account of various factors that affect track-keeping including tolerances in navigational equipment, type and weight of aircraft, and weather conditions – particularly winds that may cause drifting when aircraft are turning. Aircraft reaching 4000 ft 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 4000 ft for safety reasons, including in certain weather conditions, for example to avoid storms.

3.5.2 Changes in the NPR structure are rare and stability is regarded as important, so that people may know where aircraft noise will be experienced. The frequency with which any particular NPR is used will vary, and is an operational decision for ATC, taking account of the final destination of individual flights, together with other considerations such as overall air traffic and weather conditions, both locally and along intended routes.

3.6 Noise limits

3.6.1 During the night quota period (2330-0600) the departure noise limit is 87 dBA Lmax . During the remainder of the night period (2300-2330 and 0600-0700) the noise limit is 89 dBA. The limits apply at fixed noise monitors (see para 3.7.1 below). These night time limits are consistent with the night restrictions regime. (There is also a daytime noise limit of 94 dBA).

3.6.2 Airlines whose aircraft breach the noise limits are fined by BAA, with the money donated to local community projects.

3.6.3 There are no arrivals noise limits. A report which considered the feasibility of setting noise limits for arriving aircraft, '*Noise from Arriving Aircraft: Final Report of the ANMAC Technical Working Group*', was published in 1999. In light of the findings, the then Aviation Minister, decided against imposing operational noise limits for arriving aircraft. A code of practice has been developed (described above) for night time (and day time) arrivals.

3.7 Noise monitoring

3.7.1 Most large airports have noise and track-keeping (NTK) systems, which take radar data from air traffic control radars and combine it with flight information such as callsign, tail number, type and destination. At Heathrow airport the noise and track-keeping (NTK) system captures data from both fixed and mobile noise monitors around the airport, to be matched to operational data. This information ensures that the ANCON noise model database is kept up to date which in turn is used as an input to the annual noise contours for each of the three airports.

3.7.2 Fixed noise monitors at the airport are located at approximately 6.5km from start-of-roll (SOR). This corresponds to the flyover measurement point in the ICAO Annex 16 noise certification procedure. There are 10 fixed monitors around Heathrow. The location of the monitors takes account of the noise preferential routes.

3.7.3 The location and distance of the fixed noise monitors were decided in 2000[8] after consultation. Relating the noise limits to a reference distance 6.5 km from start-of-roll encourages aircraft operators to gain height as quickly as possible and then reduce engine power and noise at the earliest opportunity. There is also a requirement for departing aircraft to attain at least a 1000 feet altitude when passing the fixed noise monitors. This point was also chosen as few residential areas lay closer to major airports than that and this would result in a noise benefit for residents who live further out from the airport.

3.7.4 In addition, aircraft are required, after take-off, to be operated in such a way that it will not cause more than 89 dBA Lmax by night (from 2300-0700 hours local time) and that it will not cause more than 87 dBA Lmax during the night quota period (2330-0600 hours local time) as measured at any noise terminal at any of the sites referred to in the AIP[9].

[8] House of Commons *Official Report* 18 December 2000 cols 11W-12W.

[9] Section AD2-EGLL-1-16.

3.8 Noise charges

3.8.1 Conditions of use and airport charges for Heathrow[10] are published every year by BAA. The charge on landing is assessed and paid on the basis of the Maximum Total Weight Authorised (MTWA) as recorded by the airport companies on 1 April each year.

3.8.2 *Summary of charges*

- The base charges on landing apply to jet aircraft over 16 metric tonnes which meet the noise certification standards of ICAO Annex 16 Chapter 3. Non-jet aircraft and all aircraft not exceeding 16 metric tonnes automatically qualify for the base charges.

- The Chapter 3 base charge on landing is increased to three times for aircraft failing to meet Chapter 3 noise certification standards.

- A Chapter 3 minus or Chapter 4 charge applies to those jet and non-jet aircraft in excess of 16 metric tonnes which, on both arrival and departure, have a quota count of 0.5 or 1, or are exempt.

- Aircraft deemed to be marginally compliant Chapter 3 aircraft (noise performance is 5 or more EPNdB below Chapter 3 certification limits) are subject to a weight charge on landing of 150% of the Chapter 3 base charges.

- Landing charges at Heathrow, Gatwick and Stansted are increased during daytime peak periods. At Heathrow, the peak charge also applies during the following periods: 2300-0459 UTC (GMT), 1 April to 31 October and 0000-0559 UTC (GMT), 1 November to 31 March. Between 0000-0329 UTC (GMT), 1 April to 31 October and 0100-0429 UTC (GMT), 1 November to 31 March the charge is peak x 1.5.

[10] Heathrow Conditions of Use

4 Aircraft Operations

4.1 Flight Tracks

4.1.1 The flight tracks and track dispersions used for all the 2006 strategic noise mapping contours were the same as those used for the 2006 average summer 16-hour day Leq contours.

4.1.2 These were determined from radar data extracted from the airport's Noise and Track Keeping (NTK) monitoring system for the summer of 2006 and defined mean tracks and track dispersions for all outbound routes from Runways 27L, 27R and 09R (see Figure 2 for route designations). There were insufficient departures from Runway 09L in the summer of 2006 to define statistically adequate tracks and dispersions, so the 09L mean departure tracks/dispersions from the summer of 2005 were used for the 2006 strategic noise mapping exercise.

4.1.3 In the summer of 2006, radar measurements of arrival tracks between the stacks and Runways 27L, 27R, 09L and 09R confirmed that the continued use of evenly spaced 'spurs' remained a realistic method for modelling the dispersion of arrival tracks about the extended runway centre lines. The majority of aircraft joined the centre lines at distances greater than 10 km from threshold – only a very small number joined at shorter distances.

4.2 Flight Profiles and Noise Emissions

4.2.1 As for the flight tracks, the flight profiles and noise emission data used for the strategic noise mapping contours were the same as those used for the 2006 average summer 16-hour day Leq contours.

4.2.2 The average flight profiles of height and speed versus track distance for each aircraft type during the summer months of 2006 were reviewed, and updated where necessary, for both departures and arrivals. Noise event levels were then determined from a database expressing SEL[11] 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.

4.3 Traffic Distribution by Aircraft Type and Route

4.3.1 The traffic data required for the strategic noise mapping contours relates to an average 12-hour day (0700 to 1900 local time), an average 4-hour evening (1900 to 2300) local time and an average 8-hour night (2300 to 0700 local time) over the entire year. Tables 1, 2 and 3 display the distribution of departures and arrivals by ANCON type for the three time periods based on the entire year.

4.3.2 Table 4 displays the distribution of aircraft departures by route for the day, evening and night periods during 2006.

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

4.3.3 There was some loss of runway alternation at Heathrow during 2006 (due to maintenance work on some stands and taxiways) and the percentage use of the runways during westerly and easterly operations is summarised in Table 5.

5 Noise Contours

5.1 12-hour day L_{day}

5.1.1 The annual 12 hour (0700 – 1900 LT) L_{day} contours from 55 dBA to 75 dBA in 5 dB steps are displayed in Figure 3. The percentages of use of each runway direction – the 'modal split'- for this time period were 70% west – 30% east. The estimated areas, populations[12] and households within the annual 12 hour L_{day} contours are shown in Table 6(a). **Note that all the results presented here are by contour bands (as required by the Directive) and are not cumulative as is the case for the historical summer 16 hour day Leq contours.**

5.2 4 hour evening $L_{evening}$

5.2.1 The annual 4 hour (1900 – 2300 LT) $L_{evening}$ contours from 55 dBA to 75 dBA in 5 dB steps are displayed in Figure 4. The percentages of use of each runway direction – the 'modal split'- for this time period were 71% west – 29% east. The estimated areas, populations and households within the annual 4 hour evening $L_{evening}$ contours are shown in Table 6(b).

5.3 8 hour night L_{night}

5.3.1 The annual 8 hour (2300 – 0700 LT) L_{night} contours from 50 dBA to 70 dBA in 5 dB steps are displayed in Figure 5. The percentages of use of each runway direction – the 'modal split'- for this time period were 72% west – 28% east. The estimated areas, populations and households within the annual 8 hour night L_{night} contours are shown in Table 6(c).

5.4 16 hour day $L_{Aeq,16hr}$

5.4.1 The annual 16 hour (0700 – 2300 LT) $L_{Aeq,16hr}$ contours from 55 dBA to 75 dBA in 5 dB steps are displayed in Figure 6. The percentages of use of each runway direction – the 'modal split'- for this time period were 70% west – 30% east. The estimated areas, populations and households within the annual 16 hour day $L_{Aeq,16hr}$ contours are shown in Table 6(d).

5.5 24 hour L_{den}

5.5.1 The annual 24 hour L_{den} contours from 55 dBA to 75 dBA in 5 dB steps are displayed in Figure 7. The percentages of use of each runway direction – the 'modal split'- for this time period were 70% west – 30% east. The estimated areas, populations and households within the annual 24 hour day L_{den} contours are shown in Table 6(e).

[12] The population and household estimates shown in this Report are based on 2001 census data updated by CACI Ltd in 2005.

References

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

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

3 Ollerhead J B, Rhodes D P, Viinikainen M S, Monkman D J, Woodley A C
The UK Civil Aircraft Noise Contour Model ANCON:
Improvements in Version 2
R&D Report 9842, June 1999

4 Rhodes D P, Monkman D J, Woodley A C
The CAA Aircraft Noise Contour Model: ANCON Version 2.3
ERCD Report 0606 (to be published shortly)

5 Monkman D J, Rhodes D P, Deeley J, Beaton D, McMahon J
Noise Exposure Contours for Heathrow Airport 2006
ERCD Report 0701, June 2007

TABLE 1: DISTRIBUTION OF HEATHROW AVERAGE DAILY AIRCRAFT MOVEMENTS BY ANCON TYPE (ANNUAL 12 HOUR DAY 0700-1900 LOCAL TIME)

ANCON Type	Departures	Arrivals	Movements*
B707C3	0.01	0.01	**0.01**
B727C3	0.03	0.03	**0.06**
B732C3	0.02	0.02	**0.03**
B733	13.87	14.46	**28.33**
B736	5.93	5.39	**11.31**
B738	7.37	7.00	**14.37**
B741	0.13	0.14	**0.26**
B742C3	0.73	1.45	**2.19**
B744G	7.02	7.84	**14.86**
B744P	7.43	9.09	**16.52**
B744R	30.00	23.87	**53.86**
B747SP	0.35	0.27	**0.62**
B757C	0.01	0.01	**0.02**
B757E	22.47	18.81	**41.28**
B757P	0.08	0.28	**0.36**
B762	0.65	0.58	**1.23**
B763G	3.74	3.76	**7.50**
B763P	5.74	2.95	**8.70**
B763R	14.41	12.02	**26.43**
B772G	12.67	9.97	**22.64**
B772P	8.76	7.03	**15.78**
B772R	24.01	20.22	**44.23**
B773G	0.97	2.49	**3.46**
B773R	0.27	0.62	**0.89**
BA46	0.94	1.04	**1.98**
CRJ	1.69	2.18	**3.87**
CRJ700	0.96	1.27	**2.23**
DC10	0.16	0.21	**0.37**
DC87	0.00	0.00	**0.01**
EA30	4.40	4.63	**9.03**
EA31	1.96	2.41	**4.37**
EA318	0.70	0.81	**1.51**
EA319C	6.36	6.90	**13.26**
EA319V	83.06	81.27	**164.33**
EA320C	53.13	52.30	**105.44**
EA320V	55.71	54.79	**110.49**
EA321C	25.53	24.43	**49.96**
EA321V	30.79	29.46	**60.25**
EA33	11.06	12.22	**23.28**
EA34	9.56	12.27	**21.83**
EA346	6.94	8.47	**15.42**
ERJ	5.64	5.14	**10.78**
ERJ170	0.28	0.17	**0.46**
EXE2	0.01	0.01	**0.01**
EXE3	2.13	2.15	**4.28**
FK10	1.36	1.34	**2.70**
L101	0.01	0.01	**0.02**
L4P	0.02	0.02	**0.04**
LTT	2.85	2.84	**5.69**
MD11	0.27	0.81	**1.08**
MD80	10.35	11.56	**21.91**
SP	0.01	0.01	**0.01**
STP	0.03	0.02	**0.05**
STT	0.06	0.06	**0.12**
TU54	0.03	0.03	**0.05**
Totals*	**482.67**	**467.11**	**949.78**

***Totals may not sum exactly due to rounding.**

TABLE 2: DISTRIBUTION OF HEATHROW AVERAGE DAILY AIRCRAFT MOVEMENTS BY ANCON TYPE (ANNUAL 4 HOUR EVENING 1900-2300 LOCAL TIME)

ANCON Type	Departures	Arrivals	Movements*
B727C3	0.00	0.01	**0.01**
B732C3	0.00	0.00	**0.01**
B733	3.90	3.70	**7.60**
B736	1.18	1.74	**2.92**
B738	1.68	2.54	**4.22**
B741	0.01	0.00	**0.01**
B742C3	0.82	0.04	**0.86**
B744G	3.34	0.55	**3.88**
B744P	4.83	0.67	**5.50**
B744R	13.19	1.21	**14.40**
B747SP	0.03	0.12	**0.15**
B757C	0.15	0.52	**0.67**
B757E	4.97	8.81	**13.78**
B757P	0.53	0.47	**1.00**
B762	0.65	0.94	**1.59**
B763G	0.97	0.82	**1.79**
B763P	0.76	1.65	**2.41**
B763R	4.85	5.66	**10.50**
B772G	4.84	1.93	**6.77**
B772P	1.20	0.44	**1.64**
B772R	5.60	4.31	**9.91**
B773G	2.26	0.88	**3.14**
B773R	0.68	0.46	**1.14**
BA46	0.32	0.28	**0.60**
CRJ	0.57	0.06	**0.63**
CRJ700	0.35	0.04	**0.39**
DC10	0.04	0.02	**0.07**
EA30	1.16	1.22	**2.37**
EA31	0.49	0.08	**0.58**
EA318	0.72	0.61	**1.32**
EA319C	1.73	1.53	**3.26**
EA319V	20.89	24.31	**45.19**
EA320C	14.11	16.91	**31.02**
EA320V	15.11	16.74	**31.84**
EA321C	7.01	11.04	**18.04**
EA321V	6.57	8.29	**14.87**
EA33	4.84	1.86	**6.70**
EA34	7.99	4.12	**12.11**
EA346	4.56	0.80	**5.36**
ERJ	0.82	1.40	**2.23**
ERJ170	0.02	0.14	**0.15**
EXE2	0.00	0.00	**0.01**
EXE3	0.82	0.84	**1.66**
FK10	0.01	0.04	**0.04**
L101	0.01	0.01	**0.01**
L4P	0.00	0.00	**0.00**
LTT	1.14	0.90	**2.04**
MD11	0.63	0.22	**0.85**
MD80	4.11	2.94	**7.04**
SP	0.00	0.00	**0.00**
STT	0.04	0.04	**0.08**
TU54	0.00	0.00	**0.01**
Totals*	**150.50**	**131.90**	**282.40**

***Totals may not sum exactly due to rounding.**

TABLE 3: DISTRIBUTION OF HEATHROW AVERAGE DAILY AIRCRAFT MOVEMENTS BY ANCON TYPE (ANNUAL 8 HOUR NIGHT 2300-0700 LOCAL TIME)

ANCON Type	Departures	Arrivals	Movements*
B733	0.42	0.06	**0.48**
B736	0.04	0.04	**0.08**
B738	0.54	0.02	**0.56**
B741	0.00	0.00	**0.00**
B742C3	0.02	0.09	**0.11**
B744G	0.08	2.06	**2.14**
B744P	0.37	2.89	**3.25**
B744R	1.29	19.42	**20.71**
B747SP	0.01	0.00	**0.01**
B757C	0.37	0.00	**0.37**
B757E	0.38	0.17	**0.55**
B757P	0.13	0.01	**0.13**
B762	0.34	0.13	**0.46**
B763G	0.11	0.26	**0.38**
B763P	0.08	2.00	**2.08**
B763R	0.51	2.09	**2.60**
B772G	0.50	6.11	**6.61**
B772P	0.20	2.67	**2.86**
B772R	0.48	5.62	**6.09**
B773G	0.12	0.00	**0.12**
B773R	0.14	0.00	**0.14**
BA46	0.05	0.01	**0.06**
CRJ	0.00	0.01	**0.01**
CRJ700	0.00	0.01	**0.01**
DC10	0.02	0.00	**0.02**
EA30	0.42	0.11	**0.53**
EA31	0.03	0.00	**0.03**
EA319C	0.36	0.04	**0.41**
EA319V	2.41	0.76	**3.18**
EA320C	2.56	0.64	**3.20**
EA320V	1.57	0.78	**2.34**
EA321C	3.28	0.31	**3.59**
EA321V	0.82	0.37	**1.20**
EA33	0.68	2.53	**3.21**
EA34	0.91	2.08	**3.00**
EA346	0.54	2.82	**3.37**
ERJ	0.02	0.05	**0.07**
ERJ170	0.00	0.00	**0.00**
EXE3	0.23	0.23	**0.46**
FK10	0.00	0.00	**0.00**
L101	0.01	0.00	**0.01**
L4P	0.00	0.00	**0.01**
LTT	0.12	0.37	**0.49**
MD11	0.12	0.00	**0.12**
MD80	0.12	0.02	**0.15**
STP	0.02	0.02	**0.04**
STT	0.07	0.09	**0.15**
Totals*	**20.49**	**54.91**	**75.40**

***Totals may not sum exactly due to rounding.**

TABLE 4: PERCENTAGE OF HEATHROW AVERAGE DEPARTURES BY ROUTE* FOR DAY, EVENING AND NIGHT

WESTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES Annual 12 hour day 2006	PERCENTAGE OF TOTAL DEPARTURES Annual 4 hour evening 2006	PERCENTAGE OF TOTAL DEPARTURES Annual 8 hour night 2006
WOB/BPK	30.7	27.8	23.3
DVR/DET	16.7	21.4	26.1
MID	10.6	13.1	15.6
CPT/SAM	12.0	8.7	7.0
PERCENTAGE WEST	70.0	71.0	72.0
EASTERLY DEPARTURE ROUTE	PERCENTAGE OF TOTAL DEPARTURES Annual 12 hour day 2006	PERCENTAGE OF TOTAL DEPARTURES Annual 4 hour evening 2006	PERCENTAGE OF TOTAL DEPARTURES Annual 8 hour night 2006
BUZ/BPK	12.8	11.6	8.5
DVR/DET	7.0	8.2	10.4
MID/SAM	6.5	6.9	8.0
CPT	3.7	2.3	1.1
PERCENTAGE EAST	30.0	29.0	28.0

* See Figure 2

TABLE 5: PERCENTAGE USE OF THE RUNWAYS DURING WESTERLY AND EASTERLY OPERATIONS FOR DEPARTURES AND ARRIVALS FOR EACH CONTOUR SET

Heathrow contour sets	Departures west 27L / 27R	Departures east 09L / 09R
Annual L_{day}	58.7% / 41.3%	0.1% / 99.9%
Annual $L_{evening}$	59.4% / 40.6%	0% / 100%
Annual L_{night}	61.5% / 38.5%	0.2% / 99.8%
Annual L_{den}	59.0% / 41.0%	0.1% / 99.9%
Annual $L_{Aeq,16hr}$	58.9% / 41.1%	0.1% / 99.9%

Heathrow contour sets	Arrivals west 27L / 27R	Arrivals east 09L / 09R
Annual L_{day}	41.1% / 58.9%	98.2% / 1.8%
Annual $L_{evening}$	41.7% / 58.3%	96.5% / 3.5%
Annual L_{night}	51.1% / 48.9%	55.1% / 44.9%
Annual L_{den}	42.0% / 58.0%	94.4% / 5.6%
Annual $L_{Aeq,16hr}$	41.2% / 58.8%	97.8% / 2.2%

TABLE 6: HEATHROW 2006 - AREAS, POPULATIONS AND HOUSEHOLDS WITHIN CONTOUR BANDS

(a) Average mode annual 12 hour day L_{day}

Contour band (dBA)	Area (km²)	Population (000s)	Households (000s)
55 - 59.9	113.7	374.7	165.7
60 - 64.9	36.8	86.9	35.7
65 - 69.9	17.9	21.3	8.2
70 - 74.9	5.7	2.7	1.0
>75	3.5	<0.1	<0.1

(b) Average mode annual 4 hour evening $L_{evening}$

Contour band (dBA)	Area (km²)	Population (000s)	Households (000s)
55 - 59.9	119.6	344.2	150.1
60 - 64.9	37.9	85.8	34.5
65 - 69.9	18.1	18.1	7.0
70 - 74.9	6.3	2.3	1.0
>75	3.8	<0.1	<0.1

(c) Average mode annual 8 hour night L_{night}

Contour band (dBA)	Area (km²)	Population (000s)	Households (000s)
50 - 54.9	50.3	145.3	64.8
55 - 59.9	22.2	45.7	18.1
60 - 64.9	7.4	14.6	5.4
65 - 69.9	2.7	1.7	0.6
>70	1.8	<0.1	<0.1

(d) Average mode annual 16 hour day $L_{Aeq,16hr}$

Contour band (dBA)	Area (km²)	Population (000s)	Households (000s)
55 - 59.9	115.4	371.0	164.1
60 - 64.9	36.8	86.0	35.0
65 - 69.9	18.0	20.4	7.8
70 - 74.9	5.9	2.7	1.0
>75	3.6	<0.1	<0.1

(e) Average mode annual 24 hour L_{den}

Contour band (dBA)	Area (km²)	Population (000s)	Households (000s)
55 - 59.9	152.0	561.5	257.0
60 - 64.9	55.6	140.3	60.2
65 - 69.9	23.4	44.6	17.9
70 - 74.9	8.7	8.9	3.2
>75	5.0	0.7	0.3

FIGURE 1: HEATHROW AIRPORT RUNWAY LAYOUT

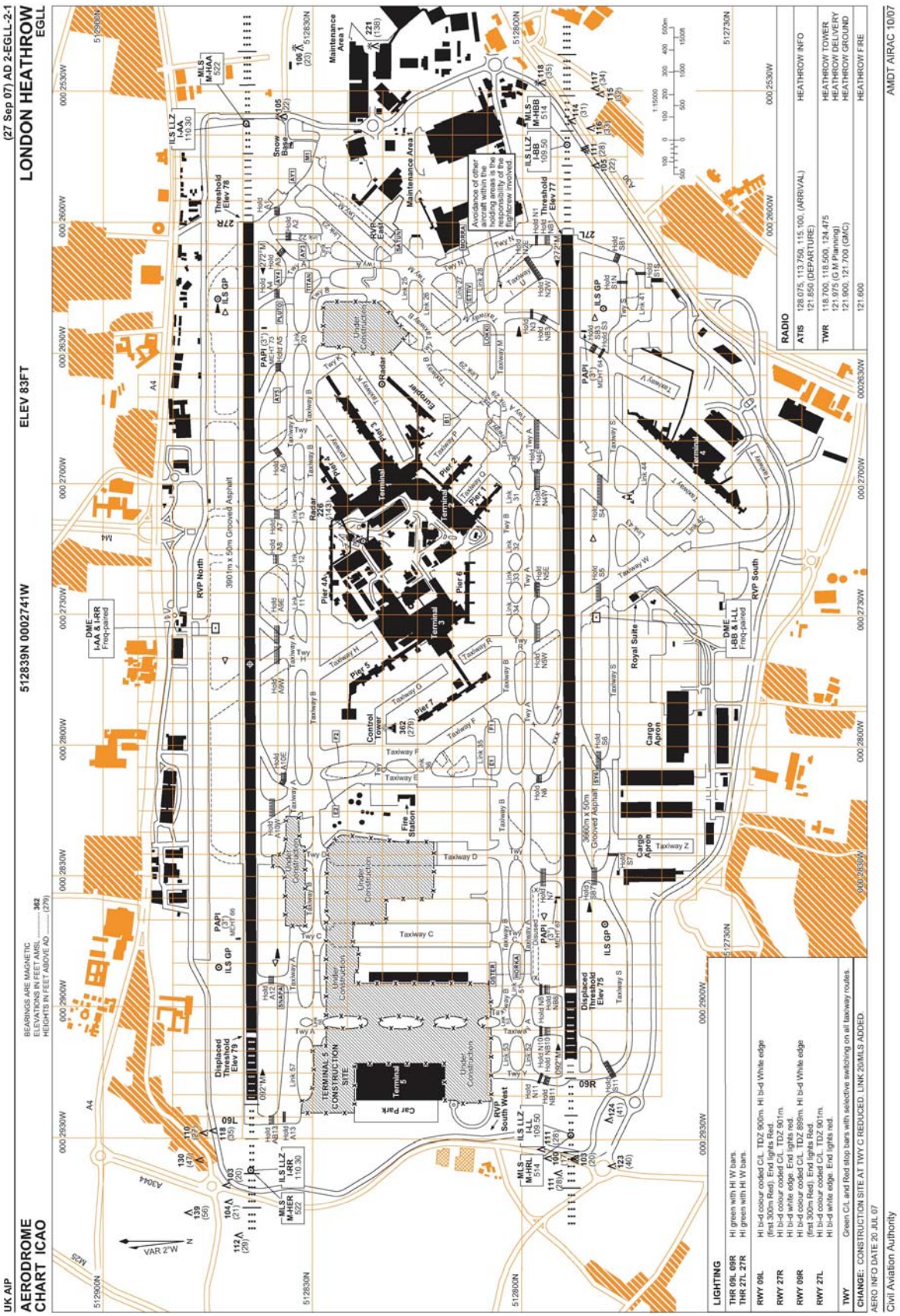


FIGURE 2: HEATHROW AIRPORT STANDARD INSTRUMENT DEPARTURE ROUTES

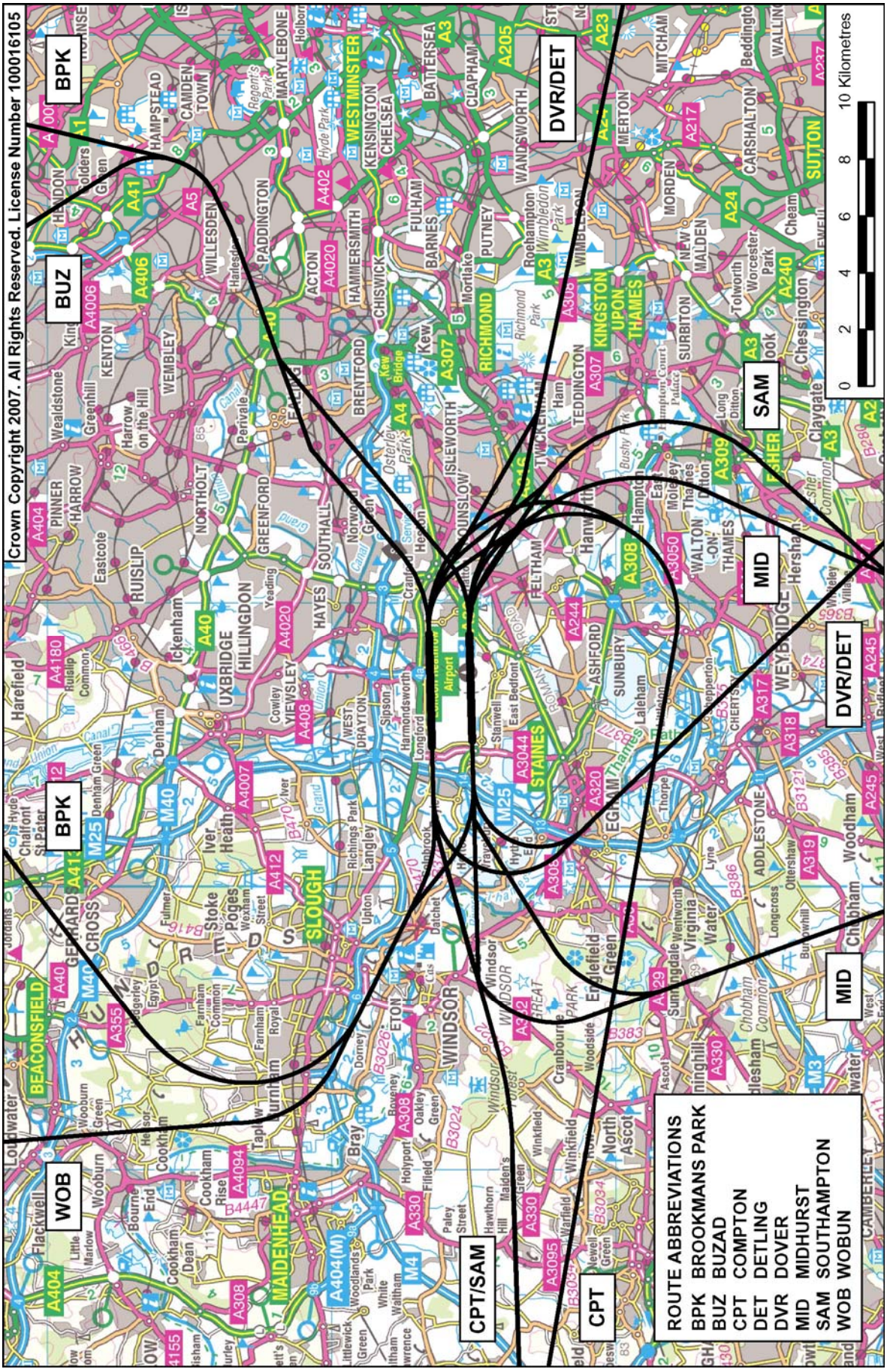


FIGURE 3: HEATHROW AIRPORT
Year 2006 annual 12 hour L_{day} terrain adjusted noise contours (0700-1900 LT)
actual modal split 70% west / 30% east

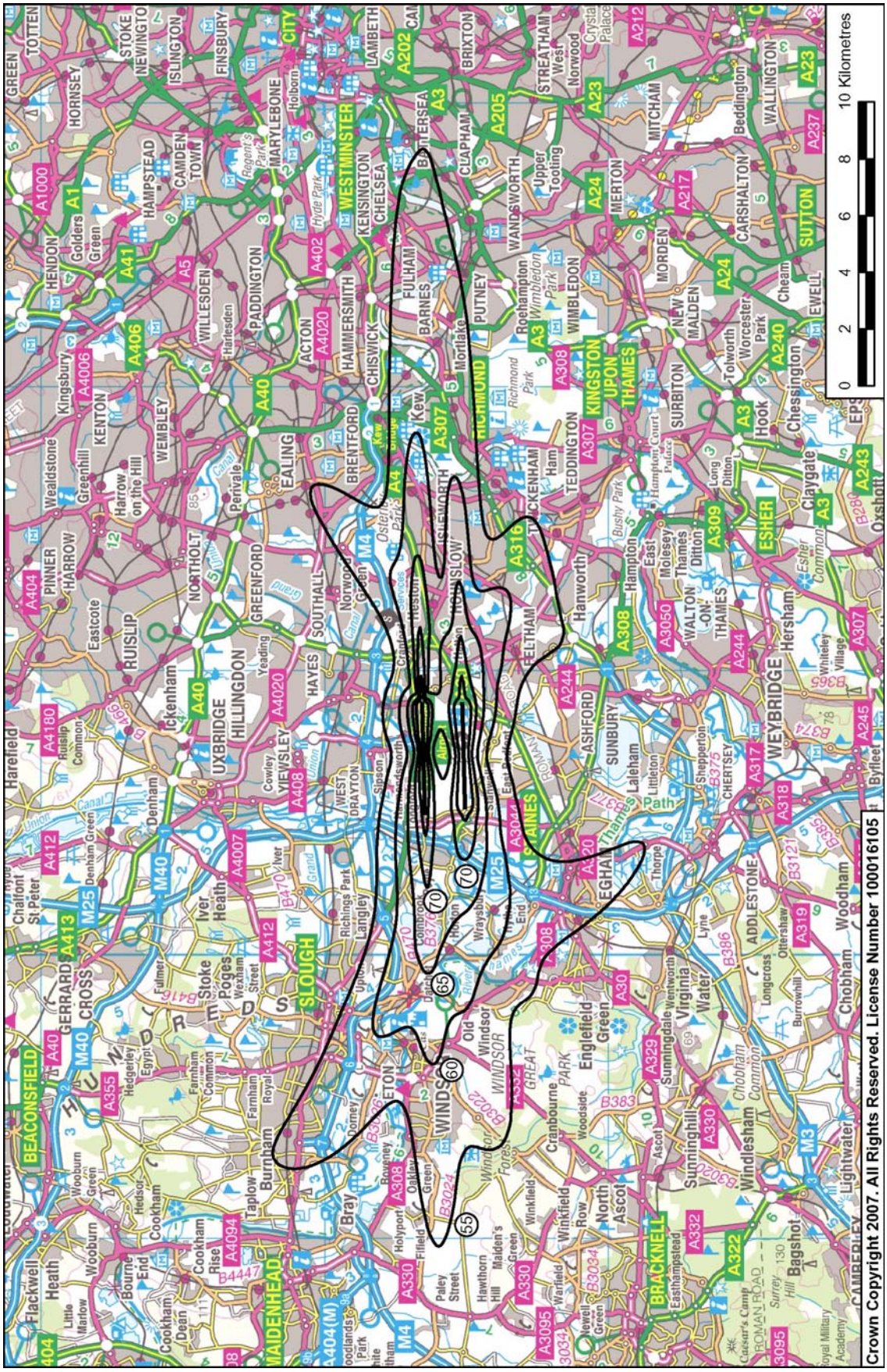


FIGURE 4: HEATHROW AIRPORT
Year 2006 annual 4 hour $L_{evening}$ terrain adjusted noise contours (1900-2300 LT)
actual modal split 71% west / 29% east

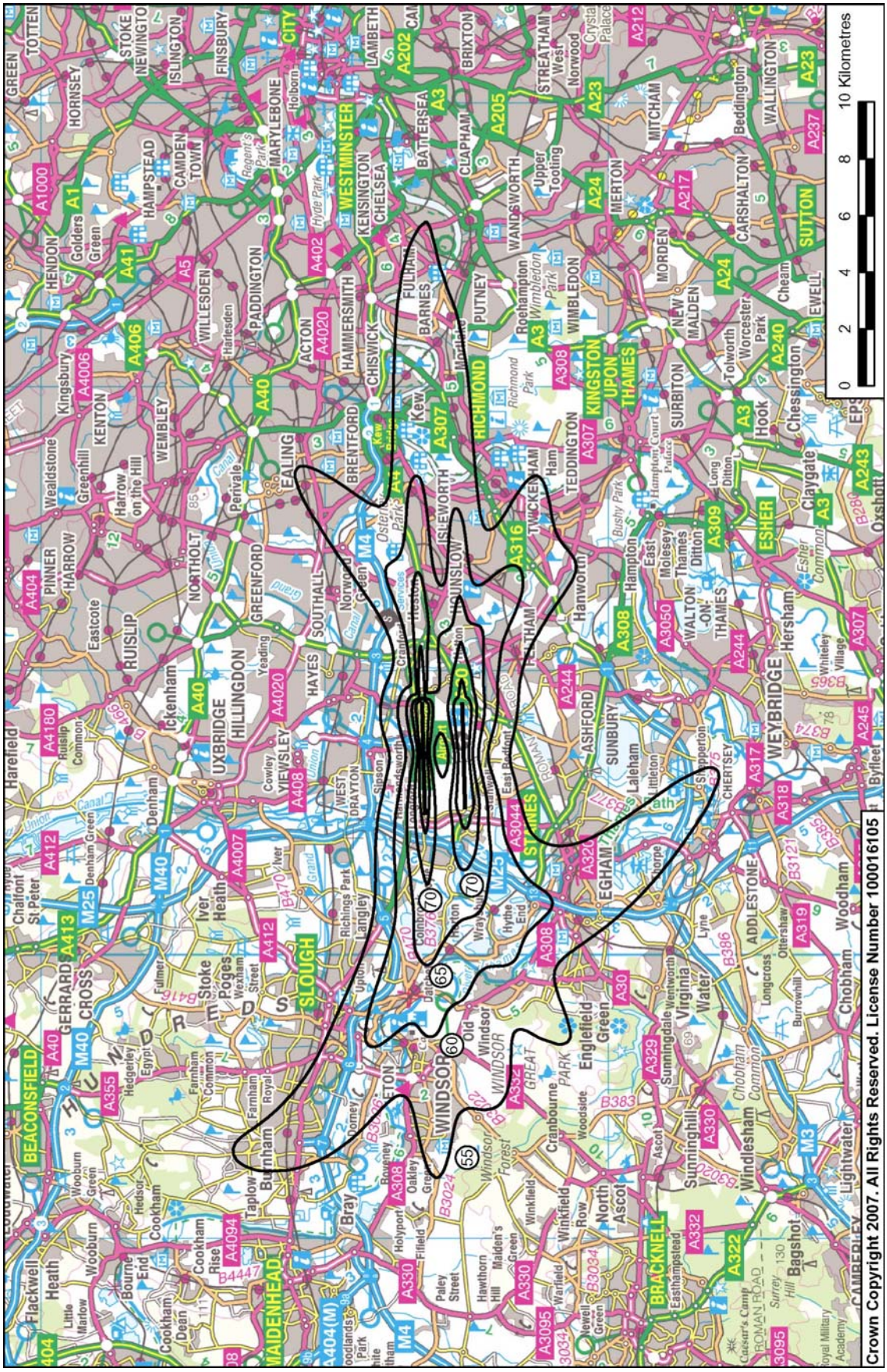


FIGURE 5: HEATHROW AIRPORT
Year 2006 annual 8 hour L_{night} terrain adjusted noise contours (2300-0700 LT)
actual modal split 72% west / 28% east

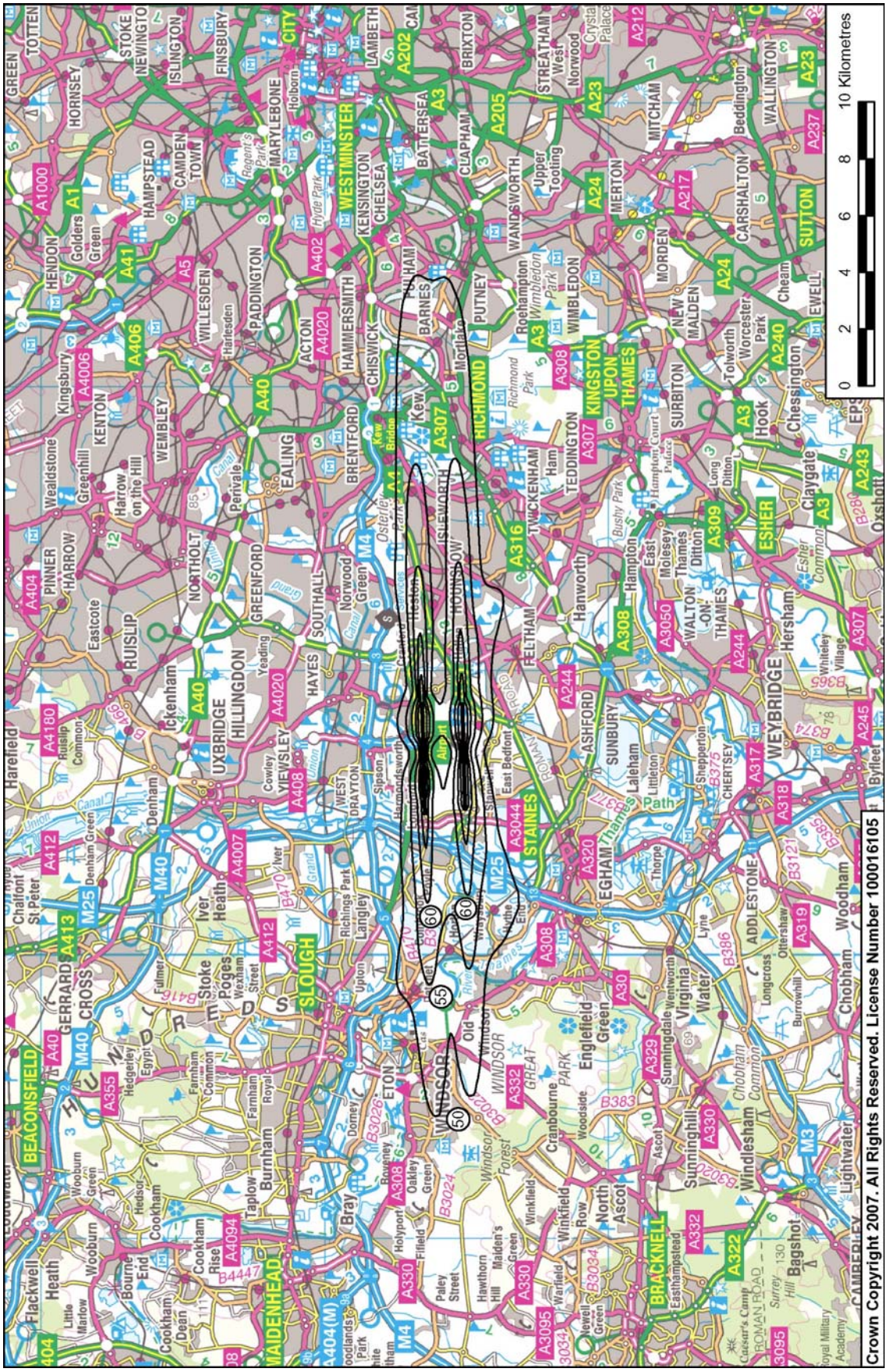


FIGURE 6: HEATHROW AIRPORT
Year 2006 annual 16 hour day $L_{Aeq,16hr}$ terrain adjusted noise contours (0700-2300 LT)
actual modal split 70% west / 30% east

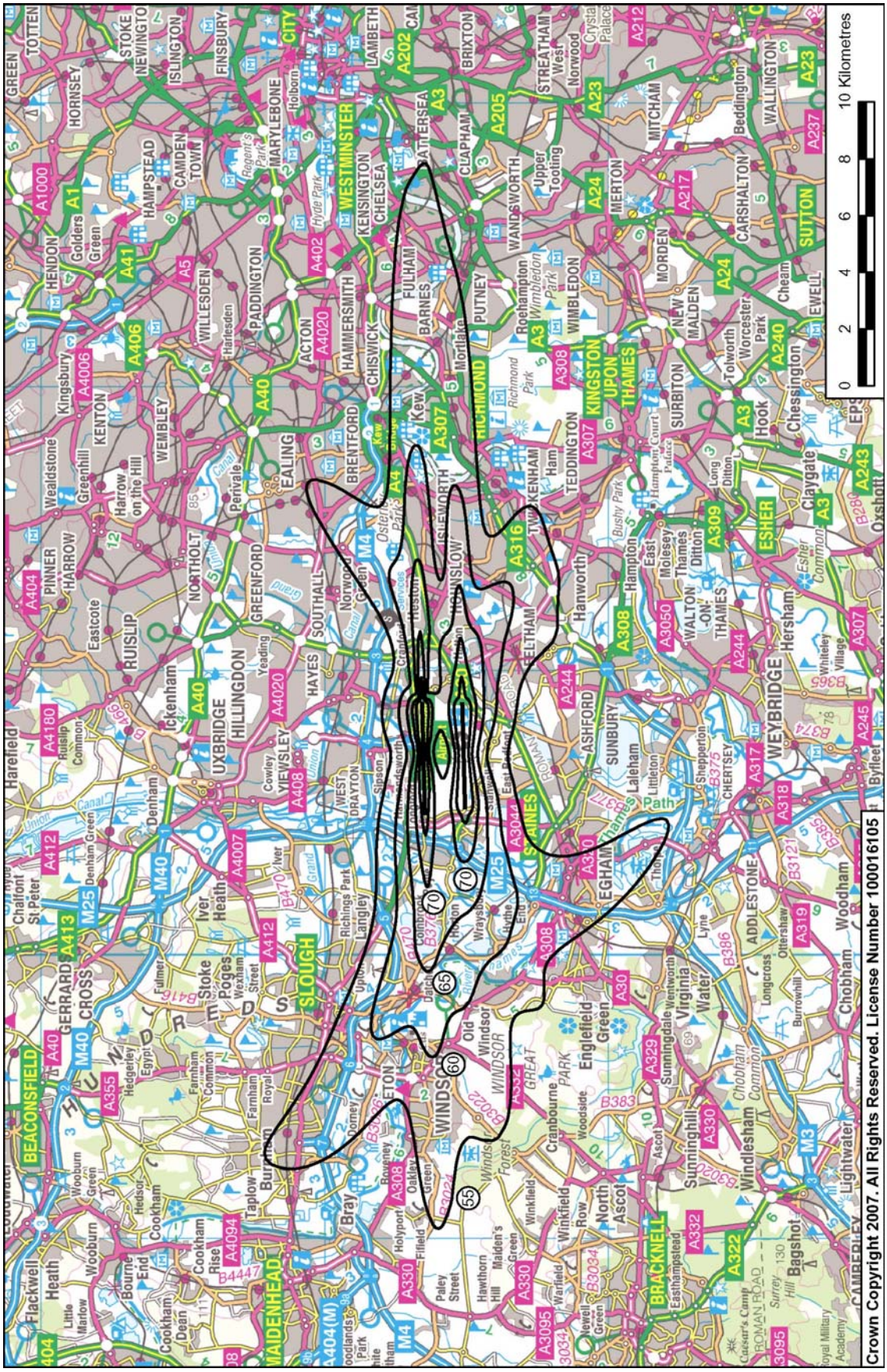
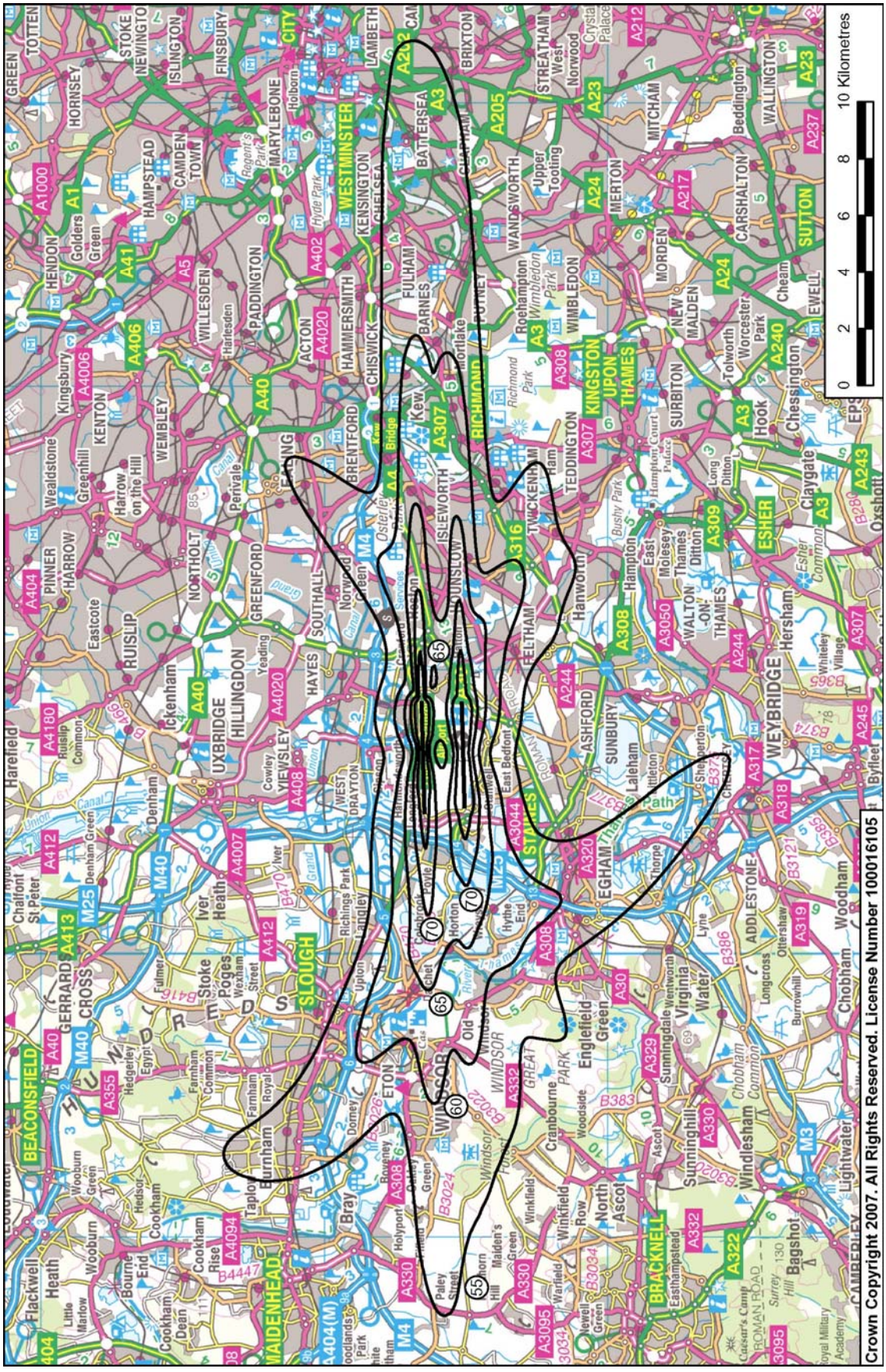


FIGURE 7: HEATHROW AIRPORT
Year 2006 annual 24 hour L_{den} terrain adjusted noise contours
actual modal split 70% west / 30% east



APPENDIX A ANCON TYPE DESCRIPTIONS

A full list of ANCON types applicable to the Heathrow 2006 strategic noise contours is summarised in the Table below:

Table A1 List of ANCON aircraft type categories *(continued on following page)*

ANCON Type	Type Description
B707C3	All Chapter 3 Boeing 707's.
B727C3	All Chapter 3 Boeing 727's.
B732C3	All Chapter 3 Boeing 737-200's.
B733	All Boeing 737-300/400/500 series
B736	All Boeing 737-600/700 series
B738	All Boeing 737-800/900 series
B741	All Boeing 747-100 series
B742C3	All Boeing 747-200/300 series certificated to Chapter 3.
B744G	Boeing 747-400 series with General Electric engines
B744P	Boeing 747-400 series with Pratt and Whitney engines
B744R	Boeing 747-400 series with Rolls Royce engines
B747SP	All Boeing 747SP series.
B757C	Boeing 757-200 series with RB211-535C engines.
B757E	Boeing 757-200 series with RB211-535E4/E4B engines.
B757P	Boeing 757-200 series with Pratt and Whitney engines.
B762	All Boeing 767-200 series.
B763G	All Boeing 767-300 series with General Electric engines.
B763P	All Boeing 767-300 series with Pratt and Whitney engines.
B763R	All Boeing 767-300 series with Rolls Royce engines.
B772G	All Boeing 777-200 series with General Electric engines
B772P	All Boeing 777-200 series with Pratt and Whitney engines.
B772R	All Boeing 777-200 series with Rolls Royce engines.
B773G	All Boeing 777-300 series with General Electric engines.
B773R	All Boeing 777-300 series with Rolls Royce engines.
BA46	All BAe 146/Avro RJ series.
CRJ	Bombardier Regional Jet 100/200.
CRJ700	Bombardier Regional Jet 700.
DC87	All McDonnell Douglas DC8-70 series
DC10	All McDonnell Douglas DC10 series

ANCON Type	Type Description
EA30	All Airbus A300 series
EA31	All Airbus A310 series
EA318	All Airbus A318 series
EA319C	Airbus A319 series with CFM-56 engines.
EA319V	Airbus A319 series with AE-V2500 engines.
EA320C	Airbus A320 series with CFM-56 engines.
EA320V	Airbus A320 series with AE-V2500 engines.
EA321C	Airbus A321 series with CFM-56 engines.
EA321V	Airbus A321 series with AE-V2500 engines.
EA33	All Airbus A330 series
EA34	All Airbus A340 series
ERJ	Embraer EMB135/145 series
ERJ170	Embraer E-170
EXE2	All Chapter 2 executive jets
EXE3	All Chapter 3 executive jets
FK10	All Fokker 70/100 series
L101	All Lockheed L1011-TriStar series
L4P	Large four-engined propeller
LTT	Large twin-turboprop
MD11	All McDonnell-Douglas MD11 series
MD80	All McDonnell-Douglas MD80 series
SP	Single piston
STP	Small twin-piston
STT	Small twin-turboprop
TU54	All Tupolev Tu-154 series