MAYOR OF LONDON

Transport for London

Inner Thames Estuary Feasibility Study

Response to Airports Commission Call for Evidence

The Mayor of London's Submission:
Supporting technical documents

23 May 2014

Title: **Aviation Noise Modelling: Heathrow Options**

Author: **CAA ERCD**

Purpose of paper: **To calculate and present the results of noise exposure contours for a series of scenarios that were developed relating to Heathrow Airport.**

Key messages:

- TfL/Atkins/CAA ERCD analysis shows that Heathrow's northwest runway proposal will expose more than 1.1 million people (1,097,200 when contour is placed upon 2012 population data, which will grow) to noise in excess of 55dB Lden, when fully utilised, compared to 725,100 people today

Civil Aviation Authority
Environmental Research and Consultancy Department

Aviation Noise Modelling: Heathrow Options

Issued: 16 May 2014

Introduction

The Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority (CAA) was commissioned by Atkins, on behalf of Transport for London (TfL), to calculate noise exposure contours for a series of scenarios that were developed by Atkins, and that relate to Heathrow Airport.

This document presents the methodology and results relating to the calculation of these noise contours. In undertaking this work, account was taken of the information presented in the Airports Commission Appraisal Framework[1] on the modelling of aviation noise.

A glossary of technical terms is provided in Appendix A.

Noise modelling

The ANCON noise model

The noise contours were calculated using the UK Civil Aircraft Noise Contour model ANCON (version 2.3). The ANCON model is developed and maintained by ERCD on behalf of the Department for Transport (DfT) and is used for the production of annual and forecast contours for Heathrow, Gatwick and Stansted airports, and a number of regional airports in the UK.

ANCON is fully compliant with the latest European guidance on noise modelling, ECAC.CEAC Doc 29 (3rd edition), published in December 2005[2]. This guidance document represents internationally agreed best practice as implemented in modern aircraft noise models.

Methodology

Aviation noise was calculated for both takeoff and landing operations, accounting for engine and airframe noise. The contours show ‘air noise’, which comprises the noise from aircraft whilst flying in the air and when on the runway during the take-off and landing roll. Noise from ground-based activities such as aircraft taxiing and engine testing (‘ground noise’) is not considered.

Information on runway, route and landing threshold geometry was provided by Atkins for each scenario. Dispersion was used to model the departure tracks, as advised by Atkins. This was transposed into the ANCON model.

[1] Airports Commission: Appraisal Framework, April 2014

[2] 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

Atkins provided annual and summer average aircraft movement numbers by aircraft type, period of the day (day, evening and night), runway and route for each scenario (assumptions on supplied data are listed in **Appendix E**). For the two scenarios that required a current fleet mix to be modelled (Runs 1a and 1b, see below), the fleet mix from the 2012 Heathrow noise contours[3] was used.

Each scenario was modelled using modal splits to represent operations both with and without a westerly preference.

The options and key assumptions for the scenarios modelled are described below. The scenarios are identified by the run option code from the original modelling specification from Atkins.

Heathrow with two-runways:

- Run 1 – 480,000 movements, future fleet mix, 2012 routes, no westerly preference (67% westerly operations) and with displaced landing thresholds ('do-minimum' scenario).
- Run 1a – 480,000 movements, 2012 fleet mix, 2012 routes, westerly preference (77% westerly operations), with displaced landing thresholds and active Cranford agreement.
- Run 1b – 480,000 movements, 2012 fleet mix, 2012 routes, no westerly preference (67% westerly operations) and with displaced landing thresholds.
- Run 1c – 480,000 movements, future fleet mix, 2012 routes, westerly preference (77% westerly operations) and with displaced landing thresholds ('do-minimum' scenario).

Heathrow with additional third runway to the northwest:

- Run 2 – 740,000 movements, future fleet mix, future routes, westerly preference (77% westerly operations) and with displaced landing thresholds.
- Run 2c – 740,000 movements, future fleet mix, future routes, no westerly preference (67% westerly operations) and with displaced landing thresholds.

Heathrow with westerly extension to northern runway:

- Run 3 – 670,000 movements, future fleet mix, future routes, westerly preference (77% westerly operations) and with displaced landing thresholds.

[3] ERCD Report 1301, Noise Exposure Contours for Heathrow Airport 2012.

- Run 3c – 670,000 movements, future fleet mix, future routes, no westerly preference (67% westerly operations) and with displaced landing thresholds.

Existing aircraft were modelled using the latest (2012) ANCON noise database for operations at Heathrow Airport. This database is reviewed and updated annually and reflects the operational noise performance of each aircraft type at Heathrow.

The estimated noise performance of the imminent and future next generation aircraft types was developed based on available manufacturers' data and current industry knowledge. The process and rationale used for this is summarised in Appendix B.

Noise exposure contours were calculated for the metrics listed below, as specified in the Appraisal Framework:

- $L_{Aeq,16h}$ metric calculated for average summer day movements provided over the 16-hour daytime period between 07:00 and 23:00. Contours from 54 to 72 dB were plotted in 3 dB steps.
- $L_{Aeq,8h}$ metric calculated for average summer night movements provided over the 16-hour daytime period between 23:00 and 07:00. Contours from 48 to 72 dB were plotted, where relevant, in 3 dB steps.
- L_{den} metric calculated for the annual average daily movements given or forecast for all runs over the 24-hour period, with weightings of 5 dB for evening (19:00 - 23:00) and 10 dB for night-time (23:00 - 07:00). Contours from 55 to 75 dB were plotted in 5 dB steps.
- N70 'number above' metric describes the number of noise events (N) exceeding an outdoor maximum noise level (L_{max}). Calculated for the busy summer day movements provided over the 16-hour daytime period between 07:00 and 23:00. Contours of N greater than 20, 50, 100, 200 and 500 were plotted where relevant.
- N60, similar to the N70 metric, but calculated for the busy summer night movements provided over the 8-hour night-time period between 23:00 and 07:00. Contours of N greater than 25 and 50 were plotted where relevant.

The areas, populations and numbers of households enclosed by the contours were calculated. The population and households estimates were calculated using the CACI 2012 update of the 2001 Census population data for the UK.

Population and household data have not been adjusted to reflect any future changes. As such, the populations and numbers of households within the

airport site boundary extensions for the future third runway and north runway extension scenarios have not been removed from these estimates.

Results

The noise contours were provided to Atkins in digital CAD format. The areas, populations and number of households enclosed by the contours for the scenarios and metrics listed above are presented in **Appendix C** (Tables C1 to C40). A summary table of the populations affected by the lower level noise contours is given in Table 1 below:

Table 1: Summary of 2012 Population Affected (thousands)

Run	54dB 16h Day L_{Aeq}	57dB 16h Day L_{Aeq}	More than 20 Events N70 16h Day	55dB 24h L_{den}	48dB 8h Night L_{Aeq}	More than 25 Events N60 8h Night
1	286.6	132.7	252.3	442.2	286.0	229.5
1a	570.7	229.1	345.3	707.5	368.8	228.0
1b	556.0	218.1	406.0	713.5	325.4	198.4
1c	302.8	136.1	221.8	501.3	323.3	343.6
2	724.3	237.1	374.6	1.097.2	782.5	971.0
2c	637.2	232.1	417.4	986.6	659.8	859.6
3	698.2	261.5	370.4	885.5	588.9	564.8
3c	642.4	249.7	404.5	826.7	510.0	554.1

A selection of contour figures produced by Atkins (16h Day N70 and Lden for Run 1a and Run 2) are presented in **Appendix D** (Figures D1 to D6).

Owing to the large numbers of operations and corresponding fleet mixes prescribed for the future scenarios, the contours calculated for some of the lower contour levels extend to much greater distances from the airport than the Heathrow Airport annual noise contours. In such cases, the results should be treated with caution because: a) the calculated contours extend beyond the geographical region within which the noise model is validated using noise measurements; and b) the routes flown by aircraft are only clearly defined close to the airport, as at greater distances aircraft may be guided off the standard routes by air traffic control.

APPENDIX A

Glossary of Technical Terms

ANCON	The UK civil aircraft noise contour model, developed and maintained by ERCD.
CAD	Computer Aided Design.
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).
ECAC	European Civil Aviation Conference.
ERCD	Environmental Research and Consultancy Department of the Civil Aviation Authority.
$L_{Aeq,16h}$	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.
$L_{Aeq,8h}$	Equivalent sound level of aircraft noise in dBA often called 'equivalent continuous sound level'. This is based on the daily average movements that take place within the 8-hour period (2300-0700 local time) over the 92-day summer period from 16 June to 15 September inclusive.
L_{den}	Equivalent sound level of aircraft noise in dBA for the 24-hour annual average period with 5 dB weightings for $L_{evening}$ and 10 dB weightings for L_{night}.
N70 & N60	'Number above' contours describe the number of noise events (N) exceeding an outdoor maximum noise level of 70 dBA Lmax for N70 (based on an average summer's 16-hour day), and 60 dBA Lmax for N60 (based on an average summer's 8-hour night).
NPPF	National Planning Policy Framework.
NPSE	Noise Policy Statement for England.
TfL	Transport for London

APPENDIX B

Future Aircraft Types for Forecasting

Introduction

The requirement to forecast aircraft noise exposure to 2050 necessitates the definition of future aircraft types and their associated noise characteristics.

Historical trends clearly show that each generation of aircraft are quieter than their predecessor, significantly so in some cases. This is a reflection of the introduction of new technologies, of which some are aimed purely at reducing aircraft noise, whilst others are, for example, aimed at reducing fuel burn.

This changing of noise performance over time necessitates the need to take into account how the aircraft fleet will change.

Methodology

For each future aeroplane type, an explicit 'surrogate' has been chosen; a similar aircraft type whose certificated noise levels are known. For a given future type, the noise model data for this surrogate aircraft are then adjusted based on the differences between the future type's predicted certification data and the surrogate aircraft's known data.

The same approach has been used as in previous assessments such as the noise study undertaken in support of the Department for Transport's (DfT) Consultation: Adding Capacity at Heathrow Airport, which formed part of the Project for the Sustainable Development of Heathrow (PSDH)[4].

Future aircraft types

The assumptions on the noise characteristics of the future aircraft types presented in this assessment are based on the latest available data. They update the assumptions used in the previous ERCD studies and are aligned to the guidance in The SA Noise Road-Map[5]. There are two categories of future aircraft:

[4] ERCD Report 0705, Revised Future Aircraft Noise Exposure Estimates for Heathrow Airport, November 2007. www.caa.co.uk/ERCDreport0705

[5] The SA Noise Road-Map, A Blueprint for Managing Noise from Aviation Sources to 2050. 2013, Sustainable Aviation.

- *Imminent* aircraft types incorporating Generation 1 technology with significant fuel burn and noise benefits. These have recently entered, or are currently offered for sale to the market, and include all-new aircraft as well as re-engined aircraft.
- *Future* aircraft types incorporating Generation 2 technology, which aim to achieve the noise goals set out in Flightpath 2050[6]. These types are envisaged to eventually replace the Imminent Generation 1 aircraft.

In the former case, the noise characteristics are well-defined. In the latter case, the assumptions are based on expected technological advances and underlying trends as well as the entry into service (EIS) date of the Generation 2 aircraft type relative to Generation 1 predecessors.

Use has been made of the Sustainable Aviation assumption of a 0.1 dB/year baseline rate of improvement from the Generation 1 introduction dates (assuming no technology step-changes or major configurational changes).

Descriptions of the basic characteristics of the Imminent (Generation 1) and Future (Generation 2) types are given in The SA Noise Road-Map. **Tables B1 and B2** below identify the new types, presenting the surrogate types and corresponding adjustments used to model them.

[6] Flightpath 2050, Europe's Vision for Aviation. 2011, European Commission.

Table B1: Generation 1 *Imminent* aircraft types and modelling assumptions

Aircraft category	Aircraft type	New ANCON model	ANCON model surrogate	Adjustment, dB	
				Departure	Arrival
Airbus single-aisle	A319 NEO	EA319NEO	A319V	-2.6	-1.9
Airbus single-aisle	A320 NEO	EA320NEO	A320V	-2.6	-2.2
Airbus single-aisle	A321 NEO	EA321NEO	A321V	-2.7	-1.0
Airbus twin-aisle	A350-800	EA358	EA33	-4.1	0.1
Airbus twin-aisle	A350-900	EA359	EA33	-4.2	0.4
Airbus twin-aisle	A350-1000	EA3510	EA33	-1.8	1.6
Airbus very large	A380-900	EA389	EA38	0.0	0.0
Boeing single-aisle	B737-700 MAX	B7377MAX	B736	-3.5	-1.0
Boeing single-aisle	B737-800 MAX	B7378MAX	B738	-3.9	-0.4
Boeing single-aisle	B737-900 MAX	B7379MAX	B738	-2.7	-0.1
Boeing twin-aisle	B787-8	B788	B763G	-4.3	-2.3
Boeing twin-aisle	B787-9	B789	B763G	-2.3	-1.1
Boeing twin-aisle	B787-10	B7810	B763G	-1.0	-0.3
Boeing very large	B747-8	B748	B744G	-4.65	-2.9
Generic regional jet	E170 NEO	ERJ170NEO	ERJ170	-6.5	-2.8
Generic regional jet	E190 NEO	ERJ190NEO	ERJ170	-4.6	-0.3

Table B2: Generation 2 *Future* aircraft types and modelling assumptions

Aircraft category	Aircraft type	New ANCON model	ANCON model surrogate	Adjustment, dB	
				Departure	Arrival
Airbus single-aisle	A319 NEO G2	EA319N2	EA319NEO	-0.7	-0.2
Airbus single-aisle	A320 NEO G2	EA320N2	EA320NEO	-0.7	-0.2
Airbus single-aisle	A321 NEO G2	EA321N2	EA321NEO	-0.7	-0.2
Airbus twin-aisle	A350-800 G2	EA358N2	EA358	-1.7	-0.4
Airbus twin-aisle	A350-900 G2	EA359N2	EA359	-2.1	-0.4
Airbus twin-aisle	A350-1000 G2	EA3510N2	EA3510	-2.0	-0.4
Airbus very large	A380-800 NEO G2	EA38NEO	EA38	-1.0	0.0
Airbus very large	A380-900 NEO G2	EA389NEO	EA389	-1.0	0.0
Boeing single-aisle	B737-700 MAX G2	B7377N2	B7377MAX	-0.7	-0.1
Boeing single-aisle	B737-800 MAX G2	B7378N2	B7378MAX	-0.6	-0.1
Boeing single-aisle	B737-900 MAX G2	B7379N2	B7379MAX	-0.6	-0.1
Boeing twin-aisle	B787-8 G2	B788N2	B788	-1.9	-0.4
Boeing twin-aisle	B787-9 G2	B789N2	B789	-2.2	-0.4
Boeing twin-aisle	B787-10 G2	B7810N2	B7810	-1.9	-0.4
Boeing very large	B747-8 G2	B748N2	B748	-2.3	-0.5
Generic regional jet	E170 NEO G2	ERJ170N2	ERJ170NEO	-1.4	-0.3
Generic regional jet	E190 NEO G2	ERJ190N2	ERJ190NEO	-1.4	-0.3

APPENDIX C

Results Tables

Scenario: Heathrow with two-runways, Run 1

480,000 movements, future fleet mix, 2012 routes, no westerly preference (67% westerly operations) and with displaced landing thresholds ('do-minimum' scenario)

Table C1: $L_{Aeq,16h\ Day}$

Contour, dBA	Area, km^2	Population	Households
>54	116.9	286,600	119,000
>57	64.7	132,700	52,500
>60	38.3	63,500	24,400
>63	22.5	20,400	7,600
>66	10.6	3,800	1,500
>69	5.6	200	100
>72	3.1	<50	<50

Table C2: N70 16h Day

Number above	Area, km^2	Population	Households
>20	110.9	252,300	103,300
>50	65.6	132,000	53,600
>100	41.3	73,700	28,500
>200	25.5	30,000	11,200
>500	1.1	<50	<50

Table C3: L_{den}

Contour, dBA	Area, km^2	Population	Households
>55	137.8	442,200	188,200
>60	54.0	116,900	45,900
>65	20.1	23,900	8,900
>70	6.2	1,700	600
>75	2.3	<50	<50

Table C4: $L_{Aeq,8h\ Night}$

Contour, dBA	Area, km^2	Population	Households
>48	90.4	286,000	121,400
>51	54.1	137,500	56,000
>54	26.8	63,600	24,300
>57	13.3	25,100	9,400
>60	6.4	4,500	1,600
>63	3.2	900	300
>66	1.8	<50	<50
>69	1.1	<50	<50
>72	0.7	<50	<50

Table C5: N60 8h Night

Number above	Area, km^2	Population	Households
>25	55.0	229,500	97,400
>50	1.0	<50	<50

Scenario: Heathrow with two-runways, Run 1a

480,000 movements, 2012 fleet mix, 2012 routes, westerly preference (77% westerly operations) and with displaced landing thresholds

Table C6: $L_{Aeq,16h\ Day}$

Contour, dBA	Area, km^2	Population	Households
>54	198.9	570,700	241,900
>57	105.4	229,100	94,500
>60	58.1	99,100	39,200
>63	34.4	41,200	16,100
>66	20.2	10,000	3,900
>69	9.9	1,700	800
>72	5.3	200	100

Table C7: N70 16h Day

Number above	Area, km^2	Population	Households
>20	162.1	345,300	142,300
>50	95.1	179,600	73,300
>100	52.1	96,500	38,200
>200	34.2	50,900	19,700
>500	2.5	200	100

Table C8: L_{den}

Contour, dBA	Area, km^2	Population	Households
>55	213.3	707,500	304,800
>60	78.6	165,100	67,800
>65	31.3	40,700	15,900
>70	10.6	3,800	1,500
>75	3.8	<50	<50

Table C9: $L_{Aeq,8h\ Night}$

Contour, dBA	Area, km^2	Population	Households
>48	107.9	368,800	157,900
>51	62.0	157,200	64,900
>54	35.1	75,700	29,400
>57	17.8	31,000	11,800
>60	9.2	9,400	3,300
>63	4.8	1,900	600
>66	2.6	<50	<50
>69	1.5	<50	<50
>72	1.0	<50	<50

Table C10: N60 8h Night

Number above	Area, km^2	Population	Households
>25	59.0	288,000	124,500
>50	1.3	<50	<50

Scenario: Heathrow with two-runways, Run 1b

480,000 movements, 2012 fleet mix, 2012 routes, no westerly preference (67% westerly operations) and with displaced landing thresholds

Table C11: $L_{Aeq,16h\ Day}$

Contour, dBA	Area, km^2	Population	Households
>54	200.7	556,000	233,200
>57	104.3	218,100	88,200
>60	57.7	102,300	40,100
>63	35.1	45,000	17,300
>66	20.6	12,500	4,800
>69	9.7	3,000	1,200
>72	5.2	200	100

Table C12: N70 16h Day

Number above	Area, km^2	Population	Households
>20	169.2	406,000	167,900
>50	91.6	175,900	70,700
>100	52.5	100,500	39,600
>200	34.1	49,600	19,100
>500	2.7	<50	<50

Table C13: L_{den}

Contour, dBA	Area, km^2	Population	Households
>55	220.8	713,500	304,900
>60	78.2	166,800	67,300
>65	32.5	45,700	17,600
>70	10.7	4,100	1,600
>75	3.9	<50	<50

Table C14: $L_{Aeq,8h\ Night}$

Contour, dBA	Area, km^2	Population	Households
>48	106.3	325,400	138,500
>51	61.4	145,700	59,400
>54	35.4	72,600	28,000
>57	17.8	27,500	10,400
>60	9.2	7,500	2,700
>63	4.9	1,800	600
>66	2.6	<50	<50
>69	1.6	<50	<50
>72	1.0	<50	<50

Table C15: N60 8h Night

Number above	Area, km^2	Population	Households
>25	51.0	198,400	84,900
>50	0.7	<50	<50

Scenario: Heathrow with two-runways, Run 1c

480,000 movements, future fleet mix, 2012 routes, westerly preference (77% westerly operations) and displaced landing thresholds ('do-minimum' scenario)

Table C16: $L_{Aeq,16h\ Day}$

Contour, dBA	Area, km^2	Population	Households
>54	118.4	302,800	127,200
>57	65.7	136,100	54,400
>60	38.5	64,600	24,900
>63	22.3	20,700	7,800
>66	10.7	4,000	1,600
>69	5.6	200	100
>72	3.1	<50	<50

Table C17: N70 16h Day

Number above	Area, km^2	Population	Households
>20	106.0	221,800	91,300
>50	65.6	131,500	53,600
>100	42.0	78,900	30,600
>200	26.7	38,900	15,000
>500	2.1	<50	<50

Table C18: L_{den}

Contour, dBA	Area, km^2	Population	Households
>55	140.0	501,300	216,000
>60	55.0	125,800	50,200
>65	20.8	27,600	10,500
>70	6.3	2,000	700
>75	2.3	<50	<50

Table C19: $L_{Aeq,8h\ Night}$

Contour, dBA	Area, km^2	Population	Households
>48	90.3	323,300	138,000
>51	53.3	149,200	61,400
>54	27.2	73,700	28,400
>57	13.4	29,900	11,300
>60	6.5	7,000	2,400
>63	3.2	1,100	400
>66	1.8	<50	<50
>69	1.1	<50	<50
>72	0.6	<50	<50

Table C20: N60 8h Night

Number above	Area, km^2	Population	Households
>25	69.0	343,600	146,900
>50	5.1	21,700	8,400

Scenario: Heathrow with additional third runway to the northwest, Run 2

740,000 movements, future fleet mix, future routes, westerly preference (77% westerly operations) and with displaced landing thresholds

Table C21: $L_{Aeq,16h\ Day}$

Contour, dBA	Area, km^2	Population	Households
>54	203.1	724,300	313,700
>57	110.6	237,100	96,900
>60	65.5	108,400	42,400
>63	38.5	43,800	17,000
>66	19.7	12,200	5,000
>69	9.6	3,000	1,200
>72	5.2	900	400

Table C22: N70 16h Day

Number above	Area, km^2	Population	Households
>20	163.3	374,600	152,600
>50	103.3	208,400	85,500
>100	70.1	118,600	46,600
>200	45.9	72,500	28,300
>500	5.8	2,400	1,000

Table C23: L_{den}

Contour, dBA	Area, km^2	Population	Households
>55	241.2	1,097,200	484,600
>60	92.7	205,700	84,700
>65	37.1	54,700	21,300
>70	10.8	4,800	1,900
>75	3.9	900	400

Table C24: $L_{Aeq,8h\ Night}$

Contour, dBA	Area, km^2	Population	Households
>48	163.0	782,500	350,200
>51	95.9	267,000	111,900
>54	51.5	122,900	48,500
>57	24.1	48,800	18,600
>60	11.6	13,200	5,000
>63	5.8	2,000	800
>66	3.2	1,100	400
>69	1.8	700	300
>72	0.9	200	100

Table C25: N60 8h Night

Number above	Area, km^2	Population	Households
>25	160.0	971,000	436,200
>50	47.0	206,100	87,900

Scenario: Heathrow with additional third runway to the northwest, Run 2c

740,000 movements, future fleet mix, future routes, no westerly preference (67% westerly operations) and with displaced landing thresholds

Table C26: $L_{Aeq,16h\ Day}$

Contour, dBA	Area, km^2	Population	Households
>54	201.2	637,200	271,600
>57	108.3	232,100	93,700
>60	64.6	103,800	40,600
>63	38.7	41,900	16,200
>66	19.4	12,100	4,900
>69	9.5	2,600	1,100
>72	5.2	900	400

Table C27: N70 16h Day

Number above	Area, km^2	Population	Households
>20	167.5	417,400	170,400
>50	107.7	231,200	93,500
>100	68.8	117,000	46,000
>200	45.1	66,300	25,800
>500	5.6	1,100	400

Table C28: L_{den}

Contour, dBA	Area, km^2	Population	Households
>55	243.5	986,600	433,800
>60	91.0	190,400	77,400
>65	36.6	49,300	19,000
>70	10.8	4,200	1,700
>75	3.9	900	400

Table C29: $L_{Aeq,8h\ Night}$

Contour, dBA	Area, km^2	Population	Households
>48	164.7	659,800	292,700
>51	95.4	241,900	100,800
>54	51.7	109,200	42,400
>57	23.6	42,800	16,300
>60	11.5	10,900	4,100
>63	5.7	1,900	800
>66	3.2	900	400
>69	1.8	700	200
>72	0.9	200	100

Table C30: N60 8h Night

Number above	Area, km^2	Population	Households
>25	159.0	859,600	385,000
>50	19.1	51,400	19,800

Scenario: Heathrow with westerly extension to northern runway, Run 3

670,000 movements, future fleet mix, future routes, westerly preference (77% westerly operations) and with displaced landing thresholds

Table C31: $L_{Aeq,16h\ Day}$

Contour, dBA	Area, km^2	Population	Households
>54	190.0	698,200	299,600
>57	104.1	261,500	108,400
>60	58.3	115,300	45,500
>63	31.3	51,100	19,700
>66	16.1	15,400	5,800
>69	8.9	4,900	1,800
>72	5.1	2,200	800

Table C32: N70 16h Day

Number above	Area, km^2	Population	Households
>20	155.9	370,400	151,500
>50	98.3	226,000	92,400
>100	62.6	127,400	51,300
>200	35.8	69,700	27,200
>500	7.3	5,900	2,100

Table C33: L_{den}

Contour, dBA	Area, km^2	Population	Households
>55	216.8	885,500	385,400
>60	81.4	180,500	73,900
>65	29.7	53,000	20,300
>70	10.0	6,300	2,200
>75	3.8	500	200

Table C34: $L_{Aeq,8h\ Night}$

Contour, dBA	Area, km^2	Population	Households
>48	131.9	588,900	256,800
>51	76.7	227,900	95,400
>54	42.0	105,800	41,700
>57	20.7	43,100	16,000
>60	10.6	10,700	3,700
>63	5.4	2,200	700
>66	2.9	200	100
>69	1.6	<50	<50
>72	0.8	<50	<50

Table C35: N60 8h Night

Number above	Area, km^2	Population	Households
>25	109.0	564,800	247,700
>50	62.0	347,800	150,500

Scenario: Heathrow with westerly extension to northern runway, Run 3c

670,000 movements, future fleet mix, future routes, no westerly preference (67% westerly operations) and with displaced landing thresholds

Table C36: $L_{Aeq,16h\ Day}$

Contour, dBA	Area, km^2	Population	Households
>54	190.0	642,400	273,000
>57	102.8	249,700	101,900
>60	57.4	112,700	44,200
>63	31.7	50,800	19,400
>66	16.1	14,700	5,600
>69	8.9	4,600	1,700
>72	5.1	2,100	700

Table C37: N70 16h Day

Number above	Area, km^2	Population	Households
>20	160.4	404,500	166,100
>50	103.5	243,000	98,700
>100	64.8	136,900	55,000
>200	36.5	67,600	26,300
>500	6.3	5,200	1,800

Table C38: L_{den}

Contour, dBA	Area, km^2	Population	Households
>55	218.6	826,700	356,400
>60	80.0	176,100	71,800
>65	29.7	49,300	18,800
>70	10.0	6,000	2,100
>75	3.8	500	200

Table C39: $L_{Aeq,8h\ Night}$

Contour, dBA	Area, km^2	Population	Households
>48	133.8	510,000	221,300
>51	76.8	193,700	80,200
>54	42.2	95,400	37,200
>57	20.6	36,800	13,500
>60	10.5	9,000	3,100
>63	5.5	1,300	500
>66	3.0	200	100
>69	1.6	<50	<50
>72	0.8	<50	<50

Table C40: N60 8h Night

Number above	Area, km^2	Population	Households
>25	136.0	554,100	242,800
>50	59.5	292,700	125,600

APPENDIX D

Results Figures

Figure D1: Run 1a – 16h Day N70 contours

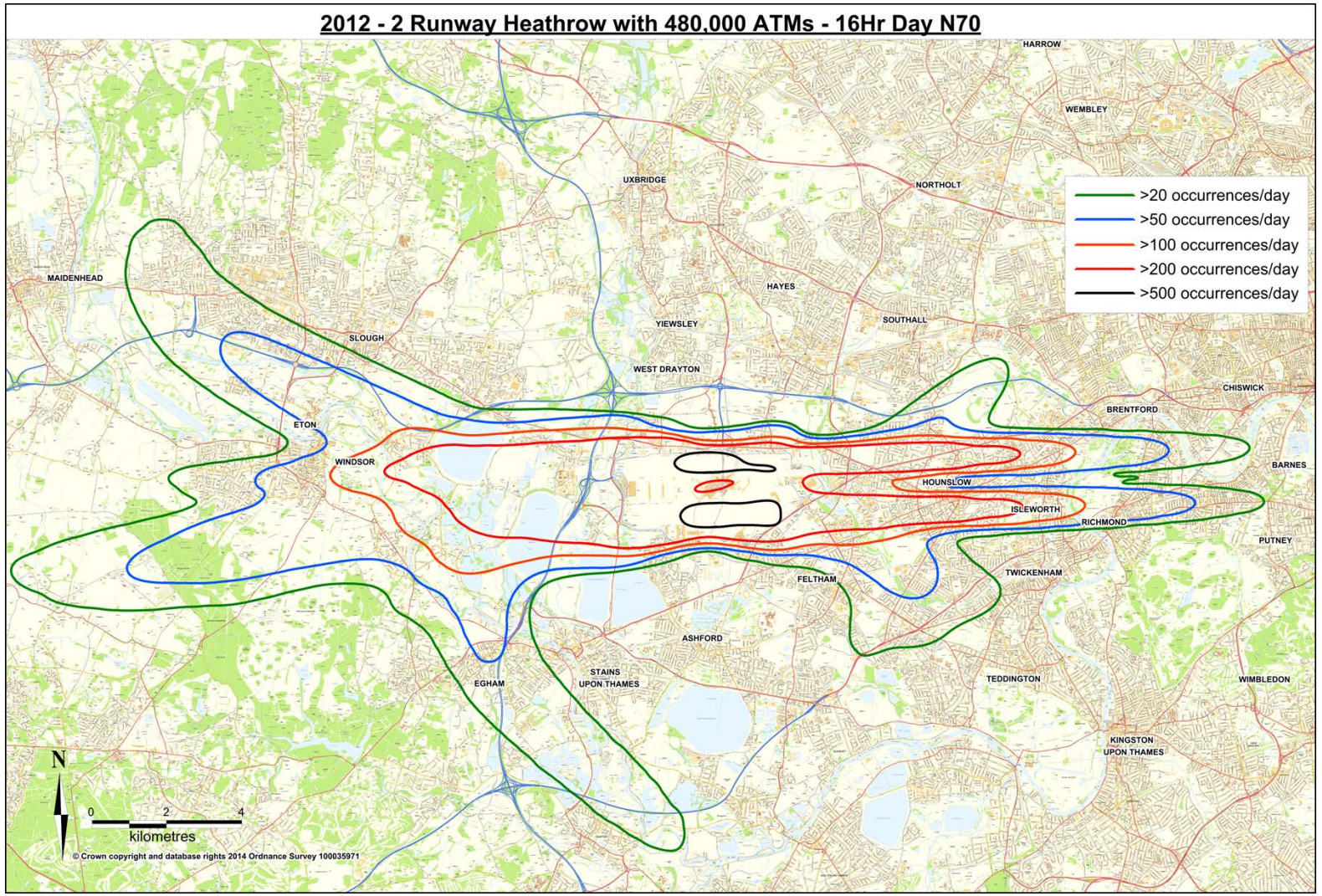


Figure D2: Run 2 – 16h Day N70 contours

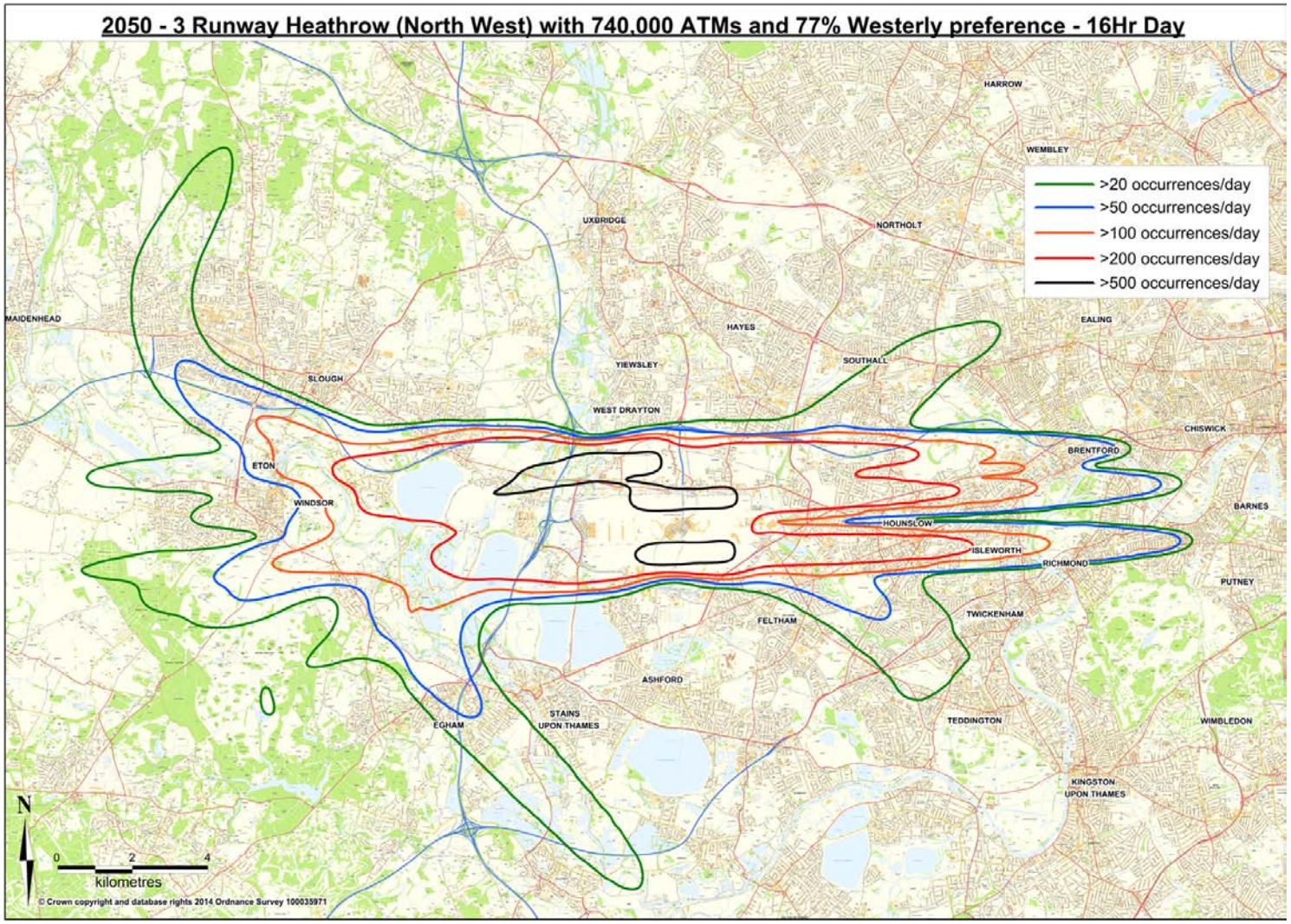


Figure D3: Run 2c – 16h Day N70 contours

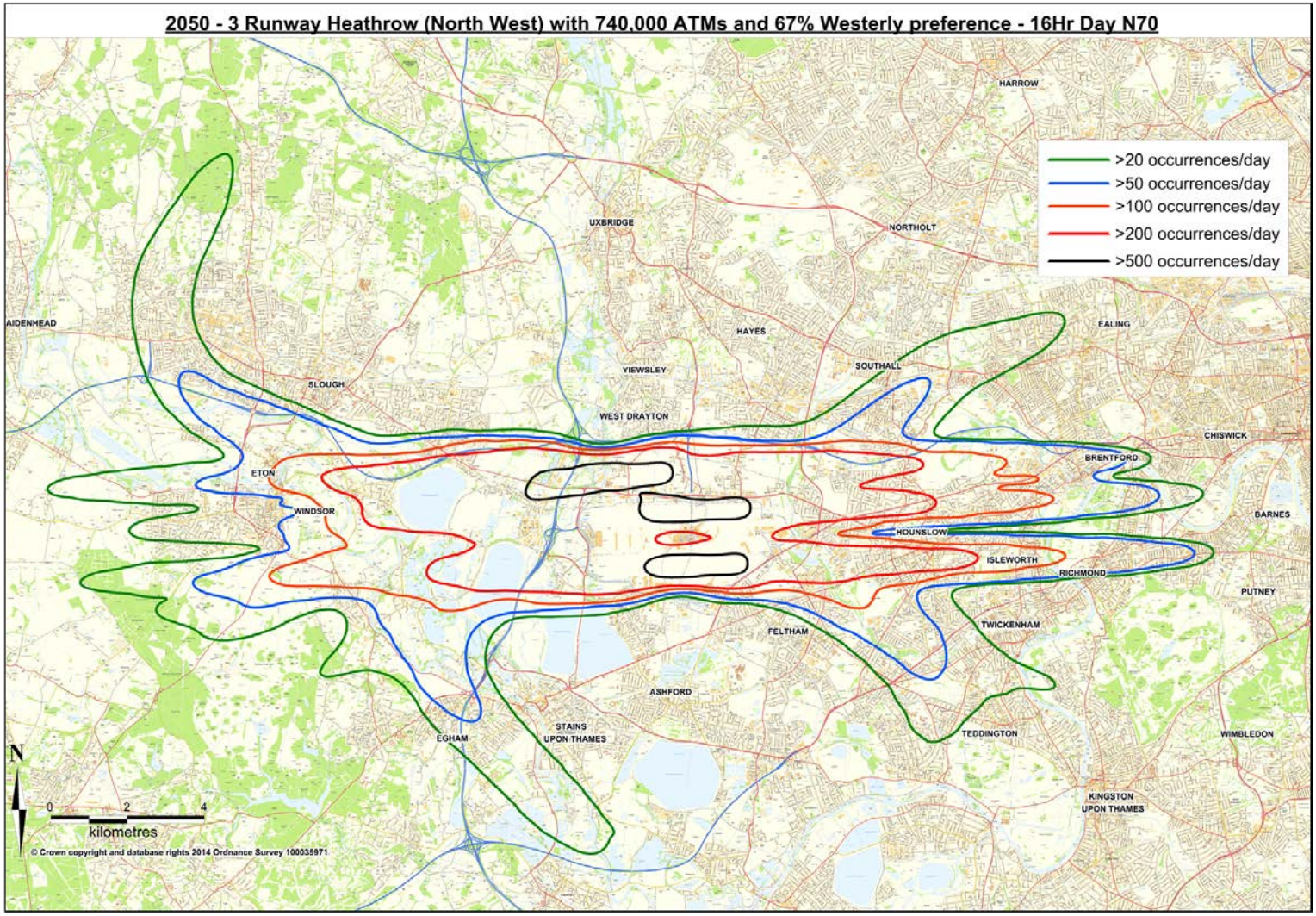


Figure D4: Run 3 – 16h Day N70 contours

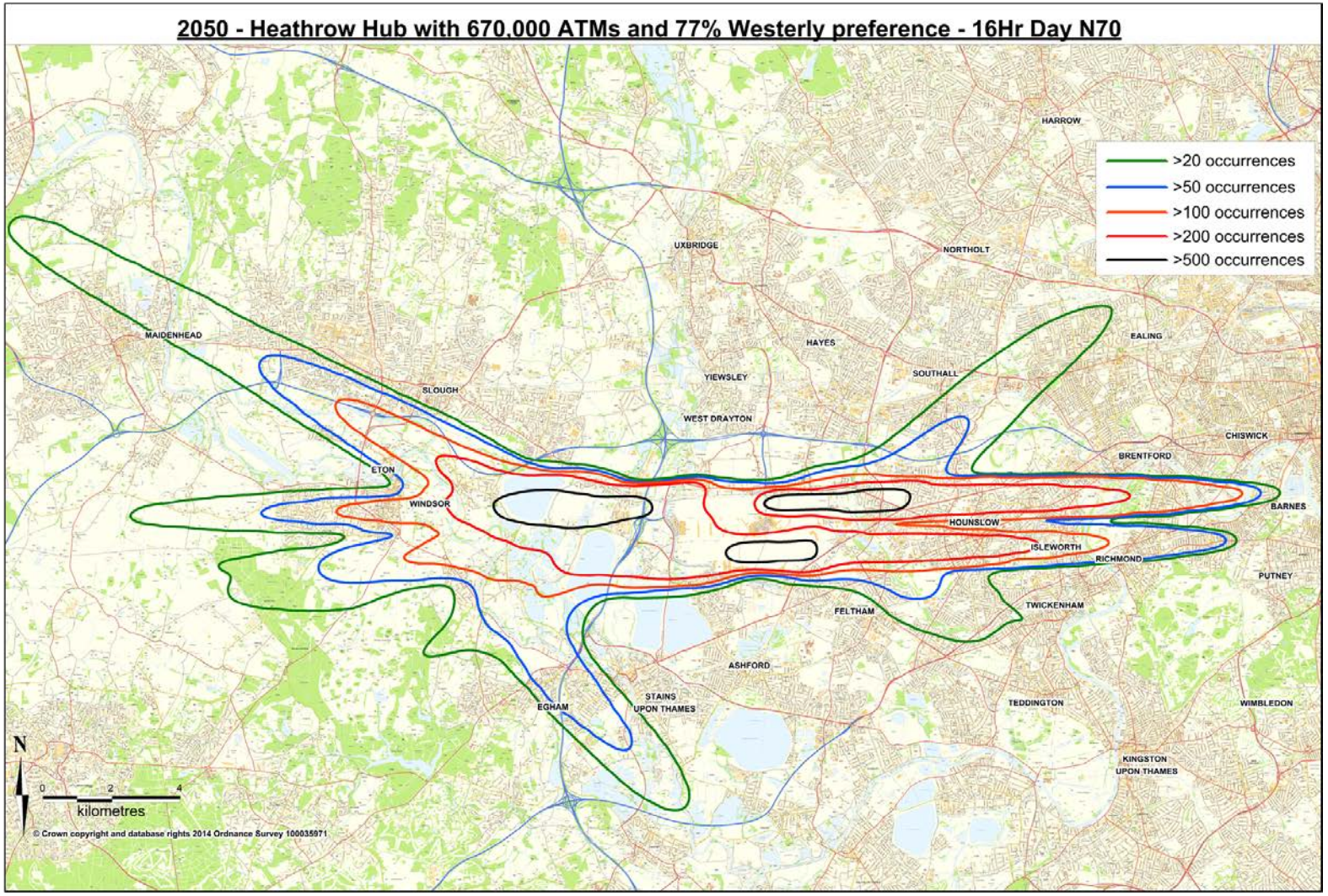


Figure D5: Run 3c – 16h Day N70 contours

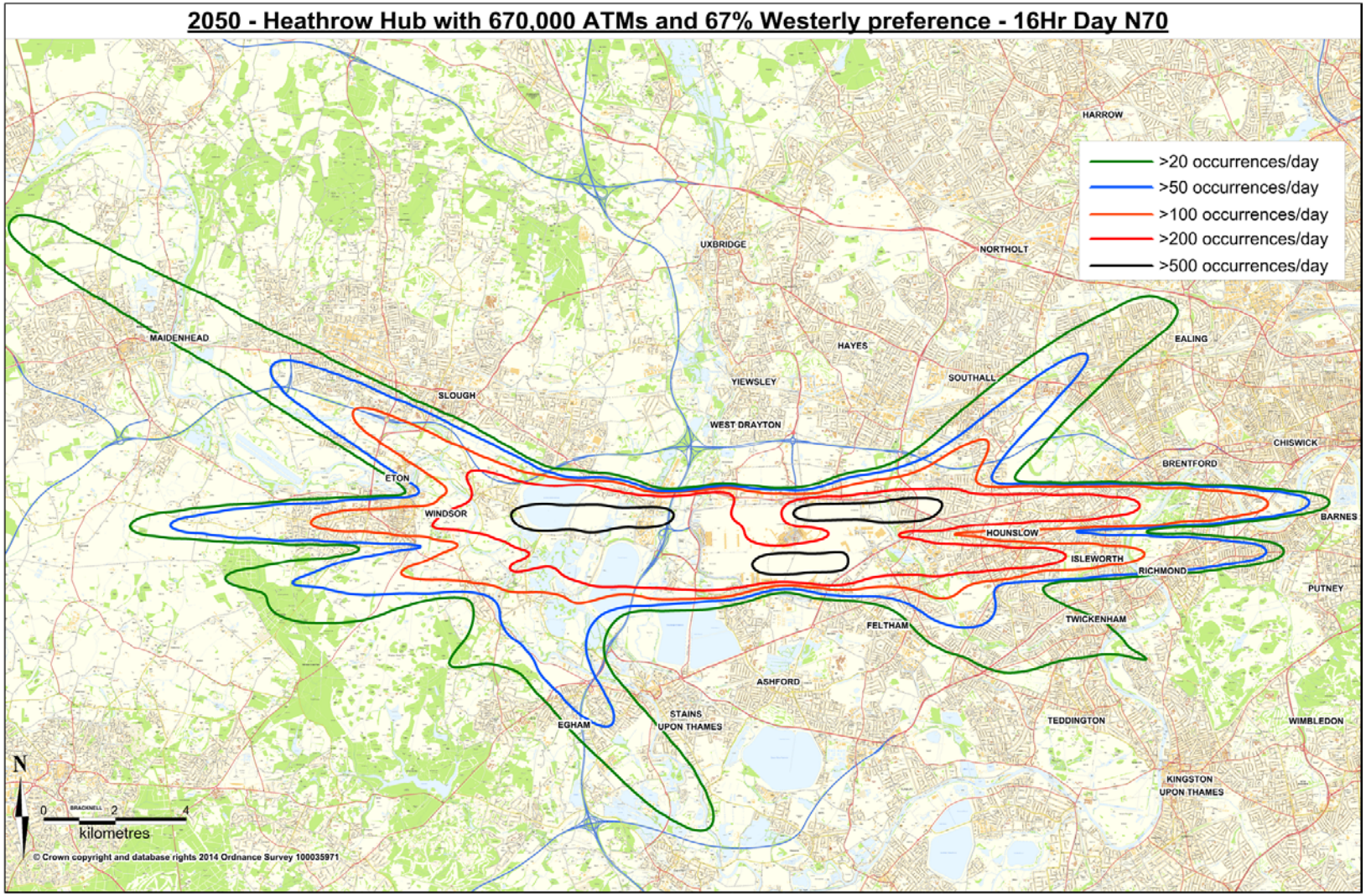
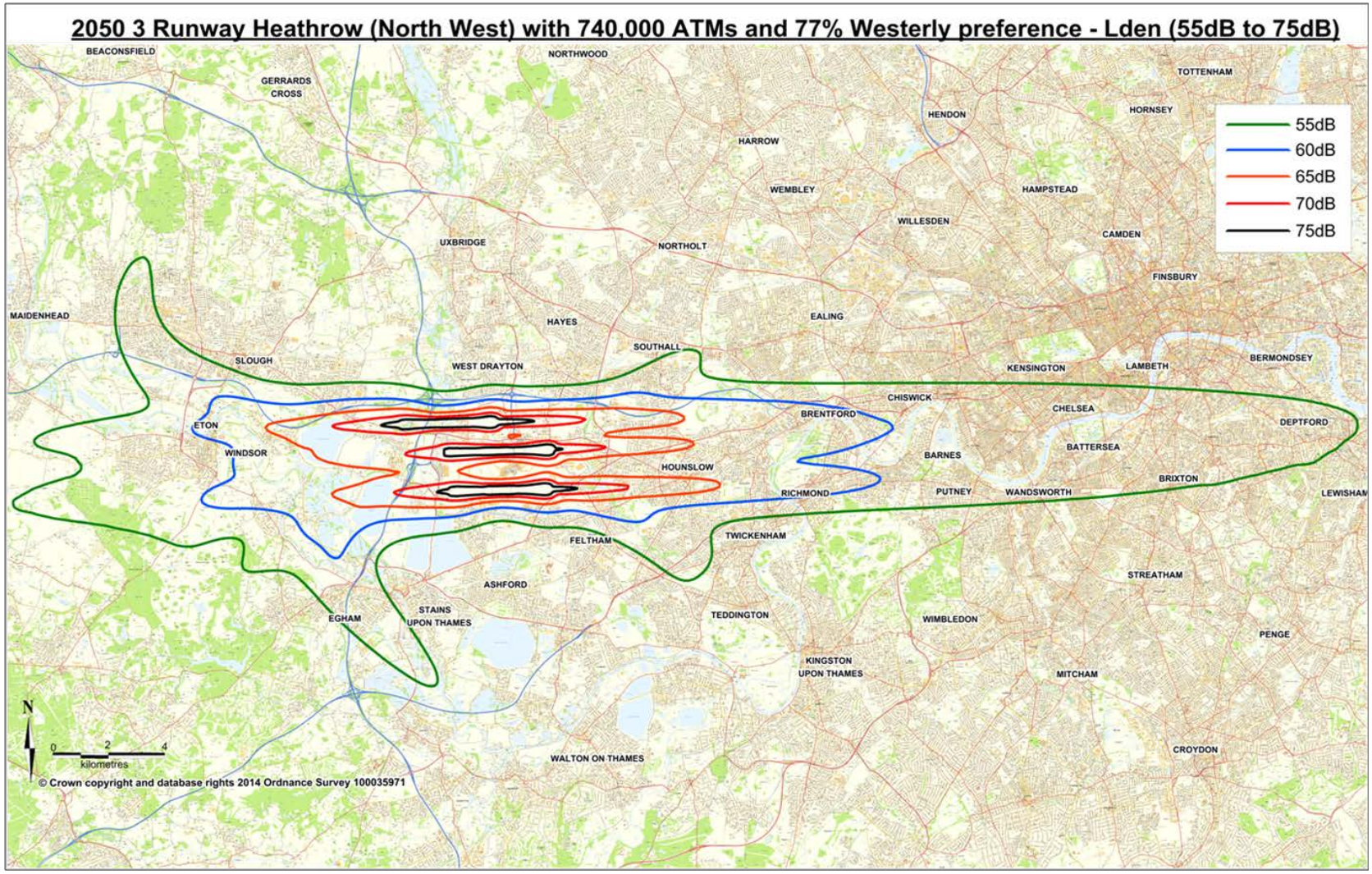


Figure D6: Run 2 (2050) 55 dB Lden contours



APPENDIX E

Assumptions

The following assumptions were made by Atkins and TfL to generate the inputs required by the ANCON modelled.

Runway location	Heathrow Ltd North West runway[7]
Background population dataset	2012 Using 2012 is potentially underestimating populations affected by noise given that London's population continues to grow. Between 2011 and 2012 the London population grew by 1.3%. An average growth rate of only 0.28% would deliver a 10% increase by 2050.
Air traffic movements	740,000 per year – fully utilised third runway
Displacement of runway thresholds vs today	It varies by runway and is up to 1000m. The displacements modelled are as per the Heathrow Ltd NW runway variation plan[7].
Runway operating modes	Northern and southern runway operated in mixed mode or segregated mode. Central runway (existing 09L / 27R) only operated as segregated. No more than one runway operated in mixed mode at any time.
Fleet mix	The 2030 DfT fleet mix forecast (carbon traded unconstrained Heathrow), produced for the Airport Commission during 2013 was taken as the base fleet mix for 2050. Some current aircraft types are assumed to have retired, with the fleet mix comprising around 73% of aircraft being launched after 2010 (e.g. A320 neo family, B737 MAX family, B787, A380 and A350), 23% aircraft launched beyond 2020 (the next generation of aircraft) and 4% aircraft launched after 2040. The proportion of flight movements to aircraft type in 2030 is applied directly to the 2050 flight movements. The 20 year lag on fleet mix assumes that new quieter aircraft and engines do not become available or the up take is slower than some

[7] http://www.heathrowairport.com/static/HeathrowAboutUs/Downloads/PDF/3R-masterplan-northwest-potential-optimisation_LHR.pdf

	forecast. Consider: • IAG (BA and Iberia) are still placing orders for conventional A320's. • An older Boeing 747-400 has an Lmax (peak noise event impact) when arriving, at 1,000 ft, of 86dB. An Airbus A380 has an Lmax arriving, at 1,000 ft, of 85dB. This represents a relatively insignificant difference, despite the A380's much heralded status as a quieter aircraft[8].
Westerly preference retained	Yes (77% of the time) but without the Cranford Agreement.
Arrivals glide slope	3 degrees 3 degrees is ICAO's currently preferred angle of glide path approach.
Flight paths	Re-designed flight paths to take account of the additional runway. With a 90% preference to use the northern or middle runway if following a departure flight path to the north and 90% preference for the middle or southern if departing to the south.
Night flights	One runway is always assumed to be closed during the 8hr night, although this alternates to provide respite. No additional movements in the night quota period 23:30 to 06:00.

[8] http://www.londonairspaceconsultation.co.uk/wp-content/uploads/2013/09/LAC_Appendix_J_StandardNoiseTables.pdf