Environmental Research and Consultancy Department

Civil Aviation Authority

Heathrow Airport 2017 Summer Noise Contours and Noise Action Plan Contours

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Summary

Overview

1. This report presents the Heathrow 2017 average summer 16-hour day and 8-hour night Leq contours, as well as the 2017 annual L_{day}, $L_{evening}$, L_{night}, L_{den} and $L_{eq,6.5hr\ night}$ noise contours to meet the requirements of Heathrow Airport's Noise Action Plan. Contours for the supplementary metrics N65 and N70 annual 16-hour day, and N60 annual 8-hour night, have also been produced. Long-term trends from 2006 to 2017 are examined and comparisons made with the 2006 (base year) and 2016 results.

2. Additional diagrams have been produced showing: single mode (i.e. 100% west and 100% east) contours; overflight contours and overflight track density diagrams for aircraft operations up to 4,000 ft AMSL based on the new 'overflight' metric proposed by the CAA; noise changes between 2006 and 2017, and noise changes between 2016 and 2017.

3. Although 2017 had the highest passenger traffic, the L_{den} 55 dBA contour had its smallest area over the 12-year study period (2006-2017).

Movements in 2017

4. Average summer day movements in 2017 at Heathrow increased by 0.5% from 2016. In contrast, summer night movements fell by 2%. The Boeing 787-9 aircraft type had the highest increase in numbers in both the summer day (+17 movements) and night (+3 movements) periods.

5. Aircraft movements over the 2017 annual L_{day} 12-hour period increased by 1% from 2016. There was a 1% decrease in movements over the 2017 annual $L_{evening}$ 4-hour period. Annual L_{night} 8-hour movements were unchanged in 2017. Total movements over the 2017 annual L_{den} average 24-hour period (1303.7) were 0.5%[1] higher than in 2016 (1297.4). Movements were 2% lower for the 2017 $L_{eq,6.5hr\ night}$ period compared to 2016.

6. The largest increase in movements over the 2017 annual average 24-hour period was for the Boeing 787-9 (+19 movements), followed by the Airbus A320neo with an increase of 12 movements. The highest decreases were for the Boeing 737-600/700 series (-10 movements), the Airbus A330 (-9) and Boeing 767-400 (-6).

[1] The percentage change from 2016 to 2017 based on the total annual movement figures shown in **Table 1** is slightly lower (+0.2%) because 2016 was a leap year.

7. The estimated percentage of aircraft in the Heathrow fleet mix meeting the ICAO Chapter 4 noise standard has risen from 94% in 2006 to over 99% in 2017.

2017 summer Leq contours

8. Leq noise modelling results for the average summer day (actual modal split) showed that the 57 dBA Leq contour area in 2017 was 93.2 km^2 (2016: 101.5 km^2). Daytime Leq contour areas have fallen by up to 9% in 2017 compared to 2016. This can be attributed to the ongoing introduction of more modern, quieter types such as the Boeing 787-9, and also to noise adjustments made to (a) the Boeing 747-400 and Airbus A380 (both with Rolls-Royce engines) on departure, and (b) Airbus A319/A320/A321 types with IAE V2500 engines on arrival, which noise measurements indicated were quieter in 2017. The Airbus A319/320/321 arrival noise reductions reflect the majority of these types having received the Fuel Over Pressure Protector (FOPP) system modification. Population and household counts within the contours also decreased.

9. The average summer night 48 dBA Leq contour area was 103.1 km^2 (2016: 115.4 km^2). Night-time Leq contour areas decreased by up to 31% in 2017. This was caused by the 2% decrease in traffic and the aforementioned noise adjustments. Population and household counts also decreased in 2017.

2017 Noise Action Plan contours

10. The noise modelling results showed that the L_{day}, $L_{evening}$, L_{night} and L_{den} cumulative contour areas in 2017 were all smaller than in 2016. For example, the 2017 L_{den} 55 dBA contour area of 182.3 km^2 was 8% smaller than in 2016 (198.0 km^2). The area reductions can be attributed to a switch to more modern, quieter aircraft types such as the Boeing 787-8/9, Airbus A320neo and Airbus A350-900, and noise reduction adjustments made to the ANCON types B744R and EA38R on departure and the EA319V, EA320V and EA321V on arrival, in the light of noise measurements undertaken in 2017. For L_{night} the further drop in B744R movements also helped to reduce the contour area. Due to relatively large shifts in the runway modal split in 2017 in favour of westerly operations and the subsequent effects on contour shapes, population and household counts within the contours did not fall in all cases in line with the areas.

11. The 2017 $L_{eq,6.5hr\ night}$ 48 dBA contour area remained at 33.9 km^2, though movements fell by 2%. Population and household counts rose as the contour extended over populated areas around Kew due to the higher percentage of westerly arrivals in 2017.

Trends since 2006

12. An examination of the long-term trends between 2006 and 2017 showed that the annual L_{day} 55 dBA contour area has been fairly steady since 2009 after the initial high in 2006, though it dipped in 2010 and declined between 2014 and 2017. Populations and households fell to a low in 2010 after dropping steadily since 2006. Movements were also at a low in 2010. After rising in 2011, the population count increased in 2013 due to the population database update, before decreasing from 2015 through to 2017 in line with the reductions in contour area.

13. The area, population and households within the $L_{evening}$ 55 dBA contour decreased in 2009 from the 2006 level as movements declined, but rose again to a high in 2011 as movements recovered. Since 2011 the area, population and households have followed a downward trend, apart from 2013 when the population increased after a major update to the population database. Movements declined between 2011 and 2014, before rising in 2015 and levelling off in 2016 and 2017.

14. For the L_{night} 50 dBA contour, areas have been relatively stable between 2011 and 2016, before dropping in 2017. Prior to 2011 the area was higher but also at a steady level. Movements over the L_{night} period have been relatively steady since 2006, in the range of 75-78 movements. The L_{night} population and household counts followed a downward trend from 2009 to 2012, but have been relatively high since 2013 due to various factors. There was a major update to the population database in 2013, when data from the 2011 Census was used for the first time, and runway resurfacing works in 2013 and 2014 affected the contour shape. A higher percentage of westerly movements and a reversion to a 'normal' usage split between the northern and southern runways influenced the contour shape in 2015. In 2017 a 10% higher percentage of westerly operations extended the contour over west London, causing a population count increase.

15. After the 2006 base year, L_{den} 55 dBA contour areas were fairly flat between 2009 and 2013, but since then have mostly fallen as the Heathrow fleet continued its switch to more modern and quieter types such as the Airbus A380, Boeing 777-300ER and Boeing 787-8/9. Population and household counts have generally declined since 2011, although in 2013 the population count increased following a major update to the population database, and also increased in 2017 as the contour extended over west London due to an 11% westerly shift in the runway modal split. Movements have been at a relatively steady level between 2006 and 2017, apart from a dip in 2010.

16. The $L_{eq,6.5hr\ night}$ 48 dBA area has generally followed a downward trend since the 2006 base year, apart from a rise in 2010 when movements increased following disruption to scheduled services. Movements between 2006 and 2017 have also been steady apart from the rise in 2010. Following two years of population

decreases in 2011 and 2012, the population rose in 2013 due to an extension of the contour over west London in line with the northern runway (the southern runway was resurfaced in 2013). However, in 2014 the population count fell to near 2012 levels as the contour area reduced and declined further in 2015 as movements of the Boeing 747-400 with Rolls-Royce engines continued to reduce. Another fall in population and household counts occurred in 2016 as a shift in the arrival runway modal split moved the contour away from populated parts of Kew. However, populations increased again in 2017 as the contour extended back over west London following a higher proportion of westerly arrival operations.

17. Between the 2006 base year and 2017 there has been a 59% reduction in movements by Boeing 747-400 aircraft over the annual 24-hour period. Newer aircraft types such as the Airbus A380 and Boeing 787-8/9 were not in service in 2006, but by 2017 there were on average 51 movements of the Airbus A380 and 100 movements of the Boeing 787-8/9 over the average 24-hour period.

18. The 2017 contour areas were below 2006 base year levels for all the noise metrics considered. For example, the 2017 L_{den} 55 dBA contour area of 182.3 km^2 was 26% smaller than the area in 2006 (244.7 km^2). Despite the area decreases, population counts for some contour levels were higher in 2017. This was due to population encroachment around Heathrow between 2006 and 2017. Had the population database remained unchanged between 2006 and 2017, the population and household counts for the 2017 contours would have all been lower than in 2006. For example, the L_{den} 55 dBA population count in 2006 was 756,100 and it decreased by 7% to 699,600 in 2017. Had the population remained at 2006 levels in 2017, the 2017 population count would have been 603,000, a decrease of 20% from 2006. This means that in the period 2006-2017 the reducing contour area meant that 56,500 people were effectively moved out of the L_{den} 55 dBA contour. This figure would have been 153,100 had the population not grown.

Noise change analysis

19. An analysis of L_{den} noise changes between 2006 and 2017 (assuming 2006 base year runway modal splits) revealed that most areas within the 2017 L_{den} 55 dBA contour have experienced noise reductions of up to 3 dB or more. There were some areas that were exposed to increases in noise levels of less than 1 dB. Around 99% of the area considered for noise changes was exposed to decreases in noise.

20. L_{den} noise changes between 2016 and 2017 (assuming the 2016 runway modal split) showed that most areas experienced decreases in noise of up to 1 dB. Approximately 5% of the total area considered was exposed to noise increases of less than 1 dB.

21. An analysis of L_{night} noise changes between 2006 and 2017 (assuming the 2006 base year L_{night} runway modal split) showed that 99% of the total area experienced reductions in noise levels of up to 3 dB or more.

22. Noise changes for L_{night} between 2016 and 2017 (assuming the 2016 runway modal split) indicated some regions that were exposed to noise increases of less than 1 dB. Around 72% of the area assessed experienced reductions of up to 2 dB.

'Noise events above' (N65/N70/N60) contours

23. Additional noise validation of L_{max} noise levels was instituted in 2017, which affects the N-contours. To enable valid comparisons of the 2017 N-contour results with previous years, the N-contours for 2006 and 2016 were recalculated and the updated results are presented in this report. The 2006 N-contour remodelling took into account L_{max} noise measurements from 2006 for the noise dominant types.

24. N65 and N70 annual 16-hour day contours, and N60 annual 8-hour night contours, have been produced for 2017. All the contour areas for N65 and N70 day have decreased between 2006 and 2017. This reflects the phase-out of the noisiest aircraft types such as the Boeing 747-400 and the introduction of more modern, quieter types, for example the Airbus A380, Boeing 777-300ER and Boeing 787-8/9. The outermost N60 night contour was also smaller in 2017 compared to 2016. However, the areas of the higher N60 contour levels increased, which can be attributed largely to the effects of differences in runway modal split and north-south runway usage between 2006 and 2017.

25. Population counts did not decrease in all cases for the N-contours, which can be explained by changes to contour shapes and primarily by the population encroachment that occurred in the areas surrounding Heathrow between 2006 and 2017.

26. An analysis of annual 16-hour day N65 changes between 2006 and 2017 (assuming the 2006 base year modal split) also showed that many areas have experienced reductions of up to 50-100 N65 events. However, there were some locations where the numbers of N65 events in 2017 increased due to (a) higher movement rates on the CPT/GOG/SAM routes in 2017, (b) a change in the position of the DET (DVR) departure mean track, and (c) a higher usage of the southern runway for arrivals in 2017 compared to 2006. Around 82% of the area considered experienced either decreases of 10 or more N65 events or changes of less than 10 events. A similar analysis of N65 changes between 2016 and 2017 (assuming the 2016 modal split) revealed that 99% of the assessment area was exposed to either decreases of more than 10 events or changes of less than 10 events.

27. An analysis of annual 16-hour day N70 changes between 2006 and 2017 (assuming the 2006 runway modal split) indicated some areas where increases in N70 events occurred. These were due to higher movement rates on the CPT/GOG/SAM routes in 2017, a bias towards the southern runway for westerly departures in 2006 and the northern runway being favoured for westerly arrivals in 2006. Approximately 80% of the assessment area was exposed to either decreases of between 10 and 150 N70 events or changes of less than 10 N70 events. This figure rose to 90% when the effects of differences in north-south runway usage were removed.

28. An analysis of annual 16-hour day N70 changes between 2016 and 2017 (assuming the 2016 modal split) showed that the entire area under consideration was either exposed to N70 changes of less than 10 events, or decreases of more than 10 events in 2017.

29. An examination of N60 changes between 2006 and 2017 (assuming the 2006 runway modal split) for the annual 8-hour night showed that all areas either experienced changes of less than 5 events or reductions of between 5 and 10 events. The N60 changes between 2016 and 2017 (assuming the 2016 runway modal split) indicated that all areas were either exposed to changes of less than 2 events or a decrease of up to 3 events per 8-hour night.

Chapter 1
Introduction

1.1 This report presents the 2017 noise exposure contours generated for London Heathrow Airport. Firstly, 2017 summer period contours are provided, which up until 2015 had been produced by ERCD on behalf of the Department for Transport (DfT). Since the 2016 study ERCD has been commissioned directly by Heathrow Airport Ltd (HAL). Secondly, contours meeting the requirements of the HAL Noise Action Plan have been produced using annual 2017 traffic data. Supplementary metric overflight contours, overflight track density diagrams and N-contours (i.e. N65, N70 and N60) have also been generated.

1.2 The latest version of the UK civil aircraft noise model, ANCON (v2.4), has been used to estimate the noise exposure around Heathrow Airport. The model calculates the emission and propagation of noise from arriving and departing air traffic and is validated with noise measurements around Heathrow.

1.3 The noise exposure metric used for the summer period 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**). The Leq 16-hour contours in this report have been plotted from 54 to 72 dBA in 3 dB steps. The Survey of Noise Attitudes (SoNA 2014)[2] found that the degree of annoyance (based on the percentage of respondents highly annoyed) previously occurring at 57 dBA, now occurs at 54 dBA.

1.4 Night-time 8-hour Leq contours have also been calculated from 48 to 72 dBA in 3 dB steps in accordance with standard practice. Average summer night Leq contours were first calculated for Heathrow for 2013 following the publication of the Aviation Policy Framework in March 2013 (**Ref 3**).

1.5 ‘Single mode’ contours for the 16-hour day and 8-hour night have also been produced. These contours illustrate the noise exposure had the airport operated in fully westerly (‘100% W’) or easterly (‘100% E’) modes throughout the period of interest.

1.6 ‘Overflight’ contours for the average summer day and night periods, using the definitions for an overflight proposed by the CAA, have been produced (**Ref 4**). Separate overflight diagrams are provided assuming 48.5 degree and 60 degree elevation angles (measured from the horizontal) as proposed in the CAA report,

[2] *Survey of Noise Attitudes 2014* (**Ref 2**), https://www.caa.co.uk/cap1506

using radar data up to an altitude of 4,000 ft AMSL[3]. Overflight track density diagrams based on the above overflight metric definitions have also been produced.

1.7 Noise Action Plan contours for L_{day}, $L_{evening}$, L_{night} and L_{den} were based on annual movement data for the 2017 calendar year (1 January to 31 December), whilst the $L_{eq,6.5hr\ night}$ contour was based on data from the combined 2017 summer and 2017-18 winter night quota seasons (i.e. the period from 26 March 2017 to 24 March 2018).

1.8 Contours for the 2017 annual period have also been produced using the supplementary noise metrics N65 and N70 for daytime, and N60 for night-time. N-contours indicate the number of aircraft noise events exceeding a certain maximum sound level (L_{max}) at a given location. For example, N70 contours show the number of events exceeding 70 dBA L_{max}.

1.9 In summary, noise contours have been produced for the following noise metrics:

- Average summer 16-hour day Leq (0700-2300 local time);
- Average summer 8-hour night Leq (2300-0700 local time);
- Annual L_{day}, $L_{evening}$, L_{night}, L_{den} and $L_{eq,6.5hr\ night}$;
- N65 and N70 for the annual average 16-hour day (0700-2300 local time); and
- N60 for the annual average 8-hour night (2300-0700 local time).

1.10 In regard to the above metrics, the following points can be noted:

- The summer day and night Leq contours have been used for airport noise in the UK for many decades;
- L_{day}, $L_{evening}$, L_{night} and L_{den} are required by the European Environmental Noise Directive (END) and allow comparison with other EU airports and other transport modes;
- HAL has advised that tracking the Leq 6.5-hour night metric is required by Heathrow's Terminal 5 planning consent;
- Virtually all annoyance and health impact research has been based on exposure measured using these time-averaged, Leq-based noise metrics;
- N60, N65 and N70 are event-based metrics, which some airports use to better understand the number of noise events that occur and where. There are no established dose-response assessments using these metrics.

[3] Above Mean Sea Level

1.11 The 2017 Noise Action Plan contours are compared with those from 2016 (**Ref 5**) and the 2006 base year (**Ref 6**) to assess the changes in area, population and households enclosed. The long-term contour trends from 2006 to 2017 are also examined.

Chapter 2

Noise modelling methodology

ANCON noise model

2.1 The noise contours were calculated with the latest version of the UK civil aircraft noise model ANCON (version 2.4), which is developed and maintained by ERCD on behalf of the Department for Transport (DfT). A technical description of the ANCON model can be found in R&D Report 9842 (**Ref 7**).

2.2 ANCON is fully compliant with the European guidance on noise modelling, ECAC.CEAC Doc 29 (4th edition), published in December 2016 (**Ref 8**). This guidance document represents internationally agreed best practice as implemented in modern aircraft noise models. The fourth edition introduced some minor changes to the modelling of start-of-roll noise, which have now been incorporated in the 2017 software update to ANCON (version 2.4).

Flight tracks

2.3 Mean departure and arrival flight tracks were generated from summer 2017 radar data. Mean tracks are the mathematical representation of an NPR/SID route swathe, consisting of a central track that defines the average aircraft position along the route swathe. Lateral dispersions across the route swathe were modelled by multiple sub-tracks derived from a statistical analysis of the underlying radar track data. The Heathrow NPR/SID routes are shown in **Figure B1** of **Appendix B**.

Flight profiles

2.4 Average flight profiles of height, speed and thrust were also based on summer 2017 radar data. These profiles represent the aircraft heights, speeds and thrust settings at various distances from the runway, averaged across all the routes for each ANCON aircraft type (for departures and arrivals separately). Daytime flight profiles were generated as in previous years. However, a separate night-time departure profile was produced for the noise dominant aircraft type operating at night, the Boeing 747-400 with Rolls-Royce engines,[4] as it was sufficiently different from the daytime profile. All other aircraft types operating at night were modelled with daytime profiles.

[4] ANCON type = B744R

2.5 The application of reverse thrust following touchdown was modelled for all ANCON types where applicable. Reverse thrust was included in both the day and night contours.

Noise data

2.6 Noise levels for each ANCON aircraft type are checked and updated each year according to the latest noise measurements, so they represent the best available data.

2.7 At Heathrow, the Noise and Track-Keeping (NTK) system captures data from both fixed and mobile noise monitors around the airport. Noise event data for individual aircraft operations are matched to operational data provided by the airport. The Heathrow NTK system employs 12 fixed monitors positioned approximately 6.5 km from start-of-roll, together with a number of mobile monitors that can be deployed anywhere within the NTK radar coverage area.[5]

2.8 The noise data collected were screened by ERCD with reference to several criteria so that only reliable data were used in the analysis. First of all, noise data that lay outside a 'weather window' were discarded. This ensured that the data used were not affected by adverse meteorological conditions such as precipitation and strong winds. Secondly, the maximum noise level of the aircraft event had to exceed the noise monitor threshold by at least 10 dB to avoid underestimates of the Sound Exposure Level (SEL). Thirdly, only measurements obtained from aircraft operations that passed through a 60-degree inverted cone, centred at the noise monitor, were retained in order to minimise the effects of lateral attenuation and lateral directivity.[6]

2.9 The ANCON model calculates aircraft noise using a noise database expressing SEL as a function of engine power setting and slant distance to the receiver – also known as the 'Noise-Power-Distance' (NPD) relationship. The ANCON noise database is continually reviewed and updated with adjustments made annually when measurements show this to be necessary.

2.10 For 2017, the most significant adjustments made to ANCON types were:

- B744R departures – 1 to 1.5 dB decrease beyond 6.5 km from start-of-roll as a result of the higher availability of noise monitors in 2017 at distances further out from the airport, which yielded measurement data not

[5] Further information on the noise monitors can be found in CAP 1149 (**Ref 9**).

[6] *Lateral attenuation* is the excess sound attenuation caused by the ground surface, which can be significant at low angles of elevation. *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.

previously available at such locations. The lower noise levels can be attributed to the marked reduction in B744R flights to Far East destinations;

- EA38R departures – 1 dB decrease between 7 and 17 km from start-of-roll;
- EA319V, EA320V, EA321V arrivals – up to 1.5 dB decreases, mainly beyond 8-10 km from threshold. These noise reductions may be attributed to the majority of these aircraft having received the Fuel Over Pressure Protector (FOPP) air flow deflectors to reduce noise on approach.

Improvements to L_{max} validation

2.11 ERCD has always validated the Leq contours against measurements by comparing each aircraft's arrival and departure Sound Exposure Level (SEL) with measured SEL values. L_{max} plays no part in this validation as it is not required for the calculation of Leq, L_{den} etc, but it is the basis for N-contours (e.g. N65, N70 and N60). Although adjustments to SELs are also made to L_{max}, it has been identified that L_{max} was underestimated for a number of common aircraft types at Heathrow.

2.12 Beginning with summer 2017 data, additional validation of L_{max} for each aircraft type has been instituted. This affects the 2017 N-contours produced in this report, and to enable valid comparisons with results from previous years, the 2006 and 2016 N-contours have been remodelled for this report. The 2006 N-contour remodelling also took into account L_{max} measurement data from 2006 for the noise dominant aircraft types. These L_{max} changes are explained in greater depth in **Appendix E**.

Traffic data

2.13 The contours were calculated using 2017 movement data extracted from the Heathrow NTK system, which stores radar data supplemented by daily flight plans. Breakdowns of the aircraft movements by ANCON aircraft type for the average summer day (0700-2300 local time) and night (2300-0700 local time), and the annual average 12-hour day (0700-1900 local time), 4-hour evening (1900-2300 local time), 8-hour night (2300-0700 local time), 24-hour period and 6.5-hour night (2330-0600 local time), are summarised in **Tables C1-C7** of **Appendix C**. (Note: The summer and annual traffic numbers have been divided

by 92 and 365[7] respectively in the tables to provide daily average figures). Detailed descriptions of individual ANCON aircraft types are given in **Table D1** of **Appendix D**.

2.14 The average number of daily movements at Heathrow over the 2017 summer day period (1273.1) was 0.5% higher than in the previous year (2016: 1266.7). In contrast, average summer night movements fell by 2% in 2017 to 83.0 (2016: 84.4).

2.15 The largest movement increases over the 2017 average summer 16-hour day period were for the ANCON types B789 (+17), EA320NEO (+13) and LTT (+12). The B736 had the highest movement decrease (-15), followed by the EA33 (-12) and EA321V (-10).

2.16 During the 2017 average summer 8-hour night period the largest movement decrease was for the ANCON type EA319V (-2). The highest movement increases were for the B789 (+3) and B788 (+2).

2.17 The annual average 24-hour daily movements for the base year 2006 and years 2009-2017 are summarised in **Table 1**, along with the total annual movements in each year. (Note that 2016 was a leap year, so the total annual movements were divided by 366 to give the annual average 24-hour daily movements on which the noise contours are calculated).

2.18 It can be seen that total movements decreased in both 2009 and 2010 relative to 2006, with the 2010 total being 5% lower than in 2006. However, in 2011 the total rose to a level 1% above the 2006 total. Movements dropped back in 2012 to a level 1% below that in 2006, and then remained at a steady level until 2016. In 2017 the movement total was close to the 2006 figure.

[7] For the 6.5-hour night, the total was divided by 364.

Table 1 Heathrow annual 24-hour movements for years 2006 & 2009-2017

Year	Total daily movements	Percentage change relative to 2006	Total annual movements
2006	1307.6	(n/a)	477,274
2009	1277.2	-2%	466,178
2010	1245.8	-5%	454,717
2011	1317.1	+1%	480,742
2012	1297.9	-1%	473,734
2013	1293.1	-1%	471,982
2014	1292.8	-1%	471,872
2015	1297.9	-1%	473,734
2016	1297.4	-1%	474,858
2017	1303.7	0%	475,848

2.19 The allocations of traffic on each departure route and arrival runway are summarised in terms of the percentage of total daily operations for each of the L_{day}, $L_{evening}$, L_{night}, L_{den} and $L_{eq,6.5hr\ night}$ time periods, for 2006 and 2009-2017, in **Tables C8-a** to **C8-j**. Route allocations for the L_{den} and L_{night} periods are also shown as pie charts following **Table C8-j** for arrivals, and for easterly and westerly departures. These charts illustrate how the proportion of flights on each route has changed over time.

2.20 The percentage allocations of traffic on each departure route and arrival runway are also summarised for single mode scenarios (e.g. 100% W departures, 100% W arrivals), for each of the L_{day}, $L_{evening}$, L_{night}, L_{den} and $L_{eq,6.5hr\ night}$ time periods, for 2006 and 2009-2017, in **Tables C9-a** to **C9-j**.

Aircraft noise classes

2.21 The 2017 Heathrow fleet mix can be considered in terms of aircraft 'Noise Class' categories (A-H), which are ranked in ascending order of noise emission, i.e. from the quietest (A) to the noisiest (H). Noise Class percentage breakdowns are summarised in **Table 2** for the 2017 annual 24-hour period, along with percentages from the 2006 base year for comparison.

Table 2 Heathrow 2017 annual average 24-hour movements by Noise Class

Noise Class	Description	2017 total	2017 percentage	2006 percentage
A	Small propeller	0.0	0.0%	< 0.1%
B	Large propeller	9.5	0.7%	0.6%
C	Narrow-body jets *(e.g. Airbus A320, Boeing 737-800)*	782.8	60.1%	65.3%
D	Wide-body twins *(e.g. Boeing 777, Boeing 787)*	388.6	29.8%	18.4%
E	Wide-body 3,4 engine *(e.g. Boeing 747-400, Airbus A380)*	122.8	9.4%	15.2%
F	1st generation wide-body 3,4 engine *(e.g. Boeing 747-100)*	0.0	0.0%	0.3%
G	2nd generation narrow-body twins *(e.g. Boeing 737-200)*	0.0	0.0%	0.0%
H	1st generation narrow-body 3,4 engine *(e.g. Boeing 727)*	0.0	0.0%	< 0.1%
	Total	**1303.7**	100.0%	100.0%

Note: Totals may not sum exactly due to rounding.

2.22 It can be seen that almost all movements in 2017 were within either Noise Classes C, D or E. The proportion of narrow-body jet aircraft (Noise Class C) decreased from 65% to 60% between 2006 and 2017. There was also a reduction from 15% to 9% in the proportion of wide-body 3 or 4-engine types (Noise Class E). In contrast, the proportion of wide-body twin-engine aircraft (Noise Class D) increased from 18% to 30% between 2006 and 2017.

2.23 The chart in **Figure B2** of **Appendix B** illustrates the breakdown of total movements by Noise Class for 2006 and 2009-2017. Movements over the annual average 24-hour period in 2017 by ANCON aircraft type are summarised in **Table C6**. They are described in more detail in the following paragraphs.

Noise Class C aircraft changes

2.24 Numbers within Noise Class C (narrow-body aircraft such as the Airbus A319, A320 and A321) dropped between 2006 and 2010, but increased in 2011 to a level higher than in 2006. Since 2011, numbers have gradually fallen, dropping below the 2010 level in 2017 (**Figure B2**). Noise Class C movements made up 60% of total movements in 2017. Within Noise Class C the highest decreases were for the B736 (-10 movements), the EA321C and EA321V (-6 each), and EA319V and EA320V (-5 each). They were partially offset by increases of the EA320NEO (+12 movements) and EA319C (+5). The Airbus A319/320/321 aircraft family accounted for 91% of Noise Class C movements in 2017.

Noise Class D aircraft changes

2.25 The next largest grouping was Noise Class D (wide-body twin-engine aircraft, such as the Boeing 777-200/300 and Boeing 787-8/9), which accounted for 30% of total movements in 2017. These have risen steadily in frequency between 2009 and 2017 (**Figure B2**). The largest increases within Noise Class D in 2017 were for the ANCON types B789, up by 19 movements, EA359 and B788 (up by 6 movements each). The largest decreases were for the EA33, down by 9 movements, and the B764, down by 6. The newest aircraft types such as the Boeing 787-8/9 series and the Airbus A350-900 made up 28% of all Noise Class D movements, an increase from 2016 when the figure was 21%.

Noise Class E aircraft changes

2.26 Movements of the Noise Class E grouping (wide-body 3 or 4-engine aircraft such as the Boeing 747-400 and Airbus A380) decreased in both 2009 and 2010 from the 2006 level, and after a small rise in 2011, have declined steadily through to 2017 (**Figure B2**). Nine percent of total movements were within Noise Class E in 2017. Within Noise Class E the largest reductions in 2017 were for the ANCON aircraft types EA34 (-3 movements) and EA346 (-2). There were increases for the EA38GP and B748 (both +1 movement). The more modern Airbus A380 aircraft accounted for 41% of total Noise Class E movements in 2017, a rise from the previous year's figure of 39%.

Fleet mix by ICAO noise Chapter

2.27 An analysis of the certification noise levels of aircraft operating at Heathrow in 2017 indicated that over 99%[8] of the fleet were compliant with the ICAO Chapter 4 noise standard.

2.28 In the 2006 base year, the estimated percentage of Chapter 4-compliant aircraft was 94%, and by 2009 this had risen to 95%. The figure was higher in 2010 and 2011 (96% in both years), and in 2012 and 2013 the compliance level had reached an estimated 97%. The compliance level was at its highest from 2014 to 2017 at an estimated 99% or higher.

Runway modal splits

2.29 In general, aircraft will take-off and land into a headwind to maximise lift during take-off and landing. The wind direction, which varies over the course of a year,

[8] The percentage figure is an estimate because in some cases, detailed aircraft information (e.g. engine modifications) was not readily available, so some assumptions had to be made.

will therefore have an important influence on the usage of runways.[9] The ratio of westerly (i.e. Runway 27L/27R) and easterly (i.e. Runway 09L/09R) operations is referred to as the *runway modal split*.

2.30 Two sets of contours have been produced for the 2017 summer 16-hour day:

(a) Using the 'actual' modal split over the Leq day period; and

(b) Assuming the 'standard' modal split over the Leq day period, i.e. the long-term modal split calculated from the 20-year rolling average. For 2017, this is the 20-year period from 1998 to 2017. Use of the standard modal split enables year-on-year comparisons without the runway usage significantly affecting the contour shape.

2.31 The 2016 and 2017 runway modal splits for the day and night summer periods are summarised in **Table 3**.

Table 3 Heathrow 2016 and 2017 summer runway modal splits

Time period	2016 actual split (W/E percentage)	2017 actual split (W/E percentage)	2016 standard split (W/E percentage)	2017 standard split (W/E percentage)
16-hour day	86 / 14	84 / 16	79 / 21	79 / 21
8-hour night	85 / 15	81 / 19	Data not available	Data not available

2.32 The annual noise contours were modelled with the 2017 actual West/East (W/E) runway modal splits, which are summarised in **Table 4** along with the modal splits from the previous year, and also the 5-year rolling average.

Table 4 Heathrow annual runway modal splits

Time period	2016 actual split (W/E percentage)	2017 actual split (W/E percentage)	5-year average 2013-2017 (W/E percentage)
12-hour day	70 / 30	81 / 19	72 / 28
4-hour evening	72 / 28	81 / 19	72 / 28
8-hour night	70 / 30	80 / 20	72 / 28
24-hour day	70 / 30	81 / 19	72 / 28
6.5-hour night	71 / 29	75 / 25	72 / 28

Note: The 6.5-hour night covers the period from the end of March in one year to the end of March in the following year.

[9] A 'westerly preference' is used at Heathrow, meaning operations in westerly mode even if there is a light tailwind, to reduce the use of easterly SIDs that tend to overfly more populated areas than the westerly SIDs.

2.33 The runway modal split percentages for each of the annual periods modelled (L_{day}, $L_{evening}$, L_{night}, L_{den} and $L_{eq,6.5hr\ night}$) are summarised in **Tables C10-a** to **C10-e** for 2006 and 2009-2017, for departures and arrivals separately.

2.34 A higher proportion of westerly movements at Heathrow tends to cause an increase in contour area. Conversely, a higher proportion of easterly movements at Heathrow tends to reduce the contour area. During easterly operations, departures from Runway 09L are restricted by the Cranford Agreement, resulting in the majority of departures operating from Runway 09R, whilst landings are on Runway 09L. This concentrates traffic onto fewer flight paths, reducing the contour area.

Topography

2.35 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.

2.36 ERCD holds Ordnance Survey terrain height data on a 50-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.

Population database

2.37 Estimates were made of the population and households enclosed within the noise contours. The population data used in this report for the 2017 contours are a 2017 update of the latest 2011 Census supplied by CACI Limited.[10] The CACI population database contains data referenced at the postcode level. Population and household numbers associated with each postcode are assigned to a single coordinate located at the postcode's centroid.

2.38 Within the extent of the 2017 L_{den} 55 dBA contour, the population count was 1% higher with the 2017 population database compared to the 2016 database.

[10] www.caci.co.uk

Chapter 3
Results

2017 summer day actual Leq contours

3.1 The Heathrow 2017 summer day Leq noise contours generated with the actual 2017 summer day period runway modal split (84% west / 16% east) are shown in **Figure B3** of **Appendix B**. The contours are plotted from 54 to 72 dBA at 3 dB intervals and overlaid onto the 2016 contours.

3.2 Cumulative estimates of the areas, populations and households within the 2017 summer day actual contours are provided in **Table 5**, along with the figures from 2016.

Table 5 Heathrow 2016 and 2017 summer day actual modal split contours – area, population and household estimates

Leq (dBA)	Area (km^2)			Population			Households		
	2016	**2017**	change	2016	**2017**	change	2016	**2017**	change
> 54	184.9	168.3	-9%	616.6	549.6	-11%	254.3	225.4	-11%
> 57	101.5	93.2	-8%	247.1	230.6	-7%	96.0	89.0	-7%
> 60	56.0	52.2	-7%	116.7	112.2	-4%	42.4	40.8	-4%
> 63	31.6	30.1	-5%	44.3	42.5	-4%	15.4	14.9	-3%
> 66	18.7	17.7	-5%	13.5	12.4	-8%	4.6	4.3	-7%
> 69	8.9	8.5	-4%	3.3	3.2	-3%	1.2	1.1	-8%
> 72	4.8	4.5	-6%	0.1	0.1	0%	< 0.1	< 0.1	(n/a)

Note: Populations and households are given in thousands. The 2016 and 2017 population/household counts are based on 2016 and 2017 CACI updates of the 2011 Census respectively.

3.3 The 2017 summer day actual **57 dBA** Leq contour enclosed an area of 93.2 km^2 and a population of 230,600. The area was 8% smaller than in 2016 (101.5 km^2), whilst the population was 7% lower than in 2016 (247,100).

3.4 The reductions in contour area reflect the ongoing introduction of quieter types such as the Boeing 787-8/9, Airbus A320neo and Airbus A350-900, and significant noise reduction adjustments made to the ANCON types B744R and

EA38R on departure and the EA319V, EA320V and EA321V on arrival, in the light of noise measurements undertaken in 2017 (see section 2.10).

3.5 The contour comparison in **Figure B3** shows the effects of the above noise changes. The arrival contour tips to the east of the airport are smaller in 2017, as are the departure lobes caused by aircraft departing to the west.

2017 summer day standard Leq contours

3.6 The Heathrow 2017 summer day Leq noise contours generated with the standard 2017 runway modal split (79% west / 21% east) are shown in **Figure B4**. The contours are plotted from 54 to 72 dBA at 3 dB intervals and overlaid onto the 2016 contours.

3.7 Cumulative estimates of the areas, populations and households within the 2017 summer day standard contours are provided in **Table 6**, along with the figures from 2016.

Table 6 Heathrow 2016 and 2017 summer day standard modal split contours – area, population and household estimates

Leq (dBA)	Area (km^2)			Population			Households		
	2016	**2017**	change	2016	**2017**	change	2016	**2017**	change
> 54	184.3	167.0	-9%	588.8	532.6	-10%	240.9	217.1	-10%
> 57	99.6	92.3	-7%	249.2	232.7	-7%	96.5	89.6	-7%
> 60	55.1	51.6	-6%	116.4	111.0	-5%	42.1	40.3	-4%
> 63	31.5	30.0	-5%	41.8	41.5	-1%	14.7	14.5	-1%
> 66	18.5	17.6	-5%	12.6	11.9	-6%	4.3	4.1	-5%
> 69	8.8	8.4	-5%	3.0	2.8	-7%	1.1	1.0	-9%
> 72	4.7	4.5	-4%	0.1	0.1	0%	< 0.1	< 0.1	(n/a)

Note: Populations and households are given in thousands. The 2016 and 2017 population/household counts are based on 2016 and 2017 CACI updates of the 2011 Census respectively.

3.8 The 2017 summer day standard **57 dBA** Leq contour enclosed an area of 92.3 km^2 and a population of 232,700. The 57 dBA area was 7% smaller than in 2016 (99.6 km^2), whilst the population was 7% lower (2016: 249,200).

3.9 Similar to the actual modal split contours, the reductions in contour area reflect the introduction of quieter types and the adjustments made to the noise database for various aircraft types, which noise measurements indicated were quieter in 2017.

2017 summer day single mode Leq contours

3.10 The Heathrow 2017 summer day Leq noise contours for 100% westerly and 100% easterly modes assuming the 2006 north-south runway usage are shown in **Figures B5** and **B6** respectively. The contours are plotted from 54 to 72 dBA at 3 dB intervals and overlaid onto the corresponding single mode contours for 2006.

3.11 Cumulative estimates of the areas, populations and households within the 2006 and 2017 summer day single mode contours are provided in **Tables 7** and **8**.

Table 7 Heathrow 2006 and 2017 summer day 100% W contours (assuming 2006 N-S runway usage) – area, population and household estimates

Leq (dBA)	Area (km^2)			Population			Households		
	2006	**2017**	change	2006	**2017**	change	2006	**2017**	Change
> 54	215.6	173.5	-20%	638.6	608.3 (522.5)	-5% (-18%)	289.5	255.2 (235.2)	-12% (-19%)
> 57	126.5	97.3	-23%	297.0	232.6 (189.1)	-22% (-36%)	128.0	90.5 (79.7)	-29% (-38%)
> 60	69.4	53.1	-23%	113.7	110.0 (83.7)	-3% (-26%)	46.5	40.3 (33.5)	-13% (-28%)
> 63	38.5	30.3	-21%	50.5	47.2 (35.6)	-7% (-30%)	20.1	16.7 (14.1)	-17% (-30%)
> 66	23.4	18.0	-23%	18.3	13.7 (11.7)	-25% (-36%)	7.0	4.8 (4.4)	-31% (-37%)
> 69	13.0	8.8	-32%	5.2	3.6 (3.0)	-31% (-42%)	2.0	1.3 (1.2)	-35% (-40%)
> 72	6.7	4.7	-30%	1.1	0.5 (0.4)	-55% (-64%)	0.4	0.1 (0.1)	-75% (-75%)

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census. Estimates for 2017 using the 2006 population database are shown in blue.

Table 8 Heathrow 2006 and 2017 summer day 100% E contours (assuming 2006 N-S runway usage) – area, population and household estimates

Leq (dBA)	Area (km^2)			Population			Households		
	2006	**2017**	change	2006	**2017**	Change	2006	**2017**	change
> 54	196.6	159.2	-19%	516.9	464.4 (390.6)	-10% (-24%)	216.1	182.8 (165.2)	-15% (-24%)
> 57	112.7	86.7	-23%	324.6	274.1 (225.7)	-16% (-30%)	136.4	106.6 (94.0)	-22% (-31%)
> 60	63.4	46.5	-27%	169.4	143.7 (116.8)	-15% (-31%)	69.6	54.0 (47.2)	-22% (-32%)
> 63	35.0	24.8	-29%	71.9	50.1 (38.8)	-30% (-46%)	28.4	17.9 (15.2)	-37% (-46%)
> 66	18.9	13.6	-28%	22.3	11.9 (9.0)	-47% (-60%)	8.7	4.4 (3.7)	-49% (-57%)
> 69	10.6	7.6	-28%	3.6	2.1 (1.6)	-42% (-56%)	1.6	0.8 (0.7)	-50% (-56%)
> 72	6.2	4.4	-29%	0.9	0.8 (0.5)	-11% (-44%)	0.4	0.3 (0.2)	-25% (-50%)

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census. Estimates for 2017 using the 2006 population database are shown in blue.

3.12 For the westerly single mode contours, the 2017 areas have all decreased relative to 2006, by up to 32%. The populations have also all decreased, although proportionately less so at the 54, 60 and 63 dBA levels. This is likely due to the effects of population encroachment between 2006 and 2017. Household counts in 2017 were all lower than in 2006.

3.13 For the easterly single mode contours, the 2017 areas have also all decreased relative to 2006, by up to 29%. Both population and household numbers were lower at all contour levels in 2017 compared to 2006.

3.14 Populations and household estimates for 2017 assuming the 2006 population database indicate that the contour populations would have decreased even more without the population encroachment that took place between 2006 and 2017.

2017 summer night actual Leq contours

3.15 The Heathrow 2017 summer night Leq noise contours generated with the actual 2017 summer night period runway modal split (81% west / 19% east) are shown in **Figure B7**. The contours are plotted from 48 to 66 dBA at 3 dB intervals (the 69 and 72 dBA contours have been omitted for clarity) and overlaid onto the 2016 contours.

3.16 Cumulative estimates of the areas, populations and households within the 2017 summer night actual contours are provided in **Table 9**, along with the figures from 2016.

Table 9 Heathrow 2016 and 2017 summer night actual modal split contours – area, population and household estimates

Leq (dBA)	Area (km^2)			Population			Households		
	2016	**2017**	change	2016	**2017**	change	2016	**2017**	change
> 48	115.4	103.1	-11%	437.9	397.9	-9%	181.8	164.6	-9%
> 51	68.2	62.4	-9%	207.8	197.2	-5%	80.4	76.0	-5%
> 54	38.9	35.1	-10%	97.2	95.1	-2%	34.8	34.3	-1%
> 57	20.5	17.7	-14%	47.4	45.3	-4%	16.2	15.6	-4%
> 60	10.3	9.1	-12%	15.8	15.4	-3%	5.1	5.0	-2%
> 63	5.4	4.8	-11%	3.2	2.7	-16%	1.0	0.8	-20%
> 66	2.9	2.6	-10%	1.1	0.7	-36%	0.3	0.2	-33%
> 69	1.8	1.5	-17%	< 0.1	< 0.1	(n/a)	< 0.1	< 0.1	(n/a)
> 72	1.3	0.9	-31%	0.0	0.0	(n/a)	0.0	0.0	(n/a)

Note: Populations and households are given in thousands. The 2016 and 2017 population/household counts are based on 2016 and 2017 CACI updates of the 2011 Census respectively.

3.17 The 2017 night actual 48 dBA Leq contour enclosed an area of 103.1 km^2 and a population of 397,900. The 48 dBA area was 11% smaller than in 2016 (115.4 km^2), whilst the population was 9% lower (2016: 437,900). Areas reduced at all contour levels in 2017. The decreases in the night contour area can be attributed mainly to the aircraft noise adjustments described in section 2.10. The contour levels from 48 to 66 dBA also had lower population and household counts in 2017 compared to 2016.

3.18 The 4% higher proportion of easterly movements in 2017 caused an extension of the Runway 09L arrival contour tip over Windsor, and conversely, shortened the length of the arrival contour lobe over west London.

2017 summer night single mode Leq contours

3.19 The Heathrow 2017 summer night Leq noise contours for 100% westerly and 100% easterly modes assuming the 2006 north-south runway usage are shown in **Figures B8** and **B9** respectively. The contours are plotted from 48 to 66 dBA at 3 dB intervals (the 69 and 72 dBA contours have been omitted for clarity) and overlaid onto the corresponding single mode contours for 2006.

3.20 Cumulative estimates of the areas, populations and households within the 2006 and 2017 summer night single mode contours are provided in **Tables 10** and **11**.

Table 10 Heathrow 2006 and 2017 summer night 100% W contours (assuming 2006 N-S runway usage) area, population and household estimates

Leq (dBA)	Area (km^2)			Population			Households		
	2006	**2017**	Change	2006	**2017**	Change	2006	**2017**	change
> 48	118.3	103.7	-12%	431.8	465.3	+8%	195.7	196.0	0%
> 51	71.4	63.3	-11%	188.5	216.9	+15%	80.2	84.3	+5%
> 54	42.2	36.7	-13%	99.1	113.7	+15%	40.6	42.2	+4%
> 57	23.3	18.1	-22%	47.3	53.1	+12%	18.4	18.4	0%
> 60	11.8	9.3	-21%	21.6	21.2	-2%	8.2	7.0	-15%
> 63	6.4	4.7	-27%	7.4	4.1	-45%	2.5	1.3	-48%
> 66	3.5	2.5	-29%	1.7	1.3	-24%	0.6	0.4	-33%
> 69	2.0	1.3	-35%	0.2	< 0.1	(n/a)	0.1	< 0.1	(n/a)
> 72	1.3	0.7	-46%	0.0	0.0	(-)	0.0	0.0	(-)

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

Table 11 Heathrow 2006 and 2017 summer night 100% E contours (assuming 2006 N-S runway usage) area, population and household estimates

Leq (dBA)	Area (km^2)			Population			Households		
	2006	**2017**	change	2006	**2017**	change	2006	**2017**	change
> 48	112.0	99.7	-11%	197.3	189.2	-4%	81.4	72.5	-11%
> 51	68.9	59.8	-13%	120.8	98.7	-18%	49.5	37.9	-23%
> 54	39.4	32.5	-18%	52.0	37.5	-28%	21.9	15.5	-29%
> 57	20.5	16.3	-20%	7.9	5.1	-35%	3.5	2.1	-40%
> 60	11.2	8.6	-23%	1.8	1.5	-17%	0.8	0.6	-25%
> 63	6.2	4.5	-27%	0.7	0.6	-14%	0.3	0.3	0%
> 66	3.4	2.4	-29%	0.2	0.2	0%	0.1	0.1	0%
> 69	1.9	1.3	-32%	0.0	0.0	(-)	0.0	0.0	(-)
> 72	1.1	0.7	-36%	0.0	0.0	(-)	0.0	0.0	(-)

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

3.21 For the westerly single mode contours, areas have all decreased in 2017 relative to 2006, by up to 46%. Populations and households, however, increased in 2017 especially at the lower level contours from 48 to 57 dBA. This can be attributed to the effects of population encroachment around Heathrow between 2006 and 2017.

3.22 For the easterly single mode contours, the 2017 areas were lower at all the contour levels, by up to 36%. There were population and household decreases at the lower level contours from 48 to 60 dBA in 2017.

2017 summer day overflight contours and track density diagrams

3.23 Contours showing the number of 2017 average summer 16-hour day overflights (up to 4,000 ft AMSL), for 48.5 and 60 degree elevation angles[11] at the ground receiver (see **Ref 4**), are shown in **Figures B10** and **B11** respectively. The results for the 2017 summer day are overlaid onto the 2016 summer day results and plotted at levels of 5, 20 and 100 overflights per 16-hour day.

3.24 It should be noted that these overflight contours have been included in this report as a supplementary metric to provide insight into the number of aircraft flyover events that might be observed. As yet there is no research or established methods for assessing the impact or health outcomes of various levels of overflight.

3.25 Overflight track density diagrams, which indicate the number of overflights using colour-shading, are provided in **Figures B10-a** to **B10-c** for the 2006, 2016 and 2017 summer day respectively assuming a 48.5 degree elevation angle. Corresponding diagrams for a 60 degree elevation angle can be found in **Figures B11-a** to **B11-c**.

2017 summer night overflight contours and track density diagrams

3.26 Contours showing the number of 2017 average summer 8-hour night overflights (up to 4,000 ft AMSL), for 48.5 and 60 degree elevation angles, are shown in **Figures B12** and **B13** respectively. The results for the 2017 summer night are overlaid onto the 2016 summer night results and plotted at levels 1, 5 and 20 overflights per 8-hour night.

3.27 Overflight track density diagrams are provided in **Figures B12-a** to **B12-c** for the 2006, 2016 and 2017 summer night respectively assuming a 48.5 degree elevation angle. Corresponding diagrams for a 60 degree elevation angle can be found in **Figures B13-a** to **B13-c**.

[11] The elevation angle is defined as the angle between the ground and the aircraft as seen from the observer at ground level.

2017 Noise Action Plan contours

3.28 The following Noise Action Plan contours for 2017 are shown in **Figures B14-B18** of **Appendix B** respectively, overlaid onto the 2016 contours:

- L_{day}, from 55 to 75 dBA in 5 dB steps;
- $L_{evening}$, from 55 to 75 dBA in 5 dB steps;
- L_{night}, from 50 to 70 dBA in 5 dB steps;
- L_{den}, from 55 to 75 dBA in 5 dB steps; and
- $L_{eq,6.5hr\ night}$, 48 dBA.

3.29 The estimated cumulative areas, populations and households within the above 2017 contours are summarised in **Tables 12-16** respectively, along with the results for 2016. The 2017 population and household figures are based on a 2017 update of the 2011 Census supplied by CACI Ltd. (The 2016 population and household figures are based on a 2016 update of the 2011 Census).

3.30 It should be noted that the 2016 L_{day}, $L_{evening}$, L_{night} and L_{den} population figures provided in this report differ from the 'official' numbers published by Defra for the Environmental Noise Directive (END) 'Round 3' strategic noise mapping exercise. This is because Defra's consultants used a separate population database for strategic noise mapping purposes. However, the population figures used in this report, which are all based on updated CACI data, will enable consistent comparisons to be made with population counts from previous years.

3.31 A comparison between the cumulative 2017 results and those from the 2006 base year are provided in **Tables C11-C15** of **Appendix C**. All the population and household figures in these tables are based on data supplied by CACI Ltd with the respective annual updates.

3.32 Percentage changes in contour area are not necessarily accompanied by similar changes in enclosed population and households because populations are unevenly distributed around the airport. Therefore, the population and household counts can be quite sensitive to changes in contour shape.

3.33 Changes in contour population counts from year to year are also influenced by the effects of the annual update to the population database. Within the region bounded by the 2017 L_{den} 55 dBA contour, there was a 1% increase in the population count between 2016 and 2017.

2017 L_{day} contours

3.34 Total movements in the 2017 L_{day} period increased by 1% from 2016 to 956 per 12-hour day (see **Table C3**). The largest increases were for the ANCON types B789 (+15 movements) and EA320NEO (+9). These were offset by decreases for the B736 (-7 movements), B764 (-6), and the EA321C and EA321V (-5 each).

3.35 The 55 dBA L_{day} contour area was 6% smaller than in 2016 and there were also area decreases at the other contour levels of up to 4% (**Table 12**).

Table 12 Heathrow 2017 L_{day} contours - area, population and household estimates

L_{day} (dBA)	Area (km^2)			Population			Households		
	2016	**2017**	change	2016	**2017**	change	2016	**2017**	change
> 55	148.9	139.3	-6%	420.8	410.4	-2%	167.3	164.7	-2%
> 60	54.7	53.2	-3%	118.3	116.8	-1%	42.8	42.5	-1%
> 65	22.1	21.6	-2%	18.1	20.1	+11%	6.2	6.9	+11%
> 70	7.0	6.9	-1%	1.3	2.0	+54%	0.5	0.7	+40%
> 75	2.7	2.6	-4%	< 0.1	< 0.1	(n/a)	< 0.1	< 0.1	(n/a)

Note: Populations and households are given in thousands. The 2016 and 2017 population/household counts are based on 2016 and 2017 CACI updates of the 2011 Census respectively.

3.36 The reductions in contour area reflect the ongoing introduction of quieter types such as the Boeing 787-8/9, Airbus A320neo and Airbus A350-900, and noise reduction adjustments made to the ANCON types B744R and EA38R on departure and the EA319V, EA320V and EA321V on arrival, in the light of noise measurements undertaken in 2017 (see section 2.10).

3.37 Population counts for the 55 dBA contour in 2017 were 2% lower than in 2016, although there were increases at the 65 and 70 dB levels. There were similar percentage changes for household counts.

3.38 The 2017 L_{day} contours are compared against the 2016 L_{day} contours in **Figure B14**. The effects of the 11% change in runway modal split in 2017 in favour of westerly operations is most evident in the departure contour lobes to the east of the airport from aircraft turning to the north and south, and also in the arrival contour lobes over Windsor, which have reduced in size. The changes to the contour shapes due to the runway modal split also played a part in the population count changes between the two years.

2017 $L_{evening}$ contours

3.39 Total movements in the 2017 $L_{evening}$ period decreased by 1% from 2016, to 270 per 4-hour evening (see **Table C4**). The largest movement decreases were for the ANCON aircraft types EA33 (-4 movements) and B736 (-3). The highest increase was for the EA359 (+3 movements).

3.40 The area of the 55 dBA $L_{evening}$ contour decreased by 7% in 2017 (see **Table 13**). There were also reductions in area at the higher contour levels of up to 8%. The reductions in contour area reflect the ongoing introduction of quieter types such as the Airbus A350-900, and the noise reduction adjustments made to the ANCON types B744R and EA38R on departure and the EA319V, EA320V and EA321V on arrival in the light of noise measurements undertaken in 2017 (see section 2.10).

Table 13 Heathrow 2017 $L_{evening}$ contours - area, population and household estimates

$L_{evening}$ (dBA)	Area (km^2)			Population			Households		
	2016	**2017**	change	2016	**2017**	change	2016	**2017**	change
> 55	129.9	121.3	-7%	348.1	307.5	-12%	136.0	119.3	-12%
> 60	48.1	45.6	-5%	91.4	84.2	-8%	32.5	30.1	-7%
> 65	19.8	19.0	-4%	11.2	10.9	-3%	4.0	3.9	-3%
> 70	6.4	6.1	-5%	0.8	0.7	-13%	0.3	0.3	0%
> 75	2.6	2.4	-8%	0.0	0.0	(-)	0.0	0.0	(-)

Note: Populations and households are given in thousands. The 2016 and 2017 population/household counts are based on 2016 and 2017 CACI updates of the 2011 Census respectively.

3.41 Reductions in population and household counts of up to 12% were found at the 55, 60 and 65 dBA contour levels.

3.42 The 2017 $L_{evening}$ contours are compared against the 2016 contours in **Figure B15**. As with the L_{day} contours, the 9% shift in runway modal split in favour of westerly operations caused the retraction of the departure contour lobes to the east of the airport formed by aircraft turning to the north and south, and likewise the arrival contour lobes over Windsor. The changes to the contour shapes due to the runway modal split also played a part in the population count changes between the two years.

2017 L_{night} contours

3.43 Total movements over the 2017 L_{night} period were unchanged from 2016 at 78 per 8-hour night (see **Table C5**). Arrivals constituted 75% of L_{night} movements. The largest increases were for the ANCON types B789 (+2 movements) and B788 (+1), whilst the largest decrease was for the B772G (-1 movement). The total night-time departures decreased from 20.2 in 2016 to 19.6 in 2017, a fall of 3%. However, the night-time arrival total was up by 1% in 2017.

3.44 The area of the L_{night} 50 dBA contour was 6% smaller in 2017, and area decreases were also seen at all the higher contour levels (see **Table 14**). The area changes can be attributed to the introduction of quieter types such as the Boeing 787-8/9 series, further reductions in movements of the noisiest type, the B744R (down by 0.6), and noise adjustments made in the light of 2017 noise measurements as described previously.

Table 14 Heathrow 2017 L_{night} contours - area, population and household estimates

L_{night} (dBA)	Area (km^2)			Population			Households		
	2016	**2017**	change	2016	**2017**	change	2016	**2017**	change
> 50	74.0	69.9	-6%	221.2	224.6	+2%	86.3	87.7	+2%
> 55	26.5	25.0	-6%	62.4	72.3	+16%	21.6	25.6	+19%
> 60	8.6	8.1	-6%	10.9	14.5	+33%	3.4	4.7	+38%
> 65	3.0	2.9	-3%	1.1	1.3	+18%	0.3	0.4	+33%
> 70	1.4	1.1	-21%	0.0	0.0	(n/a)	0.0	0.0	(n/a)

Note: Populations and households are given in thousands. The 2016 and 2017 population/household counts are based on 2016 and 2017 CACI updates of the 2011 Census respectively.

3.45 There was a 2% increase in population and households within the L_{night} 50 dBA contour, and higher increases at the 55-65 dBA contour levels. This was due to the shift in runway modal split from 70% west / 30% east in 2016 to 80% west / 20% east in 2017, which had the effect of extending the arrival contour lobes over west London.

3.46 The 2017 L_{night} contours are compared against the 2016 contours in **Figure B16**. It can be seen that arrival noise was dominant over the night period.

2017 L_{den} contours

3.47 The total annual 24-hour aircraft movements in 2017 (1304) were 0.5% higher than in 2016 (see **Table C6**). The largest movement increases were for the ANCON types B789 (+19) and EA320NEO (+12). These were offset by decreases for the B736 (-10 movements), EA33 (-9) and B764 (-6). There was a 2% reduction in movements of the Boeing 747-400 aircraft in 2017 compared to 2016.

3.48 The area of the L_{den} 55 dBA contour in 2017 was 8% smaller than in 2016 (see **Table 15**) and area reductions of up to 4% were also found at the higher contour levels. This resulted from the ongoing introduction of more modern, quieter types such as the Boeing 787-8/9 series, the Airbus A320neo and A350-900, and noise reduction adjustments made to the ANCON types B744R and EA38R on departure and the EA319V, EA320V and EA321V on arrival, in the light of noise measurements undertaken in 2017 (see section 2.10).

Table 15 Heathrow 2017 L_{den} contours - area, population and household estimates

L_{den} (dBA)	Area (km^2)			Population			Households		
	2016	**2017**	change	2016	**2017**	change	2016	**2017**	change
> 55	198.0	182.3	-8%	689.4	699.6	+1%	286.1	293.5	+3%
> 60	74.5	71.8	-4%	195.6	189.6	-3%	74.5	72.8	-2%
> 65	28.9	27.8	-4%	44.5	49.6	+11%	15.4	17.4	+13%
> 70	9.5	9.1	-4%	4.8	5.3	+10%	1.7	1.8	+6%
> 75	3.4	3.3	-3%	< 0.1	0.1	(n/a)	< 0.1	< 0.1	(n/a)

Note: Populations and households are given in thousands. The 2016 and 2017 population/household counts are based on 2016 and 2017 CACI updates of the 2011 Census respectively.

3.49 The population count was 1% higher for the 55 dBA contour level in 2017, as the arrival contour tip arising from westerly arrivals extended over west London due to the higher proportion of westerly operations (**Figure B17**). Populations decreased by 3% within the 60 dBA contour. Population rises were found at the 65 and 70 dBA contour levels. A similar pattern of changes was seen for the household counts.

3.50 The 2017 L_{den} contours are compared against the 2016 contours in **Figure B17**. The westerly arrival contour lobes to the east of the airport have extended as the shift to a 11% higher proportion of westerly movements in 2017 more than offset the downward noise adjustments to some of the arriving Airbus A320 family of

aircraft, as described in section 2.10. At the opposite end near Windsor, the reduction in proportion of easterly operations coupled with the aforementioned arrival noise reductions has helped to reduce the extent of the contour lobe. The lower proportion of easterly operations and departure noise adjustments has also caused the retraction of the easterly departure contour lobes formed by aircraft that turn to the north and south.

2017 $L_{eq,6.5hr\ night}$ contours

3.51 Total movements in the 6.5-hour night period for 2017 decreased by 2% to 16.4 (see **Table C7**) from the year before (2016: 16.8). The largest movement decrease was for the ANCON aircraft type B772G (-0.7). This was offset by an increase for the B744R (+0.8). Total 6.5-hour night departures decreased by 19% from 1.6 in 2016 to 1.3 in 2017. Total 6.5-hour night arrivals decreased by 0.1 movements from 15.2 in 2016 to 15.1 in 2017.

3.52 The 48 dBA $L_{eq,6.5hr\ night}$ contour area of 33.9 km^2 in 2017 was unchanged from 2016 (see **Table 16**).

3.53 Populations and households within the 48 dBA contour, however, increased by 24% and 27% respectively.

Table 16 Heathrow 2017 $L_{eq,6.5hr\ night}$ contour - area, population and household estimates

$L_{eq,6.5hr\ night}$ (dBA)	Area (km^2)			Population			Households		
	2016	**2017**	change	2016	**2017**	Change	2016	**2017**	change
> 48	33.9	33.9	0%	95.4	118.0	+24%	34.2	43.6	+27%

Note: Populations and households are given in thousands. The 2016 and 2017 population/household counts are based on 2016 and 2017 CACI updates of the 2011 Census respectively.

3.54 The 2017 $L_{eq,6.5hr\ night}$ 48 dBA contour is compared against the 2016 contour in **Figure B18**. The contour lobes to the east of the airport (around Kew) extended in 2017, leading to the population increases. This contour expansion can be explained by the fact that the 2017 modal split for arrivals only was 76% west / 24% east (see **Table C10-e**), which was equivalent to a 7% higher percentage of westerly arrivals than in 2016, when the arrival runway split was 69% west / 31% east.

Long-term contour trends

3.55 Long-term area, population and household trends for the outermost cumulative contour are shown graphically in **Figures B19-B23** for L_{day}, $L_{evening}$, L_{night}, L_{den} and $L_{eq,6.5hr\ night}$ respectively, for the base year 2006 and 2009 through to 2017 (note: the population and household trends are all based on updated CACI data). The westerly and easterly movement percentages (i.e. the runway modal split) have also been indicated by the dashed lines on the charts.

3.56 Some factors that had an effect on the contours between 2006 and 2017 include the following:

- 2006:
  - ICAO Chapter 4 compliance estimated at 94% of the total fleet. (In the following years, the replacement of older, noisier types by quieter types will increase the Chapter 4 compliance percentage, leading to smaller contours).
- 2009:
  - Boeing 747-400 movements were 21% lower than in 2006, causing reductions in contour size.
- 2010:
  - Disruption from volcanic ash crisis, air traffic control strikes and adverse winter weather led to higher numbers of late-running departures at night, thus increasing the size of the night-time contours;
  - Total movements were 5% lower than in 2006, helping to reduce contour areas relative to 2006;
  - A low in the percentage of westerly movements, tending to reduce contour areas.
- 2011:
  - Total movements were 6% higher than in 2010, tending to increase contour areas.
- 2013:
  - Southern runway closed at night due to the resurfacing programme, shifting the noise at night from the southern runway to the northern runway;

- A low in the percentage of westerly movements, helping to reduce contour areas.

- 2014:
  - Northern runway closed at night due to the resurfacing programme, shifting the noise at night from the northern runway to the southern runway;
  - ICAO Chapter 4 compliance reached an estimated 99% of the total fleet (5% more than in 2006), reflecting higher numbers of newer, quieter aircraft and reducing contour areas compared to 2006;
  - Westerly departure trials between August and November, and easterly departure trials between July and November, shifting the distribution of departure noise to different areas.
- 2015:
  - Return to a ‘normal’ north-south runway usage split at night following the runway resurfacing works in 2013 and 2014, shifting some noise back to the northern runway;
  - Return to (a) standard departure routes following the departure trials of 2014, and (b) distributions of departure noise experienced prior to 2014;
  - ICAO Chapter 4 compliance estimated at 99% of the total fleet, reflecting higher numbers of newer, quieter aircraft and reducing contour areas compared to 2006.
- 2016:
  - Ongoing phase-out of older, noisier aircraft types such as the Boeing 747-400 and replacement by more modern, quieter types such as the Airbus A380 and Boeing 787-8/9, helping to reduce contour areas compared to 2006.
- 2017:
  - Ongoing replacement of older, noisier aircraft types by more modern, quieter types such as the Boeing 787-8/9, Airbus A320neo and A350-900, helping to reduce contour areas compared to 2006. Majority of the A320 aircraft family now fitted with Fuel Over Pressure Protectors (FOPP) air flow deflectors, reducing approach noise.

3.57 There was a downward trend for the L_{day} 55 dBA area, population and households from 2006 through to 2010, when movements also fell to a low and the percentage of easterly operations was unusually high (see **Figure B19**). However, an increase in area in 2011 was also accompanied by an increase in populations and households, which to a large extent was due to the update to the population database in 2011, and also to the 5% higher proportion of westerly movements. From 2011 to 2014, the L_{day} area was relatively steady, before falling in 2015 through to 2017 as noise levels reduced for certain ANCON aircraft types as identified by noise measurements, and as the fleet continued to switch to more modern, quieter aircraft types. Populations rose in 2013 following the major population database update but have fallen since 2014 in line with the area reductions. The proportion of westerly movements was at its lowest in 2010 and 2013 but reached a high in 2017. Apart from 2010, total movements have been relatively steady, in the range of approximately 940-960 per 12-hour day.

3.58 The $L_{evening}$ 55 dBA area exhibited a downward trend from 2006 through to 2010 before rising in 2011 (when there was also a rise in movements), but since then, has fallen steadily through to 2017 (**Figure B20**). This downward area trend can be attributed to the introduction of quieter aircraft types and to reductions in noise levels for certain ANCON aircraft types as identified by noise measurements. After the rise in 2011, movement numbers in the evening period declined from 2012 to 2014, but rose in 2015 and levelled off in 2016 and 2017. Populations and households fell in 2009 from the 2006 levels, but increased in 2010 and 2011, and since then have fallen in unison with the area reductions apart from in 2013 when there was a major update to the 2013 population database. The percentage of westerly operations was at its lowest in 2010 and 2013 but reached a high in 2017.

3.59 The L_{night} 50 dBA area dropped between 2006 and 2009, but since then has remained at a steady level, although it fell to a low in 2017 (**Figure B21**). Since 2006, L_{night} movements have been in the range of 75-78 per night. There was a downward trend in the population and households from 2009 to 2012 after the 2009 high. However, since 2012, population and household counts have been relatively high because of a range of factors. First, the population count rose in 2013 following the major update to the 2013 population database and the southern runway resurfacing programme, which increased arrival noise over Windsor. Around 60% of this population increase was due solely to the population database update. The population also then increased in 2015 as the contour shape changed following the northern runway resurfacing works in 2014 and the subsequent reversion to a ‘normal’ north/south runway usage in 2015, coupled with a higher percentage of westerly operations. The population count increased further in 2017 as a shift to a higher proportion of westerly operations extended the contour over parts of west London.

3.60 The L_{den} 55 dBA area decreased between 2006 and 2009 as movements of the noise dominant Boeing 747-400 aircraft dropped by 21% (**Figure B22**). From 2009 to 2013 the area stayed at a similar level, but has fallen since then as the fleet continued its switch to more modern, quieter aircraft such as the Airbus A380 and Boeing 787-8/9, and also as a result of noise adjustments made to various aircraft types in the light of noise measurements undertaken annually. The L_{den} population and households declined from 2006 through to 2010, but increased in 2011 despite the area staying almost constant - mainly due to the effects of the update to the 2011 population database, and also to a higher proportion of westerly movements. Between 2011 and 2016, the population and households generally followed a downward trend, apart from in 2013, when there was a major update to the 2013 population database. In 2017 the population count increased as the westerly arrival contour extended over west London due to a relatively large shift in the runway modal split in favour of westerly operations. The frequency of movements has been fairly steady since the 2006 base year, apart from a dip in 2010 when disruptions from volcanic ash, air traffic control strikes and adverse winter weather meant the total was 5% below 2006 levels. There were lows in the proportions of westerly operations in 2010 and 2013, but a high was reached in 2017.

3.61 The $L_{eq,6.5hr\ night}$ 48 dBA area has generally followed a downward trend since 2006, except in 2010 when movements increased due to disruptions caused by volcanic ash, ATC strikes and adverse winter weather (**Figure B23**). Population and household counts moved broadly in line with the contour area from 2006 to 2011. However, in 2012 the population count fell despite an area increase, as parts of the contour retracted from densely populated areas of west London after the percentage of westerly movements reduced. The area dropped by 4% in 2013, but the population count increased by 25% as the contour extended over west London in line with the northern runway. This population rise was caused by a combination of (a) the southern runway resurfacing programme, which shifted movements to the northern runway, (b) a higher percentage of westerly operations, and (c) the major 2013 population database update based on the 2011 Census. Around 50% of the total population increase in 2013 was due solely to the population database update. The area and population/household counts declined in 2014 following a reduction in B744R movements and a shift in traffic to the southern runway whilst the northern runway underwent resurfacing works. In 2015 the area and population/household counts fell again as more B744R movements were replaced by quieter aircraft. The further decline in populations and households in 2016 resulted from a 3% shift in the runway modal split for arrivals in favour of easterly operations, which had the effect of pulling the contour away from populated areas in Kew. However, the population count increased in 2017 as a higher proportion of westerly arrivals extended the contour back over west London.

Cumulative area, population and household counts – comparisons with 2006

3.62 The 2017 and 2006 cumulative results in **Tables C11-C15** of **Appendix C** show that the 2017 annual contour areas were all below 2006 base year levels across all the noise metrics. For example, the L_{den} 55 dBA contour area in 2017 was 182.3 km^2, which was 26% smaller than the 2006 L_{den} 55 dBA area of 244.7 km^2 (**Table C14**).

3.63 For the most part, population and household counts were lower in 2017 compared to 2006, in line with the area decreases; however, in a few cases the 2017 populations were higher than in 2006. For example, the 2017 L_{day} 60 dBA contour population count was 5% higher than in 2006 (**Table C11**). These rises in population can be attributed to the effects of population encroachment between 2006 and 2017 in the areas around Heathrow. To illustrate the impact of encroachment, population and household counts for the 2017 contours have also been made using the 2006 population database. These counts, which are highlighted in blue in **Tables C11-C15**, confirm that the population and household counts would have dropped across all the noise metrics had there not been any population encroachment between 2006 and 2017. In the above example of the 2017 L_{day} 60 dBA contour, the population count would have fallen by 21% without encroachment.

3.64 The Heathrow noise contour area is largely controlled by movements of the Boeing 747-400 aircraft. Their numbers have decreased from an average of 135 movements per day in 2006 (**Ref 6**) to 55 movements in 2017, which amounts to a 59% reduction. Newer, quieter aircraft types such as the Airbus A380 and Boeing 787-8/9 were not in service in 2006, but by 2017 there was an average of 51 daily movements of the Airbus A380 and 100 daily movements of the Boeing 787-8/9. Such fleet changes helped to reduce the Heathrow contour areas between 2006 and 2017.

2017 L_{den} noise contours – comparisons with 2006

3.65 A diagram comparing the 2017 and 2006 L_{den} contours can be found in **Figure B24**. The contour lobes associated with departures turning to the north have shortened considerably, following the replacement of the Boeing 747-400 aircraft over this period of time by quieter types such as the Airbus A380 and Boeing 777-300ER. A similar change is seen in the contour lobe formed by westerly departures turning to the south (on the DVR/DET route[12]). Westerly arrival movements were more prevalent on the northern runway in 2006, thus the

[12] See **Figure 1** for the Heathrow SID route diagram.

contour lobes to the east of the airport in 2006 were more expansive along the Runway 27R extended centreline compared to 2017. There was an 11% higher percentage of westerly operations in 2017.

3.66 To eliminate the effects of changes to the runway modal split and the north-south runway usage between 2006 and 2017, the 2017 L_{den} contours have also been produced using the 2006 base year runway modal split and the 2006 north-south runway usage (see **Figure B25**). The cumulative areas and populations within the resulting L_{den} contours are summarised in **Table C16**.

3.67 As the effects of the W/E and N/S runway splits have been removed, this means that the contour changes that are visible are due to the remaining changes including:

- Improvements to the aircraft fleet;
- Variations in the tracks actually flown;
- Variations of the number of each aircraft on each route.

3.68 It should be noted that noise from different events with the same aircraft type on the same track with the same fuel load can still vary due to procedural differences, whether standard procedures or those of individual pilots. The modelling attempts to reflect the average noise level for an aircraft, flight track, stage length (distance flown) and weather. As the ANCON model is continually updated to reflect actual and average noise levels, the results of the modelling should be as accurate as possible.

Noise change diagrams for L_{den}

3.69 In order to identify the areas where L_{den} noise levels have increased or decreased whilst excluding the effect of weather patterns on runway usage, a 'noise change' map has been produced to compare the noise exposure between the 2017 and 2006 L_{den} noise contours, assuming the 2006 runway modal splits in both cases[13] (see **Figure B26**). The 2006 L_{den} modal split was 70% west / 30% east. The 'envelope' of the 2006 and 2017 L_{den} 55 dBA contours (assuming the 2006 modal split) has been used as the outer boundary of the noise changes.

3.70 As expected, most areas have experienced noise reductions of up to 3 dB or higher, which reflects the phase-out of the older, noisier aircraft types between 2006 and 2017. However, some relatively small areas have seen noise

[13] That is, the 2017 L_{day}, $L_{evening}$ and L_{night} contours (the constituent parts of 2017 L_{den}) have been modelled with the 2006 L_{day}, $L_{evening}$ and L_{night} runway modal splits respectively.

increases of less than 1 dB. For example, the noise increases over Egham resulted from a change in the position of the westerly mean tracks for the DET (previously DVR) departure routes, which were further to the west in 2017. It is estimated that 99% of the total area within the L_{den} noise change boundary experienced decreases in noise.

3.71 Another noise change diagram has been produced comparing the 2017 and 2006 L_{den} noise contours - this time assuming the 2006 runway modal split and the 2006 north-south runway usage in both cases (see **Figure B27**). A similar pattern of noise changes is seen in this diagram.

3.72 A further noise change map has been produced to compare the 2017 and 2016 L_{den} noise contours, assuming the 2016 runway modal splits in both cases[14] (see **Figure B28**). The 2016 L_{den} modal split was 70% west / 30% east. The envelope of the 2016 and 2017 L_{den} 55 dBA contours has been used as the outer boundary of the areas of noise change being considered. Most areas have experienced noise reductions of up to 1 dB, but there are some isolated areas, for example near Feltham and Staines-upon-Thames, where some noise increases (of less than 1 dB) can be identified. These areas of noise increase amount to about 5% of the total area assessed.

3.73 A summary of the annual passengers, movements and 55 dBA L_{den} contour area, populations and households for 2006 and 2009-2017 is given in **Table 17**. The annual passengers rose from 67.5 mppa in 2006 to 78.0 mppa in 2017, a 16% increase. Over the same period of time the L_{den} 55 dBA contour area fell from 244.7 km^2 to 182.3 km^2, a decrease of 26%. Although 2017 had the highest passenger traffic since 2006, the L_{den} 55 dBA contour had the smallest area.

[14] That is, the 2017 L_{day}, $L_{evening}$ and L_{night} contours (the constituent parts of 2017 L_{den}) have been modelled with the 2016 L_{day}, $L_{evening}$ and L_{night} runway modal splits respectively.

Table 17 Heathrow annual passengers/movements and 55 dBA L_{den} area/population/households for 2006 & 2009-2017

Year	Passengers (mppa)	Annual movements	55 dBA L_{den} area	55 dBA L_{den} population	55 dBA L_{den} households
2006	67.5	477,274	244.7	756.1	338.5
2009	66.0	466,178	222.1	717.9	310.8
2010	65.9	454,717	222.3	712.2	305.5
2011	69.4	480,742	221.9	739.5	318.2
2012	70.0	473,734	216.9	725.0	312.5
2013	72.4	471,982	220.4	750.9	308.5
2014	73.4	471,872	210.7	704.3	288.3
2015	75.0	473,734	200.0	695.4	285.9
2016	75.7	474,858	198.0	689.4	286.1
2017	78.0	475,848	182.3	699.6	293.5

2017 L_{night} noise contours – comparisons with 2006

3.74 A diagram comparing the 2017 and 2006 L_{night} contours can be found in **Figure B29**. Overall reductions in contour area between 2006 and 2017 can be seen. The cumulative areas, populations and households for these contours are summarised in **Table C13**. The 2017 L_{night} 50 dBA contour area of 69.9 km^2 was 17% smaller than in 2006 (84.4 km^2).

Noise change diagrams for L_{night}

3.75 A noise change diagram has been produced comparing 2017 L_{night} with 2006 L_{night} assuming the 2006 L_{night} runway modal split (72% west / 28% east) in both cases (see **Figure B30**). The envelope of the 2006 and 2017 L_{night} 50 dBA contours has been taken as the outer boundary of the noise changes. It can be seen that virtually all areas have experienced reductions in noise levels of up to 3 dB or higher, which reflects the replacement of the older, noisier types (especially the B744R) between 2006 and 2017. It is estimated that 99% of the total area within the L_{night} noise change boundary experienced decreases in noise.

3.76 An additional noise change diagram (see **Figure B31**) has been produced comparing 2017 L_{night} with 2016 L_{night} assuming the 2016 L_{night} runway modal split

(70% west / 30% east) in both cases. The envelope of the 2016 and 2017 L_{night} 50 dBA contours has been taken as the outer boundary of the noise changes. Some areas with a noise increase of less than 1 dB can be seen to the east of the airport near Kew and Richmond, and to the west near Windsor. The regions experiencing noise decreases (of up to 2 dB) made up 72% of the total area assessed.

2017 L_{night} single mode noise contours

3.77 Single mode 2017 L_{night} contours have been produced using the 2006 L_{night} north-south runway usage (see **Figures B32** and **B33**). They are overlaid onto the corresponding single mode L_{night} contours for 2006. Cumulative estimates of the areas, populations and households within the 2017 and 2006 L_{night} single mode contours (assuming the 2006 north-south runway usage in both cases) are provided in **Tables 18** and **19**.

3.78 The contour areas for both 100% westerly and 100% easterly modes have all decreased in 2017 compared to 2006. Whilst populations and households have also decreased for the most part, population increases are seen for the 100% westerly single mode contours at the 55 dBA level (**Table 18**). This can be attributed to the effects of population encroachment around Heathrow between 2006 and 2017.

Table 18 Heathrow 2006 and 2017 L_{night} 100% W contours (assuming 2006 N-S runway usage) – area, population and household estimates

L_{night} (dBA)	Area (km^2)			Population			Households		
	2006	**2017**	change	2006	**2017**	change	2006	**2017**	change
> 50	86.0	70.6	-18%	282.8	273.1	-3%	124.8	109.1	-13%
> 55	35.2	25.9	-26%	78.2	85.8	+10%	31.5	30.8	-2%
> 60	11.9	8.2	-31%	23.7	21.1	-11%	9.0	6.9	-23%
> 65	4.3	2.7	-37%	2.9	2.1	-28%	1.0	0.6	-40%
> 70	1.6	0.9	-44%	< 0.1	< 0.1	(n/a)	< 0.1	< 0.1	(n/a)

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

Table 19 Heathrow 2006 and 2017 L_{night} 100% E contours (assuming 2006 N-S runway usage) – area, population and household estimates

L_{night} (dBA)	Area (km^2)			Population			Households		
	2006	**2017**	change	2006	**2017**	change	2006	**2017**	change
> 50	82.1	67.0	-18%	140.7	99.8	-29%	57.6	38.5	-33%
> 55	32.3	24.0	-26%	28.8	15.9	-45%	12.6	7.0	-44%
> 60	11.3	7.9	-30%	1.7	1.5	-12%	0.7	0.7	0%
> 65	4.2	2.6	-38%	0.4	0.2	-50%	0.2	0.1	-50%
> 70	1.6	0.9	-44%	0.0	0.0	(-)	0.0	0.0	(-)

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

2017 N65 annual 16-hour day contours

3.79 N65 contours (i.e. contours showing the number of aircraft noise events above 65 dBA L_{max}) have been produced for the 2017 annual average 16-hour day period (0700-2300 local time), for which the runway modal split was 81% west / 19% east.

3.80 The N65 contours for both 2017 and 2006[15] are overlaid in **Figure B34** (for clarity only the 50, 200 and 500 noise event levels are shown in the diagram). At the 50 events level, it can be seen that the 2017 contours were generally smaller; however, there was an extension to the contour lobe to the west of Windsor Forest. This was a consequence of a higher movement rate on the westerly CPT and GOG (previously SAM) departure routes in 2017 compared to 2006.

3.81 The estimated cumulative areas, populations and households are summarised in **Table 20** for N65 values of 50,100, 200 and 500 events.

[15] 2006 modal split was 70% W / 30% E.

Table 20 Heathrow 2006 and 2017 annual average 16-hour day N65 contours - area, population and household estimates

N65	Area (km^2)			Population			Households		
	2006	**2017**	Change	2006	**2017**	Change	2006	**2017**	change
> 50	267.2	212.0	-21%	754.3	591.9	-22%	337.2	243.0	-28%
> 100	162.5	142.8	-12%	470.8	398.3	-15%	209.9	159.9	-24%
> 200	83.0	78.5	-5%	223.5	220.0	-2%	96.3	85.2	-12%
> 500	13.2	12.8	-3%	3.3	1.0	-70%	1.4	0.4	-71%

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

3.82 The results show that the N65 50 events contour area reduced by 21% between 2006 and 2017, which reflects the switch from the noisiest aircraft such as the Boeing 747-400 to quieter types such as the Airbus A380 and Boeing 777-300ER. The population count within this contour was also 22% lower in 2017. Area, population and household decreases were also found at all the higher contour levels.

N65 annual 16-hour day change diagrams

3.83 An N65 change map has been produced comparing the 2017 and 2006 N65 annual 16-hour results assuming the 2006 runway modal split (70% west / 30% east) in both cases (see **Figure B35**). The outer boundary for the changes is the envelope of the 2006 and 2017 N65 50 events contours assuming the 2006 runway modal split.

3.84 It can be seen that many areas have experienced reductions of up to 50-100 noise events (per annual 16-hour day) that exceed 65 dBA L_{max}. However, there were increases of up to 50 N65 events south of Windsor, which was due to the higher movement rates on the westerly CPT and GOG (SAM) departure routes as previously mentioned. An area in the vicinity of Egham also experienced increases of up to 50 N65 events, which was caused by the DET mean departure track being positioned more to the west in 2017 compared to 2006. A region to the east of the southern runway showed increases of up to 50 N65 events, with a small area experiencing an increase of between 50 and 100 N65 events. This was caused by a higher proportion of westerly arrivals on the northern runway in 2006, in contrast to 2017 when the westerly arrivals were split evenly between the two runways. Approximately 82% of the total area within the

outer boundary of noise event changes experienced either N65 decreases or changes of less than 10 N65 events.

3.85 Another N65 change map has been produced comparing the 2017 and 2016 N65 results, assuming the 2016 runway modal split (70% west / 30% east) in both cases (see **Figure B36**). The outer boundary for the changes is the envelope of the 2016 and 2017 N65 50 events contours assuming the 2016 runway modal split. Around 99% of the area considered is either exposed to changes of less than 10 N65 events or reductions of between 10 and 50 N65 events.

2017 N70 annual 16-hour day contours

3.86 N70 contours (i.e. contours showing the number of aircraft noise events above 70 dBA L_{max}) have also been produced for the 2017 annual average 16-hour day period (0700-2300 local time), for which the runway modal split was 81% west / 19% east.

3.87 The N70 contours for 2017 and 2006[16] are overlaid in **Figure B37** (for clarity only the 50, 200 and 500 noise event levels are shown in the diagram). At the 50 events level the 2017 contour is generally smaller, reflecting the switch to quieter aircraft types from the noisiest types as the Boeing 747-400. However, there was an extension to the departure contour lobe over Windsor Great Park, which was caused by a much higher movement rate on the westerly CPT and GOG (SAM) departure routes in 2017 compared to 2006, as previously mentioned.

3.88 The estimated cumulative areas, populations and households are summarised in **Table 21** for N70 values of 50,100, 200 and 500 events.

[16] 2006 modal split was 70% W / 30% E.

Table 21 Heathrow 2006 and 2017 annual average 16-hour day N70 contours - area, population and household estimates

N70	Area (km^2)			Population			Households		
	2006	**2017**	Change	2006	**2017**	change	2006	**2017**	change
> 50	119.7	102.6	-14%	252.0	233.1	-8%	105.0	89.8	-14%
> 100	71.4	66.6	-7%	136.0	134.9	-1%	56.9	50.6	-11%
> 200	41.8	40.9	-2%	63.4	91.2	+44%	24.8	32.8	+32%
> 500	2.1	1.7	-19%	< 0.1	0.1	(n/a)	< 0.1	< 0.1	(n/a)

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

3.89 The 50 events N70 contour area has reduced between 2006 and 2017 by 14%, reflecting the replacement of the noisiest aircraft such as the Boeing 747-400 and the introduction of quieter types such as the Airbus A380, Boeing 777-300ER and the Boeing 787-8/9. The population count within this contour reduced by 8%. The 44% population increase within the 200 events N70 contour for 2017 resulted from a shift back to an even usage of the northern and southern runways for westerly arrivals in 2017, which extended the contour over Hounslow.

3.90 N70 contours for 2017 assuming both the 2006 runway modal split and the 2006 north-south runway usage are overlaid onto the 2006 contours in **Figure B38** (for clarity only the 50, 200 and 500 noise event levels are shown in the diagram). The estimated cumulative areas, populations and households are summarised in **Table 22** for N70 values of 50,100, 200 and 500 events. Areas have decreased at all contour levels but population counts have increased by up to 7% in 2017, which may be attributed to the effects of population encroachment in the areas around Heathrow.

Table 22 Heathrow 2006 and 2017 annual average 16-hour day N70 contours (assuming 2006 modal split and 2006 N-S runway usage) - area, population and household estimates

N70	Area (km^2)			Population			Households		
	2006	**2017**	change	2006	**2017**	change	2006	**2017**	change
> 50	119.7	104.9	-12%	252.0	255.4	+1%	105.0	98.2	-6%
> 100	71.4	66.3	-7%	136.0	144.7	+6%	56.9	53.9	-5%
> 200	41.8	36.4	-13%	63.4	67.7	+7%	24.8	23.9	-4%
> 500	2.1	1.4	-33%	< 0.1	0.0	(n/a)	< 0.1	0.0	(n/a)

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

N70 annual 16-hour day change diagrams

3.91 An N70 change map has been produced comparing the N70 results for 2017 with those for 2006, assuming the 2006 modal split (70% west / 30% east) in both cases (see **Figure B39**). The outer boundary for the changes is the envelope of the 2006 and 2017 N70 50 events contours assuming the 2006 runway modal split. It can be seen that many areas have experienced reductions of up to 100-150 N70 events. However, there were increases of between 10 and 50 N70 events over Windsor Great Park, which were due to the higher movement rates on the westerly CPT and GOG (SAM) departure routes as previously mentioned. An area immediately to the west of the northern runway also experienced increases of between 10 and 50 N70 events. This can be explained by the westerly departures in 2006 being biased to the southern runway, whereas in 2017, westerly departures were split evenly between the two runways. An area to the east of the southern runway also showed increases of up to 50-100 N70 events. This was caused by westerly arrivals in 2006 favouring the northern runway over the annual 16-hour day period, whereas the westerly arrival split between the two runways in 2017 was even. Approximately 80% of the total assessment area was either exposed to decreases of more than 10 N70 events or changes of less than 10 N70 events.

3.92 A further N70 change map has been produced comparing the N70 results for 2017 with 2006, assuming the 2006 runway modal split and the 2006 north-south runway usage in both cases (see **Figure B40**). The outer boundary for the changes is the 2006 and 2017 N70 50 events contours assuming the 2006 runway modal split and the 2006 north-south runway usage. With the effects of the 2006 north-south runway usage removed, the areas of N70 increases to the west of the northern runway and to the east of the southern runway are reduced in size. Approximately 90% of the area within the outer boundary is exposed to

either decreases of more than 10 N70 events, or changes of less than 10 N70 events.

3.93 An N70 change map has also been produced comparing the 2017 and 2016 N70 results, assuming the 2016 runway modal split (70% west / 30% east) in both cases (see **Figure B41**). The outer boundary for the changes is the envelope of the 2016 and 2017 N70 50 events contours assuming the 2016 runway modal split. It can be seen that all areas are either exposed to changes of less than 10 N70 events or reductions of more than 10 N70 events.

2017 N70 annual 16-hour day single mode contours

3.94 Single mode 2017 N70 annual 16-hour day contours have been produced using the 2006 north-south runway usage (**Figures B42** and **B43**). They are overlaid onto the corresponding single mode N70 contours for 2006.

3.95 Cumulative estimates of the areas, populations and households within the 2017 and 2006 N70 annual 16-hour day single mode contours (assuming the 2006 north-south runway usage) are provided in **Tables 23** and **24** for 100% westerly and 100% easterly modes respectively.

3.96 All the single mode contours reduced in size in 2017 compared to 2006 by up to 15%. For some contour levels the population counts have risen due to the effects of population encroachment and changes in contour shape.

Table 23 Heathrow 2006 and 2017 annual 16-hour day N70 100% W contours (assuming 2006 N-S runway usage) – area, population and household estimates

N70	Area (km^2)			Population			Households		
	2006	**2017**	change	2006	**2017**	Change	2006	**2017**	change
> 50	121.8	103.3	-15%	220.1	208.5	-5%	92.8	80.4	-13%
> 100	77.7	69.4	-11%	133.6	143.0	+7%	55.1	54.0	-2%
> 200	51.3	44.8	-13%	94.7	99.1	+5%	38.6	36.1	-6%
> 500	4.6	4.1	-11%	0.3	0.4	+33%	0.1	0.2	+100%

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

Table 24 Heathrow 2006 and 2017 annual 16-hour day N70 100% E contours (assuming 2006 N-S runway usage) – area, population and household estimates

N70	Area (km^2)			Population			Households		
	2006	**2017**	change	2006	**2017**	change	2006	**2017**	change
> 50	97.9	83.4	-15%	312.1	293.9	-6%	131.4	114.7	-13%
> 100	62.3	57.0	-9%	179.0	191.4	+7%	73.8	73.1	-1%
> 200	41.6	35.3	-15%	92.2	93.2	+1%	36.8	34.1	-7%
> 500	18.0	15.8	-12%	11.0	8.4	-24%	5.0	3.3	-34%

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

2017 N60 annual 8-hour night contours

3.97 N60 contours (i.e. contours showing the number of aircraft noise events above 60 dBA L_{max}) have been produced for the 2017 annual average 8-hour night period (2300-0700 local time), for which the runway modal split was 80% west / 20% east. The N60 contours for years 2017 and 2006 are overlaid in **Figure B44** for the noise event levels 10, 20 and 50. The L_{night} modal split in 2006 was 72% west / 28% east.

3.98 The estimated cumulative areas, populations and households are summarised in **Table 25**. The N60 10 events contour area reduced by 10% between 2006 and 2017, reflecting the replacement of the noisiest aircraft type, the Boeing 747-400 series. However, the population count increased by 11% due to the effects of population encroachment and changes in the contour shape caused by the higher proportion of westerly operations in 2017. Increases in area at the 20 events level can be attributed to the 6% higher number of arrivals in 2017. As a result of the 11% higher proportion of westerly arrivals in 2017[17], the contour extended over west London in 2017, causing the higher population counts.

[17] See **Table C10--c**

Table 25 Heathrow 2006 and 2017 annual average 8-hour night N60 contours - area, population and household estimates

N60	Area (km^2)			Population			Households		
	2006	**2017**	change	2006	**2017**	change	2006	**2017**	change
> 10	184.4	165.7	-10%	837.2	929.9	+11%	387.6	399.0	+3%
> 20	89.9	105.1	+17%	389.9	627.3	+61%	175.7	267.8	+52%
> 50	0.5	1.5	+200%	< 0.1	5.8	(n/a)	< 0.1	2.0	(n/a)

Note: Populations and households are given in thousands. The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census. The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

N60 annual 8-hour night change diagrams

3.99 An N60 change map has been produced comparing the 2017 and 2006 annual 8-hour night N60 results, assuming the 2006 runway modal split (72% west / 28% east) in both cases (see **Figure B45**). The outer boundary for the changes is the envelope of the 2006 and 2017 annual 8-hour night N60 10 events contours assuming the 2006 runway modal split. It can be seen that all areas are either exposed to changes of less than 5 N60 events or reductions of between 5 and 10 N60 events.

3.100 A further N60 change map has been produced comparing the 2017 and 2016 annual 8-hour night N60 results, assuming the 2016 runway modal split (70% west / 30% east) in both cases (**Figure B46**). The outer boundary for the changes is the envelope of the 2016 and 2017 annual 8-hour night N60 10 events contours assuming the 2016 runway modal split. It can be seen that all areas are exposed to changes of less than 2 N60 events or a decrease of between 2 and 3 N60 events.

Chapter 4
Conclusions

4.1 In 2017, there were 1273.1 average summer 16-hour day movements at Heathrow, which was 0.5% higher than in 2016 (1266.7). The area of the 57 dBA average summer day actual modal split (84% west / 16% east) Leq contour was 93.2 km^2, 8% smaller than in 2016 (101.5 km^2). The population count within this contour dropped by 7% to 230,600 (2016: 247,100). The 57 dBA standard modal split (79% west / 21% east) Leq contour area decreased by 7% to 92.3 km^2 (2016: 99.6 km^2), and the population reduced by 7% to 232,700 (2016: 249,200).

4.2 The 2017 average summer 8-hour night movement total (83.0) was 2% lower than in 2016 (84.4). Night departure movements reduced by 7% but night arrival movements rose by 1%. The area of the 48 dBA 8-hour night actual modal split (81% west / 19% east) Leq contour decreased by 11% to 103.1 km^2 (2016: 115.4 km^2), with the population count falling by 9% to 397,900 (2016: 437,900).

4.3 Compared to 2016, the numbers of annual aircraft movements at Heathrow in 2017 were 1% higher over the L_{day} period, 1% lower for $L_{evening}$, and unchanged for L_{night}. Overall 24-hour L_{den} movements in 2017 (1303.7) were 0.5% higher than in 2016 (1297.4). Movements over the 6.5-hour night period in 2017 were 2% lower compared to 2016.

4.4 The area of the 55 dBA L_{day} contour in 2017 (139.3 km^2) was 6% smaller than in 2016. There were also area decreases of up to 4% at the other L_{day} contour levels. Similarly, the 55 dBA $L_{evening}$ contour reduced by 7% in 2017 to 121.3 km^2 and there were reductions at the higher contour levels as well of up to 8%. The area of the 50 dBA L_{night} contour in 2017 (69.9 km^2) was 6% lower than in 2016. The 55 dBA L_{den} contour area of 182.3 km^2 was 8% smaller than in 2016.

4.5 The above reductions in contour area can be attributed to the ongoing introduction of more modern, quieter types such as the Boeing 787-8/9, Airbus A320neo and A350-900, and also to downward noise adjustments made to the ANCON types B744R and EA38R on departure, and to the EA319V, EA320V and EA321V on arrival, following noise measurements undertaken in 2017.

4.6 The 2017 L_{day} contours showed population and household changes from 2016 that were not necessarily in line with the area reductions. The shift to a higher proportion of westerly operations in 2017 changed the L_{day} contour shapes, which in turn affected the population counts. The runway modal split changes also affected the shape of the 2017 $L_{evening}$ contours, though the population counts reduced for all the contours. For 2017 L_{night}, the higher percentage of westerly arrival operations extended the contours over west London, causing

increases in population counts. For 2017 L_{den}, changes to the contour shapes caused by the higher proportion of westerly operations meant that population and household counts did not fall in all cases despite the area reductions. Similar to L_{night}, the higher proportion of westerly operations extended the $L_{eq,6.5hr\ night}$ 48 dBA contour over west London in 2017, producing a rise in population and household counts.

Annual contour trends

4.7 With respect to long-term trends, the L_{day} 55 dBA contour area has been reasonably steady since 2009 after the initial high in 2006. A dip in the L_{day} area in 2010 coincided with a low in aircraft movements and a relatively high percentage of easterly movements. The L_{day} area also fell in 2015 through to 2017 when noise levels reduced for certain ANCON aircraft types as identified by noise measurement data, and as the fleet mix continued to switch to more modern, quieter aircraft. Populations and households fell to a low in 2010 after dropping from the 2006 peak but rose in 2011 and 2013 following updates to the population database. They fell again between 2015 and 2017 in line with the area reductions.

4.8 The area, population and households within the $L_{evening}$ 55 dBA contour decreased in 2009 from the 2006 peak as movements declined, but rose to a high in 2011 as movements recovered. Since 2011 the area, population and households have followed a downward trend as quieter aircraft have been introduced and noise reductions made to certain ANCON aircraft types to reflect measurement data, although in 2013 the population count increased due to the major population database update. Movements declined between 2011 and 2014, but rose in 2015 and levelled off in 2016 and 2017.

4.9 Aircraft movements over the L_{night} period have been relatively stable since 2006. The L_{night} 50 dBA area was steady between 2011 and 2016, having been higher between 2006 and 2010, and dropped further in 2017. The population and household counts followed a downward trend from 2009 through to 2012, but increased in 2013 after the population database update of 2013, which was based on the latest 2011 Census, and also because of contour shape changes caused by the southern runway resurfacing programme in 2013. A higher percentage of westerly operations and a more even split between the northern and southern runways (after the northern runway resurfacing work carried out in 2014) influenced the contour shape in 2015. Populations have remained at a relatively higher level since 2013. The population count in 2017 increased due to a higher proportion of westerly operations, which extended the contour over west London.

4.10 After the 2006 high, the L_{den} 55 dBA contour area was fairly flat between 2009 and 2013, but since then has generally fallen as the Heathrow fleet switched to

more modern, quieter types such as the Airbus A380 and Boeing 787-8/9. Populations and households trended downwards between 2011 and 2016, apart from a rise in population in 2013 due to the major population database update. The population count rose again in 2017 as the shift in runway modal split in favour of westerly operations extended the contour over west London. Aircraft movements in the L_{den} period have been at a similar level since 2006, with the exception of a drop in 2010.

4.11 The $L_{eq,6.5hr\ night}$ 48 dBA area has generally followed a downward trend between 2006 and 2017, apart from a rise in 2010, which was due to the effects of higher night movements following disruption from adverse winter weather, volcanic ash and ATC strikes. Movements over this period have been steady apart from the rise in 2010. Following two years of population decreases in 2011 and 2012, the population rose in 2013 due to an extension of the contour over west London in line with the northern runway. This was caused by resurfacing works on the southern runway coupled with a higher percentage of westerly operations. In addition, there was a major update to the population database in 2013 based on the 2011 Census. However, in 2014, the population count returned to near 2012 levels as the contour area reduced and then fell again in 2015 as more B744R movements were phased out. A reduction in the percentage of westerly arrival operations in 2016 shifted the contour away from populated areas of Kew, which in turn reduced the population count, despite the overall area increase. A return to a higher proportion of westerly arrivals in 2017 moved the contour back over west London, which caused population and household counts to rise.

Comparisons with 2006 (base year) and 2016 (previous year)

4.12 The 2017 cumulative contour areas were below 2006 levels for all the annual noise metrics considered. In most cases, populations and households within the 2017 contours were also lower than in 2006. Where there were higher populations and households in 2017, this was due to the effects of population encroachment around Heathrow between 2006 and 2017. Population and household counts for the 2017 contours, carried out with the 2006 population database instead of the 2017 database, indicated that the 2017 counts would have all been lower than in 2006 if population encroachment had not occurred.

4.13 An assessment of L_{den} noise changes between 2006 and 2017, assuming the 2006 base year modal split in both cases, indicated that 99% of the assessment area experienced noise reductions. Around 1% of the area (near Windsor and Egham) was exposed to a noise increase of less than 1 dB.

4.14 An analysis of L_{den} noise changes between 2016 and 2017, assuming the 2016 modal split in both cases, indicated that most areas have experienced noise reductions of up to 1 dB. Around 5% of the total area assessed was exposed to noise increases, which were less than 1 dB.

4.15 An analysis of L_{night} noise changes between 2006 and 2017, assuming the 2006 base year runway modal split in both cases, showed that over 99% of the area under consideration experienced reductions in noise of up to 3 dB or higher. This reflects the replacement of the older, noisier aircraft types operating at night, especially the B744R.

4.16 An assessment of L_{night} noise changes between 2016 and 2017, assuming the 2016 modal split in both cases, indicated some areas with a noise increase of less than 1 dB to the east of the airport near Kew and Richmond, and to the west near Windsor. These areas of noise increase made up 28% of the total area assessed.

4.17 Single-mode contours produced for 2017 and 2006 L_{night} (assuming the 2006 north-south runway usage) showed that areas have all reduced in 2017 compared to 2006. However, population counts increased at one of the '100% W' mode contour levels and this can be attributed to the effects of population encroachment between 2006 and 2017.

4.18 N65 and N70 annual average 16-hour day contours produced for 2006 and 2017 showed that all the contour areas have decreased between 2006 and 2017. This is indicative of the replacement of the noisiest aircraft types, such as the Boeing 747-400, by quieter types including the Airbus A380, Boeing 777-300ER and Boeing 787-8/9. There was also an area decrease for the outermost (10 events) N60 annual average 8-hour night contour in 2017 compared to 2006. However, there were area increases at some of the higher N60 contour levels, which can be attributed to differences in runway modal split and north-south runway usage between the two years.

4.19 There were increases in population and household counts in some cases for the N-contours despite the reductions in contour area. These were due to the effects of population encroachment around Heathrow and also to changes in contour shapes.

4.20 An assessment of annual 16-hour day N65 changes between 2006 and 2017, assuming the 2006 modal splits, showed that many areas have experienced reductions of up to 50-100 events. However, there were increases of up to 50 events (a) around Windsor Great Park due to higher usage of the CPT and GOG (SAM) routes in 2017, (b) near Egham due to a westerly shift in the position of the 2017 DET mean departure track relative to 2006, and (c) east of the southern runway, because the northern runway was used proportionately more for westerly arrivals in 2006, whereas westerly arrivals were evenly split between the northern and southern runways in 2017. Approximately 82% of the total assessment area experienced either decreases of between 10 and 150 N65 events or changes of less than 10 N65 events.

4.21 An analysis of annual 16-hour day N65 changes between 2016 and 2017, assuming the 2016 modal split, indicated that 99% of the area assessed was either exposed to changes of less than 10 events or reductions of up to 50 events.

4.22 An assessment of annual 16-hour day N70 changes between 2006 and 2017, assuming the 2006 runway modal splits, revealed some areas where increases in N70 events occurred. These were due to (a) higher movement rates on the CPT and GOG (SAM) routes in 2017, (b) a bias towards usage of the southern runway for westerly departures in 2006, and (c) the northern runway being favoured for westerly arrivals in 2006. Approximately 80% of the total assessment area experienced either decreases of between 10 and 150 N65 events or changes of less than 10 N65 events. This figure rose to 90% when the effects of the differences in north-south runway usage were also removed.

4.23 An analysis of annual 16-hour day N70 noise changes between 2016 and 2017, assuming the 2016 runway modal split, showed that all areas experienced changes of less than 10 events or decreases of more than 10 events.

4.24 An examination of annual 8-hour night N60 changes between 2006 and 2017, assuming the 2006 runway modal split, showed that all areas either experienced changes of less than 5 N60 events or reductions of up to 10 N60 events.

4.25 The N60 annual 8-hour night changes between 2016 and 2017, assuming the 2016 runway modal split, indicated that all areas are either exposed to changes of less than 2 N60 events or a decrease of up to 3 events.

APPENDIX A

References

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APPENDIX B

Figures

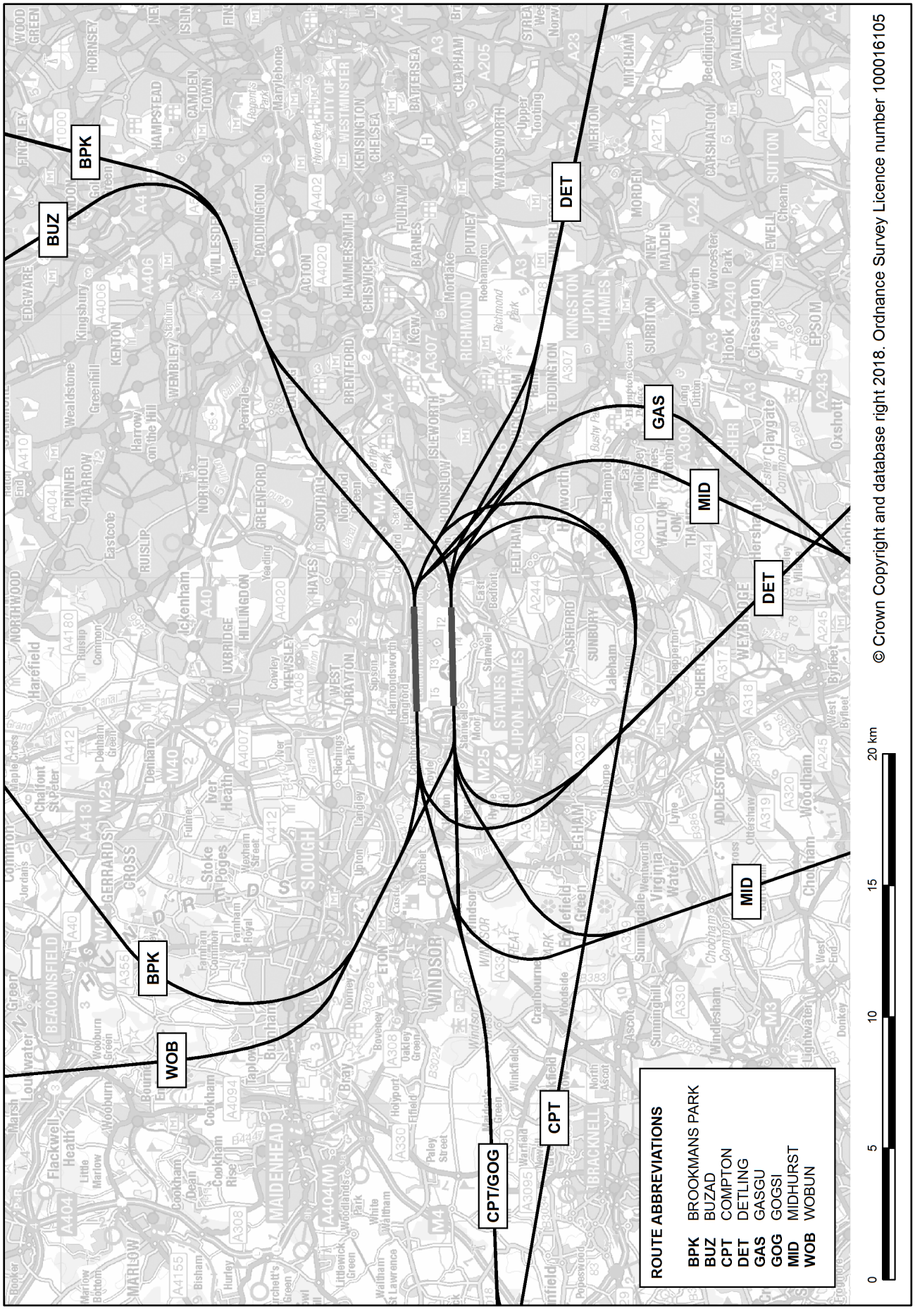
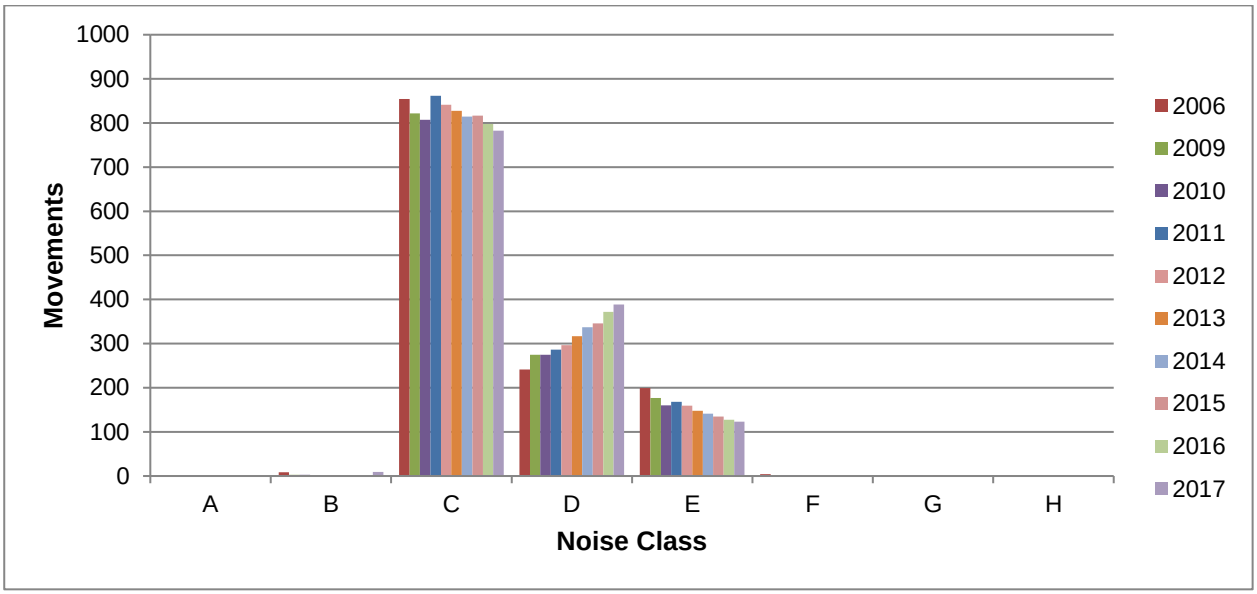


Figure B1 Heathrow NPR/SID routes

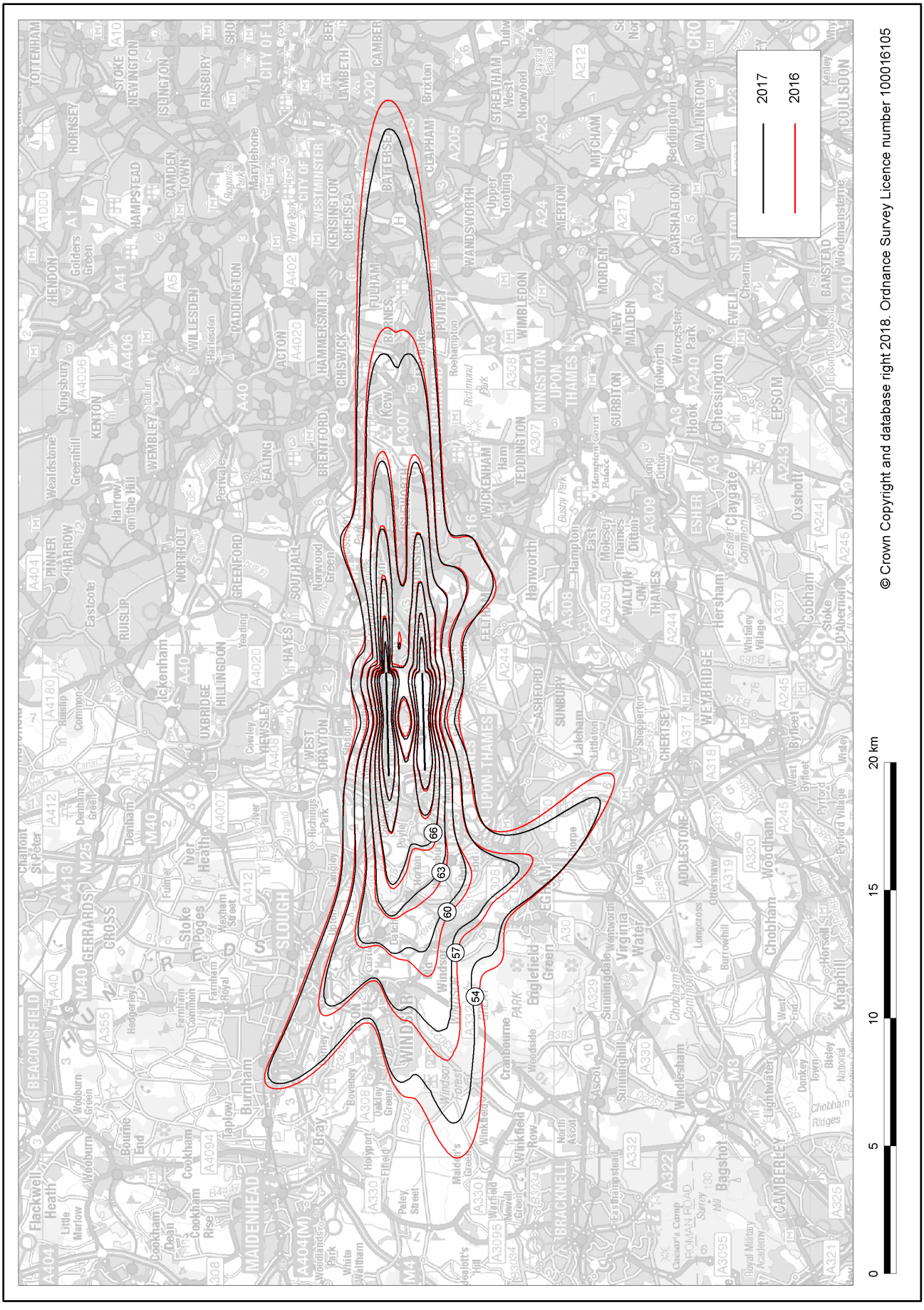
Figure B2 Heathrow annual average 24-hour movements by Noise Class



Note: Noise Class descriptions are given below:

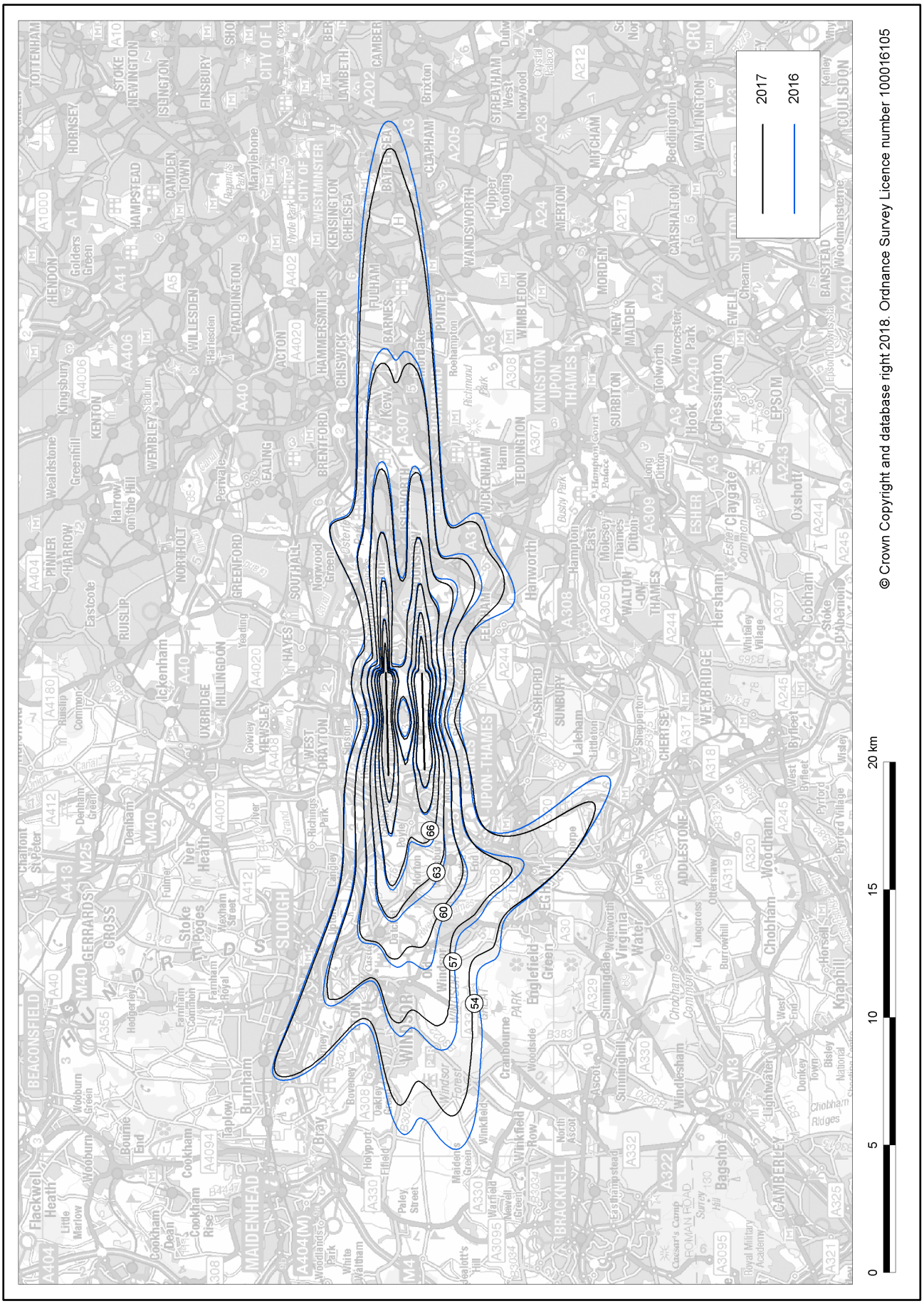
Noise Class	Description
A	Small propeller
B	Large propeller
C	Narrow-body jets *(e.g. Airbus A319, Airbus A320, Boeing 737-800)*
D	Wide-body twin engine *(e.g. Boeing 777, Boeing 787, Airbus A330)*
E	Wide-body 3,4 engine *(e.g. Boeing 747-400, Airbus A380)*
F	1st generation wide-body 3,4 engine *(e.g. Boeing 747-100)*
G	2nd generation narrow-body twin engine *(e.g. Boeing 737-200)*
H	1st generation narrow-body 3,4 engine *(e.g. Boeing 727)*

Figure B3 Heathrow 2016 and 2017 average summer day 54-72 dBA actual modal split Leq noise contours



Note: 2016 day actual modal split was 86% W / 14% E; 2017 day actual modal split was 84% W / 16% E.

Figure B4 Heathrow 2016 and 2017 average summer day 54-72 dBA standard modal split Leq noise contours



Note: 2016 day standard modal split was 79% W / 21% E; 2017 day standard modal split was 79% W / 21% E.

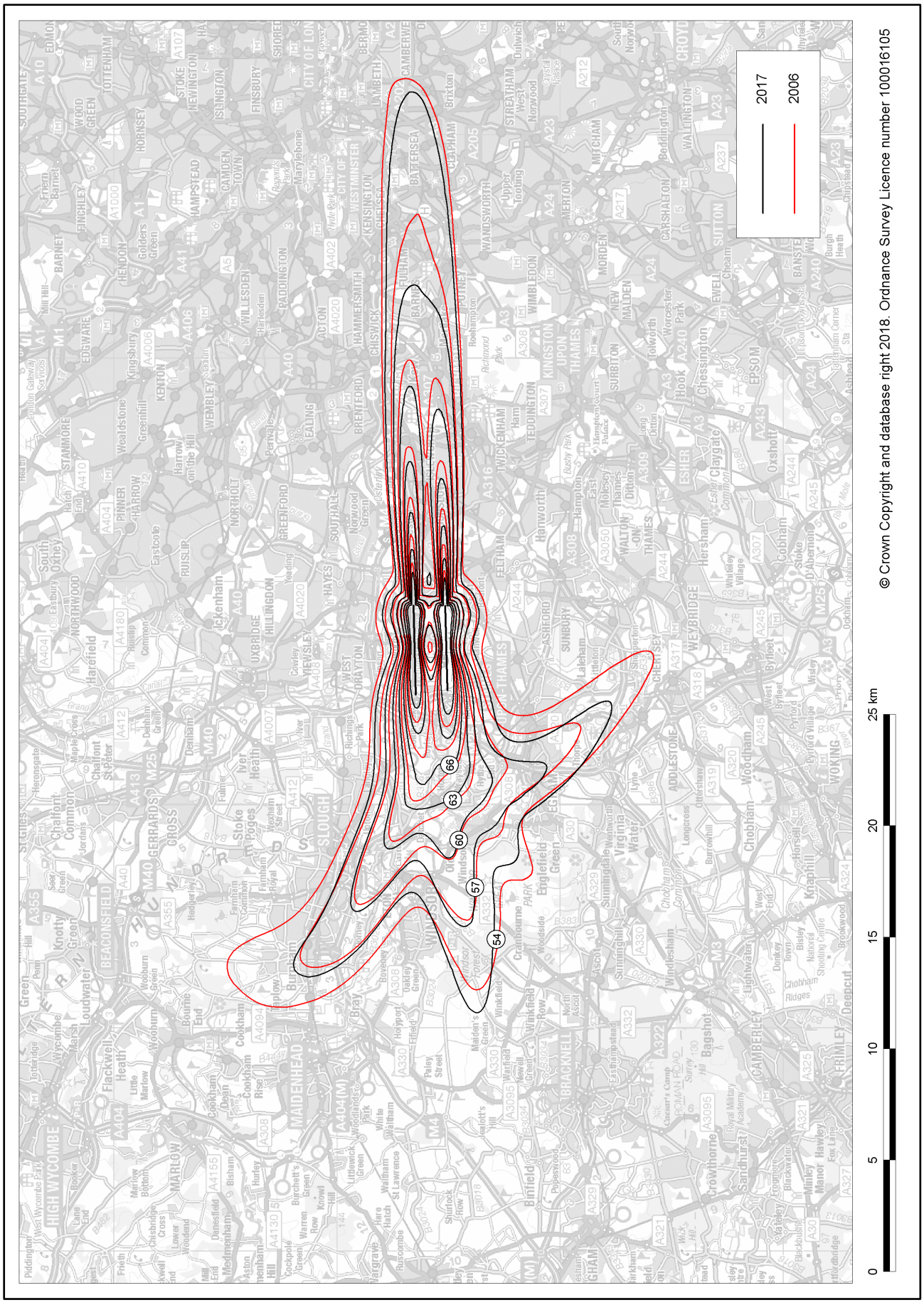


Figure B5 Heathrow 2006 and 2017 average summer day 54-72 dBA 100% W Leq noise contours (with 2006 N-S runway usage)

Figure B6 Heathrow 2006 and 2017 average summer day 54-72 dBA 100% E Leq noise contours (with 2006 N-S runway usage)

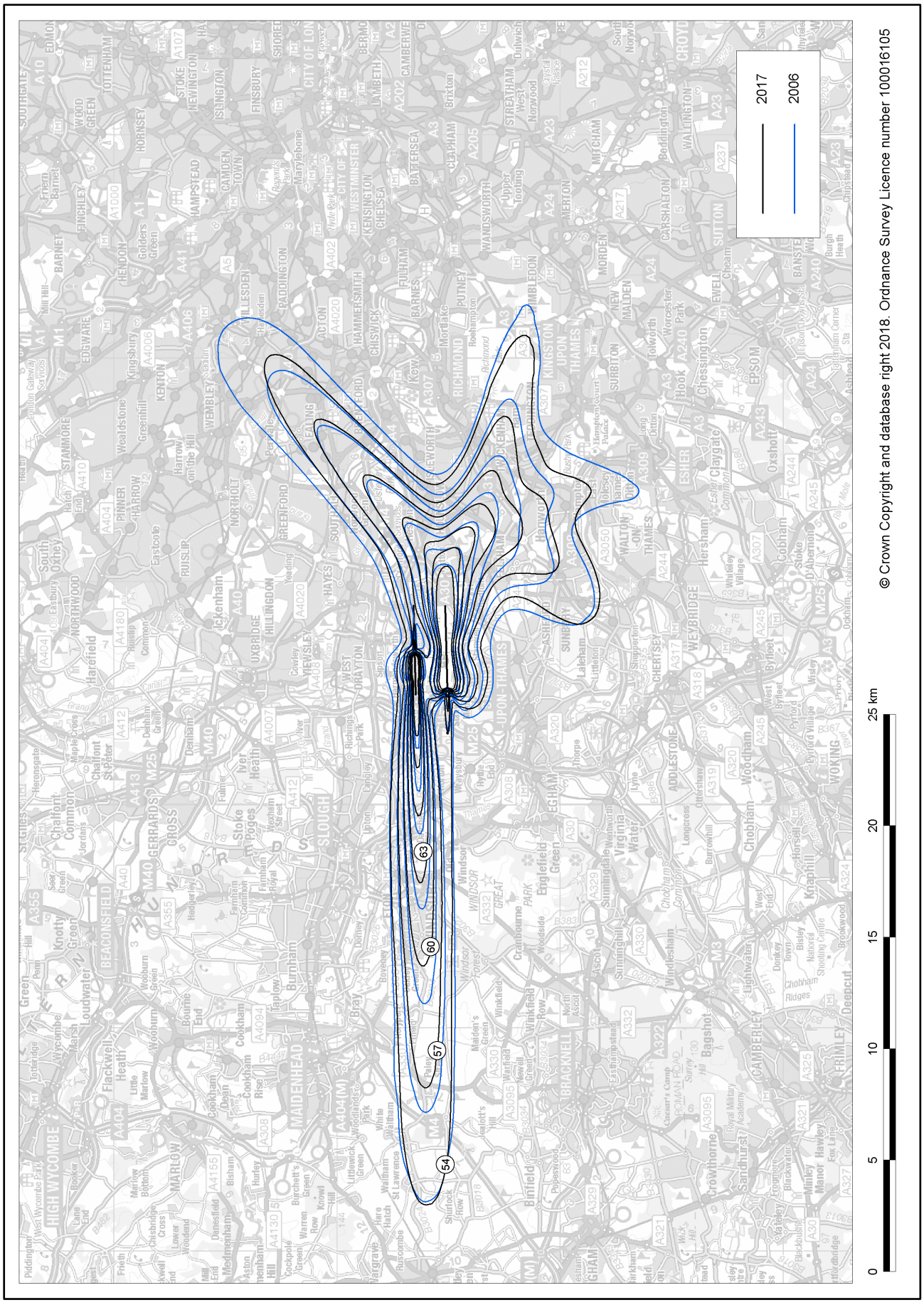
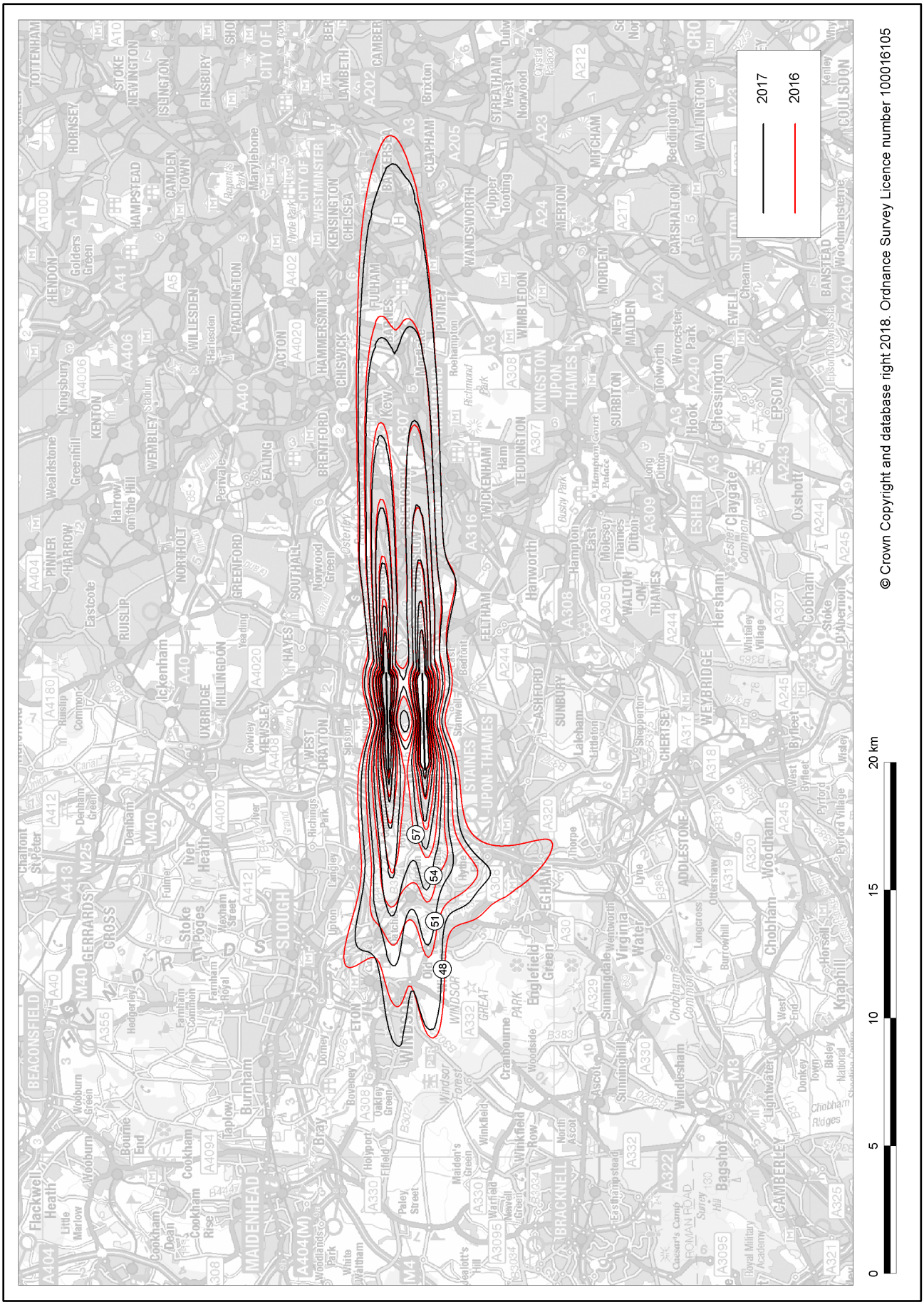


Figure B7 Heathrow 2016 and 2017 average summer night 48-66 dBA actual modal split Leq noise contours



Note: 2016 night actual modal split was 85% W / 15% E; 2017 night actual modal split was 81% W / 19% E.

Figure B8 Heathrow 2006 and 2017 average summer night 48-66 dBA 100% W Leq noise contours (with 2006 N-S runway usage)

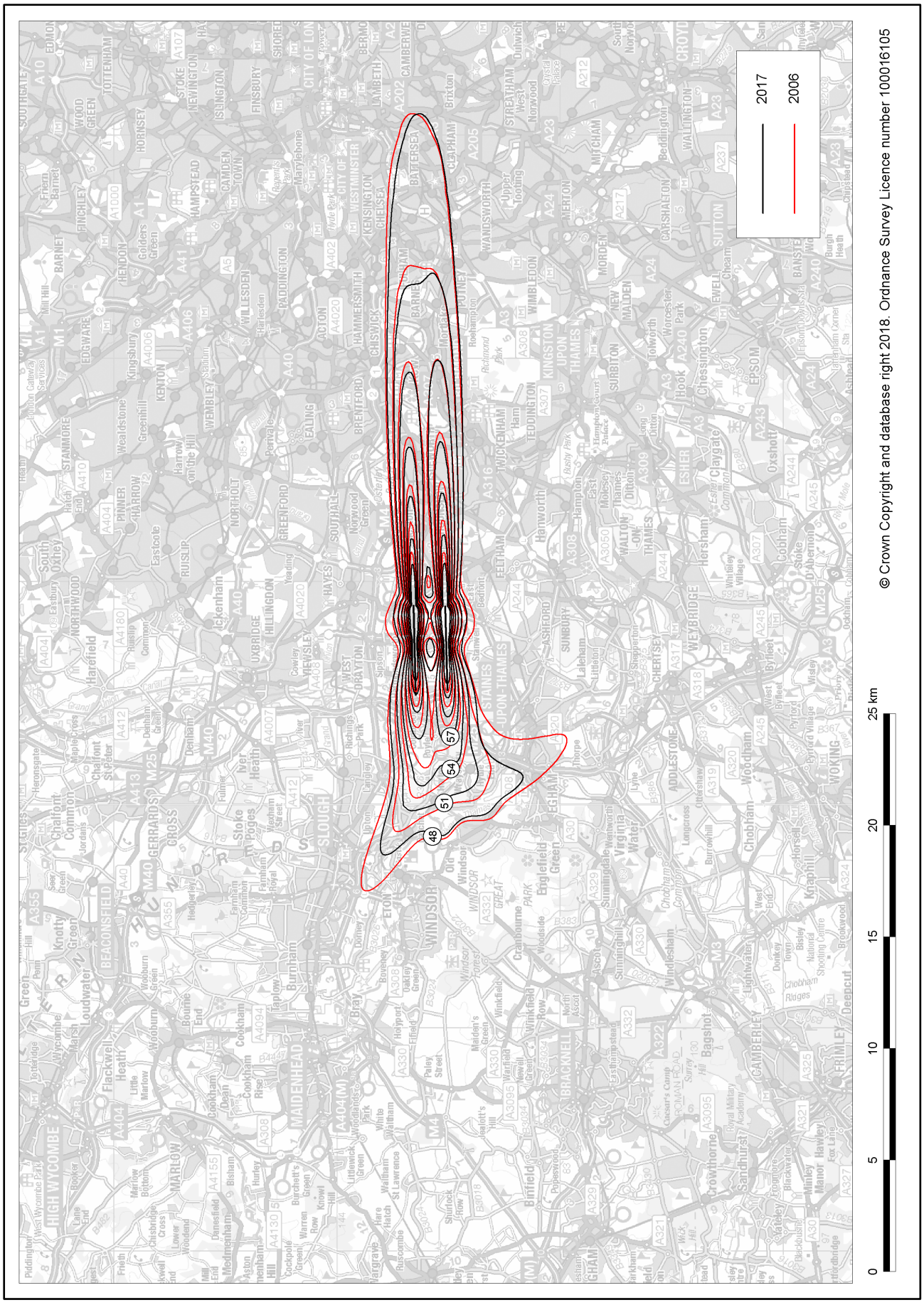
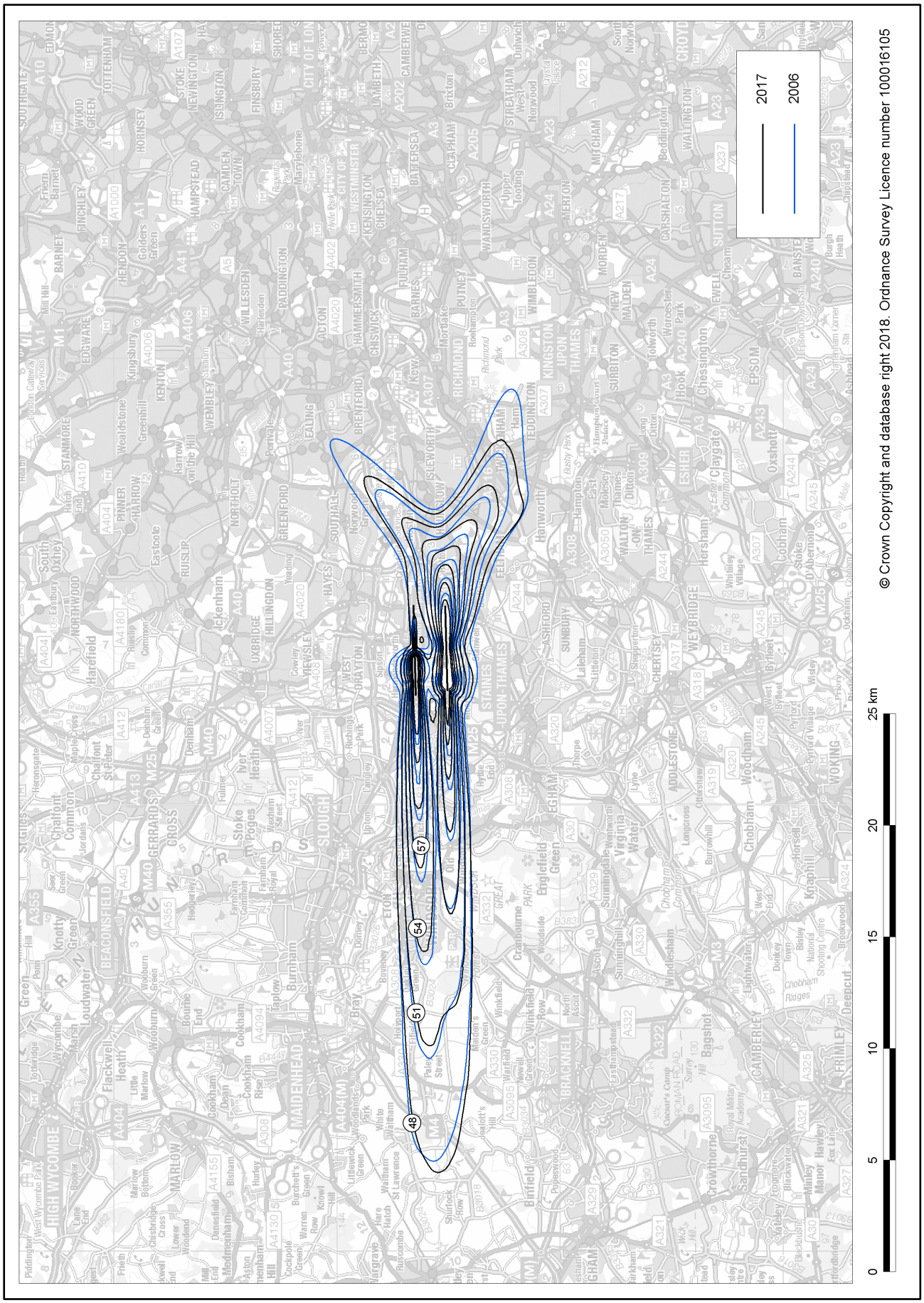


Figure B9 Heathrow 2006 and 2017 average summer night 48-66 dBA 100% E Leq noise contours (with 2006 N-S runway usage)



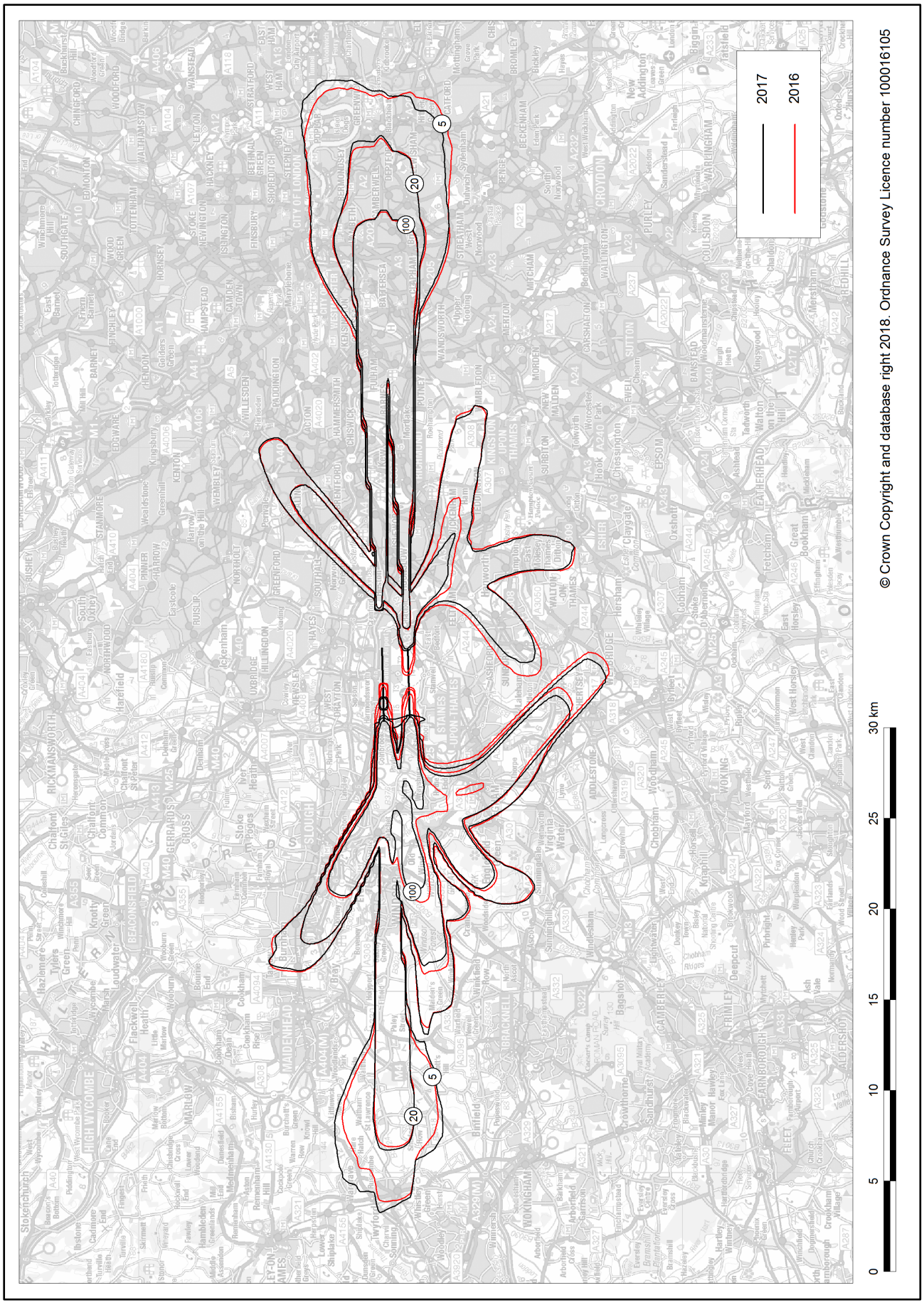


Figure B10 Heathrow 2016 and 2017 average summer day overflight contours (assuming 48.5 degree elevation angle)

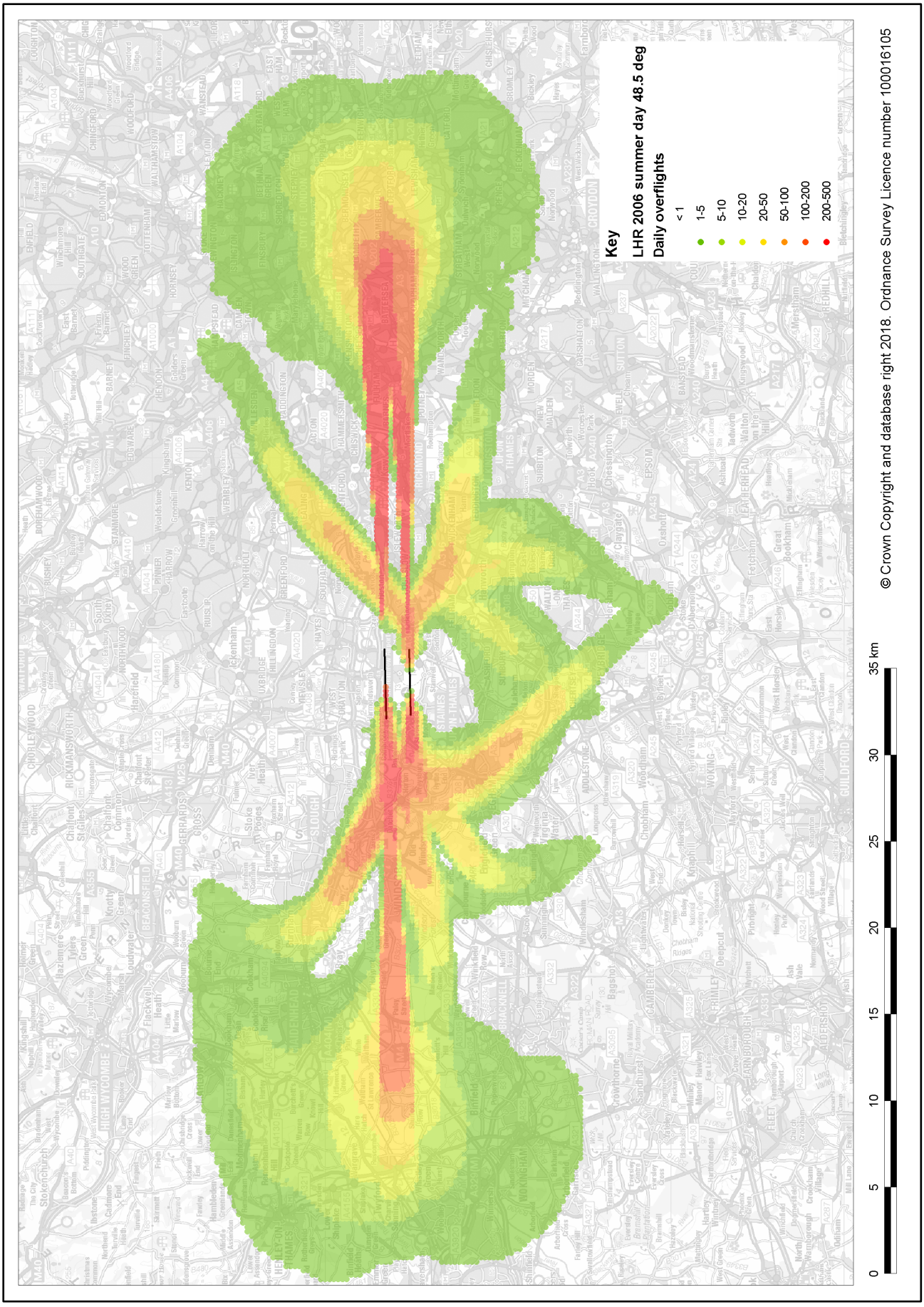


Figure B10-a Heathrow 2006 average summer day overflight track density diagram (assuming 48.5 degree elevation angle)

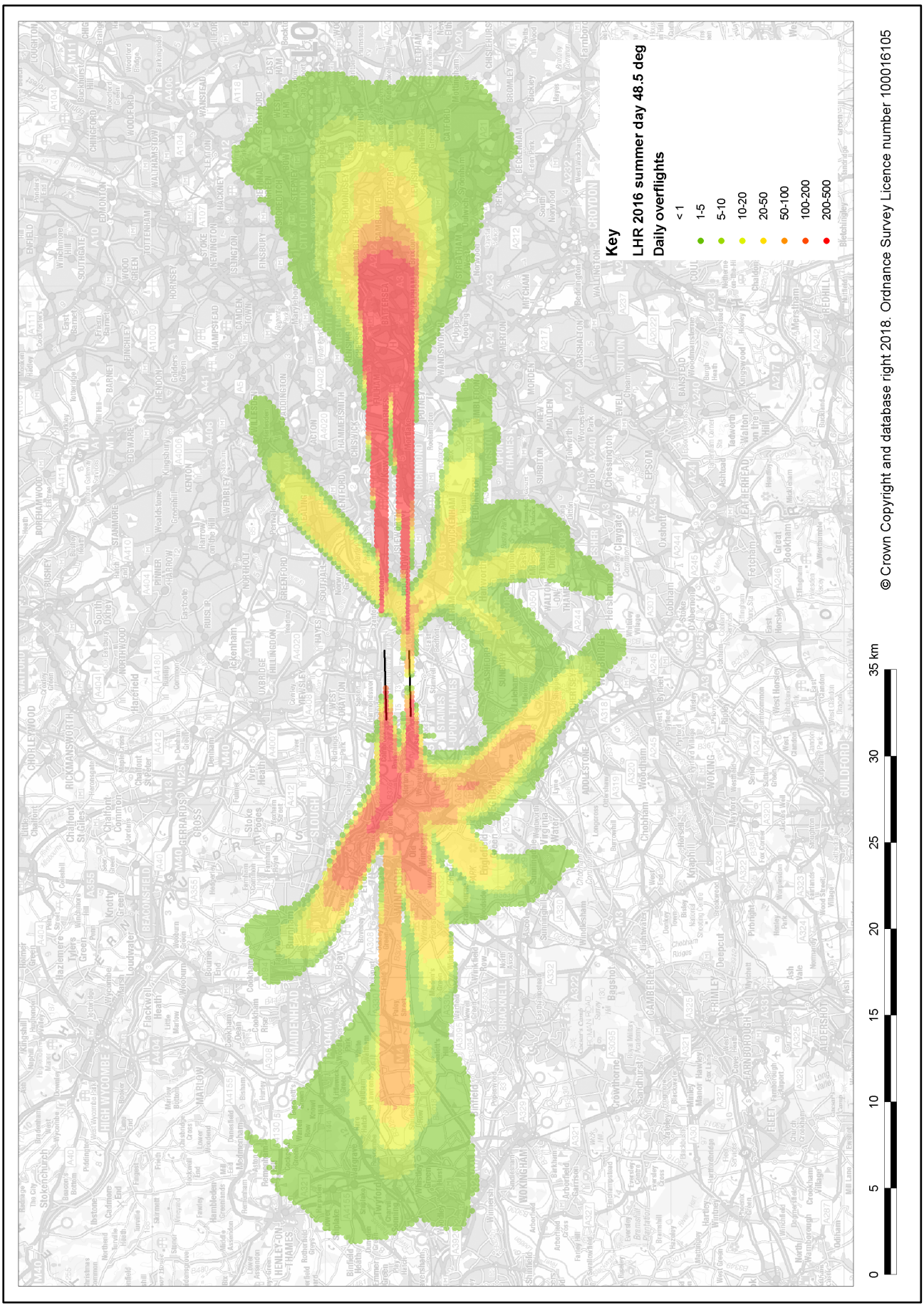


Figure B10-b Heathrow 2016 average summer day overflight track density diagram (assuming 48.5 degree elevation angle)

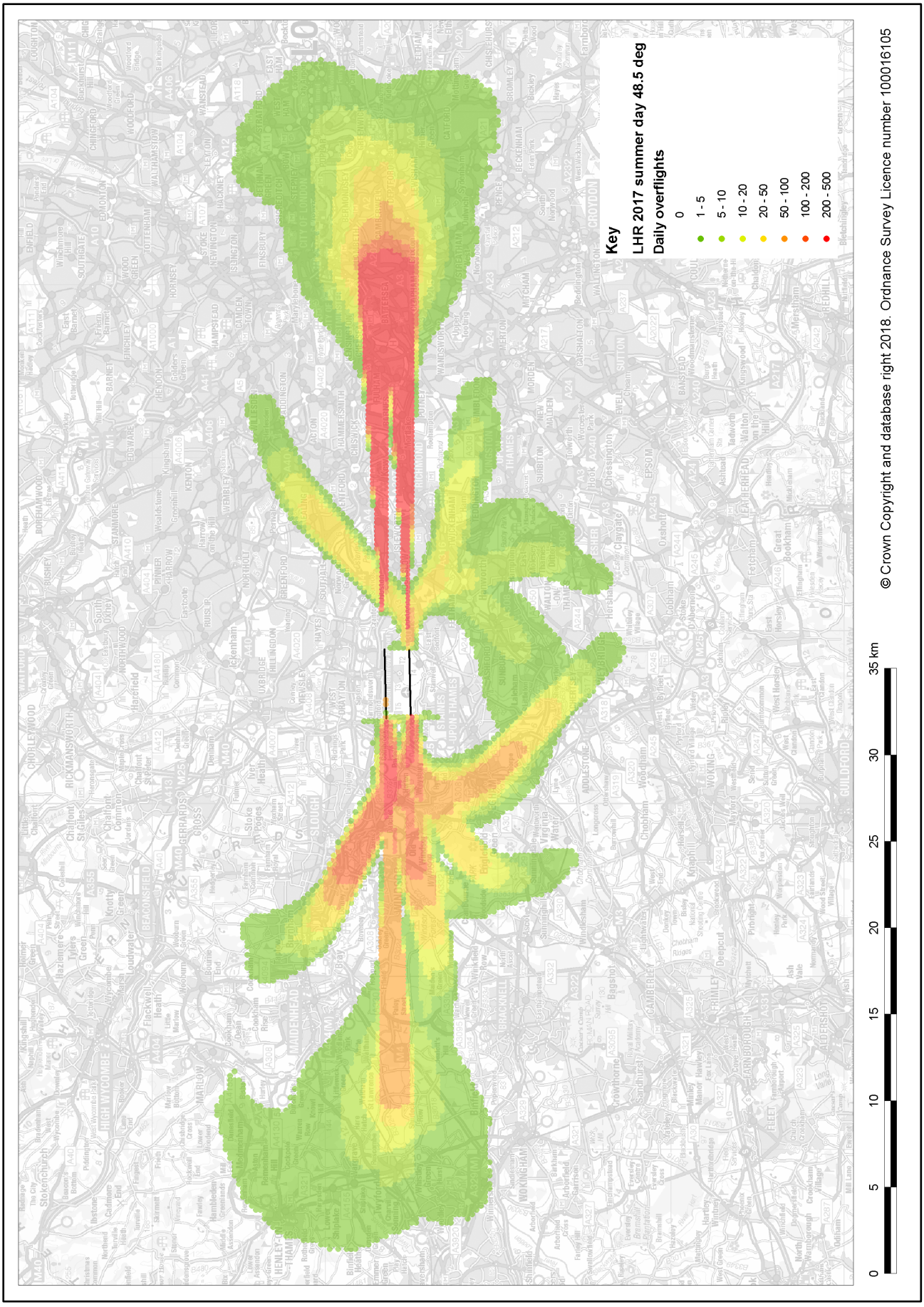


Figure B10-c Heathrow 2017 average summer day overflight track density diagram (assuming 48.5 degree elevation angle)

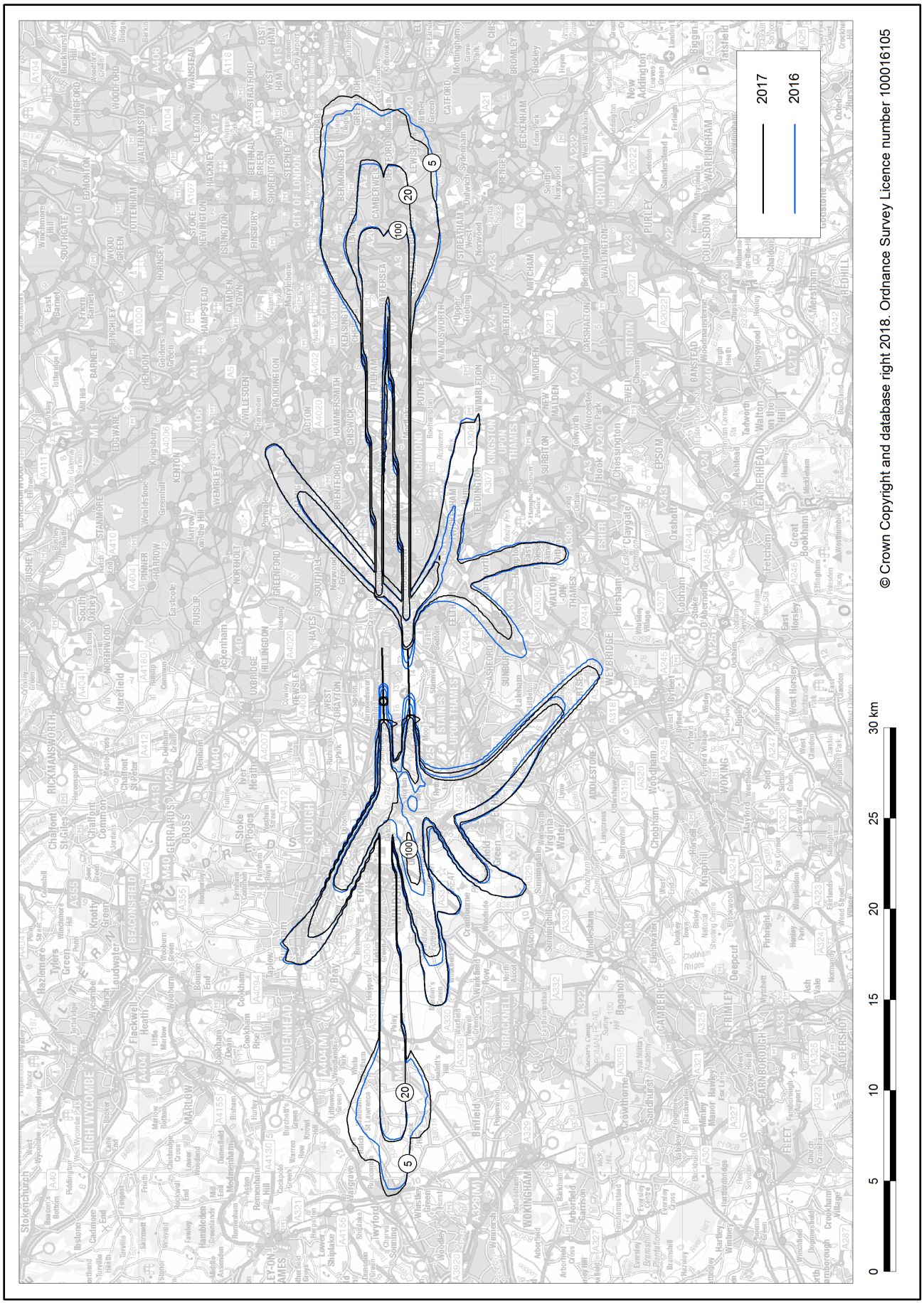


Figure B11 Heathrow 2016 and 2017 average summer day overflight contours (assuming 60 degree elevation angle)

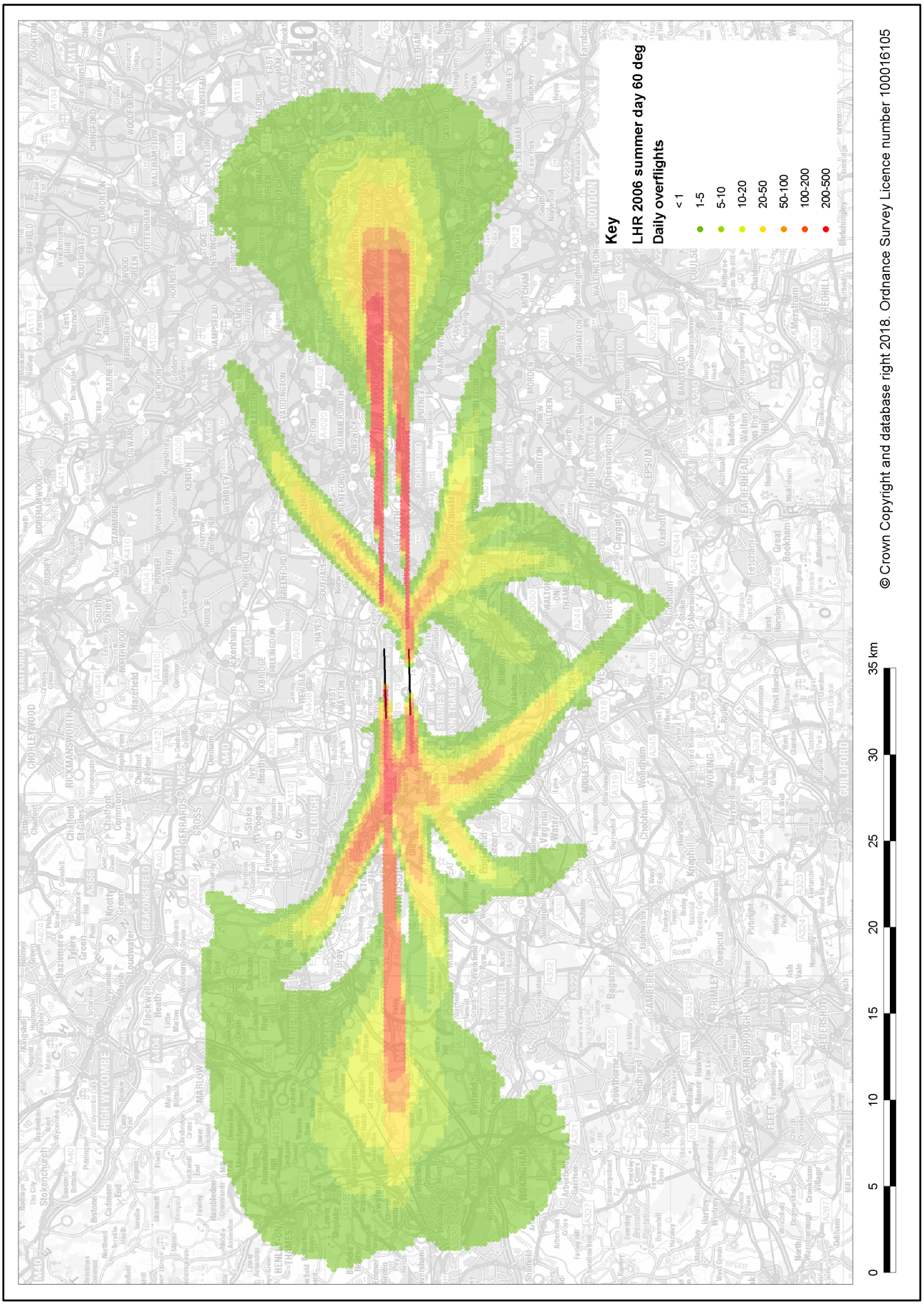


Figure B11-a Heathrow 2006 average summer day overflight track density diagram (assuming 60 degree elevation angle)

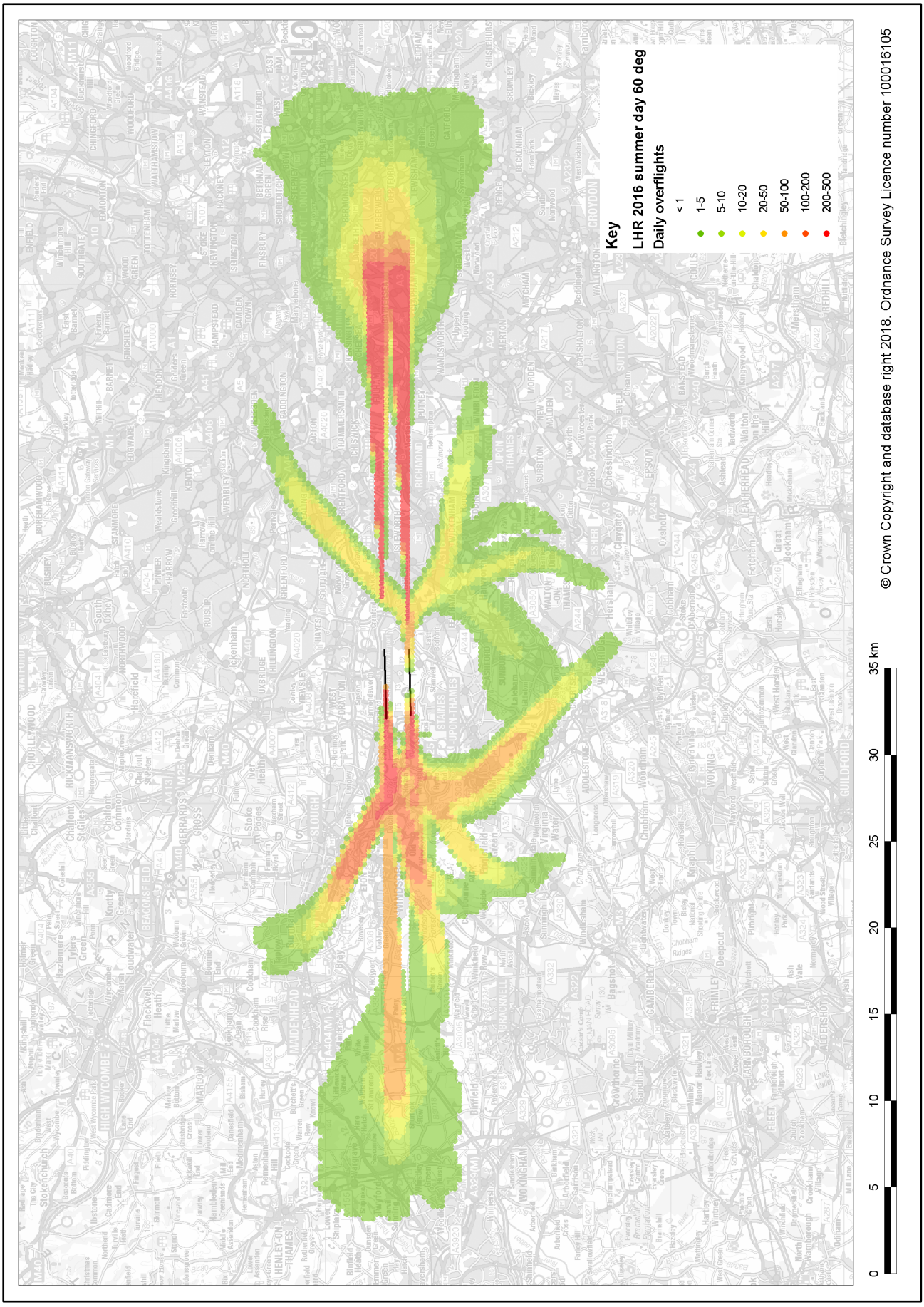


Figure B11-b Heathrow 2016 average summer day overflight track density diagram (assuming 60 degree elevation angle)

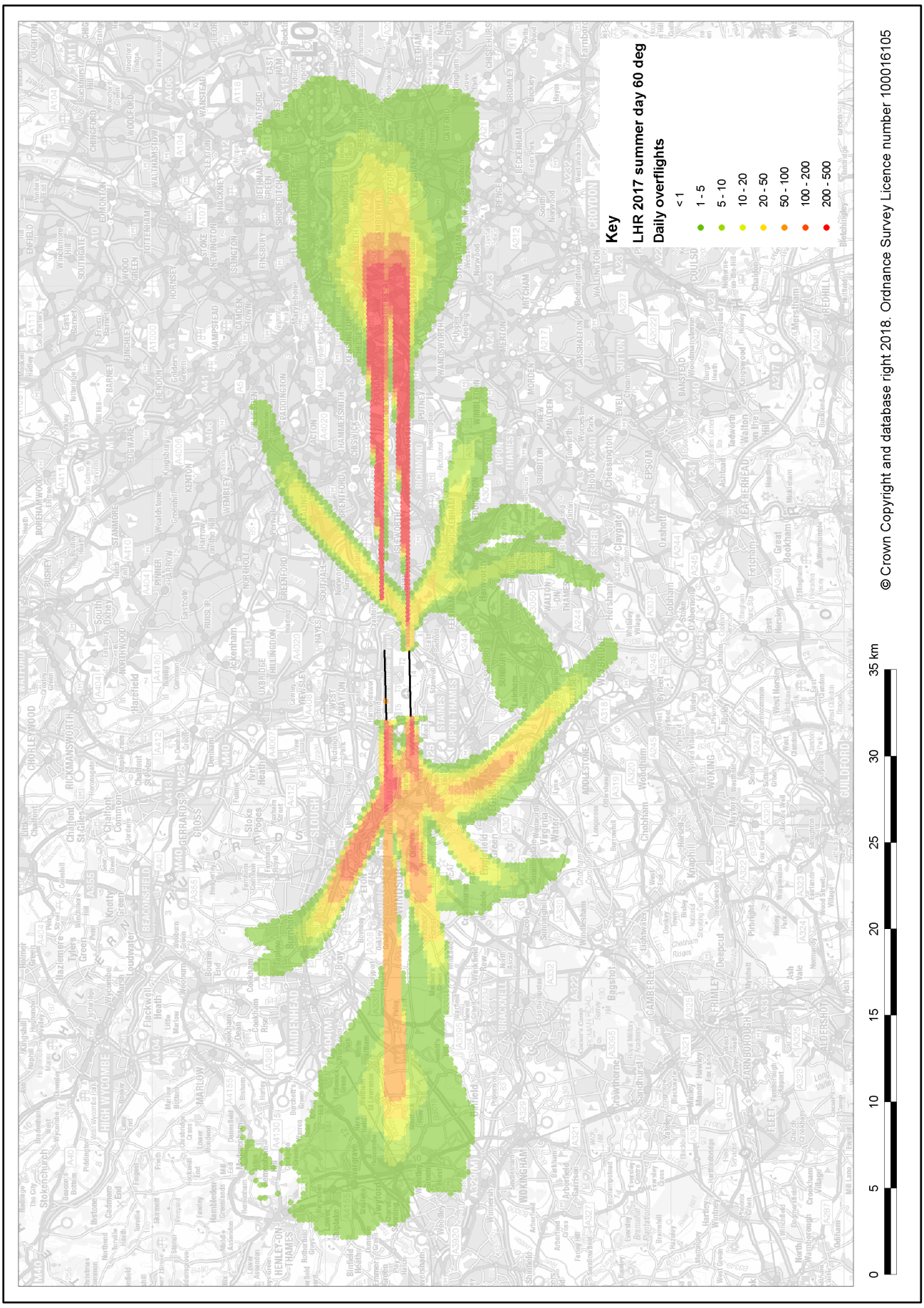
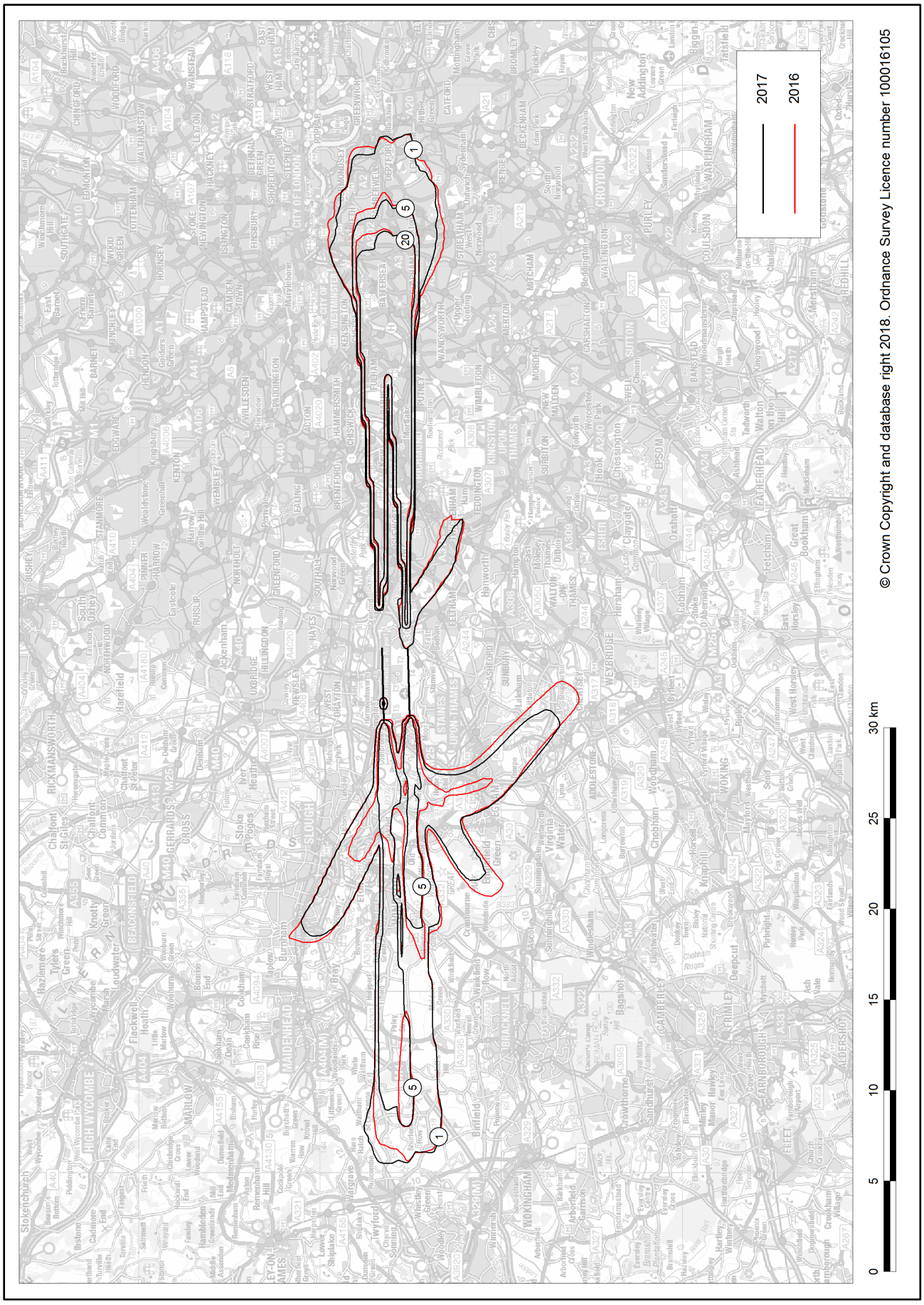


Figure B11-c Heathrow 2017 average summer day overflight track density diagram (assuming 60 degree elevation angle)

Figure B12 Heathrow 2016 and 2017 average summer night overflight contours (assuming 48.5 degree elevation angle)



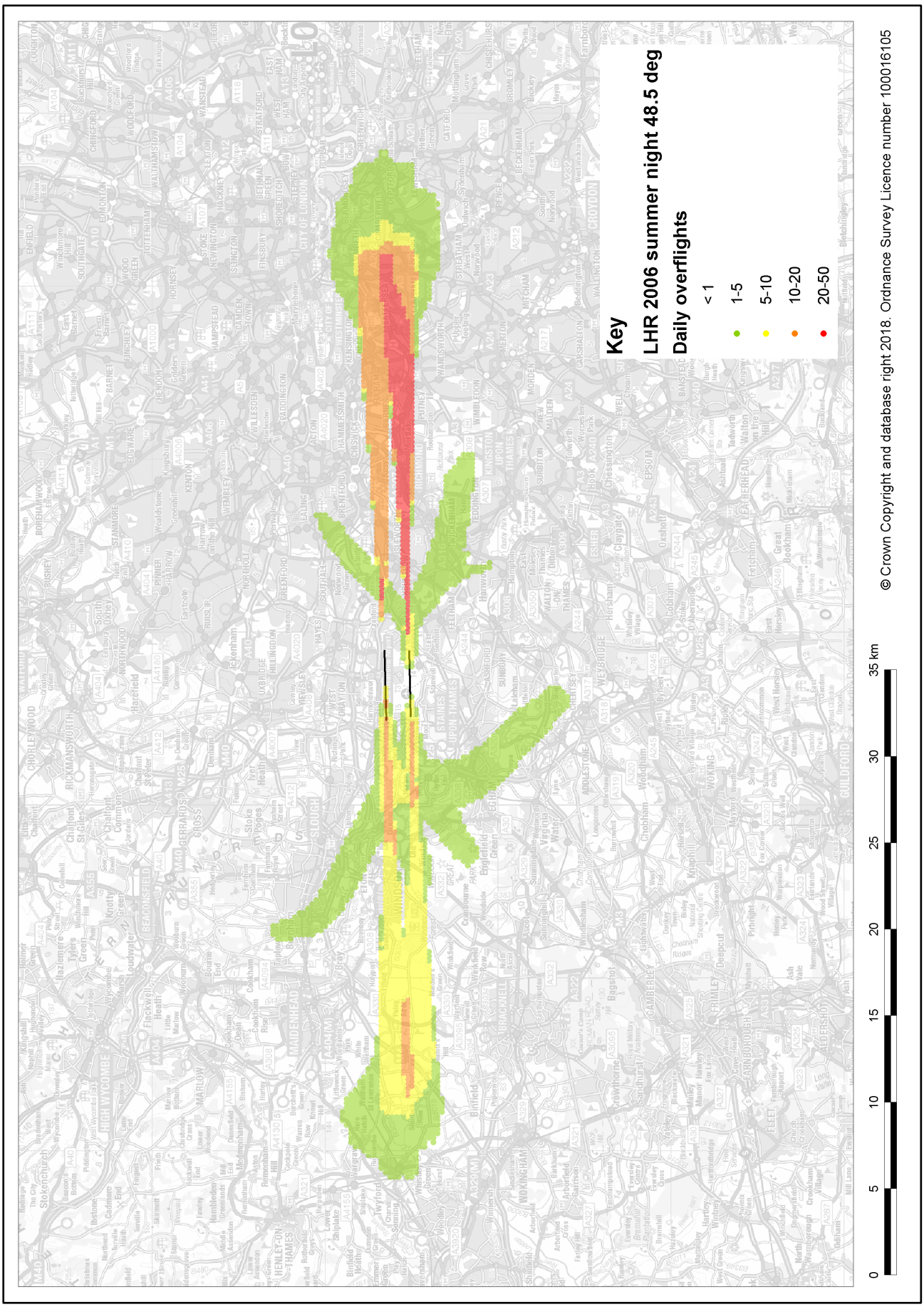


Figure B12-a Heathrow 2006 average summer night overflight track density diagram (assuming 48.5 degree elevation angle)

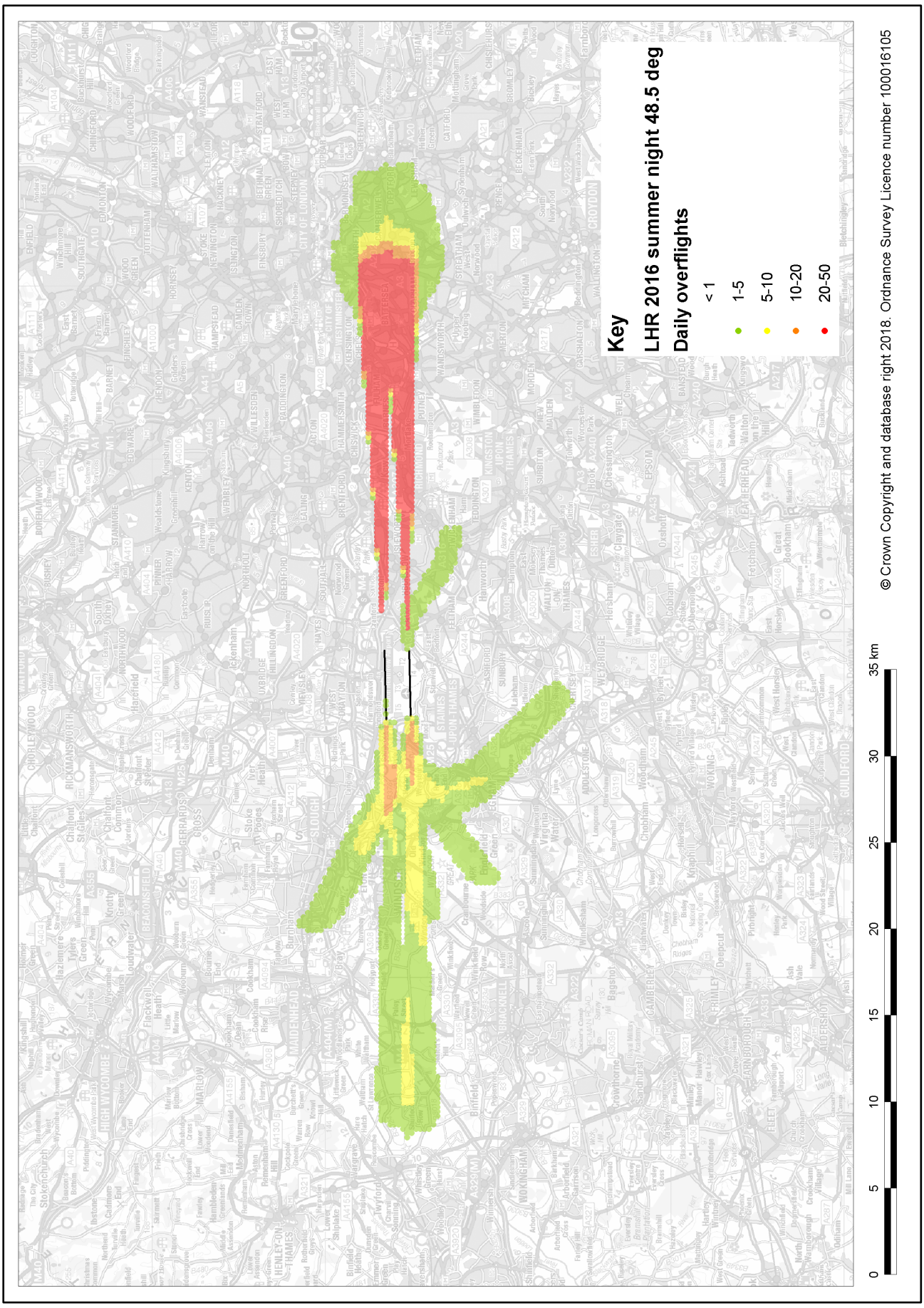


Figure B12-b Heathrow 2016 average summer night overflight track density diagram (assuming 48.5 degree elevation angle)

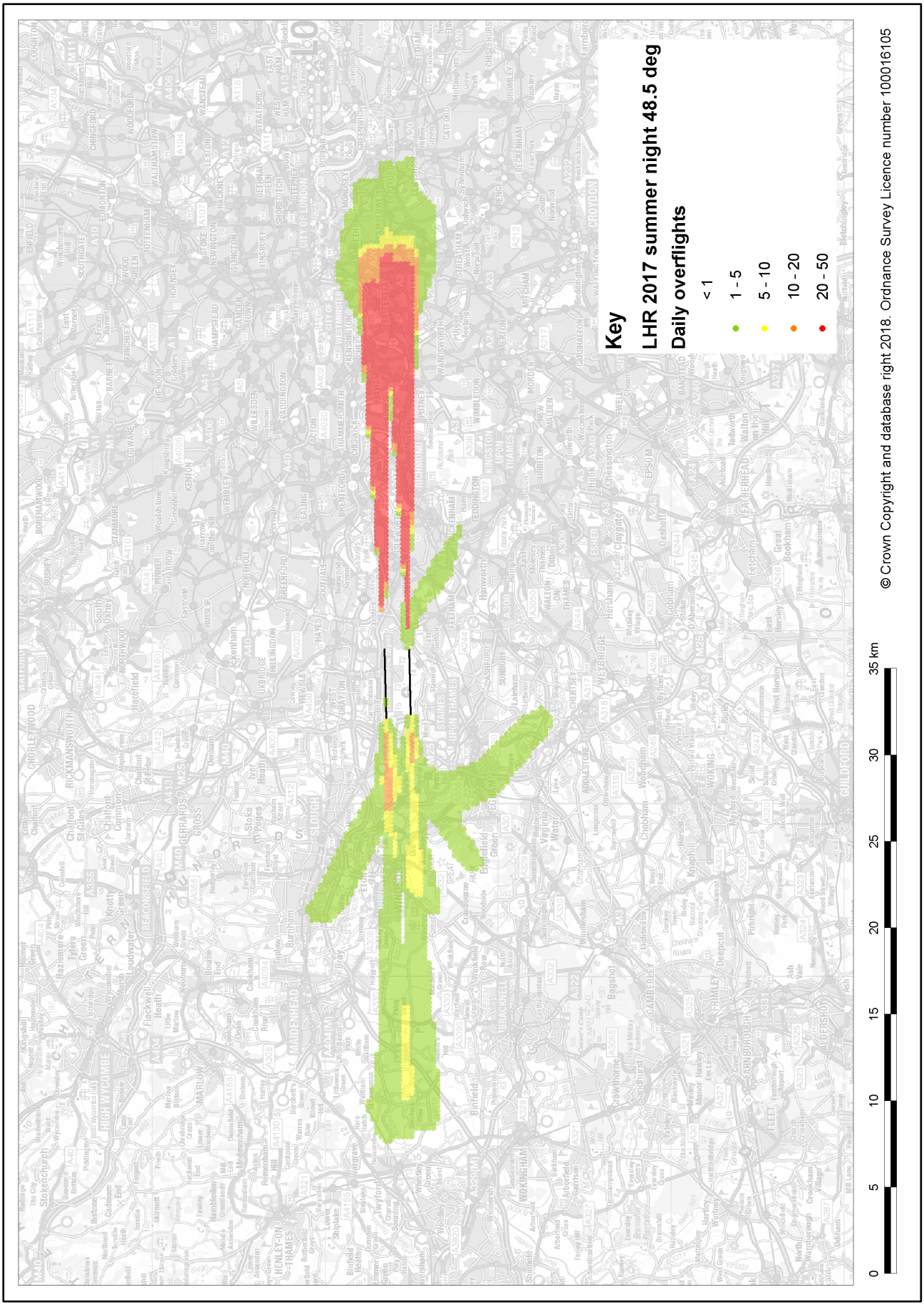
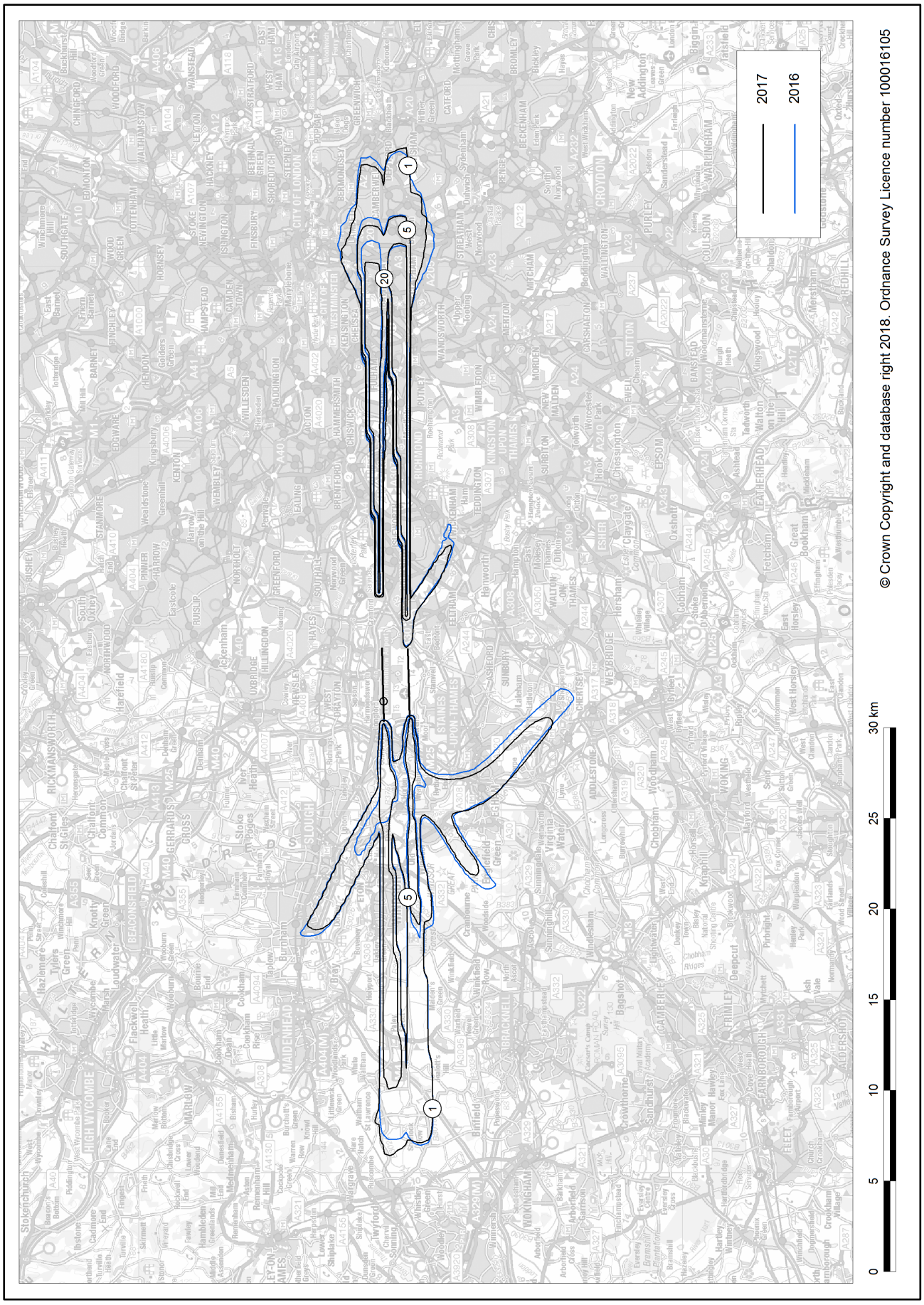


Figure B12-c Heathrow 2017 average summer night overflight track density diagram (assuming 48.5 degree elevation angle)

Figure B13 Heathrow 2016 and 2017 average summer night overflight contours (assuming 60 degree elevation angle)



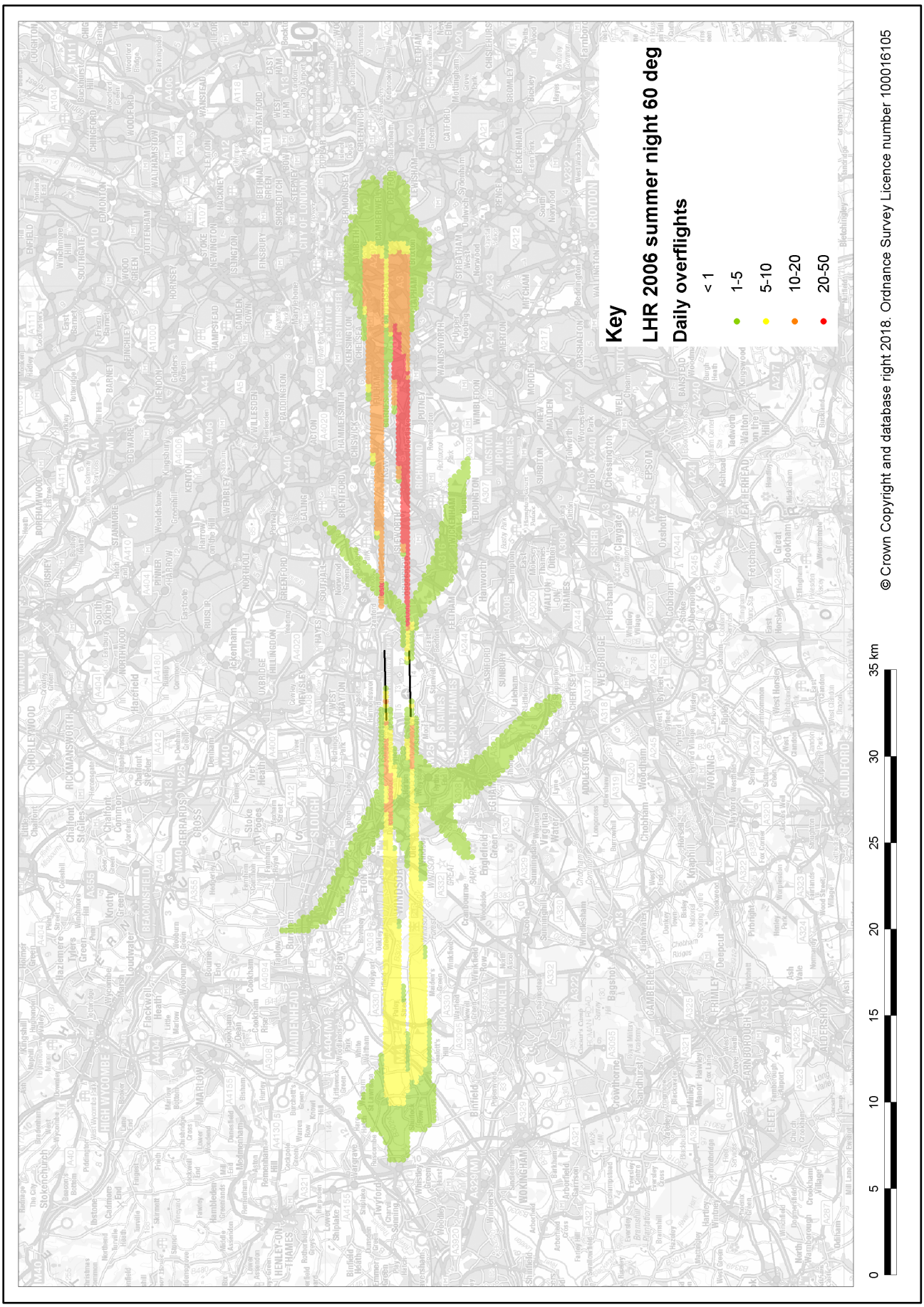


Figure B13-a Heathrow 2006 average summer night overflight track density diagram (assuming 60 degree elevation angle)

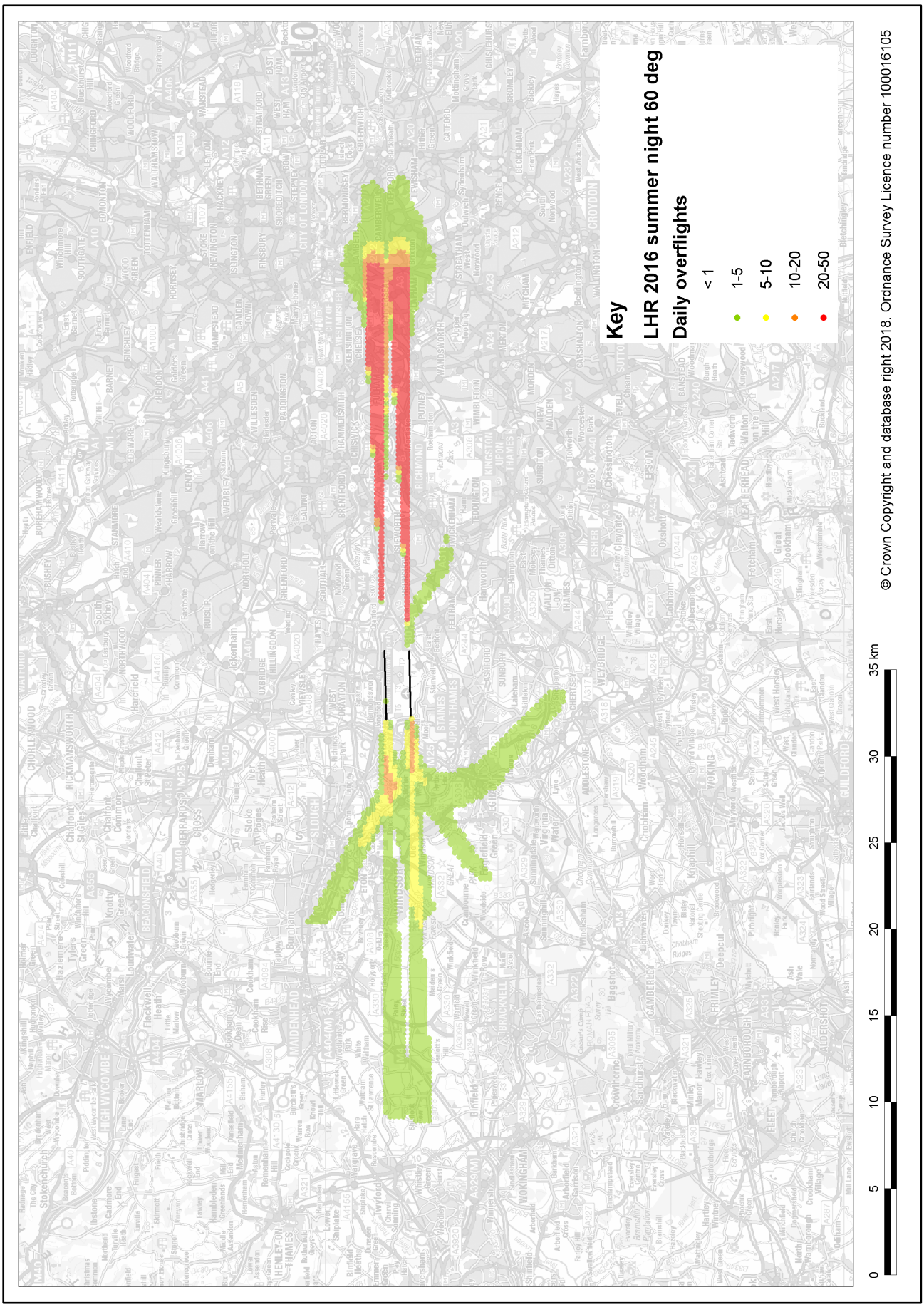


Figure B13-b Heathrow 2016 average summer night overflight track density diagram (assuming 60 degree elevation angle)

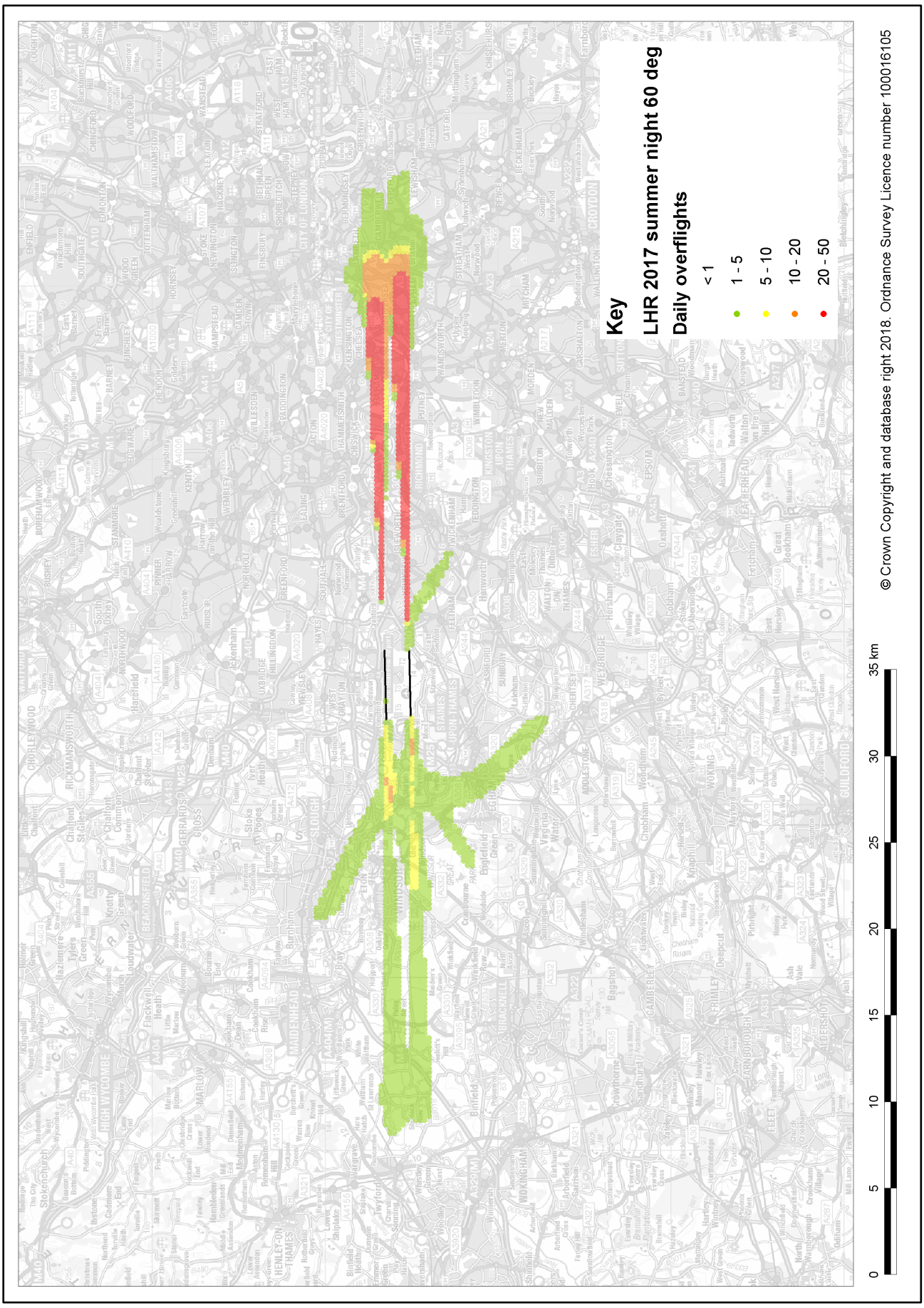


Figure B13-c Heathrow 2017 average summer night overflight track density diagram (assuming 60 degree elevation angle)

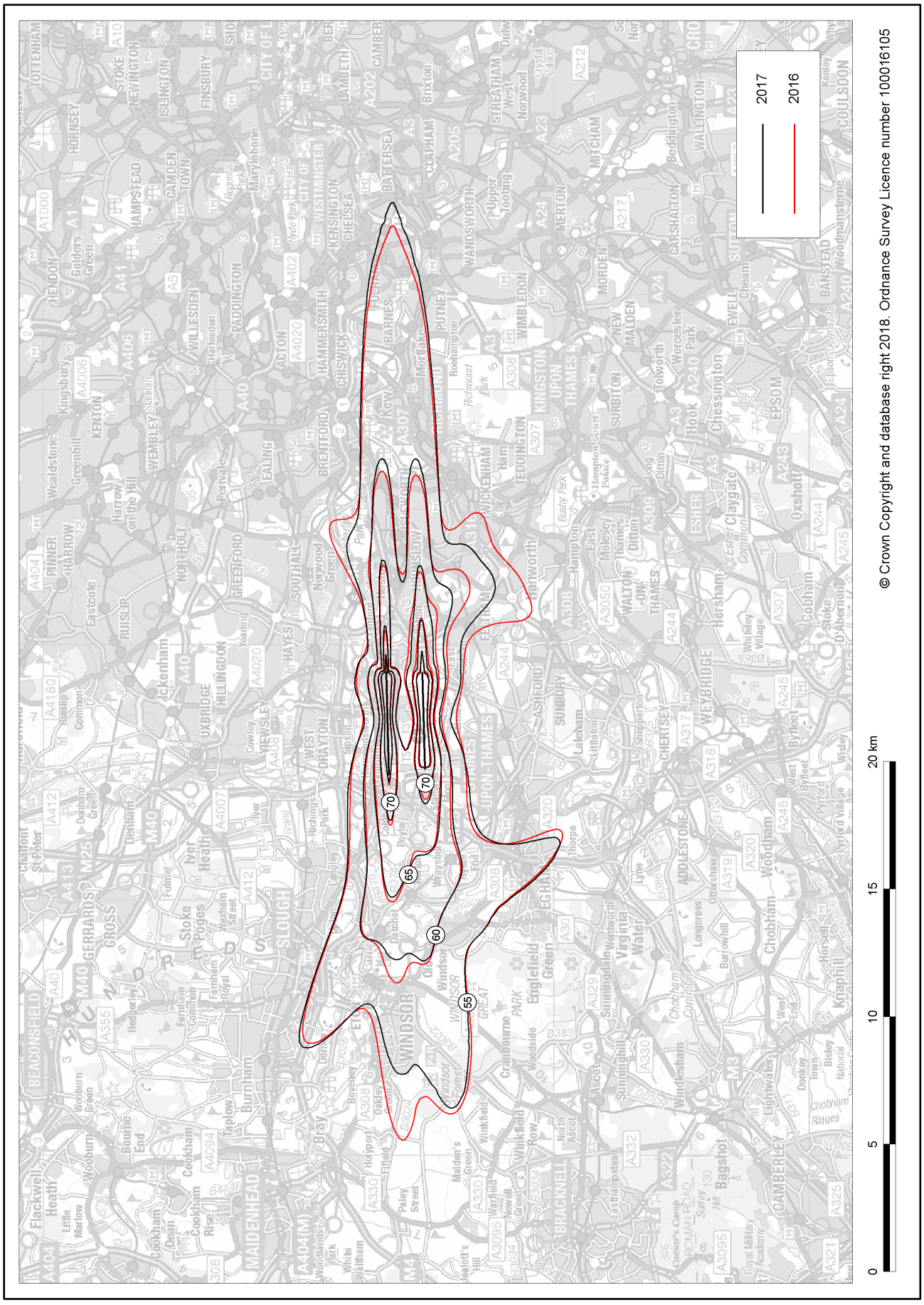


Figure B14 Heathrow 2016 and 2017 L_{day} noise contours

Note: 2016 L_{day} modal split was 70% W / 30% E; 2017 L_{day} modal split was 81% W / 19% E.

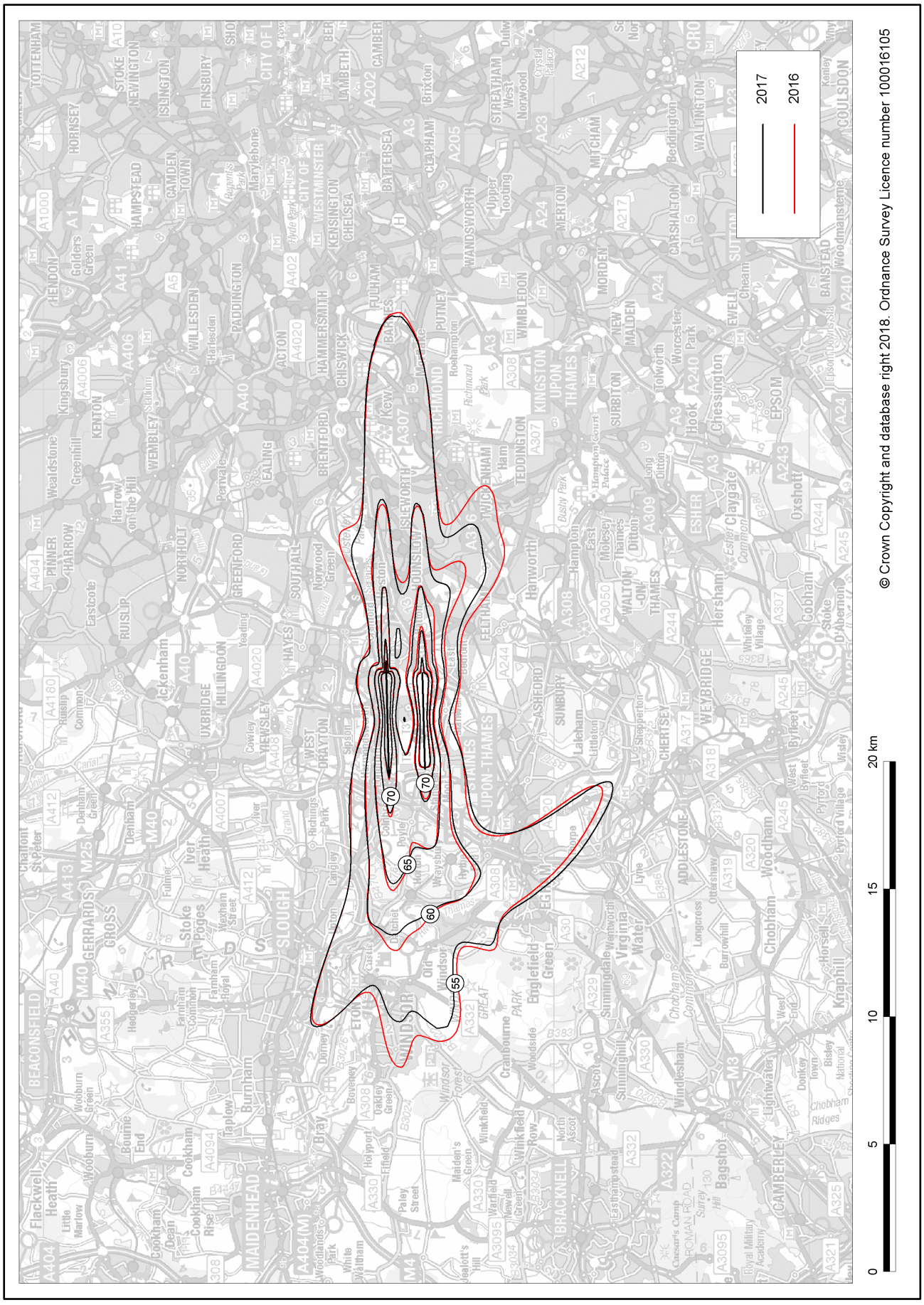


Figure B15 Heathrow 2016 and 2017 $L_{evening}$ noise contours

Note: 2016 $L_{evening}$ modal split was 72% W / 28% E; 2017 $L_{evening}$ modal split was 81% W / 19% E.

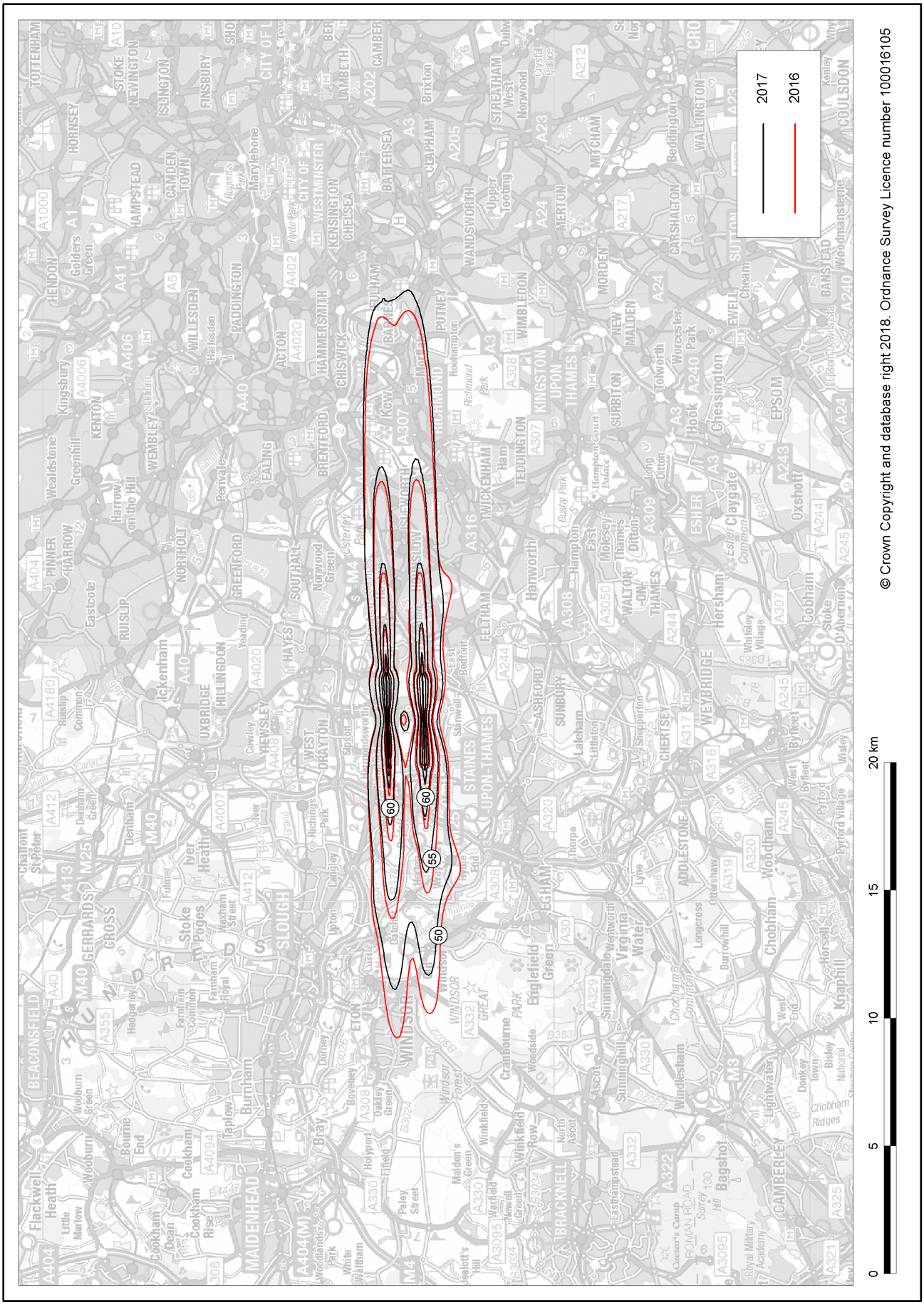


Figure B16 Heathrow 2016 and 2017 L_{night} noise contours

Note: 2016 L_{night} modal split was 70% W / 30% E; 2017 L_{night} modal split was 80% W / 20% E.

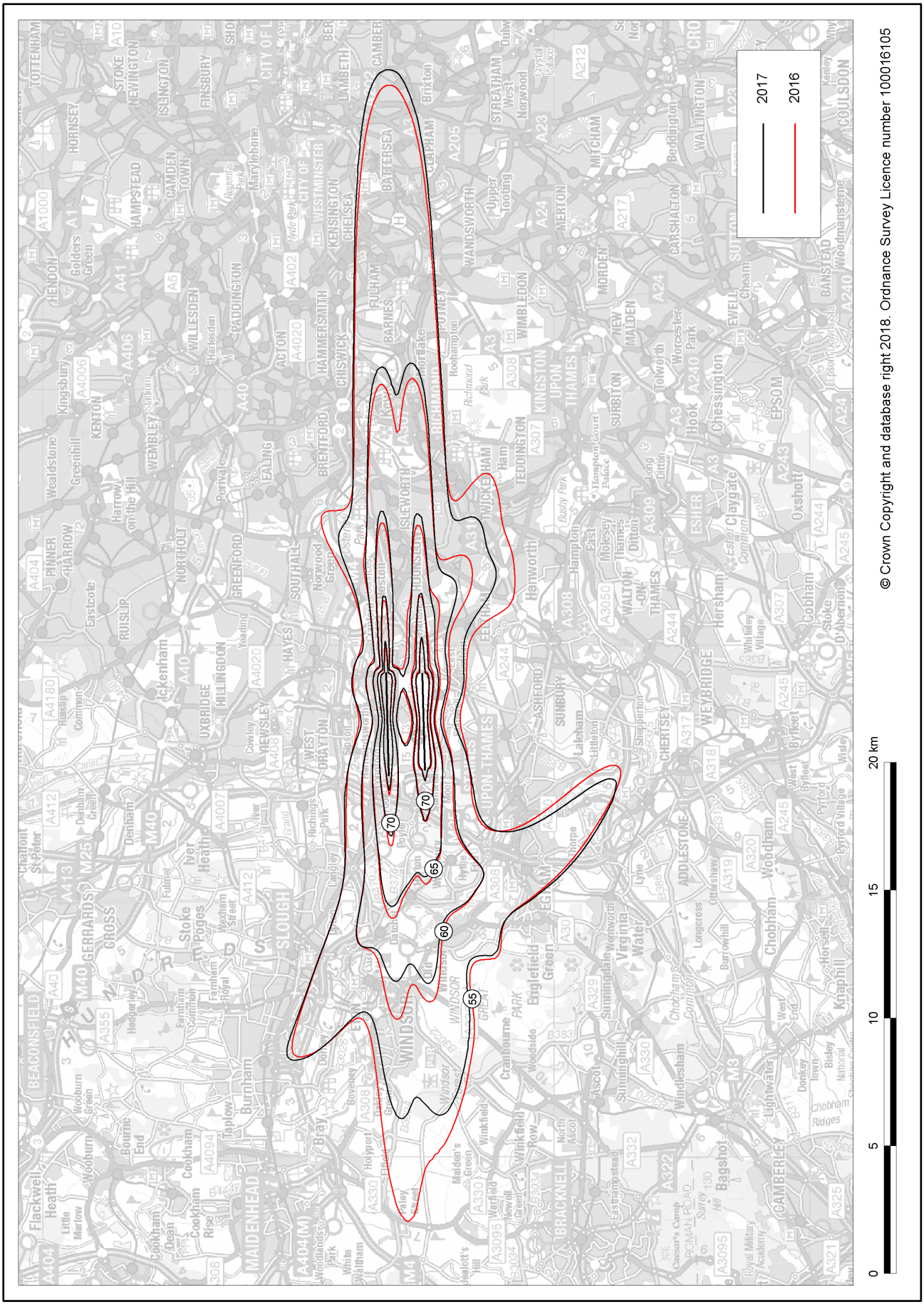
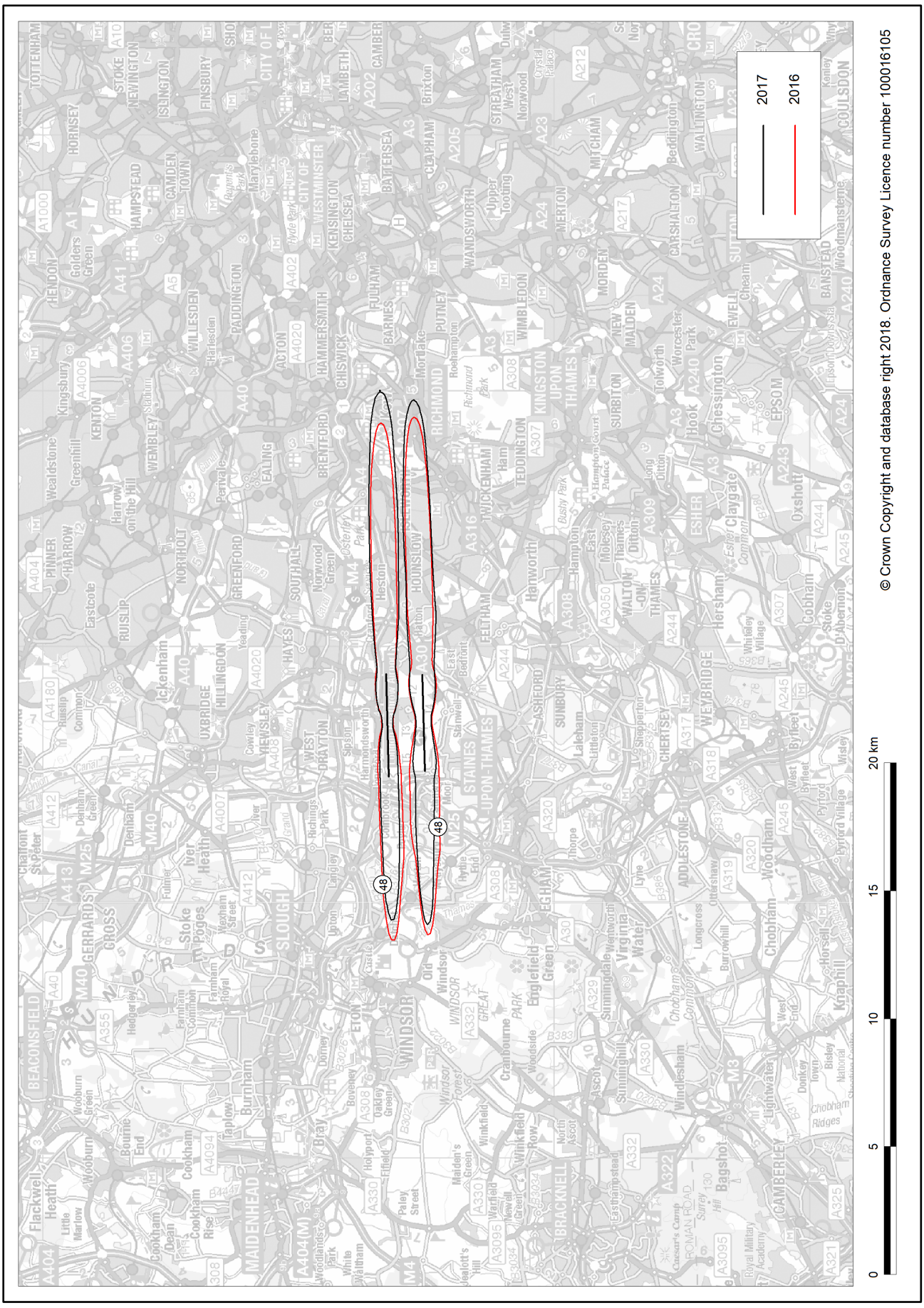


Figure B17 Heathrow 2016 and 2017 L_{den} noise contours

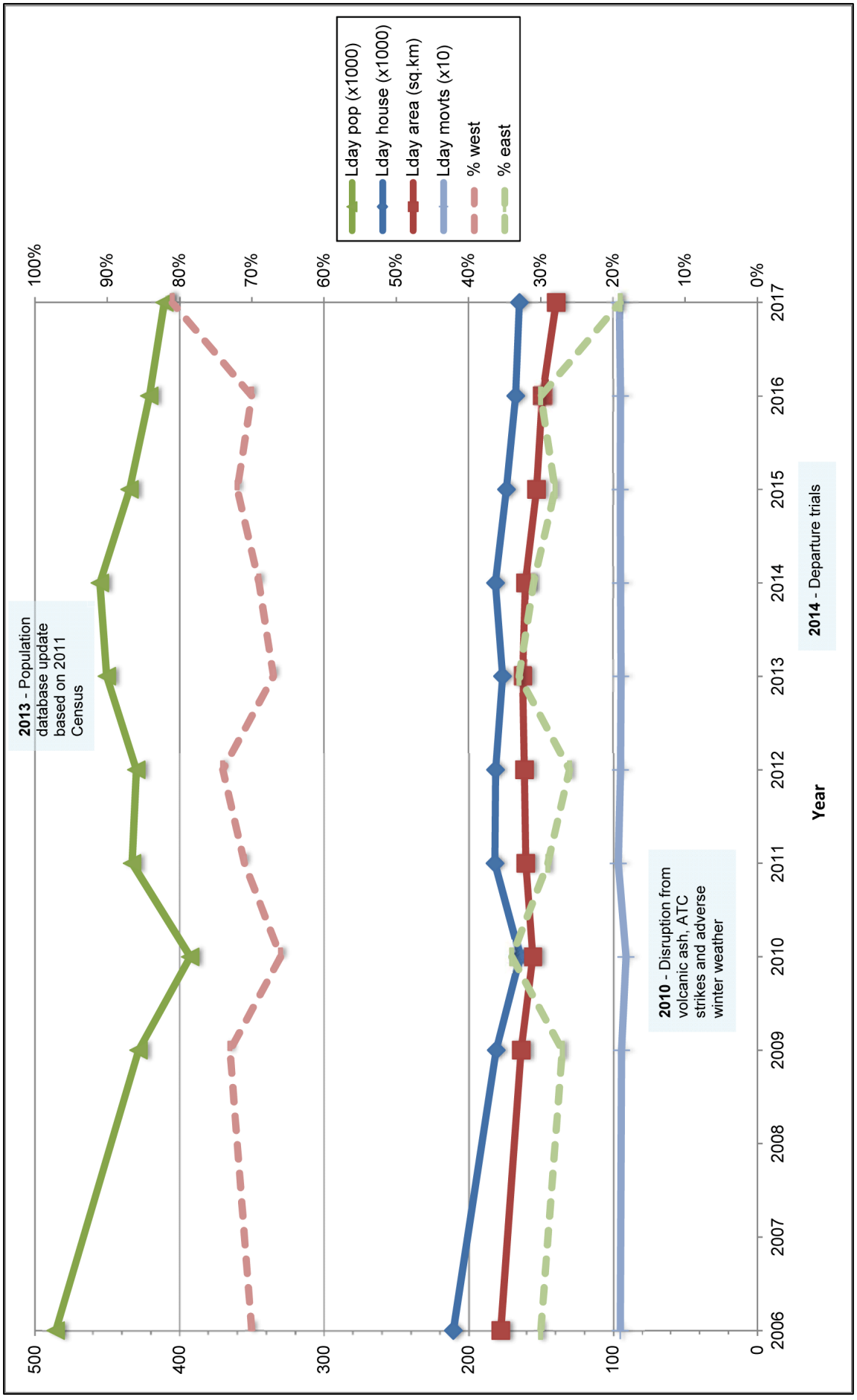
Note: 2016 L_{den} modal split was 70% W / 30% E; 2017 L_{den} modal split was 81% W / 19% E.

Figure B18 Heathrow 2016 and 2017 $L_{eq,6.5hr\ night}$ noise contours



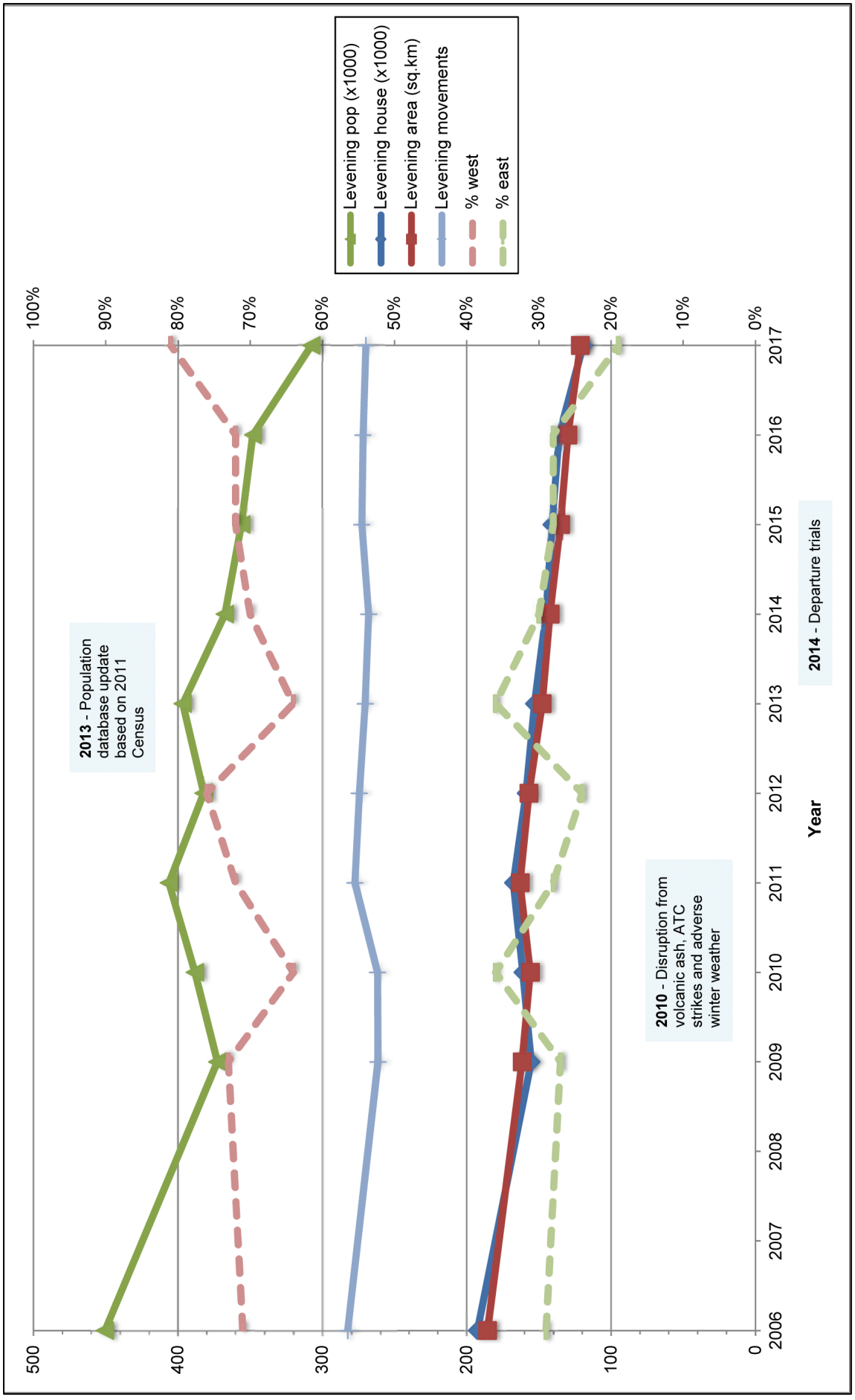
Note: 2016 $L_{eq,6.5hr\ night}$ modal split was 71% W / 29% E; 2017 $L_{eq,6.5hr\ night}$ modal split was 75% W / 25% E.

Figure B19 Heathrow 2006 to 2017 L_{day} 55 dBA area, population and household trends



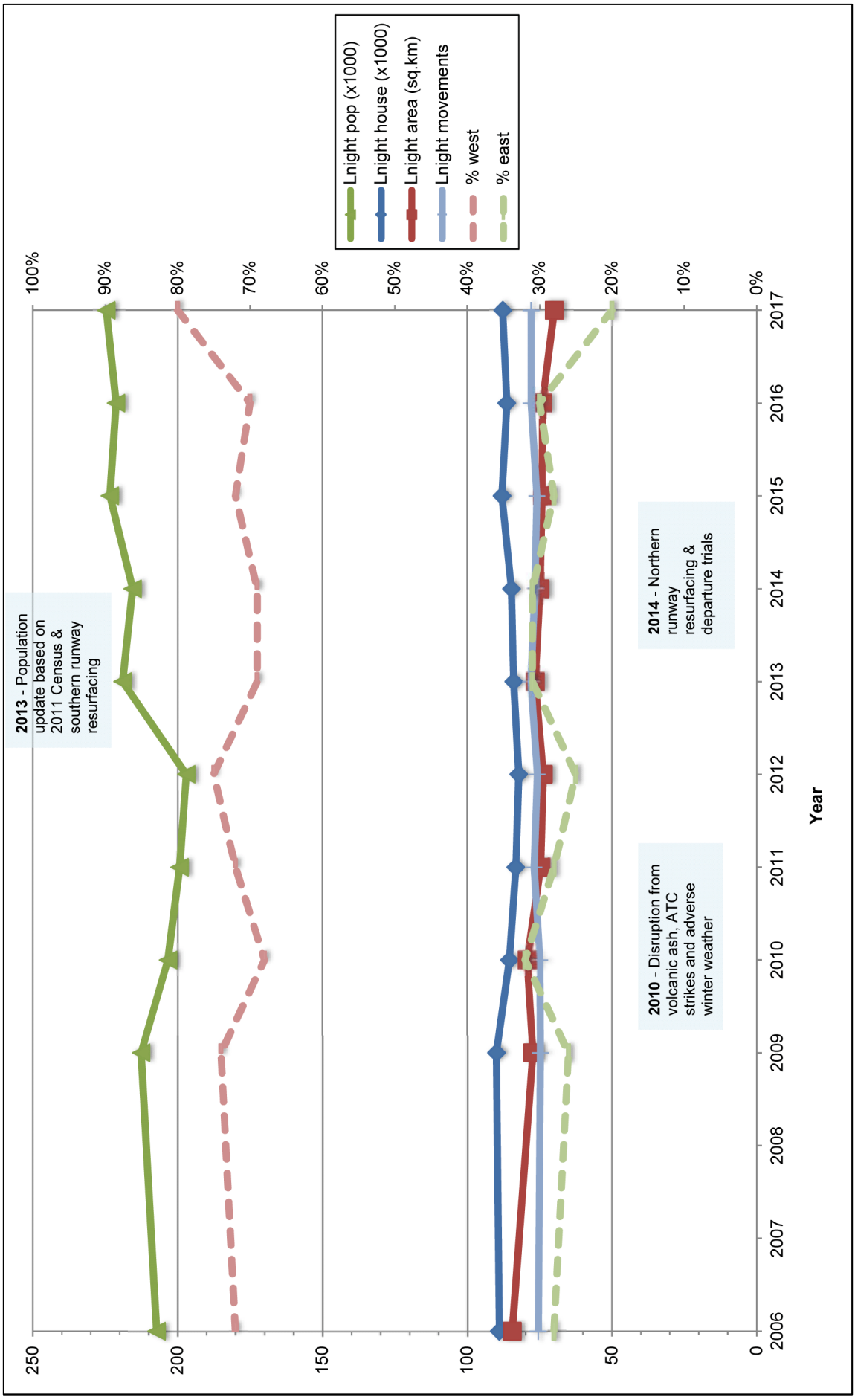
Note: There are no contour data for 2007 and 2008, and the lines joining the 2006 and 2009 data points are not meant to imply that the levels for 2007 and 2008 can be interpolated.

Figure B20 Heathrow 2006 to 2017 $L_{evening}$ 55 dBA area, population and household trends



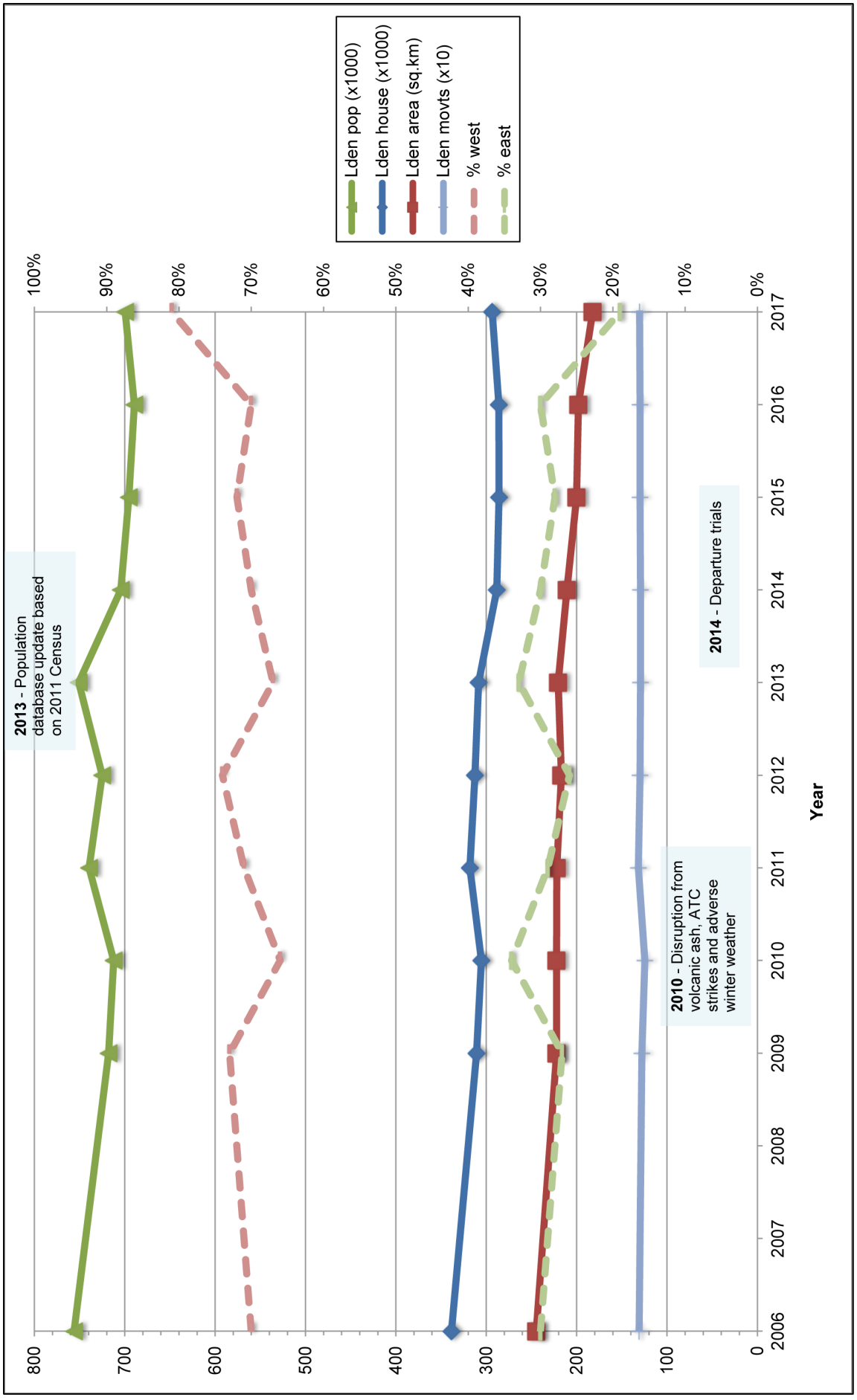
Note: There are no contour data for 2007 and 2008, and the lines joining the 2006 and 2009 data points are not meant to imply that the levels for 2007 and 2008 can be interpolated.

Figure B21 Heathrow 2006 to 2017 L_{night} 50 dBA area, population and household trends



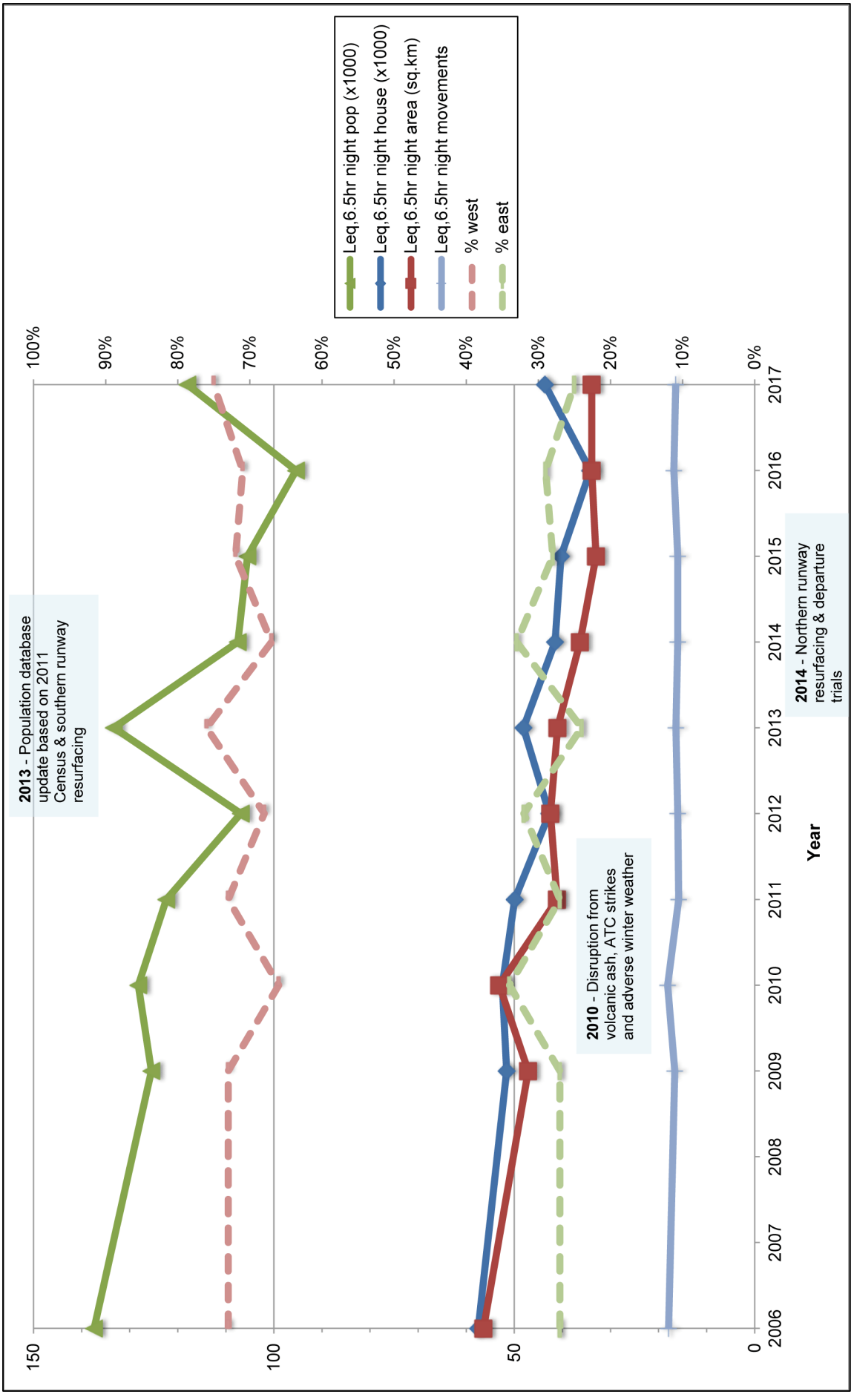
Note: There are no contour data for 2007 and 2008, and the lines joining the 2006 and 2009 data points are not meant to imply that the levels for 2007 and 2008 can be interpolated.

Figure B22 Heathrow 2006 to 2017 L_{den} 55 dBA area, population and household trends



Note: There are no contour data for 2007 and 2008, and the lines joining the 2006 and 2009 data points are not meant to imply that the levels for 2007 and 2008 can be interpolated.

Figure B23 Heathrow 2006 to 2017 $L_{eq,6.5hr\ night}$ 48 dBA area, population and household trends



Note: There are no contour data for 2007 and 2008, and the lines joining the 2006 and 2009 data points are not meant to imply that the levels for 2007 and 2008 can be interpolated.

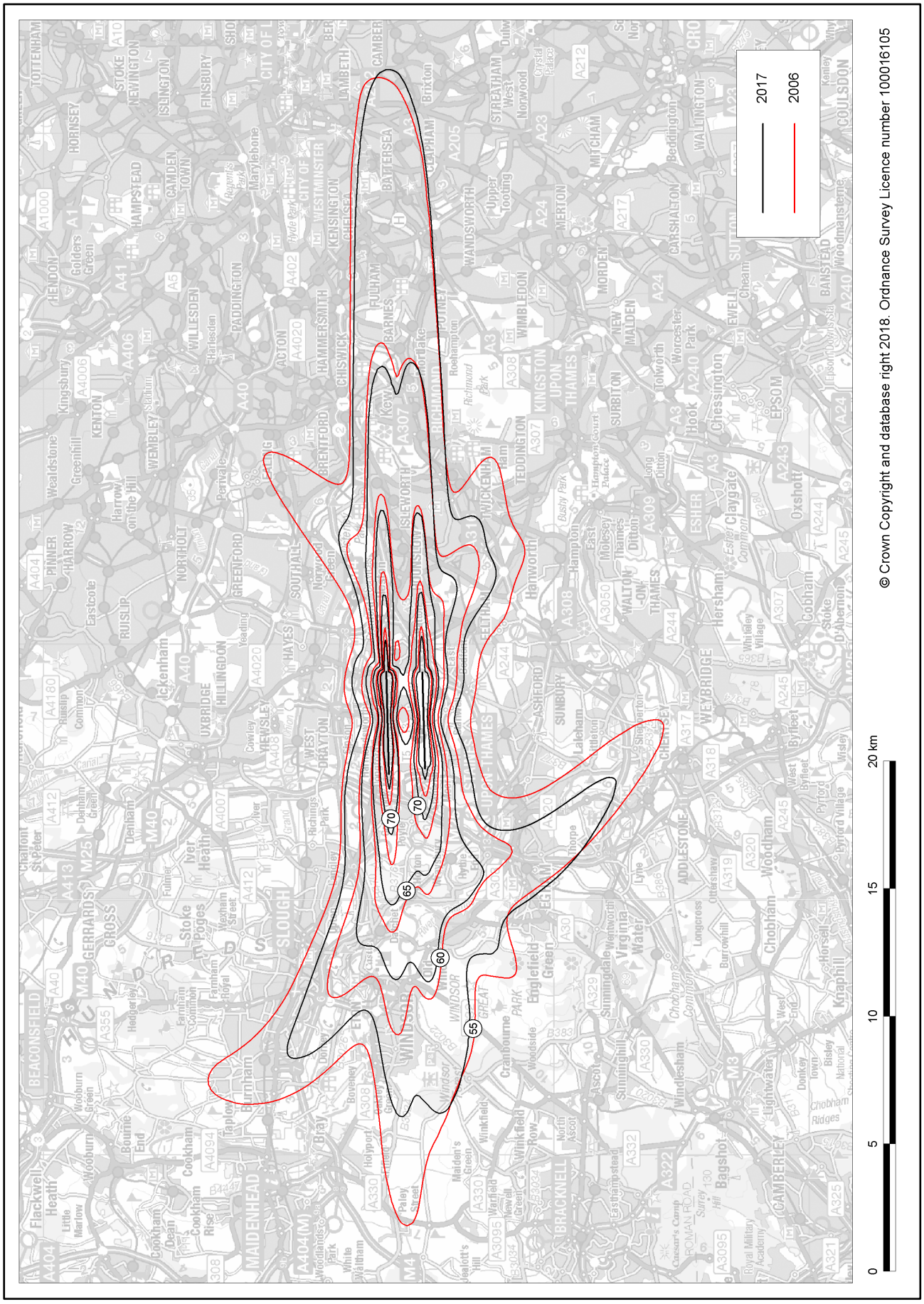
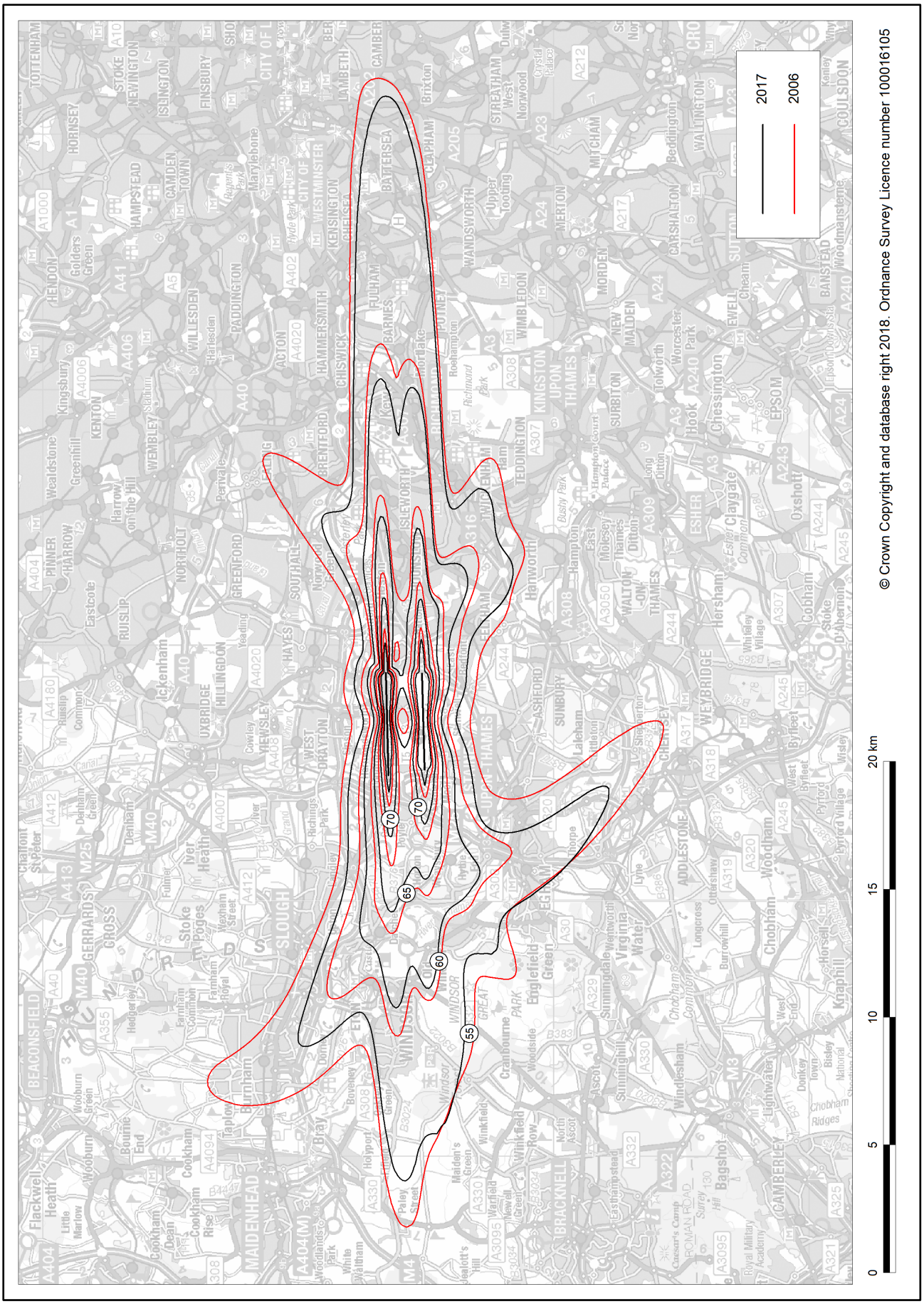


Figure B24 Heathrow 2006 and 2017 L_{den} noise contours

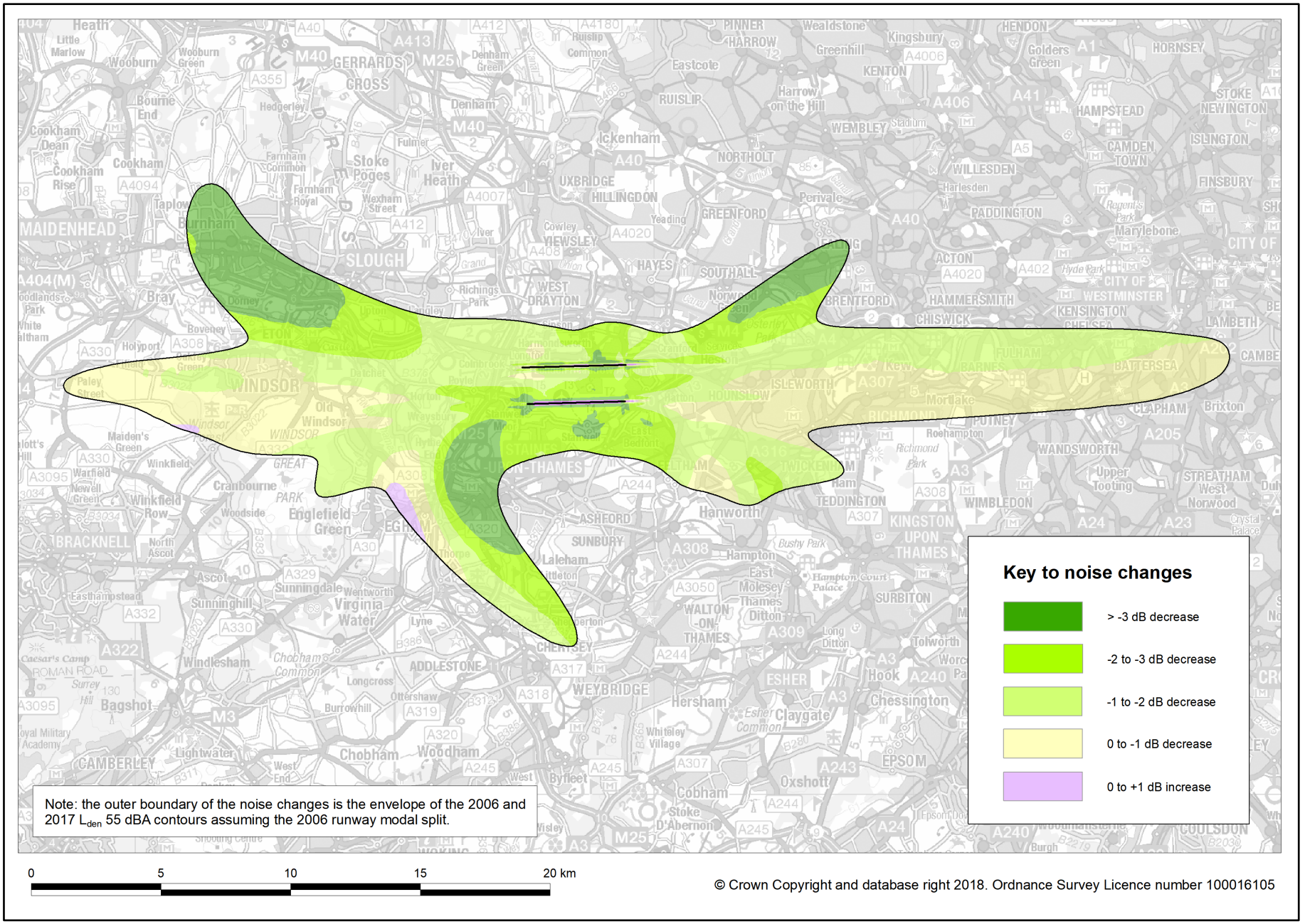
Note: 2006 L_{den} modal split was 70% W / 30% E; 2017 L_{den} modal split was 81% W / 19% E.

Figure B25 Heathrow 2006 and 2017 L_{den} noise contours (assuming 2006 runway modal split and 2006 N-S runway usage)



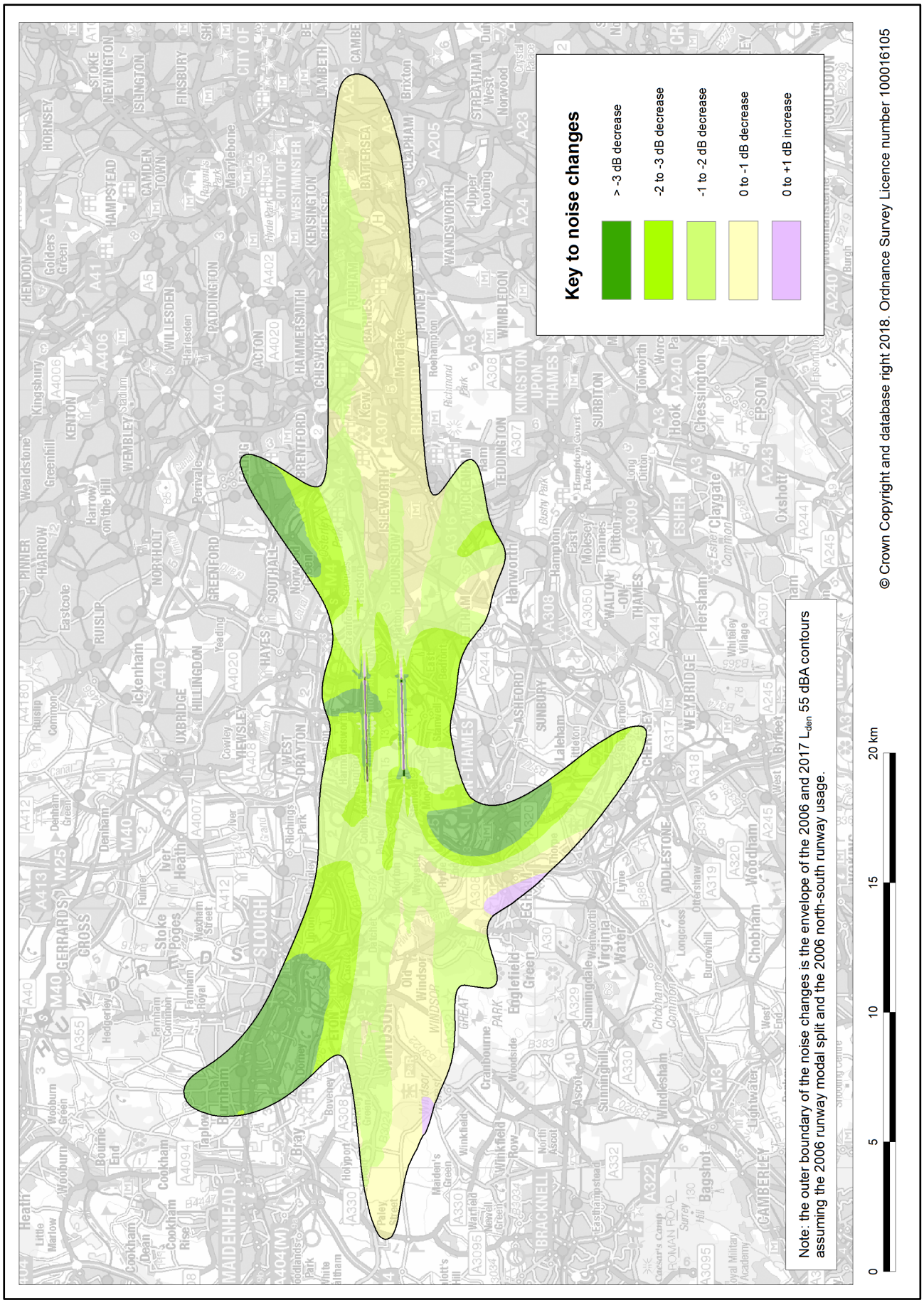
Note: 2006 L_{den} modal split was 70% W / 30% E.

Figure B26 Heathrow noise change map for 2017 vs 2006 L_{den} (assuming 2006 runway modal split)



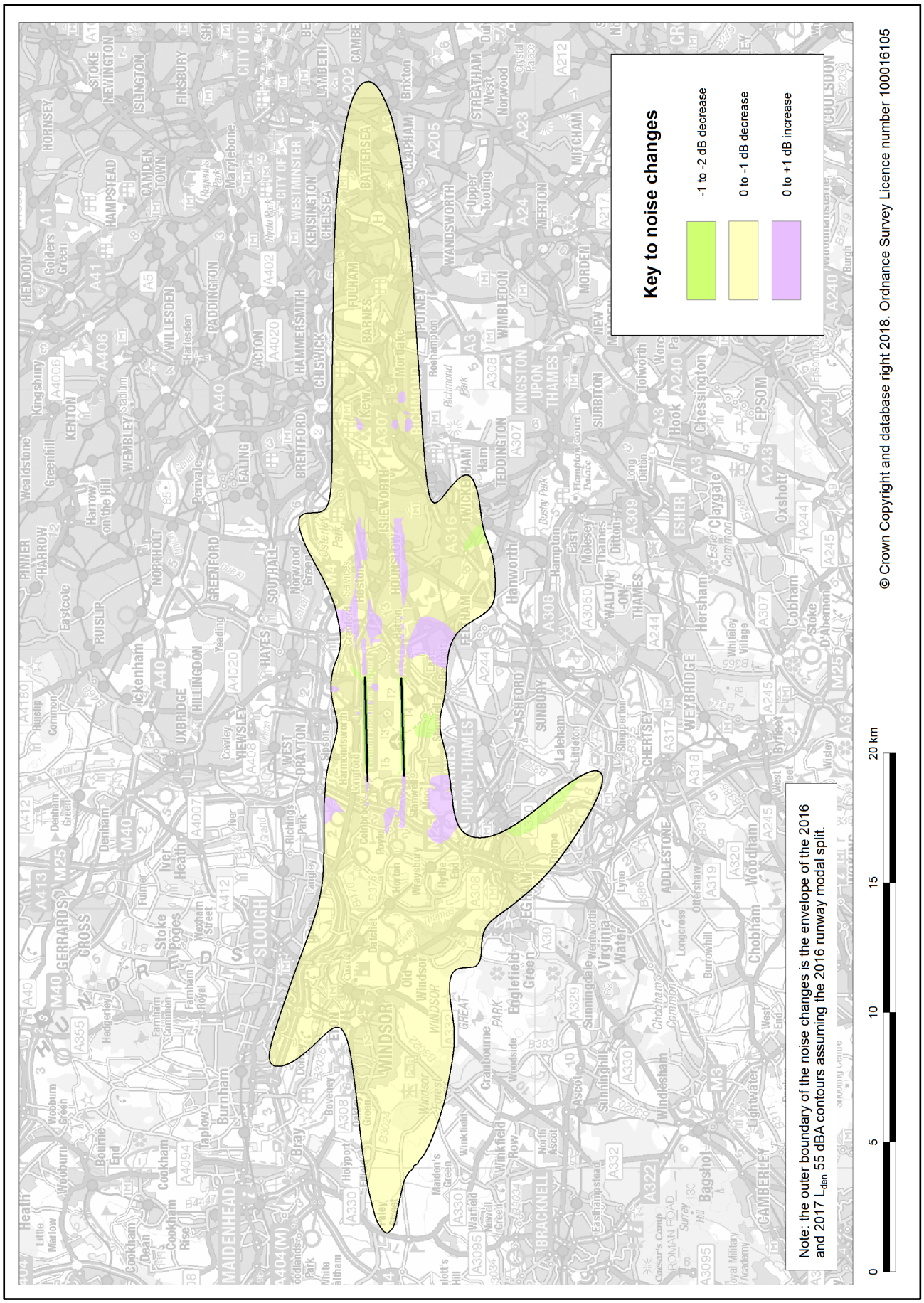
Note: 2006 L_{den} modal split was 70% W / 30% E.

Figure B27 Heathrow noise change map for 2017 vs 2006 L_{den} (assuming 2006 runway modal split and 2006 N-S runway usage)



Note: 2006 L_{den} modal split was 70% W / 30% E.

Figure B28 Heathrow noise change map for 2017 vs 2016 L_{den} (assuming 2016 runway modal split)



Note: 2016 L_{den} modal split was 70% W / 30% E.

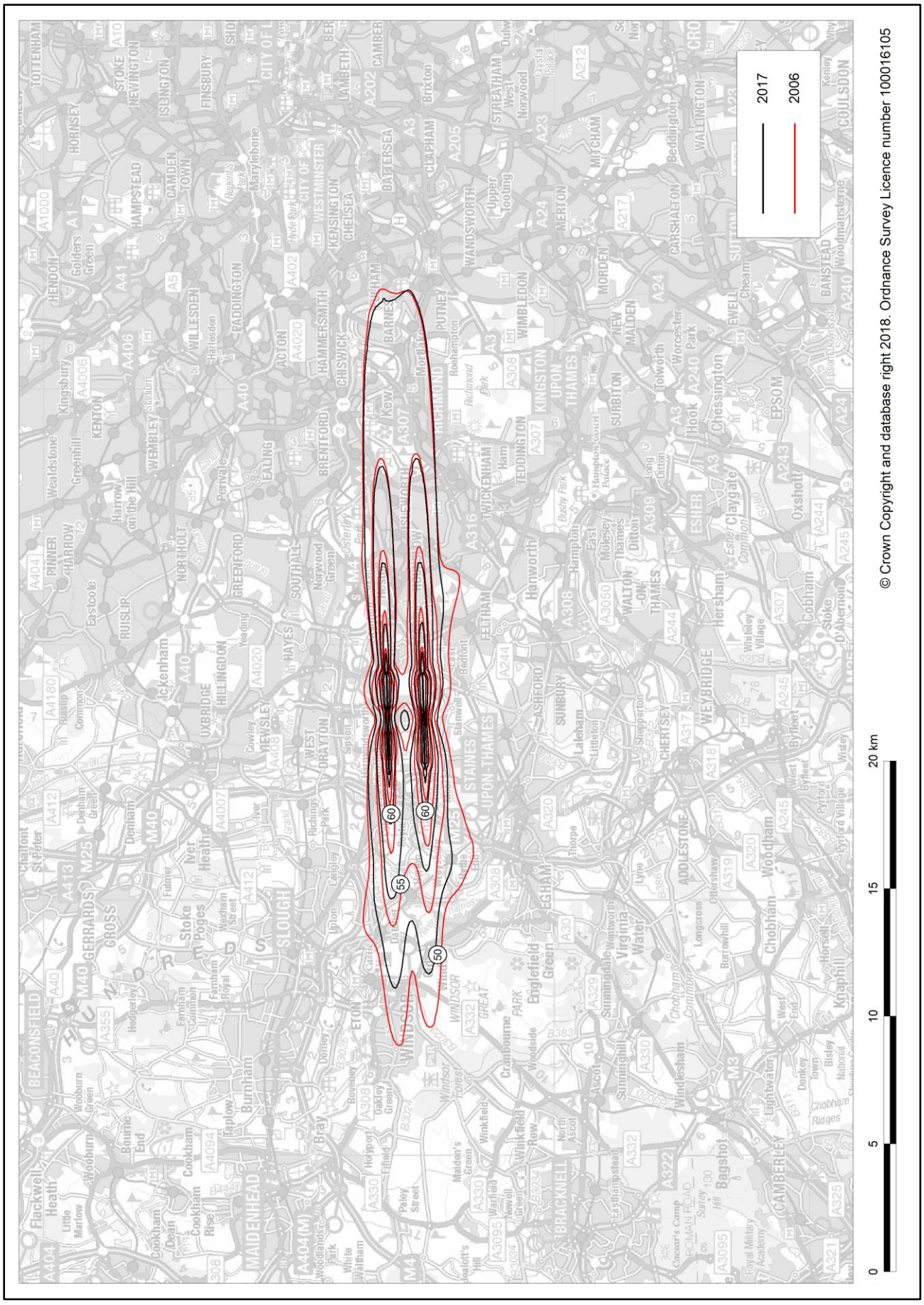
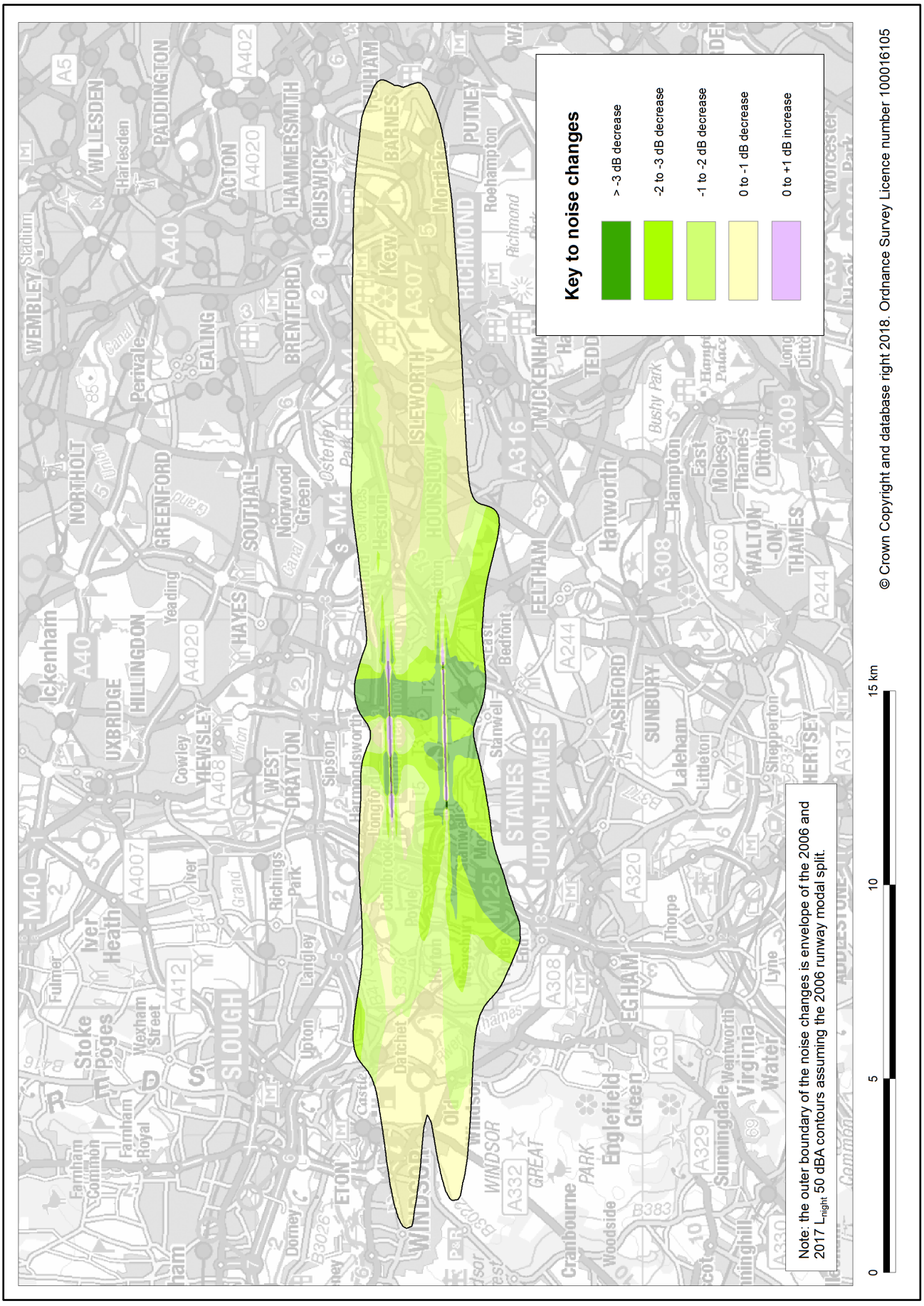


Figure B29 Heathrow 2006 and 2017 L_{night} noise contours

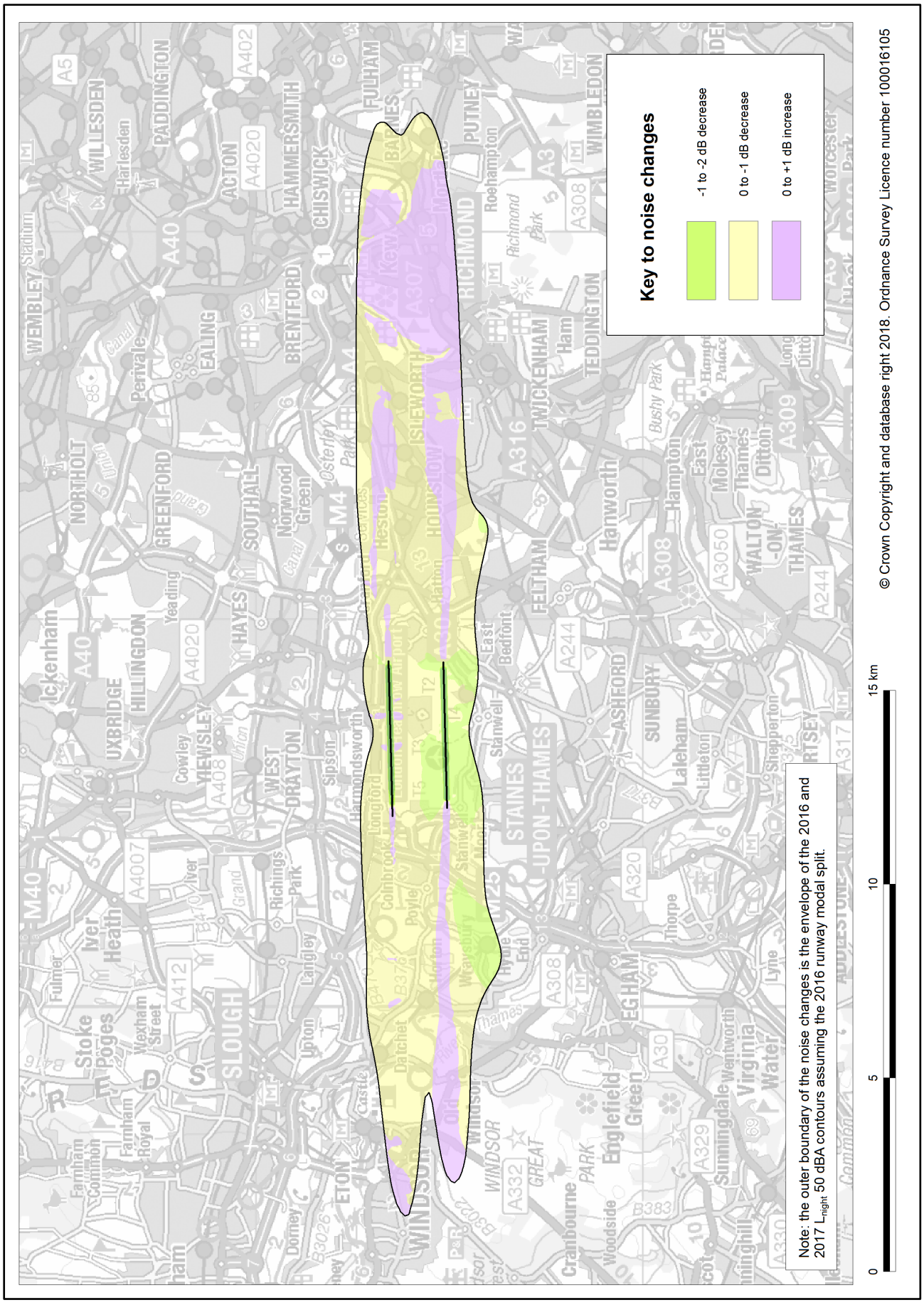
Note: 2006 L_{night} modal split was 72% W / 28% E; 2017 L_{night} modal split was 80% W / 20% E.

Figure B30 Heathrow noise change map for 2017 vs 2006 L_{night} (assuming 2006 runway modal split)



Note: 2006 L_{night} modal split was 72% W / 28% E.

Figure B31 Heathrow noise change map for 2017 vs 2016 L_{night} (assuming 2016 runway modal split)



Note: 2016 L_{night} modal split was 70% W / 30% E.

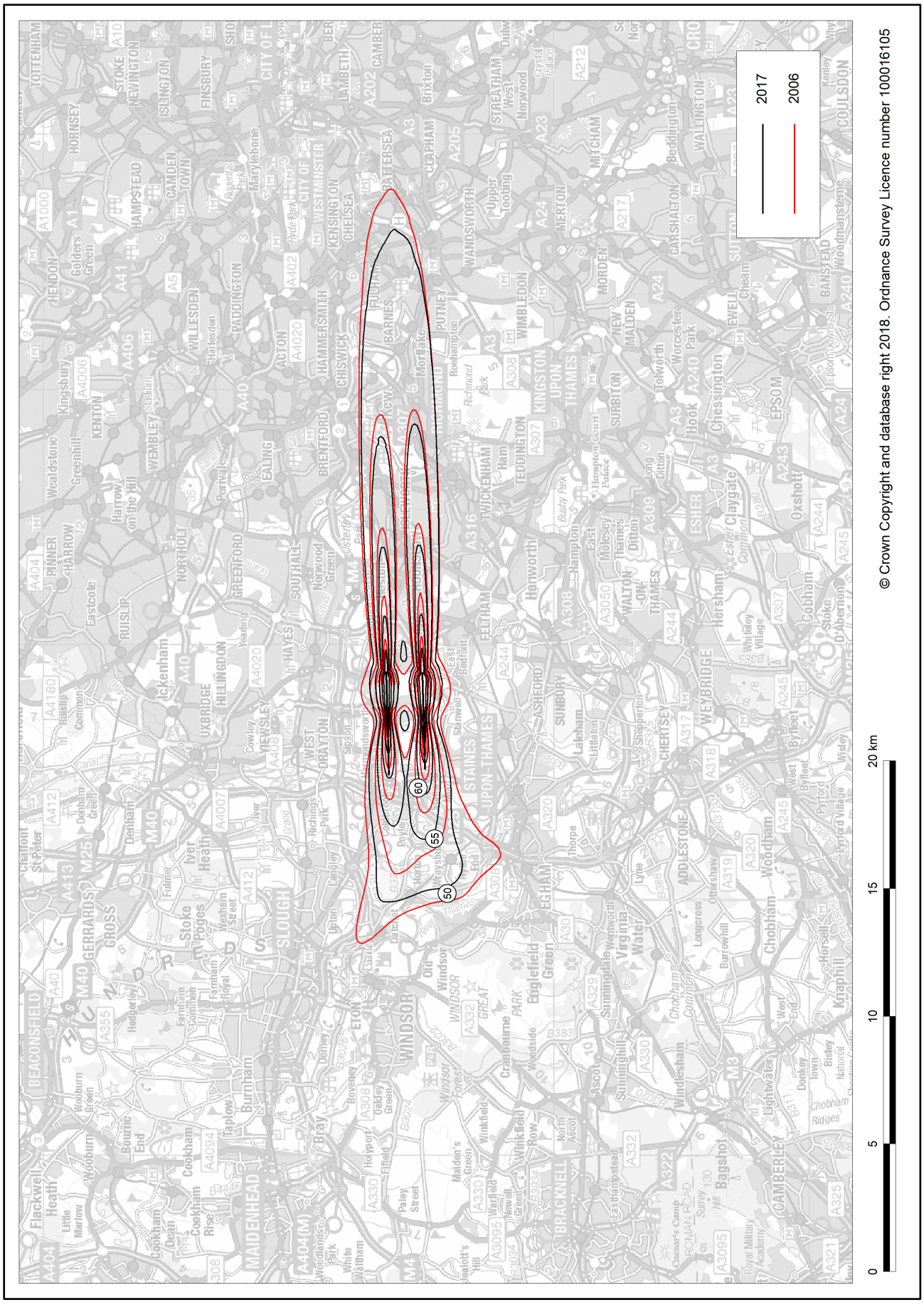


Figure B32 Heathrow 2006 and 2017 L_{night} 50-70 dBA 100% W Leq noise contours (assuming 2006 N-S runway usage)

Figure B33 Heathrow 2006 and 2017 L_{night} 50-70 dBA 100% E Leq noise contours (assuming 2006 N-S runway usage)

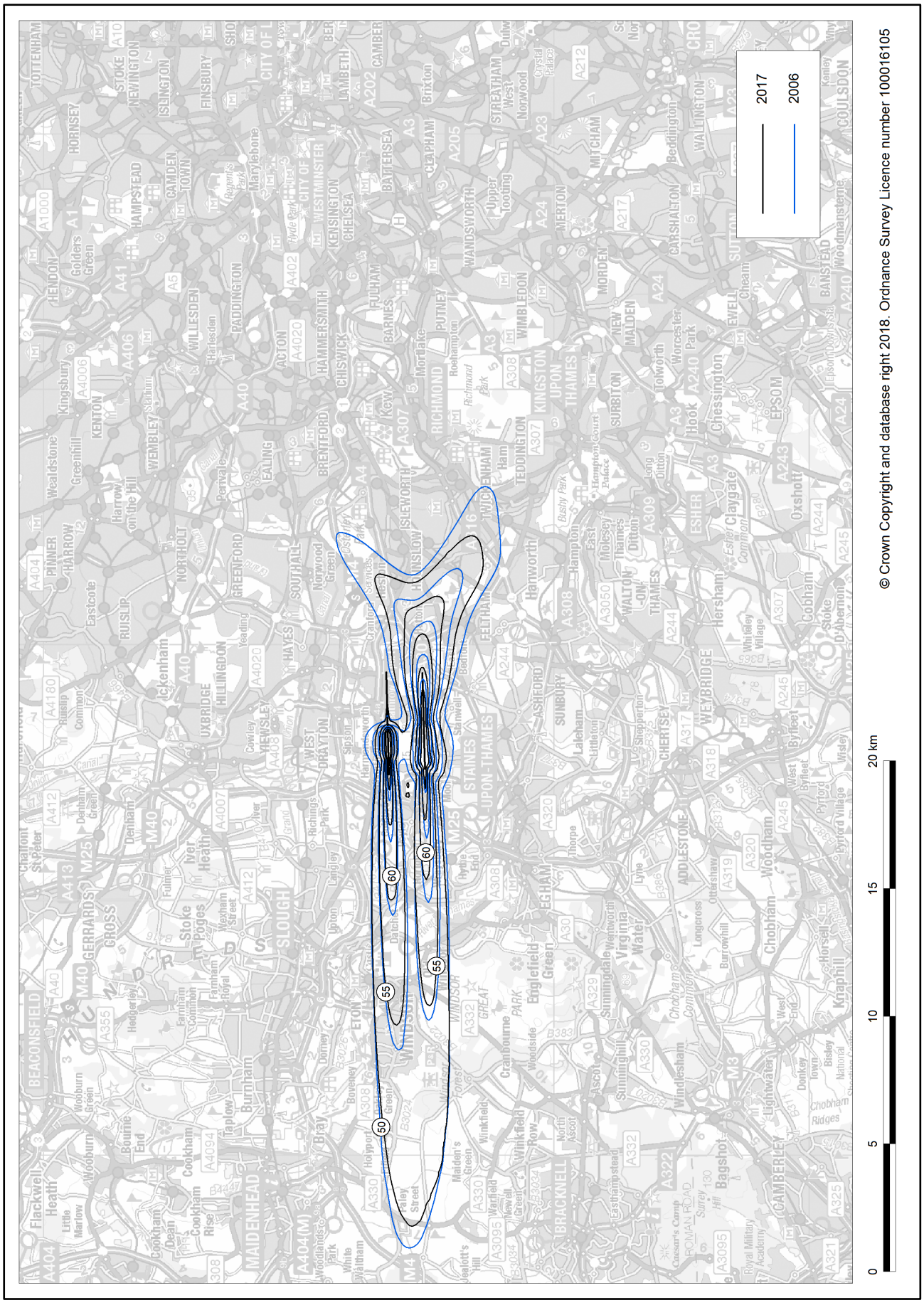
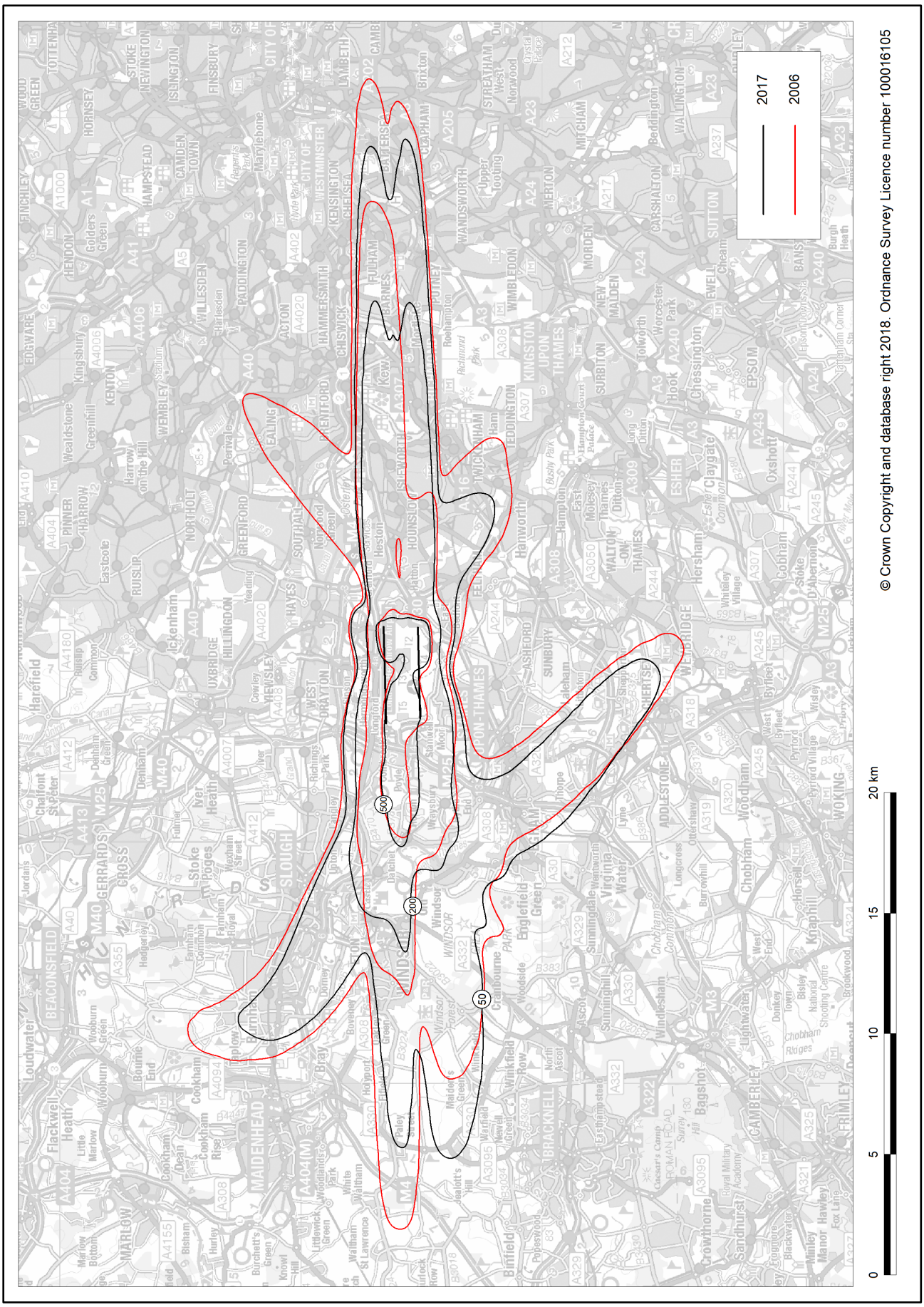
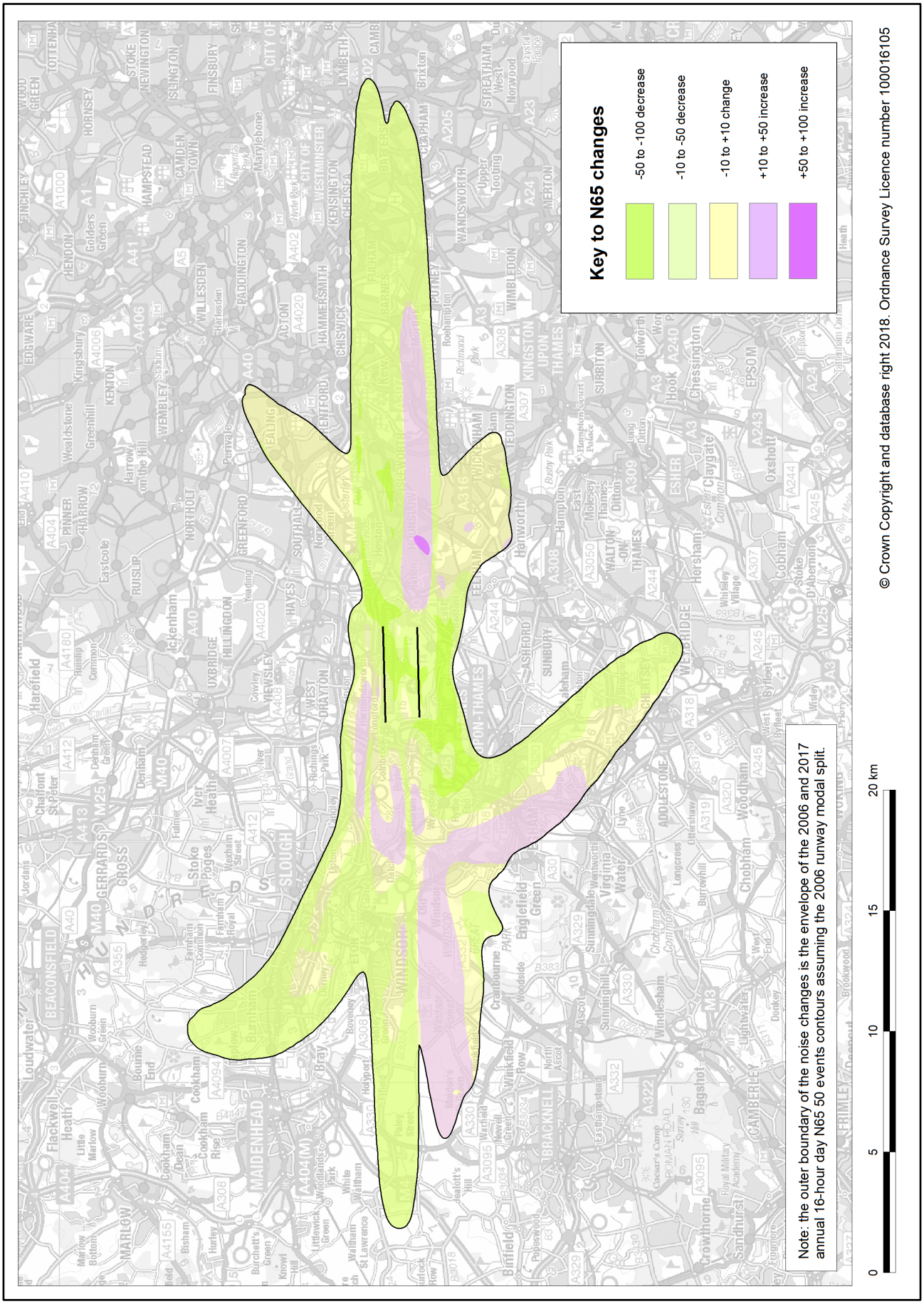


Figure B34 Heathrow 2006 and 2017 annual 16-hour day N65 contours



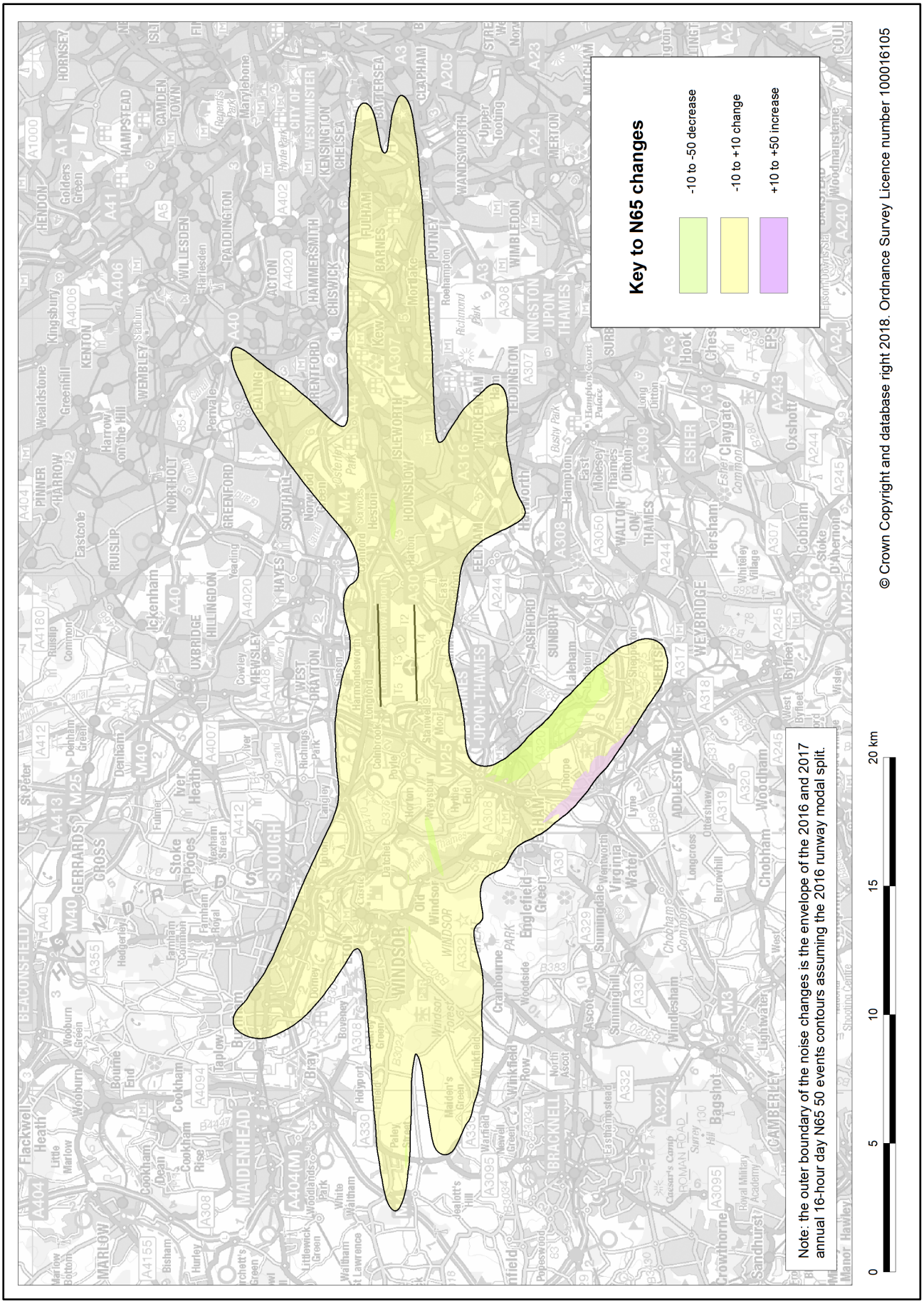
Note: 2006 annual 16-hour day modal split was 70% W / 30% E; 2017 annual 16-hour day modal split was 81% W / 19% E.

Figure B35 Heathrow change map for 2017 vs 2006 annual 16-hour day N65 (assuming 2006 runway modal split)



Note: 2006 annual 16-hour day modal split was 70% W / 30% E.

Figure B36 Heathrow change map for 2017 vs 2016 annual 16-hour day N65 (assuming 2016 runway modal split)



Note: 2016 annual 16-hour day modal split was 70% W / 30% E.

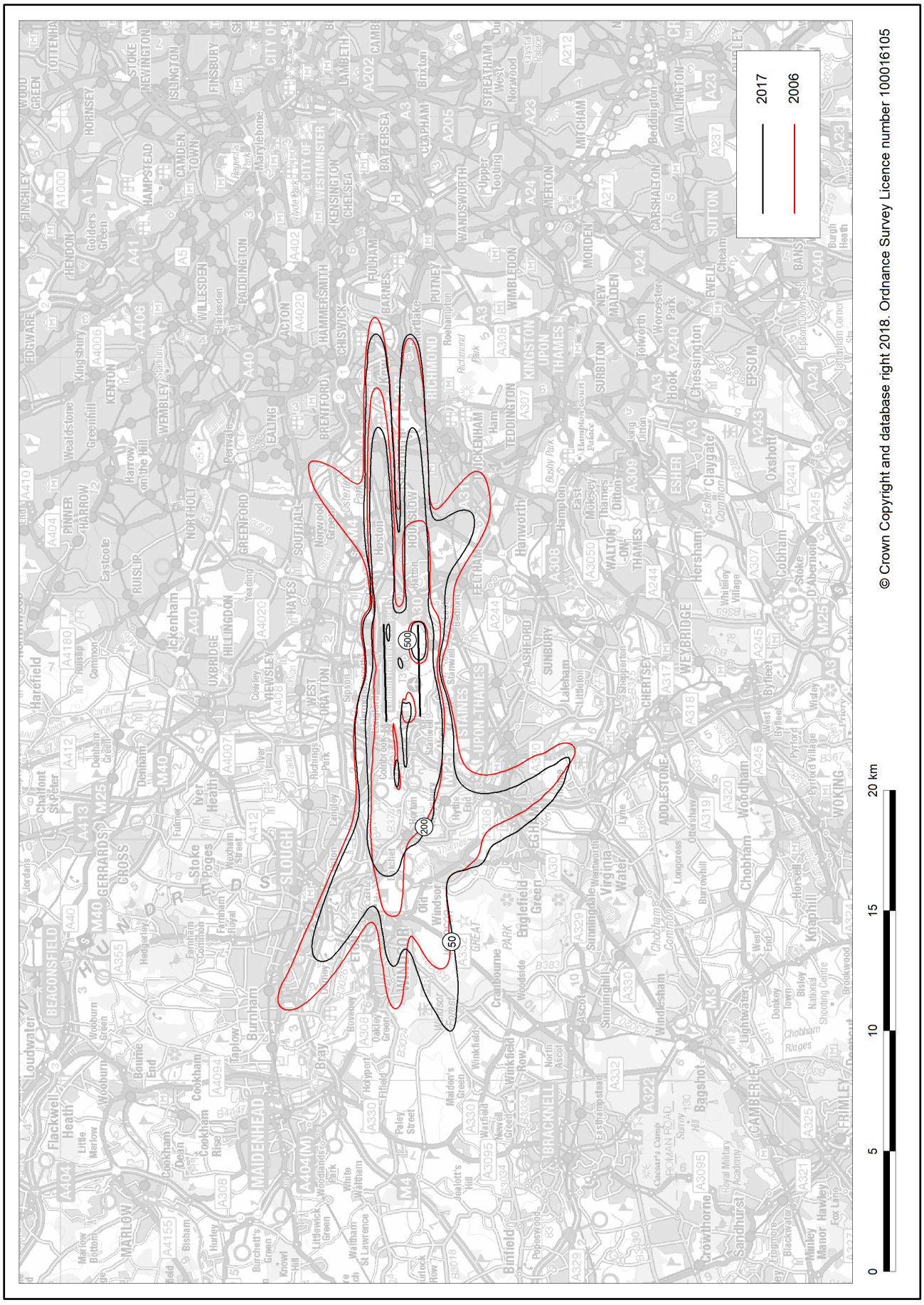
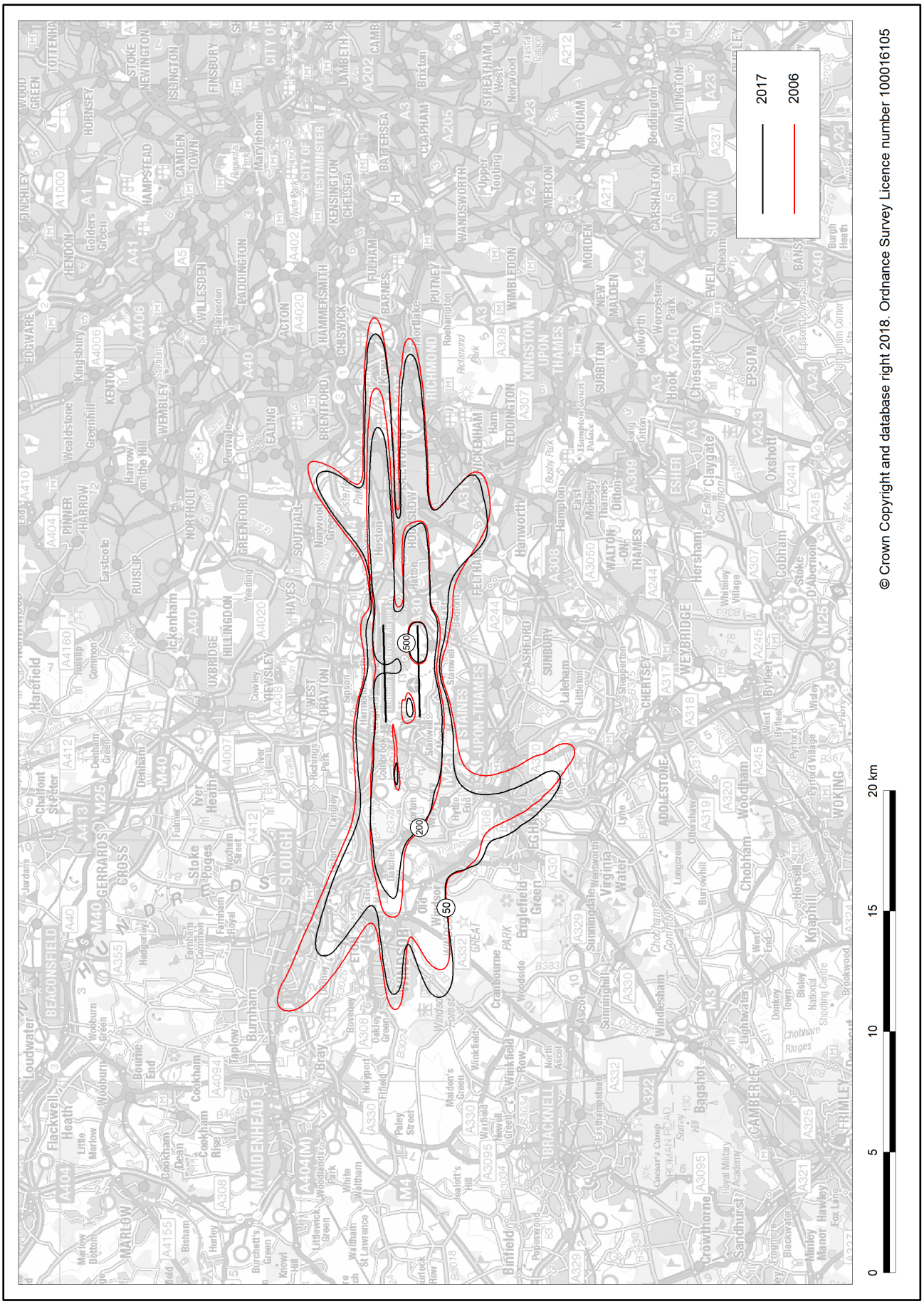


Figure B37 Heathrow 2006 and 2017 annual 16-hour day N70 contours

Note: 2006 annual 16-hour day modal split was 70% W / 30% E; 2017 annual 16-hour day modal split was 81% W / 19% E.

Figure B38 Heathrow 2006 and 2017 annual 16-hour day N70 contours (assuming 2006 modal split and 2006 N-S runway usage)



Note: 2006 annual 16-hour day modal split was 70% W / 30% E.

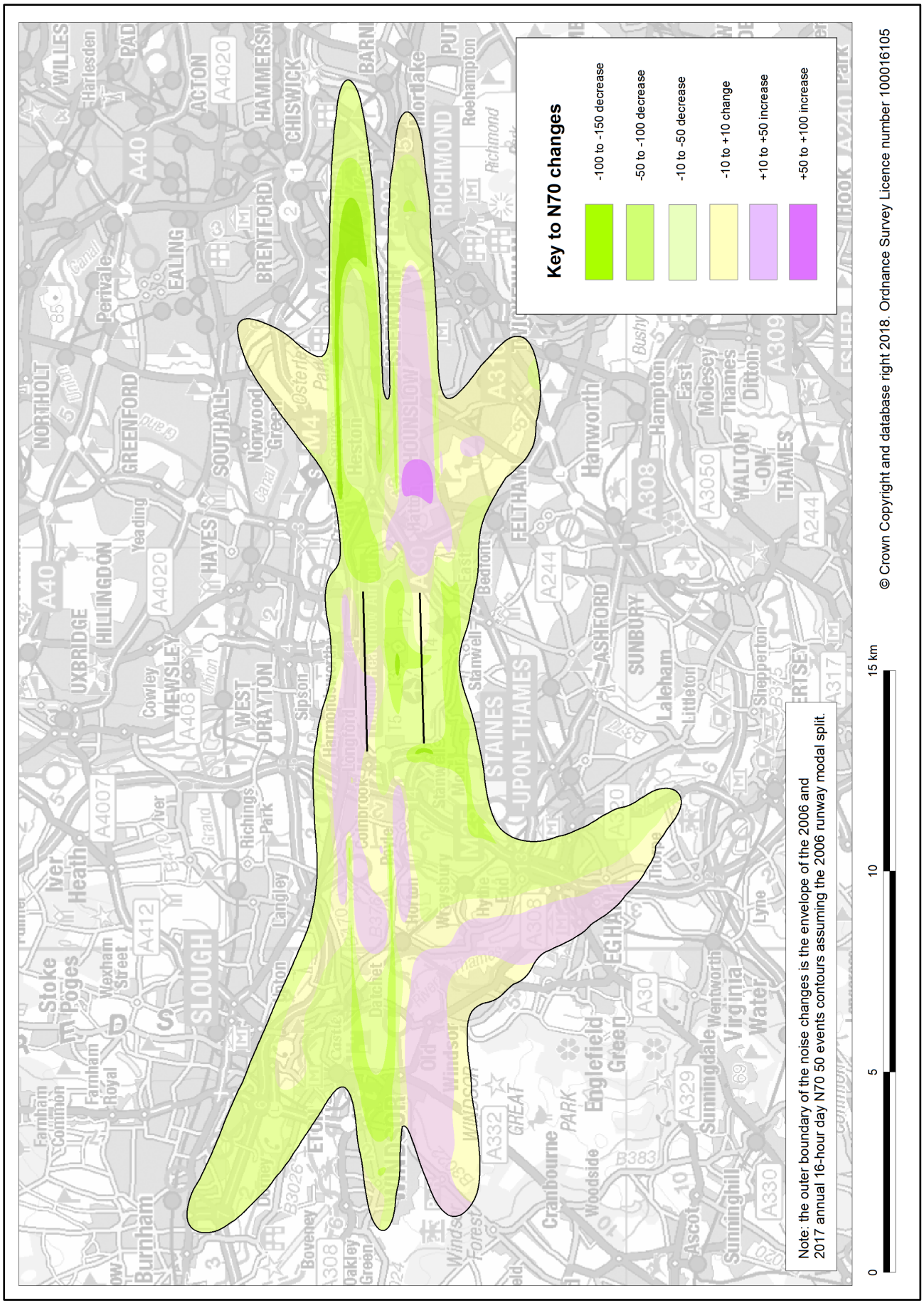
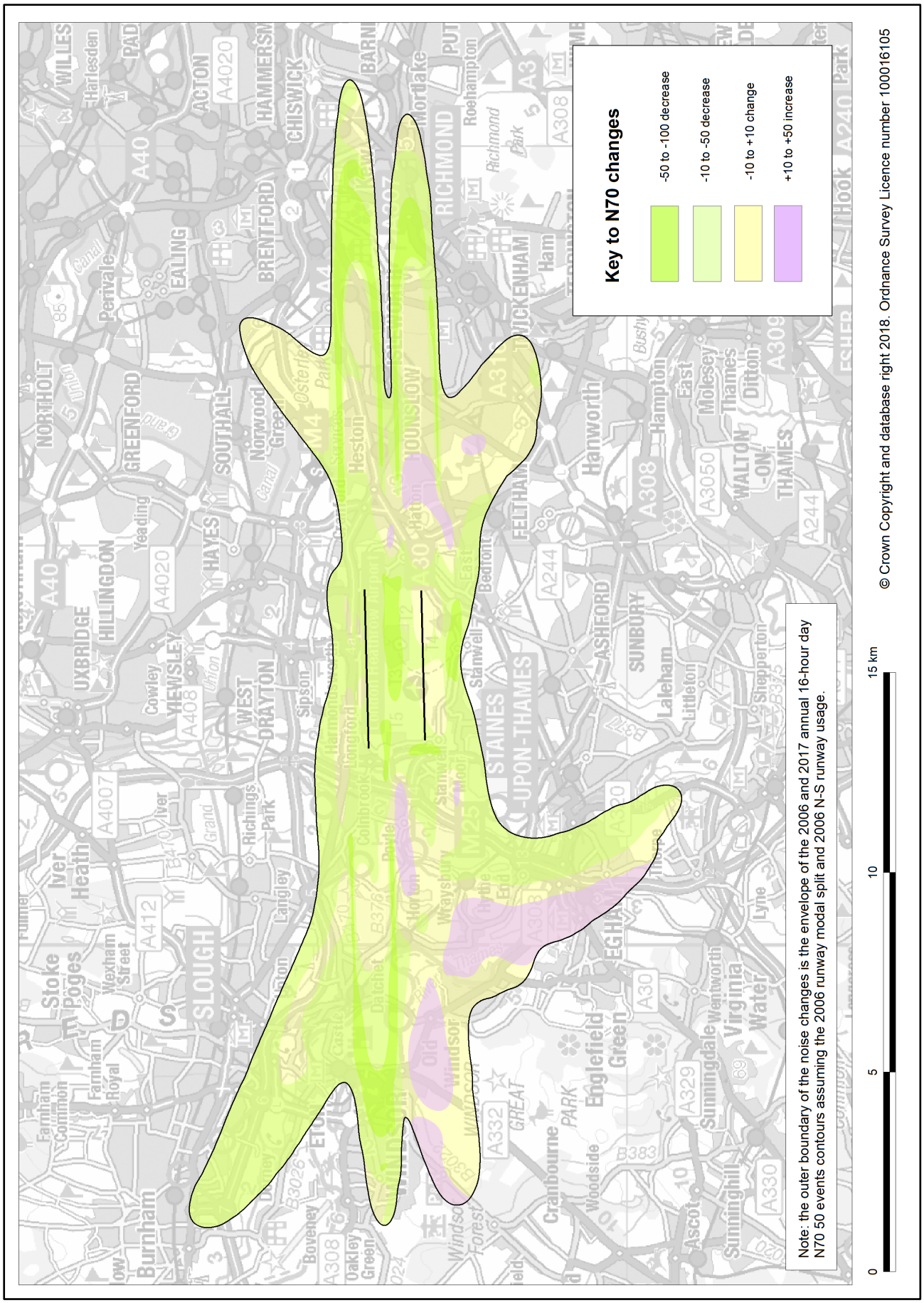


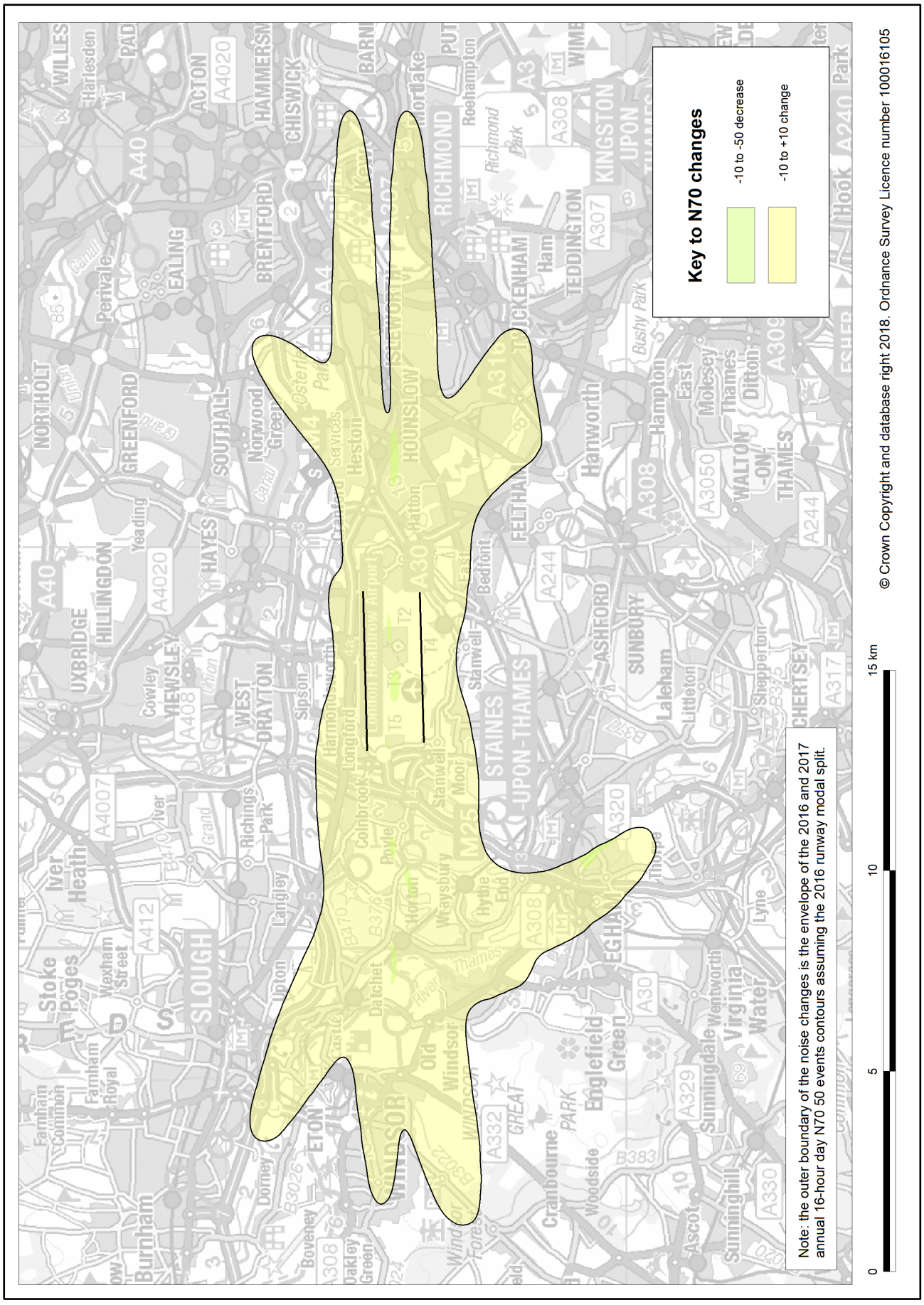
Figure B39 Heathrow change map for 2017 vs 2006 annual 16-hour day N70 (assuming 2006 runway modal split)

Figure B40 Heathrow change map for 2017 vs 2006 annual 16-hour day N70 (with 2006 runway modal split and 2006 N-S runway usage)



Note: 2006 annual 16-hour day modal split was 70% W / 30% E.

Figure B41 Heathrow change map for 2017 vs 2016 annual 16-hour day N70 (assuming 2016 runway modal split)



Note: 2016 annual 16-hour day modal split was 70% W / 30% E.

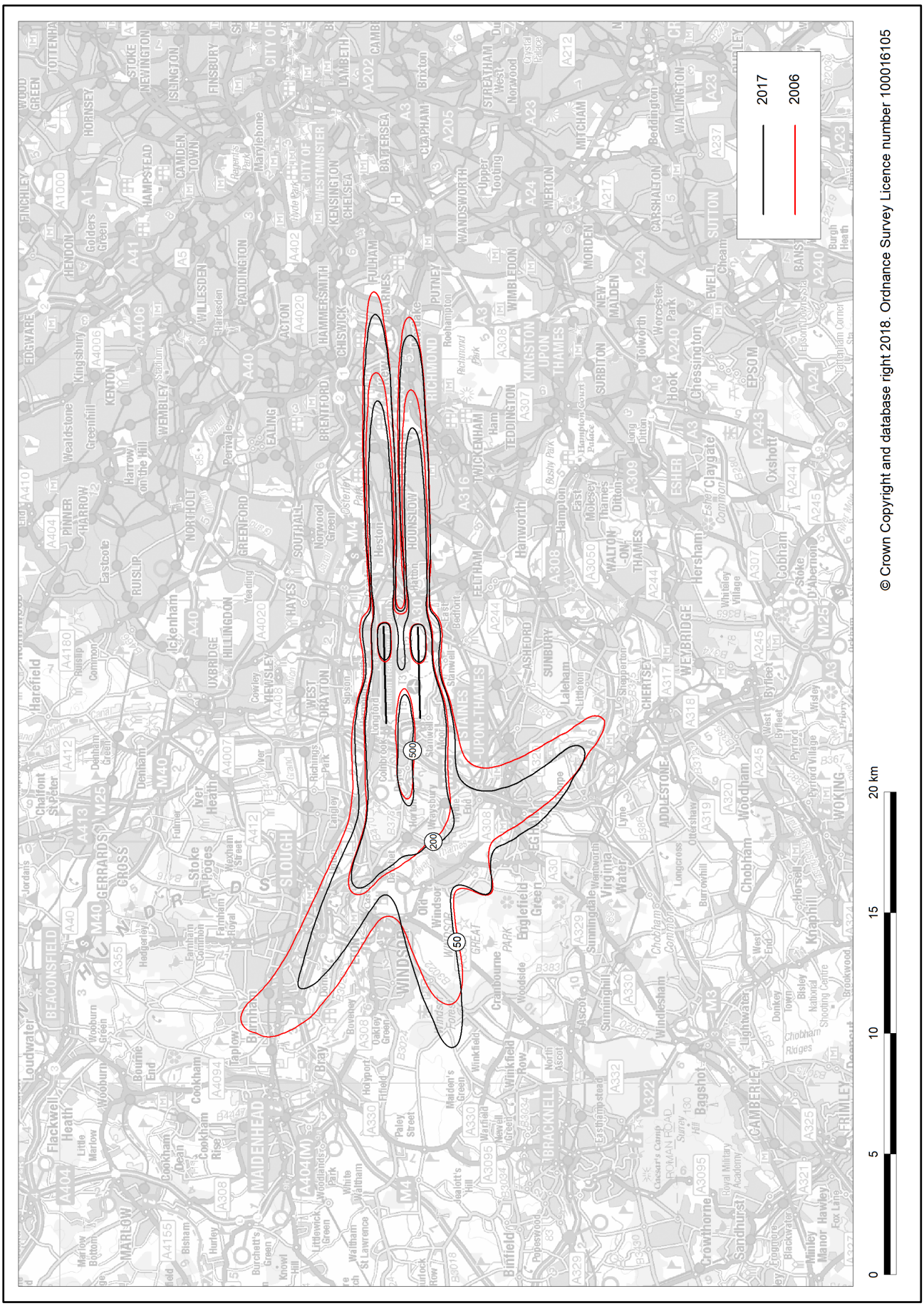


Figure B42 Heathrow 2006 and 2017 annual 16-hour day N70 100% W contours (assuming 2006 N-S runway usage)

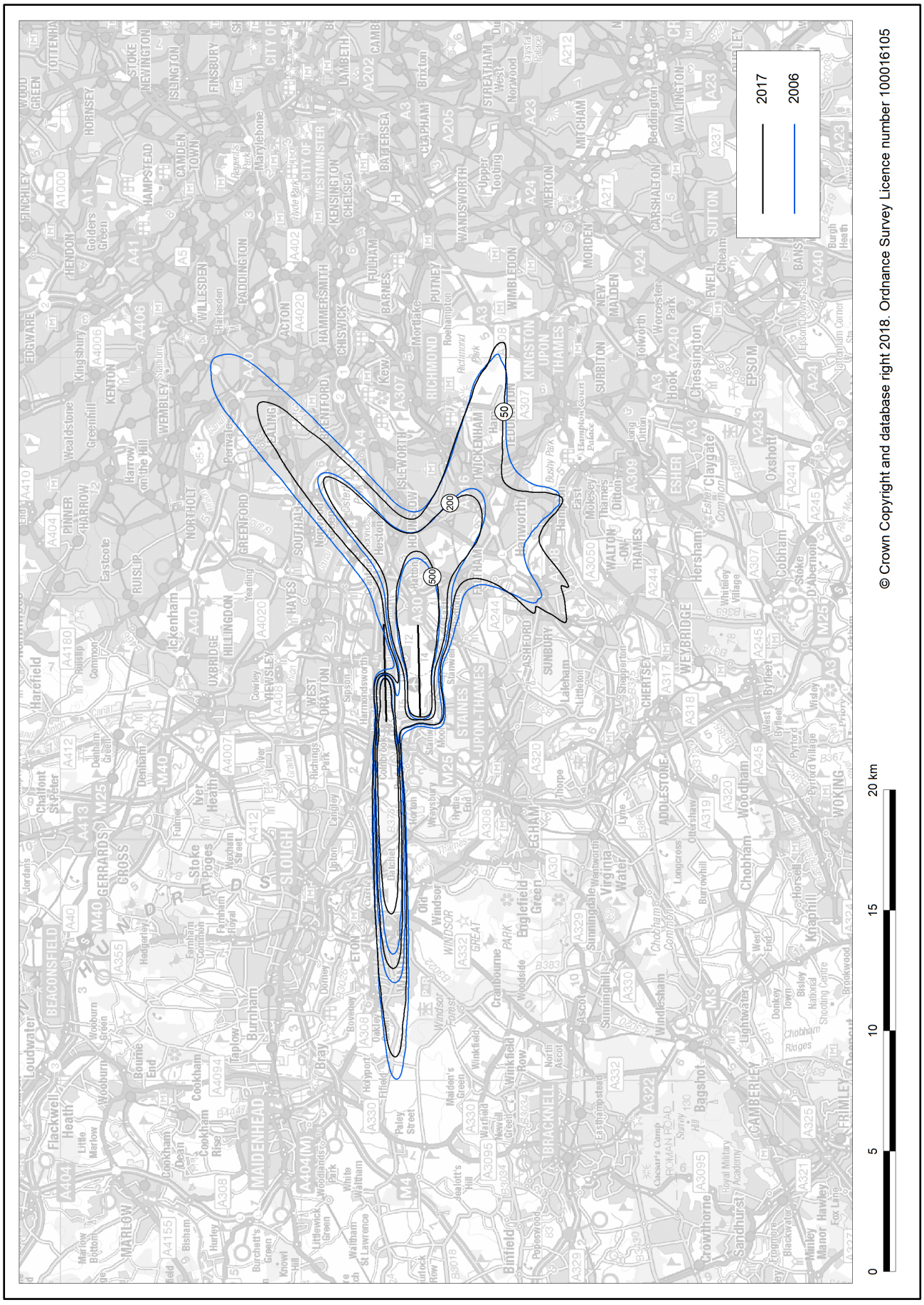


Figure B43 Heathrow 2006 and 2017 annual 16-hour day N70 100% E contours (assuming 2006 N-S runway usage)

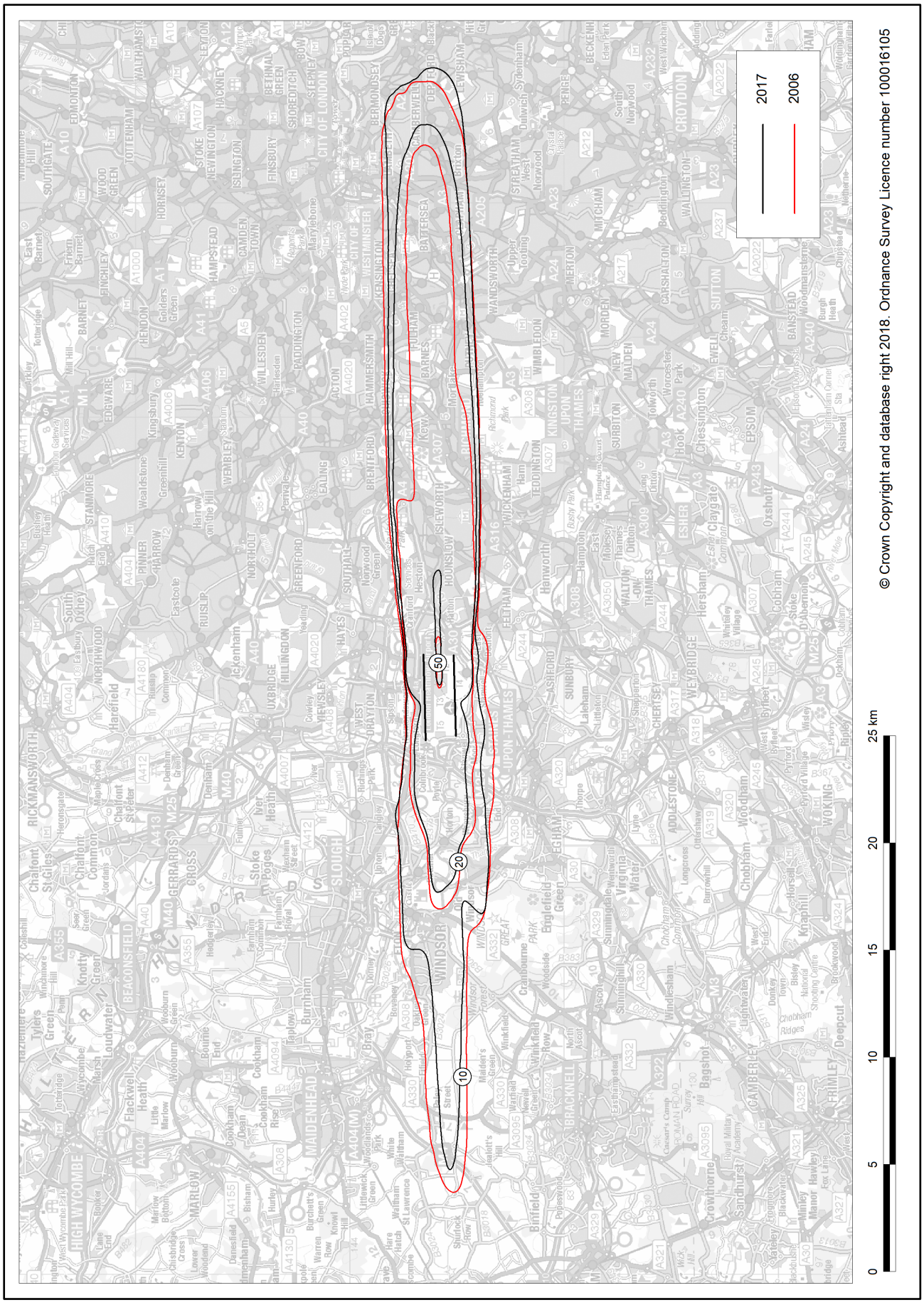
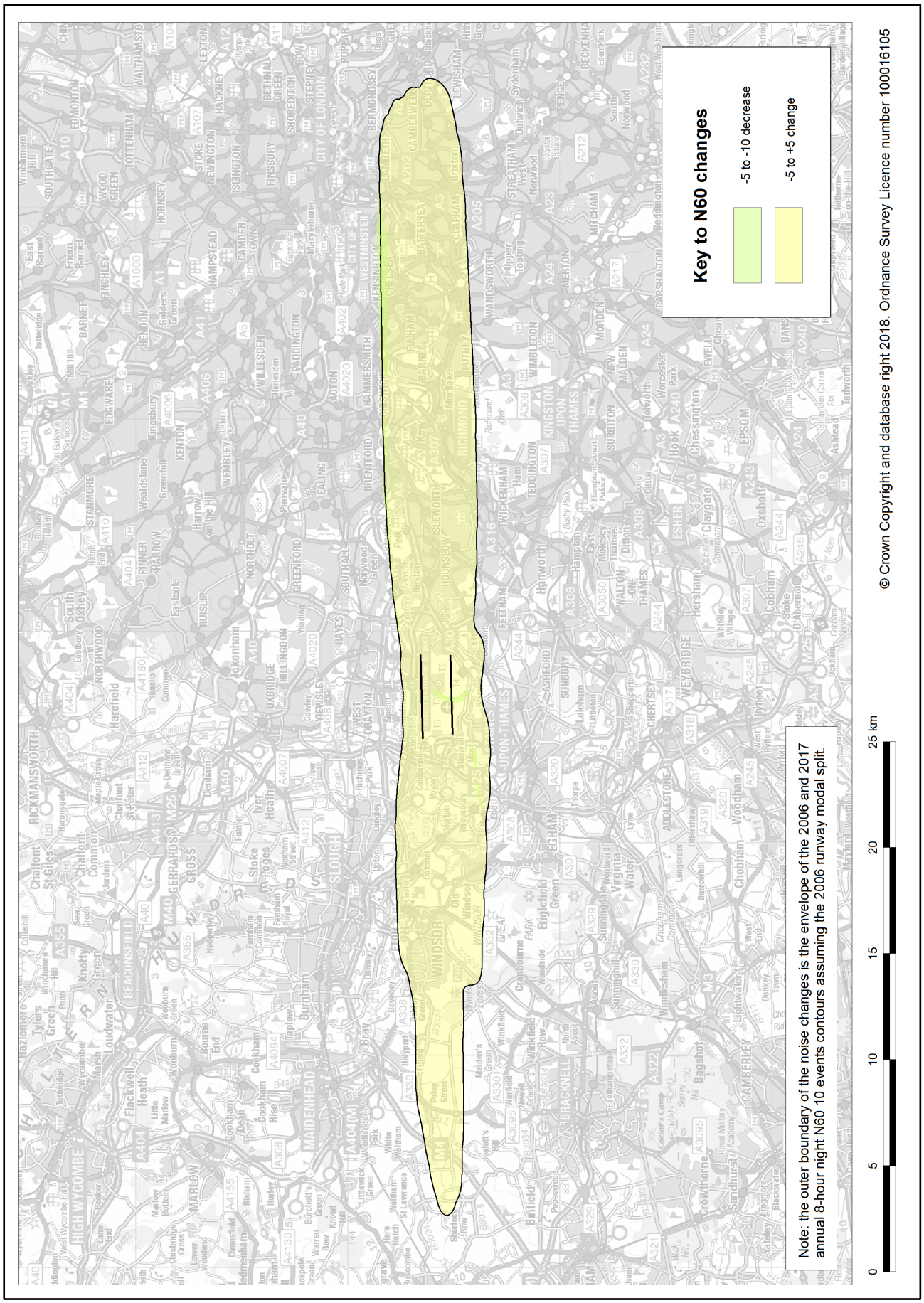


Figure B44 Heathrow 2006 and 2017 annual 8-hour night N60 contours

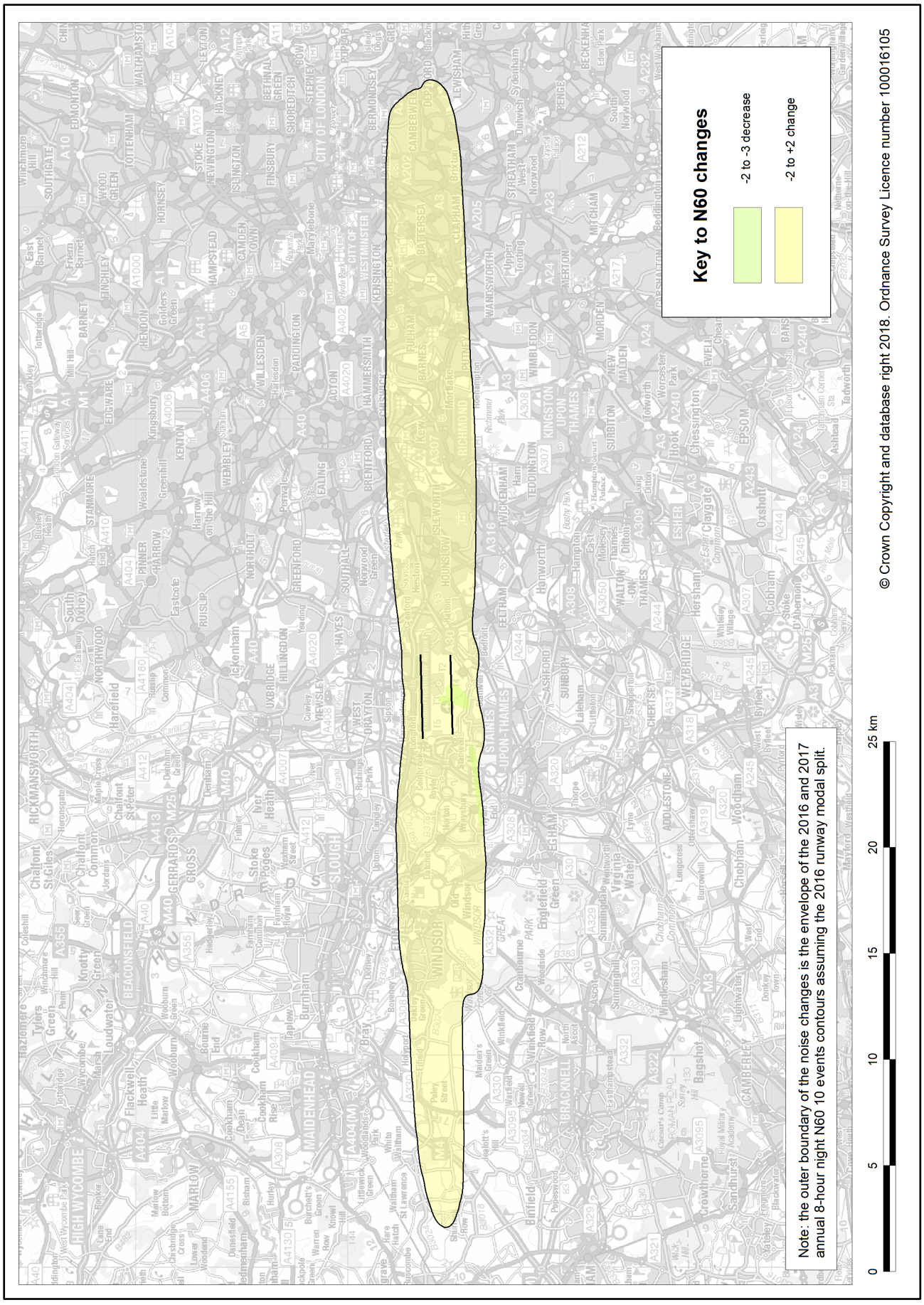
Note: 2006 annual 8-hour night modal split was 72% W / 28% E; 2017 annual 8-hour night modal split was 80% W / 20% E.

Figure B45 Heathrow change map for 2017 vs 2006 annual 8-hour night N60 (assuming 2006 runway modal split)



Note: 2006 annual 8-hour night modal split was 72% W / 28% E.

Figure B46 Heathrow change map for 2017 vs 2016 annual 8-hour night N60 (assuming 2016 runway modal split)



Note: 2016 annual 8-hour night modal split was 70% W / 30% E.

APPENDIX C

Tables

Table C1 Heathrow 2016 and 2017 average summer 16-hour day traffic movements by ANCON type

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
B733	2.1	0.3	-1.8	2.4	0.4	-2.0	4.5	0.7	-3.8
B736	14.6	7.4	-7.2	15.3	7.9	-7.3	29.9	15.4	-14.5
B738	8.5	10.0	+1.5	9.4	11.3	+1.9	17.9	21.3	+3.4
B744G	0.3	0.2	-0.1	0.3	0.2	-0.1	0.7	0.4	-0.2
B744P	1.5	1.6	+0.1	1.2	1.5	+0.3	2.8	3.2	+0.4
B744R	27.0	26.1	-0.9	18.1	16.6	-1.6	45.1	42.6	-2.5
B748	0.2	0.7	+0.6	0.2	0.7	+0.5	0.3	1.4	+1.1
B753	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B757C	0.0	0.2	+0.1	0.1	0.2	+0.1	0.2	0.4	+0.2
B757E	3.2	3.9	+0.7	3.2	3.9	+0.7	6.4	7.7	+1.3
B757P	1.1	1.1	0.0	0.4	0.4	0.0	1.4	1.5	+0.1
B762	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
B763G	9.3	8.8	-0.5	7.8	7.7	0.0	17.1	16.6	-0.5
B763P	10.0	13.3	+3.3	7.7	9.5	+1.8	17.7	22.8	+5.1
B763R	11.4	10.7	-0.8	12.2	11.4	-0.8	23.6	22.1	-1.6
B764	4.9	0.1	-4.9	4.9	0.1	-4.9	9.8	0.1	-9.7
B772G	15.4	16.9	+1.5	12.1	13.3	+1.2	27.5	30.3	+2.8
B772P	5.0	2.0	-3.0	4.2	1.4	-2.7	9.1	3.4	-5.7
B772R	15.9	15.9	+0.0	15.2	13.2	-2.0	31.1	29.1	-2.0
B773G	44.8	48.4	+3.6	37.1	41.1	+4.0	81.9	89.5	+7.6
B788	19.2	21.7	+2.5	18.2	20.0	+1.8	37.4	41.7	+4.3
B789	19.9	29.6	+9.7	15.4	22.5	+7.1	35.3	52.1	+16.8
BA46	0.7	0.0	-0.7	0.7	0.0	-0.7	1.3	0.0	-1.3
CRJ900	0.9	0.9	0.0	0.9	0.9	0.0	1.9	1.8	0.0
CS100	0.0	2.4	+2.4	0.0	2.4	+2.4	0.0	4.8	+4.8
EA30	1.5	1.9	+0.3	2.5	2.8	+0.3	4.0	4.7	+0.7
EA31	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
EA318	1.1	1.7	+0.6	1.1	1.7	+0.6	2.3	3.5	+1.2
EA319C	16.8	19.7	+2.9	16.8	21.1	+4.3	33.6	40.8	+7.2
EA319V	95.0	92.4	-2.5	94.4	92.8	-1.5	189.3	185.3	-4.1
EA320C	70.1	66.6	-3.6	73.1	69.1	-4.0	143.2	135.6	-7.6
EA320NEO	0.0	6.3	+6.3	0.0	6.4	+6.4	0.0	12.6	+12.6

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
EA320V	122.4	126.1	+3.8	122.8	127.0	+4.2	245.1	253.1	+8.0
EA321C	9.9	5.7	-4.2	11.0	7.3	-3.8	21.0	13.0	-8.0
EA321V	49.4	44.1	-5.3	50.3	45.2	-5.1	99.7	89.3	-10.4
EA33	25.0	18.9	-6.1	22.4	16.2	-6.2	47.5	35.2	-12.3
EA34	2.7	1.4	-1.3	2.9	1.6	-1.3	5.6	3.0	-2.6
EA346	7.2	6.6	-0.6	5.7	6.5	+0.8	12.8	13.1	+0.2
EA359	0.7	3.5	+2.8	0.6	3.1	+2.5	1.3	6.6	+5.3
EA38GP	11.3	11.2	-0.1	10.9	10.8	-0.1	22.2	22.0	-0.2
EA38R	15.8	14.7	-1.2	9.6	8.4	-1.1	25.4	23.1	-2.3
ERJ	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
ERJ170	0.0	0.4	+0.3	0.0	0.4	+0.3	0.1	0.7	+0.7
ERJ190	2.8	3.8	+0.9	3.0	3.9	+0.9	5.8	7.7	+1.8
EXE3	0.2	1.1	+0.9	0.2	1.1	+0.9	0.3	2.1	+1.8
FK10	2.0	0.3	-1.7	2.0	0.3	-1.7	4.0	0.6	-3.4
L4P	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LTT	0.1	6.1	+6.0	0.1	6.2	+6.0	0.3	12.3	+12.0
STT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	650.3	**654.6**	**+4.4**	616.5	**618.5**	**+2.0**	1266.7	**1273.1**	**+6.4**
			(+0.7%)			**(+0.3%)**			**(+0.5%)**

Note: Changes and totals have been calculated *before* rounding.

Table C2 Heathrow 2016 and 2017 average summer 8-hour night traffic movements by ANCON type

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
B733	0.4	0.1	-0.3	0.1	0.0	0.0	0.4	0.1	-0.3
B736	0.8	0.5	-0.3	0.2	0.0	-0.2	1.0	0.5	-0.5
B738	0.8	1.3	+0.5	0.0	0.0	+0.0	0.8	1.4	+0.6
B744G	0.0	0.0	0.0	0.0	0.0	+0.0	0.0	0.0	0.0
B744P	0.1	0.1	-0.1	0.4	0.2	-0.3	0.6	0.3	-0.3
B744R	0.9	0.3	-0.7	9.7	9.7	0.0	10.7	10.0	-0.7
B748	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B757C	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
B757E	0.1	0.0	0.0	0.1	0.0	0.0	0.2	0.1	-0.1
B757P	0.0	0.0	0.0	0.7	0.7	0.0	0.7	0.7	0.0
B763G	0.1	0.0	0.0	1.6	1.2	-0.5	1.7	1.2	-0.5
B763P	0.2	0.1	-0.1	2.4	3.8	+1.3	2.6	3.8	+1.3
B763R	1.1	1.0	0.0	0.3	0.3	0.0	1.3	1.3	-0.1
B764	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B772G	1.6	0.9	-0.8	4.9	4.5	-0.5	6.6	5.4	-1.2
B772P	0.0	0.0	0.0	0.9	0.6	-0.3	0.9	0.6	-0.3
B772R	1.7	0.8	-0.9	2.4	3.6	+1.2	4.1	4.4	+0.3
B773G	1.1	1.1	0.0	8.8	8.3	-0.4	9.9	9.4	-0.4
B788	0.5	1.1	+0.6	1.5	2.9	+1.3	2.1	4.0	+1.9
B789	0.3	0.7	+0.4	4.9	7.9	+3.0	5.2	8.6	+3.4
BA46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA30	1.0	0.9	0.0	0.0	0.0	0.0	1.0	0.9	-0.1
EA319C	0.9	1.6	+0.7	1.0	0.2	-0.8	1.9	1.7	-0.1
EA319V	1.2	1.0	-0.3	1.9	0.6	-1.3	3.1	1.6	-1.5
EA320C	3.6	3.1	-0.5	0.6	0.6	0.0	4.2	3.7	-0.5
EA320NEO	0.0	0.1	+0.1	0.0	0.0	0.0	0.0	0.2	+0.2
EA320V	2.0	2.2	+0.1	1.7	1.3	-0.4	3.7	3.5	-0.2
EA321C	1.2	1.6	+0.4	0.1	0.1	-0.1	1.3	1.6	+0.4
EA321V	1.5	1.6	+0.1	0.6	0.5	-0.1	2.0	2.1	0.0
EA33	2.1	1.6	-0.6	4.8	4.2	-0.5	6.9	5.8	-1.1
EA34	0.8	0.5	-0.3	0.5	0.3	-0.2	1.3	0.8	-0.6
EA346	0.2	0.3	+0.1	1.7	0.4	-1.3	1.9	0.7	-1.2

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
EA359	0.0	0.1	+0.1	0.1	0.5	0.4	0.1	0.5	+0.4
EA38GP	0.4	0.3	-0.1	0.8	0.8	-0.1	1.2	1.1	-0.1
EA38R	0.2	0.2	0.0	6.5	6.5	0.0	6.7	6.7	0.0
ERJ	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	-0.1
ERJ190	0.2	0.2	-0.1	0.0	0.0	0.0	0.2	0.2	0.0
EXE3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
FK10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LTT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	25.3	**23.4**	**-1.9**	59.1	**59.5**	**+0.4**	84.4	**83.0**	**-1.5**
			(-7%)			**(+1%)**			**(-2%)**

Note: Changes and totals have been calculated *before* rounding.

Table C3 Heathrow 2016 and 2017 annual 12-hour day traffic movements by ANCON type

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
B733	1.5	0.7	-0.8	1.6	0.7	-0.9	3.2	1.4	-1.8
B736	8.2	5.2	-3.0	9.9	6.0	-3.9	18.1	11.2	-6.9
B7378MAX	0.0	0.1	+0.1	0.0	0.1	+0.1	0.0	0.3	+0.3
B738	7.6	8.3	+0.7	8.2	9.1	+0.9	15.7	17.4	+1.6
B744G	0.3	0.2	-0.1	0.5	0.3	-0.1	0.8	0.5	-0.3
B744P	0.7	0.8	+0.1	0.8	0.9	+0.2	1.5	1.8	+0.3
B744R	21.2	21.9	+0.7	15.7	15.6	-0.1	36.9	37.5	+0.6
B747	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B747SP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B748	0.1	0.1	+0.1	0.1	0.6	+0.4	0.2	0.7	+0.5
B753	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.0
B757C	0.0	0.1	+0.1	0.2	0.2	0.0	0.2	0.3	+0.1
B757E	2.8	2.7	-0.1	1.8	1.7	-0.1	4.6	4.4	-0.1
B757P	0.8	0.8	0.0	0.4	0.4	+0.0	1.2	1.1	0.0
B762	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B763G	8.7	8.0	-0.7	6.0	7.0	+1.0	14.7	15.0	+0.3
B763P	10.0	12.3	+2.2	7.1	8.3	+1.2	17.1	20.5	+3.4
B763R	10.1	9.1	-1.0	7.3	6.4	-0.9	17.4	15.5	-2.0
B764	4.0	0.9	-3.2	3.4	0.6	-2.8	7.5	1.5	-6.0
B772G	12.3	12.9	+0.6	10.4	12.2	+1.7	22.7	25.1	+2.3
B772P	3.8	2.2	-1.7	3.7	2.0	-1.7	7.5	4.2	-3.3
B772R	13.3	12.1	-1.2	14.4	12.3	-2.1	27.7	24.4	-3.3
B773G	25.8	27.6	+1.8	30.9	32.8	+1.9	56.7	60.4	+3.8
B788	13.8	17.6	+3.8	15.1	16.5	+1.3	28.9	34.1	+5.2
B789	12.7	20.9	+8.2	13.3	19.8	+6.6	26.0	40.7	+14.7
BA46	0.5	0.1	-0.4	0.6	0.1	-0.5	1.1	0.2	-1.0
CRJ	0.0	0.0	+0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRJ900	0.6	0.1	-0.5	0.7	0.2	-0.5	1.4	0.3	-1.0
CS100	0.0	1.1	+1.1	0.0	1.5	+1.5	0.0	2.6	+2.6
CS300	0.0	0.2	+0.2	0.0	0.2	+0.2	0.0	0.4	+0.4
EA30	1.1	1.1	0.0	1.0	1.1	+0.1	2.1	2.2	+0.1
EA31	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.1	0.0

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
EA318	1.1	1.3	+0.2	1.1	1.9	+0.7	2.3	3.2	+0.9
EA319C	14.1	15.9	+1.8	13.9	16.2	+2.3	28.0	32.1	+4.1
EA319V	73.9	72.6	-1.3	68.1	66.8	-1.4	142.0	139.4	-2.7
EA320C	47.9	46.8	-1.1	51.7	50.9	-0.8	99.6	97.7	-1.9
EA320NEO	0.0	4.2	+4.2	0.0	4.7	+4.7	0.0	8.9	+8.9
EA320V	99.6	98.3	-1.3	89.7	88.1	-1.6	189.3	186.4	-2.9
EA321C	7.1	5.1	-2.0	8.9	5.8	-3.1	16.0	10.9	-5.2
EA321V	39.4	36.1	-3.3	32.8	31.3	-1.4	72.2	67.4	-4.8
EA33	15.4	13.8	-1.5	16.7	14.3	-2.4	32.1	28.1	-4.0
EA34	1.2	0.5	-0.7	1.5	0.5	-1.0	2.7	1.0	-1.7
EA346	5.0	3.6	-1.4	5.0	4.6	-0.3	10.0	8.3	-1.7
EA359	0.3	1.0	+0.7	0.7	2.2	+1.5	1.0	3.2	+2.2
EA38GP	6.8	6.9	+0.2	8.0	8.6	+0.6	14.8	15.5	+0.8
EA38R	9.3	8.8	-0.5	7.7	7.4	-0.3	17.0	16.2	-0.8
ERJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ERJ170	0.0	0.0	0.0	0.0	0.1	+0.1	0.0	0.1	+0.1
ERJ190	1.8	2.1	+0.3	2.4	2.8	+0.4	4.3	4.9	+0.6
EXE3	0.2	0.9	+0.7	0.2	0.7	+0.5	0.4	1.5	+1.1
FK10	1.2	0.4	-0.9	1.6	0.5	-1.1	2.8	0.8	-2.0
LTT	0.1	3.3	+3.2	0.1	3.4	+3.4	0.1	6.7	+6.5
MD11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	+0.0
STT	0.0	0.0	-0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	484.7	**488.7**	**+4.0**	463.1	**467.4**	**+4.3**	947.7	**956.0**	**+8.3**
			(+1%)			**(+1%)**			**(+1%)**

Note: Changes and totals have been calculated *before* rounding.

Table C4 Heathrow 2016 and 2017 annual 4-hour evening traffic movements by ANCON type

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
B727	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B733	0.2	0.1	-0.1	0.5	0.3	-0.2	0.7	0.4	-0.3
B736	3.7	2.0	-1.7	2.6	1.7	-0.9	6.3	3.8	-2.5
B7378MAX	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B738	2.6	2.7	+0.1	2.7	2.8	+0.1	5.3	5.5	+0.2
B744G	0.1	0.2	0.0	0.0	0.0	0.0	0.2	0.2	0.0
B744P	0.3	0.4	0.0	0.2	0.2	0.0	0.5	0.5	0.0
B744R	4.7	3.9	-0.8	1.1	1.0	-0.1	5.8	4.9	-0.9
B747	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B748	0.1	0.5	+0.4	0.0	0.0	0.0	0.1	0.5	+0.4
B753	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
B757C	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
B757E	1.1	1.1	0.0	2.1	2.0	-0.1	3.2	3.0	-0.1
B757P	0.2	0.2	0.0	0.2	0.2	0.0	0.4	0.4	0.0
B762	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B763G	0.1	0.1	+0.1	1.2	0.2	-1.0	1.3	0.3	-0.9
B763P	0.2	0.2	+0.1	0.6	0.9	+0.3	0.8	1.2	+0.4
B763R	1.2	0.9	-0.3	4.7	4.4	-0.3	5.9	5.3	-0.6
B764	0.0	0.0	0.0	0.5	0.2	-0.3	0.5	0.2	-0.4
B772G	4.6	4.7	+0.1	1.7	0.9	-0.8	6.3	5.6	-0.7
B772P	0.9	0.9	0.0	0.2	0.4	+0.2	1.2	1.3	+0.1
B772R	3.6	4.7	+1.2	1.4	1.5	+0.1	5.0	6.2	+1.3
B773G	16.7	17.0	+0.3	3.8	4.5	+0.6	20.5	21.5	+1.0
B788	4.8	3.8	-1.0	2.2	2.6	+0.4	7.0	6.4	-0.6
B789	5.7	6.7	+0.9	0.5	1.6	+1.1	6.2	8.3	+2.1
BA46	0.2	0.0	-0.1	0.1	0.0	-0.1	0.2	0.0	-0.2
CRJ900	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.2	0.0
CS100	0.0	0.6	+0.6	0.0	0.2	+0.2	0.0	0.8	+0.8
CS300	0.0	0.0	0.0	0.0	0.1	+0.1	0.0	0.1	+0.1
EA30	0.6	0.9	+0.3	1.5	1.7	+0.2	2.1	2.5	+0.4
EA31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA318	0.1	0.6	+0.6	0.0	0.1	0.0	0.1	0.7	+0.6

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
EA319C	3.9	4.1	+0.2	4.8	5.3	+0.5	8.7	9.3	+0.6
EA319V	15.5	14.2	-1.3	21.4	20.6	-0.8	36.9	34.8	-2.1
EA320C	16.8	16.7	-0.1	15.9	15.4	-0.5	32.7	32.1	-0.6
EA320NEO	0.0	1.3	+1.3	0.0	1.0	+1.0	0.0	2.3	+2.3
EA320V	21.6	20.5	-1.0	33.0	32.4	-0.6	54.5	52.9	-1.6
EA321C	2.9	1.5	-1.4	1.9	2.0	+0.1	4.8	3.5	-1.3
EA321V	7.3	7.8	+0.5	14.4	13.1	-1.4	21.7	20.8	-0.9
EA33	9.1	6.5	-2.6	4.0	2.3	-1.7	13.1	8.8	-4.3
EA34	1.4	0.8	-0.6	0.9	0.7	-0.2	2.3	1.6	-0.8
EA346	2.2	2.3	+0.1	1.0	1.0	0.0	3.2	3.3	+0.2
EA359	0.6	2.8	+2.2	0.2	1.1	+0.9	0.8	3.9	+3.1
EA38GP	3.6	4.0	+0.4	1.3	1.2	0.0	4.8	5.2	+0.4
EA38R	5.0	5.3	+0.3	0.1	0.1	0.0	5.1	5.4	+0.3
ERJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ERJ170	0.0	0.1	+0.1	0.0	0.0	0.0	0.0	0.1	+0.1
ERJ190	0.8	1.3	+0.5	0.5	0.8	+0.3	1.3	2.1	+0.8
EXE3	0.1	0.1	+0.1	0.1	0.3	+0.3	0.1	0.5	+0.3
FK10	1.1	0.3	-0.8	0.7	0.2	-0.6	1.8	0.4	-1.4
L4P	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LTT	0.0	1.5	+1.5	0.0	1.3	+1.3	0.0	2.7	+2.7
STT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	143.9	**143.6**	**-0.3**	127.9	**126.2**	**-1.6**	271.8	**269.8**	**-2.0**
			(0%)			**(-1%)**			**(-1%)**

Note: Changes and totals have been calculated *before* rounding.

Table C5 Heathrow 2016 and 2017 annual 8-hour night traffic movements by ANCON type

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
B733	0.3	0.2	-0.1	0.0	0.0	0.0	0.4	0.2	-0.2
B736	0.7	0.5	-0.1	0.1	0.0	-0.1	0.7	0.6	-0.2
B738	0.7	0.9	+0.2	0.0	0.0	0.0	0.8	0.9	+0.1
B744G	0.0	0.0	0.0	0.0	0.0	+0.0	0.0	0.0	0.0
B744P	0.1	0.1	--0.0	0.2	0.2	0.0	0.3	0.2	-0.1
B744R	0.5	0.2	-0.3	9.6	9.4	-0.3	10.2	9.6	-0.6
B748	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B757C	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
B757E	0.0	0.0	0.0	0.0	0.1	+0.1	0.1	0.2	+0.1
B757P	0.0	0.0	0.0	0.4	0.4	0.0	0.4	0.4	0.0
B763G	0.0	0.0	0.0	1.6	1.0	-0.6	1.6	1.0	-0.6
B763P	0.1	0.0	0.0	2.6	3.3	+0.8	2.7	3.4	+0.7
B763R	0.9	0.9	0.0	0.3	0.2	-0.2	1.2	1.1	-0.2
B764	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0
B772G	1.0	0.6	-0.4	5.7	5.1	-0.7	6.7	5.7	-1.0
B772P	0.0	0.0	0.0	0.9	0.7	-0.2	0.9	0.7	-0.2
B772R	1.1	0.6	-0.6	2.2	3.6	+1.4	3.3	4.2	+0.9
B773G	0.6	0.7	+0.1	8.4	8.0	-0.3	9.0	8.7	-0.2
B788	0.5	0.6	+0.1	1.8	2.9	+1.1	2.3	3.5	+1.2
B789	0.2	0.4	+0.3	4.8	6.6	+1.7	5.0	7.0	+2.0
BA46	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CS300	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA30	0.8	0.8	-0.1	0.0	0.0	0.0	0.8	0.8	-0.1
EA31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA318	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA319C	1.2	1.7	+0.5	0.5	0.2	-0.3	1.7	1.9	+0.2
EA319V	1.1	1.0	-0.1	1.0	0.5	-0.5	2.2	1.5	-0.6
EA320C	3.3	3.3	0.0	0.4	0.4	0.0	3.8	3.7	-0.1
EA320NEO	0.0	0.3	+0.3	0.0	0.0	0.0	0.0	0.3	+0.3
EA320V	2.5	2.4	-0.1	1.0	0.6	-0.3	3.4	3.0	-0.5
EA321C	0.9	1.2	+0.3	0.1	0.0	-0.1	1.0	1.3	+0.3
EA321V	1.2	1.1	-0.1	0.7	0.6	-0.1	1.9	1.7	-0.2

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
EA33	1.0	0.8	-0.2	4.8	4.5	-0.2	5.8	5.3	-0.5
EA34	0.4	0.3	-0.1	0.7	0.4	-0.3	1.1	0.6	-0.4
EA346	0.2	0.3	+0.1	1.5	0.7	-0.8	1.7	1.0	-0.7
EA359	0.0	0.1	0.0	0.1	0.6	+0.4	0.1	0.6	+0.5
EA38GP	0.2	0.2	0.0	1.3	1.4	+0.1	1.5	1.5	+0.1
EA38R	0.1	0.1	0.0	6.7	6.7	0.0	6.8	6.8	0.0
ERJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ERJ170	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ERJ190	0.2	0.2	-0.1	0.0	0.0	0.0	0.2	0.2	-0.1
EXE3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
FK10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LTT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	20.2	**19.6**	**-0.5**	57.7	**58.2**	**+0.5**	77.9	**77.9**	**-0.1**
			(-3%)			**(+1%)**			**(0%)**

Note: Changes and totals have been calculated *before* rounding.

Table C6 Heathrow 2016 and 2017 annual 24-hour day traffic movements by ANCON type

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
B727	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B733	2.1	1.0	-1.1	2.1	1.0	-1.1	4.2	2.0	-2.2
B736	12.6	7.8	-4.8	12.6	7.8	-4.8	25.1	15.5	-9.6
B7378MAX	0.0	0.1	+0.1	0.0	0.1	+0.1	0.0	0.3	+0.3
B738	10.9	11.9	+1.0	10.9	11.9	+1.0	21.8	23.8	+2.0
B744G	0.5	0.3	-0.1	0.5	0.3	-0.1	0.9	0.7	-0.3
B744P	1.2	1.3	+0.1	1.2	1.3	+0.1	2.3	2.5	+0.2
B744R	26.4	26.0	-0.5	26.4	26.0	-0.5	52.9	52.0	-0.9
B747	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B747SP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B748	0.2	0.6	+0.4	0.2	0.6	+0.4	0.3	1.2	+0.9
B753	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.0
B757C	0.2	0.2	0.0	0.2	0.2	0.0	0.3	0.4	+0.1
B757E	3.9	3.8	-0.1	3.9	3.8	-0.1	7.8	7.6	-0.2
B757P	1.0	1.0	0.0	1.0	1.0	0.0	2.0	1.9	0.0
B762	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B763G	8.8	8.2	-0.6	8.8	8.2	-0.6	17.6	16.3	-1.2
B763P	10.3	12.5	+2.3	10.3	12.5	+2.3	20.6	25.1	+4.5
B763R	12.3	10.9	-1.4	12.3	10.9	-1.4	24.6	21.9	-2.7
B764	4.1	0.9	-3.2	4.1	0.9	-3.2	8.1	1.8	-6.4
B772G	17.8	18.2	+0.3	17.8	18.1	+0.3	35.6	36.3	+0.7
B772P	4.8	3.1	-1.7	4.8	3.1	-1.7	9.6	6.2	-3.4
B772R	18.0	17.4	-0.6	18.0	17.4	-0.6	36.0	34.9	-1.1
B773G	43.1	45.3	+2.2	43.0	45.3	+2.2	86.1	90.6	+4.5
B788	19.1	22.0	+2.9	19.1	22.0	+2.9	38.2	44.0	+5.7
B789	18.6	28.0	+9.4	18.6	28.0	+9.4	37.1	56.0	+18.8
BA46	0.7	0.1	-0.6	0.7	0.1	-0.6	1.4	0.2	-1.2
CRJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CRJ900	0.7	0.2	-0.5	0.7	0.2	-0.5	1.5	0.5	-1.0
CS100	0.0	1.7	+1.7	0.0	1.7	+1.7	0.0	3.4	+3.4
CS300	0.0	0.2	+0.2	0.0	0.2	+0.2	0.0	0.5	+0.5
EA30	2.5	2.8	+0.3	2.5	2.8	+0.2	5.0	5.5	+0.5

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
EA31	0.1	0.1	0.0	0.1	0.1	0.0	0.2	0.1	0.0
EA318	1.2	2.0	+0.8	1.2	1.9	+0.8	2.4	3.9	+1.5
EA319C	19.2	21.7	+2.5	19.2	21.7	+2.5	38.4	43.3	+5.0
EA319V	90.6	87.8	-2.7	90.5	87.8	-2.7	181.1	175.7	-5.4
EA320C	68.0	66.7	-1.3	68.0	66.8	-1.3	136.1	133.5	-2.6
EA320NEO	0.0	5.8	+5.8	0.0	5.8	+5.8	0.0	11.5	+11.5
EA320V	123.6	121.2	-2.5	123.6	121.1	-2.5	247.3	242.3	-4.9
EA321C	10.9	7.8	-3.1	10.9	7.8	-3.1	21.8	15.6	-6.2
EA321V	47.9	45.0	-2.9	47.9	45.0	-2.9	95.8	89.9	-5.8
EA33	25.5	21.1	-4.4	25.5	21.1	-4.4	51.0	42.3	-8.7
EA34	3.1	1.6	-1.5	3.1	1.6	-1.5	6.1	3.2	-2.9
EA346	7.5	6.3	-1.1	7.4	6.3	-1.1	14.9	12.6	-2.3
EA359	1.0	3.8	+2.9	1.0	3.8	+2.9	2.0	7.7	+5.7
EA38GP	10.5	11.1	+0.6	10.5	11.1	+0.6	21.0	22.3	+1.2
EA38R	14.4	14.2	-0.3	14.4	14.2	-0.3	28.9	28.4	-0.5
ERJ	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
ERJ170	0.0	0.1	+0.1	0.0	0.1	+0.1	0.1	0.3	+0.2
ERJ190	2.9	3.6	+0.7	2.9	3.6	+0.7	5.8	7.2	+1.4
EXE3	0.3	1.0	+0.7	0.3	1.0	+0.7	0.5	2.0	+1.5
FK10	2.3	0.6	-1.7	2.3	0.6	-1.7	4.6	1.2	-3.4
L4P	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LTT	0.1	4.7	+4.7	0.1	4.7	+4.7	0.2	9.5	+9.3
MD11	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	648.8	**651.9**	**+3.1**	648.7	**651.8**	**+3.2**	1297.4	**1303.7**	**+6.3**
			(+0.5%)			**(+0.5%)**			**(+0.5%)**

Note: Changes and totals have been calculated *before* rounding.

Table C7 Heathrow 2016 and 2017 6.5-hour night traffic movements by ANCON type

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
B733	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B736	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B738	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
B744G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B744P	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B744R	0.1	0.1	-0.1	1.6	2.4	+0.8	1.7	2.5	+0.8
B748	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B757C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B757E	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B757P	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B763G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B763P	0.0	0.0	0.0	0.8	0.5	-0.2	0.8	0.5	-0.2
B763R	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0
B764	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B772G	0.2	0.1	0.0	2.1	1.4	-0.7	2.2	1.5	-0.7
B772P	0.0	0.0	0.0	0.1	0.3	+0.2	0.1	0.3	+0.3
B772R	0.2	0.1	-0.1	0.1	0.1	0.0	0.3	0.2	-0.1
B773G	0.2	0.2	0.0	3.0	3.0	0.0	3.2	3.3	0.0
B788	0.1	0.1	0.0	0.1	0.1	0.0	0.1	0.2	0.0
B789	0.1	0.1	0.0	2.0	2.0	0.0	2.0	2.1	+0.1
EA30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA319C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA319V	0.0	0.0	0.0	0.1	0.1	-0.1	0.2	0.1	-0.1
EA320C	0.0	0.0	0.0	0.1	0.1	0.0	0.1	0.1	0.0
EA320NEO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA320V	0.1	0.0	0.0	0.3	0.2	-0.1	0.3	0.2	-0.1
EA321C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA321V	0.1	0.1	0.0	0.1	0.1	0.0	0.2	0.2	0.0
EA33	0.1	0.1	0.0	0.4	0.3	-0.1	0.5	0.3	-0.2
EA34	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
EA346	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0
EA359	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	+0.1

ANCON type	2016 departs	2017 departs	Change departs	2016 arrivals	2017 arrivals	Change arrivals	2016 total	2017 total	Change total
EA38GP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EA38R	0.0	0.1	0.0	4.3	4.3	0.0	4.3	4.4	+0.1
ERJ	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
ERJ190	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EXE3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
LTT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
STT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	1.6	**1.3**	**-0.3**	15.2	**15.1**	**-0.1**	16.8	**16.4**	**-0.4**
			(-19%)			**(0%)**			**(-2%)**

Note: Changes and totals have been calculated *before* rounding.

Table C8-a Heathrow 2006 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.0%	0.0%	0.0%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	0.0%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.0%
09L_DVR	0.0%	0.0%	0.0%	0.0%	0.0%
09L_MID	0.0%	0.0%	0.0%	0.0%	0.0%
09L_SAM	0.0%	0.0%	0.0%	0.0%	0.0%
09R_BPK	3.2%	3.9%	1.5%	3.3%	0.9%
09R_BUZ	3.3%	2.2%	0.7%	2.9%	0.3%
09R_CPT	1.9%	1.2%	0.3%	1.6%	0.2%
09R_DVR	3.6%	4.4%	2.6%	3.7%	1.5%
09R_MID	2.4%	3.1%	1.7%	2.5%	0.5%
09R_SAM	0.9%	0.6%	0.4%	0.8%	0.2%
27L_BPK	4.5%	5.4%	2.8%	4.6%	2.3%
27L_CPT	2.3%	1.6%	0.5%	2.0%	0.5%
27L_DVR	5.0%	7.0%	4.5%	5.4%	3.8%
27L_MID	3.2%	4.1%	2.7%	3.4%	0.9%
27L_SAM	1.4%	1.2%	0.7%	1.3%	0.6%
27L_WOB	4.5%	3.2%	1.3%	4.0%	0.8%
27R_BPK	3.2%	4.0%	1.6%	3.3%	1.0%
27R_CPT	1.5%	1.1%	0.3%	1.3%	0.2%
27R_DVR	3.5%	4.4%	2.7%	3.6%	1.4%
27R_MID	2.2%	2.9%	1.6%	2.3%	0.4%
27R_SAM	0.9%	0.7%	0.4%	0.8%	0.2%
27R_WOB	3.4%	2.3%	0.9%	3.0%	0.5%
09L_ARRIVAL	14.4%	12.8%	11.5%	13.9%	9.0%
09R_ARRIVAL	0.3%	0.5%	9.3%	0.8%	14.4%
27L_ARRIVAL	14.2%	13.9%	26.6%	14.9%	33.4%
27R_ARRIVAL	20.4%	19.5%	25.4%	20.5%	26.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C8-b Heathrow 2009 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.1%	0.0%	0.1%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	0.0%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.1%
09L_DVR	0.0%	0.0%	0.1%	0.0%	0.1%
09L_MID	0.0%	0.0%	0.0%	0.0%	0.1%
09L_SAM	0.0%	0.0%	0.0%	0.0%	0.0%
09R_BPK	3.0%	4.0%	1.4%	3.1%	1.0%
09R_BUZ	2.5%	1.7%	0.6%	2.2%	0.4%
09R_CPT	2.2%	1.2%	0.3%	1.9%	0.4%
09R_DVR	2.9%	4.3%	2.4%	3.1%	1.4%
09R_MID	2.2%	2.9%	1.2%	2.3%	0.8%
09R_SAM	0.7%	0.7%	0.9%	0.7%	0.1%
27L_BPK	3.8%	5.1%	1.5%	3.9%	0.4%
27L_CPT	2.5%	1.4%	0.4%	2.1%	0.1%
27L_DVR	4.4%	6.1%	2.8%	4.6%	0.8%
27L_MID	2.9%	3.9%	1.3%	3.0%	0.4%
27L_SAM	0.9%	0.9%	1.2%	1.0%	0.1%
27L_WOB	3.8%	2.4%	0.7%	3.3%	0.1%
27R_BPK	4.0%	4.9%	1.9%	4.1%	1.1%
27R_CPT	2.6%	1.4%	0.5%	2.2%	0.4%
27R_DVR	4.6%	5.9%	3.7%	4.8%	2.0%
27R_MID	3.0%	3.8%	1.6%	3.1%	1.0%
27R_SAM	1.0%	0.9%	1.4%	1.0%	0.3%
27R_WOB	4.0%	2.2%	0.9%	3.5%	0.6%
09L_ARRIVAL	12.8%	12.1%	12.2%	12.6%	14.0%
09R_ARRIVAL	0.4%	0.4%	7.2%	0.8%	8.4%
27L_ARRIVAL	18.3%	16.3%	26.7%	18.4%	29.7%
27R_ARRIVAL	17.5%	17.5%	28.8%	18.2%	36.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C8-c Heathrow 2010 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.2%	0.0%	0.7%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	0.0%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.1%
09L_DVR	0.0%	0.0%	0.2%	0.0%	0.7%
09L_MID	0.0%	0.0%	0.1%	0.0%	0.3%
09L_SAM	0.0%	0.0%	0.0%	0.0%	0.1%
09R_BPK	3.8%	5.1%	1.9%	4.0%	1.2%
09R_BUZ	2.9%	2.1%	0.5%	2.6%	0.2%
09R_CPT	2.8%	1.4%	0.5%	2.4%	0.3%
09R_DVR	3.7%	5.6%	3.0%	4.1%	1.9%
09R_MID	2.8%	3.9%	1.3%	2.9%	1.0%
09R_SAM	0.9%	1.0%	0.9%	0.9%	0.2%
27L_BPK	3.1%	3.5%	2.0%	3.1%	1.2%
27L_CPT	2.2%	1.0%	0.6%	1.9%	0.3%
27L_DVR	3.6%	4.2%	3.3%	3.7%	1.5%
27L_MID	2.4%	2.9%	1.2%	2.4%	1.0%
27L_SAM	0.8%	0.7%	0.9%	0.8%	0.2%
27L_WOB	2.9%	1.5%	0.4%	2.4%	0.1%
27R_BPK	4.0%	5.2%	2.3%	4.2%	1.3%
27R_CPT	2.8%	1.4%	0.7%	2.4%	0.2%
27R_DVR	4.5%	6.3%	3.7%	4.8%	2.0%
27R_MID	2.9%	4.0%	1.3%	3.0%	0.9%
27R_SAM	1.0%	1.1%	1.1%	1.0%	0.2%
27R_WOB	3.6%	2.3%	0.6%	3.2%	0.3%
09L_ARRIVAL	15.9%	15.8%	14.5%	15.8%	14.0%
09R_ARRIVAL	0.8%	0.8%	8.9%	1.3%	14.1%
27L_ARRIVAL	17.9%	18.1%	25.3%	18.4%	28.8%
27R_ARRIVAL	14.5%	12.1%	24.5%	14.6%	27.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C8-d Heathrow 2011 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.1%	0.0%	0.3%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	0.1%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.0%
09L_DVR	0.0%	0.0%	0.1%	0.0%	0.4%
09L_MID	0.0%	0.0%	0.1%	0.0%	0.2%
09L_SAM	0.0%	0.0%	0.0%	0.0%	0.0%
09R_BPK	3.6%	4.5%	1.3%	3.6%	0.4%
09R_BUZ	2.5%	1.5%	0.5%	2.2%	0.2%
09R_CPT	2.5%	1.0%	0.4%	2.0%	0.0%
09R_DVR	3.1%	4.2%	2.2%	3.3%	0.6%
09R_MID	2.4%	2.9%	1.2%	2.4%	0.2%
09R_SAM	0.8%	0.8%	0.9%	0.8%	0.1%
27L_BPK	3.9%	5.2%	1.8%	4.0%	0.6%
27L_CPT	2.7%	1.2%	0.5%	2.3%	0.1%
27L_DVR	4.4%	5.6%	3.3%	4.6%	1.2%
27L_MID	2.9%	3.6%	1.7%	3.0%	0.5%
27L_SAM	1.0%	1.0%	1.0%	1.0%	0.1%
27L_WOB	3.3%	1.9%	0.6%	2.9%	0.2%
27R_BPK	4.0%	5.4%	2.2%	4.2%	0.6%
27R_CPT	2.7%	1.3%	0.6%	2.3%	0.2%
27R_DVR	4.4%	5.8%	3.5%	4.6%	1.2%
27R_MID	2.9%	3.7%	1.7%	3.0%	0.4%
27R_SAM	1.0%	1.0%	1.2%	1.0%	0.2%
27R_WOB	3.4%	2.0%	0.7%	2.9%	0.2%
09L_ARRIVAL	13.6%	12.6%	11.6%	13.2%	7.9%
09R_ARRIVAL	0.5%	0.6%	9.6%	1.1%	16.0%
27L_ARRIVAL	17.3%	17.5%	26.0%	17.8%	31.2%
27R_ARRIVAL	17.4%	16.9%	27.1%	17.8%	37.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C8-e Heathrow 2012 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.1%	0.0%	0.1%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	0.1%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.0%
09L_DVR	0.0%	0.0%	0.1%	0.0%	0.3%
09L_MID	0.0%	0.0%	0.1%	0.0%	0.2%
09L_SAM	0.0%	0.0%	0.0%	0.0%	0.1%
09R_BPK	3.0%	3.8%	1.4%	3.1%	1.1%
09R_BUZ	1.9%	1.5%	0.5%	1.7%	0.3%
09R_CPT	2.5%	1.0%	0.3%	2.0%	0.2%
09R_DVR	2.8%	3.4%	2.2%	2.9%	0.7%
09R_MID	2.1%	2.3%	1.1%	2.1%	0.5%
09R_SAM	0.6%	0.7%	0.8%	0.7%	0.1%
27L_BPK	3.7%	5.2%	1.8%	3.9%	0.8%
27L_CPT	3.1%	1.4%	0.4%	2.6%	0.2%
27L_DVR	4.5%	5.8%	3.6%	4.7%	1.5%
27L_MID	3.0%	3.5%	1.6%	3.0%	0.8%
27L_SAM	1.0%	1.0%	1.1%	1.0%	0.3%
27L_WOB	3.0%	2.1%	0.6%	2.7%	0.3%
27R_BPK	4.1%	5.6%	2.1%	4.3%	1.0%
27R_CPT	3.4%	1.5%	0.4%	2.9%	0.1%
27R_DVR	5.0%	6.1%	4.1%	5.2%	1.3%
27R_MID	3.3%	3.9%	1.6%	3.3%	0.7%
27R_SAM	1.0%	1.1%	1.2%	1.1%	0.3%
27R_WOB	3.3%	2.4%	0.7%	3.0%	0.2%
09L_ARRIVAL	12.1%	10.9%	10.2%	11.7%	17.3%
09R_ARRIVAL	0.6%	0.6%	8.4%	1.0%	11.3%
27L_ARRIVAL	18.2%	18.8%	27.7%	18.9%	28.4%
27R_ARRIVAL	17.8%	17.4%	27.8%	18.3%	31.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C8-f Heathrow 2013 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.2%	0.7%	0.1%	0.6%
09L_BUZ	0.0%	0.0%	0.1%	0.0%	0.3%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.1%
09L_DVR	0.0%	0.3%	1.5%	0.2%	0.8%
09L_MID	0.0%	0.1%	0.5%	0.0%	0.5%
09L_SAM	0.0%	0.1%	0.2%	0.0%	0.1%
09R_BPK	3.9%	5.4%	1.2%	4.1%	0.3%
09R_BUZ	2.6%	2.1%	0.4%	2.3%	0.1%
09R_CPT	3.2%	1.6%	0.3%	2.7%	0.0%
09R_DVR	3.6%	4.3%	2.2%	3.7%	0.5%
09R_MID	2.7%	3.5%	1.0%	2.8%	0.3%
09R_SAM	0.8%	1.0%	0.9%	0.8%	0.1%
27L_BPK	3.6%	4.4%	1.1%	3.6%	0.5%
27L_CPT	2.8%	1.3%	0.3%	2.3%	0.1%
27L_DVR	4.0%	4.3%	2.5%	4.0%	0.8%
27L_MID	2.6%	2.9%	1.1%	2.6%	0.4%
27L_SAM	0.9%	0.9%	0.9%	0.9%	0.1%
27L_WOB	3.0%	2.0%	0.5%	2.7%	0.2%
27R_BPK	3.7%	4.8%	2.2%	3.9%	1.0%
27R_CPT	2.9%	1.4%	0.4%	2.4%	0.2%
27R_DVR	4.3%	5.0%	5.0%	4.5%	2.0%
27R_MID	2.7%	3.3%	2.0%	2.8%	1.1%
27R_SAM	0.9%	1.1%	1.1%	0.9%	0.3%
27R_WOB	3.2%	2.2%	0.6%	2.8%	0.3%
09L_ARRIVAL	15.3%	16.5%	14.7%	15.5%	14.5%
09R_ARRIVAL	0.7%	0.7%	7.6%	1.1%	6.1%
27L_ARRIVAL	16.7%	15.3%	23.5%	16.8%	23.9%
27R_ARRIVAL	15.9%	15.3%	27.3%	16.5%	44.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C8-g Heathrow 2014 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.1%	0.0%	0.1%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	0.0%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.0%
09L_DVR	0.0%	0.1%	0.1%	0.0%	0.1%
09L_MID	0.0%	0.0%	0.1%	0.0%	0.1%
09L_SAM	0.0%	0.0%	0.0%	0.0%	0.1%
09R_BPK	3.5%	4.6%	1.4%	3.6%	0.4%
09R_BUZ	2.6%	1.9%	0.5%	2.3%	0.2%
09R_CPT	2.9%	1.3%	0.2%	2.4%	0.2%
09R_DVR	3.5%	4.3%	2.9%	3.6%	1.1%
09R_MID	2.3%	2.7%	1.4%	2.3%	0.4%
09R_SAM	0.8%	1.1%	1.0%	0.8%	0.2%
27L_BPK	3.7%	5.0%	1.8%	3.9%	0.7%
27L_CPT	2.7%	1.5%	0.3%	2.3%	0.2%
27L_DVR	4.2%	5.2%	3.9%	4.4%	1.7%
27L_MID	2.6%	3.1%	2.0%	2.7%	1.1%
27L_SAM	0.9%	1.2%	1.1%	1.0%	0.3%
27L_WOB	3.2%	2.2%	0.5%	2.9%	0.3%
27R_BPK	3.8%	5.2%	1.7%	4.0%	0.3%
27R_CPT	2.9%	1.5%	0.3%	2.4%	0.1%
27R_DVR	4.4%	5.4%	3.0%	4.5%	1.0%
27R_MID	2.7%	3.3%	1.5%	2.8%	0.4%
27R_SAM	0.9%	1.2%	1.0%	1.0%	0.2%
27R_WOB	3.4%	2.3%	0.5%	3.0%	0.2%
09L_ARRIVAL	14.3%	13.3%	11.9%	14.0%	11.2%
09R_ARRIVAL	0.6%	0.8%	11.6%	1.3%	19.0%
27L_ARRIVAL	17.2%	17.0%	27.5%	17.8%	38.6%
27R_ARRIVAL	16.8%	15.9%	23.6%	17.0%	21.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C8-h Heathrow 2015 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.3%	0.0%	0.2%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	0.0%
09L_CPT	0.0%	0.0%	0.1%	0.0%	0.1%
09L_DET	0.0%	0.1%	0.3%	0.0%	0.2%
09L_MID	0.0%	0.0%	0.1%	0.0%	0.1%
09L_SAM (GAS)	0.0%	0.0%	0.1%	0.0%	0.1%
09R_BPK	2.9%	3.6%	1.3%	3.0%	0.3%
09R_BUZ	2.1%	1.5%	0.3%	1.9%	0.1%
09R_CPT	3.0%	1.2%	0.2%	2.4%	0.0%
09R_DET	3.7%	4.8%	2.1%	3.8%	0.4%
09R_MID	2.1%	2.5%	1.0%	2.1%	0.1%
09R_SAM (GAS)	0.7%	0.8%	0.8%	0.8%	0.1%
27L_BPK	3.8%	4.9%	1.9%	3.9%	0.6%
27L_CPT	3.3%	1.4%	0.3%	2.7%	0.2%
27L_DET	4.6%	6.0%	3.2%	4.8%	1.2%
27L_MID	2.7%	3.2%	1.6%	2.8%	0.5%
27L_SAM (GOG)	0.9%	1.1%	1.0%	0.9%	0.2%
27L_WOB	3.1%	2.0%	0.5%	2.7%	0.2%
27R_BPK	3.7%	5.1%	2.1%	3.9%	0.6%
27R_CPT	3.3%	1.5%	0.3%	2.7%	0.1%
27R_DET	4.6%	6.1%	3.2%	4.9%	0.8%
27R_MID	2.8%	3.4%	1.6%	2.8%	0.4%
27R_SAM (GOG)	0.9%	1.1%	0.9%	1.0%	0.1%
27R_WOB	3.1%	2.1%	0.5%	2.8%	0.1%
09L_ARRIVAL	13.2%	12.5%	12.4%	13.0%	15.9%
09R_ARRIVAL	0.5%	0.5%	8.5%	1.0%	10.6%
27L_ARRIVAL	17.5%	17.5%	28.3%	18.1%	35.3%
27R_ARRIVAL	17.5%	16.9%	27.0%	17.9%	31.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Note: the SAM routes were renamed GOG (27L/27R) and GAS (09L/09R) in 2015, but the SAM name has been retained in this table for ease of comparison with the earlier tables.

Table C8-i Heathrow 2016 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.1%	0.0%	0.1%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	0.0%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.0%
09L_DET	0.0%	0.0%	0.1%	0.0%	0.3%
09L_MID	0.0%	0.0%	0.0%	0.0%	0.1%
09L_SAM (GAS)	0.0%	0.0%	0.0%	0.0%	0.1%
09R_BPK	3.3%	3.9%	1.6%	3.3%	0.3%
09R_BUZ	2.2%	1.3%	0.5%	1.9%	0.1%
09R_CPT	3.1%	1.1%	0.4%	2.5%	0.0%
09R_DET	3.7%	5.2%	2.5%	4.0%	0.3%
09R_MID	2.3%	2.6%	1.3%	2.3%	0.3%
09R_SAM (GAS)	0.7%	0.9%	0.9%	0.8%	0.0%
27L_BPK	4.0%	4.9%	2.6%	4.1%	1.2%
27L_CPT	3.4%	1.4%	0.5%	2.8%	0.3%
27L_DET	4.2%	6.1%	3.6%	4.5%	2.3%
27L_MID	2.9%	3.4%	1.0%	2.9%	0.9%
27L_SAM (GOG)	0.9%	1.1%	1.9%	1.0%	0.3%
27L_WOB	2.8%	1.6%	0.5%	2.4%	0.4%
27R_BPK	3.9%	5.1%	2.2%	4.0%	0.6%
27R_CPT	3.4%	1.4%	0.3%	2.8%	0.0%
27R_DET	4.2%	6.5%	3.0%	4.6%	1.2%
27R_MID	0.9%	3.5%	0.9%	1.4%	0.5%
27R_SAM (GOG)	2.7%	1.2%	1.6%	2.3%	0.2%
27R_WOB	2.8%	1.7%	0.4%	2.4%	0.2%
09L_ARRIVAL	14.1%	12.8%	13.5%	13.8%	14.0%
09R_ARRIVAL	0.5%	0.4%	9.5%	1.1%	13.8%
27L_ARRIVAL	17.0%	17.1%	25.9%	17.6%	32.0%
27R_ARRIVAL	17.2%	16.7%	25.2%	17.6%	30.5%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Note: the SAM routes were renamed GOG (27L/27R) and GAS (09L/09R) in 2015, but the SAM name has been retained in this table for ease of comparison with the earlier tables.

Table C8-j Heathrow 2017 route distributions (percentage of daily total)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.1%	0.0%	0.2%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	0.0%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.0%
09L_DET	0.0%	0.0%	0.1%	0.0%	0.1%
09L_MID	0.0%	0.0%	0.0%	0.0%	0.1%
09L_SAM (GAS)	0.0%	0.0%	0.0%	0.0%	0.1%
09R_BPK	2.3%	2.6%	1.1%	2.3%	0.5%
09R_BUZ	1.6%	0.9%	0.3%	1.4%	0.2%
09R_CPT	1.8%	0.7%	0.3%	1.5%	0.3%
09R_DET	2.2%	3.4%	1.5%	2.4%	1.3%
09R_MID	1.5%	1.7%	1.0%	1.5%	0.6%
09R_SAM (GAS)	0.5%	0.7%	0.6%	0.5%	0.2%
27L_BPK	4.6%	5.8%	2.6%	4.7%	0.7%
27L_CPT	3.5%	1.5%	0.5%	2.9%	0.1%
27L_DET	4.6%	7.3%	3.2%	5.0%	0.8%
27L_MID	3.2%	3.6%	2.2%	3.2%	0.5%
27L_SAM (GOG)	1.1%	1.6%	1.2%	1.2%	0.2%
27L_WOB	3.6%	2.0%	0.5%	3.1%	0.2%
27R_BPK	4.6%	5.6%	2.5%	4.7%	0.7%
27R_CPT	3.6%	1.5%	0.5%	3.0%	0.0%
27R_DET	4.6%	7.3%	3.1%	5.0%	0.9%
27R_MID	3.2%	1.6%	2.1%	2.8%	0.3%
27R_SAM (GOG)	1.1%	3.5%	1.1%	1.6%	0.1%
27R_WOB	3.5%	2.0%	0.5%	3.0%	0.1%
09L_ARRIVAL	9.2%	8.4%	8.7%	9.0%	10.7%
09R_ARRIVAL	0.4%	0.3%	6.1%	0.7%	11.0%
27L_ARRIVAL	19.7%	19.0%	30.4%	20.2%	33.4%
27R_ARRIVAL	19.7%	19.0%	29.6%	20.2%	36.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Note: the SAM routes were renamed GOG (27L/27R) and GAS (09L/09R) in 2015, but the SAM name has been retained in this table for ease of comparison with the earlier tables.

Pie charts based on Tables C8-a to C8-j for arrival movements:

Pie charts based on Tables C8-a to C8-j for Runway 09L/R departure movements:

Pie charts based on Tables C8-a to C8-j for Runway 27L/R departure movements:

Table C9-a Heathrow 2006 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	0.1%	0.0%	0.0%
09L_BUZ	0.0%	0.0%	0.1%	0.0%	0.0%
09L_CPT	0.0%	0.0%	0.0%	0.0%	0.0%
09L_DVR	0.0%	0.0%	0.0%	0.0%	0.0%
09L_MID	0.0%	0.0%	0.0%	0.0%	0.0%
09L_SAM	0.0%	0.0%	0.0%	0.0%	0.0%
09R_BPK	21.2%	25.5%	21.0%	22.2%	25.5%
09R_BUZ	21.6%	14.4%	9.2%	19.6%	8.5%
09R_CPT	12.3%	7.8%	3.9%	11.0%	6.5%
09R_DVR	23.3%	28.4%	37.0%	24.9%	40.7%
09R_MID	15.8%	19.8%	23.5%	17.0%	13.9%
09R_SAM	5.7%	4.0%	5.1%	5.3%	4.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_BPK	12.6%	14.2%	13.8%	13.0%	18.2%
27L_CPT	6.5%	4.2%	2.3%	5.8%	4.0%
27L_DVR	14.1%	18.5%	22.5%	15.4%	29.6%
27L_MID	9.0%	10.9%	13.5%	9.5%	7.4%
27L_SAM	3.8%	3.3%	3.6%	3.7%	5.1%
27L_WOB	12.7%	8.4%	6.3%	11.5%	5.9%
27R_BPK	9.0%	10.6%	7.9%	9.3%	8.0%
27R_CPT	4.2%	2.9%	1.6%	3.8%	1.9%
27R_DVR	9.7%	11.6%	13.7%	10.3%	11.0%
27R_MID	6.2%	7.6%	8.2%	6.6%	3.1%
27R_SAM	2.6%	1.8%	2.2%	2.4%	1.9%
27R_WOB	9.5%	6.0%	4.6%	8.6%	3.9%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	98.2%	96.5%	55.4%	94.3%	38.4%
09R_ARRIVAL	1.8%	3.5%	44.6%	5.7%	61.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	41.1%	41.6%	51.2%	42.0%	55.6%
27R_ARRIVAL	58.9%	58.4%	48.8%	58.0%	44.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C9-b Heathrow 2009 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.1%	1.9%	0.1%	1.9%
09L_BUZ	0.0%	0.0%	0.9%	0.0%	0.9%
09L_CPT	0.0%	0.0%	2.4%	0.0%	2.4%
09L_DVR	0.0%	0.2%	2.0%	0.1%	2.0%
09L_MID	0.0%	0.1%	1.6%	0.0%	1.6%
09L_SAM	0.0%	0.0%	0.3%	0.0%	0.3%
09R_BPK	22.4%	26.8%	20.9%	23.4%	20.9%
09R_BUZ	18.6%	11.6%	9.3%	17.0%	9.3%
09R_CPT	16.5%	8.0%	8.4%	14.5%	8.4%
09R_DVR	21.5%	28.9%	33.2%	23.2%	33.2%
09R_MID	16.0%	19.7%	17.1%	16.8%	17.1%
09R_SAM	4.9%	4.6%	2.0%	4.8%	2.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_BPK	10.1%	13.1%	5.8%	10.7%	5.8%
27L_CPT	6.6%	3.7%	1.7%	5.9%	1.7%
27L_DVR	11.7%	15.7%	10.6%	12.6%	10.6%
27L_MID	7.8%	10.0%	5.9%	8.3%	5.9%
27L_SAM	2.5%	2.4%	0.7%	2.5%	0.7%
27L_WOB	10.2%	6.1%	1.9%	9.2%	1.9%
27R_BPK	10.7%	12.7%	14.6%	11.1%	14.6%
27R_CPT	6.8%	3.6%	6.1%	6.1%	6.1%
27R_DVR	12.2%	15.2%	26.3%	12.9%	26.3%
27R_MID	8.1%	9.7%	14.0%	8.5%	14.0%
27R_SAM	2.7%	2.3%	4.1%	2.6%	4.1%
27R_WOB	10.8%	5.6%	8.4%	9.6%	8.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	96.8%	96.7%	62.8%	93.8%	62.6%
09R_ARRIVAL	3.2%	3.3%	37.2%	6.2%	37.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	51.0%	48.1%	48.1%	50.2%	45.2%
27R_ARRIVAL	49.0%	51.9%	51.9%	49.8%	54.8%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C9-c Heathrow 2010 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.2%	0.2%	2.2%	0.3%	9.1%
09L_BUZ	0.2%	0.0%	0.5%	0.2%	0.7%
09L_CPT	0.2%	0.1%	0.3%	0.1%	1.6%
09L_DVR	0.2%	0.1%	2.4%	0.3%	10.8%
09L_MID	0.1%	0.1%	1.2%	0.2%	4.9%
09L_SAM	0.0%	0.0%	0.5%	0.1%	1.5%
09R_BPK	22.2%	26.5%	21.4%	23.1%	17.7%
09R_BUZ	17.0%	11.2%	6.0%	15.4%	4.3%
09R_CPT	16.5%	7.1%	5.5%	14.1%	5.1%
09R_DVR	21.5%	29.3%	34.8%	23.7%	26.5%
09R_MID	16.4%	20.2%	14.9%	17.2%	15.5%
09R_SAM	5.3%	5.2%	10.2%	5.5%	2.3%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_BPK	9.0%	10.4%	11.1%	9.4%	12.8%
27L_CPT	6.6%	2.9%	3.2%	5.7%	3.2%
27L_DVR	10.6%	12.4%	18.1%	11.3%	16.2%
27L_MID	7.1%	8.4%	6.7%	7.4%	10.5%
27L_SAM	2.3%	2.1%	5.2%	2.4%	2.9%
27L_WOB	8.5%	4.4%	2.4%	7.3%	1.0%
27R_BPK	12.0%	15.3%	12.7%	12.7%	14.7%
27R_CPT	8.4%	4.0%	4.0%	7.3%	2.3%
27R_DVR	13.4%	18.4%	20.4%	14.7%	21.6%
27R_MID	8.4%	11.8%	7.1%	9.1%	9.1%
27R_SAM	2.9%	3.1%	6.0%	3.0%	2.6%
27R_WOB	10.8%	6.7%	3.1%	9.6%	3.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	95.4%	95.0%	61.9%	92.4%	50.0%
09R_ARRIVAL	4.6%	5.0%	38.1%	7.6%	50.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	55.4%	60.0%	50.8%	55.9%	51.6%
27R_ARRIVAL	44.6%	40.0%	49.2%	44.1%	48.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C9-d Heathrow 2011 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	1.4%	0.0%	11.6%
09L_BUZ	0.0%	0.0%	0.3%	0.0%	3.5%
09L_CPT	0.0%	0.0%	0.2%	0.0%	0.6%
09L_DVR	0.0%	0.0%	2.1%	0.1%	17.1%
09L_MID	0.0%	0.0%	1.0%	0.0%	8.6%
09L_SAM	0.0%	0.0%	0.2%	0.0%	1.4%
09R_BPK	24.1%	30.3%	19.9%	25.4%	15.2%
09R_BUZ	17.0%	10.2%	7.1%	15.2%	7.0%
09R_CPT	16.8%	6.6%	5.1%	14.2%	1.6%
09R_DVR	20.8%	28.0%	33.6%	22.8%	22.0%
09R_MID	16.1%	19.5%	17.3%	16.9%	8.5%
09R_SAM	5.2%	5.5%	11.9%	5.4%	3.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_BPK	10.6%	13.9%	9.7%	11.3%	11.9%
27L_CPT	7.5%	3.1%	2.9%	6.4%	1.6%
27L_DVR	12.0%	14.9%	17.3%	12.8%	22.0%
27L_MID	8.0%	9.6%	8.9%	8.4%	8.8%
27L_SAM	2.7%	2.7%	5.2%	2.7%	1.3%
27L_WOB	9.2%	5.1%	3.4%	8.1%	3.6%
27R_BPK	10.8%	14.2%	11.8%	11.6%	12.1%
27R_CPT	7.4%	3.4%	3.5%	6.4%	3.2%
27R_DVR	11.9%	15.4%	18.5%	12.9%	22.2%
27R_MID	8.0%	9.8%	8.8%	8.5%	6.9%
27R_SAM	2.6%	2.8%	6.2%	2.8%	2.9%
27R_WOB	9.3%	5.2%	3.7%	8.2%	3.5%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	96.1%	95.8%	54.4%	92.4%	33.0%
09R_ARRIVAL	3.9%	4.2%	45.6%	7.6%	67.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	49.9%	50.9%	48.9%	50.0%	54.2%
27R_ARRIVAL	50.1%	49.1%	51.1%	50.0%	45.8%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C9-e Heathrow 2012 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09LBPK	0.0%	0.0%	1.3%	0.07%	3.2%
09LBUZ	0.0%	0.0%	0.3%	0.01%	2.6%
09LCPT	0.0%	0.0%	0.2%	0.01%	1.0%
09LDVR	0.0%	0.0%	1.9%	0.09%	7.4%
09LMID	0.0%	0.0%	0.9%	0.04%	4.4%
09LSAM	0.0%	0.0%	0.4%	0.02%	2.6%
09RBPK	23.3%	30.0%	22.2%	24.74%	29.2%
09RBUZ	14.6%	11.6%	6.7%	13.67%	7.7%
09RCPT	19.3%	7.6%	3.9%	16.21%	5.0%
09RDVR	21.6%	26.8%	33.6%	23.13%	19.7%
09RMID	16.2%	18.6%	16.4%	16.70%	15.5%
09RSAM	5.0%	5.4%	12.1%	5.30%	1.8%
Total	**100%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27LBPK	9.7%	13.1%	9.2%	10.5%	10.9%
27LCPT	8.1%	3.6%	2.1%	6.9%	2.9%
27LDVR	11.7%	14.5%	18.3%	12.5%	19.4%
27LMID	7.7%	8.8%	8.2%	8.0%	9.7%
27LSAM	2.5%	2.6%	5.8%	2.6%	4.1%
27LWOB	7.9%	5.4%	3.4%	7.2%	4.8%
27RBPK	10.6%	14.1%	11.0%	11.4%	13.6%
27RCPT	9.1%	3.8%	2.4%	7.8%	1.9%
27RDVR	12.9%	15.4%	21.4%	13.7%	17.1%
27RMID	8.4%	9.7%	8.6%	8.7%	9.4%
27RSAM	2.6%	2.8%	6.1%	2.8%	4.0%
27RWOB	8.7%	6.0%	3.7%	8.0%	2.3%
Total	**100%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	95.6%	94.5%	55.0%	91.9%	60.5%
09R_ARRIVAL	4.4%	5.5%	45.0%	8.1%	39.5%
Total	**100%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	50.6%	51.9%	49.9%	50.8%	47.3%
27R_ARRIVAL	49.4%	48.1%	50.1%	49.2%	52.7%
Total	**100%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C9-f Heathrow 2013 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.1%	1.0%	7.8%	0.6%	17.5%
09L_BUZ	0.2%	0.1%	1.0%	0.2%	6.4%
09L_CPT	0.0%	0.2%	0.5%	0.1%	2.3%
09L_DVR	0.0%	1.6%	15.2%	0.9%	21.4%
09L_MID	0.0%	0.4%	5.4%	0.3%	16.8%
09L_SAM	0.0%	0.4%	2.2%	0.2%	3.4%
09R_BPK	23.2%	28.6%	13.3%	24.0%	7.3%
09R_BUZ	15.2%	11.6%	4.5%	14.0%	1.7%
09R_CPT	19.1%	8.6%	3.3%	16.3%	1.2%
09R_DVR	21.3%	23.5%	25.5%	21.9%	11.4%
09R_MID	16.1%	18.8%	10.9%	16.5%	7.1%
09R_SAM	4.8%	5.3%	10.4%	5.1%	3.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_BPK	10.4%	13.1%	6.8%	10.8%	7.7%
27L_CPT	8.0%	3.9%	1.6%	6.9%	1.0%
27L_DVR	11.6%	12.8%	13.1%	11.9%	12.1%
27L_MID	7.5%	8.7%	7.3%	7.7%	5.8%
27L_SAM	2.5%	2.7%	3.3%	2.6%	1.9%
27L_WOB	8.8%	6.0%	3.5%	8.0%	3.4%
27R_BPK	10.8%	14.3%	12.3%	11.6%	12.9%
27R_CPT	8.4%	4.2%	2.4%	7.3%	3.2%
27R_DVR	12.6%	14.8%	28.5%	13.6%	12.8%
27R_MID	7.8%	9.8%	11.5%	8.4%	34.9%
27R_SAM	2.5%	3.1%	6.3%	2.7%	4.4%
27R_WOB	9.2%	6.6%	3.3%	8.4%	0.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	95.4%	95.6%	65.6%	92.8%	69.9%
09R_ARRIVAL	4.6%	4.4%	34.4%	7.2%	30.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	51.2%	50.0%	46.2%	50.5%	34.5%
27R_ARRIVAL	48.8%	50.0%	53.8%	49.5%	65.5%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C9-g Heathrow 2014 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.1%	0.4%	1.1%	0.2%	1.0%
09L_BUZ	0.1%	0.1%	0.1%	0.1%	0.0%
09L_CPT	0.0%	0.1%	0.1%	0.0%	0.0%
09L_DVR	0.0%	0.6%	1.6%	0.2%	2.7%
09L_MID	0.0%	0.1%	1.0%	0.1%	5.2%
09L_SAM	0.0%	0.1%	0.3%	0.0%	1.7%
09R_BPK	22.4%	28.4%	18.8%	23.6%	15.9%
09R_BUZ	16.5%	11.7%	5.5%	15.1%	6.8%
09R_CPT	18.6%	8.1%	3.0%	15.8%	5.9%
09R_DVR	22.6%	26.8%	37.6%	24.0%	39.4%
09R_MID	14.7%	16.7%	17.7%	15.3%	13.1%
09R_SAM	5.0%	6.8%	13.2%	5.6%	8.3%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_BPK	10.5%	13.6%	10.2%	11.1%	10.5%
27L_CPT	7.7%	3.9%	1.5%	6.7%	3.8%
27L_DVR	11.8%	14.0%	22.2%	12.6%	27.6%
27L_MID	7.5%	8.3%	11.2%	7.8%	15.9%
27L_SAM	2.7%	3.2%	6.4%	2.9%	5.0%
27L_WOB	9.1%	6.0%	3.0%	8.3%	4.5%
27R_BPK	10.7%	14.1%	9.4%	11.4%	4.2%
27R_CPT	8.1%	4.1%	1.6%	7.0%	1.7%
27R_DVR	12.3%	14.5%	17.2%	12.9%	15.4%
27R_MID	7.6%	8.9%	8.7%	7.9%	5.8%
27R_SAM	2.5%	3.3%	5.7%	2.7%	2.9%
27R_WOB	9.6%	6.2%	2.8%	8.6%	2.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	96.1%	94.0%	50.8%	91.7%	37.0%
09R_ARRIVAL	3.9%	6.0%	49.2%	8.3%	63.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	50.6%	51.7%	53.9%	51.1%	63.8%
27R_ARRIVAL	49.4%	48.3%	46.1%	48.9%	36.2%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C9-h Heathrow 2015 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.2%	4.5%	0.2%	11.0%
09L_BUZ	0.0%	0.0%	0.3%	0.0%	1.0%
09L_CPT	0.0%	0.0%	0.8%	0.0%	4.0%
09L_DET	0.0%	0.4%	5.0%	0.2%	11.0%
09L_MID	0.0%	0.1%	1.9%	0.1%	6.0%
09L_SAM/GAS	0.0%	0.0%	0.9%	0.0%	7.0%
09R_BPK	20.0%	25.0%	20.4%	21.1%	16.3%
09R_BUZ	14.6%	10.4%	4.4%	13.4%	4.1%
09R_CPT	20.6%	8.2%	2.8%	17.4%	2.0%
09R_DET	25.5%	33.0%	32.7%	27.3%	26.5%
09R_MID	14.3%	16.7%	14.4%	14.8%	8.1%
09R_SAM/GAS	5.0%	5.7%	11.9%	5.4%	3.1%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_BPK	10.3%	12.9%	10.9%	10.9%	12.8%
27L_CPT	8.9%	3.7%	1.8%	7.6%	3.6%
27L_DET	12.5%	15.8%	18.7%	13.4%	22.8%
27L_MID	7.4%	8.5%	9.5%	7.7%	10.0%
27L_SAM/GOG	2.5%	2.8%	5.7%	2.6%	5.2%
27L_WOB	8.4%	5.3%	2.9%	7.6%	4.8%
27R_BPK	10.1%	13.5%	12.2%	10.9%	11.3%
27R_CPT	8.9%	4.0%	1.9%	7.6%	1.4%
27R_DET	12.6%	16.1%	18.7%	13.5%	15.8%
27R_MID	7.5%	9.0%	9.5%	7.9%	7.7%
27R_SAM/GOG	2.5%	2.9%	5.5%	2.7%	2.1%
27R_WOB	8.5%	5.6%	2.8%	7.7%	2.5%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	96.1%	96.1%	59.3%	92.8%	60.4%
09R_ARRIVAL	3.9%	3.9%	40.7%	7.2%	39.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	50.0%	51.0%	51.2%	50.3%	52.7%
27R_ARRIVAL	50.0%	49.0%	48.8%	49.7%	47.3%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C9-i Heathrow 2016 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.0%	1.0%	0.0%	8.2%
09L_BUZ	0.0%	0.0%	0.0%	0.0%	1.9%
09L_CPT	0.0%	0.0%	0.2%	0.0%	0.0%
09L_DET	0.0%	0.0%	1.4%	0.0%	16.7%
09L_MID	0.0%	0.0%	0.6%	0.0%	5.8%
09L_SAM (GAS)	0.0%	0.0%	0.4%	0.0%	3.0%
09R_BPK	21.6%	26.1%	22.5%	22.6%	19.6%
09R_BUZ	14.1%	8.6%	5.7%	12.6%	7.1%
09R_CPT	20.4%	7.4%	5.2%	17.0%	3.0%
09R_DET	24.3%	34.6%	34.9%	26.9%	18.9%
09R_MID	14.9%	17.2%	16.9%	15.4%	13.5%
09R_SAM (GAS)	4.8%	6.1%	11.2%	5.3%	2.2%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_BPK	11.1%	13.0%	13.6%	11.6%	14.4%
27L_CPT	9.4%	3.7%	2.8%	7.9%	3.0%
27L_DET	11.6%	16.2%	19.2%	12.9%	28.9%
27L_MID	8.0%	8.8%	10.1%	8.3%	10.9%
27L_SAM (GOG)	2.5%	3.0%	5.7%	2.7%	3.9%
27L_WOB	7.8%	4.3%	3.0%	6.9%	4.7%
27R_BPK	10.8%	13.3%	11.8%	11.4%	6.8%
27R_CPT	9.4%	3.7%	1.8%	7.9%	0.5%
27R_DET	11.6%	17.1%	16.0%	12.9%	14.6%
27R_MID	7.6%	9.2%	8.7%	8.0%	6.8%
27R_SAM (GOG)	2.5%	3.1%	5.0%	2.7%	2.9%
27R_WOB	7.7%	4.5%	2.4%	6.8%	2.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	96.3%	96.6%	59.0%	93.0%	50.4%
09R_ARRIVAL	3.7%	3.4%	41.0%	7.0%	49.6%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	49.7%	50.6%	50.7%	49.9%	51.2%
27R_ARRIVAL	50.3%	49.4%	49.3%	50.1%	48.8%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C9-j Heathrow 2017 route distributions (single mode operations)

Route	L_{day}	$L_{evening}$	L_{night}	L_{den}	$L_{eq,6.5hr\ night}$
09L_BPK	0.0%	0.1%	2.2%	0.1%	5.2%
09L_BUZ	0.0%	0.0%	0.1%	0.0%	0.5%
09L_CPT	0.0%	0.0%	0.1%	0.0%	0.5%
09L_DET	0.0%	0.0%	2.0%	0.1%	3.8%
09L_MID	0.0%	0.0%	0.7%	0.0%	1.4%
09L_SAM (GAS)	0.0%	0.0%	0.5%	0.0%	1.9%
09R_BPK	22.5%	26.2%	21.9%	23.3%	14.6%
09R_BUZ	16.7%	8.9%	6.0%	14.6%	4.7%
09R_CPT	18.6%	7.1%	5.0%	15.7%	8.0%
09R_DET	22.2%	34.3%	29.4%	25.1%	35.7%
09R_MID	15.3%	16.6%	19.8%	15.7%	6.6%
09R_SAM (GAS)	4.7%	6.9%	12.3%	5.4%	17.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_BPK	11.2%	13.4%	12.7%	11.8%	15.2%
27L_CPT	8.6%	3.5%	2.7%	7.3%	1.1%
27L_DET	11.1%	16.8%	16.1%	12.5%	17.4%
27L_MID	7.8%	8.3%	10.9%	8.0%	4.8%
27L_SAM (GOG)	2.6%	3.7%	5.8%	2.9%	11.1%
27L_WOB	8.8%	4.6%	2.8%	7.7%	3.7%
27R_BPK	11.2%	12.9%	12.5%	11.6%	14.4%
27R_CPT	8.8%	3.4%	2.6%	7.4%	0.4%
27R_DET	11.1%	16.9%	15.2%	12.5%	19.6%
27R_MID	7.8%	8.2%	10.3%	8.0%	1.9%
27R_SAM (GOG)	2.6%	3.7%	5.5%	2.9%	7.4%
27R_WOB	8.6%	4.6%	2.7%	7.5%	3.0%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
09L_ARRIVAL	96.1%	96.0%	59.0%	92.8%	49.3%
09R_ARRIVAL	3.9%	4.0%	41.0%	7.2%	50.7%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
27L_ARRIVAL	49.9%	50.0%	50.7%	50.0%	47.6%
27R_ARRIVAL	50.1%	50.0%	49.3%	50.0%	52.4%
Total	**100.0%**	**100.0%**	**100.0%**	**100.0%**	**100.0%**

Table C10-a Heathrow L_{day} W-E departure and arrival runway modal splits by year

Year	West departures	East departures	Total	West arrivals	East arrivals	Total
2006	70%	30%	100%	70%	30%	100%
2009	74%	26%	100%	73%	27%	100%
2010	66%	34%	100%	66%	34%	100%
2011	71%	29%	100%	71%	29%	100%
2012	74%	26%	100%	74%	26%	100%
2013	67%	33%	100%	67%	33%	100%
2014	69%	31%	100%	70%	30%	100%
2015	72%	28%	100%	72%	28%	100%
2016	70%	30%	100%	70%	30%	100%
2017	81%	19%	100%	81%	19%	100%

Table C10-b Heathrow $L_{evening}$ W-E departure and arrival runway modal splits by year

Year	West departures	East departures	Total	West arrivals	East arrivals	Total
2006	71%	29%	100%	72%	28%	100%
2009	72%	28%	100%	73%	27%	100%
2010	64%	36%	100%	64%	36%	100%
2011	72%	28%	100%	72%	28%	100%
2012	76%	24%	100%	76%	24%	100%
2013	64%	36%	100%	64%	36%	100%
2014	70%	30%	100%	70%	30%	100%
2015	72%	28%	100%	73%	27%	100%
2016	72%	28%	100%	72%	28%	100%
2017	81%	19%	100%	81%	19%	100%

Table C10-c Heathrow L_{night} W-E departure and arrival runway modal splits by year

Year	West departures	East departures	Total	West arrivals	East arrivals	Total
2006	74%	26%	100%	71%	29%	100%
2009	72%	28%	100%	74%	26%	100%
2010	67%	33%	100%	68%	32%	100%
2011	73%	27%	100%	71%	29%	100%
2012	75%	25%	100%	75%	25%	100%
2013	66%	34%	100%	69%	31%	100%
2014	69%	31%	100%	69%	31%	100%
2015	72%	28%	100%	73%	27%	100%
2016	72%	28%	100%	69%	31%	100%
2017	80%	20%	100%	80%	20%	100%

Table C10-d Heathrow L_{den} W-E departure and arrival runway modal splits by year

Year	West departures	East departures	Total	West arrivals	East arrivals	Total
2006	70%	30%	100%	71%	29%	100%
2009	73%	27%	100%	73%	27%	100%
2010	66%	34%	100%	66%	34%	100%
2011	71%	29%	100%	71%	29%	100%
2012	75%	25%	100%	74%	26%	100%
2013	66%	34%	100%	67%	33%	100%
2014	70%	30%	100%	70%	30%	100%
2015	72%	28%	100%	72%	28%	100%
2016	71%	29%	100%	70%	30%	100%
2017	81%	19%	100%	81%	19%	100%

Table C10-e Heathrow $L_{eq,6.5hr\ night}$ W-E departure and arrival runway modal splits by year

Year	West departures	East departures	Total	West arrivals	East arrivals	Total
2006	77%	23%	100%	72%	28%	100%
2009	62%	38%	100%	75%	25%	100%
2010	57%	43%	100%	67%	33%	100%
2011	67%	33%	100%	74%	26%	100%
2012	67%	33%	100%	68%	32%	100%
2013	65%	35%	100%	77%	23%	100%
2014	70%	30%	100%	67%	33%	100%
2015	74%	26%	100%	72%	28%	100%
2016	83%	17%	100%	69%	31%	100%
2017	56%	44%	100%	76%	24%	100%

Table C11 Heathrow 2006 & 2017 L_{day} cumulative contour area, population and household estimates

L_{day} (dBA)	2006 area	2017 area	Change in area	2006 pop	2017 pop	Change in pop	2006 house	2017 house	Change in house
> 55	177.7	139.3	-22%	485.6	410.4 (354.2)	-15% (-29%)	210.5	164.7 (148.8)	-22% (-29%)
> 60	64.0	53.2	-17%	111.0	116.8 (88.0)	+5% (-21%)	44.9	42.5 (35.1)	-5% (-22%)
> 65	27.2	21.6	-21%	24.1	20.1 (16.3)	-17% (-32%)	9.2	6.9 (6.2)	-25% (-33%)
> 70	9.3	6.9	-26%	2.8	2.0 (1.5)	-29% (-46%)	1.0	0.7 (0.6)	-30% (-40%)
> 75	3.5	2.6	-26%	< 0.1	< 0.1 (0.0)	(n/a) (n/a)	< 0.1	< 0.1 (0.0)	(n/a) (n/a)

Table C12 Heathrow 2006 & 2017 $L_{evening}$ cumulative contour area, population and household estimates

$L_{evening}$ (dBA)	2006 area	2017 area	Change in area	2006 pop	2017 pop	Change in pop	2006 house	2017 house	Change in house
> 55	185.6	121.3	-35%	450.5	307.5 (251.3)	-32% (-44%)	192.6	119.3 (105.7)	-38% (-45%)
> 60	66.1	45.6	-31%	106.3	84.2 (64.5)	-21% (-39%)	42.4	30.1 (25.5)	-29% (-40%)
> 65	28.1	19.0	-32%	20.5	10.9 (9.0)	-47% (-56%)	7.9	3.9 (3.5)	-51% (-56%)
> 70	10.0	6.1	-39%	2.4	0.7 (0.4)	-71% (-83%)	1.0	0.3 (0.2)	-70% (-80%)
> 75	3.8	2.4	-37%	< 0.1	0.0 (0.0)	(n/a) (n/a)	< 0.1	0.0 (0.0)	(n/a) (n/a)

Notes:

- Areas are given in km^2, and populations and households in thousands.
- The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census.
- The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.
- Estimates for 2017 using the 2006 population database are shown in blue.

Table C13 Heathrow 2006 & 2017 L_{night} cumulative contour area, population and household estimates

L_{night} (dBA)	2006 area	2017 area	Change in area	2006 pop	2017 pop	Change in pop	2006 house	2017 house	Change in house
> 50	84.4	69.9	-17%	207.2	224.6 (183.2)	+8% (-12%)	88.9	87.7 (78.0)	-1% (-12%)
> 55	34.2	25.0	-27%	62.0	72.3 (54.0)	+17% (-13%)	24.1	25.6 (21.0)	+6% (-13%)
> 60	11.9	8.1	-32%	16.3	14.5 (11.5)	-11% (-29%)	6.0	4.7 (4.1)	-22% (-32%)
> 65	4.5	2.9	-36%	1.7	1.3 (1.1)	-24% (-35%)	0.6	0.4 (0.4)	-33% (-33%)
> 70	1.8	1.1	-39%	< 0.1	0.0 (0.0)	(n/a) (n/a)	< 0.1	0.0 (0.0)	(n/a) (n/a)

Table C14 Heathrow 2006 & 2017 L_{den} cumulative contour area, population and household estimates

L_{den} (dBA)	2006 area	2017 area	Change in area	2006 pop	2017 pop	Change in pop	2006 house	2017 house	Change in house
> 55	244.7	182.3	-26%	756.1	699.6 (603.0)	-7% (-20%)	338.5	293.5 (271.1)	-13% (-20%)
> 60	92.7	71.8	-23%	194.6	189.6 (149.3)	-3% (-23%)	81.6	72.8 (62.6)	-11% (-23%)
> 65	37.1	27.8	-25%	54.3	49.6 (37.2)	-9% (-31%)	21.4	17.4 (14.5)	-19% (-32%)
> 70	13.7	9.1	-34%	9.6	5.3 (3.8)	-45% (-60%)	3.5	1.8 (1.4)	-49% (-60%)
> 75	5.0	3.3	-34%	0.7	0.1 (< 0.1)	-86% (n/a)	0.3	< 0.1 (< 0.1)	(n/a) (n/a)

Notes:

- Areas are given in km^2, and populations and households in thousands.
- The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census.
- The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.
- Estimates for 2017 using the 2006 population database are shown in blue.

Table C15 Heathrow 2006 & 2017 $L_{eq,6.5hr\ night}$ cumulative contour area, population and household estimates

$L_{eq,6.5hr\ night}$ (dBA)	2006 area	2017 area	Change in area	2006 pop	2017 pop	Change in pop	2006 house	2017 house	Change in house
> 48	56.4	33.9	-40%	137.4	118.0 (91.4)	-14% (-33%)	57.5	43.6 (37.1)	-24% (-35%)

Notes:

- Areas are given in km^2, and populations and households in thousands.
- The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census.
- The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.
- Estimates for 2017 using the 2006 population database are shown in blue.
- The 2006 results were based on data recorded over the 2006 calendar year. The 2017 results were based on data recorded from 26 March 2017 to 24 March 2018.

Table C16 Heathrow 2006 & 2017 L_{den} cumulative contour area, population and household estimates – assuming 2006 W/E runway modal split and 2006 N/S runway usage

L_{den} (dBA)	2006 area	2017 area	Change in area	2006 pop	2017 pop	Change in pop	2006 house	2017 house	Change in house
> 55	244.7	182.9	-25%	756.1	652.4	-14%	338.5	271.9	-20%
> 60	92.7	70.8	-24%	194.6	189.0	-3%	81.6	72.0	-12%
> 65	37.1	27.5	-26%	54.3	44.8	-17%	21.4	15.6	-27%
> 70	13.7	9.0	-34%	9.6	4.5	-53%	3.5	1.5	-57%
> 75	5.0	3.2	-36%	0.7	< 0.1	(n/a)	0.3	< 0.1	(n/a)

Notes:

- Areas are given in km^2, and populations and households in thousands.
- The 2006 population/household counts are based on a 2006 CACI update of the 2001 Census.
- The 2017 population/household counts are based on a 2017 CACI update of the 2011 Census.

APPENDIX D

ANCON type descriptions

Table D1 ANCON type descriptions

ANCON type	Description
B717	Boeing 717
B727	Boeing 727 (Chapter 2&3)
B732	Boeing 737-200 (Chapter 2&3)
B733	Boeing 737-300/400/500
B736	Boeing 737-600/700
B738MAX	Boeing 737 MAX 8
B738	Boeing 737-800/900
B747	Boeing 747-100 & 200/300 series (certificated to Chapter 3)
B744G	Boeing 747-400 with General Electric CF6-80F engines
B744P	Boeing 747-400 with Pratt & Whitney PW4000 engines
B744R	Boeing 747-400 with Rolls-Royce RB211 engines
B747SP	Boeing 747SP
B748	Boeing 747-8
B753	Boeing 757-300
B757C	Boeing 757-200 with Rolls-Royce RB211-535C engines
B757E	Boeing 757-200 with Rolls-Royce RB211-535E4/E4B engines
B757P	Boeing 757-200 with Pratt & Whitney PW2037/2040 engines
B762	Boeing 767-200
B763G	Boeing 767-300 with General Electric CF6-80 engines
B763P	Boeing 767-300 with Pratt & Whitney PW4000 engines
B763R	Boeing 767-300 with Rolls-Royce RB211 engines
B764	Boeing 767-400
B772G	Boeing 777-200 with General Electric GE90 engines
B772P	Boeing 777-200 with Pratt & Whitney PW4000 engines
B772R	Boeing 777-200 with Rolls-Royce Trent 800 engines
B773G	Boeing 777-200LR/300ER with General Electric GE90 engines
B773P	Boeing 777-300 with Pratt & Whitney PW4000 engines
B773R	Boeing 777-300 with Rolls-Royce Trent 800 engines
B788	Boeing 787-8
B789	Boeing 787-9
BA46	BAe 146/Avro RJ series
CRJ	Bombardier CRJ100/200 series
CRJ700	Bombardier CRJ700 series

ANCON type	Description
CRJ900	Bombardier CRJ900 series
CS100	Bombardier C Series CS100
CS300	Bombardier C Series CS300
DC10	McDonnell Douglas DC-10
EA30	Airbus A300
EA31	Airbus A310
EA318	Airbus A318
EA319C	Airbus A319 with CFM56 engines
EA319V	Airbus A319 with IAE V2500 engines
EA320C	Airbus A320 with CFM56 engines
EA320NEO	Airbus A320neo
EA320V	Airbus A320 with IAE V2500 engines
EA321C	Airbus A321 with CFM56 engines
EA321V	Airbus A321 with IAE V2500 engines
EA33	Airbus A330
EA34	Airbus A340-200/300
EA346	Airbus A340-500/600
EA359	Airbus A350-900
EA38GP	Airbus A380 with Engine Alliance GP7000 engines
EA38R	Airbus A380 with Rolls-Royce Trent 900 engines
ERJ	Embraer ERJ 135/145
ERJ170	Embraer E-170/175
ERJ190	Embraer E-190/195
EXE2	Chapter 2 executive jets
EXE3	Chapter 3 executive jets
FK10	Fokker 70/100
L101	Lockheed L-1011 TriStar
L4P	Large four-engine propeller
LTT	Large twin-turboprop
MD11	McDonnell Douglas MD-11
MD80	McDonnell Douglas MD-80 series
SP	Single piston
STP	Small twin-piston

ANCON type	Description
STT	Small twin-turboprop
TU54	Tupolev Tu-154

APPENDIX E

L_{max} validation

Introduction

ERCD has always validated Heathrow's Leq contours against measurements by comparing each aircraft's arrival and departure Sound Exposure Level (SEL) with measured SEL values. L_{max} plays no part in this validation as it is not required for the calculation of Leq, L_{den} etc, but it is the basis for N-contours (e.g. N65, N70 and N60). Although adjustments to SELs are also made to L_{max}, it has been identified that L_{max} was underestimated for a number of common aircraft types at Heathrow.

Beginning with summer 2017 data, additional validation of L_{max} for each aircraft type has been instituted. This has affected the 2017 N-contours produced in this report, and to enable valid comparisons with results from previous years, the 2006 and 2016 N-contours have been remodelled. The 2006 N-contour remodelling also took into account L_{max} measurement data from 2006 for the noise dominant aircraft types.

This appendix is structured as follows: (a) summary of the results of the 2017 L_{max} validation work; (b) results of remodelling the 2006 N-contours and the effects on areas and populations; (c) effects on the 2016 N-contour areas and populations due to use of the updated L_{max} results; (d) implications for long-term comparisons between the 2006 base year and 2016 (and subsequent) N-contour results.

(a) 2017 L_{max} validation results

Figures E1 to **E24** present departure and arrival SEL and L_{max} calculations from the ANCON model for six aircraft types:

- Boeing 747-400/RR engines;
- Boeing 777-300ER;
- Boeing 787-9;
- Airbus A320/CFM engines;
- Airbus A320/IAE engines; and
- Airbus A380/EA[18] engines.

These are compared against SEL and L_{max} noise measurements obtained in the vicinity of Heathrow (see **Ref 9** for further information). Because noise is measured on a logarithmic scale, the average noise level is calculated as a logarithmic average rather than an arithmetic average, giving more weight to higher noise events. For a typical normal distribution, the logarithmic average will be approximately 0.1-0.2 dB higher than the arithmetic average. The vertical bars around each measurement indicate ±1 standard deviation around the logarithmic average level and give an indication of the range and uncertainty of the measurements.

In **Figures E1** and **E2** it can be seen for the Boeing 747-400/RR engines that summer 2017 ANCON departure noise estimates for both SEL and L_{max} reduced by 0 to 2 dB compared with 2016, reflecting SEL measurements over the last three years and L_{max} measurements for 2017.

In **Figures E3** and **E4**, it can be seen for the Boeing 747-400/RR engines that summer 2017 ANCON arrival noise estimates remained unchanged for SEL compared with 2016, but reduced by around 1 dB for L_{max}.

[18] EA = Engine Alliance

In **Figure E5** it can be seen for the Boeing 777-300ER that ANCON departure noise estimates for SEL remained unchanged out to 20 km from start of take-off roll and matched 2017 summer SEL measurements. In contrast, as shown in **Figure E6**, ANCON departure L_{max} estimates were increased by around 2 dB in order to match summer 2017 Lmax measurements.

For Boeing 777-300ER arrivals there was no change required to the 2017 ANCON SEL estimates (**Figure E7**), however, ANCON L_{max} estimates were reduced by around 1 dB (**Figure E8**) to give better agreement with summer 2017 L_{max} measurements.

In **Figure E9**, for Boeing 787-9 departures a slight uplift in summer 2017 ANCON SEL estimates was applied between 14-18 km, otherwise there was already good agreement with SEL measurements. In **Figure E10**, an increase in summer 2017 ANCON L_{max} of between 1-2 dB was applied across all distances to give better agreement with L_{max} measurements.

In **Figure E11**, for Boeing 787-9 arrivals, summer 2017 ANCON SEL estimates were reduced for distances of less than 3 km from the landing threshold, but remained unchanged at all other distances. In **Figure E12** summer 2017 ANCON L_{max} estimates were increased for distances beyond 5 km from the landing threshold, but reduced for distances of less than 5 km.

In **Figure E13** for Airbus A320/CFM engine departures there were no changes to summer 2017 ANCON SEL estimates. In contrast the departure L_{max} estimates (**Figure E14**) showed a consistent underprediction of 2-3 dB. This underprediction also applied to Airbus A319 and A321 variants with CFM engines.

In **Figure E15** for Airbus A320/CFM engine arrivals, ANCON arrival SEL estimates were unchanged to those for 2016 and showed good agreement with noise measurements. However, **Figure E16** shows the corresponding ANCON arrival L_{max} estimates were increased by around 1 dB in order to agree with measurements.

In **Figure E17** for Airbus A320/IAE V2500 engine departures, ANCON departure SEL estimates were unchanged up to 20 km from start of take-off roll, with a slight increase thereafter and showed good agreement with summer 2017 SEL measurements. However, **Figure E18** shows that ANCON departure L_{max} levels were substantially underestimated: by 2 dB at 6.5 km, 5 dB at 14 km and 6-7 dB beyond 20 km from start of take-off roll. This underprediction also applied to the A319 and A321 variants that together make up 40% of daily operations.

In **Figure E19**, for Airbus A320/IAE V2500 engine arrivals, ANCON summer 2017 SEL estimates were reduced beyond 7 km from the landing threshold, reflecting consecutive year decreases in measured levels beyond 7 km that resulted from an increasing proportion of the fleet having been fitted with the FOPP noise reduction device. In **Figure E20**, ANCON summer 2017 L_{max} estimates were increased compared with summer 2016 to reflect L_{max} measurements, the increase varying between 1 dB (at 6 km), 2 dB (at 10 km) and 3 dB beyond 12 km from the landing threshold.

In **Figures E21** and **E22** for Airbus A380/EA engine departures, ANCON summer 2017 SEL and L_{max} estimates were unchanged from 2016 and reflect summer 2017 SEL and L_{max} measurements.

In **Figure E23** for Airbus A380/EA engine arrivals, ANCON summer 2017 SEL estimates were unchanged from 2016 and reflect summer 2017 SEL measurements. In contrast, **Figure E24** shows that ANCON summer 2017 L_{max} measurements increased by 1-1.5 dB between 4 and 18 km from the landing threshold.

Conclusion

Although there are relatively small increases and decreases in ANCON L_{max} noise estimates for many types, the overwhelming contribution to the overall average 1-2 dB increase in L_{max} is from the Airbus A319/320/321 families with IAE V2500 and CFM engines that account for almost 60% of daily operations.

It is also apparent that approximately two-thirds of the effect was due to underestimation of L_{max} on departure, compared to one-third on arrival. Thus, the revised N-contours are correspondingly larger along departure flight paths than they are on arrival flight paths, changing the size and shape of the N-contours. This explains the wide variation in population increases shown in this appendix.

Figure E1 Boeing 747-400/RR engines departure SEL

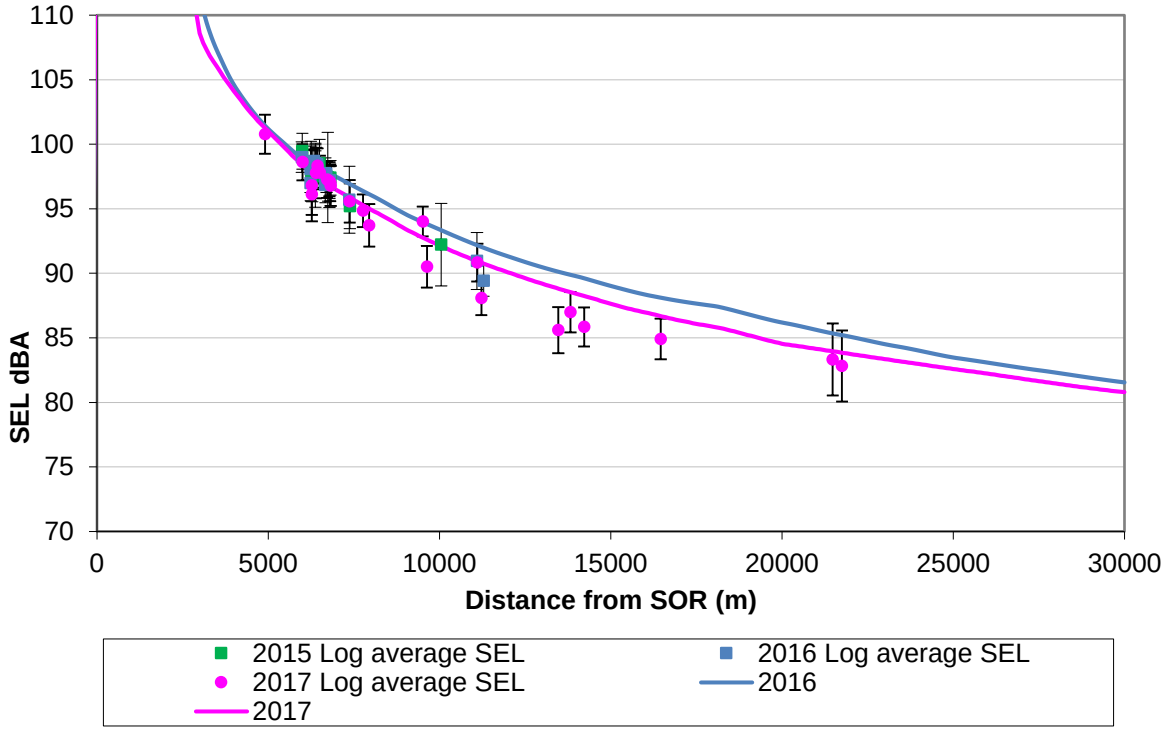


Figure E2 Boeing 747-400/RR engines departure L_{max}

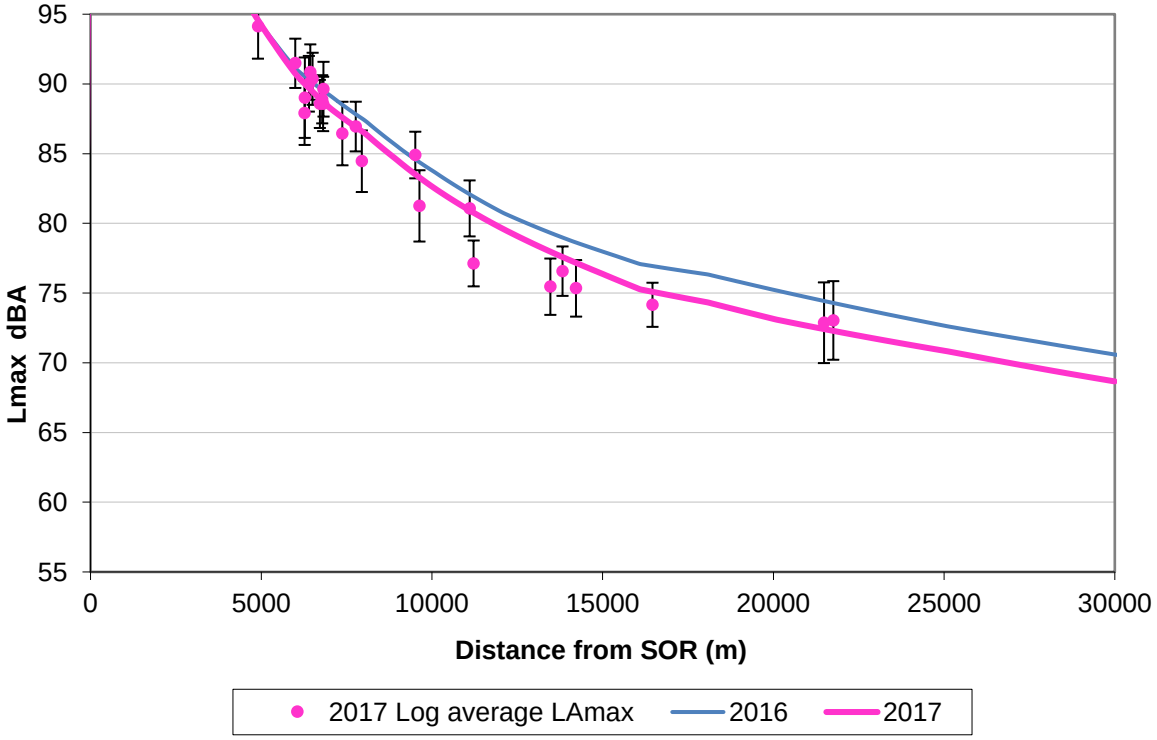


Figure E3 Boeing 747-400/RR engines arrival SEL

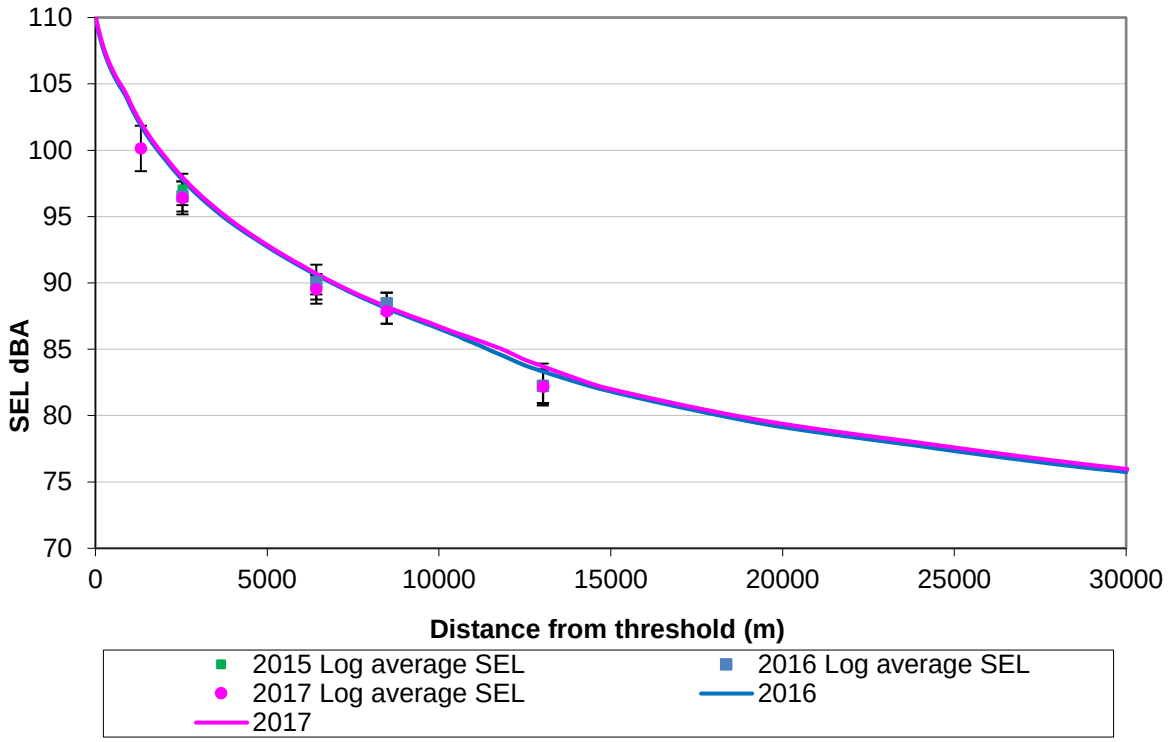


Figure E4 Boeing 747-400/RR engines arrival L_{max}

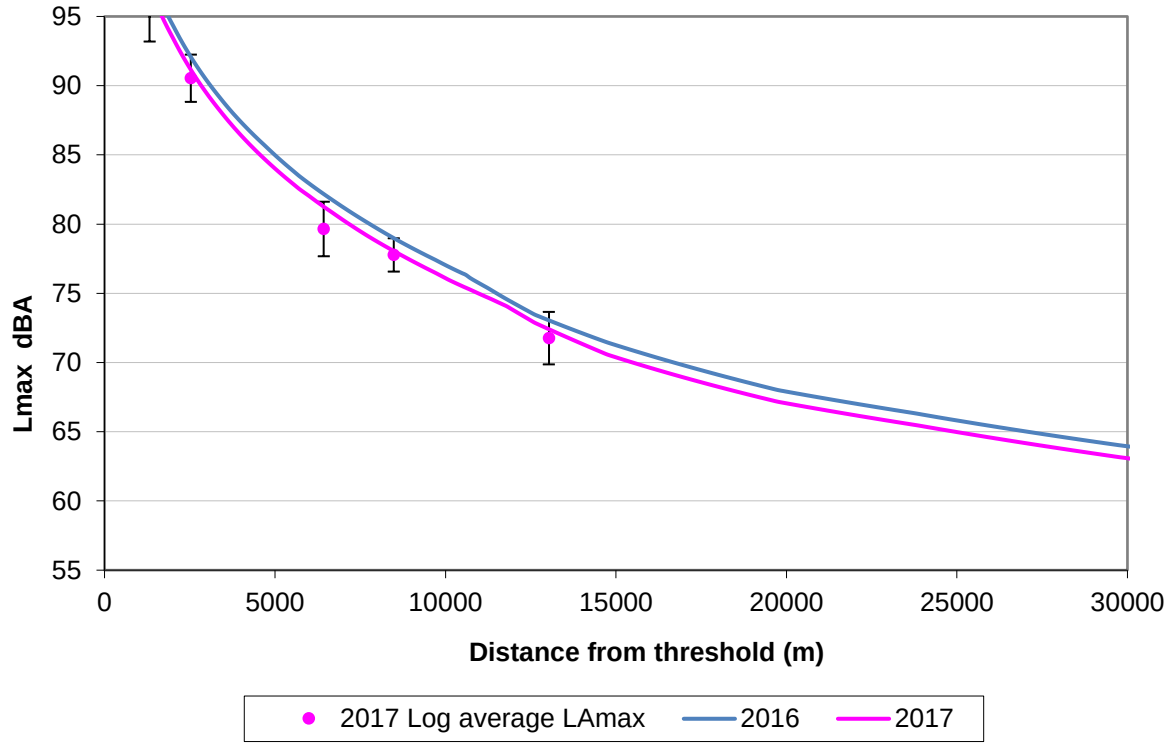


Figure E5 Boeing 777-300ER/GE engines departure SEL

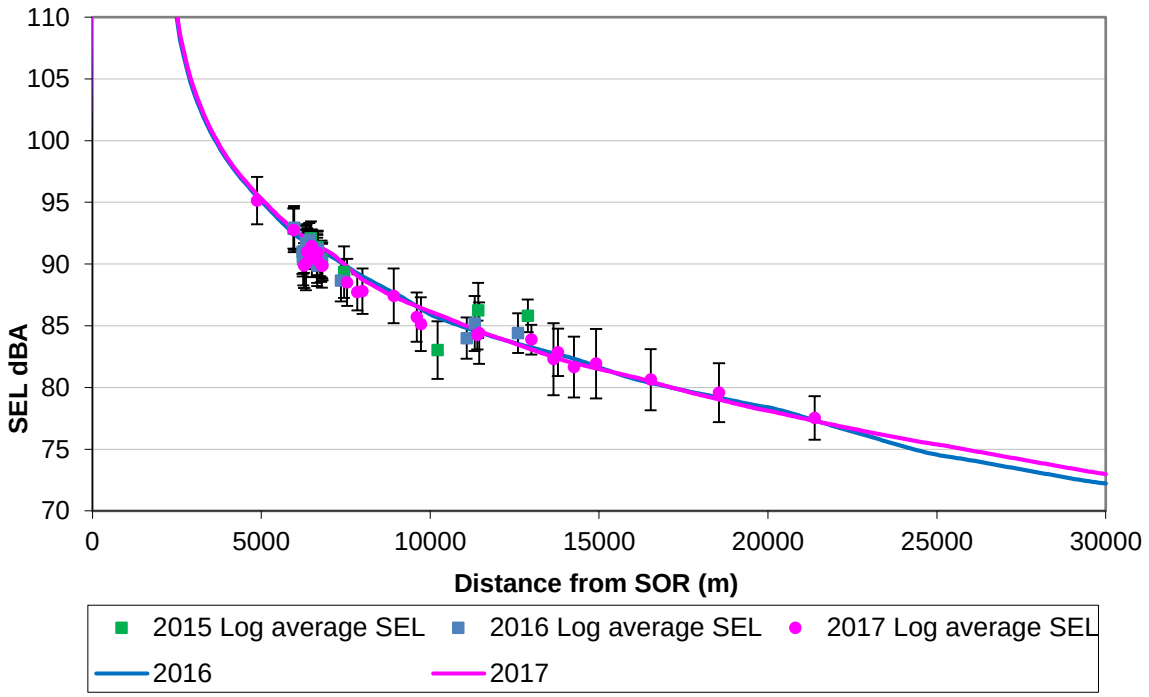


Figure E6 Boeing 777-300ER/GE engines departure L_{max}

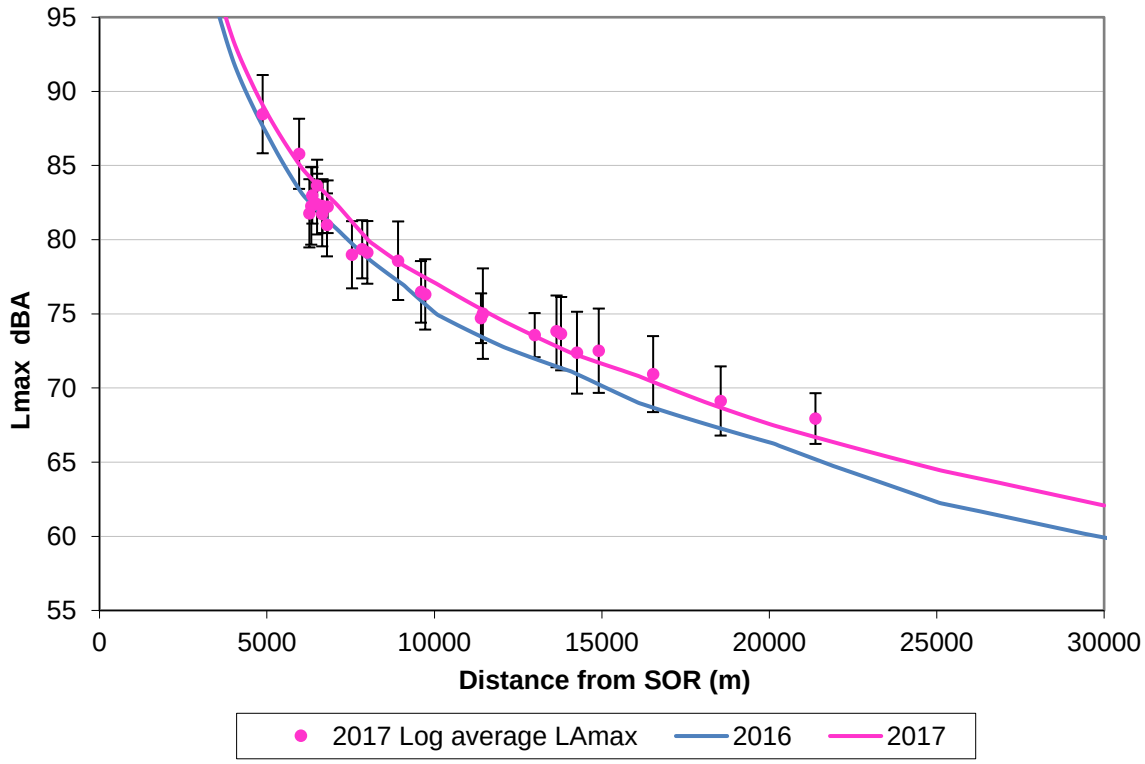


Figure E7 Boeing 777-300ER/GE engines arrival SEL

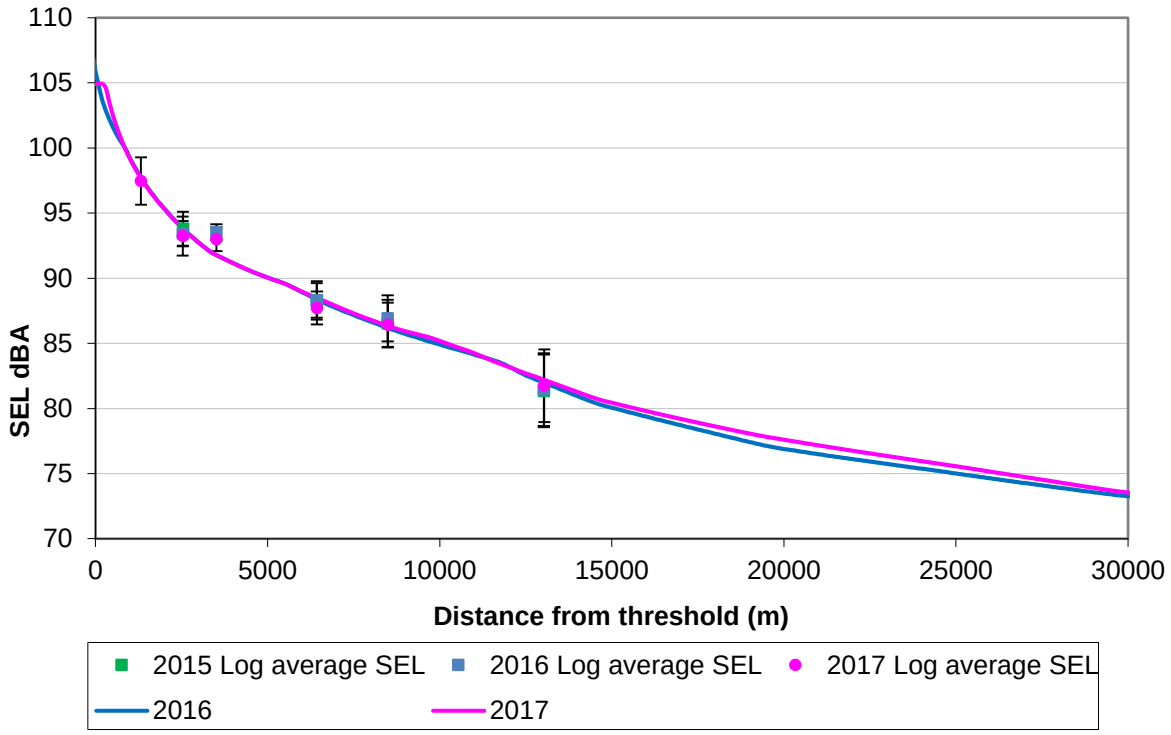


Figure E8 Boeing 777-300ER/GE engines arrival L_{max}

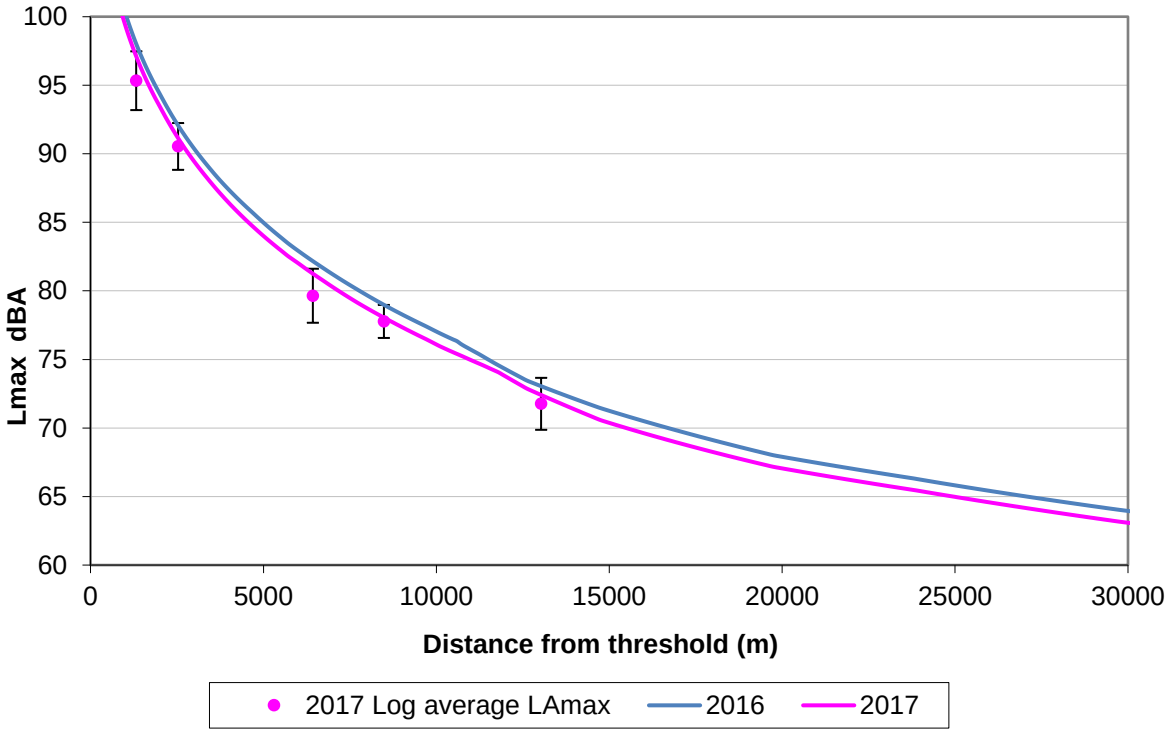


Figure E9 Boeing 787-9 departure SEL

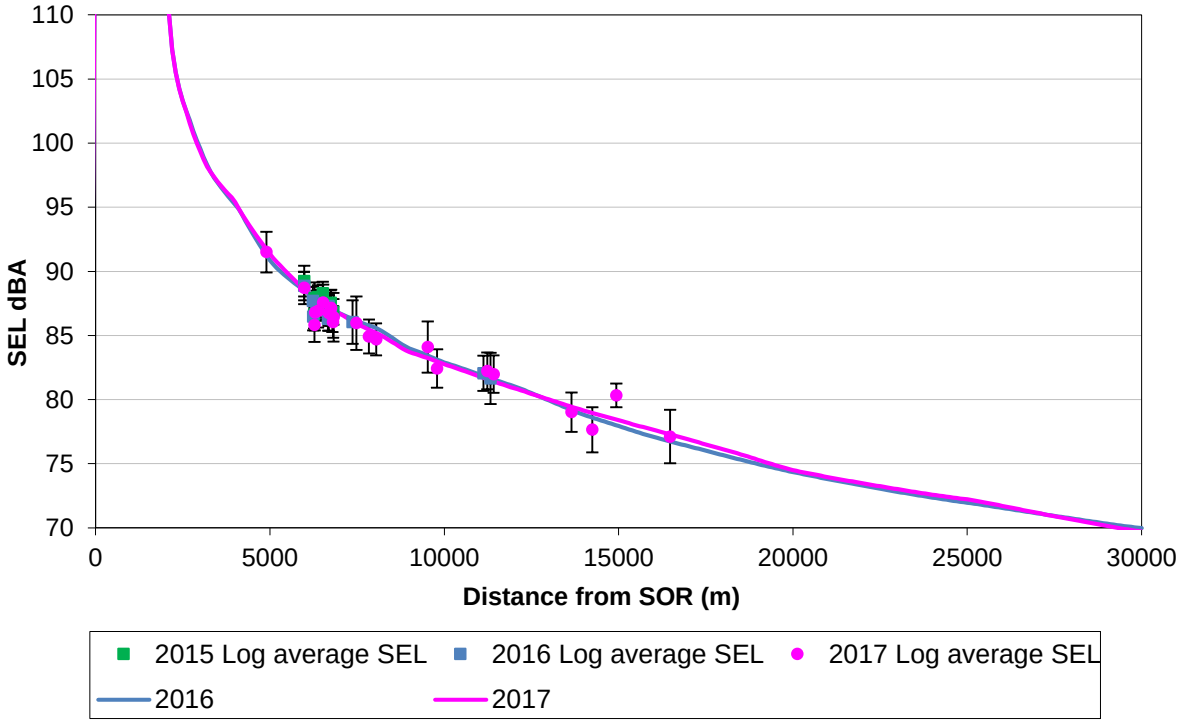


Figure E10 Boeing 787-9 departure L_{max}

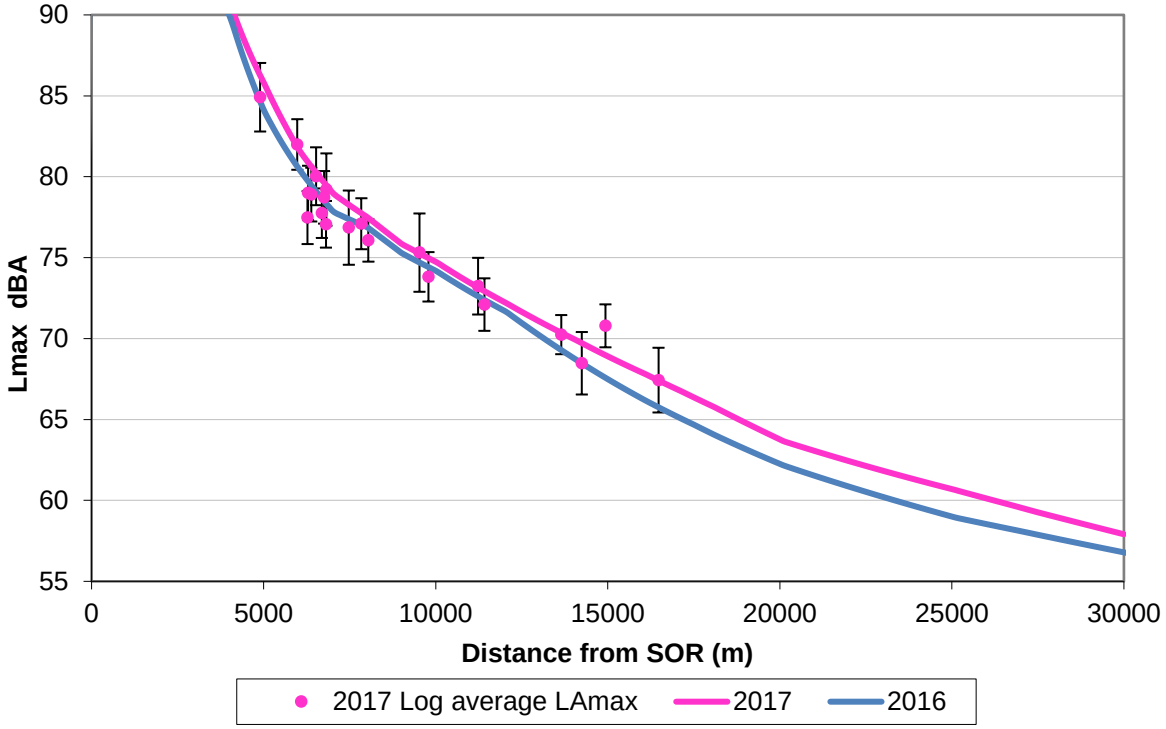


Figure E11 Boeing 787-9 arrival SEL

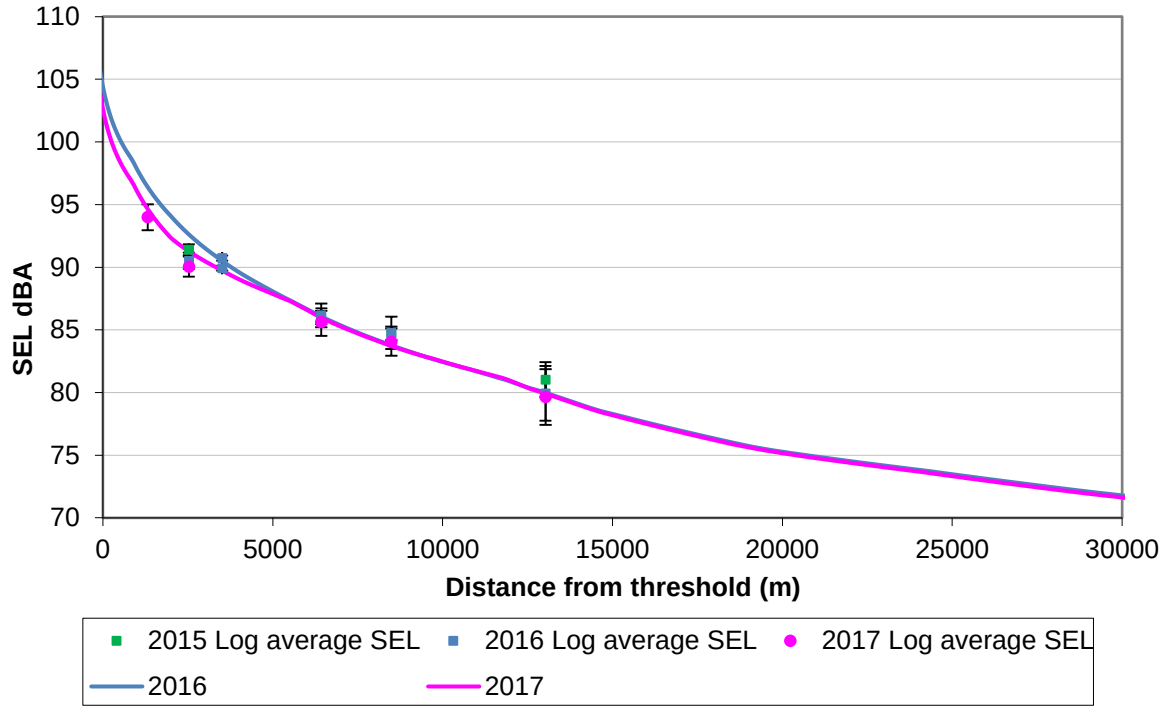


Figure E12 Boeing 787-9 arrival L_{max}

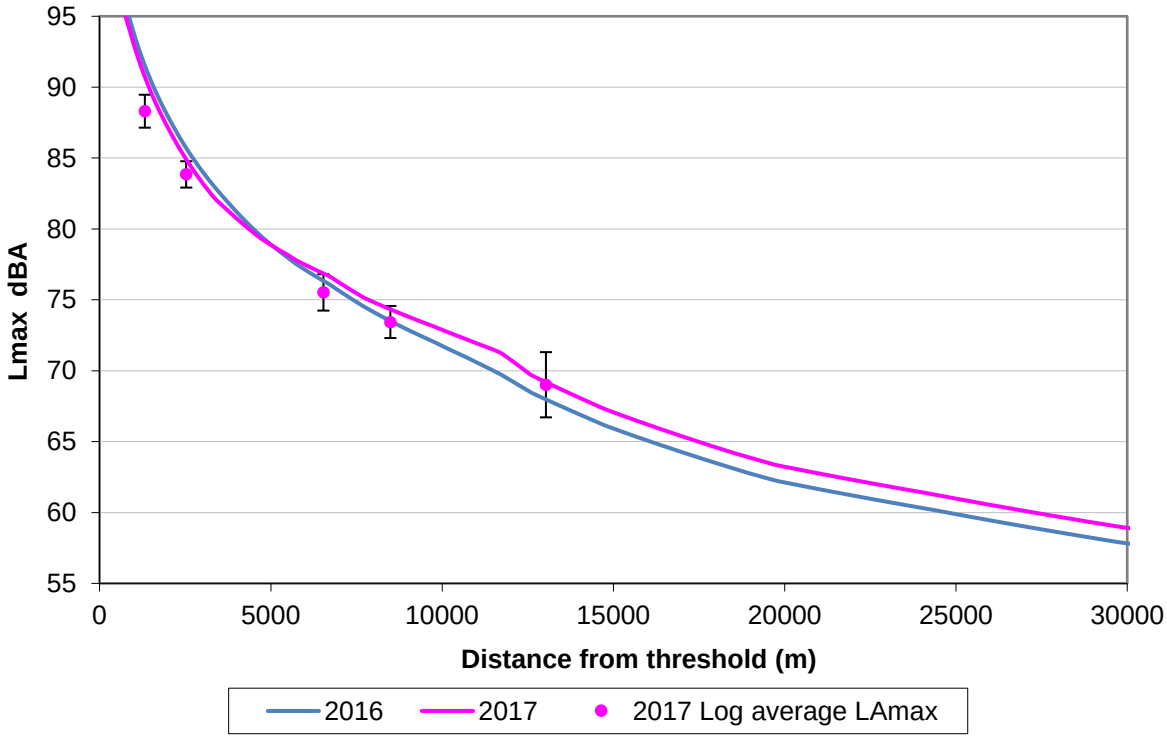


Figure E13 Airbus A320/CFM engines departure SEL

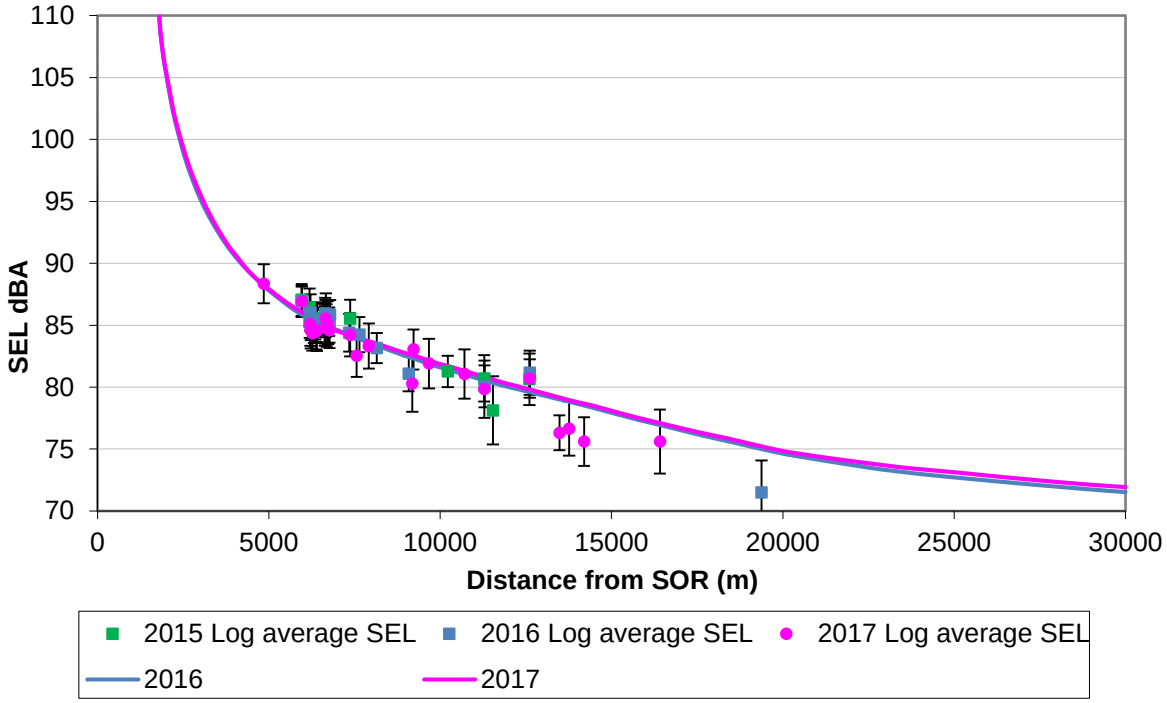


Figure E14 Airbus A320/CFM engines departure L_{max}

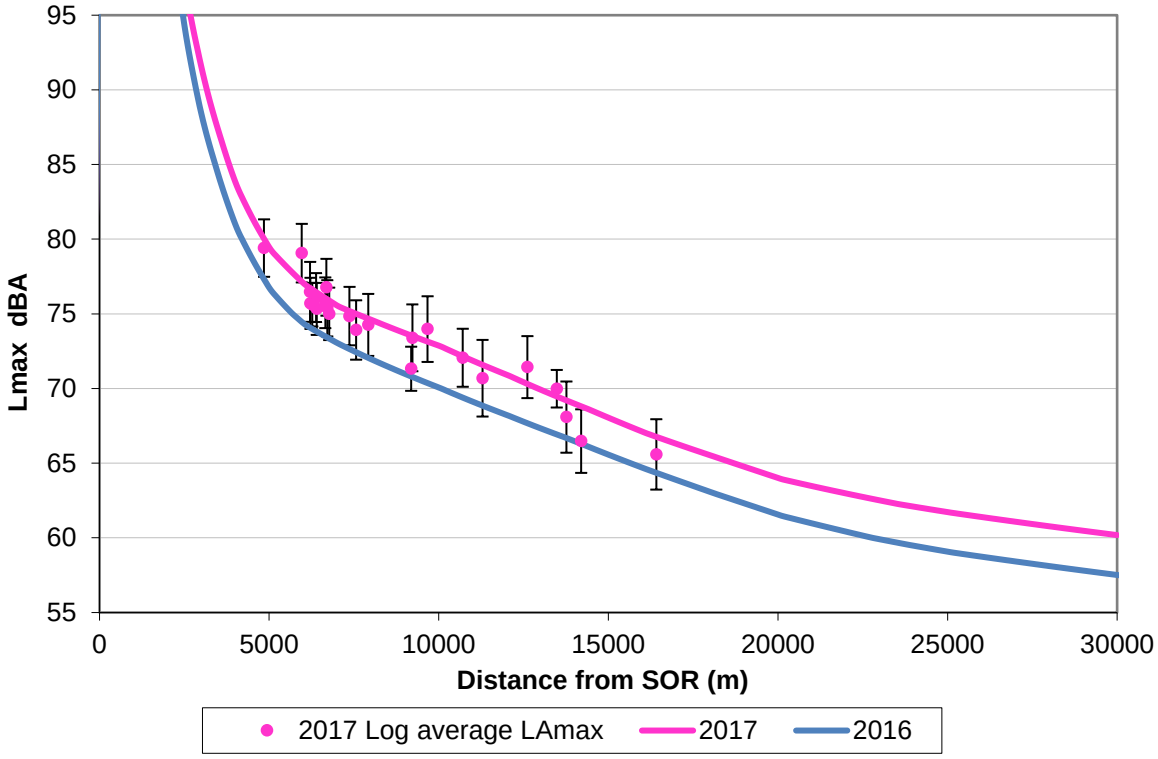


Figure E15 Airbus A320/CFM engines arrival SEL

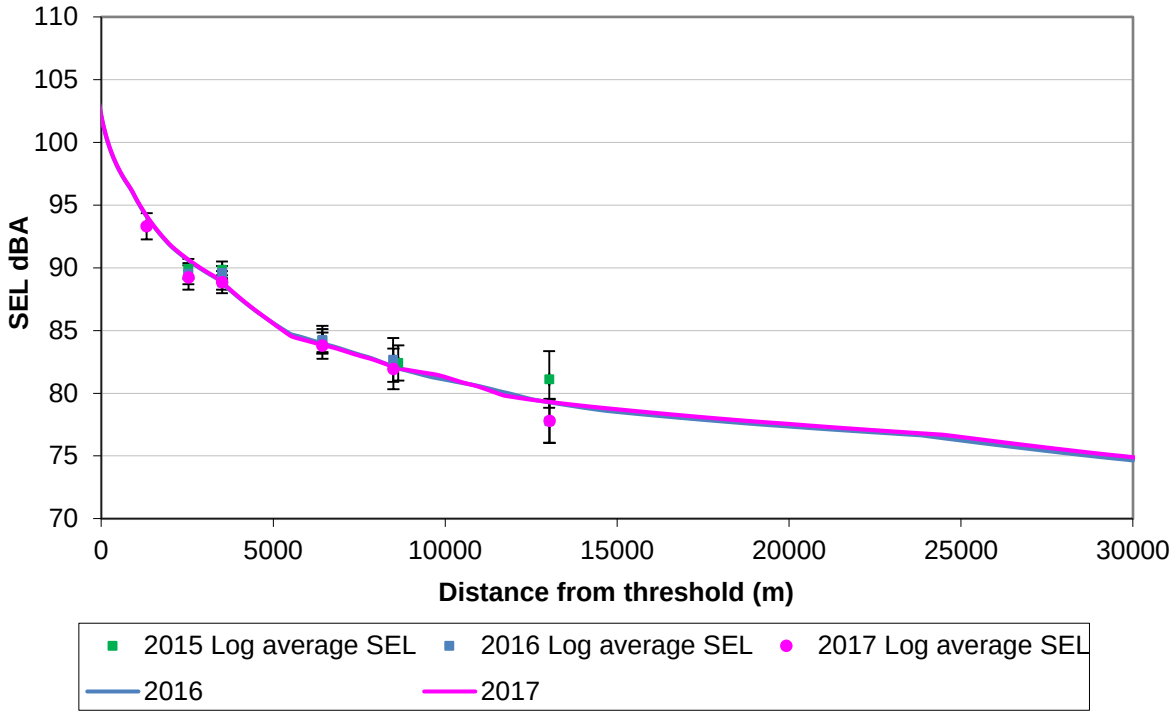


Figure E16 Airbus A320/CFM engines arrival L_{max}

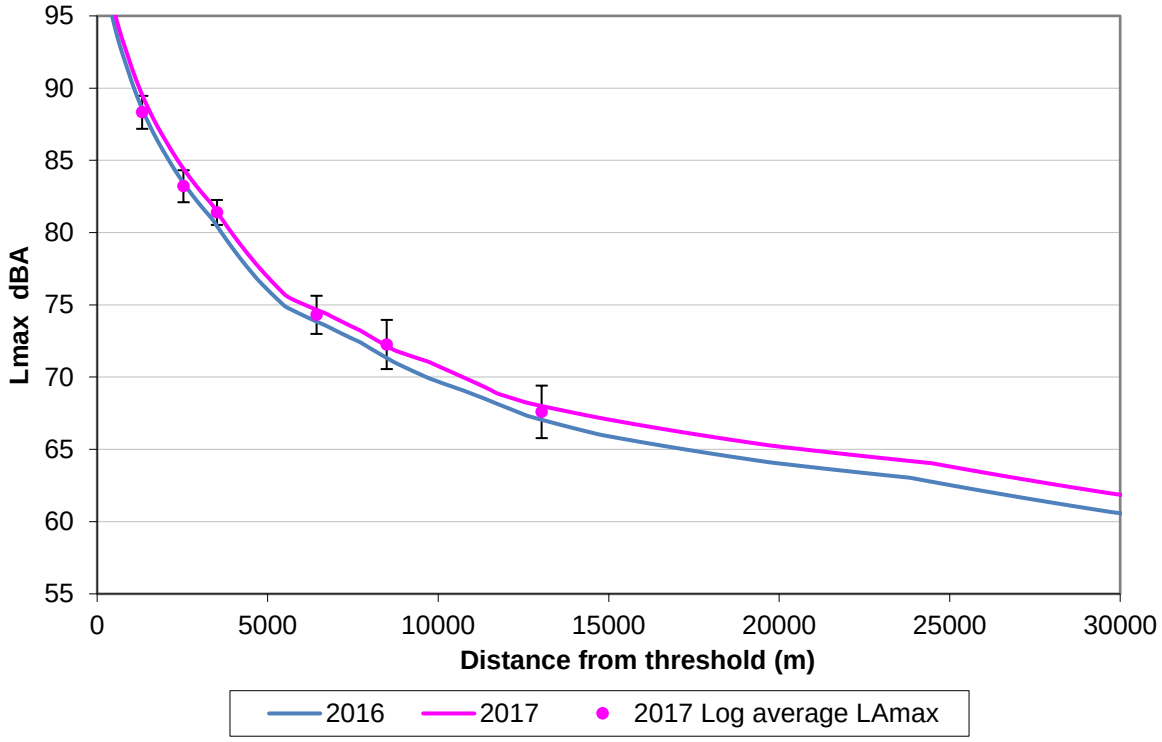


Figure E17 Airbus A320/IAE V2500 engines departure SEL

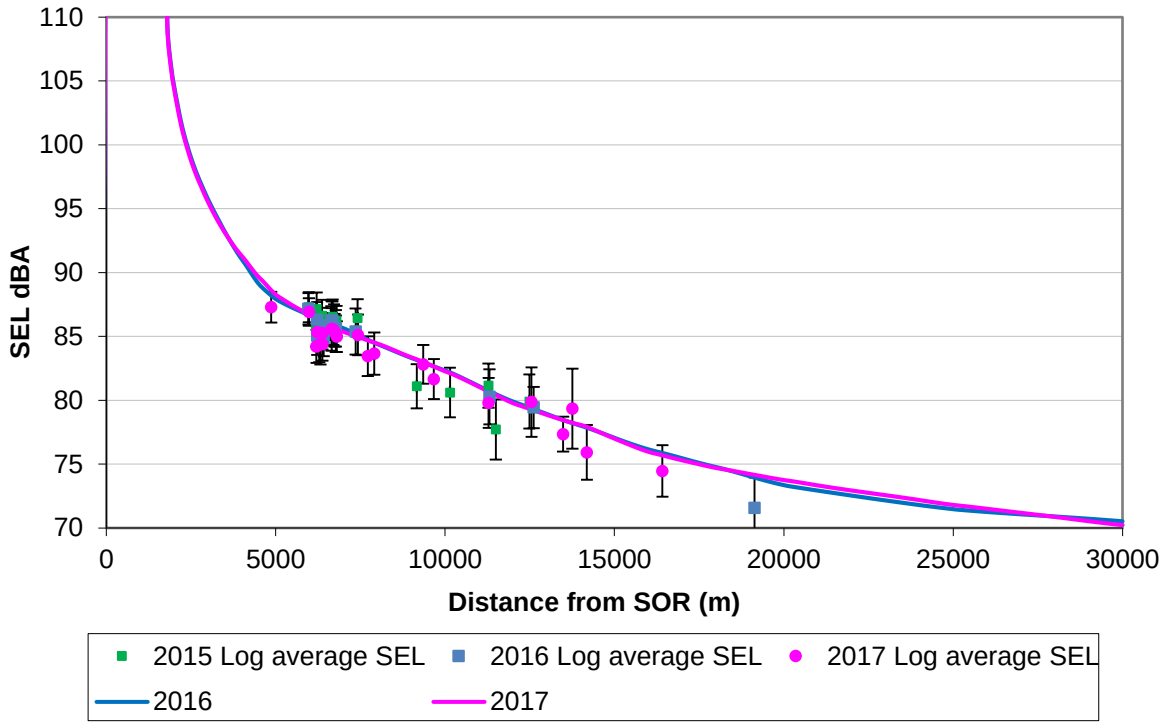


Figure E18 Airbus A320/IAE V2500 engines departure L_{max}

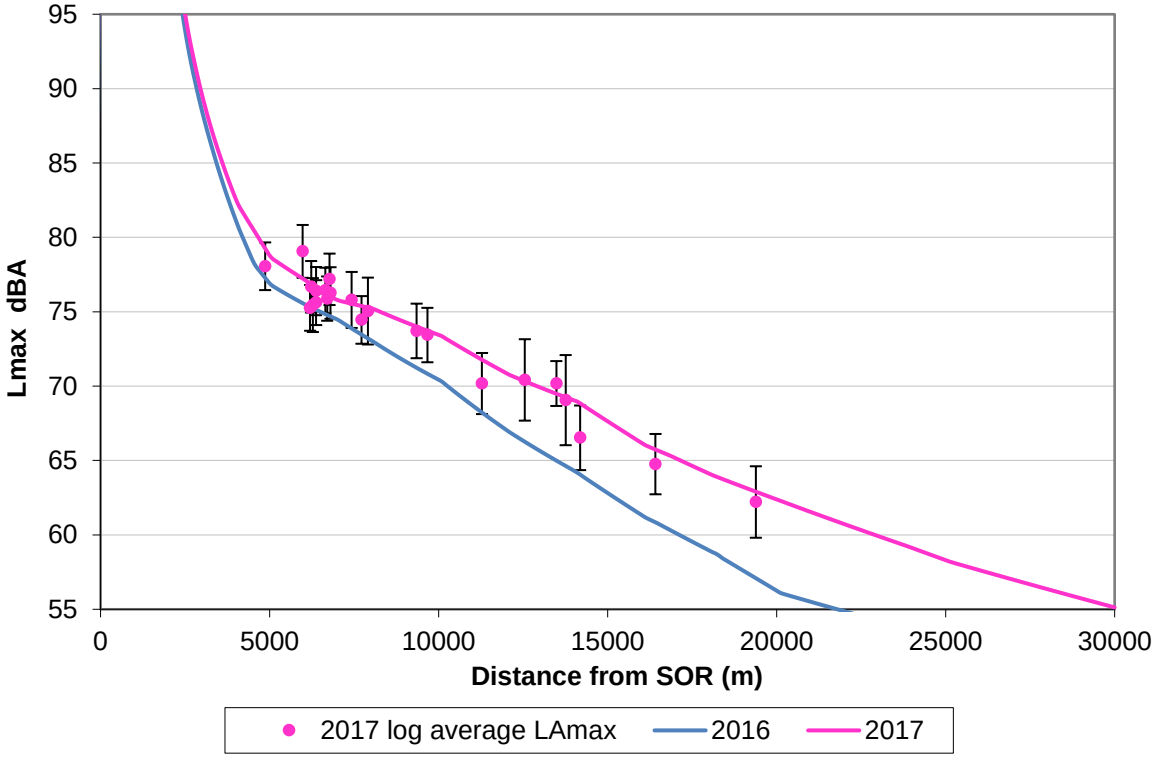


Figure E19 Airbus A320/IAE V2500 engines arrival SEL

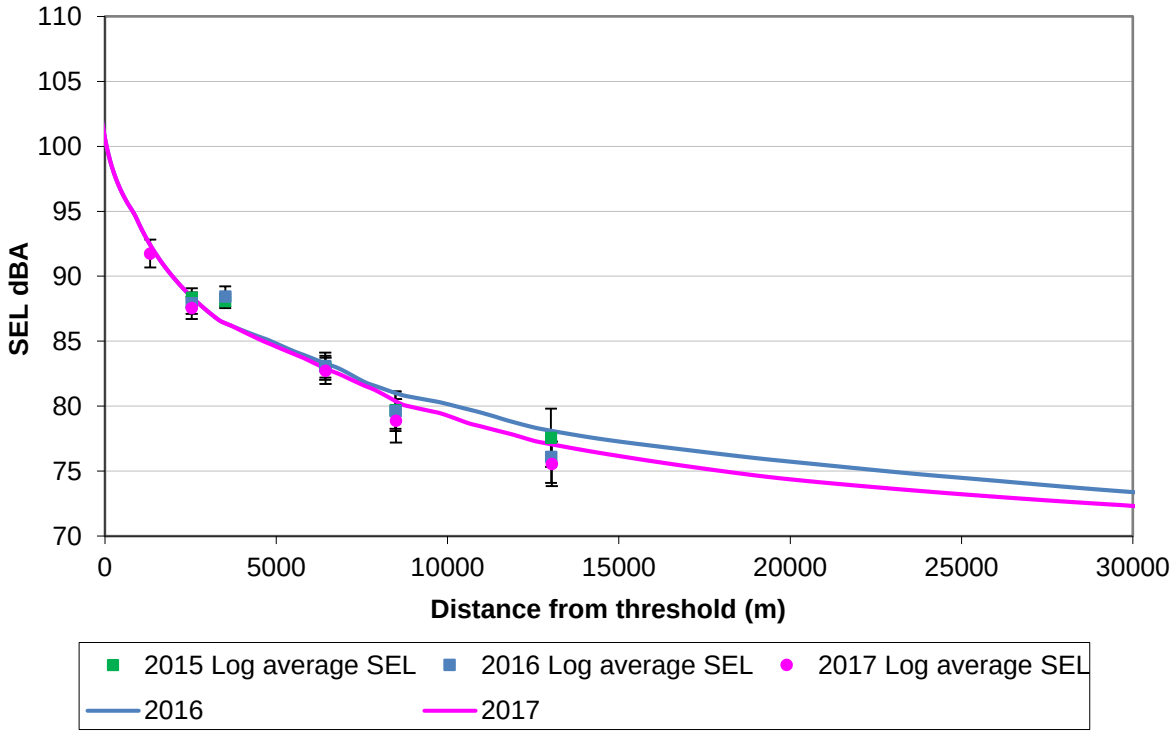


Figure E20 Airbus A320/IAE V2500 engines arrival L_{max}

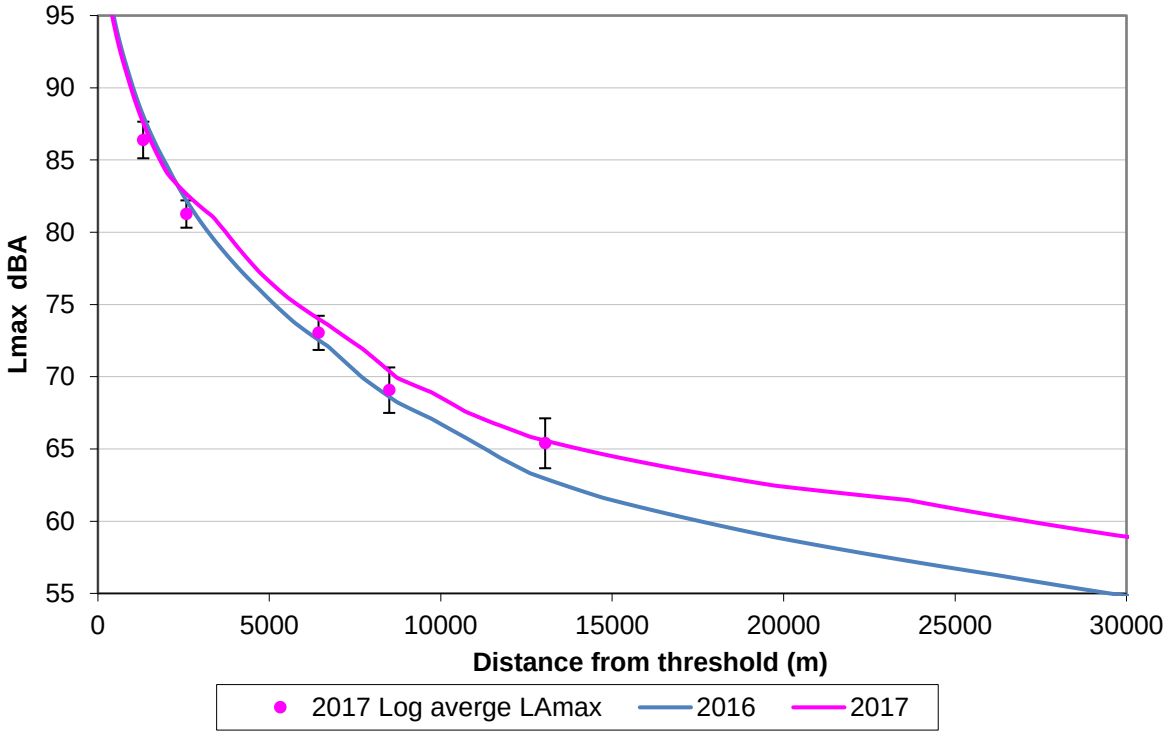


Figure E21 Airbus A380/EA engines departure SEL

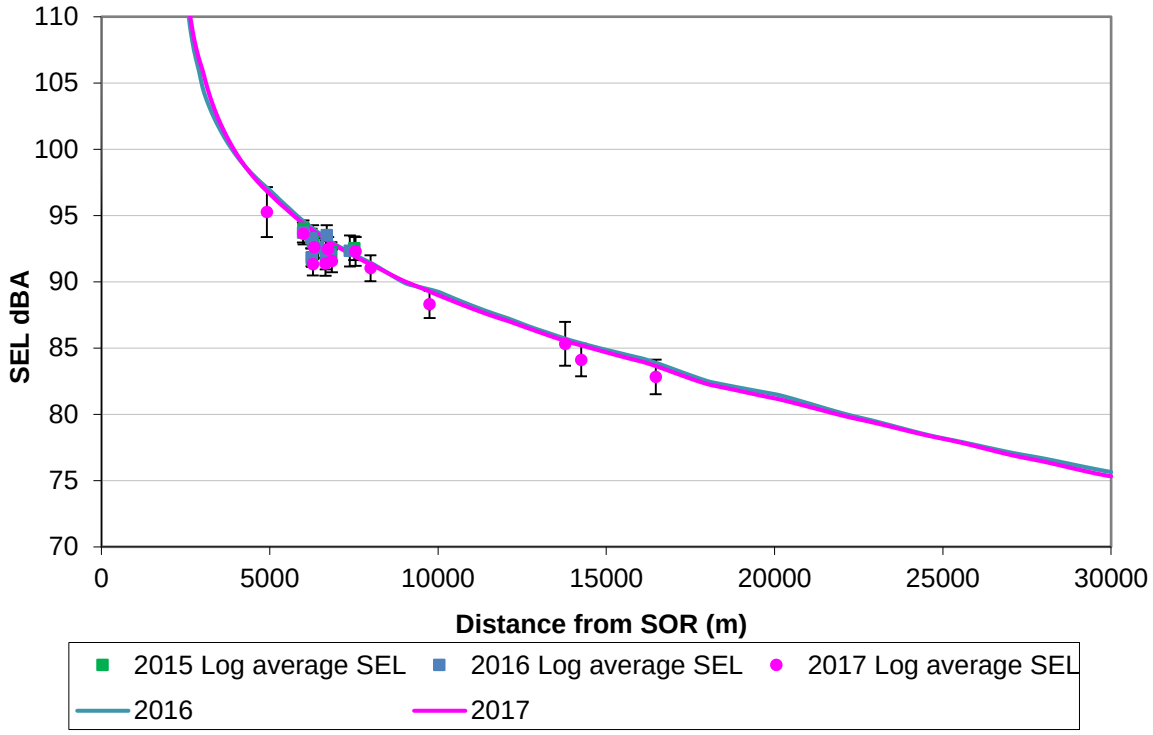


Figure E22 Airbus A380/EA engines departure L_{max}

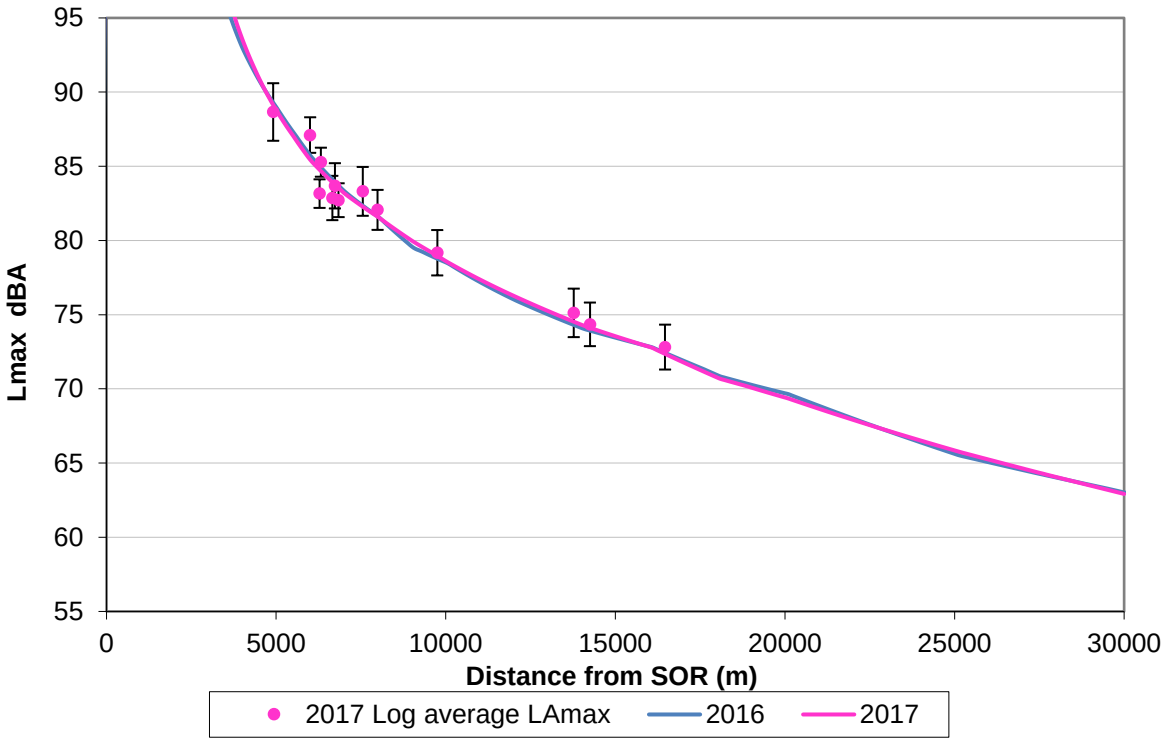


Figure E23 Airbus A380/EA engines arrival SEL

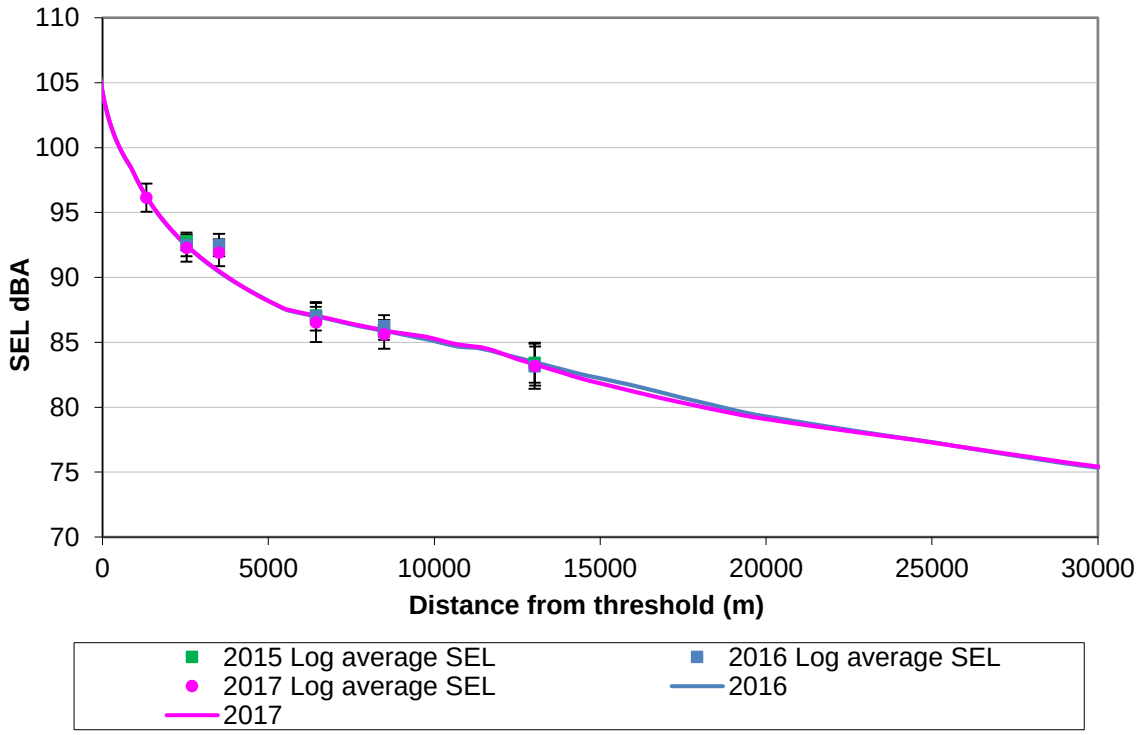
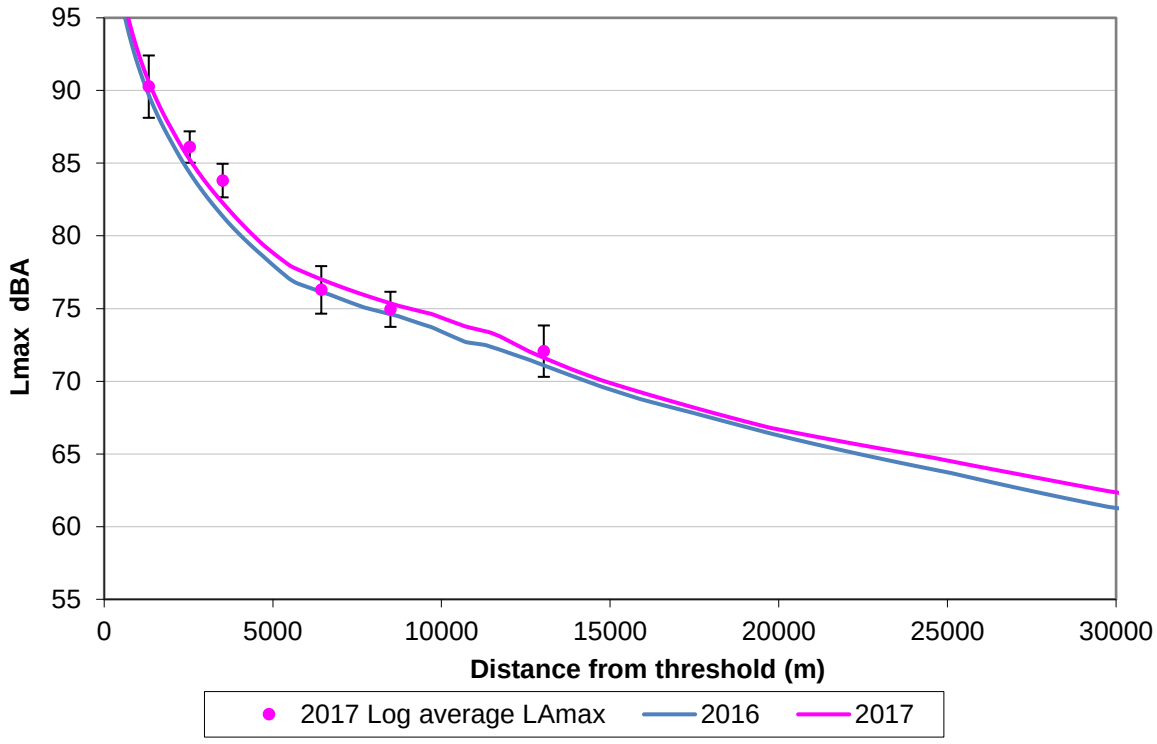


Figure E24 Airbus A380/EA engines arrival L_{max}



(b) Remodelling of 2006 N-contours

The 2006 N-contours were remodelled by running them with the 2017 L_{max} data, except for the following noise dominant types, which would have been noisier in 2006 and were therefore adjusted using 2006 L_{max} data:

- For departures - B744G, B744R, B763R. These types were used on longer range flights in 2006 prior to the introduction of BA's A380s and B788s in 2013/14.

- For arrivals - EA318, EA319C, EA319V, EA320C, EA320V, EA321C, EA321V. The A320 family changes reflect pre-FOPP modification noise levels.

    - For the CFM56 engine variant:
      +0.5 dB at 1000', +0.5 dB at 2000', +1 dB at 4000' and greater.

    - For the V2527A engine variant:
      +0.5 dB at 1000', +2 dB at 2000', +3 dB at 4000' and greater.

The greater noise adjustments for the V2527A reflect that a greater proportion have been FOPP-modified (for example, all BA's) and more CFM56-5 operators have not (e.g. Aer Lingus).

The N-contour area results in **Table E1** indicate that for N65 and N70 annual 16-hr day, the L_{max} revisions produce area increases at all levels; for example, at the 50 events level there is a 19% area increase for N65, and a 24% area increase for N70. However, for N60 annual 8-hr night, a 3% area reduction from the L_{max} changes is seen at the 10 events level. This is due to the noise dominance of B744R arrivals at night in 2006. (The L_{max} validation for the B744R on arrival led to a decrease in noise compared to the original 2006 L_{max} data).

Table E2 shows that the *population* changes resulting from the remodelling of the 2006 contours are comparable to the area changes, with an increase of 28% for the N65 50 events contour and 24% for the N70 50 events contour. The population within the N60 night 10 events contour fell by 2%, in line with the 3% area decrease.

The original and revised N65, N70 and N60 contours for 2006 are shown in **Figures E25-E27** respectively.

Table E1 2006 N-contour area changes due to L_{max} revision

Contour scenario	Original area (km^2)	Revised area (km^2)	Area change (%)
N65 annual 16-hr day			
> 50	223.6	267.2	+19%
> 100	120.3	162.5	+35%
> 200	64.6	83.0	+28%
> 500	10.8	13.2	+22%
N70 annual 16-hr day			
> 50	96.6	119.7	+24%
> 100	58.0	71.4	+23%
> 200	35.0	41.8	+19%
> 500	1.2	2.1	+75%
N60 annual 8-hr night			
> 10	190.2	184.4	-3%
> 20	92.3	89.9	-3%
> 50	3.7	0.5	-86%

Table E2 2006 N-contour population changes due to L_{max} revision

Contour scenario	Original pop. (1000's)	Revised pop. (1000's)	Population change (%)
N65 annual 16-hr day			
> 50	589.6	754.3	+28%
> 100	304.6	470.8	+55%
> 200	128.8	223.5	+74%
> 500	0.7	3.3	+371%
N70 annual 16-hr day			
> 50	202.6	252.0	+24%
> 100	109.4	136.0	+24%
> 200	45.7	63.4	+39%
> 500	0.0	< 0.1	(n/a)
N60 annual 8-hr night			
> 10	858.1	837.2	-2%
> 20	405.6	389.9	-4%
> 50	< 0.1	< 0.1	(n/a)

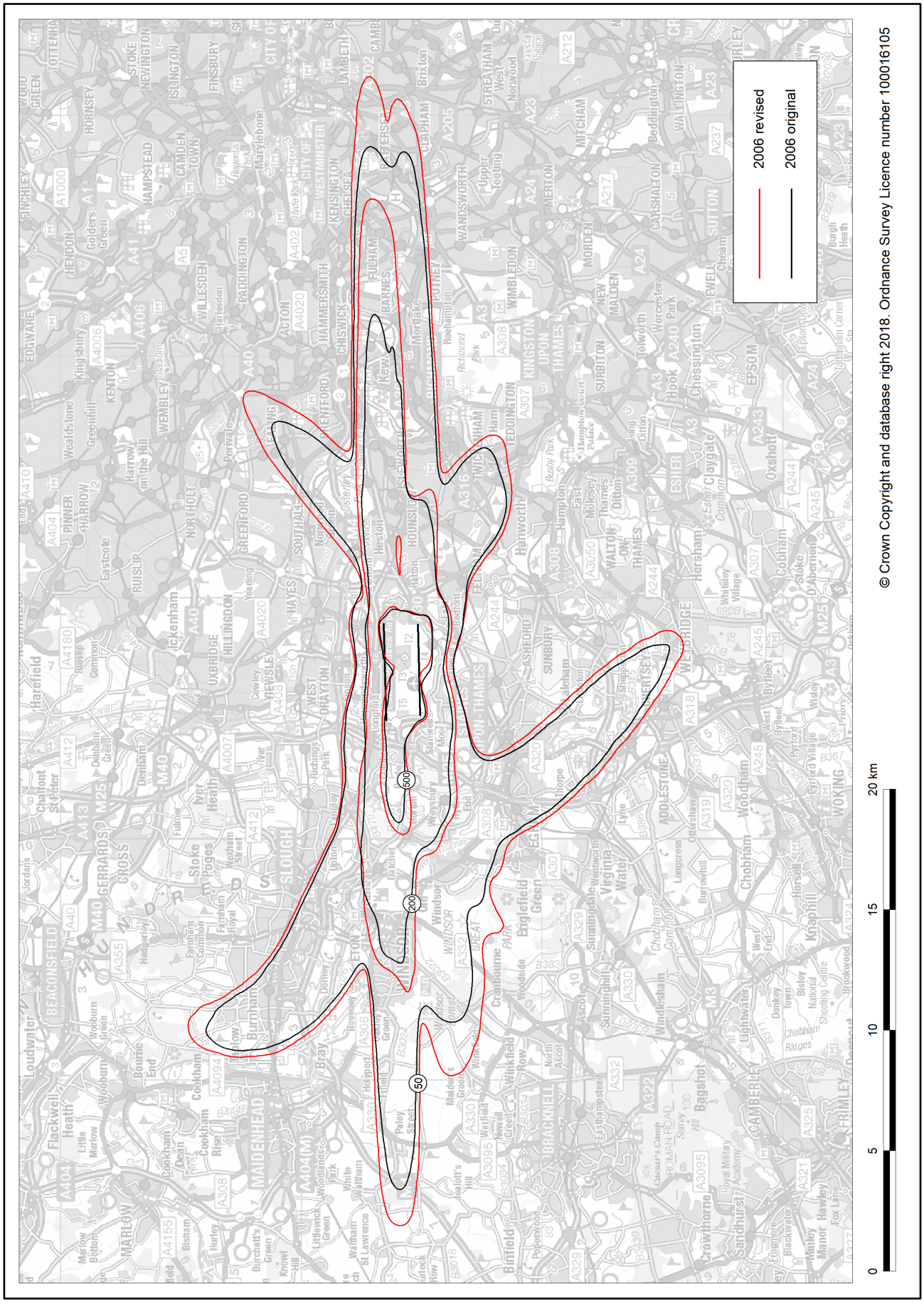


Figure E25 Heathrow 2006 annual 16-hour day N65 contours (before and after L_{max} adjustment)

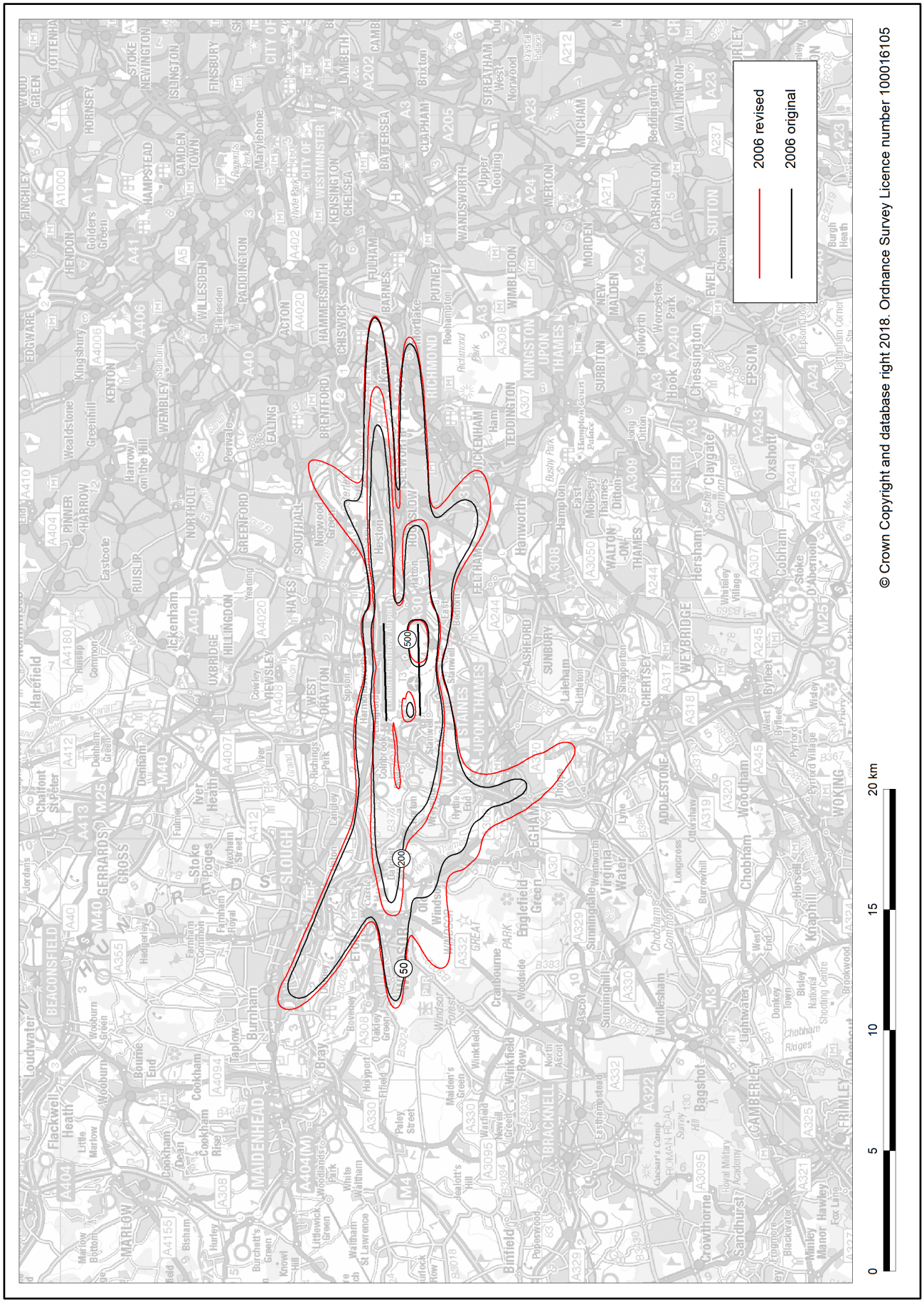


Figure E26 Heathrow 2006 annual 16-hour day N70 contours (before and after L_{max} adjustment)

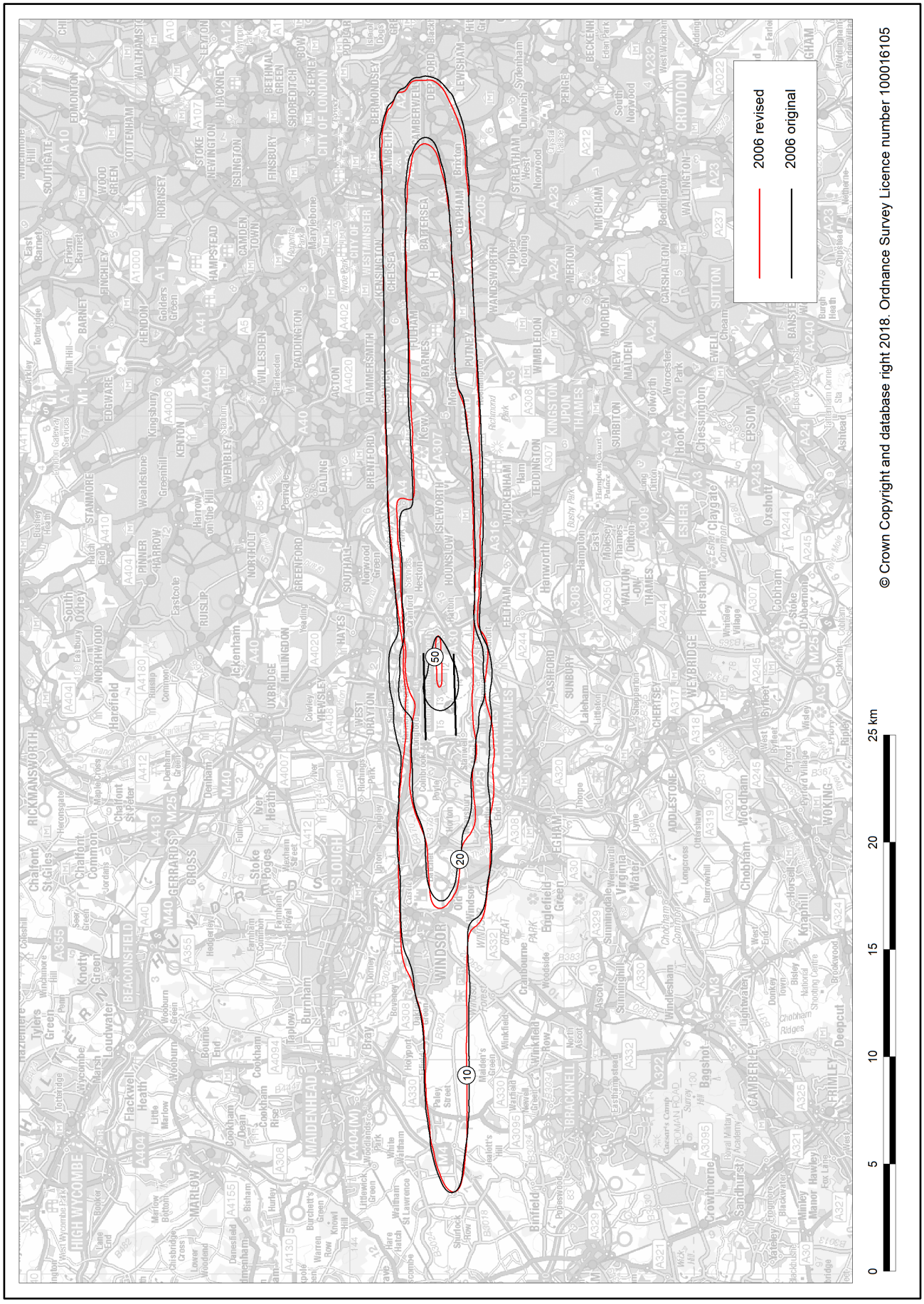


Figure E27 Heathrow 2006 annual 8-hour night N60 contours (before and after L_{max} adjustment)

(c) Effect on 2016 N-contours of revised L_{max} levels

The effects of revising the 2016 N-contours with the updated 2017 L_{max} data are summarised in **Table E3** (for areas) and **Table E4** (for populations).

Similar to 2006, there are increases in area for the N65 and N70 annual 16-hr day contours. For example, the 2016 N65 annual 16-hr day 50 events contour area increased by +22% (with a population change of +38%), whilst the N70 contour area increased by 25% (population change +25%). For N60 annual 8-hr night, the 10 events contour area increased by 4%, with a population change of +2%.

Table E3 2016 N-contour area changes due to L_{max} revision

Contour scenario	Original area (km^2)	Revised area (km^2)	Area change (%)
N65 annual 16-hr day			
> 50	189.5	231.3	+22%
> 100	111.3	139.9	+26%
> 200	60.5	77.0	+27%
> 500	7.2	11.5	+60%
N70 annual 16-hr day			
> 50	85.7	107.1	+25%
> 100	52.2	68.7	+32%
> 200	32.6	40.4	+24%
> 500	0.9	1.4	+56%
N60 annual 8-hr night			
> 10	178.8	186.2	+4%
> 20	89.0	98.2	+10%
> 50	0.1	0.4	+300%

Table E4 2016 N-contour population changes due to L_{max} revision

Contour scenario	Original pop. (1000's)	Revised pop. (1000's)	Population change (%)
N65 annual 16-hr day			
> 50	492.0	680.9	+38%
> 100	318.7	381.7	+20%
> 200	160.1	225.0	+41%
> 500	0.6	0.8	+33%
N70 annual 16-hr day			
> 50	213.1	266.7	+25%
> 100	117.9	153.4	+30%
> 200	59.5	86.5	+45%
> 500	0.0	< 0.1	(n/a)
N60 annual 8-hr night			
> 10	874.8	890.3	+2%
> 20	437.1	487.4	+12%
> 50	0.0	0.0	(n/a)

(d) Implications of N-contour remodelling on long-term area trends

This section compares the long-term trends when (a) the original and (b) the remodelled N-contour areas are used. **Table E5** summarises the N-contour area changes between 2006 and 2016, assuming the original calculated areas, i.e. without the L_{max} revisions (as presented in the 2016 Noise Contours report, ERCD Report 1701). **Table E6** summarises the N-contour area changes between 2006 and 2016, assuming the remodelled contour areas with the L_{max} revisions.

The percentage area changes from 2006-2016 are broadly similar for N65 and N70 annual 16-hr day, for both the original and remodelled areas. For example, the N65 50 events contour decreases by 15% with the original areas, and decreases by 13% with the remodelled areas, whilst the N70 50 events contour decreases by 11% for both the original and remodelled areas. However, for N60 night, the L_{max} revisions for 2006 and 2016 have the effect of turning an area decrease of 6% at the 10 events level into an area increase of 1%.

It can be concluded that there is a modest effect on the 2006 to 2016 area percentage changes for N65 and N70 annual 16-hr day when revised L_{max} data are used, as contour areas for both years are increased by comparable amounts. For night N60, the area reduction is significantly less when the revised L_{max} data are used because of the noise dominance of the arrival B744R in 2006. Broadly similar results would be expected to be achieved for trends over the period from 2006 to 2017 (or subsequent years).

Table E5 2006 to 2016 N-contour area changes with original areas

Contour scenario	2006 area (km^2)	2016 area (km^2)	Area change (%)
N65 annual 16-hr day			
> 50	223.6	189.5	-15%
> 100	120.3	111.3	-7%
> 200	64.6	60.5	-6%
> 500	10.8	7.2	-33%
N70 annual 16-hr day			
> 50	96.6	85.7	-11%
> 100	58.0	52.2	-10%
> 200	35.0	32.6	-7%
> 500	1.2	0.9	-25%
N60 annual 8-hr night			
> 10	190.2	178.8	-6%
> 20	92.3	89.0	-4%
> 50	3.7	0.1	-97%

Table E6 2006 to 2016 N-contour area changes with remodelled areas

Contour scenario	2006 area (km^2)	2016 area (km^2)	Area change (%)
N65 annual 16-hr day			
> 50	267.2	231.3	-13%
> 100	162.5	139.9	-14%
> 200	83.0	77.0	-7%
> 500	13.2	11.5	-13%
N70 annual 16-hr day			
> 50	119.7	107.1	-11%
> 100	71.4	68.7	-4%
> 200	41.8	40.4	-3%
> 500	2.1	1.4	-33%
N60 annual 8-hr night			
> 10	184.4	186.2	+1%
> 20	89.9	98.2	+9%
> 50	0.5	0.4	-20%

Glossary

Glossary	
AMSL	Above Mean Sea Level
ANCON	The UK civil aircraft noise contour model, developed and maintained by ERCD.
CAA	Civil Aviation Authority
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)
END	Environmental Noise Directive
ERCD	Environmental Research and Consultancy Department
FOPP	Fuel Over Pressure Protector
ICAO	International Civil Aviation Organization
L_{day}	Equivalent sound level of aircraft noise in dBA for the annual average 12-hour day period (0700-1900 local time).
L_{den}	Equivalent sound level of aircraft noise in dBA for the annual average 24-hour period with 5 dB weightings for $L_{evening}$ and 10 dB weightings for L_{night}.
Leq	Equivalent sound level of aircraft noise in dBA, often called ‘equivalent continuous sound level’.
$L_{eq,6.5hr\ night}$	Equivalent sound level of aircraft noise in dBA for the average 6.5-hour night quota period (2330-0600 local time).
$L_{evening}$	Equivalent sound level of aircraft noise in dBA for the annual average 4-hour evening period (1900-2300 local time).
L_{max}/L_{Amax}	Maximum sound level of a noise event in dBA.
L_{night}	Equivalent sound level of aircraft noise in dBA for the annual average 8-hour night period (2300-0700 local time).
N70/N65/N60	Number of aircraft noise events exceeding a maximum sound level (L_{max}) of 70/65/60 dBA.
NTK	Noise and Track Keeping monitoring system.

Glossary	
SEL	Sound Exposure Level
SoNA	Survey of Noise Attitudes