Environmental Research and Consultancy Department
Civil Aviation Authority

ERCD REPORT 1402

Noise Exposure Contours for Gatwick Airport 2013

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Prepared by the Civil Aviation Authority on behalf of the Department for Transport, October 2014

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Summary

This report presents the year 2013 average summer day and night noise exposure contours for London Gatwick Airport. Contours have been generated for the night period (2300-0700 local time) for the first time to meet the requirements of the Aviation Policy Framework published in March 2013.

The 57 dBA Leq day contour area for 2013 based on the actual runway modal split was calculated to be 40.9 km^2, 1% lower than in 2012. The population enclosed within the actual 57 dBA Leq day contour decreased by 11% to 3,250. The 48 dBA Leq night actual contour area was calculated to be 91.8 km^2, enclosing a population of 11,200.

October 2014

The authors of this report are employed by the Civil Aviation Authority. The work reported herein was carried out on behalf of the Department for Transport.

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

Population data used in this report are based on 2011 Census data (updated for 2013) supplied by CACI Information Services.

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Glossary

AIP Aeronautical Information Publication.

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

ATC Air Traffic Control.

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

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

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

DfT Department for Transport (UK Government).

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

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

NPD Noise-Power-Distance.

NPR Noise Preferential Route.

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

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

SEL The Sound Exposure Level of an aircraft noise event is the steady noise level, which over a period of *one second* contains the same sound energy as the whole event. It is equivalent to the Leq of the noise event normalised to one second.

SID Standard Instrument Departure.

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Executive Summary

This report presents the year 2013 average summer day and night noise exposure contours generated for London Gatwick Airport. Night period (2300-0700 local time) contours have been produced for the first time to meet the requirements of the Aviation Policy Framework published in March 2013.

The noise modelling used radar and noise data from Gatwick's Noise and Track Keeping (NTK) system. Mean flight tracks and lateral dispersions for each route, and average flight profiles of aircraft height, speed and thrust for each aircraft type, were calculated using these data.

Analysis of the 2013 summer traffic data for Gatwick revealed that average daily movements for the 16-hour daytime period (706.7) were 3% higher than the previous year (2012: 686.8). There were on average 107.7 movements per 8-hour night over the summer period.

The area of the 2013 day actual modal split (69% west / 31% east) 57 dBA Leq contour decreased by 1% to 40.9 km^2 (2012: 41.2 km^2). The slight area decrease can be attributed primarily to changes in the fleet mix, which saw reductions in EA320C departures offsetting increases in departure movements by the significantly quieter EA319C. The population count within the 2013 day actual 57 dBA contour decreased by 11% to 3,250 (2012: 3,650). This was a consequence of the considerably higher percentage of easterly operations in 2013 (an increase of 18%), which had the effect of pulling the contour away from the populated areas of Lingfield.

The area of the 2013 day standard modal split (74% west / 26% east) 57 dBA Leq contour also decreased, by 1%, to 40.9 km^2. However, the population count within the standard 57 dBA contour was 11% higher than in 2012 at 3,550, a consequence of a slight extension of the contour over parts of Lingfield, as arrival movements increased by 4% in 2013.

The area of the 2013 actual 48 dBA Leq night contour was 91.8 km^2, enclosing a population of 11,200.

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1 Introduction

1.1 Background

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

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

1.1.3 Noise exposure is depicted in the form of noise contours, i.e. lines joining places of constant Leq, akin to the height contours shown on geographical maps or isobars on a weather chart. In the UK, Leq noise contours are normally plotted at levels from 57 to 72 dBA, in 3 dB steps.[1] The 57 dBA level denotes the approximate onset of significant community annoyance.

1.1.4 Following the publication of the Aviation Policy Framework in March 2013 (**Ref 2**), there is now a commitment by the DfT to produce night (2300-0700) noise contours on an annual basis for the designated airports. So for the first time this year, 8-hour night Leq contours have also been calculated for Gatwick from 48 to 72 dBA in 3 dB steps in accordance with standard practice.

1.1.5 This report contains small-scale diagrams of the year 2013 Gatwick Leq contours overlaid onto Ordnance Survey® (OS) base maps. Diagrams in Adobe® PDF and AutoCAD DXF format are also available for download from the DfT website[2].

1.1.6 The objectives of this report are to explain the noise modelling methodology used to produce the year 2013 day and night Leq contours for Gatwick Airport, to present the calculated noise contours and to assess the changes from the previous year (**Ref 3**).

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[1] Aircraft noise contours are also produced on behalf of airports for the specific purpose of meeting the requirements of the Environmental Noise (England) Regulations 2006, which implemented Directive 2002/49/EC, Assessment and Management of Environmental Noise, in England. These are based on annual average values and require the use of different parameters (L_{day}, $L_{evening}$, L_{night}, $L_{eq,16hr}$ and L_{den} at 5 dB steps), so it is not possible to draw meaningful conclusions between the two types of contour maps. Further details about Directive 2002/49/EC are available on the Department for Environment, Food and Rural Affairs website at *www.gov.uk/defra* as well as ERCD Reports 1204, 1205 and 1206 (available from *www.caa.co.uk*), which cover Heathrow, Gatwick and Stansted 2011 noise mapping respectively.

[2] www.gov.uk/dft

1.2 Gatwick Airport

1.2.1 Gatwick Airport is located approximately 28 miles (45 km) south of London and about 2 miles (3 km) north of Crawley. Aside from the nearby towns of Crawley and Horley it is situated in mostly lightly populated countryside (**Figure 1**).

1.2.2 Gatwick Airport has one main runway, designated 08R/26L, which is 3,316 m long. The Runway 26L landing threshold[3] is displaced by 424 m, and the Runway 08R landing threshold displaced by 393 m. There is also one standby runway (08L/26R) that can be used if the main runway is out of operation, for example, due to maintenance work. There are two passenger terminals. The layout of the runways, taxiways and passenger terminals in 2013 is shown in **Figure 2**.[4]

1.2.3 In the 2013 calendar year there were 251,000 aircraft movements (2012: 247,000) at Gatwick Airport, handling 35.4 million passengers (2012: 34.2 million).[5]

[3] The runway threshold marks the beginning of the runway available for landing aircraft. A *displaced* threshold is a runway threshold that is not located at the physical end of the runway. A displaced threshold is often employed to give arriving aircraft sufficient clearance over an obstacle.

[4] UK AIP (25 Jul 2013) AD 2-EGKK-2-1

[5] Source: Civil Aviation Authority (www.caa.co.uk/airportstatistics)

2 Noise contour modelling methodology

2.1 ANCON noise model

2.1.1 Leq noise contours were calculated with the UK civil aircraft noise model ANCON (version 2.3), which is developed and maintained by ERCD on behalf of the DfT. A technical description of ANCON is provided in R&D Report 9842 (**Ref 4**). The ANCON model is also used for the production of annual contours for Heathrow and Stansted airports, and a number of other UK airports.

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

2.2 Radar data

2.2.1 The noise modelling carried out by ERCD made extensive use of radar data extracted from Gatwick Airport's Noise and Track Keeping (NTK) system. Most large airports have NTK systems, which take data from Air Traffic Control (ATC) radars and combine them with flight information such as call sign, tail number, type and destination. Analyses of departure and arrival flight tracks, and flight profiles, were based on year 2013 summer radar data.

2.3 Flight tracks

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

2.3.2 Associated with each NPR is a lateral swathe, which is defined by a pair of lines that diverge at 10 degrees from a point 2,000 m from start-of-roll, leading to a corridor extending 1.5 km either side of the nominal NPR centreline. Within this swathe the aircraft are considered to be flying on-track. The swathe takes account of various factors that affect track-keeping, including tolerances in navigational equipment, type and weight of aircraft, and weather conditions – particularly winds that may cause drifting when aircraft are turning. Aircraft reaching an altitude of 4,000 ft at any point along an NPR may be turned off the route by ATC onto more direct headings to their destinations – a practice known as 'vectoring'. ATC may

also vector aircraft from NPRs below this altitude for safety reasons, including in certain weather conditions (for example, to avoid storms).

2.3.3 Departure and arrival flight tracks were modelled using radar data extracted from the Gatwick NTK system over the 92-day summer period, 16 June to 15 September 2013. Mean flight tracks were calculated from 24-hour data this time since both day and night contours were being produced (in previous years only daytime radar data were employed).

2.3.4 **Figure 4** shows a sample of radar flight tracks from a day in June 2013. In-house radar analysis software was used to calculate mean departure flight tracks and associated lateral dispersions for each NPR/SID. Arrival tracks for Runways 08R and 26L were modelled using evenly spaced 'spurs' about the extended runway centrelines. The majority of arriving aircraft joined the centrelines at distances between 14 and 28 km from threshold for Runway 08R and between 15 and 29 km from threshold for Runway 26L.

2.4 Flight profiles

2.4.1 For each ANCON aircraft type, average flight profiles of height, speed and thrust versus track distance (for departures and arrivals separately) were reviewed and updated where necessary, using year 2013 summer radar data. The engine power settings required for the aircraft to follow the average height and speed profiles were calculated from data describing aircraft performance characteristics within each of the different aircraft type categories.

2.4.2 As for previous years, daytime flight profiles were generated as described above. Following a check on night-time profile data, it was concluded that the profiles generated from the daytime data were appropriate for use with the night contours.

2.4.3 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.

2.5 Noise emissions

2.5.1 At Gatwick, the NTK system captures data from both fixed and mobile noise monitors around the airport. Noise event data for individual aircraft operations are then matched to operational data provided by the airport. The Gatwick NTK system employs 5 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.[6]

[6] Further information on the noise monitors can be found in CAP 1149 (**Ref 6**).

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

2.5.3 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 – the so-called '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.

2.6 Traffic distributions

2.6.1 The Leq contours are based on the daily average movements that take place during the 16-hour day (0700-2300 local time) and 8-hour night (2300-0700 local time), over the 92-day summer period from 16 June to 15 September inclusive. The source of this information is the NTK system, which stores radar data supplemented by daily flight plans. Traffic statistics from NTK data were cross-checked with runway logs supplied by NATS[9] and close agreement was found.

Daytime traffic distribution by noise class

2.6.2 The average number of daily movements at Gatwick over the 2013 summer day period (706.7) was 3% higher than in the previous year (2012: 686.8).

2.6.3 **Table 1a** lists the average summer day movements[10] by 8 noise classes of aircraft, ranked in ascending order of noise emission, i.e. from least to most noisy, in 2012 and 2013. As in 2012, the majority of movements (87%) were by short-haul 'Chapter 3' and 'Chapter 4'[11] jet aircraft (Noise Class 3), the numbers of which were up by 6% in 2013, the largest increase out of all the noise classes

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

[8] 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.

[9] NATS is the provider of air traffic control services to Gatwick Airport.

[10] Includes departures and arrivals.

[11] Aircraft whose certificated noise levels are classified by the ICAO *Standards and Recommended Practices – Aircraft Noise: Annex 16 to the Convention on International Civil Aviation* into 'Chapter 3' and 'Chapter 4' types - these are typically characterised by modern, quieter, high-bypass turbofan aircraft.

(note: in 2013 an estimated 87% of the aircraft within Noise Class 3 for the daytime period were compliant with the 'Chapter 4' noise standard).

2.6.4 Movements by wide-body twin-engine aircraft (Noise Class 4) were 4% lower in 2013. However, wide-body 3/4-engine aircraft (Noise Class 5) numbers decreased by 9%, although they comprised just 1% of total movements. Around 5% of movements were by large propeller aircraft (Noise Class 2), the numbers of which dropped substantially, by 32%. The numbers of aircraft within Noise Classes 1 and 7 were insignificant, and there were no movements in Noise Classes 6 and 8.

2.6.5 **Figure 5** illustrates the changing distribution of traffic among the 8 noise classes over the period from 1988 to 2013 inclusive. The shift over the years to increasingly higher proportions of short-haul Chapter 3 & 4 aircraft (Noise Class 3) can be clearly seen.

Night-time traffic distribution by noise class

2.6.6 The average number of movements was 107.7 per night, of which 59% were arrivals.

2.6.7 **Table 1b** lists the average summer night movements by 8 noise classes of aircraft, ranked in ascending order of noise emission, i.e. from least to most noisy, in 2013. Short-haul 'Chapter 3' and 'Chapter 4' jet aircraft (Noise Class 3) formed the highest proportion of movements (90%). (Note: in 2013 an estimated 93% of the aircraft within Noise Class 3 for the night period were compliant with the 'Chapter 4' noise standard).

Daytime traffic distribution by ANCON aircraft type

2.6.8 A more detailed breakdown of the year 2013 average summer day movements, indicating the ANCON types that fall into each noise class, is provided in **Table 2a**. The largest increase in movements was for the ANCON type EA319C (Noise Class 3), up by 41 movements per day (note: ANCON type descriptions can be found in **Table 2a**). There were also notable increases in Noise Class 3 for the B738 (up by 17 movements) and the EA321V (up by 10 movements). These were offset by decreases for the B733, down by 17 movements per day, and the EA320C, down by 16 movements per day. Outside of Noise Class 3, movements of the LTT were down by 15 per day.

2.6.9 **Figure 6a** illustrates the numbers of movements by ANCON aircraft type for the 2013 average summer day. It can be seen that in 2013 the EA319C was by far the most frequent ANCON aircraft type at Gatwick with 230 daily movements (33% of total movements). This was followed by the EA320C with 96 movements (14% of total movements), the B733 with 86 movements (12% of total movements) and the B738 with 84 movements (12% of total movements).

2.6.10 The noise dominant ANCON types at Gatwick in 2013 were the EA319C, EA320C, B733 and B738. They were responsible for the highest contributions of 'noise energy', which is a function of both aircraft noise level and movement numbers.

Night-time traffic distribution by ANCON aircraft type

2.6.11 A more detailed breakdown of the year 2013 average summer night movements, indicating the ANCON types that fall into each noise class, is provided in **Table 2b**.

2.6.12 **Figure 6b** illustrates the numbers of movements by ANCON aircraft type for the 2013 average summer night. Movements were dominated by two types: the EA320C and EA319C, both with 26 movements per night.

Daytime traffic distribution by SID route

2.6.13 **Figure 7a** shows the distribution of aircraft departures by SID route for the 2013 summer day period, including figures from 2012 for comparison. The 'wraparound' route LAM/BIG/CLN/DVR from Runway 26L had the highest loading of departure traffic (30%). This was followed by the HAR/BOG route from Runway 26L with 20% of the traffic and the 26L KEN/SAM route (19%). Movements decreased by up to 8% on each of the above 26L SID routes. There were increases in traffic of up to 5% on each of the Runway 08R SIDs.

Night-time traffic distribution by SID route

2.6.14 **Figure 7b** shows the distribution of aircraft departures by SID route for the 2013 summer night period. The 'wraparound' route LAM/BIG/CLN/DVR from Runway 26L had the highest loading of departure traffic (28%). This was followed by the HAR/BOG route from Runway 26L with 26% of departures and the 26L KEN/SAM route (14%).

2.7 Runway modal splits

2.7.1 In general, aircraft will take-off and land into a headwind to maximise lift during take-off and landing. The wind direction, which varies over the course of a year, will therefore have an important influence on the usage of runways. The ratio of westerly (Runway 26L) and easterly (Runway 08R) operations is referred to as the *runway modal split*.

2.7.2 Two sets of contours have been produced for the year 2013 summer day:

(i) Contours using the 'actual' modal split over the Leq day period; and

(ii) Contours 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 2013, this is the 20-year period from 1994 to 2013. Use of the standard modal split enables year-on-year comparisons without the runway usage significantly affecting the contour shape.

2.7.3 The actual and standard daytime modal splits for 2013, together with the previous year, are summarised in the following table:

Gatwick summer day runway modal splits for 2013 and 2012

Modal split scenario	**% west (Runway 26L)**	**% east (Runway 08R)**
Actual 2013	69%	31%
Actual 2012	87%	13%
Standard 2013	74%	26%
Standard 2012	74%	26%

2.7.4 The 2013 proportion of actual westerly operations (69%) was 18% lower than in 2012. However, the 2013 standard modal split was the same as in 2012. Historical runway modal splits at Gatwick for the past 20 years are summarised in **Figure 8**.

2.7.5 The night-time actual runway modal split for the 2013 summer period was 73% west / 27% east.

2.8 Topography

2.8.1 The topography around Gatwick Airport was modelled by accounting for terrain height, and is of particular relevance on the western side of the airport around the high ground in the vicinity of Russ Hill (near Charlwood). This was achieved by geometrical corrections for source-receiver distance and elevation angles. Other, more complex effects, such as lateral attenuation from uneven ground surfaces and noise screening/reflection effects due to topographical features, were not taken into account.

2.8.2 ERCD holds OS terrain height data[12] on a 200 m by 200 m 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. The terrain heights in the vicinity of Gatwick Airport are depicted diagrammatically in **Figure 9**.

[12] Meridian™ 2

2.9 Population and 'Points of Interest' databases

2.9.1 Estimates were made of the numbers of people and households enclosed within the noise contours. The population data used in this report are a 2013 update of the 2011 Census supplied by CACI Limited[13]. It should be noted that the population database used for the year 2012 contours was a 2012 update of the earlier 2001 Census (i.e. the most up-to-date database available at the time). Within the extent of the 2013 actual 57 dBA contour, the population count with the 2013 population database was only 1% higher than that using the previous 2012 database, so the effect of the 2013 database update was of marginal significance at Gatwick.

2.9.2 The CACI population database contains data referenced at the postcode level. Population and household numbers associated with each postcode are assigned to a single co-ordinate located at the postcode's centroid. The postcode data points and associated population counts for the area around Gatwick Airport are illustrated in **Figure 10**.

2.9.3 Estimates have also been made of the numbers of noise sensitive buildings situated within the daytime contours, using the *InterestMap*™[14] 'Points of Interest' (2013) database. For the purposes of this study, the noise sensitive buildings that have been considered are schools, hospitals and places of worship.

[13] www.caci.co.uk

[14] InterestMap™ is distributed by Landmark Information Group Ltd and derived from Ordnance Survey 'Points of Interest' data.

3 Noise contour results

3.1 Day actual modal split contours

3.1.1 The Gatwick 2013 day Leq noise contours generated with the actual 2013 summer day period runway modal split (69% west / 31% east) are shown in **Figure 11a**. The contours are plotted from 57 to 72 dBA at 3 dB intervals.

3.1.2 The cumulative areas, populations and households within the 2013 day actual modal split contours are provided in the table below:

Gatwick 2013 day actual contours – area, population and household estimates

Leq (dBA)	Area (km^2)	Population	Households
> 57	40.9	3,250	1,350
> 60	23.1	1,250	500
> 63	12.5	350	150
> 66	6.7	150	100
> 69	3.5	0	0
> 72	1.9	0	0

Note: Populations and households are given to the nearest 50.

3.1.3 Estimates of the cumulative numbers of noise sensitive buildings within the 2013 day actual modal split contours are provided in the table below:

Gatwick 2013 day actual contours – noise sensitive building estimates

Leq (dBA)	Schools	Hospitals	Places of worship
> 57	3	0	2
> 60	2	0	2
> 63	2	0	2
> 66	1	0	2
> 69	0	0	0
> 72	0	0	0

3.2 Night actual modal split contours

3.2.1 The Gatwick 2013 night Leq noise contours generated with the actual 2013 summer night period runway modal split (73% west / 27% east) are shown in **Figure 11b**. The contours are plotted from 48 to 66 dBA at 3 dB intervals (note: the 69 and 72 dBA contours have been omitted to improve clarity).

3.2.2 The cumulative areas, populations and households within the 2013 night actual modal split contours are provided in the following table:

Gatwick 2013 night actual contours – area, population and household estimates

Leq (dBA)	Area (km^2)	Population	Households
> 48	91.8	11,200	4,400
> 51	47.7	5,050	2,000
> 54	25.9	1,550	650
> 57	13.9	450	200
> 60	7.2	150	100
> 63	3.8	50	50
> 66	2.0	0	0
> 69	1.2	0	0
> 72	0.7	0	0

Note: Populations and households are given to the nearest 50.

3.2.3 The 2013 night actual modal split 48 dBA contour enclosed an area of 91.8 km^2 and a population of 11,200.

3.3 Day standard modal split contours

3.3.1 The Gatwick 2013 day Leq noise contours generated with the standard 2013 summer day period runway modal split (74% west / 26% east) are shown in **Figure 12**. The contours are plotted from 57 to 72 dBA at 3 dB intervals.

3.3.2 The cumulative areas, populations and households within the 2013 day standard modal split contours are provided in the following table:

Gatwick 2013 day standard contours - area, population and household estimates

Leq (dBA)	Area (km^2)	Population	Households
> 57	40.9	3,550	1,500
> 60	23.0	1,200	500
> 63	12.5	350	150
> 66	6.7	150	100
> 69	3.5	0	0
> 72	1.9	0	0

Note: Populations and households are given to the nearest 50.

3.3.3 Estimates of the cumulative numbers of noise sensitive buildings within the 2013 day standard modal split contours are provided in the table below:

Gatwick 2013 day standard contours - noise sensitive building estimates

Leq (dBA)	Schools	Hospitals	Places of worship
> 57	3	0	2
> 60	2	0	2
> 63	2	0	2
> 66	1	0	2
> 69	0	0	0
> 72	0	0	0

4 Analysis of results

4.1 Day actual modal split contours – comparison with 2012 contours

4.1.1 The Gatwick 2013 day actual modal split Leq contours are compared against the 2012 actual Leq contours in **Figure 13**. The table below summarises the areas, populations and percentage changes from 2012 to 2013:

Gatwick day actual contours - areas and populations for 2012 and 2013

Leq (dBA)	2012 Area (km^2)	2013 Area (km^2)	Area change (%)	2012 Pop.	2013 Pop.	Pop. change (%)
> 57	41.2	40.9	-1%	3,650	3,250	-11%
> 60	23.3	23.1	-1%	1,150	1,250	+9%
> 63	12.8	12.5	-2%	400	350	-13%
> 66	6.9	6.7	-3%	150	150	0%
> 69	3.7	3.5	-5%	< 50	0	(n/a)
> 72	2.0	1.9	-5%	0	0	(n/a)

Note: the 2012 and 2013 actual runway modal splits were 87% west / 13% east and 69% west / 31% east respectively.

4.1.2 Despite the 3% increase in total movements, there were small decreases in area at all contour levels. This can be attributed mainly to the reduction in departure movements (-10) by one of the noise dominant types, the EA320C, which to a large extent offset increases in departure movements (+20) by the significantly quieter EA319C aircraft. In addition, some updates to the flight profiles in 2013 for the top two noise dominant types, the EA319C and EA320C, led to slightly smaller departure noise footprints for these aircraft, which in turn reduced the contour areas further.

4.1.3 It should be noted that percentage changes in contour areas are not necessarily accompanied by similar changes in enclosed population because of the uneven distribution of populations around the airport. This effect can be seen at the 57 dBA contour level, where the higher percentage of easterly movements in 2013 causes the eastern contour tip (which is dominated by westerly arrivals) to shift away from Lingfield, thus producing a marked decrease (-11%) in the population enclosed.

4.2 Day standard modal split contours – comparison with 2012 contours

4.2.1 The Gatwick 2013 day standard modal split Leq contours are compared against the 2012 day standard Leq contours in **Figure 14**. The following table summarises the areas, populations and percentage changes from 2012 to 2013:

Gatwick day standard contours - areas and populations for 2012 and 2013

Leq (dBA)	2012 Area (km^2)	2013 Area (km^2)	Area change (%)	2012 Pop.	2013 Pop.	Pop. change (%)
> 57	41.2	40.9	-1%	3,200	3,550	+11%
> 60	23.4	23.0	-2%	1,250	1,200	-4%
> 63	12.8	12.5	-2%	350	350	0%
> 66	6.9	6.7	-3%	150	150	0%
> 69	3.6	3.5	-3%	< 50	0	(n/a)
> 72	2.0	1.9	-5%	0	0	(n/a)

Note: the standard runway modal split was 74% west / 26% east in both 2012 and 2013.

4.2.2 The standard modal split 57 dBA contour area fell by 1% in 2013, with decreases also seen at the higher contour levels. The reason for this change is the same as for the actual modal split contours (see section 4.1.2).

4.2.3 The population within the 57 dBA contour was 11% higher in 2013 and caused by an elongation of the eastern contour tip over Lingfield in 2013. This resulted from an overall 4% increase in arrival movements in 2013, which included a large increase in EA319C landings (+22%). At the higher contour levels the populations enclosed were lower or unchanged.

4.2.4 The standard contours normally provide a clearer indication than the actual contours of 'fleet noise level' changes from year to year because they minimise the effect of any difference between the ratios of westerly to easterly operations.

4.3 Day noise contour historical trend

4.3.1 **Figure 15** shows how the 57 dBA Leq day actual modal split contour has changed in area and population terms since 1988 by comparison with the total annual (365-day) aircraft movements. (Actual modal split data are used in this figure because standard modal split contours were not produced prior to 1995).

Movement trend

4.3.2 Aircraft movements reached a low in 1991 (the year of the First Gulf War) and did not return to 1990 levels until 1995. From 1995 to 2000 they increased steadily. From 2000 to 2002 movements decreased, possibly as a consequence of the terrorist attacks on 11 September 2001. There was little change in the total annual number of movements from 2002 to 2003, but annual movements rose steadily

from 2004 to 2007. However, the annual movement figure for 2008 fell by 1% from 2007 - this may be attributed to the fluctuating oil price and economic downturn. The annual movements fell even further in 2009, by 4%, as the global recession continued to impact upon the aviation industry.

4.3.3 Movements dropped for the third year in a row in 2010, by a further 5%. This was due in part to the volcanic ash crisis in April and adverse winter weather conditions. However, there was a recovery in 2011 from the adverse events of the previous year as traffic levels rose by 4%. In 2012 traffic levels fell by about 2% following a significant drop in charter flights at Gatwick. However, movement numbers recovered by about 2% in 2013.

Area and population trend

4.3.4 From 1988 to 1993, the area within the 57 dBA Leq contour diminished markedly and then increased slightly until 1996. From 1996 onwards the area decreased slightly each year but levelled off between 1999 and 2000. In 2001 the area decreased by 22% relative to the previous year and in 2002 the contour area decreased by 19% relative to 2001. From 2002 to 2008 the contour area fluctuated within a narrow range from 45 to 49 km^2. However, the area fell below this range to 41 km^2 in 2009, and dropped further in 2010 to 39.6 km^2, the smallest ever area calculated for Gatwick. The contour area increased slightly in 2011 to 40.4 km^2 as movements recovered. In 2012 the area was again slightly higher, this time mainly due to some changes in the fleet mix. The 2013 contour area reduced slightly from 2012 despite a rise in movements, largely because of fleet mix changes in favour of quieter types.

4.3.5 The population numbers within the contours have generally moved in line with the areas, dropping to the lowest ever level in 2010, but increasing again in 2011. The marked rise in population for 2012 was largely the result of the contour extending over a densely populated area (Lingfield). In 2013 the population dropped significantly as the higher proportion of easterly movements meant that the contour moved away from Lingfield.

5 Conclusions

5.1 Year 2013 average summer 16-hour day and 8-hour night Leq noise exposure contours have been generated for Gatwick Airport using the ANCON noise model.

5.2 The results show that the actual modal split 57 dBA Leq day contour area decreased by 1% to 40.9 km^2 in 2013 (2012: 41.2 km^2), despite total movements increasing by 3% in 2013. The decrease in area can be attributed mainly to reductions in departure movements of the EA320C, which largely offset the effects of an increase in EA319C departures. The population within the actual 57 dBA Leq contour decreased by 11% compared to 2012 - this was due to a much higher percentage of easterly operations in 2013 (+18%), which shifted the contour away from Lingfield.

5.3 The 2013 standard 57 dBA Leq day contour area decreased by 1% to 40.9 km^2, (2012: 41.2 km^2). The area decreased for the same reasons as the actual modal split contours. However, the population enclosed by the 2013 standard 57 dBA Leq contour was 11% higher than in 2012. There were 4% more arrival movements in 2013, which extended the contour to the east of the airport over populated parts of Lingfield.

5.4 Night period Leq contours for 2013 have been produced for the first time. The actual modal split 48 dBA contour enclosed an area of 91.8 km^2 with a population of 11,200.

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Table 1a Gatwick 2012 and 2013 average summer day movements by noise class

Noise Class	Description	2012	2013	Percentage of total 2013 movements	Change
PROPELLER AIRCRAFT					
1	Small propeller aircraft	0.1	0.2	< 0.1%	+0.1 (*)
2	Large propeller aircraft	46.5	31.7	4.5%	-14.8 (-32%)
CHAPTER 3/4 JETS **					
3	Short-haul aircraft	579.7	617.2	87.3%	+37.5 (+6%)
4	Wide-body twin-engine aircraft	50.8	48.9	6.9%	-1.9 (-4%)
5	2nd generation wide-body 3,4-engine aircraft	9.6	8.7	1.2%	-0.9 (-9%)
LARGE CHAPTER 2/3 JETS					
6	1st generation wide-body 3,4-engine aircraft	0.0	0.0	0.0%	0.0 (*)
2nd GENERATION TWIN JETS					
7	Narrow-body twin-engine aircraft *(including Ch.2 and hushkitted versions)*	0.0	< 0.1	< 0.1%	0.0 (*)
1st GENERATION JETS					
8	Narrow-body 3,4-engine aircraft	< 0.1	0.0	0.0%	0.0 (*)
	TOTAL	686.8	**706.7**	100%	**+19.9 (+3%)**

* Percentage changes not shown due to low numbers and limited data resolution.
** An estimated 87% of *Noise Class 3* aircraft in 2013 met the 'Chapter 4' noise standard (2012: 82%).

Note: Totals may not sum exactly due to rounding.

Table 1b Gatwick 2013 average summer night movements by noise class

Noise Class	Description	2013 movements	Percentage of total 2013 movements
PROPELLER AIRCRAFT			
1	Small propeller aircraft	0.1	0.1%
2	Large propeller aircraft	0.1	0.1%
CHAPTER 3/4 JETS *			
3	Short-haul aircraft	96.7	89.8%
4	Wide-body twin-engine aircraft	10.2	9.5%
5	2nd generation wide-body 3,4-engine aircraft	0.6	0.5%
LARGE CHAPTER 2/3 JETS			
6	1st generation wide-body 3,4-engine aircraft	0.0	0.0%
2nd GENERATION TWIN JETS			
7	Narrow-body twin-engine aircraft *(including Ch.2 and hushkitted versions)*	0.0	0.0%
1st GENERATION JETS			
8	Narrow-body 3,4-engine aircraft	< 0.1	< 0.1%
	TOTAL	**107.7**	100%

* An estimated 93% of *Noise Class 3* aircraft in 2013 met the 'Chapter 4' noise standard.

Note: Totals may not sum exactly due to rounding.

Table 2a Gatwick 2012 and 2013 average summer day movements by ANCON aircraft type

Aircraft type	Noise class	ANCON type	2012	2013	Change
Single piston propeller	1	SP	< 0.1	< 0.1	0.0
Small twin-piston propeller	1	STP	0.0	< 0.1	0.0
Small twin-turboprop	1	STT	0.1	0.1	0.0
Large twin-turboprop	2	LTT	46.5	31.7	-14.8
Large four-engine propeller	2	L4P	0.0	< 0.1	0.0
Boeing 737-300/400/500	3	B733	102.6	86.0	-16.6
Boeing 737-600/700	3	B736	3.6	0.4	-3.2
Boeing 737-800/900	3	B738	67.5	84.2	+16.7
Boeing 757-200 (RB211-535E4/E4B engines)	3	B757E	29.2	24.8	-4.4
Boeing 757-200 (PW2037/2040 engines)	3	B757P	0.1	0.1	0.0
Boeing 757-300	3	B753	2.9	3.0	+0.1
BAe 146/Avro RJ	3	BA46	1.0	0.6	-0.4
Airbus A318	3	EA318	0.1	0.1	0.0
Airbus A319 (CFM-56 engines)	3	EA319C	189.8	230.3	+40.5
Airbus A319 (IAE-V2500 engines)	3	EA319V	16.3	18.2	+1.9
Airbus A320 (CFM-56 engines)	3	EA320C	112.1	95.7	-16.4
Airbus A320 (IAE-V2500 engines)	3	EA320V	2.4	10.0	+7.6
Airbus A321 (CFM-56 engines)	3	EA321C	3.4	0.2	-3.2
Airbus A321 (IAE-V2500 engines)	3	EA321V	16.5	26.7	+10.2
Executive Business Jet (Chapter 3)	3	EXE3	3.7	3.0	-0.7
Bombardier Regional Jet 100/200	3	CRJ	0.1	< 0.1	-0.1
Bombardier Regional Jet 700	3	CRJ700	0.1	0.0	-0.1
Bombardier Regional Jet 900	3	CRJ900	0.2	0.3	+0.1
Embraer 135/145	3	ERJ	0.2	0.2	0.0
Embraer 170	3	ERJ170	11.1	18.4	+7.3
Embraer 190	3	ERJ190	15.8	12.7	-3.1
Fokker 100	3	FK10	0.8	0.8	0.0
McDonnell Douglas MD80 series	3	MD80	0.1	1.5	+1.4
Boeing 767-200	4	B762	0.1	0.0	-0.1
Boeing 767-300 (GE CF6-80 engines)	4	B763G	7.3	7.7	+0.4
Boeing 767-300 (PW4000 engines)	4	B763P	1.7	0.8	-0.9
Boeing 767-300 (RR RB211 engines)	4	B763R	< 0.1	0.0	0.0
Boeing 777-200 (GE GE90 engines)	4	B772G	11.5	11.8	+0.3
Boeing 777-200 (PW400 engines)	4	B772P	0.9	0.1	-0.8
Boeing 777-200 (RR Trent 800 engines)	4	B772R	3.7	3.2	-0.5
Boeing 777-200LR/300ER (GE GE90 engines)	4	B773G	4.5	4.9	+0.4
Boeing 777-300 (RR Trent 800 engines)	4	B773R	0.1	0.6	+0.5
Boeing 787-8	4	B788	0.0	4.3	+4.3
Airbus A300	4	EA30	5.2	2.7	-2.5
Airbus A310	4	EA31	1.2	1.2	0.0
Airbus A330	4	EA33	14.6	11.5	-3.1
Airbus A340-200/300	5	EA34	0.3	0.1	-0.2
Airbus A340-500/600	5	EA346	< 0.1	0.2	+0.2
Airbus A380 (Engine Alliance GP7000 engines)	5	EA38GP	< 0.1	0.0	0.0
Airbus A380 (RR Trent 900 engines)	5	EA38R	0.0	< 0.1	0.0
Boeing 747-400 (GE CF6-80F engines)	5	B744G	9.3	8.4	-0.9

Aircraft type	Noise class	ANCON type	2012	2013	Change
Boeing 747-400 (RR RB211 engines)	5	B744R	0.0	< 0.1	0.0
Executive Business Jet (Chapter 2)	7	EXE2	0.0	< 0.1	0.0
Ilyushin Il-62	8	IL62	< 0.1	0.0	0.0
		TOTAL	686.8	**706.7**	**+19.9 (+3%)**

Note: Totals may not sum exactly due to rounding.

Table 2b Gatwick 2013 average summer night movements by ANCON aircraft type

Aircraft type	Noise class	ANCON type	Movements
Small twin-piston propeller	1	STP	< 0.1
Small twin-turboprop	1	STT	0.1
Large twin-turboprop	2	LTT	0.1
Large four-engine propeller	2	L4P	< 0.1
Boeing 737-300/400/500	3	B733	8.4
Boeing 737-600/700	3	B736	< 0.1
Boeing 737-800/900	3	B738	12.5
Boeing 757-200 (RB211-535E4/E4B engines)	3	B757E	10.3
Boeing 757-300	3	B753	1.4
BAe 146/Avro RJ	3	BA46	< 0.1
Airbus A318	3	EA318	< 0.1
Airbus A319 (CFM-56 engines)	3	EA319C	26.1
Airbus A319 (IAE-V2500 engines)	3	EA319V	1.6
Airbus A320 (CFM-56 engines)	3	EA320C	26.3
Airbus A320 (IAE-V2500 engines)	3	EA320V	1.5
Airbus A321 (CFM56 engines)	3	EA321C	0.1
Airbus A321 (IAE-V2500 engines)	3	EA321V	7.9
Executive Business Jet (Chapter 3)	3	EXE3	0.3
Bombardier Regional Jet 900	3	CRJ900	< 0.1
Embraer ERJ 135/145	3	ERJ	0.1
Embraer ERJ 190	3	ERJ190	0.3
Boeing 767-200	4	B762	< 0.1
Boeing 767-300 (GE CF6-80 engines)	4	B763G	2.0
Boeing 777-200 (GE GE90 engines)	4	B772G	2.4
Boeing 777-200 (PW PW4000 engines)	4	B772P	0.1
Boeing 777-200 (RR Trent 800 engines)	4	B772R	0.2
Boeing 777-200LR/300ER (GE GE90 engines)	4	B773G	0.4
Boeing 777-300 (RR Trent 800 engines)	4	B773R	0.1
Boeing 787-8/9/10	4	B788	0.9
Airbus A300	4	EA30	0.6
Airbus A310	4	EA31	< 0.1
Airbus A330	4	EA33	3.6
Airbus A340-200/300	5	EA34	< 0.1
Airbus A340-500/600	5	EA346	< 0.1
Boeing 747-400 (GE CF6-80F engines)	5	B744G	0.5
Boeing 747-400 (RR RB211 engines)	5	B744R	< 0.1
Boeing 727 (Chapter 3)	8	B727	< 0.1
		TOTAL	**107.7**

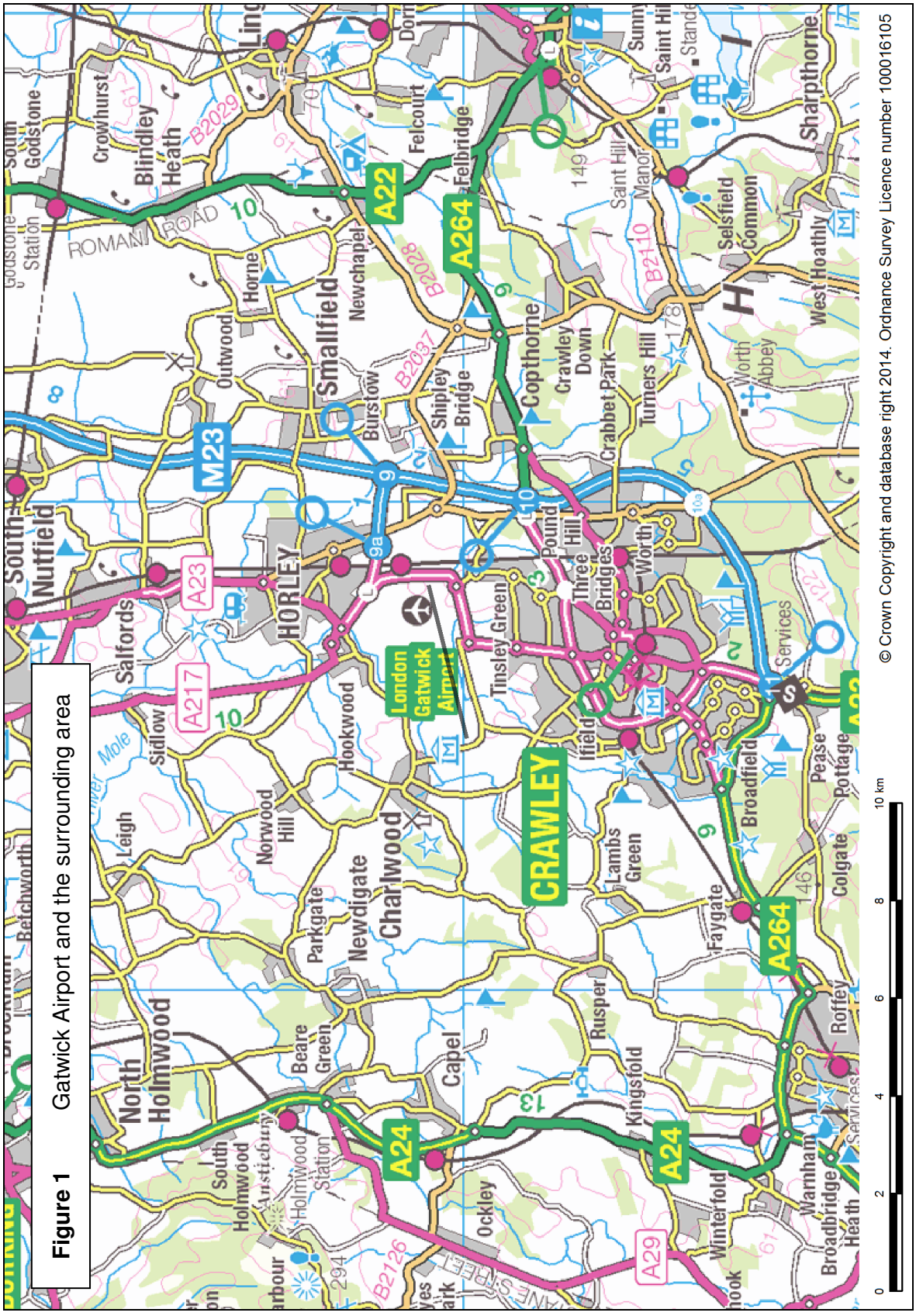


Figure 1 Gatwick Airport and the surrounding area

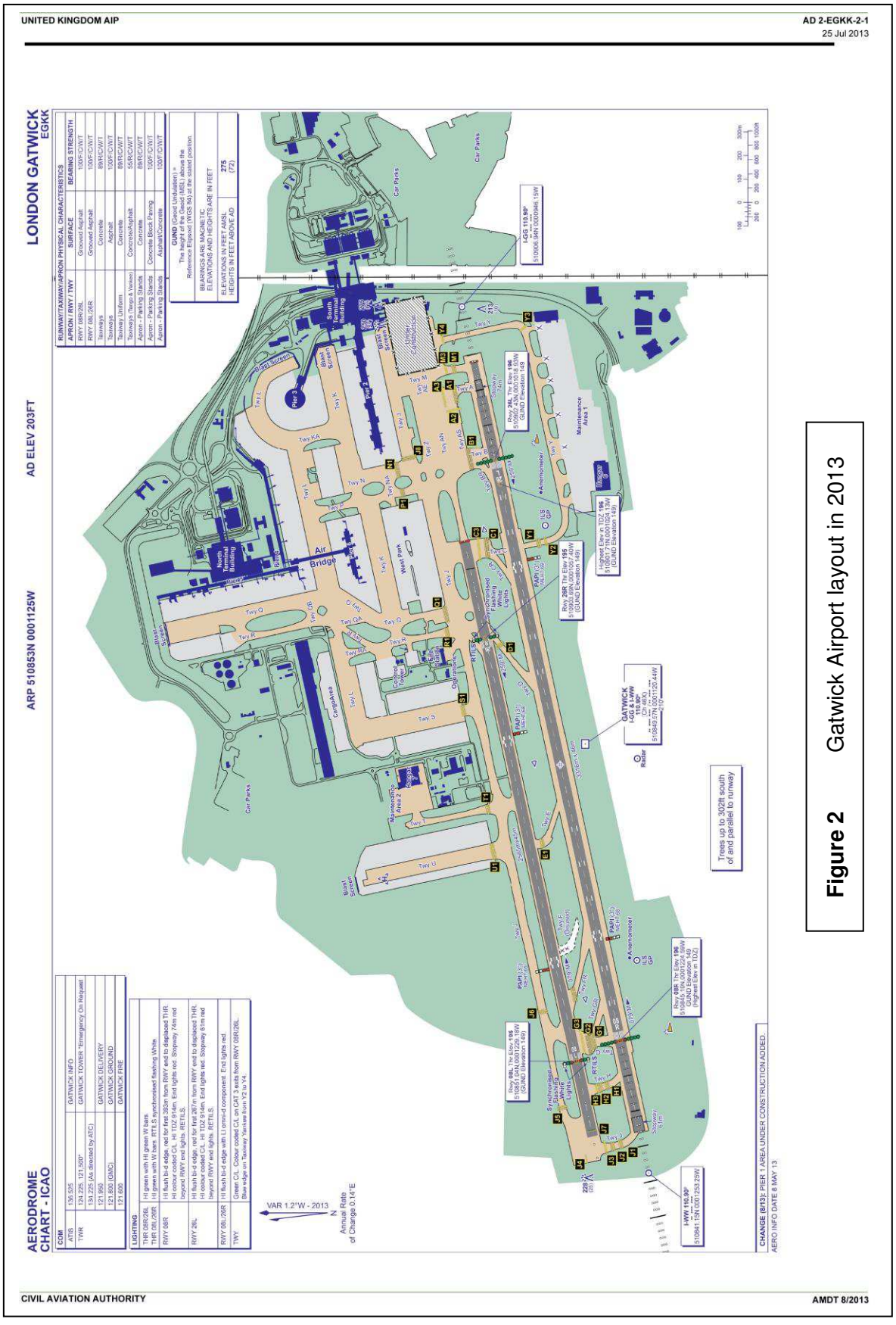


Figure 2 Gatwick Airport layout in 2013

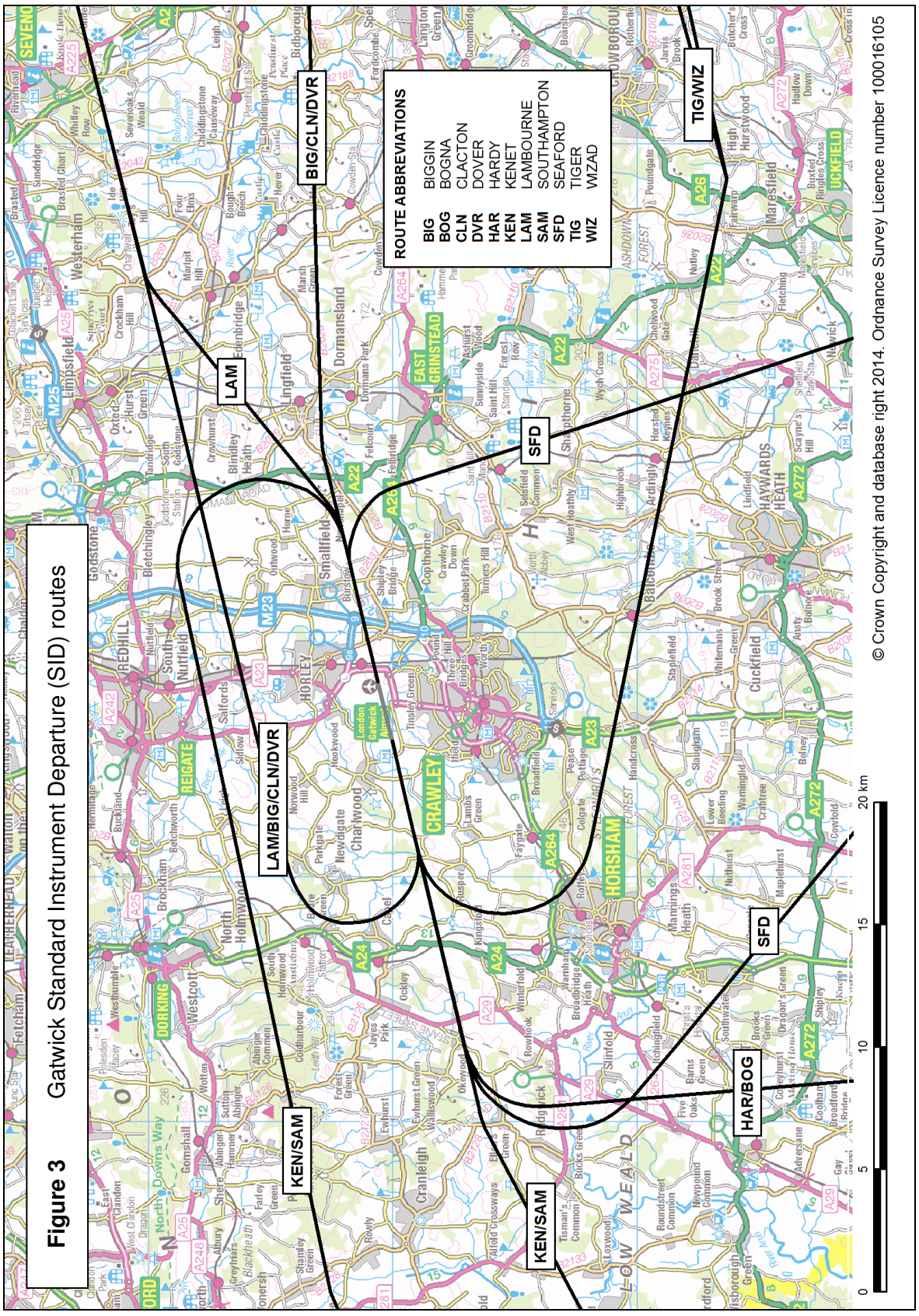


Figure 3 Gatwick Standard Instrument Departure (SID) routes

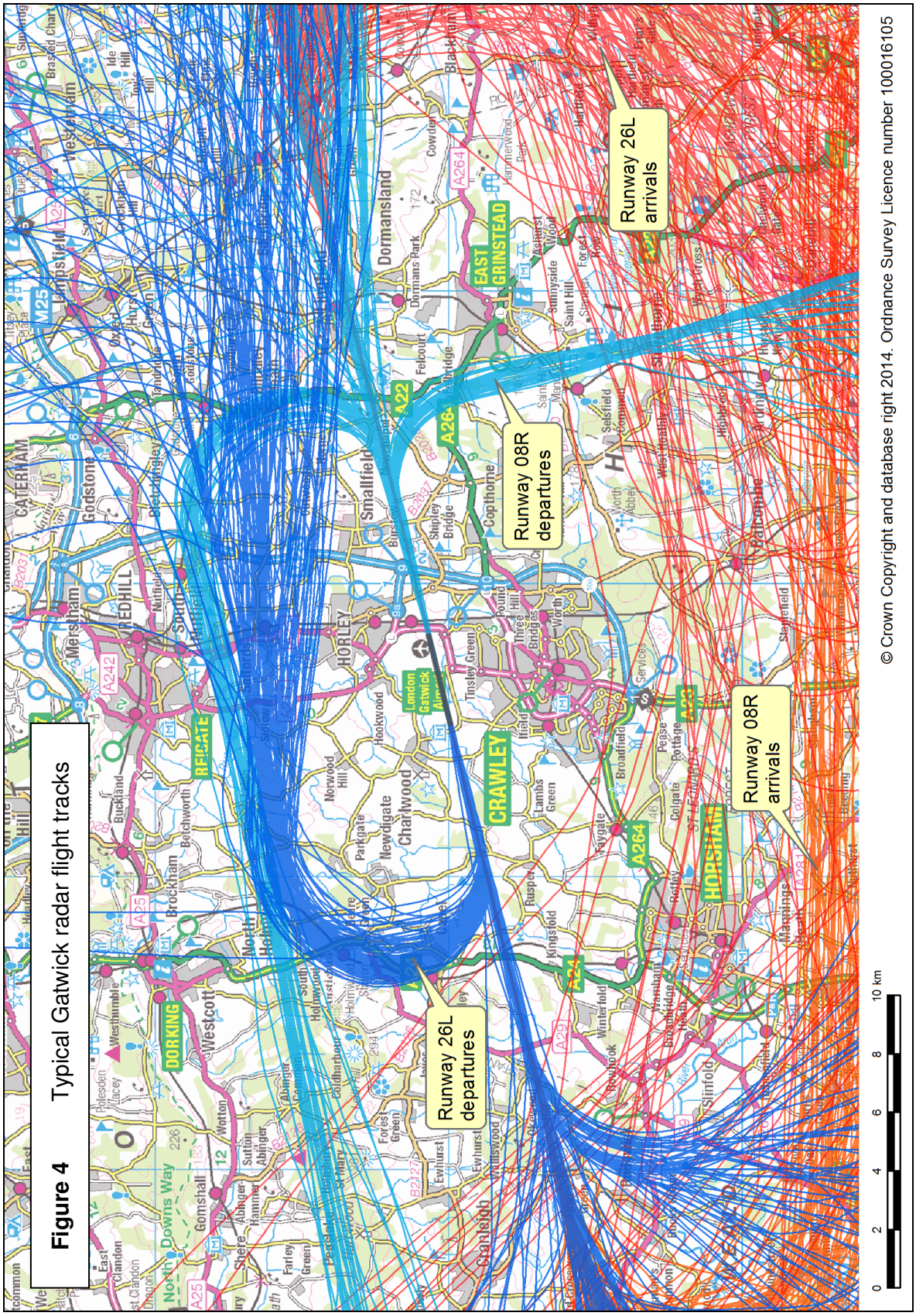
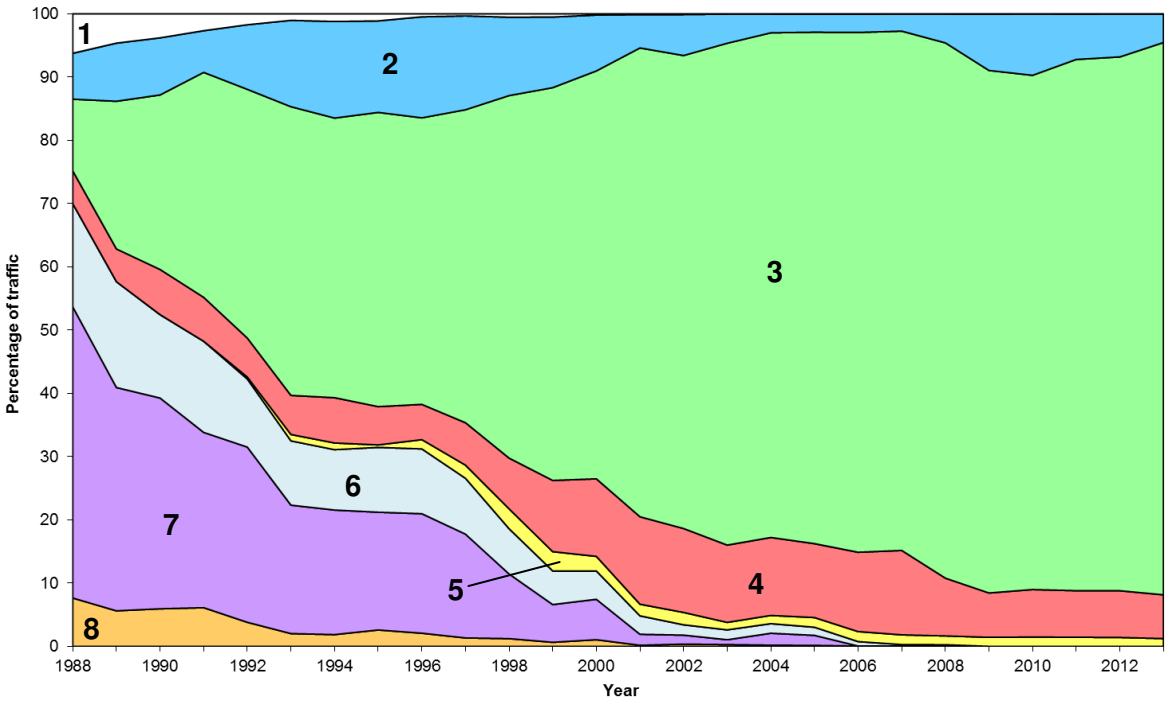


Figure 4 Typical Gatwick radar flight tracks

Figure 5 Gatwick noise class trend 1988-2013



Note: The percentages from 1990 onwards relate to the average 16-hour Leq day; before 1990 the percentages relate to the average 12-hour NNI day (0700-1900 local time). Also, the percentages before 1992 are based on departures only, from 1992 they relate to total movements.

Key to noise classes

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

Chapter 3/4 jets
3 Short-haul, e.g. Airbus A319, Boeing 737-300/400/500
4 Wide-body twins, e.g. Airbus A330, Boeing 767
5 2nd generation wide-body 3/4-engine aircraft, e.g. Airbus A340, Boeing 747-400

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

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

1st generation jets
8 Narrow body 3/4-engine aircraft (including hushkitted versions), e.g. Boeing 707

Figure 6a Gatwick 2013 average summer day movements by ANCON type

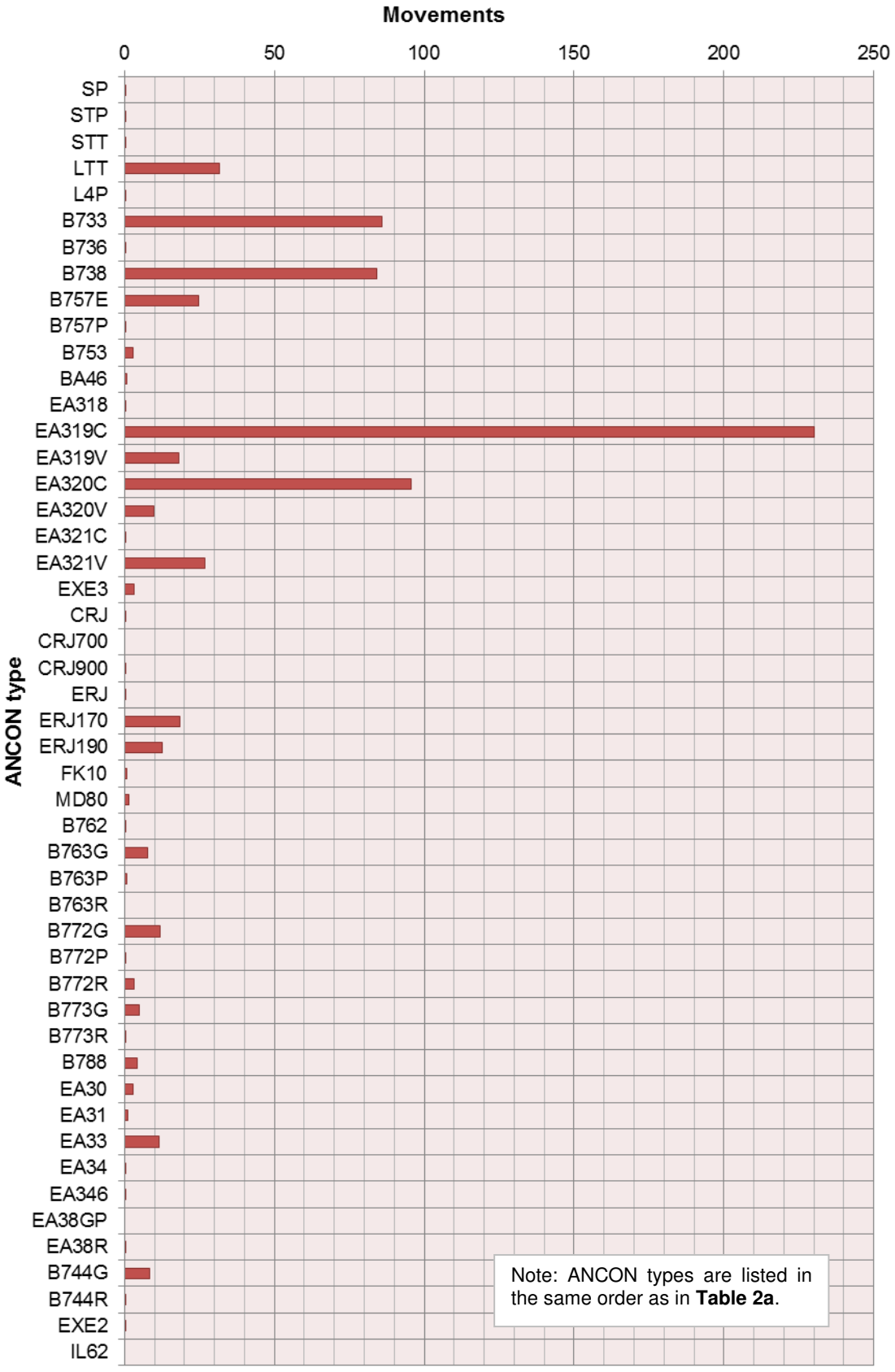
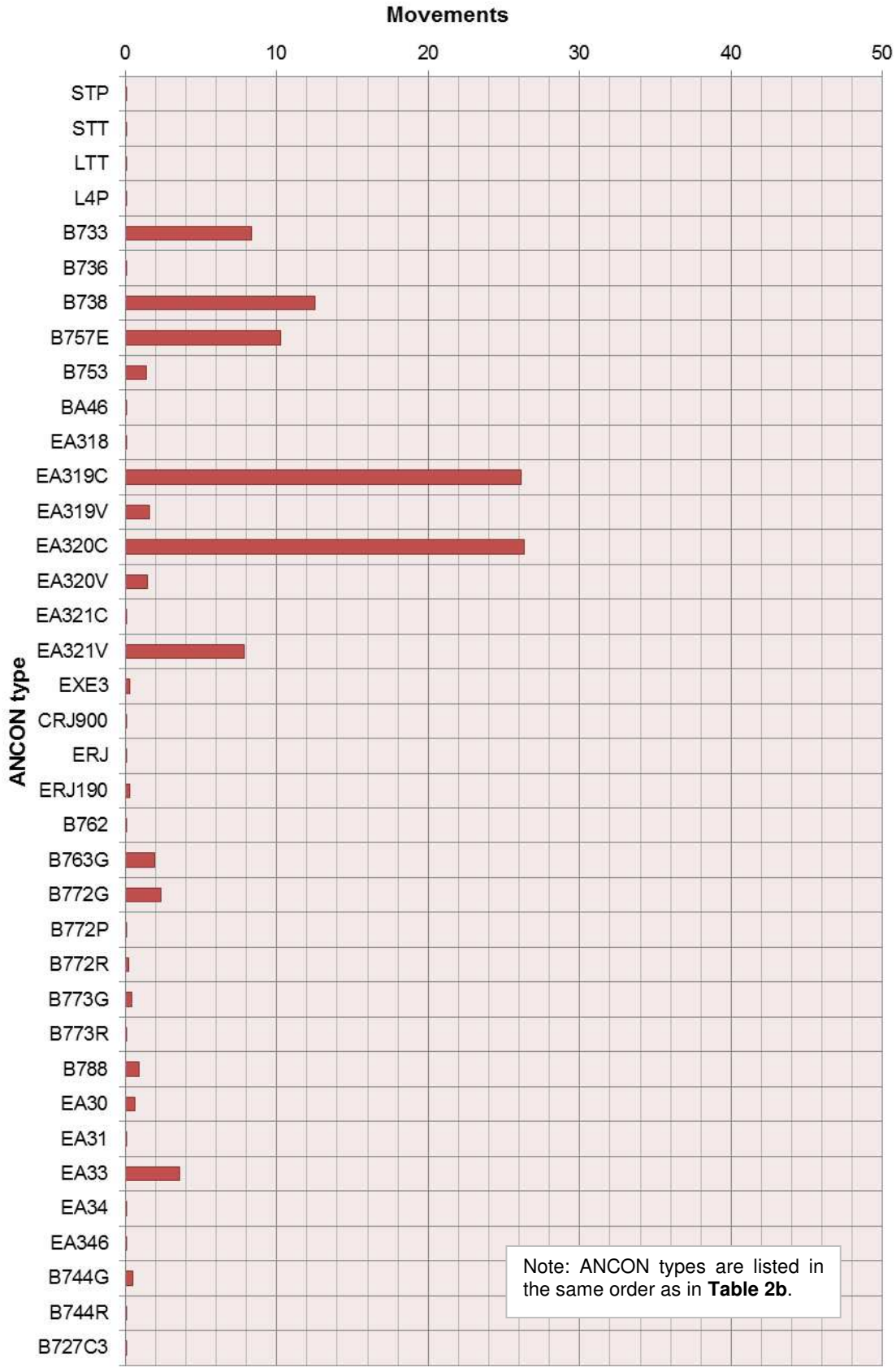


Figure 6b Gatwick 2013 average summer night movements by ANCON type



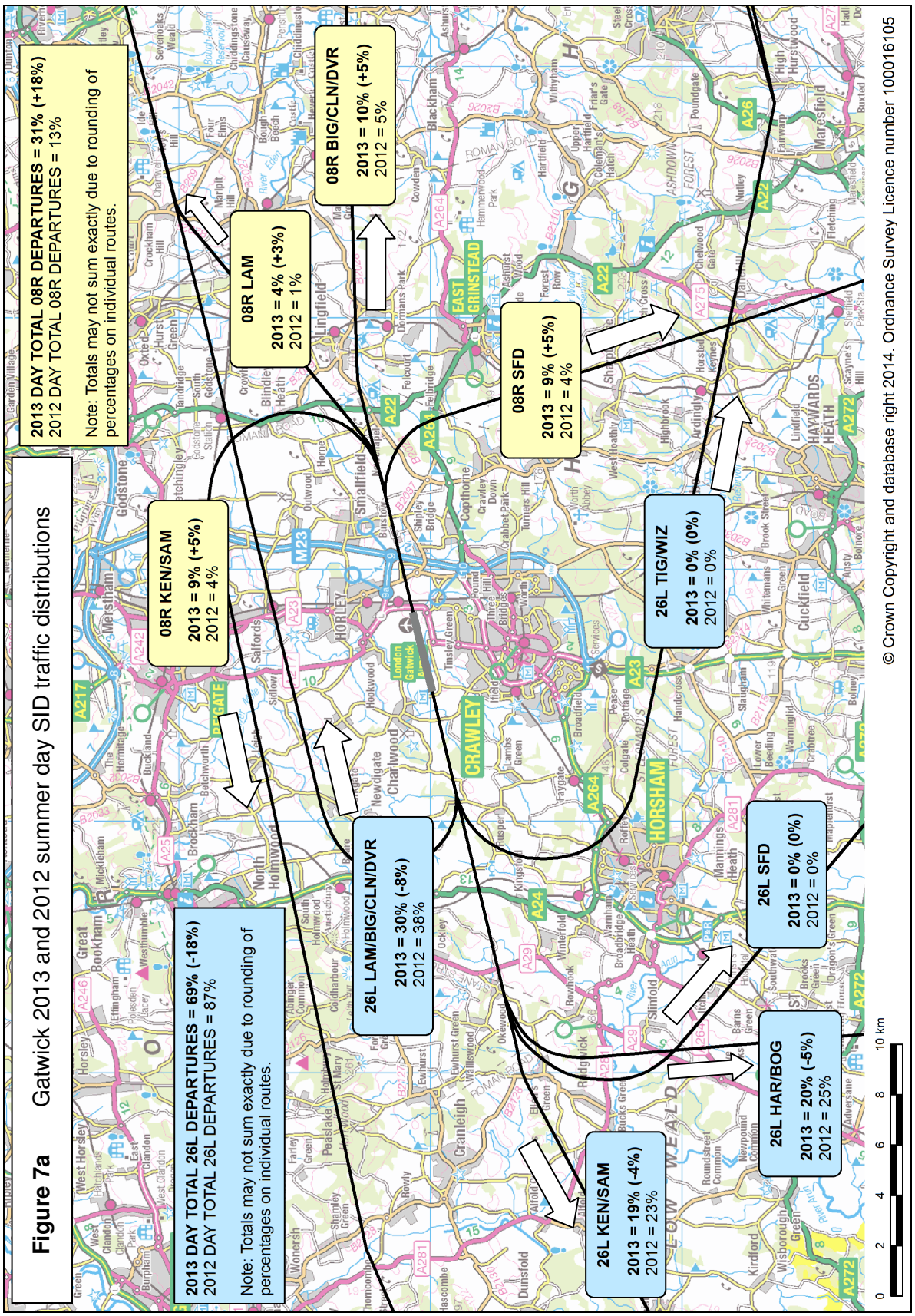


Figure 7a Gatwick 2013 and 2012 summer day SID traffic distributions

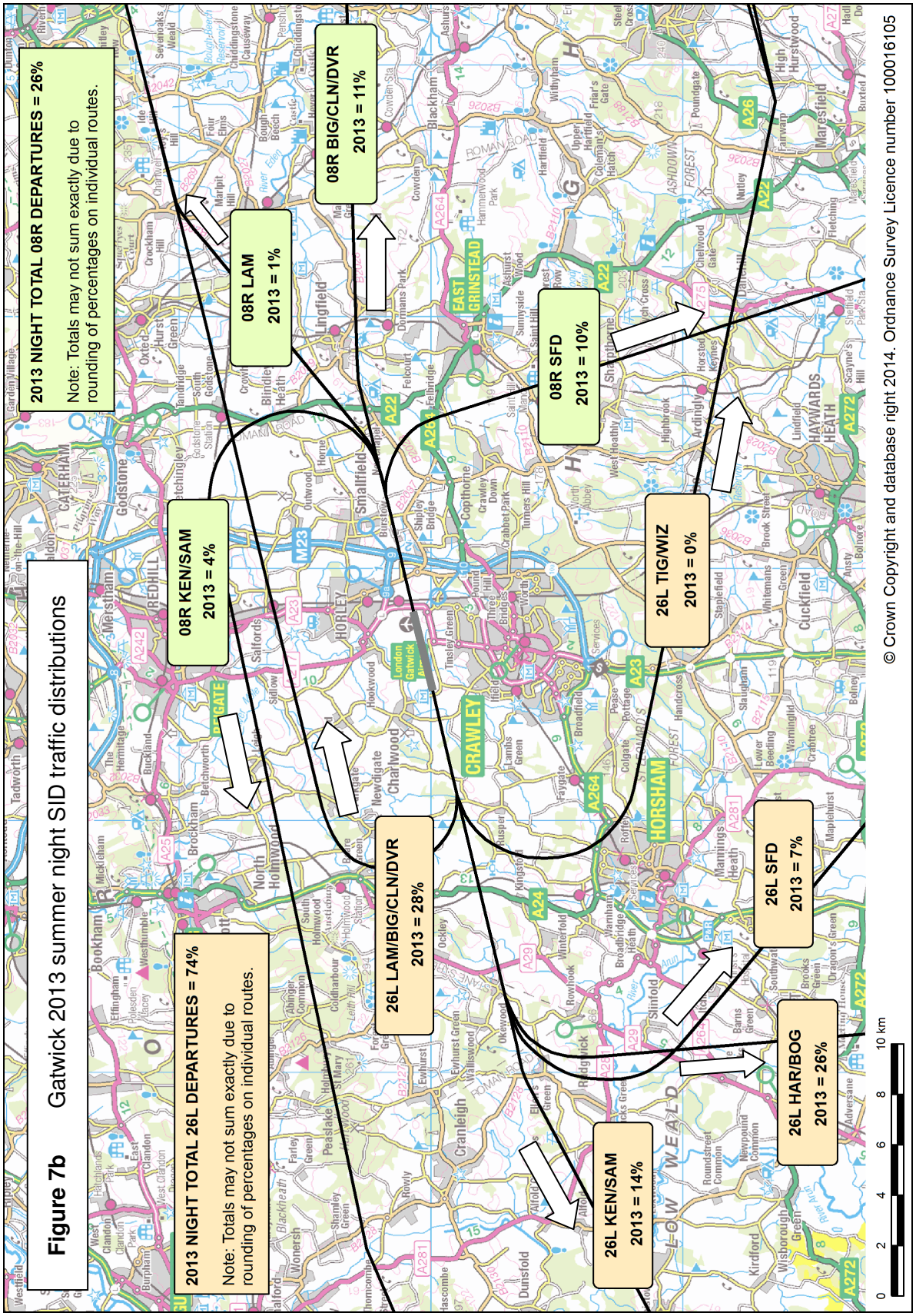
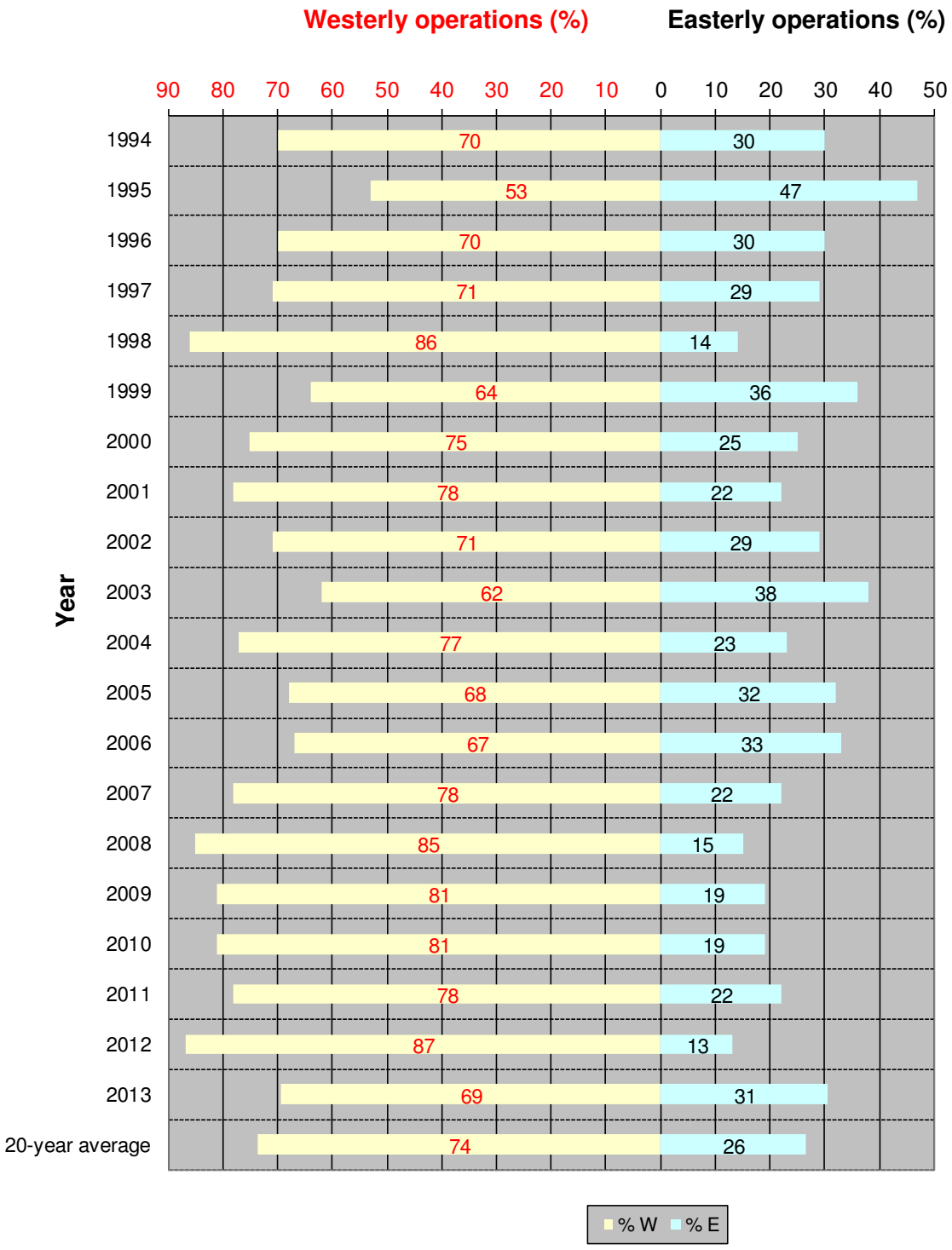


Figure 7b Gatwick 2013 summer night SID traffic distributions

Figure 8 Gatwick average summer day runway modal splits 1994-2013



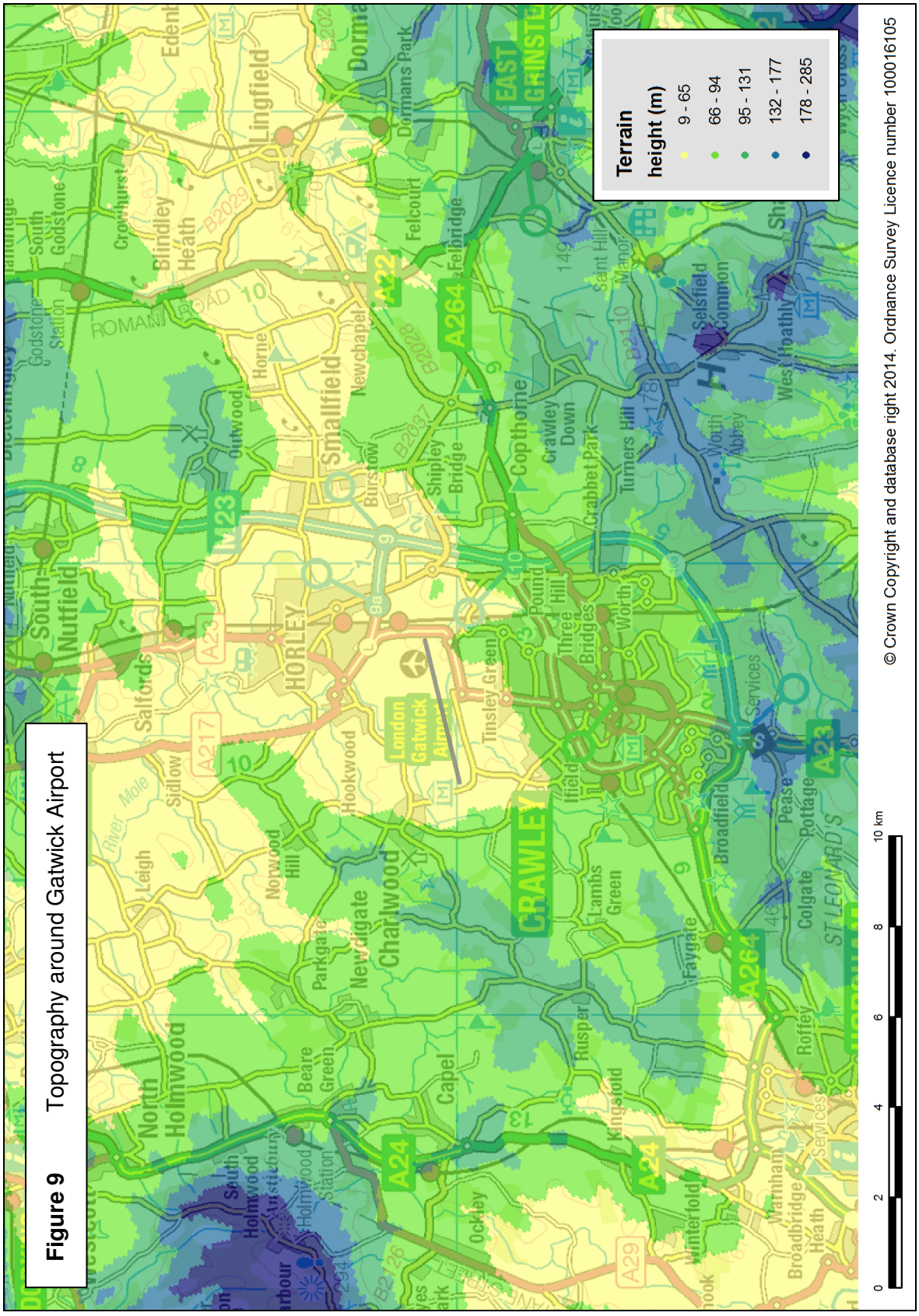


Figure 9 Topography around Gatwick Airport

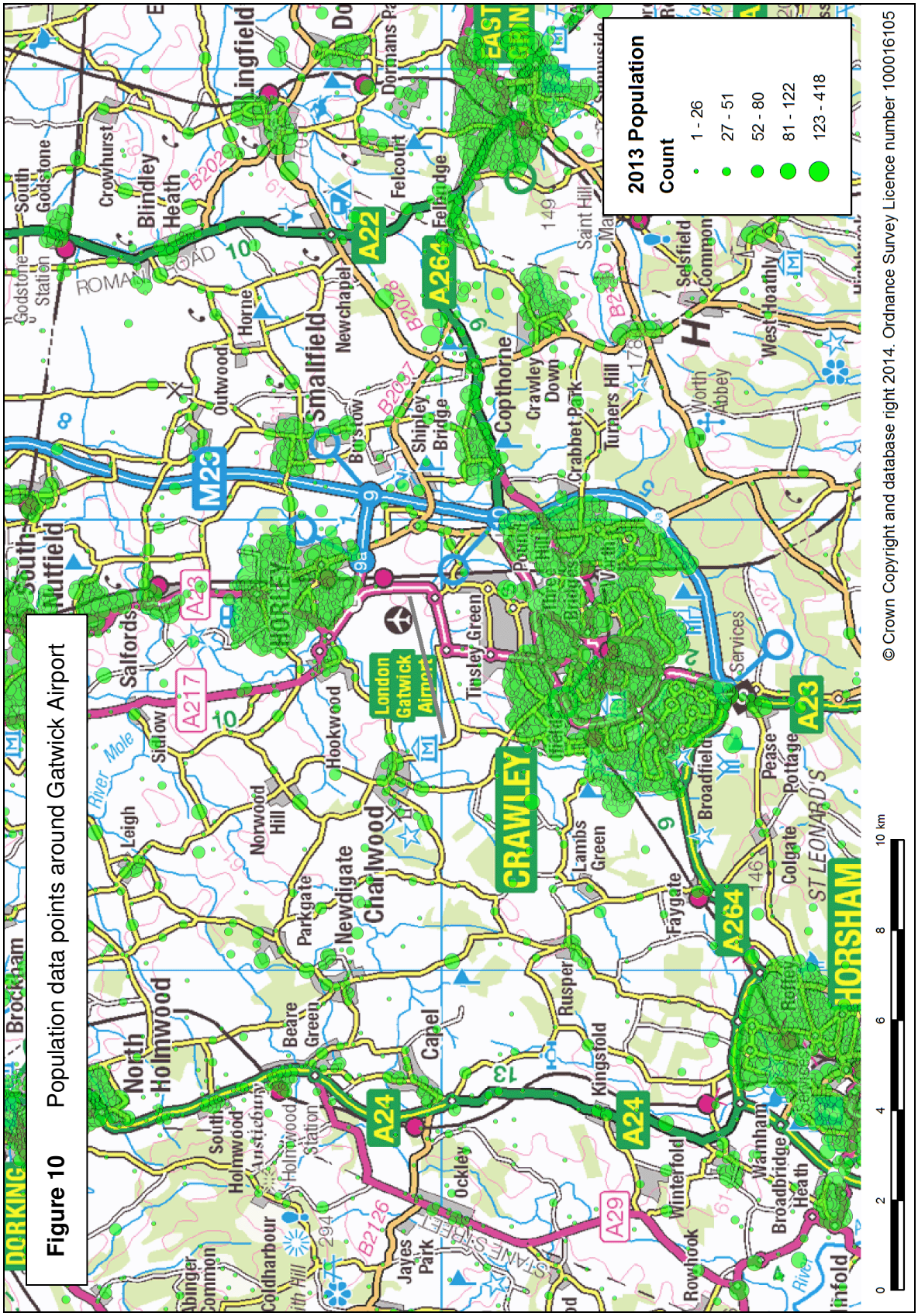


Figure 10 Population data points around Gatwick Airport

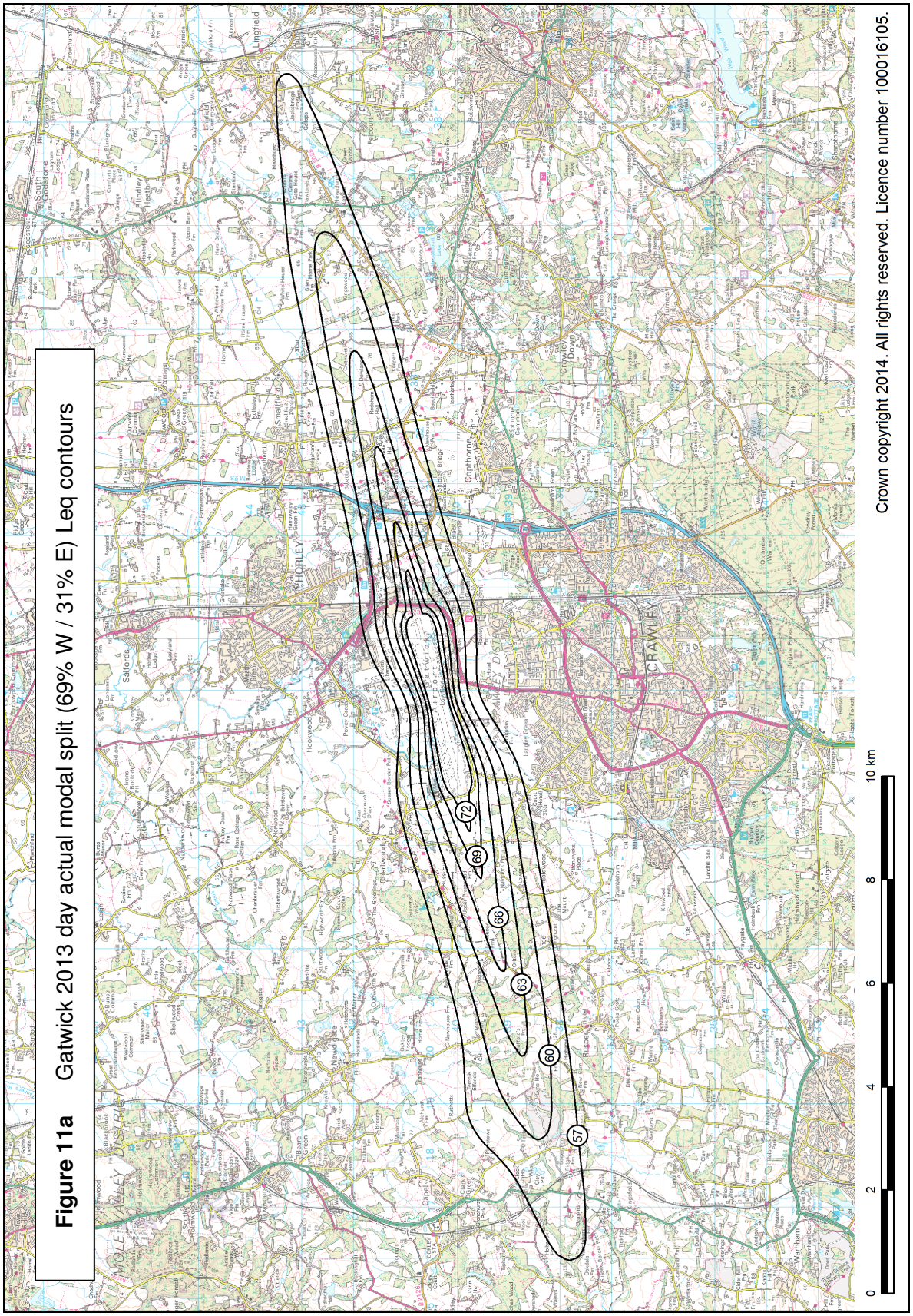


Figure 11a Gatwick 2013 day actual modal split (69% W / 31% E) Leq contours

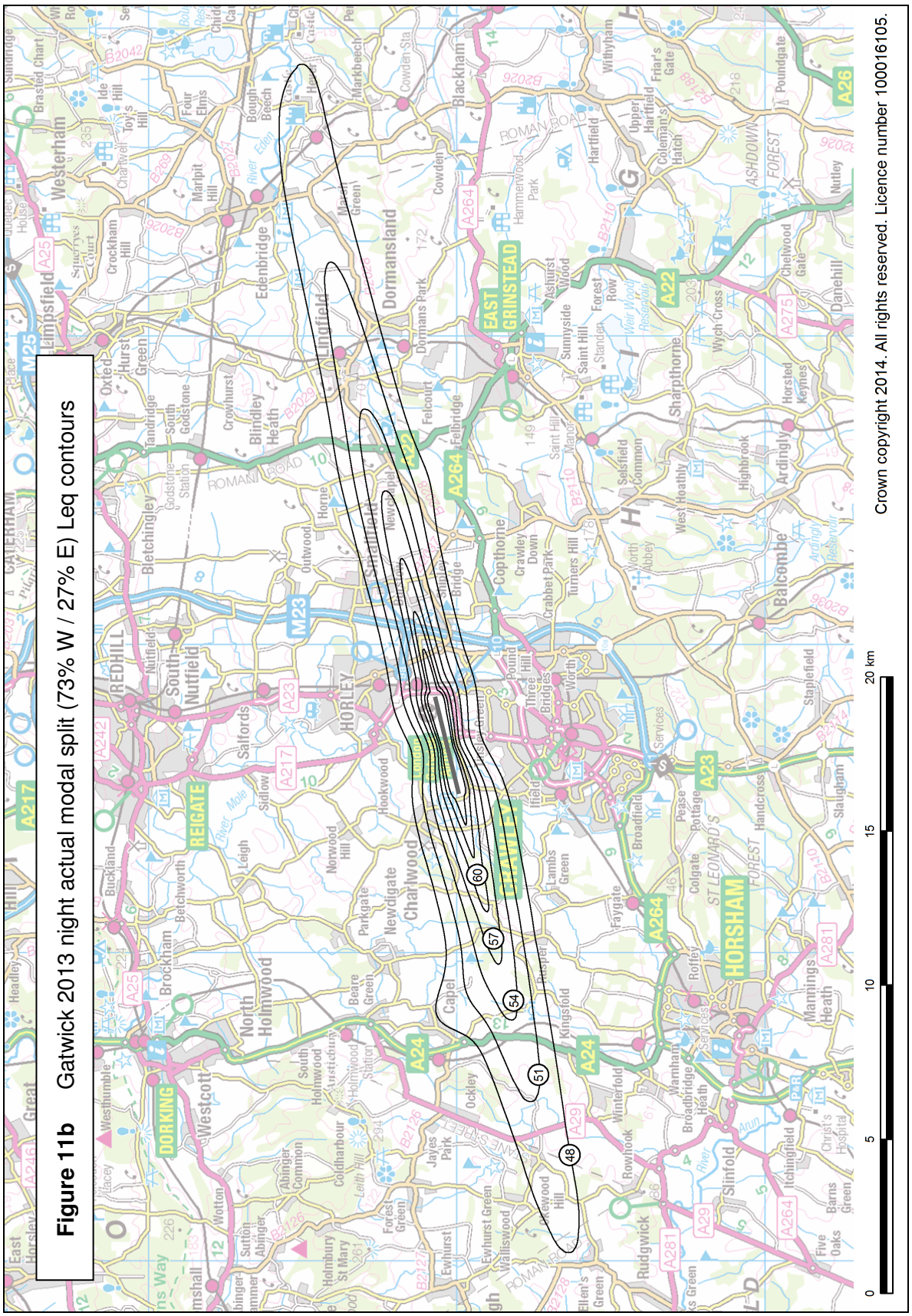


Figure 11b Gatwick 2013 night actual modal split (73% W / 27% E) Leq contours

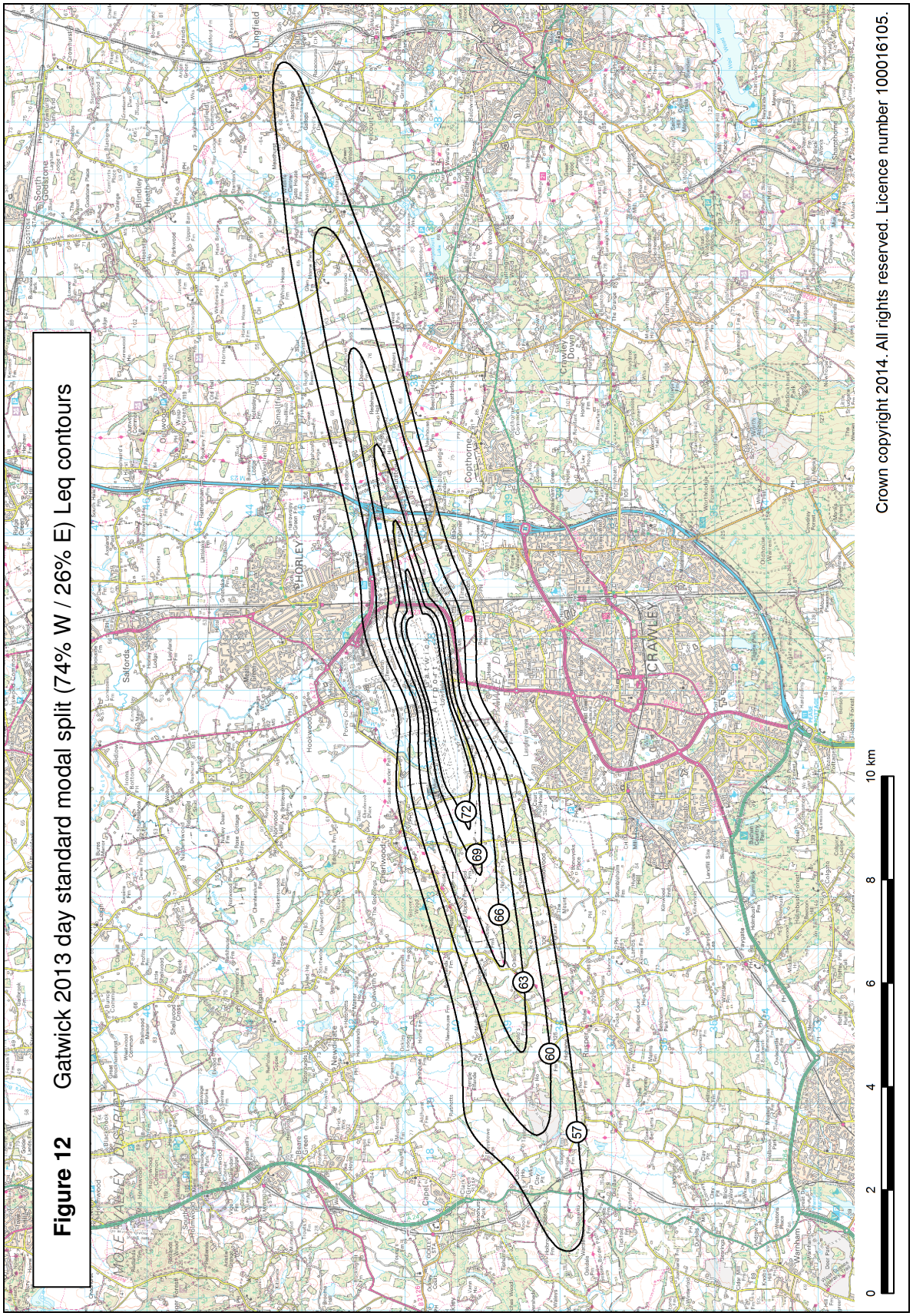


Figure 12 Gatwick 2013 day standard modal split (74% W / 26% E) Leq contours

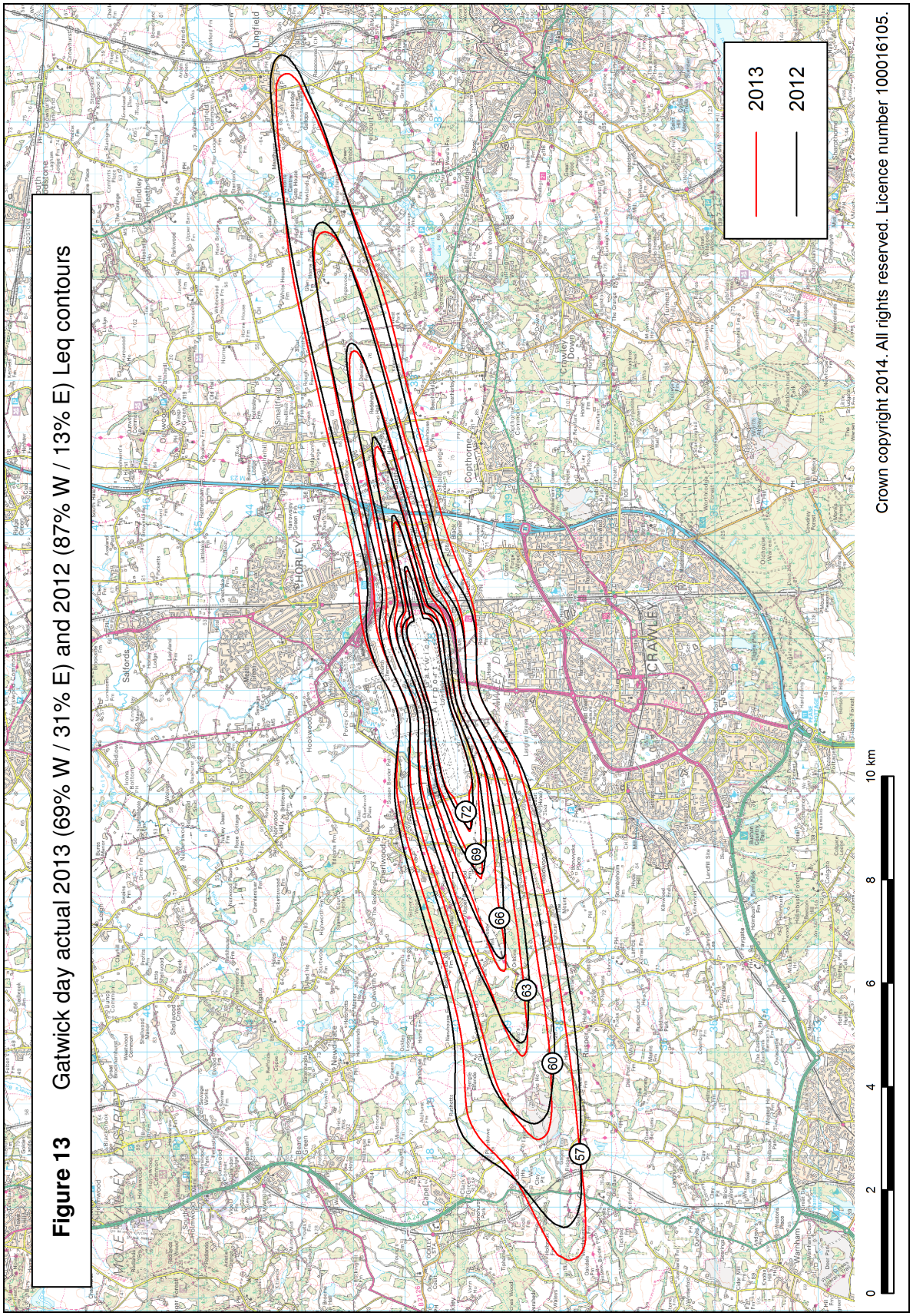


Figure 13 Gatwick day actual 2013 (69% W / 31% E) and 2012 (87% W / 13% E) Leq contours

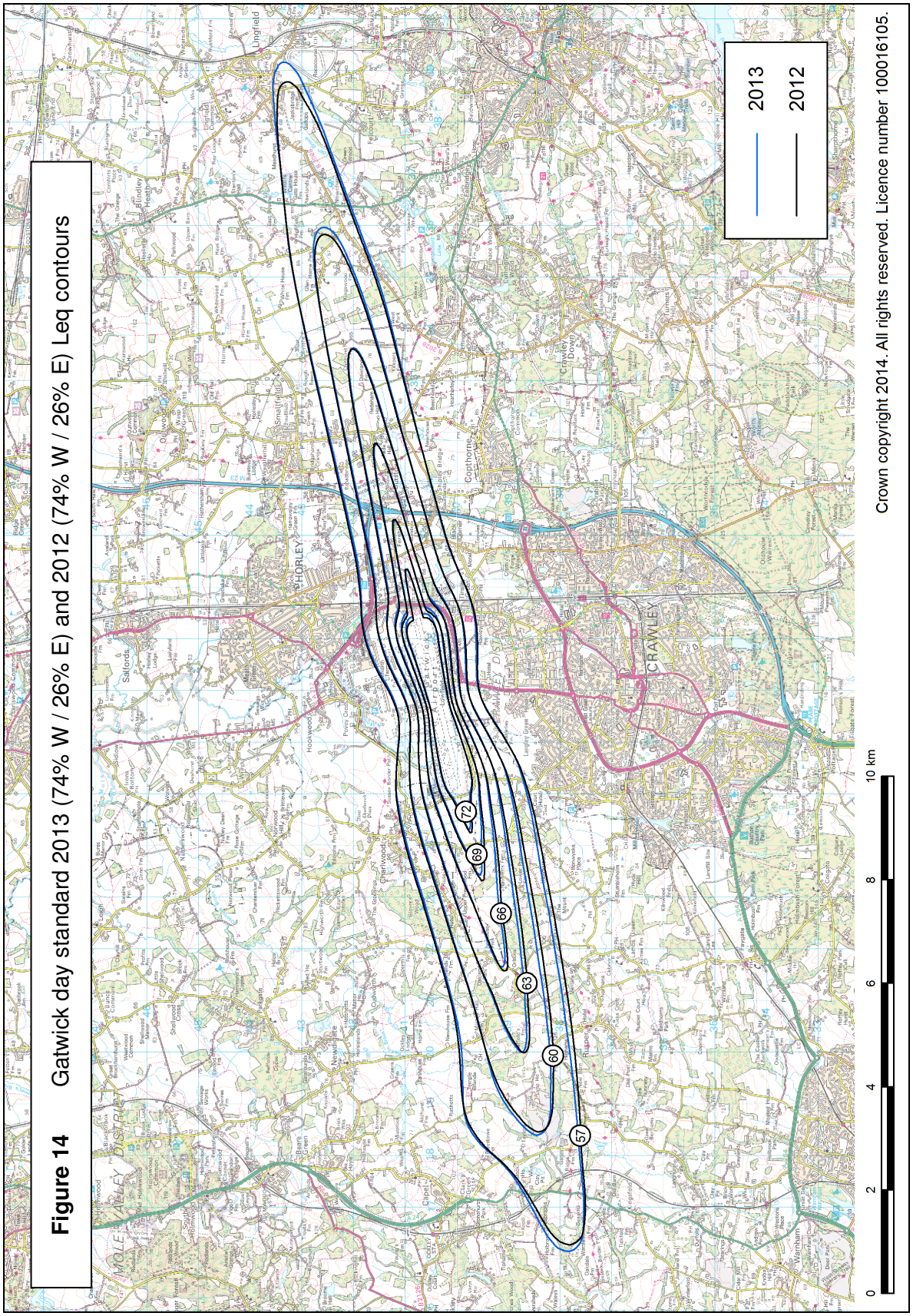


Figure 14 Gatwick day standard 2013 (74% W / 26% E) and 2012 (74% W / 26% E) Leq contours

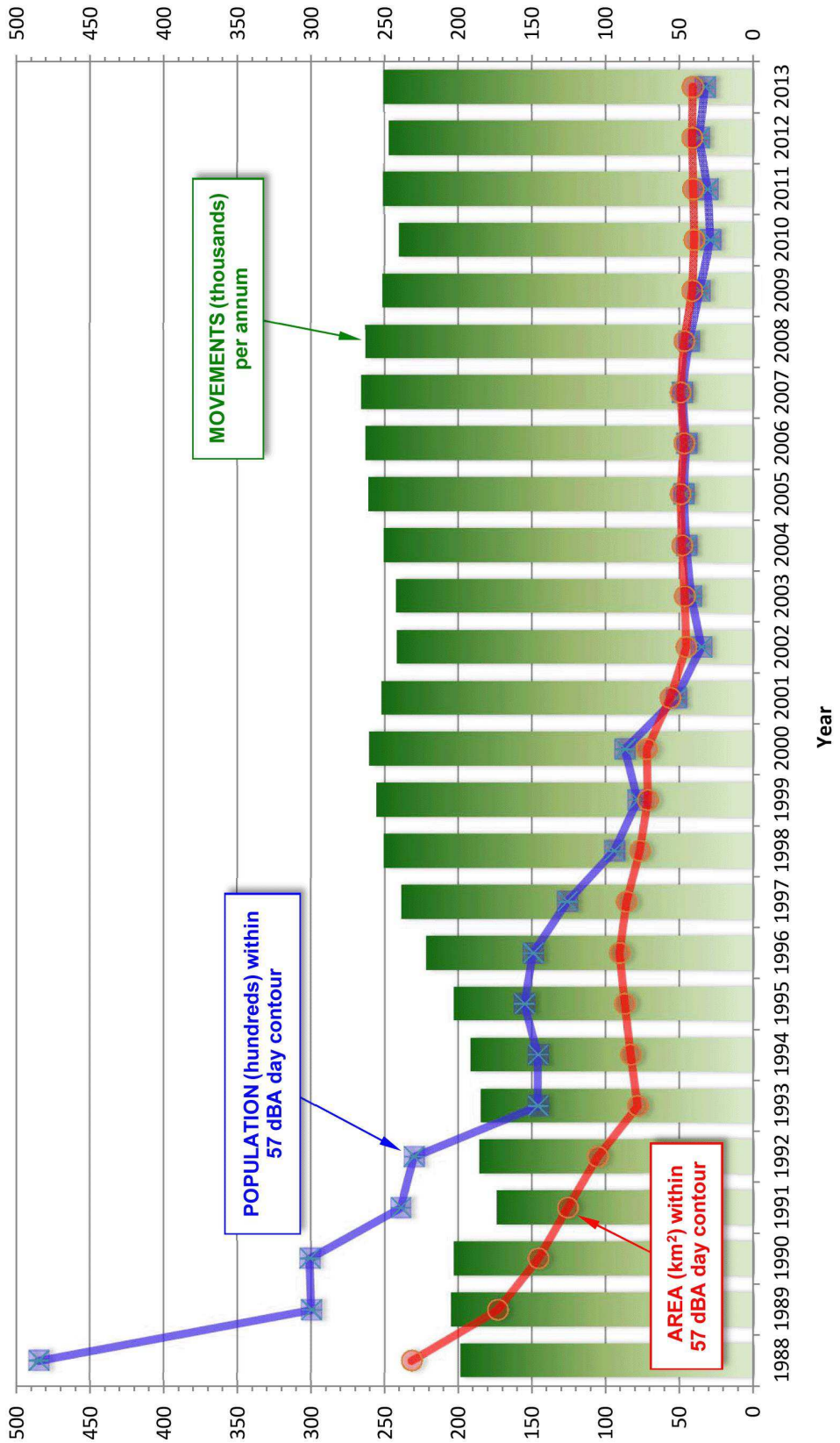


Figure 15 Gatwick annual traffic and summer day Leq noise contour area/population trend 1988-2013