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Noise contours around Brussels Airport for the year 2012

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1. Introduction

Noise contours are calculated in order to be able to make an objective assessment of the noise impact caused by an airport in the surrounding area. These noise contours reflect changes and events that can have an impact on the noise production by air traffic during arrival and take-off, and as such, can be used to describe the situation as well as to evaluate the effects of changes in the aircraft fleet, changes in number of movements and any actions taken. The accuracy of the noise contours is compared with sound measurements taken at a number of locations around the airport.

The Laboratorium voor Akoestiek en Thermische Fysica (subsequently referred to as ATF) has been calculating noise contours annually since 1996, to show the noise impact caused by flight traffic from and to Brussels Airport. It is commissioned to do this by the airport operator, currently The Brussels Airport Company. The calculations are imposed for Brussels Airport in the Flemish environmental legislation (VLAREM) which was amended in 2005[1] in accordance with the European Directive relating to the assessment and management of environmental noise, and in the environmental licence [2] of The Brussels Airport Company.

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[1] Belgian Official Journal, *Decision by the Flemish Government on the evaluation and control of environmental noise and amending the decision of the Flemish Government of 1 June 1995 on the general and sector-specific rules on environmental health*, 31 August 2005.

[2] AMV/0068637/1014B AMV/0095393/1002B*; Decision by the Flemish minister of public works, energy, environment and nature, containing the judgement about the appeals lodged against the decision with reference D/PMVC/04A06/00637 of 8 July 2004 by the provincial executive of the provincial council of Flemish Brabant, on granting of the environmental licence for a period expiring on 8 July 2024 to NV Brussels International Airport Company (B.I.A.C), Vooruitgangsstraat 80 bus 2, 1030 Brussels, to continue operating and to alter (by adding to it) an airport located at Brussels National Airport in 1930 Zaventem, 1820 Steenokkerzeel, 1830 Machelen and 3070 Kortenberg*, 30 December 2004

1.1 Calculations imposed for Brussels Airport

Under the VLAREM environmental legislation, the operator of an airport classified in category 1[3] is bound to have the following noise contours calculated annually:

- L_{den} noise contours of 55, 60, 65, 70 and 75 dB(A) to show noise impact over 24h and to determine the number of people potentially highly annoyed;
- L_{day} noise contours of 55, 60, 65, 70 and 75 dB(A) to show noise impact during the day from 07.00 to 19.00;
- $L_{evening}$ noise contours of 50, 55, 60, 65, 70 and 75 dB(A) to show noise impact during the evening from 19.00 to 23.00;
- L_{night} noise contours of 45, 50, 55, 60, 65 and 70 dB(A) to show noise impact at night from 23.00 to 07.00.

In addition to the VLAREM obligations, the environmental licence of The Brussels Airport Company imposes extra noise contour calculations:

- L_{night} and L_{den} noise contours as in the current VLAREM obligations;
- Frequency contours for 70 dB(A) and 60 dB(A); The Brussels Airport Company requested ATF to calculate the following frequency contours:
  - Frequency contours for 70 dB(A) during the day period (07.00 to 23.00) with frequencies 5x, 10x, 20x, 50x and 100x
  - Frequency contours for 70 dB(A) during the night period (23.00 to 07.00) with frequencies 1x, 5x, 10x, 20x and 50x
  - Frequency contours for 60 dB(A) during the day period (07.00 to 23.00)
  - Frequency contours for 60 dB(A) during the night period (23.00 to 07.00)

The calculation of the noise contours must be carried out in accordance with the 'Integrated noise Model' (INM) of the United States Federal Aviation Administration (FAA), version 6.0c or higher.

The number of people liable potentially highly annyed within the various L_{den} contour zones must be determined on the basis of the dose-effect ratio laid down in the VLAREM.

The noise zones must be shown on a 1/25 000 scale map.

1.2 History of noise contour calculations for Brussels Airport

The Laboratorium voor Akoestiek en Thermische Fysica has calculated noise contours annually since 1996 for the noise impact of flight traffic from and to Brussels airport, commissioned by the airport operator. Prior to the VLAREM being brought into line with the European directive on environmental

[3] Category 1 airports: Airports that meet the definition of the Chicago Convention of 1944 establishing the International Civil Aviation Organization and with a take-off and landing runway of at least 800 metres

noise in 2005, the following operational division of the day was used (day: 06.00 – 23.00; night 23.00 – 06.00). After the VLAREM was brought into line with the Directive, the official noise contours to be reported were calculated according to the division of the day in the Directive (day: 07.00 – 19.00; evening: 19.00 – 23.00; night 23.00 – 07.00).

1.3 Version of the Integrated noise Model

For the calculation of the noise contours since 2011, the latest version of the INM calculation model, i.e. the INM 7 (subversion INM 7.0b) has been used. For the years 2000 through 2010, the model's version 6.0c was always used for the officially reported noise contours. Because the model used and the related aircraft database have an impact on the calculation of the noise contours, last year the noise contours for the years 2006 through 2010 were recalculated with version 7.0b[4]. In this way, it was possible to incorporate the changes in the noise contours in 2012 as compared to the prior years without being affected by the calculation model used.

1.4 Population data

In order to determine the number of people living within the contour zones and the number of people potentially highly annoyed, the most recent data available is used. On inquiry with the Office for Statistics and Economic Information (also still called National Institute for Statistics), these were revealed to be the population figures as of 1 January 2010.

[4] Regarding the frequency contours of 60 and 70 dB(A), only the year 2010 was recalculated with the 7.0b version of the INM computer model

2. Definitions for the evaluation of noise contours

2.1 Explanation of a few frequently-used terms

2.1.1 Noise contours

As a result of flight traffic, noise impact is either observed or calculated for any point around the airport. Due to a difference in distance from the noise source, the values may vary sharply from one point to another. Noise contours are isolines or lines of equal noise impact. These lines connect together points where equal noise impact is observed or calculated.

The noise contours with the highest values are those situated closest to the noise source. Further away from the noise source, the value of the noise contours is lower.

2.1.2 Frequency contours

The acoustic impact of overflight by an aircraft can be characterised at any point around the airport by, among other factors, the maximum noise level observed during overflight. This maximum noise level can be determined, for example, as the maximum of the equivalent sound pressure levels over 1 second ($L_{Aeq,1s,max.}$)[5] during that overflight.

For the passage of an entire fleet, the number of times that the maximum sound pressure level exceeds a particular value can be calculated. The number of times on average that this value is exceeded each day is the excess frequency. Frequency contours connect locations where this number is equal.

2.1.3 Noise zones

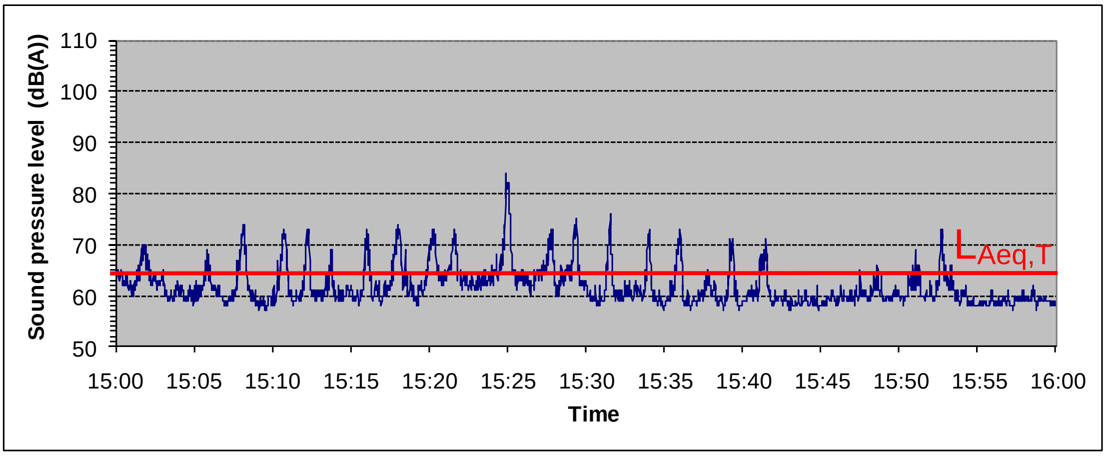
A noise zone is the zone delimited by two successive noise contours. The noise zone 60-65 dB(A) is, for example, the zone delimited by the noise contours of 60 and 65 dB(A).

2.1.4 The A-weighted equivalent sound pressure level, $L_{Aeq,T}$

The noise caused by overflying aircraft is not a constant noise, but has the characteristic of rising sharply to a maximum level and thereafter declining sharply again. To represent the noise impact at a specific place and as a result of fluctuating sounds over a period, the average energy of the sound pressure observed during the period is used (see Figure 1).

[5] The INM computer program calculates the variable $L_{Amax,slow}$. The numeric values for this variable are rather comparable with those for the variable $L_{Aeq,1s,max.}$.

Figure 1 Graph of the A-weighted equivalent sound pressure level ($L_{Aeq,T}$)



The A-weighted equivalent sound pressure level $L_{Aeq,T}$, over a period T, is the sound pressure level of the *constant* sound containing the same acoustic energy in that same period, or is a representation of the average quantity of acoustic energy observed over the period T per second. The unit for A-weighted equivalent sound pressure level is the dB(A).

The designation A-weighted (index A) means that an A-filter is used to determine the sound pressure level. This filter reflects the pitch sensitivity of the human ear. Sounds at frequencies to which the ear is sensitive are weighted more than sounds at frequencies to which our hearing is less sensitive. Internationally, the A-weighting is accepted as THE measurement for determining noise impact around airports. This A-weighting is also applied in the VLAREM legislation on airports.

In this report, 3 types of $L_{Aeq,T}$ contours are calculated, i.e.:

- L_{day}: the equivalent sound pressure level for the daytime period, defined as the period between 07.00 and 19.00
- $L_{evening}$: the equivalent sound pressure level for the evening period, defined as the period between 19.00 and 23.00
- L_{night}: the equivalent sound pressure level for the night period, defined as the period between 23.00 and 07.00

2.1.5 L_{den}

To obtain an overall picture of the nuisance around the airport, it is usually opted not to use the equivalent sound pressure level over 24 hours. or $L_{Aeq,24h}$. Noise during the evening or night period is always perceived as more annoying than the same noise during the daytime period. LAeq,24h, for example, takes no account whatever of this difference.

The European directive on assessment and management of environmental noise (implemented in the VLAREM), recommended using the parameterLden to determine the nuisance. The L_{den} (Level Day-Evening-Night) is the A-weighted equivalent sound pressure level over 24 hours, with a (penalty) correction of 5 dB(A) being applied for noise during the evening period, which rises to 10 dB(A) during the night. For the calculation of the L_{den} noise contours, the day is divided in the way used in

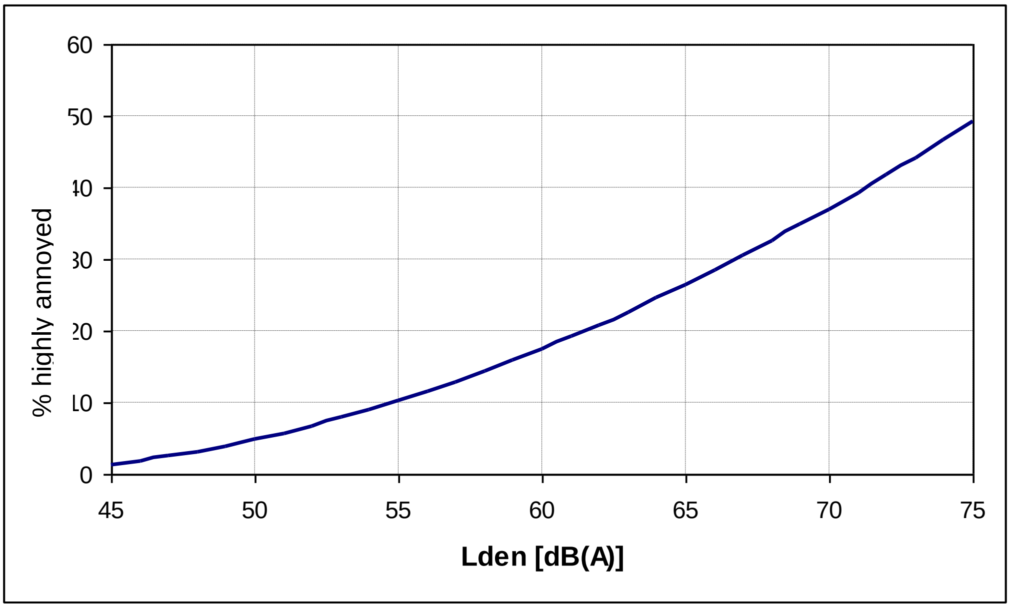
VLAREM heading 57, where the evening period runs from 19.00 to 23.00 and the night period from 23.00 to 07.00.

2.2 Link between nuisance and noise impact

To determine the number of people potentially highly annoyed within the L_{den} 55 dB(A) noise contour, a dose-effect ratio is incorporated in the VLAREM. This formula shows the percentage of the population that is highly annoyed from the noise impact expressed in L_{den} (Figure 2).

% seriously affected = $-9.199 \cdot 10^{-5}(L_{den}-42)^3 + 3.932 \cdot 10^{-2}(L_{den}-42)^2 + 0.2939(L_{den} - 42)$

Figure 2 Percentage of people potentially highly annoyed due to L_{den} from aircraft noise (source: VLAREM – environmental legislation based on Miedema 2000)



The formula shown above comes from a synthesis/analysis of various noise nuisance studies at various European and American airports carried out by Miedema[6] and was adopted door de European Commission WG2 Dose/effect [7].

[6] Miedema H.M.E, Oudshoorn C.G.M, Elements for a position paper on relationships between transportation noise and annoyance, TNO report PG/VGZ/00.052, July 2000

[7] European Commission, WG2 – Dose/effect, *Position paper on dose response relationships between transportation noise and annoyance*, 20 February 2002

3. Methodology for the calculation of the noise contours around Brussels Airport

To determine noise contours, places have to be found around the airport where an identical level of noise impact has been observed. However, measuring noise impact at every point is inconceivable. For this reason, an internationally accepted method has been devised for determining noise contours using simulations with computer models.

In Belgium, just as in many other countries, the Integrated noise Model (INM) of the United States Federal Aviation Administration (FAA) is used to calculate noise contours around airports. This model and the methodology used comply with the methodology prescribed in the VLAREM legislation (Chapter 5.57 Airports).

The procedure for calculating noise contours can be broken down into 3 phases:

- Collection of information concerning the relevant flight movements, the routes flown and the characteristics of the airport as an input for INM;
- Performance of contour calculations;
- Post-processing of the contours into a Geographic Information System (GIS).

3.1 Collection of input data

INM calculates noise contours around airports based on a 'average day (night, 24h,…)' input file. The meaning of an average day is **NOT** that a day is chosen on which all the conditions satisfied an average value. Based on the data for a complete year, an average twenty-four hour period is determined, by bringing all movements in that year into the calculation, and then dividing it by the number of days in the year.

All these aircraft movements follow determined routes, which are essentially determined by the runway used and the SID flown (Standard Instrument Departure) as regards departures or by the runway used and the STAR (Standard Instrument Arrival) as regards arrivals. The existing SIDs and STARs are shown in the AIP, Aeronautical Information Publication, and they determine the procedure that must be followed by the pilot in flight movements from and to Brussels Airport.

3.1.1 Information aircraft movements

In order to take a movement into account to determine the input for INM, a number of items of data are required:

- Aircraft type
- Time
- Nature of the movement (departure/arrival)
- Destination or origin of the movement

- Landing or take-off runway
- SIDs followed

For the contour calculations of Brussels Airport for the year 2012, the flight information was obtained from The Brussels Airport Company in the form of an extract from the central database (CDB). This database includes all the necessary data per aircraft movement. The quality of the data is very good.

For each aircraft type in the flight list, an equivalent INM type is searched on the basis of type, engines, registration, etc. In most cases, the aircraft types are present in INM, or INM provides for a substitute type, and as model versions are developed, more and more types are included in it. For a small fraction that cannot yet be identified in INM, an equivalent is sought based on other noise data, the number and type of engines and the MTOW (maximum take-off weight). Helicopter movements are not included in this model.

Based on the distance to be flown, using the conversion table provided by INM,[8], the aircraft weight is taken into account in its climb profile. The standard departure and arrival profiles contained in INM are always used for the calculation of the annual noise contours around Brussels Airport.

3.1.2 Radar data

A number of SIDs are given per runway in the Aeronautical Information Publication (AIP). These departure descriptions are not geographical stipulations, but are laid down as procedures that must be followed after take-off from Brussels Airport. For example, these procedures require pilots to carry out a manoeuvre after reaching a particular height or reaching a given geographical location. When an aircraft to reach a particular height is heavily dependent on the aircraft type (size, number of engines, etc.), weight (including the fuel load necessary to fly a particular distance) and the weather conditions, there is a wide geographical spread on the actual routes when following a particular SID.

The actual location of the average horizontal projection per SID is determined on the basis of radar data[9] during the year. The definition of a number of sub-routes besides this average route takes account of the actual spread on this SID. For a number of SIDs, just as in recent years, a split can be made based on the aircraft type to obtain a proper description of the tracks actually flown.

To determine the location of the tracks actually flown, aircraft movements are selected at random so that, on the one hand, a representative number of movements can be obtained and, on the other hand, all days of the week and seasons are taken into account. The ultimate location of the INM track with the spread is done with an INM tool which determines the average route together with the location of a number of subtracks symmetrically around this average route.

More information about the method used can be found in Appendix 3.

[8] INM user's guide: INM 6.0, Federal Aviation Administration, Office of Environment and Energy

[9] This radar data is available in the NMS of Brussels Airport up to a height of 9000 feet

3.1.3 Meteorological data

For the calculation of the contours for 2012, the actual average meteorological conditions during the year 2010 were input into the INM. As basic data to determine these averages, the weather data used was that per hour recorded during the past year in the NMS. The use of this data makes it possible to calculate an actual average headwind for each runway at the airport at the time that the runway is in use.

The average headwind for each runway of the airport is calculated as follows:

- First, the movements per runway are selected separately. The departures and arrivals are considered together.
- Each movement is connected to the meteorological data at the time of the flight via the departure or arrival time.
- Next, the component of wind speed at the time of the movement and in the direction of the runway concerned is calculated.
- Finally, an average is produced of the component of wind speed on the runway concerned across all selected movements.

The results of these calculations are:

- 4.6 knots headwind on runway 25R during the operational day period (06.00-23.00)
- 3.6 knots headwind on runway 25R during the operational night period (23.00-06.00)
- 3.8 knots headwind on runway 25L
- 4.8 knots headwind on runway 07L
- 4.8 knots headwind on runway 07R
- 8.9 knots headwind on runway 02
- 5.1 knots headwind on runway 20

The average temperature for the year 2012 that is entered into the computer model (averaged out per movement) is 11.2°C.

3.2 Performance of contour calculations

3.2.1 Match between measurements (NMS) – calculations (INM)

INM enables calculations on specific locations around the airport. To check the calculated noise contours, the noise impact as calculated with INM is compared with sound measurements taken at a number of locations.

This comparison gives an answer to the question of comparability of noise impact from calculations and measurements. Since the results of noise calculations with INM show the incident noise whereas noise measurements are always influenced by specific local conditions, and in view of the uncertainties associated with (unmanned) noise measurements (background noises, linkage to flight traffic, reflections, etc.), these comparative studies cannot make any pronouncements about the absolute accuracy of the results of the INM calculations, but can do so about the comparability with noise measurements at a number of specific locations around Brussels Airport.

3.2.2 Technical data with regard to the calculation

The calculations were carried out with the INM 7.0b with a refinement 9 and tolerance 0.5 within a grid with origin at -8 nmi[10] in the horizontal direction and -8 nmi in the vertical direction in relation to the airport reference point, and dimensions of 18 nmi in the horizontal direction and 16 nmi in the vertical direction.

The altitude of the airport reference point in relation to sea level is 184 ft.

3.2.3 Calculation of frequency contours

All noise contours, except the frequency contours, are determined and shown directly in the INM. For frequency contours, a rather more elaborate method is necessary, since the INM does not determine these contours directly.

On a regular grid around the airport, the INM calculates the maximum sound pressure level for each aircraft configuration in the input files. The result of this grid calculation is a very large file in which, per grid point, for all combinations of aircraft type, INM stage, track and subtrack, the maximum sound pressure level is recorded.

This grid is exported to an external computer program (database analysis) to count per grid point the number of times that a particular level is exceeded. This result is imported into a GIS system for further processing.

The contour lines are drawn in Arcview 3.2 with ARCISO, a contour drawing algorithm from the University of Stuttgart. A further smoothing of the contour lines obtained in this way is required.

3.3 Post-processing in a GIS

The importation of the noise contours into a Geographic Information System (GIS) makes it possible not only to print out the noise contour maps, but also to carry out a geographic analysis. So, in the first instance, the area within the various contour zones can be calculated per local authority area.

In addition, the combination of the contours with a digital population map also allows a calculation of the number of people living within the various contour zones. The population data comes from the National Institute for Statistics (NIS) and shows the demographic situation on 1 January 2010.

The population numbers are available at the level of statistical sectors. On the assumption that the population is spread evenly across the statistical sector, and by only counting the portion of the sector that lies within the contour, this gives a good approximation of reality.

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[10] 1 nmi (nautical mile) = 1,852 km (kilometer)

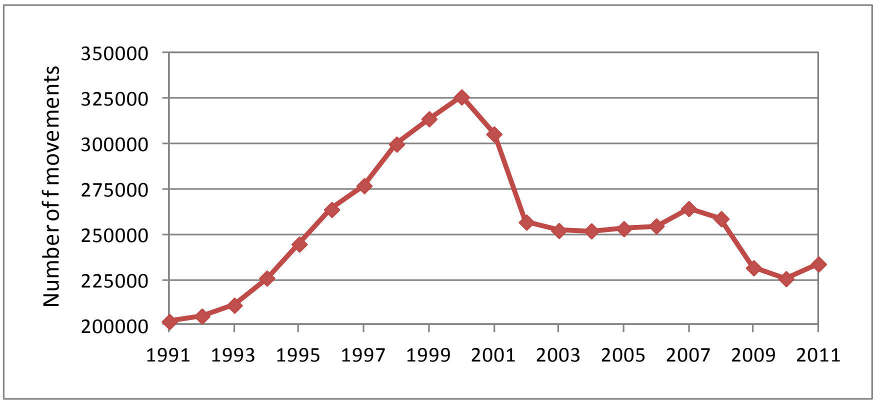
4. Results

4.1 Background information about interpretation of the results

4.1.1 Change in the number of movements

One of the important factors in the calculation of the annual noise contours around an airport is the number of movements that took place over the past year. After the small increase in the number of movements at Brussels Airport in 2011 as compared to 2010, amounting to approximately 3.6%, the number of movements dropped from 233,758 in 2011 to 223,431 in 2012. This represents a drop of approximately 4.4% as compared to 2011.

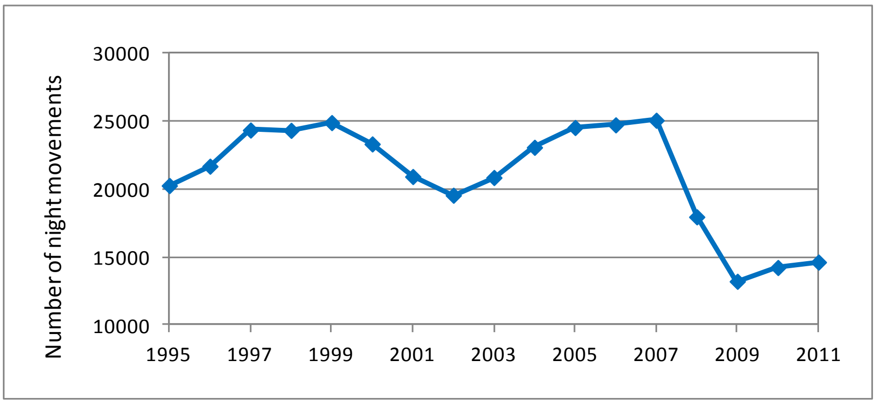
Figure 3 Change in flight traffic at Brussels Airport 1991-2012 (Source: The Brussels Airport Company)



The number of night-time movements (23:00-06:00) in 2012 has remained equal to that the one of 2011, i.e. 14,648 in each year. For 2012, the number of night slots assigned remained within the limitations imposed on the airport's slot coordinator, who since 2009 has been authorised to distribute a maximum of 16,000 night slots, of which a maximum of 5,000 may be allocated to departures (MD 21/01/2009, official amendment to the environmental approval dd. 29/01/2009).

The number of movements during the operational day period (06:00 – 23:00) fell by almost 5% from 219,110 in 2011 to 208,783 in 2012.

Figure 4 Change in flight traffic during the night (23.00-06.00) at Brussels Airport 1995-2012 (Source: The Brussels Airport Company)



As a result of the amendment to the VLAREM legislation in 2005, the noise contours are no longer measured based on a daily breakdown that coincides with the operating schedule at Brussels Airport, but, rather, the day is split up into a daytime period (07:00-19:00), an evening period (19:00-23:00) and a night period (23:00-07:00). The number of movements in 2012 counted in accordance with that breakdown, split into departures and landings, is represented for 2011, together with the trend, in Table 1. The numbers for the night period are further broken down in this table between the operational night-time period (23:00-06:00) and the morning hour between 06:00 and 07:00.

For the daytime period (07:00 – 19:00) there is a relatively strong drop in the number of movements of approximately 6% as compared to 2011, both for landings and departures.

For the evening period (19:00 – 23:00), the number of landings remained approximately equal to that of 2011, but the number of departures diminished by approximately 4%.

The number of departures during the night period (23:00 – 07:00) rose by approximately 6% as compared to 2011. Both the number of departures during the operational night period and the number of departures during the morning period between 06:00 and 07:00 increased. The number of landings during the night-time period remained approximately constant, but there was a shift in the landings from the operational night-time period to the morning hour between 06:00 and 07:00.

Table 1 Number of flights (incl. helicopter movements) in 2012 and 2011 and the change compared with 2011 according to the division of the day used in VLAREM

period	2011			2012			change compared with 2011		
	departures	arrivals	total	departures	arrivals	total	departures	arrivals	total
day (07.00-19.00)	82,196	79,247	161,443	76,999	74,349	151,348	-6.3%	-6.2%	-6.3%
evening (19.00-23.00)	22,363	25,789	48,152	22,447	24,838	47,285	0.4%	-3.7%	-1.8%
night (23.00-07.00)	12,322	11,841	24,163	12,271	12,527	24,798	-0.4%	5.8%	2.6%
23.00-06.00	*10,820*	*3,828*	*14,648*	*10,442*	*4,206*	*14,648*	*-3.5%*	*9.9%*	*0.0%*
06.00-07.00	*1,502*	*8,013*	*9,515*	*1,829*	*8,321*	*10,150*	*21.8%*	*3.8%*	*6.7%*

4.1.2 Other important changes

In addition to the number of movements there are also a number of parameters that determine the size and the position of the noise contours, including the runway and route use, the flight procedures and the fleet deployed. The most important changes that occurred in 2012 are summarised below.

Fleet changes

Just as in 2010 and 2011, during the operational night-time period of 2012, approximately 30% of the departures involved aircraft of the type B752. In second place there was the aircraft type B733, where the number of departures did decrease, by approximately 12% as compared to 2011. Also remarkable is the increased use of A319, A320, B734 and B763 aircraft in the departure fleet for the operational night period. As concerns landings, what is especially remarkable is the increase in the number of landings with A320s, while the number of landings with B733s and, to a lesser extent, also those with A319s, dropped substantially. The update in the DHL fleet, whereby the B762 aircraft were replaced with B763s in the course of 2011, means that these B762 aircraft were no longer part of the operational night fleet in 2012.

The trend in the most frequently used aircraft types during the operational night period is shown in Table 2.

Table 2 Change in the number of flight movements per aircraft type during the operational night period (23.00-06.00) for the most common aircraft types

Type	Arrivals			Departures		
(ICAO)	2011	2012	change compared with	2011	2012	change compared with
A30B	291	248	-43 (-15%)	276	258	-18 (-7%)
A319	1058	856	-202 (-19%)	110	403	293 (266%)
A320	1551	2036	485 (31%)	224	273	49 (22%)
A321	614	483	-131 (-21%)	19	18	-1 (-5%)
A332	223	368	145 (65%)	6	10	4 (67%)
A333	792	766	-26 (-3%)	10	6	-4 (-40%)
ATP	32	54	22 (69%)	274	264	-10 (-4%)
B733	1347	813	-534 (-40%)	723	633	-90 (-12%)
B734	691	681	-10 (-1%)	35	101	66 (189%)
B735	96	126	30 (31%)	6	3	-3 (-50%)
B737	319	372	53 (17%)	12	14	2 (17%)
B738	934	1025	91 (10%)	103	107	4 (4%)
B744	113	89	-24 (-21%)	25	18	-7 (-28%)
B752	1180	1164	-16 (-1%)	1159	1284	125 (11%)
B763	429	404	-25 (-6%)	297	331	34 (11%)
BE20	124	38	-86 (-69%)	117	38	-79 (-68%)
DH8D	1	84	83 (8300%)	6	15	9 (150%)
EXPL	116	95	-21 (-18%)	57	50	-7 (-12%)
MD11	38	35	-3 (-8%)	53	47	-6 (-11%)
RJ1H	277	230	-47 (-17%)	17	28	11 (65%)
RJ85	138	52	-86 (-62%)	22	11	-11 (-50%)

In contrast to the general decrease in the number of movements in 2012, the number taking place with an aircraft with an MTOW of more than 136 tonnes (heavies) during the operational daytime period rose in 2012 by a little more than 2% as compared to 2011. The most frequently used aircraft types within this group are as follows (the change from the number of movements as compared to 2011 is shown in parentheses): A332 (+1%), B763 (+2%), A333 (-6%); B744 (-17%), B772 (13%), B762 (+108%), MD11 (+13%), B742 (-15%), A310 (-17%) en B77L/B77W (+153%).

As concerns the use of aircraft types under 136 tonnes during the operational daytime period, more than half of all movements took place with the aircraft types A319 (+25%), A320 (+15%), RJ1H (-3%) and B738 (+3%). Also remarkable is the strong increase in the use of aircraft types DH8D (+81%) and E190 (+82%). In contrast, the older aircraft types RJ85 (-67%), B733 (-57%) and B734 (-32%) are gradually being phased out from the fleet composition. This trend for aircraft types under 136 tonnes during the operational daytime period is, to the largest extent, determined by the changes of the aircraft fleet used by Brussels Airlines.

Runway and route use

The preferential runway use, published in the AIP (Aeronautical Information Publication, a Belgocontrol publication), shows which runway should preferably be used, depending on the time when the movement occurs, and in some cases the destination. During the year 2012 no changes were imposed to this scheme (Table 3).

Table 3 Preferential runway use since 31/07/2010 (local time) (source: AIP 12/01/2012)

<table>
<tr><th colspan="2" rowspan="2"></th><th colspan="2">Day</th><th>Night</th></tr>
<tr><th>06:00 to 15:59</th><th>16:00 to 22:59</th><th>22:59 to 05:59</th></tr>
<tr><td rowspan="2">Mon, 06:00 - Sun, 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R/20(1)</td></tr>
<tr><td>Arrival</td><td colspan="2">25L/25R</td><td>25R/25L(2)</td></tr>
<tr><td rowspan="2">Tue, 06:00 - Wed, 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R/20(1)</td></tr>
<tr><td>Arrival</td><td colspan="2">25L/25R</td><td>25R/25L(2)</td></tr>
<tr><td rowspan="2">Wed, 06:00 - Thu, 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R/20(1)</td></tr>
<tr><td>Arrival</td><td colspan="2">25L/25R</td><td>25R/25L(2)</td></tr>
<tr><td rowspan="2">Thu, 06:00 - Fri, 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R/20(1)</td></tr>
<tr><td>Arrival</td><td colspan="2">25L/25R</td><td>25R/25L(2)</td></tr>
<tr><td rowspan="2">Fri, 06:00 - Sat, 05:59</td><td>Departure</td><td colspan="2">25R</td><td>25R(3)</td></tr>
<tr><td>Arrival</td><td colspan="2">25L/25R</td><td>25R</td></tr>
<tr><td rowspan="2">Sat, 06:00 - Sun, 05:59</td><td>Departure</td><td>25R</td><td>25R/20(1)</td><td>25L(4)</td></tr>
<tr><td>Arrival</td><td>25L/25R</td><td>25R/25L(2)</td><td>25L</td></tr>
<tr><td rowspan="2">Sun, 06:00 - Mon, 05:59</td><td>Departure</td><td>25R/20(1)</td><td>25R</td><td>20(4)</td></tr>
<tr><td>Arrival</td><td>25R/25L(2)</td><td>25L/25R</td><td>20</td></tr>
</table>

(1) runway 25R for traffic via ELSIK, NIK, HELEN, DENUT, KOK and CIV / runway 20 for traffic via LNO, SPI, SOPOK, PITES and ROUSY (aircraft with MTOW > 200 tonnes always from runway 25R regardless of the destination)
(2) Runway 25L only if air traffic control considers this necessary
(3) Between 01.00 and 06.00, no slots may be allocated for departures
(4) Between 00.00 and 06.00, no slots may be allocated for departures

If the preferential runway configuration cannot be used (for example due to meteorological conditions, works on one of the runways, etc.), then Belgacontrol will choose the most suitable alternative configuration, taking account of the weather conditions, the equipment of the runways, the traffic density, etc. Conditions are tied the preferential runway use arrangements, including wind limits expressed as a maximum crosswind and maximum tailwind at which a particular runway can be used. If these limits are exceeded, air traffic control must switch to an alternative configuration. The prevailing wind limits during the year 2011 were for all runways a maximum crosswind of 15 kt (gusts included) and a maximum tailwind of 7 kt (gusts and a buffer value of 2 kt inclusive) for all runways

During the first two weeks of August 2012, runway 25R-07L was out of operation due to maintenance work. Because, among other things, of the meteorological conditions, during this time most departures and landings were managed on runway 20.

Also as concerns the flight paths (SIDs), a few changes were made in the course of 2012:

- 28 July 2012: The SID CIV1E (runway 25R/25L) was eliminated. To replace it, the SID CIV8D (runway 25R) and the SID CIV3Q (runway 25L) were opened during the daytime periods over the weekend.
- 13 December 2012: On runway 20, the SIDs PITES4N and ROUSY4N were eliminated. Also on this runway, a shift was effected in the path of certain SIDs: this meant that the SIDs SOPOK3L, PITES4L, ROUSY4L, CIV8L, DENUT4L and DENUT3N were changed to SOPOK4L, PITES5L, ROUSY5L, CIV9L, DENUT5L and DENUT4N. In addition, for all the SIDs of runway 20 the P-RNAV description was added, so that aircraft equipped with this technology can use it.

Operating restrictions

During the year 2012 there were no changes of the operating restrictions imposed to TBAC.

4.2 Match between measurements (NMS) and calculations (INM)

The INM software enables a number of acoustic parameters to be calculated at a given location around the airport. By performing this calculation at the locations of the measuring stations of the noise Monitoring System[11], it can be examined to what extent the calculated values correspond to the values recorded by the monitoring system. This comparison is carried out for the parameters $L_{Aeq,24h.}$, L_{night} and L_{den}.

The calculated values are compared with the values resulting from correlated measured events. Only the acoustic parameters of an event are recorded on the monitoring network. To select the events resulting from aircraft, an automatic link is made in the NMS to the flight and radar data, and the events are correlated with an overflight if possible.

[11] On 1/10/2012, an entirely modernised NMS system was commissioned at Brussels Airport (ANOMS). A number of different data sources are fed into this system and correlated among themselves: they include noise measurements, cdb, radar tracks and meteorological data. No changes to the locations or the manner in which the noise is recorded at the different noise measurement positions were made upon placement into operation of the new system.

The system of correlation is definitely not perfect and events are regularly attributed to overflying traffic and vice versa. In order to minimise the contribution of these events in the comparison, the only events taken into account are those with a duration of less than 75 s.

In the tables shown below, the calculated values at the different measurement positions are compared to the values calculated on the basis of the correlated events for the parameters $L_{Aeq,24h}$, L_{night} and L_{den}. In addition to the measurement positions of The Brussels Airport Company, the results of the LNE measurement positions (NMT 40-1 and higher) were also recorded, with these data also being available and correlated to the flight data within the airport's NMS. An overview of the location of all measuring positions is given in Appendix 2.

Table 4 Match between calculations and measurements for parameter $L_{Aeq,24h}$

		$L_{Aeq,24h}$ [dB]		
		INM	NMS	INM-NMS
NMT01-1	STEENOKKERZEEL	62.6	59.8	2.8
NMT02-2	KORTENBERG	67.9	67.7	0.2
NMT03-2	HUMELGEM-Airside	63.6	62.8	0.8
NMT04-1	NOSSEGEM	61.9	63.0	-1.1
NMT06-1	EVERE	50.2	50.1	0.1
NMT07-1	STERREBEEK	48.1	48.1	0.0
NMT08-1	KAMPENHOUT	53.6	53.8	-0.2
NMT09-2	PERK	47.6	44.4	3.2
NMT10-1	NEDER-OVER-HEEMBEEK	54.1	53.5	0.6
NMT11-2	SINT-PIETERS-WOLUWE	51.1	50.7	0.4
NMT12-1	DUISBURG	47.2	42.6	4.6
NMT13-1	GRIMBERGEN	46.4	40.5	5.9
NMT14-1	WEMMEL	47.4	46.1	1.3
NMT15-3	ZAVENTEM	54.6	47.8	6.8
NMT16-2	VELTEM	56.4	56.6	-0.2
NMT19-3	VILVOORDE	52.8	51.1	1.7
NMT20-2	MACHELEN	54.5	51.7	2.8
NMT21-1	STROMBEEK-BEVER	50.4	50.4	0.0
NMT23-1	STEENOKKERZEEL	66.6	64.7	1.9
NMT24-1	KRAAINEM	52.8	52.6	0.2
NMT26-2	BRUSSEL	47.1	46.6	0.5
NMT40-1*	KONINGSLO	51.9	51.7	0.2
NMT41-1*	GRIMBERGEN	48.4	47.1	1.3
NMT42-2*	DIEGEM	64.2	63.3	0.9
NMT43-2*	ERPS-KWERPS	56.4	55.7	0.7
NMT44-2*	TERVUREN	48.1	46.7	1.4
NMT45-1*	MEISE	45.5	44.6	0.9
NMT46-2*	WEZEMBEEK-OPPEM	54.2	54.3	-0.1
NMT47-3*	WEZEMBEEK-OPPEM	51.1	50.7	0.4
NMT48-3*	BERTEM	42.2	40.8	1.4

* noise data LNE off-line correlated by the NMS

The measuring stations NMT 1-1, NMT 3-2, NMT 15-3 and NMT 23-1 are situated on the airport site and/or in the immediate vicinity of the runway system and the airport facilities. The flight-correlated noise events comprise contributions from ground noise or overflights, or a combination of both. The link to specific flight movements is not always equally reliable for these measuring stations. For these reasons, the measured values at these measuring stations are less relevant for assessing noise immission from overflying aircraft.

The comparison between calculations and measurements based on the $L_{Aeq,24h}$ shows that the discrepancy between the calculated value and the measured value for the vast majority of the measuring stations remains limited to 2 dB(A). For more than half of the measuring stations, this discrepancy is even limited to less than 1 dB(A).

There are a few noticeable outliers, where the model clearly calculates more than the noise events effectively measured (mainly NMTs 12-2 Duisburg and 13-1 Grimbergen). We are convinced that for these measuring stations, the sound pressure levels caused by an overflight are comparable with the trigger level of the measuring station. Some of the overflights are therefore not recorded as a noise event, since the trigger level is less than 10s or not at all exceeded.

A good correlation between the measured and calculated values was also found for the parameters L_{night} and L_{den} (see tables below).

Table 5 Match between calculations and measurements for parameter L_{night}

		L_{night} [dB]		
		INM	NMS	INM-NMS
NMT01-1	STEENOKKERZEEL	63.5	58.7	4.8
NMT02-2	KORTENBERG	63.3	63.2	0.1
NMT03-2	HUMELGEM-Airside	58.4	57.3	1.2
NMT04-1	NOSSEGEM	58.5	60.6	-2.1
NMT06-1	EVERE	44.5	44.9	-0.4
NMT07-1	STERREBEEK	47.6	49.4	-1.8
NMT08-1	KAMPENHOUT	51.6	52.2	-0.6
NMT09-2	PERK	44.3	43.3	1.0
NMT10-1	NEDER-OVER-HEEMBEEK	49.6	49.7	-0.1
NMT11-2	SINT-PIETERS-WOLUWE	46.1	46.4	-0.3
NMT12-1	DUISBURG	44.1	42.1	2.0
NMT13-1	GRIMBERGEN	40.4	30.2	10.2
NMT14-1	WEMMEL	42.8	40.6	2.2
NMT15-3	ZAVENTEM	51.6	48.5	3.1
NMT16-2	VELTEM	51.9	52.3	-0.4
NMT19-3	VILVOORDE	48.1	46.7	1.4
NMT20-2	MACHELEN	50.1	47.4	2.7
NMT21-1	STROMBEEK-BEVER	46.1	46.9	-0.8
NMT23-1	STEENOKKERZEEL	64.7	63.5	1.2
NMT24-1	KRAAINEM	47.6	48.2	-0.6
NMT26-2	BRUSSEL	41.4	41.0	0.4
NMT40-1*	KONINGSLO	47.7	48.0	-0.3
NMT41-1*	GRIMBERGEN	44.2	42.9	1.3
NMT42-2*	DIEGEM	58.6	58.8	-0.2
NMT43-2*	ERPS-KWERPS	51.2	50.7	0.5
NMT44-2*	TERVUREN	45.9	46.1	-0.2
NMT45-1*	MEISE	40.1	38.8	1.3
NMT46-2*	WEZEMBEEK-OPPEM	49.1	49.8	-0.7
NMT47-3*	WEZEMBEEK-OPPEM	50.2	51.1	-0.9
NMT48-3*	BERTEM	36.2	34.9	1.3

* noise data LNE off-line correlated by the NMS

Table 6 Match between calculations and measurements for parameter L_{den}

		L_{den} [dB]		
		INM	NMS	INM-NMS
NMT01-1	STEENOKKERZEEL	69.6	65.5	4.2
NMT02-2	KORTENBERG	71.8	71.7	0.1
NMT03-2	HUMELGEM-Airside	67.3	66.5	0.8
NMT04-1	NOSSEGEM	66.4	68.0	-1.6
NMT06-1	EVERE	53.7	53.9	-0.2
NMT07-1	STERREBEEK	54.1	55.3	-1.2
NMT08-1	KAMPENHOUT	58.8	59.2	-0.4
NMT09-2	PERK	52.1	50.0	2.1
NMT10-1	NEDER-OVER-HEEMBEEK	58.0	57.7	0.2
NMT11-2	SINT-PIETERS-WOLUWE	54.9	54.9	0.0
NMT12-1	DUISBURG	51.8	48.6	3.2
NMT13-1	GRIMBERGEN	49.9	43.0	6.9
NMT14-1	WEMMEL	51.1	49.4	1.7
NMT15-3	ZAVENTEM	59.2	54.6	4.6
NMT16-2	VELTEM	60.3	60.7	-0.4
NMT19-3	VILVOORDE	56.7	55.3	1.5
NMT20-2	MACHELEN	58.2	56.0	2.2
NMT21-1	STROMBEEK-BEVER	54.3	54.7	-0.4
NMT23-1	STEENOKKERZEEL	71.9	70.4	1.5
NMT24-1	KRAAINEM	56.5	56.8	-0.3
NMT26-2	BRUSSEL	51.3	51.0	0.3
NMT40-1*	KONINGSLO	55.8	56.0	-0.1
NMT41-1*	GRIMBERGEN	52.4	51.2	1.2
NMT42-2*	DIEGEM	67.8	67.3	0.5
NMT43-2*	ERPS-KWERPS	60.1	59.5	0.6
NMT44-2*	TERVUREN	53.1	52.6	0.4
NMT45-1*	MEISE	48.8	47.8	1.1
NMT46-2*	WEZEMBEEK-OPPEM	58.0	58.5	-0.5
NMT47-3*	WEZEMBEEK-OPPEM	56.8	57.2	-0.4
NMT48-3*	BERTEM	45.8	44.6	1.1

* noise data LNE off-line correlated by the NMS

4.3 Change in the event $L_{Aeq,24h}$level

In Figure 5, a change is shown in the $L_{Aeq,24h}$ level based on noise measurements throughout the year, over the period 1990-2012. These $L_{Aeq,24h}$ levels are shown, on the one hand, based on all noise events (unfilled bars) and, on the other hand, from the year 2000 onward, also based on these noise events linked to an aircraft movement (red coloured bars).

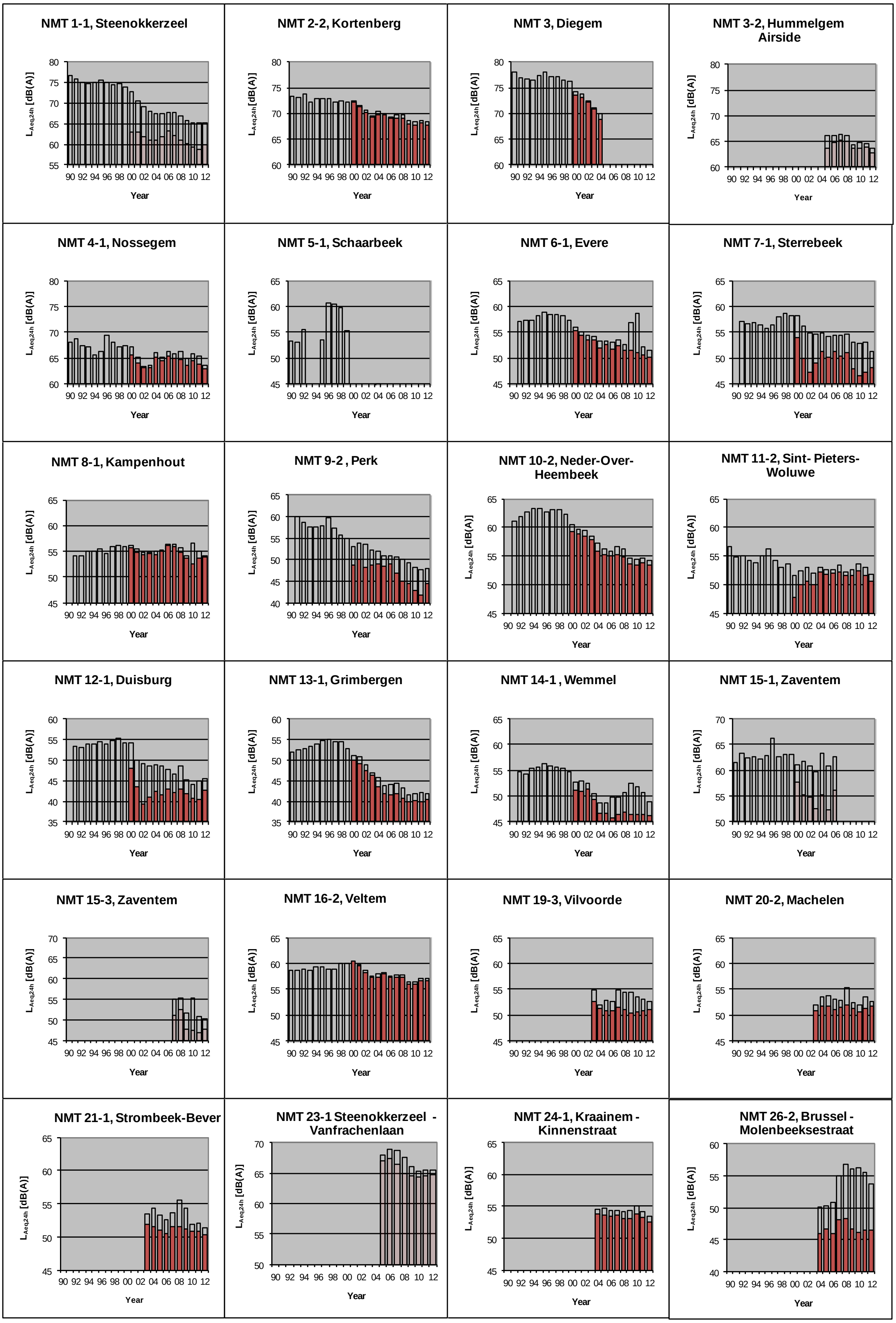
To determine $L_{Aeq,24h}$ levels based on all noise events, we started from the logarithmic average of the measured $L_{Aeq,24h}$ values recorded at the measuring stations. It was observed that outliers within these data clouds have a strong influence in the logarithmic averages, and therefore they were excluded. Outliers are defined as values that lie outside 3 standard deviations from the arithmetic average (of the dB(A) values!) These outliers are caused during calibration and testing of the NMTs or as a result of wind during stormy weather conditions.

For the determination of the aircraft linked $L_{Aeq,24h}$ level, an off-line linking procedure was used for the data up to 30/04/2004, and for the data after 30/04/2004, the correlation procedure of the B&K NMS was used (until 30/9/2012); that of the new B&K ANOMS system was used from 1/10/2012 onwards.

For the measurement stations NMT 2-2, NMT 9-2, NMT 10-2, NMT 11-2, NMT 16-2, NMT 19-3, NMT 20-2 and NMT 26-2, the data recorded at the previous locations is shown on the same graph so that the minor shifts in the measurement station have no influence on the recorded noise levels.

The values for the aircraft-linked $L_{Aeq,24h}$ level for the measuring stations NMT 1-1, NMT 3-2, NMT 15-1, NMT 15-3 and NMT 23-1 are less relevant for the reasons set out in 4.2 for the assessment of the noise immission as a result of overflights by aircraft. These values are shown in a lighter colour on the graph.

Figure 5 Change in $L_{Aeq,24h}$ level at the monitoring stations in the network of The Brussels Airport Company



4.4 Discussion of the noise contours and tables

The results of the noise contour calculations for the above described parameters (L_{day}, $L_{evening}$, L_{night}, L_{den}, freq.70,day, freq.70,night, freq.60,day and freq.60,night) are recorded in Appendix 6 and Appendix 7. The surface of the respective contour zones on one hand and the number of inhabitants within the contours on the other hand were determined by means of a projection of the calculated noise contours on a topographic map and a population map in a GIS system. As already stated earlier, in this report we chose to determine the number of inhabitants per contour zone on the basis of the most recent population data, more particularly those as of 1 January 2010. The detailed results of this calculation for each merger district can be found in Appendix 4.

Appendix 5 contains the change in the surface area for each contour zone and the number of inhabitants within the various contour zones. As already stated, version 7.0b of the INM calculation model was used for the first time for the calculation of the noise contours for 2011. In order to be able to analyse the trend over the long term, the noise contours for the years 2006 through 2010 were recalculated with the new version (INM 7.0b) of the calculation model for the parameters L_{day}, $L_{evening}$, L_{night} en L_{den}. The number of inhabitants within these recalculated noise contours was calculated by means of the population figures used for the official reporting of that year. For the frequency contours, only 2010 was recalculated with the new calculation model. The changes reported in Appendix 5 also use these recalculated figures to enable a comparison to be made over the different years that is independent of the calculation model used.

In Appendix 8, the contours for 2011 and 2012 are printed out together on a population map for comparison purposes.

Runway use plays an important role for the interpretation of the results of noise contour calculations around an airport. For the sake of completeness, these data are summarised in Appendix 1.**Lday contours**

The L_{day} contours represent the A weighted equivalent sound pressure level over the period 07:00 to 19:00 and are reported from 55 dB(A) through 75 dB(A) in steps of 5 dB(A). The changes in the L_{day} noise contour of 55 dB(A) for the years 2011 and 2012 are also reproduced in Figure 6.

The evaluation period for the L_{day} contours falls entirely within the operational daytime period, 06:00 – 23:00, as determined at Brussels Airport. This means that the runway use 'Departure 25R – Landing 25L/25R' is always preferential except for the off-peak period during the weekend (Saturday from 16:00 onwards and Sunday until 16:00) where the configuration 'Departure 20/25R – Landing 25L/25R' is used. With this last configuration, runway 20 is used for departures in an easterly direction, and runway 25R for the remaining departures, except for aircraft with a MTOW of more than 200 ton, which always take off from runway 25R.

From the runway use statistics it also becomes apparent that runway 25R was used for approximately 83% of departures during the daytime period in 2012. As a result of these movements, the L_{day} noise contours also clearly demonstrate a departure lobe in the continuation of runway 25R. Runway 20, as the preferential departure runway during the off-peak period at the weekend for departures in an easterly direction by aircraft with a MTOW of less than 200 tons, was used in 2012 for 5.2% of the departure movements during the daytime period.

As the departure routes from this runway turn away in an easterly direction at a height of 700 ft, there is a barely visible bulge in the landing contour of runway 02.

Runway 07R still accounts for 11.2% of departures as an alternative departure runway. The increased turnaway height (compared to departures from runway 20) causes a bulge that is barely visible either in a southerly direction or a northerly direction, because the departure lobe completely overlaps with the landing bulge of runway 25L. The remaining runways 07L, 02 and 25L were only used for a small minority of departures in 2012: 0.4%, 0.3% and 0.0% respectively.

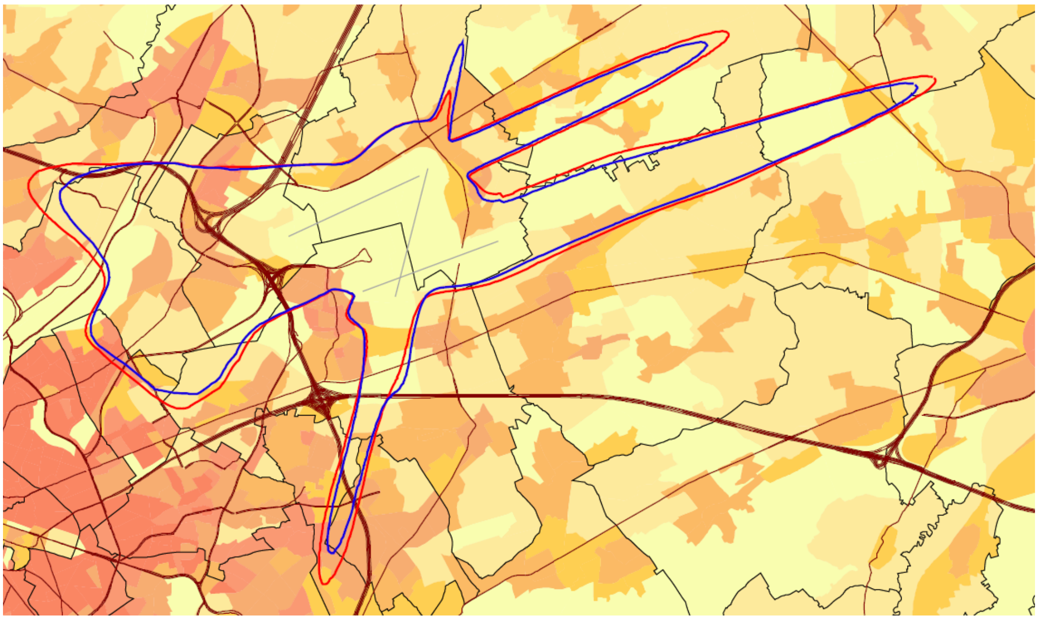
As far as arrivals are concerned, the arrival lobes on runways 25L and 25R are clearly the largest. These runways jointly account for 83.0% of all arrivals during the daytime period. The arrival lobe on runway 02, as a result of receiving 11.3% of landing traffic, is rather smaller yet still very pronounced. Even smaller is the landing lobe on runway 20, on which 5.2% of all landings took place in 2012.

In comparison with 2011, the total number of departures during the day period fell by a little more than 6% from 217.1 per day in 2011 to 203.1 per day in 2012. This decrease caused the departure lobe in the extension of runway 25R to become smaller, especially as concerns the easterly and northerly directions. For departures straight ahead, on the other hand, there is only a very limited decrease in the noise contour. This is due in particular to departures using heavy 4-engine aircraft climbing straight ahead to a height of 4000 ft. Although the total number of movements on this route also saw a decrease (from 2.1 per day in 2011 to 1.8 per day in 2012), the noise contour declined only slightly, primarily as a result of an increase in the number of B742 movements on this route. By the decline in the use of runway 07R for departures (11.2% in 2012 as compared to 15.2% in 2011) the bulge on the landing contour of runway 25L in the northerly direction has also become nearly invisible. The relative number of departures on runway 20 increased from 3.3% in 2011 to 5.2% in 2012. This increase is, to a great extent, the result of the maintenance work being carried out on runway 25R-07L during the first two weeks of August of 2012, which meant that runway 25R could not be used as a departure runway during this period. In comparison with 2011, this increase caused a bulge in the landing contour of runway 02 to become visible.

In comparison with 2011, and reflecting the trend in departures, the total number of landings during the daytime period in 2012 declined by just over 6%. Concerning the runway use for landings, the decline in the use of runway 02 (11.3% of the landings in 2012 compared to 14.9% in 2011) is striking, and is consistent with the reduced use of runway 07R for departure movements. The 'departures 07R(/07L/02) - landings 02' configuration is the main alternative configuration when weather conditions do not permit the preferential runway use (mostly due to wind limits being exceeded). The landings on runway 20 increased relatively significantly from 1.6% in 2011 to 5.2% in 2012, with the abovementioned maintenance work on runway 25R once again played an important role. The change in the landing contours reflects these observations: a relatively strong decrease in the landing lobe on runway 02 as a result of the decline in the number of movements with the reduced use of this runway. Also the landing contours in the extension of runways 25R and 25L have become smaller due to a decrease in the number of movements during the daytime period. In addition to the decrease in the number of movements and the trends in runway use, the evolution to a quieter aircraft fleet also plays a role in this development. Owing to the relatively very strong increase in the use of runway 20, the landing contour on this runway has grown.

As a result, the total area within the L_{day}-noise contour of 55 dB(A) declined in 2012 by approximately 10% as compared to 2011 (5,406 ha in 2011 versus 4,871 ha in 2012). The number of inhabitants within this noise contour declined by 14% from 39,828 in 2011 to 34,375 in 2012.

Figure 6 L_{day} noise contours of 55 dB(A) around Brussels Airport for 2011 (red) and 2012 (blue)



4.4.2 $L_{evening}$ contours

These contours show the A-weighted equivalent sound pressure level over the period 19:00 to 23:00. Unlike the L_{day} contours, the $L_{evening}$ contours have to be reported according to VLAREM from 50 dB(A) to 75 dB(A) which makes the $L_{evening}$ contours apparently larger on the maps. The changes in the $L_{evening}$ noise contour of 50 dB(A) for the years 2011 and 2012 are also reproduced in figure 7.

This evening period is entirely situated within the operational daytime period, so that more or less the same runway use is reflected as in the L_{day} contours.

During the evening period, the average number of departures per hour is approximately equal to the number during the daytime period (17.0 between 19:00 and 23:00 compared with 16.9 between 07:00 and 19:00). The number of arrivals per hour is approximately 13% lower during the evening period than in the daytime period (15.3 between 19:00 and 23:00 compared with 17.5 between 07:00 and 19:00). Runway use for both departures and landings during the evening period is very similar to runway use during the daytime period, except for a few minor shifts: the alternative configuration departure 07R – landing 02 was used somewhat more during the evening period than during the daytime period (13.1% of landings on runway 02 during the evening period versus 11.3% during the daytime period); for departures from runway 25R, relatively slightly more routes are used in the northerly direction to the detriment of routes in the easterly direction, and the use of runway 20 is also less, both for departures and for landings.

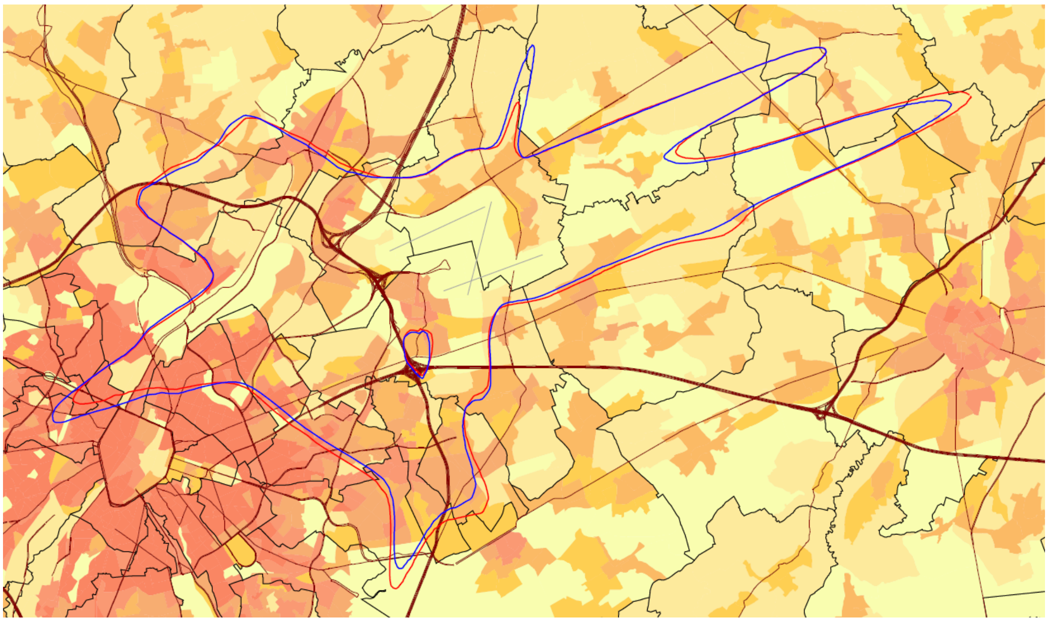
Because the number of movements on the route from runway 25R that climb straight to 4000 ft. (heavy 4-engined aircraft) during the evening period is relatively much larger than during the daytime, the departure lobe of runway 25R in the straight ahead direction is also much more pronounced for the evening period than for the daytime period. Notwithstanding the fact that the number of movements per hour from runway 25R turning away to the north and to the east during the evening period is approximately the same, the corresponding departure lobes are larger during daytime than during the evening period. This is attributable to the composition of the fleet for these routes during the evening period, when relatively greater numbers of smaller planes are used than during the daytime period. As regards the noise contours in the landing zones, these are mainly smaller due to the lower number of landings during the evening period than during the daytime, except for runway 25R, where owing to the higher proportion of large cargo planes in the fleet composition the landing contour remains equal in size during the evening period and during the daytime.

The number of departures during the evening period dropped from 70.7 per evening period in 2011 to 67.9 per evening period in 2012. Relative to 2011, there is a remarkable increase in the departure zones in the noise contour in the extension of runway 25R. This is caused by the increase in the number of movements with heavy 4-engined aircraft (primarily B742 and B744) with eastward destinations climbing straight ahead to an altitude of 4000 feet before turning away. In the northerly direction, as a result of the departures from runway 25R the noise contour remained the same, while decreasing slightly for the routes in easterly direction. Furthermore, by reducing the use of runway 07R for departures, the bulges on the landing contour of runway 25L became smaller. The bulges in the landing contour of runway 02 landing due to the departures from runway 20 increased slightly due to the rise in the number of departures on this runway from 1.7 per evening period in 2011 to 2.5 per evening period in 2012.

The total number of landings in 2012 during the evening period remained the same as in 2011 (on average 61.3 per evening period). By reducing the use of runway 02 for landings and by the changes in the fleet composition, in this case the noise contour became smaller. These landings have primarily shifted to runway 20, where a clear increase in the noise contour is visible. Although the number of landings on runway 25L remained approximately the same, the landing contour on this runway has become smaller, primarily due to a shift in the fleet mix to less noisy planes.

The total area within the $L_{evening}$-noise contour of 50 dB(A) declined from 12,547 ha in 2011 to 12,237 ha in 2012, a decrease of approximately 2%. On the other hand, the number of inhabitants within this noise contour rose by about 8% from 249,716 in 2011 to 269.635 in 2012, primarily owing to the increase in the size of the noise contour in the extension of runway 25R.

Figure 7 $L_{evening}$ noise contours of 50 dB(A) around Brussels Airport for 2011 (red) and 2012 (blue)



4.4.3 L_{night} contours

The L_{night} contours represent the A weighted equivalent sound pressure level over the period 23:00 to 07:00 and are reported from 45 dB(A) through 70 dB(A). The changes in the L_{night} noise contour of 45 dB(A) for the years 2011 and 2012 are also reproduced in figure 8.

The evaluation period of the L_{night} contours does not completely match the operational division of the day at Brussels Airport. In operational terms, the night period is from 23:00 to 06:00. The period between 06:00 and 07:00 is operationally the day period so that for this period, the runway use that was already described in the discussion of the L_{day} noise contours is applied preferentially. During the operational night period, the preferential runway use is the configuration 'Departures 25R/20 - Landings 25R/25L', except for the weekend nights, when there is alternating use of runway 25R (Friday night), 25L (Saturday night) and runway 20 (Sunday night) for both departures and arrivals. More specifically, concerning route use, during the operational night period there are no departures from runway 25R because of the tight left turn in a southerly direction. Instead, these flights from runway 25R follow a route which turns to the right (see ring route CIV1C). When runways 25R and 20 are in use together, runway 20 is always used for departures in an easterly direction for planes with MTOW<200 tonnes. The smaller aircraft heading for the Chièvres beacon that depart from runway 25R make use of the canal route (CIV7D) during the operational night period, while the larger aircraft follow the ring route.

Due to the presence of the hour between 06:00 and 07:00 in the parameter L_{night} approximately 74% of all departures in this evaluation period take place from runway 25R (two thirds of the departures between 23:00 and 07:00 actually occur in the hour between 06:00 and 07:00; see Table 1. Notwithstanding the fact that the routes involving a short left-hand turn to the south from runway 25R are not used during the operational night period, there is nonetheless a distinct departure lobe for the L_{night}-noise contours in the southerly direction (as a result of the departures between 06:00 and 07:00), which is comparable in size to the departure lobe of runway 25R in a northerly direction.

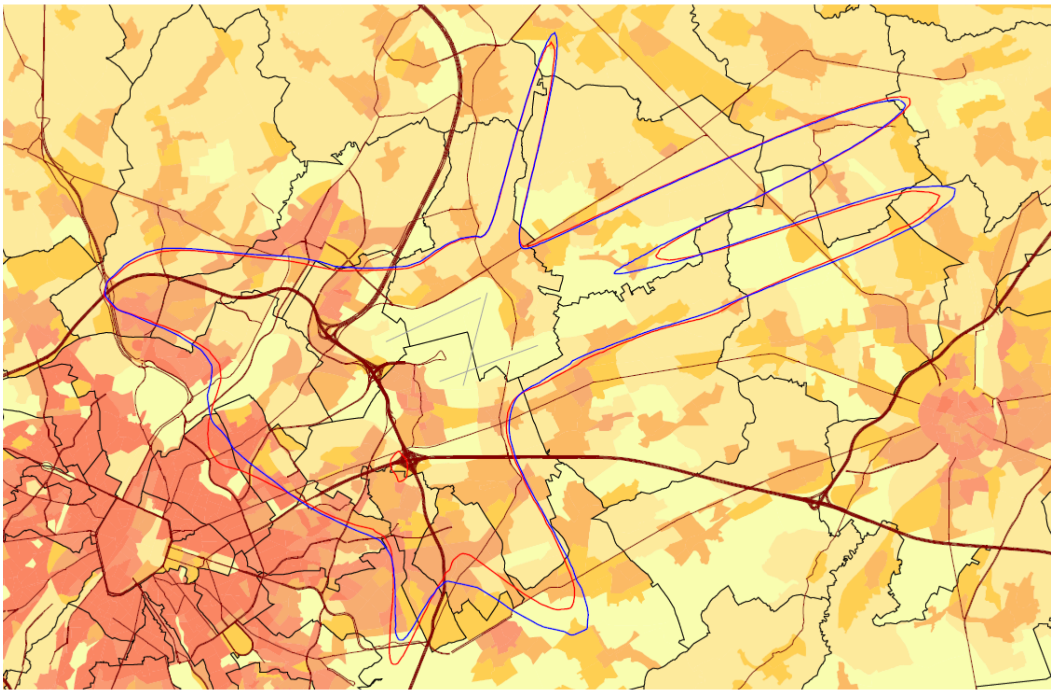
The departure lobe in the extension of runway 20 is also clearly visible (18.2% of all departures). Of the night period departures, 5.4% take place from runway 07R. Due to the overlap with the noise contour caused by landings on runway 25L, a bulge reflecting this is hardly visible. As far as landings are concerned, the vast majority of landings are handled by runways 25R and 25L (jointly 80.4%) where unlike the daytime and evening period, more aircraft land on runway 25R (40.7%) than on runway 25L (39.7%). Furthermore, clear landing contours are also visible on the extension of runways 02 (8.3% of landings) and 20 (11,2% of landings).

Compared to 2011, the total number of departure movements in 2012 during the night period from 23:00 to 07:00 rose by approximately 6%. This was combined with increased use of runway 20 from 16.2% in 2011 to 18.2% in 2012, resulting in an increase in the noise contour in the extension of this runway (with turn to the east). As a result of the replacement of the SID CIV1E (Chabert route) from Augustus 2012 by the SID CIV8D (canal route), the bulge on the departure lobe of runway 25R directly in the extension of the runway is shifted in a northerly direction. In the other departure zones, the noise contours remained approximately the same size.

The number of landings during the night period remained approximately constant. The landing contours changed in correlation with the small shifts in runway use: a limited decrease on runways 02 and 25L and a limited increase on runways 25R and 20.

Due to these developments, the surface area within the L_{night} noise contour of 45 dB(A) rose by 3% from 12,736 ha in 2011 to 13,118 ha in 2012. On the other hand, the number of inhabitants within this noise contour declined by 2% from 159,594 in 2011 to 155,655 in 2012.

Figure 8 L_{night} noise contours of 45 dB(A) around Brussels Airport for 2011 (red) and 2012 (blue)



4.4.4 L_{den} contours (day 07.00-19.00, evening 19.00-23.00, night 23.00-07.00)

The parameter L_{den} is a composite of L_{day}, $L_{evening}$ and L_{night}, giving an A-weighted equivalent level over the whole 24h period, but where evening flights are subject to a correction factor of 3.16 (or + 5 dB) and night flights to a factor of 10 (or +10 dB). These contours are reported between 55 dB(A) and 75 dB(A).

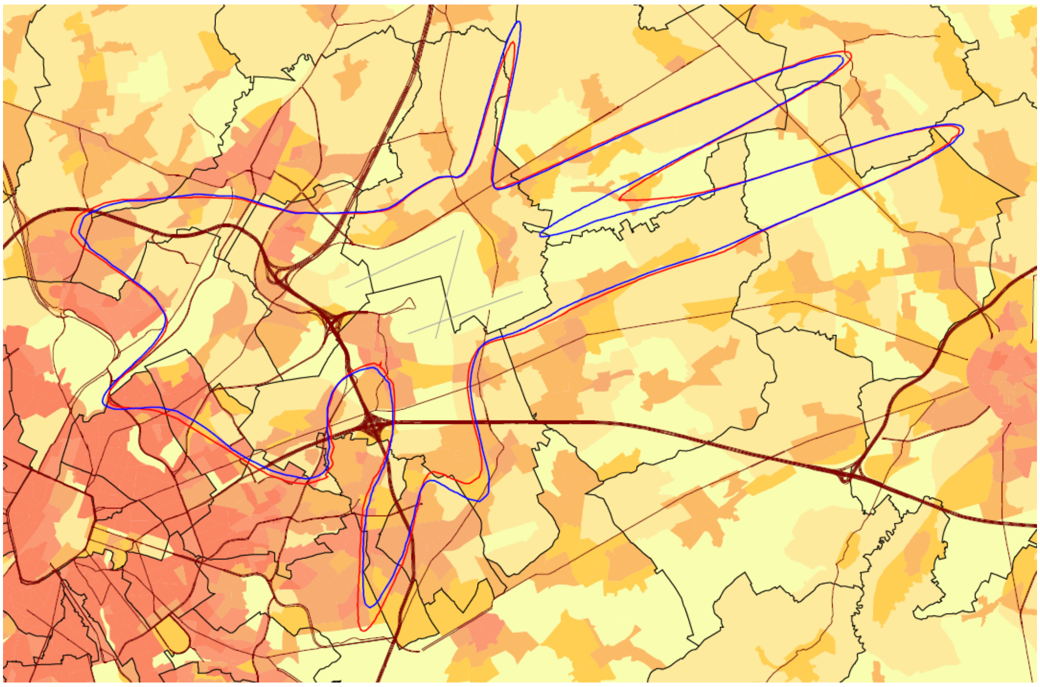
Since this is a purely mathematical operation, the observations mentioned in the previous paragraphs for the L_{day}, $L_{evening}$ and L_{night} noise contours recur in the L_{den} noise contours. The changes in the L_{den} noise contour of 55 dB(A) for the years 2011 and 2012 are also reproduced in Figure 9.

As far as the departures are concerned, there is a small increase in the L_{den} noise contours for the departure lobe of runway 25R for departures straight ahead, while the departure lobes in an eastward and northerly direction became slightly smaller. By the increase in the use of runway 20, this departure lobe also expanded.

Concerning landings, in correlation to the decrease in the alternative configuration 'Departures 07R - Landings 02' we see a decrease in the landing lobe on runway 02. The majority of these landings have shifted to runway 20, where an increase in the noise contour has become apparent. The landing contours in runways 25R and 25L remained approximately the same size.

The total area within the 55 dB(A) decreased by approximately 3% from 9,167 ha in 2011 to 8,905 ha in 2012. The number of inhabitants within this noise contour declined by 4% from 111,969 in 2011 to 107,680 in 2012.

Figure 9 L_{den} noise contours of 55 dB(A) around Brussels Airport for 2011 (red) and 2012 (blue)



4.4.5 Freq.70,day – contours (day 07.00-23.00)

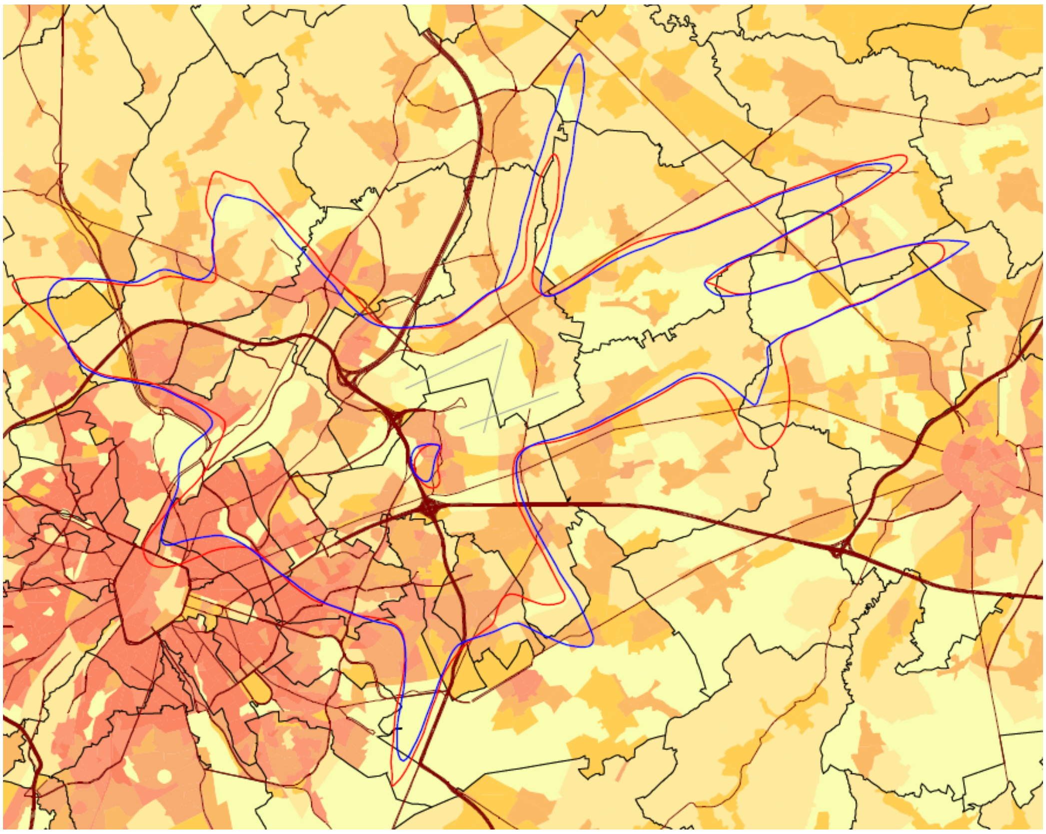
The freq.70,day contours are calculated for an evaluation period that consists of the evaluation periods of L_{day} and $L_{evening}$ combined. The observations discussed above for these parameters therefore recur to a certain extent in the freq.70,day contours. The change in the freq.70,day noise contour of 5X above 70 dB(A) for the years 2011 and 2012 is also reproduced in Figure 10.

Compared to 2011, what is remarkable for 2012 is the partial shift of the departure lobe in a northerly direction straight from runway 25R as a result of the replacement of the Chabert route with the canal route since August of 2012. In addition, there is a distinct increase in the size of the departure lobe from runway 20 and a decrease in the size of the departure lobe from runway 07R that is consistent with the change in runway use during this period.

As concerns landings, the relatively largest increase for the landing contour is on runway 20. Small shifts can be seen for runways 25R, 25L and 02.

The total area within the 5x above the 70 dB(A) contour therefore remained approximately equal (15,926 ha in 2011 as compared to 15,877 ha in 2012). The number of inhabitants declined by approximately 4% from 314,103 in 2011 to 302,136 in 2012.

Figure 10 Freq.70,day noise contours of 5x above 70 dB(A) around Brussels Airport for 2011 (red) and 2012 (blue)



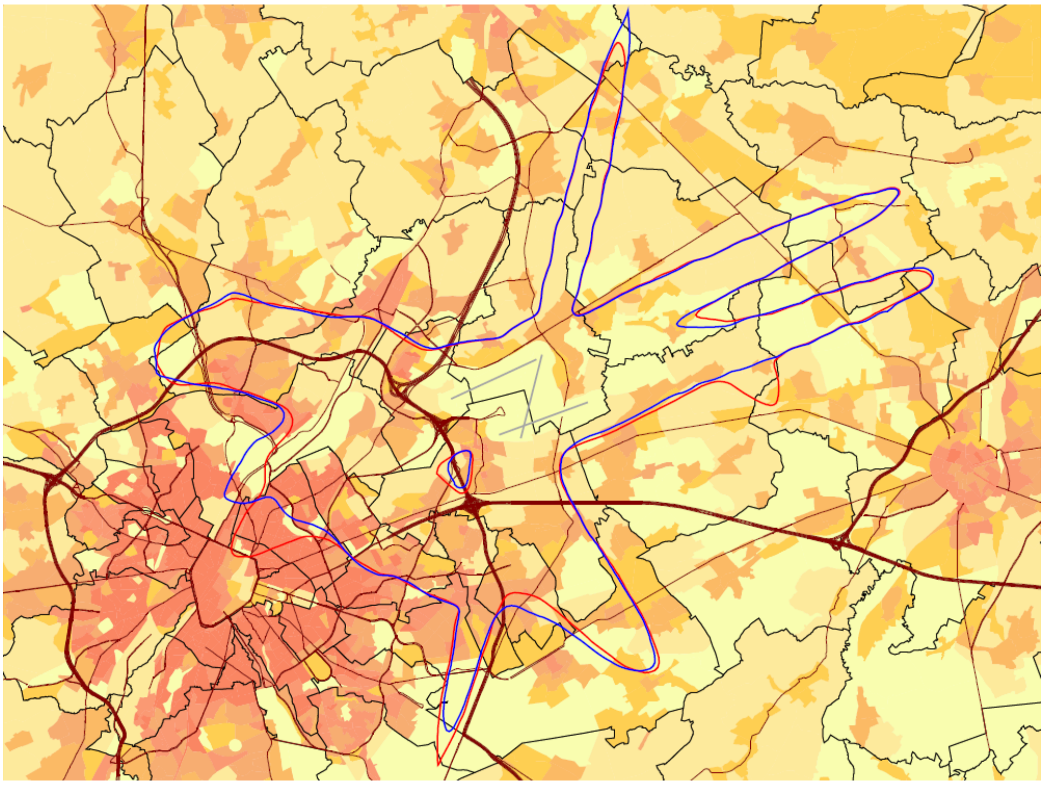
4.4.6 Freq.70,night contours (night 23.00-07.00)

The freq.70,night contours are calculated for the same evaluation period as the L_{night} noise contours. The change in the freq.70,night noise contour of 1x above 70 dB(A) for the years 2011 and 2012 is also reproduced in Figure 11.

Also in the 1x above the 70 dB(A) range it is primarily the shift as a result of the replacement of the Chabert route with the canal route since August of 2012 that is particularly striking. The other changes between the contours for 2011 and 2012 are, on the other hand, rather limited. Owing to the decline in the number of departures on runway 07R, the bulge in the landing contour in the southerly direction has virtually disappeared.

The total area within the 1x above 70 dB(A) contour decreased by approximately 1% from 15,115 ha in 2011 to 14,938 ha in 2012. The number of inhabitants declined by 14% from 271,010 in 2011 to 234,110 in 2012

Figure 11 Freq.70,night noise contours of 1x above 70 dB(A) around Brussels Airport for 2011 (red) and 2012 (blue)



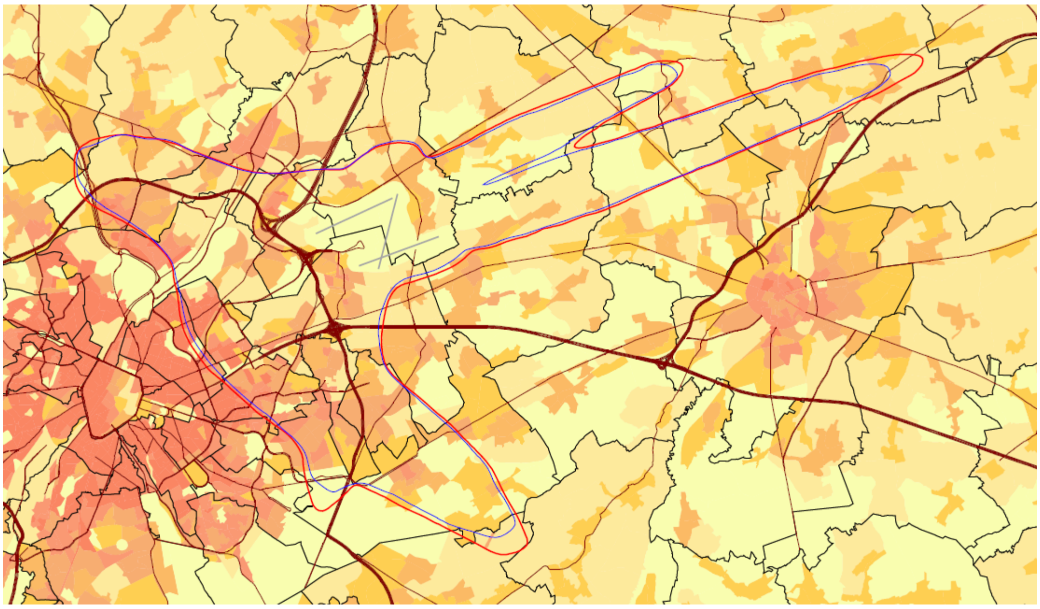
4.4.7 Freq.60,day – contours (day 07.00-23.00)

In view of the narrower angle in the vertical profile and the narrower spread of the landing flight traffic compared with departing flight traffic, the frequency contours for 60 dB(A) in the landing zones soon extend a long way from the airport. This means that these frequency contours can only be determined from the contour 50x above 60 dB(A), where the main runway use is shown in the form of contours: landings on runways 25L and 25R, departures from runway 25R with a turn away north on the one hand, and with a turn away east on the other. Owing to the higher spatial concentration of the departures from runway 25R and 20 in an eastward direction to the Huldenberg beacon, the 50x above the 60 dB(A) contour for these departures reaches beyond that for a turnaway from runway 25R in a northward direction.

The change in the freq.60,day noise contour of 50x above 60 dB(A) for the years 2011 and 2012 is also reproduced in Figure 12. This noise contour is, as concerns its shape, entirely comparable in 2012 with that for 2011, but has slightly reduced in most areas.

The total area within the 50x above the 60 dB(A) contour during the daytime period fell by approximately 7% from 16,572 ha in 2011 to 15,337 ha in 2012. This caused the population within this contour line to decline by approximately 5% from 230,793 in 2011 to 220,312 in 2012.

Figure 12 Freq.60,day noise contours of 50x above 60 dB(A) around Brussels Airport for 2011 (red) and 2012 (blue)

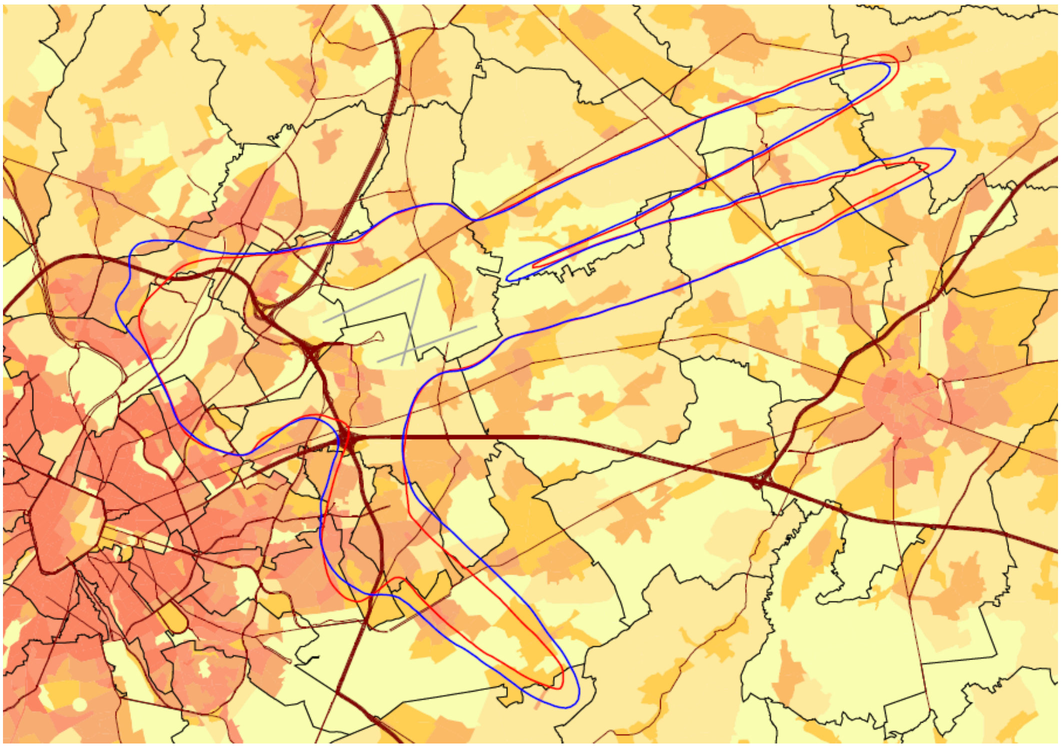


4.4.8 Freq.60,night contours (night 23.00-07.00)

For the same reasons as with the freq.60,day contours, for the freq.60,night contours, only contours for relatively high frequencies can be calculated (lowest frequency is 10x above 60 dB(A)). This means that these contours too reflect the main runway use during the night period: landings on 25R and 25L, departures from runway 25R with a turn to the north (or to the south during the morning period) and from runway 20 with a turn to the east. The change in the freq.60,night noise contour of 10x above 60 dB(A) for the years 2011 and 2012 is also reproduced in Figure 13.

The total area within the 10x above 60 dB(A) contour rose by 9% from 11,242 ha in 2011 to 12,236 ha in 2012. The number of inhabitants declined by 22% from 100,913 in 2011 to 117,284 in 2012.

Figure 13 Freq.60,night noise contours of 10x above 60 dB(A) around Brussels Airport for 2011 (red) and 2012 (blue)



4.5 Number of people potentially highly annoyed based on L_{den} noise contours

The number of people potentially highly annoyed per L_{den} contour zone and per district is determined based on the dose-response ratio contained in the VLAREM (see 2.2).

For 2012, the total number of people potentially highly annoyed within the L_{den} 55 dB(A) contour was 14,886. This represents an decrease of a little more than 3% compared to 2011, where there were 15,409 people potentially highly annoyed. This means that the number of people potentially highly annoyed remained at the same level as in 2010. This is a sharp fall compared with the year 2007 when the number of people highly annoyed was 23,732.

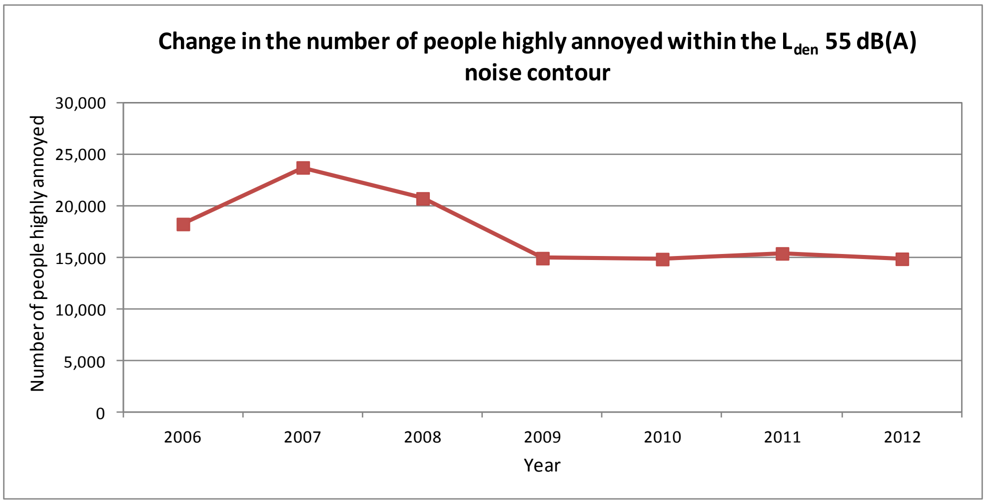
A summary per local authority area is reproduced in Table 7. Note that the values for 2006-2010 have been recaculated with version 7.0b of the INM calculation model. In the previous reports for these years INM 6.0c has been used.

The detailed data in this respect are included in Appendix 4.3.

Table 7 Change in the number of people potentially highly annoyed within the L_{den} 55 dB(A) noise contour

Year	2006	2007	2008	2009	2010	2011	2012
INM version	7.0b	7.0b	7.0b	7.0b	7.0b	7.0b	7.0b
Population data	1jan'03	1jan'06	1jan'07	1jan'07	1jan'08	1jan'08	1jan'10
Brussel	1,254	1,691	1,447	1,131	1,115	1,061	1,080
Evere	2,987	3,566	3,325	2,903	2,738	2,599	2,306
Grimbergen	479	1,305	638	202	132	193	120
Haacht	103	119	58	36	31	37	37
Herent	88	140	162	119	115	123	134
Kampenhout	747	727	582	453	483	461	399
Kortenberg	548	621	604	512	526	497	422
Kraainem	934	1,373	1,277	673	669	667	500
Leuven	0	9	22	2	1	3	5
Machelen	2,411	2,724	2,635	2,439	2,392	2,470	2,573
Schaarbeek	995	1,937	1,440	603	1,153	1,652	1,703
Sint-L.-Woluwe	382	1,218	994	489	290	196	150
Sint-P.-Woluwe	411	798	607	396	477	270	82
Steenokkerzeel	1,530	1,584	1,471	1,327	1,351	1,360	1,409
Tervuren	0	0	0	0	0	0	0
Vilvoorde	1,158	1,483	1,177	894	812	868	851
Wezembeek-O.	739	878	670	359	425	408	399
Zaventem	3,490	3,558	3,628	2,411	2,152	2,544	2,716
ZEMST	0	0	0	0	0	0	0
Total	**18,257**	**23,732**	**20,737**	**14,950**	**14,861**	**15,409**	**14,886**

Figure 14 Change in the number of people highly annoyed within the L_{den} 55 dB(A) noise contour



Appendix 1. Runway use in 2012 (compared with 2011)

The runway use was derived from the Central Database (CDB) of The Brussels Airport Company.

In Figure 16 up to and including Figure 19 the average runway use is shown for the whole 24-hour period and for the day, evening and night period, concerning both departures and arrivals for the year 2012. As a comparison, the statistics for the year 2011 are included in brackets each time.

In view of the importance of runway 25R and the impact on the counters, runway use for departures from runway 25R was divided into the 3 main directions: aircraft which turn north immediately after take-off, aircraft which turn south immediately after take-off, and those which first fly straight in a westerly direction after take-off. This latter group also contains flights that only once they have reached a height of 4000 feet turn towards the south.

In the tables under the figures, the absolute figures for runway use are given for the years 2011 and 2012.

In Figure 15 the nomenclature of the runways is shown.

Figure 15 Configuration and nomenclature of the departure and arrival runways at Brussels Airport

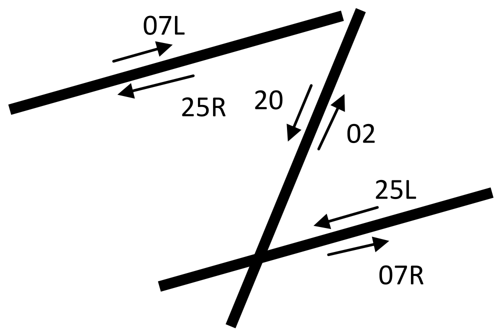
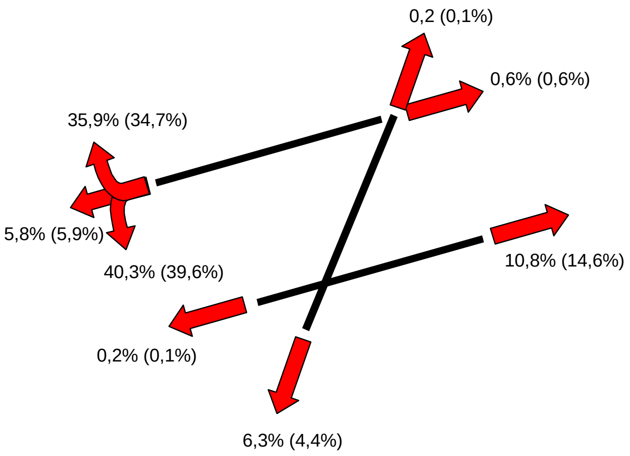
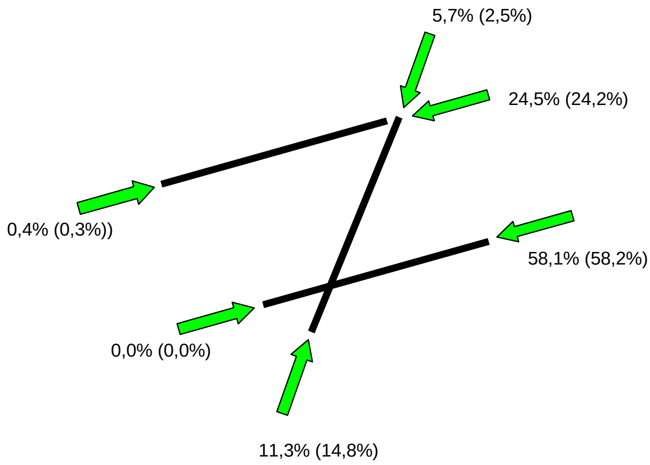


Figure 16 The runway use of the total number of departures and landings in 2012 (and 2011)

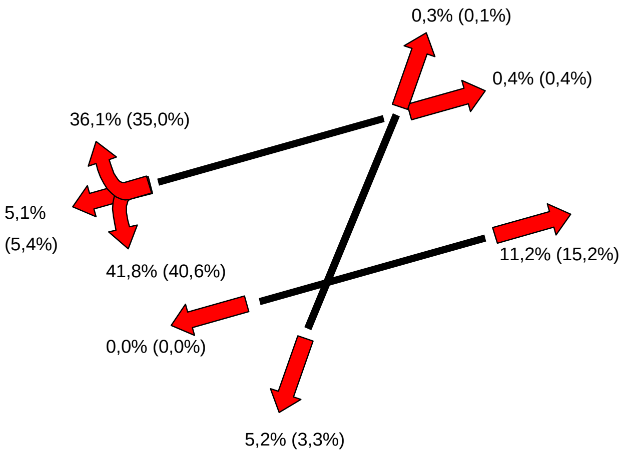


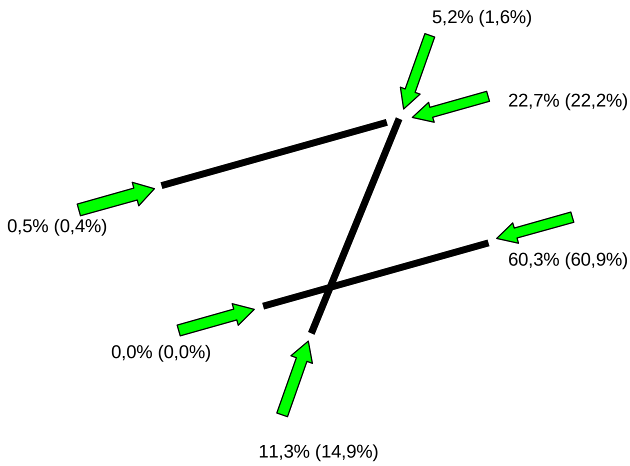


Runway	2011	2012
02	72	251
07L	808	692
07R	16,847	11,893
20	5,098	7,033
25L	91	189
25R	93,961	91,656

Runway	2011	2012
02	17,137	12,550
07L	404	453
07R	9	11
20	2,935	6,281
25L	67,380	64,363
25R	29,016	28,059

Figure 17 The runway use of the total number of departures and arrivals in 2012 (and 2011) during the day (07.00-19.00)

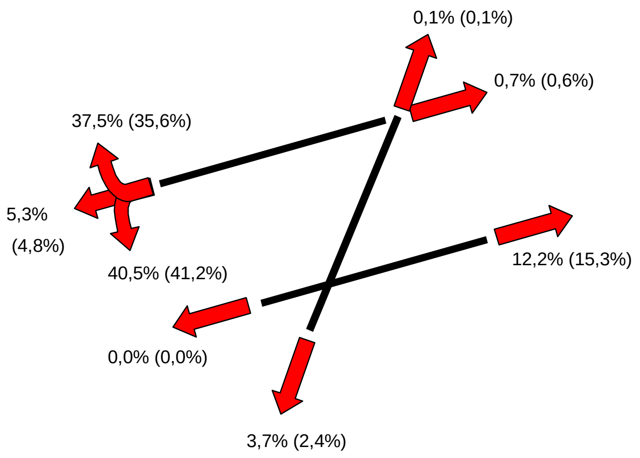


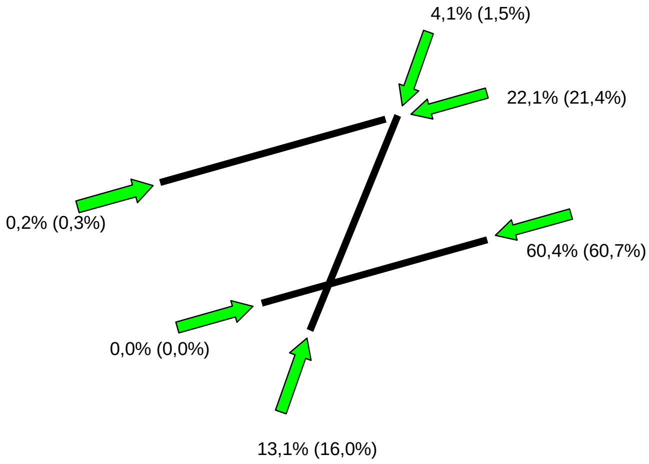


Runway	2011	2012
02	46	235
07L	375	299
07R	11,879	8,210
20	2,576	3,867
25L	36	23
25R	64,335	61,715

Runway	2011	2012
02	12,160	8,619
07L	340	392
07R	3	8
20	1,288	3,986
25L	49,571	46,061
25R	18,834	17,933

Figure 18 The runway use of the total number of departures and arrivals in 2012 (and 2011) during the evening (19.00-23.00)

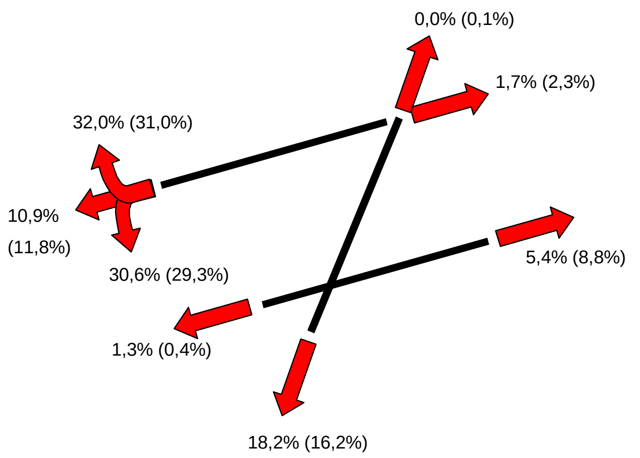


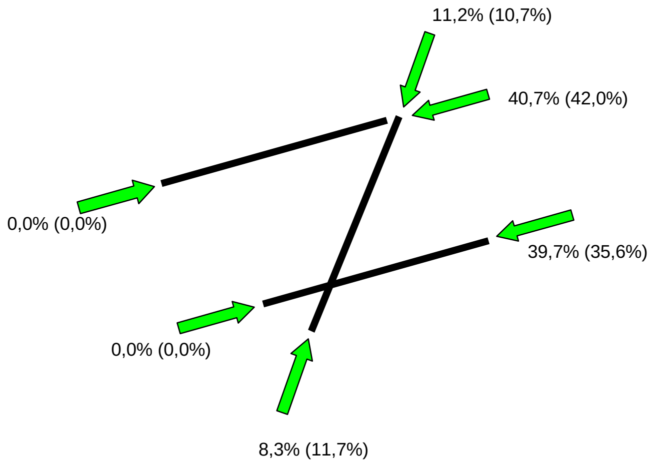


Runway	2011	2012
02	18	16
07L	165	180
07R	3,927	3,009
20	621	904
25L	2	5
25R	21,056	20,724

Runway	2011	2012
02	3,554	2,914
07L	64	57
07R	2	2
20	342	923
25L	13,454	13,465
25R	4,947	5,086

Figure 19 The runway use of the total number of take-offs and landings in 2012 (and 2011) during the night (23.00-07.00)



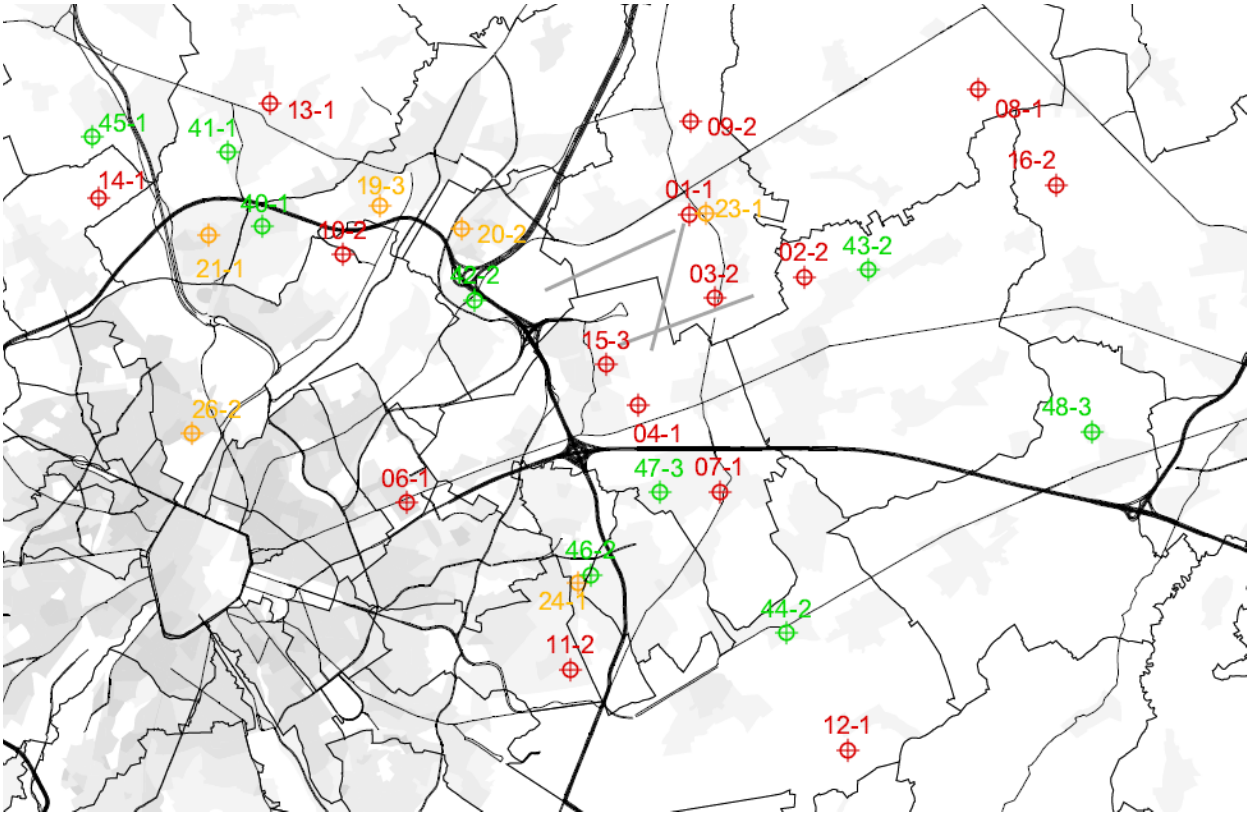


Runway	2011	2012
02	8	
07L	268	213
07R	1,041	674
20	1,901	2,262
25L	53	161
25R	8,570	9,217

Runway	2011	2012
02	1,423	1,017
07L	0	4
07R	4	1
20	1,305	1,372
25L	4,355	4,837
25R	5,235	5,040

Appendix 2. Location of the noise monitoring terminals

Figure 20 Location of the noise monitoring terminals (situation as of 31/12/2012)



(source background: population map, density 1/1/2008)

Table 8 List of the noise monitoring terminals around Brussels Airport

NMT	Owner	Type	Location
1-1	The Brussels Airport Company	Fixed	Steenokkerzeel
2-2	The Brussels Airport Company	Fixed	Kortenberg
3-2	The Brussels Airport Company	Fixed	Humelgem-Airside
4-1	The Brussels Airport Company	Fixed	Nossegem
6-1	The Brussels Airport Company	Fixed	Evere
7-1	The Brussels Airport Company	Fixed	Sterrebeek
8-1	The Brussels Airport Company	Fixed	Kampenhout
9-2	The Brussels Airport Company	Fixed	Perk
10-2	The Brussels Airport Company	Fixed	Neder-Over-Heembeek
11-2	The Brussels Airport Company	Fixed	Sint-Pieters-Woluwe
12-1	The Brussels Airport Company	Fixed	Duisburg
13-1	The Brussels Airport Company	Fixed	Grimbergen
14-1	The Brussels Airport Company	Fixed	Wemmel
15-3	The Brussels Airport Company	Fixed	Zaventem
16-2	The Brussels Airport Company	Fixed	Veltem
19-3	The Brussels Airport Company	Fixed	Vilvoorde
20-2	The Brussels Airport Company	Semi-mobile	Machelen
21-1	The Brussels Airport Company	Semi-mobile	Strombeek - Bever
23-1	The Brussels Airport Company	Semi-mobile	Steenokkerzeel
24-1	The Brussels Airport Company	Semi-mobile	Kraainem
26-2	The Brussels Airport Company	Semi-mobile	Brussel
40-1	LNE	Fixed	Koningslo
41-1	LNE	Fixed	Grimbergen
42-2	LNE	Semi-mobile	Diegem
43-2	LNE	Semi-mobile	Erps-kwerps
44-2	LNE	Fixed	Tervuren
45-1	LNE	Semi-mobile	Meise
46-2	LNE	Semi-mobile	Wezembeek-Oppem
47-3	LNE	Semi-mobile	Wezembeek-Oppem
48-3	LNE	Semi-mobile	Bertem

Appendix 3. Technical note - methodology for route input into INM

Appendix 3.1. SIDs

For the most frequently-flown SIDs, where a large geographical spread is present, the various aircraft types are subdivided into groups before determining average INM routes according to the procedure set out below.

Based on the noise measurements of the monitoring network during the year 2012, the 20 most important aircraft types were identified which made a substantial contribution to the measured equivalent sound pressure levels at one or more measuring stations. The remaining aircraft types are always considered together.

Per SID, for each of the 20 aircraft types, and for the collection of remaining aircraft types, an average route is determined using the INM-link program. Based on the location of these average routes, it is decided which aircraft types are considered in one group. For these groups, an average INM route with a spread is determined using the INM tool.

If, for one of the 20 aircraft types for a given SID, fewer than 30 movements are carried out annually, then for the analysis of this SID, this aircraft type is considered jointly with the general group.

The 20 main aircraft types for 2011 are: A319,A320, A332, B763, B738, A333, B734, RJ1H, A321, B744, B733, B752, B737, E190, RJ85, B772, B735, C130, A30B en MD11

This division into different groups is carried out for a number of SIDs of runway 25R concerning daytime flights[12](06.00-23.00) (CIV1C, NIK2C, DENUT3C, HELEN3C, SPI2C and S0P3C) and for SID SOP2J from runway 07R.

These SIDs are considered together with all other SIDs which proceed in a completely similar way in the initial period of the flight. This means that SID SOP3C was considered jointly with the SIDs ROUSY3C and PITES3C, that SID SPI2C was considered with SID LNO2C and that SID SOP2J was considered with the SIDs CIV4J, ROUSY3J and PITES3J.

The result of this exercise is shown in the table below. For each of the above-mentioned SIDs, the INM SID used is shown per aircraft type and for the group of 'other aircraft types'. The aircraft types (from the list of 20 main aircraft types) where fewer than 30 movements were carried out on the relevant SID are included in the former group. This latter are shown in the table in italics each time.

[12] During the night period (06.00-23.00) aircraft take off on runway 25R from the head of the runway as close as possible to the noise barriers. For this reason, the departure routes from runway 25R are modelled separately in the INM model for the operational day and night period.

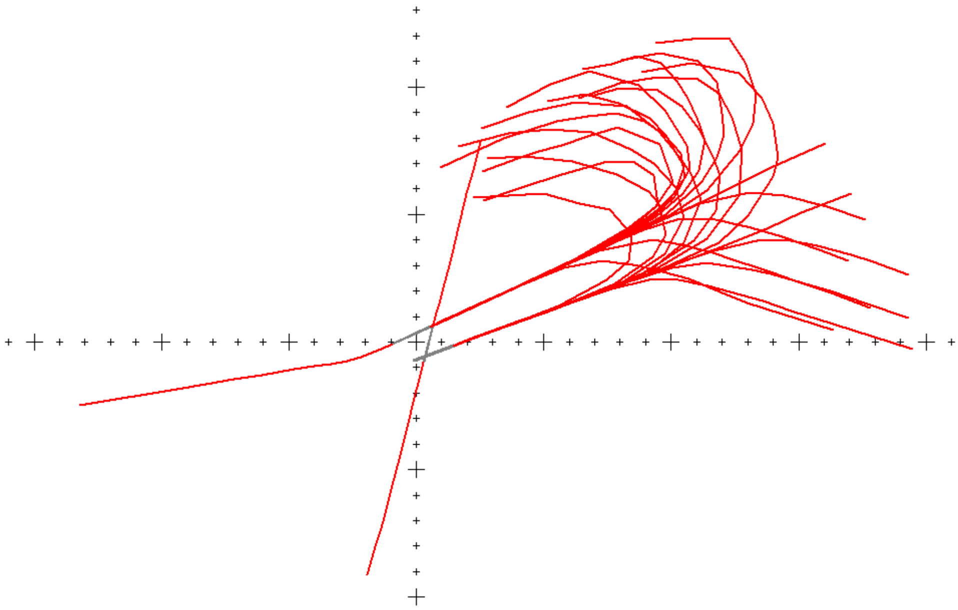
Table 9 Grouping of aircraft types for the most commonly-flown SIDs for determining the average INM routes

Type	SID						
	CIV1C	DEN3C	HEL3C	NIK2C	SOP3C	SPI2C	SOP2J
A319	G1_CIV1C	G1_DEN3C	G2_HEL3C	G2_NIK2C	G2_SOP3C	G1_SPI2C	G1_SOP2J
A320	G1_CIV1C	G1_DEN3C	G2_HEL3C	G2_NIK2C	G1_SOP3C	G1_SPI2C	G1_SOP2J
A332	G2_CIV1C	G2_DEN3C	*G1_HEL3C*	G3_NIK2C	G4_SOP3C	G2_SPI2C	G1_SOP2J
B763	G2_CIV1C	G2_DEN3C	G4_HEL3C	*G1_NIK2C*	G3_SOP3C	*G1_SPI2C*	G2_SOP2J
B738	*G1_CIV1C*	*G1_DEN3C*	*G1_HEL3C*	*G1_NIK2C*	*G1_SOP3C*	*G1_SPI2C*	*G1_SOP2J*
A333	G2_CIV1C	G5_DEN3C	*G1_HEL3C*	*G1_NIK2C*	G4_SOP3C	*G1_SPI2C*	G1_SOP2J
B734	G1_CIV1C	*G1_DEN3C*	*G1_HEL3C*	G1_NIK2C	G3_SOP3C	G3_SPI2C	G1_SOP2J
RJ1H	G2_CIV1C	G3_DEN3C	G2_HEL3C	G3_NIK2C	G4_SOP3C	G2_SPI2C	G1_SOP2J
A321	G1_CIV1C	G1_DEN3C	G2_HEL3C	G1_NIK2C	G3_SOP3C	G3_SPI2C	G1_SOP2J
B744	*G1_CIV1C*	G4_DEN3C	*G1_HEL3C*	G3_NIK2C	*G1_SOP3C*	*G1_SPI2C*	*G1_SOP2J*
B733	G3_CIV1C	*G1_DEN3C*	*G1_HEL3C*	G2_NIK2C	G1_SOP3C	G1_SPI2C	G1_SOP2J
B752	*G1_CIV1C*	G2_DEN3C	*G1_HEL3C*	*G1_NIK2C*	G1_SOP3C	*G1_SPI2C*	G1_SOP2J
B737	G1_CIV1C	*G1_DEN3C*	*G1_HEL3C*	G1_NIK2C	G4_SOP3C	*G1_SPI2C*	G1_SOP2J
E190	G3_CIV1C	*G1_DEN3C*	G3_HEL3C	G2_NIK2C	G2_SOP3C	G1_SPI2C	G1_SOP2J
RJ85	G2_CIV1C	G3_DEN3C	G2_HEL3C	G1_NIK2C	G3_SOP3C	G3_SPI2C	G3_SOP2J
B772	*G1_CIV1C*	G4_DEN3C	*G1_HEL3C*	*G1_NIK2C*	G5_SOP3C	*G1_SPI2C*	*G1_SOP2J*
B735	G1_CIV1C	*G1_DEN3C*	*G1_HEL3C*	G1_NIK2C	G3_SOP3C	G1_SPI2C	G1_SOP2J
C130	G4_CIV1C	*G1_DEN3C*	*G1_HEL3C*	G1_NIK2C	*G1_SOP3C*	*G1_SPI2C*	*G1_SOP2J*
A30B	*G1_CIV1C*	G1_DEN3C	G1_HEL3C	*G1_NIK2C*	*G1_SOP3C*	*G1_SPI2C*	*G1_SOP2J*
MD11	*G1_CIV1C*	*G1_DEN3C*	*G1_HEL3C*	*G1_NIK2C*	G3_SOP3C	*G1_SPI2C*	*G1_SOP2J*

Appendix 3.2. Arrival routes

The 60 dB(A) level is, in itself, so low that the frequency contours for 60 dB(A) being exceeded are soon far away from the airport. This means that for landings the modelling of the landing routes on 1 line with only 2 subtracks cannot be used. Before intercepting the ILS, the flights can come from almost any direction. For the modelling, for runways 25L and 25R, we divided the range of landing routes per angle of approximately 20°. Per segment of the arc, an average route is defined with two subtracks and a percentage breakdown across the various routes. These average routes are shown in Figure21. Despite this extra modelling of the landing routes, it remains the case for the 60 dB(A) frequency contours that the length of the landing contours is so great that the INM standard vertical landing profile, which takes account of a constant landing angle of 3° for most aircraft can deviate from the actual landing profile.

Figure21 INM main routes for modelling arrivals at bigger distance from Brussels Airport



Appendix 4. Results of contour calculations 2012

Appendix 4.1. Area per contour zone and per municipality: L_{day}, $L_{evening}$, L_{night}, L_{den}, freq.70,day, freq.70,night, freq.60,day, freq.60,night

Table 10 Area per L_{day} contour zone and per municipality for the year 2012

Area (ha)	L_{day} contour zone in dB(A) (day 07.00-19.00)					
Municipality	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
BRUSSEL	605	129				**734**
EVERE	90					**90**
HAACHT	18					**18**
HERENT	222					**222**
KAMPENHOUT	247	38				**285**
KORTENBERG	366	205	45	4		**621**
KRAAINEM	46					**46**
MACHELEN	338	296	198	57	9	**898**
STEENOKKERZEEL	454	303	179	107	93	**1,137**
VILVOORDE	47					**47**
WEZEMBEEK-OPPEM	53					**53**
ZAVENTEM	493	149	44	21	14	**720**
Grand total	***2,978***	***1,121***	***466***	***189***	***117***	***4,871***

Table 11 Area per $L_{evening}$ contour zone and per municipality for the year 2012

Area (ha)	$L_{evening}$ contour zone in dB(A) (ev. 19.00-23.00)						
Municipality	**50-55**	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
BRUSSEL	731	550	153				**1,434**
EVERE	307	156					**462**
GRIMBERGEN	399						**399**
HAACHT	258						**258**
HERENT	413	111					**524**
JETTE	1						**1**
KAMPENHOUT	915	243	41				**1,198**
KOEKELBERG	47						**47**
KORTENBERG	431	374	152	29	1		**987**
KRAAINEM	436	37					**473**
LEUVEN	83						**83**
MACHELEN	213	359	275	183	52	12	**1,093**
SCHAARBEEK	222	98					**320**
SINT-JANS-MOLENBEEK	117						**117**
SINT-LAMBRECHTS-WOLUWE	307						**307**
SINT-PIETERS-WOLUWE	211						**211**
STEENOKKERZEEL	444	462	299	177	101	80	**1,564**
TERVUREN	10						**10**
VILVOORDE	673	37					**711**
WEZEMBEEK-OPPEM	287	36					**323**
ZAVENTEM	1,102	418	127	37	17	12	**1,713**
Grand total	***7,608***	***2,881***	***1,046***	***427***	***171***	***103***	***12,237***

Table 12 Area per L_{night} contour zone and per municipality for the year 2012

Area (ha)	L_{night} contour zone in dB(A) (night 23.00-07.00)						
Municipality	**45-50**	**50-55**	**55-60**	**60-65**	**65-70**	**>70**	**Total**
BOORTMEERBEEK	48						**48**
BRUSSEL	546	466	18				**1,030**
EVERE	384						**384**
GRIMBERGEN	431						**431**
HAACHT	615						**615**
HERENT	476	156					**632**
KAMPENHOUT	924	384	92	4			**1,405**
KORTENBERG	401	315	130	27	2		**874**
KRAAINEM	427	20					**448**
LEUVEN	142						**142**
MACHELEN	248	366	317	131	29	2	**1,094**
ROTSELAAR	7						**7**
SCHAARBEEK	14						**14**
SINT-LAMBRECHTS-WOLUWE	174						**174**
SINT-PIETERS-WOLUWE	119						**119**
STEENOKKERZEEL	487	474	299	198	116	95	**1,669**
TERVUREN	313						**313**
VILVOORDE	557	28					**585**
WEZEMBEEK-OPPEM	571	11					**582**
ZAVENTEM	1,594	606	218	60	21	8	**2,507**
ZEMST	46						**46**
Grand total	***8,525***	***2,827***	***1,074***	***419***	***168***	***105***	***13,118***

Table 13 Area per L_{den} contour zone and per municipality for the year 2012

Area (ha)	L_{den} contour zone in dB(A) (d. 07-19, ev. 19-23, n. 23-07)					
Municipality	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
BRUSSEL	622	326	14			**962**
EVERE	316					**316**
GRIMBERGEN	42					**42**
HAACHT	214					**214**
HERENT	396	41				**437**
KAMPENHOUT	716	189	27			**932**
KORTENBERG	382	297	89	16		**783**
KRAAINEM	208	1				**209**
LEUVEN	24					**24**
MACHELEN	286	340	270	108	24	**1,027**
SCHAARBEEK	90					**90**
SINT-LAMBRECHTS-WOLUWE	34					**34**
SINT-PIETERS-WOLUWE	26					**26**
STEENOKKERZEEL	518	404	259	153	158	**1,492**
VILVOORDE	460	5				**465**
WEZEMBEEK-OPPEM	170	0				**171**
ZAVENTEM	1,119	395	112	32	23	**1,681**
ZEMST	0					**0**
Grand total	***5,623***	***1,998***	***771***	***308***	***205***	***8,905***

Table 14 Area per freq.70,day contour zone and per municipality for the year 2012

Area (ha)	Freq.70,day contour zone (day 07.00-23.00)					
Municipality	**5-10**	**10-20**	**20-50**	**50-100**	**>100**	**Totaal**
BOORTMEERBEEK	103	0	0	0	0	**103**
BRUSSEL	331	148	375	365	116	**1,335**
EVERE	1	192	314	4	0	**512**
GRIMBERGEN	919	578	61	0	0	**1,558**
HAACHT	239	87	81	0	0	**407**
HERENT	139	110	159	125	36	**569**
KAMPENHOUT	399	507	483	165	2	**1,557**
KORTENBERG	260	128	212	178	370	**1,147**
KRAAINEM	37	245	185	0	0	**467**
LEUVEN	60	18	0	0	0	**77**
MACHELEN	63	76	159	192	553	**1,043**
MEISE	95	3	0	0	0	**98**
OUDERGEM	5	0	0	0	0	**5**
SCHAARBEEK	421	102	0	0	0	**522**
SINT-JOOST-TEN-NODE	2	0	0	0	0	**2**
SINT-LAMBRECHTS-WOLUWE	154	240	138	0	0	**532**
SINT-PIETERS-WOLUWE	91	173	10	0	0	**274**
STEENOKKERZEEL	169	260	269	354	536	**1,588**
TERVUREN	183	17	0	0	0	**200**
VILVOORDE	163	237	385	11	0	**796**
WEMMEL	186	13	0	0	0	**199**
WEZEMBEEK-OPPEM	347	62	122	0	0	**530**
ZAVENTEM	733	455	843	184	71	**2,287**
ZEMST	56	11	0	0	0	**67**
Grand total	***5,155***	***3,662***	***3,797***	***1,578***	***1,684***	***15,877***

Table 15 Area per freq.70,night contour zone and per municipality for the year 2012

Area (ha)	Freq.70,night contour zone (night 23.00-07.00)					
Municipality	**1-5**	**5-10**	**10-20**	**20-50**	**>50**	**Total**
BONHEIDEN	7	0	0	0	0	**7**
BOORTMEERBEEK	279	0	0	0	0	**279**
BRUSSEL	634	523	208	6	0	**1,371**
EVERE	478	32	0	0	0	**510**
GRIMBERGEN	899	4	0	0	0	**903**
HAACHT	361	132	0	0	0	**493**
HERENT	232	240	61	0	0	**534**
KAMPENHOUT	817	308	378	0	0	**1,502**
KORTENBERG	292	189	405	0	0	**887**
KRAAINEM	443	4	0	0	0	**447**
LEUVEN	49	1	0	0	0	**50**
MACHELEN	193	186	251	393	0	**1,023**
MECHELEN	77	0	0	0	0	**77**
MEISE	17	0	0	0	0	**17**
OUDERGEM	5	0	0	0	0	**5**
SCHAARBEEK	235	0	0	0	0	**235**
SINT-LAMBRECHTS-WOLUWE	384	0	0	0	0	**384**
SINT-PIETERS-WOLUWE	211	0	0	0	0	**211**
STEENOKKERZEEL	507	201	479	409	0	**1,596**
TERVUREN	586	0	0	0	0	**586**
VILVOORDE	400	232	0	0	0	**632**
WEMMEL	61	0	0	0	0	**61**
WEZEMBEEK-OPPEM	501	28	0	0	0	**528**
ZAVENTEM	1,457	767	222	53	0	**2,499**
ZEMST	101	0	0	0	0	**101**
Grand total	***9,226***	***2,846***	***2,005***	***861***	***0***	***14,938***

Table 16 Area per freq.60,day contour zone and per municipality for the year 2012

Area (ha)	Freq.60,day contour zone (day 07.00-23.00)				
Municipality	**50-100**	**100-150**	**150-200**	**>200**	**Total**
BRUSSEL	334	377	239	98	**1,048**
EVERE	364	147	0	0	**511**
GRIMBERGEN	779	0	0	0	**779**
HAACHT	279	98	87	0	**464**
HERENT	262	263	311	0	**836**
KAMPENHOUT	1,178	58	25	0	**1,261**
KORTENBERG	216	187	570	61	**1,033**
KRAAINEM	307	284	0	0	**591**
LEUVEN	139	161	0	0	**300**
MACHELEN	123	127	205	651	**1,106**
MEISE	35	0	0	0	**35**
OVERIJSE	47	0	0	0	**47**
ROTSELAAR	505	12	0	0	**517**
SCHAARBEEK	63	0	0	0	**63**
SINT-LAMBRECHTS-WOLUWE	510	10	0	0	**521**
SINT-PIETERS-WOLUWE	302	90	0	0	**391**
STEENOKKERZEEL	293	212	215	841	**1,562**
TERVUREN	1,229	9	0	0	**1,238**
VILVOORDE	565	31	0	0	**596**
WEMMEL	5	0	0	0	**5**
WEZEMBEEK-OPPEM	409	260	0	0	**669**
ZAVENTEM	1,063	364	101	235	**1,763**
Grand total	***9,007***	***2,691***	***1,754***	***1,885***	***15,337***

Table 17 Area per freq.60,night contour zone and per municipality for the year 2012

Area (ha)	Freq.60,night contour zone (night 23.00-07.00)				
Municipality	**10-15**	**15-20**	**20-30**	**>30**	**Total**
BRUSSEL	364	351	293	0	**1,009**
EVERE	237	5	0	0	**242**
GRIMBERGEN	36	0	0	0	**36**
HAACHT	751	0	0	0	**751**
HERENT	758	3	0	0	**761**
KAMPENHOUT	990	365	3	0	**1,358**
KORTENBERG	365	561	7	0	**933**
KRAAINEM	396	0	0	0	**396**
LEUVEN	229	0	0	0	**229**
MACHELEN	95	123	834	38	**1,091**
OVERIJSE	105	0	0	0	**105**
ROTSELAAR	201	0	0	0	**201**
SINT-LAMBRECHTS-WOLUWE	10	0	0	0	**10**
SINT-PIETERS-WOLUWE	82	0	0	0	**82**
STEENOKKERZEEL	125	186	577	738	**1,625**
TERVUREN	933	0	0	0	**933**
VILVOORDE	355	20	0	0	**376**
WEZEMBEEK-OPPEM	662	0	0	0	**662**
ZAVENTEM	828	164	218	228	**1,438**
Grand total	***7,522***	***1,778***	***1,932***	***1,004***	***12,236***

Appendix 4.2. Number of inhabitants per contour zone and per municipality: L_{day}, $L_{evening}$, L_{night}, L_{den}, freq.70,day, freq.70,night, freq.60,day, freq.60,night

Table 18 Number of inhabitants per L_{day} contour zone and per municipality for the year 2012

Number of inhabitants	L_{day} contour zone in dB(A) (day 07.00-19.00)					
Municipality	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
BRUSSEL	2,682	2,063				**4,744**
EVERE	4,265					**4,265**
HAACHT	32					**32**
HERENT	556					**556**
KAMPENHOUT	767	160				**927**
KORTENBERG	1,485	360	17	2		**1,863**
KRAAINEM	287					**287**
MACHELEN	4,635	3,776	1,903	13	0	**10,326**
STEENOKKERZEEL	3,950	1,250	177	8	2	**5,387**
VILVOORDE	133					**133**
WEZEMBEEK-OPPEM	1,095					**1,095**
ZAVENTEM	4,075	669	14	0	0	**4,758**
Grand total	***23,963***	***8,277***	***2,110***	***22***	***2***	***34,375***

Table 19 Number of inhabitants per $L_{evening}$ contour zone and per municipality for the year 2012

Number of inhabitants	$L_{evening}$ contour zone in dB(A) (ev. 19.00-23.00)						
Municipality	**50-55**	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
BRUSSEL	20,313	2,637	2,110				**25,060**
EVERE	21,574	10,693					**32,267**
GRIMBERGEN	7,690						**7,690**
HAACHT	395						**395**
HERENT	1,157	66					**1,223**
JETTE	202						**202**
KAMPENHOUT	3,097	806	169				**4,072**
KOEKELBERG	9,848						**9,848**
KORTENBERG	2,718	1,308	194	11	0		**4,231**
KRAAINEM	12,259	108					**12,366**
LEUVEN	185						**185**
MACHELEN	2,964	4,848	3,302	1,875	17	0	**13,007**
SCHAARBEEK	40,864	17,498					**58,362**
SINT-JANS-MOLENBEEK	23,247						**23,247**
SINT-LAMBRECHTS-WOLUWE	13,512						**13,512**
SINT-PIETERS-WOLUWE	9,233						**9,233**
STEENOKKERZEEL	3,021	3,954	1,115	185	9	1	**8,285**
TERVUREN	0						**0**
VILVOORDE	17,355	104					**17,460**
WEZEMBEEK-OPPEM	7,281	667					**7,947**
ZAVENTEM	16,885	3,739	419	1	0	0	**21,044**
Grand total	***213,799***	***46,427***	***7,309***	***2,072***	***27***	***1***	***269,635***

Table 20 Number of inhabitants per L_{night} contour zone and per municipality for the year 2012

Number of inhabitants	L_{night} contour zone in dB(A) (night 23.00-07.00)						
Municipality	**45-50**	**50-55**	**55-60**	**60-65**	**65-70**	**>70**	**Total**
BOORTMEERBEEK	121						**121**
BRUSSEL	5,740	3,984	101				**9,825**
EVERE	23,995						**23,995**
GRIMBERGEN	10,710						**10,710**
HAACHT	1,641						**1,641**
HERENT	1,140	298					**1,437**
KAMPENHOUT	2,639	1,144	313	31			**4,128**
KORTENBERG	2,083	1,005	131	10	1		**3,230**
KRAAINEM	11,850	43					**11,893**
LEUVEN	361						**361**
MACHELEN	3,385	4,888	4,493	198	0	0	**12,964**
ROTSELAAR	3						**3**
SCHAARBEEK	1,536						**1,536**
SINT-LAMBRECHTS-WOLUWE	5,741						**5,741**
SINT-PIETERS-WOLUWE	5,268						**5,268**
STEENOKKERZEEL	2,843	4,091	1,394	338	77	2	**8,747**
TERVUREN	2,358						**2,358**
VILVOORDE	10,974	79					**11,052**
WEZEMBEEK-OPPEM	11,803	166					**11,969**
ZAVENTEM	19,761	8,317	530	8	0	0	**28,616**
ZEMST	62						**62**
Grand total	***124,012***	***24,015***	***6,963***	***585***	***78***	***2***	***155,655***

Table 21 Number of inhabitants per L_{den} contour zone and per municipality for the year 2012

Number of inhabitants	L_{den} contour zone in dB(A) (d. 07-19, ev. 19-23, n. 23-07)					
Municipality	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
BRUSSEL	1,929	4,018	123			**6,070**
EVERE	19,042					**19,042**
GRIMBERGEN	1,165					**1,165**
HAACHT	328					**328**
HERENT	1,042	14				**1,056**
KAMPENHOUT	1,899	621	138			**2,658**
KORTENBERG	1,978	771	53	6		**2,807**
KRAAINEM	4,505	2				**4,507**
LEUVEN	49					**49**
MACHELEN	3,745	4,727	3,461	151	0	**12,083**
SCHAARBEEK	15,935					**15,935**
SINT-LAMBRECHTS-WOLUWE	1,457					**1,457**
SINT-PIETERS-WOLUWE	798					**798**
STEENOKKERZEEL	3,882	3,023	704	162	6	**7,776**
VILVOORDE	7,763	13				**7,776**
WEZEMBEEK-OPPEM	3,322	6				**3,328**
ZAVENTEM	17,681	3,025	138	0	0	**20,845**
ZEMST	0					**0**
Grand total	***86,519***	***16,220***	***4,617***	***319***	***6***	***107,680***

Table 22 Number of inhabitants per freq.70,day contour zone and per municipality for the year 2012

Number of inhabitants	Freq.70,day contour zone (day 07.00-23.00)					
Municipality	**5-10**	**10-20**	**20-50**	**50-100**	**>100**	**Totaal**
BOORTMEERBEEK	609	0	0	0	0	**609**
BRUSSEL	10,757	4,178	1,301	2,355	1,753	**20,344**
EVERE	0	17,378	18,407	17	0	**35,803**
GRIMBERGEN	8,184	12,114	1,692	0	0	**21,991**
HAACHT	630	130	148	0	0	**909**
HERENT	287	282	533	211	12	**1,326**
KAMPENHOUT	1,065	1,553	1,518	545	1	**4,681**
KORTENBERG	1,528	1,097	1,110	892	762	**5,389**
KRAAINEM	582	7,753	3,899	0	0	**12,234**
LEUVEN	132	36	0	0	0	**168**
MACHELEN	865	1,307	2,350	2,616	5,248	**12,386**
MEISE	649	40	0	0	0	**689**
OUDERGEM	1	0	0	0	0	**1**
SCHAARBEEK	63,367	13,147	0	0	0	**76,515**
SINT-JOOST-TEN-NODE	169	0	0	0	0	**169**
SINT-LAMBRECHTS-WOLUWE	10,676	12,417	5,723	0	0	**28,816**
SINT-PIETERS-WOLUWE	3,435	7,647	421	0	0	**11,503**
STEENOKKERZEEL	926	1,566	2,792	2,067	854	**8,205**
TERVUREN	1,269	1	0	0	0	**1,270**
VILVOORDE	7,625	6,367	6,877	31	0	**20,900**
WEMMEL	1,394	108	0	0	0	**1,502**
WEZEMBEEK-OPPEM	7,547	1,463	2,649	0	0	**11,659**
ZAVENTEM	7,198	6,838	8,858	1,377	709	**24,981**
ZEMST	75	14	0	0	0	**89**
Grand total	***128,971***	***95,435***	***58,279***	***10,112***	***9,339***	***302,136***

Table 23 Number of inhabitants per freq.70,night contour zone and per municipality for the year 2012

Number of inhabitants	**Freq.70,night contour zone (night 23.00-07.00)**					
Municipality	**1-5**	**5-10**	**10-20**	**20-50**	**>50**	**Total**
BONHEIDEN	14	0	0	0	0	**14**
BOORTMEERBEEK	2,194	0	0	0	0	**2,194**
BRUSSEL	14,239	1,556	3,173	26	0	**18,994**
EVERE	34,760	1,043	0	0	0	**35,803**
GRIMBERGEN	15,864	11	0	0	0	**15,875**
HAACHT	1,024	208	0	0	0	**1,232**
HERENT	493	728	21	0	0	**1,242**
KAMPENHOUT	2,196	1,076	1,175	0	0	**4,447**
KORTENBERG	1,779	1,143	826	0	0	**3,748**
KRAAINEM	11,807	8	0	0	0	**11,814**
LEUVEN	100	2	0	0	0	**102**
MACHELEN	2,859	2,635	3,393	3,149	0	**12,037**
MECHELEN	264	0	0	0	0	**264**
MEISE	261	0	0	0	0	**261**
OUDERGEM	1	0	0	0	0	**1**
SCHAARBEEK	33,968	0	0	0	0	**33,968**
SINT-LAMBRECHTS-WOLUWE	18,375	0	0	0	0	**18,375**
SINT-PIETERS-WOLUWE	9,149	0	0	0	0	**9,149**
STEENOKKERZEEL	3,347	1,610	2,701	670	0	**8,328**
TERVUREN	3,673	0	0	0	0	**3,673**
VILVOORDE	9,350	3,544	0	0	0	**12,893**
WEMMEL	420	0	0	0	0	**420**
WEZEMBEEK-OPPEM	10,522	364	0	0	0	**10,887**
ZAVENTEM	18,607	7,847	1,568	233	0	**28,255**
ZEMST	135	0	0	0	0	**135**
Grand total	***195,400***	***21,774***	***12,858***	***4,078***	***0***	***234,110***

Table 24 Number of inhabitants per freq.60,day contour zone and per municipality for the year 2012

Number of inhabitants	Freq.60,day contour zone (day 07.00-23.00)				
Municipality	**50-100**	**100-150**	**150-200**	**>200**	**Total**
BRUSSEL	7,298	838	2,100	1,818	**12,054**
EVERE	29,511	6,286	0	0	**35,797**
GRIMBERGEN	13,370	0	0	0	**13,370**
HAACHT	594	192	160	0	**946**
HERENT	513	625	749	0	**1,887**
KAMPENHOUT	3,910	28	11	0	**3,948**
KORTENBERG	1,055	1,075	1,962	31	**4,123**
KRAAINEM	5,770	7,598	0	0	**13,368**
LEUVEN	889	383	0	0	**1,273**
MACHELEN	1,572	1,753	2,816	6,961	**13,102**
MEISE	638	0	0	0	**638**
OVERIJSE	184	0	0	0	**184**
ROTSELAAR	3,260	27	0	0	**3,287**
SCHAARBEEK	6,982	0	0	0	**6,982**
SINT-LAMBRECHTS-WOLUWE	26,189	244	0	0	**26,433**
SINT-PIETERS-WOLUWE	11,621	4,922	0	0	**16,543**
STEENOKKERZEEL	1,762	1,690	1,579	3,564	**8,594**
TERVUREN	11,234	105	0	0	**11,339**
VILVOORDE	11,460	86	0	0	**11,546**
WEMMEL	45	0	0	0	**45**
WEZEMBEEK-OPPEM	7,265	6,343	0	0	**13,608**
ZAVENTEM	13,513	3,438	1,169	3,125	**21,245**
Grand total	***158,634***	***35,632***	***10,547***	***15,498***	***220,312***

Table 25 Number of inhabitants per freq.60,night contour zone and per municipality for the year 2012

Number of inhabitants	Freq.60,night contour zone (night 23.00-07.00)				
Municipality	**10-15**	**15-20**	**20-30**	**>30**	**Total**
BRUSSEL	5,900	860	3,822	0	**10,582**
EVERE	12,256	270	0	0	**12,527**
GRIMBERGEN	1,358	0	0	0	**1,358**
HAACHT	2,287	0	0	0	**2,287**
HERENT	1,657	1	0	0	**1,658**
KAMPENHOUT	3,145	1,583	2	0	**4,730**
KORTENBERG	2,106	1,362	2	0	**3,470**
KRAAINEM	10,037	0	0	0	**10,037**
LEUVEN	738	0	0	0	**738**
MACHELEN	1,194	1,578	10,131	9	**12,912**
OVERIJSE	381	0	0	0	**381**
ROTSELAAR	283	0	0	0	**283**
SINT-LAMBRECHTS-WOLUWE	182	0	0	0	**182**
SINT-PIETERS-WOLUWE	4,765	0	0	0	**4,765**
STEENOKKERZEEL	902	1,062	2,805	4,419	**9,187**
TERVUREN	9,205	0	0	0	**9,205**
VILVOORDE	4,801	57	0	0	**4,858**
WEZEMBEEK-OPPEM	13,462	0	0	0	**13,462**
ZAVENTEM	6,251	1,949	3,880	2,581	**14,661**
Grand total	***80,911***	***8,723***	***20,642***	***7,009***	***117,284***

Appendix 4.3. Number of people potentially highly annoyed per L_{den} contour zone and per municipality

Table 26 Number of people potentially highly annoyed per L_{den} contour zone and per municipality for the year 2012

Number of people potentially highly annoyed	L_{den} contour zone in dB(A) (d. 07-19, ev. 19-23, n. 23-07)					
Municipality	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
BRUSSEL	229	817	33	0	0	**1,080**
EVERE	2,306	0	0	0	0	**2,306**
GRIMBERGEN	120	0	0	0	0	**120**
HAACHT	37	0	0	0	0	**37**
HERENT	132	3	0	0	0	**134**
KAMPENHOUT	237	123	39	0	0	**399**
KORTENBERG	251	154	15	2	0	**422**
KRAAINEM	500	0	0	0	0	**500**
LEUVEN	5	0	0	0	0	**5**
MACHELEN	500	982	1,034	57	0	**2,573**
SCHAARBEEK	1,703	0	0	0	0	**1,703**
SINT-LAMBRECHTS-WOLUWE	150	0	0	0	0	**150**
SINT-PIETERS-WOLUWE	82	0	0	0	0	**82**
STEENOKKERZEEL	524	611	205	66	3	**1,409**
VILVOORDE	849	2	0	0	0	**851**
WEZEMBEEK-OPPEM	398	1	0	0	0	**399**
ZAVENTEM	2,092	585	39	0	0	**2,716**
ZEMST	0	0	0	0	0	**0**
Grand total	***10,113***	***3,279***	***1,365***	***126***	***3***	***14,886***

Appendix 5. Change in area and number of inhabitants

Appendix 5.1. Change in area per contour zone: L_{day}, $L_{evening}$, L_{night}, L_{den}, freq.70,day, freq.70,night, freq.60,day, freq.60,night

Table 27 Change in the area within the L_{day} contours (2006-2012)

Area (ha)	L_{day} contour zone in dB(A) (day 07.00-19.00)*					
Year	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Totaal**
2006	3,787	1,379	545	213	150	**6,073**
2007	3,978	1,431	575	227	153	**6,364**
2008	4,072	1,492	596	232	161	**6,553**
2009	3,461	1,300	523	206	133	**5,622**
2010	3,334	1,261	514	196	126	**5,431**
2011	3,330	1,241	509	199	127	**5,406**
2012	2,978	1,121	466	189	117	**4,871**

* Calculated with INM 7.0b

Figure 22 Change in the area within the L_{day} contours (2006-2012)

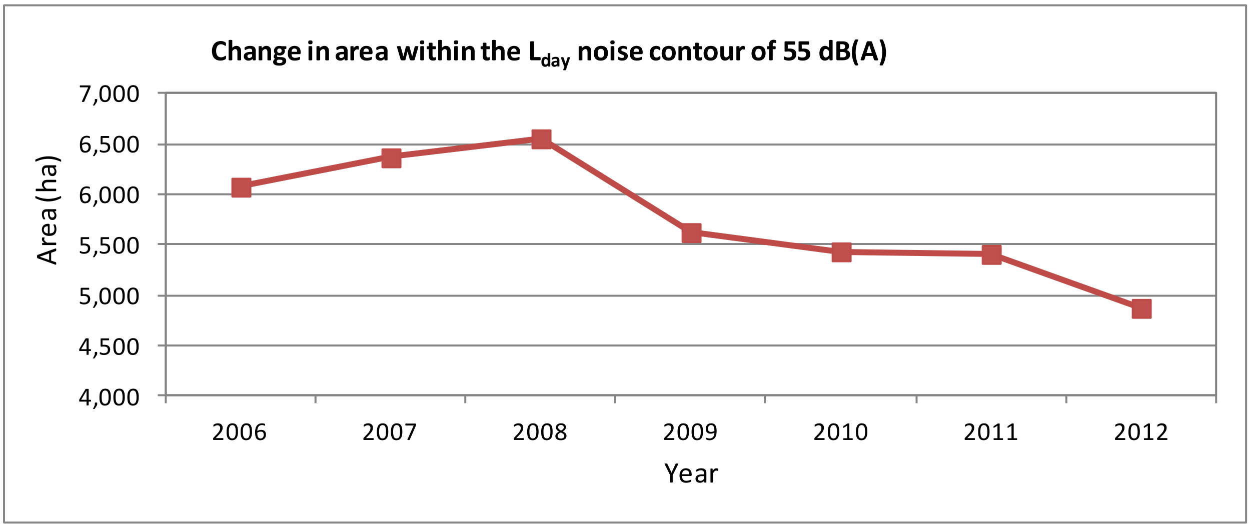


Table 28 Change in the area within the $L_{evening}$ contours (2006-2012)

Area (ha)	$L_{evening}$ contour zone in dB(A) (evening 19.00-23.00)*						
Year	50-55	55-60	60-65	65-70	70-75	>75	Total
2006	8,483	3,000	1,106	449	178	113	**13,329**
2007	9,106	3,369	1,223	506	200	124	**14,528**
2008	10,052	3,730	1,354	548	218	135	**16,037**
2009	8,313	3,126	1,146	463	178	109	**13,336**
2010	7,821	3,073	1,124	452	171	106	**12,747**
2011	7,711	3,004	1,106	446	175	105	**12,547**
2012	7,608	2,881	1,046	427	171	103	**12,237**

* Calculated with INM 7.0b

Figure 23 Change in the area within the $L_{evening}$ contours (2006-2012)

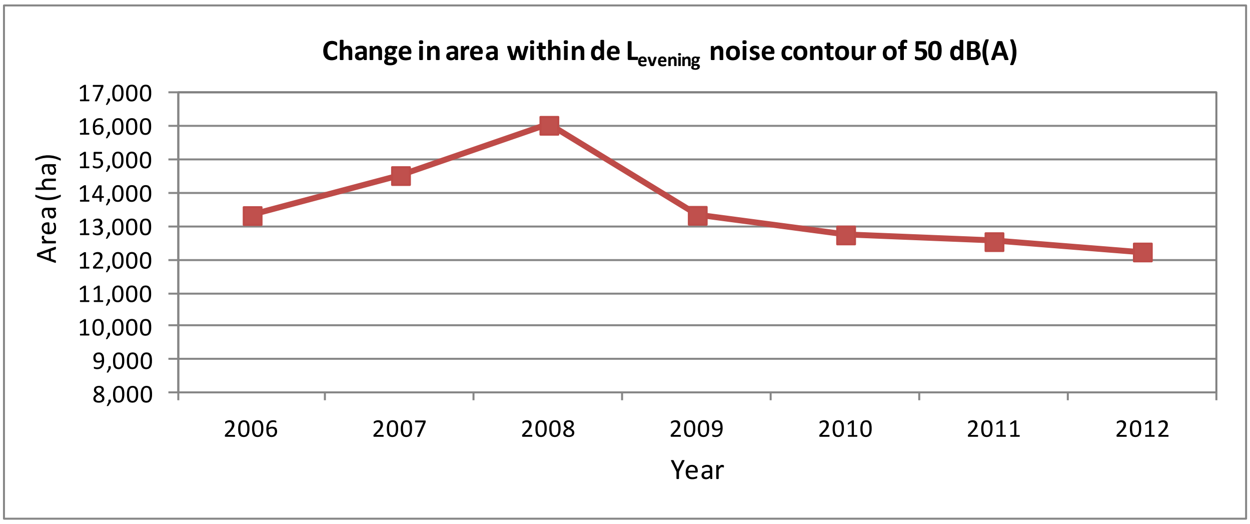


Table 29 Change in the area within the L_{night} contours (2006-2012)

Area (ha)	L_{night} contour zone in dB(A) (night 23.00-07.00)						
Year	**45-50**	**50-55**	**55-60**	**60-65**	**65-70**	**>70**	**Total**
2006	10,135	3,571	1,450	554	211	153	**16,075**
2007	10,872	3,936	1,597	625	236	165	**17,430**
2008	9,375	3,232	1,260	495	189	123	**14,673**
2009	7,638	2,613	1,014	397	155	96	**11,913**
2010	7,562	2,633	999	390	154	96	**11,835**
2011	8,184	2,803	1,066	413	164	106	**12,736**
2012	8,525	2,827	1,074	419	168	105	**13,118**

* Calculated with INM 7.0b

Figure 24 Change in the area within the L_{night} contours (2006-2012)

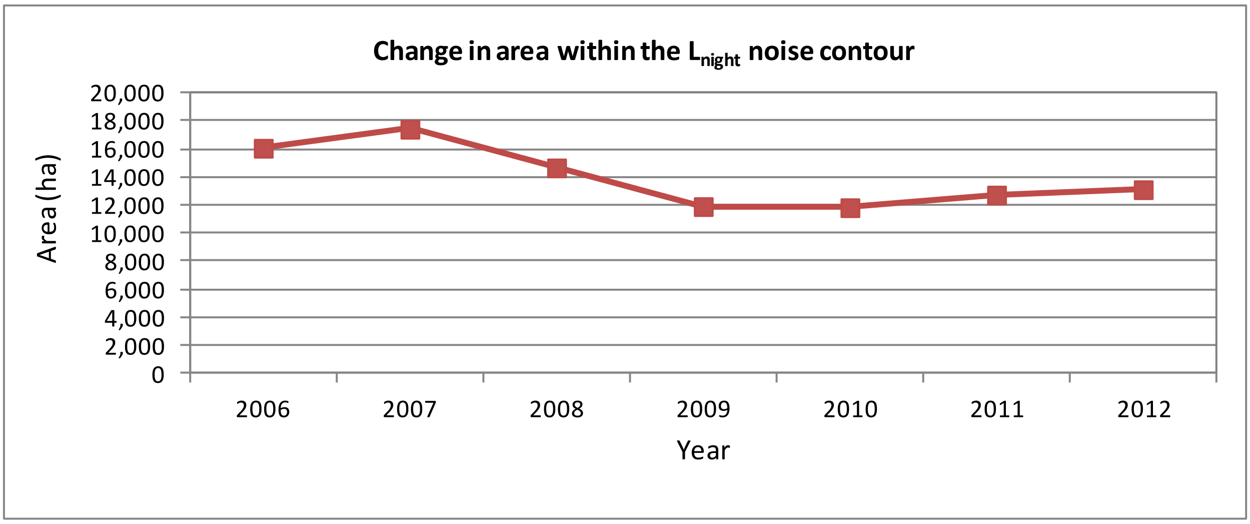


Table 30 Change in the area within the L_{den} contours (2006-2012)

Area (ha)	L_{den} contour zone in dB(A) (d. 07-19, ev. 19-23, n. 23-07)*					
Year	55-60	60-65	65-70	70-75	>75	Totaal
2006	6,963	2,448	957	373	251	**10,992**
2007	7,632	2,640	1,036	416	271	**11,996**
2008	7,118	2,483	953	379	246	**11,178**
2009	5,771	2,077	797	316	203	**9,163**
2010	5,576	2,052	782	308	199	**8,917**
2011	5,767	2,076	800	316	208	**9,167**
2012	5,623	1,998	771	308	205	**8,905**

* Calculated with INM 7.0b

Figure 25 Change in the area within the L_{den} contours (2006-2012)

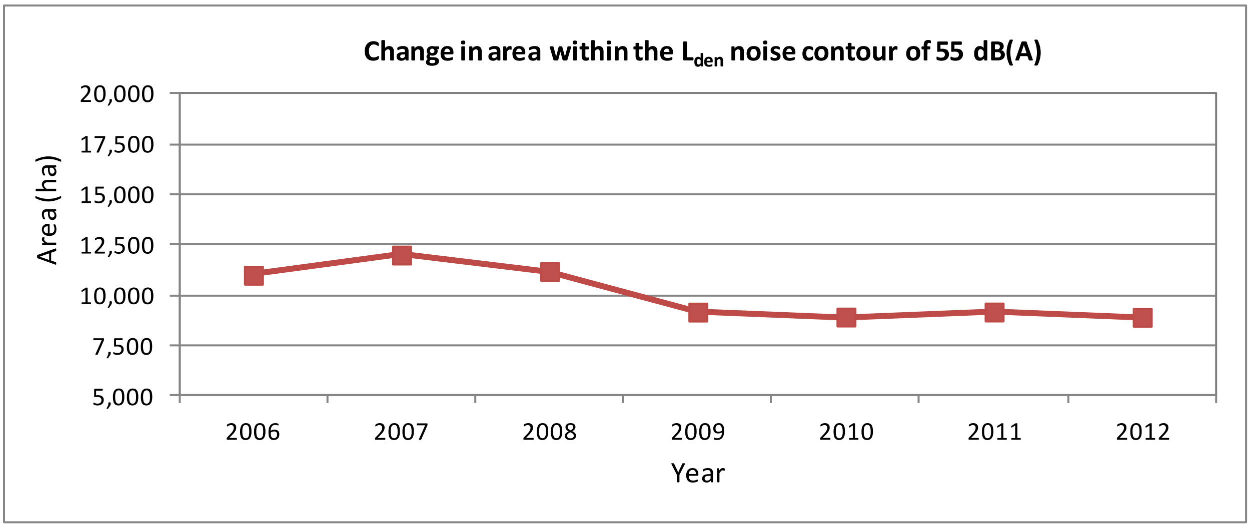


Table 31 Change in the area within the Freq.70,day contours (2010-2012)

Area (ha)	Freq.70,day contour zone (day 07.00-23.00)*					
Year	**5-10**	**10-20**	**20-50**	**50-100**	**>100**	**Total**
2006						
2007						
2008						
2009						
2010	5,171	3,164	4,119	2,097	1,877	**16,428**
2011	4,933	2,989	4,216	1,934	1,854	**15,926**
2012	5,155	3,662	3,797	1,578	1,684	**15,877**

* Calculated with INM 7.0b

Figure 26 Change in the area within the Freq.70,day contours (2010-2012)

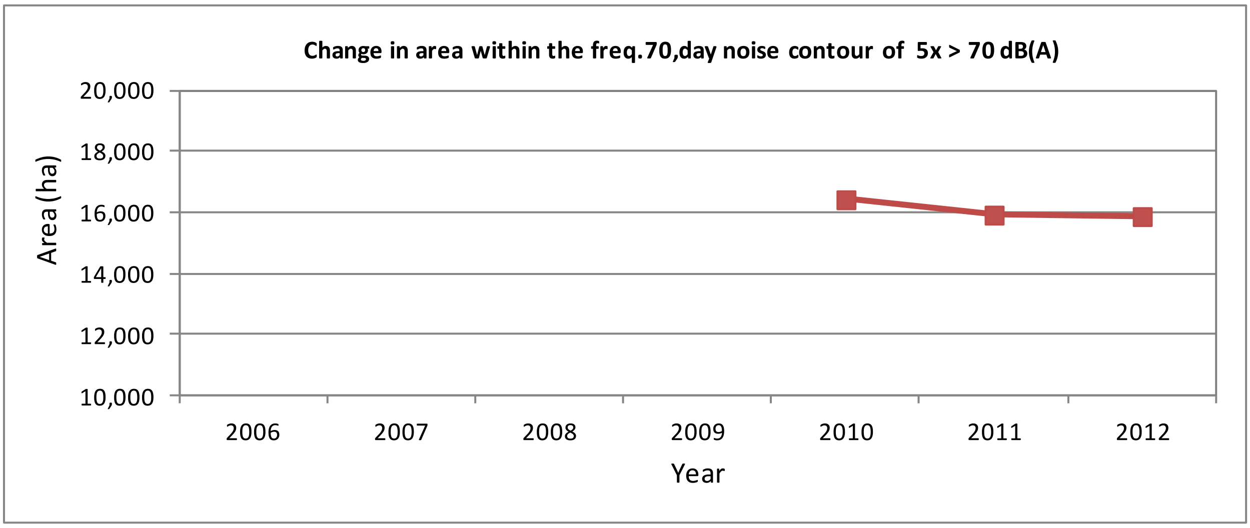


Table 32 Change in the area within the Freq.70,night contours (2010-2012)

Area (ha)	Freq.70,night contour zone (night 23.00-07.00)*					
Year	**1-5**	**5-10**	**10-20**	**20-50**	**>50**	**Total**
2006						
2007						
2008						
2009						
2010	9,535	2,679	1,948	748	0	**14,910**
2011	9,557	2,662	2,095	801	0	**15,115**
2012	9,226	2,846	2,005	861	0	**14,938**

* Calculated with INM 7.0b

Figure 27 Change in the area within the Freq.70,night contours (2010-2012)

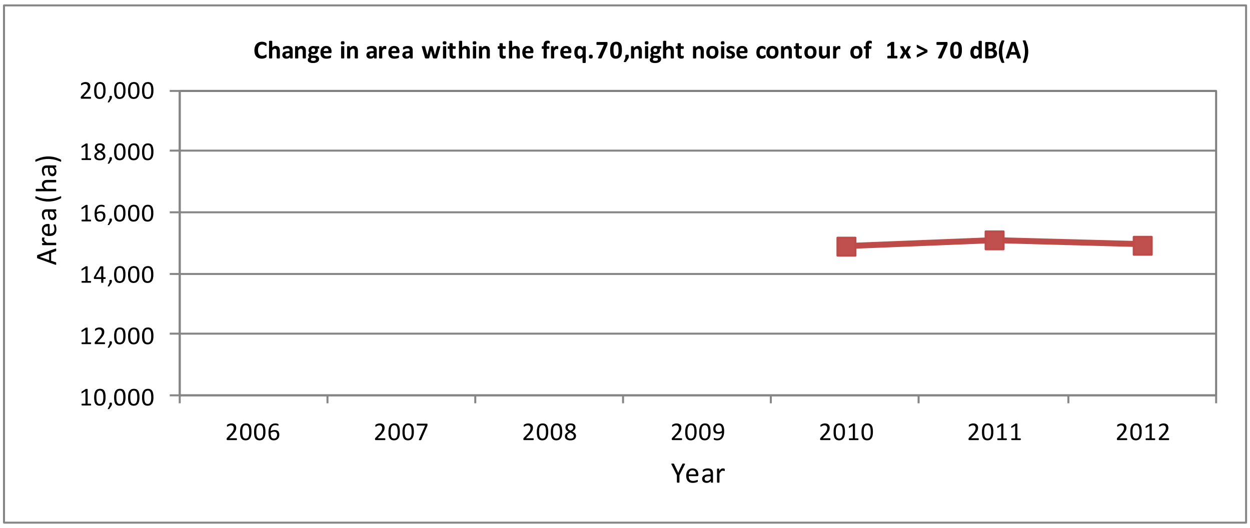


Table 33 Change in the area within the Freq.60,day contours (2010-2012)

Area (ha)	Freq.60,day contour zone (day 07.00-23.00)*				
Year	50-100	100-150	150-200	>200	Total
2006					
2007					
2008					
2009					
2010	9,288	3,313	1,681	2,409	**16,692**
2011	9,112	3,405	1,476	2,579	**16,572**
2012	9,007	2,691	1,754	1,885	**15,337**

* Calculated with INM 7.0b

Figure 28 Change in the area within the Freq.60,day contours (2010-2012)

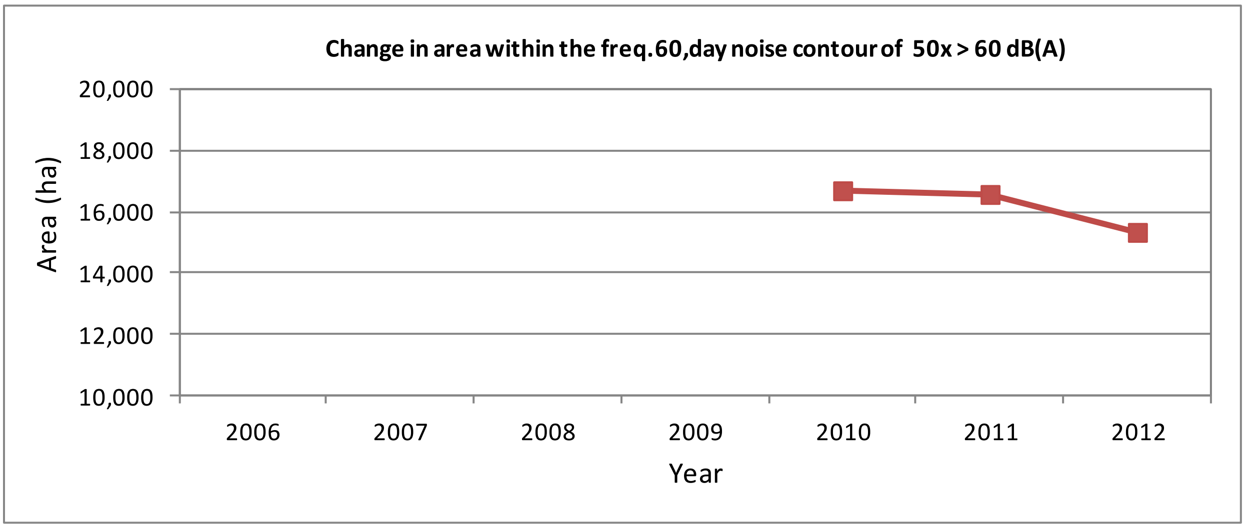
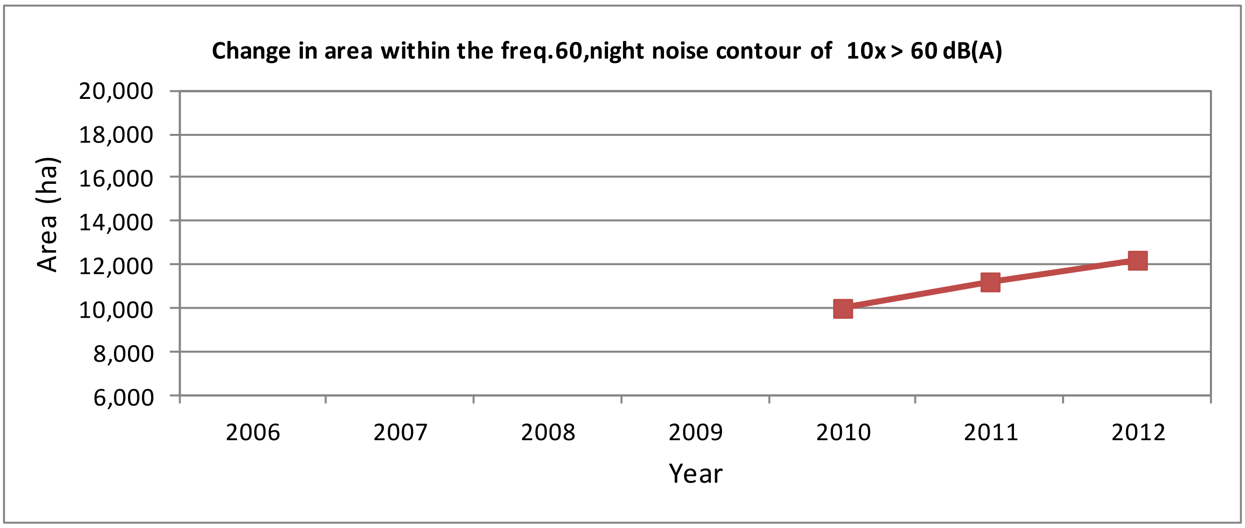


Table 34 Change in the area within the Freq.60,night contours (2010-2012)

Area (ha)	Freq.60,night contour zone in dB(A)*				
Year	10-15	15-20	20-30	>30	Total
2006					
2007					
2008					
2009					
2010	5,577	1,797	1,930	725	**10,030**
2011	6,436	1,972	1,930	905	**11,242**
2012	7,522	1,778	1,932	1,004	**12,236**

* Calculated with INM 7.0b

Figure 29 Change in the area within the Freq.60,night contours (2010-2012)



Appendix 5.2. Change in number of inhabitants per contour zone:

L_{day}, $L_{evening}$, L_{night}, L_{den}, freq.70,day, freq.70,night, freq.60,day, freq.60,night

Table 35 Change in the number of inhabitants within the L_{day} contours (2006-2012)

Number of inhabitants		L_{day} contour zone in dB(A) (day 07.00-19.00)*					
Year	**Population data**	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
2006	01jan03	39,478	9,241	2,714	74	3	**51,511**
2007	01jan06	47,260	9,966	3,168	102	3	**60,499**
2008	01jan07	44,013	10,239	3,217	101	4	**57,575**
2009	01jan07	32,144	8,724	2,815	58	3	**43,745**
2010	01jan08	30,673	8,216	2,393	35	7	**41,323**
2011	01jan08	28,828	8,486	2,460	46	7	**39,828**
2012	01jan10	23,963	8,277	2,110	22	2	**34,375**

* Calculated with INM 7.0b

Figure 30 Change in the number of inhabitants within the L_{day} contours (2006-2012)

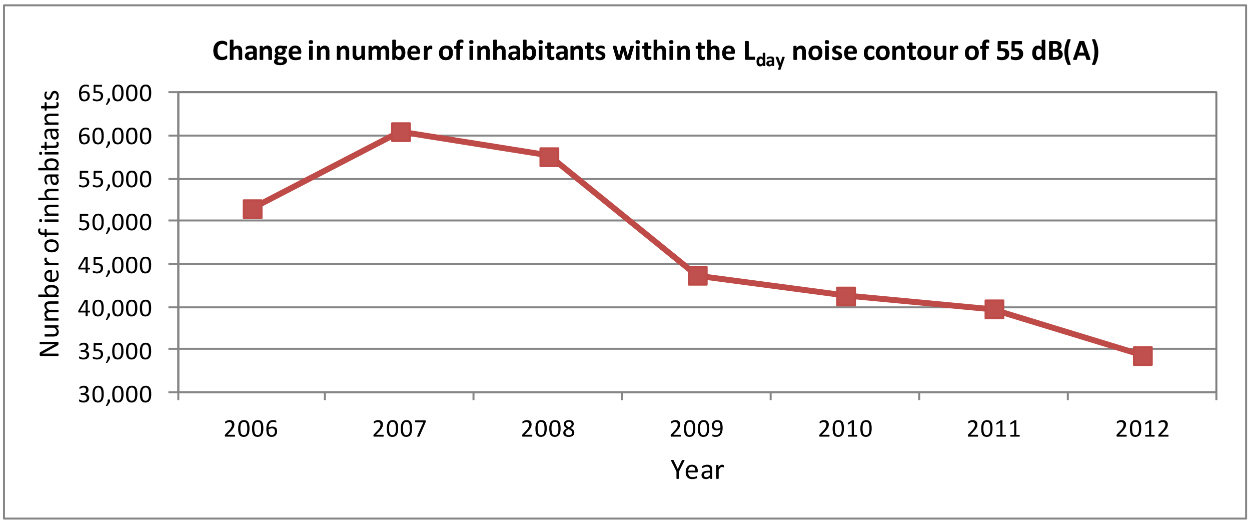


Table 36 Change in the number of inhabitants within the $L_{evening}$ contours (2006-2012)

Number of inhabitants		$L_{evening}$ contour zone in dB(A) (evening 19.00-23.00)*						
Year	**Population data**	**50-55**	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Total**
2006	01jan03	185,699	24,488	7,138	2,030	28	3	**219,386**
2007	01jan06	214,616	35,445	8,217	2,583	38	2	**260,901**
2008	01jan07	249,024	43,589	9,514	2,969	52	3	**305,152**
2009	01jan07	198,351	29,774	7,448	2,186	32	2	**237,793**
2010	01jan08	198,934	37,729	7,127	2,057	25	5	**245,878**
2011	01jan08	198,540	41,951	7,110	2,077	32	5	**249,716**
2012	01jan10	213,799	46,427	7,309	2,072	27	1	**269,635**

* Calculated with INM 7.0b

Figure 31 Change in the number of inhabitants within the $L_{evening}$ contours (2006-2012)

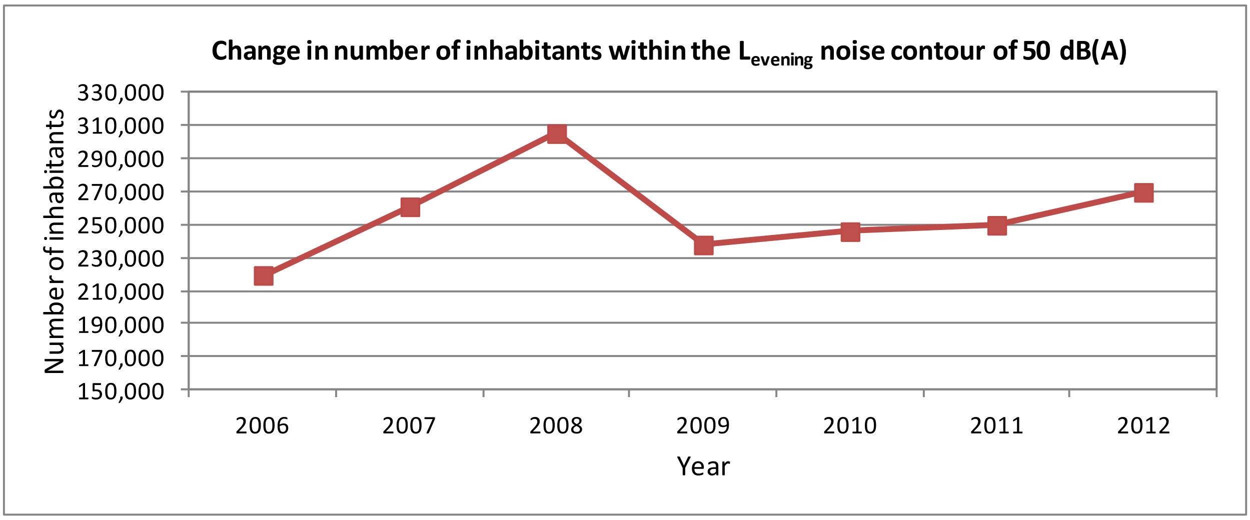


Table 37 Change in the number of inhabitants within the L_{night} contours (2006-2012)

Number of inhabitants		L_{night} contour zone in dB(A) (night 23.00-07.00)						
Year	**Population data**	**45-50**	**50-55**	**55-60**	**60-65**	**65-70**	**>70**	**Total**
2005	01jan03	76,926	21,319	5,663	533	95	3	**104,539**
2006	01jan03	72,848	20,601	5,582	594	135	2	**99,762**
2007	01jan06	111,136	21,026	6,945	909	142	2	**140,160**
2008	01jan07	79,797	18,555	5,254	457	66	3	**104,132**
2009	01jan07	60,093	13,765	4,153	327	27	2	**78,367**
2010	01jan08	62,896	15,011	3,918	329	18	5	**82,177**
2012	01jan10	124,012	24,015	6,963	585	78	2	**155,655**

* Calculated with INM 7.0b

Figure 32 Change in the number of inhabitants within the L_{night} contours (2006-2012)

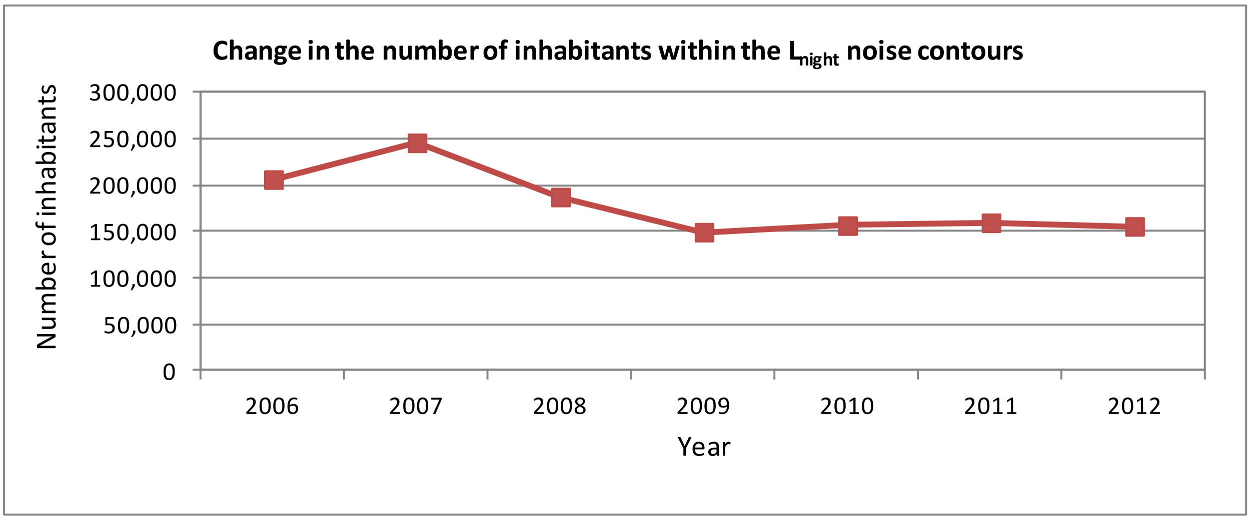


Table 38 Change in the number of inhabitants within the L_{den} contours (2006-2012)

Number of inhabitants		L_{den} contour zone in dB(A) (d. 07-19, ev. 19-23, n. 23-07)*					
Year	**Population data**	**55-60**	**60-65**	**65-70**	**70-75**	**>75**	**Totaal**
2006	01jan03	107,514	18,697	5,365	560	63	**132,198**
2007	01jan06	147,349	19,498	6,565	946	82	**174,442**
2008	01jan07	125,927	19,319	5,938	717	24	**151,925**
2009	01jan07	87,766	15,105	4,921	404	9	**108,205**
2010	01jan08	87,083	15,619	4,506	337	11	**107,556**
2011	01jan08	90,988	15,941	4,664	362	13	**111,969**
2012	01jan10	86,519	16,220	4,617	319	6	**107,680**

* Calculated with INM 7.0b

Figure 33 Change in the number of inhabitants within the L_{den} contours (2006-2012)

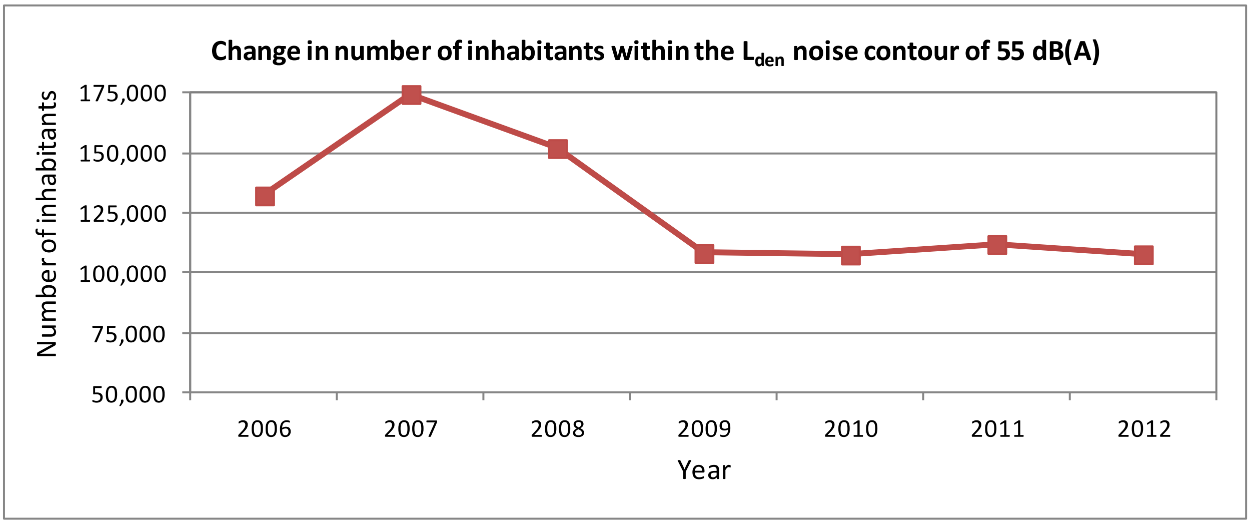


Table 39 Change in the number of inhabitants within the Freq.70,day contours (2010-2012)

Number of inhabitants		**Freq.70,day contour zone (day 07.00-23.00)***					
Year	**Population data**	**5-10**	**10-20**	**20-50**	**50-100**	**>100**	**Total**
2006							
2007							
2008							
2009							
2010	01jan08	133,468	77,606	82,703	15,348	9,874	**318,999**
2011	01jan08	133,014	80,395	78,893	11,783	10,018	**314,103**
2012	01jan10	128,971	95,435	58,279	10,112	9,339	**302,136**

* Calculated with INM 7.0b

Figure 34 Change in the number of inhabitants within the Freq.70,day contours (2010-2012)

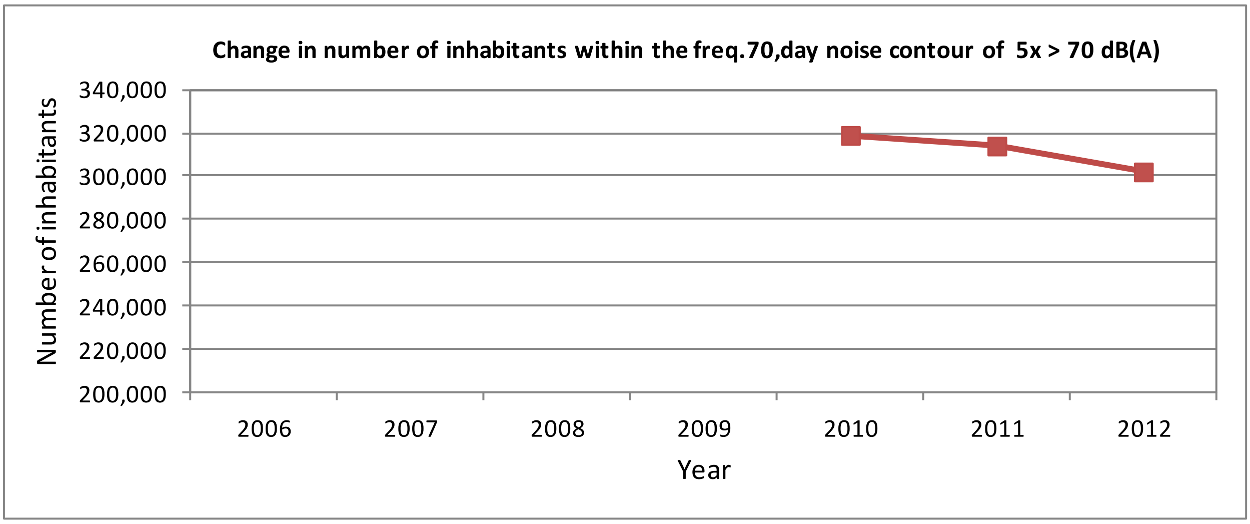


Table 40 Change in the number of inhabitants within the Freq.70,night contours (2010-2012)

Number of inhabitants		Freq.70,night contour zone (night 23.00-07.00)*					
Year	**Population data**	**1-5**	**5-10**	**10-20**	**20-50**	**>50**	**Total**
2006							
2007							
2008							
2009							
2010	01jan08	239,529	23,583	12,968	2,597	0	**278,677**
2011	01jan08	232,090	22,587	13,071	3,261	0	**271,010**
2012	01jan10	195,400	21,774	12,858	4,078	0	**234,110**

* Calculated with INM 7.0b

Figure 35 Change in the number of inhabitants within the Freq.70,night contours (2010-2012)

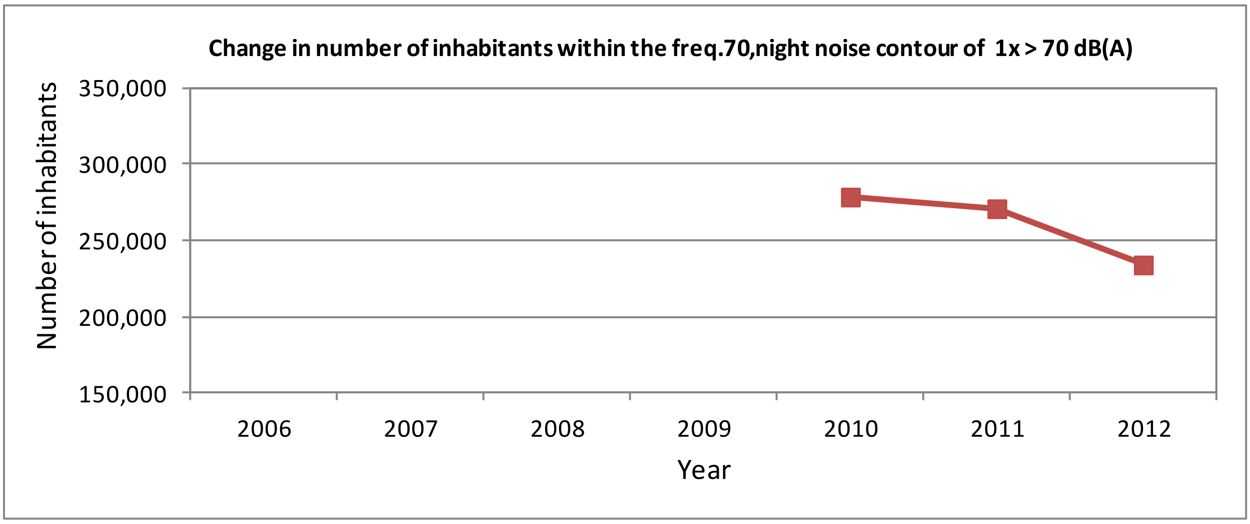


Table 41 Change in the number of inhabitants within the Freq.60,day contours (2010-2012)

Number of inhabitants		Freq.60,day contour zone (day 07.00-23.00)*				
Year	**Population data**	**50-100**	**100-150**	**150-200**	**>200**	**Total**
2006						
2007						
2008						
2009						
2010	01jan08	154,110	49,587	14,723	15,834	**234,253**
2011	01jan08	152,727	50,646	8,604	18,816	**230,793**
2012	01jan10	158,634	35,632	10,547	15,498	**220,312**

* Calculated with INM 7.0b

Figure 36 Change in the number of inhabitants within the Freq.60,day contours (2010-2012)

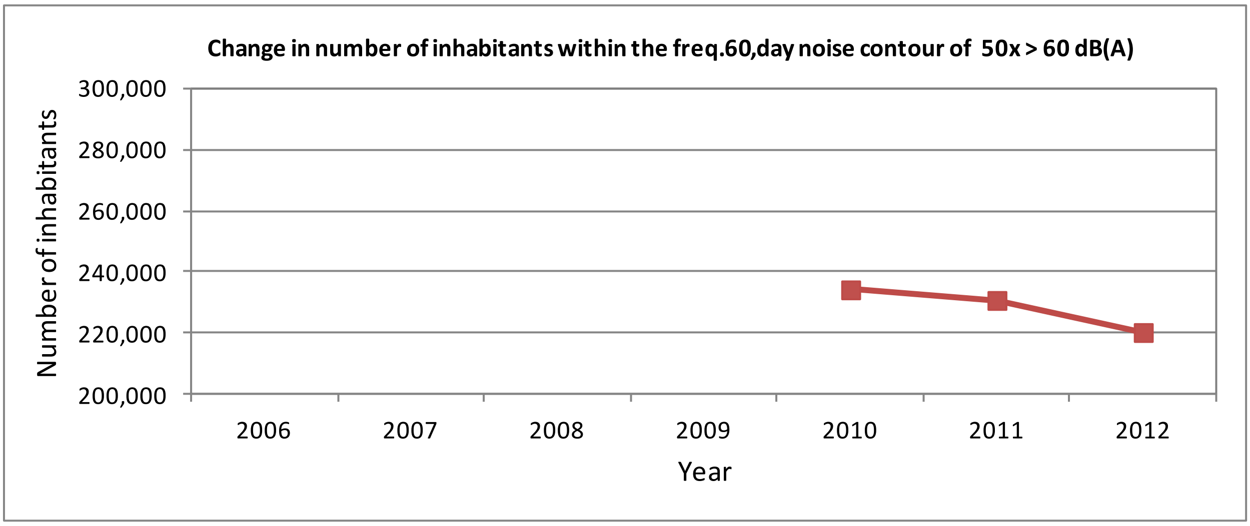
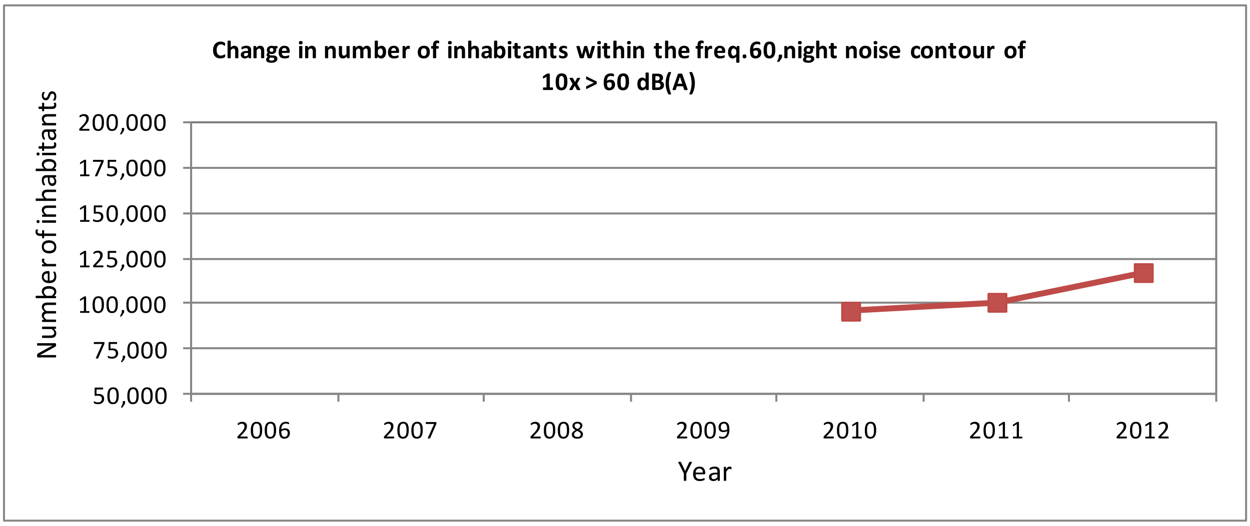


Table 42 Change in the number of inhabitants within the Freq.60,night contours (2010-2012)

Number of inhabitants		Freq.60,night contour zone in dB(A)*				
Year	**Population data**	**10-15**	**15-20**	**20-30**	**>30**	**Total**
2006						
2007						
2008						
2009						
2010	01jan08	62,090	9,411	21,231	3,262	**95,994**
2011	01jan08	65,246	9,522	20,695	5,450	**100,913**
2012	01jan10	80,911	8,723	20,642	7,009	**117,284**

* Calculated with INM 7.0b

Figure 37 Change in the number of inhabitants within the Freq.60,night contours (2010-2012)



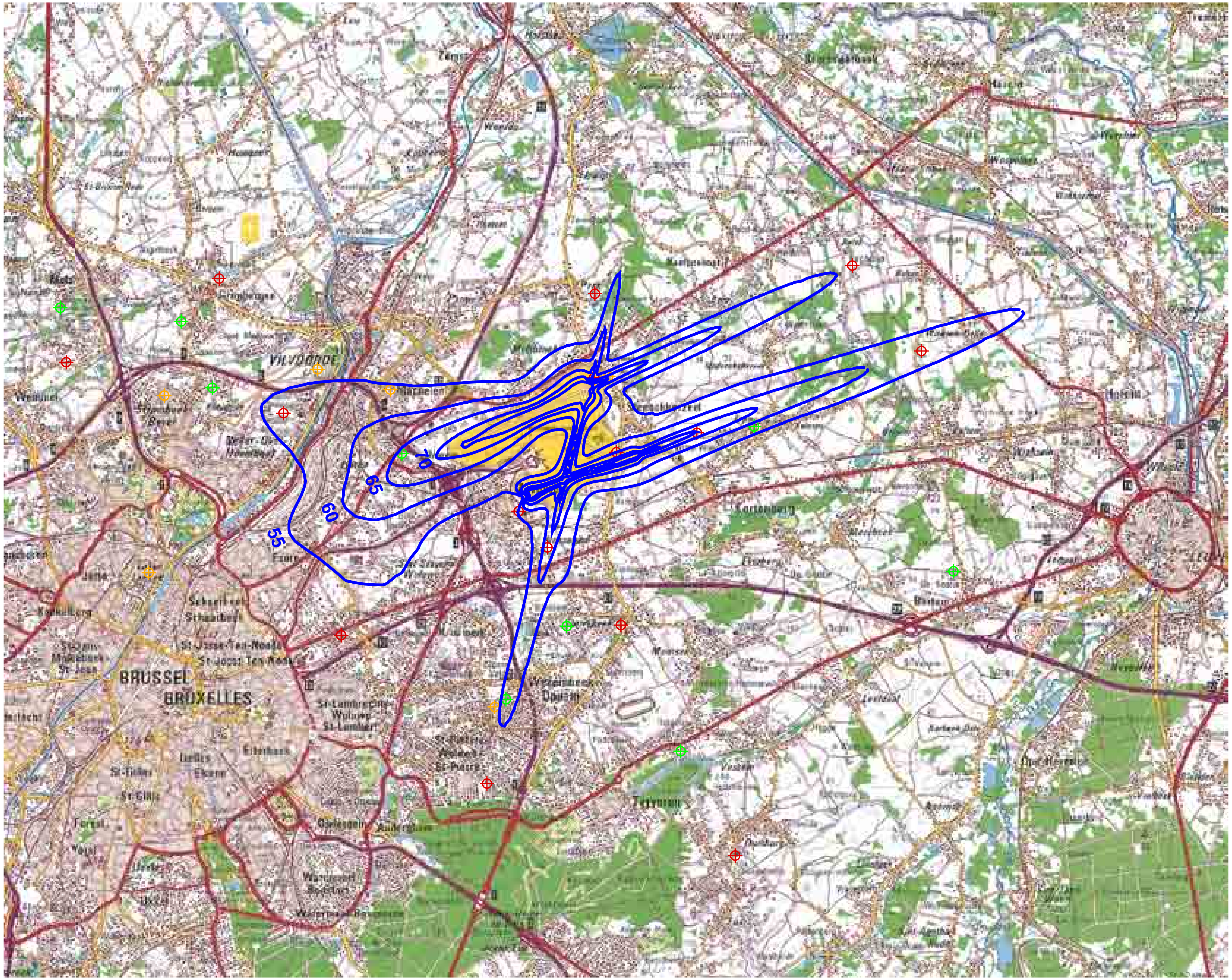
Appendix 6. Noise contours for the year 2012 on a topographical map

- L_{day} noise contours for 2012, background topographical map
- $L_{evening}$ – noise contours for 2012, background topographical map
- L_{night} noise contours for 2012, background topographical map
- L_{den} noise contours for 2012, background topographical map
- Freq.70,day – noise contours for 2012, background topographical map
- Freq.70,night – noise contours for 2012, background topographical map
- Freq.60,day – noise contours for 2012, background topographical map
- Freq.60,night – noise contours for 2012, background topographical map

L_{day} noise contours for 2012

day 07.00 - 19.00

L_{day} noise contours around Brussels Airport on a topographic map



Legend

L_{day} noise contours of 55, 60, 65, 70 and 75 dB(A) for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

0 2000 4000 Meters

Sources

topographic layer :
Raster version topographic layer NGI
Scale 1 = 100.000 (OC GIS-Vlaanderen)

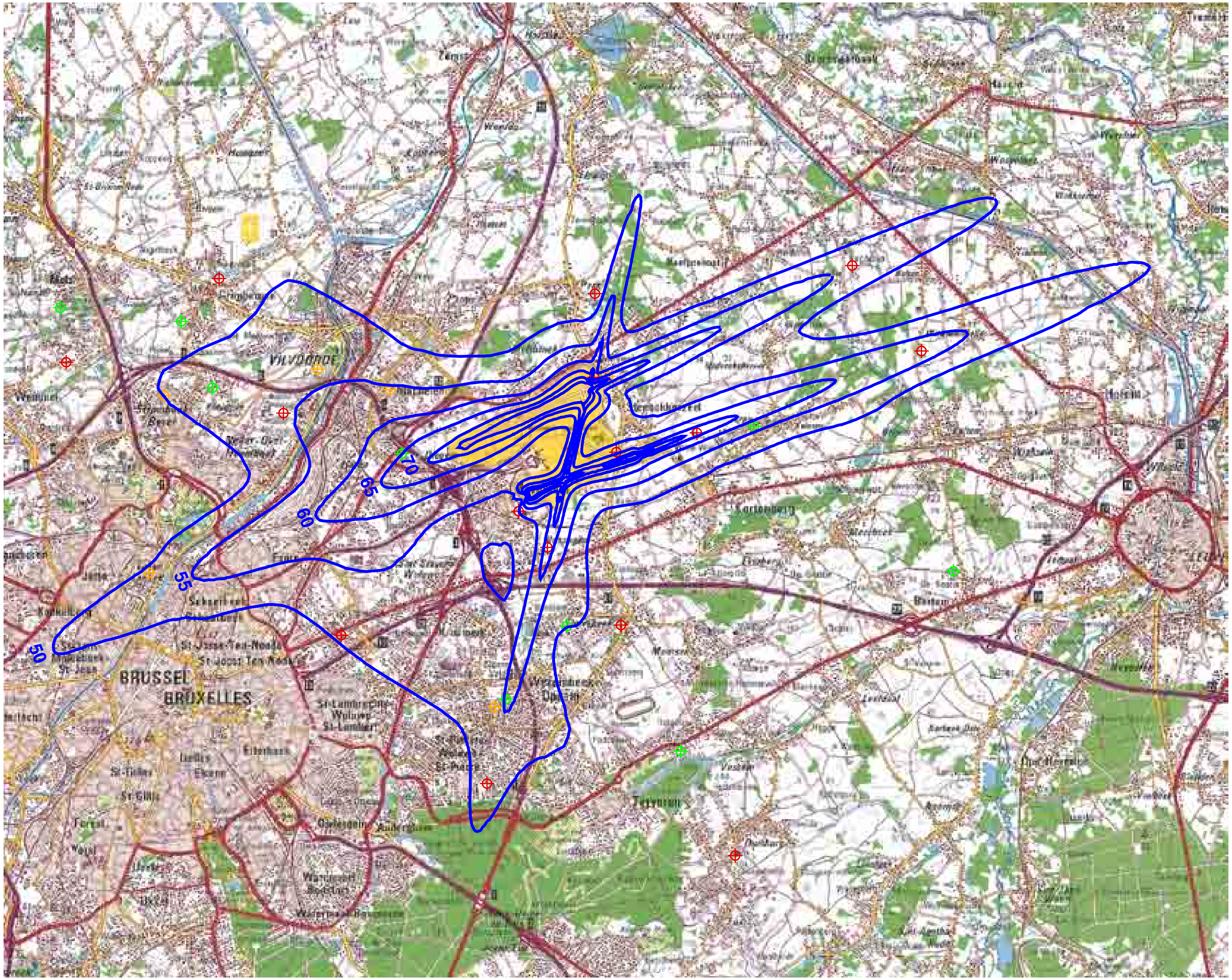
Noise contours :
Calculated by ATF with
the calculation model INM 7.0b

K.U.Leuven
LABORATORIUM VOOR AKOESTIEK and THERMISCHE FYSICA
Celestijnenlaan 200D - bus 2416
B-3001 Leuven (Heverlee)

$L_{evening}$ noise contours for 2012

evening 19.00 - 23.00

$L_{evening}$ noise contours around Brussels Airport on a topographic map



Legend

$L_{evening}$ noise contours of 50, 55, 60, 65, 70 and 75 dB(A) for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

0 2000 4000 Meters

Sources

topographic layer :
Raster version topographic layer NGI
Scale 1 = 100.000 (OC GIS-Vlaanderen)

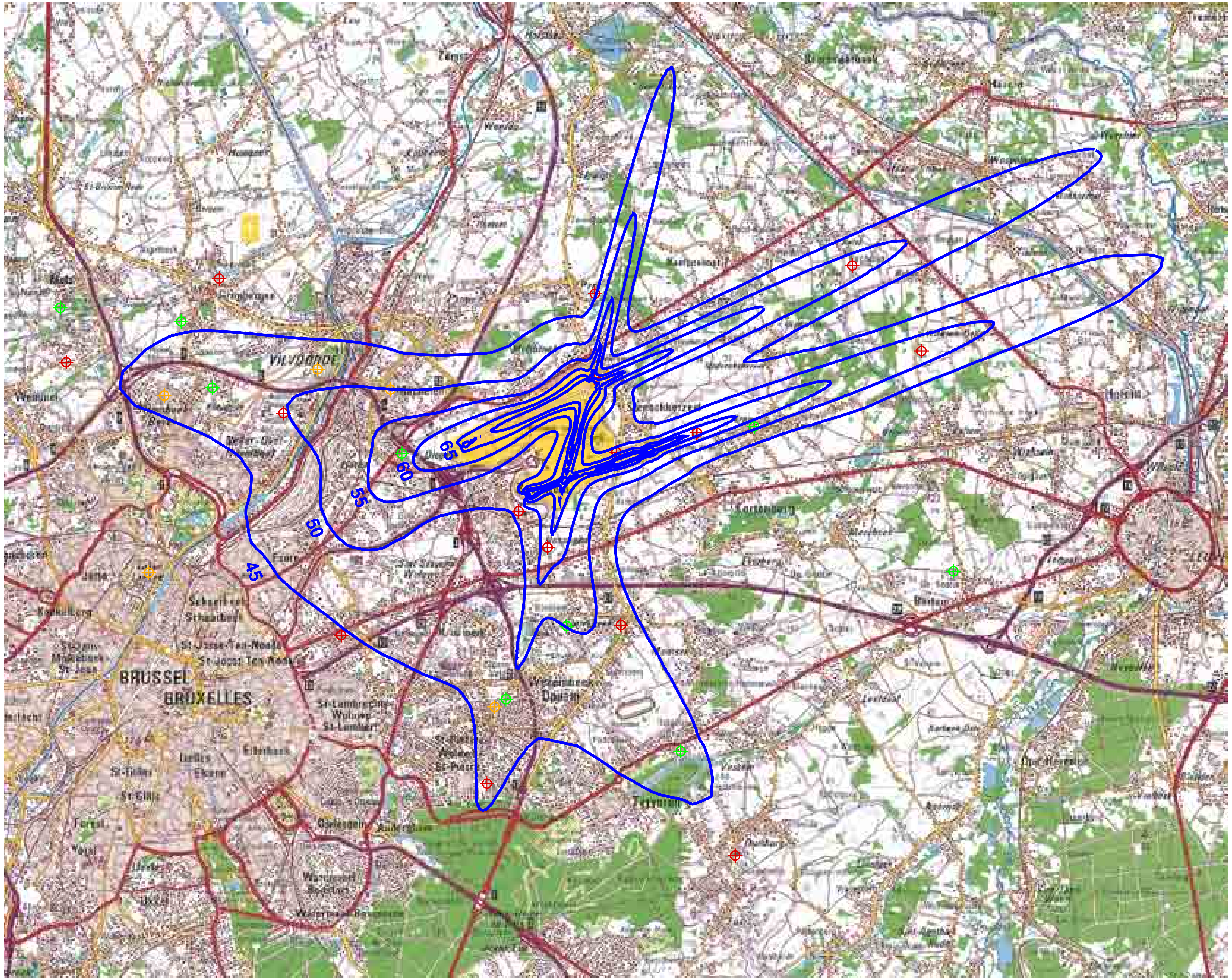
Noise contours :
Calculated by ATF with
the calculation model INM 7.0b

K.U.Leuven
LABORATORIUM VOOR
AKOESTIEK and THERMISCHE FYSICA
Celestijnenlaan 200D - bus 2416
B-3001 Leuven (Heverlee)

L_{night} noise contours for 2012

nacht 23.00u - 07.00u

L_{night} noise contours around Brussels Airport on a topographic map



Legend

L_{night} noise contours of 45, 50 55, 60, 65 and 70 dB(A) for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

0 2000 4000 Meters

Sources

topographic layer :
Raster version topographic layer NGI
Scale 1 = 100.000 (OC GIS-Vlaanderen)

Noise contours :
Calculated by ATF with
the calculation model INM 7.0b

K.U.Leuven
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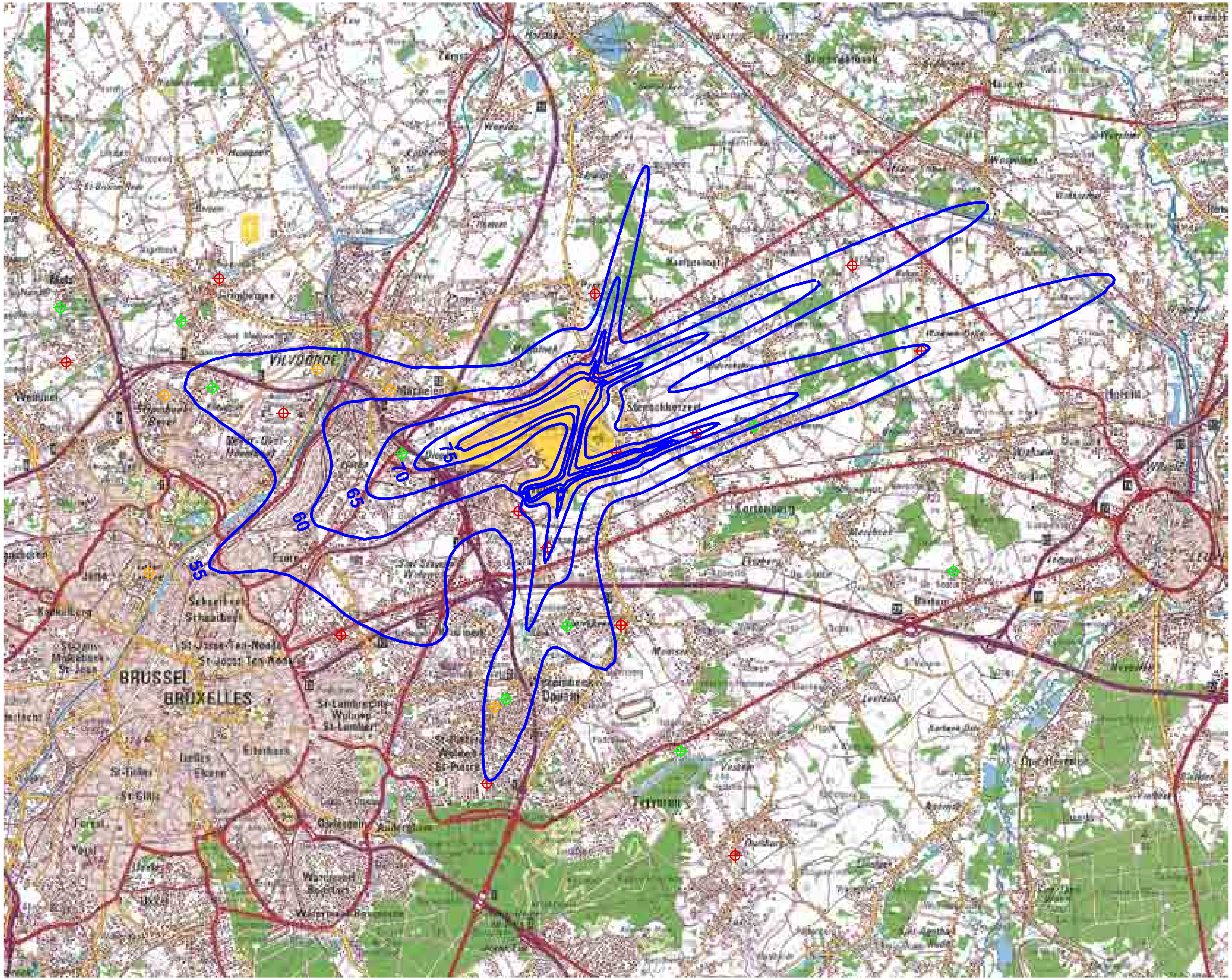
Celestijnenlaan 200D - bus 2416
B-3001 Leuven (Heverlee)

L_{den} noise contours for 2012

day 07.00 - 19.00 - evening 19.00 - 23.00 - night 23.00 - 07.00

L_{den} noise contours
around Brussels Airport
on a
topographic map



Legend

L_{den} noise contours of 55, 60, 65, 70 and 75 dB(A) for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

0 2000 4000 Meters

Sources

topographic layer :
Raster version topographic layer NGI
Scale 1 = 100.000 (OC GIS-Vlaanderen)

Noise contours :
Calculated by ATF with
the calculation model INM 7.0b

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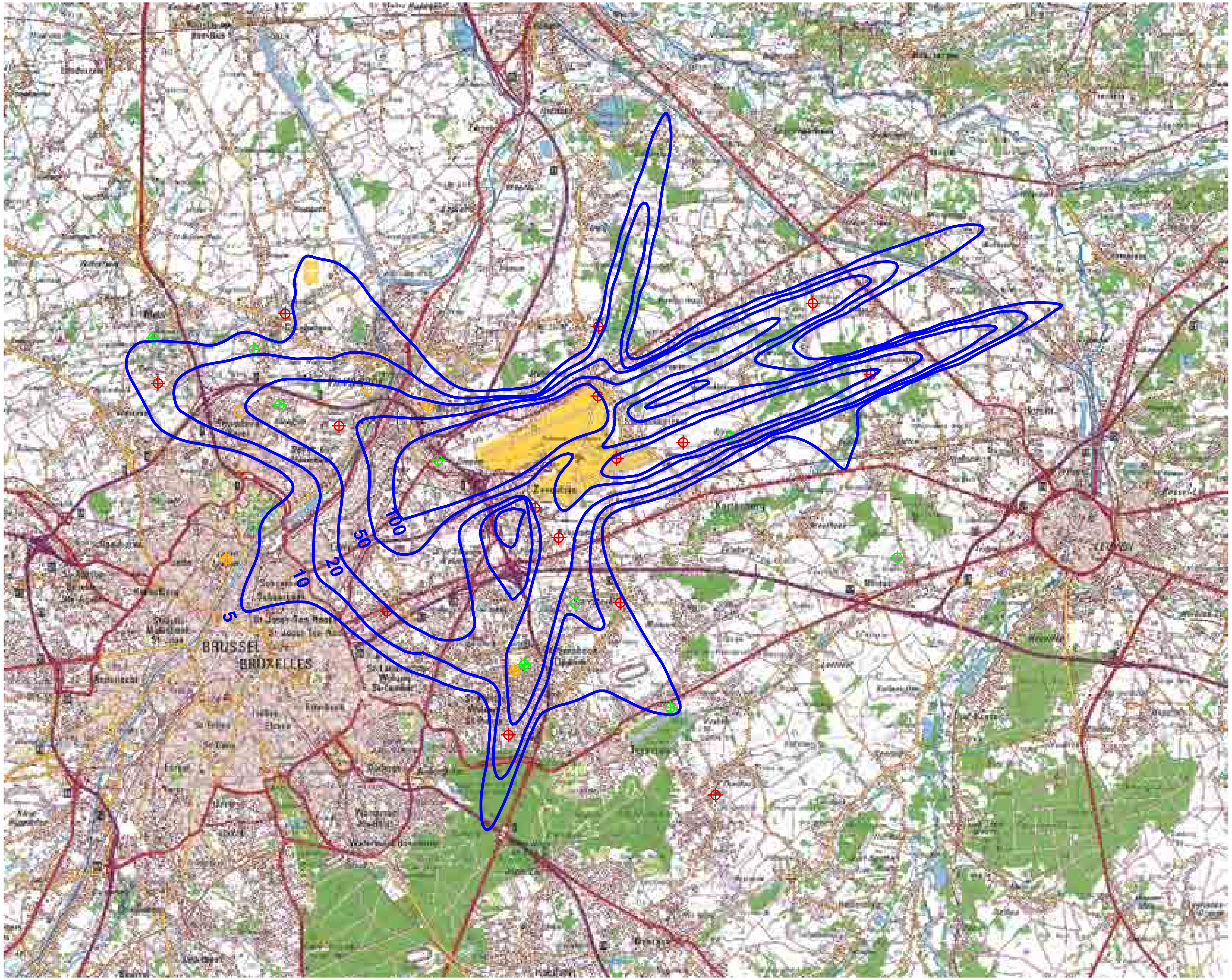
Freq.70,day noise contours for 2012

day 07.00 - 23.00

Freq.70,day noise contours
around Brussels Airport
on a
topographic map



Legend

Freq.70,day noise contours of 5x, 10x, 20x, 50x and 100x for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

0 2000 4000 Meters

Sources

topographic layer :
Raster version topographic layer NGI
Scale 1 = 100.000 (OC GIS-Vlaanderen)

Noise contours :
Calculated by ATF with
the calculation model INM 7.0b

K.U.Leuven
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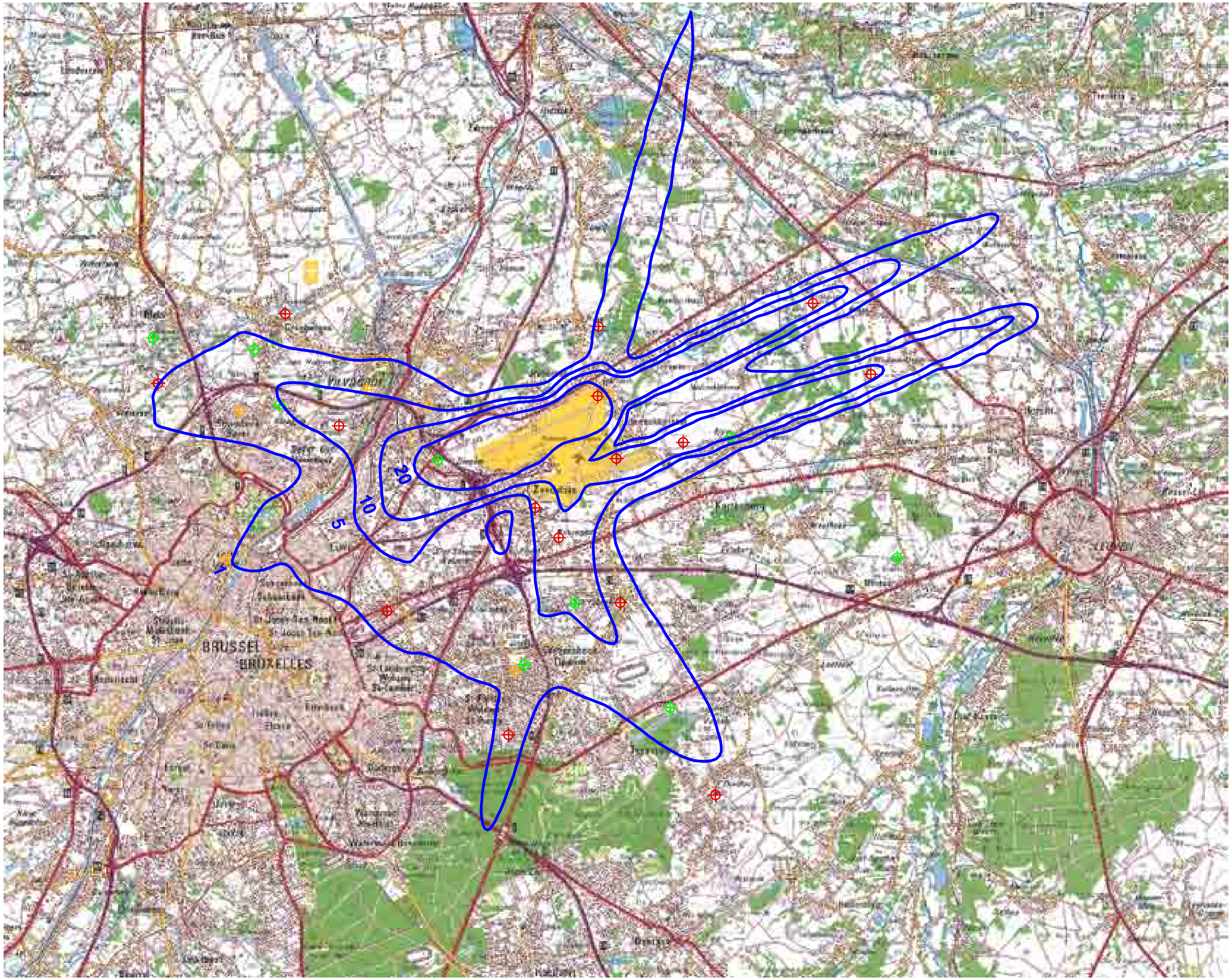
B-3001 Leuven (Heverlee)

Freq.70,night noise contours for 2012

night 23.00 - 07.00

Freq.70,night noise contours around Brussels Airport on a topographic map



Legend

Freq.70,night noise contours of 1x, 5x, 10x, 20x and 50x for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

0 2000 4000 Meters

Sources

topographic layer :
Raster version topographic layer NGI
Scale 1 = 100.000 (OC GIS-Vlaanderen)

Noise contours :
Calculated by ATF with
the calculation model INM 7.0b

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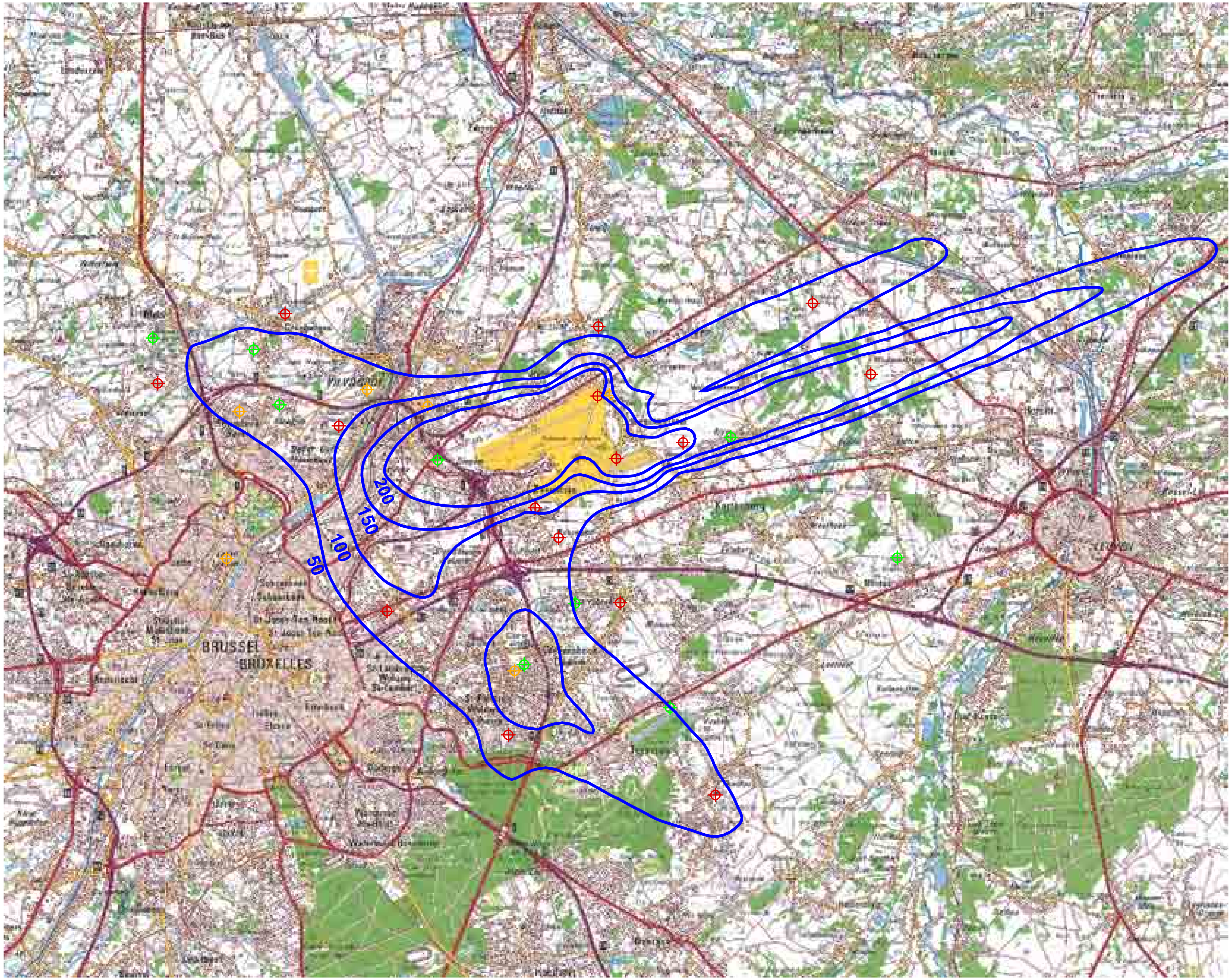
B-3001 Leuven (Heverlee)

Freq.60,day noise contours for 2012

day 07.00 - 23.00



Freq.60,day noise contours around Brussels Airport on a topographic map

Legend

Freq.60,day noise contours of 50x, 100x, 150x and 200x for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

0 2000 4000 6000 Meters

Sources

topographic layer :
Raster version topographic layer NGI
Scale 1 = 100.000 (OC GIS-Vlaanderen)

Noise contours :
Calculated by ATF with
the calculation model INM 7.0b

K.U.Leuven
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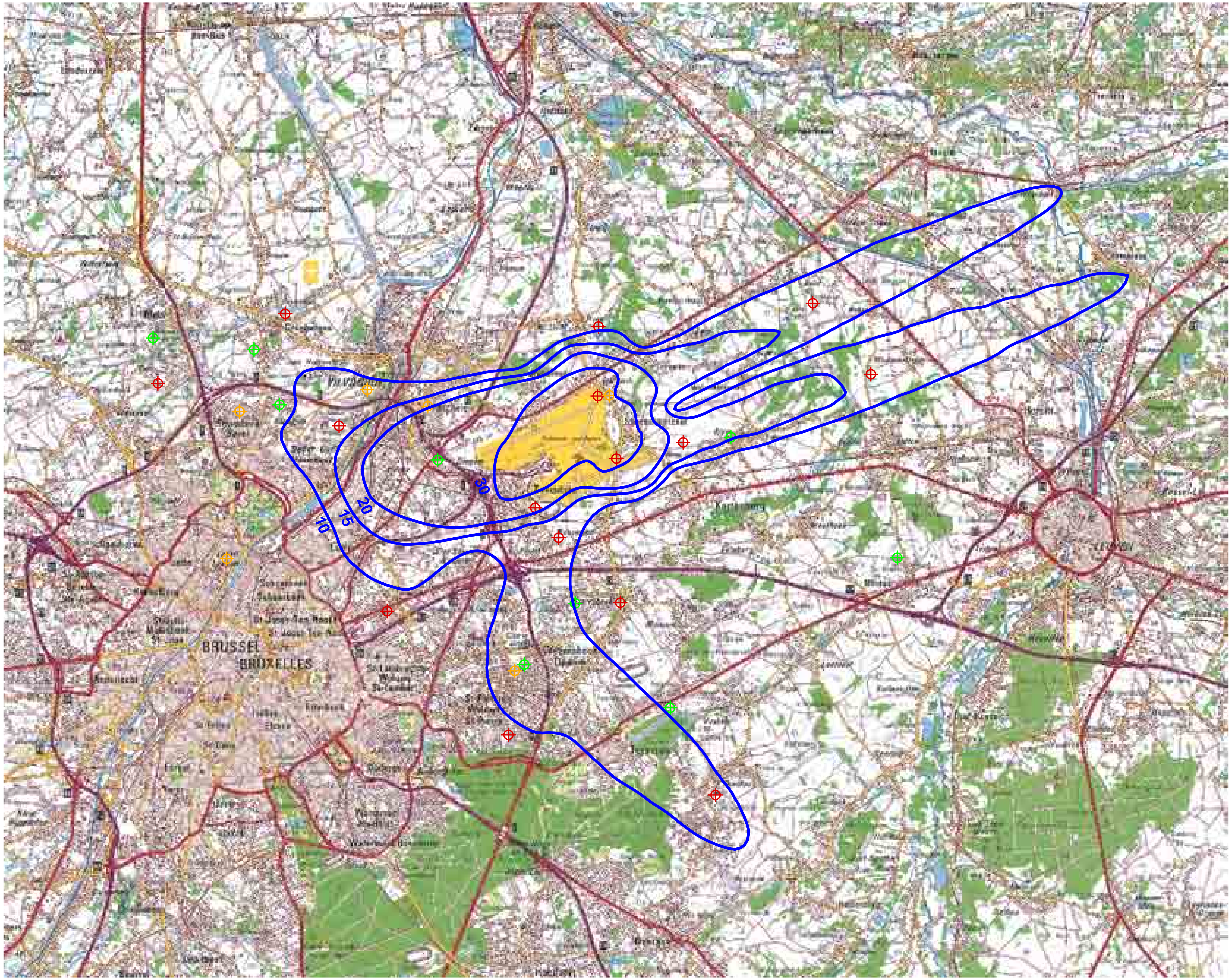
Freq.60,night noise contours for 2012

night 23.00 - 07.00

Freq.60,night noise contours
around Brussels Airport
on a
topographic map



Legend

Freq.60,night noise contours
of 10x, 15x, 20x and 30x
for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

0 2000 4000 6000 Meters

Sources

topographic layer :
Raster version topographic layer NGI
Scale 1 = 100.000 (OC GIS-Vlaanderen)

Noise contours :
Calculated by ATF with
the calculation model INM 7.0b

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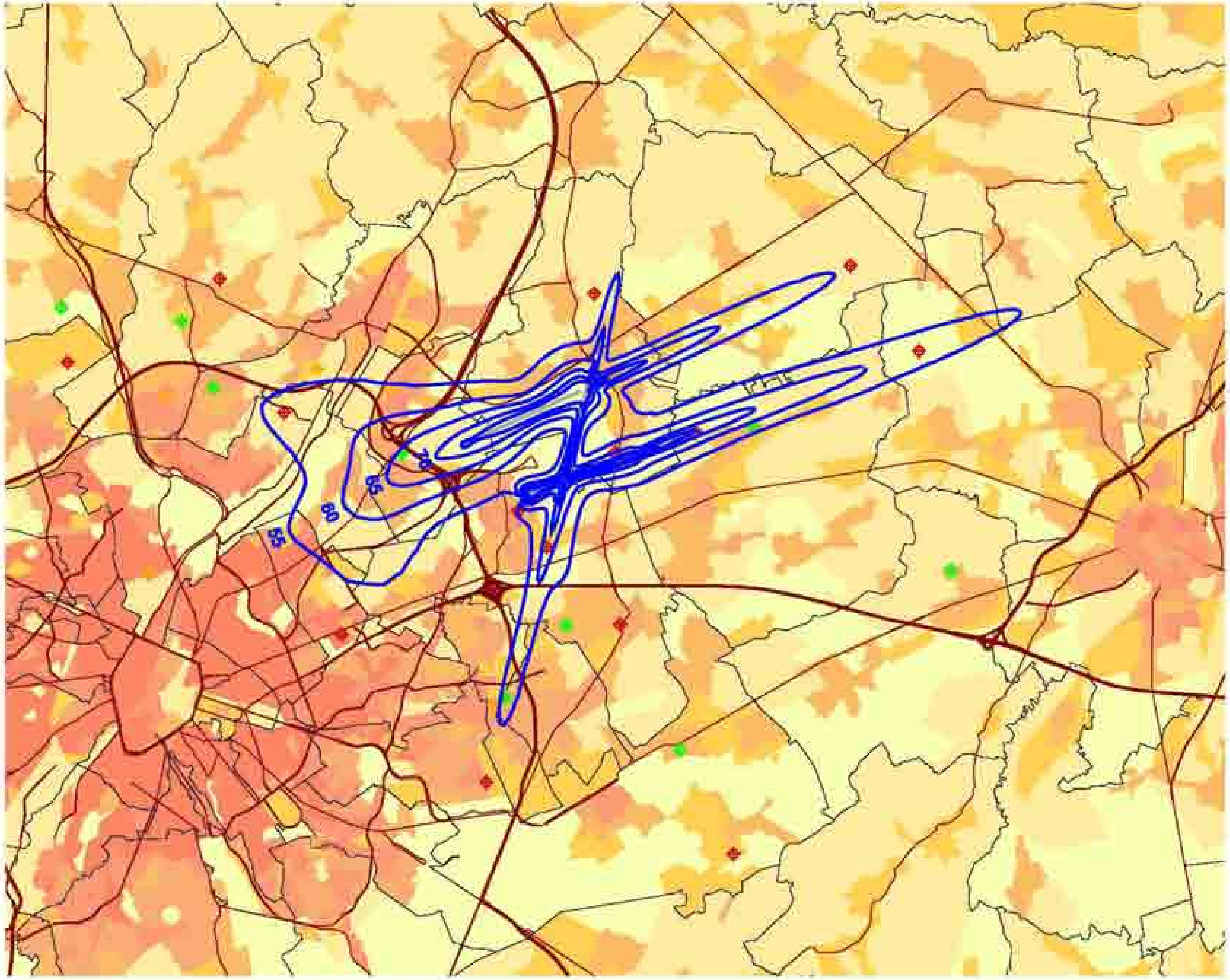
Appendix 7. Noise contours for the year 2012 on a population map

- L_{day} noise contours for 2012, background population map 2010
- $L_{evening}$ noise contours for 2012, background population map 2010
- L_{night} noise contours for 2012, background population map 2010
- $L_{den\ noise}$ contours for 2012, background population map 2010
- Freq.70,day noise contours for 2012, background population map 2010
- Freq.70,night noise contours for 2012, background population map 2010
- Freq.60,day noise contours for 2012, background population map 2010
- Freq.60,night noise contours for 2012, background population map 2010

L_{day} noise contours for 2012

day 07.00 - 19.00

L_{day} noise contours around Brussels Airport on a population map



Legend

L_{day} noise contours of 55, 60, 65, 70 and 75 dB(A) for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

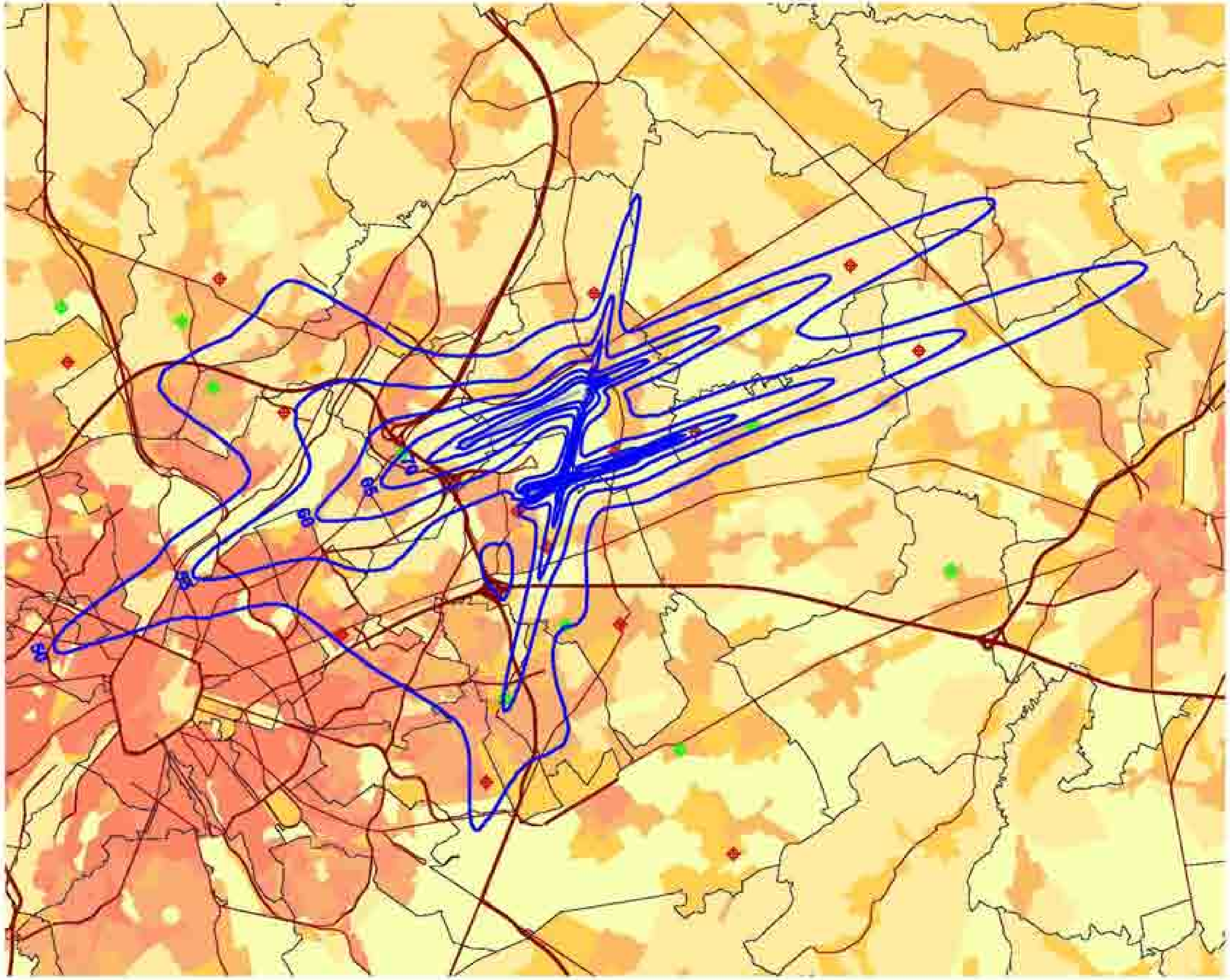
Street maps : Streetmap - Teleatlas

K.U.Leuven
LABORATORIUM VOOR AKOESTIEK and THERMISCHE FYSICA
Celestijnenlaan 200D - bus 2416
B-3001 Leuven (Heverlee)

$L_{evening}$ noise contours for 2012

evening 19.00 - 23.00

$L_{evening}$ noise contours around Brussels Airport on a population map



Legend

$L_{evening}$ noise contours of 50, 55, 60, 65, 70 and 75 dB(A) for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

Street maps : Streetmap - Teleatlas

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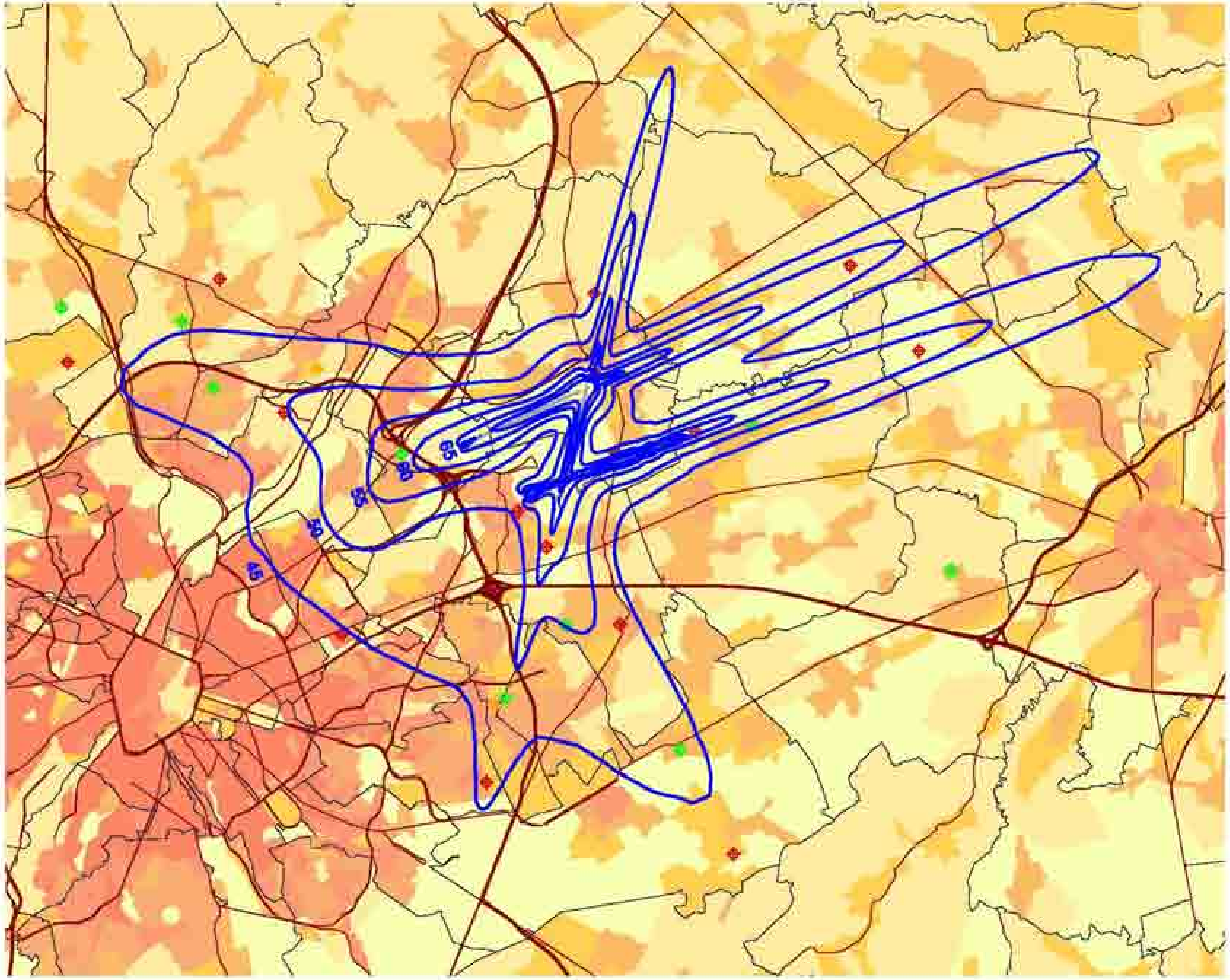
B-3001 Leuven (Heverlee)

L_{night} noise contours for 2012

night 23.00 - 07.00

L_{night} noise contours around Brussels Airport on a population map



Legend

L_{night} noise contours of 45, 50 55, 60, 65 and 70 dB(A) for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010
[inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data :
National Institute of Statistics (2010)

Statistical sectors :
AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours :
Calculated by ATF with the calculation model INM 7.0b

Street maps :
Streetmap - Teleatlas

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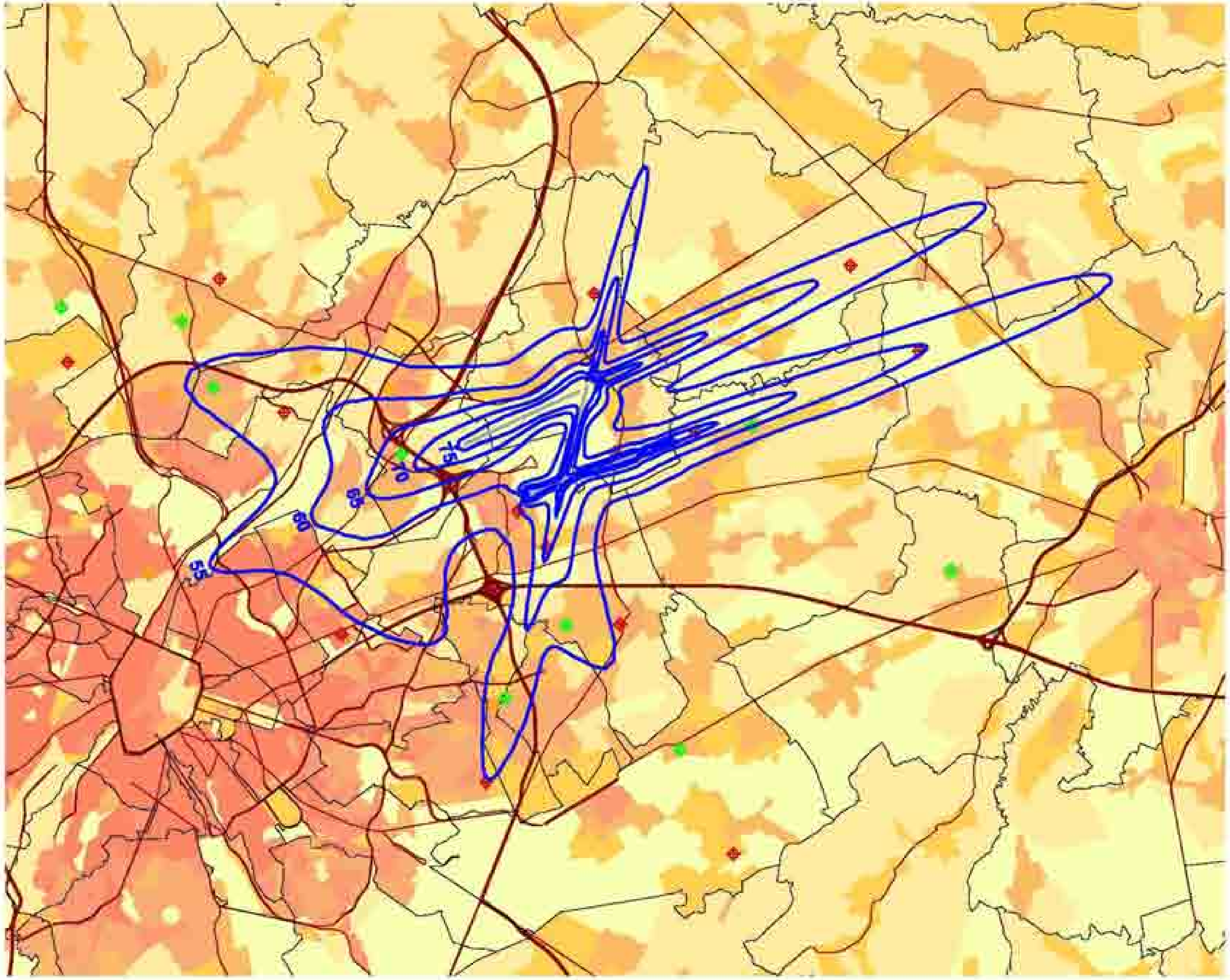
B-3001 Leuven (Heverlee)

L_{den} noise contours for 2012

day 07.00 - 19.00 - evening 19.00 - 23.00 - night 23.00 - 07.00

L_{den} noise contours around Brussels Airport on a population map



Legend

L_{den} noise contours of 55, 60, 65, 70 and 75 dB(A) for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

Street maps : Streetmap - Teleatlas

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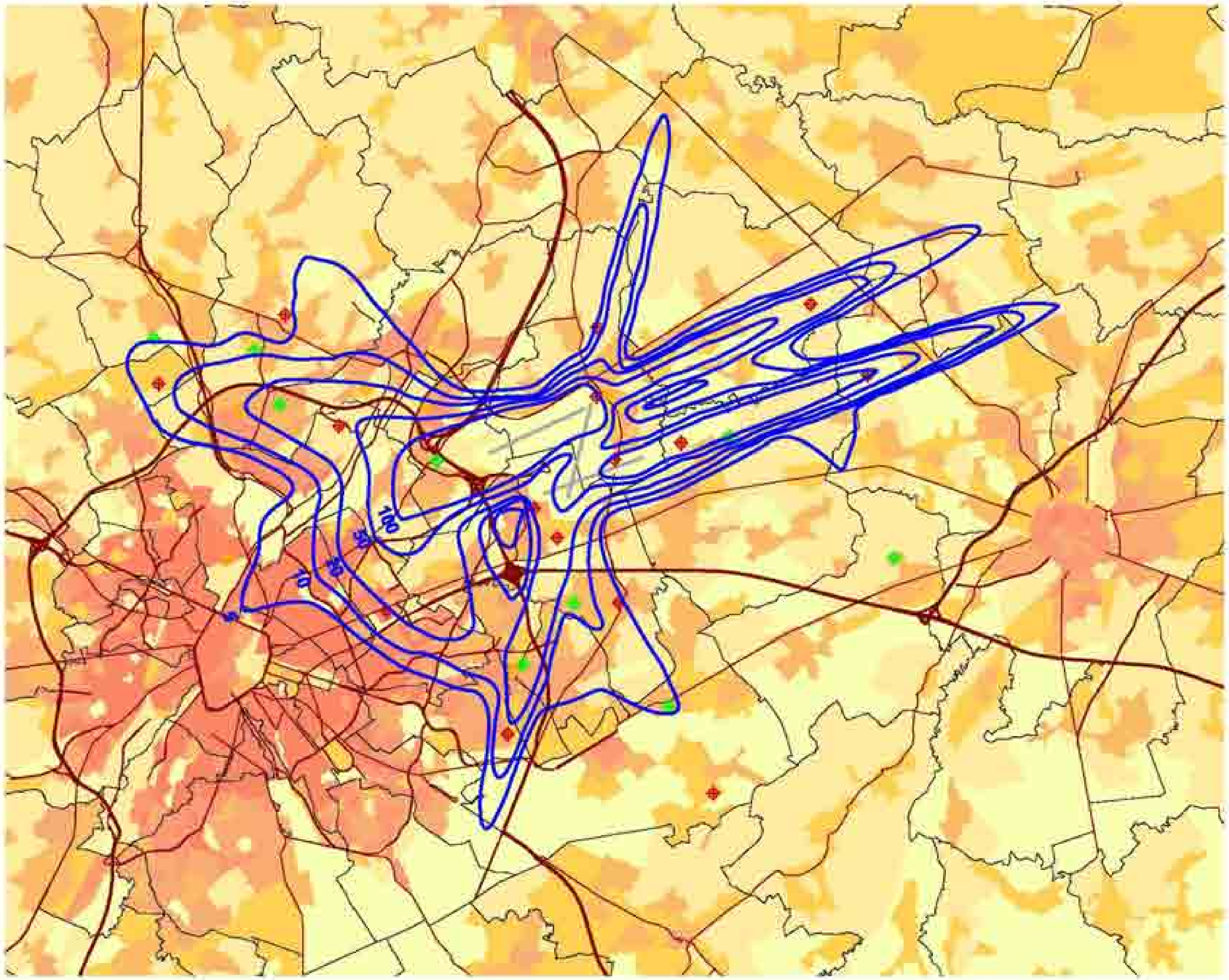
B-3001 Leuven (Heverlee)

Freq.70,day noise contours for 2012

day 07.00 - 23.00

Freq.70,day noise contours
around Brussels Airport
on a
population map



Legend

Freq.70,day noise contours of 5x, 10x, 20x, 50x and 100x for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010
[inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data :
National Institute of Statistics (2010)

Statistical sectors :
AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours :
Calculated by ATF with the calculation model INM 7.0b

Street maps :
Streetmap - Teleatlas

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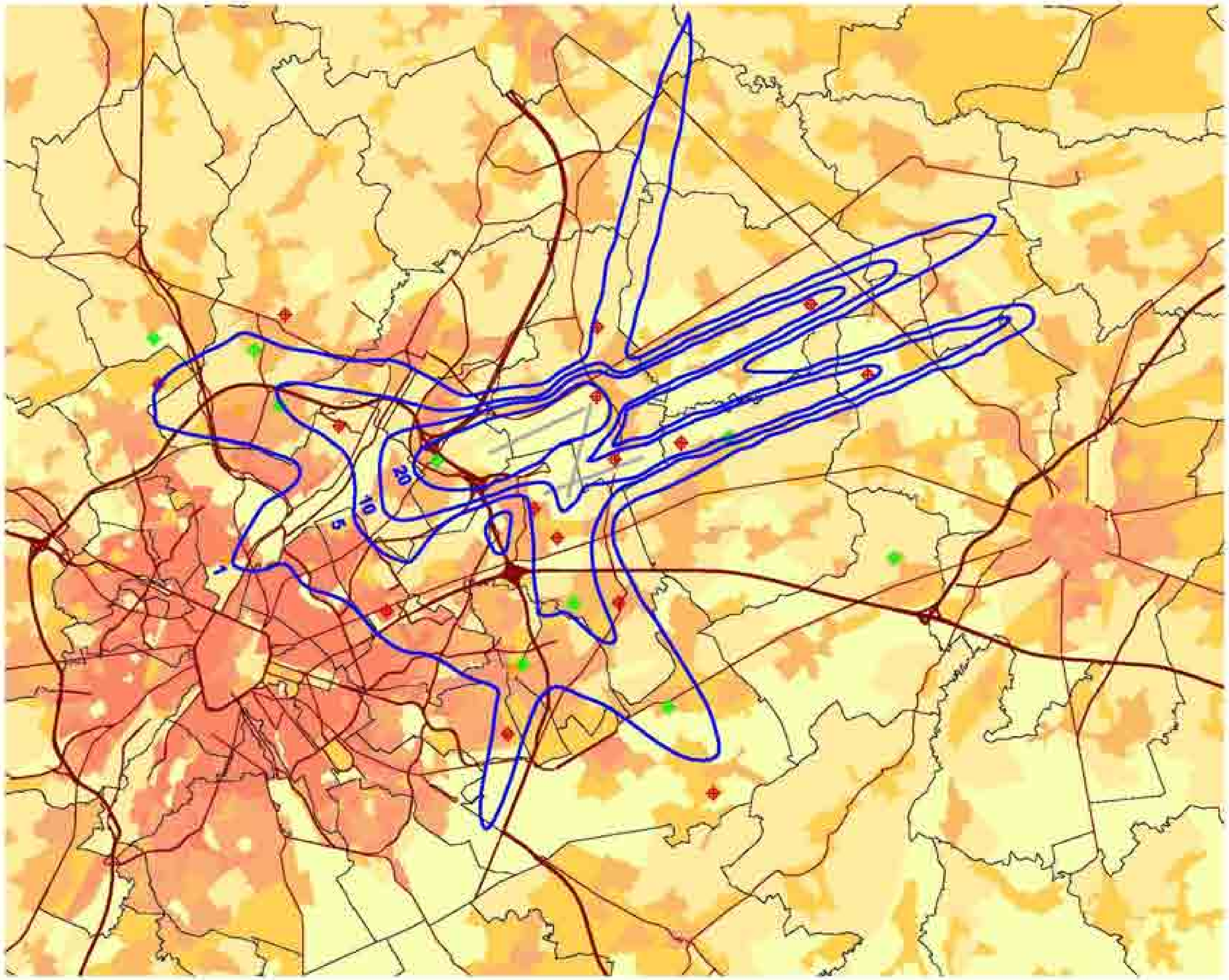
Celestijnenlaan 200D - bus 2416
B-3001 Leuven (Heverlee)

Freq.70,night noise contours for 2012

night 23.00 - 07.00

Freq.70,night noise contours around Brussels Airport on a population map



Legend

Freq.70,night noise contours of 1x, 5x, 10x, 20x and 50x for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

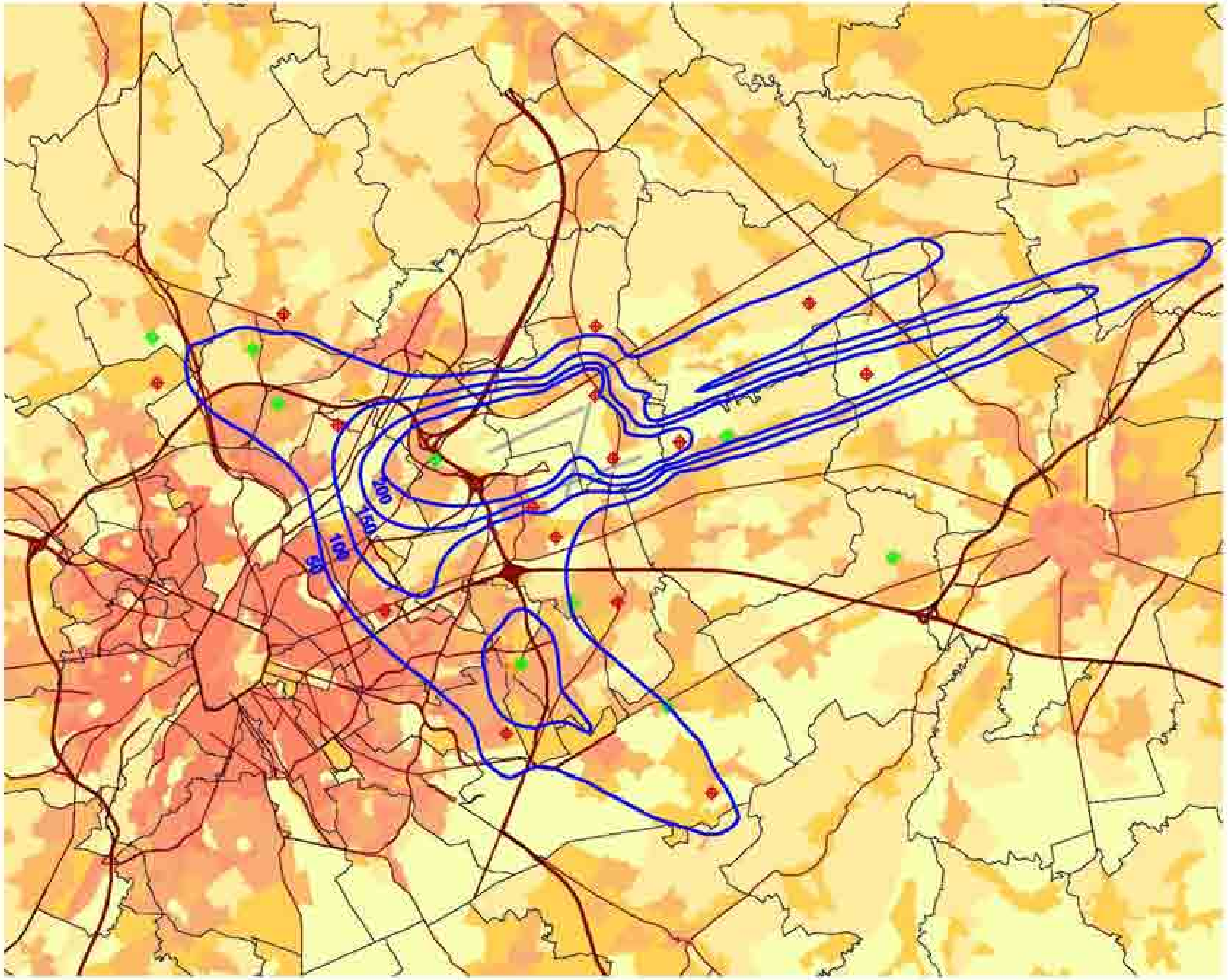
Street maps : Streetmap - Teleatlas

K.U.Leuven
LABORATORIUM VOOR AKOESTIEK and THERMISCHE FYSICA
Celestijnenlaan 200D - bus 2416
B-3001 Leuven (Heverlee)

Freq.60,day noise contours for 2012

day 07.00 - 23.00

Freq.60,day noise contours around Brussels Airport on a population map



Legend

Freq.60,day noise contours of 50x, 100x, 150x and 200x for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

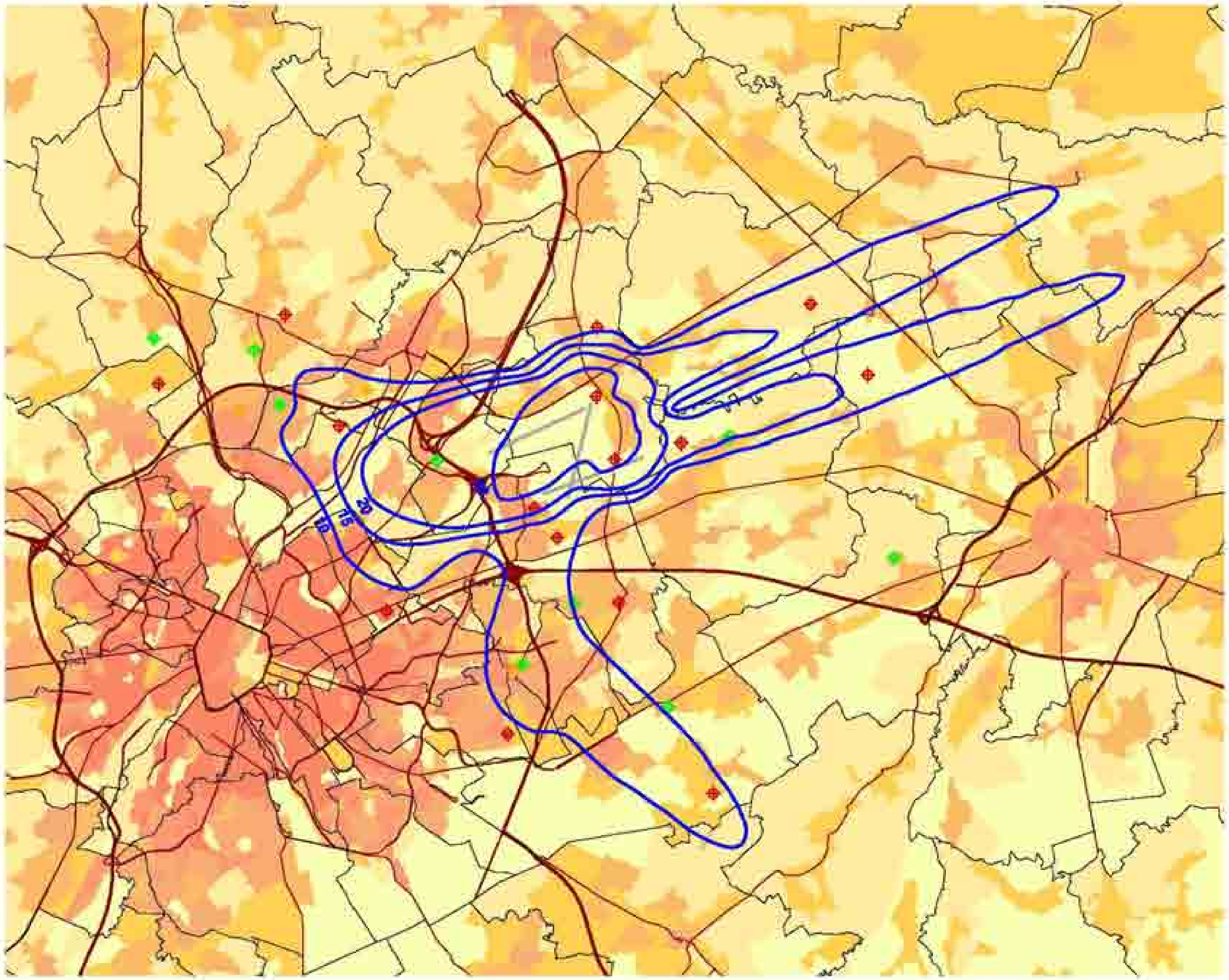
Street maps : Streetmap - Teleatlas

K.U.Leuven LABORATORIUM VOOR AKOESTIEK and THERMISCHE FYSICA Celestijnenlaan 200D - bus 2416 B-3001 Leuven (Heverlee)

Freq.60,night noise contours for 2012

night 23.00 - 07.00

Freq.60,night noise contours around Brussels Airport on a population map



Legend

Freq.60,night noise contours of 10x, 15x, 20x and 30x for 2012

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010
[inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data :
National Institute of Statistics (2010)

Statistical sectors :
AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours :
Calculated by ATF with the calculation model INM 7.0b

Street maps :
Streetmap - Teleatlas

K.U.Leuven
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Celestijnenlaan 200D - bus 2416
B-3001 Leuven (Heverlee)

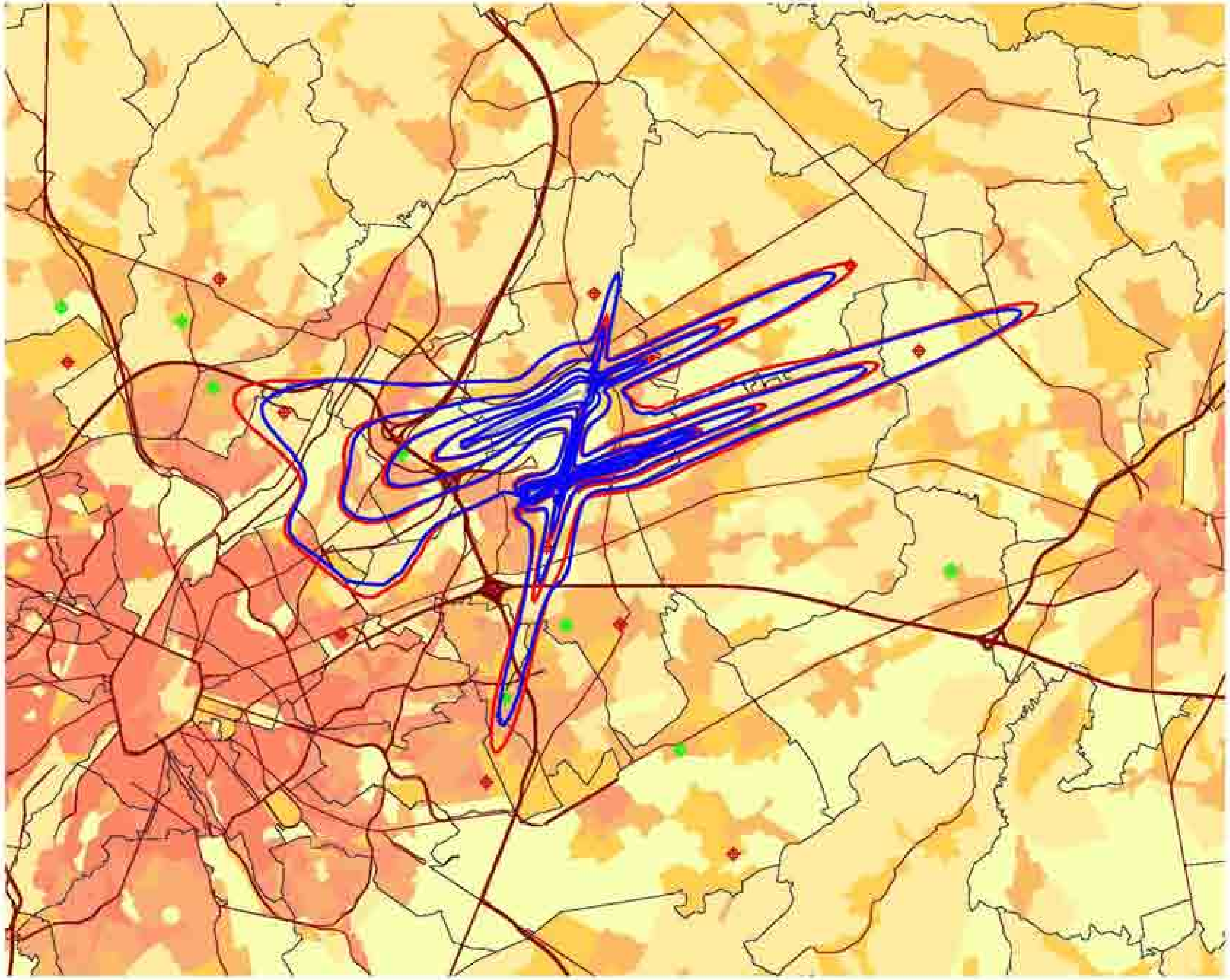
Appendix 8. Noise contour maps: change 2011-2012

- L_{day} noise contours for 2011 and 2012, background population map 2010
- $L_{evening}$ noise contours for 2011 and 2012, background population map 2010
- L_{night} noise contours for 2011 and 2012, background population map 2010
- L_{den} noise contours for 2011 and 2012, background population map 2010
- Freq.70,day noise contours for 2011 and 2012, background population map 2010
- Freq.70,night noise contours for 2011 and 2012, background population map 2010
- Freq.60,day noise contours for 2011 and 2012, background population map 2010
- Freq.60,night noise contours for 2011 and 2012, background population map 2010

Evolutie van de L_{day} - geluidscontouren for 2011 and 2012

day 07.00 - 19.00

L_{day} noise contours around Brussels Airport on a population map



Legend

L_{day} noise contours of 55, 60, 65, 70 and 75 dB(A) for 2012

L_{day} noise contours of 55, 60, 65, 70 and 75 dB(A) for 2011

Noise Monitoring Terminals

- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]

- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

Street maps : Streetmap - Teleatlas

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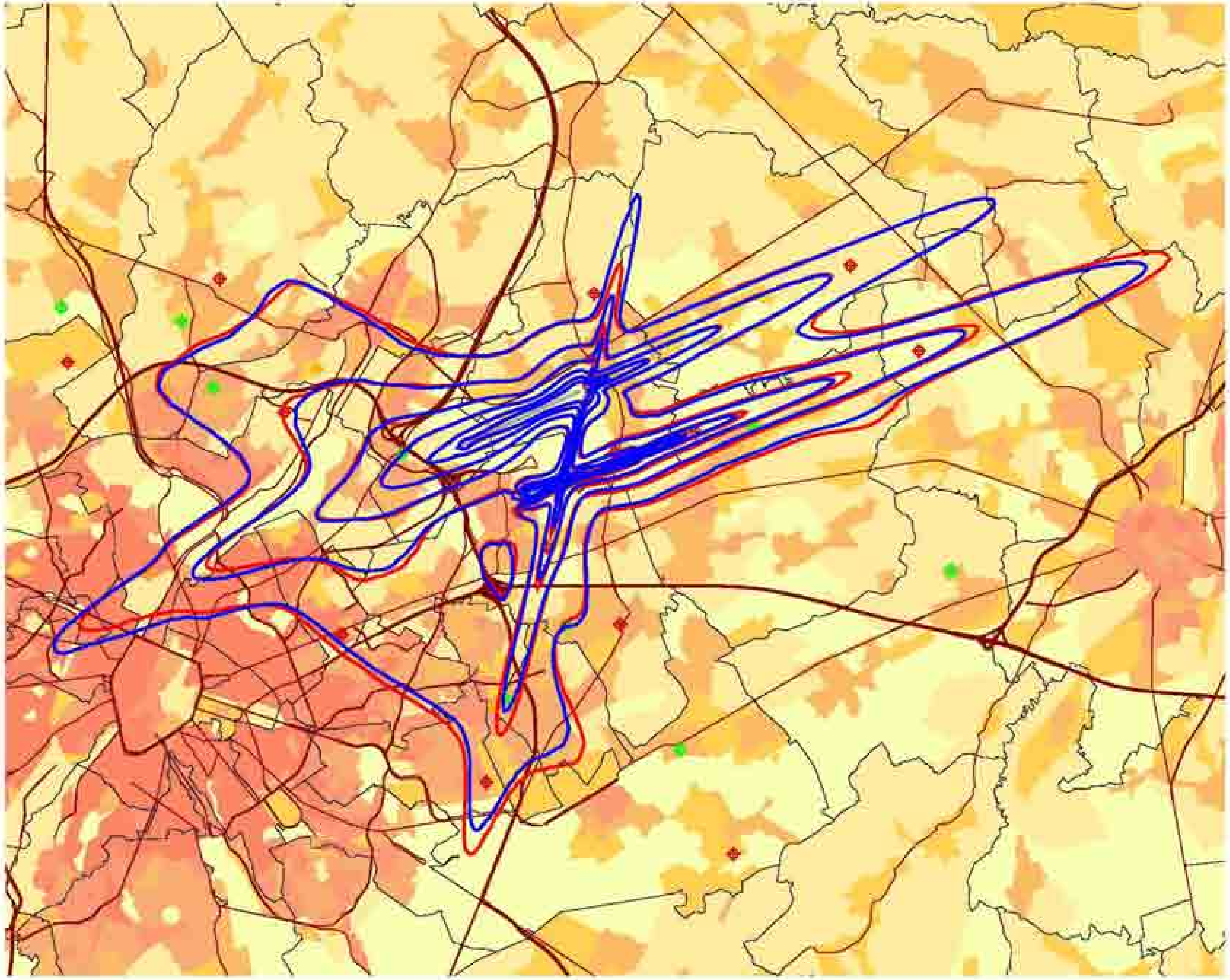
B-3001 Leuven (Heverlee)

Evolutie van de $L_{evening}$ - geluidscontouren for 2011 and 2012

evening 19.00 - 23.00

$L_{evening}$ noise contours
around Brussels Airport
on a
population map



Legend

$L_{evening}$ noise contours of 50, 55, 60, 65, 70 and 75 dB(A) for 2012

$L_{evening}$ noise contours of 50, 55, 60, 65, 70 and 75 dB(A) for 2011

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010
[inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data :
National Institute of Statistics (2010)

Statistical sectors :
AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours :
Calculated by ATF with the calculation model INM 7.0b

Street maps :
Streetmap - Teleatlas

K.U.Leuven
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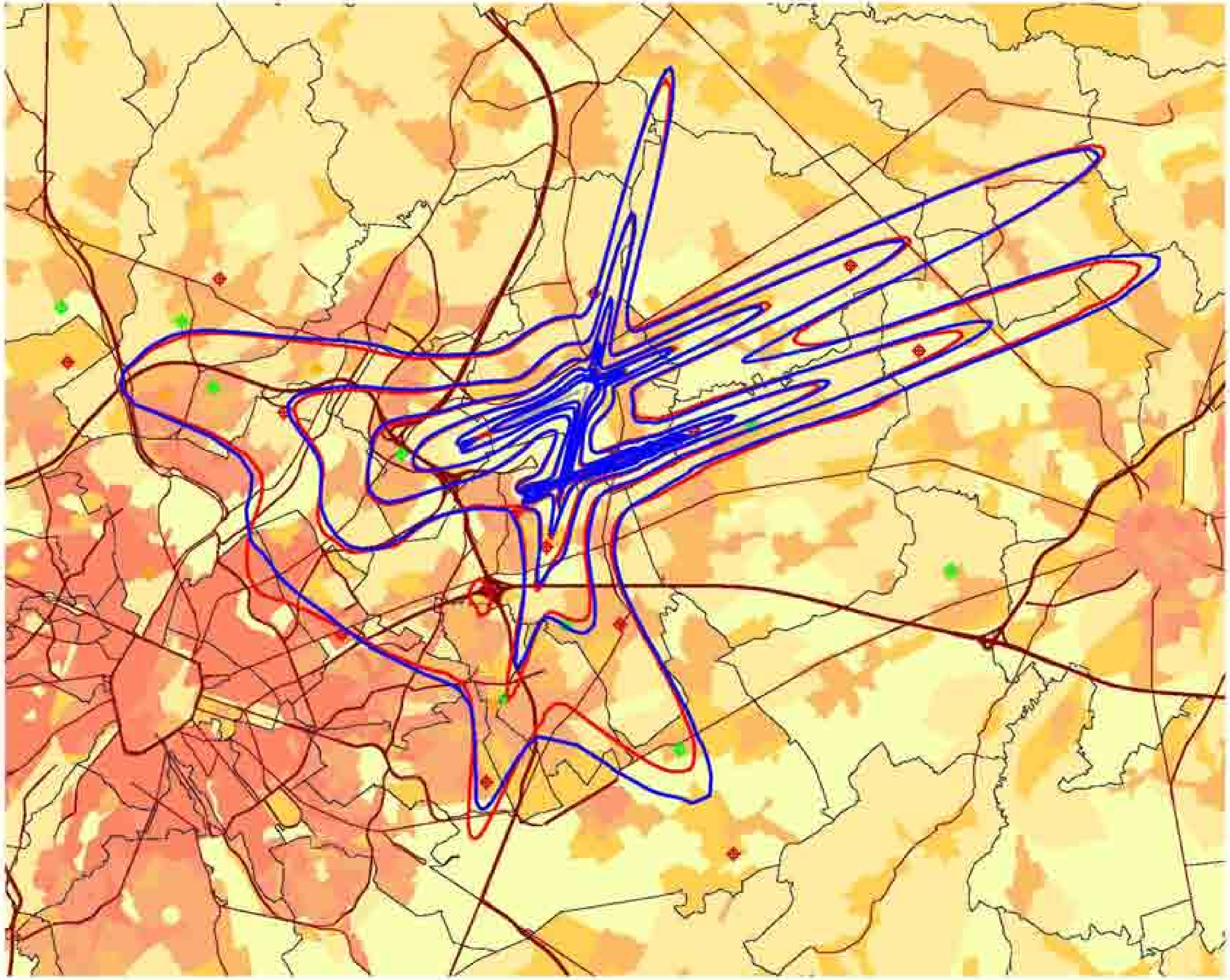
Evolutie van de L_{night} - geluidscontouren for 2011 and 2012

nacht 23.00u - 07.00u

L_{night} noise contours around Brussels Airport on a population map



Legend

- L_{night} noise contours of 45, 50, 55, 60, 65 and 70 dB(A) for 2012
- L_{night} noise contours of 45, 50, 55, 60, 65 and 70 dB(A) for 2011

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

Street maps : Streetmap - Teleatlas

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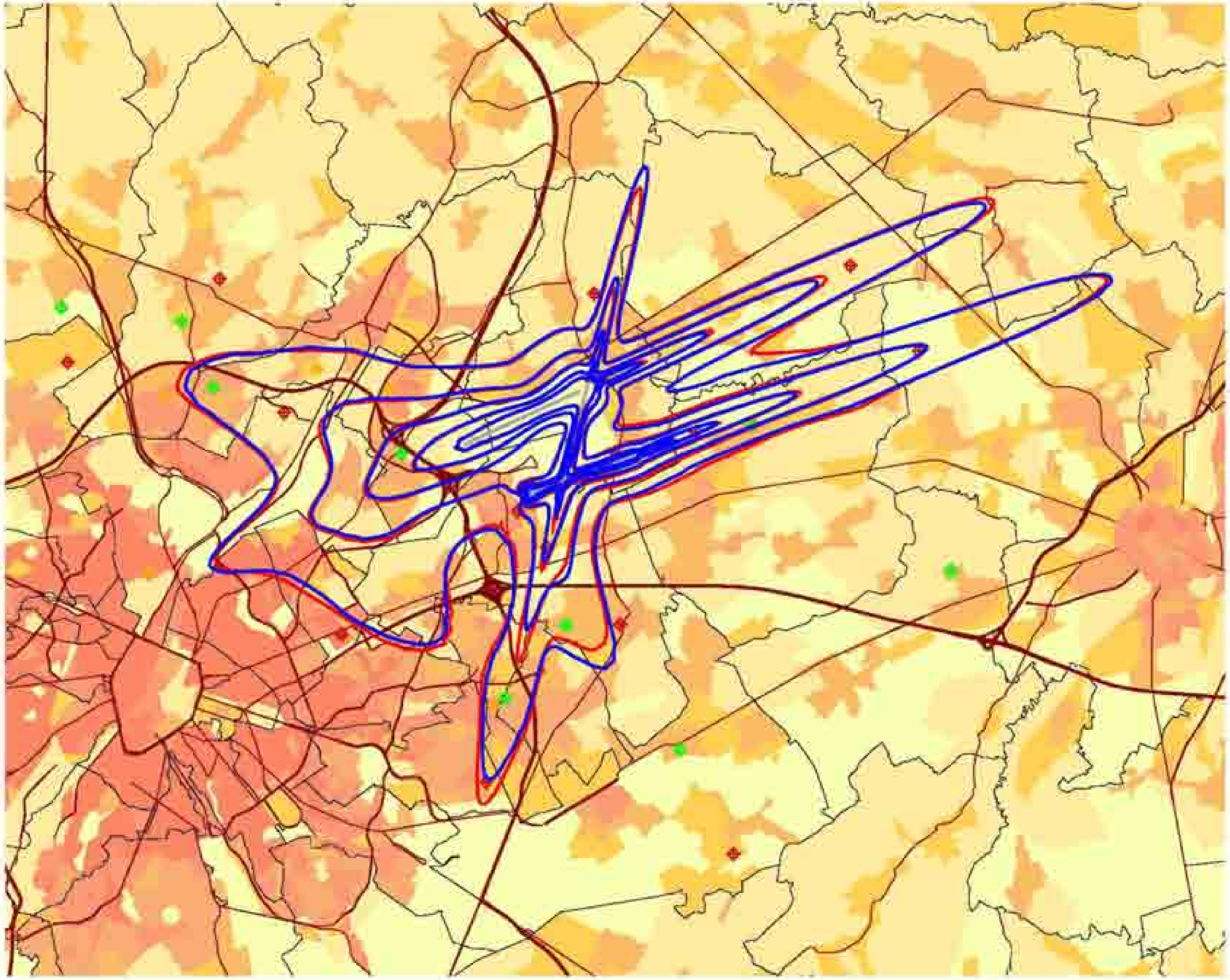
Evolutie van de L_{den} - geluidscontouren for 2011 and 2012

dag 07.00u - 19.00u - avond 19.00u - 23.00u - nacht 23.00u - 07.00u

L_{den} noise contours around Brussels Airport on a population map



Legend

L_{den} noise contours of 55, 60, 65, 70 and 75 dB(A) for 2012

L_{den} noise contours of 55, 60, 65, 70 and 75 dB(A) for 2011

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

Street maps : Streetmap - Teleatlas

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Evolutie van de Freq.70,day - geluidscontouren for 2011 and 2012

day 07.00 - 23.00

Freq.70,day noise contours
around Brussels Airport
on a
population map

Legend

- Freq.70,day noise contours of 5x, 10x, 20x, 50x and 100x for 2012
- Freq.70,day noise contours of 5x, 10x, 20x, 50x and 100x for 2011

Noise Monitoring Terminals

- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010
[inhabitants/hectare]

- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data :
National Institute of Statistics (2010)

Statistical sectors :
AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours :
Calculated by ATF with the calculation model INM 7.0b

Street maps :
Streetmap - Teleatlas

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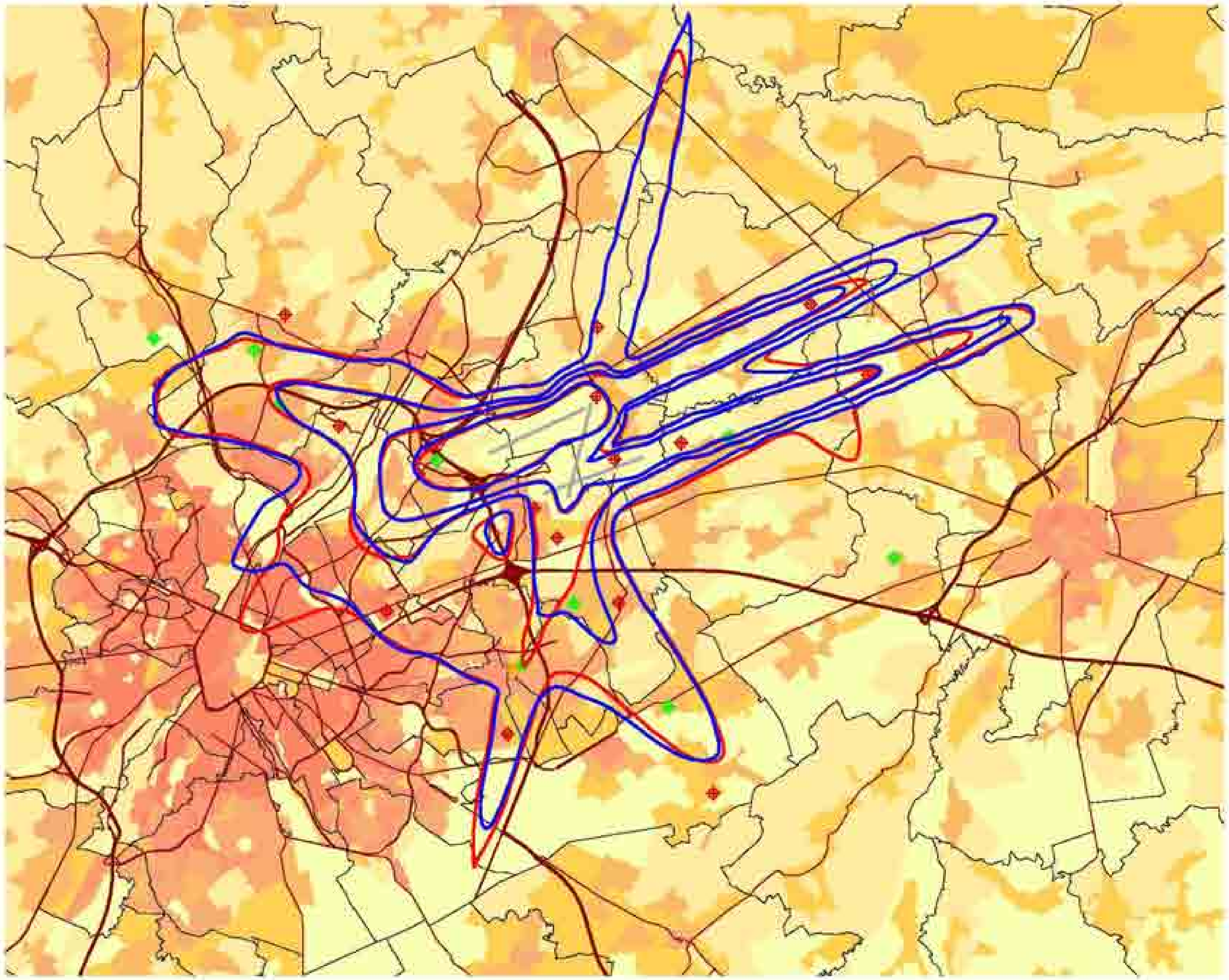
Evolutie van de Freq.70,night - geluidscontouren for 2011 and 2012

night 23.00 - 07.00

Freq.70,night noise contours around Brussels Airport on a population map



Legend

- Freq.70,night noise contours of 1x, 5x, 10x, 20x and 50x for 2012
- Freq.70,night noise contours of 1x, 5x, 10x, 20x and 50x for 2011

Noise Monitoring Terminals

- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]

- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 2000 4000 Meters

Sources

Population data :
National Institute of Statistics (2010)

Statistical sectors :
AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours :
Calculated by ATF with the calculation model INM 7.0b

Street maps :
Streetmap - Teleatlas

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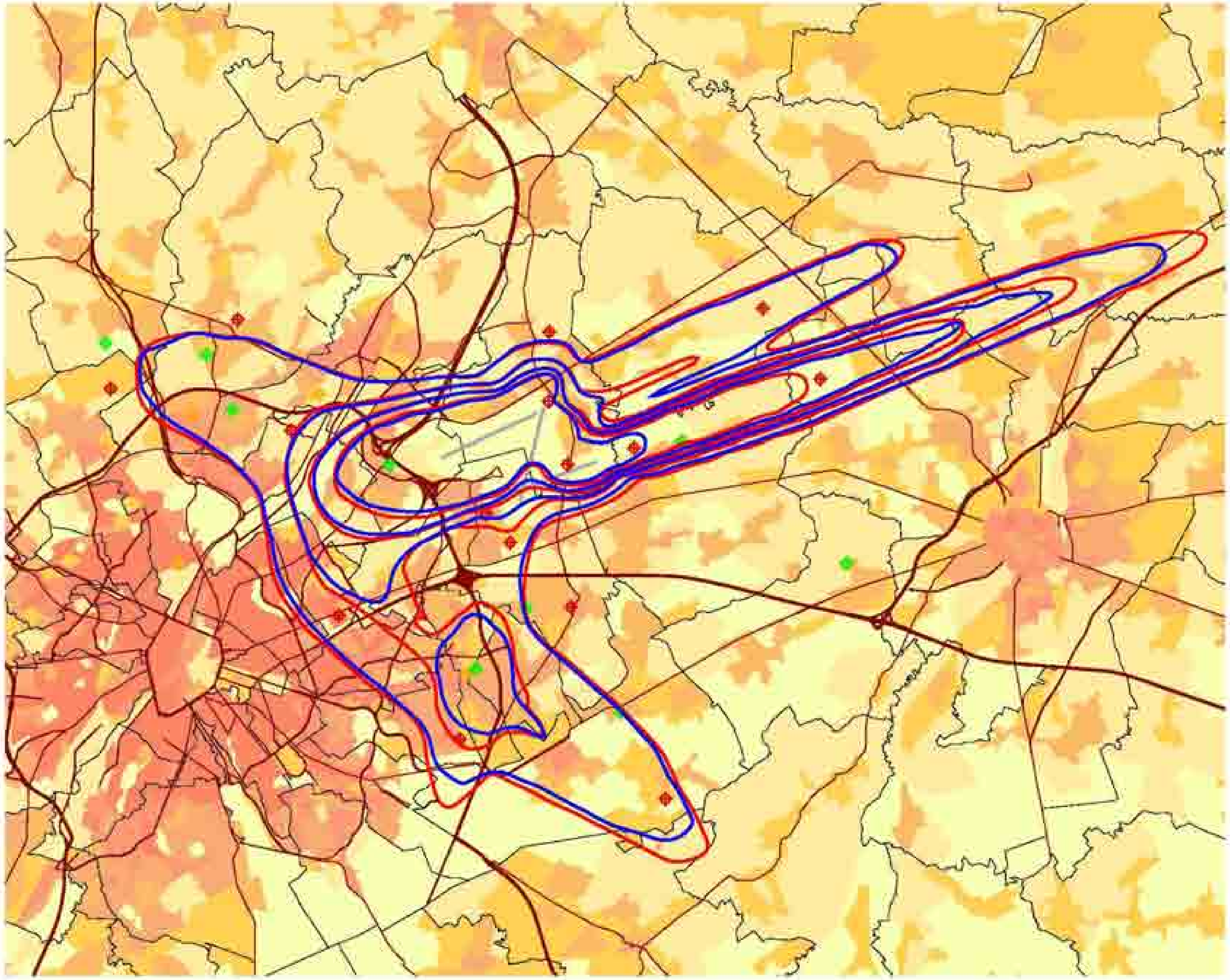
Evolutie van de Freq.60,day - geluidscontouren for 2011 and 2012

day 07.00 - 23.00

Freq.60,day noise contours around Brussels Airport on a population map



Legend

Freq.60,day noise contours of 50x, 100x, 150x and 200x for 2012

Freq.60,day noise contours of 50x, 100x, 150x and 200x for 2011

Noise Monitoring Terminals
- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]
- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 3000 6000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

Street maps : Streetmap - Teleatlas

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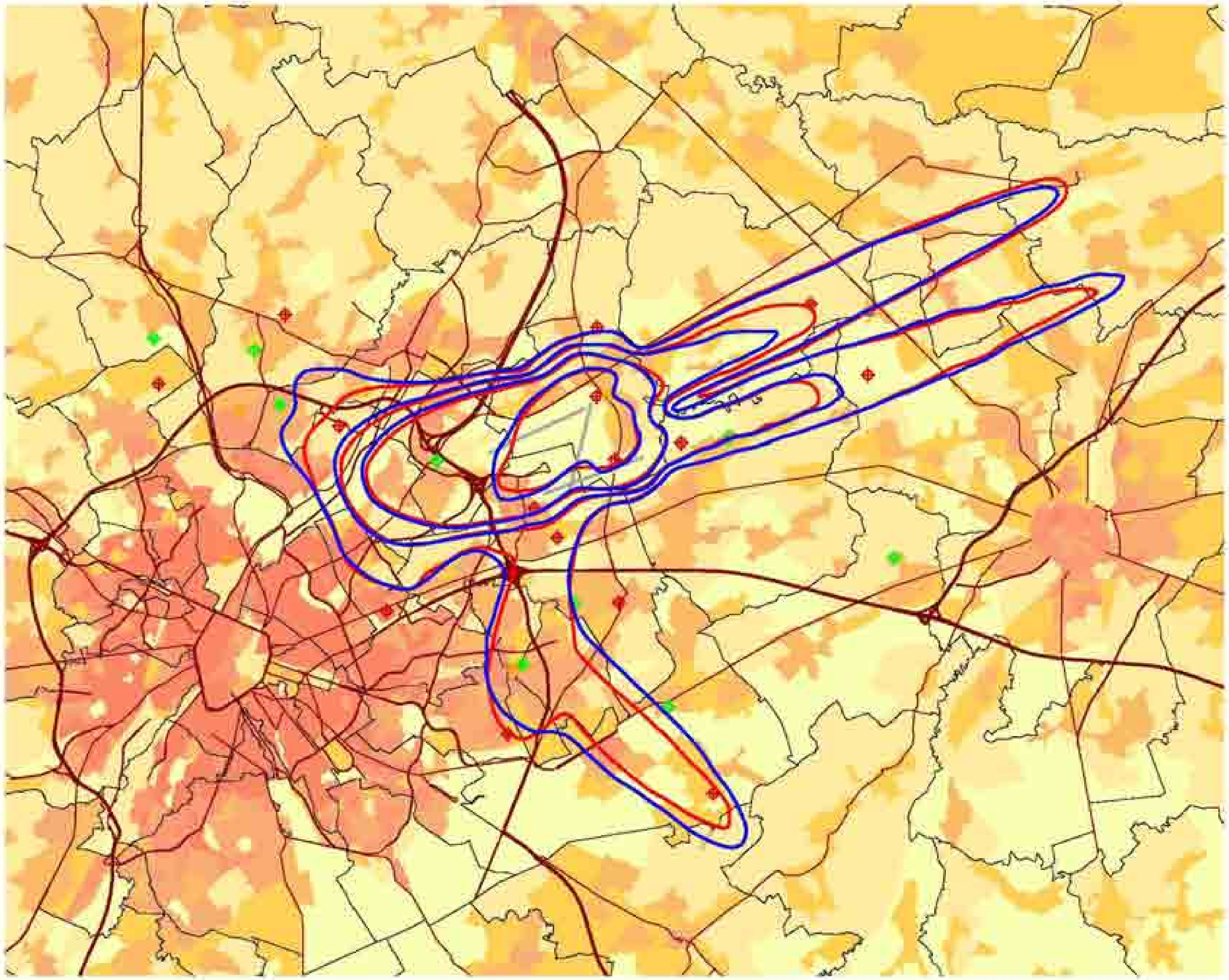
Evolutie van de Freq.60,night - geluidscontouren for 2011 and 2012

night 23.00 - 07.00

Freq.60,night noise contours around Brussels Airport on a population map



Legend

Freq.60,night noise contours of 10x, 15x, 20x and 30x for 2012

Freq.60,night noise contours of 10x, 15x, 20x and 30x for 2011

Noise Monitoring Terminals

- LNE
- Brussels Airport Semi-Mobile
- Brussels Airport Fixed

Boundary municipality

Population density 2010 [inhabitants/hectare]

- < 0.5
- 0.5 - 4.5
- 4.5 - 14.5
- 14.5 - 26.5
- 26.5 - 56.5
- 56.5 - 99.5
- >= 99.5

0 3000 6000 Meters

Sources

Population data : National Institute of Statistics (2010)

Statistical sectors : AHROM - afdeling ruimtelijke planning (OC - GIS Vlaanderen)

Noise contours : Calculated by ATF with the calculation model INM 7.0b

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