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applied acoustic design

REPORT OF

NOISE MONITORING AT HEVER

FEBRUARY 2011 TO JANUARY 2012

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Summary

A mobile Noise Monitoring Terminal (NMT) has been deployed at Hever in Kent by Gatwick Airport Ltd. The site is approximately11 nm (21 km) east of the airport.

The aim of this report is to present the results of the noise monitoring exercise over the twelve month period from February 2011 to January 2012, and to interpret the results in a way that places the contribution of the noise from aircraft using Gatwick in the context of the overall noise climate from all other sources.

The Noise monitoring Terminal (NMT) gathers data about the number and level of aircraft noise events. Aircraft noise events are bursts of noise which activate the trigger condition of more than 55 dBA for at least 10 seconds and which also correlate with radar tracks from the airport's noise and track keeping system. In addition the NMT also gathers data about the total level of noise from all sources at the site, on an hourly basis. The hourly values of total noise are a combination of the noise from the aircraft noise events and noise from all other sources, which is called residual noise.

Under prevailing wind conditions when aircraft are taking off to the west the site is overflown by arriving aircraft, and conversely by departing aircraft, when take-off is in the easterly direction. A total of about 62000 aircraft noise events were recorded by the noise monitor. On average over the year 84 % of these events were due to arrivals, and 16 % were due to departures, and 86% occurred during the daytime (07.00 to 23.00 hours) and 16% at night-time (23.00 to 07.00 hours).

The variation in numbers of such events has been examined: month by month throughout the 12 month period, day to day throughout each month and hour by hour throughout the day. The highest numbers of events occurred in June and September, the busiest hours of the day were between 08.00 and 09.00 in the morning and 19.00 and 20.00 hours in the evening, local time. The day to day variation in numbers of events recorded by the noise monitor depends on the wind direction, which determines take off direction, with numbers varying widely from no events on some days to a maximum of 404 events per day.

The maximum noise level produced by each aircraft over-flight has been recorded by the monitor. These values ranged between 55 dBA and 85 dBA, but over 75% of values were between 60 and 70 dBA, and the average of al these values over the year was 64 dBA for arrival events and 60 dBA for departures, and 63 dBA overall. A statistical distribution of the values is displayed in the report.

Each aircraft noise event may also be characterised by its duration (the time for which the aircraft noise exceeds the trigger level value of 55 dBA) and the average noise levels during this period. The average event duration of events is 35 seconds and the average noise level during events is 60 dBA.

The noise level from each aircraft noise event at the site may be combined to produce average aircraft noise levels for each month ($L_{Aeq,T}$ value) and over the entire year. The average aircraft noise level during the daytime was 51 dBA and 46 dBA at night-time.

The average level of aircraft noise at the site is generally similar to that of the residual noise. The total noise level, which is the combination of aircraft noise and residual noise levels, is generally about 3 dB higher than that of the aircraft noise.

It is possible to convert the hourly aircraft noise L_{Aeq} values into the 24 hour L_{den} noise index (day evening night level) used by Defra for noise mapping purposes, giving, on the basis of the data collected at this site over the twelve months period, an L_{den} value of 54 dBA for aircraft noise and 57 dBA for total noise at the site. These values are compared with Gatwick Airport noise contours in section 4.1 of the report.

The noise climate at the site has been placed into a wider UK context by comparisons with the results of the 2000 National Noise Incidence Study, and with World Health Organisation Guidelines for Community Noise. The daytime total noise exposure level at this site (53 dB $L_{Aeq,16hour}$) is below the WHO Guidelines of 55 dBA for the daytime, but the night-time noise exposure level (49 dB $L_{Aeq,8hour}$) is above the night-time WHO Guideline value of 45 dBA.

The average maximum noise level (L_{ASmax}) of aircraft noise events did not vary significantly with aircraft type for the relatively few aircraft types which make up most of the aircraft noise events, and that although there are some aircraft types which produce significantly higher values of L_{ASmax} there are only very small numbers of these types of events.

The information presented in this report will serve as a baseline for comparison with any future noise level surveys in this format that may be undertaken at this location.

A summary of the main noise related parameters over the 12 month noise monitoring period for the site are shown in the Table below:

Survey period	1 February 2011 to 31 January 2012
Aircraft noise event trigger level	55 dBA for 10 seconds
Number of aircraft noise events	62000
% of events due to Arrivals and Departures	84% Arrivals; 16% Departures
% events by day and night	86% Day; 14% Night
Average maximum noise level of events	60 dBA Departures, 64 dBA Arrivals; 63 dBA overall
Average noise level and duration of aircraft noise events	Average level 60 dB Average duration 35 s
Average total noise level	53 dBA Day (16h); 49 dBA Night
Average aircraft noise level	51 dBA Day (16h); 46 dBA Night
Average residual noise level	50 dBA Day (16h); 46 dBA Night
Daytime level (12 hours)	Total noise 54 dBA, aircraft noise 51 dBA
Evening level (4 hours)	Total noise 52 dBA, aircraft noise 50 dBA
Day-evening night level	Total noise: 57 dBA, Aircraft noise: 54 dBA, Residual noise 54 dBA
Background noise (L_{AS90})	39 dBA Day (16h); 28 dBA Night
Aircraft types responsible for the majority of aircraft noise events:	Airbus A319: 31 % Airbus A320: 14 % Boeing 737-400: 14 % (103 aircraft types in total)

NOISE CLIMATE AT HEVER, FEBRUARY 2011 TO JANUARY 2012: REPORT OF 12 MONTHS OF NOISE MONITORING

1.0 Introduction

1.1 A mobile Noise Monitoring Terminal (NMT) has been deployed at Hever in Kent by Gatwick Airport Ltd. This report presents a summary of the results of 12 months of noise monitoring, between February 2011 and January 2012, thus covering a complete seasonal cycle of aircraft movements.

1.2 The site is approximately11 nm (21 km) east of the airport. The noise monitor is located on a smallholding well away from the nearest road. Apart from aircraft noise there may be occasional noise from farm machinery (e.g. from a tractor), and from wind in nearby trees.

1.3 The aims of this report are:

- to present the results of the twelve month noise monitoring survey, and
- to interpret the results in a way that places the contribution of the noise from passing aircraft using Gatwick airport in the context of the overall noise climate from all other sources, and
- To provide a baseline for comparison with any future noise surveys in this format that may be undertaken at this location.

1.4 The results of the noise measurements, including both noise from aircraft and from all other sources are presented in section 3 of the Report, and section 4 places the noise climate at the site into a wider UK context through comparisons with aircraft noise contours, the results of National noise incidence surveys and with World Health Organisation Guidelines for Community Noise.

2.0 The noise data from the noise monitoring terminal

2.1 The Noise monitoring Terminal (NMT) gathers data about the number and level of aircraft noise events. Aircraft noise events are bursts of noise which activate the trigger condition of more than 55 dBA for at least 10 seconds and which also correlate with radar tracks from the airport's noise and track keeping system. In addition the NMT also gathers data about the total level of noise at the site, on an hourly basis. The hourly values of total noise are a combination of the noise from the aircraft noise events and from all other noise sources, called residual noise.

2.2 Figures 1 and 2 show typical aircraft tracks for both easterly and westerly take-offs from Gatwick, also showing the location of the NMT at Hever. It can be seen that the site lies to the east, directly on the line of the extended runway. Therefore when the take-off direction is to the west (as shown in Figure 1) the site will be overflown by some, but not all, aircraft arriving from the east, depending upon where the aircraft joins the Instrument Landing System (ILS). Figures 1 and 2 also show that there may be some aircraft departures which overfly the site during both easterly and westerly operations, and some of these may be recorded as aircraft noise events if the noise that they produce is sufficient to trigger the NMT.

2.3 The monitor was set to operate with a threshold trigger level of 55 dBA, well above the general background noise level at the site.

2.4 Further information about the NMT is given in Appendix 1, and a Glossary of acoustical terms is given in Appendix 2.

3.0 Analysis of noise monitor survey results

The results are discussed in the following sequence: the number of aircraft noise events recorded by the NMT; maximum noise levels of aircraft noise events; the noise climate at the site, including aircraft noise, residual noise, and total noise; putting the noise climate into context; aircraft types contributing to aircraft noise levels at Hever.

The data gathered during the survey is summarised in Table 6, in section 6 at the end of this Report, and displayed in Figures 3 to 9 below.

3.1 <u>The number of aircraft noise events</u>

A total of approximately 62000 such events were recorded at the noise monitor during the twelve month period. Most of these events (84%) were due to aircraft arrivals from the east with the remainder (16%) being due to departures, of which the great majority (80 % of departure events) arose from departures to the east; 86 % of events occurred in the daytime period (07.00 to 23.00 hours) and 14 % at night-time (23.00 to 07.00 hours).

The arithmetic average of the number of aircraft noise events recorded per day for each month of the survey period is shown in Figure 3 and also in Table 1 which also shows the West/East runway usage split and the % of arrivals and departures for each month.

There is a very wide variation in the number of aircraft noise events recorded from day to day throughout the year, from zero recorded events on some days in February, April and July to more than 300 events on days from May to October, with the highest number, 404 events, recorded on September 5th. The variation from day to day is mainly determined by wind direction, which determines take off direction. Table 1 also shows the lowest and highest number of events per day recorded in each month, for example in August the daily total ranged from 11 events (on the 9th August) to 344 events (on the 4th August).

Table 1 showing numbers of aircraft noise events and east west split for each month.

	Numbers of Events	Lowest/highest number of events per day	West / East split (%)	% Arrivals	% Departures
February 2011	2634	0/291	70/30	76.7	23.3
March 2011	3511	6/253	35/65	60.6	39.4
April 2011	3042	0/280	43/57	62.2	37.8
May 2011	6771	45/343	79/21	89.2	10.8
June 2011	7107	65/313	75/25	87.0	13.0
July 2011	5302	0/383	65/35	98.3	1.7
August 2011	6487	11/344	81/19	88.5	11.5
September 2011	7954	72/404	82/18	90.1	9.9
October 2011	6186	21/358	73/27	87.3	12.7

November 2011	3308	16/209	45/55	69.4	30.6
December 2011	6018	42/251	99/1	94.7	5.3
January 2012	4386	31/271	74/26	84.8	15.2

The number of aircraft noise events varies, hour by hour, throughout each day. Figure 4 shows this variation. It can be seen that, on average over the twelve month period the highest numbers of aircraft noise events per hour recorded at the site occur between 08.00 and 09.00 hours in the morning and between 19.00 and 20.00 hours in the evening (local time) when there are, on average, 11 events per hour.

3.2 Maximum noise levels and durations of aircraft noise levels

The maximum noise level produced by each aircraft over-flight ranged between 55 dBA and 85 dBA, but more than 75% of all the values lay between 60 dBA and 70 dBA with over 90% of values below 69 dBA, and 99% below 72dBA. The statistical distribution of these maximum noise levels is shown in Figure 5 which shows the spread of the values, and a difference in the peak of the distributions of 5 or 6 dB between arrivals and departures.

The average maximum noise level each month is shown in Figure 6 for both arrival and departure events for both daytime and night-time. It can be seen (i) that there is little significant variation from month to month, (ii) maximum noise levels of arrival events are on average between 3 and 4 dB higher than those from departures (iii) that for the same type of movement, whether arrival or departure, there are difference of 1 or 2 dB between daytime and night-time values.

The overall average of all of these values over the 12 month period was 64 dBA for arrival events and 60 dBA for departures, and 63 dBA overall.

The average duration of these aircraft noise events (i.e. the time for which the threshold value of 55 dBA was exceeded) was 35 seconds, and the average level of aircraft noise during the events (i.e. the L_{Aeq} value) was 60 dBA.

3.3 The total noise climate at the site

Figure 7 shows the month by month average daytime noise levels of aircraft noise. This is the notional level of aircraft noise which would occur if all the intermittent bursts of aircraft noise were averaged to give a continuous steady level of noise. Although this average noise level bears little relationship to the aircraft noise as heard, which occurs in short bursts of noise at higher levels rather than as a lower continuous average level, it is, nevertheless, a useful parameter for comparative purposes and is the internationally accepted method for measuring and comparing environmental noise.

Also shown in Figure 7 are the average monthly levels of residual noise and total noise at the site, and the average values of maximum noise levels of aircraft noise events, and of background noise (L_{AS90} values). Figure 8 shows similar data for night-time.

It can be seen that the average monthly levels of aircraft noise and of residual noise are both about 50 dBA in the daytime and both about 45 dBA at night-time, with some (about 2 dBA) month to month variation. In other words, at this location, the noise from aircraft and from all other noise sources make an approximately equal contribution to the total noise experienced at the site. The total noise level, which is the combination of aircraft noise and residual noise levels, is generally about 3 dB higher than that of the aircraft noise and the residual noise, i.e. on average about 53 dBA in the daytime and 48 dBA at night.

It can also be seen from Figures 7 and 8 that although average maximum aircraft noise levels are similar in daytime and at night, the values of the other noise level parameters (total noise level, aircraft noise levels and background noise level (L_{AS90})) are all significantly higher in the daytime than at night. There is not much month to month variation.

Therefore it can be seen that the noise from aircraft noise events, when cumulatively averaged over an extended period of time (of hours, days or months) makes a significant but not a dominant contribution to the average level of total noise at the site, with noise from all other sources, i.e. the residual noise, making a similar contribution. However each individual aircraft noise event, whenever it occurs, is likely to be clearly audible and distinguishable from the residual noise because, in addition to being different in character, it results in a noticeable increase in the level of noise over the ambient noise level during each event.

Figure 9 shows the variation of average levels of aircraft noise, residual noise, background noise and total noise at the site with hour of day. It can be seen that the noise levels do not vary much during the daytime period (06.00 to 20.00 hours) but then fall during the late evening and night-time, rising again in the early morning. The average levels over the 12 month period for various parts of the 24 hour day are shown below (Table 2):

Table 2 showing average noise levels over the 12 month monitoring period.

	Total noise $L_{Aeq,T}$	Aircraft noise $L_{Aeq,T}$	Residual noise $L_{Aeq,T}$	Background noise level (L_{AS90})
Day (16h) (07.00 - 23.00 h)	53 dBA	51 dBA	50 dBA	39 dBA
Night (8h) (23.00 - 07.00 h)	49 dBA	46 dBA	46 dBA	28 dBA
Day (12 h)* (07.00 - 19.00 h)	54 dBA	51 dBA	51 dBA	40 dBA
Evening (4 h)* (19.00 - 23.00 h)	52 dBA	50 dBA	48 dBA	33 dBA
24 hours	52 dBA	49 dBA	49 dBA	35 dBA

* The 12 hour day and 4 hour evening periods have been defined as part of the day evening night noise index, L_{den}, used for noise mapping purposes (and described later in this report).

Day evening night level (L_{den})

It is possible to use the hourly aircraft L_{Aeq} values to calculate average (L_{Aeq}) values for the daytime (07.00 to 19.00), evening (19.00 to 23.00) and night-time (23.00 to 07.00) periods used in the determination of the 24 hour L_{den} (the day evening night level) noise index used by Defra for noise mapping purposes. The values of L_{den} calculated for the 12 month period using the values in Table 2 above are: Total Noise: 57 dBA, Aircraft Noise: 54 dBA, Residual Noise: 54 dBA.

4.0 Putting the noise climate at the site into a wider UK context

4.1 Aircraft noise contours

The site at Hever lies well outside (approximately 7 nm or 13 km beyond) the lowest contour (57 dBA L_{Aeq16h}) of the latest (2010) set of aircraft noise contours for Gatwick airport published by the Civil Aviation Authority on behalf of the Department of Transport. This is consistent with the 3 month average $L_{Aeq16hour}$ value of 51 dBA for this site, as shown in the Table above, although strictly speaking the values obtained from this 3 month survey are not directly comparable with the noise contours because the two sets of values are based on averages over different time periods, and, probably, different modal splits and different mixes of aircraft types.

The 57 dBA contour is the lowest contour to be published because in the view of the UK government it denotes the approximate onset of significant daytime community annoyance. The relationship between noise and annoyance is of course not an exact one, and varies according to situation and locations.

In 2006 aircraft noise contours of day evening night level (L_{den}) were published for Gatwick airport. As for the daytime L_{Aeq} contours the site at Hever lay well outside the lowest contour of 55 dB L_{den}. As stated earlier an L_{den} value for this site over the twelve month survey period has been estimated from the values in Table 2; the L_{den} value for aircraft noise is 54 dBA.

4.2 The National Noise Incidence Study

National Noise Incidence studies of noise levels in England and Wales were carried out in 1990 and again in 2000 by the Building Research Establishment for Defra. A comparison of the data from the first two studies indicated that although there were some changes, much about the noise climate in England and Wales had not changed significantly over the 10 year period. Therefore the 2000 study remains a good basis for setting the noise levels from this study at Hever into a wider context. The results of the 2000 study, published in 2001, gave a breakdown of the proportion of UK residents exposed to noise, as follows (Table 3):

Table 3 showing proportions of population in various noise ($L_{Aeq,16h}$) exposure bands.

Proportion of the population of England and Wales living in dwellings exposed to daytime noise levels ($L_{Aeq, 16 hour}$) in 5 dB bands, in the 2000 National Noise Incidence Study	
5 dB noise exposure level bands*	Proportion in band
Less than 50 dBA	30%
50 dBA < L < 55 dBA	37%

55 dBA < L < 60 dBA	18%
Greater than 60 dBA	15%

*The noise level exposure bands in the above Table are for 'free field ' noise levels, i.e. noise levels unaffected by sound reflections from nearby surfaces. All the noise levels from the NMT at Hever are also free field values.

Since the 16 hour L_{Aeq} value for total noise for this site is 53 dBA this puts the site in the 50 to 55 dBA noise exposure band, occupied by 37 % of dwellings in the UK. In the absence of aircraft noise the noise level at the site would be 50 dBA, i.e. the residual noise level (from the Table 2 in section 3.3) which would put the site on the borderline of the lower, i.e. quieter, category (less than 50 dBA).

Lden noise exposure bands

The National Noise Incidence study also gave a similar breakdown for the L_{den} index, as shown below (Table 4):

Table 4 showing proportions of population in various (Lden) noise exposure bands.

Proportion of UK population living in dwellings exposed to noise levels in 5 dB bands, according to the L_{den} noise index, in the National Noise Incidence Study 2002	
5 dB noise exposure level bands**	Proportion in band
Less than 55 dBA	33%
55 dBA < L < 60 dBA	38%
60 dBA < L < 65 dBA	16%
Greater than 65 dBA	13%

**The noise level exposure bands in the above Table are for noise levels measured at 1m from a building facade, and so will include a contribution (assumed to be 3 dBA) from sound reflected from the facade of the building. All the noise levels from the NMT are free field values and therefore 3 dB must be added for them to be comparable with the exposure bands in the above Table.

Since the L_{den} value for the total noise at this site has been estimated as 57 dBA the addition of 3dB (i.e. a facade level of 60 dBA) would, on the basis of this estimate put the site on the borderline of two noise exposure bands (55 to 60 dBA and 60 to 65 dBA). In the absence of aircraft noise the residual noise level measured at the site would be 54 dBA, (i.e. a facade level of 57 dBA) which would put the site in the lower, i.e. quieter, of these two categories (55 to 60 dBA).

4.3 World Health Organisation and PPG 24 Guidance on Community Noise

In 2000 the World Health Organisation issued 'Guidelines for Community Noise', which are reflected in the UK Planning Policy Guidance Note 24 (Annex 2, paragraph 4): that "general daytime outdoor noise levels of less than 55 dBA are desirable to prevent significant community annoyance" and that "at night, sound pressure levels at the outside façades of living spaces should not exceed 45 dB (L_{Aeq}) so that people may sleep with bedroom windows open."

On 27th March 2012 the National Planning Policy Framework replaced all previous planning guidance including PPG24. However Local Authorities which have an adopted Core Strategy, which refers to PPG24, have 12 months to incorporate guidance on transport noise into their Core Strategy and during those 12 months it is generally considered that PPG24 can still be relied upon as the main guidance for transport related noise issues.

The National Noise Incidence Study 2000 has estimated that 55% of the population of England and Wales live in dwellings exposed to day-time noise levels above the WHO level of 55 dB $L_{Aeq,16h}$, and that 68% are exposed to night-time levels above the WHO level of 45 $L_{Aeq,8h}$.

The daytime total noise exposure level at this site (53 dB $L_{Aeq,16hour}$) is below the WHO Guidelines of 55 dBA for the daytime, but the night-time noise exposure level (49 dB $L_{Aeq,8hour}$) is above the night-time WHO Guideline value of 45 dBA.

5.0 Aircraft types contributing to the aircraft noise level at the site

5.1 One hundred and three different aircraft types contributed to the total number of 62000 aircraft noise events which occurred during the 12 month period, but most of the events arose from a relatively small number of aircraft types, with three types being responsible for more than 50 % of all aircraft noise events at the site:

- Airbus A319: 31%
- Airbus A320: 14%
- Boeing 737 - 400: 14%

5.2 Table 5 below lists the 20 aircraft types responsible for 95 % of all of the aircraft noise events which occurred during the year, showing the number of events, the average L_{ASmax} value, the % number and the cumulative % number of events for each aircraft type, presented in order, with the most frequent type at the top of the list.

Table 5 List of 20 most frequent aircraft types

	A/C Type	No. of events	Avg Lmax	% Nos	Cum. %
1	Airbus A319	19030	64.4	31.2	31.2
2	Airbus A320	8501	64.5	14.0	45.2
3	Boeing 737-400	8406	63.2	13.8	59.0
4	Boeing 737-800 (winglets)	4763	62.4	7.8	66.8
5	Boeing 757-200	2390	60.6	3.9	70.7
6	Embraer 195	2192	62.3	3.6	74.3
7	De Havilland DHC-8-400 Dash 8Q	1960	59.5	3.2	77.6
8	Airbus A321	1707	63.8	2.8	80.4
9	Boeing 777-200	1356	62.4	2.2	82.6
10	Boeing 737-300	1055	63.6	1.7	84.3
11	Boeing 757-200 winglets	1004	60.3	1.6	86.0
12	Airbus A330-200	978	65.6	1.6	87.6
13	Boeing 737-400	873	67.0	1.4	89.0

14	Boeing 767-300 winglets	667	63.5	1.1	90.1
15	Boeing 777-300 ER	567	62.8	0.9	91.0
16	ATR-72	562	61.4	0.9	92.0
17	Boeing 737-300 winglets	546	63.5	0.9	92.9
18	Airbus A300-600 pax	531	66.3	0.9	93.7
19	Boeing 737-700 (winglets)	517	62.0	0.8	94.6
20	Boeing 737-800	448	62.8	0.7	95.3

Table 6 below shows the aircraft types which produce the highest average L_{ASmax} noise levels, above 65 dBA. It can be seen that for most of these the number of aircraft noise events is very small.

Table 6 List of noisiest (highest average LAsmax value) aircraft types

A/C Type	No events	Avg Lmax
Boeing (McDonnell Douglas) MD11	2	74.2
Douglas DC-10-30/40 pax	2	71.9
Miscellaneous twin prop (Piaggio P180Avanti)	1	69.7
GS3	2	69.6
Boeing 747-400 Combi	3	69.3
Boeing (McDonnell Douglas) MD11 Freighter	1	69.0
Ilyushin IL96 pax	21	68.0
Airbus A300 Freighter	1	67.7
Airbus A340-200	1	67.5
Boeing 747-400	873	67.0
Boeing (McDonnell Douglas) MD82	21	66.9
Boeing (McDonnell Douglas) MD83	27	66.7
Airbus A310-300 Freighter	9	66.6
Airbus A300-600 pax	531	66.3
Lockheed Hercules	4	66.1
Airbus A310-300 pax	56	65.8
Airbus A330-200	978	65.6
343	110	65.3
73E	14	65.0
318	8	65.0

5.4 From these two tables it can be seen that the average maximum noise level (L_{ASmax}) of aircraft noise events did not vary significantly with aircraft type for the relatively few aircraft types which make up most of the aircraft noise events, and that although there are some aircraft types which produce significantly higher values of L_{ASmax} there are only very small numbers of these types of events.

6.0 Summary and Conclusions

This report presents the results of 12 months of noise monitoring at a site in Hever, Kent from February 2011 to January 2012.

The following aspects of the noise data have been presented and described: the number of aircraft noise events recorded by the noise monitor; the maximum noise levels of these aircraft noise events; the noise climate at the site, including average levels of aircraft noise, residual noise and total noise at the site.

The results show that the aircraft noise at the site arises mainly from aircraft arriving from the east. There has been relatively little month to month variation in noise levels during this noise monitoring.survey, which covers a full cycle of seasonal variations.

The noise climate at the site has been placed into context by comparisons with published aircraft noise contours, with the results of the 2000 National Noise Incidence Study, and with World Health Organisation Guidelines for Community Noise.

A summary of the main noise related parameters (12 monthly average) for the site at HEVER are shown in the Table 7 below:

Table 7 Summary of noise related parameters

Survey period	1 February 2011 to 31 January 2012
Aircraft noise event trigger level	55 dBA for 10 seconds
Number of aircraft noise events	62000
% of events due to Arrivals and Departures	84% Arrivals; 16% Departures
% events by day and night	86% Day; 14% Night
Average maximum noise level of events	60 dBA Departures, 64 dBA Arrivals; 63 dBA overall
Average noise level and duration of aircraft noise events	Average level 60 dB Average duration 35 s
Average total noise level	53 dBA Day (16h); 49 dBA Night
Average aircraft noise level	51 dBA Day (16h); 46 dBA Night
Average residual noise level	50 dBA Day (16h); 46 dBA Night
Daytime level (12 hours)	Total noise 54 dBA, aircraft noise 51 dBA
Evening level (4 hours)	Total noise 52 dBA, aircraft noise 50 dBA
Day-evening night level	Total noise: 57 dBA, Aircraft noise: 54 dBA, Residual noise 54 dBA
Background noise (L_{AS90})	39 dBA Day (16h); 28 dBA Night

Aircraft types responsible for the majority of aircraft noise events:	Airbus A319: 31 % Airbus A320: 14 % Boeing 737-400: 14 % (103 aircraft types in total)

Figure 1: Flight paths for a typical day of departures to the West (Arrivals are shown in Red and Departures in Green). The blue dot shows the location of the noise monitor at Hever.

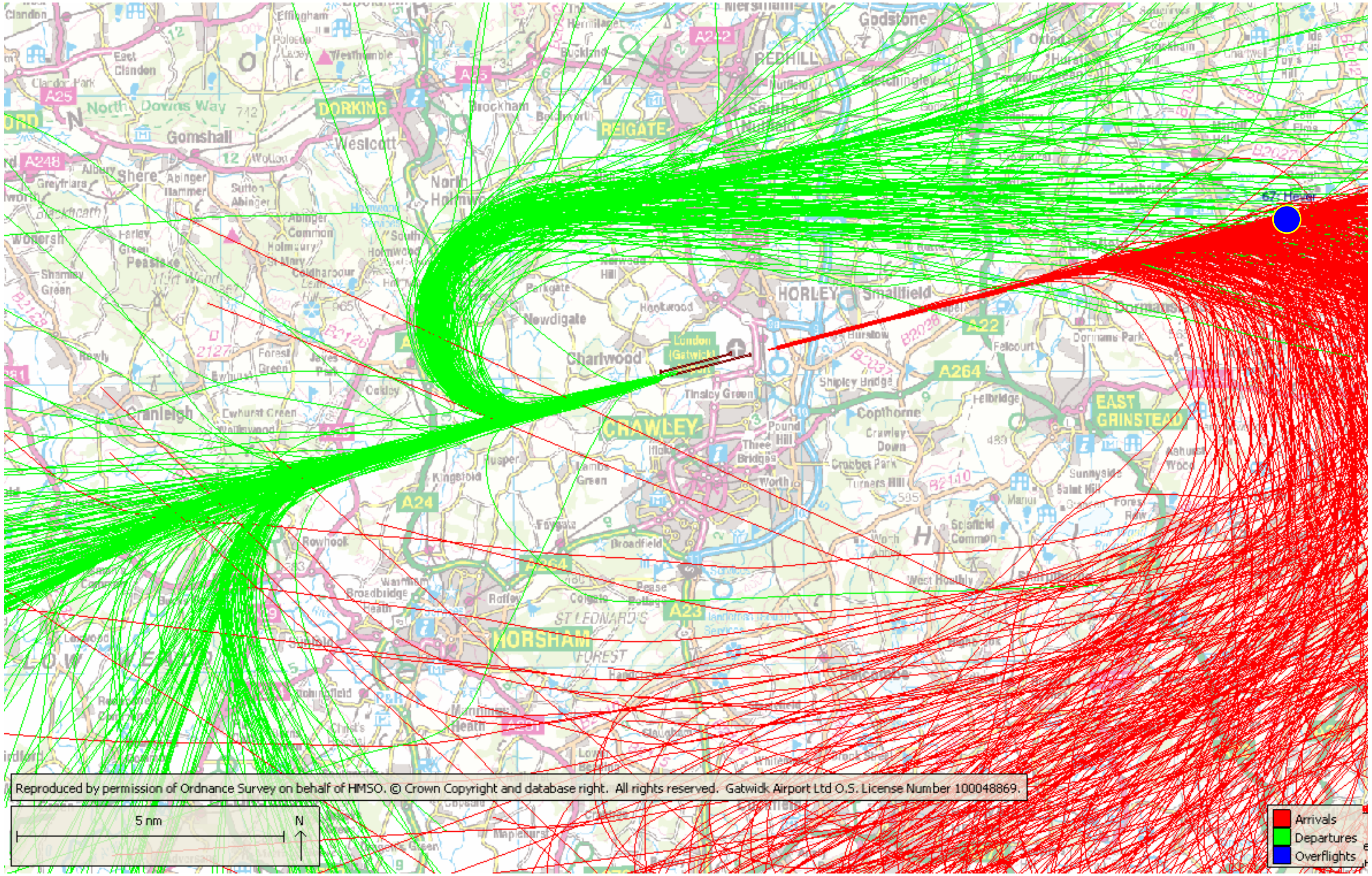


Figure 2: Flight paths for a typical day of departures to the East (Arrivals are shown in Red and Departures in Green). The blue dot shows the location of the noise monitor at Hever.

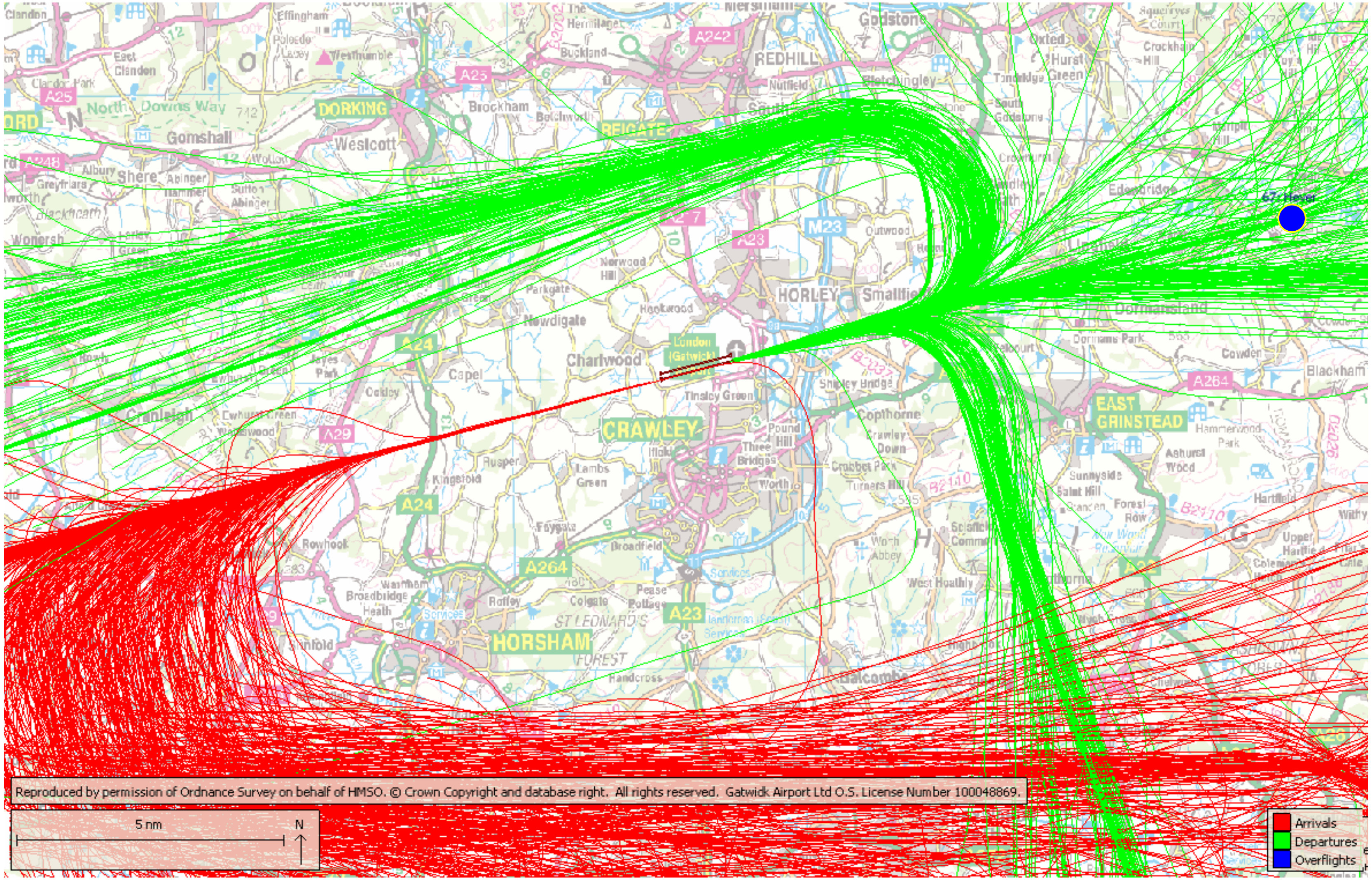


Figure 3 Average Numbers of Aircraft Noise Events per day recorded at Hever each month from February 2011 to January 2012

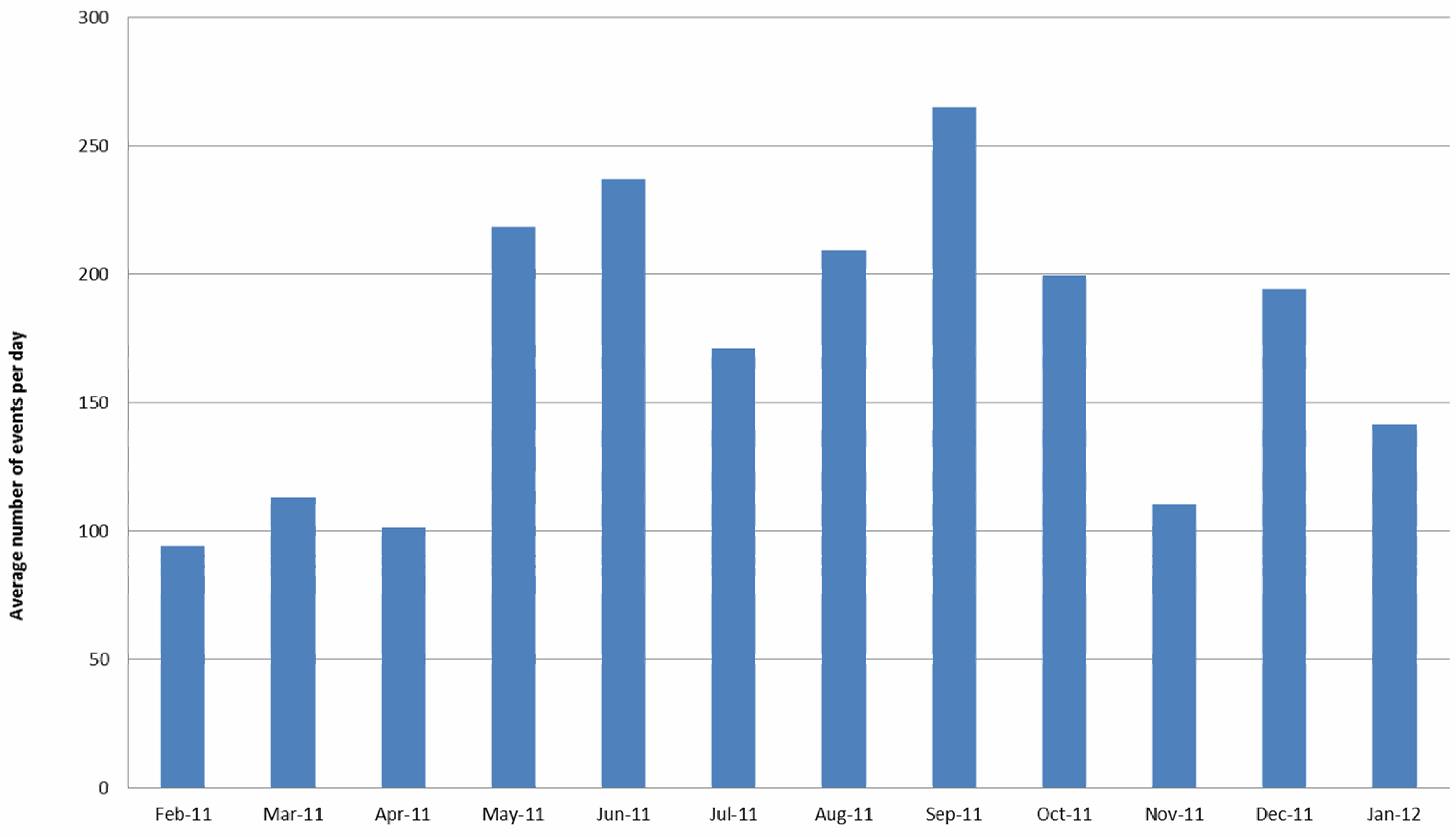


Figure 4: Average numbers of Aircraft Events events per hour recorded at Hever from February 2011 to January 2012

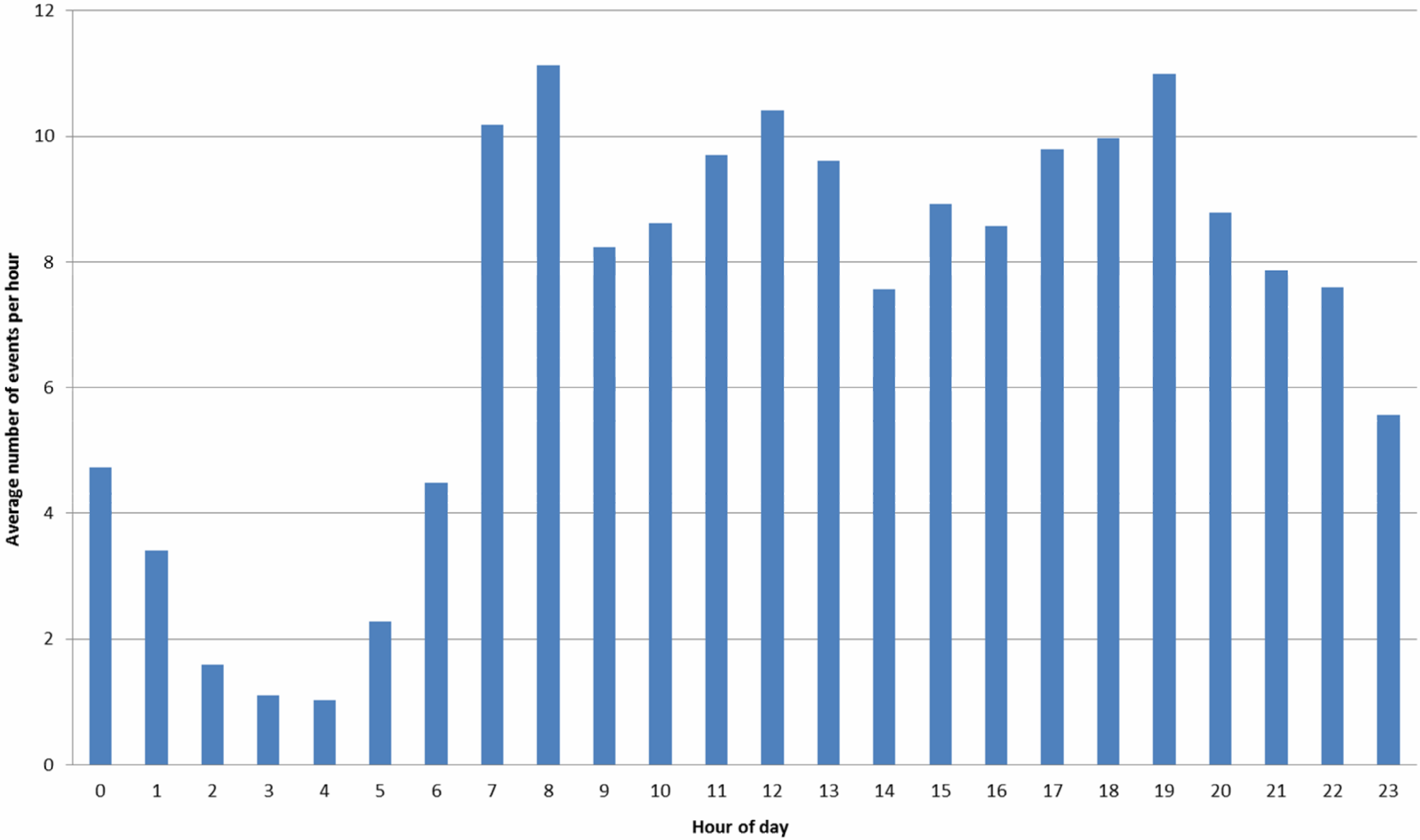


Figure 5: Statistical distribution of maximum noise levels of aircraft noise events at Hever from February 2011 to January 2012

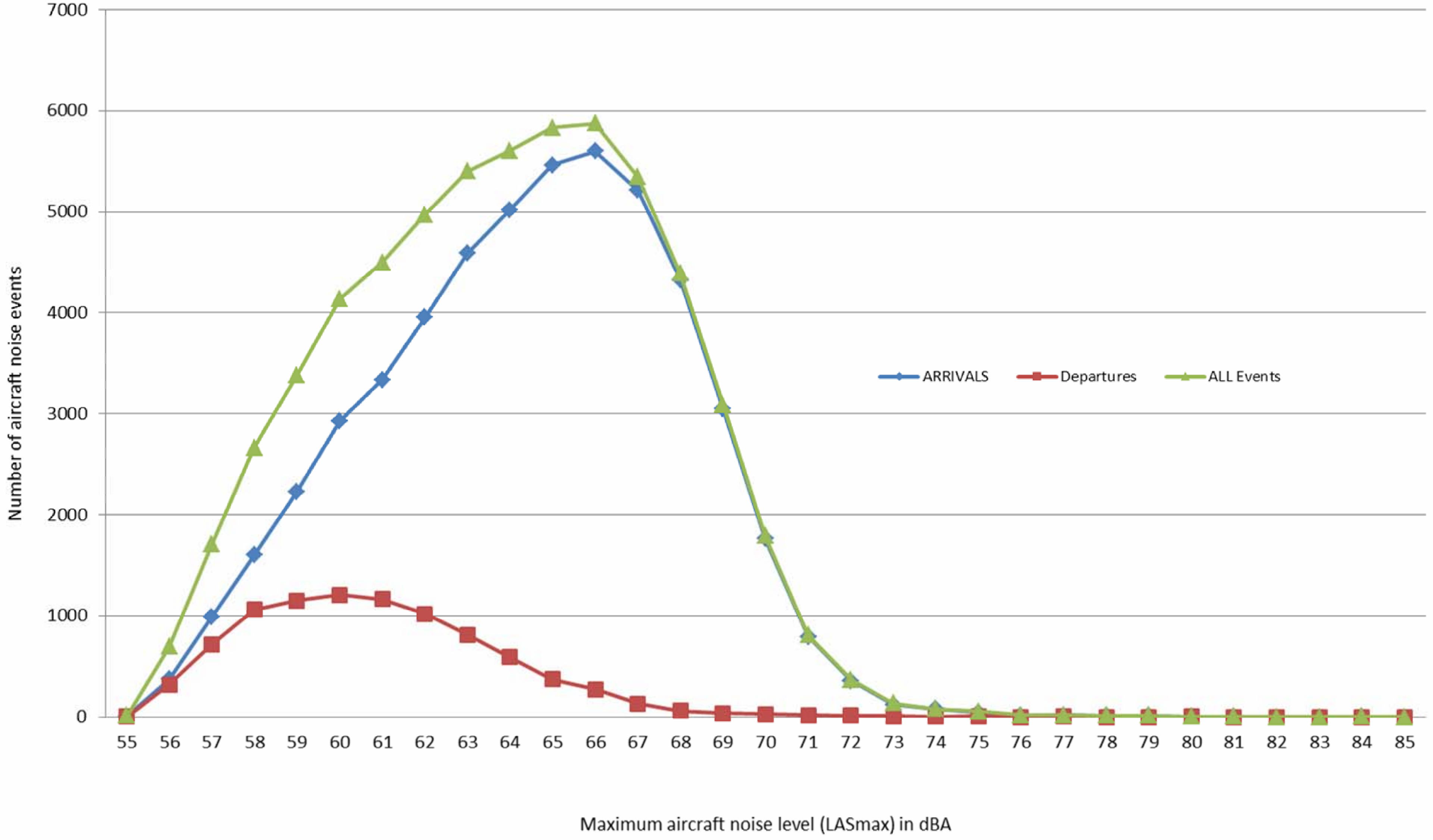


Figure 6: Averages of Maximum noise levels of aircraft noise events at HEVER, February 2011 to January 2012

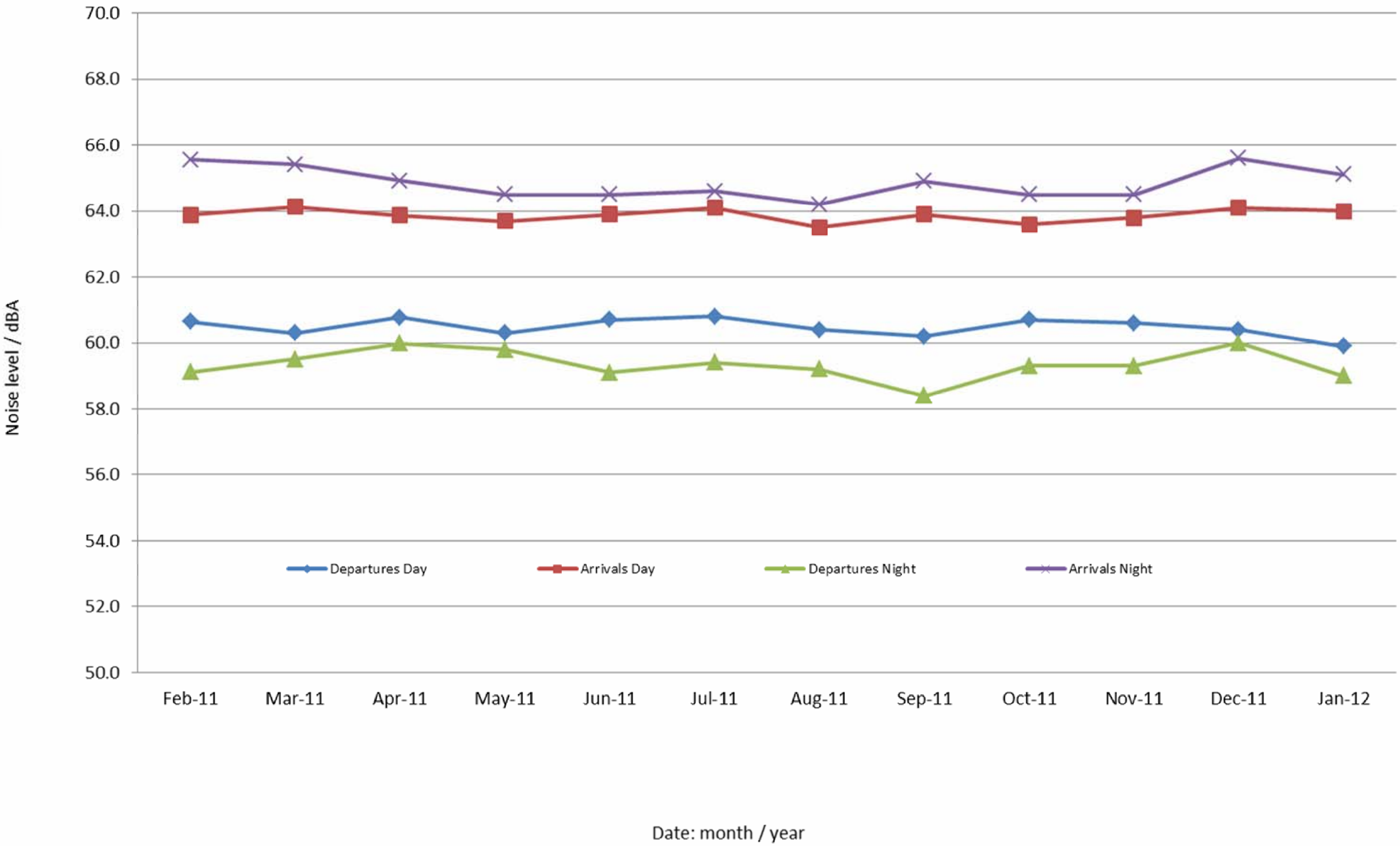


Figure 7: Monthly average daytime (16 hour) noise climate levels at Hever, February 2011 to January 2012

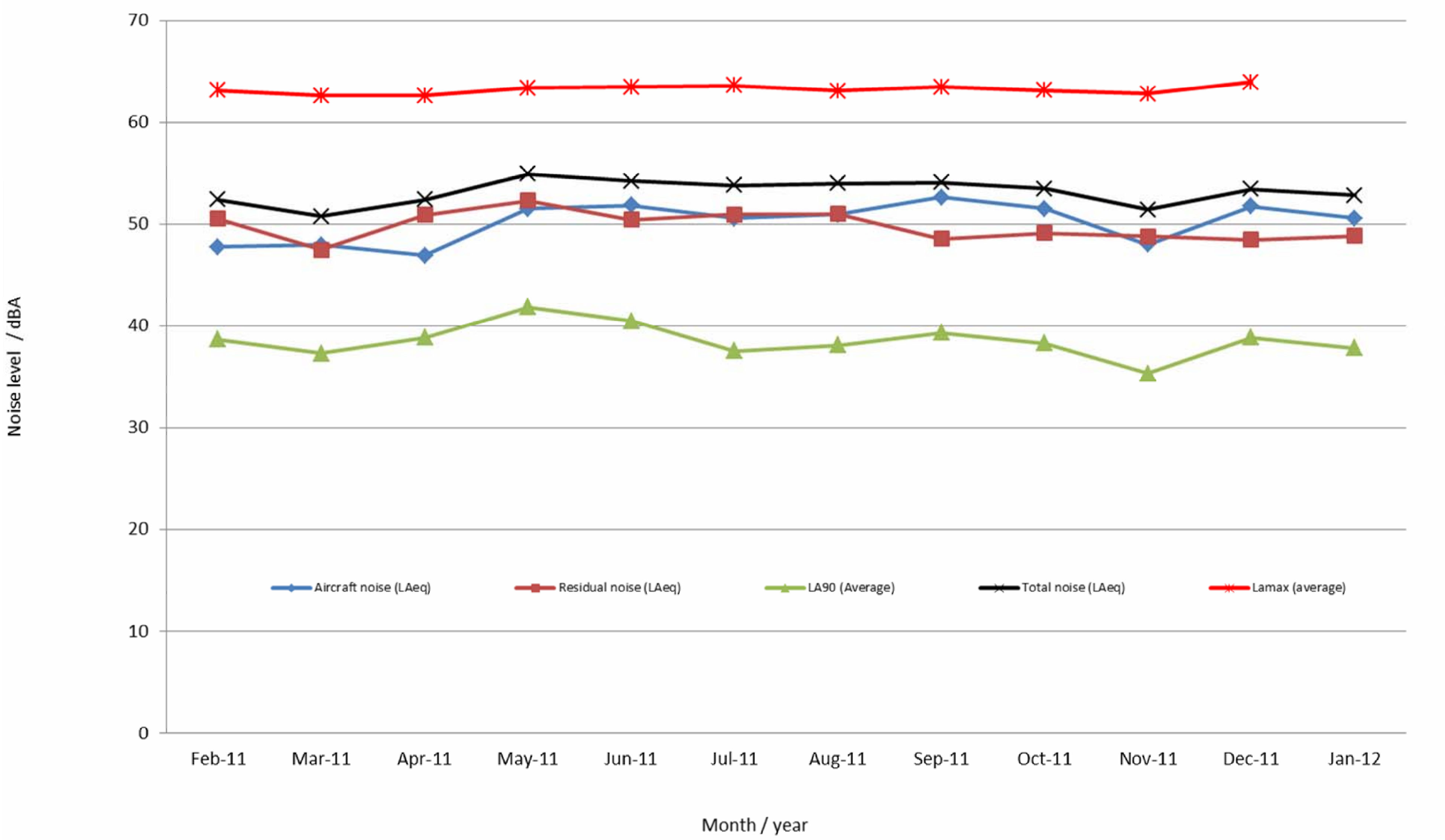
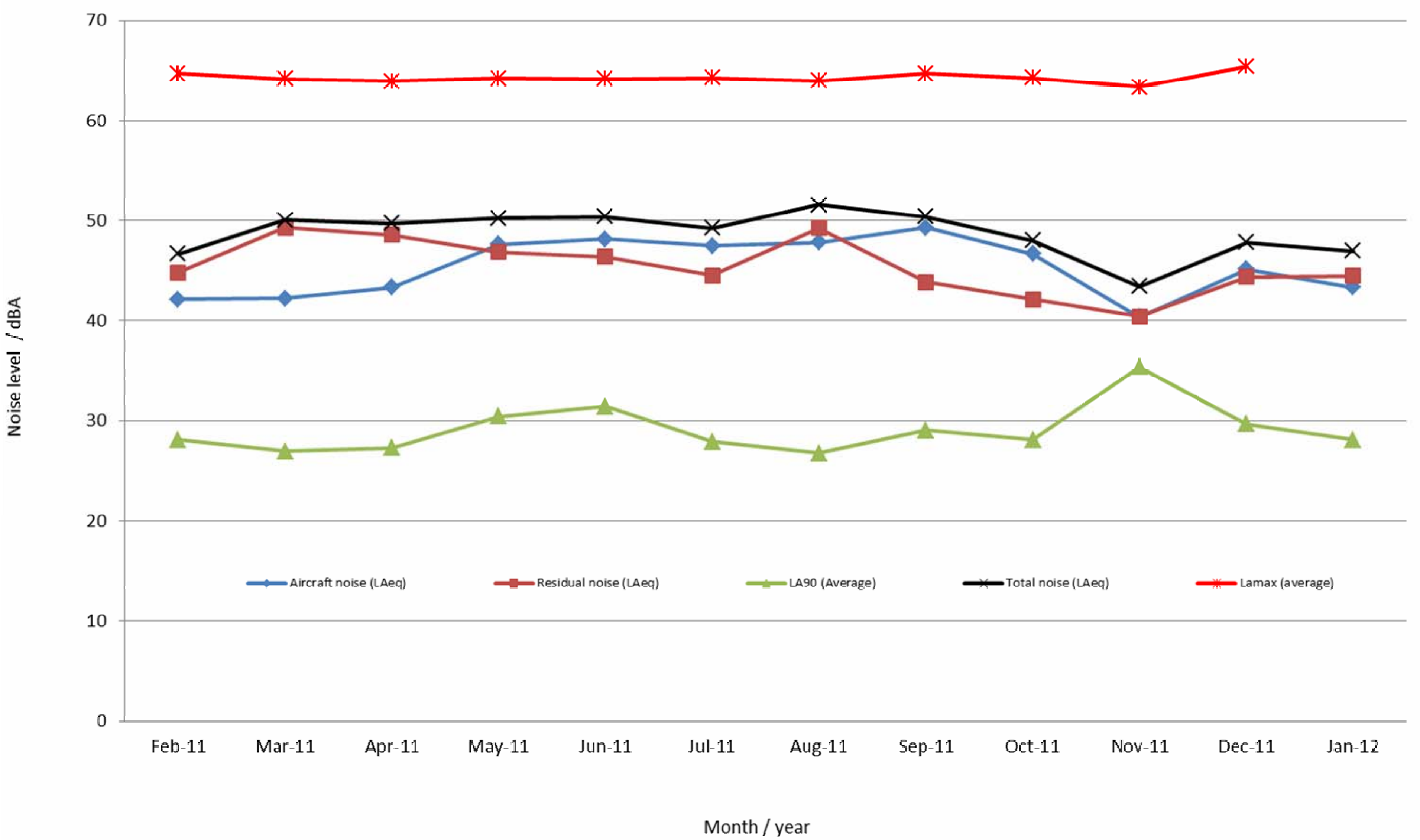


Figure 8: Monthly average night-time (8 hour) noise climate levels at Hever, February 2011 to January 2012



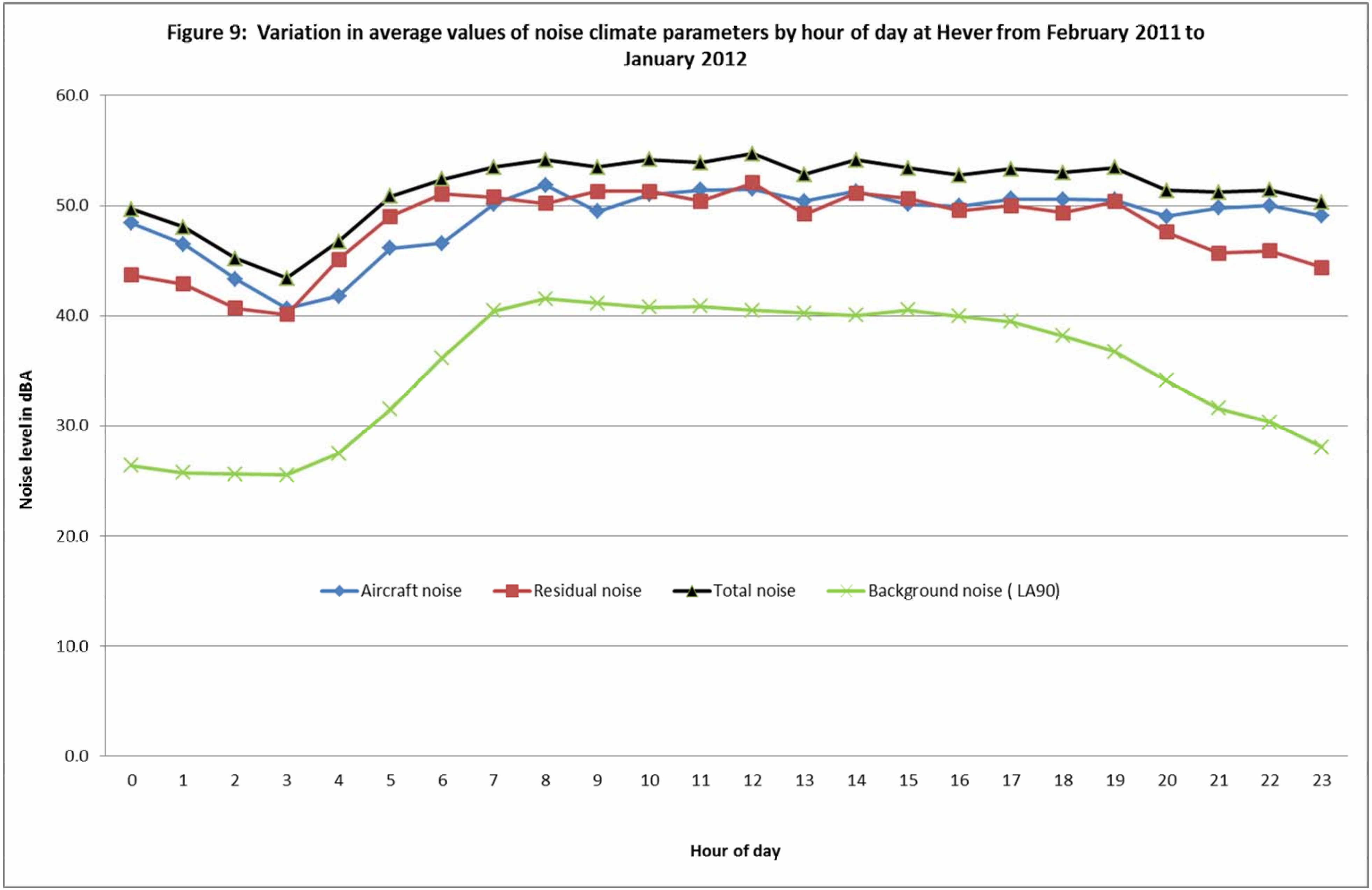


Figure 9: Variation in average values of noise climate parameters by hour of day at Hever from February 2011 to January 2012
60.0
50.0
40.0
30.0
20.0
10.0
0.0
Noise level in dBA
Aircraft noise
Residual noise
Total noise
Background noise (LA90)
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Hour of day

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APPENDIX 1

DATA FROM THE NOISE MONITORING TERMINAL

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Appendix 1

Data from the Noise Monitoring Terminal

The NMT always records all noise from all sources. It has, however, the facility to capture and show separately all noise events that meet particular pre-set conditions. This facility is used to capture noise events likely to arise from aircraft flying near to the monitor. The pre-set condition used for this study is that the noise must exceed a level of 55 dBA for a minimum duration of 10 seconds. This is arrived at following preliminary noise measurements at the site, and is broadly similar to conditions set for other such studies. It is of course likely that noise arising from activities other than aircraft using Gatwick Airport will occasionally cause noise events to be captured.

To determine which of all those events are due to aircraft using Gatwick Airport their ANOMS (Aircraft Noise Management System) 'noise to track' matching software compares all captured noise events with all Gatwick Airport's air traffic radar tracks. Noise events that are matched to aircraft are combined to provide a measure of 'aircraft noise' and noise events that are not matched to aircraft are included with 'all other noise' (i.e. that noise which is not captured as noise events, because it fails to meet the capture conditions of being above 55 dBA for 10 seconds), and is called residual noise.

Therefore wherever reference is made to aircraft noise events within this document it should be understood that these relate only to aircraft using Gatwick airport. Any noise arising from aircraft travelling to or from any other airport will be included as residual noise.

The selection of the threshold conditions (noise level and time period) which trigger the capture of a noise event is a compromise judgement designed to include as much of the noise from passing aircraft as possible whilst at the same time excluding, as far as possible, noise from other sources. For this survey a threshold trigger level 55 dBA for a duration of at least 10 seconds was used.

The following information is recorded for each noise event: date, time, duration, maximum noise level (L_{ASmax}) and SEL values, and, in addition, for aircraft noise events, event type (arrival/ departure), departure route, runway used, and aircraft type.

In addition to gathering data about noise events the NMT also collects and stores information on an hourly basis about the total level of noise at the site from all sources (including that from aircraft movements), including individual noise events.

Because the noise level is usually not constant, but varies continuously throughout each hour it is necessary to describe the total noise level statistically in terms of a measure of the average noise level throughout the hour (and called the hourly continuous equivalent noise level, L_{Aeq}) and also in terms of a series of hourly percentile levels. The most important of these is the L_{AS90}, which is the noise level exceeded for 90% of each hour. This level of noise is conventionally taken to be a measure of the background noise level for each hour, and is the more or less constant level of noise which underlies the variations caused by various transient sources including aircraft.

By using the Single Event Noise Level (SEL) for each aircraft noise event it is possible to calculate the average, or equivalent aircraft noise level (L_{Aeq}) due to aircraft noise events over a period of time (hour, day or month). Although this average noise level bears little relationship to the aircraft noise as heard, which occurs in short bursts of noise at higher levels rather than as a lower continuous average level, it is, nevertheless, a useful parameter for comparative purposes.

Since the NMT also records hourly L_{Aeq} values of the total noise from the site it is possible, by subtracting the aircraft noise level from the total noise level (using the decibel (or logarithmic) subtraction process which is appropriate in this case) to calculate the remaining component of the total noise, i.e. the residual noise level.

The residual noise is a combination of the noise from residual noise events (i.e. those captured noise events which did not match with aircraft movements) and from other residual noise, not captured as noise events, i.e. all other noise recorded by the monitor that did not exceed the trigger level for the required minimum time period.

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APPENDIX 2

GLOSSARY OF ACOUSTIC TERMS

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GLOSSARY OF TERMS

This glossary is presented in two parts. The first part contains definitions relating specifically to the context of this report, followed, in the second part, by a more general glossary of acoustic terms.

Definitions relating specifically to the context of this Report:

Aircraft noise contours

Two types of aircraft noise contours have been produced; those based on the average daytime aircraft noise levels ($L_{Aeq16hour}$), and those based on the L_{den} parameter, introduced for noise mapping purposes

$L_{Aeq16hour}$ aircraft noise contours have been produced annually and displayed on the Defra website for many years (approximately since 1990, when they replaced NNI contours) for various UK airports, including Heathrow, Gatwick and Edinburgh. The latest contours which are available are for the year 2010.

L_{den} contours

The 24 hour day-evening-night noise index (L_{den}) has been introduced by the EU for noise mapping purposes. This index is based on average levels of aircraft noise (L_{Aeq} values) throughout the day but with a weighting penalty of 5 dB applied to noise in the evening (19.00 hours to 23.00 hours) and a 10 dB penalty at night-time (23.00 hours to 07.00 hours).

All UK airports have been required to produce Action Plans based on Lden aircraft noise contours as part of the Noise mapping exercise. Accordingly contours of L_{den} were produced for the year 2006 (ERCD Report 0708) to meet the requirements of the first round noise mapping exercise Under EU Directive 2002/49/EC. L_{night} ($L_{Aeq,8hour}$), L_{day} and $L_{evening}$ contours were also produced as part of this exercise.

The $L_{Aeq16hour}$ contours are based on the average summer day, where 'summer' is the 92-day period from 16 June to 15 September, and 'day' is the 16-hour period 0700-2300 (local time). They are produced in 3 dB steps from 57 dBA to 72 dBA. The 2006 L_{den} contours were produced in 5 dB steps with the lowest (outermost contour) being for L_{den} of 55 dBA and were based on data for an average day over the whole year (2006).

Aircraft Noise events — Noise events which have been matched by the ANOMS noise and track keeping system to radar tracks in the vicinity of the NMT from aircraft arriving at or departing from Gatwick airport.

Aircraft noise level — The average noise level derived from aircraft noise events, aggregated into hourly, daily or monthly average (LAeq) values.

ANOMS — Airport Noise and Operations Monitoring System.

The software data analysis system currently in use at the airport (incorporating the NTK system).

Applied Acoustic Design (AAD)

Acoustic consultants retained by Gatwick Airport Ltd.

Average L_{ASmax} level — The arithmetic average of the L_{ASmax} values of all the events (of a particular type i.e. either aircraft noise or community noise) which occur over a particular period of time (eg hour, day or month).

Building Research Establishment

A former government organisation, now privately owned, which conducts research on noise. Carried out the National Noise Incidence Study for Defra in 2000.

Defra — UK government Department for Environment Food and Rural Affairs, which has responsibility for aspects of policy relating to environmental noise

Flight Performance Team

The unit within Gatwick Airport which monitors all aircraft movements to ensure compliance with Department for Transport noise regulations relating to track keeping, noise abatement and night flights, and which also provides a means of investigating and responding to complaints and enquiries from the public.

Instrument Landing System (ILS)

An instrument landing system (ILS) is a ground-based instrument approach system that provides precision guidance to an aircraft approaching and landing on a runway, using a combination of radio signals and, in many cases, high-intensity lighting arrays to enable a safe landing during instrument meteorological conditions, such as low ceilings or reduced visibility due to fog, rain, or blowing snow. The standard glide-slope path is 3° downhill to the approach-end of the runway.

National Noise Incidence Study

A study carried out by the Building Research Establishment for Defra based on a survey of noise levels outside 1020 dwellings in England and Wales in 2000, and extended to the whole of the UK in 2001, giving proportions of the population exposed to various levels of environmental noise.

A second National Noise Incidence study was carried out in 2000. A comparison of the data from the two studies indicated that although there were some changes, much about the noise climate in England and Wales had not changed significantly over the 10 year period. Therefore the 2000 study remains a good basis for setting the noise levels from this study at Hever into a wider context.

Noise event

A burst of noise at a high level which satisfies the noise event capture conditions for a particular NMT, i.e. which exceeds the pre-set trigger noise level (in this report 55 dBA) for a pre-set time interval (in this report 10 seconds).

Noise events are detected, captured and stored by the NMT, and following subsequent processing by the NTK system are classified in this report as either aircraft noise events or community noise events

Noise Monitoring Terminal (NMT)

The noise measurement and analysis system installed at each site consisting of a precision grade sound level meter (Larson Davis type 870) inside a weather proof and tamper proof metal cabinet connected to an outdoor microphone located at a height of approximately 3.5 m above ground level.

NTK system Noise and Track Keeping system.

A software system able to match noise events recorded by the NMTs with aircraft tracks.

PPG24 Planning Policy Guidance Note 24:Planning and Noise

A document issued by the UK government Department for the Environment in 1994 which gives guidance to local authorities and others on noise and planning.

On 27th March 2012 the National Planning Policy Framework replaced all previous planning guidance including PPG24. However Local Authorities which have an adopted Core Strategy, which refers to PPG24, have 12 months to incorporate guidance on transport noise into their Core Strategy and during those 12 months it is generally considered that PPG24 can still be relied upon as the main guidance for transport related noise issues.

Residual noise

All noise arriving at the NMT microphone apart from aircraft noise events, i.e. comprising residual noise events and all other noise which does not satisfy the trigger conditions for capture as a noise event.

Residual Noise events

Those noise events which have not been matched by the NTK system to aircraft tracks using Gatwick Airport in the vicinity of the NMT.

Statistical frequency Analysis (of L_{ASmax} noise levels)

An analysis of a group of L_{ASmax} values giving the numbers of events (or percentages of total numbers) at different dBA levels

Total noise — All noise arriving at the NMT microphone, i.e. not only including all noise events (both aircraft and residual) but also all other noise which does not satisfy the trigger conditions for capture as a noise event.

Total noise level — The average or continuous equivalent level (L_{Aeq}) of the total noise at the site, recorded each hour by the NMT, which may also be aggregated into daily or monthly values.

Total noise climate — The level of the total noise at the NMT microphone varies with time. Over a particular period of time e.g. one hour, this variation maybe described in terms of a number of different noise indices including the average or equivalent noise level, maximum and minimum noise level values and various percentile levels.

Such a description constitutes the noise climate at the site over that period of time.

The NMT records the following total noise indices every hour:
L_{Aeq}, L_{ASmax}, L_{AS10}, L_{AS50}, L_{AS90} and L_{AS99}.

World Health Organisation (WHO)

Issued 'Guidelines for Community Noise' in 2000.

A general Glossary of acoustic Terms:

A-weighting — A method of producing a single figure measure of a broad band noise (as opposed to the 8 or 9 figures which make up an octave band spectrum) which takes into account, in an approximate way at least, the frequency response of the human hearing system. The idea is that sound levels measured in this way should give an indication of the loudness of the sound.

A-weighted sound pressure level (dBA).

The value of the sound pressure level, in decibels, measured using an A-weighting electronic circuit built into the sound level meter. The vast majority of noise measurements are carried out in this way.

Day, evening, night level, L_{den}

An index of environmental noise based on average noise levels (L_{Aeq}) throughout the 24 hour period, but with a weighting factor of 5 dBA added to evening noise levels (19.00 to 23.00 hours), and a weighting of 10 dB added to night-time noise levels (23.00 to 07.00 hours). It is the noise index used in the UK Noise mapping exercise commissioned by Defra in response to the European Union Directive on Environmental Noise in 2002.

Decibel scale — The decibel scale is the scale on which sound pressure levels are commonly measured. It is a logarithmic scale and is used for convenience to compress the audible range of sound pressures into a manageable range, from 0 dB to 140 dB. The zero of the scale, 0 dB, corresponds to the notional threshold of hearing, 0.00002 Pa, and the upper limit, 140 dB, corresponds to 20 Pa, which would cause immediate damage to the ear.

Equivalent continuous sound level ($L_{Aeq,T}$), also called the Average noise level.

The $L_{Aeq,T}$ represents a measure of the 'average' sound level over the measurement period. It corresponds to the steady continuous level of sound which, over the same period of time, T, would contain the same amount of (A-weighted) sound energy as the time varying noise.
This is the most common method of measuring time varying noise, and within certain limits gives the best correlation with human response to noise, for example with annoyance.

Frequency

The frequency of a musical note is what gives it its pitch. It is the number of cycles of the fluctuating sound pressure which occur each second, and is measured in cycles per second, Hertz (Hz). The human ear can detect frequencies in the range 20 to 20000 Hz.

Most noises are a mixture of all frequencies, called broad-band noise.

$L_{AS90,T}$

This is the most commonly used of many possible statistical measures of a time varying noise. It is the 90th percentile of the statistical noise level distribution, or, more simply, the noise level that is exceeded for 90% of the measurement time (T). Thus over one hour for example it represents the noise level which is exceeded for all but (the quietest) six minutes of that hour.

It is commonly used as a measure of the background noise in any given situation, against which the level of any new, potentially intrusive source of noise is often compared. Background noise itself often varies with time and so the $L_{A90,T}$ is almost universally used as the best measure of the 'more or less always present' noise level which underlies short term variations from other sources of noise.

Although it is more usual to measure LA90 using the F weighting, the Slow weighting has been used for the data in this report, i.e. LAS90. It is not considered that the use of the S weighting will make any significant difference to the LA90 values in this case. (See under Time Weighting, Fast(F) and Slow(S)) below.

Maximum sound pressure level ($L_{ASmax,T}$)

This is the highest value of the time weighted sound pressure level, (measured using the A frequency weighting and the Slow time weighting) which occurred during the measurement period, T. It is commonly used to measure the effect of very short duration bursts of noise, such as for example sudden bangs, shouts, car horns, emergency sirens etc. which audibly stand out from the general level of, say, traffic noise, but because of their very short duration, maybe only a very small fraction of a second, may not have any effect on the $L_{Aeq,T}$ value.

In the context of this report the L_{ASmax} value for each aircraft noise event and community noise event is monitored

In this report, in line with standard practice for aircraft noise measurement, the Slow (S) time weighting has been used for measurement of maximum levels of aircraft noise, hence reference is made to L_{ASmax}. (See under Time Weighting, Fast(F) and Slow(S)) below.

Noise — Unwanted sound

Octave band spectra — In order to investigate the frequency content of broad band sounds, called its frequency spectrum, measurements of sound pressure are carried out over a range of frequency bands. The most common method is to split the audio frequency range into 8 or 9 octave bands. An octave is a frequency range from one particular frequency to double that frequency.

Octave band measurements are not referred to in this report.

Percentile noise level, (L_{ASN}, where N is a number between 0 and100)

The noise level which is exceeded for N% of the measurement period. For example, a value of $L_{A10,1hour}$ of 57 dBA means that in that hour the noise level was at or above 57 dBA for 6 minutes (i.e.10% of an hour), or alternatively, was at or below 57 dBA for 54 minutes.

Sound exposure level (SEL)

This is a measure of the A-weighted sound energy used to describe single noise events such as the passing of a train or aircraft; it is the A-weighted sound pressure level which, if occurring over a period of one second, would contain the same amount of A-weighted sound energy as the event.

SEL values for events may be used to calculate the average noise level over a period of time (hour, day or month)

Sound pressure — sound is a disturbance or fluctuation in air pressure, and sound pressure, measured in Pascals (Pa), is used as a measure of the magnitude of the sound. The human ear can detect sound pressures in the range from 0.00002 Pa to 20 Pa. This is an enormously wide range and so for convenience sound pressures are commonly measured on a decibel (dB) scale.

Time varying noise — When the level of noise varies with time, as is often the case, for example with noise from road traffic, various measures or noise indices as they are called are used to give a single figure description of the noise over a given period of time. The three most commonly used noise indices are the $L_{Aeq,T}$ the $L_{A90,T}$ and the $L_{Amax,T}$ values.

In all three cases the 'L' stands for the level of the sound in decibels, the 'A' for the fact that it is the A- weighted value, and the 'T' for the time period over which the noise is measured, for example 5min, 1 hour, 24 hour etc.

Time weighting (Fast (F) and Slow (S))

An exponential function of time, of a specified time constant, that weights the square of the instantaneous sound pressure. (Defined in BS EN 61672 – 1:2003).

There are two time constants defined in BS EN 61672 – 1:2003, designated Fast (F) and Slow (S), and noise indices such as the maximum, or percentile noise levels which are based on instantaneous time-weighted sound pressure should indicate which time weighting has been used in the measurement.

In this report, in line with standard practice for aircraft noise measurement, the Slow (S) time weighting has been used for measurement of maximum levels of aircraft noise, hence reference is made to L_{ASmax}. Because the sound level meter cannot measure using both Fast and Slow weightings simultaneously this necessarily means that the 90th percentile values have also been measured using the S weighting, hence reference is made to L_{AS90}. Although it is more usual to measure L_{A90} using the F weighting, it is not considered that the use of the S weighting will make any significant difference to the L_{A90} values in this case.