

**REPORT OF
NOISE MONITORING AT DOMEWOOD
DECEMBER 2012 TO DECEMBER 2013**

Client: Gatwick Airport Limited



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CONTENTS

1.0	Introduction	3
2.0	The data from the Noise Monitoring Terminal	3
3.0	Analysis of Noise Monitoring Survey Results	3
3.1	The numbers of aircraft noise events	3
3.2	Maximum noise levels of aircraft noise events	5
3.3	The Total noise climate at the site	5
4.0	Putting the noise climate at the site into a wider UK context	6
4.1	Aircraft noise contours	6
4.2	The National Noise Incidence Survey	6
4.3	World Health Organisation Guidance on Community Noise	7
5.0	Aircraft types contributing to the aircraft noise level at the site	7
6.0	Summary and Conclusions	9
	Figures 1 – 7	11
	Appendix 1: Data from the Noise monitoring Terminal	
	Appendix 2: Glossary of Acoustic terms	

REPORT OF NOISE MONITORING AT DOMEWOOD, DECEMBER 2012 TO DECEMBER 2013

1.0 Introduction

A mobile Noise Monitoring Terminal (NMT) has been deployed at Domewood in West Sussex by Gatwick Airport Ltd. This report presents a summary of the results of continuous noise monitoring, between 11 December 2012 and 16 December 2013, which covers a complete seasonal cycle of aircraft movements.

The site is approximately 7 km south east of the airport. The NMT is situated at the bottom of a large garden, near to trees, in a private housing estate of detached houses. Apart from noise from aircraft and occasional helicopters other noise arises from wind in the trees, from motorised lawnmowers, chain saws and other garden equipment and activities.

2.0 The noise data from the noise monitoring terminal

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, discussed below, 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.

The monitor trigger condition was originally set to operate with a threshold trigger level of 52 dBA to be exceeded for 10 seconds, but this was increased on 20 February 2013 to 55 dBA for 10 seconds because of the influence of wind noise in the trees near to the monitor.

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 Domewood. It can be seen that although the site is not directly overflowed it is fairly close to flight paths of arriving aircraft for westerly take offs, and to those of departing aircraft during easterlies.

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.

The results of the data gathered during the survey are displayed in Figures 3 to 7 below and are also summarised in the Table in section 6, on page 9.

3.1 The number of aircraft noise events

A total of approximately 43,700 aircraft noise events were recorded at the noise monitor during the monitoring period from 11 December 2012 to 16 December 2013. Examination of these data indicated a significant number of these events had durations much greater than could be expected from an aircraft noise event, particularly for events recorded in December

Noise Climate at Domewood, December 2012 to December 2013

2012 and January 2013. It is considered that the most likely explanation is that these are noise events triggered by noise from wind in the nearby trees which coincide with an aircraft event and which continue long after the aircraft has moved away. It was because of this wind generated noise that the trigger level was increased to from 52 dBA to 55 dBA from 20 February 2013.

It was decided to disregard these 'long duration' events from the data base to be used for subsequent analysis, using a criterion that events with a duration of more than 60 seconds should be removed. On this basis about 5500 of the events were removed, including all of those for December 2012, with most of the remaining deletions being from data from January 2013.

This left a data base of about 38,200 aircraft noise events which are the subject of the analysis presented in this report.

The average number of events per day for each month is shown in Figure 3 on page 12. Most (74%) of the recorded events were due to aircraft departures, 24% were due to arriving aircraft and about 2% were due to overflights.

The Domewood site is closest to the 08SFD departure route (as can be seen from page 11 Figure 2, shown in blue, heading south) and therefore the majority of departure noise events will be produced by aircraft on this route. There will also be a proportion of events captured from departures following other routes, but because these paths are further from the site (about 1.5 miles away) these will be fewer in number. Most of the events (92%) occurred in the daytime period (07.00 to 23.00 hours) and 8% at night-time (23.00 to 07.00 hours).

The variation in the number of events recorded from month to month, as shown in Figure 3, is mainly determined by wind direction, which determines take off direction. The west / east split in runway usage during the period is shown in the Table below:

Month	% westerly	% easterly
December 2012	83	17
January 2013	61	39
February 2013	44	56
March 2013	20	80
April 2013	58	42
May 2013	73	27
June 2013	61	39
July 2013	51	49
August 2013	76	24
September 2013	69	31
October 2013	75	25
November 2013	91	9
December 2013	63	37

The number of aircraft noise events varies, hour by hour, throughout each day. Figure 4 on page 12 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 in the morning between 07.00 and 9.00 hours and between 12.00 and 14.00 hours (local time).

3.2 Maximum noise levels and durations of aircraft noise levels

The maximum noise level, L_{ASmax} , produced by each aircraft noise event ranged between 52 dBA and 85 dBA, with more than 95% of events having a maximum value of less than 67 dBA. The arithmetic average of all of these values over the 12 month period was 61.4 dBA for departures and 58.0 for arrivals, and 60.1 dBA overall, with a standard deviation of 3.8 dBA.

The duration of these aircraft noise events ranged between 10 and 60 seconds, with more than 90% of events having a duration of between 10 and 51 seconds. The average duration for all events was 32 seconds, and the average level of aircraft noise during the events was 57 dBA.

3.3 The total noise climate at the site

During the daytime (as seen from Figure 5 on page 13) the average level of aircraft noise level (L_{Aeq}) varied between 44 to 49 dBA. There was a slightly larger variation in levels of residual noise (47 to 55 dBA) and the average level of the total noise, which is the combination of the aircraft noise and residual noise levels, varied between 49 and 53 dBA).

At night time (Figure 6) there was a larger variation in average aircraft noise levels, between 34 and 45 dBA, and the average residual noise level was between 40 to 47 dBA. The monthly average total noise level varied between 41 to 49 dBA.

The daytime background noise level varied throughout the 12 month period between 41 and 46 dBA in the daytime, and between 35 to 39 dBA at night.

The average of maximum aircraft noise levels was similar during the daytime and at night, within the range 57 dBA to 62 dBA.

Figures 5 and 6 (page 13) show that, as far as average noise levels are concerned the residual noise, from all other sources except aircraft, is equal to or higher than the level of aircraft noise, except for the month of July, when the aircraft noise level is higher.

The noise from aircraft noise events, when cumulatively averaged over an extended period of time (of hours, days or months) therefore makes a significant, but not a dominant contribution to the average level of total noise at the site. 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 7 (page 14) 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 these 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. Also shown in Figure 7 is the average of maximum aircraft noise levels, which does not vary significantly with hour of day.

The average levels (rounded to the nearest dB) over the 12 month period for various parts of the 24 hour day are shown below:

	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)	51	48	48	43
Night (8h) (23.00 - 07.00 h)	47	42	45	37
Day (12 h)* (07.00 - 19.00 h)	51	49	48	44
Evening (4 h)* (19.00 - 23.00 h)	48	43	46	41
24 hours	50	46	47	41

* 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).

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

4.1 Aircraft noise contours

The site at Domewood lies well outside 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 for Transport. This is consistent with the average $L_{Aeq16hour}$ value of 48 dBA for this site, as shown in the table above, although strictly speaking the values obtained from this 12 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 level 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 Domewood lay well outside the lowest contour of 55 dB L_{den} . An L_{den} value for this site over the twelve month survey period may be estimated from the values in the above Table (section 3.3); the L_{den} value for the total noise is 54 dBA and for aircraft noise it is 50 dBA.

4.2 The National Noise Incidence survey

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 Domewood 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:

Proportion of the population of England and Wales living in dwellings exposed to daytime noise levels ($L_{Aeq, 16 \text{ hour}}$) 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 Domewood are also free field values.

Since the 16 hour L_{Aeq} value of total noise for this site is 51 dBA this puts the site in the 50 to 55 dBA noise exposure band, occupied by 37 % of dwellings in the UK.

4.3 World Health Organisation Guidance on Community Noise

In 2000 the World Health Organisation issued 'Guidelines for Community Noise' 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."

The daytime total noise exposure level during the 12 month monitoring period at this site (51 dB $L_{Aeq, 16 \text{ hour}}$) is below the WHO Guidelines of 55 dBA for the daytime, but the night-time total noise exposure level (47 dB $L_{Aeq, 8 \text{ hour}}$) 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 Approximately one hundred and seven different aircraft types contributed to the total number of 38,000 aircraft noise events which occurred during the monitoring period, but most of the noise events arose from a relatively small number of aircraft types, with five types being responsible for more than 85% of all aircraft noise events at the site:

- Airbus A319: 34%
- Airbus A320: 17%
- Boeing 737 - 400: 14%
- Boeing 737 - 800: 11%
- Airbus A330 - 300: 10%

5.2 The Table below lists the 20 aircraft types responsible for more than 99% of all of the aircraft noise events which occurred during the period, showing the number and the % number of noise events and the average L_{ASmax} noise level for each aircraft type, presented in order, with the most frequent type at the top of the list.

List of 20 most frequent aircraft types in order of event numbers:

Aircraft type	Number of events	% number of events	Average LASmax (dBA)
Airbus Industrie A319	14812	34.0	59.1
Airbus Industrie A320	7452	17.1	58.4
Boeing 737-400	5978	13.7	59.7
Boeing 737-800	4679	10.7	60.6
Airbus Industrie A330-300	4263	9.8	60.8
Airbus Industrie A321	1605	3.7	62.0
Boeing 777-200	1416	3.3	57.9
Boeing 757-200	1388	3.2	58.7
Boeing 747-400	998	2.3	60.3
Boeing 777-300	673	1.5	61.4
Airbus Industrie A330-200	631	1.4	59.8
Boeing 767-300	550	1.3	61.2
Embraer 175	547	1.3	59.5
Embraer 190	394	0.9	60.4
De Havilland DHC-8-400	369	0.8	54.0
Airbus Industrie A300-600	255	0.6	62.1
Boeing 737-300	176	0.4	59.7
Boeing 737-700	173	0.4	63.2
ATR 72	171	0.4	54.5
Embraer 195	149	0.3	58.7

The table below shows the same 20 most frequent aircraft types but rearranged in order of decreasing average maximum aircraft noise event level.

Aircraft type	Average LASmax (dBA)	Number of events	% number of events
Boeing 737-700	63.2	173	0.4
Airbus Industrie A300-600	62.1	255	0.6
Airbus Industrie A321	62.0	1605	3.7
Boeing 777-300	61.4	673	1.5
Boeing 767-300	61.2	550	1.3
Airbus Industrie A330-300	60.8	4263	9.8
Boeing 737-800	60.6	4679	10.7
Embraer 190	60.4	394	0.9
Boeing 747-400	60.3	998	2.3
Airbus Industrie A330-200	59.8	631	1.4
Boeing 737-400	59.7	5978	13.7
Boeing 737-300	59.7	176	0.4
Embraer 175	59.5	547	1.3
Airbus Industrie A319	59.1	14812	34.0
Embraer 195	58.7	149	0.3
Boeing 757-200	58.7	1388	3.2
Airbus Industrie A320	58.4	7452	17.1
Boeing 777-200	57.9	1416	3.3
ATR 72	54.5	171	0.4
De Havilland DHC-8-400	54.0	369	0.8

Finally the table below shows the aircraft types which produce the highest average L_{ASmax} noise levels. It can be seen that for most of these the number of aircraft noise events is very small, and several of them are overflights by helicopters and light aircraft, are therefore not from aircraft arriving or departing from Gatwick Airport, and are marked as [Non GAL] in the Table below.

List of noisiest (highest average L_{ASmax} value) aircraft types:

Aircraft type	Average L_{ASmax} (dBA)	Number of events
McDonnell Douglas MD-82	74.5	2
McDonnell Douglas MD-83	70.3	38
Aerospatiale AS355 (Helicopter) [Non GAL]	67.9	2
Cessna Mustang (Light aircraft) [Non GAL]	66.6	8
Eurocopter 20 (Helicopter) [Non GAL]	66.5	2
Beechcraft 30 (Light aircraft) [Non GAL]	66.1	1
Agusta 109 (Helicopter) [Non GAL]	65.7	2
Airbus Industrie A340-200	65.6	4
Eurocopter 35 (Helicopter) [Non GAL]	65.1	3
Airbus Industrie A340-500	64.8	2
Pilatus PC-31 (Light aircraft) [Non GAL]	64.3	4
Beechcraft 20 (Light aircraft) [Non GAL]	64.1	2
Dassult Falcon 5X	63.8	3
Boeing 737-900	63.5	6
Boeing 737-700	63.2	173
Gulfstream V	62.8	6
Explorer (Helicopter) [Non GAL]	62.5	47
C130 Hercules [Military non GAL]	62.5	16
Tristar [Military non GAL]	62.3	1
Airbus Industrie A300-600	62.1	255

5.4 There is one aircraft type, the Airbus Industrie A300 - 600, which appears in all three lists, with 255 events and an average L_{ASmax} value of 62.1 dB. From these three tables it can be seen that, apart from this one aircraft type, 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 noise monitoring at a site in Domewood, West Sussex, between 11 December 2012 and December 2013.

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 variation noise climate parameters (including aircraft noise levels) from hour to hour, between day to night, and from month to month have been described.

Noise Climate at Domewood, December 2012 to December 2013

The results show that the aircraft noise at the site arises mainly from aircraft departing to the east (and mainly on route 08SFD) together with some noise from aircraft arriving from the east.

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 month average for the period from 1 January to 31 December 2013) for the site at Domewood are shown in the Table below:

Survey period	11 December 2012 to 16 December 2013
Aircraft noise event trigger level	From 11 December 2012: 52 dBA for 10 seconds; from 17 February 2013: 55 dBA for 10 seconds
Length of noise monitoring period	12 months (approximately),
Number of aircraft noise events	38,200 (after removal of suspected wind-noise contaminated data)
% Arrivals and Departures	74 % Departures, 24 % Arrivals (2% overflights)
% DAY and NIGHT	92% Day, 8% Night
Average maximum noise level of events	60 dBA
Average noise level and duration of aircraft noise events	57 dBA, 32 seconds
Average total noise level	51 dBA (Day); 47 dBA (Night)
Average aircraft noise level	48 dBA (Day); 42 dBA (Night)
Average residual noise level	48 dBA (Day); 45 dBA (Night)
Background noise (L _{AS90})	43 dBA (Day); 37 dBA (Night)
Daytime level (12 hours)	51 dBA (Total noise); 49 dBA (aircraft noise)
Evening level (4 hours)	48 dBA (Total noise); 43 dBA (aircraft noise)
Day-evening- night level	54 dBA (Total noise); 50 dBA (aircraft noise)

Noise Climate at Domewood, December 2012 to December 2013

Figure 1: Flight paths for a typical day of departures to the west (Arrivals are shown in red and Departures in green). Departure routes are shown in blue. The blue dot shows the location of the noise monitor at Domewood.

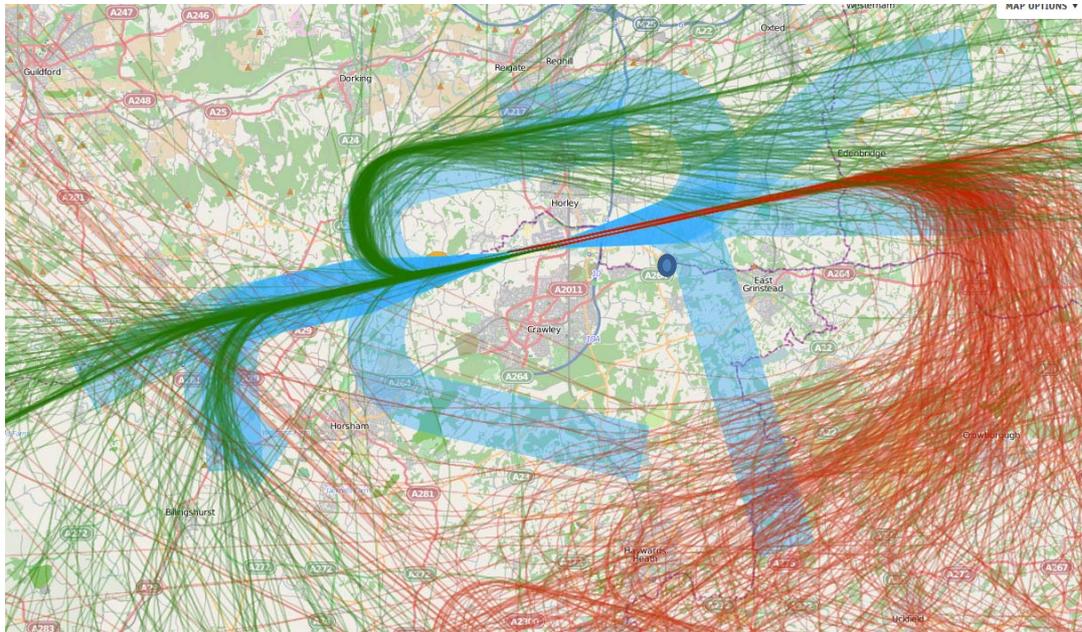
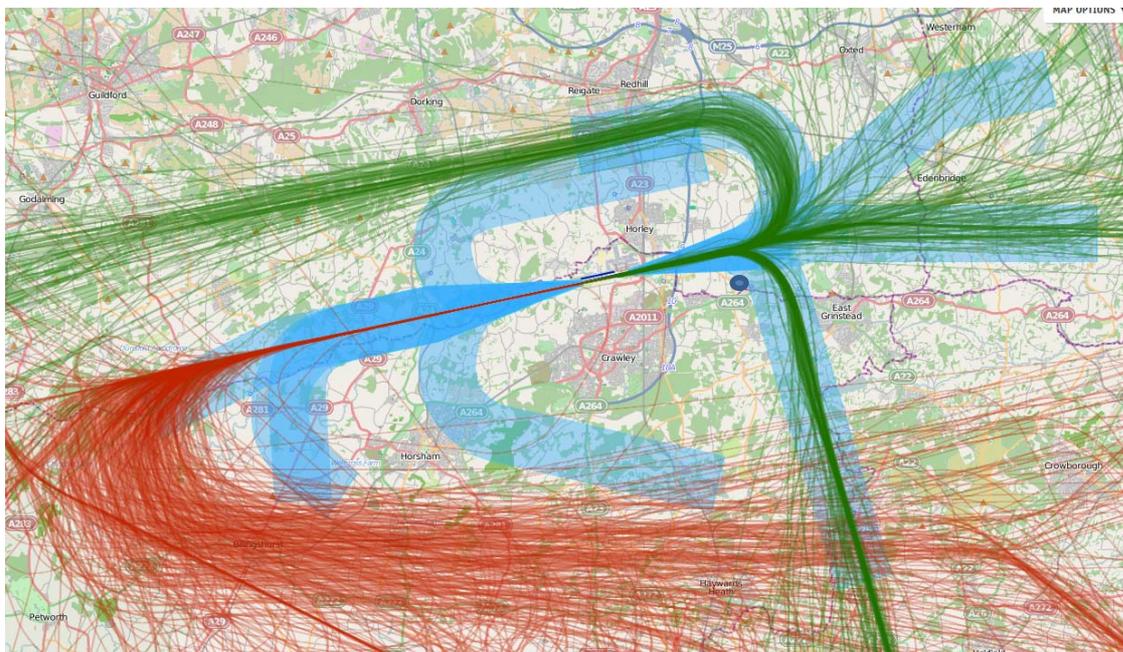
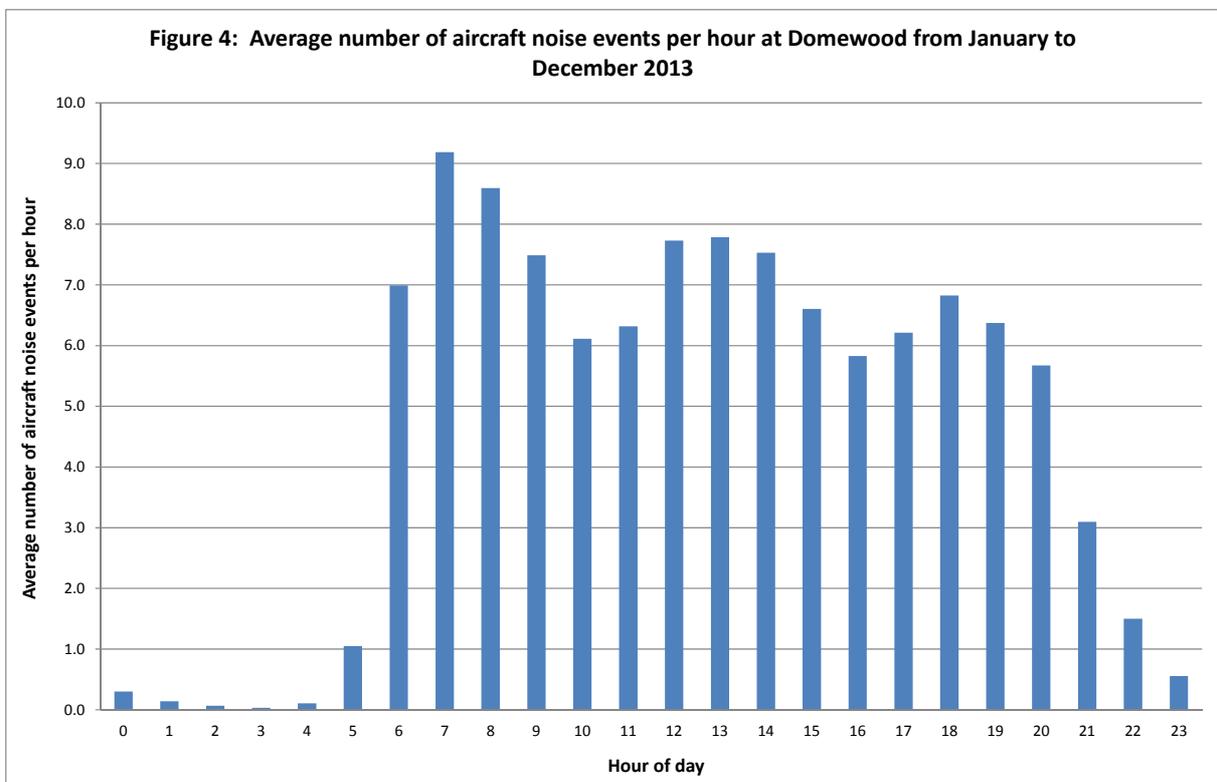
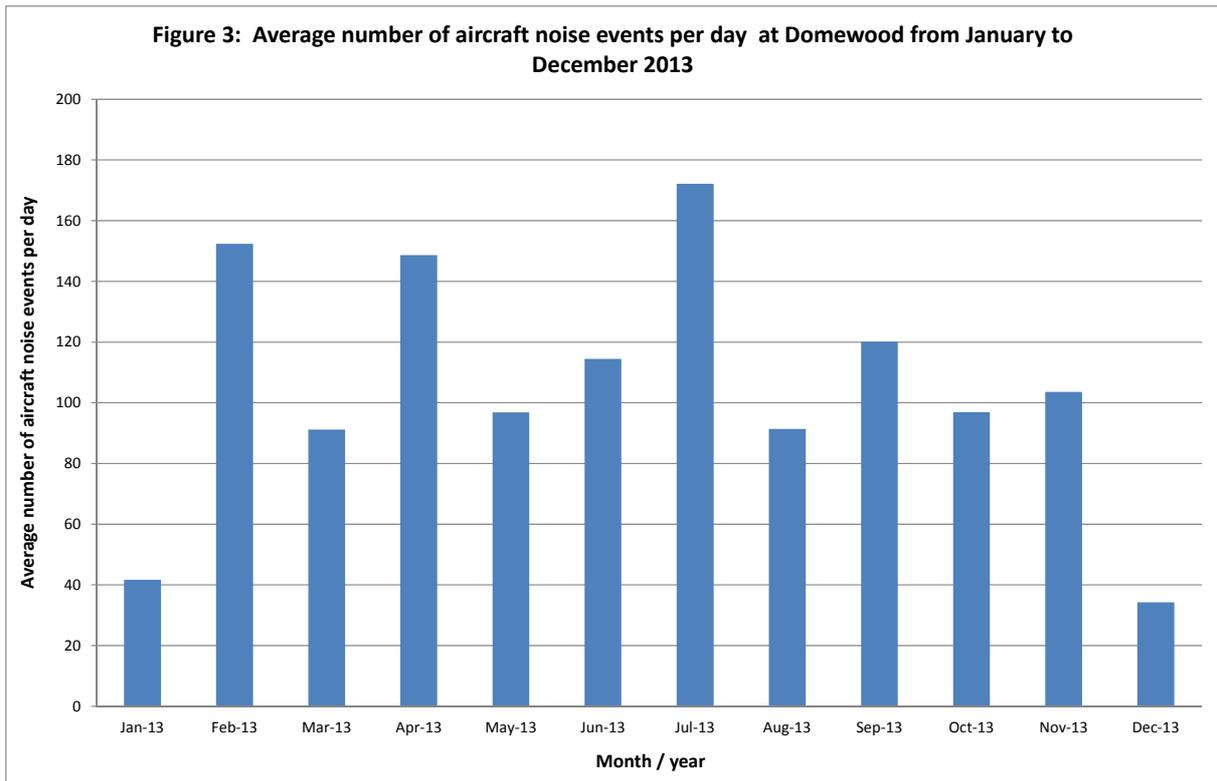


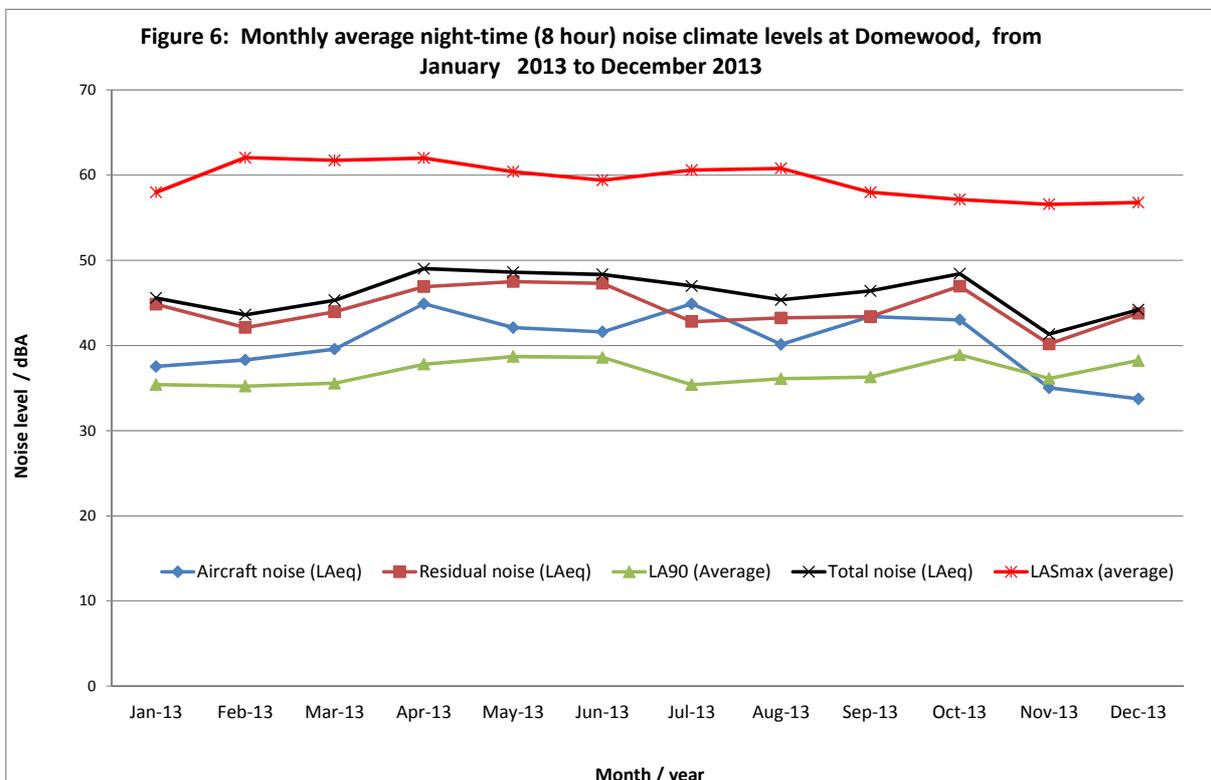
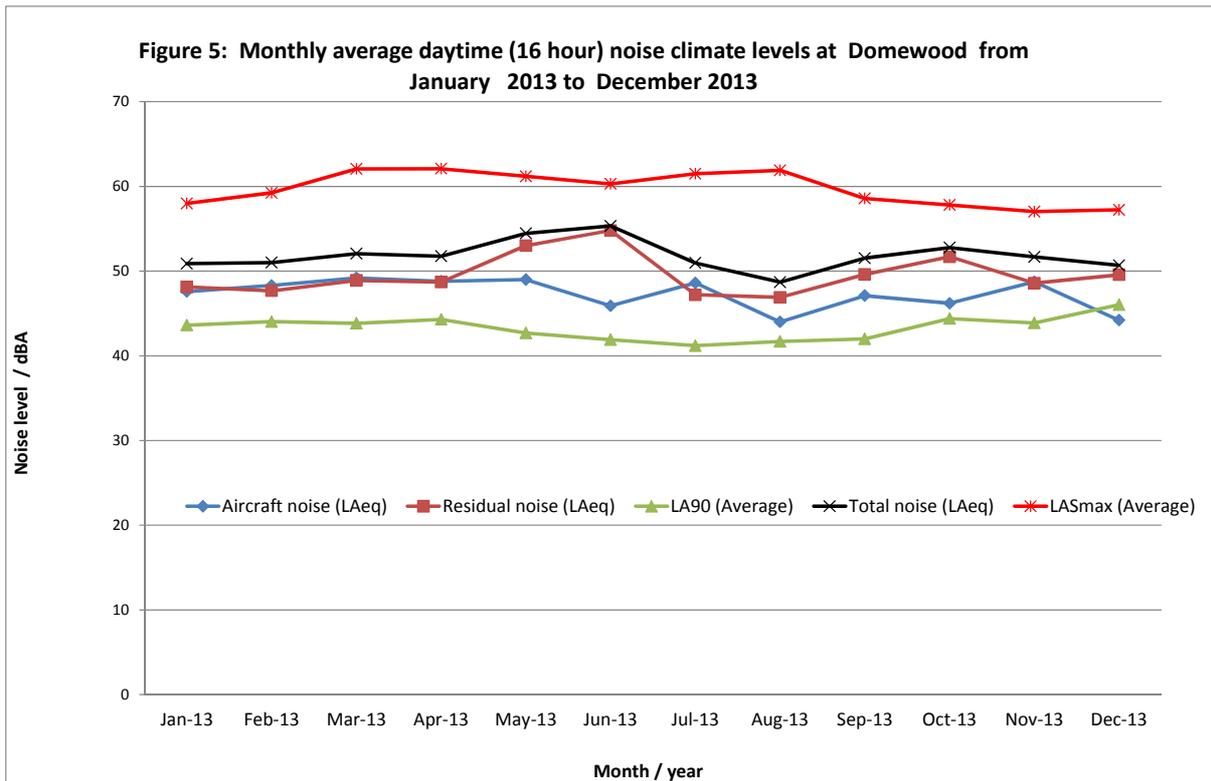
Figure 2: Flight paths for a typical day of departures to the east (Arrivals are shown in red and Departures in green). Departure routes are shown in blue. The blue dot shows the location of the noise monitor at Domewood.



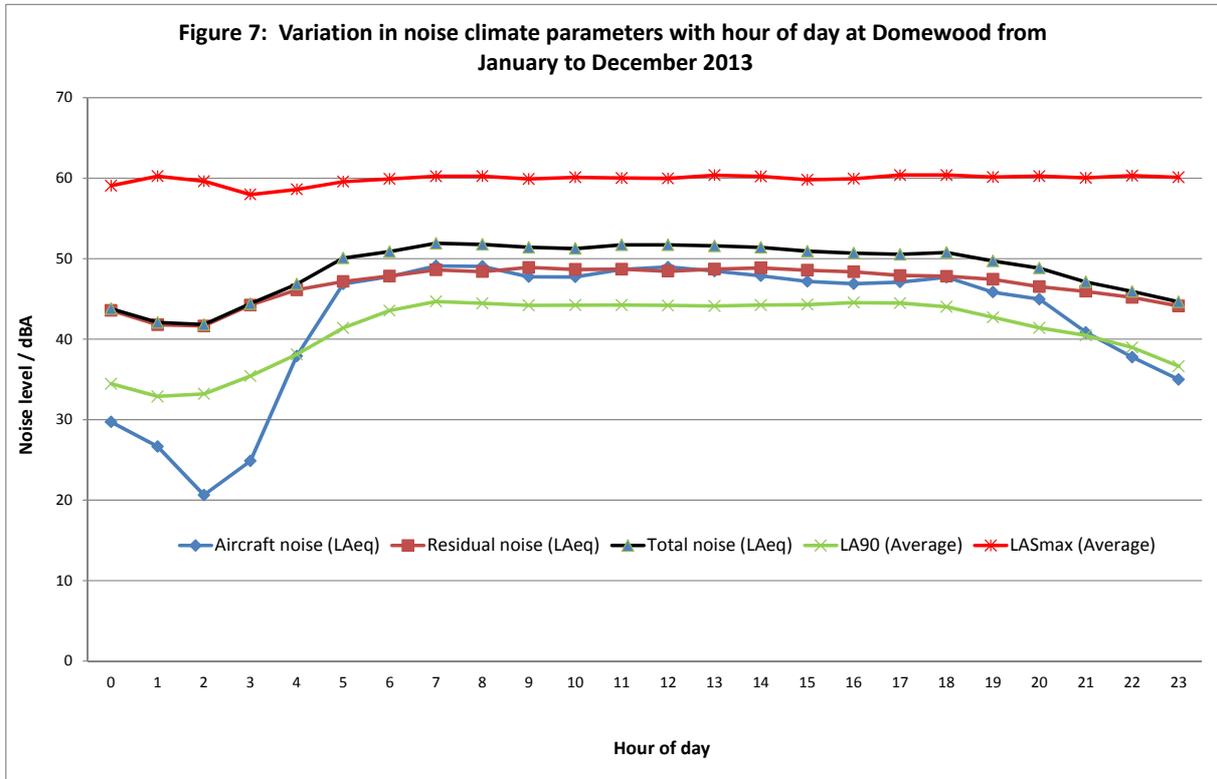
Noise Climate at Domewood, December 2012 to December 2013



Noise Climate at Domewood, December 2012 to December 2013



Noise Climate at Domewood, December 2012 to December 2013



APPENDIX 1

DATA FROM THE NOISE MONITORING TERMINAL



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Appendix 1

Data from the Noise Monitoring Terminal

The NMT records all noise regardless of its source. 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 was arrived at following preliminary noise measurements at the site, and is broadly similar to conditions set for other such studies. It is of course possible that noise arising from activities other than aircraft will occasionally cause noise events to be captured.

To determine which of all those events are due to aircraft the Gatwick Airport 'noise to track' matching software compares all captured noise events with Gatwick Airport's air traffic radar tracks, including those of overflights. Noise events that are matched to aircraft are combined to provide an hourly 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. Note that on this basis noise from overflight events will be included in the aircraft noise, but this will be a negligible contribution to the total level of aircraft noise, because of the relatively small numbers of events involved. Overflight events and the noise that they produce can, if necessary, be distinguished within the list of aircraft noise events from Gatwick Airport Arrival and Departure events.

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/overflight), 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, and is an internationally agreed parameter for the measurement of environmental noise, including aircraft noise.

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. This could also include some noise from aircraft arriving at, or departing from Gatwick, as well as from overflights, which was below the trigger level.

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 L_{den} 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 airport's 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 (L_{Aeq}) values.

ANOMS/ Casper BV Airport Noise and Operations Monitoring System. The software data analysis system (incorporating the NTK system) which was in use at the

airport until March 2013. The ANOMS system has been replaced by the Casper BV noise and track keeping system, which came into operation on 1 April 2013.

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 2000

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 Leigh into a wider context.

National Planning Policy Framework

On 27th March 2012 the National Planning Policy Framework replaced all previous planning guidance including PPG24 (see below). 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.

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 54 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 (see above) replaced all previous planning guidance including PPG24..

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 may be 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 and 100)

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.