

**REPORT OF
NOISE MONITORING AT RUDGWICK
JUNE 2012 TO MAY 2013**

Client: Gatwick Airport Limited



Report Author :
Dr R. Peters
Principal Consultant



Approved by :
A.V.H. Holdich
Executive Consultant

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THE GREEN BUSINESS CENTRE
THE CAUSEWAY
STAINES
MIDDLESEX
TW18 3AL

TELEPHONE: 01784 464404
FACSIMILE: 01784 465447

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REPORT OF NOISE MONITORING AT RUDGWICK, MAY 2012 TO MAY 2013

1.0 Introduction

A mobile Noise Monitoring Terminal (NMT) has been deployed at Rudgwick in West Sussex by Gatwick Airport Ltd. This report presents a summary of the results of continuous noise monitoring, between 1 June 2012 and 31 May 2013, which covers a complete seasonal cycle of aircraft movements.

The site is approximately 24 km south west of the airport. The NMT is situated in a quiet rural site adjacent to a farm house.

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 of more than 54 dBA for at least 15 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.

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 Rudgwick. It can be seen that the site is overflown by departing aircraft for westerly take offs, and by arriving aircraft during easterlies.

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

The monitor was set to operate with a threshold trigger level of 54 dBA, well above the general background noise level at the site.

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 38,000 such events were recorded at the noise monitor during the monitoring period; with the number each month shown in Figure 3. Just over half of the recorded events (53%) were due to aircraft departures, 46% were due to arriving aircraft and about 1% were due to overflights. Most of the departures, to the west, followed departure route 26SAM (64%) and 26BOG (35%). Most of the events (93%) occurred in the daytime period (07.00 to 23.00 hours) and 7% 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 was: June: 66% / 34%; July: 87% / 13%; August: 82% / 18%; September: 88% / 12%; October: 56% / 44%; November 82% / 18%; December 83% / 17%; January 62% / 38%; February 44% / 56%; March 20% / 80%; April 58% / 42%; May 73% / 27%.

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 in the morning between 07.00 and 9.00 hours and between 10.00 and 13.00 hours (local time).

3.2 Maximum noise levels and durations of aircraft noise levels

The maximum noise level, L_{ASmax} , produced by each aircraft over-flight ranged between 54 dBA and 93 dBA, but with more than 95% of events having a maximum value of less than 70 dBA. The arithmetic average of all of these values over the 12 month period was 61 dBA overall, with a standard deviation of 3.9 dB.

The duration of these aircraft noise events ranged between 15 and 90 seconds, but with more than 95% of events having a duration of between 10 and 58 seconds. The average duration for all events was 35 seconds, and the average level of aircraft noise during the events was 58 dBA.

3.3 The total noise climate at the site

Figure 5 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 comparing environmental noise.

Also shown in Figure 5 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 6 shows similar data for night-time.

It can be seen that during the daytime the various noise levels show little month to month variation (within ± 2 dB), with the average aircraft noise at 49 dBA, the average residual noise level at 50 dBA, and the average total noise level, which is the combination of the aircraft noise and residual noise levels, at 52 dBA. The daytime background noise level was about 38 dBA throughout the 12 month period.

The monthly average night time noise levels showed a slightly larger spread than in the daytime. At night the average level of aircraft noise was 38 dBA, i.e. 11 dBA lower than in the daytime, and the average residual noise level was 44 dBA, and the total noise level was, on average 45 dBA. The average background noise level at night was about 28 dBA.

The average of maximum aircraft noise levels was similar during the daytime and at night, within the range 58 dBA to 62 dBA.

Therefore it can be seen that, as far as average noise levels are concerned the residual noise, from all other sources except aircraft, is the highest source of noise at this site, usually 1 or 2 dB higher than the level of aircraft noise each month in daytime, but on

average about 6 dB higher at night time. 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 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 (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)	52	49	50	38
Night (8h) (23.00 - 07.00 h)	45	38	44	28
Day (12 h)* (07.00 - 19.00 h)	53	50	51	39
Evening (4 h)* (19.00 - 23.00 h)	48	45	45	33
24 hours	51	47	49	35

* 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 Rudgwick 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 of Transport. This is consistent with the average $L_{Aeq16hour}$ value of 49 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 Rudgwick 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 Rudgwick 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 Rudgwick are also free field values.

Since the 16 hour L_{Aeq} value of total noise for this site is 52 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 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 daytime noise exposure level during the 12 month monitoring period at this site (52 dB $L_{Aeq, 16 \text{ hour}}$) is below the WHO Guidelines of 55 dBA for the daytime, but the night-time noise exposure level (45 dB $L_{Aeq, 8 \text{ hour}}$) is at the same level as, but not below, 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 thirty different aircraft types contributed to the total number of 38,000 aircraft noise events which occurred during the monitoring period, but most of the events arose from a relatively small number of aircraft types, with three types being responsible for more than 60% of all aircraft noise events at the site:

- Airbus A319: 30.5%
- Airbus A320: 18.8%
- Boeing 737 - 400: 12.9%

5.2 The Table below lists the 14 aircraft types responsible for more than 90% of all of the aircraft noise events which occurred during the period, showing the number and the % number of events and the average L_{ASmax} value for each aircraft type, presented in order, with the most frequent type at the top of the list.

List of 14 most frequent aircraft types:

	Aircraft Type	Number of Events	% Number of Events	Average L_{ASmax}
1	Airbus A-319	10898	30.5	60.7
2	Airbus A-320	6731	18.8	60.7
3	Boeing 737-400	4629	12.9	62.2
4	Boeing 737-800	2422	6.7	60.6
5	Airbus A321	1332	3.7	61.0
6	Boeing 777-200	1295	3.6	62.2
7	Boeing 747-400	1173	3.3	65.8
8	De Haviland DH8-400	1084	3	59.2
9	Boeing 757-200	877	2.5	59.8
10	Aerospatiale ATR72	709	2	58.9
11	Airbus A332	588	1.6	62.8
12	Embraer 195	497	1.4	60.6
13	Boeing 767-300	319	0.9	62.8
14	Embraer 175	288	0.8	59.7

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.

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

Aircraft Type	Average L_{ASmax}	Number of Events	% Number of Events
CHINOOK (Helicopter)	76.7	1	0.003
McDonnell Douglas MD83	71.5	1	0.003
Ilyushin IL62	70.4	1	0.003
Hughes MD-500 (Helicopter)	70.1	7	0.020
Auster V 840 (light aircraft)	69.7	1	0.003
Sikorsky's S76 (Helicopter)	69.4	2	0.006
Eurocopter AS-355N (Helicopter)	69.3	1	0.003
FA5X Dassault Falcon 50	69.1	1	0.003
AH-64 Apache (Helicopter)	69.0	1	0.003
Agusta A109 (Helicopter)	68	16	0.045
Learjet 45	66.5	1	0.003
Socata TBM-700 (light aircraft)	66.5	1	0.003
Cessna Citation C560 (light aircraft)	66.1	1	0.003
Boeing 747-400	65.8	1173	3.282

5.4 There is one aircraft type, the Boeing 747-400, which appears in both lists, with 1173 events and an average L_{ASmax} value of 65.8 dB. From these two 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 12 months of noise monitoring at a site in Rudgwick, West Sussex, between June 2012 and May 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 results show that the aircraft noise at the site arises both from aircraft departing to the west (on routes 26SAM and 26 BOG) and arriving from the west, when aircraft are taking off towards the east. There has been relatively little month to month variation in aircraft noise levels during this 12 month noise monitoring period.

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 period from 1 June 2012 to 31 May 2013) for the site at Rudgwick are shown in the Table below:

Noise Climate at Rudgwick, June 2012 to May 2013

Survey period	1 June 2012 to 31 May 2013
Aircraft noise event trigger level	54 dBA for 15 seconds
Length of noise monitoring period	12 months,
W/E runway usage	June: 66% / 34%; July: 87% / 13%; August: 82% / 18%; September: 88% / 12%; October: 56% / 44%; November 82% / 18%; December 83% / 17%; January 62% / 38%; February 44% / 56%; March 20% / 80%; April 58% / 42%; May 73% / 27%.
Number of aircraft noise events	38,000
% Arrivals and Departures	53 % Departures, 46 % Arrivals (1% overflights)
Departure routes (% of aircraft noise departure events)	26SAM: 64%; 26 BOG: 35%
% DAY and NIGHT	93% Day, 7% Night
Average maximum noise level of events	61 dBA
Average noise level and duration of aircraft noise events	58 dBA, 35 seconds
Average total noise level	52 dBA (Day); 45 dBA (Night)
Average aircraft noise level	49 dBA (Day); 38 dBA (Night)
Average residual noise level	50 dBA (Day); 44 dBA (Night)
Daytime level (12 hours)	53 dBA (Total noise); 50 dBA (aircraft noise)
Evening level (4 hours)	48 dBA (Total noise); 45 dBA (aircraft noise)
Day-evening night level	54 dBA (Total noise); 50 dBA (aircraft noise)
Background noise (L_{AS90})	38 dBA (Day); 28 dBA (Night)

Noise Climate at Rudgwick, June 2012 to May 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 Rudgwick.

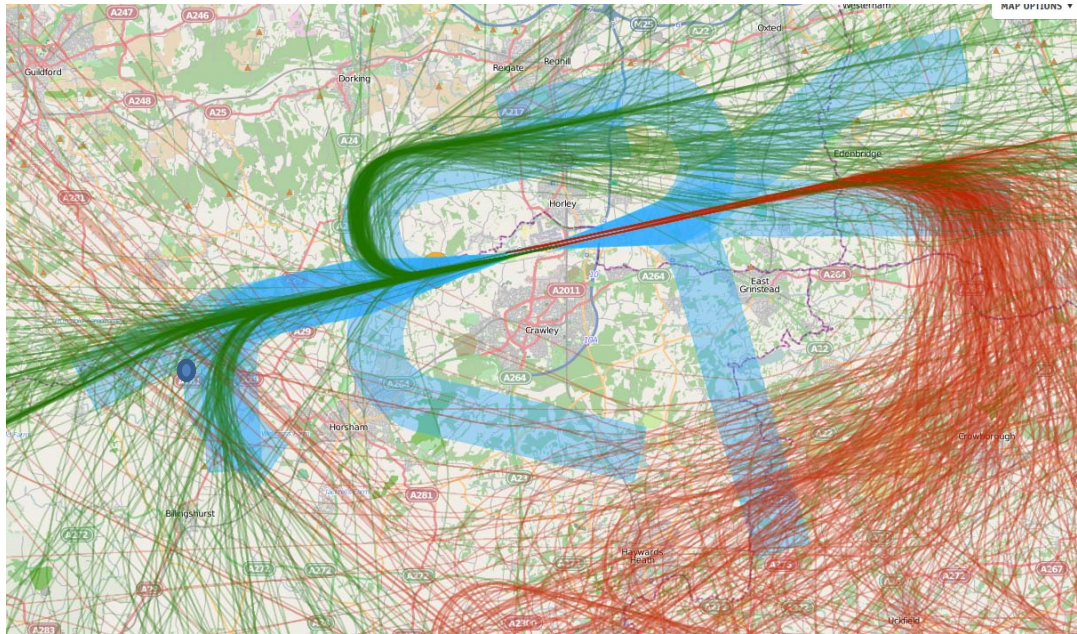
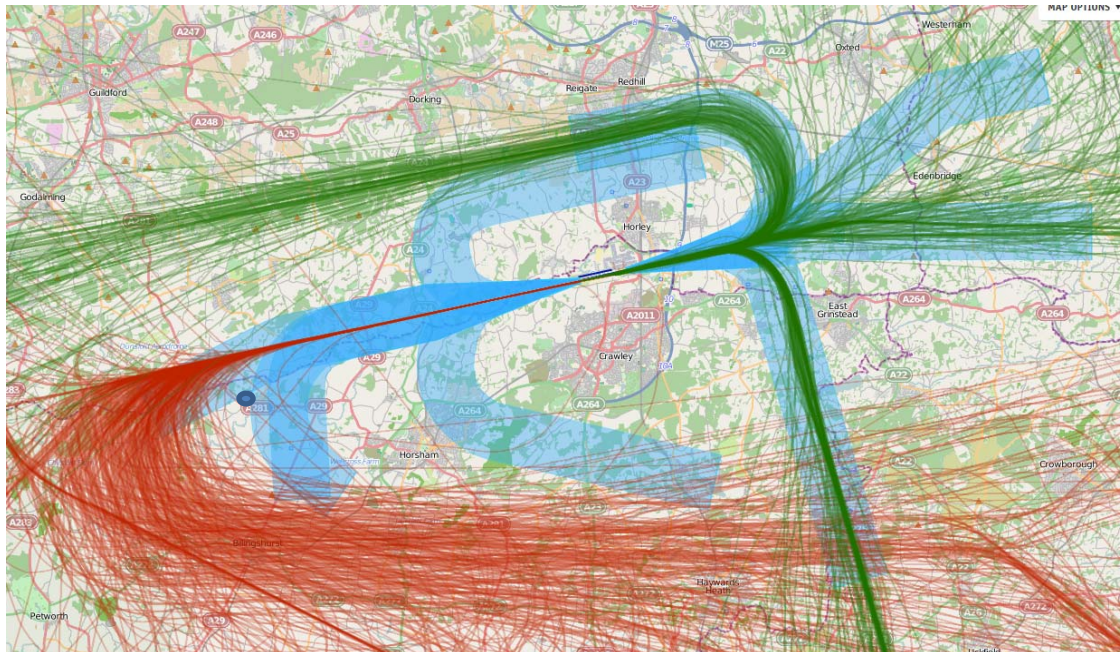
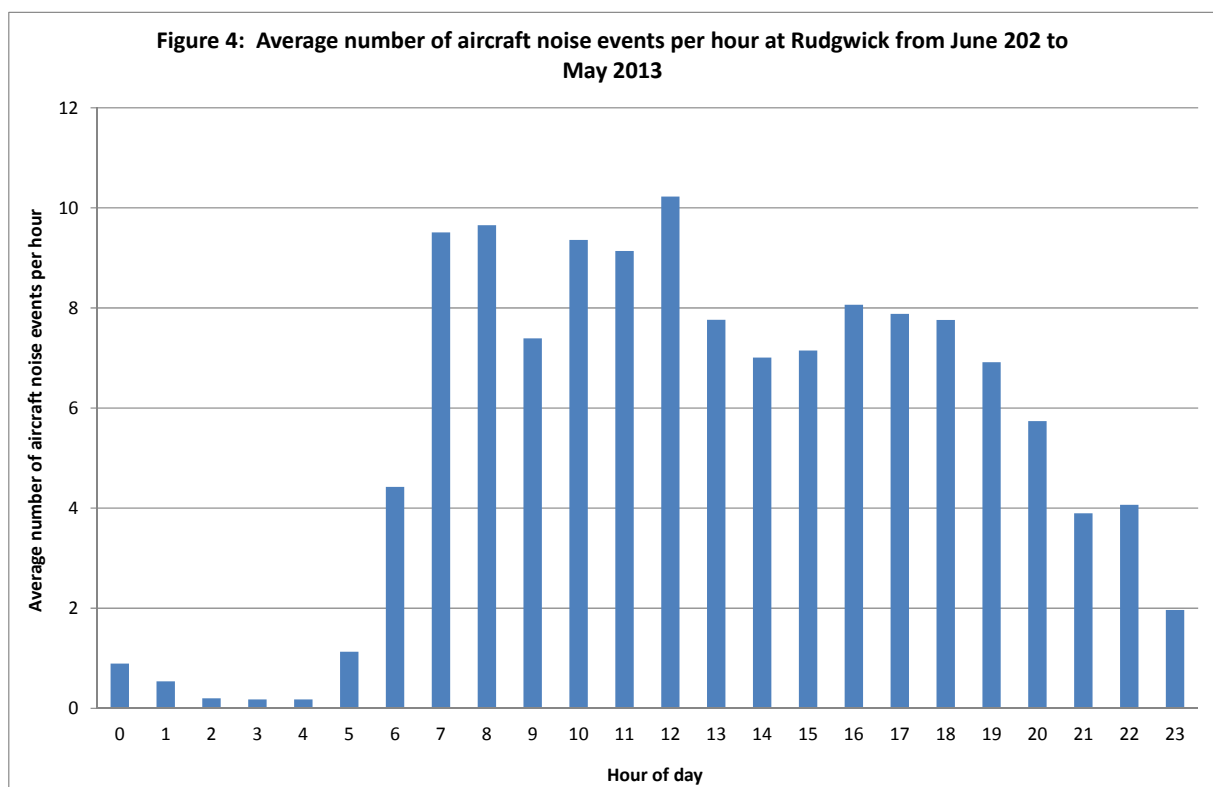
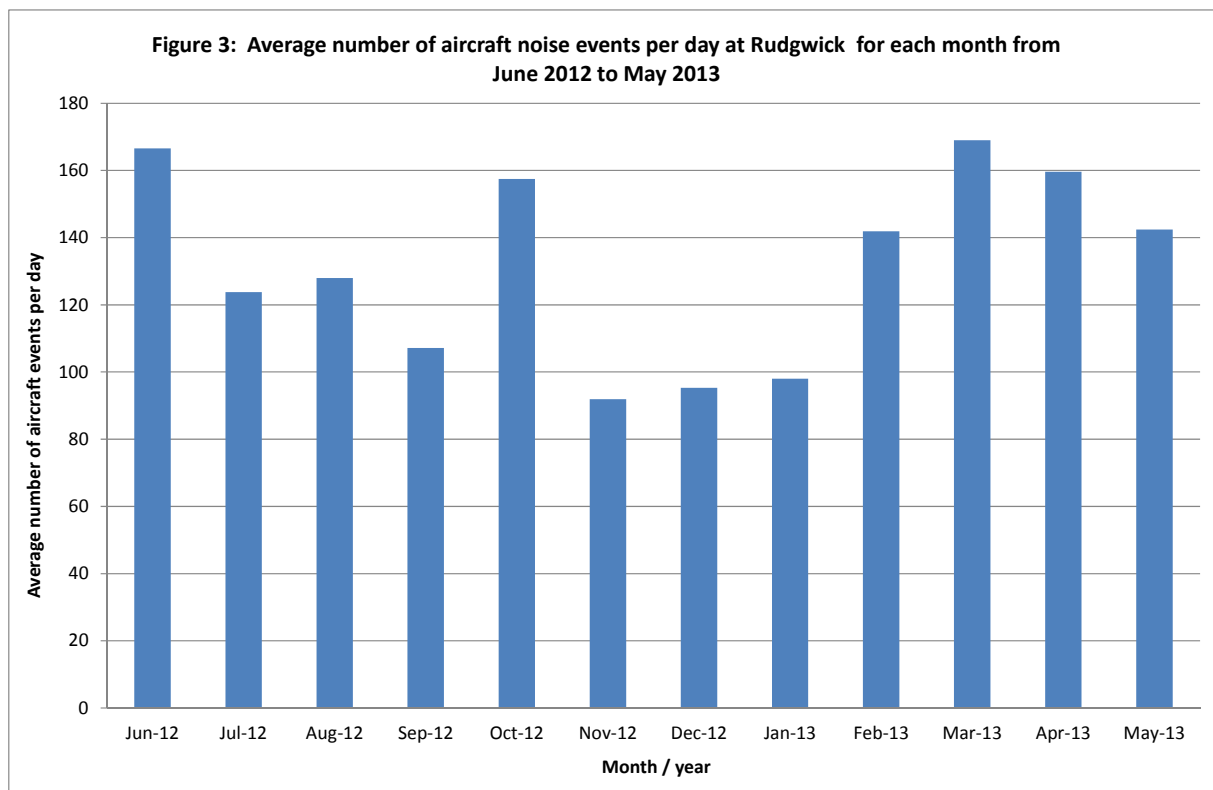


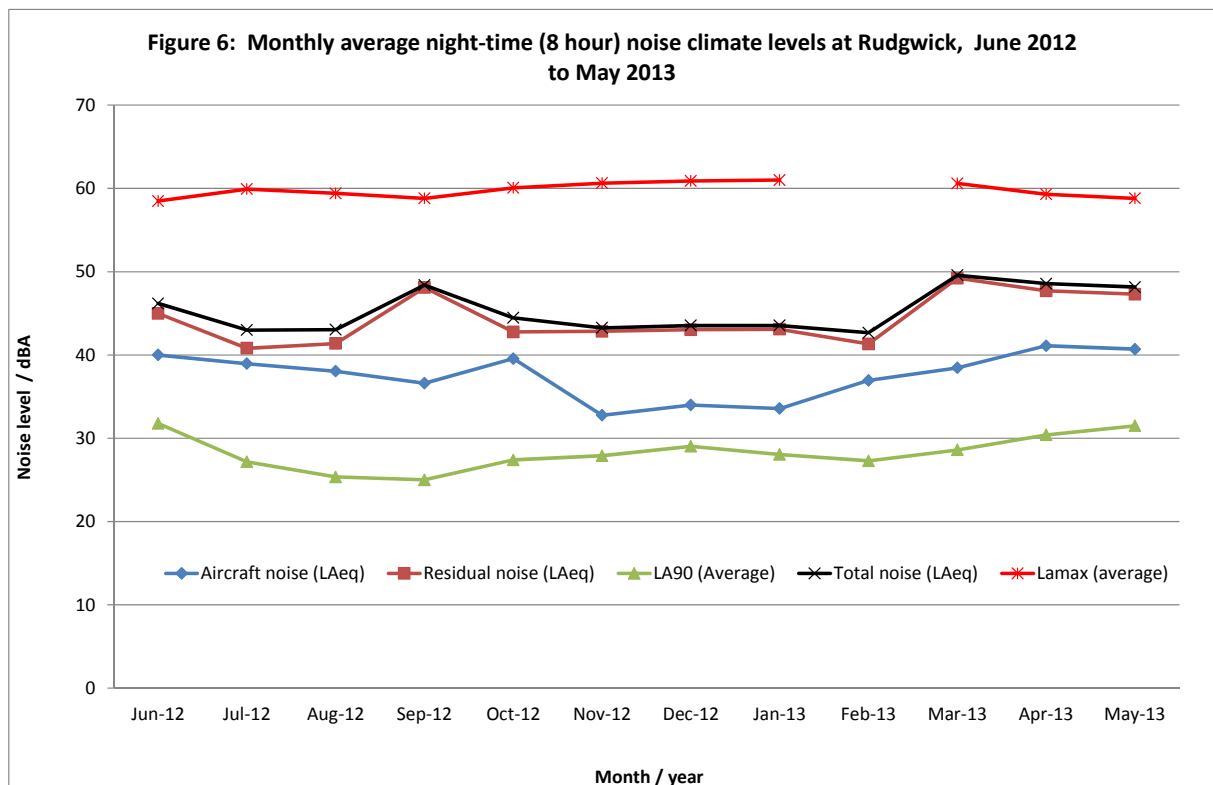
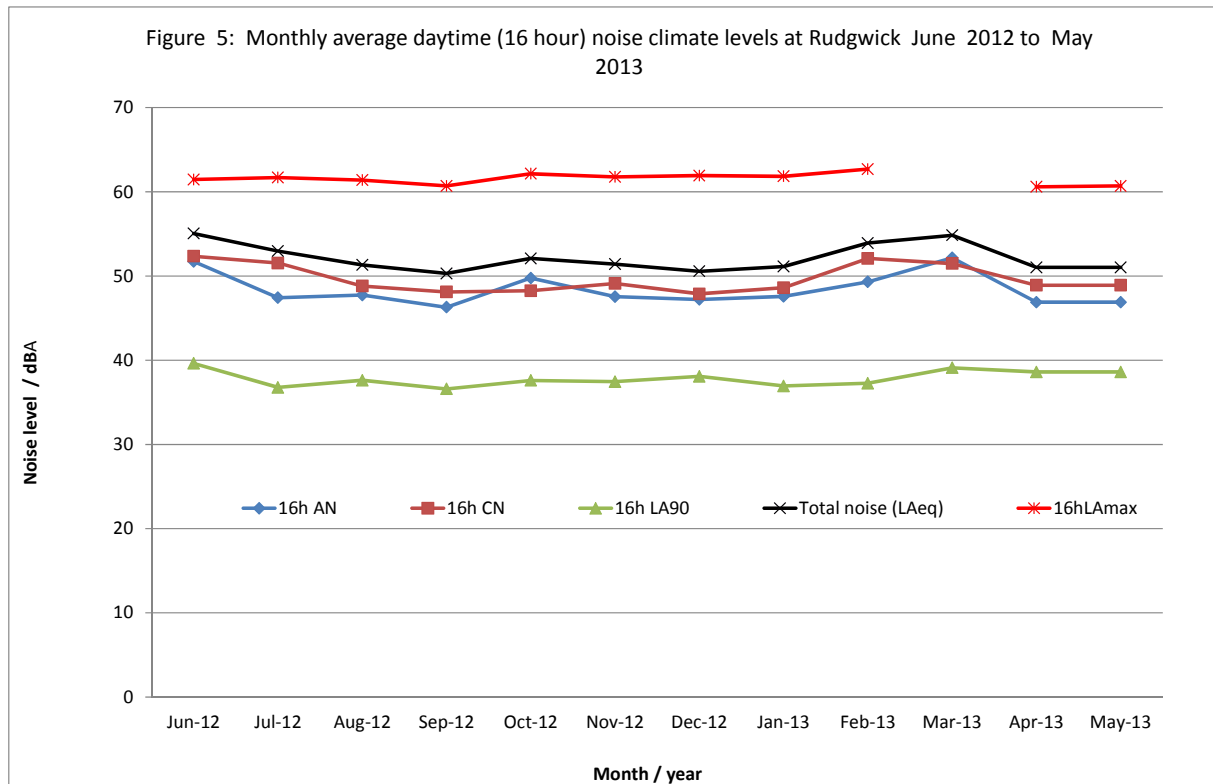
Figure 2: Flight paths for a typical day of departures to the east (Arrivals are shown in red and Departures in green). Departure routes are shown in blue. The blue dot shows the location of the noise monitor at Rudgwick.



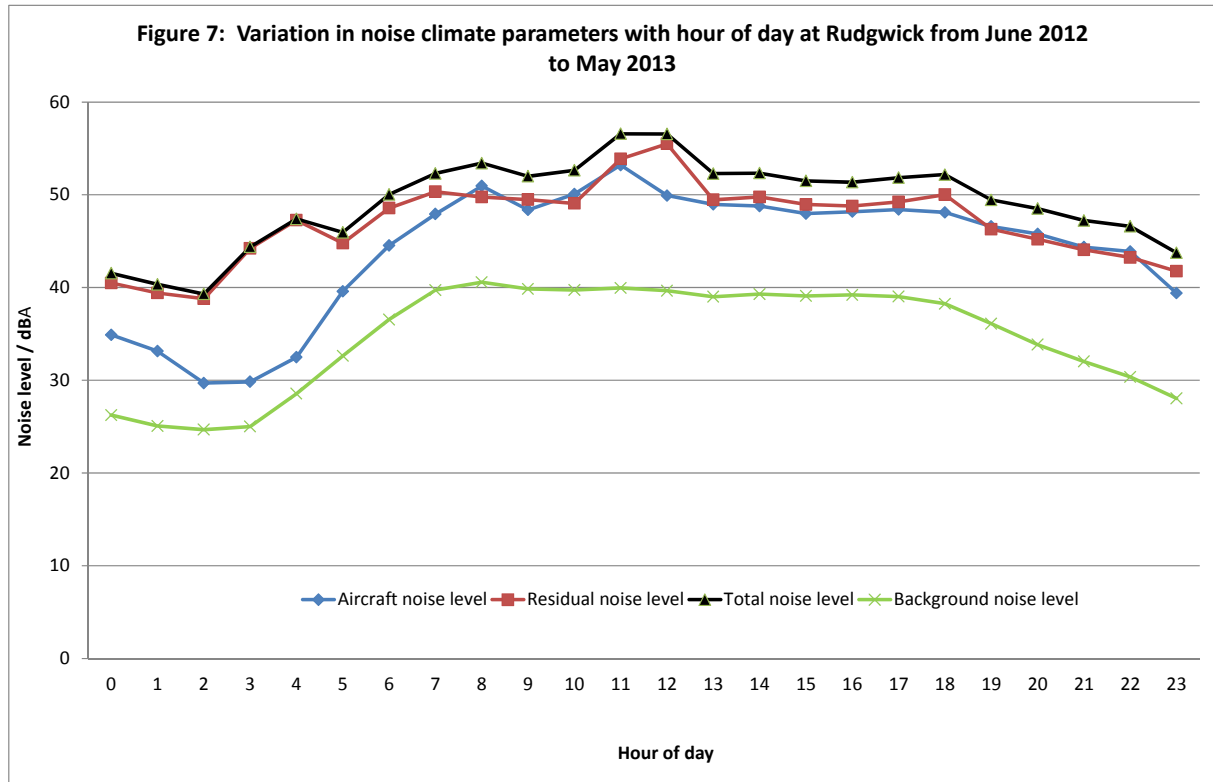
Noise Climate at Rudgwick, June 2012 to May 2013



Noise Climate at Rudgwick, June 2012 to May 2013



Noise Climate at Rudgwick, June 2012 to May 2013



APPENDIX 1

DATA FROM THE NOISE MONITORING TERMINAL



THE GREEN BUSINESS CENTRE
THE CAUSEWAY
STAINES
MIDDLESEX
TW18 3AL

TELEPHONE: 01784 464404
FACSIMILE: 01784 465447

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 54 dBA for a minimum duration of 15 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 'noise to track' matching software compares all captured noise events with 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 56 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 54 dBA for a duration of at least 15 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, 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



THE GREEN BUSINESS CENTRE
THE CAUSEWAY
STAINES
MIDDLESEX
TW18 3AL

TELEPHONE: 01784 464404
FACSIMILE: 01784 465447

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.

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 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 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.