Heathrow Community Noise and Track-keeping Report: Teddington

This document reports on a 99-day period of continuous noise monitoring from the 14 January 2013 to the 22 April 2013 using a Larson Davies LD 870 sound monitor placed in the grounds of the National Physical Laboratory, Teddington (positioned at 51° 25′ 18.21″ N, 0° 20′ 23.96″ W, 46 feet elevation). All timings are local.

Background

Heathrow Airport is committed to limiting the impacts of noise on communities around the Airport and publishes a Noise Action Plan in accordance with National and European Regulations. An objective of the plan is to better understand local noise concerns and priorities by establishing a Community Noise and Track Monitoring Programme. As part of this Programme, the Airport has agreed with local stakeholders, represented on the Noise and Track Keeping Working Group (NTKWG), that flight tracks and (where possible) noise levels affecting local communities would be examined through a series of 3-4 month studies. The studies are organised so that the noise and flight tracks are analysed over the monitoring period based on a 'grid' of local communities, defined and agreed with the NTKWG and shown below in Figure 1. The impact on the community within the grid square is then reported at the end of the monitoring period.

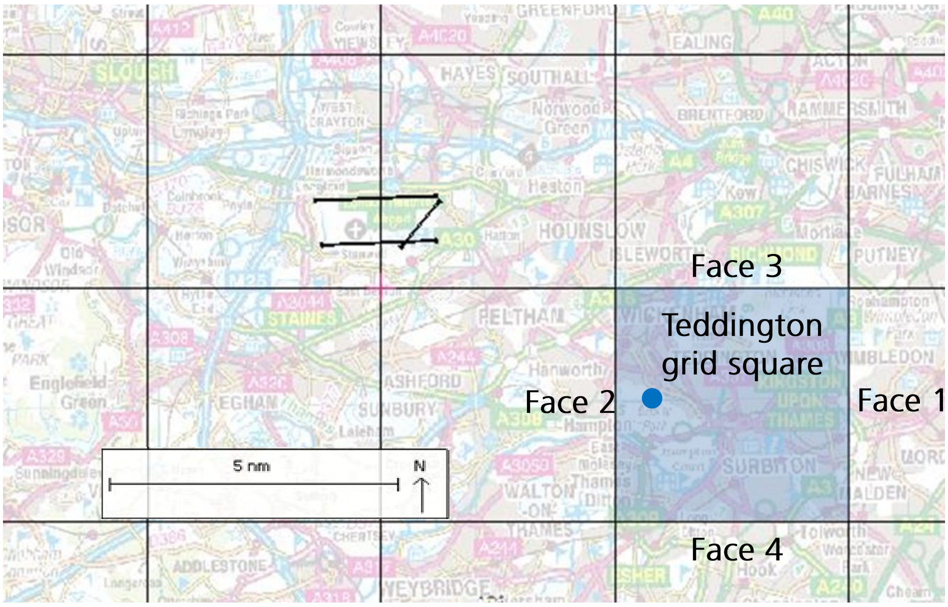

Figure 1. Map of the Heathrow area with noise monitoring grid; position of the noise monitor shown as a blue dot in the blue shaded grid (the Teddington community grid square)

This report describes the noise levels and aircraft tracks affecting the Teddington grid square, shown above. Noise levels were recorded by a temporary noise monitor situated in the grounds of the National Physical Laboratory (position indicated by blue dot). The noise monitor site was located to the south-east of Heathrow's two runways under the easterly Southampton Standard Instrument Departure (SID) route, and close to the easterly Midhurst SID. The grid is also overflown by aircraft departing on the easterly Dover SID as well as some arriving aircraft that have left the Biggin and Ockham stacks on easterly and westerly operations respectively. Flight movements of air traffic through the grid square were derived from the Airport's noise and track-keeping system. Explanations of technical terms used in this report can be found on page 9.

Flight movements

Operational background: Heathrow Airport operates in either a 'westerly' or 'easterly' direction as shown in Figure 2 on page 2. Westerly operations are typically operated when the wind comes from the west and, as a long-term annual average over 20 years, are in force for 71% of the time. Easterly operations typically take place when the wind is in an easterly direction and are in force for the remaining 29% of the time. Shorter term fluctuations between westerly and easterly operations can vary considerably from this approximate long-term 70:30 split. During the daytime there is a preference for westerly operations. This means that during periods of light easterly winds the Airport operates in a westerly direction. This preference does not operate at night.

During westerly operations runway alternation is applied. This provides for one runway to be used for arrivals from 06:00 until 15:00 and the other runway to be used for arrivals from 15:00 until after the last departure of the day. This runway alternation pattern changes by week; in alternation pattern 1 (week commencing 14 January in 2013) the designated arrivals runway is 27R between 06:00-15:00 (Figure 2; 'Westerly operations - 1') and 27L between 15:00 and the last departure of the day (Figure 2; 'Westerly operations - 2'). In alternation pattern 2 this order is reversed. After the last departure of the day a 4 week night-time alternation pattern will be utilised and this includes easterly operations should the weather conditions allow.

There is no runway alternation during the day on easterly operations due to the legacy of the Cranford Agreement, which prohibited departures from 09L, other than in limited circumstances. During easterly operations, therefore, the majority of departures use the southern runway, 09R, and the majority of arrivals tend to use the northern runway, 09L.

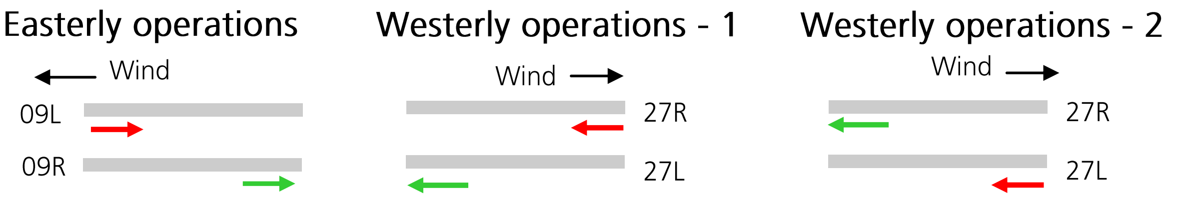

Figure 2. Illustration of the direction of easterly and westerly operations

Key: Departures → Arrivals →

Operations during the monitoring period: During the monitoring period Heathrow operated normally with no significant disruption to the flying schedule, handling a total of 124,734 air traffic movements (62,367 arrivals and 62,367 departures). During the monitoring period two trials were taking place, the second Phase of the Operational Freedoms Trial (which ended on the 28 February) and an early morning noise respite trial (which ended on the 31 March). In addition, night-time resurfacing of the southern runway started on the 3 March, but had no impact on the flying schedule. During the monitoring period, easterly operations prevailed for 60% of the time - opposite to the long-term average - with a total of 37,183 easterly arrivals and 37,319 easterly departures taking place. Westerly operations were in place for the remaining 40% of the time and these accounted for 25,184 arrivals and 25,048 departures.

Flight path information is derived from radar data using a flight monitor processing programme. A public version of this flight tracking software, 'WebTrak', is available on Heathrow Airport's noise website. During the monitoring period the flight monitor processing programme recorded 0.4% fewer flights than the runway logs due to technical reasons (see Additional Information on page 9). To track flights affecting the Teddington square during the monitoring period, a series of monitoring 'gates' were set up on the faces of the grid square (as shown in Figure 1). The traffic count for aircraft passing through these 'faces' is given in Figure 3 (note that this table is cumulative and will count an aircraft each time it enters and exits the grid).

	Easterly				Westerly			
	Face 1 (E)	Face 2 (W)	Face 3 (N)	Face 4 (S)	Face 1 (E)	Face 2 (W)	Face 3 (N)	Face4 (S)
Arrivals	371	273	38	277	2,103	1,490	222	1,699
Departures	8,374	8,687	3,953	1,853	61	162	0	38

Figure 3. Arrival and departure traffic through the faces of the grid square during the monitoring period (Face 1 – East, Face 2 – West, Face 3 – North, Face 4 – South)

Departure flight paths: During the monitoring period over 75% of aircraft overflying the Teddington grid were departing aircraft during easterly operations. Figure 4 overleaf shows the lateral distribution of departing flight paths through the grid and their vertical distribution through Face 2. Aircraft departing Heathrow follow pre-defined Standard Instrument Departure (SID) routes, usually based upon the destination of the aircraft. The majority of easterly departures overflying the Teddington grid are following the Dover SID. These aircraft overfly the northern half of the grid, generally entering the north-west quadrant of the grid between 2,000 and 4,000 feet and exit the north-east quadrant between 4,000 and 6,000 feet. The grid is also overflown by easterly departures following the easterly Midhurst and Southampton SIDs. These aircraft also enter the north-west quadrant of the grid between 2,000 and 4,000 feet, then exit the south-west quadrant between 4,000 and 6,000 feet. A small number of westerly departures overflew the grid during the monitoring period. These aircraft had initially followed the Dover SID after departing Heathrow, and having climbed above 4,000 feet, were being vectored by ATC.

Arrival flight paths: During westerly operations the Teddington grid is primarily overflown by arriving aircraft. The lateral distribution of arriving flight paths through the grid and their vertical distribution through Face 1 is shown in Figure 5 overleaf. These aircraft will have left the Ockham holding stack to the south-west of the grid to start their approach to land on Heathrow's westerly runways—runways 27L and 27R. As can be inferred from Figure 5, the majority of arriving aircraft leaving this stack do not overfly the Teddington grid. Those that do will have been tactically vectored by ATC in order to optimise the stream of arriving aircraft landing at Heathrow. These aircraft will typically overfly the grid between 6,000 and 9,000 feet. During easterly operations a very small number of arrivals that have left the Biggin stack overfly the grid, again these aircraft will have been tactically vectored by ATC.

Go-arounds: In addition to arriving and departing aircraft, the Teddington grid also experiences noise generated by aborted landings or 'go-arounds' on easterly operations. During the monitoring period fewer than ten easterly go-arounds overflew the grid.

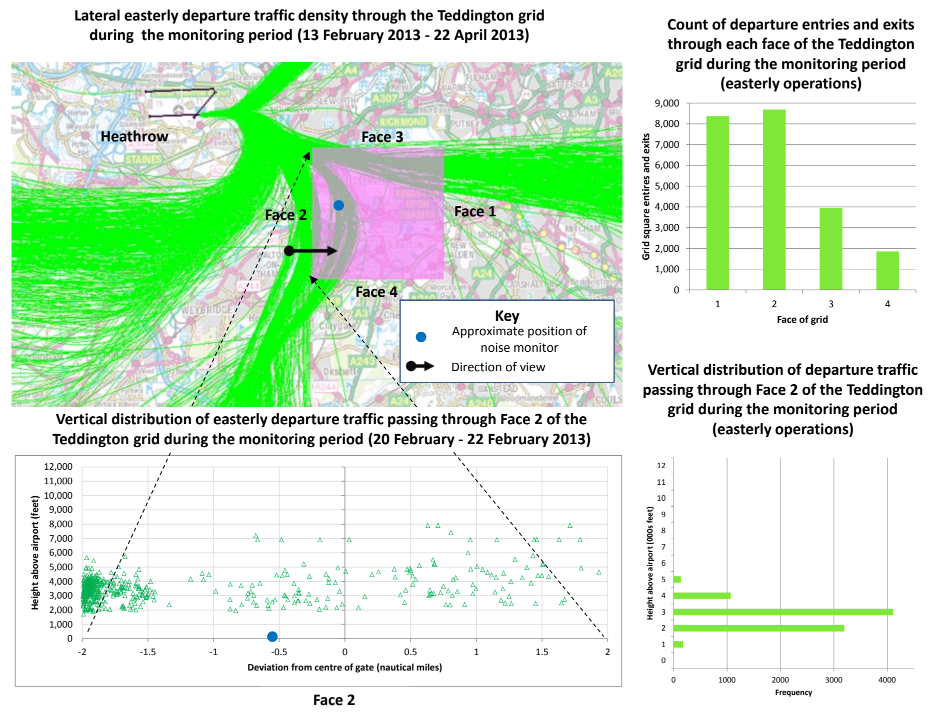

Figure 4. Lateral and vertical distribution of departing air traffic passing through the Teddington grid during the monitoring period (easterly departures) - representative sample (Heathrow flights only)

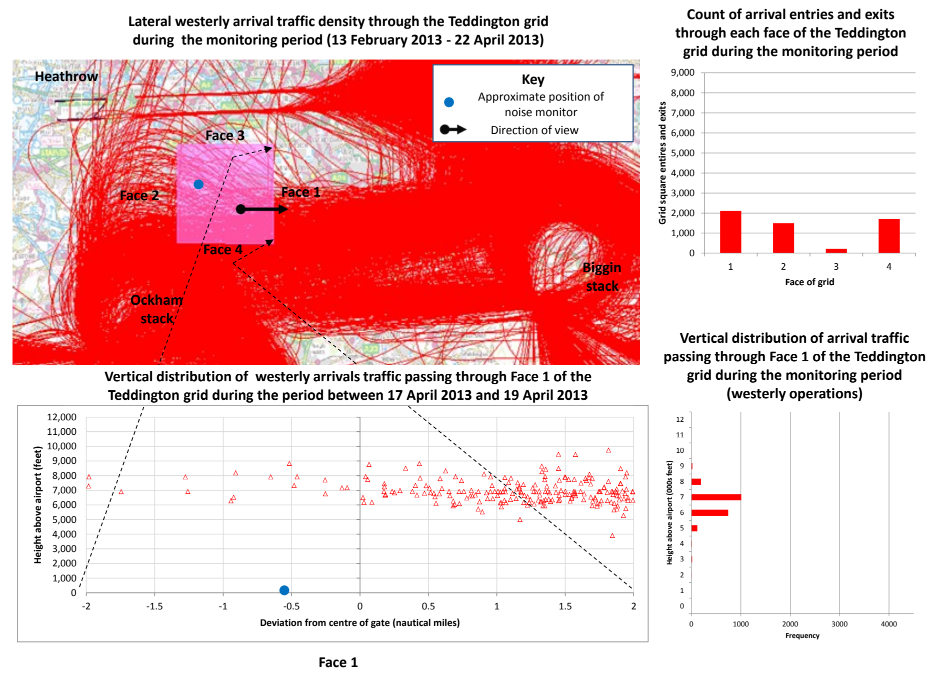

Figure 5. Lateral and vertical distribution of arriving air traffic passing through the Teddington grid during the monitoring period (westerly arrivals) - representative sample (Heathrow flights only)

Figure 6 overleaf shows the proportion of aircraft that passed through the grid during the monitoring period by direction of runway operation and hour. Given the location of the grid relative to the fight paths of arriving and departing aircraft, the grid is overflown more on days of easterly operations. The prevailing wind direction meant that Heathrow operated in this direction for the majority of the monitoring period—however, historically there are comparatively fewer days of easterly operations. Although the grid is overflown during all of the main hours of operation on both days of easterly and westerly operations, the number of aircraft will vary from hour to hour and day to day. For easterly departures this is because not all of Heathrow's departure routes overfly the grid and the number of aircraft following them will vary by hour and day. For westerly arrivals this is because arriving aircraft only overfly the grid if they have been tactically vectored by ATC after leaving the Ockham stack.

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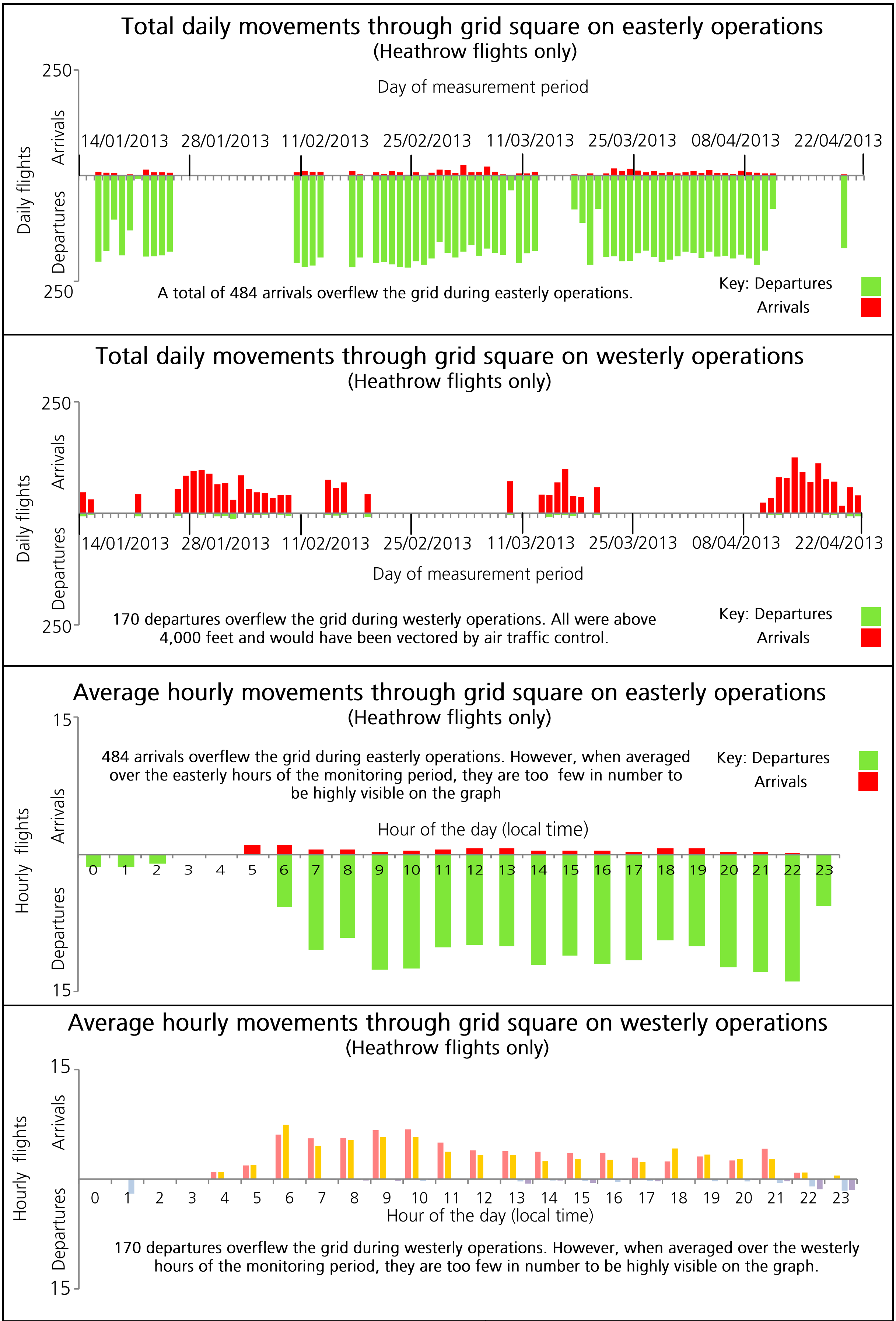

Figure 6. Daily movement totals and hourly mean averages for easterly and westerly operations through the grid square

Alternation pattern 1: Arrivals Departures
Alternation pattern 2: Arrivals Departures

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Noise — background noise

The ambient noise recorded by the monitor is generated by both aircraft and other background noise sources, including local road traffic, distant motorways and railway lines. In rural areas, the ambient level can be affected by noise sources such as farm machinery and bird song. In windy conditions, the noise generated by trees, crops and long grass can also affect the measured noise level.

Figure 7 demonstrates the average background noise level (L_{90}, dBA) recorded by the Teddington monitor over a 24 hour period (black line). Figure 7 also shows the background noise level when separated by mode of operation, easterly or westerly; shown in two shades of orange. As can be seen, the average hourly background noise levels are generally comparable for each mode of operation.

The overall trend in Figure 7 is largely in line with expected results; during the night-time period the average background noise level was relatively low, remaining below 38 dBA between 00:00-05:00 hours. After 06:00 the average background level increased slightly, remaining above 40 dBA for the rest of the day until 21:00-22:00 hours (but never rising above 45 dBA). This broadly coincides with the main period of Heathrow operations and the daytime increase in overall road traffic levels. The graph also illustrates the large variation in hourly background noise level at the monitoring site; up to 10 dBA or more during the daytime between the quietest and noisiest days. The overall noisiest day was Monday 11 March; a day with a moderate north-easterly wind, placing the site downwind of Teddington town centre and the railway station. However, even on this relatively noisy day the hourly background noise level only just exceeds 50 dBA on one occasion during daytime hours. The quietest day was Monday 21 January; a day with a light south-westerly wind, placing the site upwind of Teddington.

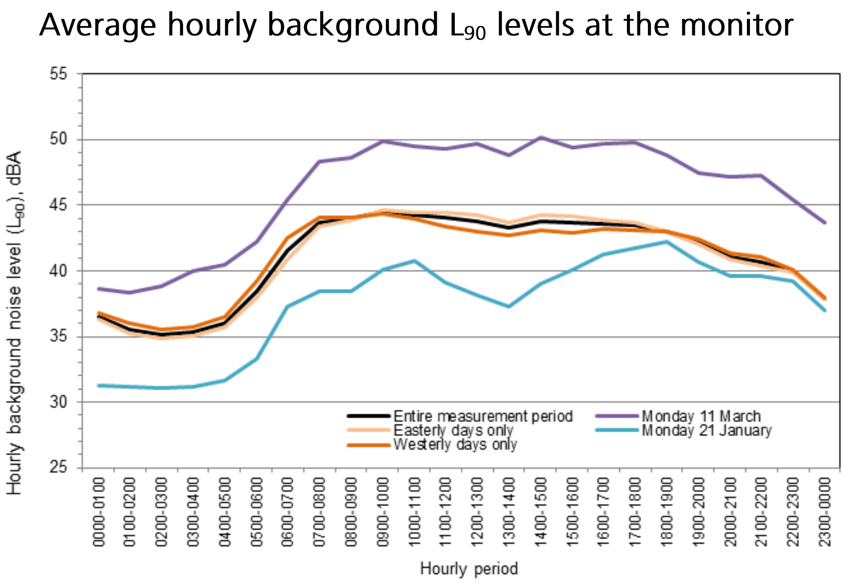

Figure 7. Hourly background L_{90} levels at the monitor averaged over 24 hour period; including Monday 11 March (noisiest day) and Monday 21 January (quietest day)

Noise — significant aircraft noise events

The noise and track keeping monitors are set up to record noise events above a pre-determined threshold level (i.e. aircraft generated noise above background - fully defined at the end of this report). This means that not every aircraft passing through the Teddington grid square generates a noise event. During the monitoring period a total of 7,578 aircraft noise events were recorded.

Since the noise monitor was positioned close to the centrelines of the easterly Southampton and Midhurst Noise Preferential Routes and well away from the main arrival flight paths, departures account for nearly all of the noise events recorded at the monitor (>99%). Figure 8 provides a summary of aircraft noise events by operation and runway after filtering for bad weather (approximately 24% of noise events were rejected due to unacceptable weather conditions in accordance with international guidelines). Accounting for rejected events, 5,778 noise events were generated by easterly departures and 4 noise events by westerly departures (5,782 in total). As noted above, only a very small number of arrival noise events were recorded at the Teddington site (5 in total).

Figure 9 indicates that medium-sized aircraft (e.g. the A320 family) and the wide-bodied B777 dominate the overall number of departure noise events due to the relatively high numbers of these types operating at Heathrow. As noted above, the location of the monitor relative to Heathrow's main arrival flight paths meant that only a very small number of arrival noise events were recorded at the Teddington site.

Figure 10 shows the average (mean) departure and arrival L_{Max} values recorded at the Teddington monitor for each aircraft type. For departures, the noisiest aircraft on average was the B747, followed by the A340, B767 and B777. On average, the quietest aircraft type on departure was the A319. The sample sizes for arrivals are too small to make any meaningful conclusions from the measured data.

The overall distribution of noise for arrivals and departures is shown in Figure 11. Figure 12 indicates the trend in the noise distribution (L_{Max}) for arrivals and departures by time period (day, evening and night). Although shown for completeness, it should again be noted that the data samples for arrivals are too small for any meaningful analysis to be made. The graphs for departures however indicate that the overall spread of the measured noise levels is generally consistent during each period of the day but that there are lower numbers of noise events during evening and night due to the lower overall traffic levels.

It is apparent from these figures that the distributions for departures appear slightly skewed (asymmetrical) because they are truncated at the 60 dBA monitor threshold. The use of this threshold is explained further on page 9. The graphs suggest a proportion of quieter aircraft events were not recorded at the monitor, which could mean that the average measured departure noise levels for some of the quieter aircraft types, shown in Figure 10, may be biased slightly upwards.

Departures (99.9% of total noise events)					Arrivals (0.1% of total noise events)				
09L	09R	27L	27R	Total	09L	09R	27L	27R	Total
98	5,680	4	0	5,782	2	1	2	0	5

Figure 8. Aircraft noise events by operation and runway following filtering for bad weather

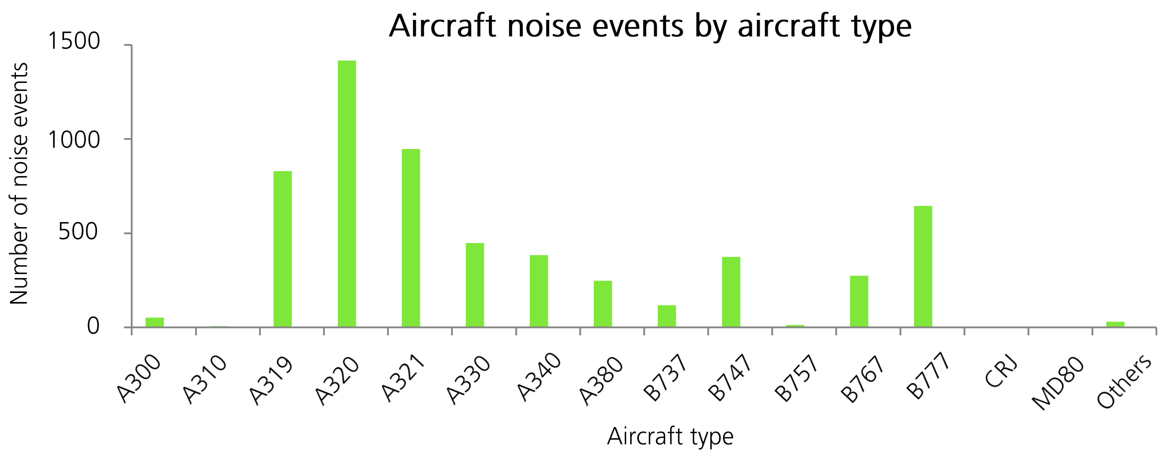

Figure 9. Number of departure and arrival aircraft noise events by aircraft type

Key: Departures
Arrivals

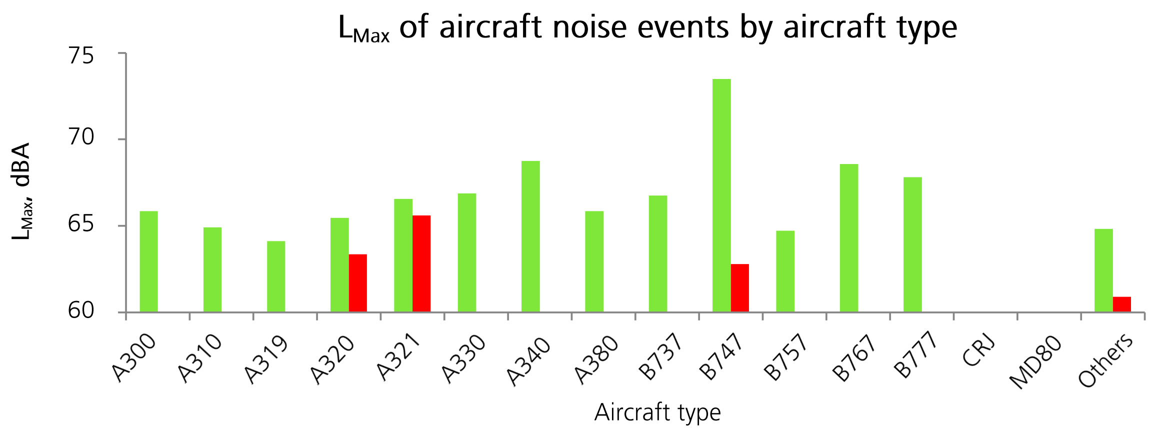

Figure 10. Average (mean) L_{Max} by aircraft type for departures and arrivals

Key: Departures
Arrivals

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Noise distribution for departures and arrivals

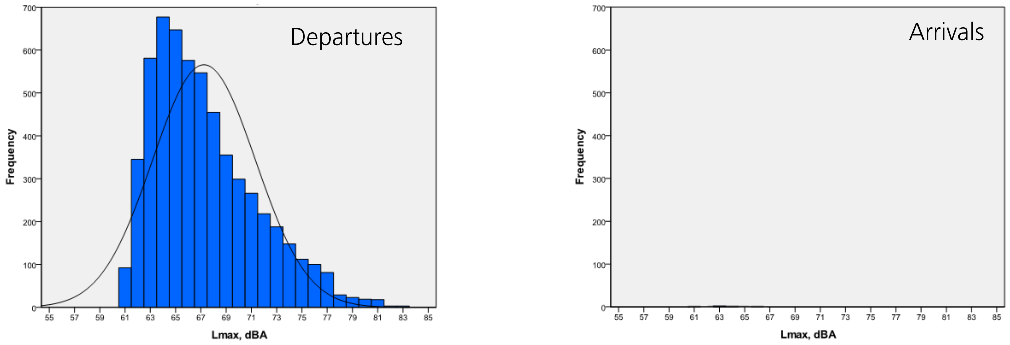

Figure 11. Above left: L_{Max} frequency distribution of departure noise levels
Above right: L_{Max} frequency distribution of arrival noise levels

Noise distribution for departures and arrivals by periods of the day

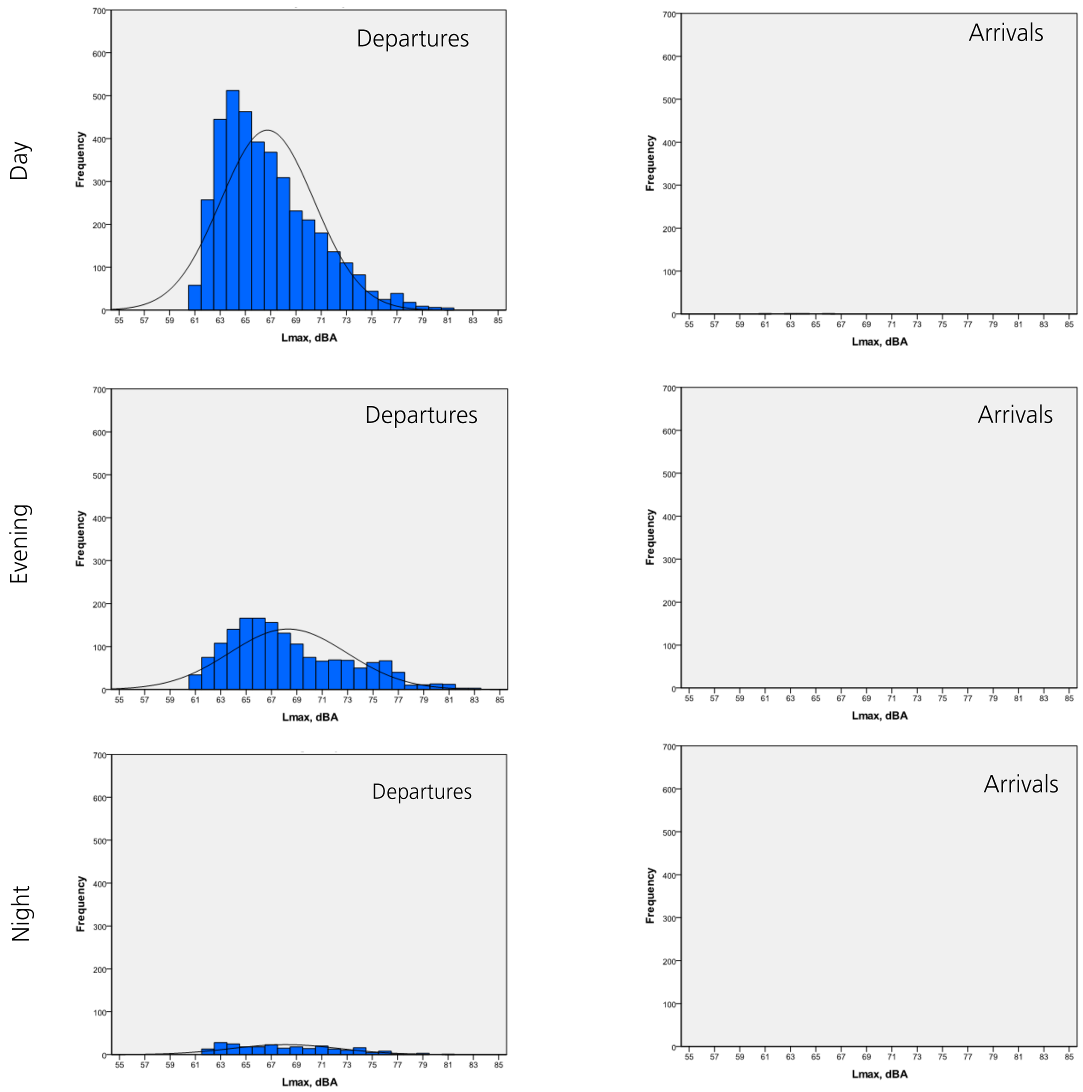

Figure 12. L_{Max} distribution of departure (left) and arrival (right) noise level recorded on the A-weighted sound level over the three averaging periods of L_{Max} (Day — 12 hour period 07:00-19:00), L_{Max} (Evening — 4 hour period 19:00-23:00) and L_{Max} (Night — 8 hour period 23:00-07:00)

Conclusions

Background

This report describes the overflight and noise experience measured for the Teddington grid square over a 99-day period from the 14 January 2013 to the 22 April 2013. During the monitoring period the grid square was overflown by approximately 14,700 Heathrow arrivals and departures. During the same period there were approximately 124,700 air traffic movements at Heathrow.

Heathrow operates in either a westerly or easterly direction, primarily due to prevailing wind conditions. The long -term ratio of easterly to westerly operations is approximately 30:70. However, prevailing wind conditions during the monitoring period resulted in a 60:40 ratio - opposite to the long-term trend.

Flight movements

The Teddington grid is overflown during all of the main hours of operation on both days of easterly and westerly operations. However, as the grid is not under all of Heathrow's departure routes, and arrivals only overfly the grid when being tactically vectored by ATC, the number of aircraft will vary from hour to hour, and day to day.

The grid is primarily overflown by departing aircraft on easterly operations. The majority of these are following the Dover Standard Instrument Departure (SID) route and overfly the northern half of the grid. Other departing aircraft follow the Southampton or Midhurst SIDs and overfly the eastern half of the grid. On easterly operations departing aircraft will typically enter the grid above 2,000 feet and exit it above 4,000 feet. Very few departures overfly the grid during westerly operations, those that did during the monitoring period had climbed above 4,000 feet and were being vectored by ATC.

During westerly operations the Teddington grid is overflown by arriving aircraft that have left the Ockham holding stack to the south-west to start their approach to land. However, the majority of arriving aircraft leaving this stack do not overfly the grid - those that do are being tactically vectored by ATC in order to optimise the stream of landing aircraft. During easterly operations only a very small number of arriving aircraft that are being tactically vectored by ATC will overfly the grid. Typically arriving aircraft overfly the grid between 6,000 and 9,000 feet.

Noise

The noise monitor was located in the grounds of the National Physical Laboratory close to the easterly Southampton and Midhurst SIDs, and well away from the main arrival flight paths. The overall trend in measured background noise levels at the site broadly coincided with the main period of operations at Heathrow and road traffic levels. On average background noise levels were similar for easterly and westerly operations.

Unsurprisingly almost all of the noise events collected by the monitor were for departing aircraft. Accounting for events rejected in line with international standards, half of the easterly departures overflying the grid generated a noise event above the monitor threshold of 60 dBA. The majority of these were recorded for medium-sized aircraft (e.g. the A320 family) or the wide bodied B777 which is reflective of the aircraft mix at Heathrow. Excluding small sample sizes, the nosiest departing aircraft on average was the B747, followed by the A340, B767 and B777. Due to a pre-set monitor threshold it is possible that a proportion of noise events for quieter aircraft types such as the A319 may not have been collected. Measured noise levels for this type of aircraft may therefore be biased slightly upwards.

The overall distribution of the measured departure noise levels was generally consistent during each period of the day, but with fewer noise events generated during evening and night.

There were too few noise events triggered by arriving aircraft to undertake a meaningful analysis.

Summary

The results of the Teddington monitoring period represent a snapshot of the track and noise impact. The results generated for both easterly and westerly operations are broadly what might be expected in the future. However, given the prevalence of easterly operations during the monitoring period, the number of aircraft overflying the grid would have been higher than the long-term average. Additionally, the first 7 weeks of the monitoring period coincided with the end of the Operational Freedoms trial which would have influenced the tracks of some departing aircraft overflying the grid.

As part of this program we expect to return to the grid square in the future to conduct a further 3-4 month community noise study.

Additional information

References

- Heathrow Airport, Noise Action Plan 2010-2015 http://www.heathrowairport.com/noise
- Department for Transport — Heathrow Noise Contours https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3933/heathrow-2011-report.pdf
- Operational Freedoms at Heathrow http://www.heathrowairport.com/noise
- South East Airports Task Force http://assets.dft.gov.uk/publications/south-east-airports-taskforce-report/south-east-airports-taskforce-report.pdf
- Early morning noise respite trial: http://www.heathrowairport.com/noise/noise-in-your-area/early-morning-trial
- Night-time runway resurfacing: http://www.heathrowairport.com/noise/noise-in-your-area/runway-resurfacing

Explanation of terms used:

- Noise can be defined as unwanted sound. Sound in air can be considered as the propagation of energy through the air in the form of oscillatory changes in pressure. The size of the pressure changes in acoustic waves is quantified on a logarithmic decibel (dB) scale, firstly because the range of audible sound pressures is very great and secondly because the loudness function of the human auditory system is approximately logarithmic. The dynamic range of the auditory system is generally taken to be 0 dB to 140 dB. The additional noise from two sources producing the same sound pressure level, will lead to an increase of 3 dB. A 3 dB noise change is generally considered to be just noticeable, a 5 dB change is generally considered to be clearly discernible and a 10 dB change is generally accepted as leading to the subjective impression of a doubling or halving of loudness. 'A-weighting' accounts for the acoustic sensitivity of the human ear to a range of sound levels. Its application to dB produces the 'dBA' scale.
- The L_{Max} value is the maximum value that the A-weighted sound pressure level reaches during a given measurement period of time. For the measurement of aircraft noise, it is usual practice to measure L_{Max} using the sound level meter's slow (S) response setting.
- L_{90} is the noise level exceeded for 90% of the measurement period and is used to quantify the background level of noise.

Noise monitor details:

- To ensure that as far as possible only genuine aircraft noise events are measured (i.e. noise peaks caused by aircraft movement), the noise monitors are set up to record noise events above a pre-determined threshold level. The Teddington monitor was set with a threshold of 60 dBA, meaning that noise events below 60 dBA L_{Max} were not recorded by the monitor. The choice of threshold level is often a compromise between (i) losing a proportion of quieter aircraft events and (ii) recording a large number of spurious non-aircraft events. At locations such as Teddington, where the background noise level can vary on occasion (for example, due to road traffic noise), it can be difficult to select an appropriate threshold level that is low enough to capture a suitable number of lower-level aircraft noise events, but high enough to ensure that extraneous noise is not recorded. Setting the threshold at 60 dBA appeared to be low enough to capture a significant proportion of the distribution of departure L_{Max} levels during each time period, although the distributions do appear to be truncated at the 60 dBA monitor threshold. This means that the average measured departure noise levels for some of the quieter aircraft types shown in Figure 10 may be biased slightly upwards.
- Approximately 24% of all measurements were rejected due to unacceptable weather conditions, i.e. wind speeds greater than 10 m/s or during periods of precipitation (in accordance with recommended international guidance on aircraft noise monitoring).

Differences between the runway logs and the flight monitor processing programme

- Occasionally and infrequently felling of radar plots occurs. This happens when the number of radar returns captured by the radar for monitoring purposes, exceeds its capacity. Consequently some of the radar returns are dropped. The NTKWG are aware of this and Heathrow Flight Performance log these instances.

Continued on the next page

Additional information (continued)

Trials and other activities taking place during the monitoring period:

- A trial of 'Operational Freedoms' started at Heathrow on 1 November 2011, to explore if the runways and the airspace around the airport can be used in a more efficient and flexible way. The trial took place in two phases, the first from 1 November 2011 to 29 February 2012, the second from 1 July 2012 to 28 February 2013. This trial is a recommendation of the Government's South East Airport Taskforce which was set up in 2010 to look at how to make London's airports 'better, not bigger'. The trial looked at whether new procedures can be used to bring benefits to the local community through less late-running flights; to passengers, by providing a more punctual service; and to the environment, by reducing aircraft stacking times and reducing emissions. This trial will not result in an increase in the number of flights operating into or out of Heathrow.
- An early morning arrival trial was conducted between 5 November 2012 and 31 March 2013 in order to examine the feasibility of providing predictable respite to some communities under the approach paths. The trial was developed together with British Airways, HACAN (Heathrow Association for the Control of Aircraft Noise) and NATS following community feedback on the value of predictable respite. A number of trial zones were designed to be free of aircraft movements and were activated on a schedule system thereby providing respite on a predictable basis. The zones were active each day between 2330 at night and 0600 in the morning. The trial is now complete and the lessons learnt will be applied to future trials.
- Between 3 March and 31 October 2013 night-time resurfacing of Heathrow's southern runway (09R/27L) is taking place. This is an essential maintenance task that takes place roughly once every decade. During the resurfacing, for five nights per week between 2230 (local) and 0600 (local), all flights will use the northern runway (09L/27R). Since Heathrow has relatively few night flights, the changes won't affect many aircraft – mostly arrivals after 0430 (local). There will be no additional night flights.

Report prepared for Heathrow Airport by Helios and the CAA. For further information please visit the Heathrow Airport noise website www.heathrowairport.com/noise; alternatively please contact the Heathrow noise action line (on 0800 344 844) or Heathrow Flight Performance directly (Second Floor Meridian, The Compass Centre, Nelson Road, Heathrow Airport, Hounslow, TW6 2GW, UK).