Heathrow Community Noise and Track-keeping Report: Barnes

This document reports on a 92-day period of continuous noise monitoring from 8 August 2011 to the 8 November 2011 using a Larson Davies LD 870 sound monitor placed at the 'Barnes' wetland site (positioned at 51°28′35.26" N, 0°13′57.50" W, 13ft elevation). All timings are local.

Background

Heathrow Airport is committed to limiting the impact 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.

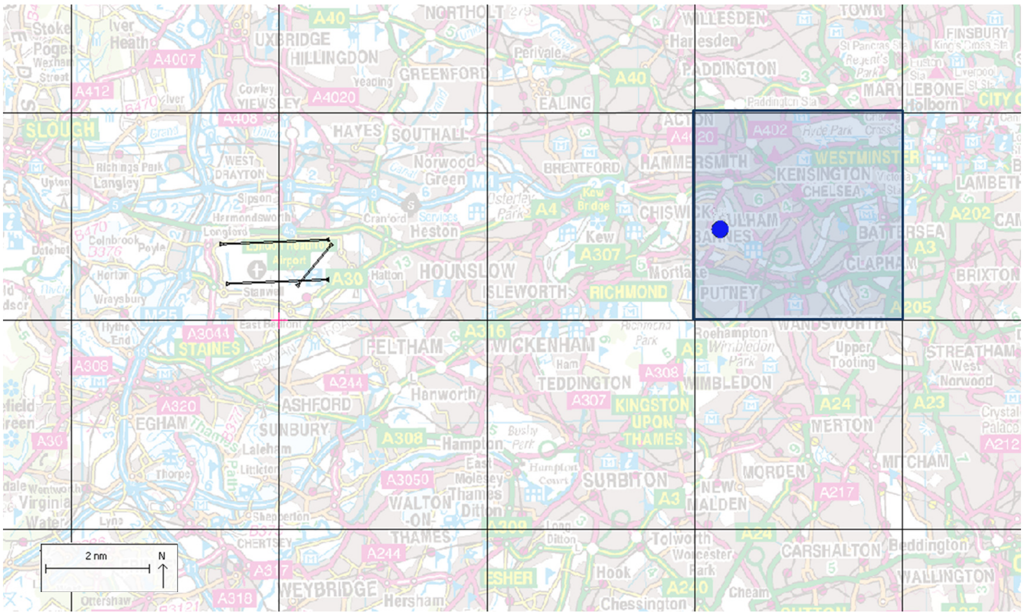


Figure 1. Map of the Heathrow area with noise monitoring grid; position of the noise monitor shown as a blue dot mid-way along the left-hand side of the blue shaded grid (the Barnes community grid square area)

This report describes the noise levels and aircraft tracks affecting the 'Barnes' grid square, shown above. Noise levels were recorded by a temporary noise monitor situated at the Barnes wetland centre close to the A306 road (position indicated by blue dot). The noise monitor site is located between the 55 and 60 L_{DEN} noise contour (average 2010 contours, www.dft.gov.uk), to the east of Heathrow's two runways. Flight movements of air traffic through the grid square were derived from the Airport's noise and track-keeping system. N.B. *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 used when the wind is in an easterly direction, 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 a westerly preference is operated. 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, after which landing aircraft use the first runway again until 06:00. The runway alternation pattern changes by week; in alternation pattern 1 (week commencing 2 January in 2012) the arrivals runway is designated 27R between 06:00-15:00 (Figure 2; 'Westerly operations— 1') and 27L between 1500 and the last departure of the day (Figure 2; 'Westerly operations— 2'). In alternation pattern 2 this order is reversed.

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. On easterly operations, therefore, the majority of departures use the southern runway, 09R, and the majority of arrivals tend to use the northern runway, 09L.

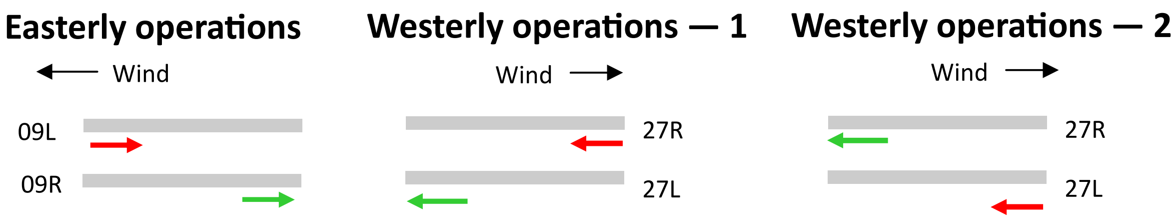


Figure 2. Illustration of the direction of easterly and westerly operations | **Key: Departures → Arrivals →**

Operations during the monitoring period: During the monitoring period Heathrow operated normally, handling a total of 123,715 air traffic movements (arrivals and departures) without interruption (e.g. airport closure due to meteorological activity or industrial action). During the monitoring period, westerly operations prevailed for 76% of the time - higher than the long term average. Over the period, a total of 47,225 westerly arrivals and 46,862 westerly departures operated from Heathrow. Easterly operations were in place for the remaining 24% of the time and these accounted for 14,971 arrivals and 14,657 departures over the monitoring period.

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. To track flights affecting the Barnes grid 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 sometimes count a flight several times if it passes through multiple 'gates').

	Easterly				Westerly			
	Face 1 (N)	Face 2 (E)	Face 3 (S)	Face 4 (W)	Face 1 (N)	Face 2 (E)	Face 3 (S)	Face4 (W)
Arrivals	20	9	5	15	324	46,949	171	60,178
Departures	11	23	18	23	0	0	0	0

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

Arrival flight paths: The Barnes grid square is only materially affected by arriving traffic during westerly operations. During these operations the grid square is overflown by arrivals for the southern and northern runways, 27L and 27R respectively. The distribution of the aircraft arrival flight paths through the most significant 'faces' of the grid 'square' (Face 2 and Face 4) are illustrated in Figure 4 overleaf. These arrivals are destined for 27L and 27R and are being established on the Instrument Landing System (ILS) for final approach. Consequently, the tracks become more laterally concentrated into a very narrow horizontal and vertical range at heights of approximately 2,000-5,000ft, as shown in the figure. These arrivals are significantly more widely distributed horizontally at the eastern face than they are at the western face. The lateral range of the tracks at the easterly face spans from the centre of the grid face to its southerly and northern edges and the vertical distribution at the grid face ranges from heights of 2,500 feet through to heights of approximately 4,500 feet. There are two distinct flight groupings, both of approximately the same size, constituting the arrivals for the Northern runway (centre of grid-face coincident with the position of the noise monitor) and the Southern runway (at an approximate displacement of 0.7 NM to the south).

Departure flight paths: The Barnes grid square is only affected by departing traffic during easterly operations. Hardly any of the 09L and 09R departure traffic passes through the monitoring grid and that which does is at an altitude of at least 4,000ft, having followed the route of the 'Dover' NPR (which avoids the grid square) up to this altitude. Aircraft will, in general, only be vectored 'off' an NPR at an altitude lower than 4000ft for the purposes of weather avoidance. The distribution of the aircraft departure flight paths through the grid are illustrated in Figure 5 overleaf.

Go-arounds and calibration flights: In addition to arriving and departing aircraft, the Barnes grid square also experiences noise generated by aborted landings — or 'go-arounds' (there were 88 westerly go-arounds during the monitoring period). Finally, a small proportion of the air traffic included in Figure 3 arises from tracks generated by calibration flights performed by light aircraft.

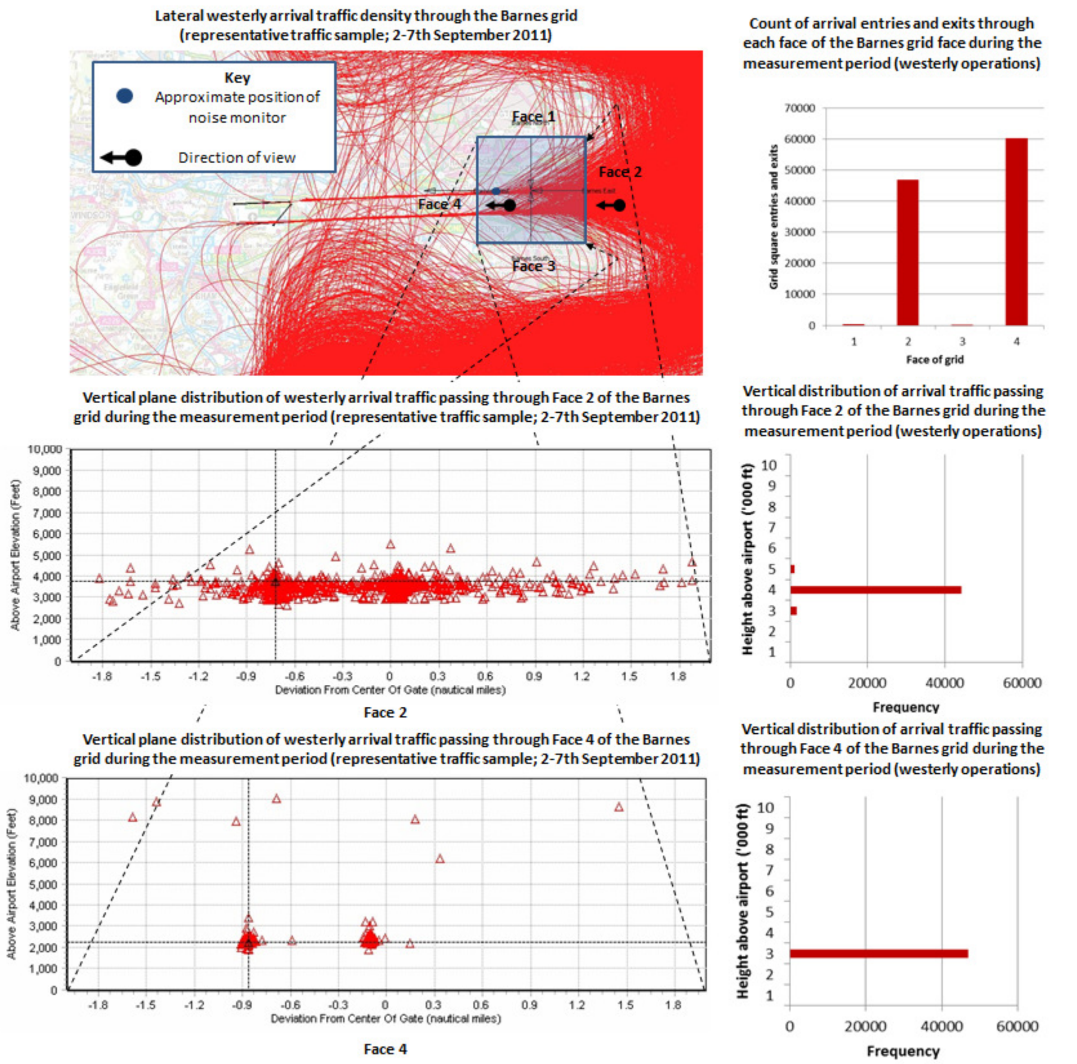


Figure 4. The lateral and vertical distribution of all arriving air traffic passing through Northern (Face 1) and Southern (Face 3) faces of the Barnes grid square during the monitoring period

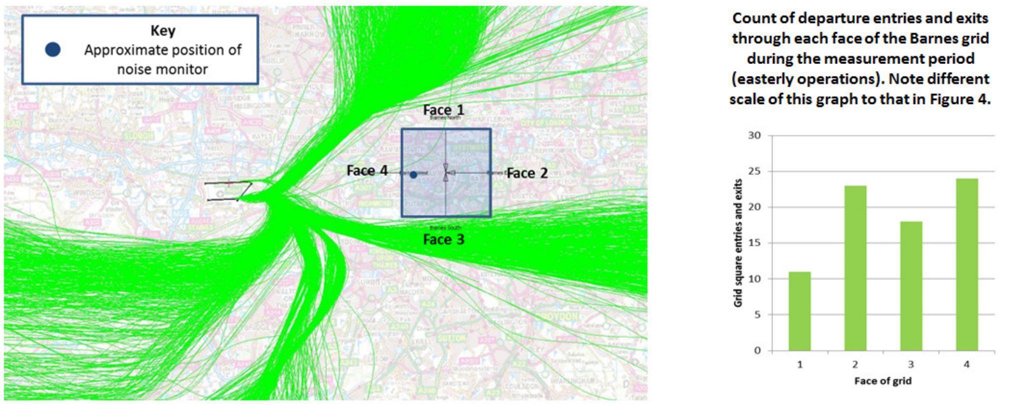
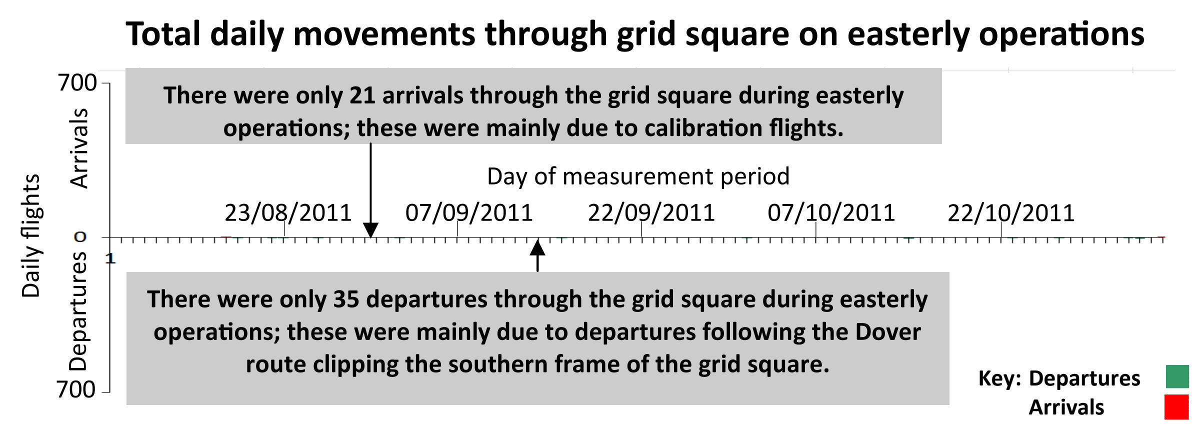
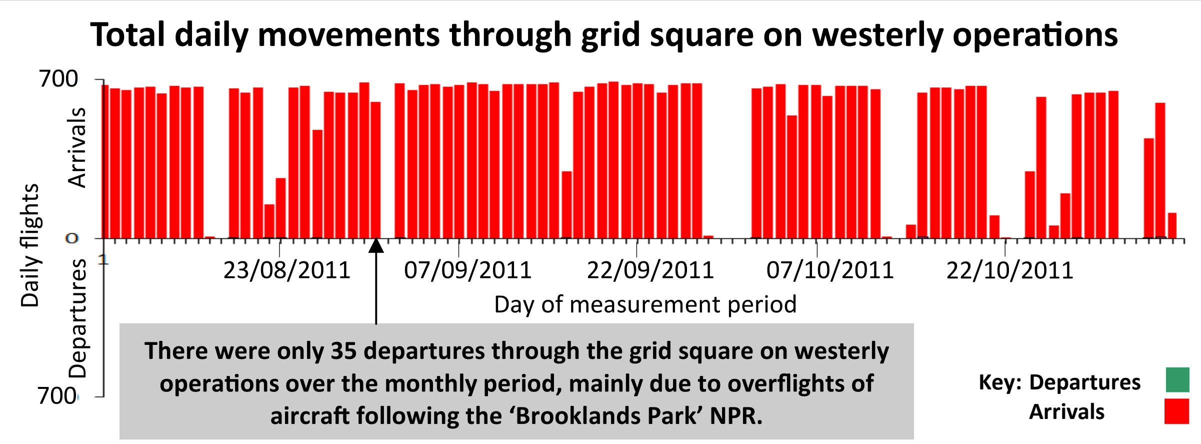
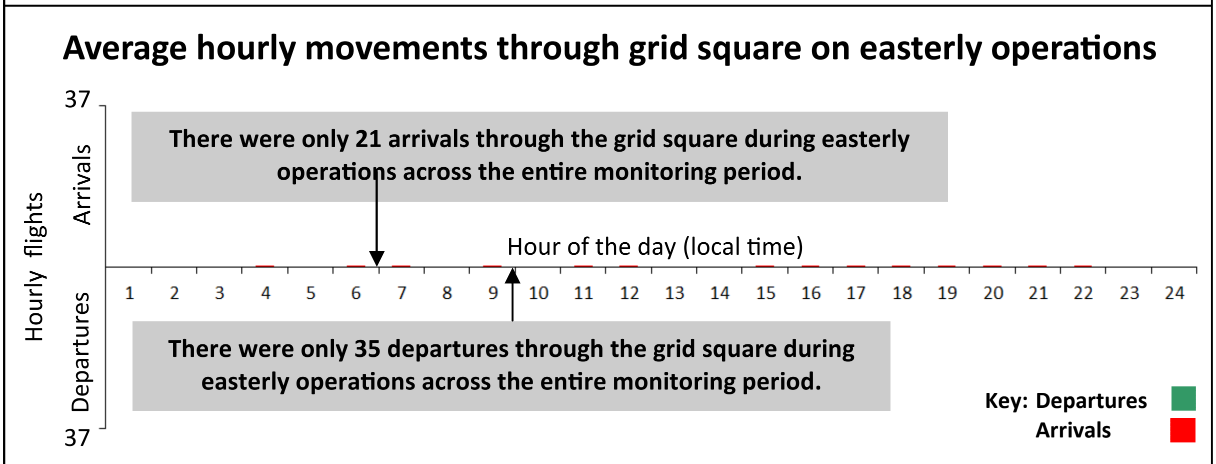


Figure 5. The lateral and vertical distribution of all departing air traffic passing through the Barnes grid

Figure 6 on page 4 demonstrates the proportion of air traffic that passes through the grid square by direction of operation and by hour— indicating that the grid was almost solely influenced by westerly operations for the majority of the monitoring period. When affected by westerly arrivals, the grid square was overflown throughout the day; the lower graph shows that parity of use between the two alternation patterns (note the slightly higher use of alternation pattern 2, reflective of the extra week of that operation over which monitoring took place). During the monitoring period approximately 7% of arrivals operated out of alternation; this was partly due to the 'operational freedoms' trial which is discussed further in the conclusions section.







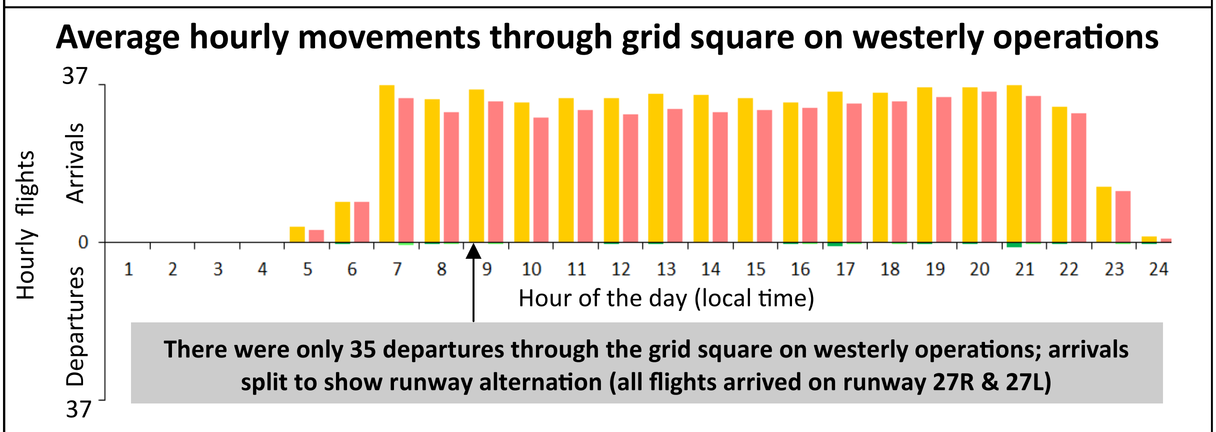


Figure 6. Daily movement totals and hourly mean averages for easterly and westerly operations through the grid square

Arrivals — Departures on alternation pattern 1
Arrivals — Departures on alternation pattern 2

Noise — background noise

The ambient noise recorded by the monitor is generated by both aircraft and other background noise sources including road traffic, vehicle alarms, distant motorways and railway lines. 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 noise monitor over a 24 hour period (black line). Figure 7 also shows the background noise level when separated by mode of operation, either easterly or westerly; as shown in two shades of orange. As can be seen, slightly lower background noise levels were recorded over the daytime period during periods of easterly operation; an easterly wind would mean that the site was upwind of Barnes and the nearby A306 road.

The overall trend in Figure 7 is largely in line with expected results; during the night-time period of 00:00-05:00 hours the average background noise level was less than 40 dBA, rising to over 45 dBA after 06:00 hours for the rest of the day until 21:00-22:00 hours. 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 between the quietest and noisiest days. The overall noisiest day was Thursday 6 October; a day with a strong westerly wind, placing the site downwind of Barnes and the A306 road. The quietest day was Tuesday 8 November; a day with a light easterly wind, placing the site upwind of Barnes and the A306 road.

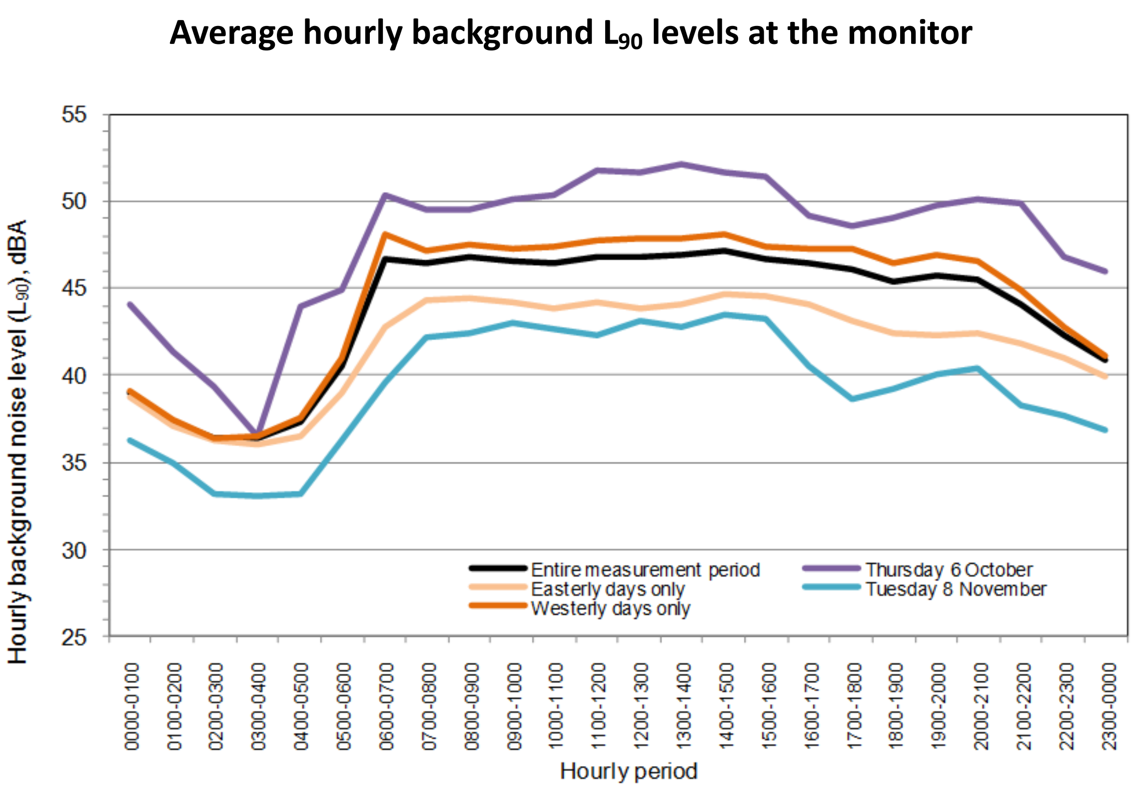


Figure 7. Hourly background L_{90} levels at the monitor averaged over 24 hour period; including Thursday 6 October (noisiest day) and Tuesday 8 November (quietest day)

Noise — significant aircraft noise events

The noise and track keeping monitors were 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 Barnes grid square generated a noise event. During the monitoring period a total of 36,047 aircraft noise events were recorded.

As the noise monitor was positioned close to the extended centreline of runway 27R, westerly arrivals account for nearly all of the noise events recorded at the site (>99%). Figure 8 provides a summary of aircraft noise events by operation and runway after filtering for bad weather (approximately 14% of noise events were rejected due to unacceptable weather conditions, in accordance with international guidelines). Accounting for rejected events, 18,985 noise events were generated by westerly arrivals on runway 27R and 12,022 noise events by arrivals on runway 27L.

As Figure 8 also indicates, the noise and track keeping system logged three noise events for arrivals on runway 09L. These were in fact all caused by the same ILS calibration flight passing over the noise monitor on three separate occasions whilst calibrating the 27R landing system (and the aircraft eventually landed on runway 09L). Thus, a total of 31,010 arrival noise events were recorded at the Barnes monitor after filtering for bad weather.

Figure 9 indicates that medium-sized aircraft (e.g. the A320 family) dominate the overall numbers of aircraft noise events due to the relatively high numbers of these types operating at Heathrow. Figure 10 shows the average (mean) departure and arrival L_{Max} values recorded at the Barnes monitor for each aircraft type. For arrivals, the noisiest aircraft on average was the A330, followed by the B747, A310, A300, and A340. Although the average departure noise levels are also shown in Figure 10 (for the A319, A340 and B777), the sample sizes are too small for any meaningful analysis to be made.

The overall distribution of noise (L_{Max}) 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). The graphs for arrivals indicate that the overall spread of the measured noise levels is generally consistent during each period of the day but that there are much lower numbers of noise events during evening and night due to the lower traffic levels. Although not shown explicitly in Figure 12, it should also be noted that the noise distributions for arrivals are effectively aggregations of two separate distributions; one for arrivals on runway 27R and another for arrivals on 27L (the latter being moderately quieter on average due to the greater distance from the Barnes noise monitor). This pattern is particularly evident in the graph for night arrivals.

Departures (0% of total noise events)					Arrivals (100% of total noise events)				
09L	09R	27L	27R	Total	09L	09R	27L	27R	Total
0 (0%)	6 (0%)	0 (0%)	0 (0%)	6 (0%)	3 (0%)	12,022 (39%)	18,985 (61%)	0 (0%)	31,010 (100%)

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

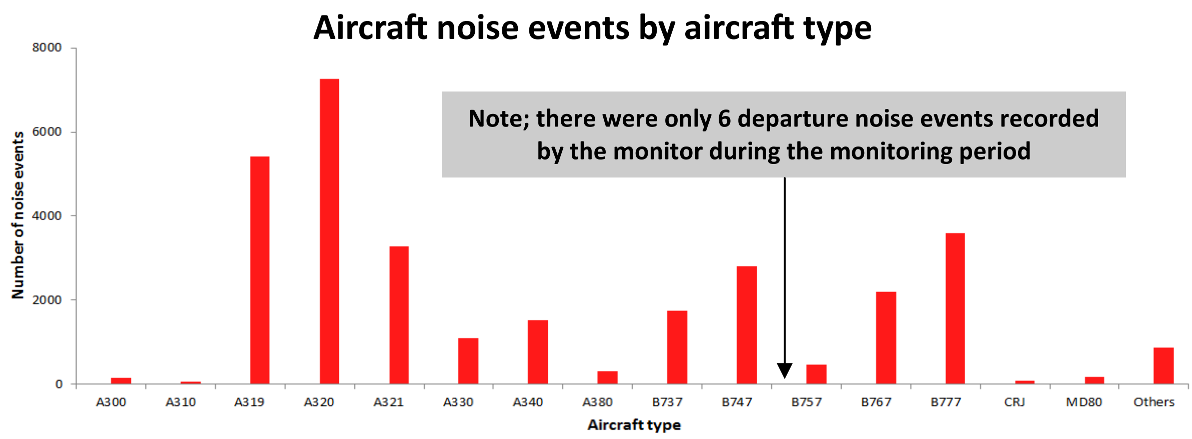


Figure 9. Number of departure and arrival aircraft noise events by aircraft type

Key: Departures (green)
Arrivals (red)

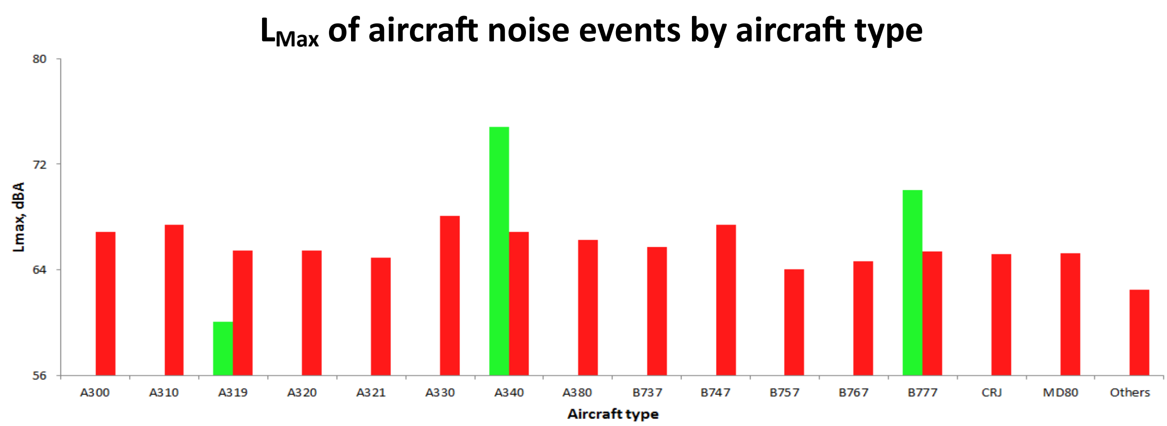


Figure 10. Mean average L_{Max} by aircraft type for departures and arrivals

Key: Departures (green)
Arrivals (red)

Noise distribution for departures and arrivals

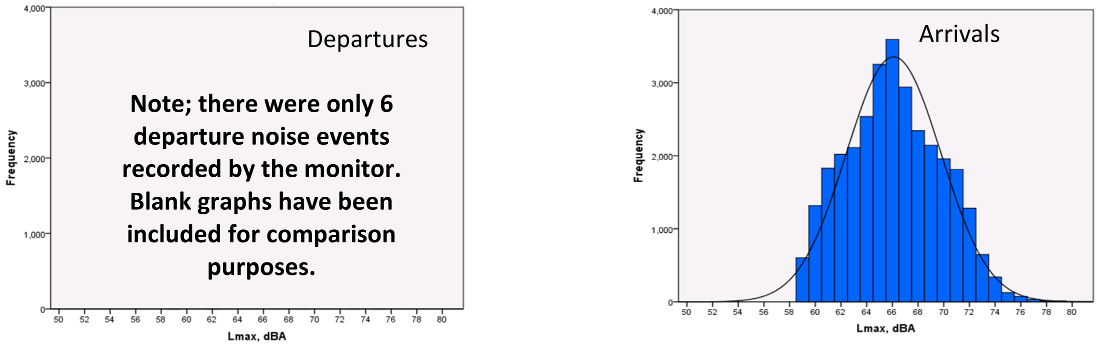


Figure 11. Above left: L_{Max} frequency distribution of departure noise levels
Above right: L_{Max} frequency distribution of arrival noise levels

Noise distribution for departures and arrivals by periods of the day

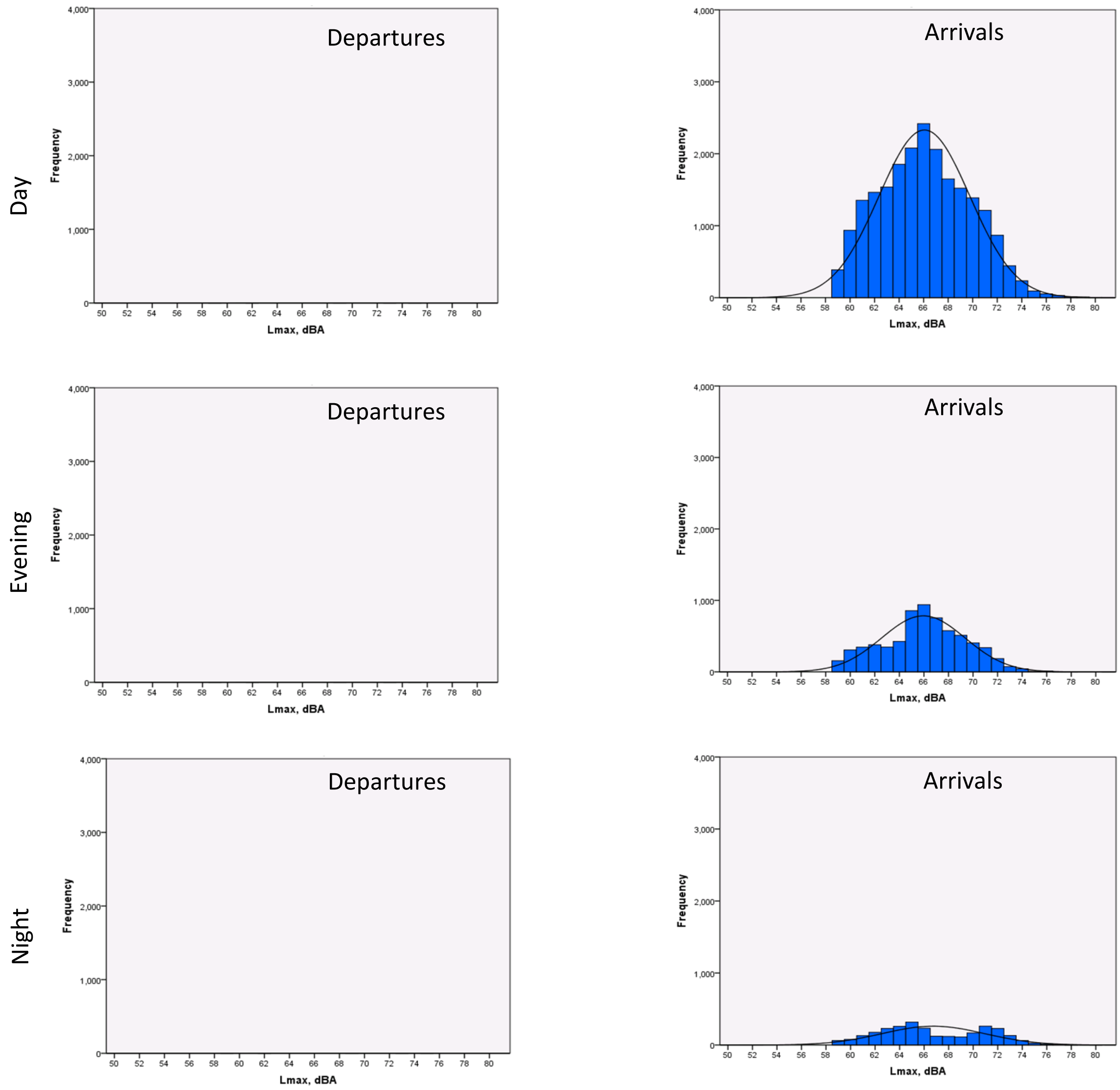


Figure 12. L_{Max} distribution of departure (left) and arrival (right) noise level recorded on the A-weighted sound level over the three averaging periods of L_{Max}(Day — 12 hour period 07:00-19:00), L_{Max}(Evening — 4 hour period 19:00-23:00) and L_{Max}(Night — 8 hour period 23:00-07:00).

Conclusions

This report describes the overflight and aircraft noise experience as measured for the Barnes grid square over a four month (92 day) period from 8th August 2011 to 8th November 2011. During the monitoring period the Barnes grid square was overflown by 123,715 Heathrow arrivals and departures, mainly at altitudes of between 2,000-5,000 ft. These overflights within the grid square are largely confined to the central and southern half of the quadrant. Compared to long-term average for Heathrow Airport, the measurement period experienced a higher proportion of westerly operations overall.

During westerly operations the Barnes grid square experiences approximately equal numbers of overflights by aircraft arriving on the northern and southern runway (as averaged over the two alternation patterns). As the arriving flights are near to touch-down, they are confined to a very narrow lateral and vertical flight path towards the southern part of the grid square and therefore affect a fairly limited area (which becomes more concentrated from East to West as the aircraft establish themselves on the ILS approach for landing).

On westerly days of operation the Barnes site experiences more background noise than it does on days of easterlies; indeed westerly arriving flights account for nearly all of the significant aircraft noise events. It should also be noted that the noise distributions for arrivals are effectively aggregations of two separate distributions; one for arrivals on runway 27R and another for arrivals on 27L (the latter being moderately quieter on average due to its greater distance from the Barnes noise monitor).

The majority of significant aircraft noise events at the Barnes site are generated by medium sized arriving aircraft (such as the A320); reflective of the traffic mix that dominates the operations at Heathrow. Exceptional noise events for arrivals are, almost without exception, caused by the older, heavier and noisier types such as the B747 and A330 and A310 which are due to be phased out from airline fleets over the next 5-10 years. Overall the noisiest aircraft types are generally wide body with the exception of the A300, of which relatively few operate at the airport and are, again, likely to be phased out over the coming years. It should be noted that the departure noise levels reported are based on very small sample sizes and, as such, do not produce statically significant results. The noise distributions measured at the monitoring point indicate that arrivals cause louder and more frequent noise events during the day-time and evening then during the night period (2300-0700) when lower numbers of aircraft noise events means that they be differentiated by runway. Only a very small number of departure noise events were recorded at the Barnes site. This is unsurprising since the monitor was located well outside any of the departure NPRs. After filtering for bad weather only six noise events were generated by easterly departures, all of which were from runway 09R.

The results of the Barnes monitoring period represent a snapshot of the track and noise impact caused on the southern part of the grid square. The results generated for westerly operations are broadly what might be expected in the future. However, the impact of westerly operations may change with the further use of ‘operational freedoms’ at Heathrow, the use of which will depend on the outcome of the current trial and subsequent public consultation (please see reference section for more information).

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, Draft Noise Action Plan 2010-2015 http://www.heathrowairport.com/noise/
- Department for Transport — Heathrow Noise Contours http://www.dft.gov.uk/pgr/aviation/
- Operational Freedoms at Heathrow http://www.heathrowtrial.com/
- South East Airports Task Force http://www.dft.gov.uk/publications/

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.
- L_{90} is the noise level exceeded for 90% of the measurement period and is used to quantify the background level of noise.
- 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 is taking place in two phases, the first from 1 November 2011 to 29 February 2012, the second from 1 July 2012 to 30 September 2012. 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 will look 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.

Noise monitoring 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 Barnes monitor was set with a threshold of 58 dBA, meaning that noise events below 58 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 Barnes, where the background noise level is frequently varying (for example, due to airport ground noise or local road traffic), it becomes 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. However setting the threshold at 58 dBA appeared to be low enough to capture almost the entire distribution of L_{Max} levels during each time period, although the distributions do appear to be slightly truncated at the 58 dBA monitor threshold. This could mean that the average measured aircraft noise levels for some of the quieter aircraft types shown in Figure 10 may be biased slightly upwards.
- Approximately 14% 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).

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