Heathrow Community Noise and Track-keeping Report: Ham Island

This document reports on a 96-day period of continuous noise monitoring from the 26 November 2012 to the 1 March 2013 using a Larson Davies LD 870 sound monitor placed on Ham Lane, Ham Island (positioned at 51° 27′ 54.94″ N, 0° 34′ 9.08″ W, 62 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.

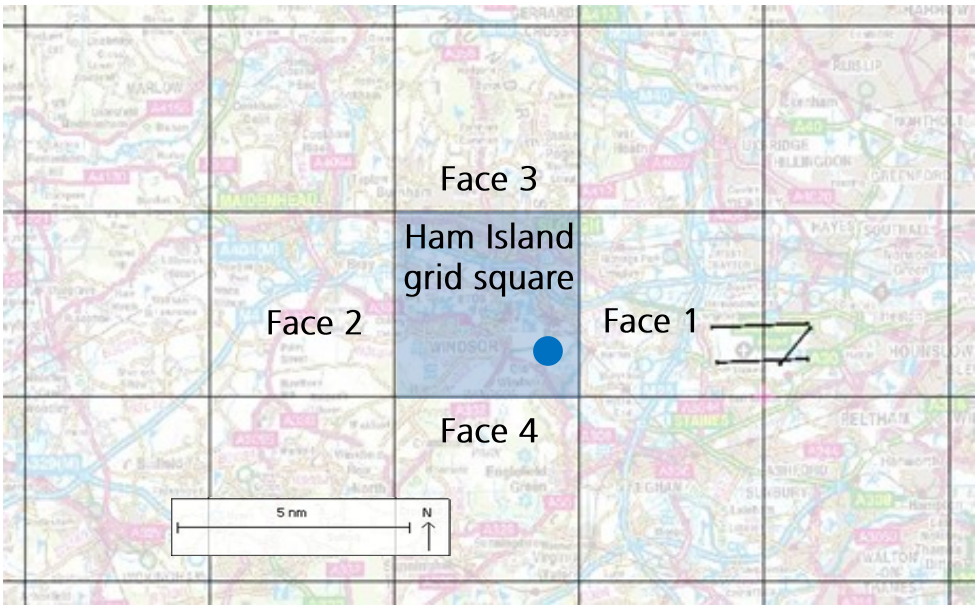

Figure 1. Map of the Heathrow area with noise monitoring grid; position of the noise monitor shown as a blue dot in the blue shaded grid (the Ham Island community grid square)

This report describes the noise levels and aircraft tracks affecting the 'Ham Island' grid square, shown above. Noise levels were recorded by a temporary noise monitor situated in a rural location on Ham Island (position indicated by blue dot). The noise monitor site was located to the west of Heathrow's two runways, close to the extended centre line of runway 09R and several of the westerly departure routes, and between the 60 and 63 L_{eq} noise contours (average 2011 contours, see references on page 9). 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 2 January in 2012) 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.

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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.

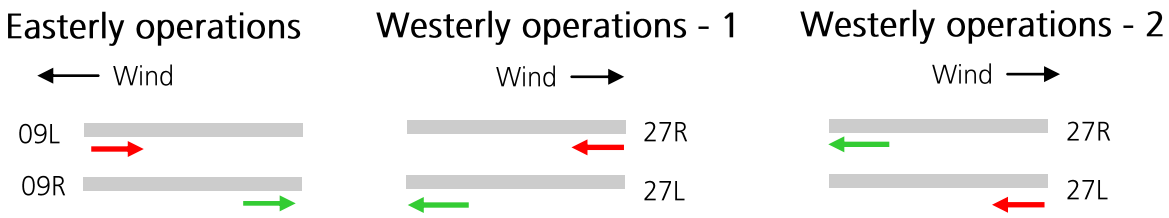

Figure 2. Illustration of the direction of easterly and westerly operations | Key: Departures → Arrivals →

Operations during the monitoring period: During the monitoring period Heathrow operated normally, handling a total of 118,176 air traffic movements (arrivals and departures). The airport did suffer from disruption due to adverse weather on the 12 December (freezing fog) and the 18-21 January (snow). As is typical for the time of year, there was also a planned reduction in the schedule on Christmas Eve, Christmas Day, Boxing Day, New Year's Eve and New Year's Day. In addition the second phase of Operational Freedoms and an early morning noise respite arrival trial were running during this monitoring period. During the monitoring period, westerly operations prevailed for 67% of the time - similar to the long term average - with a total of 39,371 westerly arrivals and 39,407 westerly departures taking place. Easterly operations were in place for the remaining 33% of the time and these accounted for 19,718 arrivals and 19,680 departures during 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. During the monitoring period the flight monitor processing programme recorded 0.2% fewer flights than the runway logs due to technical reasons (see Additional Information on page 9). To track flights affecting the Ham Island 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 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	19,855	19,812	70	57	10	6	5	3
Departures	3	13	0	12	28,814	9,664	11,735	7,367

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)

Arrival flight paths: During easterly operations the Ham Island grid is primarily overflown by arrivals landing on the northern and southern runways, 09L and 09R respectively. Figure 4 overleaf shows the lateral distribution of arriving flight paths through the grid and the vertical distribution through Face 1. The images show that landing aircraft are concentrated laterally and vertically in two groups as they exit the grid through Face 1 (indicated by two black circles). This is because the aircraft are established on the Instrument Landing System (ILS) for final approach. The larger concentration of arrivals for runway 09L reflects of 90% of easterly arrivals landing on this runway during the representative sample of days analysed. Landing aircraft typically enter the grid (Face 2) above 2,000 feet and exit it between 900 feet and 1,200 feet (Face 1). A very small number of easterly arrivals also overfly the grid, generally at heights above 6,000 feet, prior to commencing their approach. Similarly during westerly operations a very small number of arrivals will occasionally also overfly the grid prior to commencing their approach.

Departure flight paths: Aircraft departing Heathrow follow pre-defined Standard Instrument Departure (SID) routes, usually based upon the destination of the aircraft. The Ham Island grid is usually only overflown by departing aircraft during westerly operations. Figure 5 overleaf shows the lateral distribution of departing flight paths through the grid and the vertical distribution through Face 1. On westerly operations, aircraft following the Brookmans Park and Wobun SIDs overfly the northern half of the grid, and aircraft departing on the Compton, Midhurst and Southampton SIDs (as well as some of the aircraft that depart from runway 27R and follow the Dover SID) overfly the southern half of the grid. Approximately 95% of westerly departures enter the grid (Face 1) between 1,000 and 4,000 feet, and over 80% of departures exit the grid between 2,000 and 6,000 feet. Additionally,14 departures following the Compton SID overflew the grid during easterly operations. All these aircraft were above 4,000 feet and would have been vectored by air traffic control.

Go-arounds: In addition to arriving and departing aircraft, the Ham Island grid also experiences noise generated by aborted landings or 'go-arounds' on westerly operations. During the monitoring period seven westerly go-arounds overflew the grid.

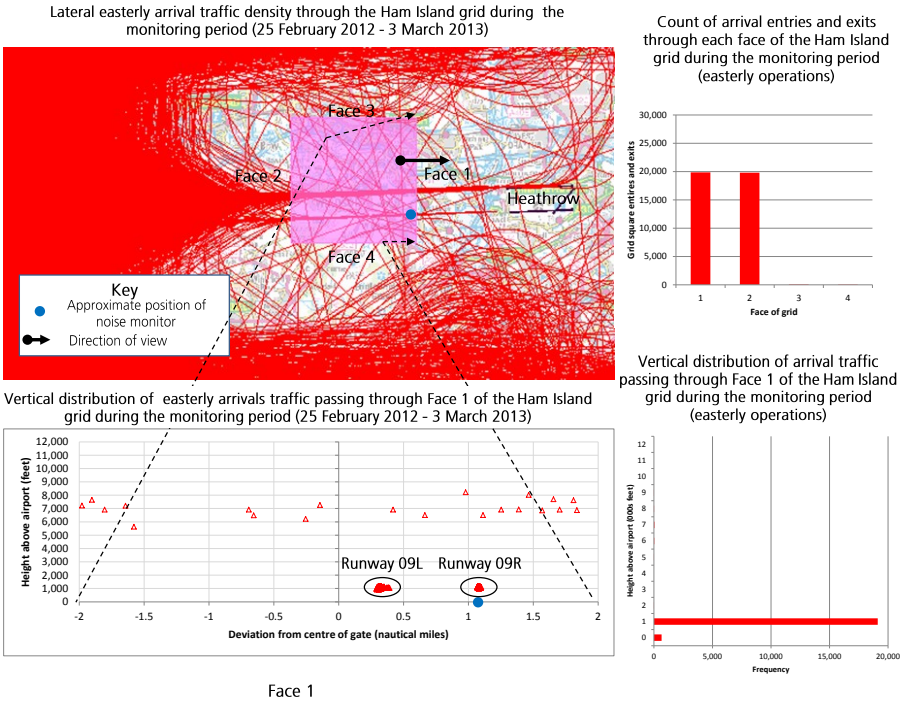

Figure 4. Lateral and vertical distribution of arriving air traffic passing through the Ham Island grid during the monitoring period (easterly operations) - representative sample (Heathrow flights only)

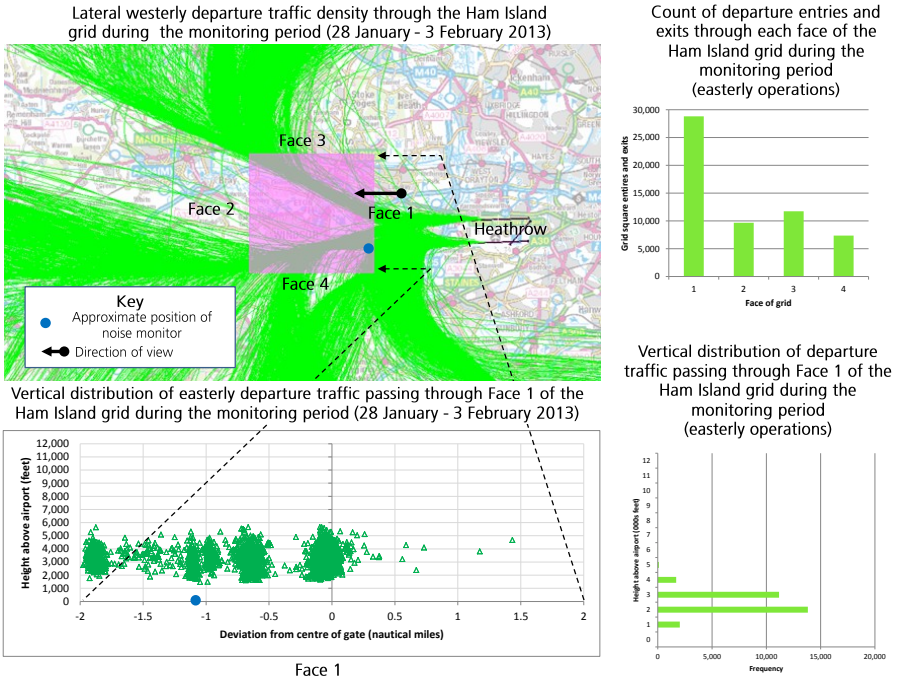

Figure 5. Lateral and vertical distribution of departing air traffic passing through the Ham Island grid during the monitoring period (westerly operations) - representative sample (Heathrow flights only)

Figure 6 overleaf shows the proportion of aircraft that passed through the grid by direction of runway operation and hour. During the monitoring period the grid was overflown throughout the main hours of operation by arrivals on days of easterly operations and departures on days of westerly operations. Being under Heathrow's final approach paths, all arrivals landing on the easterly runways overflew the grid. Fewer aircraft overflew the grid on days of westerly operations as not all of Heathrow's departure routes pass through the Ham Island grid. Of the westerly departures that did overfly the grid during the monitoring period, a very small number (less than 0.3%) operated out of alternation for safety reasons. There is no runway alternation pattern for easterly operations.

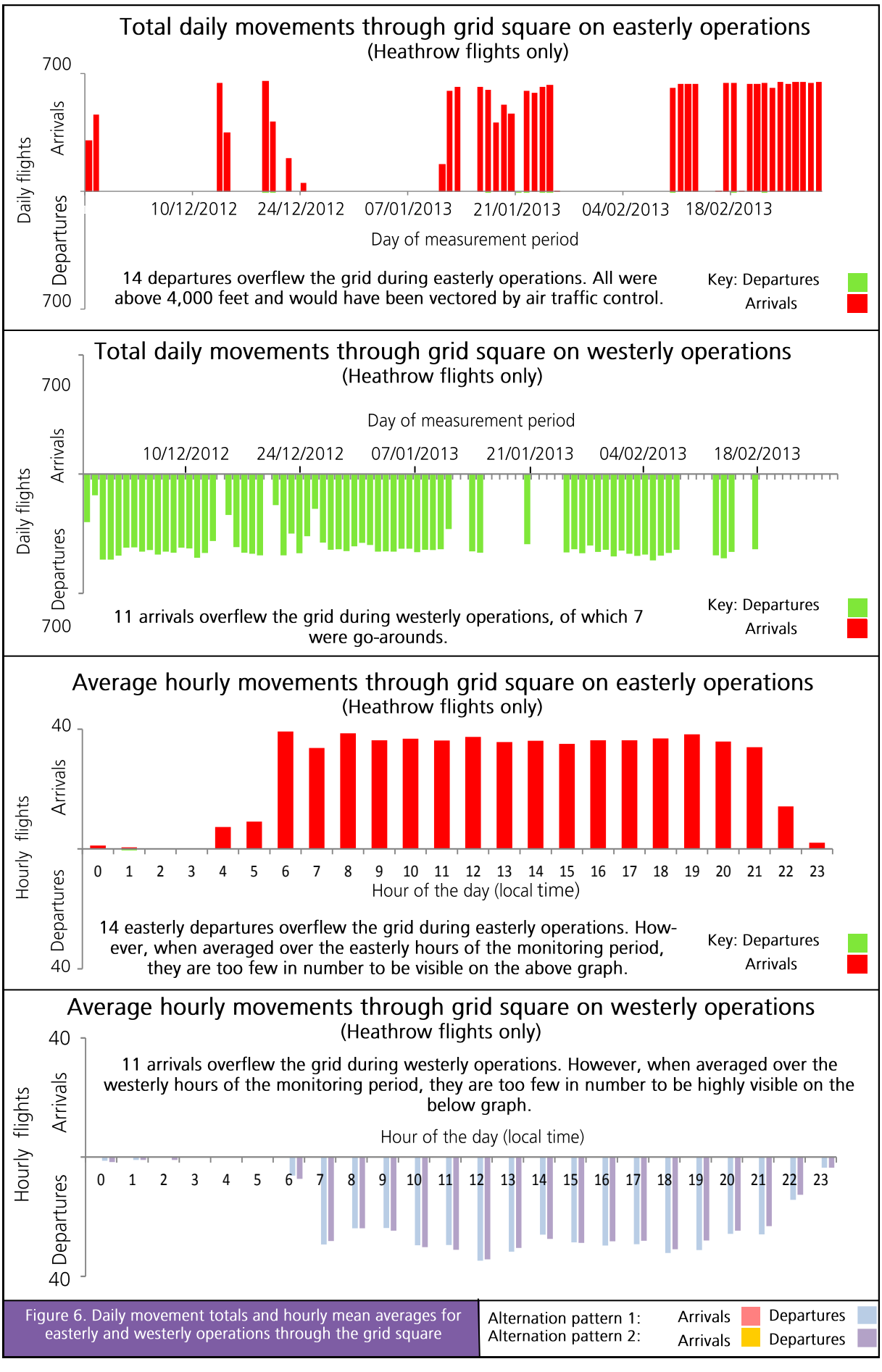

Figure 6. Daily movement totals and hourly mean averages for easterly and westerly operations through the grid square

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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 Ham Island 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, background noise levels are generally comparable for each mode of operation although, on average, slightly higher background noise levels were recorded during periods of easterly operation, when the prevailing wind direction would generally place the site downwind of the M25 motorway.

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 43 dBA or more after 06:00 hours for the rest of the day until 22:00 hours. This broadly coincides with 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 15 dBA or more between the quietest and noisiest days. The overall noisiest day was Thursday 29 November; a day with a light north-westerly wind, placing the site downwind of the M4 (with clear peaks in the hourly background level caused by the morning and evening rush-hour periods).The quietest day was Monday 21 January; a day with a light south-westerly wind, placing the site upwind of the M25 and M4 (on that day, the airport was also subject to some disruption due to adverse weather – see page 2).

Average hourly background L_{90} levels at the monitor

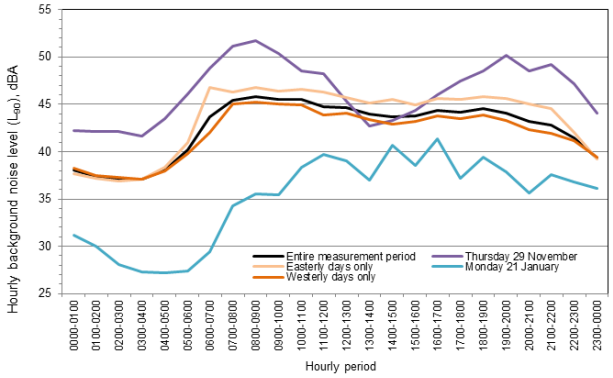

Figure 7. Hourly background L_{90} levels at the monitor averaged over 24 hour period; including Thursday 29 November (noisiest day) and Monday 21 January (quietest day)

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 Ham Island grid square generates a noise event. During the monitoring period a total of 31,094 noise events were recorded.

The noise monitor was positioned close to several of the westerly departure routes. Despite the site also being located close to the extended centreline of runway 09R, departures account for nearly all of the noise events recorded at the monitor (94%). This is unsurprising since during periods of easterly operations the majority of arrivals tend to use the northern runway, 09L (see Page 2). Figure 8 provides a summary of aircraft noise events by operation and runway after filtering for bad weather (approximately 17% of noise events were rejected due to unacceptable weather conditions in accordance with international guidelines).

Accounting for rejected events, 24,179 noise events were generated by westerly departures and 1,496 noise events by easterly arrivals. As Figure 8 also indicates, the noise and track keeping system logged one valid noise event for a departure on runway 09R (a B777 departing on the easterly Compton SID) and one noise event for an arrival on runway 27L. The arrival noise event was in fact caused by an A321 departure from runway 27R that experienced engine trouble on take-off and performed a go-around, eventually landing on runway 27L (thus recorded as an arrival by the NTK system). In summary, a total of 25,677 noise events were recorded at the Ham Island monitor after filtering for bad weather.

Figure 9 indicates that medium-sized aircraft (e.g. the A320 family) and, to a lesser extent, the wide-bodied B777, dominate the overall number of departure 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 Ham Island monitor for each aircraft type. For departures, the noisiest aircraft on average was the B747, followed by the B767, A330 and B777.

For arrivals (and excluding the result for the MD80, for which there were only two recorded noise events), the noisiest aircraft on average was the A300, followed by the A380, B757 and A340. Unexpectedly the quietest aircraft on average was the B747. This can be explained as follows: Due to the greater distance from the Ham Island monitor, arrivals on runway 09L were typically measured as being between 10-15 dB quieter than arrivals on 09R. Thus, even though the significant majority of easterly arrivals tend to use the northern runway, many of them were too quiet to be recorded by the monitor. The exception however was the B747, for which a higher proportion of noise events were caused by arrivals on runway 09L than on 09R. For all other aircraft types, a higher proportion of (noisier) 09R arrivals were recorded by the monitor. This meant that the overall average L_{Max} value was biased downwards to a greater extent for the B747 than for any other aircraft type. If 09L arrivals are excluded from the analysis then the B747 would be the noisiest aircraft on average at the Ham Island monitor location.

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 for arrivals and departures by time period (day, evening and night). In Figures 11 and 12 it is apparent that the noise distributions for arrivals are effectively aggregations of two separate distributions; one for arrivals on runway 09R and another for arrivals on 09L. As explained above, 09L arrivals were measured as being significantly quieter due to the greater distance from the Ham Island noise monitor. The aggregated arrival results should therefore be treated with some caution and considered in light of the observation made above regarding the result for the B747.

The graphs for departures 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. It is apparent from these figures that the distributions for departures appear slightly skewed (asymmetrical) because they are truncated at the 62 dBA monitor threshold. The use of this threshold is explained further on page 9. The graphs suggest a small proportion of quieter departure events were not recorded at the monitor, which means that the average measured noise levels for some of the quieter aircraft types shown in Figure 10 may be biased slightly upwards.

Departures (94% of total noise events)					Arrivals (6% of total noise events)				
09L	09R	27L	27R	Total	09L	09R	27L	27R	Total
0	1	9,829	14,350	24,180	707	789	1	0	1,497

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

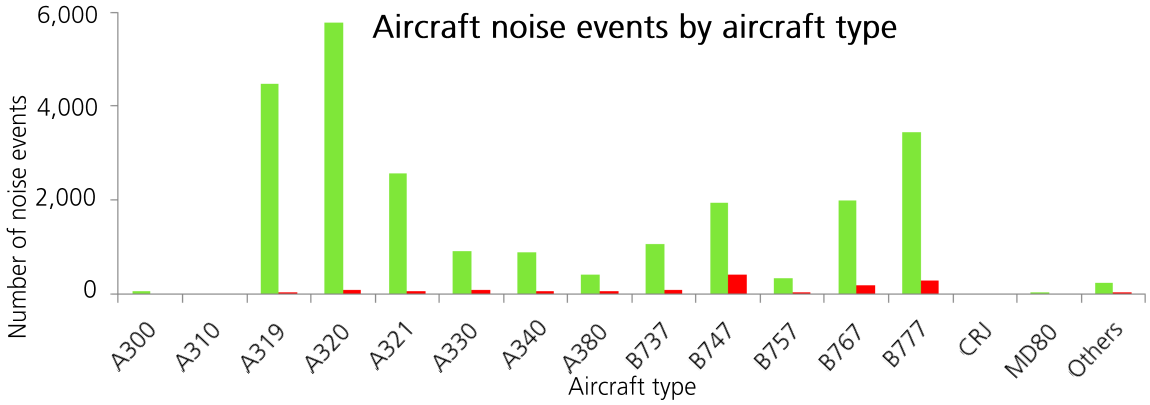

Figure 9. Number of departure and arrival aircraft noise events by aircraft type

Key: Departures Arrivals

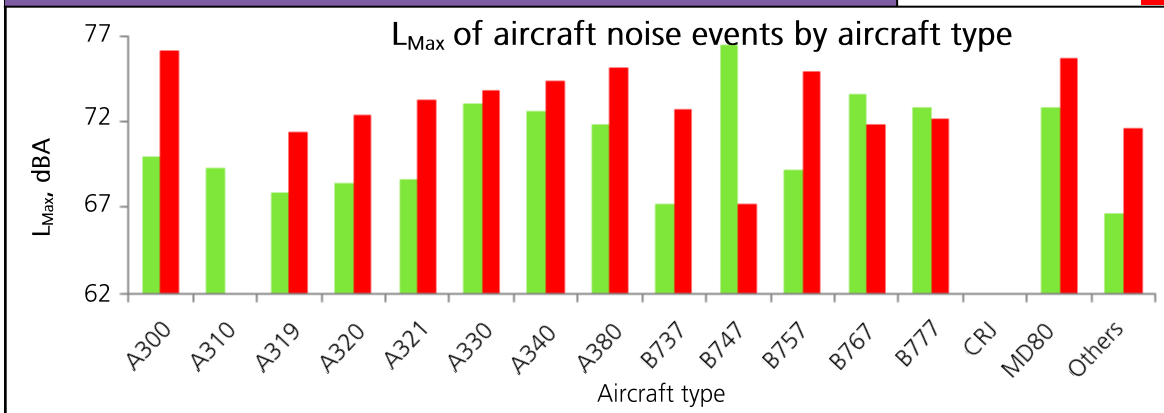

Figure 10. Average (mean) L_{Max} by aircraft type for departures and arrivals

Key: Departures Arrivals

Noise distribution for departures and arrivals

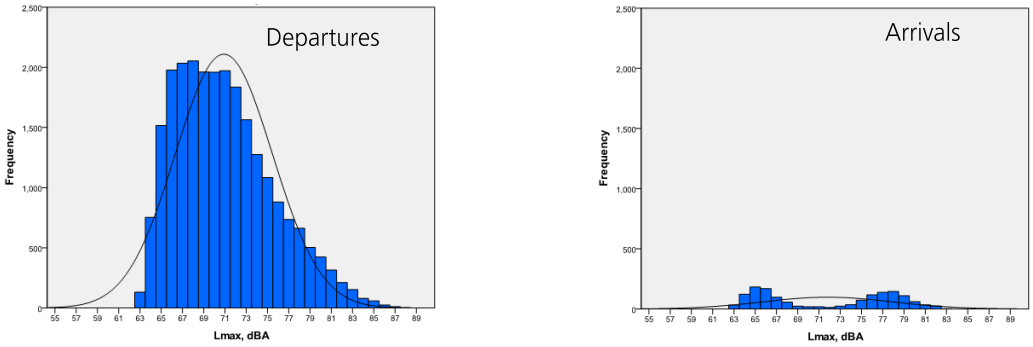

Figure 11. Above left: L_{Max} frequency distribution of departure noise levels
Above right: L_{Max} frequency distribution of arrival noise levels

Noise distribution for departures and arrivals by periods of the day

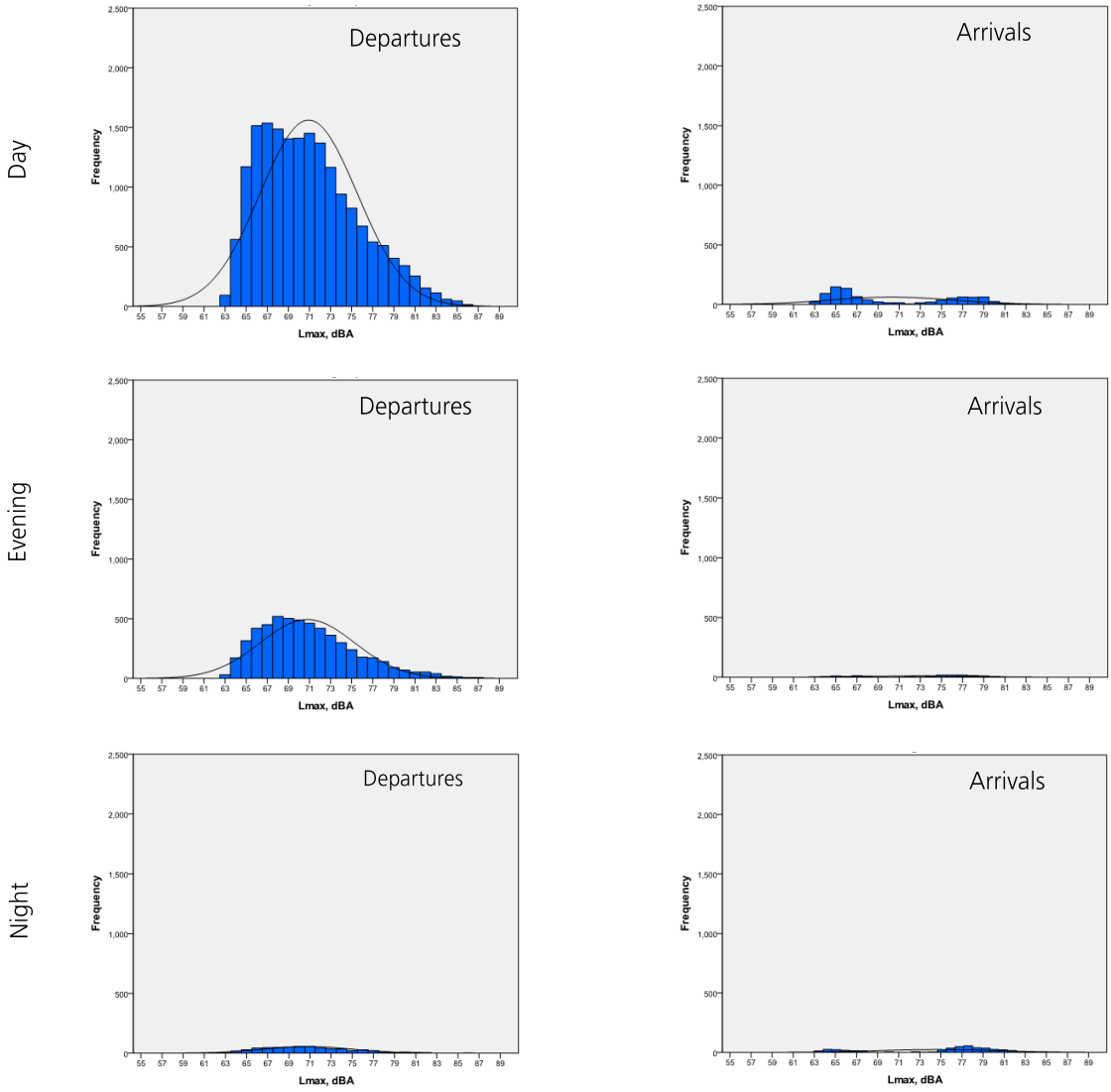

Figure 12. L_{Max} distribution of departure (left) and arrival (right) noise level recorded on the A-weighted sound level over the three averaging periods of L_{Max} (Day — 12 hour period 07:00-19:00), L_{Max} (Evening — 4 hour period 19:00-23:00) and L_{Max} (Night — 8 hour period 23:00-07:00)

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Conclusions

Background

This report describes the overflight and noise experience measured for the Ham Island grid square over a 96-day period from the 26 November 2012 to the 1 March 2013. During the monitoring period the grid square was overflown by a total of 118,176 Heathrow arrivals and departures.

Heathrow operates in either a westerly or easterly direction, primarily due to prevailing wind conditions. During the monitoring period the proportion of easterly and westerly operations was similar to the long-term average.

Flight movements

Given its proximity to Heathrow, the Ham Island grid is overflown by arriving aircraft throughout the main hours of operation when the runways are operating in an easterly direction. Being close to touchdown, the flight paths of these aircraft are concentrated laterally and vertically in two streams, one for runway 09L and the other for runway 09R. As there is no runway alternation during the day for easterly operations, the vast majority will land on runway 09L. Landing aircraft typically enter the grid above 2,000 feet and exit between 900 feet and 1,200 feet.

During westerly operations the Ham Island grid is oveflown by departing aircraft throughout the main hours of operation. However, fewer aircraft overfly the grid on days of westerly operations as not all of Heathrow's departure routes pass through the grid. The northern half of the grid is overflown by departing aircraft following the Brookmans Park and Wobun Standard Instrument Departure (SID) routes, whereas aircraft following the Compton, Midhurst and Southampton SIDs (as well as some of the aircraft that depart from runway 27R and follow the Dover SID) overfly the southern half of the grid. Departing aircraft will typically enter the grid above 1,000 feet and exit between 2,000 and 6,000 feet. In addition to departures, the grid also experiences noise from aborted landings during westerly operations. However, during the monitoring period only seven aborted landings overflew the grid.

Noise

The noise monitor site was located to the west of Heathrow's two runways, close to the extended centre line of runway 09R and several of the westerly departure routes. The overall trend in background noise levels measured at the monitoring site broadly coincided with daytime increases in road traffic levels. On days of easterly operations the monitoring site was downwind of the M25 motorway and consequently experienced slightly higher background noise than on days of westerly operations.

Nearly all the aircraft noise events recorded above a pre-defined threshold level of 62 dBA were for departing aircraft on westerly operations. Despite being located close to the extended centre line of runway 09R, only a comparatively small number of noise events due to arriving aircraft were recorded during easterly operations. This is unsurprising as the vast majority of arriving aircraft tend to land on runway 09L— the distance of this runway from the monitoring site meant that the vast majority of the aircraft landing on runway 09L did not register a noise event above the pre-defined threshold.

The majority of aircraft noise events generated were by medium-sized aircraft (e.g. the A320 family), which reflects the traffic mix at Heathrow. For departing aircraft the noisiest aircraft on average was the B747, followed by the B767, A330, and B777. For arrivals the noisiest aircraft on average was the A300, followed by the A380, B757, and A340. Unlike other aircraft types, more noise events were collected for B747s landing on 09L than 09R which overall resulted in the B747 appearing to be the quietest arriving aircraft. However, when noise events measured for arrivals on 09L are excluded, the B747 was the noisiest arriving aircraft

For departures, the noise distributions measured at the monitoring site were generally consistent for each period of the day but with fewer events during the evening and night due to the lower traffic levels. For arrivals, the distributions were an aggregate of noise events for aircraft landing on runways 09L and 09R and should therefore be treated with caution.

Summary

The results of the Ham Island monitoring period represent a snapshot of the track and noise impact. The results generated for easterly operations are broadly what might be expected in the future. It should be noted that during this period some of the departing aircraft that registered noise events were subject to the Operational Freedoms Trial that is now complete (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, 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

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 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 Ham Island monitor was set with a threshold of 62 dBA, meaning that noise events below 62 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 Ham Island, where the background noise level is frequently varying (for example, due to road traffic noise), 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 62 dBA appeared to be low enough to capture almost the entire distribution of departure L_{Max} levels during each time period, although the distributions do appear to be slightly truncated at the 62 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. In addition, the average measured arrival noise levels are effectively aggregations of two separate distributions; one for arrivals on runway 09R and another for arrivals on 09L (with measurements for the latter being truncated by the 62 dBA monitor threshold).
- Approximately 17% 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. 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 did 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.

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).