Heathrow Community Noise and Track-keeping Report: Feltham

This document reports on a 124-day period of continuous noise monitoring from the 15 May 2014 to the 15 September 2014 using a Larson Davies LD 870 sound monitor placed at the West Middlesex Crematorium in Feltham (positioned at 51° 26' 51.1"N, 0° 23' 21.70"W, 59 feet elevation). It reports on both normal operations and two airspace trials that took place during the monitoring period. 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. The Airport has agreed with local stakeholders 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 4 nautical mile by 4 nautical mile 'grid'. The impact on the community within the grid square is then reported at the end of the monitoring period.

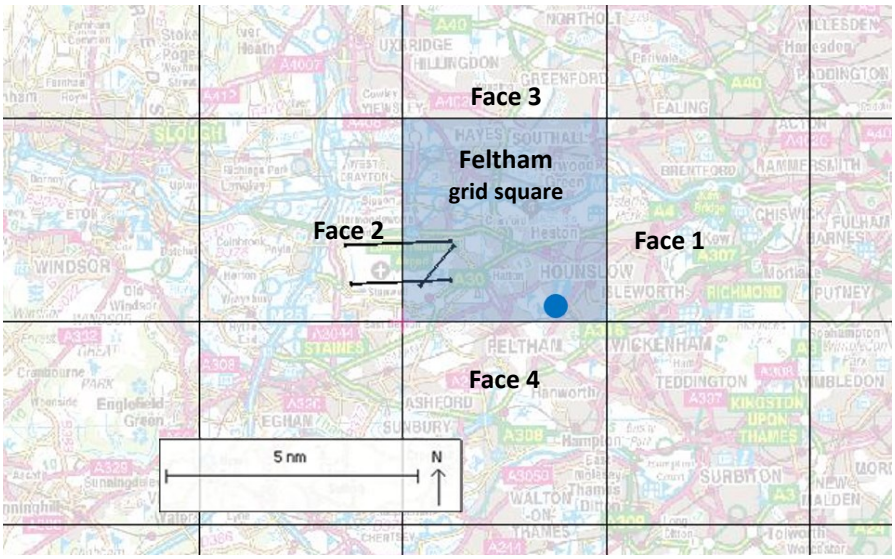


Figure 1. Map of the Heathrow area with noise monitoring grid; position of the noise monitor shown as a blue dot in the blue shaded grid (the Feltham grid)

This report describes the noise levels and aircraft tracks affecting the Feltham grid square, shown above. Noise levels were recorded by a temporary noise monitor situated in the grounds of the South West Middlesex Crematorium in Feltham (approximate position indicated by blue dot). The monitoring site was positioned under the easterly Midhurst (MID), Compton (CPT) and Southampton (SAM) Noise Preferential Routes (NPRs), and on the edge of the Detling (DET) NPR. These routes are used by approximately 60% of the Heathrow departures that take-off from runways 09R and 09L. The site was also located at the edge of the 60 L_{eq} noise contour (average 2013 contours). 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 13.

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 13 January in 2014) 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 (continued on page 2).

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

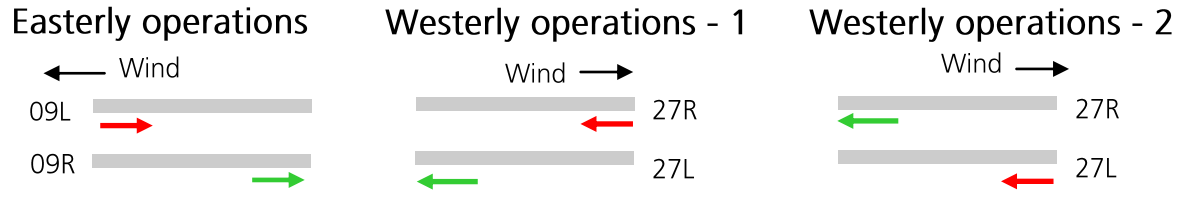


Figure 2. Illustration of the direction of easterly and westerly operations

Key: Departures → Arrivals →

Operations during the monitoring period: During the monitoring period, Heathrow handled a total of 166,299 air traffic movements (83,148 arrivals and 83,151 departures). Westerly operations prevailed for 67% of the time - just below the long term average - with a total of 55,620 westerly arrivals and 55,874 westerly departures taking place. Easterly operations were in place for the remaining 33% of the time and these accounted for 27,528 arrivals and 27,277 departures. During the noise monitoring period, Heathrow ran a series of airspace trials to inform future thinking on airspace design. The trials involved departing aircraft only; there were no changes to the flight paths of arriving aircraft (these trials are explained on page 4).

Flight path information is derived from radar data using a flight monitor processing programme (ANOMS) endorsed by the CAA. A public version of this flight tracking software, 'WebTrak', is available on Heathrow Airport's noise website. To track flights affecting the Feltham grid 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	80	194	152	100	56,152	160	432	737
Departures	13,761	0	17	13,411	0	0	0	0

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)

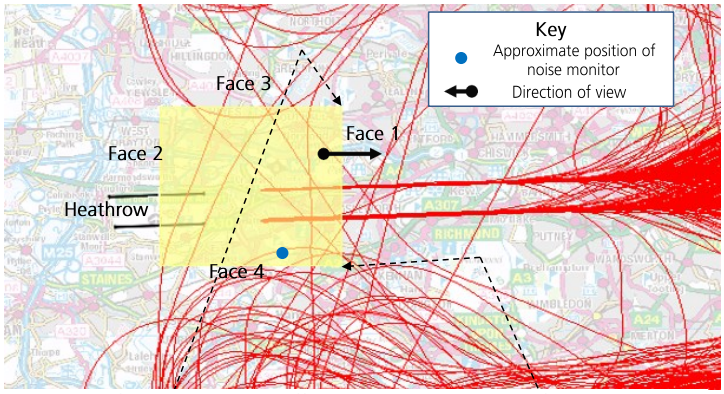
Normal operations during the monitoring period: The following text describes the flight paths of aircraft in the Feltham grid during typical ('normal') operations (trial periods are described separately on page 4).

Arrival flight paths (normal operations): During westerly operations the Feltham grid is overflown by all arriving aircraft landing on runways 27L and 27R. Figure 4 on page 3 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 enter the grid through Face 1 (indicated by two black circles), with 99% of landing aircraft being between 900 and 1,200 feet (69% of them between 1,000 and 1,100 feet). This is because the aircraft are only a short distance from touchdown and established on the Instrument Landing System (ILS) for final approach. A small number of easterly arrivals also overflew the grid, generally at heights above 6,000 feet, prior to commencing their approach to runways 09L and 09R.

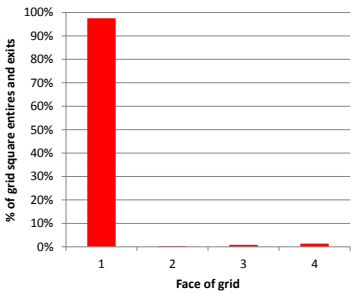
Departure flight paths (normal operations): During easterly operations the Feltham grid is overflown by all departing aircraft taking off from runways 09L and 09R. Due to there being no runway alternation during the day on easterly operations, 99.7% of easterly departures during the monitoring period took-off from runway 09R. Figure 5 overleaf shows the tracks of departing aircraft during a day of normal operations. This shows aircraft tracks to be laterally concentrated into several groups and reflects them following pre-defined Standard Instrument Departure (SID) routes, usually based on the destination of the aircraft. Aircraft departing to the north east are following the Brookmans Park and Buzad SIDs, while those departing to the south/east are following the Compton, Midhurst, Southampton and Detling SIDs. Figure 5 also shows the lateral and vertical distribution of flights through the southern face (Face 4) of the grid. This shows that the majority (86%) of easterly departures will exit the southern face of the grid above 2,000 feet. All westerly departures commence their take-off roll inside the grid but are not included in this noise report as they will not have left the ground or are not visible to radar when exiting the westerly face of the grid. No westerly departures overflew the grid during the monitoring period.

Go-arounds and calibration flights: In addition to arriving and departing aircraft, the Feltham grid also experiences noise generated by aborted landings or 'go-arounds', and calibration flights. During the monitoring period 100 easterly go-arounds overflew the grid. Calibration flights took place on the 30 and 31 August.

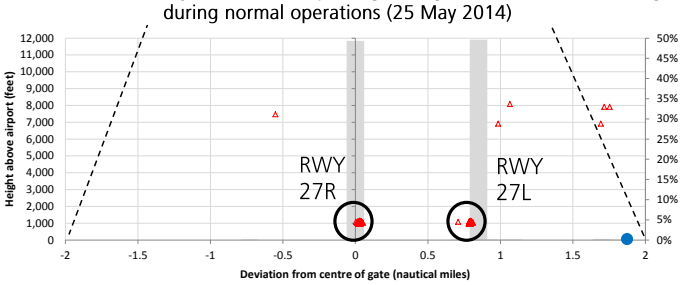
Lateral westerly arrival traffic density through the Feltham grid during normal operations (25 May 2014)



Arrival entries and exits through each face of the Feltham grid during normal operations (westerly arrivals)



Distribution of westerly arrivals traffic passing through Face 1 of the Feltham grid during normal operations (25 May 2014)



Face 1

Vertical distribution of arrival traffic passing through Face 1 of the Feltham grid during normal operations (westerly arrivals)

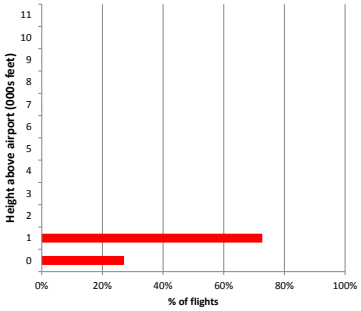
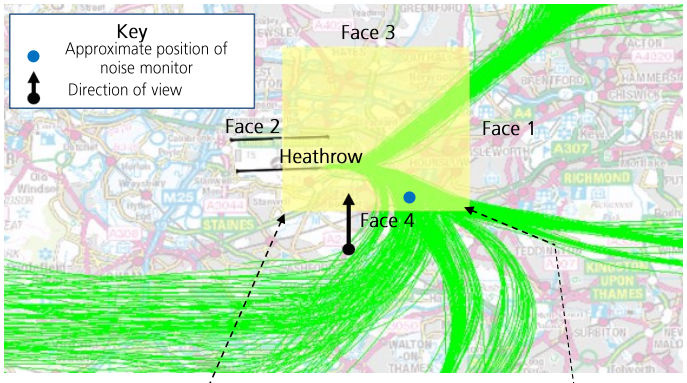
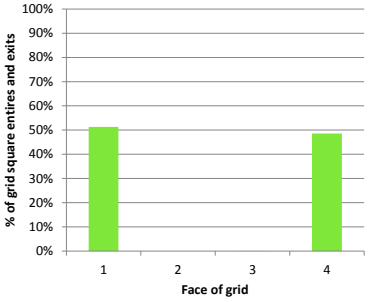


Figure 4. Lateral and vertical distribution of arriving air traffic passing through the Feltham grid during normal operations (westerly arrivals) - representative sample (Heathrow flights only)

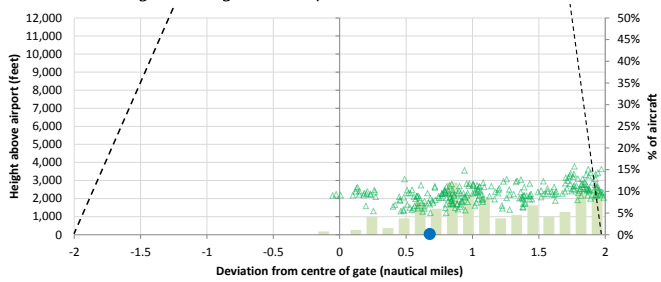
Lateral easterly departure traffic density through the Feltham grid during normal operations (25 June 2014)



Departure entries and exits through each face of the Feltham grid during normal operations (easterly departures)



Distribution of easterly departure traffic passing through Face 4 of the Feltham grid during normal operations (25 June 2014)



Face 4

Vertical distribution of departure traffic passing through Face 4 of the Feltham grid during normal operations (easterly operations)

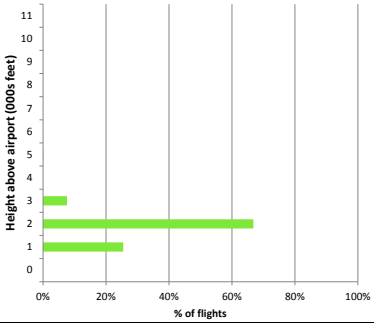


Figure 5. Lateral and vertical distribution of departing air traffic passing through the Feltham grid during normal operations (easterly departures) - representative sample (Heathrow flights only)

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Airspace trials

Airspace trials during the trial period: During the monitoring period, Heathrow undertook a series of airspace trials to inform future thinking on airspace design. Two trials, the easterly Midhurst trial and the easterly Package trial, influenced the tracks of departing aircraft flying through the Feltham grid. Both involved (temporary) trial SIDs on some of the departure routes. Neither trial changed the flight paths of arriving aircraft or the daily flying schedule. *Further information on the trials can be found on the noise pages of the Heathrow website (*www.heathrowairport.com/noise*).*

Background to the airspace trials: Each day over 600 aircraft depart from Heathrow. These aircraft follow predefined departure routes (SIDs). The routes were designed in the 1960s, an era where aircraft had different performance characteristics to those of today, and do not fully utilise the benefits of the modern navigation equipment carried by approximately 98% of the aircraft operating from Heathrow. This situation is not unique to Heathrow and applies to most other major airports in the UK.

The UK Future Airspace Strategy (FAS) is planning to modernise the airspace around the UK using, amongst other things, more precise navigation standards. A major part of FAS is the NATS London Airspace Management Project (LAMP) which will redesign the airspace around London. This, along with the gradual phasing out of ground-based navigation infrastructure across the country, means that airports will not be able to use their currently published 'conventional' departure routes from 2019/20, and therefore routes need to be redesigned for modern navigation standards.

Rationale for the trials: Modern navigation standards such as Area Navigation (RNAV) (see page 13) allow aircraft to fly predefined routes to a higher degree of accuracy and consistency. Heathrow, supported by NATS and British Airways, undertook a series of trials to further their understanding on the operation of RNAV1 routes and inform future thinking on airspace redesign. The trials aimed to explore both the operational opportunities offered by RNAV1 routes and understand the potential consequences.

Easterly Midhurst trial (16 December 2013 to 15 June 2014): This trial involved the existing easterly Midhurst routes for runways 09L and 09R only. The main objective of this trial was to assess the feasibility and benefits of providing local communities sited beneath the departure flight path with a predictable break from aircraft noise, referred to as 'predictable respite'. It also provided evidence of how closely RNAV1 equipped aircraft could follow a defined trial route and remain within an associated indicative NPR (see page 13), and determined that such trials could be undertaken without any adverse impact on the operation of Heathrow. During the trial four (temporary) RNAV1 departure routes (routes MID 1M and MID 1N from runway 09R, and MID 1P and MID 1Q from runway 09L) were positioned either side of the existing easterly Midhurst departure routes for their respective runways, but within the existing NPRs. The trial routes in use were alternated weekly and flown by British Airways aircraft. All other airlines continued to use the existing easterly Midhurst route and other easterly departure routes were unaffected by the trial. Due to there being no day-time runway alternation on runway 09L, there was very little use of trial routes MID 1P and MID 1Q.

The tracks of aircraft when trial routes MID 1M and MID 1N were in operation are shown in figures 6 and 7 respectively. At a first glance, comparing these figures to normal operations (Figure 5) shows no major change in the overall pattern of aircraft tracks through the Feltham grid. However, reference to the lower left-hand images in each figure shows a change in the concentrations of departures passing through Face 4 of the grid when the trial routes were in operation (approximately 1.6nm and 0.8nm to the east of the centre of Face 4 when MID 1M and MID 1N were operating respectively). This demonstrates both the potential for alternating RNAV1 routes to provide a predictable break from aircraft noise, but at the same time the possibility of concentrating aircraft tracks (and by inference aircraft noise) in the grid.

In practice, the Feltham grid did not experience periods of predictable respite during the trial as other aircraft continued to operate on existing 'conventional' routes whose use could not be alternated. Correspondingly, no complaints were received in relation to the trial, and there was no increase in the average level of complaints from populations to the east of Heathrow during the trial period. All but a very small number of British Airways aircraft that departed on the easterly Midhurst route during the trial flew the RNAV1 trial SIDs and there was no impact on the operation of Heathrow as a result of the trial. *A report on the trial commissioned by Heathrow can be found on the Heathrow website (*www.heathrowairport.com/noise*).*

Easterly Package (28 July to 12 November 2014): This trial involved (temporarily) modifying the course of the easterly Midhurst and Southampton departure routes for runway 09R and runway 09L so that the two routes effectively operated as one. In parallel with the Westerly Package trial (see the Windsor Great Park Community noise monitoring report), this trial was used to inform the possibility of decreasing holding times on the ground via new route designs that reduced separations between departing aircraft. Similar to the easterly Midhurst trial, the trial routes were designed to the RNAV1 navigation standard, but their use was not alternated weekly. In order to achieve the above objective, part of the trial route was located outside of the existing NPR. All aircraft normally operating on the existing easterly Midhurst and Southampton routes were involved in the trial. Other easterly departure routes were unaffected by the trial. The trial also initially involved the easterly Compton route, but the associated trial route was withdrawn after an initial period of operations.

The tracks of departing aircraft operating during the easterly package trial are shown in Figure 8. Comparing these images to those in normal operations (Figure 5) shows the effect of (continued on page 6)

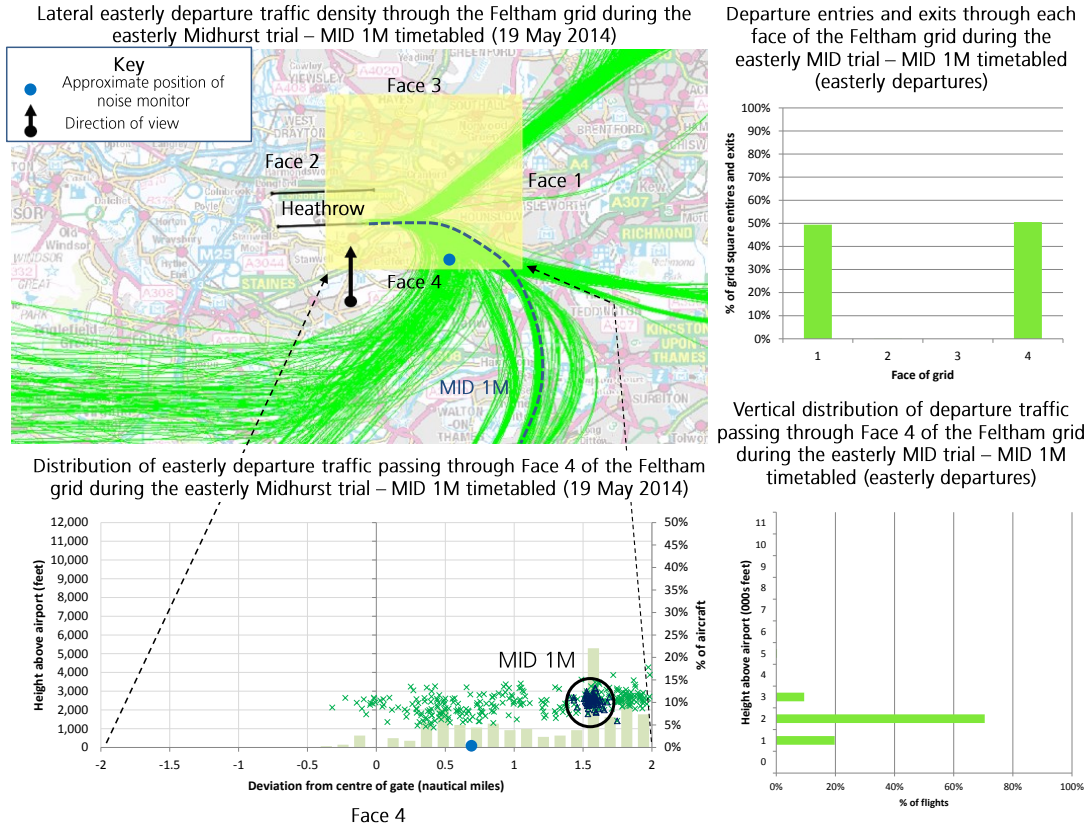

Figure 6. Lateral and vertical distribution of departing air traffic passing through the Feltham grid during the easterly Midhurst trial (RNAV1 SID MID 1M timetabled) - representative sample (Heathrow flights only)

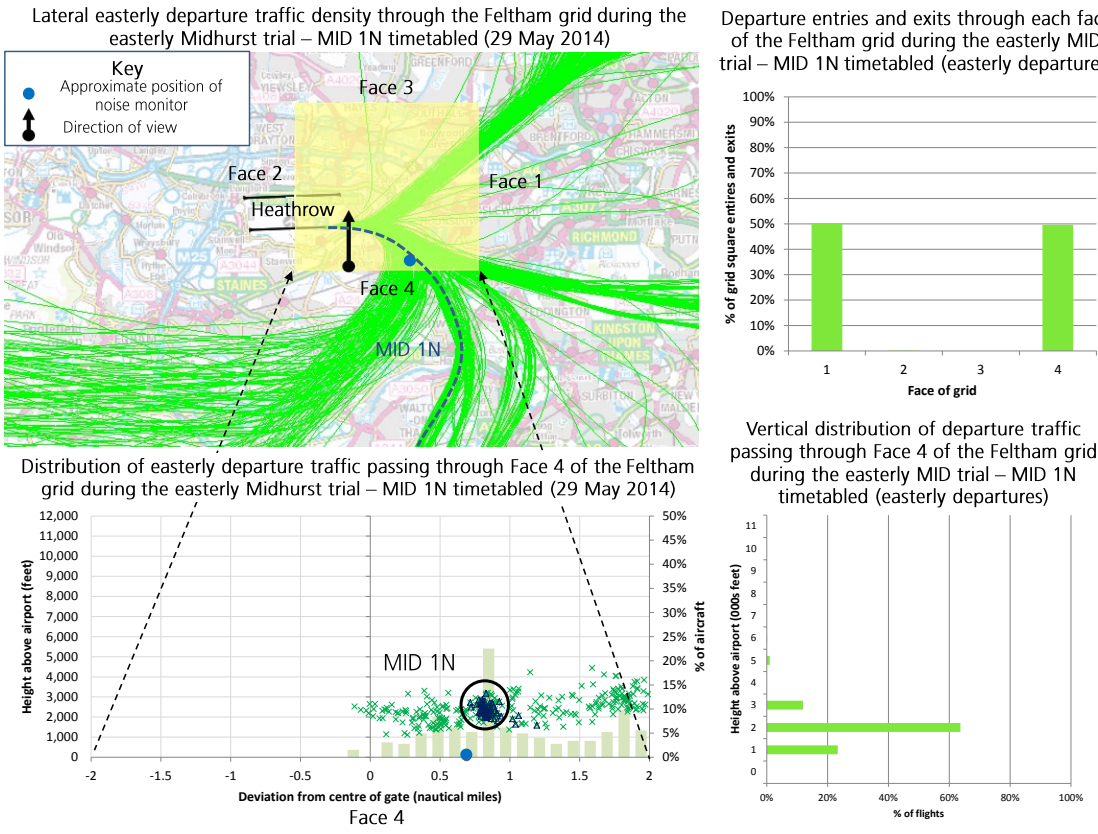

Figure 7. Lateral and vertical distribution of arriving air traffic passing through the Feltham grid during the easterly Midhurst trial (RNAV1 SID MID 1N timetabled) - representative sample (Heathrow flights only)

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bringing the easterly Midhurst and Southampton routes closer together during the trial. Although there were no significant changes in the proportion of aircraft flying through each face of the grid during the trial, or their associated heights, at approximately 1.4nm to the east of the centre of Face 4 there was a significant concentration of aircraft exiting the grid. Again, this demonstrates both the potential for RNAV1 routes to allow aircraft to fly pre-defined routes more precisely, but at the same time the possibility of concentrating aircraft tracks (and by inference aircraft noise) in the grid.

A high proportion of aircraft that departed on the easterly Midhurst and Southampton routes during the trial flew the RNAV1 trial SID and there was no impact on the operation of Heathrow as a result of the trial. The trial ended 10 weeks early (12 November) as sufficient data had been collected to assess the trial against its objectives. At the same time, this trial, along with a parallel westerly package trial received a higher than envisaged number of complaints.

Other trials during the monitoring period: Two other trials took place during the monitoring period. Both the DOKEN trial (16 December 2013 and 15 June 2014) and Westerly Package (25 August to 12 November 2014) involved departing aircraft during westerly operations. As the Feltham grid is not usually overflown by departing aircraft during westerly operations it was unaffected by these trials.

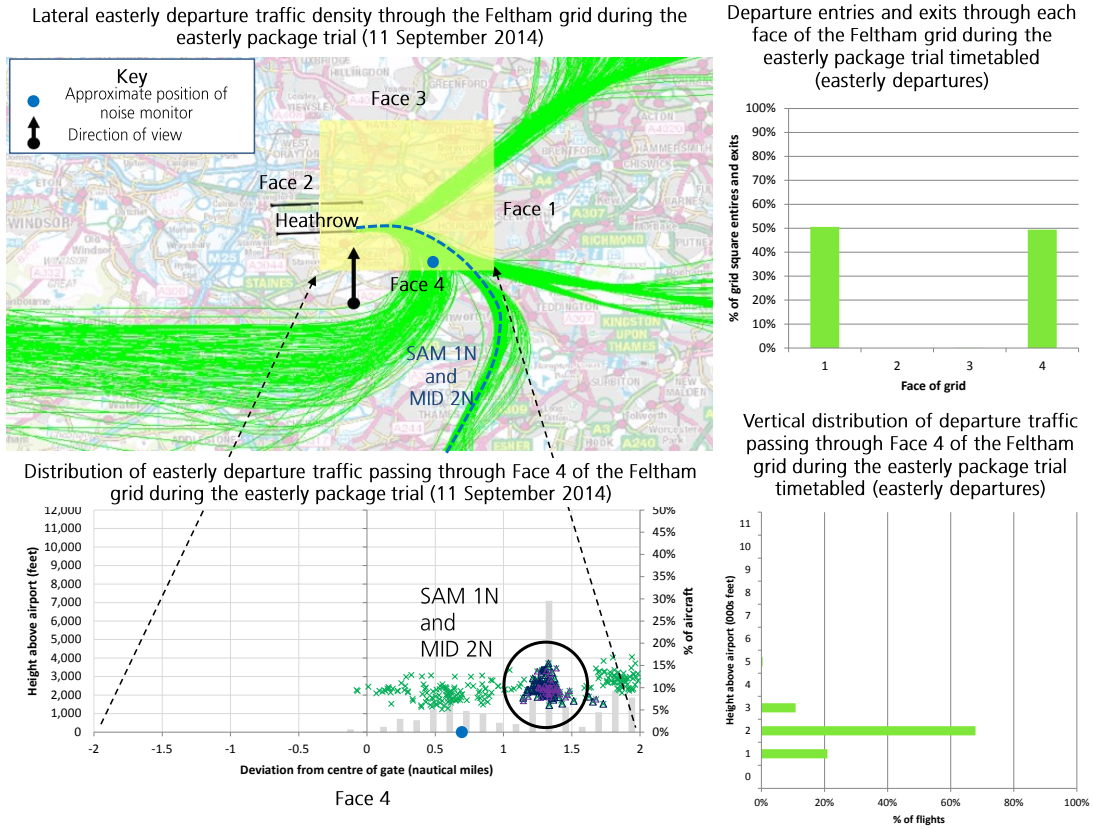

Figure 8. Lateral and vertical distribution of departing air traffic passing through the Feltham grid during the easterly package trial - representative sample (Heathrow flights only)

Figure 9 overleaf shows the proportion of aircraft that passed through the grid by direction of runway operation and hour. As the Feltham grid includes the easterly thresholds of Heathrow's two runways, it is overflown by all arriving aircraft during westerly operations and all departures during easterly operations.

The top two graphs in Figure 9 show the number of daily movements through the grid during easterly and westerly operations respectively, and highlights when the various trials took place. The second graph shows that on days where only easterly operations took place (i.e. there were no corresponding westerly operations on the same day), the daily number of departures through the grid remained relatively constant throughout the monitoring period (i.e. they were not influenced by the trials), with any fluctuations reflecting typical variations in the daily flying schedule.

The bottom two images in Figure 9 show the average hourly arrivals and departures through the grid during easterly and westerly operations. These are not presented separately for normal operations and trials, however investigation shows that while the number of daily flights remained constant, there were fluctuations in the average number of hourly movements. This is most likely to reflect fluctuations in hourly movements rather than be attributable to the trial.

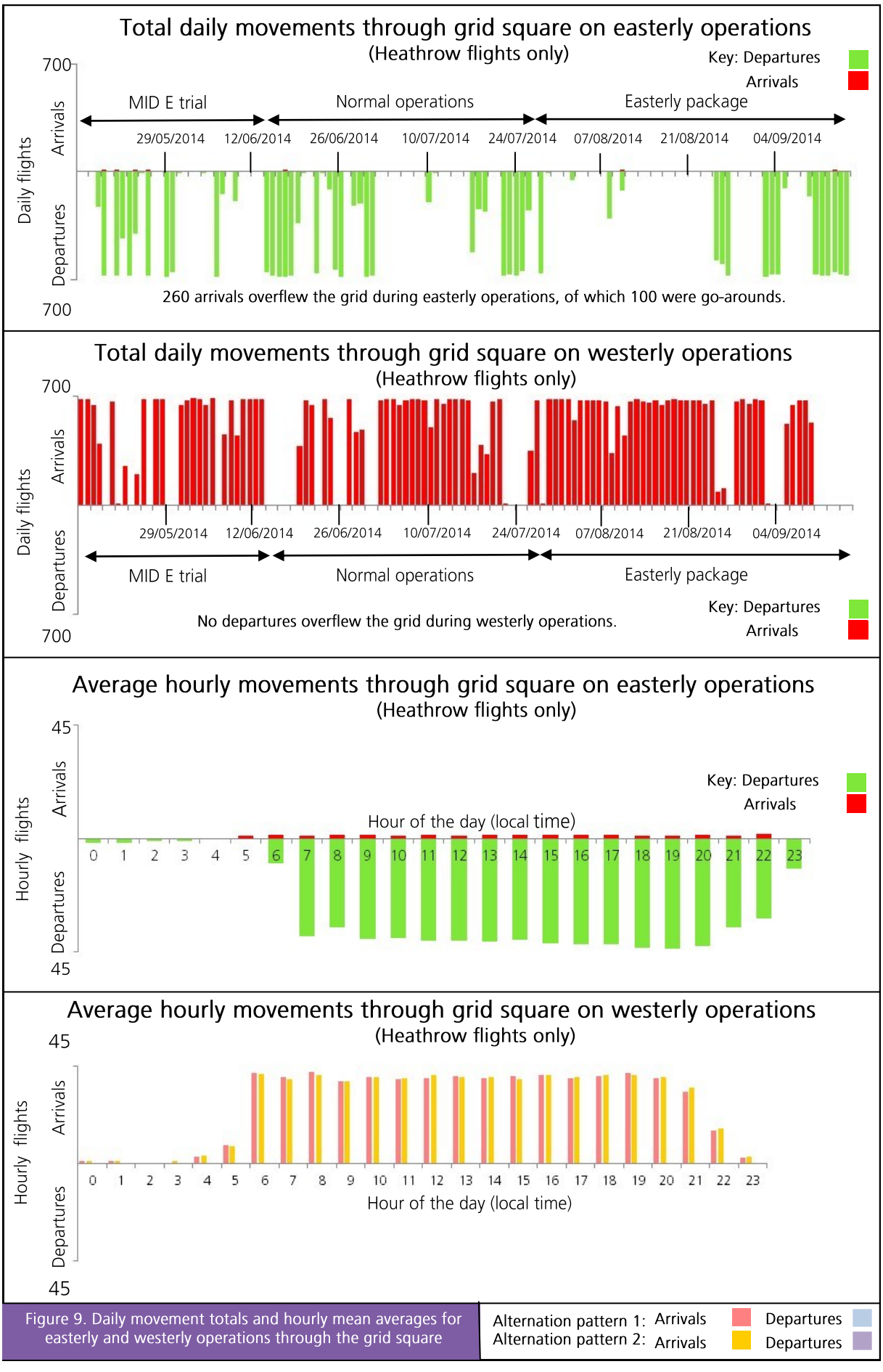

Figure 9. Daily movement totals and hourly mean averages for easterly and westerly operations through the grid square

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 10 demonstrates the average background noise level (L_{90}, dBA) recorded by the South West Middlesex Crematorium monitor over a 24 hour period (black line). Figure 10 also shows the background noise level when separated by mode of operation, easterly or westerly; shown in two shades of orange (i.e. when the prevailing wind direction during those periods would generally contain an easterly or westerly component respectively). As can be seen, average hourly background noise levels are generally comparable for each mode of operation.

The overall trend in Figure 10 is largely in line with expected results; during the night-time period the average background noise level was relatively low, remaining below 40 dBA between 2300-0600 hours. After 0600 the average background level increased slightly, remaining above 40 dBA for the rest of the day (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 a moderate variation in hourly background noise level at the monitoring site; typically between 5 to 10 dBA between the quietest and the noisiest days. One of the noisiest days was Tuesday 12 August; a day with a moderate westerly to south-westerly wind, placing the site downwind of Feltham town centre and the A312 Uxbridge Road. However, even on this relatively noisy day the hourly background noise level never exceeded 50 dBA. One of the quietest days was Sunday 29 June; a day with a light northerly wind, placing the site upwind of the A312 and A314 main roads (but downwind of the Waterloo to Reading railway line).

Average hourly background L_{90} levels at the monitor

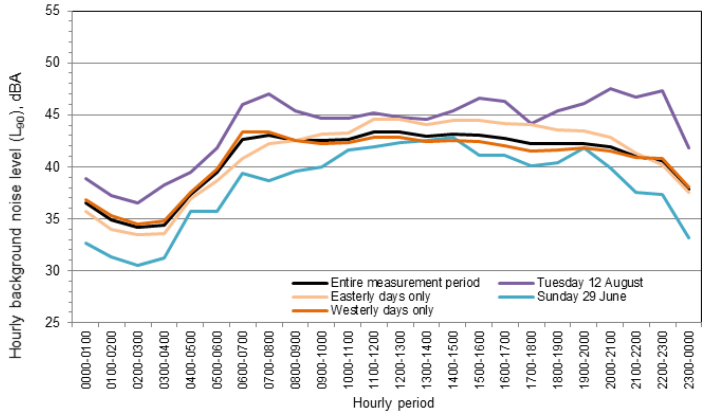

Figure 10. Hourly background L_{90} levels at the monitor averaged over 24 hour period; including Tuesday 12 August (noisiest day) and Sunday 29 June (quietest day)

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 Feltham grid square generates a noise event. During the monitoring period a total of 15,123 aircraft noise events were recorded.

Since the noise monitor was positioned close to the centrelines of the easterly Compton, Southampton and Midhurst NPRs and well away from the main arrival flight paths, departures account for nearly all of the noise events recorded at the monitor (>99%). Figure 11 provides a summary of aircraft noise events by operation and runway after filtering for bad weather (approximately 10% of noise events were rejected due to unacceptable weather conditions in accordance with international guidelines). Accounting for rejected events, 13,580 noise events were generated by easterly departures and 66 noise events by westerly arrivals on runway 27L (four of the westerly arrival events were caused by go-arounds). One noise event was also recorded for an easterly arrival on 09R which overflew the noise monitor as it performed a go-around.

Figure 12 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 Feltham site.

Figure 13 shows the average (mean) departure and arrival L_{Max} values recorded at the monitor for each aircraft type. For departures, the noisiest aircraft on average was the B747, followed by the B767, A330 and A340. On average, the quietest aircraft type on departure was the CRJ. The sample sizes for arrivals are too small to make any meaningful conclusions from the measured data.

Departures (99.5% of total noise events)					Arrivals (0.5% of total noise events)				
09L	09R	27L	27R	Total	09L	09R	27L	27R	Total
11	13.569	0	0	13.580	0	1	66	0	67

Figure 11. Aircraft noise events by operation and runway following filtering for bad weather

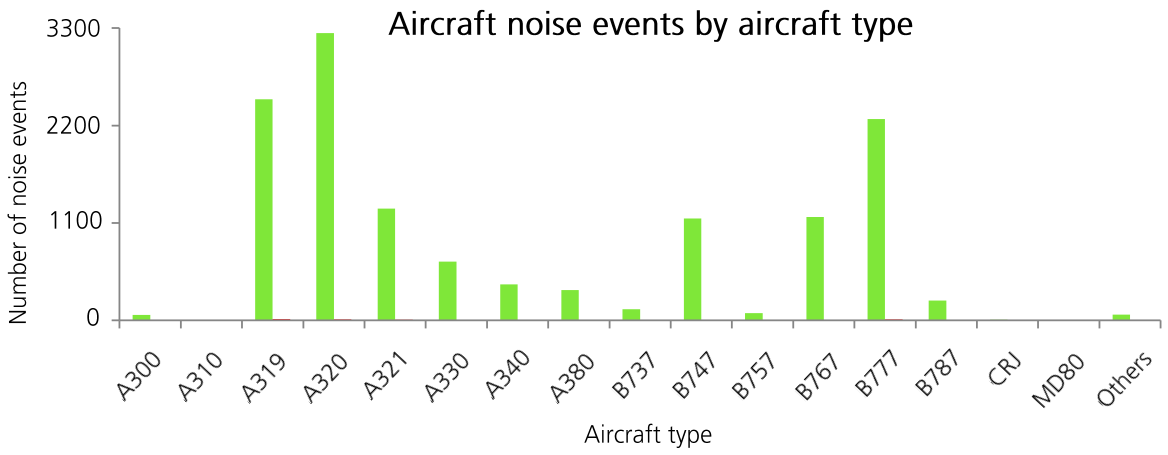

Figure 12. Number of departure and arrival aircraft noise events by aircraft type

Key: Departures
Arrivals

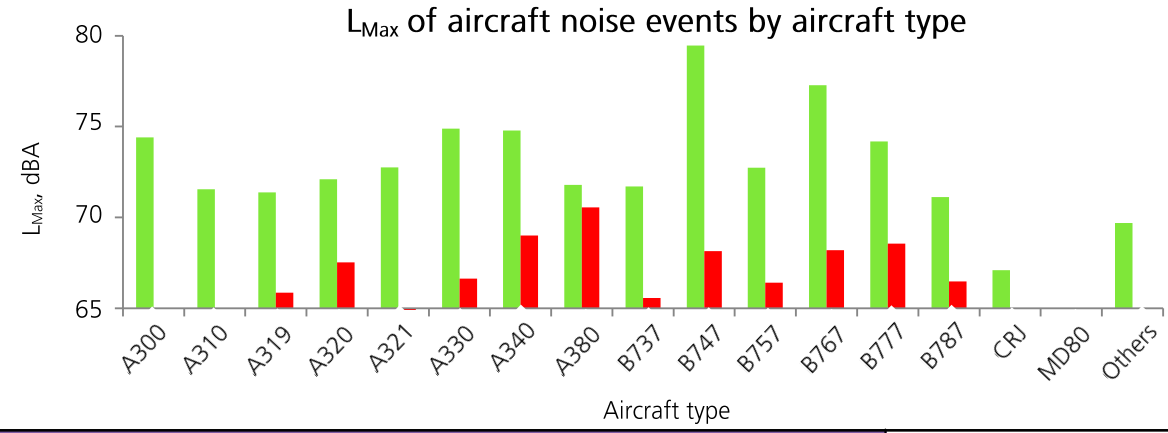

Figure 13. Average (mean) L_{Max} by aircraft type for departures and arrivals

Key: Departures
Arrivals

As explained earlier, Heathrow airport conducted a series of easterly departure airspace trials during the monitoring period. Two of these trials, the easterly Midhurst trial (16 December 2013 – 15 June 2014) and the easterly package trial (28 July 2014 – 12 November 2014) influenced the tracks of some departing aircraft through the Feltham grid. Since the deployment of the monitor covered the last month of the first trial and the first seven weeks of the second trial, further analysis of the noise level differences during each period is provided below.

Figure 14 compares the average departure L_{Max} values for British Airways aircraft on the MID 1M and MID 1N trial routes with those on the conventional easterly Midhurst route. In every case, aircraft on the MID 1M route were 2 to 5 dB quieter, on average, than aircraft on either the MID 1N route or the conventional easterly Midhurst route. These results can be explained by the relative distances from the noise monitor of the flight paths flown along each route; aircraft on the MID 1N and conventional easterly Midhurst routes typically passed much closer to the noise monitor compared to aircraft on the MID 1M route.

Figure 15 compares the departure L_{Max} values for all aircraft on the MID 2N easterly package trial route and the conventional easterly Midhurst route. The results show no consistent difference between the average noise levels for aircraft on the trial and conventional route. Figure 16 on the other hand shows that aircraft on the SAM 1N trial route were, on average, 1 to 4 dB noisier at the monitor compared to aircraft on the conventional easterly Southampton route. Again these results can be explained by the relative distances from the noise monitor of the flight paths flown along each route; aircraft on the SAM 1N trial route typically passed much closer to the noise monitor compared to aircraft on the conventional easterly Southampton route.

The overall distribution of noise (L_{Max}) for arrivals and departures is shown in Figure 17. Figure 18 indicates the trend in the noise distribution 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 the evening and night due to the lower overall traffic levels.

In this instance the monitor threshold was set at 62 dBA, which appeared to be low enough to capture almost the entire distribution of L_{Max} departure levels during each time period. The use of this threshold is explained further on page 13.

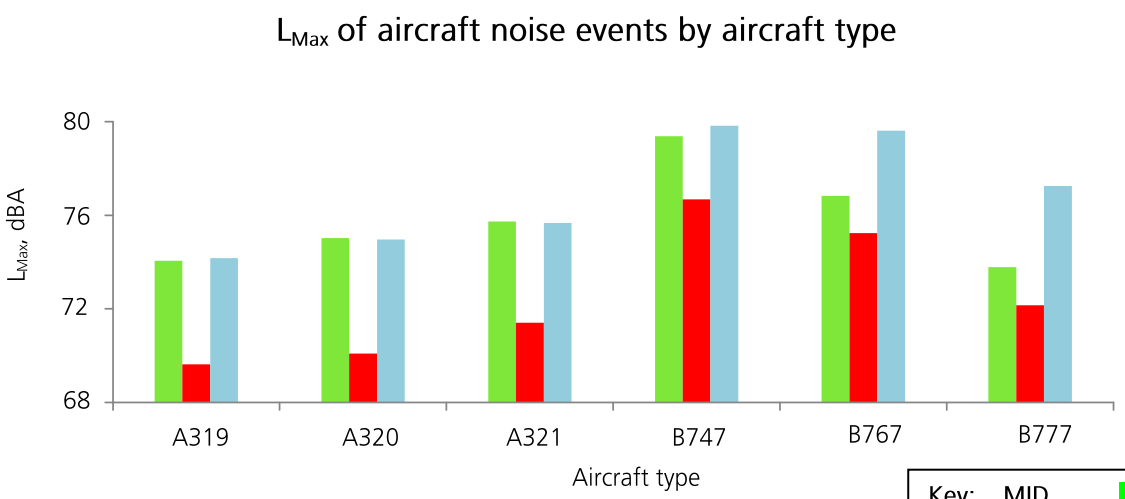

Figure 14. Average (mean) L_{Max} by aircraft type for the MID 1M and MID 1N trial routes and the conventional easterly Midhurst departure route (BA aircraft only)

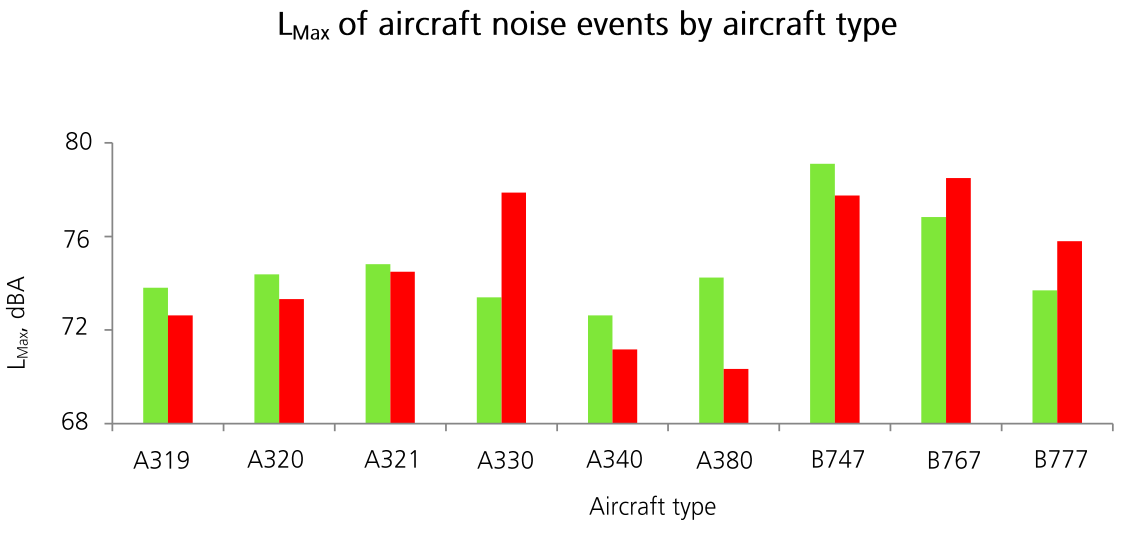

Figure 15 Average (mean) L_{Max} by aircraft type for the MID 2N trial route and the conventional easterly Midhurst departure route

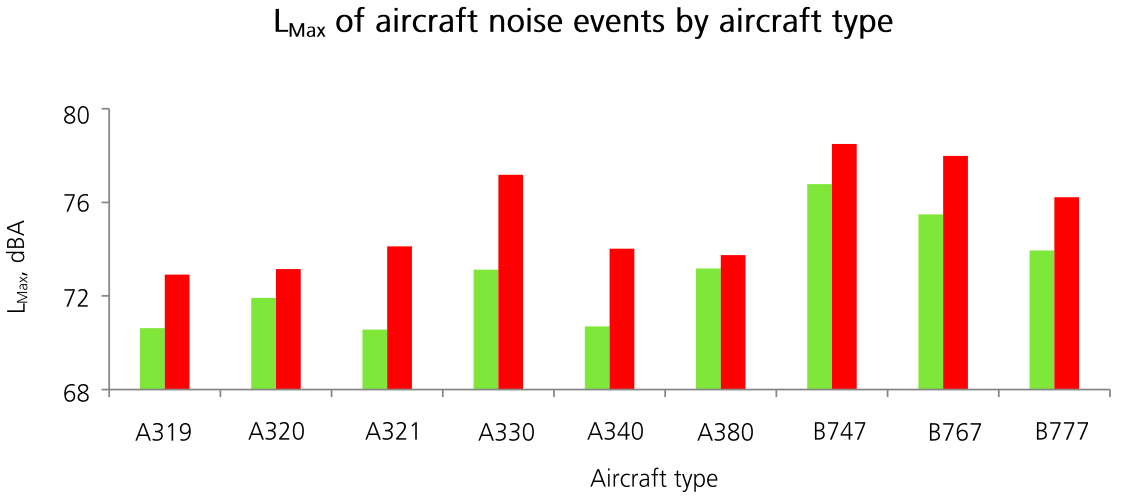

Figure 16 Average (mean) L_{Max} by aircraft type for the SAM 1N trial route and the conventional easterly Southampton route

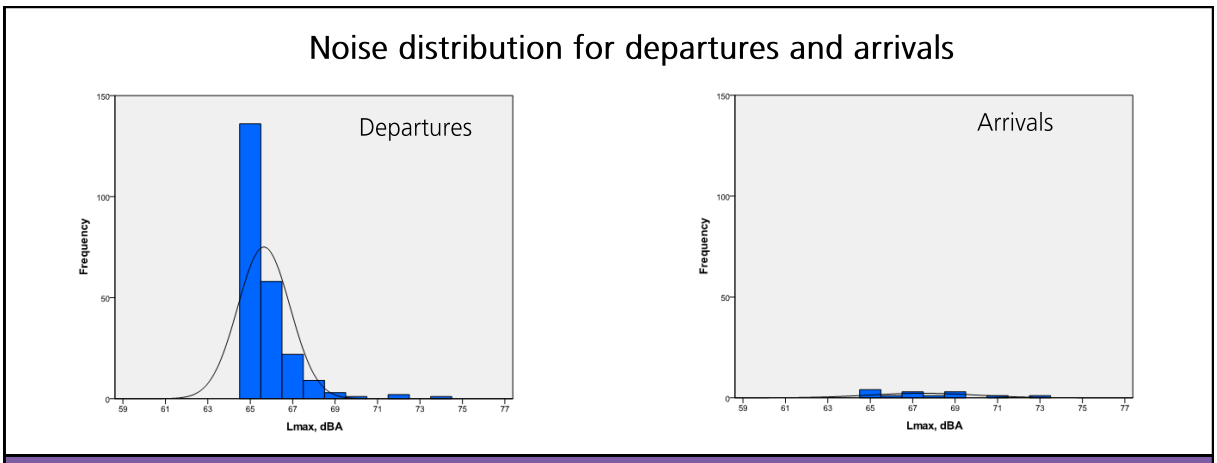

Figure 17. Above left: L_{Max} frequency distribution of departure noise levels
Above right: L_{Max} frequency distribution of arrival noise levels

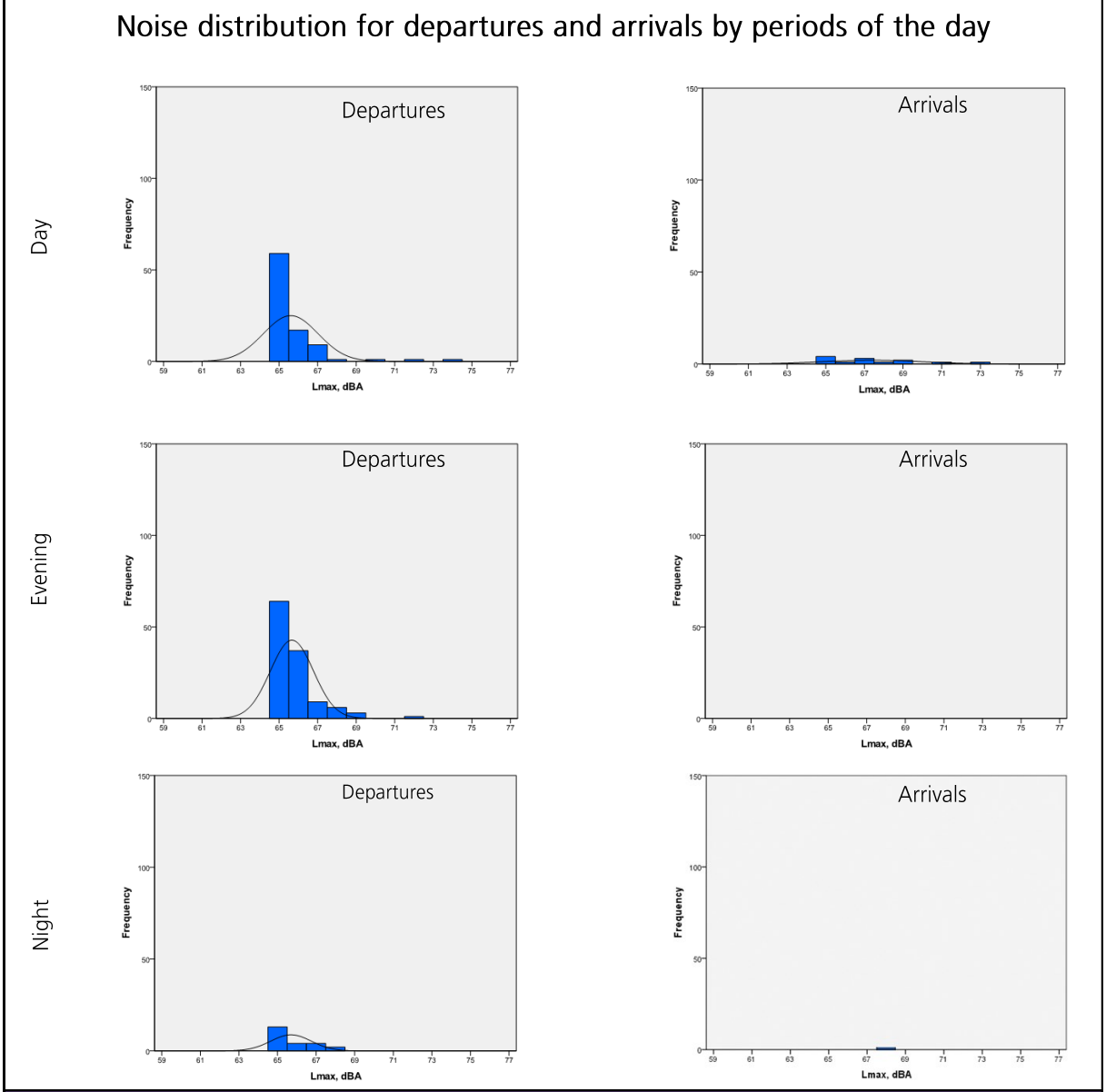

Figure 18. L_{Max} distribution of departure (left) and arrival (right) noise level recorded on the A-weighted sound level over the three averaging periods of L_{Max} (Day — 12 hour period 07:00-19:00), L_{Max} (Evening — 4 hour period 19:00-23:00) and L_{Max} (Night — 8 hour period 23:00-07:00)

Conclusions

Background

This report describes the overflight and noise experience measured for the Feltham grid square over a 124-day period from 15 May 2014 to the 15 September 2014. During this period the grid was overflown by 55,620 arrivals and 27,277 departures, equating to approximately 670 aircraft per day.

Flight movements – 'normal operations'

The Feltham grid includes the western thresholds of Heathrow's two runways, meaning that it will be overflown by all arriving aircraft during westerly operations and all departing aircraft during easterly operations:

- During westerly operations arriving aircraft landing at Heathrow will already be established on the Instrument Landing System for final approach before entering the grid. These aircraft will enter the grid in two tight concentrations (one for each runway) between 900 and 1,200 feet and descend on a 3 degree glideslope until touchdown.
- During easterly operations departing aircraft take-off from Heathrow and typically climb above 2,000 feet before exiting the grid. These aircraft follow one of six pre-defined departure routes and the tracks of departing aircraft through the grid are grouped around the ground tracks of these routes.

Flight movements – 'airspace trials'

During the monitoring period Heathrow ran a series of trials aimed at informing future airspace design. An area of particular interest was gaining a better understanding the opportunities and consequences of designing departure routes with a more accurate and consistent navigation standard (RNAV1). For example, could concepts intended to provide communities under the flight paths with a predictable break from aircraft noise ('predicable respite') be operated and what would be the consequences of exposing smaller (or new) populations to aircraft noise more frequently.

These trials did not influence the number of aircraft flying through the grid each day, but two did temporarily change the tracks, and concentration of tracks, of some departing aircraft passing through the Feltham grid (the tracks of arriving aircraft were unchanged). The first trial, the easterly Midhurst trial (16 December 2013 to 15 June 2014), involved alternating four (temporary) trial RNAV1 departure routes to test the concept of predictable respite. The second, the easterly package trial (28 July to 12 November 2014), used two (temporary) trial RNAV1 departure routes to inform the possibility of decreasing aircraft holding times on the ground via route designs that reduced the separations between departing aircraft.

The trials had no adverse impact on the operation of Heathrow and identified a number of lessons for future airspace design. In particular, they demonstrated both the potential for RNAV1 routes to allow aircraft to fly pre-defined routes more precisely, but at the same time the possibility of concentrating aircraft tracks (and by inference aircraft noise). In terms of community response, there was no increase in complaints from populations to the east of Heathrow for the easterly Midhurst trial. However, there was a higher than envisaged number of complaints for the easterly package trial. By the 12 November, sufficient data had been collected for this trial and it ended early on this date.

Aircraft noise – 'normal operations'

During the monitoring period a temporary noise monitor was placed in the grounds of South West Middlesex Crematorium in Feltham, close to the easterly Midhurst, Compton and Southampton departure routes. The noise monitor collected aircraft noise events above a 62 dBA threshold. Given its location, all but a few noise events were generated by departing aircraft following one of the routes close to the noise monitor. Medium-sized aircraft (e.g. the A320 family) and the wide-bodied B777 dominated the overall number of departure noise events due to the relatively high numbers of these types operating at Heathrow. The noisiest departing aircraft on average was the B747, followed by the B767, A330 and A340. The quietest departing aircraft on average was the CRJ.

Aircraft noise – 'airspace trials'

During the easterly Midhurst trial the noise monitor was located approximately 0.4, 0.5 and 0.1 nautical miles from the centrelines of the existing easterly Midhurst route, and the MID 1M and MID 1N trial routes respectively. Data collected by the noise monitor shows that aircraft on the MID 1M route were, on average, 2 to 5 dB[1] quieter than aircraft on the MID 1N route. Although not taking into account the noise from aircraft on other departure routes, it does give an indication of the change in noise environment at the monitoring site due to the weekly alternation of the trial route in use.

During the easterly package trial, there was no consistent difference between the average aircraft noise levels generated by departing aircraft following the MID 2N trial route and conventional easterly Midhurst route. On the other hand, aircraft following the SAM 1N trial route were, on average, 1 to 4 dB noisier at the monitor compared to aircraft on the conventional Southampton route. Again these results can be explained by the relative distances from the noise monitor of the flight paths flown along each route.

Summary

The monitoring period represents a snapshot of the track and noise impact in the Feltham grid. The results generated for normal operations are broadly what might be expected in the future at the South West Middlesex Crematorium site. However, given the locations of the arrival and departure routes within the grid, different noise levels could be expected if the monitor were placed at other locations.

[1] A 3dB change is just perceptible to the human ear.

Additional information

References

- Heathrow Airport, Noise Action Plan 2010-2015: www.heathrowairport.com/noise
- Department for Transport — Heathrow Noise Contours: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/368905/LHR_2013_report.pdf
- Heathrow airspace trials: www.heathrowairport.com/noise/future-plans/modernising-uk-airspace/heathrow%E2%80%99s-airspace-trials

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 South West Middlesex Crematorium monitor was set with a threshold of 62 dBA, meaning that noise events below 62 dBA L_{Max} were not recorded by the monitor (note, the choice of monitor threshold does not affect the measurement of L_{90}). 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. However setting the threshold at 62 dBA appeared to be low enough to capture almost the entire distribution of L_{Max} departure levels during each time period.

Approximately 10% 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).

Standard Instrument Departure (SID) routes and Noise Preferential Routes (NPRs)

Aircraft taking off from Heathrow follow pre-defined routes, known as SIDs, usually based upon the destination of the aircraft. There are sets of SIDs for both easterly and westerly operations. Because all aircraft perform differently, or may be affected by weather conditions which can cause them to drift left or right, there will be some variation as to where different aircraft will fly relative to the SID. For this reason there are also corridors, known as NPRs, which extend 1.5 kilometres either side of the route centreline. As long as jet aircraft remain within the NPR up to an altitude of 4,000 feet they are considered to be on track.

Air Traffic Control (ATC) is responsible for the routing of aircraft once airborne. When they have reached 4,000 feet, ATC can instruct the pilots to leave the SID (and by definition the NPR too) and fly a more direct heading to their destination, although aircraft can continue to follow the SID until its end (and 6,000 feet). Additionally, ATC can direct aircraft off the SID at an altitude below 4,000 feet if this is required for safe separation from other aircraft or for other safety reasons such as weather avoidance. This is known as vectoring.

Dover and Detling SIDs

Previous noise monitoring reports referred to the Dover (DVR) SID. This SID was withdrawn from service on the 14 November 2014 and aircraft that previously followed the Dover SID are referred to as following the Detling (DET) SID. There has been no associated change in the route followed by departing aircraft - prior to the 14 October 2014 both the Dover and Detling SIDs operated with the same ground track.

Area Navigation (RNAV)

The trial routes for both the easterly Midhurst and easterly Package trial were designed using a more precise navigation standard, known as RNAV1, that is published for Heathrow's existing departure routes. When following an RNAV1 SID an aircraft will navigate between a series of waypoints held in its on-board Flight Management System (FMS). The RNAV1 standard means that the navigation systems on-board the aircraft must be able to control the navigation of the aircraft to within +/- 1 nautical miles of the centreline of the RNAV1 route for 95% of the time. In practice the actual performance is normally significantly better. This allows routes to be flown to a higher degree of accuracy and consistency than those published on the basis of ground-based navigation aids.

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).