



Heathrow Airport Joining Point Distance Analysis for 2018

Heathrow Airspace and Noise Performance Team

Heathrow
Making every journey better

Executive summary

Summary of average Joining Point (JP) distance from runway threshold for 2018			
Variation	Overall	JP = 13.6 nautical miles (NM) JP distance increased between 2001-2009 and 2015-2017 JP distance reduced between 2011-2014 JP distance reduced in 2018 compared to 2017	
	Runway	Easterly operations	JP was the same for 09L as in 2017 JP for 09L is closer than for other runway ends JP was farther for 09R than in 2017
		Westerly operations	JP was closer for both 27L and 27R than in 2017
	Arrival rate	JP was farther out than average with less than 14 arrivals/hour JP was closer when utilisation was between 30 and 48 arrivals/hour	
	Day vs. Night	JP was farther out at night	
	Season	JP was farther out during the Winter Season	
	Wake category	JP was farther out for Medium & Heavy aircraft JP was closer for Super, Upper & Light aircraft	
	Weather	JP was farthest when there were headwinds JP was typically farther out when disruptive conditions were present	

Introduction

This slide pack represents an update of the Joining Point study undertaken by NATS in 2016. The focus of the updated version is the analysis of 2018 data on its own and in relation to previous years' trends as elaborated in the previous version.

In assessing the Joining Point the primary areas of evaluation to understand the impact on changes in Joining Point were as follows:

- Time of year/season
- Time of day
- Arrival rate and utilisation
- Traffic type by wake vortex category
- Weather conditions

Additionally, variations by runway end were assessed.

Note: The years 2003, 2007 and 2013 have been removed from some charts and tables in order to maintain readability.

Definition

- (a) Between 0600 and 2330 hours (local time) where the aircraft is approaching Runway 27 (L or R) and is using the ILS in IMC or VMC it shall not descend on the glidepath below an altitude of 2500 ft (Heathrow QNH) before being established on the localizer, nor thereafter fly below the glidepath. An aircraft approaching without assistance from the ILS shall follow a descent path which will not result in its being at any time lower than the approach path that would be followed by

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an aircraft using the ILS glidepath, and shall follow a track to intercept the extended runway centre-line at or above 2500 ft.

- (b) Between 2330 and 0600 hours (local time) where the aircraft is approaching runway 27 (L or R) and is using the ILS in IMC or VMC it shall not descend on the glidepath below an altitude of 3000 ft (Heathrow QNH) before being established on the localizer at not less than 10nm from touchdown, nor thereafter fly below the glidepath. An aircraft approaching without assistance from the ILS shall follow a descent path which will not result in its being at any time lower than the approach path that would be followed by an aircraft using the ILS glidepath, and shall follow a track to intercept the extended runway centre-line at or above 3000 ft.
- (c) Between 0700 and 2300 hours (local time) where the aircraft is approaching Runway 09 (L or R) and is using the ILS in IMC or VMC it shall not descend on the glidepath below an altitude of 2500 ft (Heathrow QNH) before being established on the localizer, nor thereafter fly below the glidepath. An aircraft approaching without assistance from the ILS shall follow a descent path which will not result in its being at any time lower than the approach path that would be followed by an aircraft using the ILS glidepath, and shall follow a track to intercept the extended runway centre-line at or above 2500 ft.
- (d) Between 2300 and 0700 hours (local time) where the aircraft is approaching Runway 09 (L or R) and is using the ILS in IMC or VMC it shall not descend on the glidepath below an altitude of 3000 ft (Heathrow QNH) before being established on the localizer at not less than 10 nm from touchdown, nor thereafter fly below the glidepath. An aircraft approaching without assistance from the ILS shall follow a descent path which will not result in its being at any time lower than the approach path that would be followed by an aircraft using the ILS glidepath, and shall follow a track to intercept the extended runway centre-line at or above 3000 ft.

Landing aircraft on approach to the airport have to align directly with the runway and intercept the Instrument Landing System (ILS). The distance from the runway from which the aircraft intercepts the ILS is known as the Joining Point. The full definition as described in the AIP snapshot (left). A Joining Point summary paragraph from the annual Flight Performance report is copied below.

Throughout the presentation the Joining Point will be referenced in the context of an average value. Unless stated this will be calculated as the mean average.

Noise Abatement – Joining Point

Although there are no set heights for arriving aircraft, the Government has specified the minimum heights at which the aircraft must be established on the final approach. The aim of these requirements is to keep aircraft higher for longer and avoid prolonged periods of level flight, therefore benefiting communities close in to the airport.

• Westerly operations

Between 06.00 and 23.30 hours local, aircraft are required to be established on the ILS not below 2,500ft above mean sea level. This equates to a distance of about eight nautical miles. Between 23.30 and 06.00 hours local, the altitude is raised to 3,000ft above mean sea level together with an additional requirement to join the ILS no closer to the runway than 10 nautical miles.

• Easterly operations

Between 07.00 and 23.00 hours local, aircraft are required to be established on the ILS not below 2,500ft above mean sea level. This equates to a distance of about eight nautical miles. Between 23.00 and 07.00 hours local, the altitude is raised to 3,000ft above mean sea level together with an additional requirement to join the ILS no closer to the runway than ten nautical miles.

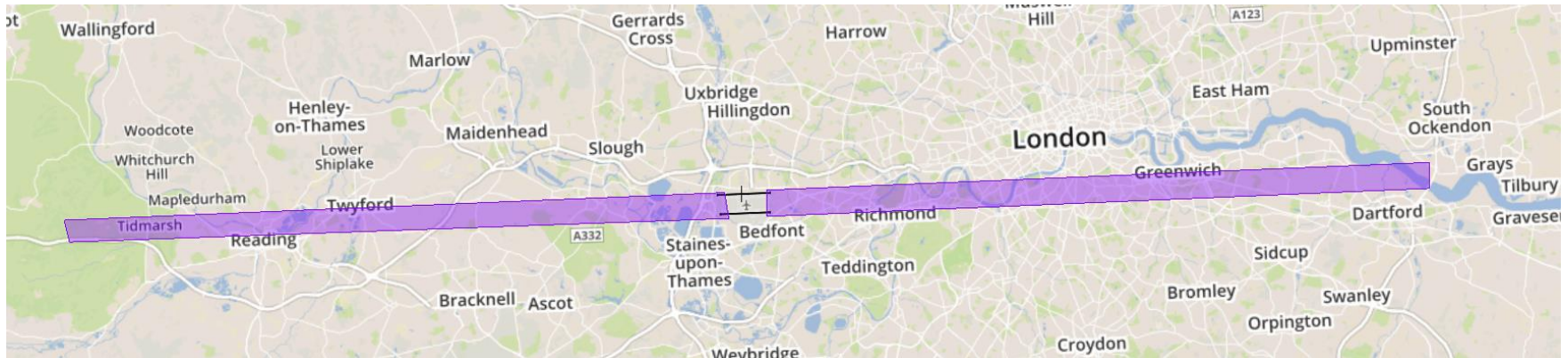
Data

The data used to support this assessment is data from ANOMS (Airport Noise Operational Management System), Heathrow's noise and track keeping system. The data is derived from radar feeds.

The weather data comes from actual weather recordings as reported in METAR messages for Heathrow.

The Joining Point for an aircraft is considered to be the point when it enters either the easterly polygon (when arriving on runways 09L and 09R), or the westerly polygon (when arriving on runways 27L and 27R). The polygons are depicted below.

Only flights which entered the polygons with an altitude above 1,500ft and below 8,500ft, and at a distance between 5.0 and 26.0 nautical miles (NM) from the threshold have been included in the analysis.



Data

Sample communities under flight path (listed for geographical purposes only):

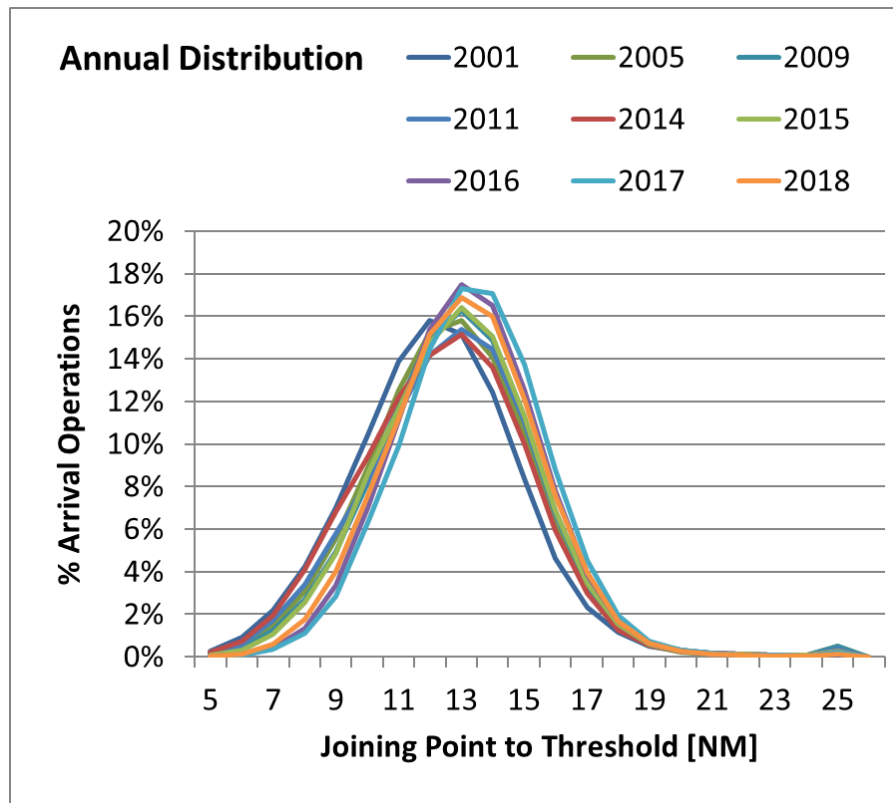
Distance in nautical miles and statute miles, to runway threshold	Westerly Arrivals 27L & 27R	Easterly Arrivals 09L & 09R
5 (5.75)	Isleworth, Richmond	Windsor
6 (6.90)	Richmond, Kew, North Sheen	Clewer Green
7 (8.05)	Mortlake, East Sheen	Oakley Green, Legoland Windsor
8 (9.20)	Barnes, Putney	Fifield
9 (10.35)	Fulham, Hurlingham Park	Money Row Green
10 (11.50)	Sands End, Battersea	Braywoodside
11 (12.65)	Battersea Park	Open farmland
12 (13.80)	Nine Elms, Stockwell	Shurlock Row
13 (14.96)	Camberwell	Open farmland
14 (16.11)	Peckham	Hurst
15 (17.26)	New Cross Gate	Charvil Country Park
16 (18.41)	Deptford	Sonning
17 (19.56)	Blackheath, Greenwich	Reading East
18 (20.71)	Kidbrooke Playing Fields	Reading
19 (21.86)	Castlewood	Caversham, Reading
20 (23.01)	Shooters Hill GC	West Reading
21 (24.16)	Welling	Tilehurst
22 (25.31)	Bexleyheath	Denefield School
23 (26.46)	Erith	Tidmarsh
24 (27.61)	Crayford Marshes	Open farmland
25 (28.76)	Crayford Marshes	Open farmland
26 (29.92)	Purfleet	Open farmland

Distribution by year

The average Joining Point value in 2018 was 13.6NM. This compares against the average value of 13.3NM for the whole period between 2001 and 2017. The table below shows that the annual variation exceeds the long term average by 0.3NM.

Over 95% of all arrivals have a Joining Point value inside 17.4NM.

The standard deviation of the distribution is 2.6NM.

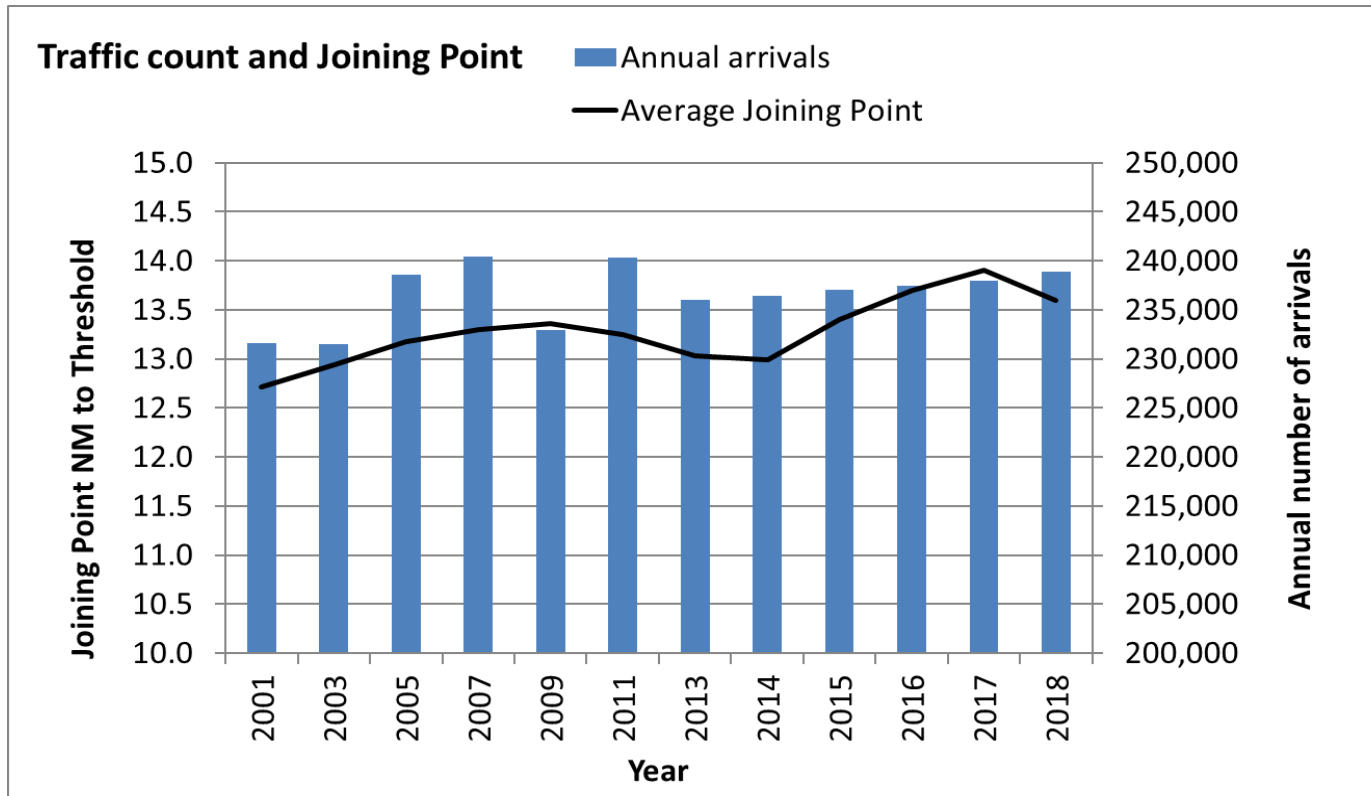


Year	Average Joining Point (NM)	Standard Deviation (NM)
2001	12.7	2.6
2003	12.9	2.6
2005	13.2	2.7
2007	13.3	2.6
2009	13.4	2.7
2011	13.2	2.7
2013	13.0	2.7
2014	13.0	2.7
2015	13.4	2.6
2016	13.7	2.4
2017	13.9	2.4
2018	13.6	2.6
Average	13.3	2.6

Variation by year

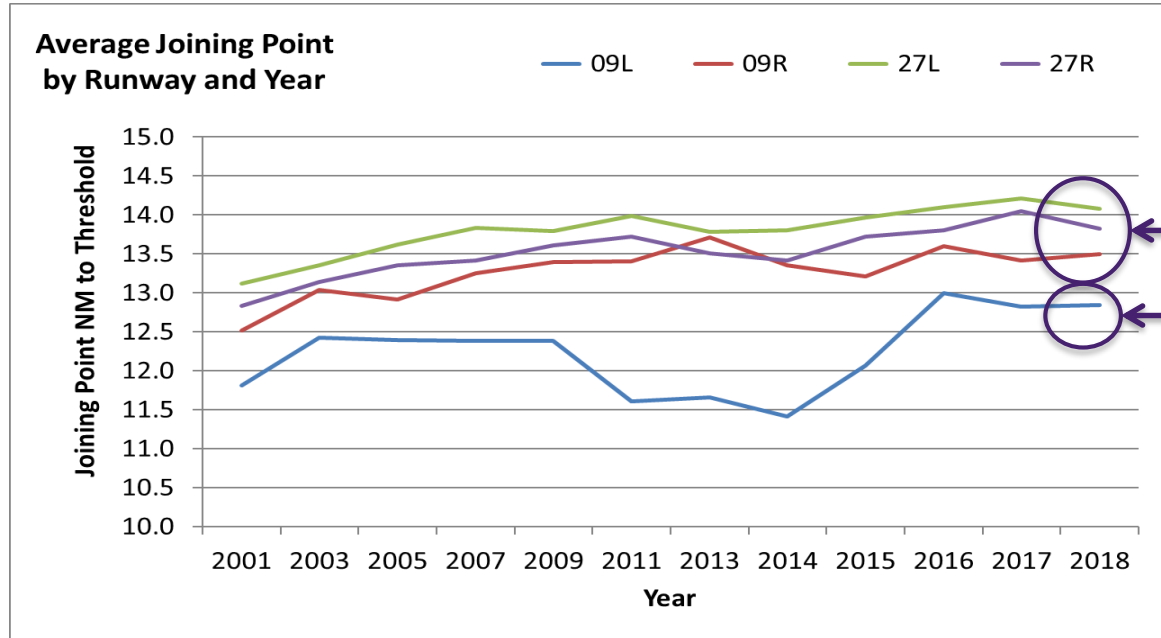
The chart below shows how the average Joining Point values have varied in time along with changes in the annual number of arrivals.

An increase in the average Joining Point value coincided with increases in the annual number of arrivals up to 2009 but reduced in 2011, 2013 and 2014. Subsequently 2015, 2016 and 2017 saw an increase in the average Joining Point with increase in the annual number of arrivals. However, despite the increase in the number of arrivals the average Joining Point decreased in 2018.



Variation by year and runway

The chart and table below show the variation in average Joining Point distance and utilisation for each runway by year.



The average Joining Point distance for both 27R and 27L decreased back to 2016 levels.

The average Joining Point distance for 09R remained fairly constant.

The average Joining Point distance for 09L is typically closer to the runway threshold.

The average Joining Point distance for 09L maintained the same level in 2018 as in 2017.

Arrival Runway Utilisation									
RWY	2001	2005	2009	2011	2014	2015	2016	2017	2018
09L	23%	27%	25%	26%	28%	26%	28%	18%	33%
09R	2%	1%	2%	2%	3%	2%	2%	1%	3%
27L	42%	36%	37%	36%	35%	36%	35%	40%	32%
27R	33%	36%	36%	36%	34%	36%	35%	40%	33%

Variation by year and runway: 09L

Joining Point NM to Threshold	% Arrival Operations Runway 09L								
	2001	2005	2009	2011	2014	2015	2016	2017	2018
5	1%	0%	0%	1%	1%	0%	0%	0%	0%
6	2%	1%	1%	2%	2%	1%	0%	0%	0%
7	5%	3%	3%	6%	6%	4%	1%	2%	2%
8	8%	6%	6%	10%	12%	8%	3%	4%	4%
9	11%	9%	9%	14%	16%	11%	6%	8%	7%
10	13%	12%	12%	14%	14%	14%	10%	11%	11%
11	14%	13%	14%	13%	13%	14%	13%	14%	14%
12	13%	14%	14%	11%	9%	12%	16%	16%	15%
13	12%	13%	13%	8%	8%	11%	16%	15%	15%
14	9%	11%	11%	7%	7%	10%	13%	12%	12%
15	6%	8%	8%	6%	6%	7%	9%	9%	9%
16	3%	5%	5%	4%	4%	4%	6%	5%	6%
17	2%	3%	2%	2%	2%	2%	3%	3%	3%
18	1%	1%	1%	1%	1%	1%	1%	1%	1%
19	0%	1%	1%	0%	0%	0%	1%	1%	1%
20	0%	0%	0%	0%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%	0%	0%
24	0%	0%	0%	0%	0%	0%	0%	0%	0%
25	0%	0%	0%	0%	0%	0%	0%	0%	0%
26	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average Joining Point NM to Threshold	11.8	12.4	12.4	11.6	11.4	12.1	13.0	12.8	12.8
Standard Deviation	2.7	2.8	2.7	2.9	2.8	2.7	2.4	2.5	2.5
95th Percentile	16.2	16.8	16.7	16.6	16.5	16.7	17.1	17.1	17.1

The average Joining Point distance for 09L has remained constant compared to 2017. In 2018 the highest proportion of arrivals joined between 12 and 13NM.

The average Joining Point distance characteristics remained essentially constant between 2017 and 2018.

Variation by year and runway: 09R

Joining Point NM to Threshold	% Arrival Operations Runway 09R								
	2001	2005	2009	2011	2014	2015	2016	2017	2018
5	0%	0%	0%	0%	0%	0%	0%	0%	0%
6	1%	1%	0%	0%	0%	0%	0%	0%	0%
7	2%	2%	1%	1%	0%	0%	0%	0%	0%
8	4%	4%	2%	2%	2%	2%	1%	2%	2%
9	7%	7%	5%	5%	5%	5%	4%	4%	4%
10	11%	10%	10%	8%	9%	11%	9%	9%	9%
11	18%	16%	14%	12%	13%	14%	12%	14%	13%
12	19%	17%	15%	18%	18%	17%	17%	18%	17%
13	12%	13%	14%	16%	17%	16%	17%	16%	15%
14	9%	11%	12%	13%	13%	13%	14%	14%	13%
15	6%	7%	10%	9%	9%	9%	10%	9%	10%
16	4%	5%	7%	7%	6%	6%	7%	6%	6%
17	2%	3%	4%	4%	4%	3%	4%	4%	4%
18	2%	2%	3%	2%	2%	2%	2%	2%	2%
19	1%	1%	1%	1%	1%	1%	1%	1%	1%
20	1%	0%	1%	1%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%	0%	0%
24	0%	0%	0%	0%	0%	0%	0%	0%	0%
25	0%	1%	0%	0%	0%	0%	0%	0%	0%
26	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average Joining Point NM to Threshold	12.5	12.9	13.4	13.4	13.4	13.2	13.6	13.4	13.5
Standard Deviation	2.7	2.9	2.8	2.6	2.5	2.4	2.5	2.5	2.5
95th Percentile	17.2	17.7	18.1	17.6	17.5	17.3	17.8	17.7	17.9

The average Joining Point distance has slightly increased, while the peak at the most frequent Joining Point band has slightly decreased.

The highest proportion of arrivals have still joined between 12 and 13NM.

Variation by year and runway: 27L

% Arrival Operations Runway 27L									
Joining Point NM to Threshold	2001	2005	2009	2011	2014	2015	2016	2017	2018
5	0%	0%	0%	0%	0%	0%	0%	0%	0%
6	1%	0%	0%	0%	0%	0%	0%	0%	0%
7	1%	1%	0%	0%	0%	0%	0%	0%	0%
8	3%	2%	1%	1%	1%	1%	1%	0%	1%
9	5%	4%	3%	2%	3%	2%	2%	2%	2%
10	9%	7%	6%	6%	7%	6%	5%	5%	5%
11	13%	11%	11%	10%	11%	10%	10%	8%	9%
12	16%	15%	15%	15%	16%	15%	14%	14%	15%
13	16%	17%	18%	18%	18%	18%	18%	18%	18%
14	14%	16%	17%	18%	17%	18%	18%	18%	19%
15	9%	12%	13%	14%	13%	14%	14%	16%	14%
16	5%	7%	8%	8%	7%	8%	9%	10%	9%
17	3%	3%	4%	4%	4%	4%	5%	5%	5%
18	2%	1%	2%	2%	2%	2%	2%	2%	2%
19	1%	1%	1%	1%	1%	1%	1%	1%	1%
20	0%	0%	0%	0%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%	0%	0%
24	0%	0%	0%	0%	0%	0%	0%	0%	0%
25	0%	1%	1%	0%	0%	0%	0%	0%	0%
26	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average Joining Point NM to Threshold	13.1	13.6	13.8	14.0	13.8	14.0	14.1	14.2	14.1
Standard Deviation	2.6	2.5	2.5	2.4	2.4	2.3	2.3	2.2	2.2
95th Percentile	17.3	17.3	17.4	17.5	17.4	17.6	17.6	17.7	17.6

The average Joining Point distance for 27L has slightly decreased in 2018.

The highest proportion of aircraft have joined between 13 and 14NM, which is in line with previous years.

Variation by year and runway: 27R

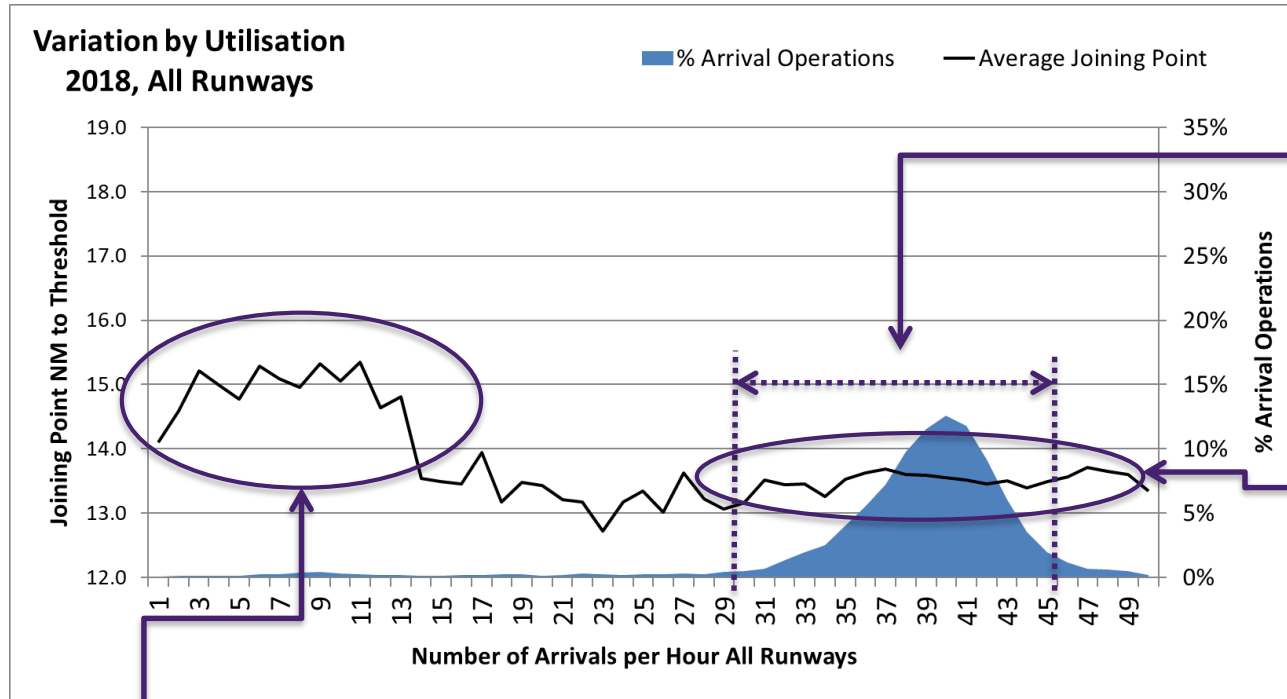
Joining Point NM to Threshold	% Arrival Operations Runway 27R								
	2001	2005	2009	2011	2014	2015	2016	2017	2018
5	0%	0%	0%	0%	0%	0%	0%	0%	0%
6	0%	0%	0%	0%	0%	0%	0%	0%	0%
7	1%	1%	1%	0%	0%	0%	0%	0%	0%
8	3%	2%	2%	1%	1%	1%	1%	1%	1%
9	6%	5%	4%	3%	4%	3%	2%	2%	3%
10	10%	8%	8%	7%	8%	7%	6%	5%	6%
11	14%	13%	12%	11%	13%	11%	11%	9%	11%
12	17%	16%	16%	16%	17%	16%	16%	15%	15%
13	16%	17%	17%	18%	18%	18%	18%	18%	18%
14	13%	15%	16%	17%	16%	17%	18%	18%	17%
15	9%	11%	12%	12%	11%	12%	13%	14%	13%
16	5%	6%	7%	7%	6%	7%	8%	9%	8%
17	2%	3%	4%	4%	3%	4%	4%	5%	4%
18	1%	1%	2%	2%	1%	2%	2%	2%	2%
19	0%	0%	1%	1%	0%	1%	1%	1%	1%
20	0%	0%	0%	0%	0%	0%	0%	0%	0%
21	0%	0%	0%	0%	0%	0%	0%	0%	0%
22	0%	0%	0%	0%	0%	0%	0%	0%	0%
23	0%	0%	0%	0%	0%	0%	0%	0%	0%
24	0%	0%	0%	0%	0%	0%	0%	0%	0%
25	0%	1%	1%	0%	0%	0%	0%	0%	0%
26	0%	0%	0%	0%	0%	0%	0%	0%	0%
Average Joining Point NM to Threshold	12.8	13.3	13.6	13.7	13.4	13.7	13.8	14.0	13.8
Standard Deviation	2.4	2.6	2.6	2.4	2.4	2.4	2.2	2.2	2.3
95th Percentile	16.5	17.1	17.4	17.3	17.0	17.4	17.3	17.6	17.5

The average Joining Point distance for 27R has decreased in 2018.

The highest proportion of aircraft joined between 13 and 15NM, which is mostly in line with previous years.

Variation by runway utilisation

The chart below tracks the average Joining Point distance for all runways based on the number of arrivals in the clock hour (00 - 59 minutes in the hour) in 2018.



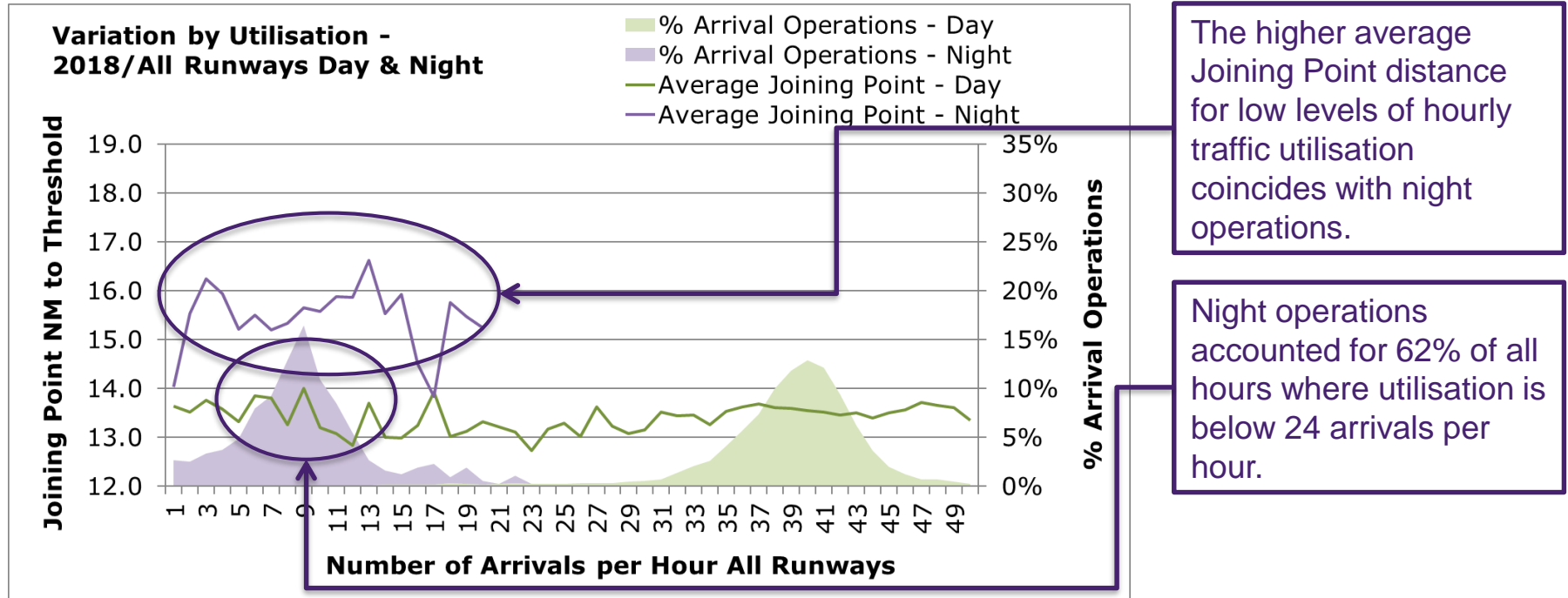
For majority of operations (>91%) the runway utilisation was between 31 and 46 arrivals per hour.

The Joining Point distance fluctuated around the 13.5NM value during busier periods with hourly movement count between 31 and 48 arrivals. This is lower compared to 2017 (13.7NM).

The average Joining Point value has been consistently higher during periods of low intensity traffic (less than 15 arrivals per hour) than the annual average. The annual average for 2018 is 13.6NM.

Variation by utilisation and time of day

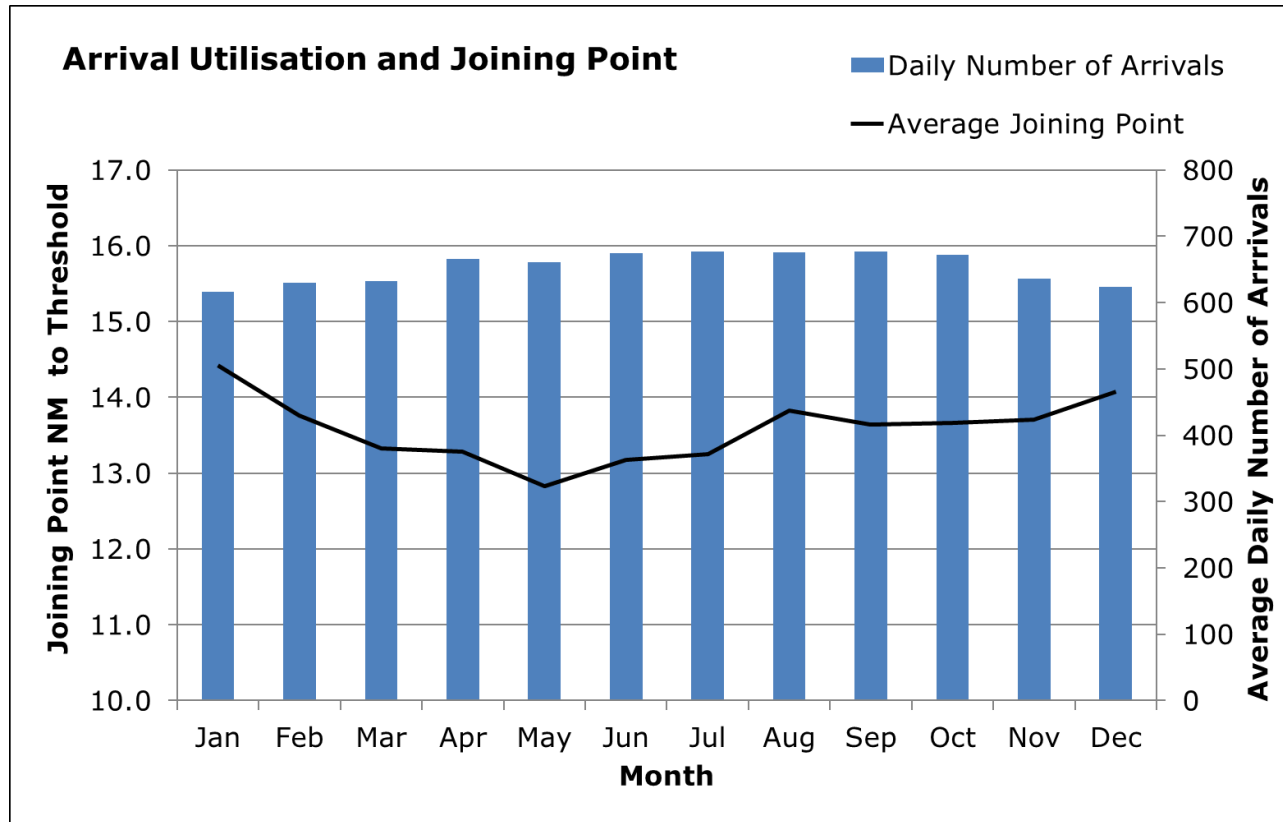
Hours were categorised into Night (23:30 – 05:59 local) and Day (06:00 – 23:29 local) operations.



ATC Viewpoint: During night operations aircraft are more likely to receive a “straight in approach”. This allows aircraft to become established on the ILS sooner and perform a more efficient descent. This, coupled with the requirement that westerly operations should not become established before 10.0NM during night operations, will contribute to the increased Joining Point value.

Variation by season

In 2018 the Joining Point had a spread of 1.5NM during the year, ranging from 12.8NM to 14.4NM.

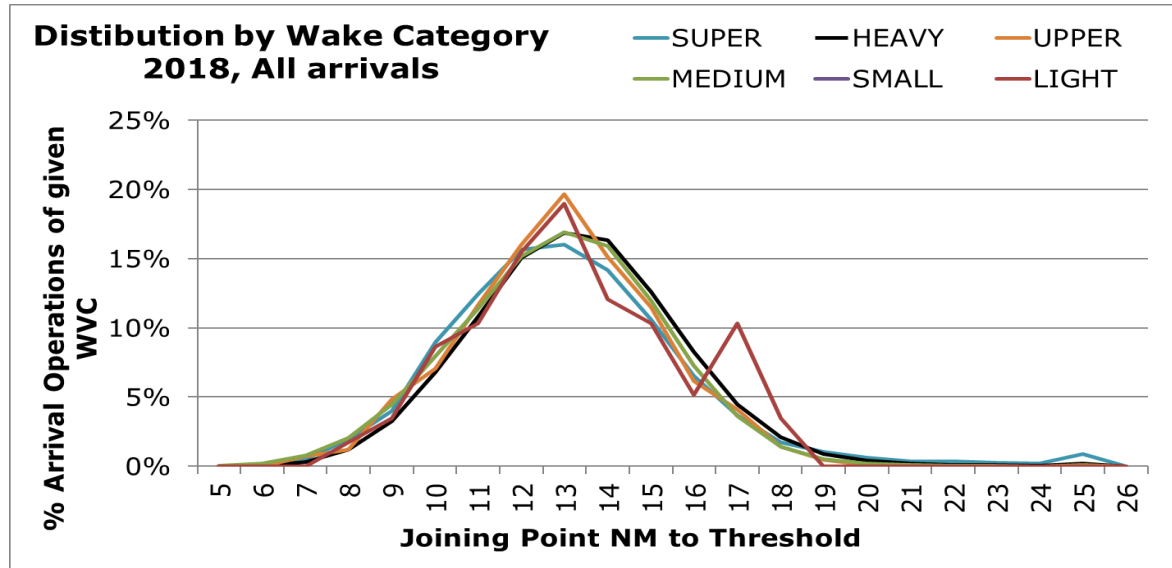


The highest average Joining Point distance occurred during the winter period (December - February) and in the busy summer period (August), with the peak in January at 14.4NM.

The lowest average Joining Point distance occurred during the summer period (May-July). The lowest was in May at 12.8NM.

Variation by aircraft wake category

The chart and table show how the Joining Point distance has varied by aircraft wake category.



The average Joining Point distance shows that arrivals classified as Super, Upper and Light join closer to the runway threshold.

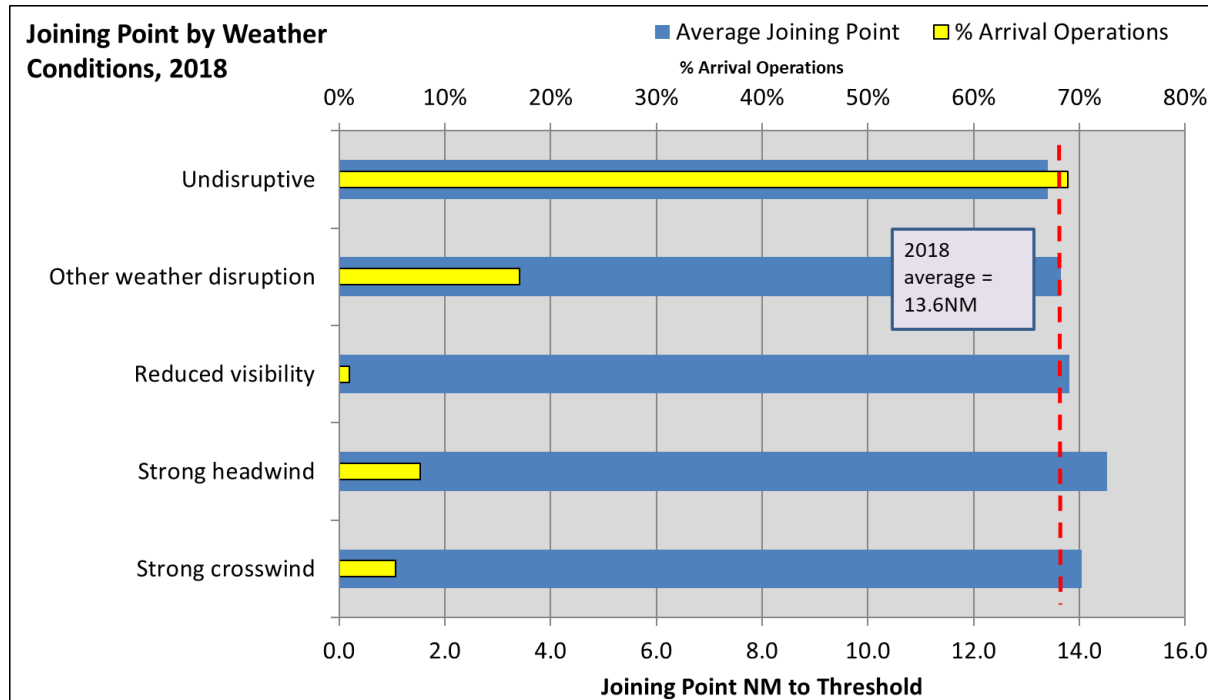
Arrivals classified as Medium and Heavy typically joined further away from the threshold. Arrivals classified as Light accounted for less than 0.1% of all arrivals. Arrivals classified as Super accounted for 3.5% of all arrivals.

Average Joining Point by Wake Category (NM)						
Year	Super	Heavy	Upper	Medium	Small	Light
2001		12.9	12.2	12.8	12.8	12.8
2005		13.3	12.5	13.2	13.0	13.5
2009	14.1	13.6	12.9	13.3	13.1	13.9
2011	14.1	13.5	13.1	13.1	12.7	13.9
2014	13.6	13.3	12.7	12.8	12.9	13.9
2015	13.6	13.6	13.1	13.2	15.0	14.5
2016	13.8	13.9	13.4	13.6	11.1	14.3
2017	13.8	13.9	13.8	13.9	16.6	14.0
2018	13.6	13.8	13.4	13.4		13.7

Variation by weather conditions

The chart below shows the average Joining Point distance for the different weather conditions for 2018.

Weather scenario name	Definition
Undisruptive	Headwind ≤ 10 kts, crosswind ≤ 10 kts, visibility ≥ 5000 m and cloud base ≤ 1000 ft
Strong headwind	Headwind ≥ 10 kts, crosswind ≤ 10 kts, visibility ≥ 5000 m and cloud base ≤ 1000 ft
Strong crosswind	Headwind ≤ 10 kts, crosswind ≥ 10 kts, visibility ≥ 5000 m and cloud base ≤ 1000 ft
Reduced visibility	Visibility < 1000 m
Other weather disruption	Any other set of parameters that does not fit the definitions above



The average Joining Point distance was highest and in excess of 14.0NM during headwind conditions.

The Joining Point distance was typically higher during disruptive weather conditions.

What is the reason for 2018 decrease in Joining Point?

- In theory there are several possible explanations:
 - Change in runway usage – there was an increased use of 09L which experienced a lower Joining Point than runways when on westerly operations.
 - There was a higher number of flights (in proportion to all air traffic at Heathrow) during the night time while the average night Joining Point distance was lower in 2018 than it was in 2017.
- More than one explanation is very likely

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