RUNWAYS 30L AND 30R DEPARTURE OPERATIONS REPORT

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Community Relations Office

Metropolitan Airports Commission
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metroairports.org

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EXECUTIVE SUMMARY

During an MSP Listening Session in July 2019, community members discussed concerns related to departures from Runway 30L. At the MSP Noise Oversight Committee (NOC) meeting in September 2019, NOC members echoed the concerns about the use of Runways 30L and 30R for aircraft departing Minneapolis-St. Paul International Airport (MSP). In response, the NOC included an item to conduct a Runway 30L and 30R Departure Study in the 2020 Work Plan.

This study provides trend information on the use of Runways 30L and 30R in 2019 and was prepared in fulfillment of the NOC 2020 Work Plan. For comparison purposes, aircraft activity from 2016 through 2018 was used to compare to 2019 activity. Differences in the use of runways is noted as applicable.

The use of Runways 30L and 30R has varied since 2010. In 2019, Runway 30L was used for 24 percent of MSP departures and Runway 30R was used for 21 percent of departures. The use of the runways has been decreasing, from a combined use of about 58 percent in 2010 down to 45 percent of departures in 2019. Runway 30L was used more often for departures than Runway 30R for most of the years in the study time period with the exception of 2010 and 2016.

Weather, special events and airfield maintenance all impact the operational flow of air traffic daily. Airline schedules and changing fleet characteristics affect runway use monthly and annually. The use of the runways during peak hours of the day is similar in 2019 when compared to an average of 2016-2018. The runways are utilized similarly in the 11pm to 5am time period but have variations throughout the remainder of the day.

The average number of days with at least six hours of North Flow (use of Runways 30L, 30R and 35) or Mixed Flow A (use of Runways 30L, 30R and 17) activity and the average number of successive days in these flows in 2016-2018 and 2019 were similar. While in North Flow, the use of Runway 30L increased three percent in 2019 compared to the previous three-year average while the use of Runway 30R decreased three percent.

The most common headings flown by aircraft departing Runway 30L are categorized by a 230° heading. This use has been above 60 percent of all Runway 30L departures every year included in this study. The most common headings flown by aircraft departing Runway 30R are categorized by a 340° heading. This use has been above 30 percent of all Runway 30R departures every year included in this study.

Altitudes for regional jets has remained consistent from 2016 through 2019 for both runways. Altitudes for narrow body jets decreased slightly (about 300 feet at 10 miles from MSP) on both runways since 2016. Alternatively, wide body jets increased departure altitude in 2019 on Runway 30L. No significant differences between the runways were identified.

1. Introduction

The Metropolitan Airports Commission (MAC) is a public corporation governed by a board of commissioners that reports to the Governor of Minnesota and the Minnesota State Legislature. The MAC is charged with managing a system of seven airports within the Minneapolis-St. Paul metropolitan area, including Minneapolis-St. Paul International Airport (MSP). In addition to the MAC, other air transportation entities play critical roles in the successful operation of an airport. The Federal Aviation Administration (FAA) regulates all aircraft activity. At MSP, the FAA's Air Traffic Control (ATC) is solely responsible for directing aircraft on the ground and in the air. ATC's highest priority is the safe and efficient movement of air traffic. Air transportation companies, such as airlines, provide transportation services for people and products. **Figure 1 - Air Transportation Entities** below outlines the primary air transportation units responsible for the successful operation of MSP.

Figure 1 - Air Transportation Entities

The MAC has designated the Noise Oversight Committee (NOC) as its primary advisory body regarding aircraft noise issues associated with flight operations at MSP. The NOC directed MAC staff to conduct an analysis of MSP Runways 30L and 30R departure activity. A graphic of the MSP runway layout is provided in **Figure 2 - MSP Runway Layout**.

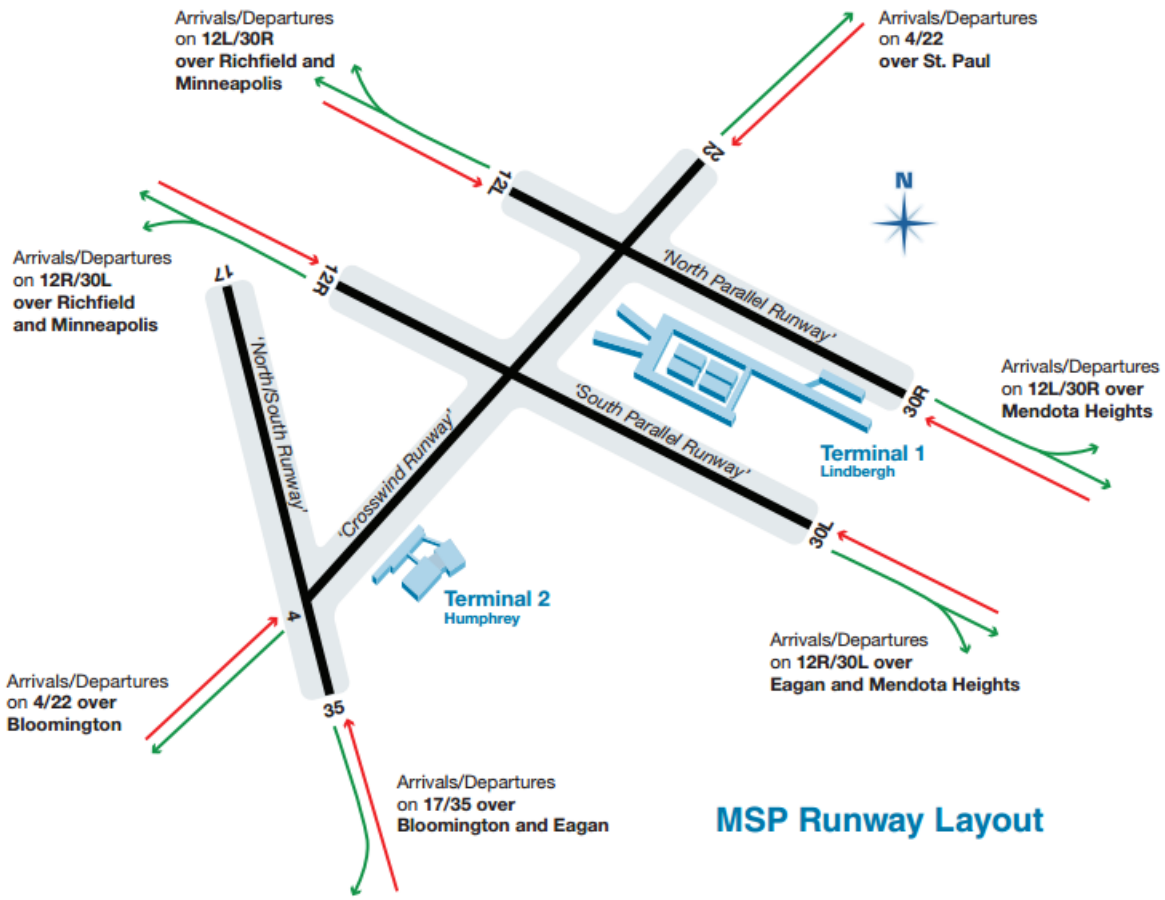


Figure 2 - MSP Runway Layout

2. BACKGROUND

As shown in **Figure 3 - MSP Runway Configurations**, Runways 30L and 30R are used during two primary airport configurations: (1) North Flow – where aircraft are departing from Runways 30L and 30R and arriving on Runways 30L and 30R and 35; and (2) Mixed Flow A – where aircraft are departing from Runway 17, 30L, and 30R, with aircraft arriving to Runways 30L and 30R.

The MSP Runway Use System (RUS) prioritizes arrival and departure runways to promote flight activity over less-populated residential areas as much as possible. During a North Flow, the Priority 4 departure runways (30L and 30R) are used for aircraft taking off. The RUS is maximized in Mixed Flow A, where the Priority 1 arrival runways (30L and 30R) are used for arrivals, while the Priority 2 departure runway (17) is used for departures in addition to Priority 4 departure runways (30L and 30R). In Mixed Flow A, departures that could utilize Runway 30L are redirected to Runway 17 to make use of the RUS.

As shown in **Figure 4 - MSP Departures by Year,** the use of Runways 30L and 30R has varied since 2010. The use of the runways has been decreasing, from a combined use of about 58 percent down to 45 percent of departures in 2019. In 2019, there were a total of 48,544 departures from 30L and 42,707 departures from 30R. The use of Runway 30L, as a percentage of MSP total departures, was highest in 2014. The use of Runway 30R as a percentage of total MSP departures was highest in 2010 and has been consistent since about 2014.

The last study on Runway 30L and 30R departures was conducted in 2013. During the previous year, the NOC recommended the FAA vector northbound departures from Runways 30L and 30R to headings of 320°, 340° and 360° in order to obtain greater dispersal of departure flights. This current study finds these divergent headings are being used by the FAA.

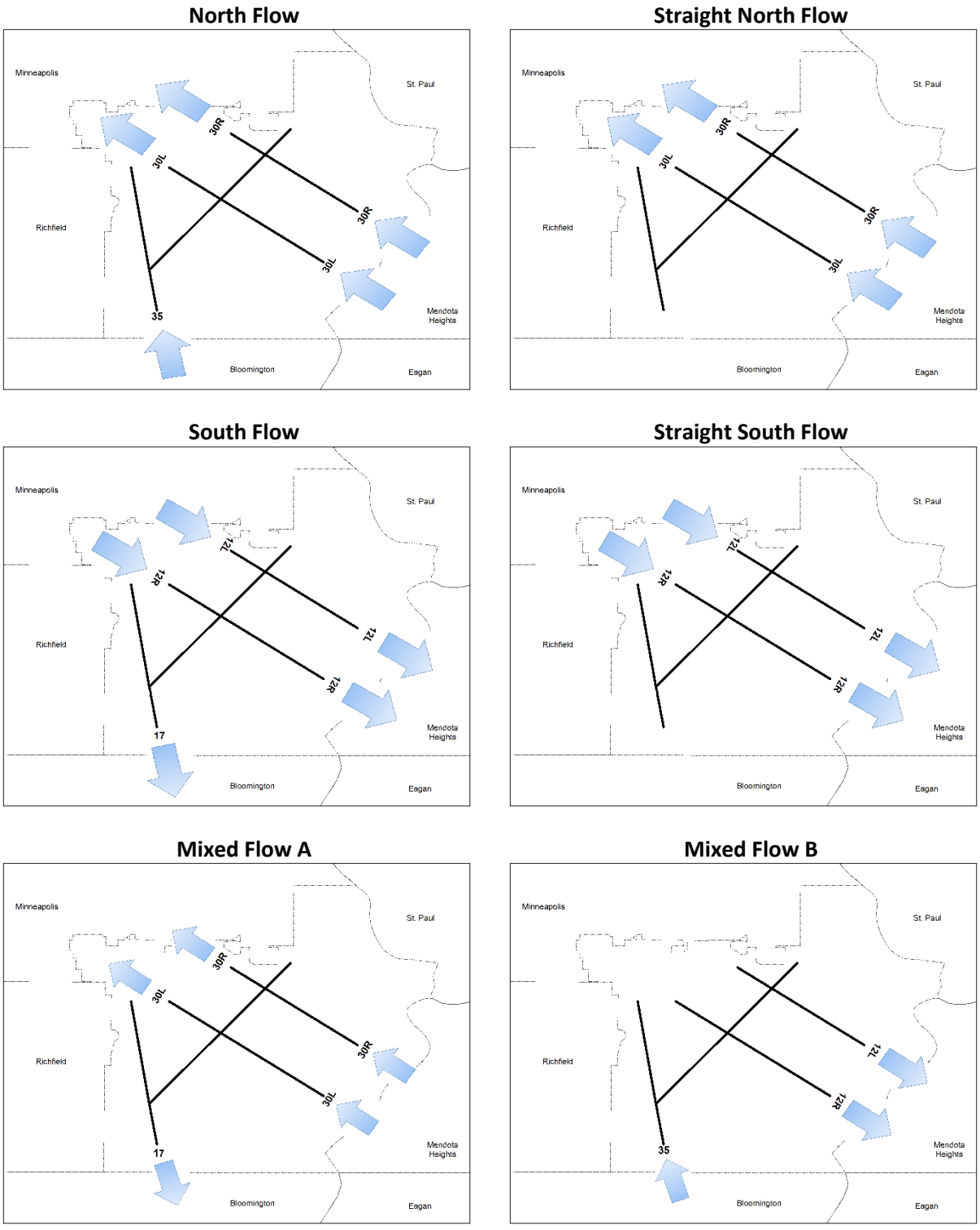


Figure 3 - MSP Runway Configurations

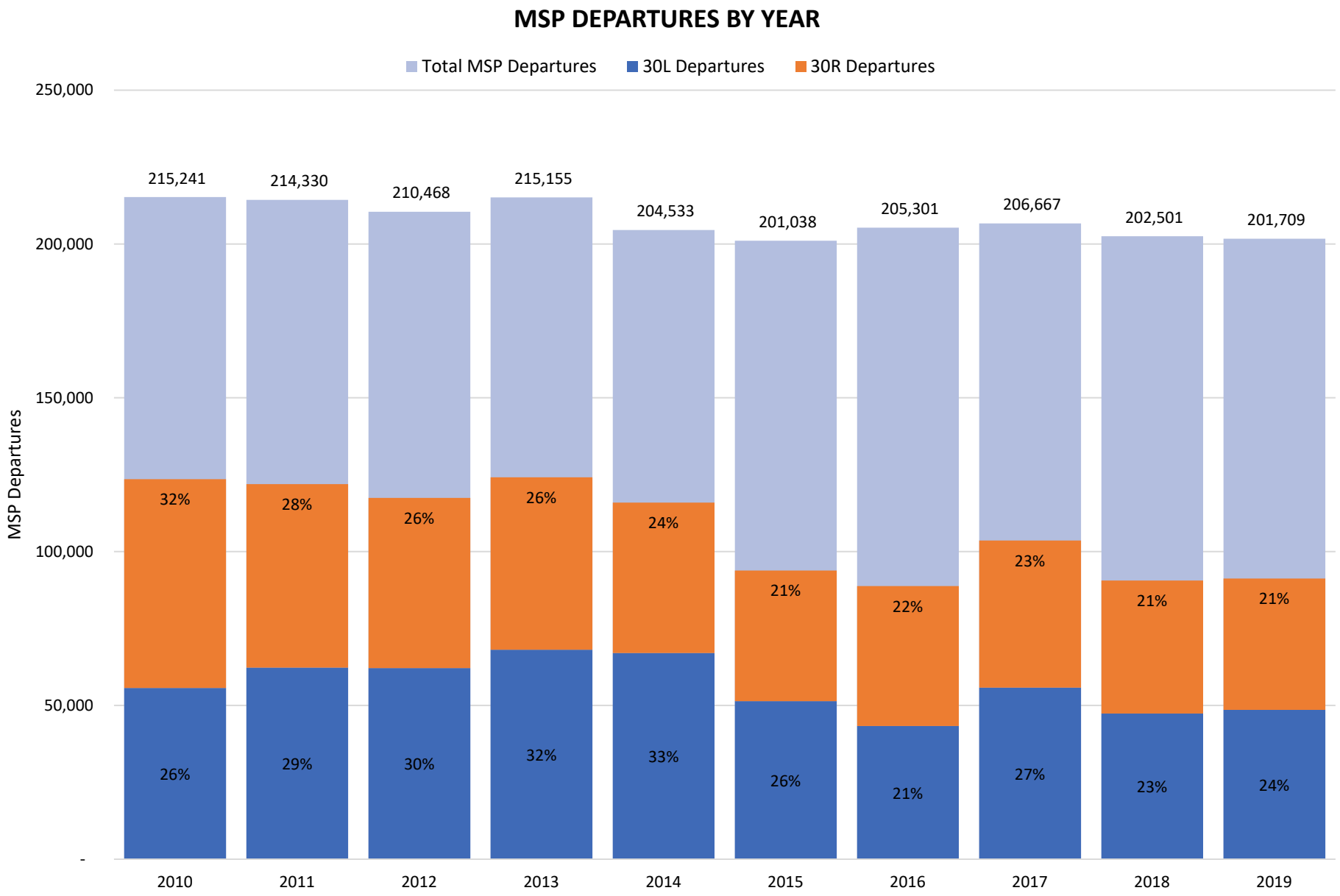


Figure 4 - MSP Departures by Year

3. Runway Use

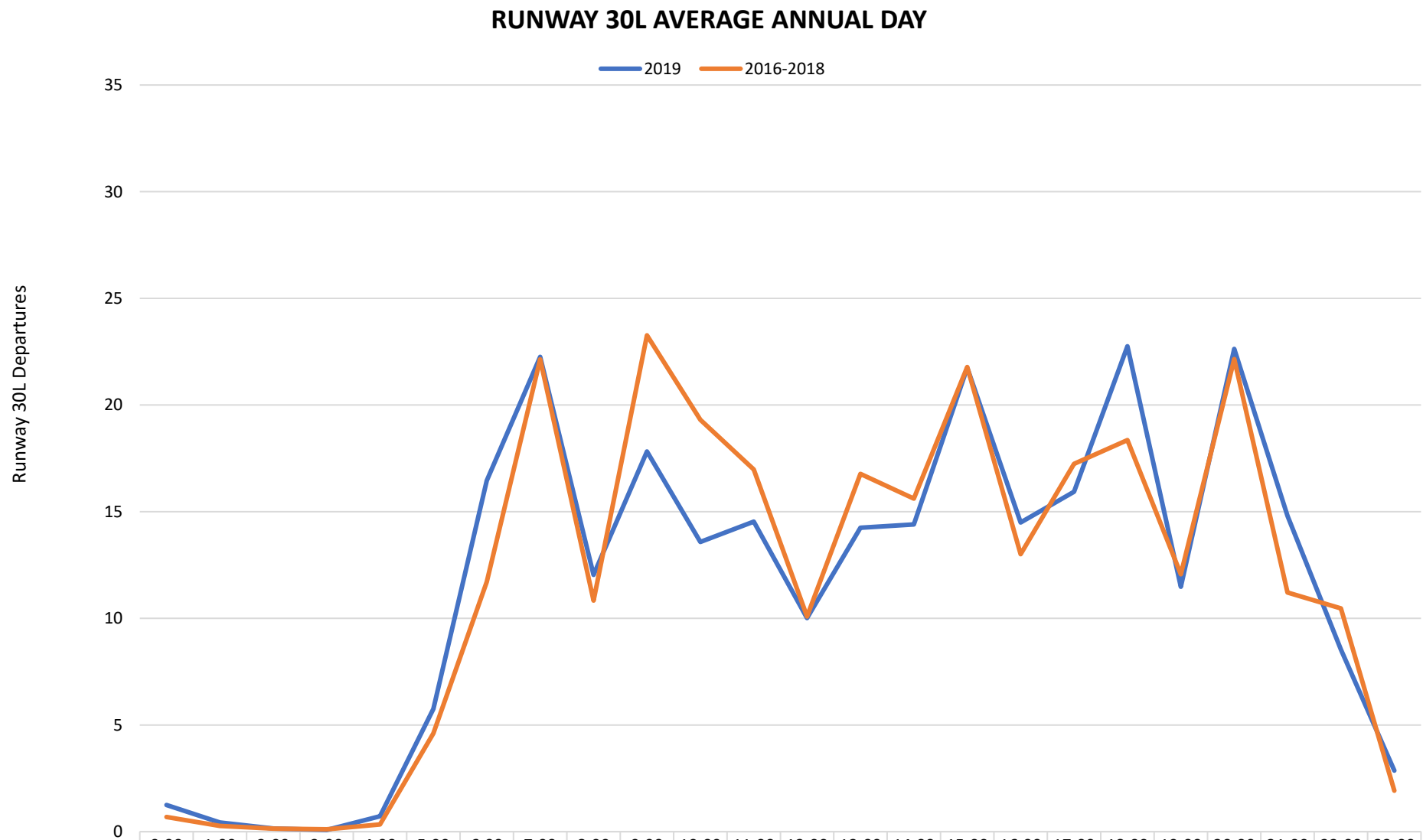
Weather, special events and airfield maintenance all impact the operational flow of air traffic daily. Airline schedules and changing fleet characteristics affect runway use monthly and annually.

Figure 5 - Runway 30L Average Annual Day and **Figure 6 – Runway 30R Average Annual Day** show the average number of departures during each hour when the airport was in either a North Flow or Mixed Flow A in 2019 compared to an average of the previous three years. As shown, Runway 30L and 30R are used very little between 11pm and 5am. Throughout the remainder of the day, peaks and valleys are prevalent, which are driven by airline scheduling trends. The first peak of the day for both runways occurred in the 7am hour followed by the first valley in the 8am hour. After 8am, differences and similarities occur between the runways. In 2019, there were 17 fewer average daily departures on Runway 30L between 9am and 3pm when compared to the previous three years. However, there were five more average daily departures on 30L in 2019 in the 6pm hour and four more average daily departures in the 9pm hour. In 2019, on average there were four more departures from 30R in the 6am hour and eleven fewer departures between 3pm and 8pm. In the 8pm hour, there is a peak number of departures that use Runway 30R.

Depictions of average days are informative, but averages can be misleading. **Figure 7 - Peak Hour Departure Operations** depicts the highest number of Runway 30L and 30R departures that occurred on any given hour in 2019. In general, the peaks and valleys are similar to the averages. Unusual departure peaks were often related to runway closures for weather or maintenance.

Figure 8 - MSP Days in North Flow or Mixed Flow A shows the number of days in which six or more hours were spent in North Flow or Mixed Flow A. The average number of days with at least six hours of North Flow or Mixed Flow A activity for 2016-2018 was about 174 days. This number was similar in 2019, with 173 days. The number of successive days in these flows was similar with an average of 5 days in 2019 and the three previous years.

Figure 9 - Departure Runway Distribution first lays out the distribution of North Flow and Mixed Flow A use in 2016-2018 (Average) and 2019. The use of North flow decreased by six percent in 2019 and was replaced by an equivalent increase in Mixed Flow A. The figure then lays out the distribution of runway use in 2016-2018 (Average) and 2019 in South Flow and Mixed Flow A. These percentages do not reflect the annual percent use of departures. They are only including the time the airport was configured in a North Flow and a Mixed Flow A, respectively. When MSP was configured in a North Flow in 2016-2018 (Average), 56 percent of all departures used Runway 30L and 44 percent of all departures used Runway 30R. That percentage changed to 59 percent and 41 percent in 2019. In the Mixed Flow A configuration, 14 percent of all departures used Runway 30L and 39 percent of all departures used Runway 30R in 2016-2018 (Average). That changed to 15 percent and 38 percent in 2019.



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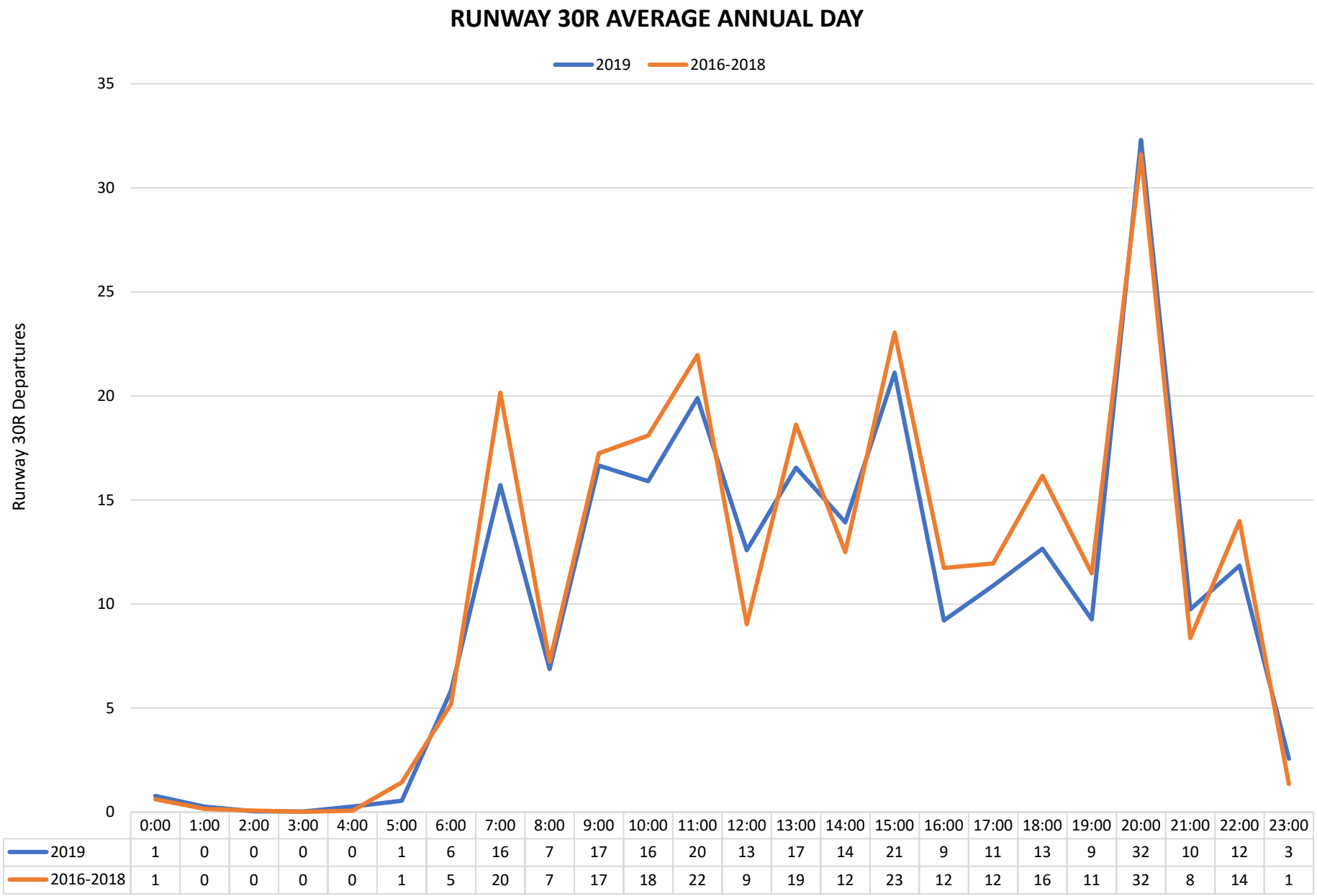
2019	1	0	0	0	1	6	16	22	12	18	14	15	10	14	14	22	14	16	23	11	23	15	9	3
2016-2018	1	0	0	0	0	5	12	22	11	23	19	17	10	17	16	22	13	17	18	12	22	11	10	2

Figure 5 - Runway 30L Average Annual Day



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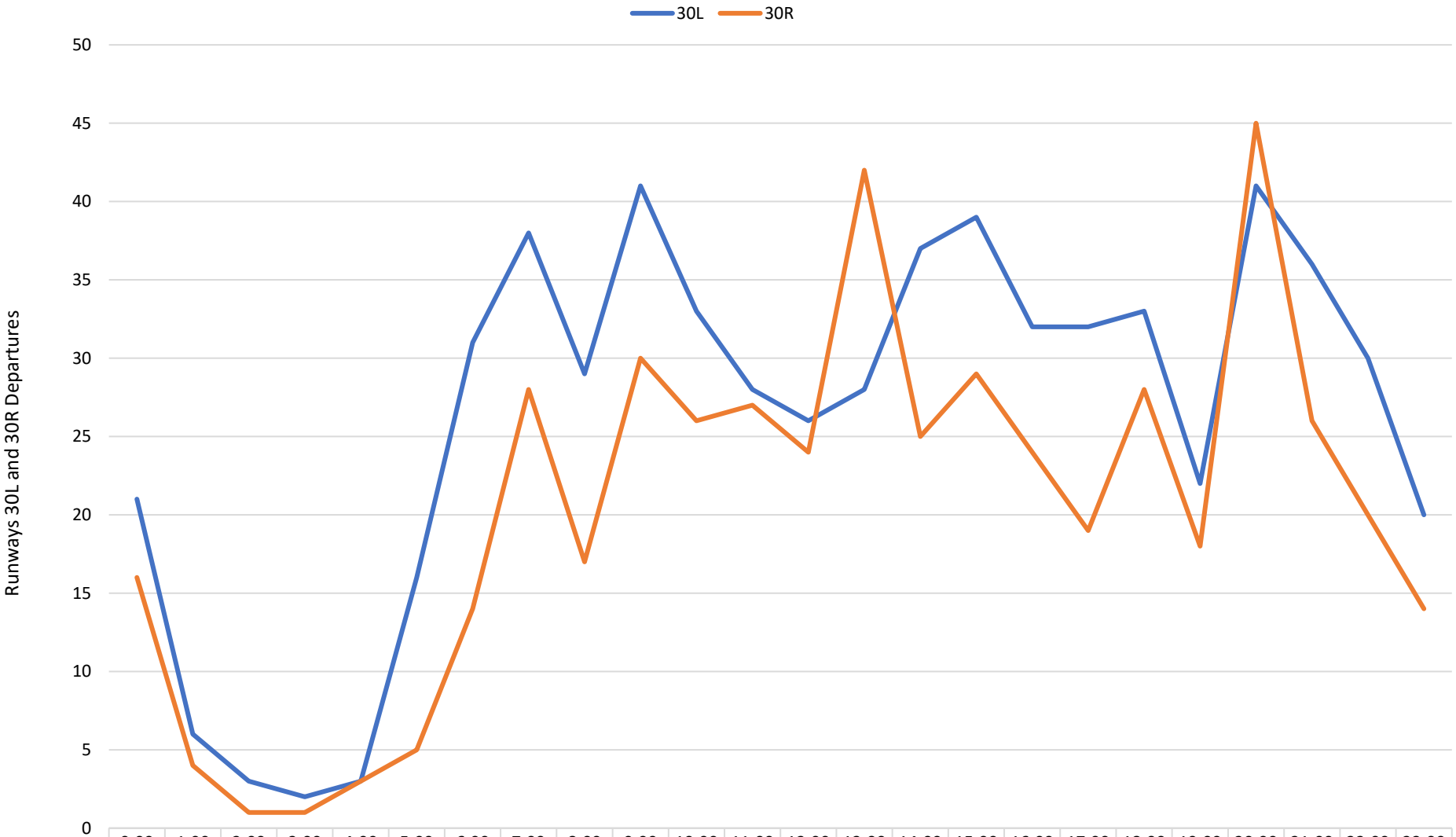
2019	1	0	0	0	0	1	6	16	7	17	16	20	13	17	14	21	9	11	13	9	32	10	12	3
2016-2018	1	0	0	0	0	1	5	20	7	17	18	22	9	19	12	23	12	12	16	11	32	8	14	1

Figure 6 – Runway 30R Average Annual Day

2019 PEAK HOUR DEPARTURE OPERATIONS



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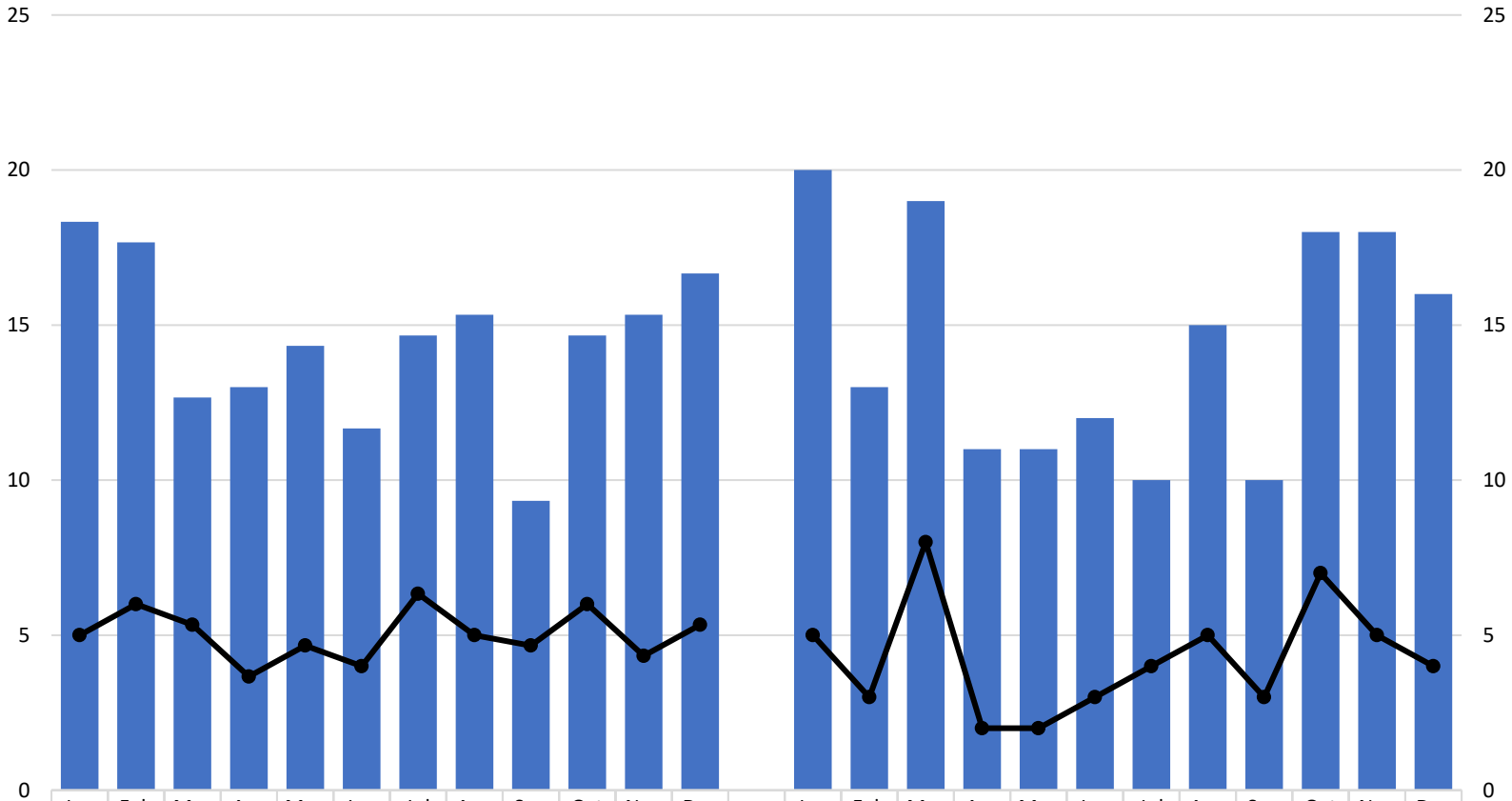
30L	21	6	3	2	3	16	31	38	29	41	33	28	26	28	37	39	32	32	33	22	41	36	30	20
30R	16	4	1	1	3	5	14	28	17	30	26	27	24	42	25	29	24	19	28	18	45	26	20	14

Figure 7 - Peak Hour Departure Operations

MSP DAYS IN NORTH FLOW OR MIXED FLOW A



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	2016-2018 (Average)												2019											
Total Days	18	18	13	13	14	12	15	15	9	15	15	17	20	13	19	11	11	12	10	15	10	18	18	16
Successive Days	5	6	5	4	5	4	6	5	5	6	4	5	5	3	8	2	2	3	4	5	3	7	5	4

**Days were counted when North Flow or Mixed Flow A was used at least 6 hours or more*

Figure 8 - MSP Days in North Flow or Mixed Flow A

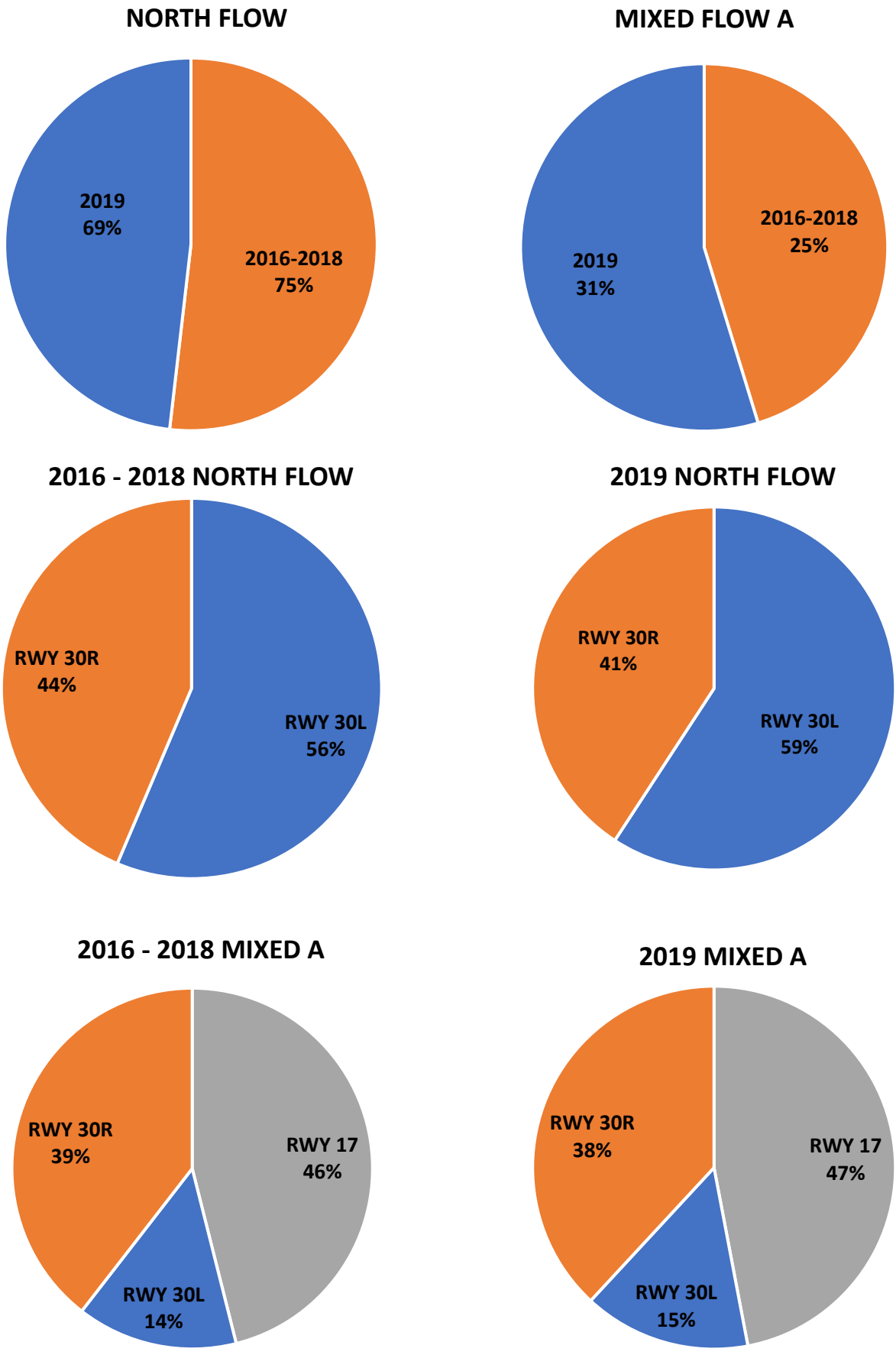
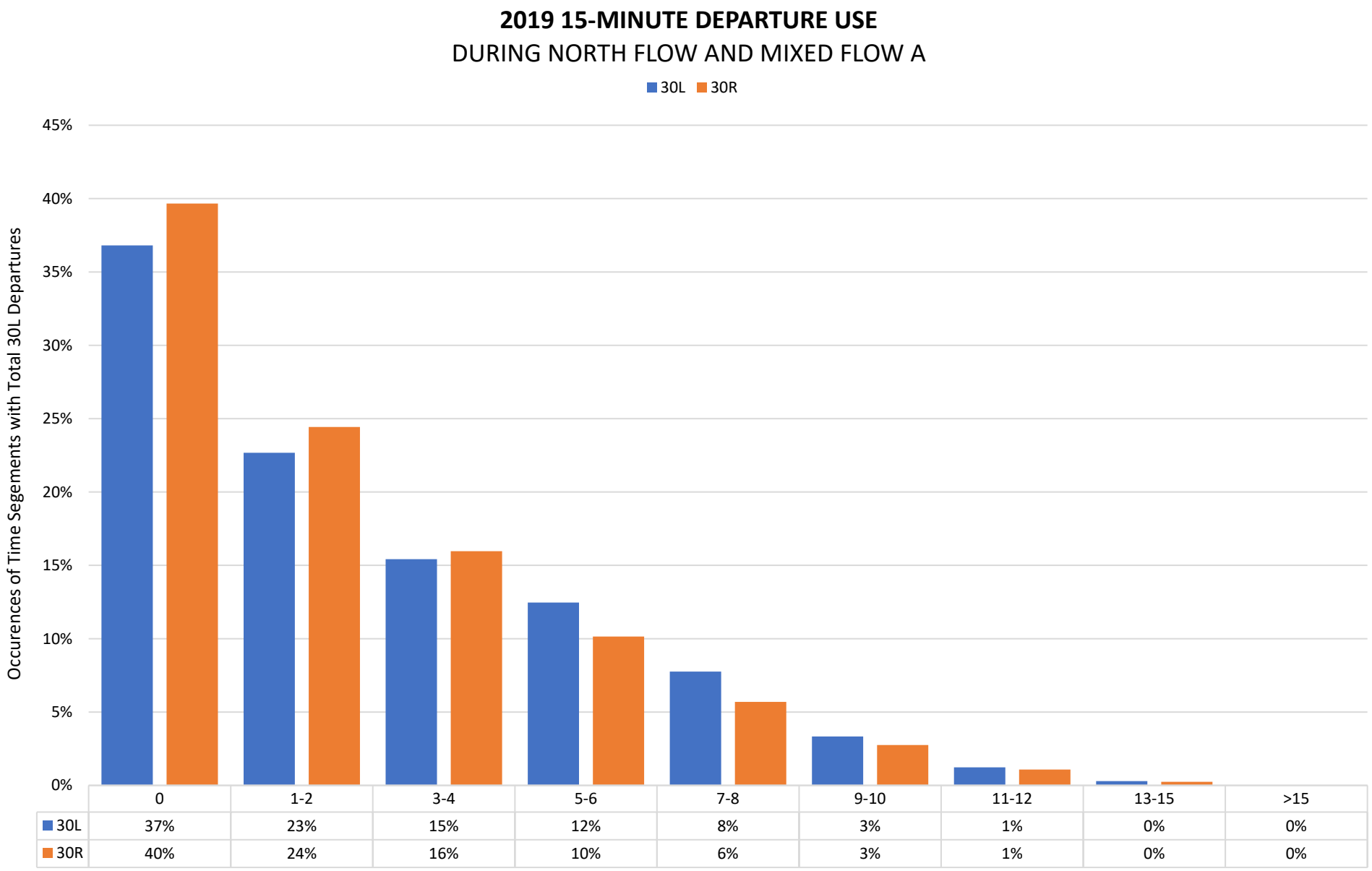


Figure 9- Departure Runway Distribution

4. Flight Frequency

To investigate whether the flight frequency within the 15-minute segments has changed, this analysis counts the number of Runway 30L and 30R departures during 15-minute segments in 2019 and compares to 2016-2018 (Average). **Figure 10 - 2019 15-Minute Departure Use** and **Figure 11 - 2016-2018 (Average) 15-Minute Departure Use** displays the percent of time the runway departures occurred at various levels of frequency (i.e. the number of Runway 30L departures per 15-minutes was 0, 1-2, 3-4, 5-6, etc.).

It is important to note that although the runways may be available for departure, they may not necessarily be used. Overnight hours are the most frequent occurrence of this situation. While there are many instances when the runways are available for use, Runway 30L was not used 37 percent and Runway 30R was not used 40 percent of the time they were available for use during the 2016-2018 time period. In 2019, this increased on Runway 30L by one percent and decreased on Runway 30R by one percent.

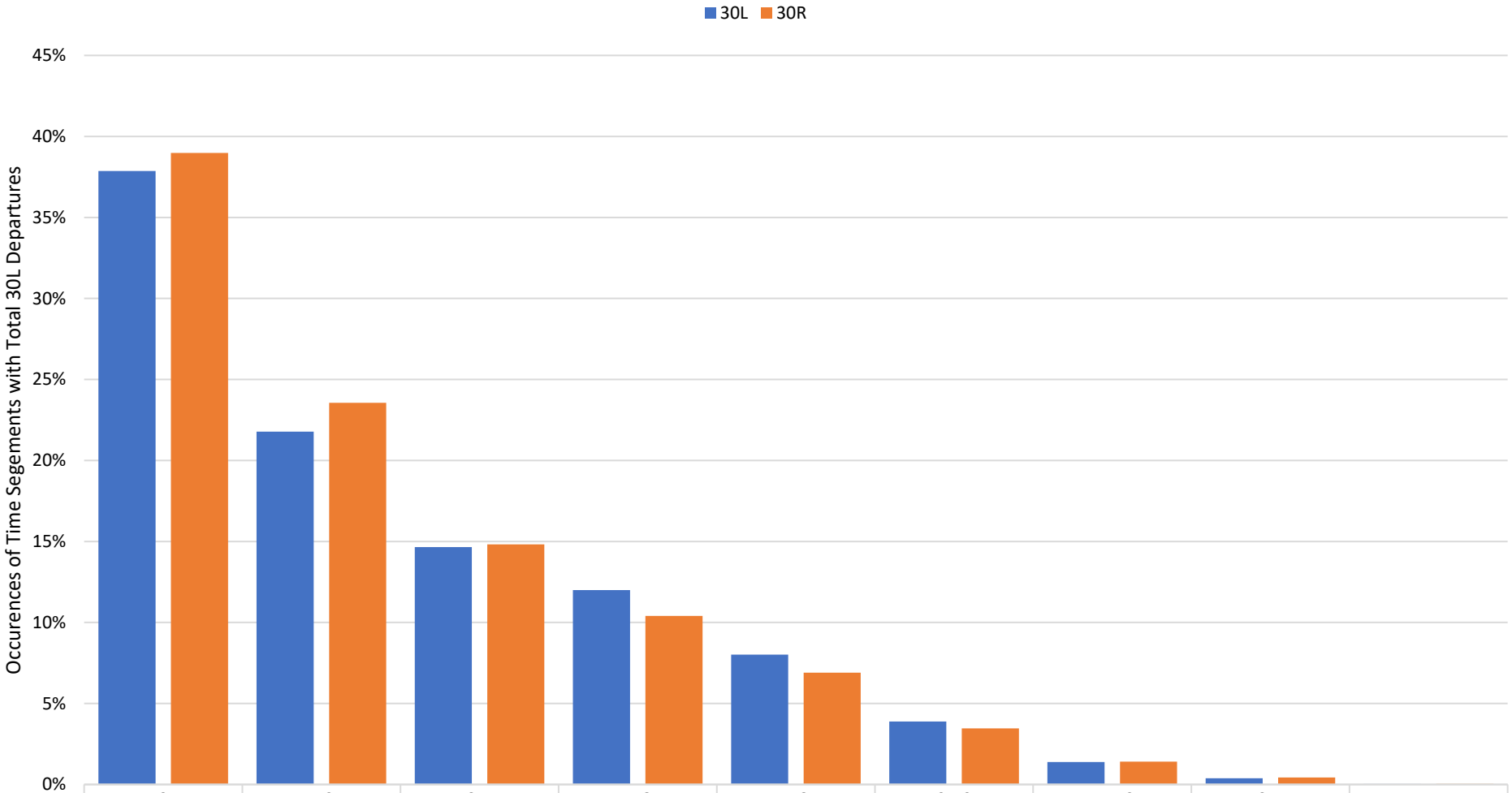


	0	1-2	3-4	5-6	7-8	9-10	11-12	13-15	>15
30L	37%	23%	15%	12%	8%	3%	1%	0%	0%
30R	40%	24%	16%	10%	6%	3%	1%	0%	0%

Figure 10 - 2019 15-Minute Departure Use

2016-2018 (AVERAGE) 15-MINUTE DEPARTURE USE

DURING NORTH FLOW AND MIXED FLOW A



	0	1-2	3-4	5-6	7-8	9-10	11-12	13-15	>15
30L	38%	22%	15%	12%	8%	4%	1%	0%	0%
30R	39%	24%	15%	10%	7%	3%	1%	0%	0%

Figure 11 - 2016-2018 (Average) 15-Minute Departure Use

5. Runways 30L and 30R Departure Headings

Runway 30L serves aircraft departing to destinations that are generally north, northwest, west, southwest and south of MSP. Additionally, Runway 30L is wider and longer than Runway 30R, which makes Runway 30L preferable for extra-large and/or extra-heavy aircraft. Runway 30R serves aircraft departing to destinations that are generally north, northeast, east, southeast and south of MSP. This covers a broad range of geographic locales. To accommodate that traffic, FAA Air Traffic Control (ATC) assigns a broad range of headings. While there is a range available to ATC, the FAA uses primary headings for departure. Using primary headings improves consistency, repeatability and safety and are chosen by ATC after considering numerous criteria including the aircraft's destination, routing, aircraft type, weather conditions, other air traffic and airport configuration. The aircraft destination and associated routing are important determinants to the heading assigned to a departure. For the purposes of this analysis, headings were assigned to the modeling tracks described below and may not representative actual ATC instruction for any given operation.

For the purpose of modeling aircraft noise, the Aviation Environmental Design Tool (AEDT) uses model tracks; however, the actual flight paths would be distributed along these tracks. Aircraft were assigned a modeled track and then dispersed from the base track using a standard distribution method within the model. The industry and the MAC continue to use this method during the development of aircraft noise exposure contours.

Figure 12 - Runway 30L Modeled Departure Tracks below shows the location of the different tracks for Runway 30L departures. These tracks were developed using actual flight data and continue to be evaluated on an annual basis. Actual flights can be assigned to a modeled track using a best-fit approach. The tracks in Figure 12 are categorized by general headings in **Figure 13 - Runway 30L Modeled Departure Tracks by Heading**. **Figure 16 - Runway 30R Modeled Departure Tracks** shows the location of the model tracks for Runway 30R departures. The tracks in Figure 16 are categorized by general headings in **Figure 17 - Runway 30R Modeled Departure Tracks by Heading**. The headings used were assigned by MAC staff and may not represent actual ATC instruction.

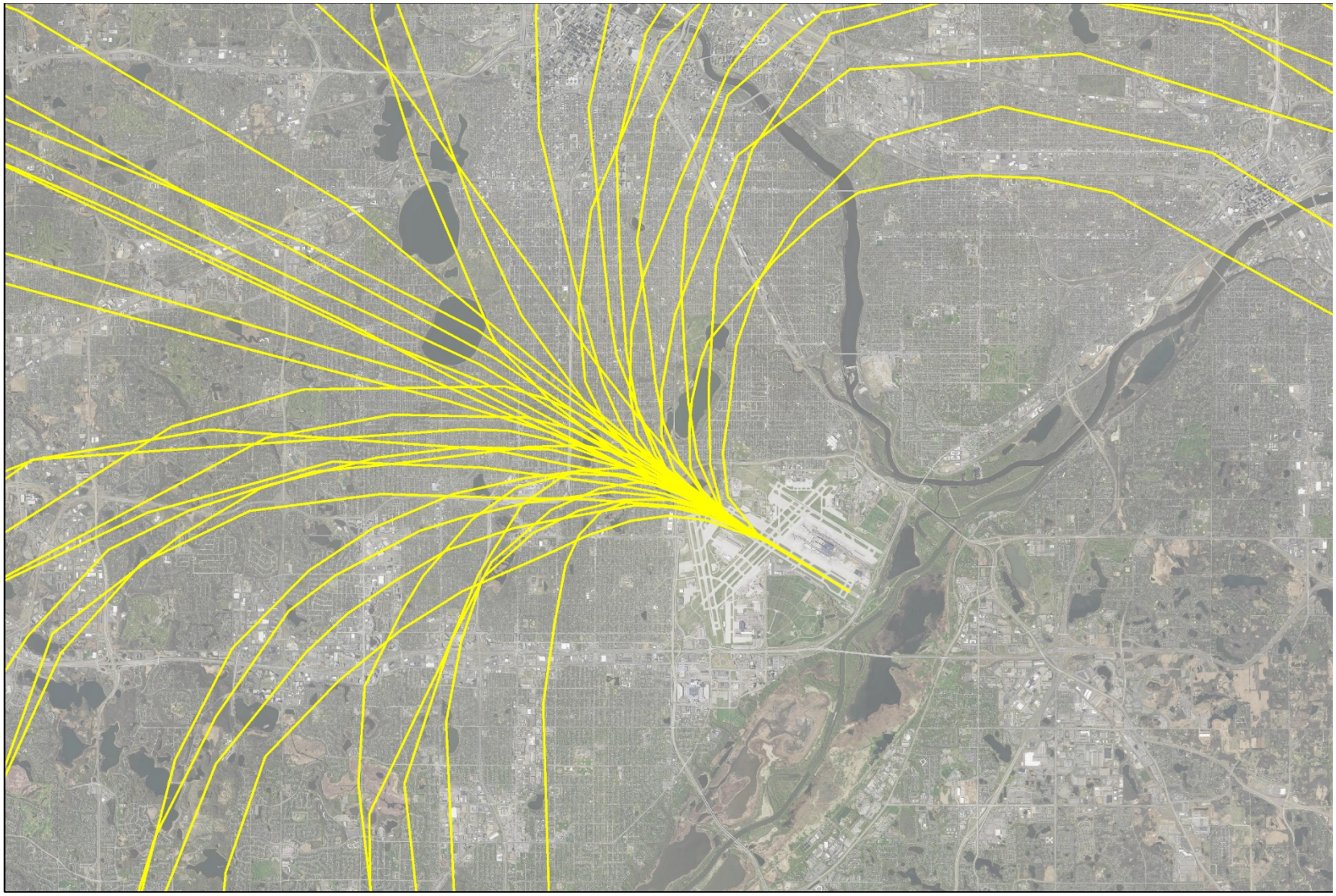
The result of this process is encapsulated in **Figure 14 - Runway 30L Departure Heading Use** and **Figure 18 - Runway 30R Departure Heading Use.** The figures show variation in departure heading usage. The most common tracks flown by aircraft departing Runway 30L are the tracks categorized by a 230° heading. This use has been above 60 percent of all Runway 30L departures every year. The most common tracks flown by aircraft departing Runway 30R are the tracks categorized by a 340° heading. This use has been above 30 percent for all Runway 30R departures every year.

Northbound aircraft departures on Runway 30R are using the 320°, 340° and 360° headings as previously requested by the NOC. This allows a greater dispersion of flight tracks over residential areas to the north of MSP.

As noted, the aircraft destination and associated routing are important determinants to the heading assigned to a departure. Destination is determined by the aircraft operator. At MSP, airlines determine

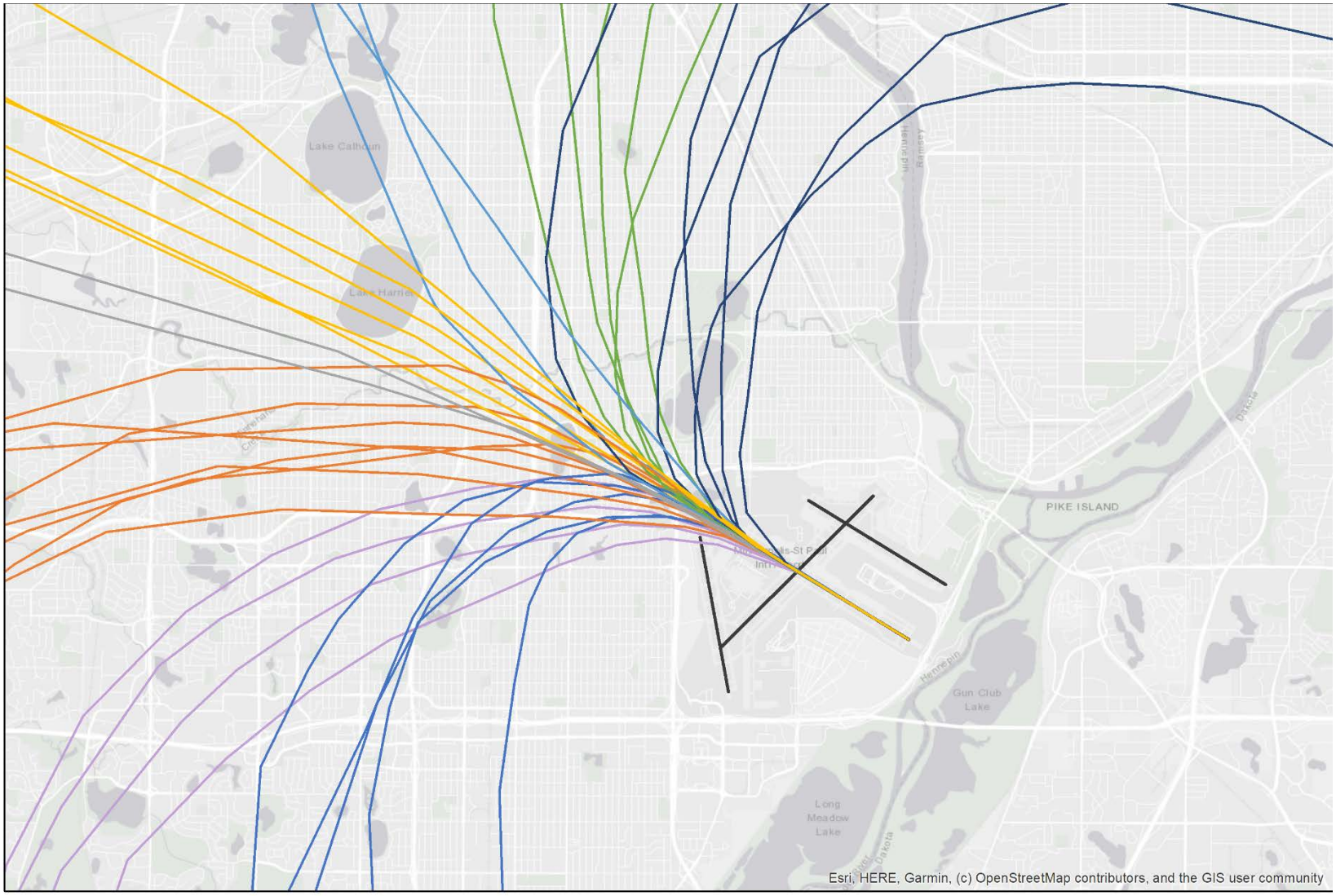
the schedule of aircraft operations, and the frequency of flights to their chosen destinations. How quickly the airlines change the schedule would be contingent on their responsiveness to market demand.

Because airline scheduling decisions vary throughout the day, headings that favor certain regions of the country may be more prevalent during certain hours of the day. **Figure 15 - 2019 Runway 30L Heading Use by Time** and **Figure 19 - 2019 Runway 30R Heading Use by Time** provide the utilization of headings by hours of the day in 2019. These charts only determine how heading-use fluctuates during the day; it does not account for total volume of departures during these hours.



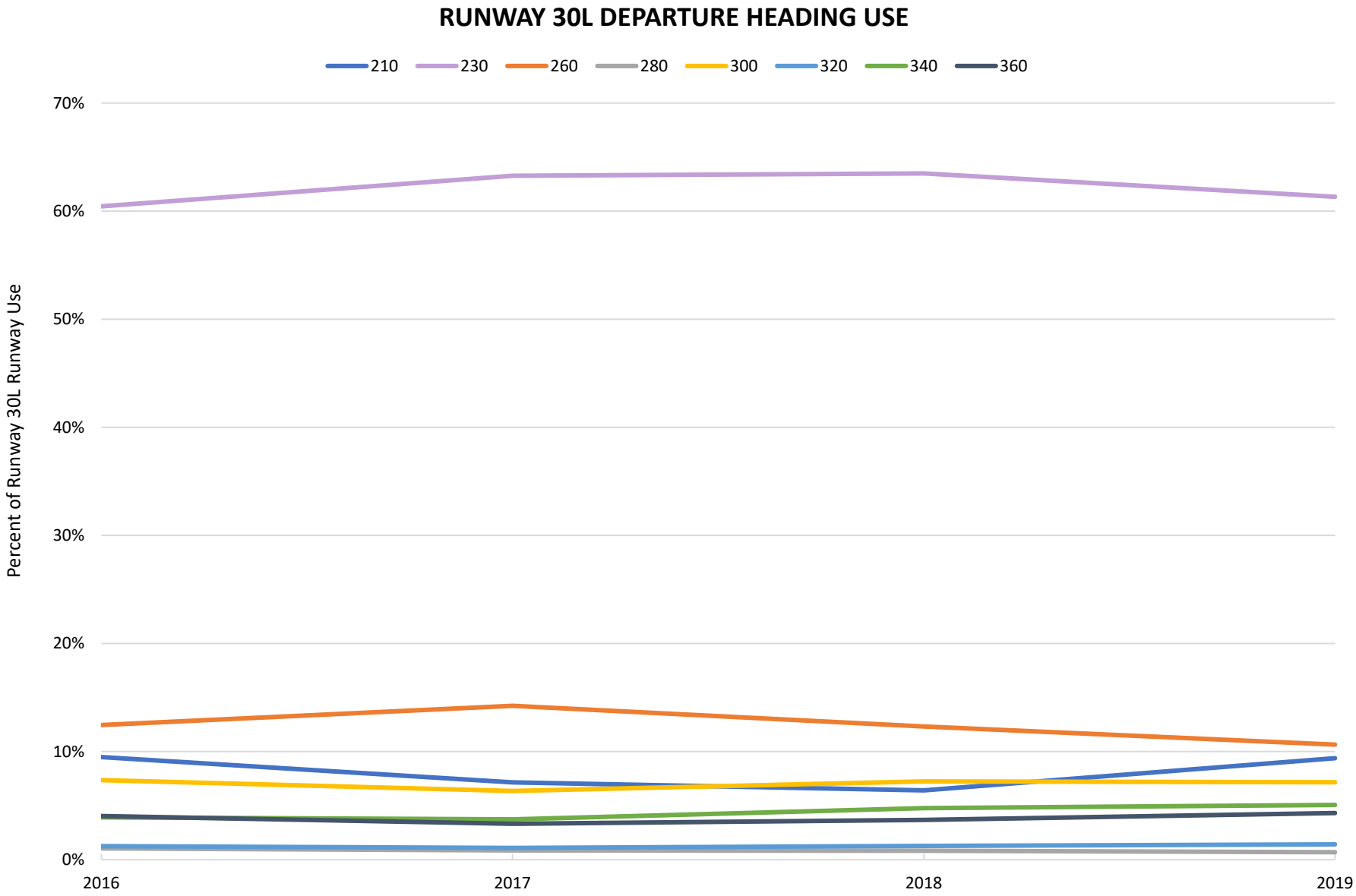
Note: AEDT modeled flight tracks shown, flight paths from actual operations have greater dispersion.

Figure 12 - Runway 30L Modeled Departure Tracks



Note: AEDT modeled flight tracks shown, flight paths from actual operations have greater dispersion.

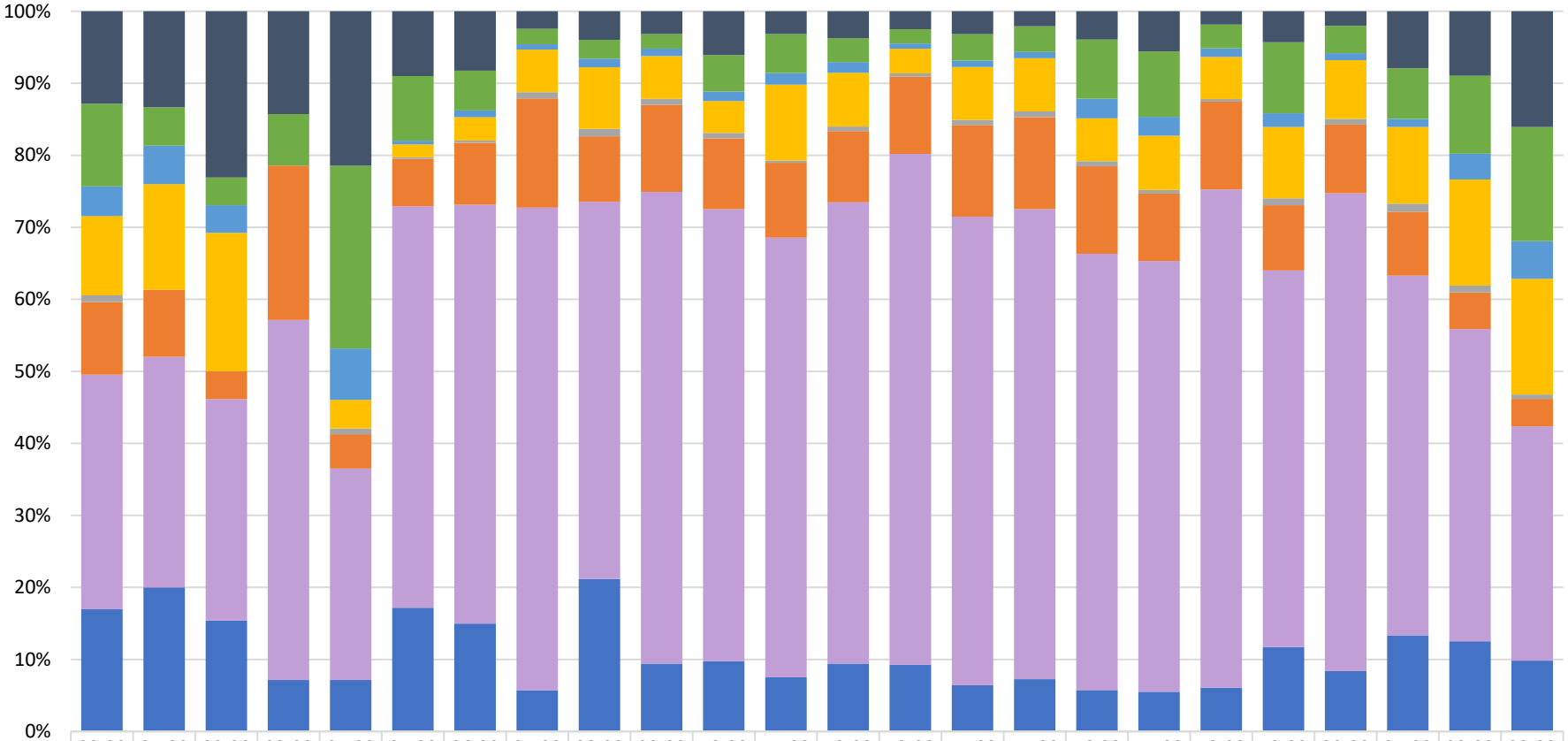
Figure 13 - Runway 30L Modeled Departure Tracks by Heading



Note: AEDT modeled flight tracks used for analysis, flight paths from actual operations have greater dispersion.

Figure 14 - Runway 30L Departure Heading Use

RUNWAY 30L DEPARTURE HEADING USE BY TIME



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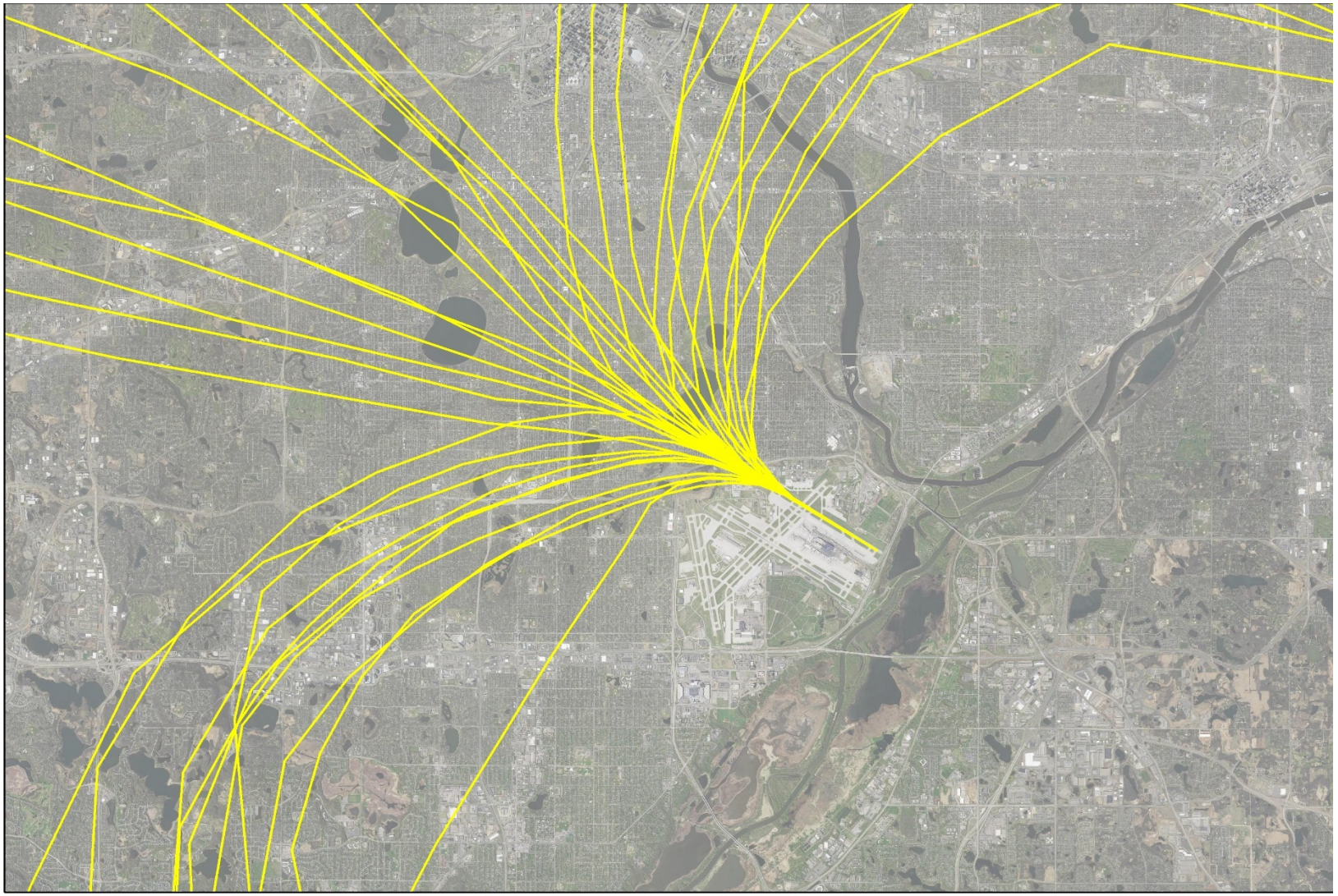
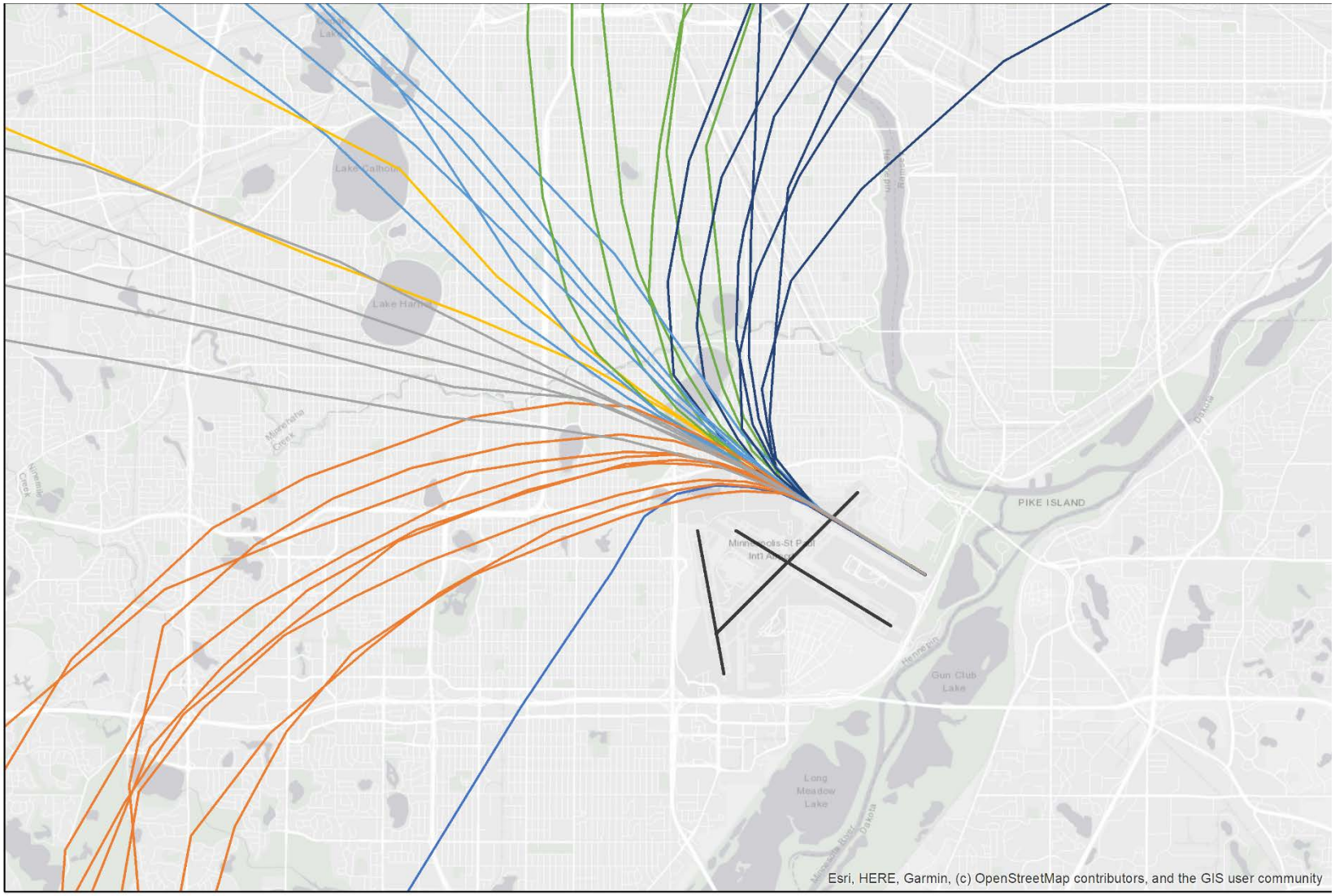
360	13%	13%	23%	14%	21%	9%	8%	2%	4%	3%	6%	3%	4%	3%	3%	2%	4%	6%	2%	4%	2%	8%	9%	16%
340	11%	5%	4%	7%	25%	9%	6%	2%	3%	2%	5%	5%	3%	2%	4%	4%	8%	9%	3%	10%	4%	7%	11%	16%
320	4%	5%	4%	0%	7%	0%	1%	1%	1%	1%	1%	2%	1%	1%	1%	1%	3%	3%	1%	2%	1%	1%	4%	5%
300	11%	15%	19%	0%	4%	2%	3%	6%	9%	6%	4%	11%	7%	3%	7%	7%	6%	8%	6%	10%	8%	11%	15%	16%
280	1%	0%	0%	0%	1%	0%	0%	1%	1%	1%	1%	0%	1%	0%	1%	1%	1%	1%	0%	1%	1%	1%	1%	1%
260	10%	9%	4%	21%	5%	7%	9%	15%	9%	12%	10%	10%	10%	11%	13%	13%	12%	9%	12%	9%	10%	9%	5%	4%
230	33%	32%	31%	50%	29%	56%	58%	67%	52%	65%	63%	61%	64%	71%	65%	65%	61%	60%	69%	52%	66%	50%	43%	33%
210	17%	20%	15%	7%	7%	17%	15%	6%	21%	9%	10%	8%	9%	9%	6%	7%	6%	6%	6%	12%	8%	13%	13%	10%

Figure 15 - 2019 Runway 30L Heading Use by Time



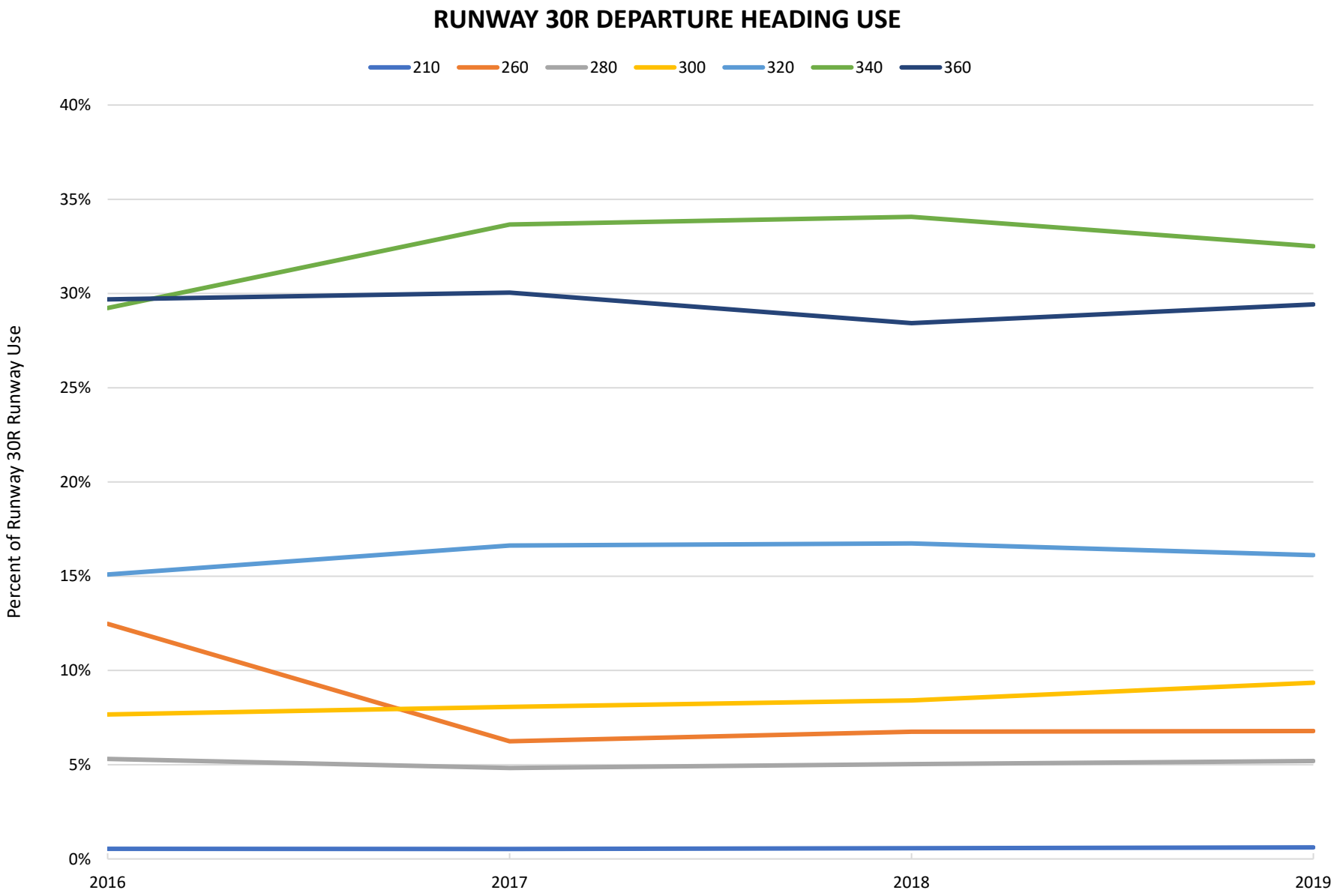
Note: AEDT modeled flight tracks shown, flight paths from actual operations have greater dispersion.

Figure 16 - Runway 30R Modeled Departure Tracks



Note: AEDT modeled flight tracks shown, flight paths from actual operations have greater dispersion.

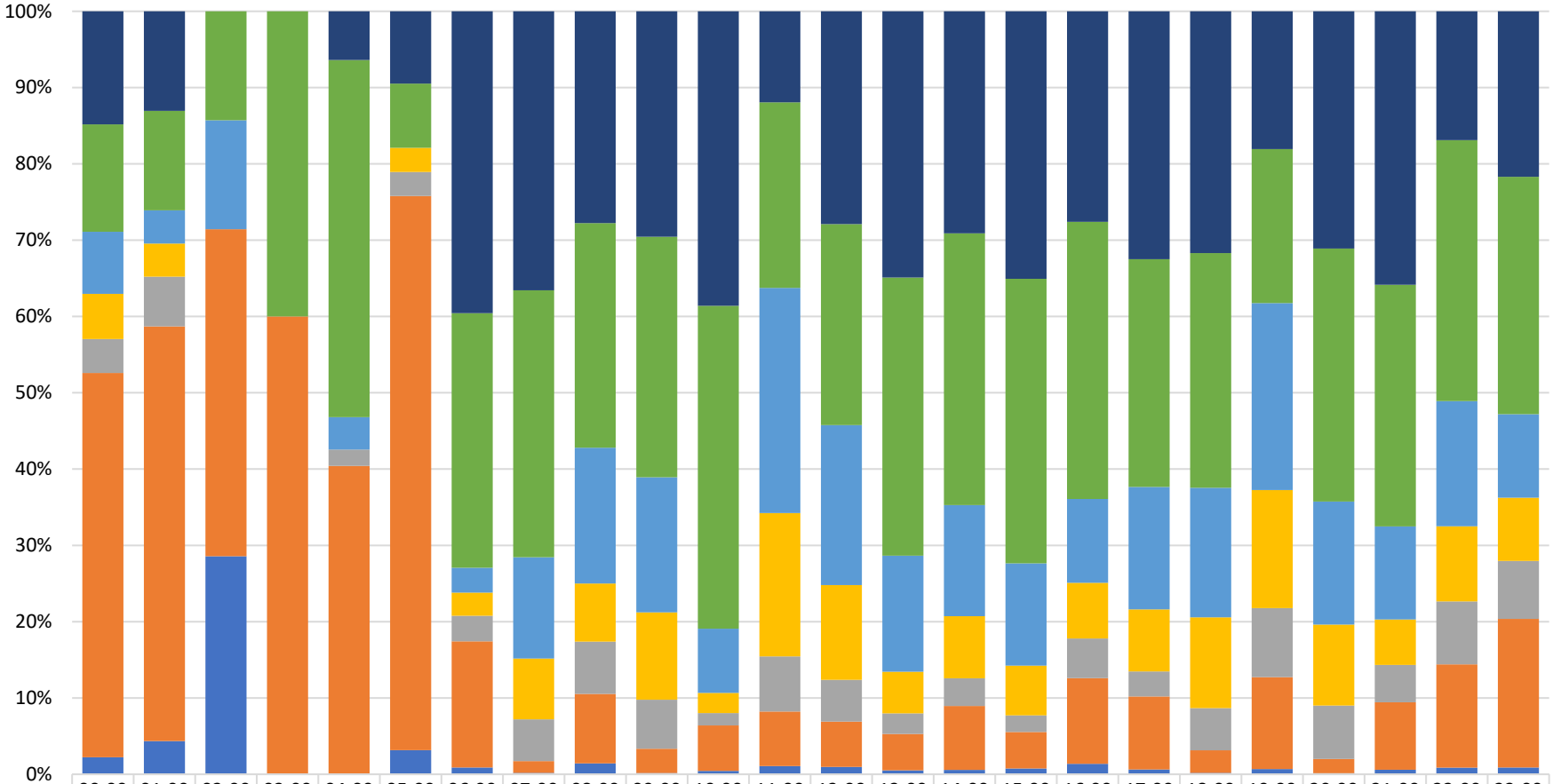
Figure 17 - Runway 30R Modeled Departure Tracks by Heading



Note: AEDT modeled flight tracks used for analysis, flight paths from actual operations have greater dispersion.

Figure 18 - Runway 30R Departure Heading Use

RUNWAY 30R DEPARTURE HEADING USE BY TIME



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360	15%	13%	0%	0%	6%	9%	40%	37%	28%	30%	39%	12%	28%	35%	29%	35%	28%	32%	32%	18%	31%	36%	17%	22%
340	14%	13%	14%	40%	47%	8%	33%	35%	29%	32%	42%	24%	26%	36%	36%	37%	36%	30%	31%	20%	33%	32%	34%	31%
320	8%	4%	14%	0%	4%	0%	3%	13%	18%	18%	8%	30%	21%	15%	15%	13%	11%	16%	17%	25%	16%	12%	16%	11%
300	6%	4%	0%	0%	0%	3%	3%	8%	8%	11%	3%	19%	12%	5%	8%	7%	7%	8%	12%	15%	11%	6%	10%	8%
280	4%	7%	0%	0%	2%	3%	3%	5%	7%	6%	2%	7%	5%	3%	4%	2%	5%	3%	6%	9%	7%	5%	8%	8%
260	50%	54%	43%	60%	40%	73%	17%	2%	9%	3%	6%	7%	6%	5%	8%	5%	11%	10%	3%	12%	2%	9%	14%	19%
210	2%	4%	29%	0%	0%	3%	1%	0%	1%	0%	0%	1%	1%	1%	1%	1%	1%	1%	0%	1%	0%	1%	1%	1%

Figure 19 - 2019 Runway 30R Heading Use by Time

6. AEDT Noise Model Data

The Federal Aviation Administration Office of Environment and Energy (FAA-AEE) recognizes that the environmental consequences stemming from the operation of commercial aviation – primarily noise, emissions, and fuel consumption – are highly interdependent and occur simultaneously throughout all phases of flight. The AEDT is a software system designed to model aviation related operations in space and time to compute noise, emissions, and fuel consumption.

AEDT is the federally prescribed model required under 14 CFR Part 150 to develop the annual Day-Night Average Sound Level (DNL) contour, which is the basis for the MSP Annual Noise Contour Report and related noise mitigation program. While the focus on traditional AEDT modeling efforts is typically a DNL noise exposure contour, the software has the capability to produce alternate supplementary noise metrics. One such metric option available is Number Above (NA) Noise Level, which counts the number of aircraft operating over a specified decibel threshold.

In April 2020, the FAA competed their Report to Congress regarding evaluation of the DNL metric. The report satisfies Sections 188 and 173 of the FAA Reauthorization Act of 2018. In the report the FAA notes that,

> "… while the DNL metric is FAA's decision-making metric, other supplementary metrics can be used to support further disclosure and aid in the public understanding of community noise effects."

The report further notes that,

> "Noise modeling is the only practical way to predict geospatial noise effects in a surrounding community when analyzing proposals related to aviation noise. Noise modeling is also necessary for a wide variety of other proposed federal actions, such as those resulting from airfield changes or changes in airspace management. The assessment of these actions requires the review of future case proposals and can therefore only be considered through predictive modeling."

AEDT allows for multiple noise metrics to be used for analysis. MAC's Noise and Operations Monitoring System (MACNOMS) data for aircraft operations including aircraft type, aircraft track, aircraft altitude and operation time were input into the AEDT software for modeling. In this evaluation, the number of noise events above 65 dBA (also referred to as NA65 or "count above 65") was used. Using a dense grid system, the model output displays how many times aircraft caused the sound pressure to rise above 65 dBA at various points throughout the community. To make the results applicable to this analysis, actual aircraft departures from Runways 30L and 30R over the course of 2019 were modeled.

The results of the AEDT model are shown in **Figure 20 - 2019 MSP Total Operations, Average Daily Aircraft Events Above 65 dB**, **Figure 21 - 2019 MSP Runway 30L and 30R Departures, Average Daily Aircraft Events Above 65 dB**, **Figure 22 - 2019 MSP Runway 30L Departures, Average Daily Aircraft Events Above 65 dB** and **Figure 23 - 2019 MSP Runway 30R Departures, Average Daily Aircraft Events Above 65 dB.** The pattern shown by the number of sound events over 65 dB on each runway is mirrored, with a higher number of events close to the airport and fewer events as flights are dispersed on different headings away from the airport. As shown, events from departures off Runway 30L occur primarily in areas of southwestern and western Minneapolis, Richfield, Edina, Bloomington and Saint Louis Park. Events from departures from Runway 30R occur primarily in areas of southeastern and central Minneapolis.

MSP 2019 AVERAGE DAILY AIRCRAFT SOUND EVENTS OVER 65 DB - ALL OPERATIONS

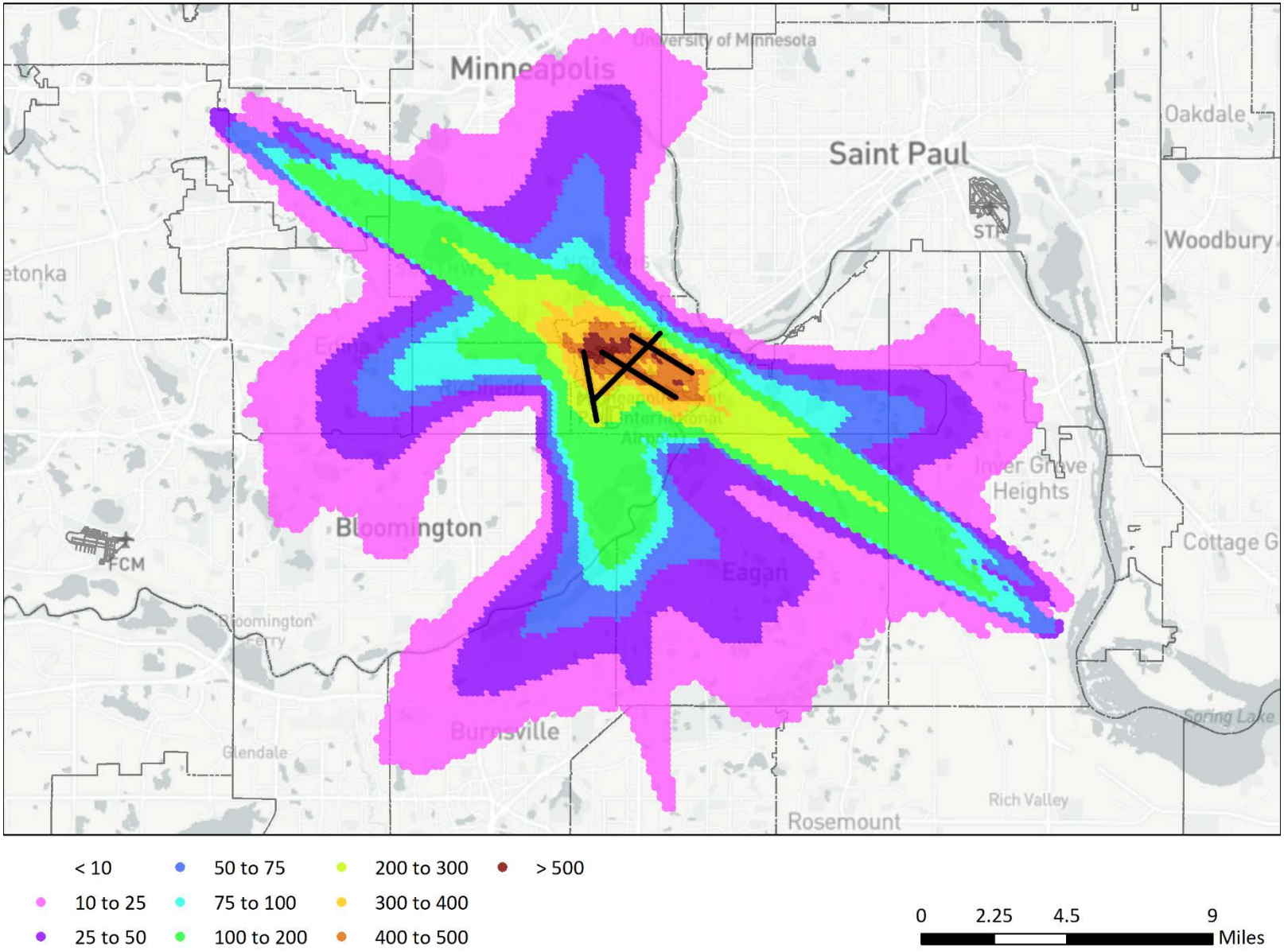

Figure 20 - 2019 MSP Total Operations, Average Daily Aircraft Events Above 65 dB

MSP 2019 AVERAGE DAILY AIRCRAFT SOUND EVENTS OVER 65 DB - 30L AND 30R DEPARTURES

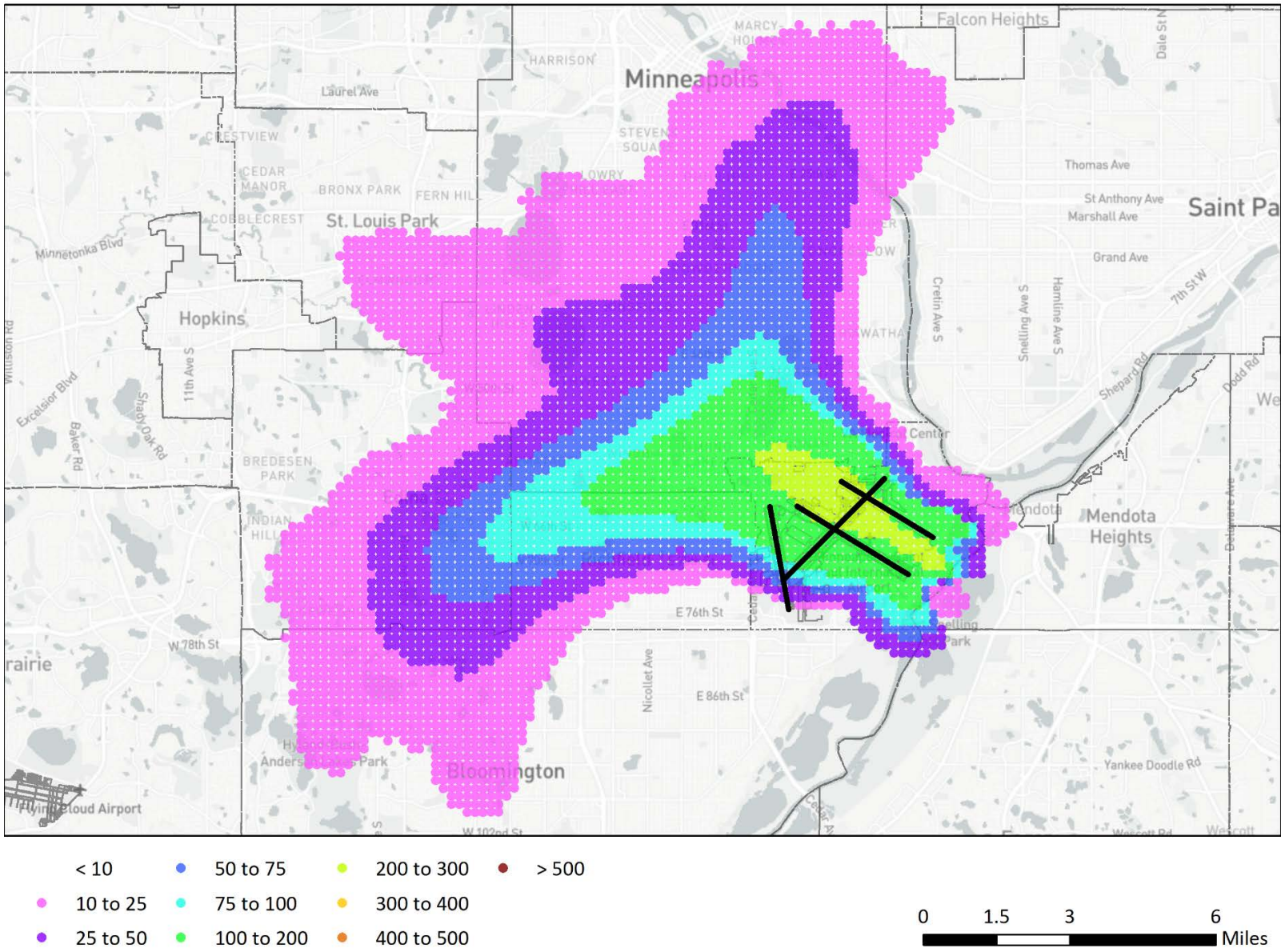

Figure 21 - 2019 MSP Runway 30L and 30R Departures, Average Daily Aircraft Events Above 65 dB

MSP 2019 AVERAGE DAILY AIRCRAFT SOUND EVENTS OVER 65 DB - 30L DEPARTURES

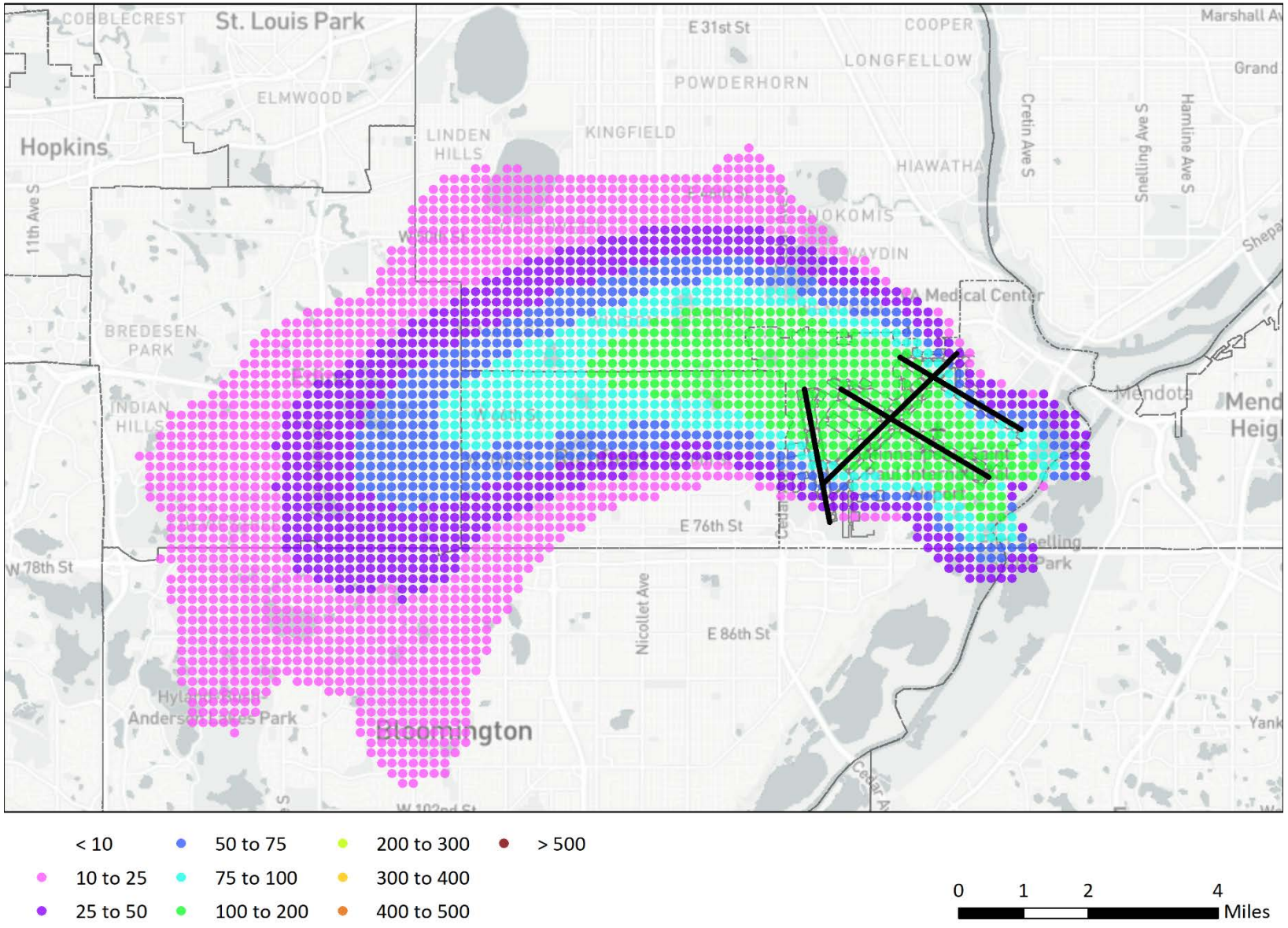

Figure 22 - 2019 MSP Runway 30L Departures, Average Daily Aircraft Events Above 65 dB

MSP 2019 AVERAGE DAILY AIRCRAFT SOUND EVENTS OVER 65 DB - 30R DEPARTURES

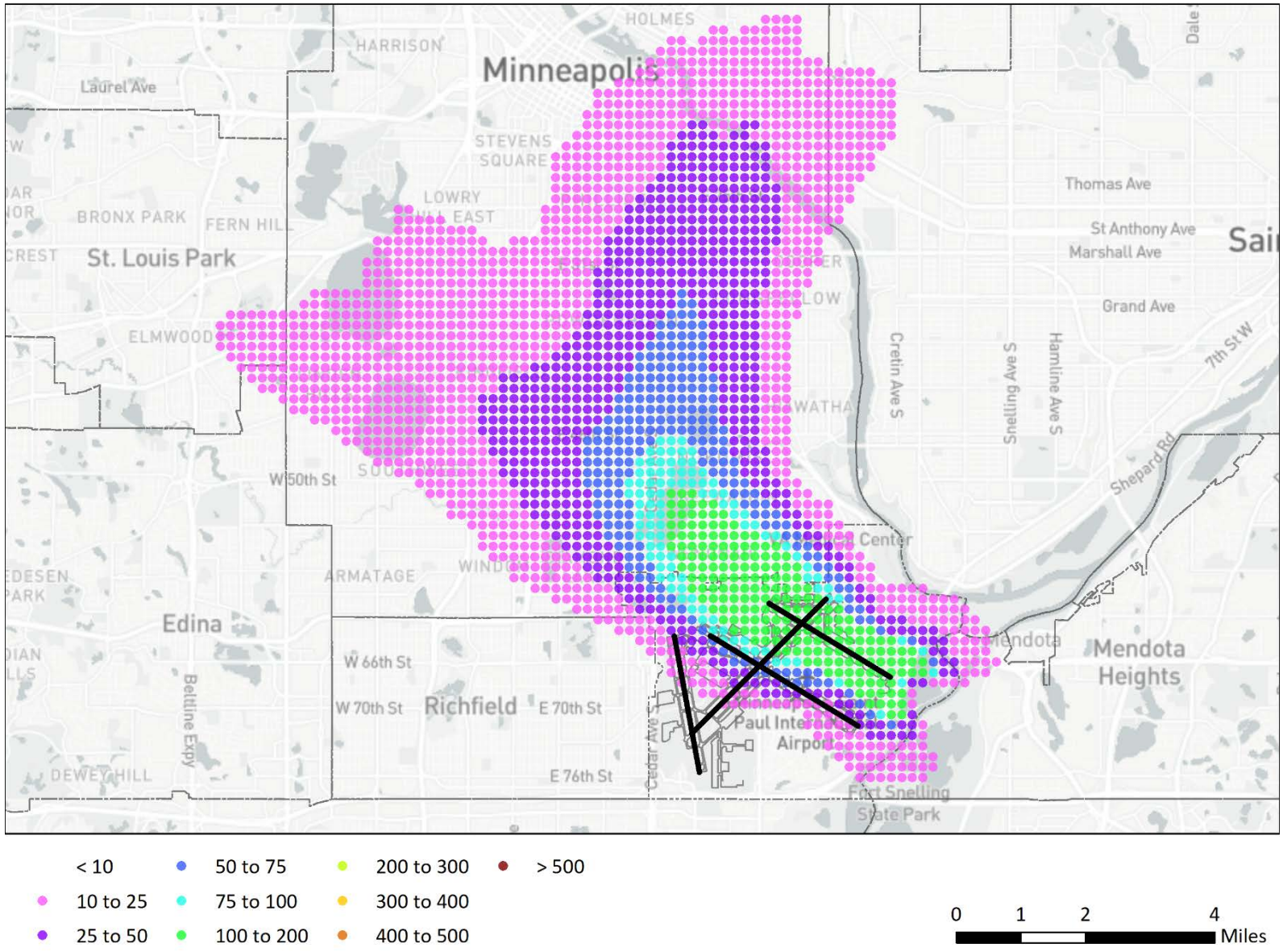

Figure 23 - 2019 MSP Runway 30R Departures, Average Daily Aircraft Events Above 65 dB

7. Runways 30L and 30R Departure Altitude

Departure procedures are an important part of any discussion related to aircraft overflights. Because sound pressure travels as a wave, the distance away from a sound source is important. For aircraft overflights, that is a combination of lateral distance—i.e. distance along the ground—as well as altitude or distance above the ground. The Inverse-Square Law can be used a general rule of thumb in this instance. This axiom states that sound pressure will decrease by 50 percent as the distance away from a sound source doubles. Due to the logarithmic scale for sound, that equates to a six-decibel reduction for every doubling of distance. Because sound waves are impacted by atmospheric and physical environment conditions, measured values may not fully conform to this rule. To reduce the sound of aircraft, the flight track could be moved away from the receiver or the aircraft could be higher.

To compare aircraft departures from 2016 and 2019, the study identified average departure altitudes at multiple measurement points along a track. Concentric rings centered on the start of takeoff roll from Runway 30L or 30R every mile between two miles and ten miles were used as measurement gates. **Figure 24 - Runway 30L Distance Measurement Rings** illustrates the location of those rings for Runway 30L and **Figure 25 - Runway 30R Distance Measurement Rings** illustrates the location of those rings for Runway 30R. **Figure 26 - Average Runway 30L Narrowbody Departure Altitude, Figure 27 - Average Runway 30L Widebody Departure Altitude,** and **Figure 28 - Average Runway 30R Narrowbody Departure Altitude** display the result of the comparison.

Altitudes for regional jets remained consistent from 2016 through 2019 for both runways on average, and altitudes for narrow body jets decreased on both runways since 2016. On Runway 30L the difference in altitude from 2016 to 2019 is 13 feet at two miles and 340 feet at ten miles. On Runway 30R the difference in altitude from 2016 to 2019 is 5 feet higher at two miles and 309 feet lower at ten miles.

Additionally, data show an increase in altitude for wide body jets departing in 2019 on Runway 30L. The difference in altitude from 2016 to 2019 is 106 feet at two miles increasing to 374 feet at ten miles.

Figure 29 – Departure Altitude Runway 30L and 30R compares the departure altitude of the runways and illustrates no substantial differences.

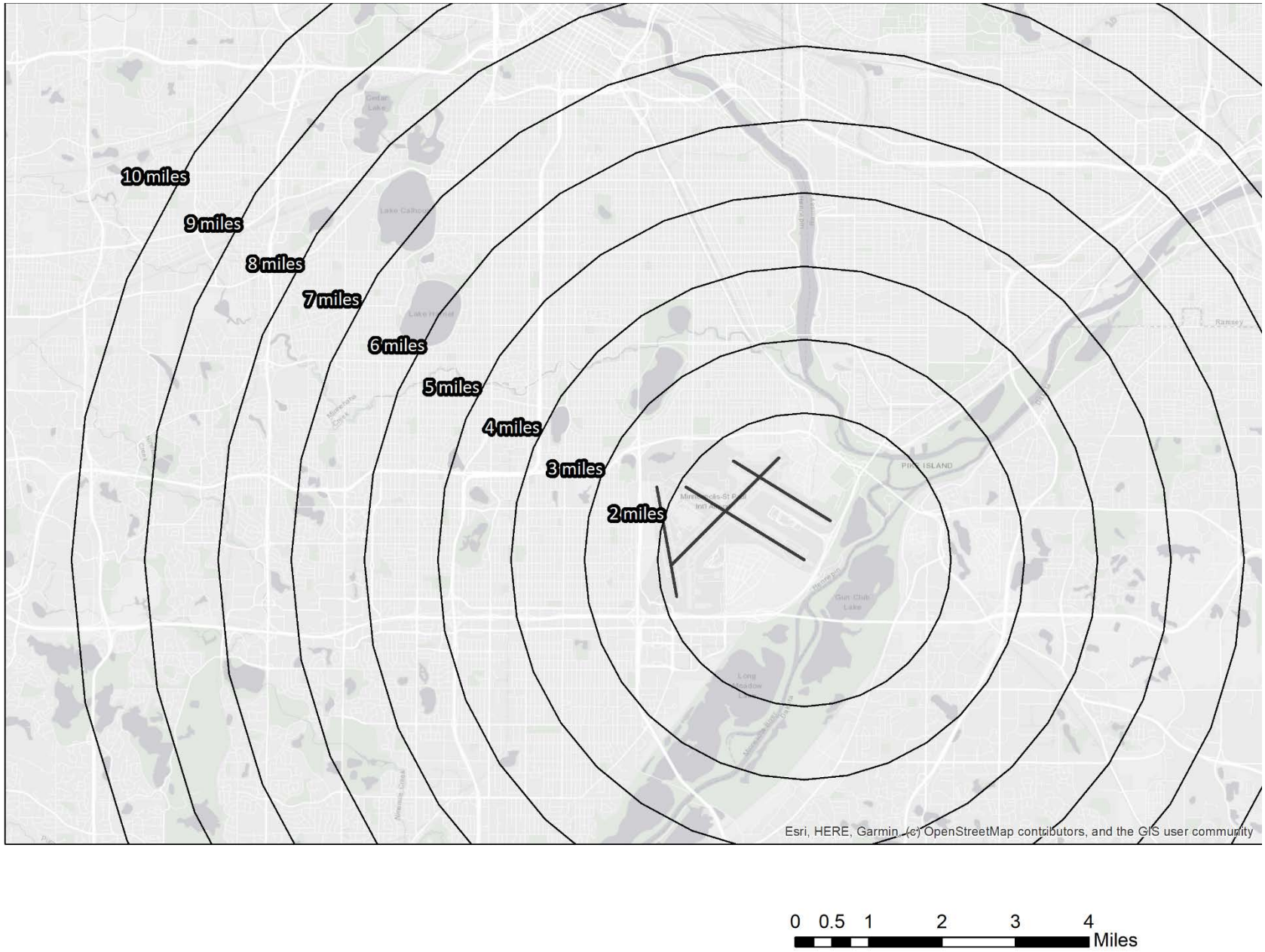

Figure 24 - Runway 30L Distance Measurement Rings

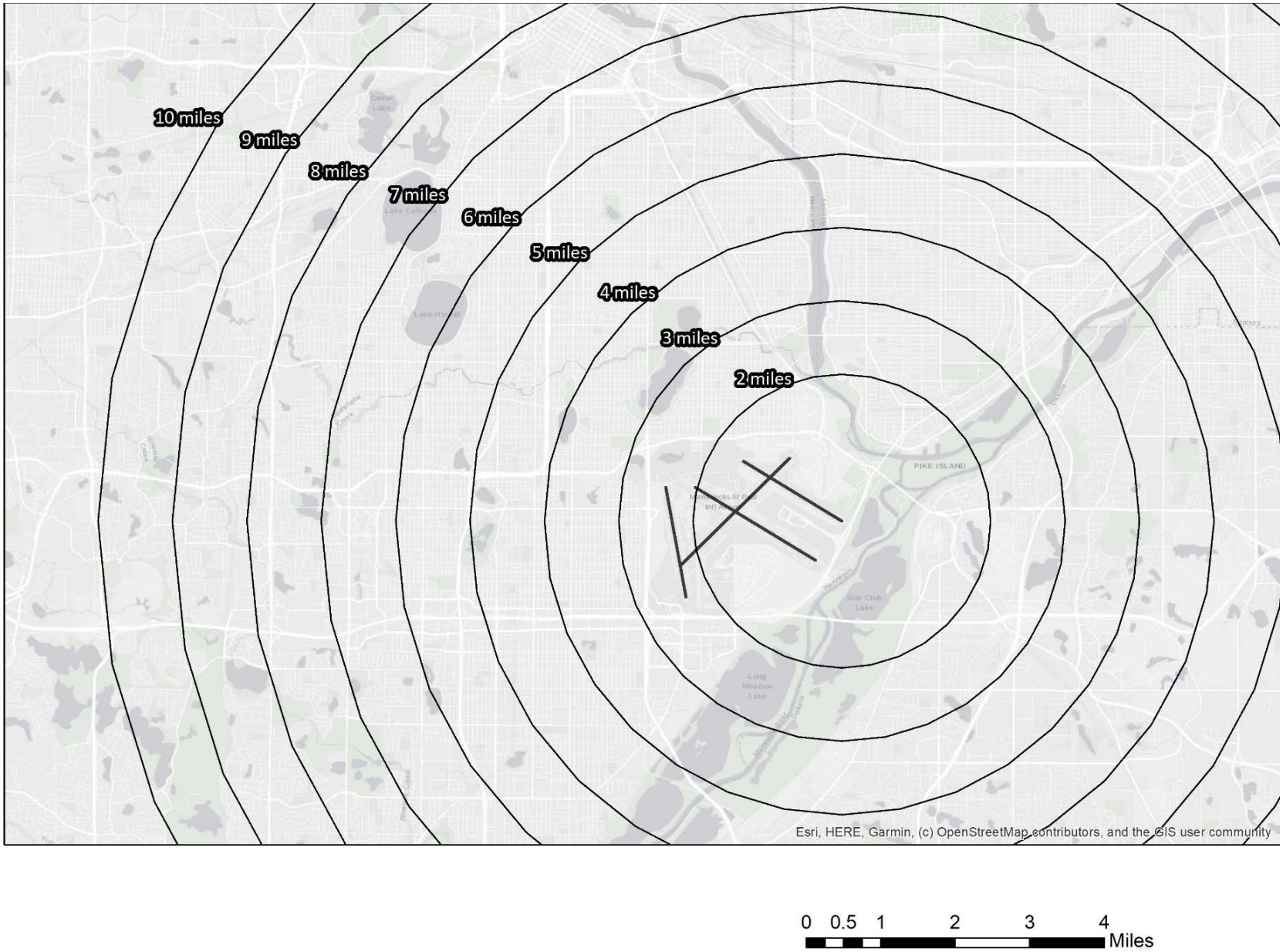

Figure 25 - Runway 30R Distance Measurement Rings

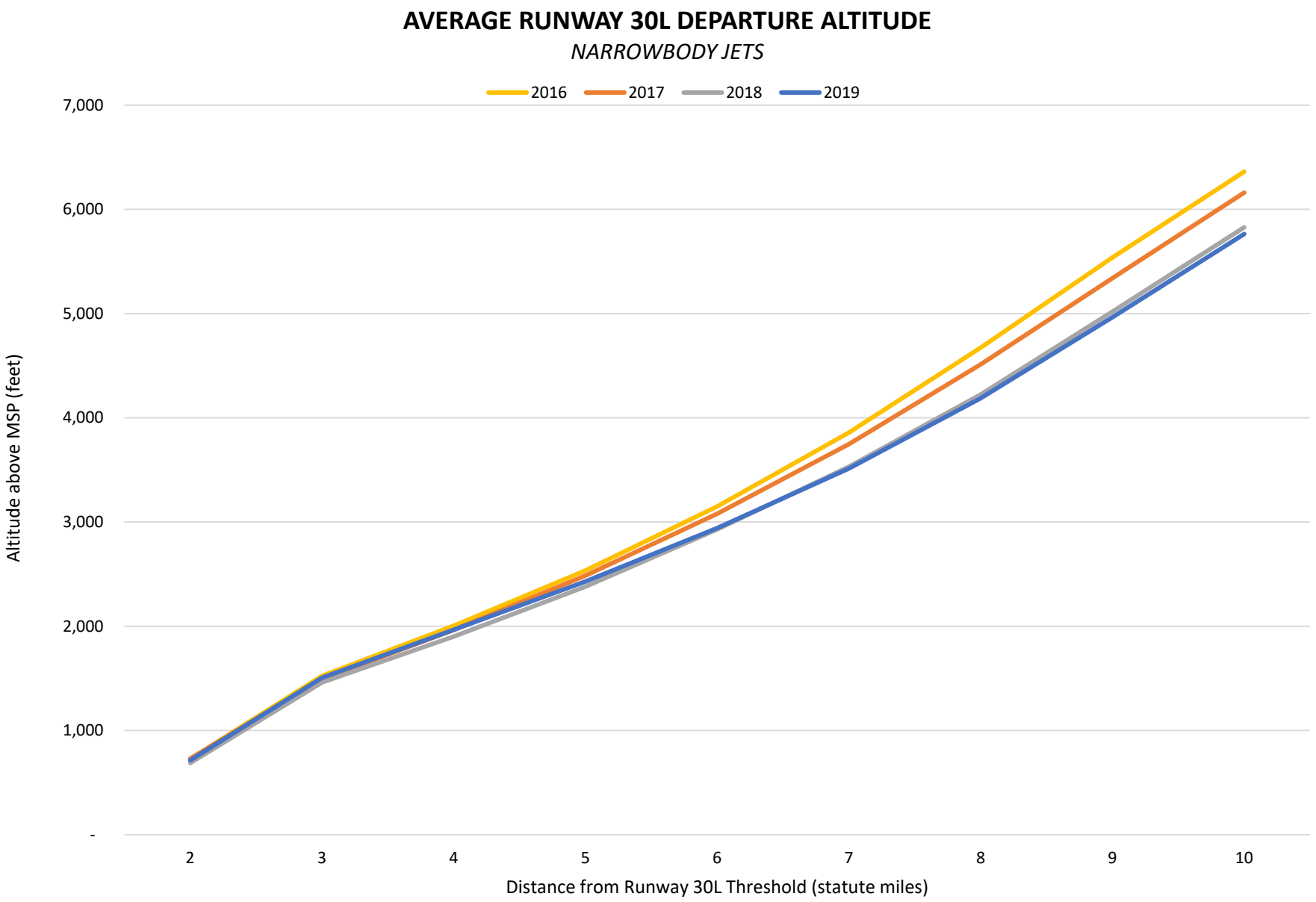

Figure 26 - Average Runway 30L Narrowbody Departure Altitude

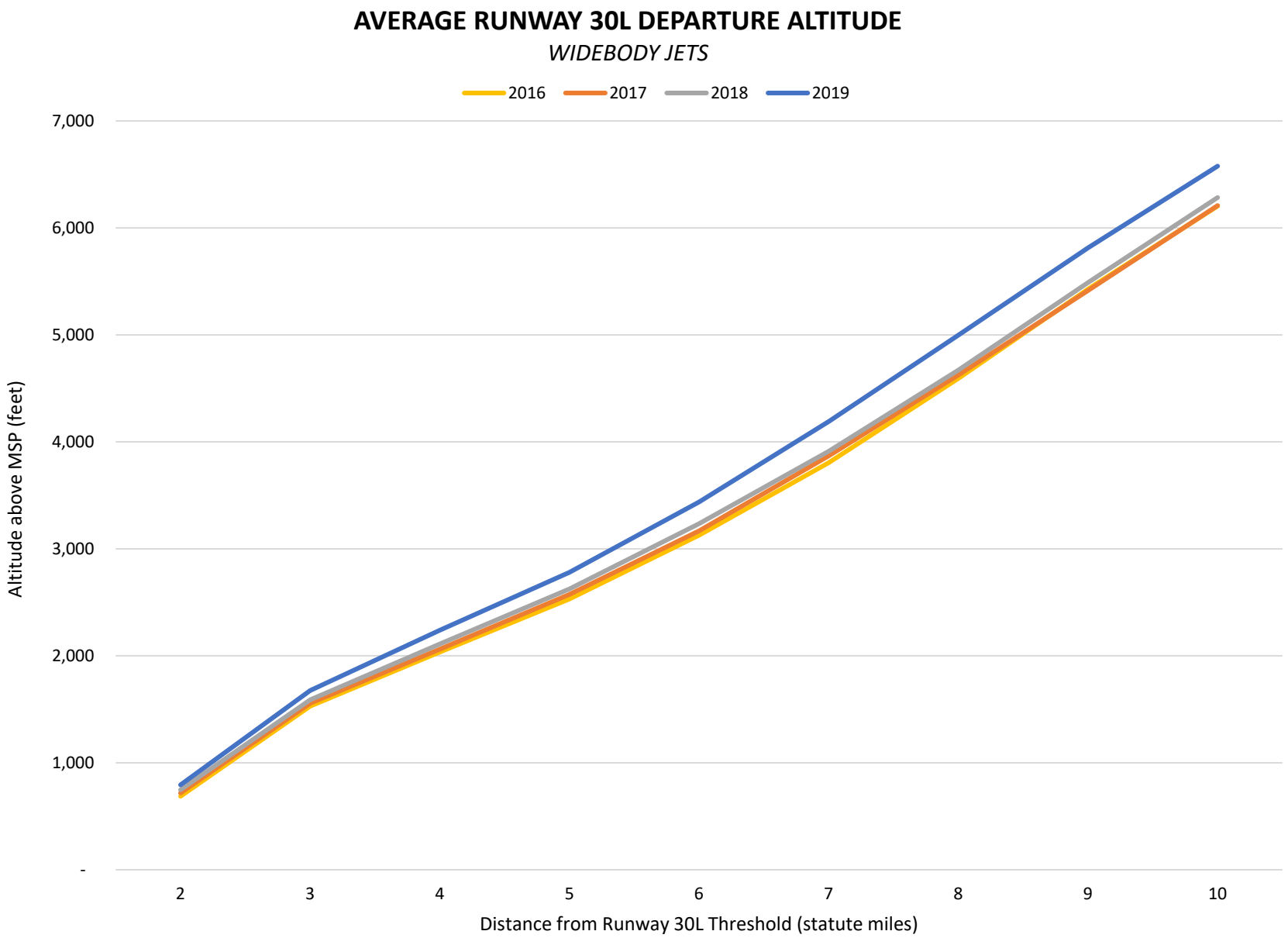

Figure 27 - Average Runway 30L Widebody Departure Altitude

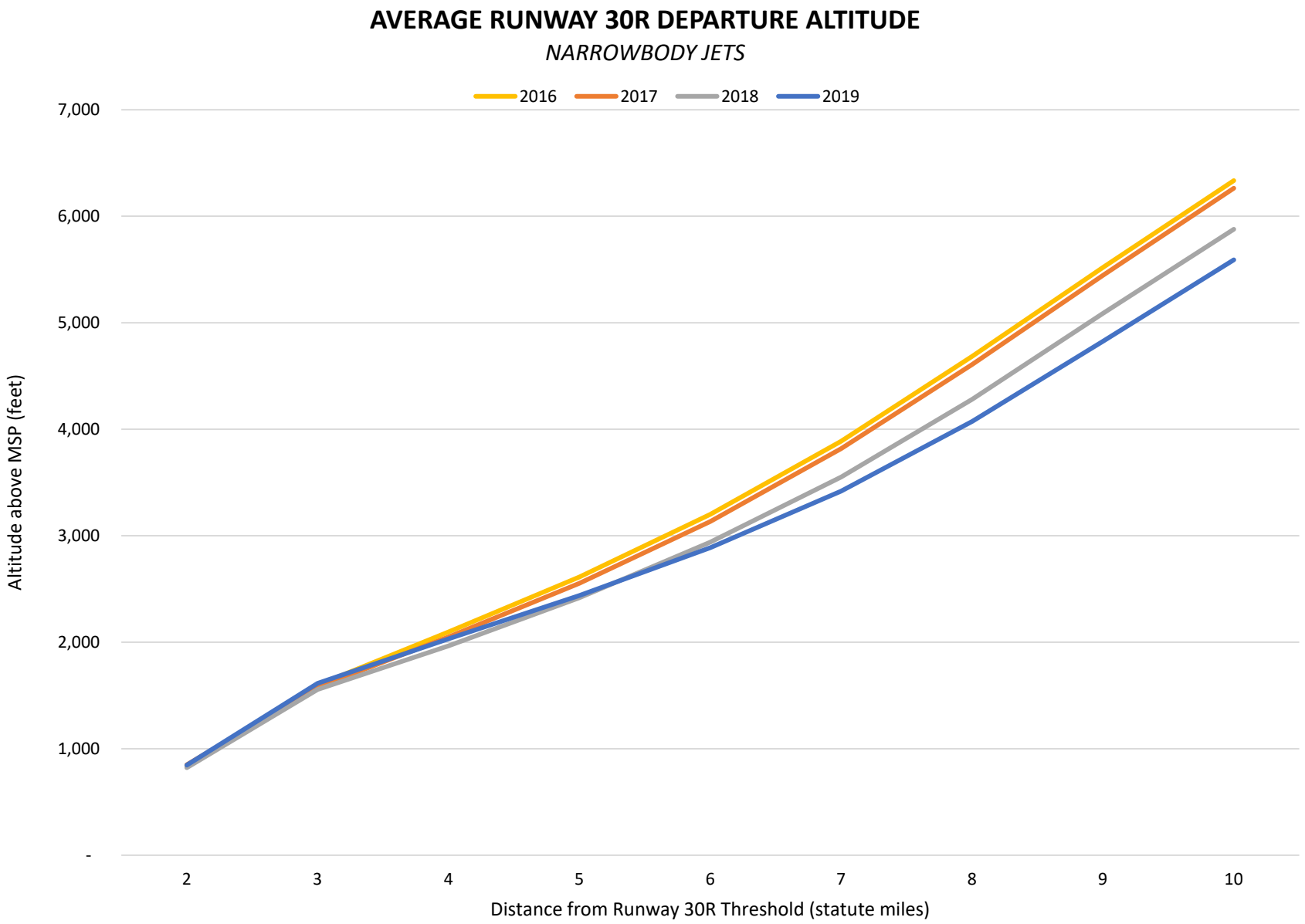

Figure 28 - Average Runway 30R Narrowbody Departure Altitude

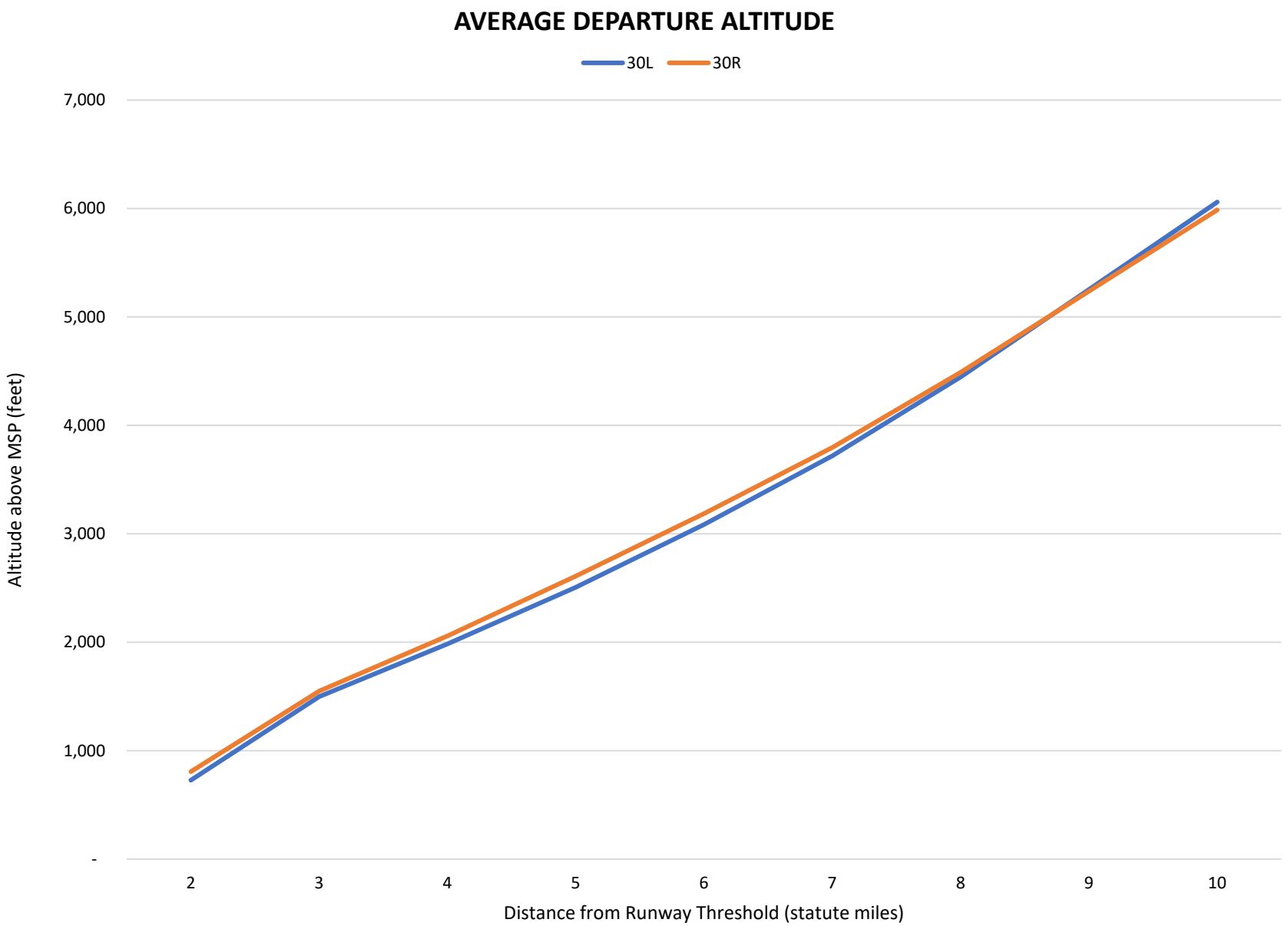

Figure 29 – Departure Altitude Runway 30L and 30R