APPENDIX B

AVIATION ACTIVITY FORECAST REVIEW

This appendix discusses information regarding aviation activity forecasts that supplement the materials in **Section 2.4.1**. This appendix consists of the following sections:

- B.1 Overview of Annual Activity Levels at O'Hare and 2018 Monthly Activity
- B.2 Analysis of the Terminal Area Forecast Outlook for Activity over the Proposed Interim Fly Quiet Period
- B.3 Analysis of Peak Activity at O'Hare
- B.4 Proposed Interim Fly Quiet Nighttime Period Modeled
- B.5 The City of Chicago Design Day Flight Schedule
- B.6 Adjustments to the Design Day Flight Schedule
- B.7 Revised Design Day Flight Schedule

Identifying the level of airport activity and the associated aircraft types are essential steps in the process of evaluating aviation environmental conditions. A number of sources exist to identify total annual aviation activity levels at airports. The most recent and comprehensive data set for Chicago O'Hare International Airport was prepared by the Chicago Department of Aviation (CDA) and its consultant, Ricondo & Associates. It provides annual and average daily activity characteristics, and it is in the form of a design day flight schedule that identifies aircraft type and time of day of operation.

Before beginning the environmental analysis portion of this Written Re-Evaluation of the O'Hare Modernization Environmental Impact Statement (EIS) for the Proposed Interim Fly Quiet, FAA commissioned a comprehensive review of the design day flight schedule created by the CDA. The comprehensive review included analyzing current trends at O'Hare, current peak period schedules for O'Hare in the summers of 2016 and 2018, representative day operations at the airport for the months included in the Proposed Interim Fly Quiet period, a comprehensive analysis of nighttime operations during these times, and a review of cargo activity. The purpose of this review was to decide whether the design day flight schedule was appropriate to model the environmental impacts that would occur during the Proposed Interim Fly Quiet beginning in November 2019. If approved by FAA, the Proposed Interim Fly Quiet could begin in November 2019, continue through mid-May 2020 (discontinuing during the rehabilitation of 4R/22L), and resume in mid-September 2020 until the end of January 2021. The Proposed Interim Fly Quiet would be in place for approximately 11 months.

The evaluation of the CDA flight schedules did not include the development of a new forecast for the Proposed Interim Fly Quiet. FAA third-party consultants—led by HMMH and its forecasting specialists, InterVISTAS—proposed changes to the CDA design day flight schedule to better reflect the nighttime operations based on historical activity levels for days representative of the peak period and the Proposed Interim Fly Quiet. The CDA accepted changes proposed by FAA as noted in their letter from August 28, 2018 (see **Attachment B-2**).

B.1 OVERVIEW OF ANNUAL ACTIVITY LEVELS AT O'HARE AND 2018 MONTHLY ACTIVITY

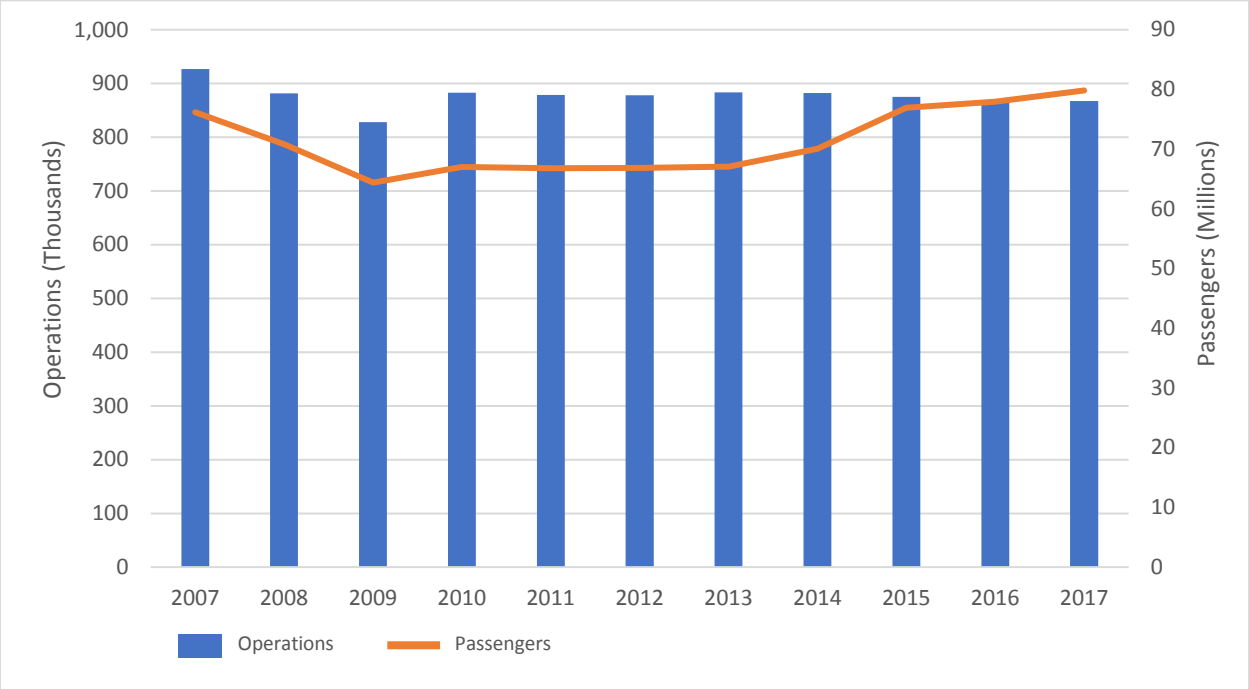
As shown in **Table B-1,** O'Hare is the third busiest airport by passenger volume in the United States (U.S.). In 2017, passenger enplanements at O'Hare increased by 2.4 percent from 2016 to 2017, making it the sixth-fastest-growing airport among the largest ten.

TABLE B-1
RANKING OF U.S. AIRPORTS BY PASSENGER ENPLANEMENTS

Rank	Airport	Calendar Year 2017 Passengers	Percent Change
1	Atlanta Hartsfield-Jackson International Airport	103,902,992	-0.3%
2	Los Angeles International Airport	84,557,968	4.5%
3	**Chicago O'Hare International Airport**	**79,828,183**	**2.4%**
4	Dallas-Fort Worth International Airport	67,092,194	2.3%
5	Denver International Airport	61,379,396	5.3%
6	New York Kennedy International Airport	59,392,500	0.5%
7	San Francisco International Airport	55,822,129	5.1%
8	Las Vegas International Airport	48,565,117	2.2%
9	Seattle-Tacoma International Airport	46,934,194	2.6%
10	Charlotte Douglas International Airport	45,909,899	3.3%
Source: ACI World Airport Traffic Dataset			

As illustrated in **Figure B-1**, O'Hare's passenger traffic has increased an average of 0.5 percent annually from 2007 to 2017, while annual aircraft operations have decreased an average of 0.7 percent. Over this span, passengers and operations at O'Hare were negatively impacted by external factors such as the Global Financial Crisis of 2008, higher fuel prices, and changes in airline fleet strategies. While numbers of both operations and passengers have remained relatively flat over the ten-year time-period, total passengers have increased 19.0 percent over the more recent period from 2013 to 2017. Most of this increase was experienced in 2014 and 2015, when passengers increased 4.5 and 9.8 percent respectively. From 2013 to 2017, operations decreased from 883,287 to 867,049 as airlines increased the average aircraft size in terms of seats per departure to accommodate additional passengers during the period.

FIGURE B-1
O'HARE OPERATIONS AND PASSENGERS (CALENDAR YEARS 2007–17)



Source: Chicago Department of Aviation Facts and Figures (https://www.flychicago.com/business/CDA/factsfigures/Pages/airtraffic.aspx)

O'Hare operates as a hub for both United Airlines and American Airlines, which generate large numbers of connecting passengers. Connecting passenger traffic represented 46.4 percent of passengers at O'Hare in 2017. The connecting passenger ratio has decreased since 2007, when 51.0 percent of O'Hare's passengers were connecting. Absolute numbers of connecting passengers have also decreased 4.6 percent at O'Hare, from 38.9 million in 2007 to 37.1 million in 2017.

In contrast to connecting passengers, origin and destination (O&D) passengers—those who begin or end their travel at O'Hare—have increased 14.5 percent, from 37.3 million in 2007 to 42.8 million in 2017. A history of local and connecting traffic is presented in **Figure B-2.**

Both O&D passengers and connecting passengers were negatively impacted by the Global Financial Crisis of 2008. From the peak of the previous economic cycle in 2007 to the trough of the current economic cycle in 2009 following the Global Financial Crisis, O'Hare's O&D passengers decreased 17.7 percent while connecting traffic decreased by 13.3 percent.

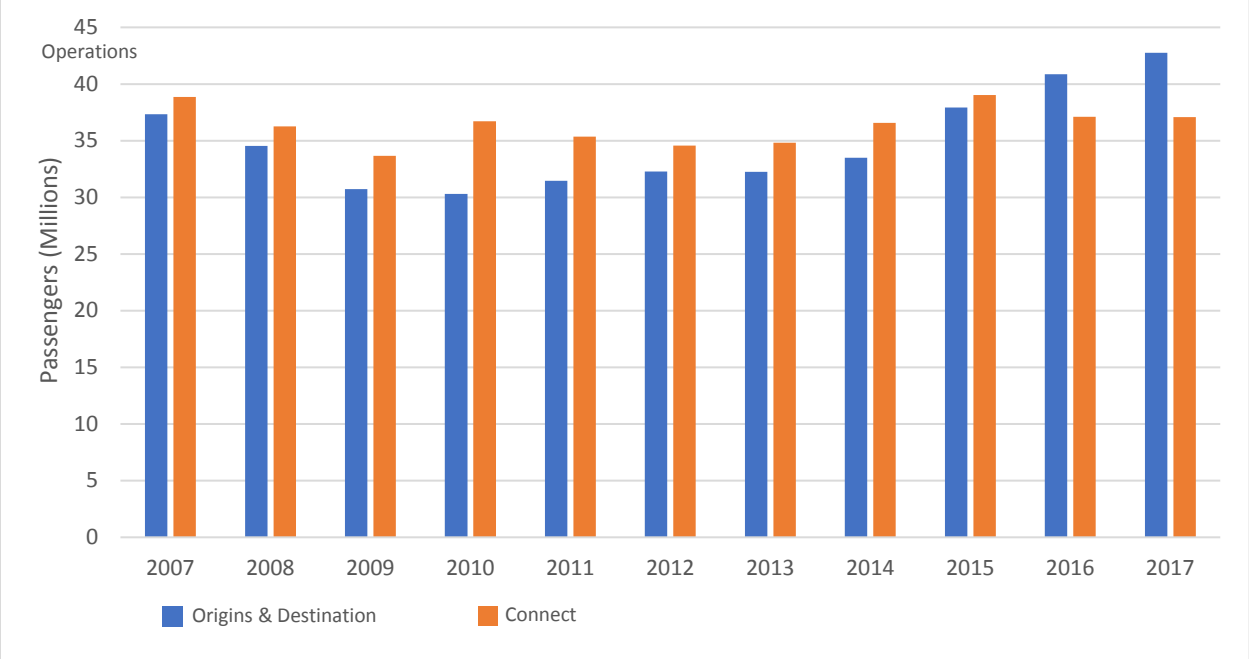
Connecting traffic at O'Hare was also negatively impacted by the rolling hub concept implemented by American and United from 2009 through 2014. (A rolling hub means that the amount of aircraft arrivals and departures is relatively consistent over the course of the day.) Rolling hub schedules are less costly for airlines because they require fewer staff and facilities; using rolling hub schedules helped the airlines defray cost increases in jet fuel. In 2015, United and American began to move away from the rolling hub concept, returning to a hub structure with more defined connecting banks. This caused an increase in connecting passengers in 2015.

American and United expect that shorter connecting times created by more defined connecting banks will lead passengers to prefer those airlines, creating a unit revenue and yield premium that will

outweigh their higher operational costs (facilities and personnel). Airlines typically pursue this higher-revenue strategy when the underlying demand and the economy are strong; when demand lags and/or fuel costs rise, a lower-cost rolling hub becomes more attractive. It is normal for airlines to adjust their position on this continuum depending on demand conditions driven by economic growth and costs driven by oil prices.

In 2016 and 2017 connecting passengers at O'Hare decreased because of the increased availability of non-stop flights that overfly hubs in the U.S. airline industry, the lack of aircraft gates at O'Hare that would allow additional flights, and the timing of new aircraft deliveries to hub airlines at O'Hare.

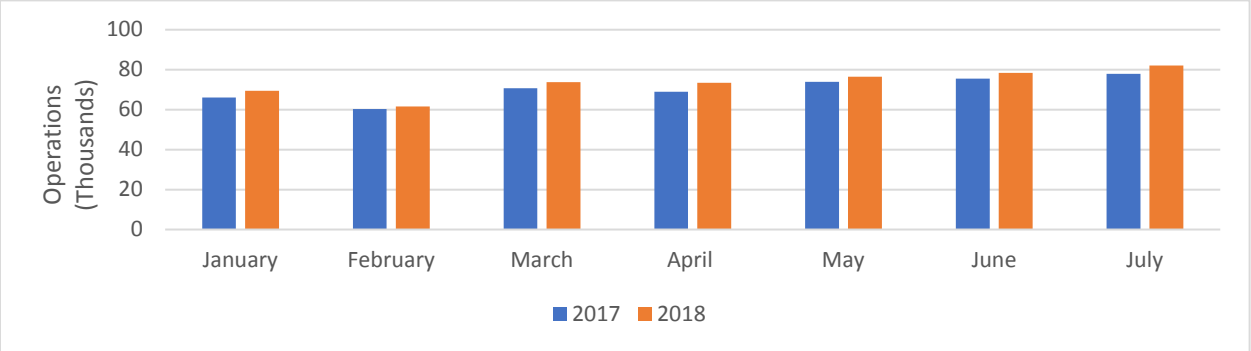
FIGURE B-2
O'HARE ORIGIN & DESTINATION AND CONNECTING PASSENGERS (CALENDAR YEARS 2007–17)



Source: Chicago Department of Aviation Facts and Figures (https://www.flychicago.com/business/CDA/factsfigures/Pages/airtraffic.aspx), US DOT O&D Survey CY 2007-2017, Sabre MIDT CY 2007-2017

As shown in **Figure B-3**, aircraft operations increased year-over-year for the first seven months of 2018 by 4.4 percent. This increase in total operations has largely come from air carrier operations as both hub carriers grow at O'Hare.

FIGURE B-3
O'HARE TOTAL OPERATIONS (JANUARY–JULY 2017 AND 2018)

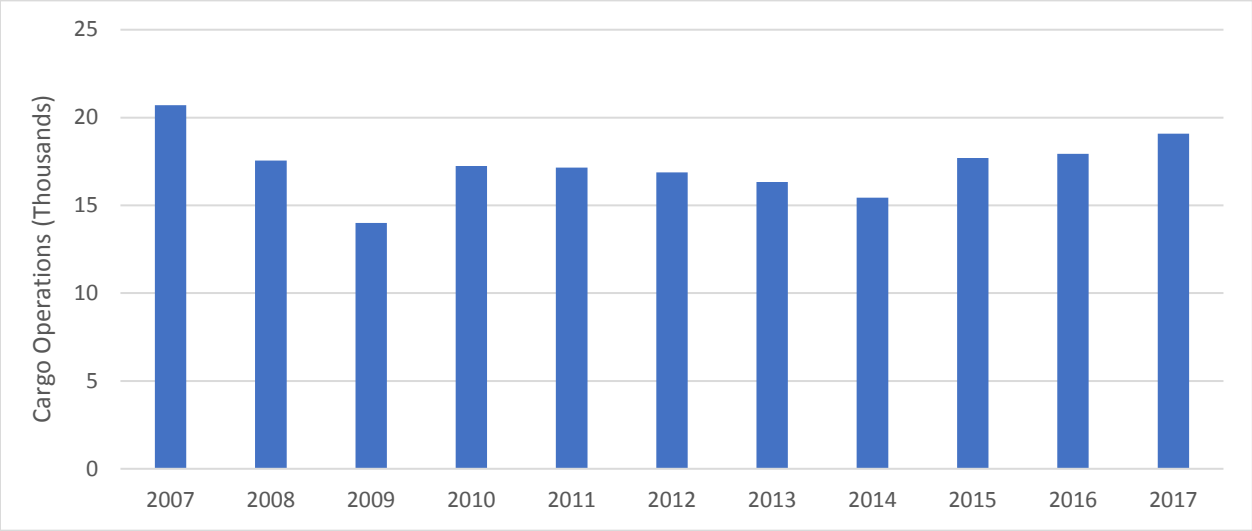


Source: Chicago Department of Aviation Facts and Figures (https://www.flychicago.com/business/CDA/factsfigures/Pages/airtraffic.aspx)

Cargo operations at O'Hare peaked in 2007, then decreased dramatically during the Global Financial Crisis of 2008, which coincided with a global decrease in air cargo. While cargo operations in 2017 are still below their 2007 peak, as shown in **Figure B-4**, they have increased each year since 2014. In 2017, cargo operations increased 6.4 percent from 2016 levels. This growth is driven not only by the demand to move goods through O'Hare to other regions of the world, but also by the August 2017 opening of O'Hare's Northeast Cargo Center. This facility, a major cargo center, expands and enhances the efficiency of the airport's cargo operations. Two of the three phases of this project are now complete. Improved efficiency accounts for some of O'Hare's increase in cargo operations during 2016 and 2017.

In summary, cargo activity initially decreased in 2008, remained relatively constant for four years, and has increased since 2014. The 2008–09 decrease in O'Hare cargo activity was consistent with the concurrent global air cargo collapse. In the U.S., passenger airlines reduced wide-body capacity on domestic routes; these were the aircraft capable of accommodating meaningful belly cargo payload. At the same time, cargo integrators FedEx and UPS filled the gap created by the airlines' lack of domestic passenger wide-bodies. Today, most domestic air cargo is accommodated by FedEx and UPS and other cargo carriers. The more recent increase in air cargo is due to the increasing popularity of e-commerce. Amazon and its competitors now dominate retail activity in the U.S., and Amazon has recently begun carrying its own air cargo.

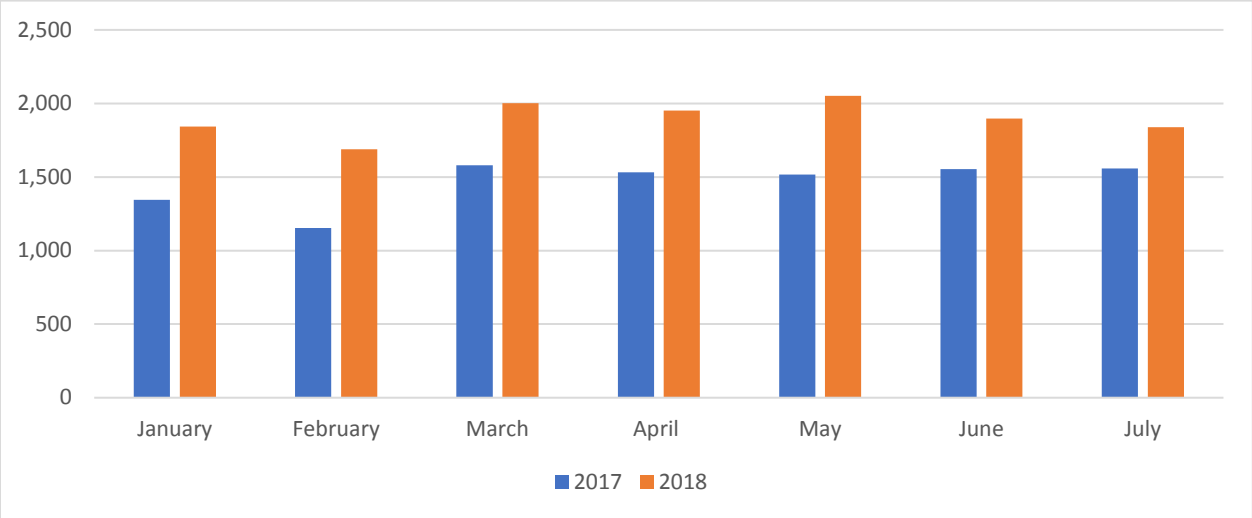
FIGURE B-4
O'HARE CARGO OPERATIONS (2007–17)



Source: Chicago Department of Aviation Facts and Figures
(https://www.flychicago.com/business/CDA/factsfigures/Pages/airtraffic.aspx)

The new O'Hare Northeast Cargo Center continues to impact cargo activity, which is still growing in 2018. This is illustrated in **Figure B-5.** Cargo operations have increased 30.6 percent in the first seven months of 2018 compared to the first seven months of 2017.

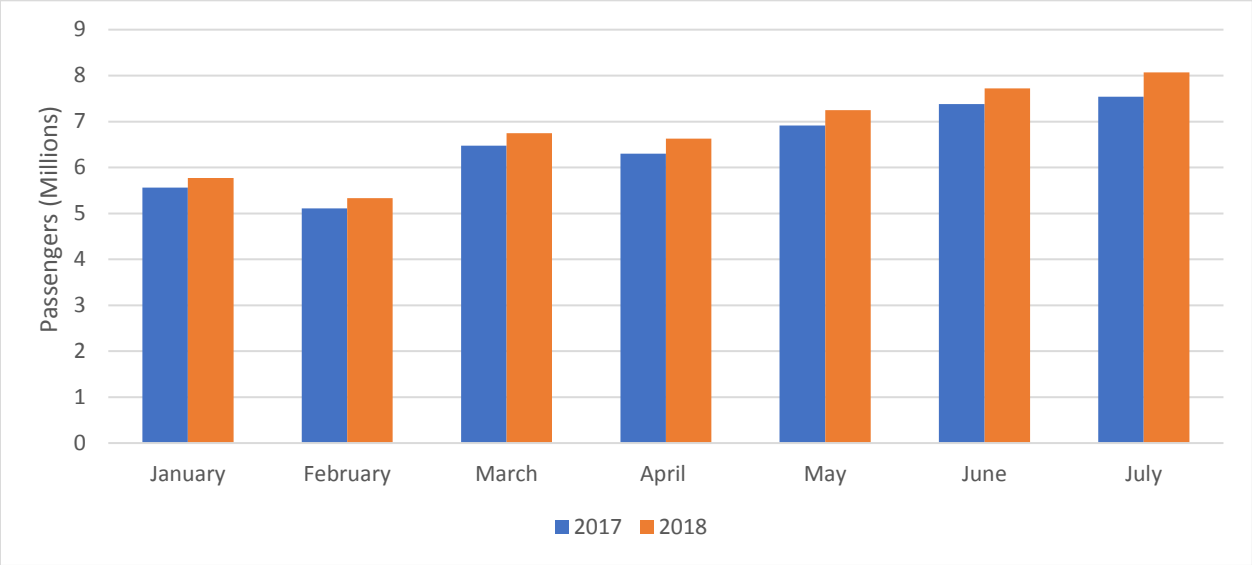
FIGURE B-5
O'HARE CARGO OPERATIONS (JANUARY–JULY 2017 AND 2018)



Source: Chicago Department of Aviation Facts and Figures
(https://www.flychicago.com/business/CDA/factsfigures/Pages/airtraffic.aspx)

As demonstrated in **Figure B-6**, 4.9 percent more passengers traveled through O'Hare in the first seven months of 2018 than the first seven of 2017. These passenger increases parallel the 4.2 percent increase in air carrier operations during the same period.

FIGURE B-6
O'HARE PASSENGERS (JANUARY–JULY 2017 AND 2018)



Source: Chicago Department of Aviation Facts and Figures (https://www.flychicago.com/business/CDA/factsfigures/Pages/airtraffic.aspx)

This recent growth in air carrier operations is largely due to an increase in United's scheduled passenger operations. In 2018, United is expected to increase its aircraft operations by 8.5 percent, while its seat capacity is expected to grow 4.5 percent. This growth is occurring in smaller, more regional markets that can be accommodated on smaller aircraft. United's growth at O'Hare in 2018 is part of its strategy to strengthen the hub-and-spoke network by adding more short-haul, highly profitable markets. American, O'Hare's second hub carrier, also grew in 2018, though not as quickly as United. American is increasing aircraft operations by 1.5 percent; the carrier's seats are increasing 3.6 percent, demonstrating a shift toward larger aircraft. This shift is consistent with industry practices, as the carrier's smaller, older, and less economical aircraft are being retired. **Table B-2** illustrates United's and American's growth, and that of other carriers, in 2018.

TABLE B-2
O'HARE SCHEDULED PASSENGER OPERATIONS GROWTH BY CARRIER (CALENDAR YEARS 2017–18)

	United		American		Other		Total	
	2017	**2018**	**2017**	**2018**	**2017**	**2018**	**2017**	**2018**
Departures	195,480	212,130	162,492	164,937	60,198	60,804	418,170	437,871
Seats (Millions)	20.9	21.9	16.8	17.4	9.5	9.8	47.3	49.1
Seats/Departure	107	103	103	106	158	161	113	112
Percent Change								
Departures		*8.5%*		*1.5%*		*1.0%*		*4.7%*
Seats		*4.5%*		*3.6%*		*3.0%*		*3.9%*
Source: Innovata Schedules, via Diio, CY 2017-18. Schedules accessed on August 7, 2018.								

B.2 ANALYSIS OF THE TERMINAL AREA FORECAST OUTLOOK FOR ACTIVITY OVER THE PROPOSED INTERIM FLY QUIET PERIOD

At the time of the start of this Re-Evaluation, the 2017 FAA Terminal Area Forecast (TAF) was the latest available. FAA produces the TAF every year for each towered airport in the United States. Using industry-standard methodology, FAA forecasts both enplaned passengers (passengers boarding flights) and aircraft operations for each airport.

Table B-3 provides a summary of the 2017 FAA TAF for O'Hare for the period 2017–22 (it is prepared for the Federal Fiscal Year (FFY), which ends September 30). As shown in **Table B-3** below, enplaned passengers are forecast to increase from 38,281,295 in 2017 to 44,229,350 in 2022, an average annual growth rate of 2.9 percent. From 2018 to 2020, the TAF forecasts that total commercial operations remain flat, from 883,000 in 2018 to 882,000 in 2020. In 2021, operations are forecast to decrease to 870,000 as FAA assumes the beginning of a rapid phase-out of 50-seat regional jets. In FFY 2022, the TAF forecasts that total commercial operations will decrease to 856,000. **Table B-3** also provides a summary of total aircraft operations.

TABLE B-3
FAA TAF FOR O'HARE – FEDERAL FISCAL YEARS (FFY)

	2017	**2018**	**2019**	**2020**	**2021**	**2022**	**AAGR**
Enplaned Passengers	38,281,295	40,420,752	41,475,054	42,435,043	43,328,861	44,229,350	2.9%
Y-o-Y Growth (%)	2.5%	5.6%	2.6%	2.3%	2.1%	2.1%	N/A
Commercial Operations	853,212	882,682	884,863	881,615	869,703	855,700	0.1%
Y-o-Y Change (%)	-1.4%	3.5%	0.2%	-0.3%	-1.4%	-1.6%	N/A

Aircraft Operations	859,271	888,366	890,367	887,298	875,386	861,383	0.0%
Y-o-Y Change (%)	-1.5%	3.4%	0.2%	-0.3%	-1.3%	-1.6%	N/A
Notes: Y-o-Y = Year-over-Year and AAGR = Average Annual Growth Rate							
Source: FAA TAF January 2018.							

From its review of the commercial operations forecast in the TAF compared to an estimate of commercial operations using U.S. Department of Transportation T-100 and Innovata Schedule data, FAA third-party consultants concluded that commuter operations (defined as commercial operations with 50 or fewer seats, which excludes large regional jets) would increase in 2018 by 9.5 percent after four consecutive years of decreasing operations. This analysis of more recent data is inconsistent with the 2017 TAF, which forecasts a decrease in 2018 commuter operations of 0.1 percent. FAA third-party consultants's analysis is important because of the need to make sure that sufficient operations are reflected in the design day flight schedule developed for the Proposed Interim Fly Quiet period. Since the TAF was the basis for the number of operations forecast in the CDA's design day flight schedules in the forecasted years, the TAF does not reflect as many operations as are being operated in 2018. **Table B-4** shows the difference in commuter operation growth rates used in this analysis.

TABLE B-4
FAA TAF FOR O'HARE COMPARED TO ANALYSIS OF HISTORICAL COMMUTER OPERATIONS – FEDERAL FISCAL YEARS

	2015	2016	2017	2018
FAA TAF				
TAF Air Carrier	591,160	589,663	624,774	654,376
Y-o-Y Growth (%)	10.4%	-0.3%	6.0%	4.7%
TAF Commuter and Air Taxi	282,591	275,607	228,438	228,306
Y-o-Y Growth (%)	-15.9%	-2.5%	-17.1%	-0.1%
T-100 Analysis				
T-100 Air Carrier	556,149	556,866	591,310	615,725
Y-o-Y Change (%)	10.4%	0.1%	6.2%	4.1%
T-100 Commuter	272,947	262,296	217,802	238,395
Y-o-Y Change (%)	-16.3%	-3.9%	-17.0%	9.5%
Notes: Y-o-Y = Year-over-Year. T-100 data refers to a report of onboard passengers published by the US Department of Transportation. The T-100 analysis defines "Air Carrier operations" as commercial operations on aircraft with more than 100 seats, the E-190 (which may have fewer than 100 seats), and Large Regional Jets (RJs), which are defined as aircraft with seat counts between 51-99. "Commuter" is defined as aircraft with 50 or fewer seats.				
Source: FAA; T-100, Innovata Schedule Data, InterVISTAS Analysis.				

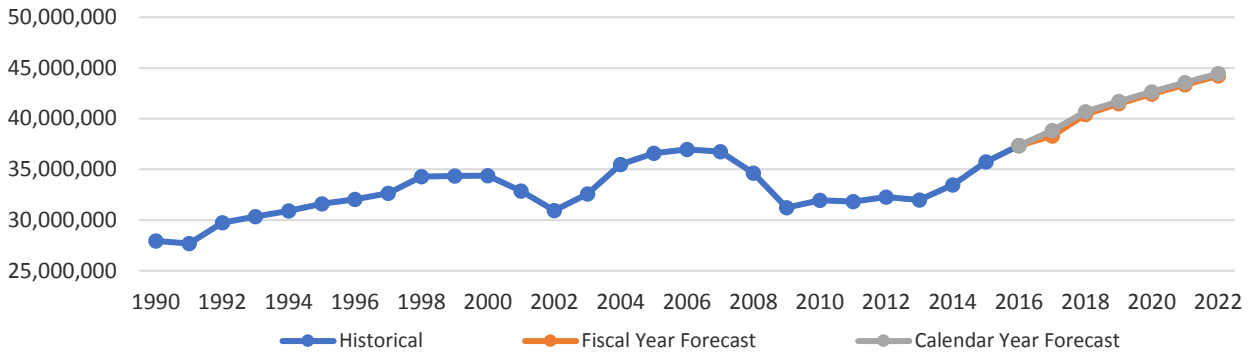
Furthermore, the 2017 TAF does not forecast aircraft operations to increase between 2018 and 2022, meaning that the under-representation of aircraft operations obeserved in 2018 is not capable of being recovered in subsequent years. For the purposes of this analysis, FAA TAF data was converted to calendar years (ending December 31). This conversion was done to compare and analyze the design day as it relates to the calendar year. FAA TAF activity levels by calendar year decrease from 888,866 in 2018 to 861,525 in 2022 is shown in **Table B-5**.

TABLE B-5
FAA TAF FOR O'HARE – CALENDAR YEARS

	2017	2018	2019	2020	2021	2022	AAGR
Enplaned Passengers	38,816,159	40,684,328	41,715,051	42,658,498	43,553,983	44,451,670	2.8%
Y-o-Y Growth (%)		4.8%	2.5%	2.3%	2.1%	2.1%	N/A
Aircraft Operations	866,545	888,866	889,600	884,320	871,885	861,525	-0.1%
Y-o-Y Change (%)		2.6%	0.1%	-0.6%	-1.4%	-1.2%	N/A
Notes: AAGR=Average Annual Growth Rate and Y-o-Y= Year-over-Year.							
Source: FAA TAF January 2018.							

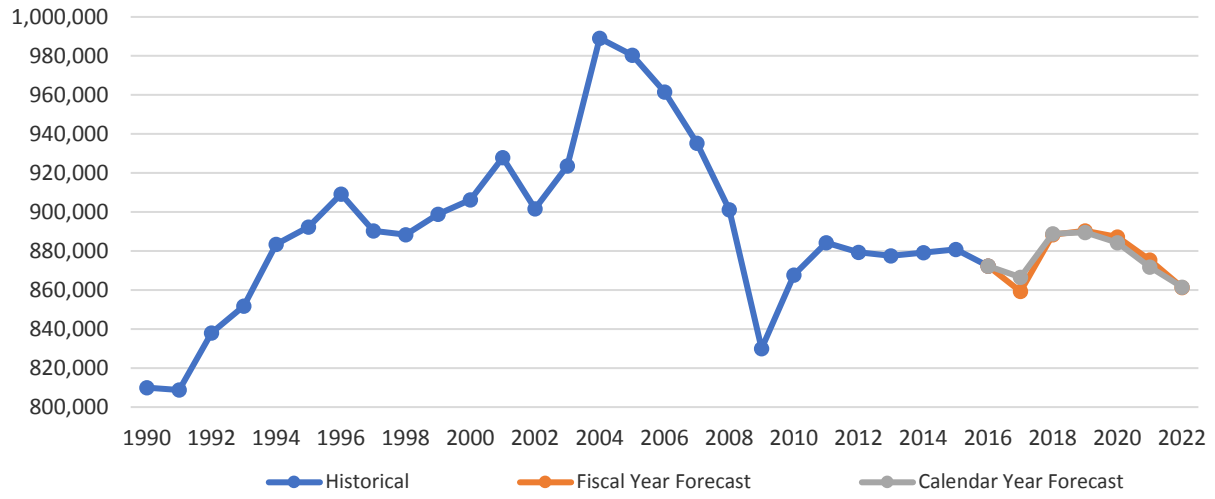
Figures B-7 and B-8 below show comparisons of FAA TAF for the fiscal years, as well as calendar years, for annual enplaned passengers and annual aircraft operations, respectively.

FIGURE B-7
O'HARE HISTORICAL AND FORECAST ENPLANED PASSENGERS



Source: FAA TAF January 2018 and InterVISTAS analysis.

FIGURE B-8
O'HARE HISTORICAL AND FORECAST AIRCRAFT OPERATIONS



Source: FAA TAF January 2018 and InterVISTAS analysis

FAA TAF was used to develop the operations and passenger forecasts for the Proposed Interim Fly Quiet period. As referenced above, the Proposed Interim Fly Quiet period is spread across several years (2019 to 2021), therefore the annual TAF operations were pro-rated on a monthly basis to project operations for the Proposed Interim Fly Quiet period. The basis for the pro-ration was the monthly share of Chicago O'Hare's aircraft operations from O'Hare's Air Traffic Activity Data System (ATADS) data as shown in **Table B-6.**

TABLE B-6
SHARE OF ANNUAL O'HARE OPERATIONS BY MONTH

Month	Year	Operations	Share (%)
January	2018	69,419	7.9%
February	2018	61,563	7.0%
March	2018	73,836	8.4%
April	2017	69,009	7.9%
May	2017	73,928	8.5%
June	2017	75,553	8.6%
July	2017	77,851	8.9%
August	2017	80,110	9.2%
September	2017	73,613	8.4%
October	2017	76,726	8.8%
November	2017	71,369	8.2%
December	2017	71,850	8.2%
		874,827	**100.0%**

Note: Data for January–March is from 2018; April–December is from 2017.
Source: Chicago Department of Aviation Facts and Figures (https://www.flychicago.com/business/CDA/factsfigures/Pages/airtraffic.aspx).

The above breakdown of monthly operations was then applied to the annual TAF operations for the years reflected in the Proposed Interim Fly Quiet period (2019, 2020, 2021). This resulted in 788,524 total operations for the Proposed Interim Fly Quiet period, as seen in **Table B-7** below.

TABLE B-7
PROJECTED O'HARE OPERATIONS FOR THE PROPOSED INTERIM FLY QUIET PERIOD

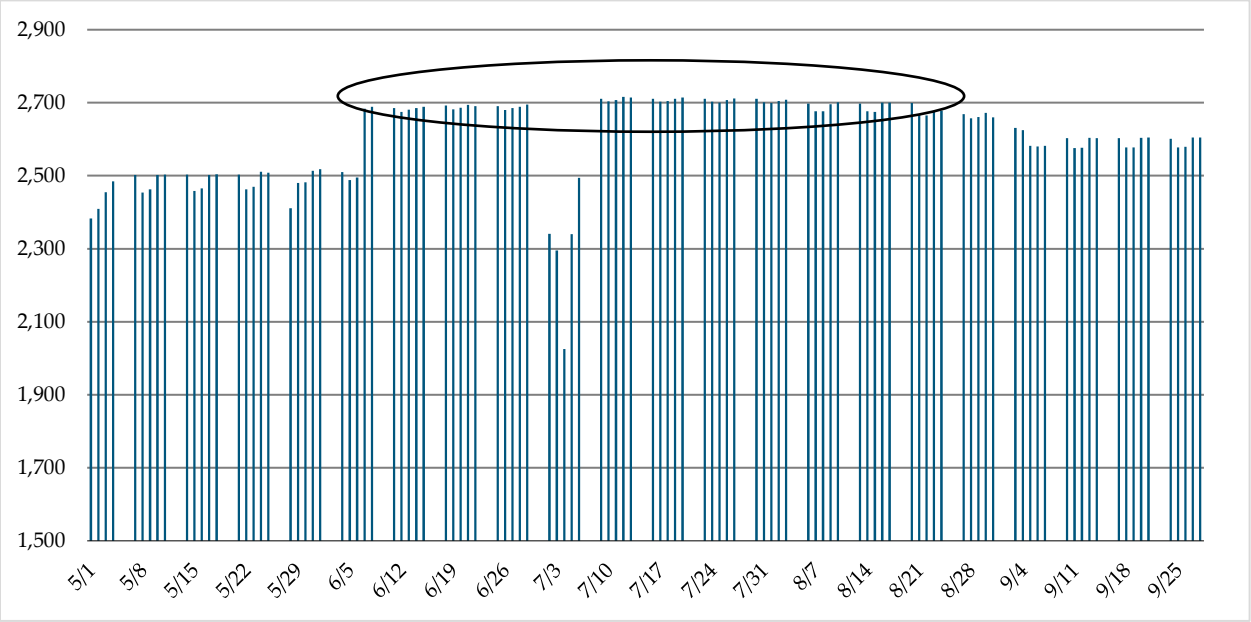
Proposed Interim Fly Quiet Period Month	Start	End	Share of Annual Operations (%)	Projected Interim Fly Quiet Operations
November	11/1/2019	11/30/2019	8.2%	72,574
December	12/1/2019	12/31/2019	8.2%	73,063
January	1/1/2020	1/31/2020	7.9%	70,172
February	2/1/2020	2/29/2020	7.0%	62,231
March	3/1/2020	3/31/2020	8.4%	74,637
April	4/1/2020	4/30/2020	7.9%	69,758
May	5/1/2020	5/15/2020	8.5%	37,365
June				
July				
August				
September	9/16/2020	9/30/2020	8.4%	37,206
October	10/1/2020	10/31/2020	8.8%	77,559
November	11/1/2020	11/30/2020	8.2%	72,143
December	12/1/2020	12/31/2020	8.2%	72,630
January	1/1/2021	1/31/2021	7.9%	69,186
Total				**788,524**

Source: Chicago Department of Aviation Facts and Figures (https://www.flychicago.com/business/CDA/factsfigures/Pages/airtraffic.aspx) and FAA 2017 TAF.

B.3 ANALYSIS OF PEAK ACTIVITY AT O'HARE

A comparison of scheduled peak period operations to the Proposed Interim Fly Quiet design day schedule forecast is important in evaluating the appropriateness of the design day flight schedule used for environmental processing. FAA third-party consultants examined an average weekday for the summers of 2016 and 2018, which is the period of the year in which passengers and passenger operations peak. The CDA's original design day flight schedule was based on the peak period average weekday in July 2016. **Figure B-9** illustrates the 2016 peak period.

FIGURE B-9
O'HARE SCHEDULED PASSENGER OPERATIONS 2016



Source: Innovata Schedules via Diio, accessed May 2018.

The peak period average day in 2016 was identified as July 27, which had 2,567 total scheduled passenger operations; 216 of which occurred at night. On this day, nighttime passenger operations accounted for 8.4 percent of the total scheduled passenger operations at O'Hare. This is shown in **Table B-8.**

TABLE B-8
PEAK PERIOD AVERAGE WEEKDAY SCHEDULED PASSENGER OPERATIONS (JULY 27, 2016)

	July 27, 2016
Nighttime Operations (10:00:00 p.m. – 6:59:59 a.m.)	216
Total Scheduled Operations	2,567
Nighttime Share	*8.4%*
Source: Innovata Schedules, via Diio, accessed May 2018.	

The peak period average day in July 2018 was found to be July 26. FAA third-party consultant's analysis of this day demonstrated that more scheduled passenger operations were expected to occur than forecast based on FAA TAF and demonstrated that there was a change in airline scheduling that resulted in more scheduled passenger operations in the nighttime period. This is illustrated in **Table B-9.** In the representative 2018 day, 9.5 percent of scheduled passenger operations occurred at night, a 1.1 percentage point higher share than observed in 2016. The difference in nighttime scheduled passenger operations between 2016 and 2018 was 40; the 2018 rate was 18.5 percent higher than 2016.

TABLE B-9
PEAK PERIOD AVERAGE WEEKDAY SCHEDULED PASSENGER OPERATIONS COMPARISON (JULY 27, 2016 VS. JULY 26, 2018)

	July 27, 2016	July 26, 2018
Nighttime Operations (10:00 p.m. – 6:59 a.m.)	216	256
Total Scheduled Operations	2,567	2,708
Nighttime Share of Total	*8.4%*	*9.5%*
Source: Innovata Schedules, via Diio, accessed May 2018.		

The fleet mix serving O'Hare has changed since 2016. Newer aircraft are usually more fuel-efficient, making them less costly to operate. The newer aircraft can also be quieter than the historic aircraft still used by many legacy carriers. As shown in **Table B-10**, more scheduled passenger operations are occurring in the representative July 2018 day. However, the fleet mix has continued to evolve from older aircraft such as the McDonnell Douglas jets to newer, quieter Boeing and Airbus aircraft. It is also evident, based on **Table B-10,** that the airlines continue to phase out of the CRJ 100/200 and Embraer 135/145 in favor of larger regional jets.

TABLE B-10
SCHEDULED PASSENGER OPERATIONS FLEET MIX

Aircraft	Passenger Operations		Share of Operations	
Type	**July 2016**	**July 2018**	**July 2016**	**July 2018**
CRJ 100/200 + Embraer 135/145	805	762	31.4%	28.1%
Boeing 737-800	317	420	12.3%	15.5%
CRJ 700 + Embraer 170	327	394	12.7%	14.5%
CRJ 900 + Embraer 175	238	254	9.3%	9.4%
A 320	213	173	8.3%	6.4%
Boeing 737-900	134	122	5.2%	4.5%
A 321	62	120	2.4%	4.4%
A 319	89	117	3.5%	4.3%
Boeing 757	48	52	1.9%	1.9%
Boeing 777-200/300/777	56	49	2.2%	1.8%
Boeing 737-700	26	48	1.0%	1.8%
Boeing 717	10	44	0.4%	1.6%
Boeing 787	18	38	0.7%	1.4%
Embraer 190	20	26	0.8%	1.0%
MD 80/82/83/88	102	18	4.0%	0.7%
A 330-200/300	22	16	0.9%	0.6%
Boeing 767-300	32	15	1.2%	0.6%
Boeing 747-400 + 800	14	8	0.5%	0.3%
A 340	2	4	0.1%	0.1%

Aircraft	Passenger Operations		Share of Operations	
Type	**July 2016**	**July 2018**	**July 2016**	**July 2018**
MD-90	6	4	0.2%	0.1%
A 350-900	N/A	2	0.0%	0.1%
A 380	N/A	2	0.0%	0.1%
General Aviation	26	20	1.0%	0.7%
Total	**2,567**	**2,708**	**100%**	**100%**

Source: Innovata Schedules, via Diio. July 27, 2016 and July 26, 2018 are representative days. Schedules accessed in May 2018.

The changes in scheduling time of day and aircraft types from the peak period representative day in 2016 to that of 2018 indicated the need for an analysis of scheduled passenger operations for an average day during the Proposed Interim Fly Quiet period. The analysis included the days of the representative months as shown in **Table B-11.**

TABLE B-11
PROPOSED INTERIM FLY QUIET PERIOD AVERAGE WEEKDAY SCHEDULED PASSENGER OPERATIONS COMPARISON

	Average		Mode	
	Date	**Day**	**Date**	**Day**
Quarter 1, 2018	February 27, 2018	Tuesday	March 1, 2018	Thursday
April 1—May 15, 2018	April 10, 2018	Tuesday	May 8, 2018	Tuesday
September 16–30, 2018	September 25, 2018	Tuesday	September 18, 2018	Tuesday
Quarter 4, 2018	October 31, 2018	Wednesday	October 4, 2018	Thursday
Total Proposed Interim Fly Quiet Period	**March 13, 2018**	**Tuesday**	**March 15, 2018**	**Thursday**

Source: Innovata Schedules via Diio, accessed June 3, 2018.

The average days examined outside of the summer period were used to better understand the level of operations occurring at O'Hare during the Proposed Interim Fly Quiet period, mainly to ensure that the design day flight schedule modeled the appropriate number of total operations, but more specifically the number of scheduled nighttime operations.

During the equivalent Proposed Interim Fly Quiet months in 2018, the average (arithmetic mean) scheduled nighttime passenger operations are 173, with the September-December months average being 205 and the January-March months average totaling 164. This is illustrated in **Table B-12.**

TABLE B-12
AVERAGE DAY IN THE EQUIVALENT MONTHS OF THE PROPOSED INTERIM FLY QUIET PERIOD (2018)

			Average Day		
	Date	**Day**	**Nighttime**	**Total**	**Share Nighttime**
Quarter 1, 2018	February 27, 2018	Tuesday	164	2,284	7.2%
April 1 - May 15, 2018	April 10, 2018	Tuesday	175	2,379	7.4%
September 15 - 30, 2018	September 25, 2018	Tuesday	205	2,571	8.0%
Quarter 4, 2018	October 31, 2018	Wednesday	205	2,479	8.3%
Total Proposed Interim Fly Quiet Period	**March 13, 2018**	**Tuesday**	**173**	**2,351**	**7.4%**
Source: Innovata Schedules via Diio. accessed June 3, 2018.					

As shown in **Table B-13**, the typical (mode) scheduled passenger operations during the nighttime of the equivalent Proposed Interim Fly Quiet months in 2018 are 175, with the mode of 211 in the October-December months and 168 in the January-March months.

TABLE B-13
MODE DAY IN THE EQUIVALENT MONTHS OF THE PROPOSED INTERIM FLY QUIET PERIOD (2018)

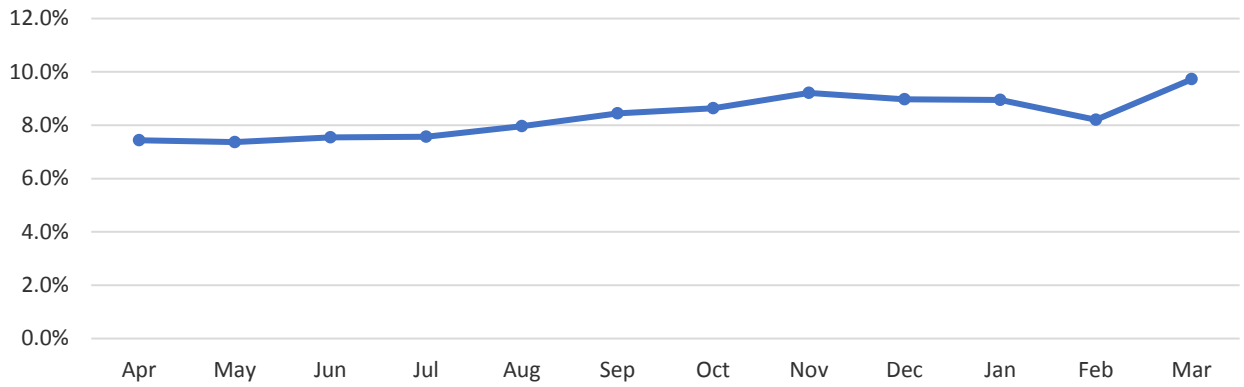
			Mode		
	Date	**Day**	**Nighttime**	**Total**	**Share Nighttime**
Quarter 1, 2018	March 1, 2018	Thursday	168	2,313	7.3%
April 1 - May 15, 2018	May 8, 2018	Tuesday	196	2,456	8.0%
September 15 - 30, 2018	September 18, 2018	Tuesday	205	2,571	8.0%
Quarter 4, 2018	October 4, 2018	Thursday	211	2,608	8.1%
Total Proposed Interim Fly Quiet Period	**March 15, 2018**	**Thursday**	**175**	**2,382**	**7.3%**
Source: Innovata Schedules via Diio. Accessed June 3, 2018.					

Therefore, from a forecasting perspective, the minimum nighttime passenger operations during the Proposed Interim Fly Quiet period should be 211.

Cargo operations were also reviewed. As noted above, they have increased every year since 2014. With new facilities, the airport is able to process additional cargo. Unlike passenger operations, cargo activity

peaks during the winter months, as seen in **Figure B-10**. The winter months are included in the Proposed Interim Fly Quiet period, making it an important piece of the design day flight schedule.

FIGURE B-10
MONTHLY SHARE OF O'HARE CARGO OPERATIONS, YEAR END MARCH 2018



Source: Chicago Department of Aviation Facts and Figures (https://www.flychicago.com/business/CDA/factsfigures/Pages/airtraffic.aspx).

During this analysis of O'Hare's cargo operations, it was also determined that cargo opertions account for roughly two percent of the airport's total activity. Analysis of the annual cargo data for the initial Proposed Interim Fly Quiet period determined that not enough cargo operations were being allocated during the nighttime hours. This is shown in **Table B-14** below.

TABLE B-14
CARGO OPERATIONS – DAY/NIGHT DISTRIBUTION

Proposed Interim Fly Quiet Period Design Day Flight Schedule				
	Arrivals	**Departures**	**Total**	**% Share**
Nighttime	4,988	5,806	10,794	45.0%
Daytime	7,018	6,153	13,171	55.0%
Total	**12,006**	**11,959**	**23,965**	**100.0%**

CY 2017					
	Arrivals	**Departures**	**Total**	**% Share**	**Variance to Proposed Interim Fly Quiet**
Nighttime	4,964	5,850	10,814	47.0%	20
Daytime	6,539	5,671	12,210	53.0%	-961
Total	**11,503**	**11,521**	**23,024**	**100.0%**	**-941**

Note: Variance to Proposed Interim Fly Quiet indicates the difference in actual operations in 2017 compared to the Proposed Interim Fly Quiet flight Schedule.
Source: Aerobahn Data.

Year End March 2018					
	Arrivals	**Departures**	**Total**	**% Share**	**Variance to Proposed Interim Fly Quiet**
Nighttime	5,085	5,907	10,992	46.3%	198
Daytime	6,783	5,955	12,738	53.7%	-433
Total	**11,868**	**11,862**	**23,730**	**100.0%**	**-235**

Note: Variance to Proposed Interim Fly Quiet indicates the difference in actual operations in Year End March compared to the Proposed Interim Fly Quiet flight Schedule.
Source: Aerobahn Data.

While the Proposed Interim Fly Quiet period has more overall cargo operations, about 200 more nighttime operations are occuring in year end March 2018 than accounted for in the Proposed Interim Fly Quiet period design day flight schedule.

B.4 PROPOSED INTERIM FLY QUIET NIGHTTIME PERIOD MODELED

As noted in the noise section of this Re-Evaluation, the standard metric for evaluating aircraft noise is the Day-Night Average Sound Level (DNL). The DNL metric includes a sound-level weighting for sounds during the nighttime hours (10:00 p.m. to 6:59 a.m.). However, the Proposed Interim Fly Quiet mode occurs during a subset of the nighttime hours that starts at 10:30 p.m. and ends at 5:30 a.m. For purposes of the forecast analysis, this is referred to as the Proposed Interim Fly Quiet period.

The analysis of the Proposed Interim Fly Quiet period (10:30 p.m.—5:30 a.m.) found the following conclusions that are summarized in **Table B-15**:

- During the peak period in July 2016, 75 passenger aircraft operations were scheduled. That number increased to 83 in the peak period day in July 2018.
- Similarly, during the Proposed Interim Fly Quiet period during the representative 2016 months, the typical (mode) total of scheduled passenger aircraft operations was 54. That number increased to 64 in 2018.

TABLE B-15
VARIANCE BETWEEN 2016 AND 2018 NIGHTTIME PASSENGER AIRCRAFT OPERATIONS

	October			**July**		
Time Period	**2016**	**2018**	**Variance**	**2016**	**2018**	**Variance**
22:00—22:29	12	16	4	18	39	21
05:31—06:59	103	131	28	123	135	12
22:30—05:30	***54***	***64***	***10***	***75***	***83***	***8***
Total Nighttime	**169**	**211**	**42**	**216**	**257**	**41**

Source: Innovata Schedules via Diio. Accessed June 3, 2018.

B.5 THE CITY OF CHICAGO DESIGN DAY FLIGHT SCHEDULE

The CDA produced a memorandum that detailed the forecast methodology used to create the design day flight schedule for the Proposed Interim Fly Quiet period modeling. The forecast was reviewed prior to any environmental evaluation to ensure that the operation levels predicted in the design day flight schedule were appropriate and accurately reflected real-world scenarios. The schedule was based on a peak period average day in July 2016. While the peak period average day should be conservative when modeling the non-peak periods of the Proposed Interim Fly Quiet, FAA third-party consultants found that using 2016 as the base year was no longer appropriate due to increased nighttime flying.

The design day flight schedule created by the CDA had 2,636 operations occuring in the representative day. As illustrated in **Table B-16**, of the 2,636 operations, 96 percent were scheduled passenger operations, while two percent each were cargo and general aviation.

TABLE B-16
DESIGN DAY FLIGHT SCHEDULE OPERATIONS BY CATEGORY

	CDA Design Day Flight Schedule	Share of Total
Passenger Operations	2,522	96%
Cargo Operations	62	2%
General Aviation Operations	52	2%
Total Day	**2,636**	**100%**
Source: City of Chicago.		

Of the 2,636 operations in the design day flight schedule, 8.9 percent occurred during nighttime hours. As illustrated in **Table B-17**, this included 191 passenger operations, 33 cargo operations, and three general aviation operations.

TABLE B-17
DESIGN DAY FLIGHT SCHEDULE OPERATIONS BY CATEGORY

	CDA Design Day Flight Schedule
Day Passenger	2,331
Day Cargo	29
Day General Aviation	49
Subtotal Day	*2,409*
Night Passenger	191
Night Cargo	33
Night General Aviation	3
Subtotal Night	*227*
Total	**2,636**
Source: City of Chicago.	

Based on analysis of 2018 scheduled passenger totals and the growth in O'Hare cargo operations, FAA third-party consultants concluded that it was necessary to modify the design day flight schedule to more accurately model the Proposed Interim Fly Quiet period.

B.6 ADJUSTMENTS TO THE DESIGN DAY FLIGHT SCHEDULE

FAA third-party consultants concurred with the CDA design day flight schedule overall activity level of 2,636 operations. Through the changes outlined below, however, the consultants proposed to modify the schedule by increasing the amount of operations at night by 34 flights and reducing from the day period by the same amount. Based on the Proposed Interim Fly Quiet period observations, 10 of the 34 nighttime flights (29.4 percent) would occur during the Proposed Interim Fly Quiet period of 10:30 p.m. to 5:30 a.m.

As shown in **Table B-18** and **Table B-19**, this adjustment brought the design day flight schedule day-night split more in line with the historical average of 90/10, which is based on data from the CDA's Airport Noise Management System.

TABLE B-18
MODIFICATIONS MADE TO THE CDA DESIGN DAY FLIGHT SCHEDULE BY TIME OF DAY

	CDA Design Day Flight Schedule	FAA Modified Design Day Flight Schedule	Change
Day	2,409	2,375	-34
Night	227	261	34
Total	**2,636**	**2,636**	**0**
Night %	*8.61%*	*9.90%*	*1.29%*
Source: Ricondo & Associates and InterVISTAS, Inc. analyses.			

Based on FAA third-party consultants evaluations, the total increase in nighttime operations should be 32 passenger flights, one cargo flight, and one general aviation flight.

TABLE B-19
MODIFICATIONS TO THE CDA DESIGN DAY FLIGHT SCHEDULE BY CATEGORY

	CDA Design Day Flight Schedule	FAA Modified Design Day Flight Schedule	Change
Daytime (7:00 a.m. - 10:00 p.m.)			
Passenger	2,331	2,299	-32
Cargo	29	28	-1
General Aviation	49	48	-1
Subtotal Day	*2,409*	*2,375*	*-34*

	CDA Design Day Flight Schedule	FAA Modified Design Day Flight Schedule	Change
Nightime (10:00 p.m.- 7:00 a.m.)			
Passenger	191	223	32
Cargo	33	34	1
General Aviation	3	4	1
Subtotal Night	*227*	*261*	*34*
Total	**2,636**	**2,636**	**0**
Source: Ricondo & Associates and InterVISTAS, Inc. analyses.			

FAA third-party consultant analysis also showed slightly more arrivals at night during the Proposed Interim Fly Quiet period. The proposed adjustments in **Table B-20** reflect that trend.

TABLE B-20
PROPOSED MODIFICATIONS TO THE NIGHTTIME ARRIVALS AND DEPARTURES

	CDA Design Day Flight Schedule	Design Day Flight Schedule Split	FAA Modified Design Day Flight Schedule	Modified Split
Night Arrivals	133	58.6%	158	60.5%
Night Departures	94	41.4%	103	39.5%
Total Night	**227**	**100.0%**	**261**	**100.0%**
Source: Ricondo & Associates and InterVISTAS, Inc. analyses.				

Flights added to the Proposed Interim Fly Quiet period have the same aircraft types and operational characteristics as other flights in the Proposed Interim Fly Quiet period. The majority of these flights were added during the middle of the night, when the schedule was light and the airport would be operating Proposed Interim Fly Quiet. The additions were made by copying existing operations to maintain alignment with runway use and other operational considerations. For example: To add one B739 arrival, the B739 arrival at 04:49 in the design day flight schedule is copied and the time changed to 00:45.

Flights added to the nighttime period (outside of the Proposed Interim Fly Quiet period) were either copies of flights as described above or flights (hours identified as being just after 7:00 a.m. or just before 10:00 p.m.) shifted from the shoulder hours by changing the time. Of the 24 flights added, only nine were shifted.

To balance the increase in operations at night, flights during the day needed to be removed. It was necessary to remove 25 daytime flights, but spreading them out during the day was done to minimize effects on runway use hourly operational levels.

B.7 REVISED DESIGN DAY FLIGHT SCHEDULE

The CDA released a revised design day flight schedule memorandum, which follows this section for reference, that addressed the comments from FAA third-party consultants. This modification to the design day flight schedule was supported by the CDA, as is indicated by the letter in **Appendix B-2**. With these changes, the design day flight schedule kept the overall number of operations at 2,636, but with more operations occuring in the night—more specifically during the Proposed Interim Fly Quiet period. **Table B-21** illustrates the difference between the two nighttime periods.

TABLE B-21
REVISED DESIGN DAY FLIGHT SCHEDULE

	CDA Design Day Flight Schedule	FAA Modified Design Day Flight Schedule
Nighttime Operations	227	261
Total Daily Operations	**2,636**	**2,636**
Share Nighttime	***8.6%***	***9.9%***
Source: Ricondo & Associates and InterVISTAS, Inc. analyses.		

The new design day flight schedule accurately reflects current aircraft operations. The nighttime operations number reflects, to the best of FAA third-party consultants's knowledge, what the nighttime would be in the Proposed Interim Fly Quiet period. The share of nighttime operations to total operations remains around 10 percent, which is O'Hare's historic rate.

ATTACHMENT B-1

PROPOSED INTERIM FLY QUIET RE-EVALUATION FLIGHT SCHEDULE DEVELOPMENT MEMORANDUM

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July 2018 | DRAFT

Chicago O'Hare International Airport

Flight Schedule Development for Interim Fly Quiet Analysis

Prepared on behalf of:

The City of Chicago Department of Aviation

Prepared for:

The Federal Aviation Administration

Prepared by:

RICONDO

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LIST OF EXHIBITS

1. INTRODUCTION

This document describes the methodology and assumptions used to develop flight schedules for airfield and airspace simulation modeling in support of the Chicago O'Hare International Airport (ORD or the Airport) Interim Fly Quiet (IFQ) Runway Rotation Plan Re-Evaluation. The flight schedule and simulation modeling analyses were initially conducted in summer 2017. Subsequently, the IFQ Runway Rotation period was revised. Information on the schedule development and context to the revised IFQ Runway Rotation period are provided in this document.

2. INTERIM FLY QUIET RUNWAY ROTATION PLAN SCHEDULE DEVELOPMENT

2.1 BACKGROUND

The O'Hare Noise Compatibility Commission (ONCC) formed an Ad-Hoc Fly Quiet Committee in 2015 as a result of a recommendation by the City of Chicago Department of Aviation (CDA) to temporarily modify the existing Fly Quiet program which has been in place at the Airport since 1997. The ONCC, CDA, and the Federal Aviation Administration (FAA) have overseen a series of three runway rotation tests to test potential runway use rotation options that balance nighttime runway noise. Test 1 occurred between July 2016 and December 2016; Test 2 occurred between April 2017 and July 2017; and Test 3 occurred between July 2017 and October 2017. An IFQ Runway Rotation Plan was voted on and approved by the ONCC on December 8, 2017. The IFQ period was originally proposed to begin in March 2018, shortly after the closure of Runway 15-33, and end in November 2020 with the planned commissioning of Runway 9C-27C.

The development of a flight schedule used to analyze the IFQ Runway Rotation Plan began in May 2017 and assumed an analysis period of June 1, 2018 to May 31, 2019 as shown in **Exhibit 1**. The flight schedule development and airfield and airspace simulation modeling, which used the flight schedule as an input assumption, was initiated prior to the ONCC and CDA endorsement of the IFQ Plan to accommodate the anticipated analysis schedule.

EXHIBIT 1: INITIAL INTERIM FLY QUIET RUNWAY ROTATION PLAN AND RUNWAY CLOSURE SCHEDULE

Project	2018												2019											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Interim Fly Quiet (12 months)						1	2	3	4	5	6	7	8	9	10	11	12							
Rwy 4L/22R (Reconstruction)																		1	2	3	4	5	6	

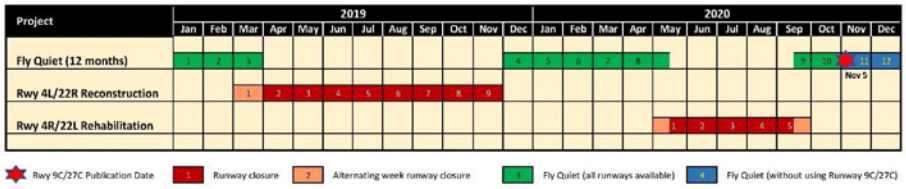
Interim Fly Quiet (all runways available) 24-Hour Runway Closure

SOURCES: Chicago Department of Aviation, May 2017; Federal Aviation Administration, May 2017; Ricondo & Associates, Inc., May 2017.

2.2 INTERIM FLY QUIET TIMEFRAME ADJUSTMENTS

Adjustments to the proposed timeframe of the IFQ Plan occurred following the development of the initial flight schedule. The first revision of the proposed IFQ period accounted for a shift in the analysis schedule and additional runway rehabilitation work identified by CDA. The FAA's Third-Party Consultant (TPC) received approval to begin work in April 2018 and a revised proposed nonconsecutive 12-month IFQ Runway Rotation period was submitted by CDA to the FAA in April 2018. The revised proposed schedule, shown in **Exhibit 2**, included January 1, 2019, through March 31, 2019; December 1, 2019, through May 15, 2020; and September 16, 2020, through December 31, 2020. This schedule accommodated anticipated runway closures associated with the reconstruction of Runway 4L-22R in 2019 and rehabilitation of Runway 4R-22L in 2020. The proposed IFQ Runway Rotation period would extend beyond the commissioning of Runway 9C-27C but would not consider the runway in the rotation plan.

EXHIBIT 2: FIRST REVISION TO THE INTERIM FLY QUIET RUNWAY ROTATION PLAN AND RUNWAY CLOSURE SCHEDULE



SOURCES: Chicago Department of Aviation, March 2018; Federal Aviation Administration, March 2018; Ricondo & Associates, Inc., March 2018.

In June 2018, a second revision was made to further adjust the proposed IFQ Runway Rotation timeframe. The revised period included an 11-month nonconsecutive schedule; November 1, 2019, through May 15, 2020; and September 16, 2020, through January 31, 2021. The schedule adjustment reflected additional refinement of the runway reconstruction and rehabilitation schedule and accommodation of the estimated completion of the Re-Evaluation analysis, approximately one year after the April 2018 start. **Exhibit 3** shows the updated IFQ Runway Rotation schedule incorporating the revised IFQ Runway Rotation Plan start, the closure of Runway 4L-22R for reconstruction, the nighttime closure of Runway 4R-22L for rehabilitation, and the closure of Runway 9R-27L following the commissioning of Runway 9C-27C to accommodate construction of the Runway 9R Extension.

EXHIBIT 3: SECOND REVISION TO THE INTERIM FLY QUIET RUNWAY ROTATION PLAN AND RUNWAY CLOSURE SCHEDULE

SOURCES: Chicago Department of Aviation, June 2018; Federal Aviation Administration, June 2018; Ricondo & Associates, Inc., June 2018.

As detailed in Exhibit 3, the IFQ schedule consists of two intervals spread over a 15-month period. The two intervals total 11 months and occur during the fall, winter, and spring seasons when major runway construction work is not anticipated to occur:

- November 1, 2019, through May 15, 2020
- September 16, 2020, through January 31, 2021

2.3 ANALYSIS PERIOD

Due to the reasons noted above, adjustments to the flight schedule and simulation modeling output were necessary to account for changes in the period of the IFQ Runway Rotation and airport activity information available after the modeling was complete in 2017. For example, the schedule was developed assuming a consecutive 12-month calendar year with the representative day reflecting peak period summer weekday activity levels, but the IFQ Runway Rotation Plan schedule no longer included summer months. In addition, the FAA released the 2017 TAF in January of 2018 which includes shifts in forecasted activity. Also, an additional several months of historical activity was available as well as updated airline schedule information. The FAA, the FAA's TPC, the CDA, and CDA's consultants Ricondo and Landrum & Brown jointly assessed schedule and model output changes that were necessary to account for shifts in assumptions that occurred following the completion of flight schedule development and modeling. The following sections include information on the original schedule development and agreed upon adjustments.

3. FEDERAL AVIATION ADMINISTRATION'S TERMINAL AREA FORECAST ANNUAL DEMAND

The 2016 TAF was the FAA's TAF of record at the time of the original schedule development in May 2017. The FAA subsequently released the 2017 TAF in January 2018, which forecast higher activity levels in terms of aircraft operations and enplaned passengers at ORD during the analysis period. A comparison of the two TAFs is provided in **Table 1**.

TABLE 1: ANNUAL AIRCRAFT OPERATIONS

CALENDAR YEAR	2016 TAF OPERATIONS	2017 TAF OPERATIONS	CHANGE FROM 2016 TAF	2016 TAF PASSENGERS	2017 TAF PASSENGERS	CHANGE FROM 2016 TAF
2016	871,171	869,067	(0.2%)	75,381,376	75,167,432	(0.3%)
2017	865,738	866,545	0.1%	77,507,966	77,632,319	0.2%
2018	856,851	888,866	3.7%	79,113,660	81,368,655	2.9%
2019	844,844	889,600	5.3%	80,614,860	83,430,103	3.5%
2020	833,626	884,320	6.1%	82,089,538	85,316,995	3.9%
2021	825,484	871,885	5.6%	83,527,498	87,107,967	4.3%

SOURCES: Federal Aviation Administration, 2016 Terminal Area Forecast, January 2017; Federal Aviation Administration, 2017 Terminal Area Forecast, January 2018.

The TAF was used as the basis of future activity and representative day flight schedule development. The TAF was converted from federal fiscal year to calendar year (CY) and then used to inform calendar year activity as well as total activity associated with the Re-Evaluation analysis period. The analysis period associated with the IFQ period

at the time the schedule was developed was 12 consecutive months, June 2018 through May 2019. Following the April 2018 update of the IFQ period, the Re-Evaluation analysis was adjusted to align with the non-consecutive 11-month period. **Table 2** shows annual activity levels for CY 2016 and estimated 11-month period activity for the original and revised IFQ periods of analysis based on the 2016 and 2017 TAF.

TABLE 2: ANNUAL ACTIVITY LEVELS

PERIOD	2016 TAF OPERATIONS	2017 TAF OPERATIONS	2017 TAF OPERATIONS CHANGE	2016 TAF PASSENGERS	2017 TAF PASSENGERS	2017 TAF PASSENGER CHANGE
CY2016	871,171	869,067	N/A	75,381,376	75,167,432	N/A
Original IFQ Re-Evaluation Analysis Period (June 1, 2018 – May 31, 2019)[1]	851,287	888,265	4.3%	79,623,016	82,095,374	2.9%
Revised IFQ 11 Month Period (November 1, 2019 - May 15, 2020, and September 16, 2020 - January 31, 2021)	744,628	788,524	5.9%	70,857,632	73,608,223	3.9%

NOTE:
1 Reflects 12-month analysis period. Original IFQ Runway Rotation schedule from March 2018 to November 2020.
SOURCES: Federal Aviation Administration, 2016 Terminal Area Forecast, January 2017; Federal Aviation Administration, 2017 Terminal Area Forecast, January 2018. Federal Aviation Administration, Air Traffic Activity System (ATADS), April 2018, Ricondo & Associates, Inc., July 2018 (analysis).

Utilizing CY 2016 as the base year, flight schedules were developed depicting activity levels for a representative day within the period selected for the IFQ analysis. A change in the ratio of the representative day to the analysis period total activity, described in Section 4, was used to account for changes between the 2016 and 2017 TAF.

4. REPRESENTATIVE DAY SELECTION METHODOLOGY AND RESULTS

The relationship of annual activity to peak period activity was evaluated. Over the last several years the airline industry has taken a dynamic approach to the allocation of capacity by scheduling more closely seasonal demand. This includes operating more seats during periods of high demand and making cuts to schedules during historically lower demand periods. **Exhibit 4** illustrates an example of the industry change in the variance of monthly flights from the annual average. In 2007, schedules varied no more than 8 percent from the average monthly number of flights. Because of this scheduling approach, February 2017 was nearly 20 percent below the monthly average, while the peak month of August was more than 10 percent higher than the monthly average.

EXHIBIT 4: VARIANCE OF MONTHLY FLIGHTS FROM ANNUAL AVERAGE – U.S. AIRPORTS

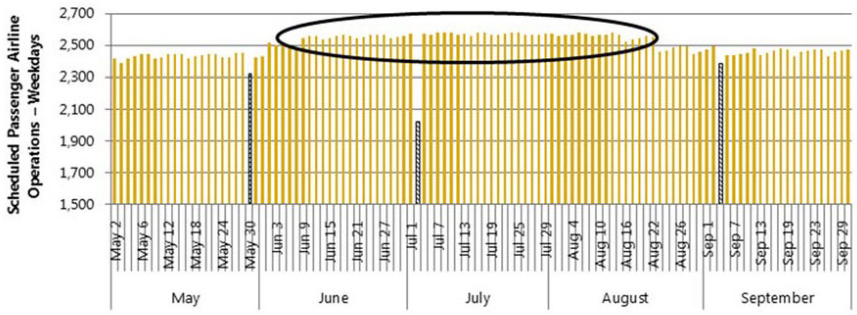
SOURCE: Innovata, July 2017.

When analyzing a peak period, observations during a peak month may be skewed by holidays and weekends. Therefore, an approach was taken to identify peak period average weekday, or representative day, within a peak period, rather than only a peak month. The identification of the peak is based on passenger airlines, which account for approximately 96 percent of aircraft operations at ORD. The peak period was identified over a multiple-month period based on historical data. In 2016, the peak activity was measured by aircraft passenger operations during June, July, and August.[1] Using this peak period, a representative day was identified, after removing weekends and holidays, which typically operate with significantly lower levels of activity than weekdays.

Exhibit 5 identifies the peak-period average weekday that falls between June 13 and August 19.

[1] June, July, and August were included in the IFQ Runway Rotation Plan schedule available at the time of schedule development in May 2017.

EXHIBIT 5: PEAK PERIOD AVERAGE WEEKDAY OPERATIONS



SOURCES: Innovata, July 2017; Ricondo & Associates, Inc., July 2017 (analysis).

During this peak period, airlines scheduled an average of 2,567 weekday aircraft operations. Three days within this peak period aligned with this weekday average. All three days represented the 25th busiest day in 2016 for aircraft operations. However, July 27th also represented the busiest of the three days for scheduled seat capacity. Therefore, July 27th was selected as the representative day in 2016, which is equivalent to 0.309 percent of total annual aircraft operations. July 27th represented a total of 2,681 operations which included scheduled airline operations, cargo and general aviation operations. This was the 93rd percentile day in the evaluation year.

Cargo and general aviation operations were also modeled in this analysis. Cargo aircraft operations are not separately identified in the TAF; therefore, specific assumptions have been made to identify the level of cargo aircraft activity. This analysis assumes that the share of passenger and cargo aircraft operations remains constant through the IFQ period. Passenger airlines will comprise approximately 96 percent of operations, while cargo and general aviation will represent approximately 2 percent each. General aviation operations will be reflected as forecast in the 2016 TAF.

4.1 TOTAL IFQ RUNWAY ROTATION PERIOD ACTIVITY

The total activity over the IFQ period was calculated by allocating and adding monthly data for the nonconsecutive 11-month period. An analysis of the distribution of monthly activity was performed. **Table 3** depicts actual monthly aircraft operations at ORD as a percentage of total annual operations, as reported by the FAA for the twelve-month period ending March 2018. The 11-month IFQ period total activity was calculated by multiplying annual operations by the percentages shown in Table 3 for the individual months comprising the 11-month period and adding those amounts together to arrive at the total operations as shown in **Table 4**. The ratio of representative day to annual domestic and international volumes was assumed to remain constant over the forecast period.

TABLE 3: PERCENTAGE OF ANNUAL AIRCRAFT OPERATIONS BY MONTH (TWELVE MONTHS ENDING MARCH 2018)

MONTH	PERCENTAGE OF ANNUAL OPERATIONS
April 2017	7.9%
May 2017	8.5%
June 2017	8.6%
July 2017	8.9%
August 2017	9.2%
September 2017	8.4%
October 2017	8.8%
November 2017	8.2%
December 2018	8.2%
January 2018	7.9%
February 2018	7.0%
March 2018	8.4%
Full Year	**100.0%**

SOURCE: Federal Aviation Administration Air Traffic Activity System (ATADS), April 2018.

The ratio of the flight schedule daily operations used for the modeling to the annual and total period activity is shown in Table 4. The analysis period for the original IFQ schedule was CY 2016. The representative day was equivalent to 0.308 percent of total annual operations forecasted in 2016 TAF adjusted to CY. In the 11-month revised IFQ period, this equates to 0.334 percent of total period operations. Also shown is the average period day to flight schedule day ratio. In the 11-month revised IFQ period, this ratio is 0.89 percent and was used in post processing of the simulation output to convert the simulated day to an average day volume.

TABLE 4: RELATIONSHIP OF REPRESENTATIVE DAY TO TOTAL PERIOD ACTIVITY

PERIOD	FLIGHT SCHEDULE DAILY OPERATIONS	TOTAL PERIOD OPERATIONS[1]	TOTAL PERIOD AVERAGE DAILY OPERATIONS	FLIGHT SCHEDULE TO TOTAL PERIOD OPERATIONS RATIO	AVERAGE PERIOD DAY TO FLIGHT SCHEDULE DAY RATIO
CY2016	2,681	871,171	2,380	0.308%	0.89%
Original IFQ Period (Consecutive 12 months)	2,636	888,265	2,434	0.297%	0.92%
Revised IFQ Period (11 nonconsecutive months)[2]	2,636	788,524	2,354	0.334%	0.89%

NOTES: All data show for CY2017.
1 CY 2016 annual operations based on the 2016 TAF. IFQ annual operations are based on the 2017 TAF.
2 November 1, 2019 through May 15, 2020, and September 16, 2020 through January 31, 2021.
SOURCES: Federal Aviation Administration Air Traffic Activity System (ATADS); Federal Aviation Administration 2016 Terminal Area Forecast; Ricondo & Associates, Inc., July 2018 (analysis).

5. SCHEDULE DEVELOPMENT METHODOLOGY

In support of the IFQ modeling and analysis, design day flight schedules (DDFS) of passenger activity and all aircraft operations (passenger airline, cargo, and general aviation) at ORD were developed. In this study, the design day represents activity on the representative day. The DDFSs were developed for both the base year and the IFQ period of analysis.

The following subsections describe the methodology and assumptions used in the development of the DDFSs, along with the results for the base year and the IFQ period of analysis.

5.1 FLEET MIX DEVELOPMENT

The fleet mix on the representative day was developed in two stages. First, a specific annual aircraft fleet mix at ORD was identified for the IFQ evaluation period, to provide estimates of average aircraft size for the representative day. The annual fleet mix was developed based on anticipated aircraft to be used by carriers operating at ORD in 2018. This was informed primarily by published fleet plans available through public sources. It is anticipated that carriers at ORD will continue to upgauge the size of aircraft operating at ORD. Current fleet orders and public guidance from American Airlines and United Airlines indicate that both carriers plan to replace older 50-seat regional jets with larger regional jets, and in some markets increasing gauge from larger regional jets to small mainline aircraft. Both carriers have reconfigured gate positions, removing gates that were previously limited to 50-seat aircraft to provide the flexibility to accommodate larger regional aircraft.

Second, the fleet mix was refined based on demand during the representative day. Using the representative day flight schedule for the base year, specific flights were upgauged to meet demand growth, and some frequencies were consolidated to account for declining total operations. For each upgauge or frequency consolidation, the annual fleet mix served to inform which aircraft types and sizes were expected to operate at ORD. The result was a fleet mix for the IFQ representative day, which is compared with the base year representative day fleet mix in **Table 5**.

Review and adjustments to the design day schedule and simulation output occurred in June 2018 to account for changes following the schedule development and modeling. Section 6 and Appendix A includes additional information on these adjustments.

5.2 DESIGN DAY FLIGHT SCHEDULE DEVELOPMENT—PASSENGER AIRLINES

The DDFS represents aircraft operations and passenger activity anticipated at ORD during the representative day. The DDFS includes information on airline, aircraft arrival time, aircraft departure time, aircraft origin and destination (O&D), equipment type, aircraft seat capacity, load factors, and arriving and departing passenger volumes specific to each flight. Passenger volumes are provided for both O&D and connecting passengers.

TABLE 5: REPRESENTATIVE DAY FLEET MIX

AIRCRAFT	2016 DDFS OPERATIONS	% OF TOTAL (2016)	IFQ DDFS OPERATIONS	% OF TOTAL (IFQ)
CRJ-100/200 and Embraer 135/145	807	30%	561	21%
CRJ-700 and Embraer 170	329	12%	487	18%
CRJ-900 and Embraer 175	241	9%	249	9%
Embraer 190	20	1%	20	1%
Boeing 717	10	0%	21	1%
A319	86	3%	100	4%
A320	223	8%	169	6%
A321	62	2%	227	9%
Boeing 737-600	2	0%	0	0%
Boeing 737-700	35	1%	15	1%
Boeing 737-800	319	12%	336	13%
Boeing 737-900	127	5%	77	3%
MD-80/82/83/88	96	4%	64	2%
MD-90	6	0%	2	0%
Boeing 757	48	2%	33	1%
Boeing 767-300/767-300F	36	1%	19	1%
A300	7	0%	7	0%
A330-200/300	22	1%	12	0%
A350-900	0	0%	6	0%
Boeing 787	18	1%	39	1%
A340	2	0%	2	0%
DC-10F	16	1%	10	0%
MD-11F	2	0%	2	0%
Boeing 777-200/300/777F	50	2%	67	3%
Boeing 747-400 and -8	36	1%	33	1%
A380	0	0%	4	0%
Cessna 208 Caravan	22	1%	22	1%
General Aviation	59	2%	52	2%
Total	**2,681**	**100%**	**2,636**	**100%**

NOTE: Percentages may not add due to rounding

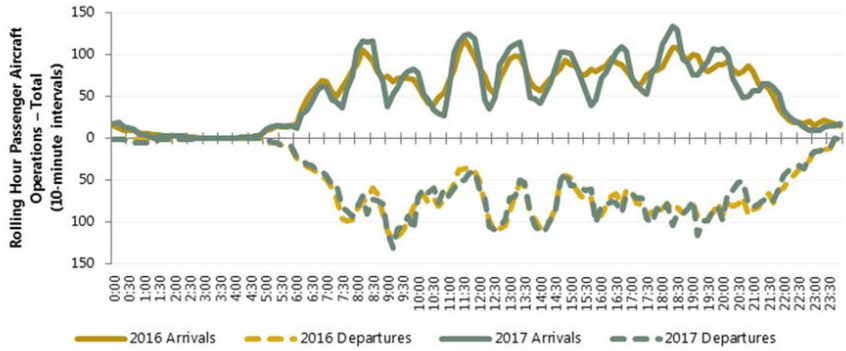
SOURCES: Chicago Department of Aviation, July 2017; Innovata, July 2017; Federal Aviation Administration, Air Traffic Activity Data System, July 2017; Federal Aviation Administration, Terminal Area Forecast, July 2017 (FY 2016–2045); Federal Aviation Administration, Traffic Flow Management System Counts, July 2017; U.S. Department of Transportation, T100, July 2017; Ricondo & Associates, Inc., July 2017 (analysis).

5.2.1 PASSENGER AIRLINES DESIGN DAY FLIGHT SCHEDULE—BASE YEAR (2016)

Schedule data for the representative day in 2016 were compared with the representative day in 2017 to identify any significant differences in airline scheduling patterns, bank structures, or day-night distribution. As shown on

Exhibit 6, the representative day in 2017 shows some variation from 2016. In particular, the peaking characteristics and nighttime operations show differences. The schedule analysis included development of 2018 activity patters that accounted for the shift in peaking characteristic, United Airlines' continued rebanking initiative designed to increase connectivity through its ORD hub, and the planned opening of the new L concourse "stinger" gates. As a result, the IFQ schedules were adjusted to reflect these changes after the base year.

EXHIBIT 6: COMPARISON OF 2016 AND 2017 REPRESENTATIVE DAY SCHEDULES



SOURCES: Innovata, July 2017; Ricondo & Associates, Inc., July 2017 (analysis).

Passenger volumes on each flight were calculated by applying flight-specific load factors—based on U.S. Department of Transportation (DOT) T-100 data for July 27, 2016. The share of O&D and connecting passengers was determined based on the share of O&D and connecting passengers at the Airport in the third quarter of 2016. Shares were determined for each flight segment by operating airline, with flight-specific adjustments depending on the time of day (i.e., a flight departing at 5:00 a.m. would have no connecting passengers, because it departs before any arrivals, and it is assumed passengers are not connecting overnight at ORD).

5.2.2 PASSENGER AIRLINES DESIGN DAY FLIGHT SCHEDULE—INTERIM FLY QUIET

The IFQ DDFS was constructed based on demand during the representative day, as forecast in the TAF. In the development of the DDFS, it was assumed that the representative day-to-annual ratio of passengers and operations would remain stable from the base year through the planning horizon. In addition, the 2017 scheduled activity profile during the representative day was used to build the IFQ DDFS. Certain minor revisions to the 2017 schedule were made to facilitate gating and reflect the most up-to-date activity patterns. Additional revisions were made to account for minor changes that occurred between the time the representative day schedule was queried for use in this analysis and when it was flown a few months later. These included shifting operations from hub carriers to regional airlines and change of aircraft type with that of a similar capacity (e.g., changing a United Airlines marketed flight from a Trans States Embraer ERJ-145 to a Mesa Canadair CRJ-200, and changing a Boeing 737-800 to an Airbus A320). These changes are reflected in the schedule to enable a more realistic matching of flights without materially affecting the daily fleet mix relative to the initial draft schedule. This affected 25 matched flights

throughout the day. Additionally, British Airways' announcement of Airbus A380 service to the Airport was incorporated, and the Lufthansa Airbus A380 roundtrip was converted to a Boeing 747-8 aircraft.

An iterative process was employed to determine future load factors and seat capacity. The steps in the process, which simulates an individual airline's changes in flight frequency and aircraft size in response to forecast growth, are as follows:

- Passenger and aircraft operation rates of change, as developed in the forecasts, were applied to the base year schedule to establish "targets" of passenger and aircraft operation levels for the IFQ DDFS. These targets provide guidance for the number of aircraft operations and enplaned passengers expected in the future DDFS.
- Forecast passenger growth rates were applied to the base year schedule on a route-by-route basis. If the resulting load factor was less than the flight-specific threshold (approximately 90 percent), then the aircraft assigned in the schedule remained unchanged. If the resulting load factor exceeded the flight-specific threshold, then one of three changes was made: the base year aircraft was increased in gauge, based on the airline's expected fleet mix; a new flight was added to the airline-market combination, with passengers distributed evenly across the flights; or the flight was left unchanged to meet forecast operations and projected fleet mix targets. The last option was only considered if the load factor did not exceed 100 percent.
  - Occasionally professional judgment was used to determine whether an increase in gauge and/or a new flight was added to the airline-market combination. These decisions were based on if an airline currently has, or is expected to have, an aircraft that could reasonably operate in the market and if the addition of a flight would be consistent with forecast growth of aircraft operations and projected fleet mix. In nearly all cases, the decision was made to upgauge the flight due to the declining number of total aircraft operations.
  - When consolidating frequencies to meet aircraft operations targets, priority was given to markets that are mostly or entirely served by 50-seat regional jets. Frequencies in these markets were eliminated, with one or more flights upgauged to a 76-seat regional jet, which is consistent with public guidance from major airlines regarding their future fleets of 50-seat regional jets.

In the development of the DDFS, it was assumed that the aircraft gauge would not decrease in future years. For example, in a future schedule, capacity growth in a market currently served by a single daily Boeing 737-800 operation was accommodated by a larger aircraft, rather than the simultaneous addition of a new daily Boeing 737-700 operation and a down-gauging of the current operation to a Boeing 737-700.

Adjustments to the design day schedule and simulation output that occurred in June 2018 are described in Section 6 and Appendix A.

5.3 DESIGN DAY FLIGHT SCHEDULE DEVELOPMENT – CARGO AND GENERAL AVIATION

While the TAF forecasts general aviation activity, it does not separately forecast cargo and passenger airline activity; both are presented as air carrier. Multiple sources were used to differentiate passenger airline and cargo airline activity for the purposes of flight schedule development. DOT T-100 data were used to identify air carrier operations as either passenger airline or cargo airline operations during 2016. This percentage of cargo operations, approximately 2 percent, was used to inform the cargo level of activity in the DDFS. Further analysis was conducted to account for growth of cargo airline activity during 2017. Based on trends in the latest data available, an additional cargo roundtrip flight was modeled into the IFQ flight schedule. Following schedule development and simulation

modeling, cargo activity increased at the airport. Section 6 and Appendix A includes information on adjustments that were made to the schedule and simulation output to account for changes, particularly regarding night operations.

General aviation activity accounts for 2 percent of total aircraft operations in the 2016 TAF. This ratio was applied to the design day similar to cargo activity. Aerobahn surface management system data were used to identify arrival and departure times, origin and destination airport, and aircraft type for both cargo and general aviation activity. Data were sourced for the representative day in 2016 and applied to the IFQ flight schedules, adding or removing flights as necessary based on forecast activity levels.

6. SCHEDULE ADJUSTMENTS

The IFQ flight schedule was further reviewed in May and June 2018 following the start of the FAA's TPC analysis. The FAA, its TPC, CDA, and CDA consultants Ricondo and Landrum & Brown reviewed the schedule and simulation output. Particular consideration was given to day and night scheduling patterns at ORD, recent growth in cargo activity, and historical proportion of operations occurring during day and night periods. The IFQ Team's findings are detailed in a separate memorandum submitted to the FAA and contained as **Appendix A**. The IFQ Team and CDA determined that modification of flight times was necessary to shift flights from the daytime period to the nighttime period to achieve a representative volume of activity at night. As a result, nighttime activity increased from 227 operations in the original flight schedule to approximately 261 nighttime operations in the adjusted schedule. However, the total number of operations in the flight schedule remained at 2,636. The individual flights that were adjusted are also contained in Appendix A. Because TAAM modeling had been previously completed, adjustments were made to the processed simulation data and the individual flight times were adjusted as described. The output results from the four simulation runs used to prepare the TAAM statistical data packages were updated and adjusted data packages were transmitted. The flight times for the individual operations were adjusted, but travel times, runway use and arrival/departure procedures were unchanged.

7. DESIGN DAY FLIGHT SCHEDULE RESULTS

This section provides a summary of key metrics from the base year and IFQ period flight schedules after incorporation of the flight time adjustments detailed in Section 6 and Appendix A of this document. Daily activity, peak hour, and nighttime (2200–0659) activity were analyzed. Daily and peak-hour operations are shown in **Table 6**.

TABLE 6: DAILY AND PEAK OPERATIONS

	2016	IFQ	PERCENT CHANGE
Daily Operations			
Arrival	1,344	1,321	-2%
Departure	1,337	1,315	-2%
Combined	2,681	2,636	-2%
Peak Hour Operations			
Arrival	120	134	12%
Departure	122	132	8%
Combined	200	239	20%
Daily Passengers			
Arrival	122,319	129,938	6%
Departure	122,614	130,179	6%
Combined	244,933	260,117	6%
Peak Hour Passengers			
Arrival	11,197	13,049	17%
Departure	11,074	12,581	14%
Combined	20,271	23,869	18%

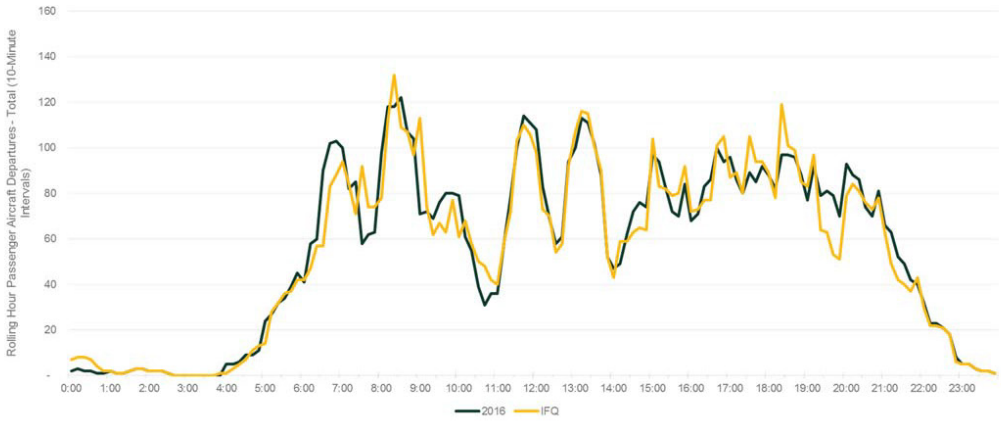
NOTE: Daily operations includes cargo and general aviation operations in addition to passenger operations.
SOURCES: Innovata, July 2017; U.S. Department of Transportation, T-100, July 2017; Ricondo & Associates, Inc., July 2018 (analysis).

As shown in Table 6, total daily operations declined between 2016 and the IFQ period, from 2,681 daily flights to 2,636 daily flights. Passengers, however, increase from 244,933 to 260,117, as airlines accommodate increasing demand through a combination of larger-gauge aircraft and higher load factors. Peak-hour aircraft operations and total passenger peak-hour activity also increase in the IFQ period. Peak-hour operations increase from 200 in 2016 to 239 in the IFQ period, due to additional scheduled activity by passenger airlines during the 1700 hour. Rolling 60-minute arrivals, departures, and combined aircraft operations for the base year and IFQ period are depicted on **Exhibit 7**, **Exhibit 8**, and **Exhibit 9**, respectively.

EXHIBIT 7: ROLLING HOUR AIRCRAFT ARRIVALS

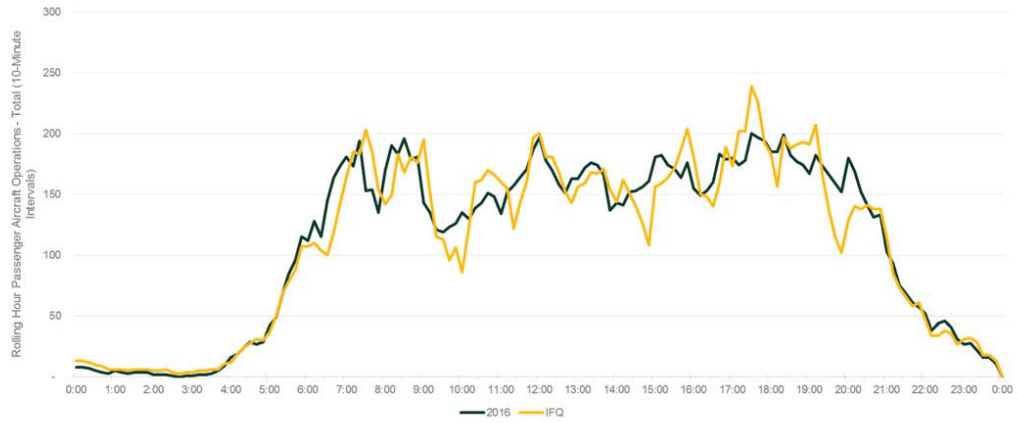
SOURCES: Innovata July 2017; Ricondo & Associates, Inc., July 2018 (analysis).

EXHIBIT 8: ROLLING HOUR AIRCRAFT DEPARTURES



SOURCES: Innovata July 2017; Ricondo & Associates, Inc., July 2018 (analysis).

EXHIBIT 9: ROLLING HOUR AIRCRAFT COMBINED OPERATIONS



SOURCES: Innovata July 2017; Ricondo & Associates, Inc., July 2018 (analysis).

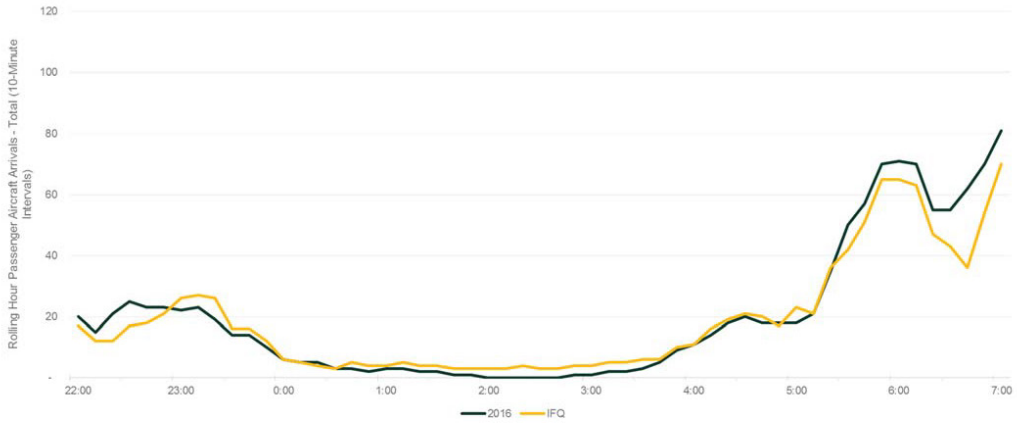
Daily nighttime operations are shown for arrival, departure, and combined aircraft operations for the base year and IFQ period in **Table 7**. Nighttime operations (those that occur between 2200 and 0659) are expected to decline from 264 total operations to 261 operations. However, as a percentage of total aircraft operations, nighttime operations increase from 9.8 percent of total aircraft operations in 2016 to 9.9 percent in the IFQ period. This decline is driven by 2017 schedule data, as depicted on **Exhibit 10**, **Exhibit 11**, and **Exhibit 12.**

TABLE 7: NIGHTTIME OPERATIONS

NIGHT OPERATIONS	2016	IFQ	CHANGE
Arrival	151	158	4.6%
Departure	113	103	-8.8%
Combined	264	261	-1.1%
Percent of Total Operations	9.8%	9.9%	0.1pts

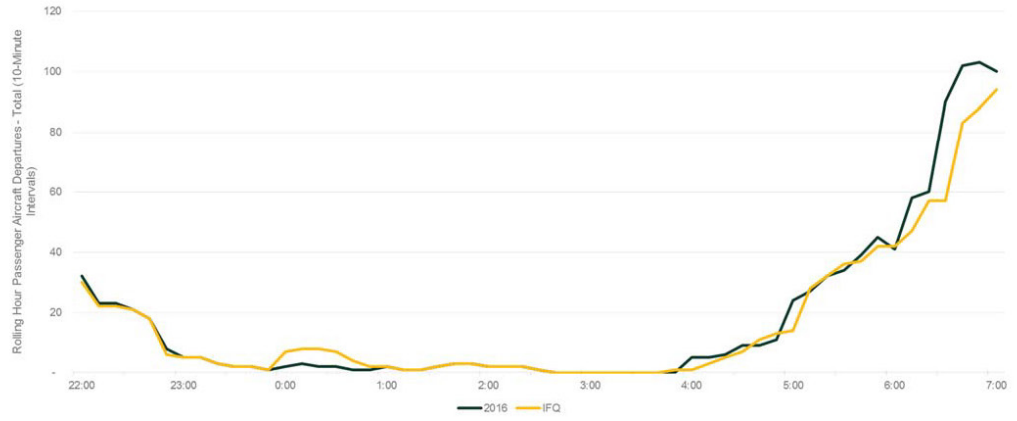
SOURCES: Innovata, July 2017; Ricondo & Associates, Inc., July 2018 (analysis).

EXHIBIT 10: ROLLING HOUR PASSENGER AIRCRAFT ARRIVALS (NIGHTTIME)



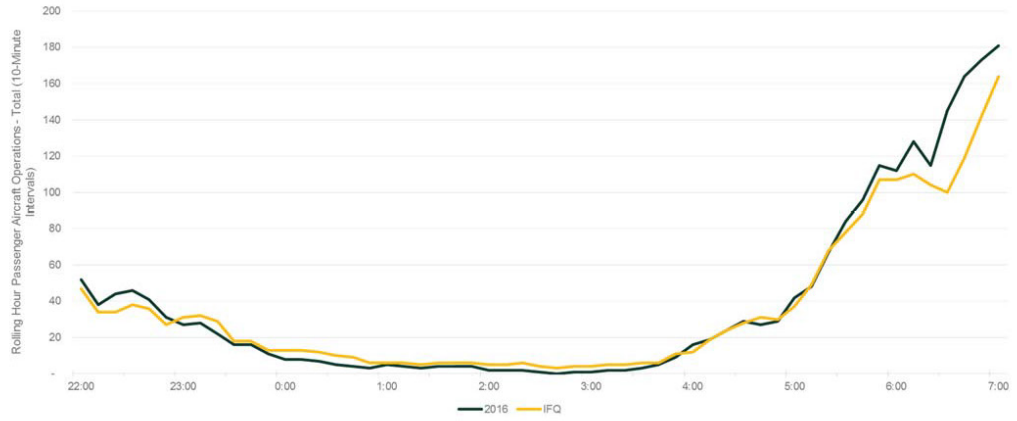
SOURCES: Innovata July 2017; Ricondo & Associates, Inc., July 2018 (analysis).

EXHIBIT 11: ROLLING HOUR PASSENGER AIRCRAFT DEPARTURES (NIGHTTIME)



SOURCES: Innovata July 2017; Ricondo & Associates, Inc., July 2018 (analysis).

EXHIBIT 12: ROLLING HOUR PASSENGER AIRCRAFT COMBINED (NIGHTTIME)



SOURCES: Innovata July 2017; Ricondo & Associates, Inc., July 2018 (analysis).

APPENDIX A DESIGN DAY FLIGHT SCHEDULES FOR THE INTERIM FLY QUIET PERIOD MEMORANDUM

D R A F T M E M O R A N D U M

To: A. Hanson, FAA
D. Wasiuk, HMMH

From: D. Meehan, InterVISTAS
K. Currie, InterVISTAS
R. Mentzer, Jr., HMMH

Re: Design Day Flight Schedules for the Interim Fly Quiet Period

Introduction

InterVISTAS and HMMH (collectively, the "IFQ Team") have analyzed the Design Day Flight Schedule ("DDFS") prepared by Ricondo for environmental modeling purposes related to the Interim Fly Quiet Runway Rotation Plan ("IFQ") at Chicago O'Hare International Airport ("ORD"). The DDFS was developed using a typical day in the summer of 2016, when the forecast was developed for future modeling purposes in 2017. Since then, a number of aspects of typical activity have changed at ORD including more commercial passenger and cargo aircraft activity, particularly in the nighttime from 2200 to 0659, and from 2230 to 0530 when the IFQ may be in effect. Therefore, the IFQ Team is requesting some adjustments be made to the DDFS, as described below.

Passenger Operations Observations

- During the peak period day in July of 2016, there were 216 scheduled passenger operations in the nighttime. That number will increase to 257 scheduled passenger operations in the nighttime in the peak period day in July of 2018.
- However, the IFQ period would not occur in the summer, it may occur:
  - Twice from December through March,
  - Once during parts of April, May, and September, and
  - Once from October through November.
- During the equivalent IFQ months in 2018, the average (arithmetic mean) scheduled passenger operations during the nighttime are 173, with the average operations for the September – December months of 205, and the average operations for the January – March months of 164.
- Similarly, the typical (mode) scheduled passenger operations during the nighttime of the equivalent IFQ months in 2018 are 175, with the mode in the October – December months of 211, and 168 in the January – March months.

Therefore, from a purely forecasting perspective, the minimum number of nighttime passenger operations during the IFQ period should be 211 in the DDFS. Based on information provided by Ricondo, there are currently 191 nighttime passenger

operations in the DDFS schedule, and 201 nighttime passenger operations after TAAM processing nighttime passenger operations.

Cargo Operations Observations

- Since 2014, cargo operations at ORD have been increasing each year.
- Over the past two years, ORD has completed new cargo facilities, which are able to accommodate additional cargo processing.
- In the first four months of 2018, cargo activity at ORD has increased year over year as measured by both the Chicago Department of Aviation activity statistics and ANM data.
- Unlike passenger operations, cargo operations activity peaks in the winter, which is during the IFQ period.
- Since 2016, cargo operations during the IFQ period increased by an annual total of 200 by 2018, or between one and two during a typical day.

Ricondo has 33 nighttime cargo operations and 29 daytime cargo operations in the DDFS; it is typical at ORD for cargo operations to be relatively evenly split between day and night activity. The IFQ Team recommends adding one cargo operation at night to the DDFS for a total of 34 to account for increases in cargo activity since 2016.

Other Considerations

FAA and other members of the IFQ Team have voiced concerns that nighttime activity should represent approximately 10% of total activity in the DDFS, as this is typical recently at ORD. The combination of raising the number of nighttime passenger operations to 211 and cargo operations to 34 discussed above would not be sufficient to achieve that representative share.

Proposed Adjustment to Nighttime Activity

The IFQ team has examined the data used in the DDFS, and would note that if the flights operating less than ten minutes before 2200, and less than ten minutes after 0700 were shifted into the nighttime period, there would be 223 passenger flights, 34 cargo flights, and 4 general aviation flights during the nighttime, which is 9.9% of the 2,636 flights in the DDFS. Because this adjustment would address the concerns noted above, the IFQ team recommends that it be adopted.

IFQ Hours (2230-0530) Observations

While nighttime activity has a tenfold impact on the results of noise modeling, activity during the hours of IFQ has particular impact on air quality analysis. Therefore, the IFQ Team has examined the change in passenger operations during the equivalent IFQ hours from 2016 to 2018.

- During the peak period day in July of 2016, there were 75 scheduled passenger operations during the IFQ hours. That number increased to 83 scheduled passenger operations during the IFQ Hours in the peak period day in July of 2018.

- Similarly, the typical (mode) scheduled passenger operations during the IFQ hours during the IFQ months in 2016 was 54. That number increased to 64 scheduled passenger operations during the IFQ hours in the IFQ months in 2018.

Proposed Adjustment to Activity During IFQ Hours

The IFQ team proposes to leave the DDFS at 2,636 operations. However, through the changes outlined below the IFQ team proposes to increase the amount of operations at night by 34 flights and reduce the same amount from the day period. Based on IFQ period observations above, 10 of the 34 flights would occur during the IFQ period.

This adjustment will bring the DDFS day-night split more in line with the historical average of 10% reported by the CDA. The new day-night split will be 9.9%.

	DDFS	MOD DDFS	Change
Day	2,409	2,375	-34
Night	227	261	34
Total	2,636	2,636	0
Night %	8.61%	9.90%	1.29%

Based on the IFQ team evaluations the increase in night operations should consist of 32 passenger flights, 1 cargo flight and 1 general aviation flight.

	DDFS	**MOD DDFS**	Change
Day Pass	2,331	**2,299**	-32
Day Cargo	29	**28**	-1
Day GA	49	**48**	-1
Subtotal Day	2,409	**2,375**	-34
Night Pass	191	**223**	32
Night Cargo	33	**34**	1
Night GA	3	**4**	1
Subtotal Night	227	**261**	34
Total	2,636	**2,636**	0

The IFQ team analysis also showed slightly more arrivals at night during the future IFQ period and the proposed adjustments reflect that trend.

	DDFS	DDFS Split		MOD DDFS	MOD Split
Night Arrivals	133	58.6%		158	60.5%
Night Departures	94	41.4%		103	39.5%
Total Night	227	100.0%		261	100.0%

Flights added to the IFQ period are copies of the same aircraft type operation in the IFQ period. The majority of these flights are added during the middle of the night when the schedule was very light and the airport would be in IFQ. The additions were made by copying existing operations to maintain alignment with runway use and other

operational considerations. For example: To add one B739 arrival - The B739 arrival at 0449 in the DDFS is copied and the time changed to 0045.

Flights added to the Night period (outside of the IFQ period) were either copies of flights as described above or some flights identified just after 0700 or just before 2200 to be shifted from day to night by changing the time. Of the 24 flights added only nine were shifted.

To balance out the increase in operations at night, flights during the day need to be removed. Removal of 25 daytime flights is necessary and they are spread out during the day to minimize effects on runway use hourly operational levels.

The table below identifies each of the flights in the DDFS to be modified.

Type	HMMH added Mrkt Cat	Rt	ETD	ETA	Registration	Gate	Origin	Dest	MODE	TIME	Original DayNight	MOD DayNight	IFQ	NOTES
B739	P	KLAXKORD	?	4:49	PAX1495	C26	KLAX	KORD	A	0:45		N	IFQ	copy 4:49 flight to 0:45
A321	P	KLAXKORD	?	0:22	PAX1002	G08	KLAX	KORD	A	1:15		N	IFQ	copy 0:22 flight to 1:15
B752	P	KSEAKORD	?	5:03	PAX1500	B03	KSEA	KORD	A	1:20		N	IFQ	copy 5:03 flight to 1:20
A321	P	KLAXKORD	?	0:14	PAX1001	K18	KLAX	KORD	A	2:00		N	IFQ	copy 0:14 flight to 2:00
B752	P	KSEAKORD	?	5:03	PAX1500	B03	KSEA	KORD	A	2:20		N	IFQ	copy 5:03 flight to 2:20
A321	P	KLAXKORD	?	0:14	PAX1001	K18	KLAX	KORD	A	2:30		N	IFQ	copy 0:14 flight to 2:30
A321	P	KLASKORD	?	4:19	PAX1458	M03	KLAS	KORD	A	3:00		N	IFQ	copy 4:19 flight to 3:00
A319	P	CYVRKORD	?	5:00	PAX1497	C20	CYVR	KORD	A	3:15		N	IFQ	copy 5:00 flight to 3:15
B739	P	KLAXKORD	?	4:49	PAX1495	C26	KLAX	KORD	A	3:30		N	IFQ	copy 4:49 flight to 3:30
A321	P	KLAXKORD	?	5:59	PAX1005	K10	KLAX	KORD	A	5:49		N	N	copy 5:59 flight to 5:49
CRJ7	P	KDAYKORD	?	6:13	PAX1512	E01	KDAY	KORD	A	5:50		N	N	copy 6:13 flight to 5:50
B752	P	KLAXKORD	?	6:40	PAX1526	B07	KLAX	KORD	A	5:51		N	N	copy 6:40 flight to 5:51
B737	P	KINDKORD	?	7:49	PAX1551	E08	KIND	KORD	A	5:55		N	N	copy 7:49 flight to 5:55
B739	P	KTPAKORD	?	8:02	PAX1582	C28	KTPA	KORD	A	5:57		N	N	copy 8:02 flight to 5:57
B752	P	KLAXKORD	?	6:40	PAX1526	B07	KLAX	KORD	A	5:58		N	N	copy 6:40 flight to 5:58
CRJ2	P	KFWAKORD	?	7:06	PAX1541	C11	KFWA	KORD	A	6:59	D	N	N	move to night
CRJ2	P	KEAUKORD	?	7:19	PAX1545	C15	KEAU	KORD	A	6:55	D	N	N	move to night
CRJ7	P	KMHKKORD	?	7:45	PAX1050	L05B	KMHK	KORD	A		D			remove flight
B737	P	KINDKORD	?	7:49	PAX1551	E08	KIND	KORD	A		D			remove flight
B739	P	KMSPKORD	?	8:09	PAX1603	C29	KMSP	KORD	A		D			remove flight
A321	P	KCLTKORD	?	8:31	PAX1077	H09	KCLT	KORD	A		D			remove flight
A321	P	KLGAKORD	?	9:15	PAX1101	H14	KLGA	KORD	A		D			remove flight
B739	P	KDENKORD	?	9:30	PAX1636	B16	KDEN	KORD	A		D			remove flight
A321	P	KJFKKORD	?	10:41	PAX1125	G16	KJFK	KORD	A		D			remove flight
B739	P	KMIAKORD	?	10:53	PAX3123	C23	KMIA	KORD	A		D			remove flight
B752	P	KMCOKORD	?	11:10	PAX1678	B03	KMCO	KORD	A		D			remove flight
B752	P	EINNKORD	?	11:25	PAX1708	B07	EINN	KORD	A		D			remove flight
B739	P	KLASKORD	?	12:36	PAX1741	C24	KLAS	KORD	A		D			remove flight
A321	P	KATLKORD	?	12:40	PAX1196	H09	KATL	KORD	A		D			remove flight
A319	P	KPITKORD	?	12:40	PAX1212	H10	KPIT	KORD	A		D			remove flight
A321	P	KLGAKORD	?	14:06	PAX1232	H11A	KLGA	KORD	A		D			remove flight
B752	P	EGPHKORD	?	14:35	PAX3082	M02	EGPH	KORD	A		D			remove flight
B739	P	KLASKORD	?	14:41	PAX1824	B22	KLAS	KORD	A		D			remove flight
B739	P	MDPCKORD	?	17:30	PAX3097	M18	MDPC	KORD	A		D			remove flight
B752	P	BIKFKORD	?	18:15	PAX1484	M09	BIKF	KORD	A		D			remove flight
B738	P	KRSWKORD	?	20:51	PAX1437	H16	KRSW	KORD	A		D			remove flight
A321	P	KMIAKORD	?	21:47	PAX3043	H12	KMIA	KORD	A	22:01	D	N	N	move to night
B739	P	KIAHKORD	?	21:50	PAX3175	B21	KIAH	KORD	A	22:02	D	N	N	move to night
B739	P	KFLLKORD	?	21:54	PAX3178	B22	KFLL	KORD	A	22:05	D	N	N	move to night
B738	P	KLGAKORD	?	21:59	PAX3045	K15	KLGA	KORD	A	22:07	D	N	N	move to night
B739	P	KFLLKORD	?	21:54	PAX3178	B22	KFLL	KORD	A	22:05		N	N	copy 21:54 flight to 22:05
B739	P	KFLLKORD	?	21:54	PAX3178	B22	KFLL	KORD	A	22:10		N	N	copy 21:54 flight to 22:10
B738	P	KSFOKORD	?	22:20	PAX3180	C09	KSFO	KORD	A	22:18		N	N	copy 22:20 flight to 22:18
B739	P	KFLLKORD	?	21:54	PAX3178	B22	KFLL	KORD	A	22:25		N	N	copy 21:54 flight to 22:25
B772	P	KORDRCTP	0:30	?	PAX4082	?	KORD	RCTP	D	4:45		N	IFQ	copy 0:30 flight to 4:45
CRJ2	P	KORDKROC	7:00	?	PAX1517	?	KORD	KROC	D	5:45		N	N	copy 7:00 flight to 5:45
CRJ2	P	KORDKROC	7:00	?	PAX1517	?	KORD	KROC	D	5:48		N	N	copy 7:00 flight to 5:45
B752	P	KORDKDEN	12:25	?	PAX1721	?	KORD	KDEN	D	6:35		N	N	copy 12:25 flight to 6:35
B712	P	KORDKDTW	8:45	?	PAX1590	?	KORD	KDTW	D	6:37		N	N	copy 8:45 flight to 6:37
CRJ2	P	KORDKROC	7:00	?	PAX1517	?	KORD	KROC	D	6:55	D	N	N	move to night
GLF5	G	KORDKDAL	7:00	?	NON4011	?	KORD	KDAL	D	6:45	D	N	N	move to night GA
B712	P	KORDKDTW	8:45	?	PAX1590	?	KORD	KDTW	D		D			remove flight
CRJ2	P	KORDKAVL	10:45	?	PAX1649	?	KORD	KAVL	D		D			remove flight
B752	P	KORDKDEN	12:25	?	PAX1721	?	KORD	KDEN	D		D			remove flight
B772	P	KORDRJAA	12:25	?	PAX4119	?	KORD	RJAA	D		D			remove flight
CRJ2	P	KORDKAVL	13:45	?	PAX1702	?	KORD	KAVL	D		D			remove flight
B788	P	KORDEGLL	17:10	?	PAX4032	?	KORD	EGLL	D		D			remove flight
DC10	**C**	**KORDKIND**	**21:56**	**?**	**NON1014**	**?**	**KORD**	**KIND**	**D**	**22:03**	**D**	**N**	**N**	**one cargo - change time to 22:03**
B788	P	KORDEGLL	22:25	?	PAX4061	?	KORD	EGLL	D	22:07		N	N	copy 22:25 flight to 22:07

ATTACHMENT B-2

CHICAGO DEPARTMENT OF AVIATION PROPOSED INTERIM FLY QUIET FORECAST SUPPORT LETTER

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CHICAGO DEPARTMENT OF AVIATION
CITY OF CHICAGO

August 28, 2018

Ms. Amy Hanson
Chicago Airports District Office
Federal Aviation Administration
2300 E. Devon Avenue, Room 320
Des Plaines, IL 60018

Subject: Interim Fly Quiet Forecast and Flight Schedule Development

Dear Ms. Hanson:

This letter addresses the forecast and flight schedules developed for the O'Hare Modernization ("OM") Environmental Impact Statement ("EIS") Written Re-Evaluation of the proposed Interim Fly Quiet ("IFQ") Runway Rotation Plan. The Chicago Department of Aviation ("CDA") has reviewed and supports the forecasted activity being used in the analysis. The annual enplaned passenger and operational activity is based on the Federal Aviation Administration ("FAA") 2017 Terminal Area Forecast ("TAF") released in January 2018. The CDA finds the forecasted level of activity reasonable for purposes of the analysis and supports its use. The CDA also supports the flight schedules, including adjustment thereof, used for analyses of daily activity. The memo prepared by the CDA's consultant Ricondo & Associates, Inc. (*Flight Schedule Development for Interim Fly Quiet Analysis, July 2018)* provides information about the flight schedule development and simulation modeling output adjustments sought for approval by the FAA (including the FAA's Third-Party Consultants InterVISTAS and HMMH). The CDA is supportive of these changes and agrees with the results.

Should you have any questions or if I can be of any further assistance for the IFQ analysis, please do not hesitate to contact me.

Sincerely,

Aaron J. Frame
Deputy Commissioner of Environment

AJF/jj

cc: Ricondo & Associates, Inc.
CDA Environment Division file

10510 WEST ZEMKE ROAD, P.O. BOX 66142, CHICAGO, ILLINOIS 60666

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