APPENDIX D AIRFIELD AND AIRSPACE MODELING

This appendix contains background material that provides information on the Total Airspace and Airport Modeler (TAAM)¹ version evaluation material and data developed by the Chicago Department of Aviation (CDA) with the direction, oversight, review, and approval by the Federal Aviation Administration (FAA). This material supports the Terminal Area Plan and Air Traffic Procedures (TAP) Environmental Assessment (EA) and its alternatives. This appendix consists of the following sections:

- D.1 Introduction
- **D.2** TAAM Calibration (see **Attachment D-1**)
- D.3 FAA Review of Air Traffic Assumptions and TAAM Simulations
- D.4 Weather Analysis and Operating Configurations (see Attachment D-6)
- D.5 TAAM Operational Forecast

This appendix has seven attachments:

- Attachment D-1 Appendix A 2018 O'Hare TAAM Model Calibration
- Attachment D-2 TAP EA Simulation Data Package Interim No Action
- Attachment D-3 TAP EA Simulation Data Package Build Out No Action
- Attachment D-4 TAP EA Simulation Data Package Interim Proposed Action
- Attachment D-5 TAP EA Simulation Data Package Build Out Proposed Action
- Attachment D-6 Appendix B Weather Analysis and Annualization
- Attachment D-7 Appendix D Chicago O'Hare Fly Quiet Program Manual

D.1 INTRODUCTION

TAAM is a computer model that simulates aircraft activity on the ground and in the air. It is capable of modeling gates, taxiways, and runways, along with arrival and departure routes in the air, for a flight schedule. Each runway configuration is modeled for the complete flight schedule and the results for each configuration are combined to provide an average day set of results. These results provide detailed inputs for the noise, air quality, and surface traffic analyses. **Sections D.2** through **D.5** of this appendix describe the use of TAAM for this EA in more detail.

D.2 TAAM CALIBRATION

TAAM was previously used for the simulation models for the 2019 Interim Fly Quiet Written Re-Evaluation of the O'Hare Modernization Program (OMP) Environmental Impact Statement (EIS); it was first developed

¹ TAAM is a product of Jeppesen.

for the 2005 OMP EIS and used for the 2015 Re-Evaluation of the OMP EIS. For this EA, TAAM underwent an iterative process of data collection/analysis, TAAM modeling, animation review, and simulation output metric analysis to verify that the TAAM models reflect real-world operating conditions specific to O'Hare. The calibration effort included evaluation of runway throughput, runway use, arrival taxi in times, departure taxi out times, standoff use, and percentage of day and night operations. This effort produced four calibrated TAAM models as the basis for the EA. A summary of the calibration effort and resulting simulation assumptions is attached as **Attachment D-1**.

D.3 FAA REVIEW OF AIR TRAFFIC ASSUMPTIONS AND TAAM SIMULATIONS

An FAA Air Traffic Workgroup reviewed the TAAM simulation assumptions and experiments supporting the environmental consequences analyses for the EA. The FAA Air Traffic Workgroup, consisting of senior FAA air traffic representatives from Chicago Air Traffic Control facilities (O'Hare Air Traffic Control Tower, Chicago TRACON, and Chicago Center), reviewed and approved all configurations modeled through TAAM. Central Service Center and Chicago Airports District Office representatives also participated in the workgroup.

The process for the TAAM simulations for the EA followed the method used in the original EIS simulations completed in 2003-04, 2014-15 simulations for the 2015 Re-Evaluation, and 2018 simulations for the Interim Fly Quiet Re-Evaluation. The work, conducted by Ricondo & Associates (City of Chicago consultant), was carried out under the FAA's direction, oversight, review, and approval.

The workgroup provided and reviewed operating assumptions including but not limited to airspace routings, taxi routings, runway/fix assignments, and throughput numbers. Each simulation experiment included animations that displayed the planned operation of aircraft at the airport and in the airspace. During each review session, the workgroup reviewed the animations and results. Any issues or inconsistencies with the TAAM animations were discussed with Ricondo & Associates, who then made appropriate modifications to the experiments and later delivered the results for additional review and ultimate approval. This process was completed for each configuration.

The simulation process consisted of the following steps for each condition:

- A 24-hour design day flight schedule (DDFS) was created and incorporated into the TAAM model.
- Analyses of wind and weather data determined the percent occurrence of major operating configurations² and weather conditions, as well as which of the operating configurations had high enough occurrences to model.
- Simulations from the TAAM calibration were modified to reflect the future airfield and terminal layout depicted in the future Airport Layout Plan .
- The Air Traffic Workgroup drafted, reviewed, and confirmed an experimental design identifying the combinations of operating configurations, weather conditions, and aircraft activity levels to be modeled.³

² An airport operating configuration refers to the direction or flow of the airport and identifies which runways are in use.

³ The Air Traffic Workgroup is comprised of representatives from O'Hare Tower (ORD ATCT), Chicago TRACON (C90), Chicago ARTCC (ZAU), the National Air Traffic Controllers Association (NATCA), the FAA Central Service Center (AJV-C25), the FAA Airports Great Lakes Region (AGL-600), the FAA Chicago Airports District Office (ADO-CHI-600), the FAA's third-party contractor Harris Miller Miller & Hanson (HMMH), and Ricondo & Associates, Inc.

- Operating assumptions for each TAAM experiment were developed, reviewed, and refined by the Air Traffic Workgroup.
- The simulation team developed initial TAAM models for each experiment specified in the design. The Air Traffic Workgroup reviewed the animations and output statistics for these models and provided comments and refinements to the simulation team.
- The simulation team created refined TAAM models based on the FAA's direction and comments. These refined animations and output statistics were reviewed and additional comments and refinements provided to the simulation team.
- When a particular TAAM experiment or set of TAAM experiments was refined to the simulation team and the FAA's satisfaction, the FAA prepared a memorandum stating concurrence with the assumptions used in the model(s) and that the experiments were a reasonable representation of how the airfield and airspace would operate under those conditions.

Based on the workgroup's comprehensive review, the FAA workgroup is satisfied that the TAAM modeling simulation experiments depict a reasonable representation of how the operating configurations would be used at O'Hare for the future conditions. Additional details on each simulated condition are provided in **Attachments D-2** through **D-5**.

D.4 WEATHER ANALYSIS AND OPERATING CONFIGURATIONS

A weather conditions analysis was performed to determine the weighting of operating configurations at O'Hare for the EA future conditions. The analysis determined the weighting of airfield operating configurations estimated to occur over a future 12-month calendar year (January 1–December 31). The Air Traffic Workgroup identified six operating configurations to model for the EA. Weather conditions (cloud ceiling height, visibility, wind velocity and direction, and precipitation) and airfield condition (dry or wet/contaminated pavement) determined the airfield and airspace operating procedures modeled for each operating configuration.

To establish weightings for the operating configurations modeled for each condition, weather data gathered from the National Centers for Environmental Information and airfield condition data extracted from the CDA's Electronic Logging System were used to determine the percentage of the year that each operating configuration that could be used. Ten full years of data (from January 1, 2009, to December 31, 2018) were reviewed; 99.3 percent of the analyzed historical weather and airfield condition data fit the criteria (wind, ceiling height, visibility, and airfield pavement condition) of the six modeled operating configurations. This resulted in six simulated operating configurations for each condition, two Visual Flight Rules (VFR) configurations and one Instrument Flight Rules (IFR) configuration in each direction as follows:

- VFR West with Land and Hold Short Operations (LAHSO),
- VFR West without LAHSO,
- IFR West,
- VFR East with LAHSO,
- VFR East without LAHSO, and
- IFR East.

Additional details are provided in Attachment D-6.

D.5 TAAM OPERATIONAL FORECAST

The CDA developed a DDFS for each condition. As shown in **Table D-1**, the Interim No Action and the Interim Proposed Action level of operations are the same. The Build Out No Action and the Build Out Proposed Action level of operations are also the same, but they are forecasted higher than the Interim Condition. For further details on the DDFS, see **Chapter 1.3** and **Appendix B**.

TABLE D-1 ANNUAL AND DAILY OPERATIONS FOR EACH SIMULATED ALTERNATIVE

	Interim No Action	Interim Proposed Action	Build Out No Action	Bulid Out Proposed Action
Annual Operations	952,489	952,489	1,013,856	1,013,856
Daily Operations	2,820	2,820	2,993	2,993
Source: CDA, 2020				

The TAAM simulations are consistent with the existing Fly Quiet Program preferred runways and procedures. The CDA and the FAA provided guidance on the times that the existing Fly Quiet Program procedures should be included in the model. Fly Quiet Program procedures start at or after 10:30:00 p.m. and stop at or prior to 5:30:00 a.m., based on the air traffic demands for each scenario.

See Attachment D-7 for further details on the existing Fly Quiet Program.

ATTACHMENT D-1

APPENDIX A – 2018 O'HARE TAAM MODEL CALIBRATION

This attachment contains background material which supplements the TAAM version evaluation material and data developed by the CDA. This material supports this EA and its alternatives.

The simulation models used during the 2019 Interim Fly Quiet Re-Evaluation (which were first developed for the 2005 OMP EIS and subsequently used for the 2015 Re-Evaluation of the OMP EIS) underwent an iterative process of data collection/analysis, TAAM modeling, animation review, and simulation output metric analysis to verify that the TAAM models reflect real-world operating conditions specific to O'Hare. The following sections provide a summary of the calibration effort and resulting simulation assumptions.

Appendix A

2018 O'Hare TAAM Model Calibration



Calibration Resolution

August 7, 2019



AGENDA

- Calibration Summary
 - Purpose and Objective
 - Methodology
 - Experimental Design
 - Airfield Layout
- Calibration Date Selection
- Airfield and Airspace Operating Assumptions
 - Gating
 - Taxi Routes
 - Airspace Routes

- Data Collection and Analysis
 - Touchdown/Liftoff vs. Scheduled Gate Time
 - Arrival and Departure Throughput
 - Arrival Standoff
 - Taxi Speeds
 - Runway Exit Distribution
 - Runway Crossings
 - Pushback Movements
 - Departure Line Up
- Comparison of Simulated and Historical Operations



Final Environmental Assessment



Appendix D

PURPOSE AND OBJECTIVE

- Calibration is conducted to achieve a reasonable correspondence between historical operations and simulation model output
 - Iterative process of data collection/analysis, TAAM modeling, animation review, and simulation metric analysis
- TAAM modeling at O'Hare
 - Original model calibration as part of the O'Hare Modernization (OM) Environmental Impact Statement (EIS)
 - Calibrated OM EIS models used for two subsequent TAAM modeling efforts
 - 2015 Re-Evaluation of the OM EIS
 - Interim Fly Quiet Runway Rotation Plan Re-Evaluation
- Opportunity to verify the TAAM models reflect real-world operating conditions specific to O'Hare
 - Significant airfield/aircraft changes since 2005 OM EIS
 - Additional software functionality
- Produce calibrated TAAM models that will serve as the basis for modeling scenarios



METHODOLOGY



Experiment Number	TAAM Experiment	Operating Configuration	Notes
801	VFR West		
802	IFR West		Triple simultaneous ILS approaches; dependency b/w 28R/C operations; below 800/2
803	VFR East		
804	IFR East		Triple simultaneous ILS approaches; dependency b/w 10L/C operations; mixed use on 9R; below 800/2
	Existing runway	Primary arrivals Primary departures	
*O*HARE 21			
ix D		D-12	NOVE

Appendix D

AIRFIELD LAYOUT

- Existing Condition from O'Hare International Airport Draft Future Airport Layout Plan
- Runway 9C-27C East Package winter suspension
- Pre-Runway 9C-27C Package 1 construction

MAY 2017





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Appendix D

NOVEMBER 2022



Appendix D

NOVEMBER 2022

OVERVIEW

- Calibration days are chosen to represent typical real-world operating performance for each of the modeled airfield operating configurations
 - Runway allocation and throughput
 - Taxi times
 - Gate and hold pad usage
 - Aircraft towing (maintenance and remote parking)
- The process for identifying calibrations days includes an analysis of airfield conditions and operating performance to ensure that acceptable days are selected



METHODOLOGY

- Airport construction documentation was used to determine the range of dates when airfield conditions matched the calibration airfield
 - Short Term Operational Phasing (STOP) and FAA daily briefings were reviewed for daily airfield closures and NAVAID outages
 - Taxiways G and E south of the Scenic Pad closed June 22, 2017 as part of Runway 9C-27C Package 1
- Historic schedule and operational data were evaluated to determine acceptable for calibration dates
 - The airfield operating configuration in use was determined using FAA Aviation System Performance Metrics (ASPM) data
 - Daily operations numbers were calculated using FAA Operations Network (OPSNET) data
 - Aerobahn, Airport Noise Monitoring System (ANMS), and air carrier schedules were used to verify that weather conditions or other uncommon events did not affect the airport
 - Delays, unscheduled runway closures, etc.



SELECTED CALIBRATION DATES

Configuration	Simulation Schedule Date	Operational Metric Dates
VFR West	May 23	May 2, 22, 29, 30, and 31
VFR East	May 23	May 5, 8, 12, 15, and 26
IFR West	February 7	February 7
IFR East	April 30	April 30

- VFR Calibration
 - The selected dates are comprised entirely of the modeled airfield operating configuration
 - Proximity of dates means similar activity profiles and simplifies simulation schedule preparation
- IFR Calibration Days
 - Limited choice of days with a significant number of hours of the modeled airfield operating configuration
 - Weather data (precipitation and freezing temperatures) was reviewed to verify the selected dates are acceptable for calibration





Appendix D

NOVEMBER 2022

GATE LAYOUT GATE GAUGE AND MOVEMENT AREA PUSHBACKS



Appendix D

NOVEMBER 2022

GATE LAYOUT SCHEDULED PASSENGER AIRLINE GATE ALLOCATION



TAXI ROUTES WEST FLOW





TAXI ROUTES EAST FLOW



SOURCE: Ricondo & Associates, Inc., Draft O'Hare International Airport Future Airport Layout Plan, August 10, 2018 (basemap).



AIRSPACE ROUTES WEST FLOW

EXPERIMENT 801: VFR WEST



SOURCE: Federal Aviation Administration, August 2017 (radar map).



Appendix D

EXPERIMENT 802: IFR WEST



FINAL

NOVEMBER 2022

AIRSPACE ROUTES EAST FLOW

EXPERIMENT 803: VFR EAST



EXPERIMENT 804: IFR EAST



SOURCE: Federal Aviation Administration, August 2017 (radar map). FINAL 18 CCDA Appendix D D-24 NOVEMBER 2022



OVERVIEW

- Operational data was collected in two ways:
 - Field observations recorded from the CDA Airfield Operations Tower
 - Monday September 17, 2018: West Flow
 - Tuesday September 18, 2018: East Flow
 - Saab Sensis Aerobahn Surface Management System
 - Animation
 - Data Reports
- Statistical analysis of operational data was compiled to look for any trends and quantify typical aircraft behavior



TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME OBJECTIVES

- Replicate typical observed trends in historical runway movement and gate times
 - Key times for calibration are arrival touchdown and departure pushback
 - Modeling of ground movements will produce appropriate arrival gate and departure liftoff times
 - Focus on reproducing historical day/night percentages
- Maintain simulation flight schedule integrity at ORD
 - Scheduled departure and arrival times
- Utilize native TAAM functionality to vary times of arrivals and departures
 - Estimated time of departure (ETD) randomization
 - Creates variation from iteration to iteration



TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME METHODOLOGY

- Typical trends were identified by analyzing 10 days of historical data from May 2017
 - 5 days of VFR West
 - 5 days of VFR East
- Aerobahn was used to compile:
 - Scheduled departure pushback time
 - Actual departure pushback time
 - Scheduled arrival gate time
 - Actual arrival touchdown time
- Compiled data were used to calculate the variation between
 - Scheduled and actual pushback time
 - Scheduled arrival gate and actual touchdown time



TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME ACTUAL PUSHBACK VS. SCHEDULED GATE TIME – MAY 2017 VFR WEST/EAST DAYS





TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME SIMULATION ASSUMPTIONS - DEPARTURES

- TAAM ETD randomization distributes pushback times evenly between minimum and maximum values
- Accounts for large percentage of variation in historical pushback times
- Accounts for increased frequency of departures pushing back early/on-time during first departure bank
- Focus on hours immediately before/after the day/night cutoff

AGGREGATE PUSHBACK DISTRIBUTION



■ 8:00 to 5:59 ■ 6:00 to 6:59 ■ 7:00 to 7:59



Appendix D

NOVEMBER 2022

TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME ACTUAL TOUCHDOWN VS. SCHEDULED GATE TIME – MAY 8, 2017 ROLLING HOUR





TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME SIMULATION ASSUMPTIONS - ARRIVALS

- Allow TAAM to calculate arrival ETD using point-to-point method
- · Adjust TAAM-calculated arrival ETD consistent with aggregate touchdown distribution buckets
 - Focus on hours immediately before/after the day/night cutoff
- Allow TAAM ETD randomization to vary arrival ETD consistent with the aggregate touchdown distribution limits





AGGREGATE TOUCHDOWN DISTRIBUTION

TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME CALIBRATION RESULTS - VFR

EXPERIMENT 801: VFR WEST										
		Arrivals		Departures			All Operations			
Time Period	Scheduled	Historical	Simulated	Scheduled	Historical	Simulated	Scheduled	Historical	Simulated	
7:00 to 21:59	90.3%	88.8%	88.8%	93.1%	91.9%	91.9%	91.7%	90.4%	90.3%	
22:00 to 6:59	9.7%	11.2%	11.2%	6.9%	8.1%	8.1%	8.3%	9.6%	9.7%	

EXPERIMENT 803: VFR EAST										
		Arrivals		Departures			All Operations			
Time Period	Scheduled	Historical	Simulated	Scheduled	Historical	Simulated	Scheduled	Historical	Simulated	
7:00 to 21:59	90.3%	88.8%	88.8%	93.1%	91.9%	91.8%	91.7%	90.4%	90.3%	
22:00 to 6:59	9.7%	11.2%	11.2%	6.9%	8.1%	8.2%	8.3%	9.6%	9.7%	



TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME CALIBRATION RESULTS - IFR

EXPERIMENT 802: IFR WEST										
		Arrivals		Departures			All Operations			
Time Period	Scheduled	Historical	Simulated	Scheduled	Historical	Simulated	Scheduled	Historical	Simulated	
7:00 to 21:59	91.5%	90.5%	90.3%	94.7%	93.0%	93.0%	93.1%	91.7%	91.6%	
22:00 to 6:59	8.5%	9.5%	9.7%	5.3%	7.0%	7.0%	6.9%	8.3%	8.4%	

EXPERIMENT 804: IFR EAST										
		Arrivals		Departures			All Operations			
Time Period	Scheduled	Historical	Simulated	Scheduled	Historical	Simulated	Scheduled	Historical	Simulated	
7:00 to 21:59	92.0%	91.5%	91.0%	94.9%	88.8%	92.9%	93.5%	90.2%	92.0%	
22:00 to 6:59	8.0%	8.5%	9.0%	5.1%	11.2%	7.1%	6.5%	9.8%	8.0%	

• Historical hourly weather data recorded thunderstorms with lighting in the vicinity of O'Hare on April 30, 2017 after 20:00

· This weather delayed some departure operations, pushing a greater than typical number of operations to the nighttime

• Thunderstorms and lightning are a non-modeled weather condition and the observed difference between historical and simulated nighttime departures is anticipated/acceptable



ARRIVAL AND DEPARTURE THROUGHPUT OBJECTIVES AND METHODOLOGY

- Objectives
 - Adjust TAAM arrival and departure settings to produce accurate/sustainable arrival and departure rates
 - Calibrated arrival and departure throughput will be carried forward into future simulation analyses
- Methodology
 - Compiled historical 15-minute throughput using Airport Noise Management System (ANMS) data
 - 5 days of VFR West
 - 5 days of VFR East
 - 1 day of IFR West
 - 1 day of IFR East
 - Identified maximum frequently occurring throughput and adjusted TAAM settings to produce the identified arrival/departure rate



10 11 12

9

ARRIVAL AND DEPARTURE THROUGHPUT VFR WEST ARRIVALS - MAY 2017



ALL ARRIVAL RUNWAYS




ARRIVAL AND DEPARTURE THROUGHPUT VFR EAST ARRIVALS – MAY 2017







ARRIVAL AND DEPARTURE THROUGHPUT VFR ARRIVALS MODELING ASSUMPTIONS

- An arrival rate of 11 operations was observed multiple times per day and for successive 15minute periods
- TAAM final approach separation adjusted to produce an arrival rate of 11 operations when wake turbulence separation is not required
- Adding one Category C or higher aircraft reduced the observed arrival rate to 10 operations
- TAAM final approach separation was confirmed to produce an arrival rate of 10 operations when at least one aircraft requires wake turbulence separation



FINAL

EAST AND WEST FLOW - ALL ARRIVAL RUNWAYS

Appendix D

*O*HARE 21

ARRIVAL AND DEPARTURE THROUGHPUT VFR WEST DEPARTURES – MAY 2017







ARRIVAL AND DEPARTURE THROUGHPUT VFR EAST DEPARTURES – MAY 2017







ARRIVAL AND DEPARTURE THROUGHPUT VFR DEPARTURES MODELING ASSUMPTIONS

- A departure rate of 16 operations was observed multiple times per day and for successive 15-minute periods
- TAAM departure settings were modified to produce a departure rate of 16 operations when all aircraft within the 15-minute period can utilize 6,000 feet and airborne separation



EAST AND WEST FLOW – ALL DEPARTURES RUNWAYS



ARRIVAL AND DEPARTURE THROUGHPUT IFR WEST ARRIVALS – FEBRUARY 7, 2017











ARRIVAL AND DEPARTURE THROUGHPUT

IFR EAST ARRIVALS – APRIL 30, 2017







ARRIVAL AND DEPARTURE THROUGHPUT IFR ARRIVALS MODELING ASSUMPTIONS

- TAAM final approach separation adjusted to produce the following arrival rates when no wake turbulence separation is required:
 - Runways 9L, 27R, and 27L 10 arrivals
 - Runway 9R 4 to 5 arrivals
 - Runways 10C and 28C 9 arrivals
- Adding one Category C or higher aircraft does not always reduce the simulated throughput because the TAAM minimum final approach separations for some runways are approaching wake turbulence separation minima









FINAL



Appendix D

ARRIVAL AND DEPARTURE THROUGHPUT IFR WEST DEPARTURES – FEBRUARY 7, 2017







ARRIVAL AND DEPARTURE THROUGHPUT IFR EAST DEPARTURES – APRIL 30, 2017







ARRIVAL AND DEPARTURE THROUGHPUT IFR DEPARTURES MODELING ASSUMPTIONS

- The observed reduction in departure throughput during IFR when compared to VFR was assumed to be attributable to dependent arrivals
- VFR TAAM departure settings were retained





ARRIVAL STANDOFF

Sample Gate Activity – C26					
Origin	Destination	Arrival Time	Departure Time	Buffer Time	
RON ¹	KPHL	n/a	7:42	0:20	
KMSP	MMUN	8:02	9:05	0.20	
KCLE	KFLL	9:43	10:47	0:38	
KPDX	KALB	12:35	13:28	1:48	
KIAD	KATL	13:49	14:45	0:21	
кмсо	KMSP	15:02	15:59	0:17	
KSAN	KDCA	16:38	18:05	0:39	
KSNA	KSMF	19:22	20:10	1:17	
KEWR	KSFO	21:34	22:45	1:24	



TAXI SPEEDS



(taxiway speed data); Ricondo & Associates, Inc., September 2018 (analysis).



RUNWAY EXIT DISTRIBUTION VFR WEST







RUNWAY EXIT DISTRIBUTION IFR WEST







RUNWAY EXIT DISTRIBUTION VFR EAST



Runway 10C Runway 10R Taxiway W3 Taxiway W4 Taxiway W5 Aircraft Group Small Regional Lage Regional 20.7% 82.5% Small Wide Body Lugge Wide Body 8717-8 100 Alterett Group naimag T Tasiyong F Texivery 401 d. 50.2% (3.2%) 50.0%



RUNWAY EXIT DISTRIBUTION IFR EAST





D-53

NOVEMBER 2022

RUNWAY CROSSINGS METHODOLOGY

- Two runway crossing types were observed
 - Free Flow Crossing
 - The crossing aircraft proceeds immediately across the runway without having to wait for arriving/departing aircraft
 - Impeded Crossing
 - Runway crossings requiring the crossing aircraft to wait for arriving/departing aircraft
 - Number of observations were very limited due to the design of typical taxi routes
- Two times were recorded for each crossing:
 - Acceleration Pause: time elapsed between runway operation clearing the intersection and start of movement
 - Travel Time: time elapsed to clear the runway



RUNWAY CROSSINGS OBSERVATIONS

- Free Flow Crossing
 - The average time to travel from hold line to hold line was approximately 25 seconds
 - Average crossing time translates to 15 knot taxi speed
- Impeded Crossing
 - The average time required to begin acceleration after the arriving/departing aircraft clears the runway/taxiway intersection was 15 seconds
 - The average speed time to travel from hold line to hold line was approximately 34 seconds, including acceleration from a stop
 - Average crossing time translates to 10.5 knot taxi speed



RUNWAY CROSSINGS MODELING ASSUMPTIONS

- Taxiing speeds on taxiways crossing runway centerlines will be 15 knots
- Impeded runway crossing aircraft will pause for 25 seconds before beginning a runway crossing
 - Observed 15 second pause after arriving/departure aircraft clears the runway/taxiway intersection
 - Additional 10 seconds to account for slower average crossing speed due to acceleration
- Aircraft crossing an active arrival runway will clear the hold line before the next arriving aircraft is 0.5 NM from the runway threshold (consistent with OM EIS)



PUSHBACK MOVEMENTS METHODOLOGY

- Pushback procedure observations tracked the time elapsed from when an aircraft commenced its pushback movement until the aircraft began to taxi under its own power
- Apron area movement observations within the Operations Tower occurred on September 17th and 18th, 2018
 - Additional observations were recorded for the same days through Aerobahn
- Several times were recorded for each operations, the times were used to calculate the following:
 - Average Pushback Speed
 - Pushback Time
 - Elapsed time of tug maneuvering the aircraft from the gate to the engine spool up position
 - Starts when tug commences movement and ends when tug stops
 - Average speed calculated using measured distances of typical maneuvers by concourse and pushback movement time recorded during observations
 - Engine Spool Up
 - · Elapsed time to between when the tug stops and the aircraft moves under its own power
 - Includes tug disconnect, engine spool up, and control surface check



PUSHBACK MOVEMENTS OBSERVATIONS - AVERAGE PUSHBACK SPEED – ALL AIRCRAFT



PUSHBACK MOVEMENTS **OBSERVATIONS - AVERAGE PUSHBACK SPEED – REGIONAL AIRCRAFT**



Appendix D

NOVEMBER 2022

PUSHBACK MOVEMENTS OBSERVATIONS - AVERAGE PUSHBACK SPEED – NARROW BODY AIRCRAFT



PUSHBACK MOVEMENTS OBSERVATIONS - AVERAGE PUSHBACK SPEED – WIDE BODY AIRCRAFT



Appendix D

PUSHBACK MOVEMENTS OBSERVATIONS - ENGINE SPOOL UP – ALL AIRCRAFT



PUSHBACK MOVEMENTS **OBSERVATIONS - ENGINE SPOOL UP - REGIONAL JETS**



Appendix D

PUSHBACK MOVEMENTS **OBSERVATIONS - ENGINE SPOOL UP - NARROW BODY AIRCRAFT**





Appendix D

PUSHBACK MOVEMENTS OBSERVATIONS - ENGINE SPOOL UP – WIDE BODY AIRCRAFT



Appendix D

NOVEMBER 2022

PUSHBACK MOVEMENTS UNIQUE PUSHBACK OPERATIONS – GATES F26 & F28



- Require extended pushback distance to allow for engine spool up outside movement area
- Pushback procedure for F26 was recorded from inside terminal
 - Total pushback time: 69 seconds
 - Pushback distance estimated based on observed route tug follows ~ 560 feet
 - Average pushback speed: 4.81 kts
 - Engine spool up same as typical nonmovement area operations



*O*HARE 21



PUSHBACK MOVEMENTS UNIQUE PUSHBACK OPERATIONS – GATES K18 & K20



- Aircraft pushed into movement area
- Pushback procedure for K18 was recorded from inside terminal
- Confirmed that pushback speed and engine spool up were consistent with non-movement area operations



PUSHBACK MOVEMENTS MODELING ASSUMPTIONS

- Regional Jet and Narrow Body: 3.0 knots
- Wide Body: 2.5 knots
- Regional Jet: 155 seconds
- Narrow Body: 164 seconds
- Domestic Wide Body: 249 seconds
- International Wide Body: 307 seconds



DEPARTURE LINE UP METHODOLOGY

- Acceleration Pause: elapsed time between proceeding departure and start of movement
- Line Up Time: time elapsed between the start of movement and in position on the runway
- Times were summed to determine complete line up time
- Regional Jets (CRJ7, E170, etc.)
- Narrow Body (B738, A321, etc.)
- Wide Body (B772, B744, etc.)



DEPARTURE LINE UP OBSERVATIONS – RUNWAY 28R





DEPARTURE LINE UP OBSERVATIONS – RUNWAY 22L



 *O*HARE 21
 FINAL
 65
 CECADA

 Appendix D
 D-71
 NOVEMBER 2022

DEPARTURE LINE UP OBSERVATIONS – RUNWAY 9R




DEPARTURE LINE UP OBSERVATIONS – RUNWAY 10L







- Longest observed line up times (wide bodies) do not exceed successive departure separation









SOURCES:

O'Hare International Airport, Airport Noise Management System, May 2017(actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).



FINAL

utilization of rotation runways is not

depicted.

Appendix D









D-80



FINAL

NOVEMBER 2022

Appendix D



Arrivals						Departures						
		Taxi Time		Operations				Taxi Time		Operations		
	Runway	Simulated	Historical	Simulated	Historical		Runway	Simulated	Historical	Simulated	Historical	
	27R	13:55	14:10	322	339		28R	15:19	13:01	790	776	
	27L	9:50	9:59	537	479		22L	13:39	14:47	423	409	
	28C	12:41	12:39	333	351		All	14:44	13:38	1,213	1,185	
	All	11:44	12:00	1.192	1.169							

NOTES:

Simulated taxi times are the average of 11 iterations.
Historical taxi times are the average of 5 days from May 2017.
Arrival taxi times measure from touchdown to gate.

4/ Departure taxi times measure from start of pushback to liftoff.







NOTES:

1/ Simulated runway utilization is the average of 11 iterations.

2/ Historical runway utilization is the average of 5 days from May 2017.







SOURCES:

*O*HARE 21

O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).

FINAL

utilization of rotation runways is not

depicted.

Appendix D









Final Environmental Assessment

Appendix D



Arrivals						Departures					
		Taxi Time		Operations			Taxi Time		Operations		
	Runway	Simulated	Historical	Simulated	Historical	Runway	Simulated	Historical	Simulated	Historical	
	9L	16:43	16:55	445	451	9R	13:07	13:15	627	643	
	10C	12:32	13:36	503	539	10L	16:21	15:49	6108	568	
	10R	18:39	18:14	204	188	All	14:43	14:27	1,236	1,211	
	All	15:14	15:36	1.153	1.178						

NOTES: 1/ Simulated taxi times are the average of 11 iterations. 2/ Historical taxi times are the average of 5 days from May 2017. 3/ Arrival taxi times measure from touchdown to gate.

4/ Departure taxi times measure from start of pushback to liftoff.





Simulated Historical

NOTES:

1/ Simulated runway utilization is the average of 11 iterations.

2/ Historical runway utilization is the average of 5 days from May 2017.







D-92











Arrivals						Departures						
		Taxi Time		Opera	Operations			Taxi Time		Operations		
	Runway	Simulated	Historical	Simulated	Historical		Runway	Simulated	Historical	Simulated	Historical	
	27R	14:50	13:15	303	299		28R	16:07	15:27	629	647	
	27L	9:57	9:12	470	450		22L	14:35	13:15	422	392	
	28C	12:29	11:39	261	300		All	15:30	14:37	1,050	1,039	
	All	12:01	11:03	1.034	1.049							

NOTES: 1/ Simulated taxi times are the average of 11 iterations. 2/ Historical taxi times are the average of February 7, 2017. 3/ Arrival taxi times measure from touchdown to gate.

4/ Departure taxi times measure from start of pushback to liftoff.







NOTES:

Simulated runway utilization is the average of 11 iterations.
Historical runway utilization is from February 7, 2017.







SOURCES:

*O*HARE 21

O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).

FINAL

depicted.

Appendix D









Arrivals						Departures						
		Taxi Time		Operations			Taxi Time		Operations			
	Runway	Simulated	Historical	Simulated	Historical	Runway	Simulated	Historical	Simulated	Historical		
	9L	17:41	18:33	457	426	9R	23:57	21:08	564	559		
	9R	10:56	12:42	130	118	10L	30:41	24:59	548	545		
	10C	12:54	14:52	495	502	All	27:17	23:02	1,112	1,104		
	All	14:41	16:08	1.082	1.046							

NOTES: 1/ Simulated taxi times are the average of 11 iterations.

2/ Historical taxi times are the average of April 30, 2017.

3/ Arrival taxi times measure from touchdown to gate.

4/ Departure taxi times measure from start of pushback to liftoff.





NOTES:

Simulated runway utilization is the average of 11 iterations.
Historical runway utilization is the average of April 30, 2017.





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Appendix D

ATTACHMENT D-2 TAP EA SIMULATION DATA PACKAGE – INTERIM NO ACTION

This attachment contains background material which supplements the TAAM material and data developed by the CDA. This material supports this EA and its Interim No Action Alternative. Please note that when the TAAM simulations were developed, the No Action Alternatives were originally named No Project and the Proposed Action Alternatives were originally named With Project.


November 2020

Chicago O'Hare International Airport

Terminal Area Plan and Air Traffic Procedures Environmental Assessment Simulation Data Package – No Project Interim

Prepared on Behalf of:

Chicago Department of Aviation

Prepared for:

Federal Aviation Administration

Prepared by:

RICONDO & ASSOCIATES, INC.

Table of Contents

1.	Backg	round and General Operating Assumptions1-1
	1.1	Terminal Area Plan and Air Traffic Procedures Environmental Assessment1-1
	1.2	Overview of Simulation Process1-2
	1.3	Weather Conditions and Operating Configurations1-3
	1.4	Airfield Layout and Runway End Definition Data1-4
	1.5	Design Day Flight Schedule, Gating, and Aircraft Parking1-4
		1.5.1 Air Carrier Gating and Repositioning Analysis1-7
		1.5.2 Cargo and General Aviation Parking Areas1-7
	1.6	Arrival Fixes by Departure Airport1-31
	1.7	Taxi Speeds1-31
	1.8	Intersection Departure Procedures1-31
	1.9	Runway Crossing Assumptions1-37
	1.10	Aircraft Separation/Spacing Assumptions1-38
	1.11	Fly Quiet Program (Noise Abatement Procedures)1-41
2.	ТААМ	Simulation Summary Results2-1
	2.1	TAAM Reporting2-1
	2.2	Peak Operations, Delay, and Travel Times2-1
	2.3	TAAM Simulation Multi-Iteration and Annualized Results2-4

1. Background and General Operating Assumptions

1.1 Terminal Area Plan and Air Traffic Procedures Environmental Assessment

The O'Hare International Airport (O'Hare or the Airport) Modernization Program (OMP) was approved by the Federal Aviation Administration (FAA) in the 2005 O'Hare Modernization (OM) Environmental Impact Statement (EIS).¹ The OMP resulted in airfield capacity improvements that have been or are in the process of being completed, including construction and lengthening of several runways. The OMP also included additional terminal facilities at the Airport. However, by 2015 the conditions and needs for terminal infrastructure at O'Hare had evolved from those envisioned in the OMP due to airline mergers, formation of airline alliances, and development of international and domestic code-share partners. With these changes in mind, the Terminal Area Plan (TAP) will replace and/or update outdated/insufficient infrastructure and facilities in the terminal core, increase gate frontage,² and provide balanced opportunities for all airlines.

Similarly, some air traffic procedures for arriving and departing aircraft operating in the airspace around O'Hare and on the airfield have evolved since the approval of the OM EIS and 2015 Re-Evaluation. In addition, the FAA wishes to retain some existing procedures set to expire upon completion of the OMP runway reconfiguration to provide flexibility and maintain efficiency. These changes, collectively referred to as the Air Traffic Procedures (ATP), include:

- changes to the criteria for conducting land and hold short operations (LAHSO);
- development of consolidated wake turbulence separation standards; and
- retention of the Runway 10R-28L offset final approaches.

This Environmental Assessment (EA) is being conducted to assess the changes associated with the TAP and ATP. The following conditions were evaluated:

- With Project Full Build
- With Project Interim
- No Project Full Build
- No Project Interim

¹ The 2015 Re-Evaluation of the OM EIS assessed the effects from changes to the phased implementation of the OMP that were evaluated during the 2005 OM EIS.

² Gate frontage is the available length along terminal buildings that may be used for parking aircraft at individual gate positions.

This report summarizes the airfield, airspace, and other operating assumptions used as inputs for the simulation models for the No Project Interim condition. The simulation models were developed using Jeppesen's Total Airspace and Airport Modeler (TAAM), a fast-time delay and travel time computer simulation model that is used to calculate delay and travel times by simulating aircraft operations on the ground and in the air. The outputs from TAAM provided inputs for air quality, noise, and surface traffic analyses.

1.2 Overview of Simulation Process

The simulation modeling completed for the No Project Interim condition consisted of the following steps:

- Simulations from the No Project Full Build condition³ were modified to reflect the airfield condition that would exist without the airfield projects being evaluated as part of this EA. Modifications generally included adjusting of the Concourse L gate layout.
- Analyses of wind and weather data were conducted to determine the percent occurrence of major operating configurations and weather conditions, as well as to determine which of the operating configurations had high enough occurrences to model. The previous 10 full calendar years of weather data (2009 to 2018) were used for the analysis.⁴
- Based on FAA guidance, a 24-hour design day flight schedule (DDFS) was created and incorporated into the TAAM model. The DDFS includes 2,820 daily operations (arrivals and departures) and reflects an annual demand of 952,489 operations.
- An experimental design, enumerating the combinations of operating configurations, weather conditions, and the aircraft activity levels to be modeled, was drafted, reviewed, and confirmed by the Air Traffic Workgroup.⁵

- ⁴ Additional operating configurations are anticipated to be used at O'Hare that were not modeled as part of the TAP and ATP EA. The estimated annual occurrence of these operating configurations was not high enough to justify modeling.
- ⁵ The Air Traffic Workgroup is comprised of representatives from the Airport's Air Traffic Control Tower (ATCT), Chicago Terminal Radar Approach Control (TRACON) facility (C90), Chicago ARTCC (ZAU), the National Air Traffic Controllers Association (NATCA), the FAA Central Service Center (AJV-C25), the FAA Airports Great Lakes Region (AGL-600), the FAA Chicago Airports District Office (ADO-CHI-600), the FAA's third-party contractor Harris Miller Miller & Hanson (HMMH), and Ricondo & Associates, Inc.

³ The No Project Full Build condition simulation models were derived from the 2018 O'Hare Calibration, an iterative process of data collection/analysis, TAAM modeling, animation review, and simulation output metric analysis to verify the TAAM models reflect real-world operating conditions specific to O'Hare. The calibration effort included evaluation of runway throughput, runway usage, arrival taxi in times, departure taxi out times, standoff usage, and the percentage of day and night operations. The calibration effort produced four calibrated TAAM models to be used as the basis for the TAP and ATP EA. A summary of the calibration effort and resulting simulation assumptions is attached as **Appendix A**.

- Operating assumptions for each of the TAAM experiments were developed, reviewed, and refined by the Air Traffic Workgroup.
- Initial TAAM experiment models were developed by the simulation team for each of the experiments specified in the experimental design. The animations and output statistics for these models were reviewed by the Air Traffic Workgroup, which provided comments and refinements to the simulation team.
- Refined TAAM models were developed by the simulation team based on FAA direction and comments. These refined animations and output statistics were again reviewed, and additional comments and refinements were provided to the simulation team.
- When a particular TAAM experiment or set of TAAM experiments were refined to the simulation team and FAA's satisfaction, a memorandum was prepared by the FAA stating that the air traffic members of the Air Traffic Workgroup concurred with the assumptions used in the model(s) and that the experiments were a reasonable representation of how the airfield and airspace would operate under those conditions and, therefore, were acceptable for use in the TAP and ATP EA technical analyses.

1.3 Weather Conditions and Operating Configurations

Six operating configurations were identified by the Air Traffic Workgroup to be modeled for the TAP and ATP EA. Weather conditions (cloud ceiling height, visibility, wind velocity and direction, and precipitation) and airfield condition (dry or wet/contaminated pavement) determine the airfield and airspace operating procedures modeled for each operating configuration.

To establish weightings for the operating configurations modeled as part of the No Project Interim condition, weather data gathered from the National Centers for Environmental Information (NCEI) and airfield pavement condition data extracted from the Chicago Department of Aviation's (CDA) Electronic Logging System (ELS) were utilized to determine the percentage of the year each operating configuration could be used. Ten full years of data, from January 1, 2009, to December 31, 2018, were reviewed; 99.3 percent of the analyzed historical weather and airfield condition data fit within the criteria (wind, ceiling height, visibility, and airfield pavement condition) of the six modeled operating configurations.

Table 1-1 shows the experiment number and annual weighting associated with each modeled operatingconfiguration for the No Project Interim condition. The full weather analysis can be found in **Appendix B**.

TABLE 1-1: WEIGHTING FOR MODELED OPERATING CONFIGURATIONS

TAAM Experiment Number	Operating Configuration	Estimated Annual Occurrence of Modeled Operating Configurations
901	VFR West with LAHSO	37.7%
902	VFR West without LAHSO	14.5%
903	IFR West	4.3%
904	VFR East with LAHSO	24.3%
905	VFR East without LAHSO	16.1%
906	IFR East	3.1%
Total		100.0%

NOTES:

IFR – Instrument Flight Rules

VFR – Visual Flight Rules

LAHSO – Land and Hold Short Operations

TAAM - Total Airspace and Airport Modeler

SOURCES: National Centers for Environmental Information, July 2019 (January 1, 2009, through December 31, 2018, weather data); Chicago Department of Aviation, August 2019 (January 1, 2009, through December 31, 2018, airfield condition data); U.S. Department of Transportation, Federal Aviation Administration, June 2020 (adjustment of modeled configuration occurrence); Ricondo & Associates, Inc., June 2020 (analysis). PREPARED BY: Ricondo & Associates, Inc., September 2020.

1.4 Airfield Layout and Runway End Definition Data

Exhibits 1-1 and **1-2** illustrate the airfield layout and runway end points used for the No Project Interim condition TAAM models, respectively. The runway end coordinates and elevations utilized in TAAM and shown on Exhibit 1-2 were gathered from the *O'Hare International Airport Draft Future ALP*.

1.5 Design Day Flight Schedule, Gating, and Aircraft Parking

The DDFS prepared for the No Project Interim condition contains 2,820 total aircraft operations, representing an annual demand of 952,489 operations. Further information regarding forecast assumptions and DDFS development can be found in **Appendix C**.





Terminal Area Plan and Air Traffic Procedures EA

NOTE

NORTH





LEGEI	ND
	Movement Area

1/ Intersection departure and land and hold short operations (LAHSO) coordinates and elevations interpolated using the Airport Layout Plan. 2/ End point elevation in feet above mean sea level (MSL) 3/ TCH - Threshold Crossing Height (feet above grade) GS Angle - Glide Slope Angle

LEGEI	ND .	
	Movement Area	

DOINT		DESCRIPTION	TCU	GS Anglo			LATITU	DE				LONGIT	UDE				
POINT	KONWATID	DESCRIPTION	ПСП	G5 Aligie	N/S	DEG.	MIN.	SEC.	DECIMAL	W/E	DEG.	MIN.	SEC.	DECIMAL	ENDPOIN	LEVATION	KONWAT WIDTH
А	9L		55	3.00°	N	42	00	10.20	42.002833	w	87	55	36.03	87.926675	6	68.0	150
В	27R		55	3.00°	N	42	00	10.19	42.002831	W	87	53	56.70	87.899083	6	63.6	150
С	9C		55	3.00°	N	41	59	17.89	41.988303	W	87	55	53.66	87.931572	6	73.2	200
D	27C		56	3.00°	N	41	59	17.92	41.988311	w	87	53	24.75	87.890208	6	52.4	200
E	27C	LAHSO			N	41	59	17.90	41.988306	w	87	55	33.49	87.925969	6	67.1	200
F	9C	LASHO			N	41	59	17.92	41.988311	w	87	53	57.51	87.899308	6	52.7	200
G	9R		59	3.00°	N	41	59	02.02	41.983894	w	87	55	53.65	87.931569	6	68.2	150
н	27L		58	3.00°	N	41	59	02.04	41.983900	w	87	53	24.55	87.890153	6	50.3	150
I.	9R	Intersection Departure			N	41	59	02.02	41.983894	w	87	55	35.24	87.926456	6	64.9	150
1	27L	Intersection Departure			N	41	59	02.04	41.983900	W	87	53	41.75	87.894931	6	51.2	150
к	10L		56	3.00°	N	41	58	08.38	41.968994	w	87	55	53.51	87.931531	6	72.1	150
L	28R		54	3.00°	N	41	58	08.65	41.969069	w	87	53	01.42	87.883728	6	51.4	150
м	10L	Intersection Departure			N	41	58	08.45	41.969014	W	87	55	15.03	87.920842	6	65.7	150
Ν	28R	Intersection Departure			N	41	58	08.59	41.969053	w	87	53	43.99	87.895553	6	50.4	150
0	10C		55	3.00°	N	41	57	56.53	41.965703	w	87	55	53.48	87.931522	6	69.4	200
Р	28C		55	3.00°	N	41	57	56.76	41.965767	w	87	53	30.52	87.891811	6	50.1	200
Q	28C	LAHSO			N	41	57	56.55	41.965708	W	87	55	37.74	87.927150	6	66.6	200
R	10R		55	3.00°	N	41	57	25.92	41.957200	w	87	55	40.30	87.927861	6	80.0	150
S	28L		55	3.00°	N	41	57	26.09	41.957247	w	87	54	01.04	87.900289	6	58.0	150
т	4L				N	41	58	53.96	41.981656	w	87	54	50.10	87.913917	6	55.7	150
U	22R		49	3.00°	N	41	59	51.13	41.997536	w	87	53	46.94	87.896372	6	47.7	150
v	4R		52	3.00°	N	41	57	11.98	41.953328	W	87	53	57.91	87.899419	6	61.4	150
W	22L		55	3.00°	N	41	58	11.72	41.969922	W	87	52	47.08	87.879744	6	54.4	150
	S: Ricondo & A	Associates, Inc., O'Hare Inter	national	Airport Draft	Airport L	ayout Pla	n, May 2	019 (runv	vay widths, co	ordinates	s, and ele	vations);	Ricondo	& Terminal		EXH	IBIT 1-2



Runway End Definition Data

Drawing: P:\Simulation ns\02-Airfield\AutoCAD\Runway End Coordinates.dwgLayout: 2023_NP_Interim_RWY ENDS Plotted: Nov 3, 2020, 07:47AM

Terminal Area Plan and Air Traffic Procedures EA

1.5.1 Air Carrier Gating and Repositioning Analysis

A gating analysis was conducted to assign air carrier arrival and departure operations a terminal contact gate. Gate assignments considered factors such as gate allocation and gauge, aircraft turn times (time necessary to load and/or unload aircraft), and gate separation times (time between an aircraft departing a gate and a subsequent arrival at the gate). **Exhibits 1-3** and **1-4** illustrate the gate allocation and gauge and gate assignment ramp charts, respectively.

In addition, some arriving and departing operations were assigned repositioning movements. Repositioning movements are when air carrier aircraft that are not carrying passengers are moved between two gates or moved between a remote location and a gate. The simulated repositioning movements replicate additional aircraft activity that currently occurs at O'Hare and is anticipated to continue in the future.⁶ Exhibit 1-5 depicts the remote locations used for TAAM modeling.

For the No Project Interim condition, 219 repositioning movements, divided among three categories, were simulated:

- Remain Overnight (RON) Parking and Maintenance (98 movements)
 - Aircraft that arrive and are repositioned from the gate to a remote location for RON parking and/or to undergo maintenance; or
 - Aircraft that utilized RON parking and/or underwent maintenance at a remote location that are repositioned to a gate for departure.
- Gate Availability (69 movements)
 - Aircraft with long turn times that are repositioned to/from remote locations so that the gate can be used to accommodate other aircraft; or
 - Aircraft that arrive from foreign airports and unload passengers at Terminal 5 and are subsequently repositioned to Terminal 1, 2, or 3 for departure.
- Aircraft Switches and Maintenance (52 movements)
 - Aircraft that are repositioned to/from remote locations throughout the day to conduct in-depth servicing or maintenance.

1.5.2 Cargo and General Aviation Parking Areas

Exhibit 1-6 depicts the parking areas for general aviation (GA) and cargo operations.

⁶ Members of the Air Traffic Workgroup and airline representatives met on August 23, 2019, to discuss existing and future repositioning activity. The topics discussed included the volume of repositioning movements, the remote locations aircraft are repositioned to/from during non-deicing season, and the methods used to reposition aircraft (aircraft taxiing under their own power or towed by aircraft tractors).





ating Layout - NA Interim_20191031.dwgLayout: NAInterim_01_CTA Plotted: Nov 3, 2020, 07:56AM Drawing: P:\Si ord tap eav

Terminal Area Plan and Air Traffic Procedures EA

Gate Gauge and Airline Allocation





EA - Gating Layout - NA Interim 20191031.dwgLayout: NAInterim 02 T5 Plotted: Nov 3, 2020, 07:56AN Drawing: P:\Simu kord tap ea\As

Terminal Area Plan and Air Traffic Procedures EA

Gate Gauge and Airline Allocation





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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

Ramp Charts

Simulation Data Package - No Project Interim





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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

Ramp Charts





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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

Simulation Data Package - No Project Interim





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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

Simulation Data Package - No Project Interim



<u> </u>	1 2	3	4	5	6	7 	8	9	10	11 	12	13	14 	15 	16 	17 	1
L L24 Embraer-170 (85.33)					AA 3 MSP	0 E75 5781 4051 SYR		52 50 CR7 AA 3162 2989 RIC ASE			32 AA 3544 JA)	15 75 4095	29 AA 3 FW	24 CR7 ³¹⁷⁴³¹⁰¹ A DTW	2 2 2	0 20 5 CR7 2999 DTW	50 CR 4A 31 D/
L L23 Embraer-170 (85.33)					30 AA 3349 EWR	22 45 75 8812 A/ ALB G	5 47 CR7 3920 4075 RB LEX	10 55 E75 AA 3572 3636 CMH TUL		48 39 E75 3672 3649 TUL PVD		50 30 E75 AA 3621 3576	33 AA 389 PV	25 E75 22 4120 VM BDL		4 	5 A 3
LL22 Embraer-170 (85.33)						40 C AA 3113 ICT	20 R7 ³¹³⁰	55 51 E75 AA 3225 3075 MHT BOI			16 50 AA 3894 4074 ALB YQ	а в	55 E75 AA 4064 41 XNA MI	0 87 20	0 51 AA 2970 3064 ASE TYS		50 AA 3 MS
L L21 Embraer-170 (85.33)						40 AA 3000	30 CR7 4 3089 U GRR	12 57 E75 3207 3044 ALB COS	0		5 45 E75 AA 3241 3234 BWI ALB		24 AA 3636 TUL	75 ¹⁷ 3635 XNA	0 45 AA 3399 4199 CMH TUL	4 R	5 A 3
L L20 Embraer-170 (85.33)						38 (AA 4 FSI	36 CR7 113 3522	15 AA 3656 333 LIT MS	5 30		10 50 E75 AA 3707 4156 CVG HPN	m	12 E7 AA 4198 PVD	15 5 3 3402 PIT		44 	4 A 4
Canadair-700 (76:25)						36 CI 3036 BNA	21 R7 ³⁰¹⁹			26 CR7 AA 3522 400	6 34 7 40 39 307 JF CLE	19 R7 1 3012	20 AA 4171 MHK	9 3896 MLI		53 33 CR7 ^{AA} 3999 3804 CVGCMH	19-
L L3 Canadair-700 (76.25)						12 CR7 AA 3057 3	15 236 YZ	15 CR7 3093 30 DTW M	10 051 ¢I		37 AA 32 YY	7 20 CR7 36 2995 Z DTW		43 32 CR7 3159 3240 TVC BNA	42 CF AA 319	12 (R7 , 91	50 CF AA 32 BT
L L5 Canadair-700 (76.25)						11 CR7 AA 3443 3 MHK B	14 789 WI	0 51 AA 3150 3247 BNA IND			58 33 ER4 # #	1		55 30 CRJ 4A # #	39 C AA 3061 TVC	20 R7 3137 BNA	2.7
L L7 Canadair-700 (76:25)						51 CR7 AA 3260 32 FWA H	14 233 PN			35 AA GS	45 CR7 3959 3950 P MQT	u	22 AA 3056 GRR	10 87 3029 SYR	6 46 CR7 AA 3686 3581 ROC GRR		
L L9 Canadair-700 (76.25)							7 CR7 AA 3689 33 ROC CM	7 908 ИН		8 50 CR7 AA 3017 3082 DSM SGF	3 A 3 M	9 26 CR7 02 3078 SN FAR			2 CR7 AA 3016 305 RST DTM	4 4: 9 A/	3 A 3:
L L11 Canadair-700 (76.25)							15 5 CR7 3211 320 CLE CLI	9 8 E			3 	9 CR7 5 CR7 413 DT OM	67 86		56 40 CR7 AA 3044 2977 COS SDF		C A 3
L L13 Canadair-700 (76.25)						4: 43 31 DS	5 35 CR7 90 3178 M BNA				4 	0 30 CR7 118 3126		4	10 35 CR7 272 3198	33 C 3253 BTV	R7 3

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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020



Ramp Charts





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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

EXHIBIT 1-4 (6 OF 19)

Ramp Charts





ation/KORD TAP EA/Assumptions/05-Gating/AutoCAD/TAP EA - Ramp Charts - NP Interim 20200921.dwoLavout; Ramp Charts (7) Plotted; Nov 4, 2020. 08:45PM

Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

Simulation Data Package - No Project Interim



	L	1	2	3	4 	5	6	7	8	9	10	11 ↓	12	13	14 	15 	16 	17	18
K K16 B777-200LR,-300ER (212.6)						15 AA	7M8	30 337 LGA		11 7M8 AA 2513 1 MSY A	16 356 BQ	10 1 321 AA 1431 24 ABQ RN	15 27	39 AA 2 SMI	49 7M8 843 2639 SFO		10 77W AA 8	0 4 36 A	5 A 18
K K12 B777-200,-300 (200)						20 	789	30 1417 CUN		10 1 738 AA 2805 60 BDL BZ	0 50		32 3 AA 279 MIA	30 21 6 2796 MIA		48 789 2412	45 	789	15 46 LHR
KK10 A321NEO (117.4)	0) AA		32N		0 2847 PHX		8 AA 2897 1589 PIT ST	1 5		7 738 AA 2721 263	7 4	14 1 738 AA 1167 11	15 01	20 73 AA 337	8 33 19	E A	2 0 321 A 256 256	29 AA 1	7 M 779
K K8 A321NEO (117.4)	0) AA			7M8			30 345	16 7 AA 198	30 38 30 1438	0 2 7M8 AA 2849 1779		21 738 AA 1924	29	18 738 AA 2590 1-	14 46 491 AA	26 321 4 739	10 50 321 AA 1359	10 73 AA 1356	8
KK6 A321NEO (117.4)	0) AA		738		1	25 784	0 AA	738 24	8 33 128 AA	32N 32	25 32N AA 277	LGA 5 20 0 32N 1 AA 2744		9 1 7M8 AA 2298 11	0 60	1X	53 33 CR7 4929 3438	9 321 AA 2223	19 288
H H9 A321NEO (117.4)	0) AA			738		CLT	238	DF 6 29 34 AA :	-W CL 321 2883 395	T CLT 55 0 738 AA 816 2503	DEN 38 AA	54 321 1136 2095		PDX DE 3 0 738 AA 2780 1165	N	40 42 2835	35 32N 1277	DFW 1 1 7M8 AA 2881 154	LAS 0 .3
H H11A A321NEO (117.4)	0) AA		71	M8		2498	BO 18 AA 226	о\$ MCI 7M8	25 1948	MCI AUS 55 57 7M8 AA 2582 1045	CL	8 1 8 1 AA 1332 94	1	DEN SEA 2 54 738 AA 2667 1486		DF۱	W MIA 27 71 AA 14	STL SAI 39 M8 75 1485	V 5 A
H H11B B757-200W-300W (135)					0 7M AA	МИ 0 8 129	A CLT 10 AA	7M8	PHL 19 1637	BWI SEA 46 52 738 AA 2598 1162		MIA RDI 6 5 738 AA 2327 1553	J 47 AA	RDU DCA 52 7M8 2754 115		13 7M8 AA 349	MCI 30 30	SEA 59 57 738 ^{AA 2642 2798}	F
H H15 B777-200,-300 (200)						LGA 40 AA	7M8	20 1629	PIT 29	EWR TUS 51 7M8 2098 2470		AUS SNA 4 3 738 AA 1110 1167	DF	W MCI	58 58 788 AA 1258	LGA 25 AA	LGA 55 788 110	SNA SFC	3 78 384
H H17	0			738		0000000		AUS '' 15 625	7 AA 2900	- DEN 49 7M8		MCO DCA 59 59 7M8	41	50 738 2817 1315	DFW	47 38 5 2429	FCO 22 73 AA 295	30 8 294	AX 52
H H18	40			32			D	5	LGA	YVR 30	۳ ا	BOS PDX 51 53 738	19 73	31 8	SNA 20 7M	DFW	LGA	LGA 30	DEN 50
A321NEO (117.4)	DF	¥585 W				0 7	250 MI 38	6 4	0 7M8	20	²	A 998 2080 ASP CLT 59 1 738	LGA	2398 PBI 7M8	BOS	20	AUS	1251 BOS 13 39	AA 1 MCI
H H16 A321NEO (117.4))					ΑA	147 MC	70 A C E	A 2485 WR	1121 MCO		AA 2358 2820 TUS BDL	MCO	232 1505 SAT	LGA	1464 TPA	AA 1537 23 RDU EW	882 AA VR BE	1 28: DL

Drawing: P\Simulation\KORD_TAP_EA\Assumptions\05-Gating\AutoCAD\TAP EA - Ramp Charts - NP Interim_20200921.dwgLayout: Ramp Charts (8) Plotted: Nov 4, 2020, 08:45PM

Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020



Ramp Charts



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H H16X B767-300ER W (167)	$\left \right $																		1/1:
H H14 A321NEO (117.4)	0 AA		7:	38		0 140 BOS	19 AA 125 SFO	738 3	30 367 LGA	15 0 319 3331 3880 IAH ELF) 	59 0 738 AA 1230 1834 SAT EWR	21 7 AA 163 PIT	45 38 7 2817 CLT	14 738 AA 496 DCA E	18 363 CA	7 1 738 AA 1883 156 CLT SN	1 33 73 68 AA 122 A MSP	2 8 79 CL
H H12 A321NEO (117.4)	0 AA				738			1	19 40 1349 A RDU S	0 51 738 A 1477 869 YR IAH		58 55 738 AA 1470 1022 MCI MCO	15 7M AA 1540 SEA	30 8 2881 STL	59 1 7M8 AA 2517 28 SJC AT	0 41 1L	3 738 738 AA 869 1150 IAH SJC	5 26 71 6 AA 660 2 BZN	AE 0
H H10 A321NEO (117.4)					5 	0 A	18 130 AT	5 39 0 AA DC	738 466 193 A EW	0 33 5 AA 2 R DFV	30 738 180 527 V LGA		15 73 AA 140 BOS	30 2302 LGA	59 1 738 AA 1313 1308 RSW MIA		0 5 7M8 AA 2470 24 DEN MSF	5 26 7 AA 33 PHL	38
H H8 A321NEO (117.4)				******	10 	738	30 398 LGA	13 AA 362 LAX	321 121 DFV	0 7 V		50 49 738 AA 813 773 BDL DEN	13 738 AA 1033 DCA	29 1168 SAN	57 0 738 AA 2614 1304 SFO AUS	m m	59 1 738 AA 2691 2499 SFO DCA	26 7 AA 240 LAS	38
H H6 A321NEO (117.4)					u	0 AA	738 105 SE	0 34 58 AA A MSF	54 738 1510 496 DCA	14 320 AA 2580 YYZ	25 2854 JAC	50 50 7M8 AA 2209 1213 STL SEA	10 738 AA 1300 ATL	29 4 122 A MSP F	9 55 738 A 2840 1710 HL MSY	HA4	0 738 1969 960 X ATL	30 AA 364 PVD	9 9 3 PV
H H5 A321NEO (117.4)		10 AA 2776 LAX		******	321	-		42 1384 LAX		52 319 AA 1426 28 PIT CN	10 72 1H	48 46 738 AA 1393 657 TPA BWI		44 44 28 CI	5 32 320 72 1224 MH JAC	9 6 738 AA 2264 58 BOS CL	3	12 31 AA 1573 SAT	9
H H4 A321NEO (117.4)					0 7M8 AA	40 1411 MIA	2 321 AA 1949 2 PHX	20 2052 CLT	9 AA 2889 BUF	319 55 659 SAT	3' Av Di	1 44 7M8 A 1052 272 FW JFK	29 3 AA 192 PHL	35 20 1920 PHL	4 320 AA 1650 2600 CLT PH	5 45 AA JA	25 19 ²⁸⁵³ C	4: 	9 31 A 1
H H3A Canadair-700 (76.25)							21 CF AA 3176 MSN	31 2975 DSM	5 47 ER4 3837 4219 HSV SCE	14 AA 3197 310 DAY MS	5 22 :N	44 AA 1000 DA1	21 R4 5 3603 YBHM	22 CF AA 3005 BNA	30 3087 RAP	25 0 ER4 4123 3518 EVVEVV	AA 3 AVP	50 ER4 462 3858 CMI	
H H2 Canadair-700 (76.25)						Feleration and a star	16 CR7 AA 2981 DTW	21 5 3002 A CLE E	51 46 ER4 AA 3807 3525 DLH BMI	8 55 CR7 3187 3098 TVC RAP		44 AA 373 GS	24 R4 8 3328 0 PIT		58 48 AA 3051 3276 MCI RIC		AA 405	29 R4 ^{22 3587} CVG	
H H1B Canadair-700 (76.25)						30 ^{AA}	CR7	25 4 3534 A/ CMH S	6 43 ER4 A 3540 4069 GF PIA	7 55 CR7 3138 3267 SDF GRR		30 ER 3926 4 RST E	15 44 123 A4	CR7 3247 3079 D SLC	2		12 57 ER4 3336 3895 MDT SGF	u 	
H H1A Canadair-700 (76.25)							15 CR7 AA 3149 2 CLE O	15 40 986 AA MA GS	42 ER4 4125 3415 0 COU	2 50 CR7 3342 3763 AVP BNA		14 ER4 AA 4084 33 FNT Of	14 501 VIA		55 38 CR7 3233 2952 HPN OKC		7 49 ERD 3466 3343 JLN AZO		

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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020



EXHIBIT 1-4 (9 OF 19)

Ramp Charts



		1	2	3	4	5	6	7	8	9	10 I	11 I	12 I	13 I	14 I	15 I	16 I	17 I	1
G G1B Canadair-700 (76.25)							14 CR7 AA 314732 TVC BV	10 33 AEI 241 3577 WI CMI	25 84 ₃₉₂₆ RST	49 55 CR7 AA 3535 4238 MQT DSM		12 1 ER4 AA 4069 42 PIA CL	0 32 C 36 3267 E GRR	15 R7 3191	17 AA 4114 340 FAR CW	5 06	4 55 AA 3328 3364 PIT LIT	n ni	5: A#
G G1A Canadair-700 (76.25)							14 CR7 3088 3055 FNT INE	30 AA EF 3401 MLI	25 4 ³⁹¹³ GRB	34 CR. 31123 MEIM	10 J 1113	11 5 AA ER4 3492 4100 MLI ER	28 28 0 0 0 0 0 0 0 0	30 CR7 908 3929	31 AA 3115 3 ICT	7 J 114	59 55 ER4 AA 35843755 CID FSD	5	
G G3 Canadair-700 (76.25)) vA			CR7			39	9 29 EF 59 AA 410	25 4 74087	1 2 CRJ AA 3134 3115 MKE ICT	n	10 55 ER4 4A 4235 3547 BNA ALO	27 C AA 40 LEX	27 R7 75 3757 MEM	0 (CRJ AA 3130 312: YUL CHC	2	54 54 ER4 AA 4205 3533	43 AA BN	E 37
G G5 Canadair-700 (76.25)			in manna	Sunnunda			10 55 CR7 3219 3217 GRR BDL	27 ER AA 4090 PIA	22 4 4180 HSV	4 4 11 24	8 26 ER4 77 4171 D MHK	10 55 ER4 3913 4205 GRB TYS	26 CR 4A 3105 2 DTW	10 7 2962 FNT	25 EF AA 415 GRB	20 4 44018 BMI	54 45 AA 3409 3875 LAN TVC	40 	E 331 (A
G G7 Canadair-700 (76:25)) vA			CR7			3739 MEN	23 ER AA 4072	21 4 ³³⁸⁷	25 AER4 4061 3 MSN E	16 1 3641 DBQ	9 53 ER4 3813 3462 TOL AVP		14 CRT 4238 4 DSM D	7 2 138		53 45 AA 3501 4106 ФМА РІА	39 	E 40-
G G9 Canadair-700 (76.25)							20 E AA 369 LAN	44 R4 9 4076 SDF	4 47 ER4 4041 3492 ABE MLI			9 50 ER4 3387 4102 CWA SDF	39 CAA 311 CH	9 15 CRJ 1 3119 MOVKE	22 ER4 4218 3 MEM F	10 4 382	51 44 AA ER4 3\$57 4104 QMI CID		(4)
G G11 Canadair-700 (76.25)) VA			ER4			59 4061 MSN	40 	40 ER4 788 3369 A AZO	20 AA 3764 3 CVG S	15 643 UX	7 46 ER4 3369 4052 AZO ABE			19 AA 3643 40 SUX DE	6 45	49 44 AA ER4 4137 3600 DSM ATW	35 E MHK	R 589
G G13 Canadair-700 (76.25)				*****				AA4 ALC	36 R4 085 4005 DAY	45 AA IN	30 СR7 55 3272 р окс	6 ERD AA 3474 3466 CMI JLN	5	52 35 ER4 ^{AA} 3641 3589 DBQ MHK	17 (ER4 4153 362 ATW TO	4 L	40 35 A ER4 4108 3906 ER COU	24 ER AA 4197 SUX	4 7 4 T
G G17 Canadair-700 (76.25)							18 ER4 AA 3690 ATW E	16 37 4 AA 4234 3879 3NA SU)	30 R4 4206 TYS	13 0 ER4 3951 3786 GRR LIT		4 45 ER4 4076 3619 SDF GSO	4	4 28 ER4 473 3857	to a second to second		36 25 ER4 4237 3629 CLE RST	22 ER AA 3651 LSE	4 3 G
G G19A Canadair-700 (76.25)							13 ER4 AA 4214 3 TOL C	14 34 1389 AA 3 VG JLN	40 RD 448 3474 CMI			4 45 ER4 AA 3525 4154 BMI GRB			14 55 ER4 3660 4086 SGF SDF		AA 3619 GSO	25 4 3370 DSM	
G G19 Canadair-700 (76.25)								21 ER4 AA 3711 BMI	20 ⁸⁸¹³	4 55 AA 4129 4114 SGF FAR		59 44 ER4 ^{AA} 3739 3336 MEM MDT	13 53 CR7 AA 3217 3016 BDL RST		52 31 ER4 ^{AA} 3344 3651 RIC LSE		16 ER4 3412 334 IND MI	5 7 1	
G G18 raer-135,-140,-145 (65.75)							9 AA 3601 358 AZO OR	1		44 38 ER4 3993 3927 SCE DLH	20 AA 33 CVG	42 ER4 89 4153 ATW	41 11 11	0 26 ER4 80 3782	4: 4: 4: 4: 4: 4: 4: 4: 4: 4: 4: 4: 4: 4	3 25 R4 47 3376		21 ER4 AA 3603 BHM	2 41 C

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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020



EXHIBIT 1-4 (10 OF 19)

Ramp Charts





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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

Ramp Charts



	1	2	3	4	5	6 I	7	8 I	9 1 JJ	10	11 J	12 L	13 .L	14	15	16	17 I	18
F F6 Embraer-170 (85.33)						1	3 UA 5069 EAU	55 RJ 5054 PAH	16 7 UA 5112 5645 FWA LNK	.		1	0 CR5 UA 5292 5130 COS AVI		3 50 CR5 A 3834 3790 UL ATW	29 UA 3 CID	50 CRJ 782 3900 ATW	
F F7 Embraer-170 (85.33)							1 CRJ UA 5156 SPI	25 5480	8 10 CR5 UA 3842 4851 GSP TUL				56 CR5 UA 4673 RAP	35 4670 CVG		29 UA 4: MEM	CR5 234 3984 FN) ‡ T
F F9 Embraer-170 (85.33)							4 CR5 UA 3784 3 CAK	21 8805 FAR	12 UA 3764 CAE	0 RJ 4871 CHA	11	n	50 0 CR5 UA 3794 4852 FSD ABE	ui u	55 50 CR5 3919 3908 ND STL			
F F11 Embraer-170 (85.33)							54 50 CRJ VA 3905 3786 MKE TVC		10 UA 3785 ABE	45 J 3888 MKE			14 1 CRJ UA 5040 56 MKG IN	0 59 D	55 1 CR5 UA 5039 510 SHD DL	О в н	8 CR5 UA 3920 379 FSD HP	5 33 N
F F15 Embraer-170 (85.33)							53 55 CRJ UA 5493 5673 FNT MKE		5 10 CRJ UA 3942 3878 SCE GRE) 3 3			9 CRJ UA 5101 5092 DLH MBS		4 37 ACR9 556 4528 .TL TVC		57 (CR5 UA 3880 4834 SGF PVE) 4 2
F F17 Embraer-170 (85.33)							51 50 CRJ 1A 3899 3826 ATW HPN		5 10 CRJ UA 3891 3769 DAY ATV) 9 7			9 CRJ UA 3863 33 ICT E	15 912 VV	55 55 CR5 VA 3871 3845 MDT DSM			
F F21 Embraer-170 (85.33)							57 0 CRJ UA 3922 3841 GRB MSN		3 5 CRJ UA 3833 3885 MKE RST				3 CRJ UA 3901 4815 CWA TVC		50 20 CR5 3984 YYZ		20 50 CR5 UA 3965 CVG	
0 F F23 Embraer-170 (85.33) UA		c	:R5		0 5855 PVD	43 	52 CRJ 5109 5808 X FNT	45 U/ LE	5 5 CRJ 4 3795 3890 X CWA				58 CRJ UA 3956 3926 CRW CAE	5				
F F25 Embraer-170 (85.33)						UA 48	45 CRJ 08 3904 SCE	UA3	40 CRJ ³⁸¹⁷ 4800 P GSO	44 U4 58 FN	30 CRJ 64 5643		57 0 CRJ UA 4847 4809 ATW AVP		46 50 CR5 JA 3924 4818 CLE MLI		54 (CR5 UA 4803 3876 LNK CAP) 3 <
F F27 Embraer-170 (85.33)					a dalah sebagai dalam	25 UA 38 DAY	45 RJ 24 4822 PNS	6 CRJ UA 3923 3 LNK G	15 964 RR				57 0 CRJ JA 3768 3860 FAR GSO	40 	0 45 CRJ 3 3869 4847 SO AZO ''		10 UA 5859 YWG	СF
F F28 Embraer-170 (85.33)		**********				10 CRJ UA 5082 5361 MKG BHM	44 U/ 38	3 37 CRJ 90 4817 AY FSD	10 5 CR9 4502 4587 RDU MTJ				49 30 CRJ 38/13 3776 CAK RST	32 UA : AZC	35 CR5 3791 4820 MEM		10 CRJ UA 4830 C TVC [15 389: 289
F F26 Embraer-170 (85.33)					n	0 CR UA 3898 AZO	35 4866 MDT	1 UA 4676 XNA	0 R4 4632 STL	14: UA T\	4855 3944 C SDF	5 UA 3915 CHA	30 4872 GRB	4 	1 45 CRJ 3906 NT DAY		10 CRJ UA 4806 3 XNA 0	15 3869 385

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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020



EXHIBIT 1-4 (12 OF 19)

Ramp Charts



<u> </u>	1	2	3	4	5	6	7	8	9	10	11 	12	13	14 	15 	16 	17 	1
F F24 mbraer-135,-140,-145 (65,75)								15 UA 40 GRB	ERJ 17 4	10 133 CID			11 UA 460 CLE	ER4 01 4746 SDF				
F F22 Canadair-700 (76.25)							5 UA 4397 TYS	ERJ 4	10 1254 IND			2 UA 4838 MDT	30 3810 CWA				5 0 UA 3867 3822 MSN SCE	
F F20A '-700W,-800W,-900W (117.4)					25 UA	30 M9 1421 ALB												
F F20 Embraer-170 (85.33)							0 51 UA 4787 4726 MLI XNA	50 35 ER4 UA 4762 4608 EVV EVV	5 UA 4301 MSN	ERJ	35 4348 MSN	59 CRJ UA 3946 3934 HSV FSI	D 5 5	133 UA AV	40 CRJ 3762 4811 P ICT		3 1 CRJ UA 5045 5089 MBS FWA	
F F18 Embraer-170 (85.33)							45 50 CRJ UA 3773 3831 ERI CAK	15 C UA 39 BIS	30 RJ 48 3917 AVP			59 CR. UA 3906 SCE	30 4865 CID	UA S GRI	35 CRJ 570 5088 R UIN		2 55 UA 5305 5556 FAR SBN	
F F16 '-700W,-800W,-900W (117.4)					18 UA 102 SMF	739 29) 55 2347 DFW	5 15 CF UA 390 / ATW	20 3 3875 ¢AK			58 58 CRJ UA 3775 3955 SAV RAF		10 45 CRJ UA # # CHŒRI		39 UA GF	0 CRJ 3865 4841 RB AVP	
F F14 '-700W,-800W,-900W (117.4)					20 UA 56 EUG	61	W 56 M	5 41 TY	58 E7W UA 5906 55 BNA AB	5 520 3Q		56 55 CRJ WA 3935 3764 GRR SGF	. .	55 45 CRJ 9054 5059 CGI CGI		37 UA CW	0 CRJ 4848 4830 VA ABE	
F F12 Embraer-170 (85.33)						24 UA : MKE	45 CR5 3767 3893 IND	2 CRJ UA 3873 38 FAR AE	0 74 3E			55 CRJ VA 5523 581 BHM TU	2 0 L	55 35 CRJ WA 3761 4877 ABE DAY		51 (CRJ UA 5033 5142 EAU OGS	2 5	
F F10 Embraer-170 (85.33)							54 UA 4025 CVG	5 ERJ 424 DA	19 13 13 19 19 19 19 19 19 19 19 19 19 19 19 19	J J 1110 SLN		55 50 CRJ 4867 3921 TYS LNK	14 UA 394 SGF	30 RJ 43 3849 CAK	55 CRJ VA 5887 5146 MKE SPI	36 UA LIT	50 CRJ 3933 4856 MKE	
EE7 A318,319,320,321 (111.8)						25 CR 5085 5 MBSF	0 5 5459 RIC	50 E70 UA 4677 GRR	15 4787 CLE			55 50 CRJ 3814 3765 CAK ATW	13 CI UA 487 RST	25 RJ 7 3768 MSN	49 35 CRJ 5043 5547 CKB XNA	UA 3 MKE	50 CRJ 3928 3781 CAE	
E E9A Embraer-170 (85.33)					13 UA 486 GEG	739	50 992 BOS	14 CF UA 381 MKE	19 9 3816 SGF			4 E7W UA 5356 568 BNA LG	D 7 4	10 40 E70 UA 4315 MISIN	10 40 E70 UA 4071 CLE		5 UA 4103 PNS	
E E11A Embraer-170 (85.33)						5 30 5619 BTV	3 E7W UA 3681 370 RDU JA	0 0 0 0 7 X H 3 4 4 4 4 4 4 4 4 4 4 4 4 4	8 30 CRJ 309 4804 PN ILM			48 CRJ UA 5861 530 PVD LI	0 3 7 U, 38	9 30 CRJ 326 3853 IPN SCE	55 CRJ UA 5633 TVC	26 5038 SHD	56 0 CRJ JA 3783 3882 RST GSO	ľ

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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020



Ramp Charts





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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

Ramp Charts





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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

Simulation Data Package - No Project Interim



	1	2	3	4	5	6	7	8	9	10	11 L	12 L	13 L	14 L	15 	16	17 I	18
C C23 B757-200W-300W (135)				15 	739 1155 ATL	30 UA 9 LAX	1 739 10 1161 CLE	39 UA PHL	5 739 2409 776 . MCO	19 73 UA 1850 MCO	29 40 8 2397 UA CMH RD	46 739 2406 2208 U MSY	13 739 UA 2287 SEA	25 2220 DEN	49 0 739 UA 755 1195 EWR AUS		56 7MX UA 555 36 SAN LA	0 39 X
C C21 B767-300ER W (167)					53 UA 1067 RNO	738	45 878 СМН	15 UA 1499 RIC	2 739 287 YVR		24 31 319 5679 UA 5 A BWI	45 7MX 66 1723 SFO	8 739 UA 2385 0 DEN B	15 4 556 U/ UF IA	1 40 738 1160 1280		56 0 739 UA 1598 1444 BOS ORF	
C C20 B777-200,-300 (200)	2 1	:1 JA 1962 AX		777		403 DEN	11. 11	1 5 7M9 UA 754 2193 MSP EWR		11 777 UA 532 DEN D	15 359 EN	4	5 45 789 A 1403	20 UA	789 958 U	0 59 777 A 639 248 FO SFO	15 788 UA	15 18
C C19 B767-300ER W (167)	0101110-01031 01000				20 UA 150 FAI	738	0 1166 LGA		14 7MX UA 635 BWI	25 2246 DEN	29 UA 3 BDL	45 739 05 374	7 739 UA 2129 2 SJC R	17 39 004 U/ OC RS	9 55 738 A 2404 994 SW MCI	, n	8 0 7MX IA 597 440 AS EWR	
C C18 B777-200LR,-300ER (212.6)					20 UA 229 LAX	789	0 1846 SEA	30 UA	0 777 835 PVG	н. п	25 	55 359 851 PEK	0 359 UA	30 36 944 UA FRA LA	50 777 2039 592	5 110	50 359 JA	2 98
C C17 -700W,-800W,-900W (117.4)					9 UA 1279 YVR	319	50 2227 CHS	11 UA 2086	2 739 2185 BZN		739 2220	31 664	55 2 7MX UA 2004 578 PDX BOS		3 319 UA 2284 2039	5 4' 	7 59 739 A 1126 743	
C C16 B777-200LR,-300ER (212.6)						15 UA	0 359 733	42 UA 1553	30 319 2025	35 UA	45 739 1634 609	5 UA 1872	359 1836	31 UA	0 359 336 407	5 11 11	50 359 JA	2 90
C C15 B767-300ER W (167)		36 UA 781 DEN		320		2	15 198	1 55 738 UA 1967 632 DSM IAD	18 5 UA 3415 3694	43 UA	319 5253 5955 F CLT		5 738 UA 230 1 SNA	15 128 AH	55 2 319 VA 387 2175 BTV MSN	42 UA	2 55 739 2247 336 A MDT	-
C C11 B757-200W-300W (135)					35 UA	738 1504	25 32 UA 761 LGA	26 5 0 1266 U OMA D	0 0 320 A 531 588 CA YYC	и. 1	43 11 E	50 753 2075 549 WR PDX	25 5 320 UA 30	5 4 5 U	45 320 JA 765 913	38 UA SN/	55 738 1219 790 A BOS	-
C C10 B777-200LR,-300ER (212.6)					6 UA 1285	320	45 2306		50 N) 77W H	20 40 11 UA	50 359 682 775	6 788 UA 2265 LAX	30 2243 LAX	50 50 788 UA 153 DUB	5 77W	25 111	
C C9 B767-300ER W (167)	15 UA 2224			320			40 359	0 5 753 UA 2001 1198 EWR CUN		27 3 UA 729	30 19 2391	0 0 320 UA 586 1634) 25 7 4 UA 91	40 39 3 397 TPA	52 0 753 UA 1564 1641 BOS SEA	20 UA	763 50 843	
C C8 Embraer-170 (85.33)						9 UA 4790 LAN	45 4684 ROA	5 57 E7W ^{UA} 3607 3544	8 5 CR9 UA 4575 4574 STL ELP	29 59 CR5 UA 4734 SDF	45 C U/4	15 R5 1794	11 2 E7W 3496 3476 ATL BTV	34 UA SD	E7W ³⁵ 519 3629 F TUL		57 52 UA 5269 5596 ABQ YHZ	

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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020



Simulation Data Package - No Project Interim





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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020

Simulation Data Package - No Project Interim



	1 	2 3	4 	5	6	7 8	9	10	11 	12	13	14 L	15	16	17	1
B B19 A318,319,320,321 (111.8)				15 1 319 UA 182 OR	15 47 25 UA RF GR	319 206 476 R YYZ	39 30 319 519 1270 PIT SAV		22 5 CR9 UA 5750 5969 SYR PN	5 45 UA s TU	0 E70 4386 4078 L GSP	46 U, TF	6 320 A 592 116 PA SN	9 45 0 UA A CV	50 E7W 4251 4315 G MSP	
B B18 Embraer-170 (85.33	0) UA	CR9			45 5656 SYR	31 3 CR9 UA 4564 454 STL MS	0 41 0 8 54 42 457 4587 4507 0 8 6 8 6 8 6 8 6 7 4507 0 8 6 8 6 7 4507 4507 4507 4507 4507 4507 4507 45	32 UA 450 DT	25 CR9 9 4511 W STL	53 50 E7W JA 3608 3591 ND DCA	17 CR UA 4546 SYR	30 9 4523 CHS	55 45 CR9 ^{UA} 4579 4525 CVG OMA	48 	3 1 CR9 A 4520 452 AT ST	
B B17 B747-800 (224.6)				55 VA 218 HNL		78X		10 34 219 U4 HNL IAI	359 32200			15 3	45 437 MUC	35 UA	359 972 BRU	
B B16 B747-800 (224.6)		olisti barotasorragia	25 	0 789 636 EWR	47 UA SF	7 1161 O	77	0 531 LAX		5 359 UA	25 895 HKG		55 359 UA 19 EV	15 30 95 UA VR	0 359 952 MUC	
B B14 B757-200W-300W (135)	0 UA	319)		0 1146 LGA	34 753 UA 1153 2 CLE F	35 139 LL MCI	0 19 ¹⁹¹¹ DCA	49 0 319 UA 609 1741 DCA LGA	38 UA OM/	0 738 1087 2081 A MIA	2 50 320 UA 370 556 ALB BDL		5 0 E7W 5236 5694 DCA LGA		JA G
B B12 B757-200W-300W (135)	,		5 101	0 319 1023 DCA	32 UA 68 SFO	753 30 204 LAX	25 30 319 UA 628 2097 LGA MYR	0 71 UA 775 BOS	VI9 310 U LAX P	0 55 320 A 1574 2088	u 11	1 45 319 ^{UA} 3618 3581 JAX JAX	44 UA UA LG	35 57W 4 5477 A BJX	10 58 320 2372 2205 YVR DFW	
BB11 -700W,-800W,-900W (117.4)			19444	20 UA 1562 ANC	7M9	0 748 IAH	25 30 319 UA 490 1621 BTV BTV	51 40 319 1496 1505 DCA RAP	12 32 UA 2081 ORF	43 5 570 U YVR D	2 \$ 319 A 366 734 CA PI	5 4 1			6 320 UA 1658 18 SYR B	1 : 89: 5T
B B10 '-700W,-800W,-900W (117.4)	15 UA 1800 SFO		7M9			45 1 212 U MIA D	1 0 20 A320 UA 182 1967 UA LH PWM AU	10 319 1660 S MSP	27 UA 4821 3 SBN M	15 39 770 UA 1DT LGA	319 1697 616 A DCA	5 37 5 UA 1 LG4	41 319 1213 2212 4 BNA		6 320 UA 1194 19 JAC B	1 : 52
-700W,-800W,-900W (117.4)				20 UA 637 LAS	738	45 5 742 UA RSW IA	40 7M9 A 2246 638 H PHL	0 319 UA 3536 35 MSY LG	0 37 18 UA GA LGA	51 320 1953 1651 SAT	UA 2 LGA	0 319 202 2406 LGA		m	58 0 320 UA 692 692 MCI LGA	-
B B8 B757-200W-300W (135)				3 UA 745 PDX	753	51 1 1996 5 SJU U	2 0 20 CRJ 074 5940 UA JIN LAN CV	42 E7W 3587 3675 /G BNA	5 1	0 30 41 319 A 5364 UA	0 739 432 622 MCO	n m	55 1 320 VA 1705 158 СМН SM	0 5 8 U F R	2 5 319 A 1810 702 AP CLE	2
B757-200W-300W (135)				54 VA 214 SFO	753	46 7 2192 UA SAN DO	8 13 739 7 A 605 769 UA 54 CA SFO YYZ	5 38 ^{17 2019} JAC	45 	5 753 272 810 30 SFO	3 0 738 UA 656 509 PHX LGA	139 UA FLL	49 753 1728 541 LAS	n	5 55 319 5742 5654 BOI DTW	
-700W,-800W,-900W (117.4)				5 10 7M9 UA 814 CLE	0 39 4 UA 2 5 CLE	7M9 2116 206 MCO	2 71 UA 57 BUF	15 0 1590 SAN	45 35 E7W ^{5567 5807} OKC DAY	58 7N UA 1251 BOS	0 19 230 EWR	26 UA 16 ORF	0 319 341 387 JAC	44 UA DS	0 319 1979 624 M DCA	

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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020



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	(1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	1
BB5 '-700W,-800W,-900W (117.4)	0 UA			E7W			54 3722 CVG		55 55 CRJ VA 3934 4849 FSD SBN	15 UA 3969 CMH	E	RJ	45 4245 BHM	20 UA 5438 5 TYS B	15 ³⁵¹ NA			51 UA 4062 I¢T	E
BB4 '-700W,-800W,-900W (117.4)						19 UA 619 SEA	738	45 558 ROC		5 7M9 UA 977 EWR	24 2133 LAS	25 CRJ 1949 3774 PIA AZC	5 0 7M9 UA 397 241 ROC SEA	20 1 UA 5677 53 SLC TY	0 31 S	48 54 7M9 UA 1544 1603 PHL PHX	4	4 5 7M9 JA 743 76 W/R DE	6 35 N
B B3 B757-200W-300W (135)					23 UA 101 SAN	0	753	45 2244 SFO	11 0 UA 320 1868 910 DFW LGA	39 UA SA	40 753 233 1659 T CUN								
B B2W B777-200LR,-300ER (212.6)												15 3 UA	45 59 881 NRT		35 11	5 789 198 14	5 25 39 UA	789 90 AN	5)9 IS
BB2 B757-200W-300W (135)						35 7 UA	30 53 2194 LAX	4 UA 203 BOS	753 16 P ¹	14 41 63 ^{UA} 463	30 320 ₂₁₇₈ A SMF								
B B1 Embraer-170 (85.33)	0 UA			CR9			35 4527 DTW	3 45 CR9 UA 4519 4539 YYZ BGR	11 55 CR9 UA 4538 4582 MCI SYR	20 CRS UA 4511 CHS	9 4513 SAT			11 CR9 UA 5829 ASE	25 5642 DTW	48 55 CR9 UA 5544 5466 BDL MSP	39 U, M) CR9 4 4578 45 TJ R	0 118 DU
- Unassigned																			

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Terminal Area Plan and Air Traffic Procedures EA

NOVEMBER 2020



EXHIBIT 1-4 (19 OF 19)

Ramp Charts





Drawing: P:\Simulation\KORD_TAP_EA\Assumptions\02-Airfield\AutoCAD\TAP EA - Repositioning Remote Locations.dwgLayout: No Project - Interim Plotted: Oct 30, 2020, 04:17PM

Terminal Area Plan and Air Traffic Procedures EA







SOURCES: Ricondo & Associates, Inc., O'Hare International Airport Draft Future Airport Layout Plan, May 2019; Ricondo & Associates, Inc., List of Proposed and Baseline Projects, October 2019; Ricondo & Associates, Inc., August 2020.

NORTH 0 Not To Scale

Drawing: P1SimulationIKORD_TAP_EAlAssumptions102-AirfieldIAutoCADITAP EA - GA and Cargo Parking Areas.dwgLayout: No Project - Interim Plotted: Oct 30, 2020, 04:21PM

Terminal Area Plan and Air Traffic Procedures EA Appendix D

General Aviation and Cargo Parking Areas

1.6 Arrival Fixes by Departure Airport

Arrival fixes were assigned based on the location of the departure airport. **Exhibits 1-7** and **1-8** depict the arrival fix assignments for West Flow and East Flow, respectively.

1.7 Taxi Speeds

Taxi speeds were established for taxiways and aprons. **Exhibits 1-9** and **1-10** depict the taxi speeds for West Flow and East Flow, respectively.

1.8 Intersection Departure Procedures

Departures utilizing Runways 9R-27L and 10L-28R are encouraged to use intersection departure procedures whenever possible so that arrivals from the outboard runways (Runways 9L-27R, 9C-27C, 10C-28C, and 10R-28L) can taxi behind departing aircraft, reducing delay incurred by both arriving and departing aircraft. However, some departures cannot use intersection departure procedures due to runway length requirements. A subset of widebody⁷ operations that is representative of the characteristics of the operations that typically utilize the full length of the departure runway was restricted from using intersection departure procedures. This subset was defined based on the airline and the great circle distance⁸ from O'Hare to the destination airport. **Tables 1-2** and **1-3** detail the air carrier operations and cargo operations, respectively, that were in the DDFS and restricted from using intersection departures.

⁷ This refers to aircraft with a fuselage wide enough to accommodate two passenger aisles.

⁸ This is the shortest distance between two points on the surface of a sphere, measured along the surface of the sphere.

NOVEMBER 2020



SOURCE: Terminal Area Plan and Air Traffic Procedures Environmental Assessment Air Traffic Workgroup, August 2019.

EXHIBIT 1-7

West Flow

Not To Scale NORTH 0

Drawing: P:\Simulation\KORD_TAP_EA\Assumptions\04-Airspace\AutoCAD\KORD TAP EA - Arrival Fixes by Departure Airport.dwgLayout: NPInterim_West Plotted: Oct 30, 2020, 04:24PM

Terminal Area Plan and Air Traffic Procedures EA Appendix D

Simulation Data Package - No Project Interim NOVEMBER 2022

Arrival Fixes by Departure Airport

NOVEMBER 2020



SOURCE: Terminal Area Plan and Air Traffic Procedures Environmental Assessment Air Traffic Workgroup, August 2019.

EXHIBIT 1-8

East Flow

NORTH 0 Not To Scale

Drawing: P:\Simulation\KORD_TAP_EA\Assumptions\04-Airspace\AutoCAD\KORD TAP EA - Arrival Fixes by Departure Airport.dwgLayout: NPInterim_East Plotted: Oct 30, 2020, 04:24PM

Terminal Area Plan and Air Traffic Procedures EA Appendix D

Simulation Data Package - No Project Interim NOVEMBER 2022

Arrival Fixes by Departure Airport