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

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**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.

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**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 configurations 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.  

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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 (AVJ-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

<table>
<thead>
<tr>
<th></th>
<th>Interim No Action</th>
<th>Interim Proposed Action</th>
<th>Build Out No Action</th>
<th>Build Out Proposed Action</th>
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<td>Annual Operations</td>
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<td>1,013,856</td>
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<td>Daily Operations</td>
<td>2,820</td>
<td>2,820</td>
<td>2,993</td>
<td>2,993</td>
</tr>
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</table>

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
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
Calibration Summary
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

Determine Operating Configurations

Identify Calibration Airfield/Days

Analyze Historic Operational Data and Field Observations

Develop Simulation Assumptions

Review Animations

TAAM Simulation Modeling

Review and compare output metrics

Refine Simulation Assumptions

Finalize Calibrated TAAM Model

Documentation of Model Calibration and Assumptions and Metrics

Calibrated Models Serve as Basis for TAP EA TAAM Modeling
## EXPERIMENTAL DESIGN

<table>
<thead>
<tr>
<th>Experiment Number</th>
<th>TAAM Experiment</th>
<th>Operating Configuration</th>
<th>Notes</th>
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<tbody>
<tr>
<td>801</td>
<td>VFR West</td>
<td></td>
<td></td>
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<tr>
<td>802</td>
<td>IFR West</td>
<td></td>
<td>Triple simultaneous ILS approaches; dependency b/w 28R/C operations; below 800/2</td>
</tr>
<tr>
<td>803</td>
<td>VFR East</td>
<td></td>
<td></td>
</tr>
<tr>
<td>804</td>
<td>IFR East</td>
<td></td>
<td>Triple simultaneous ILS approaches; dependency b/w 10L/C operations; mixed use on 9R; below 800/2</td>
</tr>
</tbody>
</table>

**Legend**

- Existing runway
- Primary arrivals
- Primary departures
AIRFIELD LAYOUT

• May 2017
  – Existing Condition from O’Hare International Airport Draft Future Airport Layout Plan

• Minimal airfield impacts due to construction
  – Runway 9C-27C East Package winter suspension
  – Pre-Runway 9C-27C Package 1 construction

SOURCES:
Calibration Date Selection
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

<table>
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<tr>
<th>Configuration</th>
<th>Simulation Schedule Date</th>
<th>Operational Metric Dates</th>
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</thead>
<tbody>
<tr>
<td>VFR West</td>
<td>May 23</td>
<td>May 2, 22, 29, 30, and 31</td>
</tr>
<tr>
<td>VFR East</td>
<td>May 23</td>
<td>May 5, 8, 12, 15, and 26</td>
</tr>
<tr>
<td>IFR West</td>
<td>February 7</td>
<td>February 7</td>
</tr>
<tr>
<td>IFR East</td>
<td>April 30</td>
<td>April 30</td>
</tr>
</tbody>
</table>

- 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
Airfield/Airspace

Operating Assumptions
GATE LAYOUT
GATE GAUGE AND MOVEMENT AREA PUSHBACKS

EXPERIMENT 803: VFR EAST

EXPERIMENT 804: IFR EAST

EXPERIMENT 801: VFR WEST

EXPERIMENT 802: IFR WEST

SOURCE: Federal Aviation Administration, August 2017 (radar map).
Data Collection/Analysis
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

Percentage of Departures

Variation Between Scheduled and Actual Pushback Time (Minutes)

< -10 -10 to -5 -5 to 0 0 to 5 5 to 10 10 to 15 15 to 20 20 to 25 25 to 30 30 to 35 35 to 40 40 to 45 45 to 50 50 to 55 55 to 60 > 60

1% 6% 22% 27% 16% 7% 4% 3% 2% 1% 1% 1% 1% 1% 0% 6%

Note:
Negative values indicate pushback prior to scheduled time and positive values indicate pushback after scheduled time.

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

• Utilize TAAM ETD randomization to vary pushback times by 15 minutes (-5 to 10)
  – TAAM ETD randomization distributes pushback times evenly between minimum and maximum values
  – Accounts for large percentage of variation in historical pushback times

• Adjust scheduled departure time for departures between 6:00 and 7:59
  – 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
TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME
ACTUAL TOUCHDOWN VS. SCHEDULED GATE TIME – MAY 8, 2017 ROLLING HOUR

NOTE:
Negative values indicate touchdown prior to scheduled time and positive values indicate touchdown after scheduled time.

SOURCES:
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

NOTE:
Negative values indicate pushback/touchdown prior to scheduled time and positive values indicate pushback/touchdown after scheduled time.

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

#### EXPERIMENT 801: VFR WEST

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<th>Time Period</th>
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<th>All Operations</th>
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#### EXPERIMENT 803: VFR EAST

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<tbody>
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<td>Historical</td>
<td>Simulated</td>
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<tr>
<td>7:00 to 21:59</td>
<td>90.3%</td>
<td>88.8%</td>
<td>88.8%</td>
</tr>
<tr>
<td>22:00 to 6:59</td>
<td>9.7%</td>
<td>11.2%</td>
<td>11.2%</td>
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### TOUCHDOWN/LIFTOFF VS. SCHEDULED GATE TIME CALIBRATION RESULTS - IFR

#### EXPERIMENT 802: IFR WEST

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<td>22:00 to 6:59</td>
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#### EXPERIMENT 804: IFR EAST

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<td>7.1%</td>
<td>6.5%</td>
<td>9.8%</td>
<td>8.0%</td>
</tr>
</tbody>
</table>

- IFR East
  - 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
ARRIVAL AND DEPARTURE THROUGHPUT
VFR WEST ARRIVALS – MAY 2017

**RUNWAY 27R**

**RUNWAY 27L**

**RUNWAY 28C**

**ALL ARRIVAL RUNWAYS**

SOURCES:
ARRIVAL AND DEPARTURE THROUGHPUT
VFR EAST ARRIVALS – MAY 2017

**RUNWAY 9L**

**RUNWAY 10C**

**RUNWAY 10R**

**ALL ARRIVAL RUNWAYS**

SOURCES:
ARRIVAL AND DEPARTURE THROUGHPUT
VFR ARRIVALS MODELING ASSUMPTIONS

• Maximum Throughput
  – An arrival rate of 11 operations was observed multiple times per day and for successive 15-minute periods
  – TAAM final approach separation adjusted to produce an arrival rate of 11 operations when wake turbulence separation is not required

• Wake Turbulence Throughput
  – 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

SOURCES:
ARRIVAL AND DEPARTURE THROUGHPUT
VFR WEST DEPARTURES – MAY 2017

**RUNWAY 28R**

Number of Observations

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<th>1</th>
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Discrete 15-Minute Operations

**RUNWAY 22L**

Number of Observations

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<td>0</td>
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</tr>
</tbody>
</table>

Discrete 15-Minute Operations

**ALL DEPARTURE RUNWAYS**

Number of Observations

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
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<th>20</th>
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<tbody>
<tr>
<td>66</td>
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<td>5</td>
<td>10</td>
<td>2</td>
<td>0</td>
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</tr>
</tbody>
</table>

Discrete 15-Minute Operations

**SOURCES:**

ARRIVAL AND DEPARTURE THROUGHPUT
VFR EAST DEPARTURES – MAY 2017

RUNWAY 9R

RUNWAY 10L

ALL DEPARTURE RUNWAYS

SOURCES:
ARRIVAL AND DEPARTURE THROUGHPUT
VFR DEPARTURES MODELING ASSUMPTIONS

• Maximum Throughput
  – 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

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

RUNWAY 27R

RUNWAY 27L

RUNWAY 28C

ALL ARRIVAL RUNWAYS

SOURCES:
ARRIVAL AND DEPARTURE THROUGHPUT
IFR EAST ARRIVALS – APRIL 30, 2017

SOURCES:
O’Hare International Airport, Airport Noise Management System, April 2017 (actual runway time); Ricondo & Associates, Inc., November 2018 (analysis).
ARRIVAL AND DEPARTURE THROUGHPUT
IFR ARRIVALS MODELING ASSUMPTIONS

• Maximum Throughput
  – 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

• Wake Turbulence Throughput
  – 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

SOURCES:
O'Hare International Airport, Airport Noise Management System, February and April 2017 (actual runway time); Ricondo & Associates, Inc., November 2018 (analysis).
ARRIVAL AND DEPARTURE THROUGHPUT
IFR WEST DEPARTURES – FEBRUARY 7, 2017

RUNWAY 28R

RUNWAY 22L

ALL DEPARTURE RUNWAYS

SOURCES:
O'Hare International Airport, Airport Noise Management System, February 2017 (actual runway time); Ricondo & Associates, Inc., November 2018 (analysis).
ARRIVAL AND DEPARTURE THROUGHPUT
IFR EAST DEPARTURES – APRIL 30, 2017

RUNWAY 9R

RUNWAY 10L

ALL DEPARTURE RUNWAYS

SOURCES:
O’Hare International Airport, Airport Noise Management System, April 2017 (actual runway time); Ricondo & Associates, Inc., November 2018 (analysis).
ARRIVAL AND DEPARTURE THROUGHPUT
IFR DEPARTURES MODELING ASSUMPTIONS

• Maximum Throughput
  – 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

SOURCES:
O’Hare International Airport, Airport Noise Management System, February and April 2017 (actual runway time); Ricondo & Associates, Inc., November 2018 (analysis).
ARRIVAL STANDOFF

• Modeling the typical variation between arrival touchdown and scheduled gate times causes some aircraft to land prior to their assigned gate becoming available.
• Aircraft recheck the occupancy of their assigned gate just prior to reaching the terminal core.
• Aircraft with occupied gates will taxi to a hold pad to wait for their assigned gate.
• Aircraft will wait 30 minutes for their assigned gate to become available before selecting a suitable alternative gate.

### Sample Gate Activity – C26

<table>
<thead>
<tr>
<th>Origin</th>
<th>Destination</th>
<th>Arrival Time</th>
<th>Departure Time</th>
<th>Buffer Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>RON(^1)</td>
<td>KPHL</td>
<td>n/a</td>
<td>7:42</td>
<td>0:20</td>
</tr>
<tr>
<td>KMSP</td>
<td>MMUN</td>
<td>8:02</td>
<td>9:05</td>
<td>0:38</td>
</tr>
<tr>
<td>KCLE</td>
<td>KFLL</td>
<td>9:43</td>
<td>10:47</td>
<td>1:48</td>
</tr>
<tr>
<td>KPDX</td>
<td>KALB</td>
<td>12:35</td>
<td>13:28</td>
<td>0:21</td>
</tr>
<tr>
<td>KIAD</td>
<td>KATL</td>
<td>13:49</td>
<td>14:45</td>
<td>0:17</td>
</tr>
<tr>
<td>KMCO</td>
<td>KMSP</td>
<td>15:02</td>
<td>15:59</td>
<td>0:39</td>
</tr>
<tr>
<td>KSAN</td>
<td>KDCA</td>
<td>16:38</td>
<td>18:05</td>
<td>1:17</td>
</tr>
<tr>
<td>KSNA</td>
<td>KSMF</td>
<td>19:22</td>
<td>20:10</td>
<td>1:24</td>
</tr>
<tr>
<td>KEWR</td>
<td>KSFO</td>
<td>21:34</td>
<td>22:45</td>
<td>1:24</td>
</tr>
</tbody>
</table>

**NOTE:**
RON – Remain Overnight
TAXI SPEEDS

WEST FLOW

EAST FLOW

RUNWAY EXIT DISTRIBUTION
VFR WEST

Aircraft Group | Taxiway 3 | Taxiway 4 | Taxiway 6 | Taxiway 8 | Taxiway 10
--- | --- | --- | --- | --- | ---
Small Regional | - | - | - | - | -
Small Narrow Body | - | - | - | - | -
Large Narrow Body | - | - | - | - | -
Large Wide Body | - | - | - | - | -
Boeing 777-8 | - | - | - | - | -

**Runway 27L**

**Runway 28C**

**Sources:**
RUNWAY EXIT DISTRIBUTION
IFR WEST

Runway 27R

<table>
<thead>
<tr>
<th>Aircraft Group</th>
<th>Taxiway J</th>
<th>Taxiway L</th>
<th>Runway 27R</th>
<th>Taxiway XL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Regional</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>Large Regional</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Small Narrow Body</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Large Narrow Body</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Small Wide Body</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Large Wide Body</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>737-8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Runway 27L

<table>
<thead>
<tr>
<th>Aircraft Group</th>
<th>Taxiway J</th>
<th>Taxiway L</th>
<th>Runway 27L</th>
<th>Taxiway XL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Regional</td>
<td>5.0%</td>
<td>5.0%</td>
<td>30.0%</td>
<td>30.0%</td>
</tr>
<tr>
<td>Large Regional</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Small Narrow Body</td>
<td>-</td>
<td>-</td>
<td>9.0%</td>
<td>9.0%</td>
</tr>
<tr>
<td>Large Narrow Body</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Small Wide Body</td>
<td>-</td>
<td>-</td>
<td>38.0%</td>
<td>38.0%</td>
</tr>
<tr>
<td>Large Wide Body</td>
<td>-</td>
<td>-</td>
<td>100.0%</td>
<td>100.0%</td>
</tr>
<tr>
<td>737-8</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
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</table>

Runway 28C

<table>
<thead>
<tr>
<th>Aircraft Group</th>
<th>Taxiway AA</th>
<th>Taxiway BB</th>
<th>Taxiway CC</th>
<th>Taxiway DD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Regional</td>
<td>1.1%</td>
<td>1.1%</td>
<td>3.6%</td>
<td>3.6%</td>
</tr>
<tr>
<td>Large Regional</td>
<td>-</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Small Narrow Body</td>
<td>-</td>
<td>-</td>
<td>2.9%</td>
<td>2.9%</td>
</tr>
<tr>
<td>Large Narrow Body</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Small Wide Body</td>
<td>-</td>
<td>-</td>
<td>2.6%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Large Wide Body</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>737-8</td>
<td>-</td>
<td>-</td>
<td>2.0%</td>
<td>2.0%</td>
</tr>
</tbody>
</table>

SOURCES:
RUNWAY EXIT DISTRIBUTION
VFR EAST

Runway 9L

Runway 10C

Runway 10R

SOURCES:
RUNWAY EXIT DISTRIBUTION
IFR EAST

**Runway 9L**

**Runway 9R**

**Runway 10C**

**Sources:**
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 operation, 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

NOTE:
Average speed calculated using measured distances of typical maneuvers by concourse and pushback movement time recorded during observations.
PUSHBACK MOVEMENTS
OBSERVATIONS - AVERAGE PUSHBACK SPEED – REGIONAL AIRCRAFT

Average speed calculated using measured distances of typical maneuvers by concourse and pushback movement time recorded during observations.

NOTE:

Average = 3.1
PUSHBACK MOVEMENTS
OBSERVATIONS - AVERAGE PUSHBACK SPEED – NARROW BODY AIRCRAFT

Average speed calculated using measured distances of typical maneuvers by concourse and pushback movement time recorded during observations.
NOTE:
1/ Average speed calculated using measured distances of typical maneuvers by concourse and pushback movement time recorded during observations.
2/ International includes all foreign flag air carriers operating at ORD
PUSHBACK MOVEMENTS
OBSERVATIONS - ENGINE SPOOL UP – ALL AIRCRAFT

NOTE:
Engine Spool Up includes tug disconnect, engine spool up, and control surfaces check. Engine spool up concludes when the aircraft first moves under own power.
PUSHBACK MOVEMENTS
OBSERVATIONS - ENGINE SPOOL UP – REGIONAL JETS

NOTE:
Engine Spool Up includes tug disconnect, engine spool up, and control surfaces check. Engine spool up concludes when the aircraft first moves under own power.
PUSHBACK MOVEMENTS
OBSERVATIONS - ENGINE SPOOL UP – NARROW BODY AIRCRAFT

NOTE:
Engine Spool Up includes tug disconnect, engine spool up, and control surfaces check. Engine spool up concludes when the aircraft first moves under own power.
PUSHBACK MOVEMENTS
OBSERVATIONS - ENGINE SPOOL UP – WIDE BODY AIRCRAFT

**Domestic Wide Body**

<table>
<thead>
<tr>
<th>Time (Seconds)</th>
<th>Number of Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 300</td>
<td>1</td>
</tr>
<tr>
<td>300-330</td>
<td>2</td>
</tr>
<tr>
<td>330-360</td>
<td>3</td>
</tr>
<tr>
<td>360-390</td>
<td>4</td>
</tr>
<tr>
<td>&gt; 390</td>
<td>5</td>
</tr>
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</table>

Average = 249

**International Wide Body**

<table>
<thead>
<tr>
<th>Time (Seconds)</th>
<th>Number of Aircraft</th>
</tr>
</thead>
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<td>&lt; 300</td>
<td>1</td>
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<tr>
<td>300-330</td>
<td>2</td>
</tr>
<tr>
<td>330-360</td>
<td>3</td>
</tr>
<tr>
<td>360-390</td>
<td>4</td>
</tr>
<tr>
<td>&gt; 390</td>
<td>5</td>
</tr>
</tbody>
</table>

Average = 307

**NOTE:**

Engine Spool Up includes tug disconnect, engine spool up, and control surfaces check. Engine spool up concludes when the aircraft first moves under own power.
• 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 non-movement area operations
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

• Average Pushback Speed
  – Regional Jet and Narrow Body: 3.0 knots
  – Wide Body: 2.5 knots

• Engine Spool Up Time
  – Regional Jet: 155 seconds
  – Narrow Body: 164 seconds
  – Domestic Wide Body: 249 seconds
  – International Wide Body: 307 seconds
DEPARTURE LINE UP

METHODOLOGY

• Two times were recorded for each line up observation:
  – 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

• Observations for each runway were separated into three groups of similar aircraft to look for differences in line up time performance
  – Regional Jets (CRJ7, E170, etc.)
  – Narrow Body (B738, A321, etc.)
  – Wide Body (B772, B744, etc.)
DEPARTURE LINE UP
OBSERVATIONS – RUNWAY 28R

Regional Jets
Average=28.8

Narrow Body
Average=31.2

Wide Body
Average=39.0

All Departures
Average=31.3
DEPARTURE LINE UP
OBSERVATIONS – RUNWAY 22L

<table>
<thead>
<tr>
<th>Time (seconds)</th>
<th>Number of Aircraft</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-17</td>
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<tr>
<td>19-21</td>
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</tr>
<tr>
<td>23-25</td>
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<td>27-29</td>
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</tr>
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<td>39-41</td>
<td>12</td>
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<td>43-45</td>
<td>14</td>
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<tr>
<td>47-49</td>
<td>16</td>
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<tr>
<td>51-53</td>
<td>18</td>
</tr>
<tr>
<td>55-57</td>
<td>20</td>
</tr>
</tbody>
</table>

Average for Regional Jets: 28.8 seconds

Average for Narrow Body: 29.9 seconds

Average for Wide Body: 32.7 seconds

Average for All Departures: 29.3 seconds
DEPARTURE LINE UP
OBSERVATIONS – RUNWAY 9R

Regional Jets
Average = 29.2

Narrow Body
Average = 32.9

Wide Body
Average = 36.0

All Departures
Average = 30.6
DEPARTURE LINE UP
OBSERVATIONS – RUNWAY 10L

Regional Jets

Narrow Body

Average=31.3

Wide Body

Average=36.8

All Departures

Average=30.6

Chicago O'Hare International Airport
Draft Environmental Assessment
APPENDIX D
D-73
JUNE 2022
FINAL
DEPARTURE LINE UP
MODELING ASSUMPTIONS

• No significant difference was observed between runways for the all aircraft average line up time

• Although line up time performance does vary between aircraft groups, the observed difference is not anticipated to impact TAAM model departure runway throughput
  – Longest observed line up times (wide bodies) do not exceed successive departure separation

• Average of all departure line up times, 30.4 seconds, translates to a runway entrance link speed of approximately 10 knots
Comparison of Simulated and Historical Operations
EXPERIMENT 801: VFR WEST AIRPORT THROUGHPUT

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 801: VFR WEST
RUNWAY 27R

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

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

Legend
- Arrivals - TAAM
- Arrivals - ANMS
- Departures - TAAM
- Departures - ANMS
EXPERIMENT 801: VFR WEST
RUNWAY 27L

Legend
- Arrivals - TAAM
- Arrivals - ANMS
- Departures - TAAM
- Departures - ANMS

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

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.
EXPERIMENT 801: VFR WEST
RUNWAY 28C

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O’Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 801: VFR WEST
RUNWAY 28R

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 801: VFR WEST
RUNWAY 22L

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
# EXPERIMENT 801: VFR WEST
## TAXI TIMES

### Sources:
- O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time)

### Taxi Time Operations
#### Arrivals

<table>
<thead>
<tr>
<th>Runway</th>
<th>Taxi Time</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Simulated</td>
<td>Historical</td>
</tr>
<tr>
<td>27R</td>
<td>13:55</td>
<td>14:10</td>
</tr>
<tr>
<td>27L</td>
<td>9:50</td>
<td>9:59</td>
</tr>
<tr>
<td>28C</td>
<td>12:41</td>
<td>12:39</td>
</tr>
<tr>
<td>All</td>
<td>11:44</td>
<td>12:00</td>
</tr>
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</table>

#### Departures

<table>
<thead>
<tr>
<th>Runway</th>
<th>Taxi Time</th>
<th>Operations</th>
</tr>
</thead>
<tbody>
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<td>22L</td>
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</tr>
<tr>
<td>All</td>
<td>14:44</td>
<td>13:38</td>
</tr>
</tbody>
</table>

### 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.

### Sources:
- O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time)
EXPERIMENT 801: VFR WEST
RUNWAY UTILIZATION

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 International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 803: VFR EAST
AIRPORT THROUGHPUT

Legend
- Arrivals - TAAM
- Departures - TAAM
- Arrivals - ANMS
- Departures - ANMS

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 803: VFR EAST
RUNWAY 9L

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 803: VFR EAST
RUNWAY 10C

Arrivals - TAAM
Departures - TAAM

Legend
Arrivals - ANMS
Departures - ANMS

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 803: VFR EAST
RUNWAY 10R

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 803: VFR EAST
RUNWAY 9R

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are the average of 5 days from May 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O’Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 803: VFR EAST
RUNWAY 10L

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
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4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O’Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
## EXPERIMENT 803: VFR EAST
### TAXI TIMES

### 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.

### SOURCES:

#### Arrivals

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<th>Operations</th>
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<td>10R</td>
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</tr>
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</table>
EXPERIMENT 803: VFR EAST
RUNWAY UTILIZATION

SOURCES:

NOTES:
1/ Simulated runway utilization is the average of 11 iterations.
2/ Historical runway utilization is the average of 5 days from May 2017.

<table>
<thead>
<tr>
<th>Runway</th>
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<tr>
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<td>53%</td>
</tr>
<tr>
<td>10L</td>
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0% 10% 20% 30% 40% 50% 60%

Simulated Historical
EXPERIMENT 802: IFR WEST
AIRPORT THROUGHPUT

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are from February 7, 2017.

SOURCES:
O’Hare International Airport, Airport Noise Management System, February 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 802: IFR WEST
RUNWAY 27R

Legend
- Arrivals - TAAM
- Arrivals - ANMS
- Departures - TAAM
- Departures - ANMS
- Non-Modeled Config.

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are from February 7, 2017.

SOURCES:
O'Hare International Airport, Airport Noise Management System, February 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 802: IFR WEST
RUNWAY 27L

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are from February 7, 2017.

SOURCES:
O'Hare International Airport, Airport Noise Management System, February 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 802: IFR WEST
RUNWAY 28C

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are from February 7, 2017.

SOURCES:
O'Hare International Airport, Airport Noise Management System, February 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 802: IFR WEST
RUNWAY 28R

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are from February 7, 2017.

SOURCES:
O'Hare International Airport, Airport Noise Management System, February 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 802: IFR WEST
RUNWAY 22L

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are from February 7, 2017.

Legend
- Arrivals - TAAM
- Arrivals - ANMS
- Departures - TAAM
- Departures - ANMS
- Non-Modeled Config.

SOURCES:
O‘Hare International Airport, Airport Noise Management System, February 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
## EXPERIMENT 802: IFR WEST
### TAXI TIMES

#### SOURCES:
- O'Hare International Airport, Airport Noise Management System, February 2017 (actual runway time);

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<th>Operations</th>
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<tr>
<td>All</td>
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</tr>
</tbody>
</table>

**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.

**SOURCES:**
- O’Hare International Airport, Airport Noise Management System, February 2017 (actual runway time);
EXPERIMENT 802: IFR WEST
RUNWAY UTILIZATION

NOTES:
1/ Simulated runway utilization is the average of 11 iterations.
2/ Historical runway utilization is from February 7, 2017.

SOURCES:
O’Hare International Airport, Airport Noise Management System, February 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 804: IFR EAST
AIRPORT THROUGHPUT

Legend
- Arrivals - TAAM
- Arrivals - ANMS
- Departures - TAAM
- Departures - ANMS
- Non-Modeled Wthr.

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are from April 30, 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 804: IFR EAST
RUNWAY 9L

Notes:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
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3/ Historical rolling hour operations are from April 30, 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

Sources:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 804: IFR EAST
RUNWAY 10C

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2/ Simulated rolling hour operations are the average of 11 iterations.
3/ Historical rolling hour operations are from April 30, 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O’Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
**EXPERIMENT 804: IFR EAST**
**RUNWAY 9R**

**Legend**
- Arrivals - TAAM
- Arrivals - ANMS
- Departures - TAAM
- Departures - ANMS

**NOTES:**
1. Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
2. Simulated rolling hour operations are the average of 11 iterations.
3. Historical rolling hour operations are from April 30, 2017.
4. Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

**SOURCES:**
O’Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
EXPERIMENT 804: IFR EAST
RUNWAY 10L

NOTES:
1/ Rolling hour calculation includes all operations in the following 60-minute period (i.e., 5:10 rolling hour includes scheduled arrival activity between 5:10 and 6:10).
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3/ Historical rolling hour operations are from April 30, 2017.
4/ Runway rotation Test 2 was in effect from April 30, 2017 to July 23, 2017. Runway rotation will not be modeled and utilization of rotation runways is not depicted.

SOURCES:
O'Hare International Airport, Airport Noise Management System, May 2017 (actual runway time); Ricondo & Associates, Inc., December 2018 (TAAM modeling).
## EXPERIMENT 804: IFR EAST
### TAXI TIMES

### Arrivals

<table>
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<tr>
<th>Runway</th>
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<th>Operations</th>
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### Departures

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<td>Historical</td>
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<td>10L</td>
<td>30:41</td>
<td>24:59</td>
</tr>
<tr>
<td>All</td>
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<td>23:02</td>
</tr>
</tbody>
</table>

**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.

**SOURCES:**
EXPERIMENT 804: IFR EAST
RUNWAY UTILIZATION

NOTES:
1/ Simulated runway utilization is the average of 11 iterations.
2/ Historical runway utilization is the average of April 30, 2017.

SOURCES:
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.
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. Background and General Operating Assumptions ................................................................. 1-1
   1.1 Terminal Area Plan and Air Traffic Procedures Environmental Assessment ........ 1-1
   1.2 Overview of Simulation Process .................................................................................. 1-2
   1.3 Weather Conditions and Operating Configurations ................................................... 1-3
   1.4 Airfield Layout and Runway End Definition Data ....................................................... 1-4
   1.5 Design Day Flight Schedule, Gating, and Aircraft Parking........................................ 1-4
      1.5.1 Air Carrier Gating and Repositioning Analysis ................................................................. 1-7
      1.5.2 Cargo and General Aviation Parking Areas...................................................................... 1-7
   1.6 Arrival Fixes by Departure Airport ............................................................................. 1-31
   1.7 Taxi Speeds .................................................................................................................. 1-31
   1.8 Intersection Departure Procedures ............................................................................ 1-31
   1.9 Runway Crossing Assumptions ............................................................................... 1-37
   1.10 Aircraft Separation/Spacing Assumptions................................................................. 1-38
   1.11 Fly Quiet Program (Noise Abatement Procedures). .................................................. 1-41

2. TAAM Simulation Summary Results ......................................................................................... 2-1
   2.1 TAAM Reporting ............................................................................................................. 2-1
   2.2 Peak Operations, Delay, and Travel Times ................................................................. 2-1
   2.3 TAAM Simulation Multi-Iteration and Annualized Results........................................ 2-4
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). 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, 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 condition\(^3\) 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.\(^5\)

---

\(^3\) 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.

\(^4\) 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.
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 operating configuration for the No Project Interim condition. The full weather analysis can be found in Appendix B.

<table>
<thead>
<tr>
<th>TAAM Experiment Number</th>
<th>Operating Configuration</th>
<th>Estimated Annual Occurrence of Modeled Operating Configurations</th>
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<td>VFR West with LAHSO</td>
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</tr>
<tr>
<td>902</td>
<td>VFR West without LAHSO</td>
<td>14.5%</td>
</tr>
<tr>
<td>903</td>
<td>IFR West</td>
<td>4.3%</td>
</tr>
<tr>
<td>904</td>
<td>VFR East with LAHSO</td>
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<tr>
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<td>3.1%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>100.0%</td>
</tr>
</tbody>
</table>

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).


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.
NOTE
GA - General Aviation


EXHIBIT 1-1
Airfield Layout
### Runway End Definition Data

#### SOURCES:

#### NOTES:
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)
4/ GS Angle - Glide Slope Angle

---

### LEGEND
- Movement Area

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<table>
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<tr>
<th>POINT</th>
<th>RUNWAY ID</th>
<th>DESCRIPTION</th>
<th>TCH</th>
<th>LS Angle</th>
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<th>LONGITUDE</th>
<th>END POINT ELEVATION</th>
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<td>651.4</td>
<td>150</td>
</tr>
</tbody>
</table>

---

### EXHIBIT 1-2

Runway End Definition Data

---

Terminal Area Plan and Air Traffic Procedures EA

Simulation Data Package - No Project Interim

APPENDIX D  
D-116  
JUNE 2022
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).
EXHIBIT 1-3 (1 OF 2)
Gate Gauge and Airline Allocation

<table>
<thead>
<tr>
<th>AIRCRAFT TYPE</th>
<th>AIRLINE ALLOCATION</th>
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</thead>
<tbody>
<tr>
<td>E145</td>
<td>Delta Air Lines</td>
</tr>
<tr>
<td>CRJ7</td>
<td>American Airlines</td>
</tr>
<tr>
<td>E175</td>
<td>United Airlines</td>
</tr>
<tr>
<td>B739</td>
<td>FIS Capable Gate</td>
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<tr>
<td>A321</td>
<td>Spirit Airlines</td>
</tr>
<tr>
<td>B753</td>
<td>CDA Common Use</td>
</tr>
<tr>
<td>B772</td>
<td>Delta Air Lines</td>
</tr>
<tr>
<td>B773</td>
<td>American Airlines</td>
</tr>
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<td>B779</td>
<td>United Airlines</td>
</tr>
<tr>
<td>CDA - Chicago Department of Aviation</td>
<td></td>
</tr>
<tr>
<td>1/ Includes All Nippon Airways, Lufthansa, and Copa departures</td>
<td></td>
</tr>
<tr>
<td>2/ Includes Aer Lingus arrivals and departures; Iberia and Japan Airlines departures</td>
<td></td>
</tr>
</tbody>
</table>

NOTES:
1/ Includes All Nippon Airways, Lufthansa, and Copa departures
2/ Includes Aer Lingus arrivals and departures; Iberia and Japan Airlines departures
3/ CDA - Chicago Department of Aviation
4/ FIS - Federal Inspection Service
**Gate Gauge and Airline Allocation**

**AIRCRAFT TYPE**
- E145
- CRJ7
- E175
- A321
- B752
- B753
- B772
- B773
- B744
- B748
- A388

**AIRLINE ALLOCATION**
- Delta Air Lines
- American Airlines
- United Airlines
- JetBlue Airways
- Alaska Airlines
- Air Canada
- Alaska Airlines
- Delta Air Lines
- American Airlines

**NOTES**
1. Includes All Nippon Airways, Philippine Airlines, and Copa departures
2. Includes Aer Lingus arrivals and departures; Iberia and Japan Airlines departures
3. CDA - Chicago Department of Aviation
4. FIS - Federal Inspection Service

**SOURCES:**
EXHIBIT 1-4 (6 OF 19)

Ramp Charts


Chicago O'Hare International Airport Draft Environmental Assessment
Exhibit 1-4 (13 of 19)

Ramp Charts


Chicago O’Hare International Airport Draft Environmental Assessment

Appendix D
D-132
June 2022

Terminal Area Plan and Air Traffic Procedures EA Simulation Data Package - No Project Interim
Ramp Charts


Chicago O'Hare International Airport

Terminal Area Plan and Air Traffic Procedures EA

Simulation Data Package - No Project Interim

EXHIBIT 1-4 (14 OF 19)
EXHIBIT 1-4 (15 OF 19)

Ramp Charts


APPENDIX D

D-134

JUNE 2022

Terminal Area Plan and Air Traffic Procedures EA

Simulation Data Package - No Project Interim
Ramp Charts

EXHIBIT 1-4 (16 OF 19)
### Ramp Charts

#### Exhibit 1.4 (17 of 19)

**Terminal Area Plan and Air Traffic Procedures EA**

**Simulation Data Package - No Project Interim**

**APPENDIX D**


**Chicago O'Hare International Airport**

**Draft Environmental Assessment**

**JUNE 2022**

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**Terminal Area Plan and Air Traffic Procedures EA**

**Simulation Data Package - No Project Interim**

**APPENDIX D**


**Chicago O'Hare International Airport**

**Draft Environmental Assessment**

**JUNE 2022**

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**Terminal Area Plan and Air Traffic Procedures EA**

**Simulation Data Package - No Project Interim**

**APPENDIX D**


**Chicago O'Hare International Airport**

**Draft Environmental Assessment**

**JUNE 2022**
## Ramp Charts

### EXHIBIT 1-4 (18 OF 19)

### Terminal Area Plan and Air Traffic Procedures EA


**Chicago O'Hare International Airport**

**Draft Environmental Assessment**

**APPENDIX D**

**JUNE 2022**

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 |
| K9/26, R18/35 (T2, T1) | K14/31 MDA (4, 4) | K14/31 MDA (5) | EWR, LGA, CLE (50) | DCA, SFO, LAS (10) | DCA, SFO, LAS (10) | JFK, LGA, CLE (50) | ANC, MDW, CLE (50) | SFO, EWR, DFW (10) | SFO, EWR, DFW (10) | SFO, EWR, DFW (10) | SFO, EWR, DFW (10) |
| 0 | CR9 | CR9 | EWR | JFK | JFK | JFK | JFK | SFO | SFO | SFO | SFO |
| 0 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 | 319 |
| 25 | 789 | 0 | 789 | 0 | 789 | 0 | 789 | 0 | 789 | 0 | 789 |
| 15 | 319 | 50 | 319 | 50 | 319 | 50 | 319 | 50 | 319 | 50 | 319 |
| 15 | 319 | 50 | 319 | 50 | 319 | 50 | 319 | 50 | 319 | 50 | 319 |

**Simulation Data Package - No Project Interim**

**November 2020**

**Drawing:** P:\Simulation\KORD_TAP_EA\Assumptions\05-Gating\AutoCAD\TAP EA - Ramp Charts - NP Interim_20200921.dwg

**Plotted:** Nov 4, 2020, 08:46PM
Repositioning Remote Locations

LEGEND
- Remote Positioning Location

NOTE
GA - General Aviation

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 widebody\(^7\) 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 distance\(^8\) 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.
EXHIBIT 1-7
Arrival Fixes by Departure Airport
West Flow

LEGEND
- MADII
- WYNE
- WATSN
- TRTLL
- BENKY
- FYTTE
- PRAKY

NOTE
1/ Prop arrivals are restricted from using TRTLL. All prop arrivals from KDEC are assigned to BENKY.


Terminal Area Plan and Air Traffic Procedures EA
APPENDIX D
D-142
JUNE 2022
EXHIBIT 1-8

Arrival Fixes by Departure Airport
East Flow

NOTES
1/ Prop arrivals are restricted from using SHAIN. All prop arrivals from KDEC and KBRL are assigned to TRTLL.
2/ KBMI, KCMI, KSPI, and KPIA arrivals are assigned to TRTLL but are offloaded to SHAIN when possible.