Attachment D:
Operational Analysis of Centerfield Taxiway Alternatives at Logan International Airport

Report No. 300280.005

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EXECUTIVE SUMMARY

This document represents Attachment D to the main report "Logan International Airport, Additional Taxiway Evaluation Report."[1] This Attachment presents an operational analysis of the use of the proposed Centerfield Taxiway.

The Total Airspace and Airport Modeller (TAAM), an airport operations simulation model, was used to simulate the southwest flow configuration at Boston-Logan International Airport (the Airport). The purpose of this analysis was to (1) assess how the Centerfield Taxiway—a full-length taxiway that will be provided between Runways 4L-22R and 4R-22L—will change aircraft taxiing patterns, departure queuing locations, and departure queuing durations and (2) provide input data to noise and air quality modeling efforts conducted subsequently by Harris Miller Miller & Hanson Inc. (HMMH).

The simulation effort focused on the southwest flow configuration at the Airport, when Runways 27 and 22L are used by arrivals and Runways 22R and 22L are used by departures. Modeling assumptions associated with these operating configurations were developed collaboratively with air traffic controllers from the Boston Airport Traffic Control Tower and reflect current air traffic control rules and Boston Tower standard operating procedures.

Two Centerfield Taxiway use scenarios were evaluated in this analysis. In the first scenario, termed Alternative 1, departures assigned to Runway 22L were assumed to taxi out to depart via Taxiway Q and the Centerfield Taxiway whereas departures assigned to Runway 22R were assumed to taxi out to depart via Taxiway November in the same manner as they do today. Departures assigned Runway 22L were presumed to be similar to those that currently use this runway for departure, namely long-haul domestic and international flights that require use of this longer runway.

In the second scenario, termed Alternative 2, Runway 22R departures were assigned to the Centerfield Taxiway on a demand responsive basis to reduce the length of the departure queue that forms on Taxiway N. In Alternative 2, Runway 22R departures were rerouted to Runway 22R via Taxiway Q and the Centerfield Taxiway when the departure queue on Taxiway November reached Runway 15L-33R. In all other aspects, Alternative 2 was the same as Alternative 1.

All TAAM simulations were conducted using a flight schedule intended to represent average day, peak month activity in the year 2010. This schedule consisted of 1,503 daily flights.

Results of the TAAM simulation experiments for both Centerfield Taxiway use scenarios were summarized in terms of unimpeded taxiing time and "delay" (additional taxi/queue time) separately for arrivals and departures, and combined overall average delay. The table below shows these results in terms of averages per operation by alternative. In addition, detailed taxiing times for individual segments of Taxiway November and the Centerfield Taxiway were summarized for use in subsequent air emissions and noise modeling efforts.

[1] "Logan International Airport, Additional Taxiway Evaluation Report per FAA August 2, 2002 Record of Decision," Harris Miller Miller & Hanson Inc. Report 300280.001, May 2006.

Results Summary

Scenario	Average unimpeded ground time (minutes)		Average taxiing delay* (minutes)		Overall average delay* (minutes)
	Arrivals	Departures	Arrivals	Departures	
Alt. 1	5.0	8.4	1.5	6.7	4.9
Alt. 2	5.0	8.5	1.5	8.2	5.6

* "Delay" represents additional taxi/queue time.
Source: Leigh Fisher Associates, March 2006.

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1 INTRODUCTION

This document represents Attachment D to the main report "Logan International Airport, Additional Taxiway Evaluation Report."[2] This Attachment presents an operational analysis of the use of the proposed Centerfield Taxiway. The main report discusses the purpose, methodology and results of all of the assessments.

The overall study of which this Attachment is a part was conducted to evaluate the environmental effects of alternative scenarios pertaining to the taxiing and queuing of aircraft on Taxiway November and on the proposed new Centerfield Taxiway whose impacts were assessed in the Environmental Impact Statement for Logan Airside Improvements Planning Project. This overall study is designed to address requirements of the Record of Decision on the EIS in which the Federal Aviation Administration (FAA) deferred a decision on the new taxiway pending an additional analysis of taxiway operations on the northern portion of the airfield. Phase 1 of the evaluation addressed Taxiway November, and is reported in the main report and other technical Attachments. The Phase 2 analysis discussed herein was conducted "to assess potential beneficial operational procedures that would preserve or improve the operational and environmental benefits of the Centerfield Taxiway."[3]

This report presents the assumptions, methodology, and findings of simulation analysis of Centerfield taxiway use alternatives proposed for Boston-Logan International Airport (the Airport). This analysis was conducted 1) to assess how the Centerfield Taxiway—a full-length taxiway that will be provided between Runways 4L-22R and 4R-22L—will change aircraft taxiing patterns, departure queuing locations, and departure queuing durations, and 2) to provide input data to noise and air quality modeling efforts conducted subsequently by Harris Miller Miller & Hanson Inc. (HMMH).

Leigh Fisher Associates (LFA) conducted the simulation analysis using TAAM, the Total Airspace and Airport Modeller, between September 2005 and December 2005. TAAM is a time-based simulation model that is able to simulate aircraft movements in detail, both in the airspace and on the ground. TAAM was selected for use in this analysis for the following reasons:

- TAAM provides users with the ability to estimate the cumulative time spent by aircraft on various taxiway sections, which was needed for subsequent noise and emissions modeling efforts.
- TAAM had been used in prior analyses of north taxiway operations conducted by HMMH and the Mitre Corporation, as well as in similar analyses at other Airports across the United States.
- TAAM provides users with the ability to trigger changes in taxiway utilization in a dynamic, demand responsive manner, similar to the way in which FAA air traffic controllers would actually manage aircraft operations on the ground.

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[2] "Logan International Airport, Additional Taxiway Evaluation Report per FAA August 2, 2002 Record of Decision," Harris Miller Miller & Hanson Inc. Report 300280.001, May 2006.

[3] Lewis, Paula, Department of Transportation, Federal Aviation Administration New England Region, "Record of Decision, Airside Improvements Planning Project, Logan International Airport, Boston, Massachusetts," Section VIII (3); 2 August 2002.

- TAAM enables models to be developed interactively with air traffic controllers, facilitating rapid model development and validation.

Although the focus of the analysis was on Centerfield Taxiway use, all of the airfield improvements proposed in the Airside Development Program Final Environmental Impact Study—including the Centerfield Taxiway, extension of Taxiway D, realignment of the southwest corner taxiway system, realignment of Taxiway November, and Runway 14-32—were incorporated into the airfield layouts modeled in the study. The airfield layout that was simulated in the study is shown in Figure 1.

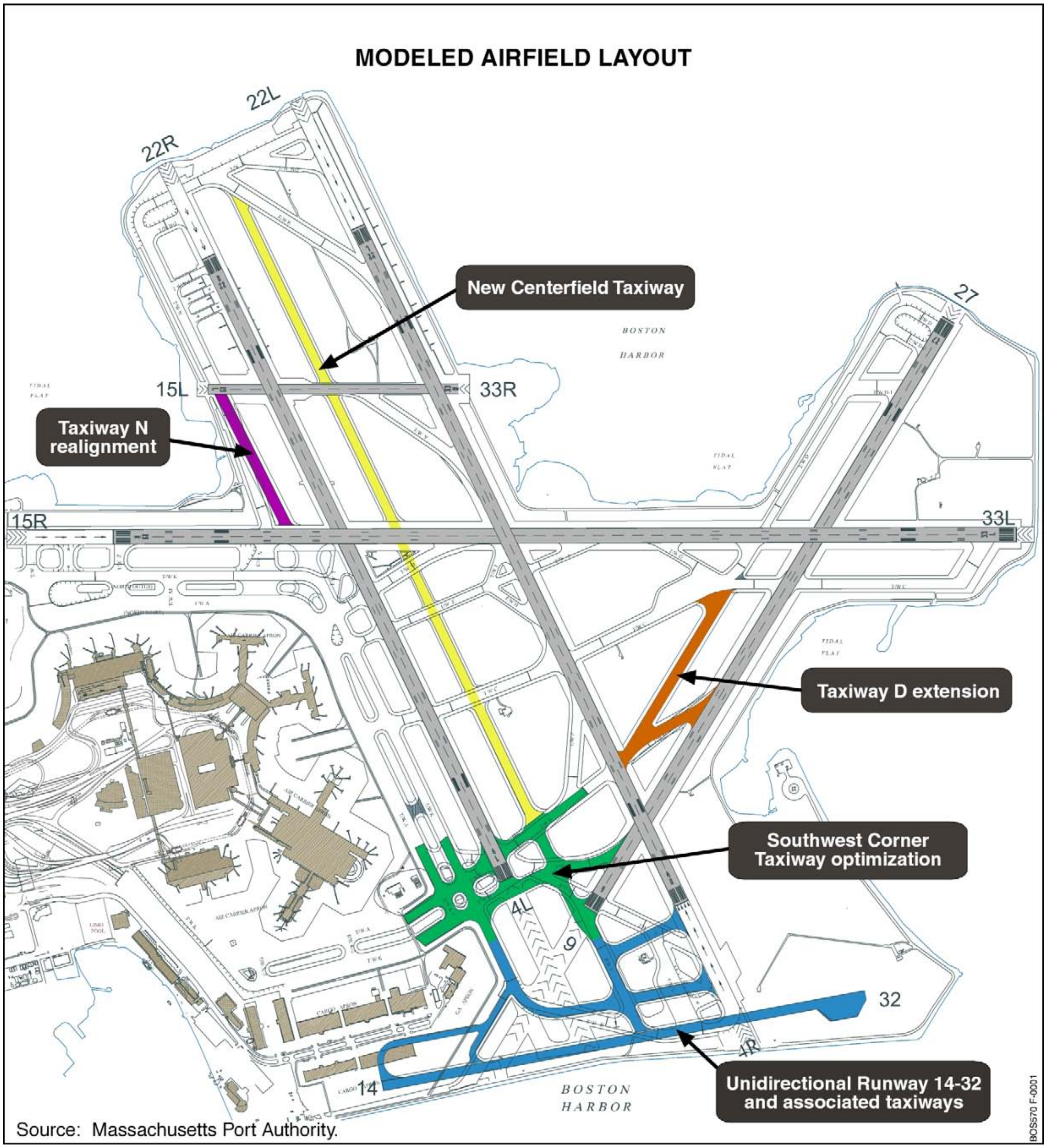


Figure 1 Modeled Airfield Layout

2 CENTERFIELD TAXIWAY USE ALTERNATIVES

Two taxiway use alternatives were evaluated in this study. The alternatives presented below differ primarily in the way the Centerfield Taxiway is used by departing aircraft north of Runway 15R-33L. These alternatives are depicted in Figure 2 and described in the following paragraphs.

2.1 Alternative 1

In Alternative 1, existing taxiway use patterns would be retained with the exception that departures assigned to Runway 22L would taxi to the northern end of Runway 22L east via Taxiway Q across Runway 22R and then north via the Centerfield Taxiway. This taxiing route would replace the existing taxiing route, in which aircraft taxi north on Taxiway November to the northern end of Runway 22R and then turn east to cross Runway 22R and enter the Runway 22L departure queue.

As described in greater detail in subsequent sections of this report, departures assigned Runway 22L were presumed to be similar to those that currently use this runway for departure, namely long-haul domestic and international flights that require use of longer Runway 22L.

2.2 Alternative 2

Alternative 2 was modeled to evaluate the effects of using the Centerfield Taxiway to balance the departure queue on Taxiway November. In this alternative, the Centerfield Taxiway is used as an alternate route for Runway 22R departures.

In Alternative 2, Runway 22R departures are re-routed to the Centerfield Taxiway when queues on Taxiway November reach the Runway 15L intersection. Aircraft that are assigned this alternate route cross Runway 22R via Taxiway Q and then taxi north on the Centerfield Taxiway. This balancing of the departure queue occurs mostly during departure peak periods.

The use of the Centerfield Taxiway by Runway 22L departures is identical to that in Alternative 1.

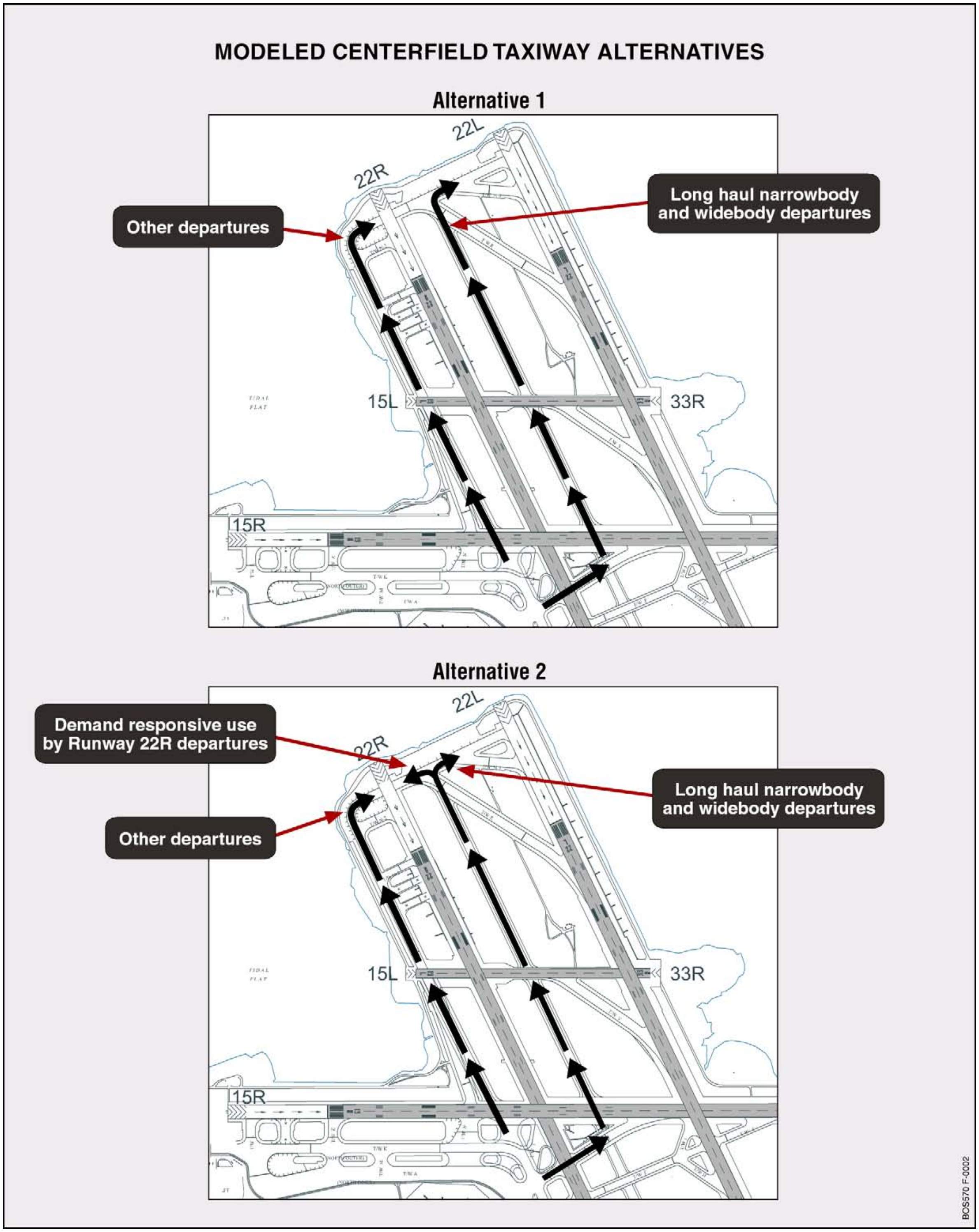


Figure 2 Modeled Centerfield Taxiway Alternatives

3 TAAM MODELING ASSUMPTIONS

The modeling assumptions discussed below were applied to both alternatives evaluated in this analysis.

3.1 Flight Schedule

Both alternatives were simulated at a projected Year 2010 activity level. LFA developed a 2010 "design day" flight schedule for use in TAAM that reflects a high-activity design day in order to approximate "worst-case" noise and air quality impacts. Table 1 provides 2010 annual activity totals obtained from the Federal Aviation Administration's (FAA's) Terminal Area Forecasts (TAF) and the corresponding 2010 "design day" traffic totals that were simulated. Figure 3 depicts the temporal distribution of the simulated traffic sample. A detailed description of the future flight schedule assumptions and development process is provided in Appendix A.

Table 1 Simulated Activity Level

	2010 Operations	
	Annual	"Design day" TAAM traffic sample
Air carrier *(1)*	246,909	776
Air taxi *(2)*	191,326	600
General aviation/Military *(3)*	40,417	127
Total	478,652	1,503

(1) Air Carrier: aircraft with seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds carrying passengers or cargo for hire or compensation.
(2) Air Taxi/Commuter: aircraft designed to have a maximum seating capacity of 60 seats or a maximum payload capacity of 18,000 pounds carrying passengers or cargo for hire or compensation.
(3) General Aviation/Military: takeoffs and landings of all civil and military aircraft, except those classified as air carriers or air taxis/commuters.

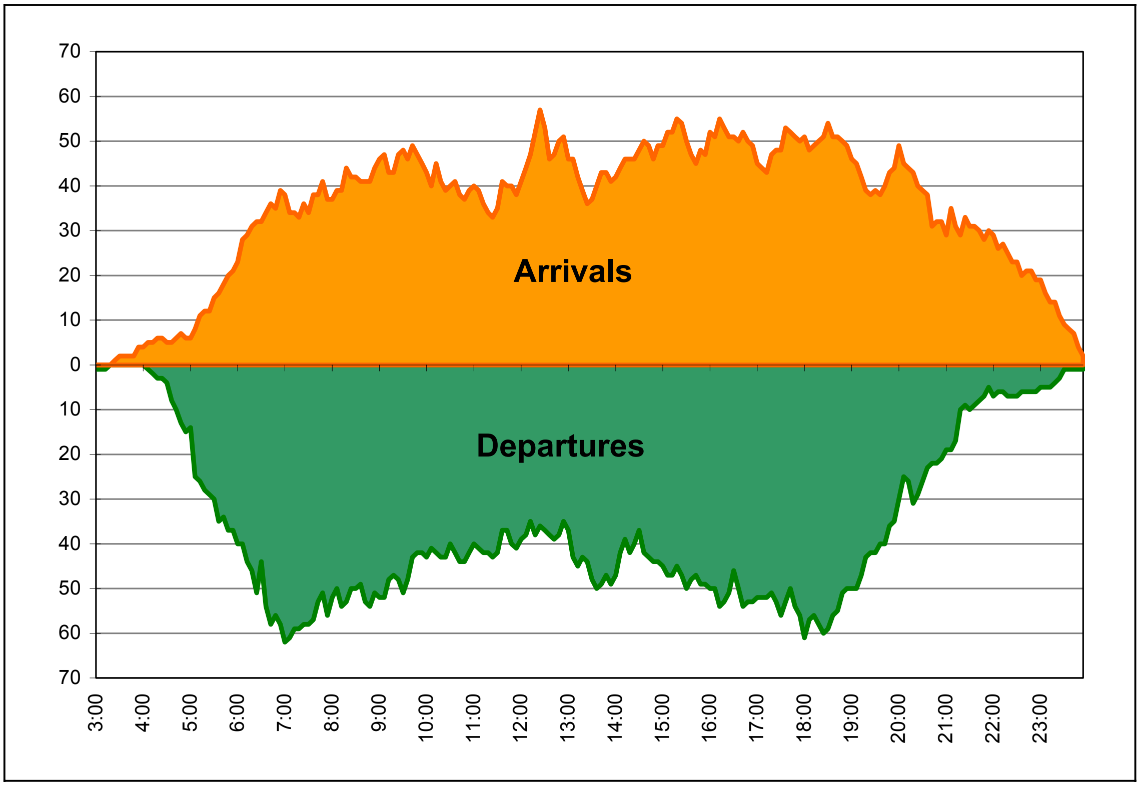
Source: Annual - Federal Aviation Administration Terminal Area Forecast.
Design day - Leigh Fisher Associates, March 2006.

3.2 Runway Use Configurations and Weather Conditions

In both of the TAAM simulation experiments[4] conducted for this analysis, a southwest flow operating configuration was assumed. In this configuration, Runways 27 and 22L were used by arrivals and Runways 22R and 22L were used by departures.

[4] In this report, a "simulation experiment" is defined as a single TAAM simulation run performed for a specified level of aviation activity, weather condition, and airfield use configuration.

Both Centerfield Taxiway use alternatives were modeled assuming that visual flight rules (VFR) conditions would be present at the Airport. Such weather conditions enable air traffic controllers to apply VFR flight procedures and visually separate arriving and departing traffic in the vicinity of the Airport.



Source: Leigh Fisher Associates, March 2006

Figure 3 Daily Traffic Profile: Simulated Traffic Schedule

3.3 Runway Assignments and Dependencies

3.3.1 Arrivals

In accordance with runway assignment strategies used by controllers, Runway 27 was modeled as the primary arrival runway, while Runway 22L was primarily used to accommodate arrivals from the north. Widebody aircraft arrivals were also assigned to the longer Runway 22L because of the additional length required by these aircraft.

TAAM input parameters were developed to approximate land-and-hold short (LAHSO) procedures that are accepted by some pilots landing on Runway 22L. Pilots that accept a LAHSO clearance to Runway 22L must exit Runway 22L before reaching the runway's intersection with Runway 27. With the use of LAHSO Boston Tower controllers can land aircraft independently on Runways 22L and 27. In cases were aircraft performance characteristics make LAHSO operations infeasible (e.g., widebody aircraft, international arrivals), approaches to the two arrivals runways were assumed to be dependent of each other.

3.3.2 Departures

Departures from the Airport were primarily assigned to Runway 22R. However some operations were “offloaded” to Runway 22L according to runway assignments observed on a flight strip data sample provided by BOS Tower. Based on the analysis of this flight strip data sample approximately 19% of widebody, 8% of narrowbody, and 1% of small jet aircraft were assigned to Runway 22L.

In south flow, noise abatement restrictions require jet aircraft departing from Runways 22L and 22R to turn left to a heading of 140 degrees on initial climb in order to avoid noise sensitive areas to the south and west of the Airport. Because of the lack of a divergent departure procedure jet aircraft departures from Runways 22R and 22L were assumed to be dependent on one another, limiting the maximum departure throughput rate that could be achieved.

3.4 Taxiway Flows

Taxiways flows were modeled based on strategies outlined in the *Logan Airside Improvements Planning Project Final Environmental Impact Statement*, and discussions with Boston Tower controllers. These taxiway strategies are summarized in the following paragraphs.

3.4.1 Arrivals

To prevent head-to-head taxiing flows on Taxiway K, aircraft assigned to gates south of Taxiway C were assumed to taxi southbound on the Centerfield Taxiway after exiting their arrival runway and cross Runway 22R at either Taxiway E or W. Aircraft assigned to gates north of or abeam of Taxiway C, were assumed to taxi northbound on the Centerfield Taxiway after exiting their arrival runway and cross Runway 22R at Taxiway C or F. TAAM was able to effectively manage head-to-head conflicts on the Centerfield Taxiway using its internal logic. Once aircraft reached the west side of Runway 22R, they were assumed to proceed via Taxiway A to their assigned gate.

3.4.2 Departures

Taxiway K was assumed to be the primary taxiing route out of the terminal area for departing aircraft. In Alternative 1, departing aircraft were then assumed to proceed via Taxiway November or the Centerfield Taxiway depending on their assigned runway. Departures assigned to Runway 22R were assumed to taxi via Taxiway November to the north end of the runway, whereas departures assigned to Runway 22L were assumed to cross Runway 22R at Taxiway Q and then taxi northward on the Centerfield Taxiway to the north end of the runway.

Similar taxiing routes were assumed in Alternative 2 except that some Runway 22R departures were rerouted to the north end of Runway 22R via Taxiway Q and the Centerfield Taxiway on a demand responsive basis. Aircraft were rerouted to Runway 22R via the Centerfield Taxiway in this manner whenever the Runway 22R departure queue on Taxiway November reached Runway 15L-33R.

These taxiway flows are illustrated in Figure 2.

3.5 Runway Crossing Parameters

In both alternatives evaluated, aircraft crossing the primary departure were assumed to use the model's runway crossing algorithm during periods of low demand. At periods of high demand, a 90-second gap was introduced in the departure stream to allow the waiting aircraft to cross Runway 22R when six or more aircraft were waiting to cross.

3.6 Airport Layout and Gate Assignments

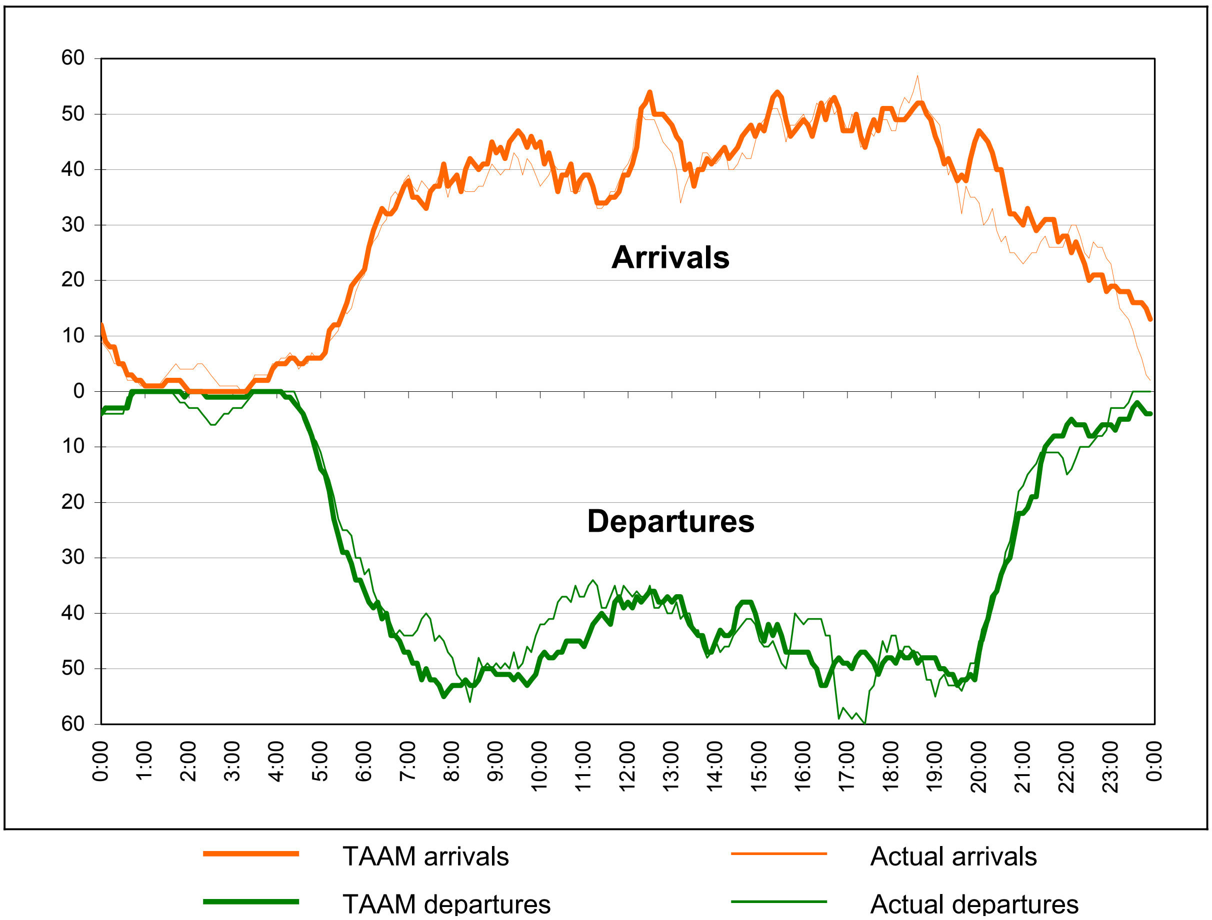
AutoCAD drawings provided by Massport were used to generate the layout for the Airport. Gate positions and airline assignments were estimated using a July 2005 Terminal layout provided by Massport. Gates at main terminals were grouped based on their usage by individual airlines. Cargo aircraft were assigned to either the north cargo apron located to the west of Terminal E, or to the south cargo apron located south of Terminal B. A general aviation parking area was defined at the northwest corner of the airfield.

4 BASELINE MODEL CALIBRATION

After an initial "draft" version of the baseline experiment was developed, LFA validated the draft experiment with FAA Boston Tower controllers and Massport staff through examination of TAAM animations, simulation queuing statistics, and runway flow rates.

A model calibration exercise was conducted to verify that the TAAM model input data produced reliable, valid results. This calibration exercise focused primarily on whether the modeled configuration produced runway flow rates comparable to historical data as well as target runway flow rates reported by the Boston Tower.

Figure 4 shows a comparison of runway flow rates for the modeled Alternative 1 with those recorded by Massport's noise monitoring system during a day when the Airport operated in the modeled south flow configuration. The figure shows flow rates for rolling 60-minute periods, measured every 6 minutes. As shown in the figure, the flow rates generated by TAAM compare well with those actually experienced at the Airport.



Source: Leigh Fisher Associates, March 2006

Figure 4 Daily Traffic Profile: TAAM Simulated vs. Actual

5 TAAM RESULTS

TAAM generates detailed output reports regarding all aircraft operations that occur in the simulation. These reports include information regarding the time spent in the simulation, the extent to which the operations were delayed relative to both scheduled and unimpeded times, and the locations at which delays were incurred. For this study, these detailed output data were summarized in terms of several key performance statistics which are shown in Table **2** and described in the following paragraphs.

5.1 Unimpeded Ground Times

"Unimpeded" aircraft ground times are measured as the unimpeded time from gate to lift-off for departures, and unimpeded time from touch-down to gate for arrivals. This "unimpeded" time is the amount of time it would take the aircraft to traverse its taxiing route if it were the only aircraft in the simulation. Average unimpeded ground times per operation for each alternative are presented in Table **2**. As expected, unimpeded departure ground times increase in Alternative 2 as taxiing distance increases when aircraft departing Runway 22R are rerouted to the Centerfield Taxiway.

Table 2 Results Summary

	Average unimpeded ground time (minutes)		Average taxiing delay (minutes)		
Scenario	Arrivals	Departures	Arrivals	Departures	Overall average delay (minutes)
Alt. 1	5.0	8.4	1.5	6.7	4.9
Alt. 2	5.0	8.5	1.5	8.2	5.6

Source: Leigh Fisher Associates, March 2006.

5.2 Taxiing Delays

For purposes of this discussion, taxiing "delays" represent additional travel times beyond the unimpeded ground times, due to the presence of other aircraft in the simulation. Taxiing delays include any delays incurred while aircraft are on the ground, including delays incurred during taxiing, departure lineup queue, runway crossings, and gate pushbacks. Average taxiing delays for each alternative are provided in Table **2**. As expected, taxiing delays increase in Alternative 2, reflecting added runway crossing delays associated with this alternative.

5.3 Overall Delay

Overall delay includes all delays incurred by aircraft during each phase of flight, including airborne delay components not included in taxiing delays. As with taxiing delay, the overall delay represents the additional travel time incurred as a result of interactions among aircraft in the simulation. Table **2** presents the average overall delays per operation for each alternative, for both arrivals and departures combined. As shown, Alternative 1 results in lower overall aircraft delays than Alternative 2.

5.4 Detailed Taxiing Times by Taxiway Segment

Detailed taxiing times for individual taxiway segments, which were developed for use as inputs for emissions and noise modeling efforts, are provided in Appendix B.

APPENDIX A 2010 DESIGN DAY FLIGHT SCHEDULE DEVELOPMENT

The following paragraphs describe the development of a flight schedule for use in Total Airspace and Airport Modeller (TAAM) simulation modeling efforts for Boston-Logan International Airport (the Airport). This flight schedule was developed to represent anticipated peak month, average day (PMAD) conditions in the year 2010.

A.1 Flight Schedule Development Process

The 2010 PMAD schedule was developed using a five-step process, which can be summarized as follows:

1. Assemble a 2005 flight schedule using historical 2005 activity data. This baseline demand flight schedule served as the primary source of information concerning (1) current aircraft fleet mixes, and (2) current temporal distributions of arrival and departure activity during the day.
2. Match arriving flights in the 2005 flight schedule with subsequent departures. Matching these flights enables more realistic simulation of aircraft activity by appropriately propagating arrival delays to subsequent departures and ensuring that departing flights do not occur until the aircraft these flights will use has landed at the Airport.
3. Establish future year flight schedule activity level targets using data on existing peak month activity, and aviation activity forecasts.
4. Develop a preliminary 2010 flight schedule via “cloning” the 2005 flight schedule to achieve specified 2010 aviation activity targets.
5. Adjust peaking patterns in the 2010 flight schedule to reflect expected dispersion of aircraft operations from peak periods as demand levels increase.

The following paragraphs describe these steps in greater detail.

A.1.1 Assembling the 2005 Flight Schedule

The 2005 flight schedule was assembled using flight activity data from two primary sources: (1) Official Airline Guide (OAG), which was used to develop the demand sample of scheduled commercial airline activity; and (2) the Massachusetts Port Authority’s (Massport’s) PASSUR system, which was used to develop the demand sample of non-scheduled activity, including charter, cargo, and general aviation activity.

Data for July 29, 2005, were used in this exercise for the following reasons:

- July has typically been one of the busiest months of activity at the Airport and is representative of airline summer scheduling patterns that are characteristic of peak month activity.
- Weather conditions at the Airport and other key airports on the East Coast of the U.S. were generally good on July 29, meaning that activity data from PASSUR were more likely to represent activity patterns unaffected by weather–related airport or airspace capacity limitations.
- July 29 provided a weekday activity pattern, which is more representative of the conditions for which airfield improvements are being planned than weekend activity patterns.

The total activity for the 2005 flight schedule included 1,465 operations of which 643 were air carrier, 702 air taxi/commuter, and 120 general aviation/military. These activity levels are consistent with those reported by the FAA's Air Traffic Analysis and Data System (ATADS) for July 29, 2005.

A.1.2 Matching Arriving and Departing Flights

As mentioned previously, arrival and departure operations were "matched" with one another when possible to reflect the relationship between arrival times and departure times. The necessary criteria for a match between an inbound and an outbound aircraft were (1) aircraft type for the two operations had to be identical (2) both aircraft had to be operated by the same carrier and (3) the estimated time of departure (ETD) of the outbound aircraft had to be later than the estimated time of arrival (ETA) of the inbound aircraft. Acceptable ranges of turn-around times based on broad aircraft categories were applied to the potential matches identified by the necessary criteria. These ranges are summarized in Table 3. Attempts were made to match inbound aircraft with outbound aircraft in the order of their ETAs and ETDs, respectively (i.e., in a first-in-first-out fashion).

Table 3 Flight Matching Criteria

	Turn-around times (minutes)	
Aircraft classification	Minimum turn-around time	Maximum turn-around time
Widebody jets (Domestic)	60	120
Widebody jets (International)	105	240
Narrowbody jets (Domestic)	25	240
Narrowbody jets (International)	60	240
Regional jets	20	120
Small props	15	120
Commuter props	20	120

Source: Leigh Fisher Associates, November 2005.

A.1.3 Establishing Future Year Activity Targets

In order to generate PMAD flight schedules that were generally consistent with the annual demand forecasts prepared by the FAA in 2005, LFA first developed target PMAD aircraft operations to guide the development of the detailed flight schedules.

In preparing these targets, the following data were reviewed:

1. Historical aircraft operations reported by the FAA for the last 12-month period of data available (October 2004 through September 2005).
2. Future aircraft operations reported by the FAA's Terminal Area Forecasts (TAF) for fiscal year 2010.

The following subsections document the development of PMAD activity levels and fleet mix distribution that were used as targets in generating the detailed PMAD flight schedules.

A.1.3.1 PMAD Activity Levels

Historical data on peak month activity in relation to annual activity were reviewed in order to develop an assumption regarding future PMAD aircraft operations as a percentage of annual aircraft operations.

Table 4 Summary of Annual & Peak Month Average Day (PMAD) Operations

	2005 *(a)*	2010
Annual aircraft operations	428,877	478,652
PMAD aircraft operations	1,347 *(b)*	1,503
PMAD as % of annual	0.31%	0.31%

(a) October 2004 through September 2005.

(b) Value for 2005 is historically observed PMAD level for August 2005 excluding weekend activity. Value for 2010 was computed by Leigh Fisher Associates, assuming that the ratio of PMAD activity to annual activity would remain constant at approximately 0.31% between 2005 and 2010.

Sources: Federal Aviation Administration 2005 *Terminal Area Forecast* .

As shown on Table 4, it was forecast that the number of PMAD aircraft operations would increase from an estimated 1,347 in 2005 to 1,503 in 2010. This increase in PMAD aircraft operations is consistent with the forecast increase in annual aircraft operations.

As shown above, the 2005 PMAD activity level is lower than the activity level in the July 29, 2005 flight schedule. We believe this reflects inordinately high levels of air taxi and other non-scheduled activity that took place on July 29, 2005, possibly because of the good weather conditions or special events (e.g., Boston Red Sox game) that occurred on this day.

A.1.3.2 Aircraft Fleet Mix

The FAA's 2005 Terminal Area Forecast was used to establish targets for the FAA's broad categories of aircraft activity—namely air carrier, air taxi/commuter, and general aviation/military. Within these broad categories, fleet mix proportions of specific aircraft types were assumed to remain at or near their existing proportions. This assumption was considered suitable and sufficient for purposes of subsequent analyses.

Table 5 below shows comparisons among historical (2005 ATADS), design day (July 29, 2005) and target (2010 Target) fleet mixes.

Table 5 Comparative Fleet Mixes

Aircraft operator *(a)*	2005 ATADS *(b)*	July 29, 2005 *(c)*	2010 Target *(d)*
Air carrier	51%	44%	52%
Air taxi/commuter	42%	48%	40%
General aviation/military	7%	8%	8%
Total	100%	100%	100%

(a) Aircraft classifications are defined as follows:
Air carrier: Operations performed carrying passengers or cargo for hire or compensation with aircraft that have a seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds.
Air taxi/commuter: Operations performed carrying passengers or cargo for hire or compensation with aircraft that have a maximum seating capacity of 60 seats or less or a maximum payload capacity of 18,000 pounds or less.
General Aviation/military: Operations other than those classified as air carriers or air taxis/commuter.
(b) FAA *Air Traffic Analysis and Data System* (ATADS) data for the period October 1, 2004 to September 30, 2005.
(c) Leigh Fisher Associates 2005 flight schedule developed using data from the *Official Airline Guide* and Massport's *PASSUR* system for July 29, 2005.
(d) FAA 2005 *Terminal Area Forecast* for Federal Fiscal Year 2010.

Source: Leigh Fisher Associates, November 2005.

As shown above, the "2010 Target" fleet mix does not differ much from the 2005 ATADS mix, but does differ from the July 29, 2005, fleet mix. In particular, the 2010 Target fleet mix includes a lower proportion of air taxi/commuter operations than the July 29 mix, but higher proportions of air carrier activity. As mentioned earlier, this could be attributed to inordinate high levels of air taxi and other non-scheduled activity because of good weather conditions or special events on July 29, 2005.

A.1.4 Adding and Subtracting Flights to Reflect Target Activity Levels

Flights were added or subtracted from the 2005 flight schedule to produce a 2010 PMAD flight schedule that approximates the 2010 target fleet mix shown in Table 5. Each of the major components of the fleet mix—air carrier, air taxi/commuter, and general aviation/military—was cloned separately, reflecting the different adjustments that needed to be made to each of these components. Table 6 shows the number of flights that were added to or subtracted from the July 29, 2005, flight schedule to create the 2010 PMAD flight schedule.

In the cases of air carrier and general aviation/military activity—where operations needed to be added to the flight schedule—flights were randomly duplicated—or cloned—as needed to achieve the target demand level. Matched flights, which consist of both an arrival and departure, were cloned as a group. In the case of air taxi/commuter traffic, flights were randomly deleted from the July 29, 2005, flight schedule to meet the target activity levels.

Table 6 2010 PMAD Schedule Activity Levels Targets

Aircraft operator *(a)*	July 29, 2005	2010 PMAD	Difference
Air carrier	643	776	133
Air taxi/commuter	702	600	(102)
General aviation/military	120	127	7
Total	1,465	1,503	38

(a) Aircraft classifications are defined as follows:
Air carrier: Operations performed carrying passengers or cargo for hire or compensation with aircraft that have a seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds.
Air taxi/commuter: Operations performed carrying passengers or cargo for hire or compensation with aircraft that have a maximum seating capacity of 60 seats or less or a maximum payload capacity of 18,000 pounds or less.
General Aviation/military: Operations other than those classified as air carriers or air taxis/commuter.

Source: Leigh Fisher Associates, November 2005.

A.1.5 Peaking Adjustments

Following the cloning process, Leigh Fisher Associates adjusted the temporal distributions of activity in order to avoid a situation in which the future flight schedules reflect an unrealistically "peaked" activity pattern, with cloned flights occurring at the exact times of the original flight from which they were cloned. To accomplish this, cloned flights were offset between 15 and 30 minutes from the times assigned to the flights from which they were cloned.

A.2 Resulting 2010 PMAD Flight Schedule

The resulting 2010 Peak Month Average Day flight schedule includes 1,503 daily operations—751 arrivals and 752 departures. Table 7 summarizes the fleet mix associated with the 2010 PMAD schedule.

Figure 3 in Section 3.2 of the body of the report shows the temporal distribution and hourly peaking patterns associated with by the future 2010 flight schedule.

Table 7 2010 Peak Month Average Day Flight Schedule

Aircraft operator *(a)*	Arrivals	Departures	Total
Air carrier	388	388	776
Air taxi/commuter	300	300	600
General aviation/military	63	64	127
Total	751	752	1,503

(a) Aircraft classifications are defined as follows:
Air carrier: Operations performed carrying passengers or cargo for hire or compensation with aircraft that have a seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds.
Air taxi/commuter: Operations performed carrying passengers or cargo for hire or compensation with aircraft that have a maximum seating capacity of 60 seats or less or a maximum payload capacity of 18,000 pounds or less.
General Aviation/military: Operations other than those classified as air carriers or air taxis/commuter.

Source: Leigh Fisher Associates, November 2005.

APPENDIX B TAXIING TIME DATA SUMMARY

This appendix provides a table of the total taxi times by location and alternative. A graphic is included to show the locations for reference.

Table 8 Taxiing Times by Taxiway Segment

TAXIING TIMES BY TAXIWAY SEGMENT

Segment name	Length (meters)	Taxiing Time (minutes) Alt. 1	Alt. 2
N1	22	32	37
N2a	80	641	648
N2b	71	473	483
N3	66	440	451
N4	80	482	512
N5	80	418	485
N6	80	389	422
N7	80	381	356
N8	80	360	265
N9	80	336	180
N10a	10	38	23
N10b	70	240	118
N11	80	257	123
N12	80	230	119
N13	80	191	115
N14	80	169	114
N15	80	163	113
N16a	49	84	69
Totals		5,323	4,632

Segment name	Length (meters)	Taxiing Time (minutes) Alt. 1	Alt. 2
X1	23	-	16
X2a	80	-	281
X2b	50	-	93
X3	80	7	280
X4	80	7	246
X5	80	7	228
X6	80	7	181
X7	80	7	134
X8	80	7	93
X9	80	7	44
X10	80	7	26
X11	80	7	18
X12a	29	2	6
X12b	51	4	11
X13	80	7	18
X14	80	7	18
X15	80	7	17
X16	80	7	18
X17	80	7	17
X18a	56	5	12
Totals		105	1,756

Segment name	Length (meters)	Taxiing Time (minutes) Alt. 1	Alt. 2
Z1	63	7	7
Z2	80	132	102
Z3	80	8	25
Z4	80	7	7
Totals		153	140

Note: See Figure for taxiway segment locations
Source: Leigh Fisher Associates, March 2006

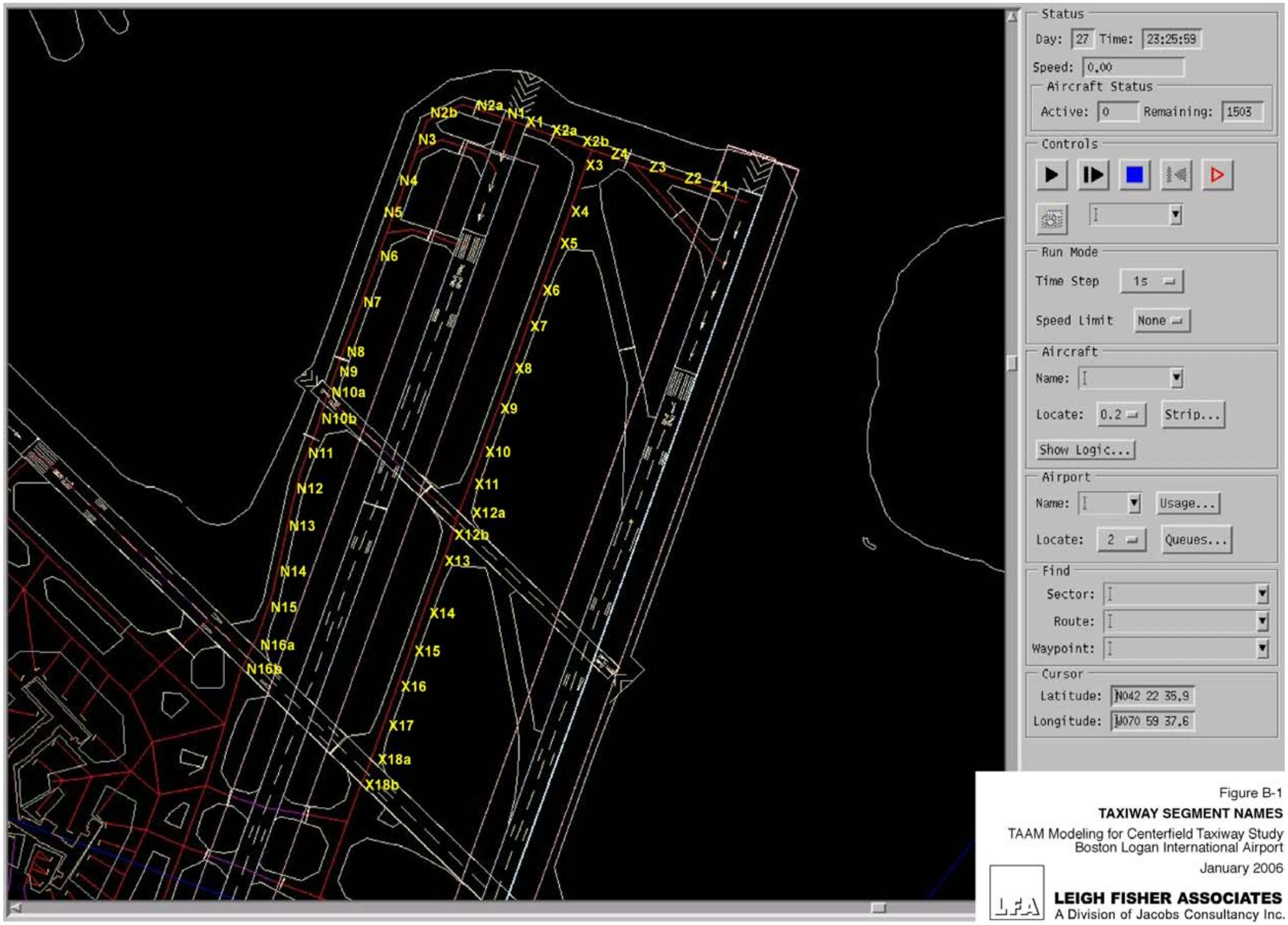


Figure 5 Taxiway Segment Names