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PORTLAND INTERNATIONAL AIRPORT

Data Package Number 5

Airport Capacity Enhancement Plan Phase II

Terminal Location Study

February 2004

Prepared by
Federal Aviation Administration
FAA William J. Hughes Technical Center
Atlantic City International Airport, New Jersey

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Information in this document is subject to change as Design Team analysis progresses.

16. Abstract

This interim report contains technical data pertaining to the Portland International Airport Terminal Location Study.

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Portland International Airport (PDX)

Data Package Number 5

Airport Capacity Enhancement Plan Phase II

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DEPARTMENT OF TRANSPORTATION UNITED STATES OF AMERICA

February 2004

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LIST OF EXHIBITS

1. INTRODUCTION

Accepted Model Inputs

The Design Team accepted the following model inputs, which were presented in Data Package 4 at the September 25th meeting. These inputs will be used in the simulations. Their details appear in Appendix B.

- Runway crossing links and clearance times for runways 10R, 10L, 10X, and 28X.
- Runway dependencies for Southbound departures on 28L & 28X, and 10R & 10X.

Status of Inputs and Tasks

Exhibit 1 shows the status of model inputs and tasks.

Model Inputs from the 2001 Study

The following lists the model inputs used during the 2001 study and this study (and defined in Appendix A):

- Aircraft Classifications.
- ATC Separations.
- Lateness Distribution (Arrival Variability Distribution).
- Gate Service Times (Minimum Turn-Around Times).

Appendices

The appendices contain detailed information:

- Appendix A lists the model inputs from the 2001 Design Team Study.
- Appendix B lists the accepted model inputs for this study.
- Appendix C contains the accepted results.
- Appendix D contains the list of abbreviations and their definitions.

EXHIBIT 1 – STATUS OF INPUTS AND TASKS

(Updated 11/17/03)

INPUTS AND TASKS	STATUS
ALPs, Improvements, Simulation Scenarios	DP5
Airline Groups and Alliances and Gate Usage—for Each Simulation Scenario	X
Exit Probabilities and Occupancy Times for: New Runway – Centralized & Decentralized Terminals – East & West Flows 10R/28L – Centralized Terminal (with taxiways realigned) – East & West Flows	X
Runway Crossing Times	X
Taxiway Routes for Each Simulation Scenario & Configuration—2 Runway Case Centralized & Existing Runways – East and West Flows – DP5 Decentralized & Existing Runways – East and West Flows – DP5 Centralized & New Runway – East and West Flows – DP5 Decentralized & New Runway – East and West Flows – DP5	DP5 Animation
Taxiway Routes for Each Simulation Scenario & Configuration—3 Runway Case Centralized & Existing Runways – East and West Flows – DP5 Decentralized & Existing Runways – East and West Flows – DP5 Centralized & New Runway – East and West Flows – DP5 Decentralized & New Runway – East and West Flows – DP5	DP5 Animation
Annual & Daily Demand	X
Fleet Mix	X
Operational Procedures & Percent Occurrence – Simulated	X
Other Model Inputs	X
Annual Demand Levels (Future Demands)	X
Demand Characteristics (Future Demands)	X
Experimental Design	DP5
Simulation Results	DP5
Travel Times – 2-Runways (Graph)	DP5
Travel Times – 3-Runways (Graph)	DP5

Note: X: The item was previously accepted and appears in Appendix B of this Data Package.
DPn: Data Package n.

2. POTENTIAL IMPROVEMENTS AND AIRPORT DIAGRAM

The Portland International Airport (PDX) Capacity Enhancement Plan Update was completed in 2001. The current Design Team was formed to evaluate the potential benefits of two terminal location alternatives – a Centralized Terminal and a Decentralized Terminal.

Exhibit 2 summarizes proposed improvements for the Airport Capacity Enhancement Plan Phase II Terminal Location Study. The potential improvements are grouped as follows:

- Airfield.
- Facilities and Equipment.
- Operational.
- User and Policy.

The proposals for this Design Team study focus on the taxiways and new terminal locations. The Airfield Delay Simulation Model (ADSIM) and SIMMOD are capable of simulating the ground movement and the PDX departure procedures. However, ADSIM was the model of choice for modeling terminal locations, taxiway delays, and number of runway crossings. **The Design Team used ADSIM for the simulations.**

Exhibit 3 lists the proposed simulation scenarios.

Exhibit 4 presents a diagram of the existing airport.

Exhibit 5 presents PDX runway configurations.

Exhibit 6 shows the modeling airfield map for the existing airport. Exhibit 7 shows the modeling airfield map with the Centralized Terminal and New Runway. Exhibit 8 shows the modeling airfield map with the Decentralized Terminal and New Runway.

The Design Team combined improvements into logical packages and reduced the required experiments to a more manageable number.

Note: This study was formed to evaluate the potential benefits of the Centralized and Decentralized Terminal locations, with and without the New Runway. This study DOES NOT evaluate the benefit of the New Runway. The benefit of the New Runway was previously evaluated in the 2001 Capacity Enhancement Plan Update.

EXHIBIT 2 - POTENTIAL IMPROVEMENTS (PDX)

(Updated 3/20/03)

<u>Airfield Improvements</u>

SIMULATE CENTRALIZED TERMINAL.

- Without departure noise restrictions -- *All Aircraft Can Do Divergent Turns*
- With & without the 3rd parallel runway (full length,12,000' long, & 3250' south of existing 10R/28L).
- North/South Taxiway connecting the East ends of the existing parallel runways -- all demands.

SIMULATE DECENTRALIZED TERMINAL.

- Without departure noise restrictions -- *All Aircraft Can Do Divergent Turns*
- With & without the 3rd parallel runway (full length,12,000' long, & 3250' south of existing 10R/28L).
- North/South Taxiway connecting the East ends of the existing parallel runways -- all demands.

FULL-LENGTH Parallel Runway.

- **Imp (D+C1+B) in 2001 Data Pkg 7.**
- 12,000' long and 3,250' south of existing 10R/28L.
- Without departure noise restrictions.
- 3 independent arrival streams to parallel runways in VMC -- TRIPLES IN VFR1 and VFR2.
- 2 independent arrival streams to outboard runways in IMC -- (IFR1).
- North/South Taxiway connecting the East ends of the existing parallel runways -- all demands.
- North/South Taxiway connecting the East ends of the new runway to 10R/28L, with Decentralized Terminal –- all demands.

N/S taxiway connecting East ends of the existing parallel runways.

- **Imp (C) in 2001 Data Pkg 7.**
- North/South taxiway would relieve ground congestion in the East and West Flows.
- In the East Flow, it would reduce taxi times for arrivals on 10L, which are gated in Terminals A, B, and C. By enabling more arrivals to land on 10L, it would let more southbound props depart on 10R. With the existing noise restrictions, the taxiway would give controllers more flexibility in departing aircraft, especially in the West Flow.
- With no noise restrictions, departure runways could be assigned based on direction of flight rather than gate location -- especially in the West Flow.

<u>Facilities and Equipment Improvements -- none</u>

<u>Operational Improvements -- none</u>

<u>User and Policy Improvements/Options -- none</u>

Notes: Simulations assume simultaneous straight-in visual approaches are permitted.
Existing runways are separated by 3,100'.
FAATC notes on 1999 instrument approaches at PDX:

CAT II/III ILS:	10R
CAT I ILS:	10R/L, 28R/L
LOC/DME:	21
VOR/DME:	21, 28R
NDB or GPS:	28L
NDB:	28R

EXHIBIT 3 - SIMULATION SCENARIOS (PDX)

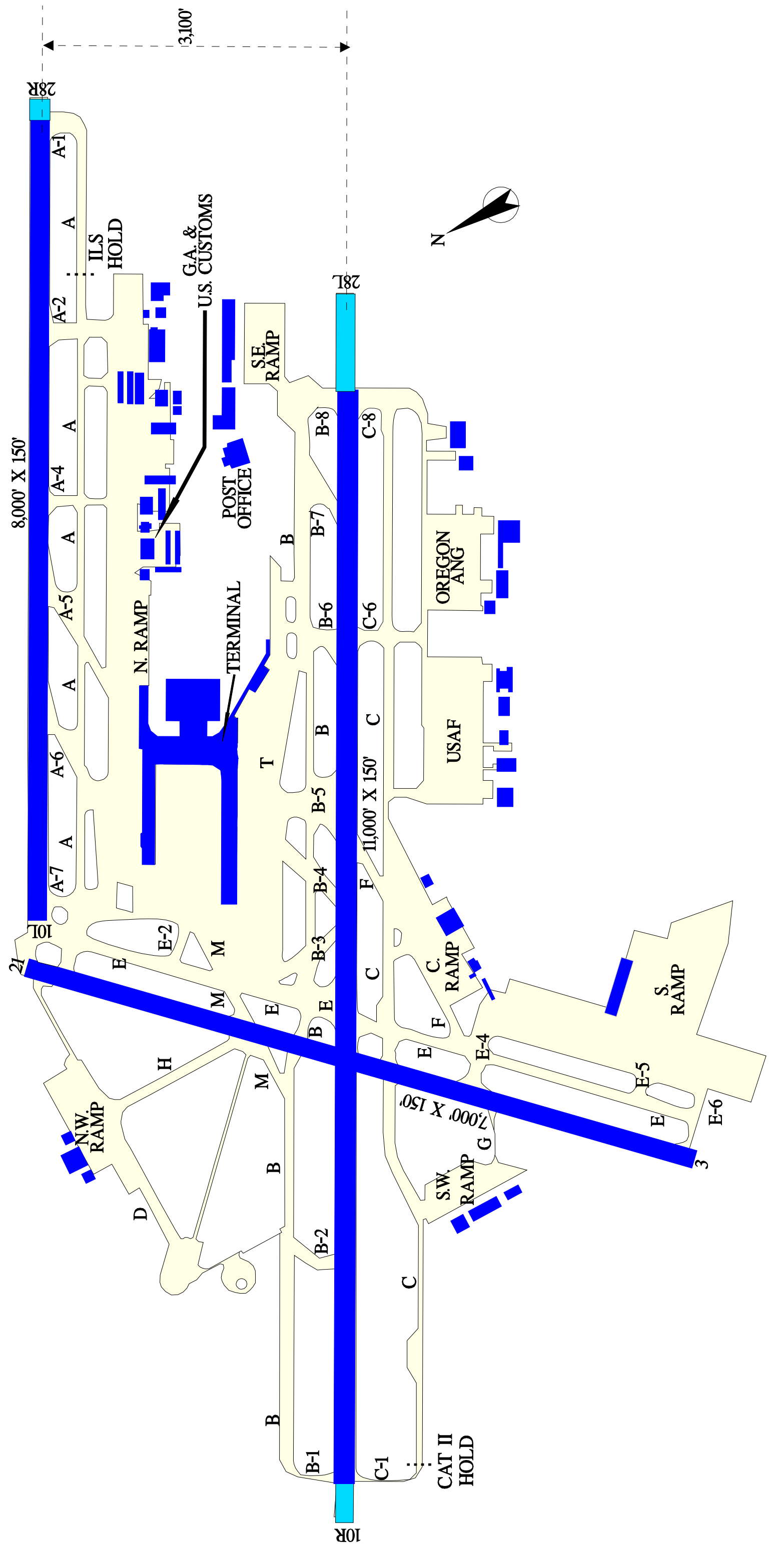
(Updated 9/17/03)

		Simulate at These Demand Levels		
Pkg	**Description of Package**	**F1**	**F1.5**	**F2**
(A)	**Centralized Terminal & 2 Existing parallel runways** • ***No Departure Noise Restrictions (All Aircraft Can Do Divergent Turns)*** • ***N/S Twy Connecting East Ends of Existing Parallels -- all demands***	Y	Y	Y
(B)	**Decentralized Terminal & 2 Existing parallel runways** • ***No Departure Noise Restrictions (All Aircraft Can Do Divergent Turns)*** • ***N/S Twy Connecting East Ends of Existing Parallels -- all demands***	Y	Y	Y
(C)	**FULL LENGTH Parallel Runway**	Not Simulated		
(C+A)	**Centralized Terminal & Full Length Parallel Runway** • ***No Departure Noise Restrictions (All Aircraft Can Do Divergent Turns)*** • ***N/S Twy Connecting East Ends of Existing Parallels -- all demands*** • ***3 Independent Arrival Streams to Parallels in VMC -- triple approaches in VFR1/VFR2***	Y	Y	Y
(C+B)	**Decentralized Terminal & Full Length Parallel Runway** • ***No Departure Noise Restrictions (All Aircraft Can Do Divergent Turns)*** • ***N/S Twy Connecting East Ends of Existing Parallels -- all demands*** • ***N/S Twy to East Ends of New Runway – all demands*** • ***3 Independent Arrival Streams to Parallels in VMC -- triple approaches in VFR1/VFR2***	Y	Y	Y

Notes:

- **Y/N/? -- Do/Do Not/Maybe Simulate at this demand level.**
- **Model Centralized vs. Decentralized Terminal at 3 operational levels (484,000 ops, 554,000 ops, and 620,000 ops) to capture taxiway travel times and delay using ADSIM.**
  - Do-Nothing Case will not be modeled – it is not needed. Instead, the model will be calibrated against an improvement scenario from the 2001 Study -- (C1+B), N/S Twy and All Aircraft Can Diverge. 8/4/03
  - Model N/S Taxiway connecting East Ends of Existing Parallel Runways.
  - Model N/S taxiway connector to the new runway as an integral part of the new third parallel, with the Decentralized Terminal. (Connector is on the East Side.)
  - East and West Flows.
  - VFR1 schedule (full demand) will be used to capture taxi times and runway crossings. VFR2 and IFR1 will not be simulated. (See Appendix B, page B-2. 7/15/03)
  - Measure arrival and departure taxi times, and the number of runway crossings.
  - Use 2 sink nodes for each new terminal location (Centralized, Decentralized). Military and Cargo will be relocated. If there is less than 25% difference in the terminal options, all agreed to add more nodes to the terminal configurations.
  - Runway 3/21 will be considered an operational runway with the 2-runway simulations.
  - Runway 3/21 will become a taxiway for the 3-runway simulations.
  - **No Departure Noise Restrictions=Divergent Turns. (Departure Noise Restrictions were studied in the 2001 Design Team & 2002 Tactical Initiatives. There was no need to include them in this study. 9/17/03)**
  - **ATC departure runway dependencies include departure-air crossovers for northbound departures on 28L and southbound departures on 28L, 28R, and 28X. 7/15/03**
  - VFR1 and VFR2 are VMC. IFR1 is IMC.
  - **Assume 10L and Taxiway E-2 are extended for all simulations. Assume 10L extension would be constructed prior to 2010. (The Tower said Runway 3/21 is used as a taxiway 90% of the time. It is used as a runway only 10-15 days per year. Tower thought the extended E-2 should be in place for the 2-runway case and that it would also provide a benefit to PDX for the current airport.) 6/20/03**

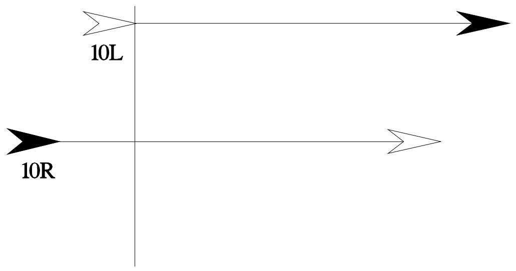
EXHIBIT 4 - PORTLAND AIRPORT LAYOUT – EXISTING AIRFIELD

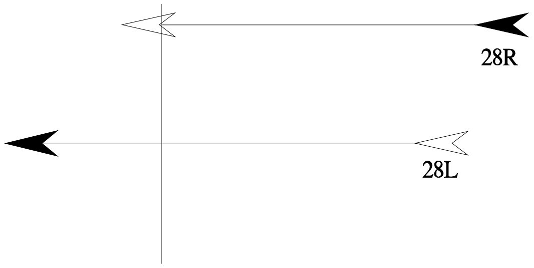


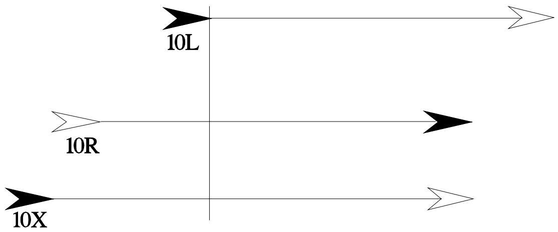
Updated 9/18/03:	**Deleted E-1 designator. Alpha taxiway runs the whole length of the runway.**
Updated 10/15/01:	Updated table to reflect the changes in Concourse C. Corrected CAT II.
Updated 10/4/00:	Exits B-3 & B-4 were added. Gate areas were updated. Taxiway T was extended west. Hold lines were moved. Exit A-3 was removed.

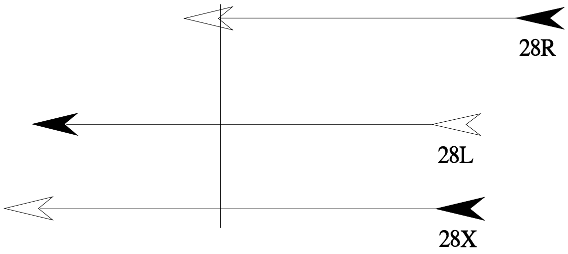
EXHIBIT 5 - RUNWAY CONFIGURATIONS

(Updated 9/17/03)


EAST VFR -- EXISTING RUNWAYS


WEST VFR -- EXISTING RUNWAYS


EAST VFR -- WITH NEW RUNWAY

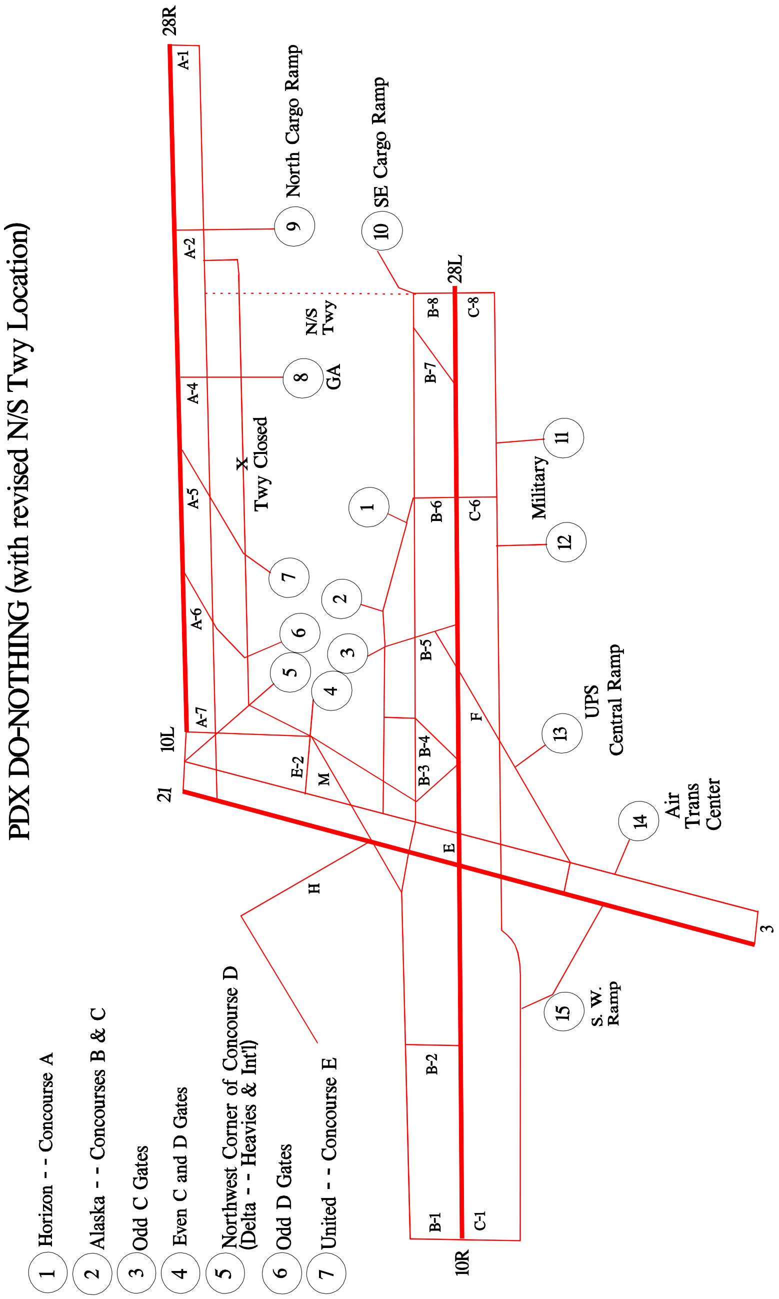

WEST VFR -- WITH NEW RUNWAY

◀ = PRIMARY ARR OR DEP RUNWAY

Notes: **Runway 3/21 will be considered a taxiway in the 2-runway simulations because the Tower said 3/21 is used as a taxiway 90% of the time. 9/17/03**
Runway 3/21 will become a taxiway in the 3-runway simulations.
Runway 10L/28R extension is for departures. Arrival thresholds will probably remain the same.
The new south runway, 10X/28X, can be used for any type of arrival. No jets can depart on the runway. Only Southbound props can depart on the runway. This is due to ATC departure-air crossover issues (not noise restrictions).

EXHIBIT 6 - MODELING AIRFIELD MAP -- PDX DO-NOTHING

(Updated 9/17/03)



Note: The West end of Taxiway C was redrawn to be more realistic, 3/12/03.
The Do-Nothing airfield was simulated in the 2001 Design Team.
The map was corrected on 4/16/03. Primary corrections include: A-7, B-2, B-3 & B-4, and E-1. Concourses were properly named. Other corrections were cosmetic.
Deleted E-1 designator on 9/17/03.

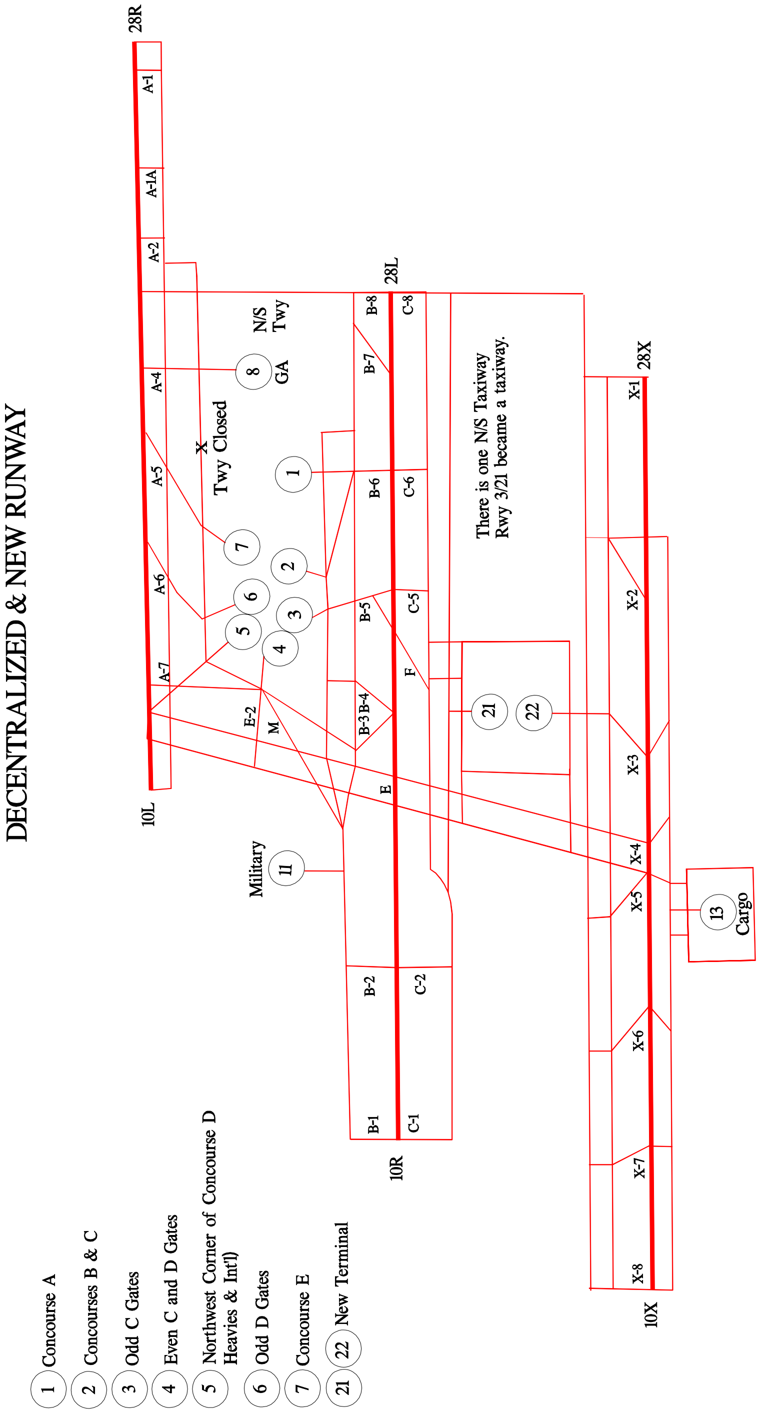
EXHIBIT 7 - MODELING AIRFIELD MAP – PDX WITH CENTRALIZED TERMINAL

(Updated 9/17/03)

Note: This airfield will be used for the 2-runway simulations and the 3-runway simulations. **All simulations will assume that the 10L/28R and E-2 extensions are in place. All simulations will also assume the mid-field N/S taxiways are in place, and Runway 3/21 will be a taxiway and realigned. 9/17/03**
The map was corrected on 4/16/03. Primary corrections include: A-7, B-2, B-3 & B-4, and X-5. Concourses were properly named. Other corrections were cosmetic.
Deleted E-1 designator on 9/17/03.

EXHIBIT 8 - MODELING AIRFIELD MAP – PDX WITH DECENTRALIZED TERMINAL

(Updated 9/17/03)



Note: This airfield will be used for the 2-runway simulations and the 3-runway simulations. **All simulations will assume that the 10L/28R and E-2 extensions are in place.** 6/20/03

The map was corrected on 4/16/03. Primary corrections include: A-7, B-2, B-3 & B-4, X-5, and X-7. Concourses were properly named. Other corrections were cosmetic.

All simulations assume Runway 3/21 will be a taxiway. 9/17/03

Deleted E-1 designator on 9/17/03.

3. ADSIM SIMULATIONS AND RESULTS

Simulation Results

Exhibit 9 graphically shows the Total Travel Times from ADSIM simulation results for the 2-Runway cases.

Exhibit 10 graphically shows the Total Travel Times from ADSIM simulation results for the 3-Runway cases.

Exhibit 11 has the detailed ADSIM simulation results.

PDX Experimental Design

Exhibit 12 describes the PDX Experimental Design. The Experimental Design consists of three demand levels (daily aircraft schedules). The Experimental Design normally includes runs for VFR and IFR simulations and for operations in both directions on each runway. For the Terminal Location Study, only the VFR1 condition was simulated. **This study measures the taxi travel times and number of runway crossings associated with the terminal location, with and without the new runway.**

The improvements were combined into logical packages to facilitate the analysis.

Discussion of Special Issues

Assume Taxiway E-2 is extended for all simulations. The Tower said Runway 3/21 is used as a taxiway 90% of the time. It is used as a runway only 10-15 days per year. The Tower thought the extended E-2 should be in place for the 3-runway case and that it would also provide a benefit to PDX for the current airport. **The benefit of extending E-2 can be evaluated in a Tactical Initiative at the end of this study. 6/18/03.**

For the Terminal Location Study, only the VFR1 condition will be simulated. This study measures the taxi travel times and number of runway crossings associated with the terminal location. Taxiway congestion is greatest in VFR1 because demand and taxiway delays are greatest in VFR1. When using the same runway assignments, the nominal travel times are the same in all weather conditions. There is less taxiway delay in VFR2 and IFR1 because the arrival rates are lower in those conditions and there is less taxiway congestion. **Therefore, only the EAST VFR1 simulations are required to represent East Flow and only the WEST VFR1 simulations are required to represent the West Flow. 2/10/04.**

When simulating the East Flow, the East Flow used the same runway dependencies as the West Flow to quickly simulate the East Flow and because the Tower said East and West Flows are similar. Those results are shown in this report. As time allowed, we tested this assumption and ran the East Flow simulations with actual East Flow dependencies. The results were similar and differences are described later in this report. **Because both methods of simulating the East Flow dependencies produce similar results, one could use the West Flow dependencies for the East Flow. 2/10/04.**

(A) CENTRALIZED AND 2-RUNWAYS – NO GROUND CROSSINGS

The modeling assumed that there would be enough space on Taxiway E (realigned) for aircraft to taxi around aircraft parked at the end of Concourse C. These simulations used the revised departure taxiway routes from ADSIM gates 6, 7, and 8 to Runway 28L so those departures would use the N/S Taxiway connecting the East ends of the Existing Runways.

Results

The East Flow travel times are higher than the West Flow travel times. Exhibit 9 graphically shows the travel times for the East and West Flows.

	Travel Times – Centralized		
Flow & Experiment	F1	F1.5	F2
West (601H series)	11,453	15,143	20,994
East (604H series)	12,974	17,500	25,542
East Times are Higher than West by	13%	16%	22%

Notes: The East Flow was simulated using the runway dependencies from the West Flow. As time permitted, the Tech Center ran the simulation for the F1 demand using the actual East Flow dependencies. The travel times for that simulation were 1% higher than those using the West Flow dependencies for the East Flow.

The East Flow travel times are higher than the West Flow travel times primarily due to taxiway congestion where departures are in a queue for 10L.

Runway Assignments

There were no runway crossings on the ground. Air Carriers were assigned by Route of Flight.

The Tech Center applied the following logic provided by the Tower:

- The N/S Taxiway was used in the West Flow.
- All Military operations arrive and depart on 28L.
- All Cargo arrive and depart on 28L.
- All GA arrive and depart on 28R.
- **All Air Carrier operations are assigned by Route of Flight with a few exceptions.**
- **No runway crossings on the ground.**

The following table shows the runway use for the Centralized 2-Runway Case at Future 2:

West and East Flow Runway Use

	Arrivals		Departures	
	28R/10L	28L/10R	28R/10L	28L/10R
Centralized	56%	44%	38%	62%

Note: Centralized had no runway crossings. Air Carrier arrivals and departures were assigned by Route of Flight. There were no air carrier crossovers in the air.

(B) DECENTRALIZED AND 2-RUNWAYS

The Design Team tried to minimize the number of times an aircraft crossed an active runway when it evaluated various methods of assigning aircraft to the runways. When aircraft were assigned by Gate to avoid crossing a runway on the ground, there were air crossovers. When aircraft were assigned by Route of Flight to avoid crossing in the air, there were ground crossovers.

The following describes the logic used in generating the runway assignments for the simulations:

- **(B-1) 611K – NO crossings on the ground (ARR & DEP assigned by Gate)**
- **(B-2) 611C –X2 – ARR cross on the ground (ARR by Route of Flight, DEP by Gate)**
- **(B-3) 611C-NEW2 – ARR & DEP cross on the ground (ARR & DEP by Route of Flight)**

Results

In most cases, the East Flow travel times were less than 10% higher than the West Flow travel times. Exhibit 9 graphically shows the travel times for the East and West Flows.

		Travel Times – Decentralized		
	Flow & Experiment	F1	F1.5	F2
(B-1)	**611K – West – NO crossings on the ground**	16,464	32,142	59,662
	614K – East – NO crossings on the ground	18,212	34,547	67,651
	East Times are Higher than West by	11%	7%	13%
(B-2)	**611C –X2 – West – ARR cross on the ground**	14,394	23,059	38,133
	614C –X2 – East – ARR cross on the ground	15,539	24,304	40,148
	East Times are Higher than West by	8%	5%	5%
(B-3)	**611C-NEW2– West– ARR & DEP cross on the ground**	13,676	18,706	27,237
	614C-NEW2– East– ARR & DEP cross on the ground	14,557	19,856	29,631
	East Times are Higher than West by	6%	6%	9%

Note: The East Flow was simulated using the West Flow runway dependencies. As time permitted, the Tech Center ran the simulations for the F1 demand using the actual East Flow dependencies. The travel times for most of those simulations were 1% higher than those using the West Flow dependencies for the East Flow.

Runway Assignments

The Tech Center applied the following logic for assigning runways:

- All Military operations arrive and depart on 28L.
- All GA arrive 28R. Southbound GA depart on 28L.
- **For the 611K simulations:**
  - All Cargo and Air Carrier operations are assigned by Gate.
  - **There were no runway crossings on the ground.**
- **For the 611C-X2 simulations:**
  - All Cargo and Air Carrier arrivals are assigned by Route of Flight and their departures are assigned by Gate.
  - **There were many arrival runway crossings on the ground.**
- **For the 611C-NEW2 simulations:**
  - All Cargo and Air Carrier operations are assigned by Route of Flight.
  - **There were many arrival and departure runway crossings on the ground.**

The following table shows the runway use for the Decentralized 2-Runway Case at Future 2:

		West and East Flow Runway Use			
		Arrivals		Departures	
		28R/10L	28L/10R	28R/10L	28L/10R
(B-1)	611K – West – NO crossings on the ground	37%	63%	34%	66%
(B-2)	611C –X2 – West – ARR cross on the ground	55%	45%	39%	61%
(B-3)	611C-NEW2– West– ARR & DEP cross on the ground	57%	43%	43%	57%

(C+A) CENTRALIZED AND 3-RUNWAYS

These simulations used the revised departure taxiway routes from ADSIM gates 6, 7, and 8 to Runway 28L so those departures would use the N/S Taxiway connecting the East ends of the Existing Runways.

The initial runway assignment logic for the Centralized 3-Runway case had arrivals on all 3 runways, but primarily on the existing runways to reduce taxi time and the number of runway crossings. However, if the runway were constructed, the Tower and the Tech Center felt it would be more reasonable to have arrivals on the outer runways. It would reduce arrival and departure delays on the existing runways. The arrivals would cross an active runway on the ground. Since it would be a departure-only runway, the runway crossing could be done safely and easily. **Therefore, the Tower and the Tech Center recommend using the simulations with arrivals on the outer runways and eliminating the simulations with arrivals on 3 runways. Both sets of results are presented below.**

Results

Exhibit 10 graphically shows the travel times for the West Flow Centralized and Decentralized cases.

The travel times with arrivals on 3 runways and arrivals on the outers are very close. The reduction in delays offset the increase in taxi times.

With arrivals on 3 runways, the East Flow travel times are higher than the West Flow travel times. We did not simulate arrivals on the outer runways for the East Flow. We expect those East Flow delays to be higher than the West Flow.

	Travel Times – Centralized		
Flow & Experiment	F1	F1.5	F2
ARRIVE ON 3 RUNWAYS (primarily the existing)			
West (621D series)	11,086	13,973	18,050
East (624D series)	11,997	15,903	21,264
East Times are Higher than West by	8%	14%	18%
ARRIVE ON OUTER RUNWAYS			
West (621F series)	11,300	14,141	18,005
East (624F series)	East Flow	Was Not	Simulated

Note: The East Flow was simulated using the runway dependencies from the West Flow. As time permitted, the Tech Center ran the simulation for the F1 demand using the actual East Flow dependencies. The travel times for that simulation were 2% higher than those using the West Flow dependencies for the East Flow.

The Tech Center applied the following logic provided by the Tower:

- All Military operations arrive and depart on 28L.
- **All Cargo arrive 28X.**
- **All Cargo depart on 28L, except Southbound Cargo, which depart 28X.**
- All GA arrive on 28R. Southbound GA depart on 28L.
- **For 621D series – ARRIVE ON EXISTING RUNWAYS:**
  - All Air Carrier operations are assigned by Route of Flight with a few exceptions.
  - **No runway crossings on the ground.**
- **For 621F series – ARRIVE ON OUTER RUNWAYS:**
  - All Air Carrier operations are assigned by Route of Flight with a few exceptions.
  - **Arrivals do many runway crossings on the ground. They cross a departure-only runway.**

The following table shows the runway use for the Centralized 3-Runway Case at Future 2:

	West and East Flow Runway Use					
	Arrivals			Departures		
	28R/10L	28L/10R	28X/10X	28R/10L	28L/10R	28X/10X
621D – ARR EXISTING	51%	40%	9%	38%	57%	5%
621F – ARR OUTERS	53%	2%	45%	30%	64%	6%

(C+B) DECENTRALIZED AND 3-RUNWAYS

These simulations used the revised departure taxiway routes from ADSIM gates 6, 7, and 8 to Runway 28L so those departures would use the N/S Taxiway connecting the East ends of the Existing Runways.

The initial runway assignment logic for the Decentralized 3-Runway case had arrivals on all 3 runways to reduce taxi time and the number of runway crossings. After additional analysis, the Tower and the Tech Center felt it would be more reasonable to have arrivals on the outer runways. It would reduce arrival and departure delays on the existing runways. The arrivals would cross an active runway on the ground. Since it would be a departure-only runway, the runway crossing could be done safely and easily. **Therefore, the Tower and the Tech Center recommend using the simulations with arrivals on the outer runways and eliminating the simulations with arrivals on 3 runways. Both sets of results are presented below.**

Results

Exhibit 10 graphically shows the travel times for the West Flow Centralized and Decentralized cases.

The travel times with arrivals on 3 runways and arrivals on the outers are close. The reduction in delays offset most of the increase in taxi times.

With arrivals on 3 runways, the East Flow travel times are higher than the West Flow travel times. We did not simulate arrivals on the outer runways for the East Flow. We expect those East Flow delays to be higher than the West Flow.

	Travel Times – Decentralized		
Flow & Experiment	F1	F1.5	F2
ARRIVE ON ALL 3 RUNWAYS			
West (631G series)	9,436	12,440	16,792
East (634G series)	10,497	13,500	18,158
East Times are Higher than West by	11%	9%	8%
ARRIVE ON OUTER RUNWAYS			
West (631H series)	10,452	13,664	17,987
East (634H series)	East Flow	Was Not	Simulated

Note: **The East Flow was simulated using the runway dependencies from the West Flow. As time permitted, the Tech Center ran the simulation for the F1 demand using the actual East Flow dependencies. The travel times for that simulation were 1% higher than those using the West Flow dependencies for the East Flow.**

The Tech Center applied the following logic provided by the Tower:

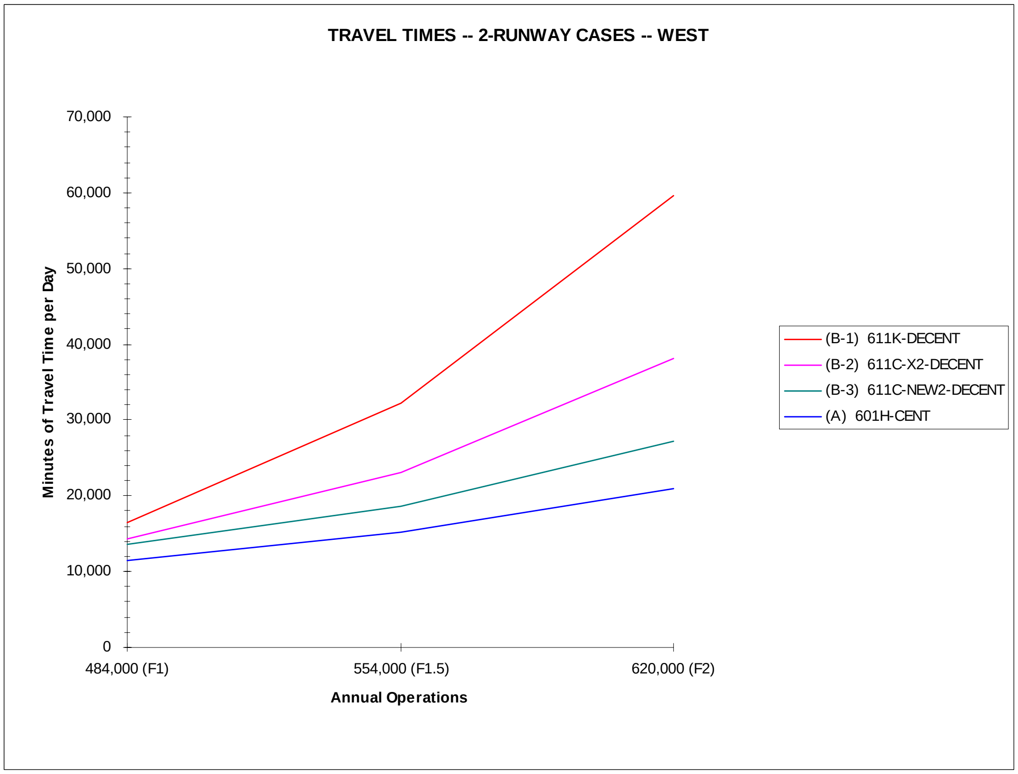
- The N/S Taxiway was used in the West Flow.
- All Military operations arrive and depart on 28L.
- All Cargo arrive on 28X.
- All Cargo depart on 28L, except Southbound props which depart on 28X.
- All GA arrive 28R. Southbound GA depart 28L.
- **For 3-arrival runways:**
  - Commercial Arrivals and Departures are assigned by Gate.
  - **No runway crossings on the ground, except for Cargo departures on 28L and 28X.**
- **For Arrivals on the Outer Runways:**
  - Commercial Arrivals are assigned by Route of Flight.
  - Commercial Departures are assigned by Gate.
- **Arrivals cross on the ground. Cargo departures on 28L and 28X cross on the ground.**

The following table shows the runway use for the Decentralized 3-Runway Case at Future 2:

	West and East Flow Runway Use					
	Arrivals			Departures		
	28R/10L	28L/10R	28X/10X	28R/10L	28L/10R	28X/10X
631G – ARR ON 3 RUNWAYS	33%	20%	47%	19%	69%	12%
631H – ARR OUTERS	52%	2%	46%	19%	69%	12%

EXHIBIT 9 - PDX TRAVEL TIME RESULTS FOR 2-RUNWAY CASES (GRAPHS)

(Updated 1/27/04)



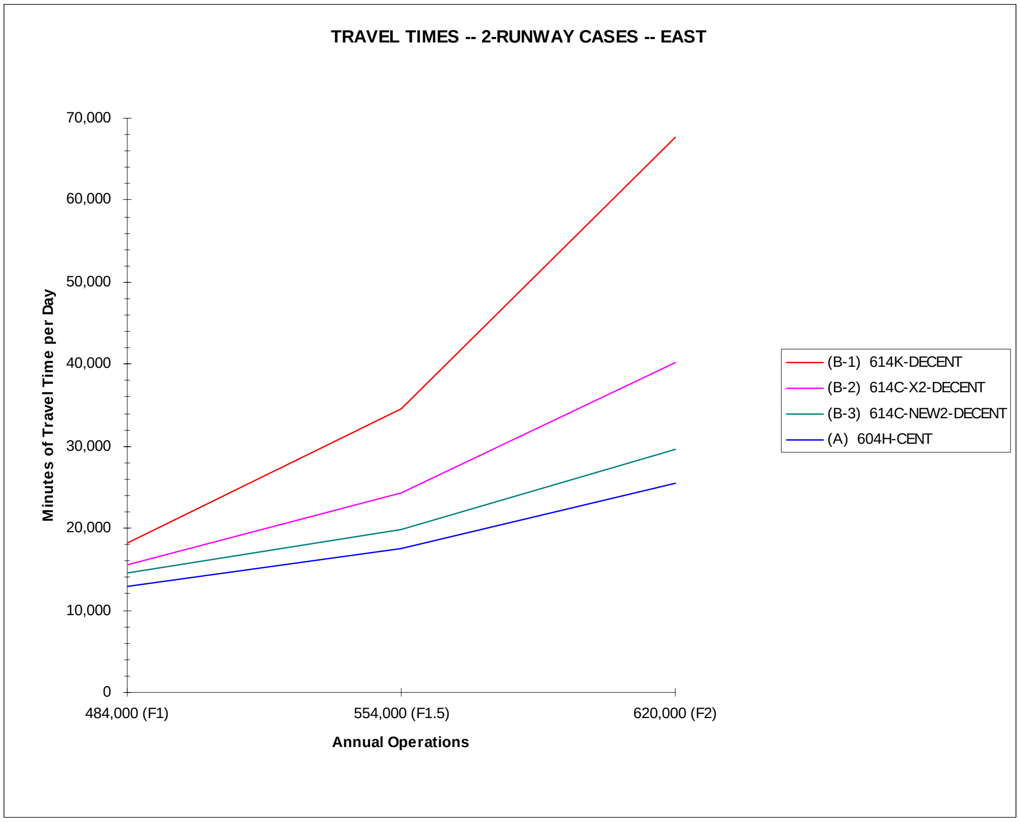


EXHIBIT 10 - PDX TRAVEL TIME RESULTS FOR 3-RUNWAY CASES (GRAPH)

(Updated 2/10/04)

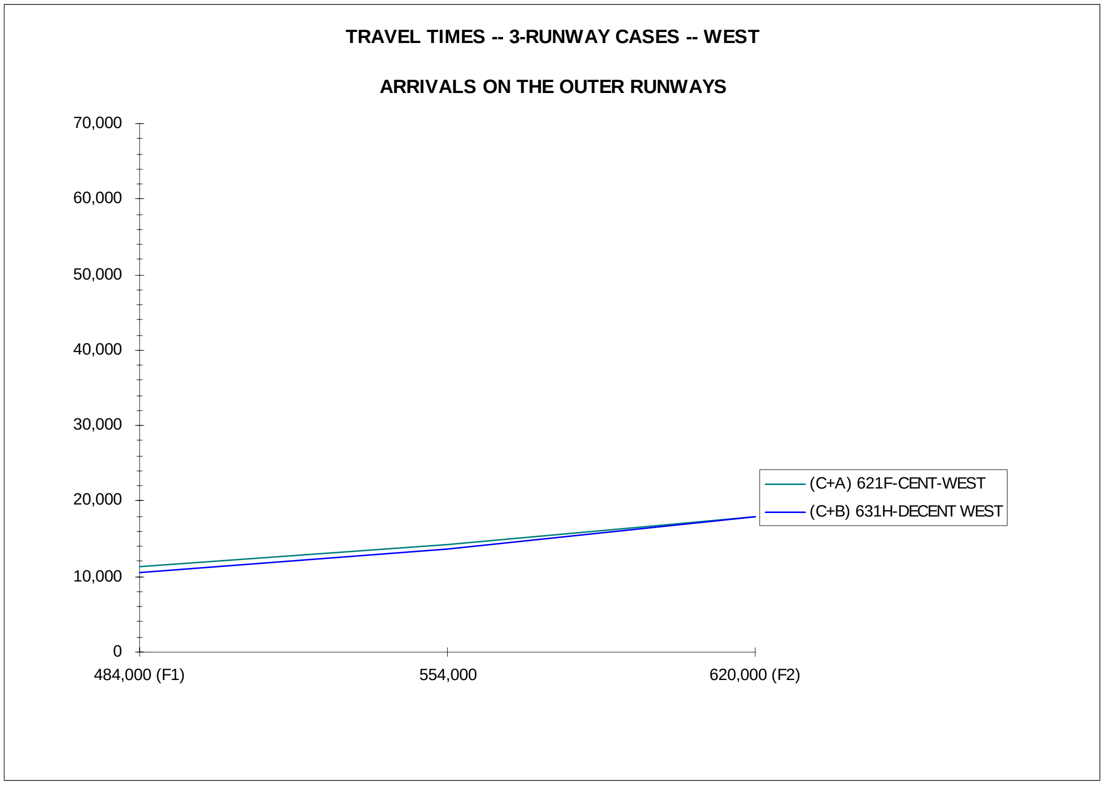


EXHIBIT 11 - PDX ADSIM RESULTS

DAILY DELAYS AND TRAVEL TIMES (in minutes)

(Updated 2/10/04)

				ARRIVALS				/		DEPARTURES				/ TOTAL /		**TOTAL TRAVEL TIMES**		
EXPERIMENT #			FLOW RATE	**AIR DELAY**	TAXI-IN DELAY	RWY-XNG DELAY	HOLDING AREA /	/FLOW RATE	**RUNWAY DELAY**	TAXI-OUT DELAY	RWY-XNG DELAY	GTE-HLD RWY-CNG	GROUND DELAYS	/ARRIVAL /AIR	**ARRIVAL GROUND**	**DEPARTURE GROUND**	**TOTAL**

(A) CENTRALIZED & 2-RUNWAYS – NO RUNWAY GROUND CROSSINGS (and NO AIR CROSSOVERS)

West Flow was presented in DP4 – Sept 2003 – Arrivals and Departures assigned by Route of Flight

EXPERIMENT #			FLOW RATE	**AIR DELAY**	TAXI-IN DELAY	RWY-XNG DELAY	HOLDING AREA /	/FLOW RATE	**RUNWAY DELAY**	TAXI-OUT DELAY	RWY-XNG DELAY	GTE-HLD RWY-CNG	GROUND DELAYS	/ARRIVAL /AIR	**ARRIVAL GROUND**	**DEPARTURE GROUND**	**TOTAL**
201H	WEST VFR1	TOTAL	756.0	**1069.1**	41.0	.0	.0	756.0	**1915.4**	785.1	.0	.0	**2741.5**	1061.1	3040.7	7350.7	**11452.5**
401H	WEST VFR1	TOTAL	865.0	**1864.5**	54.8	.0	.0	865.0	**3338.4**	1106.7	.0	.0	**4499.9**	1858.0	3497.2	9787.7	**15142.9**
601H	WEST VFR1	TOTAL	969.0	**3572.7**	80.9	.0	.0	969.0	**6013.8**	1515.6	.0	.0	**7610.4**	3557.8	3949.6	13487.0	**20994.4**

East Flow is new in DP5 – Arrivals and Departures assigned by Route of Flight

EXPERIMENT #			FLOW RATE	**AIR DELAY**	TAXI-IN DELAY	RWY-XNG DELAY	HOLDING AREA /	/FLOW RATE	**RUNWAY DELAY**	TAXI-OUT DELAY	RWY-XNG DELAY	GTE-HLD RWY-CNG	GROUND DELAYS	/ARRIVAL /AIR	**ARRIVAL GROUND**	**DEPARTURE GROUND**	**TOTAL**
204H	EAST VFR1	TOTAL	756.0	**1102.7**	141.3	.0	.0	756.0	**2501.8**	1569.0	.0	.0	**4212.1**	1094.0	3951.4	7928.6	**12974.0**
404H	EAST VFR1	TOTAL	865.0	**2013.6**	280.2	.0	.0	865.0	**4004.4**	2384.5	.0	.0	**6669.1**	2006.8	4672.6	10820.9	**17500.4**
604H	EAST VFR1	TOTAL	969.0	**3716.0**	599.7	.0	.0	969.0	**7196.2**	4183.2	.0	.0	**11979.1**	3699.8	5520.2	16321.9	**25542.0**

EXHIBIT 11 - PDX ADSIM RESULTS (Cont)

DAILY DELAYS AND TRAVEL TIMES (in minutes)

(B-1) DECENTRALIZED & 2-RUNWAYS – NO RUNWAY GROUND CROSSINGS (and ARRIVALS & DEPARTURES DO AIR CROSSOVERS)

EXPERIMENT #			ARRIVALS					/	DEPARTURES				/ TOTAL /		**TOTAL TRAVEL TIMES**		
			FLOW RATE	**AIR DELAY**	TAXI-IN DELAY	RWY-XNG DELAY	HOLDING AREA	/FLOW / RATE	**RUNWAY DELAY**	TAXI-OUT DELAY	RWY-XNG DELAY	GTE-HLD RWY-CNG	GROUND DELAYS	/ARRIVAL /AIR	**ARRIVAL GROUND**	**DEPARTURE GROUND**	**TOTAL**
West Flow - From DP4 – Sept 2003 – Arrivals and Departures assigned by Gate																	
211K	WEST VFR1	TOTAL	756.0	**2372.7**	107.0	224.0	.0	756.0	**4857.6**	1221.4	.0	.0	**6410.0**	2366.2	3605.8	10492.1	**16464.1**
411K	WEST VFR1	TOTAL	865.0	**9964.8**	282.8	352.0	.0	865.0	**10317.2**	2367.9	.0	.0	**13319.8**	9958.8	4428.7	17754.9	**32142.4**
611K	WEST VFR1	TOTAL	969.0	**23400.2**	692.9	503.1	.0	968.9	**19663.7**	5459.8	.0	.0	**26319.5**	23394.3	5515.5	30752.6	**59662.4**
East Flow – New for DP5 – Arrivals and Departures assigned by Gate																	
214K	EAST VFR1	TOTAL	756.0	**2597.9**	24.0	93.8	.0	756.0	**5288.3**	1799.6	.0	.0	**7205.7**	2592.9	4173.4	11445.7	**18212.0**
414K	EAST VFR1	TOTAL	865.0	**10532.9**	212.4	143.6	.0	865.0	**10633.8**	3344.2	.0	.0	**14334.0**	10525.7	5027.8	18993.9	**34547.4**
614K	EAST VFR1	TOTAL	969.0	**25204.0**	1233.2	174.3	.0	969.0	**21141.2**	9077.1	.0	.0	**31625.8**	25210.3	6696.9	35743.7	**67650.9**

(B-2) DECENTRALIZED & 2-RUNWAYS – ARRIVALS DO RUNWAY GROUND CROSSINGS (and DEPARTURES DO AIR CROSSOVERS)

West Flow – New for DP5 – Arrivals assigned by Route of Flight and Departures assigned by Gate																	
211C-X2	WEST VFR1	TOTAL	756.0	**1135.1**	121.7	166.2	.0	756.0	**3740.4**	794.8	.0	.0	**4823.1**	1125.4	4258.4	9010.0	**14393.8**
411C-X2	WEST VFR1	TOTAL	865.0	**2347.3**	367.9	274.4	.0	865.0	**9079.7**	1263.6	.0	.0	**10985.7**	2337.3	5225.6	15495.8	**23058.7**
611C-X2	WEST VFR1	TOTAL	969.0	**5964.6**	1347.3	428.7	.0	969.0	**16964.3**	2510.1	.0	.0	**21250.4**	5954.0	6950.8	25228.2	**38133.0**
East Flow – New for DP5 – Arrivals assigned by Route of Flight and Departures assigned by Gate																	
214C-X2	EAST VFR1	TOTAL	756.0	**1197.6**	82.9	123.3	.0	756.0	**4098.3**	869.2	.0	.0	**5173.8**	1188.3	5089.2	9261.7	**15539.2**
414C-X2	EAST VFR1	TOTAL	865.0	**2416.3**	409.9	222.4	.0	865.0	**8943.7**	1766.2	.0	.0	**11342.2**	2405.9	6287.8	15610.1	**24303.8**
614C-X2	EAST VFR1	TOTAL	969.0	**6488.6**	1753.3	363.5	.0	969.0	**16139.3**	3556.3	.0	.0	**21812.4**	6476.2	8494.4	25177.4	**40148.0**

(B-3) DECENTRALIZED & 2-RUNWAYS – ARRIVALS & DEPARTURES DO RUNWAY GROUND CROSSINGS (and NO AIR CROSSOVERS)

West Flow – New for DP5 – Arrivals and Departures assigned by Route of Flight																	
211C-NEW2	WEST VFR1	TOTAL	756.0	**1060.1**	112.4	144.8	.0	756.0	**2272.9**	640.3	68.3	.0	**3238.6**	1053.3	4362.2	8260.4	**13675.9**
411C-NEW2	WEST VFR1	TOTAL	865.0	**2024.4**	220.0	210.7	.0	865.0	**4368.0**	924.1	113.4	.0	**5836.1**	2016.3	5207.7	11482.0	**18706.0**
611C-NEW2	WEST VFR1	TOTAL	969.0	**4108.1**	548.5	339.9	.0	969.0	**8415.7**	1447.7	203.7	.0	**10955.5**	4099.7	6290.1	16847.6	**27237.4**
East Flow – New for DP5 – Arrivals and Departures assigned by Route of Flight																	
214C-NEW2	EAST VFR1	TOTAL	756.0	**1095.0**	85.6	100.1	.0	756.0	**2662.2**	819.5	54.9	.0	**3722.2**	1089.1	5253.7	8214.2	**14557.0**
414C-NEW2	EAST VFR1	TOTAL	865.0	**2063.0**	265.4	161.4	.0	865.0	**4775.9**	1245.8	93.8	.0	**6542.3**	2051.9	6320.3	11484.1	**19856.3**
614C-NEW2	EAST VFR1	TOTAL	969.0	**4276.1**	870.8	295.7	.0	969.0	**9127.3**	2187.8	222.3	.0	**12703.8**	4261.5	7813.8	17555.6	**29630.9**

EXHIBIT 11 - PDX ADSIM RESULTS (Cont)

DAILY DELAYS AND TRAVEL TIMES (in minutes)

					ARRIVALS				/		DEPARTURES			/ TOTAL /		**TOTAL TRAVEL TIMES**		
EXPERIMENT #				FLOW RATE	**AIR DELAY**	TAXI-IN DELAY	RWY-XNG/ DELAY	HOLDING AREA /	/FLOW RATE	**RUNWAY DELAY**	TAXI-OUT DELAY	RWY-XNG DELAY	GTE-HLD RWY-CNG	GROUND DELAYS	/ARRIVAL /AIR	**ARRIVAL GROUND**	**DEPARTURE GROUND**	**TOTAL**
(C+A) CENTRALIZED & 3-RUNWAYS — NO AIR CROSSOVERS																		
West Flow – From DP4 (ARR on Existing Runways) – Arrivals and Departures assigned by Route of Flight – No Runway Ground Crossings																		
221D	WEST	VFR1	TOTAL	756.0	**696.8**	33.7	.0	.0	756.0	**1655.2**	800.3	.0	.0	**2489.2**	691.2	3228.6	7166.0	**11085.8**
421D	WEST	VFR1	TOTAL	865.0	**1133.2**	50.4	.0	.0	865.0	**2678.4**	1033.2	.0	.0	**3762.0**	1128.2	3720.8	9124.1	**13973.0**
621D	WEST	VFR1	TOTAL	969.0	**1856.9**	70.0	.0	.0	969.0	**4450.3**	1509.9	.0	.0	**6030.2**	1845.1	4205.7	11999.0	**18049.8**
East Flow – New for DP5 (ARR on Existing Runways) – Arrivals and Departures assigned by Route of Flight– No Runway Ground Crossings																		
224D	EAST	VFR1	TOTAL	756.0	**701.6**	101.3	.0	.0	756.0	**1995.5**	1337.6	.0	.0	**3434.4**	696.5	3952.1	7348.0	**11996.5**
424D	EAST	VFR1	TOTAL	865.0	**1148.8**	231.3	.0	.0	865.0	**3286.9**	2192.3	.0	.0	**5710.5**	1143.3	4676.0	10084.1	**15903.4**
624D	EAST	VFR1	TOTAL	969.0	**1889.7**	493.1	.0	.0	969.0	**5236.3**	3497.5	.0	.0	**9226.9**	1878.1	5477.9	13908.4	**21264.4**
West Flow – New for DP5 (ARR on 2 Outer Runways) – Arrivals and Departures assigned by Route of Flight – Arrivals Cross on the Ground																		
221F	WEST	VFR1	TOTAL	756.0	**885.5**	29.2	22.7	.0	756.0	**1214.2**	653.8	.0	.0	**1919.8**	877.9	4032.5	6390.0	**11300.4**
421F	WEST	VFR1	TOTAL	865.0	**1440.2**	40.0	28.5	.0	865.0	**1922.5**	927.2	.0	.0	**2918.1**	1432.9	4646.3	8061.8	**14141.1**
621F	WEST	VFR1	TOTAL	969.0	**2422.6**	54.7	37.0	.0	969.0	**3277.0**	1240.5	.0	.0	**4609.3**	2408.6	5265.9	10330.2	**18004.7**
(C+B) DECENTRALIZED & 3-RUNWAYS – SOME RUNWAY GROUND CROSSINGS																		
West Flow – From DP4 (ARR on 3 Runways) – Arrivals and Departures assigned Gate – No Runway Ground Crossings – ARR & DEP Do Air Crossovers																		
231G	WEST	VFR1	TOTAL	756.0	**612.8**	21.6	30.2	.0	756.0	**1443.6**	386.8	9.7	.0	**1891.9**	607.8	2777.8	6049.9	**9435.5**
431G	WEST	VFR1	TOTAL	865.0	**1005.2**	30.4	44.4	.0	865.0	**2806.0**	536.1	15.2	.0	**3432.1**	1001.5	3218.2	8220.7	**12440.3**
631G	WEST	VFR1	TOTAL	969.0	**1579.6**	42.6	58.1	.0	969.0	**5283.0**	804.3	22.6	.0	**6210.6**	1569.3	3632.2	11590.5	**16792.0**
East Flow – New for DP5 (ARR on 3 Runways) – Arrivals and Departures assigned Gate – No Runway Ground Crossings – ARR & DEP Do Air Crossovers																		
234G	EAST	VFR1	TOTAL	756.0	**619.3**	9.9	5.1	.0	756.0	**1546.1**	486.2	8.5	.0	**2055.9**	615.1	3015.0	6867.3	**10497.4**
434G	EAST	VFR1	TOTAL	865.0	**987.5**	14.5	7.2	.0	865.0	**2822.3**	668.6	14.5	.0	**3527.2**	982.4	3488.9	9028.5	**13499.7**
634G	EAST	VFR1	TOTAL	969.0	**1549.4**	39.1	10.0	.0	969.0	**5459.9**	1004.8	22.0	.0	**6535.9**	1537.8	3953.2	12667.0	**18157.9**
West Flow – New for DP5 (ARR on Outer Runways) – Arrivals assigned by Route of Flight and Departures assigned by Gate – ARR Cross on Ground & DEP in Air																		
231H	WEST	VFR1	TOTAL	756.0	**839.9**	29.1	54.8	.0	756.0	**1262.4**	384.1	8.4	.0	**1738.7**	833.3	3759.1	5859.3	**10451.8**
431H	WEST	VFR1	TOTAL	865.0	**1413.7**	45.2	68.4	.0	865.0	**2526.5**	516.3	12.9	.0	**3169.3**	1408.0	4344.8	7911.4	**13664.2**
631H	WEST	VFR1	TOTAL	969.0	**2288.1**	58.4	87.4	.0	969.0	**4625.5**	698.4	17.4	.0	**5487.1**	2276.8	4896.0	10814.1	**17986.9**

EXHIBIT 12 - PDX EXPERIMENTAL DESIGN

(Updated 2/10/04)

		----- WEST FLOW -----	----- EAST FLOW -----	
	ADSIM SIMULATIONS	ARR = **28R**, 28L, **28X** DEP = 28R, **28L**	ARR = 10R, **10L**, **10X** DEP = **10R**, 10L	
PKG	**FUTURE 1** **484,000 ANNUAL OPS**	**47.7%**	**52.3%**	
(A)	Centralized & Existing Runways	**201**	**204**	
(B)	Decentralized & Existing Runways	**211**	**214**	
(C+A)	Centralized & New Runway	**221**	**224**	
(C+B)	Decentralized & New Runway	**231**	**234**	
PKG	**FUTURE 1.5** **554,000 ANNUAL OPS**	**47.7%**	**52.3%**	
(A)	Centralized & Existing Runways	**401**	**404**	
(B)	Decentralized & Existing Runways	**411**	**414**	
(C+A)	Centralized & New Runway	**421**	**424**	
(C+B)	Decentralized & New Runway	**431**	**434**	
PKG	**FUTURE 2** **620,000 ANNUAL OPS**	**47.7%**	**52.3%**	
(A)	Centralized & Existing Runways	**601**	**604**	
(B)	Decentralized & Existing Runways	**611**	**614**	
(C+A)	Centralized & New Runway	**621**	**624**	
(C+B)	Decentralized & New Runway	**631**	**634**	

Note: **There are 3 ways that we assigned runways for (B) Decentralized & Existing Runways. GA use 28R/10L and Military use 28L/10R. The following describes the Commercial runway assignments:**

- **(B-1) 611K – NO crossings on the ground (ARR & DEP assigned by Gate)**
- **(B-2) 611C –X2 – ARR cross on the ground (ARR by Route of Flight, DEP by Gate)**
- **(B-3) 611C-NEW2 – ARR & DEP cross on the ground (ARR & DEP by Route of Flight)**

Note: **For the Terminal Location Study, only the VFR1 condition will be simulated.** This study measures the taxi travel times and number of runway crossings associated with the terminal location. Taxiway congestion is greatest in VFR1 because demand and taxiway delays are greatest in VFR1. When using the same runway assignments, the nominal travel times are the same in all weather conditions. There is less taxiway delay in VFR2 and IFR1 because the arrival rates are lower in those conditions and there is less taxiway congestion. **Therefore, only the EAST VFR1 simulations are required to represent East Flow and only the WEST VFR1 simulations are required to represent the West Flow. 2/10/04.**

4. DESIGN TEAM SCHEDULE

Exhibit 13 lists the meetings concerning the completion of significant tasks, outputs, and target dates of the PDX Design Team schedule. These milestones and meetings will be held at key decision points, and will help the Design Team monitor the progress of the study.

EXHIBIT 13 - DESIGN TEAM SCHEDULE

(Updated 2/10/04)

Date	Event	Objective	Task	Responsibility	Output
11/21/02	1.	Preliminary Meeting. Review Design Team Purpose. Identify Objectives & Potential Improvements.	Review Potential Improvements & Tactical Initiatives performed in 2002. Agree on Scope of Work, Assumptions, Forecasts, & Data Requirements.	Entire Design Team.	Initial List of Potential Improvements. Agree on Study Direction.
1/15/03	2.	Collect Data	On-Site Data Collection.	Tech Center.	Establish Taxiway Routes and Parameters for Analysis.
1/16/03	3.	Kick Off Meeting. Review Design Team Purpose. Identify Objectives & Potential Improvements.	Review Data Package 1 & Potential Improvements. Agree on Scope of Work, Assumptions, Forecasts, & Data Requirements. Review & Agree on Purpose and Inputs.	Entire Design Team.	Initial List of Potential Improvements. Agree on Study Direction.
3/27/03	4.	Review Model Inputs & Potential Improvements & Airfield Layouts.	Review Data Package 2 & Potential Improvements. Establish Taxiway Routes.	Entire Design Team.	Agree on Inputs & Direction.
6/26/03	5.	Review Model Inputs & Potential Improvements & Airfield Layouts.	Review Data Package 3 & Potential Improvements. Review taxiway routes and results.	Entire Design Team.	Agree on Inputs & Direction.
9/25/03	6.	Review Model Inputs & Potential Improvements Results.	Review Data Package 4 & Potential Improvements. Review model inputs, runway use, and results.	Entire Design Team.	Agree on Inputs & Direction.
Scheduled 12/4/03 Actual 2/19/04	7.	Review Model Inputs & Potential Improvements Results.	Review Data Package 5 & Potential Improvements. Review model inputs, runway use, and results.	Entire Design Team.	Agree on Inputs & Direction.
/ /	?	• • •			
/ /	?	Complete & Publish Final Report.	Publish & Distribute Final Report.	FAA HQ.	Final Report.
/ /	?	Complete & Publish Summary Data Package.	Publish & Distribute Summary Data Package.	Tech Center.	Summary Data Package.

* Number of meetings and target dates are tentative and may be adjusted as progress is achieved.

APPENDIX A

MODEL INPUTS FOR 2001 DESIGN TEAM STUDY

NOTE: The PDX Tower owns a 5 NM ring around PDX.

<u>**AIRCRAFT CLASSIFICATIONS (UPDATED 8/11/00)**</u> **Accepted by PDX Team on 10/12/00**

H	**= HEAVY**	**Heavy aircraft.** Heavy aircraft weighing more than 255,000 pounds (e.g., L1011, DC10, B747, B767, DC8S, A300).
757	**= 757**	**B757.** B757 only**.**
LJ	**= LARGE JET**	**Large Jets. Includes Regional Jets.** Large jet aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., DC9, B737, B727, MD80, CRJ).
LTP	**= LARGE TURBO PROP**	**Large Turbo Props.** Large commuter aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., ATR-42*, DH8, DH7, BA41*, SF34*).
S+	**= SMALL+**	**Small Commuters. Includes Business Jets.** Small commuter aircraft weighing more than 12,500 and less than 41,000 pounds (e.g., BA31, BE02, E120, LR31, LR36).
S	**= SMALL**	**Small twin & single engine props.** Small, single or twin engine aircraft weighing 12,500 pounds or less (e.g. BE58, C340, C441, AC21, BE20, C172, C210, DO27).

Notes: **For wake turbulence application, FAA Handbook 7110.65 considers LJ & LTP as “large” and S+ & S as “small”.**

- ***** The aircraft ATR-42 and SF34 are exempt from the small category and are classified as large aircraft for separation purposes. (Source: FAA memo from ANM-531.4). They are classified as LTP (Large Turbo Prop) in this study.
- The critical factor in determining aircraft class should be <u>approach speeds</u> and how arrivals are separated at the point of closest approach (at threshold, except for a faster aircraft followed by a slower aircraft).
- Weights refer to maximum certified takeoff weights.
- These aircraft classes will enable us to define the model inputs more accurately and more clearly by distinguishing the key differences in operational characteristics.

Notes: **At the July 20th meeting, the Design Team agreed on the following:**

- **Regional Jets have the same departure noise procedures and prop-to-jet penalties as Large Jets. Regional Jets will be in the same class as Large Jets.**
- **Turbo Props that were treated as M (Medium) in the 1996 study will be treated as LTP (Large Turbo Props or S+ (Small+) for this study.**

LENGTH OF COMMON APPROACH (NAUTICAL MILES) -- 1996 PDX STUDY (WITH 2000 CLASSES)

Accepted by PDX Team on 10/12/00

For the simulations, it is defined as the length of the final common approach, along which speed control *cannot* be used to separate aircraft. This differs from the 8 NM final associated with Noise Abatement procedures. The Tracon can use speed control to separate aircraft, which are at least 5 NM away from the runway end.

	Class	Heavy	757	Large Jet	LTP	Small+	Small
VFR	NM	5	5	5	5	5	3
IFR	NM	5	5	5	5	5	5

Source: 1996 PDX STUDY

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

APPROACH SPEEDS (KNOTS) -- 1996 PDX STUDY (WITH 2000 CLASSES)

Accepted by PDX Team on 10/12/00

The speed is given in knots for each class of aircraft flying along the common approach defined above. The standard deviation is 5 knots. The model uses three standard deviations in selecting approach speeds. Therefore, the speeds may vary by 15 knots, plus or minus.

	Class	Heavy	757	Large Jet	LTP	Small+	Small
VFR	Knots	155	140	140	130	130	110
IFR	Knots	155	140	140	130	130	110

Source: 1996 PDX STUDY (Based on Arts data for 7/20/94.)

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

1999 PDX FLEET MIX (UPDATED 8/11/00)

Accepted by PDX Team on 10/12/00

Aircraft Class	1999 Fleet Mix
Heavy	4.7%
B-757	5.2%
Large Jet	46.3%
Large Turbo Prop	17.6%
Small+	14.7%
Small	11.5%
TOTAL	100.0%

Source: Data provided by Port of Portland.

Notes: At the July 20, 2000 meeting, the Design Team agreed to the following:

- **Use the fleet mix presented in Data Package 1. Since that meeting, the mix was modified to reflect the change in an aircraft class definition -- Large Turbo Prop instead of Large Commuter.**
- **Regional Jets are included in the aircraft class Large Jet because they have the same departure noise restrictions, prop-to-jet penalties, approach speeds, and separations.**
- **Business Jets will be simulated as Small+/Small props, with the same departure procedures as the Small+/Small props. This was also done in the 1996 PDX Study because the percentage of Business Jets was small. Because we are limited to 6 aircraft classes in ADSIM, the Design Team agreed that it was still reasonable to treat Business Jets as Small+/Small props.**

SIMULATED DEMAND CHARACTERISTICS -- PDX

Accepted by PDX Team on 10/12/00

ANNUAL & DAILY DEMAND

DEMAND LEVEL	ANNUAL OPERATIONS	DAILY OPERATIONS	EQUIVALENT DAYS
1999--Baseline	322,000	1,006	320
FUTURE 1	484,000	1,512	320
FUTURE 2	620,000	1,938	320

NOTE: (Annual Operations) / (Daily Operations) = Equivalent Days

PDX DEMAND CHARACTERISTICS

Annual Distribution of Traffic--(GA & MI annual ops increase according to Port's 2020 forecasts)

DEMAND	COMMERCIAL		GA		MILITARY		TOTAL	
1999-- Baseline	275,000	85.4%	38,000	11.8%	9,000	2.8%	322,000	100.0%
FUTURE 1	429,000	88.6%	45,000	9.3%	10,000	2.1%	484,000	100.0%
FUTURE 2	565,000	91.1%	45,000	7.3%	10,000	1.6%	620,000	100.0%

NOTES: **1999 distribution was based on the 1999 Port statistics.**
Commercial counts include Air Carrier, Commuter, and Air Taxis.
FAA Technical Center developed the FUTURE 1 & FUTURE 2 distributions based on the following growth assumptions of the Port's forecasts for PDX:

* FUTURE 1 represents the Port's expected forecast for 2020.
* FUTURE 2 represents the Port's high growth forecast for 2020.
* FUTURE 1 and FUTURE 2 have 45,000 annual GA operations.
* FUTURE 1 and FUTURE 2 have 10,000 annual MILITARY operations.

Daily Distribution of Traffic

DEMAND	COMMERCIAL		GA		MILITARY		TOTAL	
1999-- Baseline	860	85.5%	118	11.7%	28	2.8%	1,006	100.0%
FUTURE 1	1,342	88.8%	140	9.3%	30	2.0%	1,512	100.0%
FUTURE 2	1,768	91.2%	140	7.2%	30	1.5%	1,938	100.0%

NOTES: **Daily counts for Commercial, GA, and MI have an even number of ops per day in order to have equal numbers of arrivals and departures.**
Percentages are rounded to 1 decimal place.

SIMULATED FLEET MIXES – PDX

Accepted by PDX Team on 11/30/00

Overall -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
47	4.7%	52	5.2%	466	46.3%	177	17.6%	148	14.7%	116	11.5%	1,006	100.0%	Baseline
74	4.9%	80	5.3%	720	47.6%	274	18.1%	212	14.0%	152	10.1%	1,512	100.0%	Future 1
97	5.0%	106	5.5%	940	48.5%	360	18.6%	261	13.5%	174	9.0%	1,938	100.0%	Future 2

Commercial -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
47	5.5%	52	6.0%	444	51.7%	173	20.1%	100	11.6%	44	5.1%	860	100.0%	Baseline
74	5.5%	80	6.0%	694	51.7%	270	20.1%	156	11.6%	68	5.1%	1342	100.0%	Future 1
97	5.5%	106	6.0%	914	51.7%	356	20.1%	205	11.6%	90	5.1%	1768	100.0%	Future 2

GA -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
0	.0%	0	.0%	2	1.7%	0	.0%	48	40.7%	68	57.6%	118	100.0%	Baseline
0	.0%	0	.0%	4	2.9%	0	.0%	56	40.0%	80	57.1%	140	100.0%	Future 1
0	.0%	0	.0%	4	2.9%	0	.0%	56	40.0%	80	57.1%	140	100.0%	Future 2

Military -- Daily Fleet Mix by Class

H		757		LJ		LTP		S+		S		Total		
0	.0%	0	.0%	20	71.4%	4	14.3%	0	.0%	4	14.3%	28	100.0%	Baseline
0	.0%	0	.0%	22	73.3%	4	13.3%	0	.0%	4	13.3%	30	100.0%	Future 1
0	.0%	0	.0%	22	73.3%	4	13.3%	0	.0%	4	13.3%	30	100.0%	Future 2

NOTES: **Baseline Demand Characteristics developed from 1999 Port data as follows:**

Overall fleet mix – from Port data, Calendar Year 1999.
GA and MI fleet mixes -- from Port data, Calendar Year 1999.
GA fleet mix -- revised by Design Team on 10/12/00.
Commercial fleet mix -- computed from the other Baseline fleet mixes.

Future 1 and Future 2 Demand Characteristics developed as follows:

GA fleet mix -- same as GA fleet mix in Baseline Demand.
MI fleet mix -- same as MI fleet mix in Baseline Demand -- as close as possible.
Commercial mix – same as Commercial fleet mix in Baseline Demand.
Overall fleet mix – computed from the other fleet mixes for that future demand.

Percentages are rounded to 1 decimal place.

BASELINE DEMAND -- HOUR COUNT SUMMARY

Accepted by PDX Team on 11/30/00

HOUR	ARR	DEP	ARR+DEP
0	6	5	11
1	4	3	7
2	2	1	3
3	5	1	6
4	4	4	8
5	8	9	17
6	12	48	60
7	19	46	65
8	26	33	59
9	27	25	52
10	29	22	51
11	34	22	56
12	27	33	60
13	29	35	64
14	21	26	47
15	26	22	48
16	33	27	60
17	40	30	70
18	28	22	50
19	34	23	57
20	31	26	57
21	20	18	38
22	23	14	37
23	15	8	23
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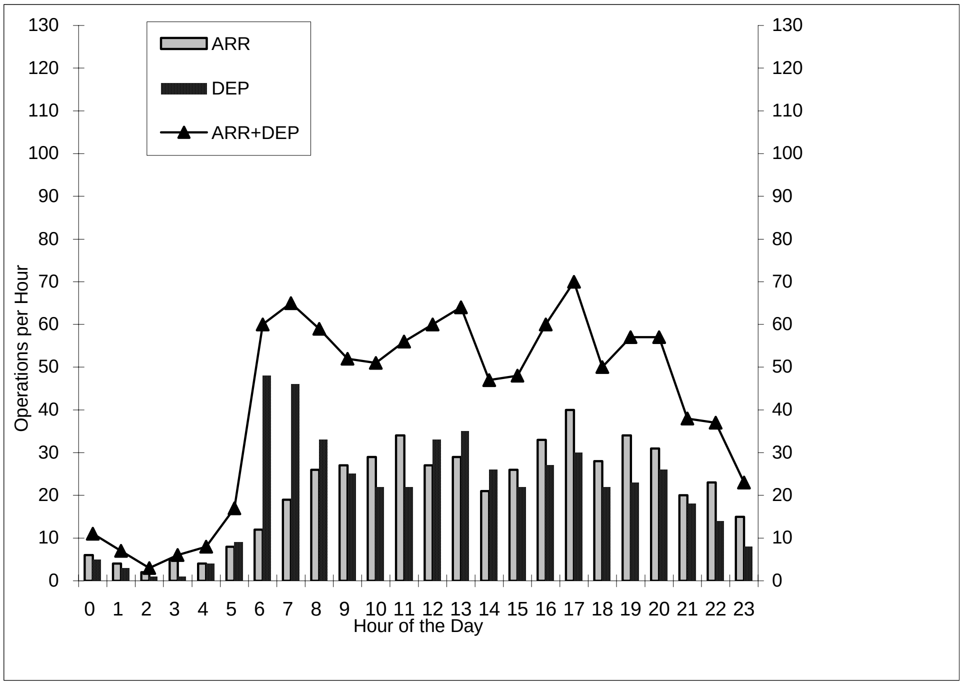
	503	503	1006



Hour Counts -- Baseline demand

The Technical Center used the Tower Counts and OAG from Tuesday, July 27, 1999, and cargo schedules for August 2000, to develop hour counts. July 1999 was selected because it is one of the months for which we have OAG data and July is a busy month at PDX. Tuesday the 27th was selected because we wanted a good VFR1 day with low airline-reported delays obtained from CODAS (Consolidated Operations and Delay Analysis System) on APO-130's web site.
Note: 10/15/01: VFR was changed to VFR1.

We used cargo schedules for August 2000 because the cargo operators could not provide us with schedules for 1999.

We will simulate 1,006 ops at the baseline demand -- 860 air carrier (commercial), 118 GA, and 28 Military ops.

HOUR COUNTS -- 1999 DEMAND (SCD-322)

LOCAL HOUR	ARRIVALS HOUR COUNTS				DEPARTURES HOUR COUNTS				TOTAL HOUR COUNTS			
	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL
0	6	0	0	6	2	3	0	5	8	3	0	11
1	4	0	0	4	3	0	0	3	7	0	0	7
2	2	0	0	2	1	0	0	1	3	0	0	3
3	5	0	0	5	1	0	0	1	6	0	0	6
4	4	0	0	4	4	0	0	4	8	0	0	8
5	7	1	0	8	9	0	0	9	16	1	0	17
6	12	0	0	12	48	0	0	48	60	0	0	60
7	16	3	0	19	42	4	0	46	58	7	0	65
8	19	7	0	26	28	3	2	33	47	10	2	59
9	21	3	3	27	18	4	3	25	39	7	6	52
10	24	3	2	29	19	2	1	22	43	5	3	51
11	31	3	0	34	19	2	1	22	50	5	1	56
12	24	2	1	27	28	3	2	33	52	5	3	60
13	19	7	3	29	27	6	2	35	46	13	5	64
14	17	3	1	21	21	4	1	26	38	7	2	47
15	20	5	1	26	15	7	0	22	35	12	1	48
16	29	4	0	33	22	4	1	27	51	8	1	60
17	34	6	0	40	27	3	0	30	61	9	0	70
18	24	3	1	28	15	6	1	22	39	9	2	50
19	30	4	0	34	20	3	0	23	50	7	0	57
20	27	2	2	31	25	1	0	26	52	3	2	57
21	19	1	0	20	16	2	0	18	35	3	0	38
22	23	0	0	23	13	1	0	14	36	1	0	37
23	13	2	0	15	7	1	0	8	20	3	0	23
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	430	59	14	503	430	59	14	503	860	118	28	1006

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

AC -- **Tower Counts & OAG counts were supplemented to get AC counts.**
The counts include all cargo ops.

GA/MI -- **The 1999 counts were based on the hourly PDX Tower counts for 7/27/99**
and the cargo schedules obtained from the cargo operators.

HOUR COUNTS -- FUTURE 1 DEMAND (SCD-484)

LOCAL HOUR	ARRIVALS HOUR COUNTS				DEPARTURES HOUR COUNTS				TOTAL HOUR COUNTS			
	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL
0	9	0	0	9	3	3	0	6	12	3	0	15
1	6	0	0	6	5	0	0	5	11	0	0	11
2	3	0	0	3	2	0	0	2	5	0	0	5
3	8	0	0	8	2	0	0	2	10	0	0	10
4	6	0	0	6	6	0	0	6	12	0	0	12
5	11	1	0	12	14	0	0	14	25	1	0	26
6	19	0	0	19	75	0	0	75	94	0	0	94
7	25	4	0	29	65	5	0	70	90	9	0	99
8	30	8	0	38	44	4	3	51	74	12	3	89
9	33	4	4	41	28	5	3	36	61	9	7	77
10	38	4	2	44	30	2	1	33	68	6	3	77
11	48	3	0	51	30	2	1	33	78	5	1	84
12	37	2	1	40	44	4	2	50	81	6	3	90
13	30	8	3	41	42	7	2	51	72	15	5	92
14	27	4	1	32	33	5	1	39	60	9	2	71
15	31	6	1	38	23	8	0	31	54	14	1	69
16	45	5	0	50	34	5	1	40	79	10	1	90
17	53	7	0	60	42	4	0	46	95	11	0	106
18	37	4	1	42	23	7	1	31	60	11	2	73
19	47	5	0	52	31	4	0	35	78	9	0	87
20	42	2	2	46	39	1	0	40	81	3	2	86
21	30	1	0	31	25	2	0	27	55	3	0	58
22	36	0	0	36	20	1	0	21	56	1	0	57
23	20	2	0	22	11	1	0	12	31	3	0	34
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	671	70	15	756	671	70	15	756	1342	140	30	1512

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

Future 1 hour counts are 50% higher than 1999 hour counts.

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA, and MI maintain their own peaking characteristics.

HOUR COUNTS -- FUTURE 2 DEMAND (SCD-620)

LOCAL HOUR	ARRIVALS HOUR COUNTS				DEPARTURES HOUR COUNTS				TOTAL HOUR COUNTS			
	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL	AC	GA	MI	TOTAL
0	12	0	0	12	4	3	0	7	16	3	0	19
1	8	0	0	8	7	0	0	7	15	0	0	15
2	4	0	0	4	3	0	0	3	7	0	0	7
3	10	0	0	10	3	0	0	3	13	0	0	13
4	8	0	0	8	8	0	0	8	16	0	0	16
5	14	1	0	15	18	0	0	18	32	1	0	33
6	25	0	0	25	99	0	0	99	124	0	0	124
7	33	4	0	37	86	5	0	91	119	9	0	128
8	40	8	0	48	58	4	3	65	98	12	3	113
9	43	4	4	51	37	5	3	45	80	9	7	96
10	50	4	2	56	40	2	1	43	90	6	3	99
11	63	3	0	66	40	2	1	43	103	5	1	109
12	49	2	1	52	58	4	2	64	107	6	3	116
13	40	8	3	51	55	7	2	64	95	15	5	115
14	36	4	1	41	43	5	1	49	79	9	2	90
15	41	6	1	48	30	8	0	38	71	14	1	86
16	59	5	0	64	45	5	1	51	104	10	1	115
17	70	7	0	77	55	4	0	59	125	11	0	136
18	49	4	1	54	30	7	1	38	79	11	2	92
19	62	5	0	67	41	4	0	45	103	9	0	112
20	55	2	2	59	51	1	0	52	106	3	2	111
21	40	1	0	41	33	2	0	35	73	3	0	76
22	47	0	0	47	26	1	0	27	73	1	0	74
23	26	2	0	28	14	1	0	15	40	3	0	43
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	884	70	15	969	884	70	15	969	1768	140	30	1938

NOTES: **AC counts include Air Carrier, Commuter, and Air Taxi.**

Future 2 hour counts are 28% higher than the Future 1 hour counts.

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA, and MI maintain their own peaking characteristics.

HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS -- PDX

LOCAL HOUR	SCD-322 (1999) HOUR COUNTS			SCD-484 (FUTURE 1) HOUR COUNTS			SCD-620 (FUTURE 2) HOUR COUNTS		
	ARR	DEP	TOTAL	ARR	DEP	TOTAL	ARR	DEP	TOTAL
0	6	5	11	9	6	15	12	7	19
1	4	3	7	6	5	11	8	7	15
2	2	1	3	3	2	5	4	3	7
3	5	1	6	8	2	10	10	3	13
4	4	4	8	6	6	12	8	8	16
5	8	9	17	12	14	26	15	18	33
6	12	48	60 *	19	75	94 **	25	99	124 ***
7	19	46	65 *	29	70	99 **	37	91	128 ***
8	26	33	59	38	51	89	48	65	113
9	27	25	52	41	36	77	51	45	96
10	29	22	51	44	33	77	56	43	99
11	34	22	56	51	33	84	66	43	109
12	27	33	60 *	40	50	90 **	52	64	116 ***
13	29	35	64 *	41	51	92 **	51	64	115 ***
14	21	26	47	32	39	71	41	49	90
15	26	22	48	38	31	69	48	38	86
16	33	27	60 *	50	40	90 **	64	51	115 ***
17	40	30	70 *	60	46	106 **	77	59	136 ***
18	28	22	50	42	31	73	54	38	92
19	34	23	57	52	35	87	67	45	112
20	31	26	57	46	40	86	59	52	111
21	20	18	38	31	27	58	41	35	76
22	23	14	37	36	21	57	47	27	74
23	15	8	23	22	12	34	28	15	43
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	503	503	1006	756	756	1512	969	969	1938

NOTES: **Counts include AC (Air Carrier/Commuter/Air Taxi), GA, and MI.**

1999 --
Highest hour count is 70 -- at 5pm (1700 hrs).
6 hours have counts of at least 60. See *.
Between 5pm and 8pm, the number of hourly ops ranges from 50 to 70.

Future 1 --
Highest hour count is 106 -- at 5pm (1700 hrs).
6 hours have counts of at least 90. See **.
Between 5pm and 8pm, the number of hourly ops ranges from 73 to 106.

Future 2 --
Highest hour count is 136 -- at 5pm (1700 hrs).
6 hours have counts of at least 115. See *.**
Between 5pm and 8pm, the number of hourly ops ranges from 92 to 136.

HOUR COUNT SUMMARY

Accepted by PDX Team on 11/30/00

PDX CHART -- HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS

HOUR	1999	F1	F2
0	11	15	19
1	7	11	15
2	3	5	7
3	6	10	13
4	8	12	16
5	17	26	33
6	60	94	124
7	65	99	128
8	59	89	113
9	52	77	96
10	51	77	99
11	56	84	109
12	60	90	116
13	64	92	115
14	47	71	90
15	48	69	86
16	60	90	115
17	70	106	136
18	50	73	92
19	57	87	112
20	57	86	111
21	38	58	76
22	37	57	74
23	23	34	43
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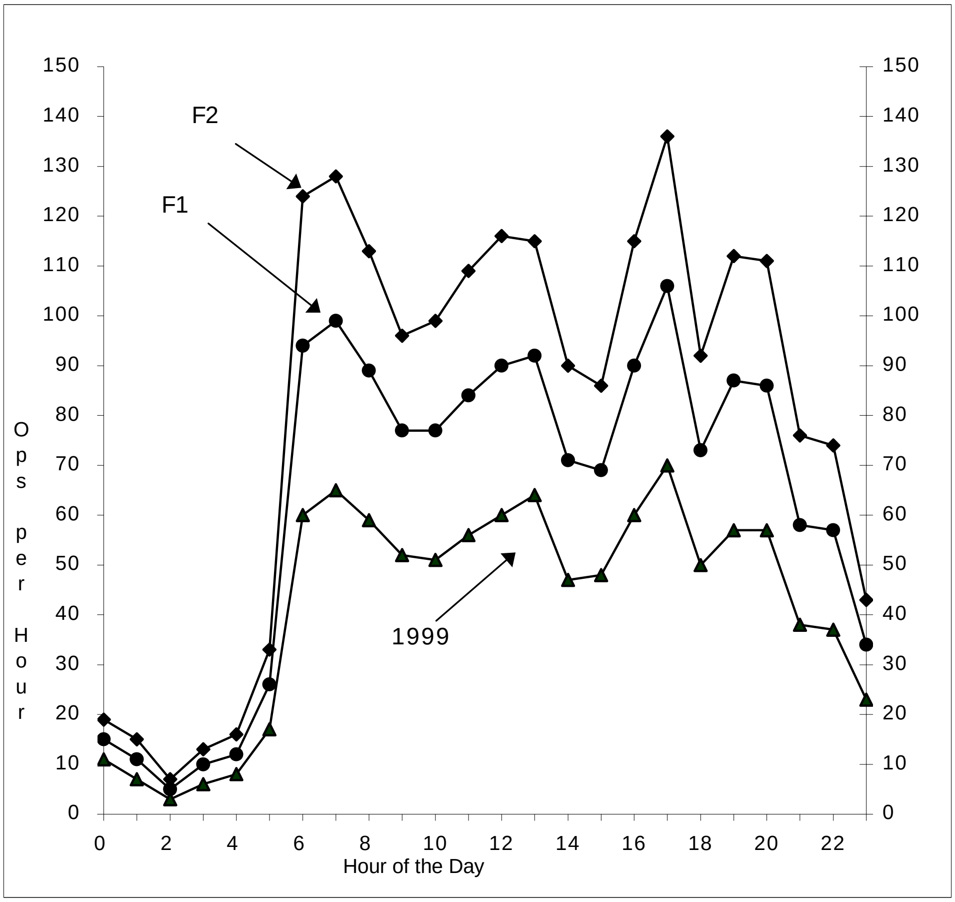
	1006	1512	1938



NOTES: **Future 1 hour counts are 50% higher than 1999 hour counts.**
Future 2 hour counts are 28% higher than the Future 1 hour counts.

As agreed upon by the Design Team, no attempt was made to smooth out hourly counts at higher demands. AC, GA, and MI maintain their own peaking characteristics.

OAG COUNTS -- July 27, 1999
CARGO COUNTS -- August 2000

Accepted by PDX Team on 11/30/00

OAG & CARGO COUNTS -- BY AIRLINE

Airlines (Passenger Carriers)	OAG/FAATC	FAA Code	ARR	DEP	TOTAL
Air Canada (AirBc, Ltd.)--Large Turbos	ZX	ABL	5	5	10
Alaska Airlines	AS	ASA	49	49	98
American Airlines	AA	AAL	4	2	6
America West Airlines	HP	AWE	6	6	12
Canadian Airlines (CX -- Large Turbos)	CP/CX	CDN	3	3	6
Continental Airlines	CO	COA	3	2	5
Delta Airlines (D1--HVY&Intl, DL--Other Jets)	DL/DL&D1	DAL	25	25	50
Frontier Airlines	F9	FFT	----	----	----
Hawaiian Airlines	HA	HAL	1	1	2
Horizon Airlines (HZ--Large Jets)	QX/HZ	QXE	30	30	60
Horizon Airlines (QX--Large Turbos)	QX	QXE	65	65	130
Northwest Airlines	NW	NWA	3	3	6
Reno Air	QQ	ROA	5	5	10
Skywest (DL Connection)	OO/DL	SKW/DAL	2	2	4
Skywest (UA Express) (UX--Large Turbos)	OO/UA/UX	SKW/UAL	39	39	78
Southwest Airlines	WN	SWA	31	31	62
Trans World Airlines	TW	TWA	3	3	6
United Airlines	UA	UAL	31	31	62
TOTAL PASSENGER OPS			**305**	**302**	**607**

Airlines (Cargo Carriers)	OAG/FAATC Code	FAA Code	ARR	DEP	TOTAL
Airborne Express	1F/C3	ABX	2	2	4
Ameriflight--Box-Haulers	B4	AMF	12	12	24
BAX Global / Burlington--Jets	H1/8W/C3	ATN	1	1	2
DHL Airways (via KHA in 1999)--Jets	ER/C1	DHL/KHA	1	1	2
Emery Worldwide--Jets	EB/C3	EWW	1	1	2
Federal Express--Box-Haulers	FM/B3	FDX	10	8	18
Kitty Hawk Airlines (supports DHL)--Jets	1K	KHA/DHL	----	2	2
Nippon Cargo Airlines--Jets	1N	NCA	1	----	1
UPS--Box-Haulers via Ameriflight	5X/B2	UPS	12	12	24
UPS—Jets	5X/C2	UPS	5	5	10
TOTAL CARGO OPS			**45**	**44**	**89**
GRAND TOTALS			**350**	**346**	**696**

Source: OAG of July 27,1999 and cargo operations for August 2000. The Tech Center modified the cargo operations in order to conform to the fleet mix of the Baseline demand.

Note: The Tech Center added some codes to assist us in our schedule generation. We want to easily identify Large Turbo Props and Box-Haulers from the Jet operations. Therefore, we used some codes that help us; but these codes do not mean anything to the rest of the Design Team:

- **B1, B2, B3, and B4 represent Box-Haulers by gate ramp areas: South Ramp, Central Ramp (UPS), Air Trans Center, and SW Ramp (Ameriflight), respectively.**
- **Similarly, C1, C2, C3, and C4 represent Jet operations at those ramp areas.**
- **CX, QX, UX, ZX represent Large Turbo Props for CP, QX, UA/Skywest, and ZX.**
- **HZ represents Horizon jets.**

GATE ASSIGNMENTS **Accepted by PDX Team on 10/12/00**

Airline (Passenger Carriers)	OAG Code	FAA Code	Terminal/Gates
Air Canada (AirBc, Ltd.)	ZX	ABL	E6
Alaska	AS	ASA	B2-B4, C2, C9, C13, C20-C23
American	AA	AAL	C4, C6
America West	HP	AWE	D3, D5
Canadian Airlines	CP	CDN	
Columbia Pacific	7C	COL	
Continental Airlines	CO	COA	D1,D4
Delta	DL	DAL	D5-D15
Frontier Airlines	F9	FFT	D6
Harbor Airlines	HG	HAR	A5-A12
Hawaiian Airlines	HA	HAL	D14
Horizon Air	QX	QXE	A1-A12, B4
Northwest	NW	NWA	C17, C19
Reno Air	QQ	ROA	C11
Skywest (DL Connection)	OO/DL	SKW/DAL	E7
Skywest (UA Express)	OO/UA	SKW/UAL	E6
Southwest	WN	SWA	C14-C16, C18
Trans World	TW	TWA	D2, D8
United Airlines	UA	UAL	E1-E5

Airline (Cargo Carriers)	OAG Code	FAA Code	Terminal/Gates
ABX Air, Inc.	W0	------	
Aeroflight		TTY	
Airborne Express	1F	ABX	Air Trans Center
AirPac (supports Airborne & Aeroflight)	------	APC	Air Trans Center
Ameriflight	------	AMF	South West Ramp
BAX Global (via Air Transport Intl)	H1	ATN	Air Trans Center
Burlington Air Express	8W	ASW	Air Trans Center
Cargolux Airlines (began service-2000)	S1	CLX	Air Trans Center
DHL Airways (via KHA in 1999)	ER	DHL/KHA	South Air Cargo Ramp
Emery Worldwide	EB	EWW	Air Trans Center
Empire Airlines (supports FedEx)	----	CFS	Air Trans Center
Evergreen Airlines (supports USPS)	1E	EIA	South Air Cargo Ramp
Federal Express	FM	FDX	Air Trans Center
Kitty Hawk Airlines (supports DHL)	1K	KHA/DHL	South Air Cargo Ramp
Korean Air	KE	KAL	Air Trans Center
Nippon Cargo Airlines	1N	NCA	Air Trans Center
UPS (& Box-Haulers via Ameriflight)	5X	UPS	UPS -- Central Ramp
Western Air Express (supports UPS)	----	WAE	UPS -- Central Ramp

Source: **Airlines were taken from the OAG of July 27, 1999, 2000 data collection, and the Port.**
Added Aeroflight (TTY) on 10/30/00.

Comments:

- **Gate usage is based on July 1999, when PDX Terminals B & C were undergoing construction.**
- **Box-Haulers -- Ameriflight, UPS and Airborne (via Ameriflight), Federal Express (via Western Air Express).**

CARGO LOCATIONS

Accepted by PDX Team on 11/30/00
FAATC added cargo codes on 12/11/00

North Cargo Ramp:		None
South Cargo Ramp:	C1/B1	DHL (Operated by Kitty Hawk in 1999 and Reliant in 2000) Evergreen (contracted by USPS--US Postal Service) Kitty Hawk
Central Cargo Ramp:	C2/B2	UPS (& Box-Haulers via Ameriflight & Western Air Express)
Air Trans Center:	C3/B3	Airborne, AirPac, BAX, Burlington, Cargolux, Emery, Federal Express (& Box-Haulers by Empire), Korean Air, Nippon Cargo Airlines
South West Cargo Ramp:	C4/B4	Ameriflight (& Ameriflight courier Box-Haulers)

Comments:

- **Gate usage is based on July 1999, when PDX Terminals B & C were undergoing construction.**
- **Box-Haulers are Small/Small+ cargo feeders. Some Small aircraft (SW3, BE9/BE99, and BE90) were reclassified as Small+ because they are Turbo Props and cannot diverge to the North. The Box-Haulers are associated with the following cargo carriers:**
  Ameriflight
  UPS and Airborne (via Ameriflight)
  Federal Express (via Western Air Express)
- **Box-Hauler statistics -- provided by the Port for 1999 -- updated on 11/14/00:**
  5:30am - 8:00am: 24 Box-Hauler Departures per day -- on average
  4:30pm - 6:00pm: 23 Box-Hauler Arrivals per day -- on average
  7:00pm - 8:30pm: 14 Box-Hauler Arrivals per day -- on average
- **The number of Box-Haulers simulated is similar, but not identical, to the above numbers.**

FLEET MIX COST

Accepted by PDX Team on 6/24/01

DEMAND	**FLEET MIX COST (Direct Operating Cost per Hour) in year 2000 dollars**
1999	**$ 1,660**

NOTE:

The direct operating costs for the air carriers were for their 1st quarter 2000 costs, which were based on carrier Form 41 filings with DOT and published in *Aviation Daily*. When the 1st quarter costs were not available, the 1999 year-end costs were used. The operating costs for non-scheduled aircraft were developed using information provided by APO-110. The Technical Center used the cost for each airline and aircraft type at PDX.

AIRCRAFT GATE SERVICE TIMES

Accepted by PDX Team on 11/30/00

To simulate more realistic conditions, the departure time of a continuing arrival is adjusted to assure the aircraft meets its minimum gate service time (minimum turn-around time). These times represent the minimum time it takes to service an aircraft -- from the time it arrives at the gate until pushback. If an aircraft arrives late, the model will delay its departure in order to insure that the minimum gate service time is met.

Minimum Turn-Around Times in Minutes -- with a cumulative probability distribution

Heavy		757		LJ		LTP		S+		Small	
Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.	Min.	Cum. Prob.
60	0.79	45	0.92	20	0.20	20	0.07	20	1.00	10	0.16
90	1.00	50	1.00	25	0.25	30	0.97			15	0.56
				30	0.50	40	1.00			20	0.64
				35	0.64					25	1.00
				40	1.00						

Source:

Heavy, 757, LJ, LTP, S+ -- Based on November 2000 values provided by the airlines serving PDX and their minimum turn-around times at PDX.

Small -- Values were from the 1996 PDX Design Team. Values for Small were weighted by percent of small-twins and small-singles in the 1996 study. The maximum gate service time at PDX was then reduced to 25 minutes (from 35 minutes). The original values for small-twins and small-singles were developed during the Newark Study (before 1990) and were used in the Charlotte, Dulles, and Cincinnati Design Team studies.

ARRIVAL AIRCRAFT LATENESS DISTRIBUTION

Accepted by PDX Team on 7/20/00

(ARRIVAL VARIABILITY DISTRIBUTION) -- 1996 PDX DESIGN TEAM STUDY

To simulate more realistic conditions, a lateness distribution (arrival variability distribution) is added to the OAG scheduled arrival time. The distribution should represent the average deviation from the scheduled arrival time, excluding delays at the destination airport (PDX).

The arrival aircraft lateness distribution is shown as a cumulative probability. For each arrival, the lateness distribution is sampled and the resulting time is added to the scheduled arrival time. This input varies the arrival time of an aircraft during each iteration of the simulation.

Amount by which actual arrival time at threshold would exceed scheduled arrival time at threshold	Distribution of aircraft lateness (cumulative %)
-20	0.0 %
-15	4.7 %
- 2	31.5 %
0	52.6 %
5	70.3 %
10	83.6 %
15	94.3 %
30	95.9 %
45	98.4 %
60	100.0 %

This table reads as follows:
0% arrive at the threshold more than 20 minutes early
4.7% (4.7% - 0%) arrive between 15 and 20 minutes early
26.8% (31.5% - 4.7%) arrive between 2 and 15 minutes early

Source: Values used in the 1994 & 1989 Seattle Design Team studies.

VFR SEPARATIONS — Accepted by PDX Team on 11/30/00

STANDARD VFR1 (VISUAL) ARR/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds
At Point of Closest Approach <<with missed approach buffer>>

ARR/ARR (NM)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	4.26	5.06	5.06	4.69	5.56	5.04
757	*Treat as Heavy*	4.26	5.06	5.06	4.69	5.56	5.04
LJ	*(7110.65--Large)*	3.40	3.19	3.19	2.96	3.76	3.39
LTP	*(7110.65--Large)*	3.40	3.19	3.19	2.96	3.76	3.39
S+	*(7110.65--Small)*	3.40	3.19	3.19	2.96	2.96	3.39
SM	*(7110.65--Small)*	3.40	3.19	3.19	2.96	2.96	2.66

Expected VFR1 ARR/ARR separations for PDX: 3.4 NM 1.52 minutes
Expected VFR1 Arrival Flow Rates for PDX: 39 arrivals/runway (max thruput)

STANDARD VFR1 (VISUAL) DEP/DEP SEPARATIONS (in Minutes) -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+

D/D (Minutes)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00
757	*Treat as Heavy*	1.50	2.00	2.00	2.00	2.00	2.00
LJ	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	0.83
LTP	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	0.83
S+	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	0.83
SM	*(7110.65--Small)*	0.83	0.83	0.75	0.75	0.75	0.58

Expected VFR1 D/D separations for PDX: 1.05 minutes
Expected VFR1 Departure Flow Rates for PDX: 57 departures/runway (max thruput) -- with no mixed ops

STANDARD VFR1 (VISUAL) DEP/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds

D/A (NM)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	1.68	1.52	1.52	1.41	1.41	1.19
757	*Treat as Heavy*	1.68	1.52	1.52	1.41	1.41	1.19
LJ	*(7110.65--Large)*	1.68	1.52	1.52	1.41	1.41	1.19
LTP	*(7110.65--Large)*	1.68	1.52	1.52	1.41	1.41	1.19
S+	*(7110.65--Small)*	1.68	1.52	1.52	1.41	1.41	1.19
SM	*(7110.65--Small)*	1.46	1.32	1.32	1.23	1.23	1.04

Expected VFR1 D/A separations for PDX: 1.43 NM
When departure starts to roll, arrival must be at least this far from threshold: 0.64 minutes

NOTES: **VFR A/D Separations (minutes) are the Runway Occupancy Times (ROTs).**
Approach Speeds in Knots: Heavy--155; 757--140; LJ --140; LTP--130; S+--130; SM--110
Expected PDX approach speed: 134 knots (2.23 NM/minute)

Notes on Sigmas:

In general, the models will vary the separations by ± 3 sigmas (standard deviations).
Separations will be within ± 1 sigma approximately 68.3% of the time.
Separations will be within ± 2 sigmas approximately 91% of the time.
Separations will be within ± 3 sigmas approximately 99.7% of the time.
ARR/ARR Standard Sigma = 18 Seconds. (Source: FAA-EM-78-8A)
Critical Function: The 18-second sigma is used to calculate the buffer, which is added to the minimum IFR separations, to generate the average IFR separations.
For a pair of arrivals, the average separation = (minimum separation in NM) + (1.65 * sigma in NM).

IFR SEPARATIONS **Accepted by PDX Team on 11/30/00**

STANDARD IFR ARR/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds
At Point of Closest Approach <<with 2.5 NM minimum spacing on a Runway>>

ARR/ARR (NM)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	5.29	6.16	6.16	6.07	7.07	6.91
757	*Treat as Heavy*	5.29	6.16	6.16	6.07	7.07	6.91
LJ	*(7110.65--Large)*	3.79	3.66	3.66	3.57	5.07	4.91
LTP	*(7110.65--Large)*	3.79	3.66	3.66	3.57	5.07	4.91
S+	*(7110.65--Small)*	3.79	3.66	3.66	3.57	3.57	4.91
SM	*(7110.65--Small)*	3.79	3.66	3.66	3.57	3.57	3.41

Expected IFR ARR/ARR separations for PDX: 4.15 NM 1.86 minutes
Expected IFR Arrival Flow Rates for PDX: 32 arrivals/runway (max thruput)

STANDARD IFR DEP/DEP SEPARATIONS (in Minutes) -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+

DEP/DEP (Minutes)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
HVY	*(7110.65--Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00
757	*Treat as Heavy*	1.50	2.00	2.00	2.00	2.00	2.00
LJ	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	1.00
LTP	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	1.00
S+	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	1.00
SM	*(7110.65--Small)*	1.00	1.00	1.00	1.00	1.00	1.00

Expected IFR DEP/DEP separations for PDX: 1.10 minutes
Expected IFR Departure Flow Rates for PDX: 55 departures/runway (max thruput) -- with no mixed ops

STANDARD IFR DEP/ARR SEPARATIONS -- AVERAGE

Report FAA-EM-78-8A -- with updated ATC separations (7110.65) for Hvy/757/S+ and PDX approach speeds

DEP/ARR (NM)

LEAD	***TRAIL----***	**HVY**	**757**	**LJ**	**LTP**	**S+**	**SM**
ALL CLASSES		2.00	2.00	2.00	2.00	2.00	2.00

Expected IFR DEP/ARR separations for PDX: 2.00 NM
When departure starts to roll, arrival must be at least this far from threshold: 0.90 minutes

NOTES: **IFR A/D Separations (minutes) are the Runway Occupancy Times (ROTs).**
Approach Speeds in Knots: Heavy--155; 757--140; LJ --140; LTP--130; S+--130; SM--110
Expected PDX approach speed: 134 knots (2.23 NM/minute)

Notes on Sigmas:

In general, the models will vary the separations by ± 3 sigmas (standard deviations).
Separations will be within ± 1 sigma approximately 68.3% of the time.
Separations will be within ± 2 sigmas approximately 91% of the time.
Separations will be within ± 3 sigmas approximately 99.7% of the time.
ARR/ARR Standard Sigma = 18 Seconds. (Source: FAA-EM-78-8A)
Critical Function: The 18-second sigma is used to calculate the buffer, which is added to the minimum IFR separations, to generate the average IFR separations.
For a pair of arrivals, the average separation = (minimum separation in NM) + (1.65 * sigma in NM).

DEPARTURE PUSH -- 1996 PDX STUDY **Accepted by PDX Team on 7/20/00**

Departure Push = 5

Arrivals are usually given priority over departures. However, during a departure push, spacing between arrivals may be increased in order to reduce departure delay.

When five departures initiate their pushback, the Tower would space out arrivals in order to allow an aircraft to depart between two arrivals. At the current demand level, with both parallels operating, this would seldom occur. As demand increases, the Tower would increase the frequency of the departure pushes.

D/D Noise Dependency for Turboprop/Jet -- 1996 PDX STUDY **Accepted by PDX Team on 7/20/00**

VFR & IFR: 2 minutes (unless the 2 aircraft have divergent turns).

Without the noise restrictions, the standard VFR D/D separation for a Turboprop followed by a Jet would be 1 minute in VFR and 2 minutes in IFR.

With the PDX Noise restrictions, when a Turboprop departure is followed by a Jet departure, the Departure-to-Departure (D/D) separation is 2 minutes in both VFR and IFR. The additional 1-minute separation in VFR prevents the Jet from overtaking the Turboprop, which is a slower aircraft. This 2-minute separation in VFR does not apply when the Turboprop and the Jet have divergent turns.

Note: 10/15/01: VFR refers to VFR *separations*. IFR refers to IFR *separations*.

DEPARTURE RUNWAY OCCUPANCY TIMES (SECONDS) -- STANDARD (WITH 2000 CLASSES): **Accepted by PDX Team on 7/20/00**

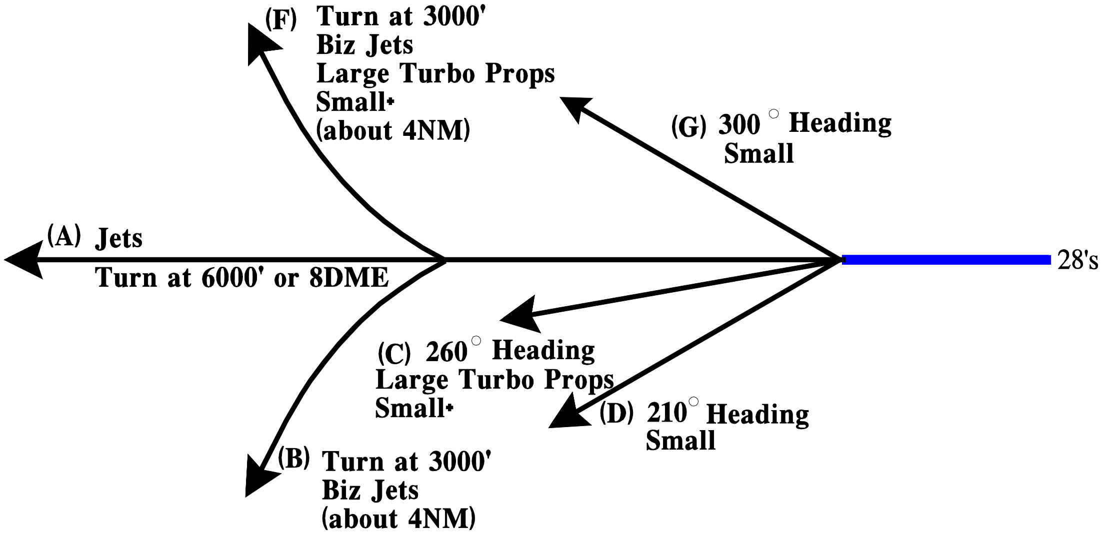
These are the minimum times a departure is on the runway. Runway crossing times and aircraft separations cannot violate these minimums.

	Class	Heavy	757	Large Jet	LTP	Small+	Small
Standard	Seconds	39	39	39	39	39	34

Source: **Standard values used in all design team studies. These values were used in the 1996 PDX STUDY.**

PDX NOISE DEPENDENCIES -- WEST FLOW (Same Runway) Accepted by PDX Team on 7/20/00 (Updated 8/2/00)

(B) & (C) & (D) -- Totally independent WRT noise
(A) & (C) & (D) -- Totally independent WRT noise
(C) & (D) & (G) -- Independent of everyone WRT noise
(A) South & (A) North -- Full noise dependency
(A) & (B) -- Noise Dependent up to 3000' (about 4NM from west end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(A) & (F) -- Noise Dependent up to 3000' (about 4NM from west end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(F) & (B) -- Noise Dependent up to 3000' (about 4NM from west end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)



WEST FLOW: There are no departure fix restrictions for 2 dis-similar jets going to the same exit fix at the center. Updated 12/94.

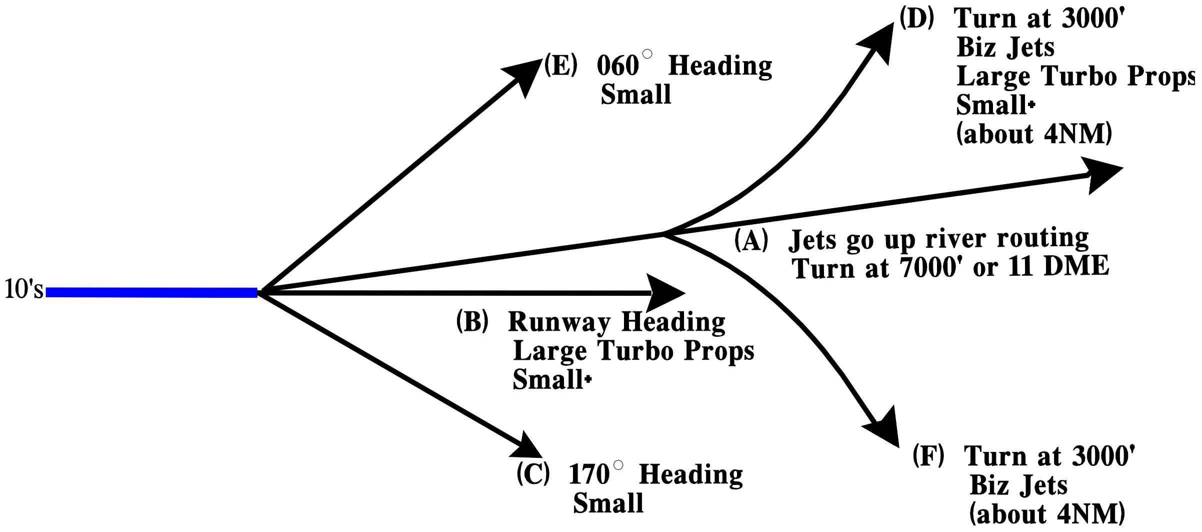
VFR FLIGHT PLAN -- Small aircraft can do an immediate turn onto any of several departure paths. Updated 12/94.

Note: Assume all Biz Jets are quiet because most are quiet.
WRT = with respect to.

Notes: **Headings for Southbound Small are now 210° (instead of 240° in 1996 Study).**
Small+ aircraft follow the same heading as Large Turbo Props.
Regional Jets have the same procedures as Large Jets (A).

PDX NOISE DEPENDENCIES -- EAST FLOW (Same Runway) Accepted by PDX Team on 7/20/00 (Updated 8/2/00)

(A) & (B) & (C) & (E) -- Totally Independent WRT Noise
(B) & (C) & (E) -- Independent of Everyone WRT Noise
VFR Flight Plans -- No Noise Dependency
(A) South & (A) North -- Full Noise Dependency
(A) & (D) -- Noise Dependency to 3000' (about 4NM from east end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(A) & (F) -- Noise Dependency to 3000' (about 4NM from east end of runway)
(Jet / Turbine = 1 minute, Turbine / Jet = 2 minutes)
(F) & (D) -- Noise Dependency to 3000' (about 4NM from east end of runway)
(Jet / Turbine = 1 miute, Turbine / Jet = 2 minutes)



EAST FLOW: To depart 2 dis-similar jets (when the trail aircraft is a smaller jet) going to the same exit fix at the center -- controllers must add 30 seconds to trail departure, if they cannot insert a different type of departure. However, they can usually insert a different type of departure, thereby eliminating the need to add the extra separation. Updated 12/94.

VFR FLIGHT PLAN -- Small aircraft can do an immediate turn onto any of several departure paths. Updated 12/94.

Note: Assume all Biz Jets are quiet because most are quiet.
WRT = with respect to.

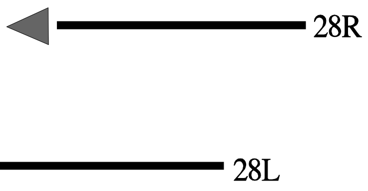
Notes: **Headings for Southbound Small are now 170° (instead of 120° in 1996 Study).**
Small+ aircraft follow the same heading as Large Turbo Props.
Regional Jets have the same procedures as Large Jets (A).

OTHER DEPARTURE DEPENDENCIES

Accepted by PDX Team on 7/20/00

D/D Rwy Dependencies due to Noise for Offset Departure Thresholds

WEST FLOW -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-14)



Departure on 28R followed by a Departure on 28L -- VFR & IFR Noise Dependency:

<u>28R/28L</u>

Jet/Jet:	Use 1.25 minutes (0.25 minutes added to std Jet/Jet) When Heavy is lead aircraft, add 0.25 minutes to std Heavy/Jet When 757 is lead aircraft, add 0.25 minutes to std 757/Jet
Turboprop/Turboprop:	Use 1.25 minutes (0.25 minutes added to std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes added to std Turboprop/Jet)
Jet/Turboprop:	Use 1.00 minute (0.00 minutes added to std Jet/Turboprop) When Heavy is lead aircraft, add 0.00 minutes to std Heavy/Turboprop When 757 is lead aircraft, add 0.00 minutes to std 757/Turboprop

Departure on 28L followed by a Departure on 28R -- VFR & IFR Noise Dependency:

<u>28L/28R</u>

Jet/Jet:	Use 0.75 minutes (0.25 minutes subtracted from std Jet/Jet) When Heavy is lead aircraft, subtract 0.25 minutes from std Heavy/Jet When 757 is lead aircraft, subtract 0.25 minutes from std 757/Jet
Turboprop/Turboprop:	Use 0.75 minutes (0.25 minutes subtracted from std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes subtracted from std Turboprop/Jet)
Jet/Turboprop:	Use 0.75 minutes (0.25 minutes subtracted from std Jet/Turboprop) When Heavy is lead aircraft, subtract 0.25 minutes from std Heavy/Turboprop When 757 is lead aircraft, subtract 0.25 minutes from std 757/Turboprop (Adjusted format on 1/17/01)

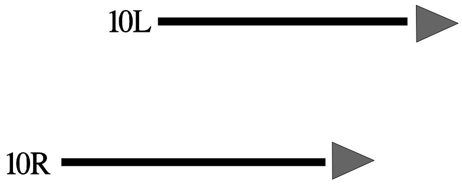
Note: Turboprop can be LTP or S+.
Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES

Accepted by PDX Team on 7/20/00

D/D Rwy Dependencies due to Noise for Offset Departure Thresholds

EAST FLOW -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-15)



Departure on 10R followed by a Departure on 10L -- VFR & IFR Noise Dependency:

10R/10L

Jet/Jet:	Use 2.00 minutes (1.00 minute added to std Jet/Jet) When Heavy or 757 is lead aircraft, use 2.00 minutes
Turboprop/Turboprop:	Use 2.00 minutes (1.00 minute added to std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes added to std Turboprop/Jet)
Jet/Turboprop:	Use 1.25 minutes (0.25 minutes added to std Jet/Turboprop) When Heavy is lead aircraft, add 0.25 minutes to std Heavy/Turboprop When 757 is lead aircraft, add 0.25 minutes to std 757/Turboprop

Departure on 10L followed by a Departure on 10R -- VFR & IFR Noise Dependency:

10L/10R

Jet/Jet:	Use 0.66 minutes (0.34 minutes subtracted from std Jet/Jet) When Heavy is lead aircraft, subtract 0.34 minutes from std Heavy/Jet When 757 is lead aircraft, subtract 0.34 minutes from std 757/Jet
Turboprop/Turboprop:	Use 0.66 minutes (0.34 minutes subtracted from std Turboprop/Turboprop)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes subtracted from std Turboprop/Jet)
Jet/Turboprop:	Use 0.66 minutes (0.34 minutes subtracted from std Jet/Turboprop) When Heavy is lead aircraft, subtract 0.34 minutes from std Heavy/Turboprop When 757 is lead aircraft, subtract 0.34 minutes from std 757/Turboprop (Adjusted format on 1/17/01)

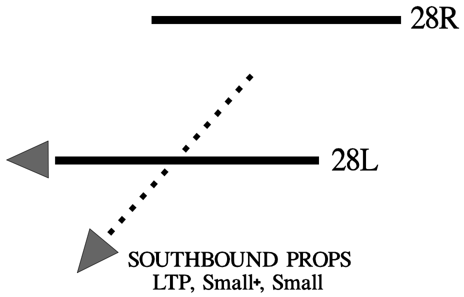
Note: Turboprop can be LTP or S+.
Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES

Accepted by PDX Team on 11/30/00

D/D Rwy Dependencies due to Departure Air Crossovers

WEST FLOW -- SOUTHBOUND AIR CROSSOVERS -- from 1996 PDX Study
(Data Pkg 13, Appendix A, page A-10)



SOUTHBOUND PROPS (LTP or S+ or Small) departing 28R are permitted to turn south as soon as they are airborne. Therefore, there is a dependency between a southbound departure on 28R and a departure on 28L. Under the existing noise restrictions, any prop (LTP or S+ or Small) can turn south immediately.

28R/28L: Southbound Departure on 28R Followed by Departure on 28L

28R/28L
LTP or S+ or Small/Any Aircraft: VFR: 50 seconds for Prop to cross 28L
IFR1: 70 seconds for Prop to cross 28L & be verified by radar

28L/28R: Departure on 28L Followed by Southbound Departure on 28R

(D/D Offsets & Separations in the 1996 Study, Data Pkg 13, Appendix A, *pages A-14 & A-22*)

28L/28R
Heavy or 757/LTP or S+ or Small: VFR: 1.75 minutes (due to wake vortex & offset thresholds)
IFR1: 1.75 minutes (due to wake vortex & offset thresholds)
Updated 757 info on 10/30/00.

LJ/LTP or S+ or Small: VFR: 20 seconds (due to diverging paths & offset thresholds)
IFR1: 45 seconds (due to diverging paths & offset thresholds)

LTP or S+ northbound/LTP or S+: VFR: 20 seconds (due to diverging paths & offset thresholds)
IFR1: 45 seconds (due to diverging paths & offset thresholds)

LTP or S+ southbound/LTP or S+: VFR: 45 seconds (due to offset thresholds)
IFR1: 45 seconds (due to offset thresholds)

LTP or S+/Small: VFR: 20 seconds (due to diverging paths & offset thresholds)
IFR1: 45 seconds (due to diverging paths & offset thresholds)

Small/LTP or S+ or Small: VFR: 20 seconds (due to diverging paths & offset thresholds)
IFR1: 45 seconds (due to diverging paths & offset thresholds)

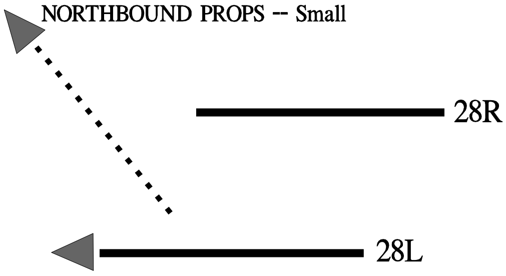
Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES

Accepted by PDX Team on 11/30/00

D/D Rwy Dependencies due to Departure Air Crossovers

WEST FLOW -- NORTHBOUND AIR CROSSOVERS -- from 1996 PDX Study
(Data Pkg 13, Appendix A, page A-11)



SMALL NORTHBOUND PROPS departing 28L are permitted to turn north as soon as they are airborne. Therefore, there is a dependency between a northbound departure on 28L and a departure on 28R. Under the existing noise restrictions, any Small can turn north immediately.

28R/28L: Departure on 28R Followed by Northbound Departure on 28L

(D/D Separations in the 1996 Study, Data Pkg 13, Appendix A, page A-22)

28R/28L

Heavy or 757/Small:	VFR:	2 minutes (due to wake vortex)
	IFR1:	2 minutes (due to wake vortex) (D/D separations) **Updated 757 info on 10/30/00.**
LJ/Small:	VFR:	50 seconds (D/D separations)
	IFR1:	1 minute (D/D separations)
LTP or S+/Small:	VFR:	50 seconds (D/D separations)
	IFR1:	1 minute (D/D separations)
Small/Small:	VFR:	20 seconds (D/D separations)
	IFR1:	1 minute (D/D separations)

28L/28R: Northbound Departure on 28L Followed by Departure on 28R

28L/28R

Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 28R
	IFR1:	70 seconds for Prop to cross 28R & be verified by radar

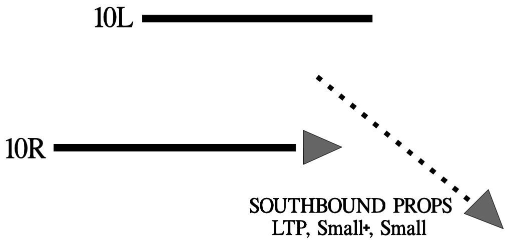
Note: Improvement Package (A), All Turbo Props and Biz Jets Can Do Divergent Turns, will permit LTP or S+ aircraft to turn north immediately. For that simulation, the separation for a LTP or S+ aircraft will be the same as that of a Small.

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

EAST FLOW -- SOUTHBOUND AIR CROSSOVERS -- from 1996 PDX Study
(Data Pkg 13, Appendix A, page A-12)



SOUTHBOUND PROPS (LTP or S+ or Small) departing 10L are permitted to turn south as soon as they are airborne. Therefore, there is a dependency between a southbound departure on 10L and a departure on 10R. Under the existing noise restrictions, any prop (LTP or S+ or Small) can turn south immediately.

10L/10R: Southbound Departure on 10L Followed by Departure on 10R

10L/10R
LTP or S+ or Small/Any Aircraft: VFR: 50 seconds for Prop to cross 10R
IFR1: 70 seconds for Prop to cross 10R & be verified by radar

10R/10L: Departure on 10R Followed by Southbound Departure on 10L

(D/D Offsets & Separations in the 1996 Study, Data Pkg 13, Appendix A, pages A-15 & A-22)

10R/10L
Heavy or 757/LTP or S+ or Small: VFR: 2.25 minutes (due to wake vortex & offset thresholds)
IFR1: 2.25 minutes (due to wake vortex & offset thresholds)
Updated 757 info on 10/30/00.

LJ/LTP or S+: VFR: 1.25 minutes (due to offset thresholds)
IFR1: 1.25 minutes (due to offset thresholds)

LJ/Small: VFR: 1 minute (due to offset thresholds)
IFR1: 1.25 minutes (due to offset thresholds)

LTP or S+ northbound/LTP or S+: VFR: 2 minutes (due to offset thresholds)
IFR1: 2 minutes (due to offset thresholds)

LTP or S+ southbound/LTP or S+: VFR: 1.25 minutes (due to offset thresholds)
IFR1: 1.25 minutes (due to offset thresholds)

LTP or S+ northbound/Small: VFR: 2 minutes (due to offset thresholds)
IFR1: 2 minutes (due to offset thresholds)

LTP or S+ southbound/Small: VFR: 1.08 minutes (due to offset thresholds & diverging paths)
IFR1: 1.25 minutes (due to offset thresholds & diverging paths)

Small northbound/Small: N/A: Small aircraft on 10R usually go southbound

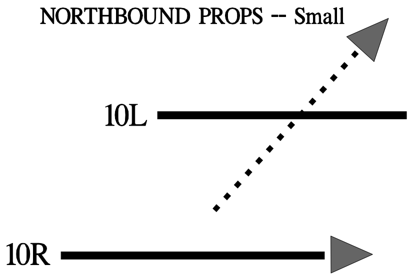
Small southbound/Small: VFR: 30 seconds (due to offset thresholds & diverging paths)
IFR1: 45 seconds (due to offset thresholds & diverging paths)

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

OTHER DEPARTURE DEPENDENCIES **Accepted by PDX Team on 11/30/00**

D/D Rwy Dependencies due to Departure Air Crossovers

EAST FLOW -- NORTHBOUND AIR CROSSOVERS -- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-13)



SMALL NORTHBOUND PROPS departing 10R are permitted to turn north as soon as they are airborne. Therefore, there is a dependency between a northbound departure on 10R and a departure on 10L. Under the existing noise restrictions, any Small can turn north immediately.

10L/10R: Departure on 10L Followed by Northbound Departure on 10R

(D/D Offsets & Separations in the 1996 Study, Data Pkg 13, Appendix A, pages A-15 & A-22)

10L/10R		
Heavy or 757/Small:	VFR:	1.66 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.66 minutes (due to wake vortex & offset thresholds)
		Updated 757 info on 10/30/00.
LJ/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)
LTP or S+/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)
Small/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)

10R/10L: Northbound Departure on 10R Followed by Departure on 10L

10R/10L		
Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 10L
	IFR1:	70 seconds for Prop to cross 10L & be verified by radar

Note: Improvement Package (A), All Turbo Props and Biz Jets Can Do Divergent Turns, will permit LTP or S+ aircraft to turn north immediately. For that simulation, the separation for a LTP or S+ aircraft will be the same as that of a Small.

Note: 10/15/01: VFR refers to VFR1 and VFR2 simulations. IFR1 refers to IFR1 simulations.

Additional IFR1 Dependencies due to Departure Air Crossovers

A/D IFR1 Runway Dependencies due to Departure Air Crossovers

-- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-9)

In IFR1, there is an additional runway dependency for an aircraft departing the north runway, turning south, and crossing over the south runway. The arrival on the south runway must have landing assured before the southbound departure can be released.

Similarly, in IFR1, there is an additional runway dependency for an aircraft departing the south runway, turning north, and crossing over the north runway. The arrival on the north runway must have landing assured before the southbound departure can be released.

Arrival/Departure Turning and Crossing the Arrival Runway

South Runway/North Runway:	IFR1:	5 seconds (for arrival to have landing assured)
North Runway/South Runway:	IFR1:	5 seconds (for arrival to have landing assured)

D/A IFR1 Runway Dependencies due to Departure Air Crossovers

-- from 1996 PDX Study (Data Pkg 13, Appendix A, page A-9)

In IFR1, there is an additional runway dependency for an aircraft departing the north runway, turning south, and crossing over the south runway. The arrival on the south runway must be at least 2 NM in-trail behind the southbound departure when the southbound departure is released.

Similarly, in IFR1, there is an additional runway dependency for an aircraft departing the south runway, turning north, and crossing over the north runway. The arrival on the north runway must be at least 2 NM in-trail behind the departure when the northbound departure is released.

The D/A separation of 2 NM must be adjusted to reflect the offsets of the runway thresholds.

Departure/Arrival (when departure turns and crosses the arrival runway)

28R/28L:	IFR1:	2.3 NM (distance of arrival from its threshold) (2 NM + 0.3 NM offset)
28L/28R:	IFR1:	1.7 NM (distance of arrival from its threshold) (2 NM - 0.3 NM offset)
10R/10L:	IFR1:	2.9 NM (distance of arrival from its threshold) (2 NM + 0.9 NM offset)
10L/10R:	IFR1:	1.1 NM (distance of arrival from its threshold) (2 NM - 0.9 NM offset)

Note: These A/D and D/A dependencies protect *for* a missed approach.
Note: 10/15/01: IFR1 refers to IFR1 simulations.

IFR1 -- Staggered Approaches to Parallel Runways with Offset Thresholds (from PDX 1996 Study)

Accepted by PDX Team on 2/1/01

In IFR1, PDX conducts staggered approaches to the parallel runways. PDX must use at least a 1.5 NM stagger. To insure that minimum separations are not violated, a 2 NM longitudinal stagger will be simulated. Because the thresholds are offset, we will simulate the stagger as follows:

Arrival/Arrival

28R/28L:	IFR1:	2.3 NM (distance of trailing arrival from its threshold) (2 NM + 0.3 NM offset)
28L/28R:	IFR1:	1.7 NM (distance of trailing arrival from its threshold) (2 NM - 0.3 NM offset)
10R/10L:	IFR1:	2.9 NM (distance of trailing arrival from its threshold) (2 NM + 0.9 NM offset)
10L/10R:	IFR1:	1.1 NM (distance of trailing arrival from its threshold) (2 NM - 0.9 NM offset)

Note: 10/15/01: IFR1 refers to IFR1 simulations.

OPERATIONAL PROCEDURES AND MINIMA -- DEFINITIONS

Accepted by PDX Team on 11/30/00

These were developed from the 1996 PDX Study -- based on the PDX Airside Capacity Study (final report), March 1991, pgs A-9 thru A-13. They were revised in July 2000 to reflect current conditions and assumptions:

- **1.5 NM staggered approaches to parallel runways in IFR for Do-Nothing case.**
- **Runway 3 will not be used for arrivals**. Current ATC rules for LAHSO (Land and Hold Short Operations) have such severe restrictions that they effectively do not permit simultaneous arrivals to Runway 3 and 10R/28L.

VFR1: Ceiling ≥ 3,500' *and* Visibility ≥ 10 miles.
Visual (VFR1) separations.
Simultaneous visual approaches to both parallel runways by all aircraft types.
Runway 3 not used for arrivals in VFR1.
Although not permitted under noise abatement procedures, ATC rules would permit certain small aircraft to make visual **dependent** approaches to Runway 3. Current LAHSO rules do not permit small aircraft to make simultaneous approaches to Runway 3 and 10R/28L, even when the runways are dry and there is no tailwind.

VFR2: Less than VFR1, *and*, Ceiling ≥ 2,000' *and* Visibility ≥ 5 miles.
IFR separations for A/A. Visual (VFR1) separations for others.
Simultaneous approaches may be permitted to the parallel runways.
10/26/95 Update: Small_as_Trail can use Visual A/A separations.
Runway 3 not used for arrivals in VFR2.
ATC rules would permit certain small aircraft to make **dependent** approaches to Runway 3 when the runways are dry. VFR2 usually occurs in the winter when the runways are wet. In addition, current LAHSO rules do not permit small aircraft to make simultaneous approaches to Runway 3. In reality, Runway 3 cannot and would not be used for arrivals in VFR2.

IFR1: Less than VFR2, *and*, Ceiling ≥ 200' *and* Visibility ≥ 0.5 miles.
IFR separations are required.
1.5 NM staggered approaches to existing parallel runways in West and East flows.
Visual approaches are not allowed to any runway.

IFR2: Less than IFR1, *and*, Ceiling ≥ 100' *and* Visibility ≥ 0.25 miles.
IFR separations. Arrive on 10R. Depart on 10R & 10L.

IFR3: Visibility < 0.25 miles *and* ≥ 0.125 miles.
IFR separations. Arrive on 10R. Depart on 10R & 10L.
SMGCS is expected in Fall 2001. The expected departure minimums are 300' RVR for SMGCS participants and 500' RVR for all others. **Updated 1/18/01.**

Minimums obtained from approach plates:

- **10R: CAT I minimums are 200'AGL and 3/8 mile.**
- **10L: CAT I minimums are 450' AGL and 1 mile.**
- **28R: CAT I minimums are 300 AGL and 1 mile. Updated 10/30/00.**
- **28L: CAT I minimums are 400' AGL and 1/2 mile. Updated 10/30/00.**

OPERATIONAL PROCEDURES AND MINIMA -- SIMULATED (UPDATED 8/11/00)

Accepted by PDX Team on 10/12/00

At the July 20, 2000 meeting, the Design Team agreed it was reasonable to use the values from the 1996 PDX Study. With the addition of the new tower and CAT I ILS approaches to 10R and 28L, the minimums changed from 1996 minimums. However, the Design Team agreed that the percentages of VFR1, VFR2, and IFR1 were still reasonable to use in the annual delay calculations.

Weather	VFR1	VFR2	IFR1	
MINIMA	VISUAL	<VIS & ≥IFR	CAT I	ALL WEATHER
Ceiling:	3500'	2000'	200'	
Visibility:	10 miles	5 miles	0.5 miles	
EAST FLOW (10s)	35.3%	9.2%	7.8%	52.3%
WEST FLOW (28s)	39.1%	5.0%	3.6%	47.7%
	-----	-----	-----	-----
TOTAL	74.4%	14.2%	11.4%	100.0%

Note: 10/15/01: VFR1 and VFR2 are VMC. IFR1 is IMC.
10/15/01: VFR1, VFR2, and IFR1 refer to simulated procedures/conditions.

1996 PDX Study -- PDX Tower:

- All aircraft usually do or can operate in IFR1 & IFR2.
- Fog usually occurs from sunrise to 10am.
- VFR3 is not needed.
- VFR2 usually occurs in full days; thus, the VFR2 Factor = 1.
- IFR1 usually occurs in full days; thus, the IFR1 Factor = 1.

1996 PDX Study -- Design Team:

- At the January 18, 1995 meeting, the Design Team agreed to simulate only VFR1, VFR2, and IFR1 based on the list of improvements.
- The Technical Center compared the Port of Portland's 4 years of runway use data (1990-1993), presented at the May 1995 meeting, to the 10 years of runway use data (1979-1988) summarized above. For all weather conditions, both sets of data showed the East Flow usage was 52.3% and the West Flow usage was 47.7%. At the July 1995 meeting, the Design Team agreed to use the above values, *Operational Procedures and Runway Utilization Simulated*, for the SIMMOD annualizations**.**

RUNWAY EXIT DATA -- 1996 STUDY (WITH 2000 CLASSES) Accepted by PDX Team on 10/12/00 (UPDATED 8/11/00)

Note: ***At the July 20th meeting, the Design Team agreed to use the 1996 exit data for this study. The tables were updated to reflect the changes in the aircraft class definitions.***

Runway 10R -- 1996 PDX STUDY (With 2000 Classes)

Exit	E	---	B5/F	B6/C6		
Distance	4600’		6900’*	8500’	TOTAL	
Heavy Usage			70%	30%	100%	Adjusted by
ROT			53	64	56 sec	Tower & FAATC 12/94
757 Usage	17%		81%	2%	100%	
ROT	40		53	64	51 sec	
Large Jet Usage	17%		81%	2%	100%	
ROT	40		53	64	51 sec	
LTP Usage	41%		54%	5%	100%	LTP treated
ROT	40		55	57	49 sec	as Medium in 1996 Study
Small+ Usage	41%		54%	5%	100%	Small+ treated
ROT	40		55	57	49 sec	as Medium in 1996 Study
Small Usage	93%		7%		100%	
ROT	47		60		48 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.
Exits B3/B4 have been added about 5,600' from the 10R threshold.
Most of the 2000 data collection had a key taxiway closed that affected exit usage.
At the July 2000 meeting, the Design Team agreed to use the 1996 exit data for this study.

Runway 10L -- 1996 PDX STUDY (With 2000 Classes)

Exit	A5	A4	A2/A3	A1/END		
Distance	3400’rhs	4200’	5900’*	8000’	TOTAL	
Heavy Usage			80%	20%	100%	
ROT			51	65	54 sec	
757 Usage	5%	5%	74%	16%	100%	
ROT	37	37	51	65	52 sec	
Large Jet Usage	5%	5%	74%	16%	100%	
ROT	37	37	51	65	52 sec	
LTP Usage	28%	50%	22%		100%	LTP treated
ROT	37	42	58		44 sec	as Medium in 1996 Study
Small+ Usage	28%	50%	22%		100%	Small+ treated
ROT	37	42	58		44 sec	as Medium in 1996 Study
Small Usage	16%	84%			100%	
ROT	42	47			46 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.

Legend:
% - Exit Utilization (percent)
s - Runway Occupancy Time (seconds)
h - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
* - Combination of h, rhs, and 90° exits

RUNWAY EXIT DATA (cont)

Accepted by PDX Team on 10/12/00

Runway 28R -- 1996 PDX STUDY (With 2000 Classes)

Exit	A2/A3	A4	A5	A6	A7/END		
Distance	2100’	3800’	4600’hs	5900’hs	8000	TOTAL	
Heavy Usage				80%	20%	100%	
ROT				44	63	48 sec	
757 Usage		1%	21%	60%	18%	100%	
ROT		35	39	44	63	46 sec	
Large Jet Usage		1%	21%	60%	18%	100%	
ROT		35	39	44	63	46 sec	
LTP Usage		27%	64%	9%		100%	LTP treated
ROT		37	41	50		41 sec	as Medium in 1996 Study
Small+ Usage		27%	64%	9%		100%	Small+ treated
ROT		37	41	50		41 sec	as Medium in 1996 Study
Small Usage	5%	84%	11%			100%	
ROT	24	43	42			42 sec	

Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.
ADSIM links for the 28R exits are 311 through 315. 1/11/01--FAATC.
For the NEW RUNWAY, ADSIM will use 28R occupancy times and probabilities. 1/11/01-- FAATC.
ADSIM links for the NEW RUNWAY exits are 331 through 335. 1/11/01--FAATC.

Runway 28L -- 1996 PDX STUDY (With 2000 Classes)

Exit	B6/C6	B5/F	CE/E	B2		
Distance	2500’	4100’*	6400’	8500’	TOTAL	
Heavy Usage			80%	20%	100%	
ROT			57	61	58 sec	
757 Usage		18%	80%	2%	100%	
ROT		39	49	61	47 sec	
Large Jet Usage		18%	80%	2%	100%	
ROT		39	49	61	47 sec	
LTP Usage	18%	78%	4%		100%	LTP treated
ROT	31	40	60		39 sec	as Medium in 1996 Study
Small+ Usage	18%	78%	4%		100%	Small+ treated
ROT	31	40	60		39 sec	as Medium in 1996 Study
Small Usage	12%	80%	8%		100%	
ROT	34	42	48		42 sec	

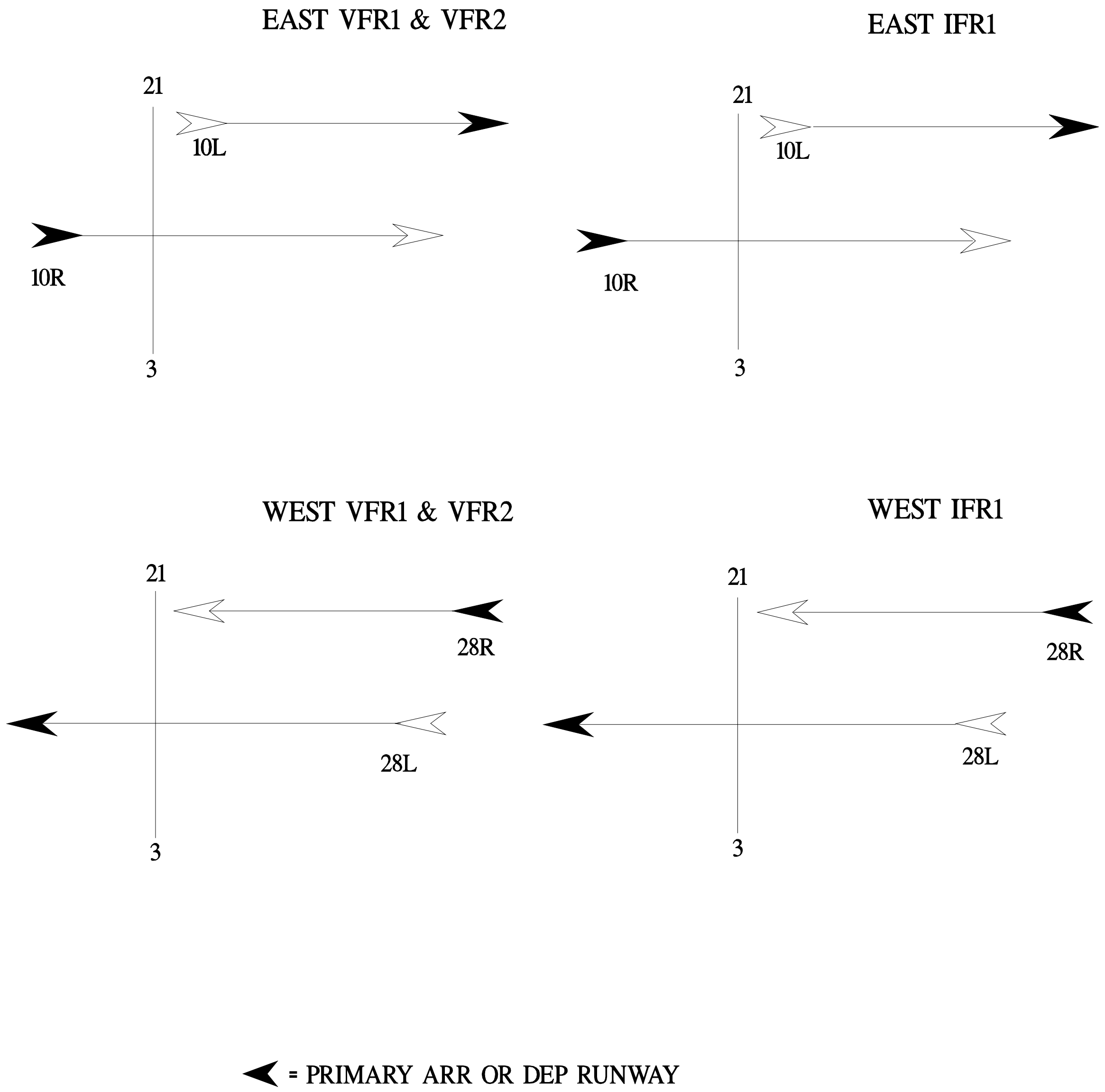
Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by PDX Tower.
Exits B3/B4 have been added about 5,400' from the 28L threshold.
Most of the 2000 data collection had a key taxiway closed that affected exit usage.
At the July 2000 meeting, the Design Team agreed to use the 1996 exit data for this study.
ADSIM links for the 28L exits are 321 through 324. 1/11/01--FAATC.

Runway 3 -- Runway 2 in 1996 PDX STUDY (With 2000 Classes)

Exit	E4	C/CE	B	M		
Distance	2200’	3100’	4400’	4800’hs	TOTAL	
LTP Usage			50%	50%	100%	LTP treated
ROT			45	47	46 sec	as Medium in 1996 Study
Small+ Usage			50%	50%	100%	Small+ treated
ROT			45	47	46 sec	as Medium in 1996 Study
Small Usage	75%	25%			100%	
ROT	34	43			36 sec	

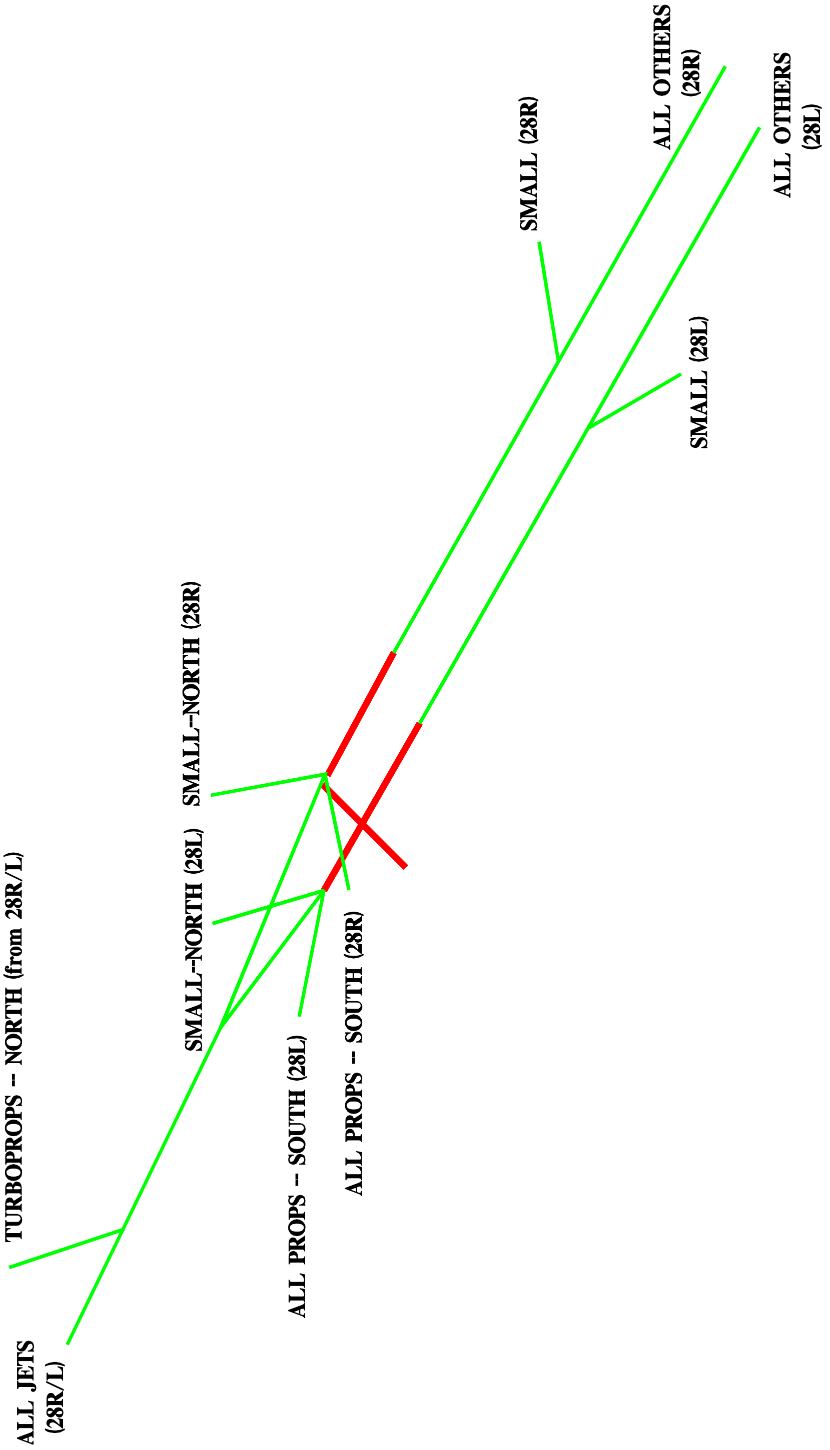
Notes: Distance in feet from threshold. Conditions were VFR and dry. Observed by FAATC.

FROM SUMMARY DATA PACKAGE – Runway Configurations (PDX Do-Nothing)–October 2001



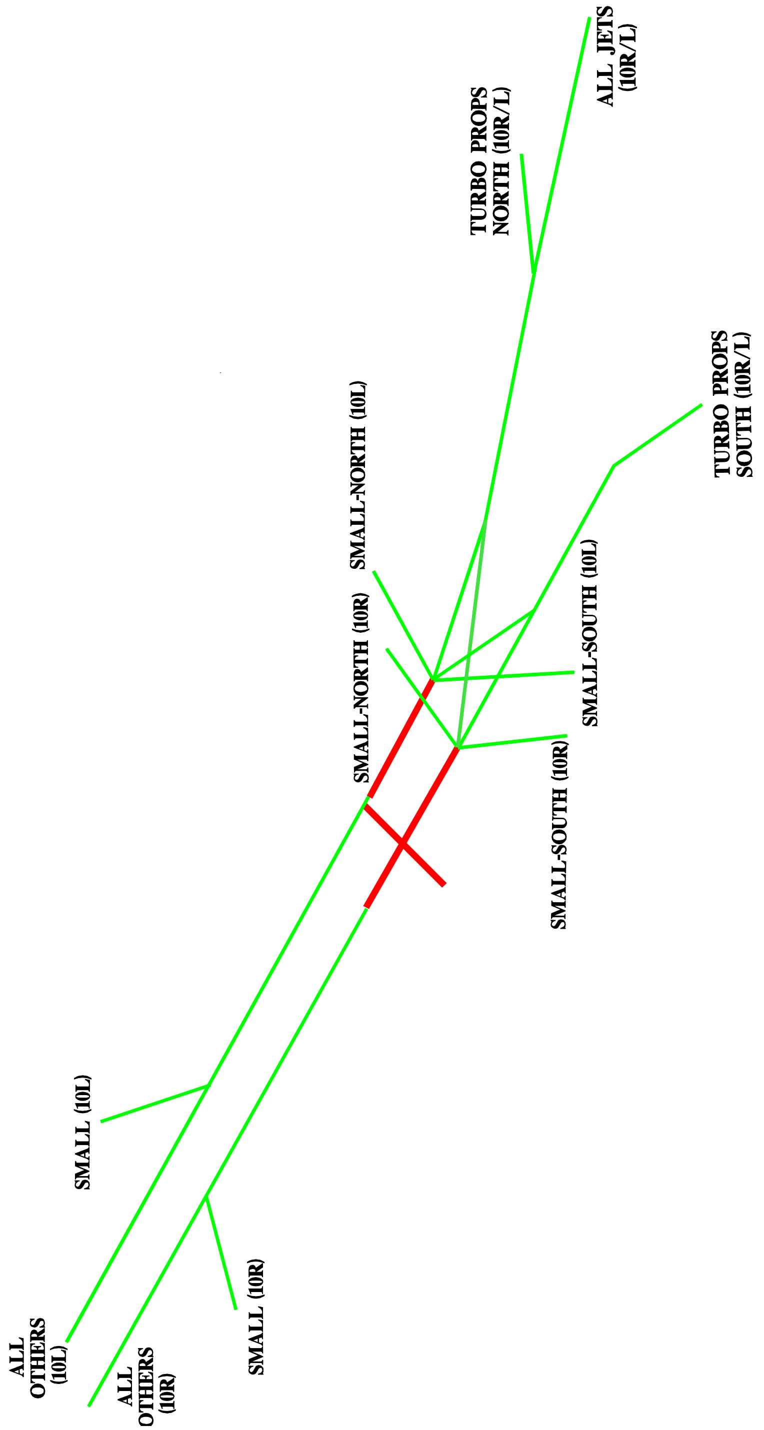
Note: **Accepted by the PDX Design Team at the meeting on July 20, 2000.**
Runway 3/21 will be considered an operational runway.
VFR2 -- any size aircraft can land on 10L and 28L.
10L & 28L have CAT I ILS -- with staggered approaches in IFR1.
10/15/01: Clarified the note on staggered approaches in IFR1.

FROM SUMMARY DATA PACKAGE–Modeling Airspace Map--WEST Flow (PDX Do-Nothing)–October 2001



Accepted 10/12/00: **Departure restrictions still apply.**
LTP and S+ aircraft classes are considered Turbo Props in this study.

FROM SUMMARY DATA PACKAGE–Modeling Airspace Map--EAST Flow (PDX Do-Nothing)–October 2001



Accepted 10/12/00: **Departure restrictions still apply.**
LTP and S+ aircraft classes are considered Turbo Props in this study.

FROM SUMMARY DATA PACKAGE – Summary of Key Inputs & Assumptions – October 2001

Annual and Daily Demand

The Design Team simulated 3 demand levels. The schedule for the 1999 demand level was developed from Tower counts and OAG data for Tuesday, July 27, 1999, and cargo schedules for August 2000.

Demand Level	Annual Operations	Daily Operations	Equivalent Days
1999(Baseline)	322,000	1,006	320
Future 1	484,000	1,512	320
Future 2	620,000	1,938	320

Note: (Annual Operations) / (Daily Operations) = Equivalent Days

Fleet Mix By Aircraft Classifications

H Heavy	757	LJ Large Jet	LTP Large Turboprop	S+ Small+	S Small	Total	
4.7%	5.2%	46.3%	17.6%	14.7%	11.5%	100.0%	1999 (Baseline)
4.9%	5.3%	47.6%	18.1%	14.0%	10.1%	100.0%	Future 1
5.0%	5.5%	48.5%	18.6%	13.5%	9.0%	100.0%	Future 2

Percentages are rounded to 1 decimal place.

Aircraft Classifications

Aircraft Classifications used were based on 1999 FAA separation standards.

VFR1/VFR2/IFR1 Simulations and VMC/IMC Conditions

The Design Team simulated 3 conditions (VFR1, VFR2, and IFR1), which reflect the runway operating conditions associated with specific ceiling and visibility minimums. They are defined in Appendix A, pages A-29 and A-30.

VFR1 and VFR2 are VMC (Visual Meteorological Conditions). IFR1 is IMC (Instrument Meteorological Conditions).

FROM SUMMARY DATA PACKAGE – Summary of Key Inputs & Assumptions – October 2001 (cont)

IMC (IFR1 Simulations)

When arrival demand consistently exceeds its capacity, its associated delays escalate dramatically. This typically occurs in IMC conditions. In reality, flights are cancelled when delays are high. However, delay reporting systems do not capture the delays associated with cancelled flights. The costs of cancelled flights include: passenger costs; hotel costs; re-issued tickets; disruptions to the schedule and bank integrity; equipment; and crew re-positioning and re-scheduling. The actual delay costs of cancelled flights are very difficult to measure because most of the information is proprietary, and the costs of cancellations and deviations vary greatly between airlines. Therefore, to capture the costs associated with cancelled flights, the Design Team simulated a full schedule in all weather conditions.

IMC/IFR1 Factor

The Design Team also simulated full days of IMC conditions. Because of the climate and terrain along the Columbia River, PDX remains in IMC conditions most of the day. Therefore, the annual delay calculations used an IMC/IFR1 Factor of 1.

Operational Procedures and Minima Simulated

The Design Team simulated the following operational procedures and minima. The percentages of occurrence were the values used in the 1996 PDX Design Team Study.

Weather	VFR1	VFR2	IFR1	
MINIMA	VISUAL	<VIS & ≥IFR	CAT I	ALL WEATHER
Ceiling:	3500'	2000'	200'	
Visibility:	10 miles	5 miles	0.5 miles	
EAST FLOW (10s)	35.3%	9.2%	7.8%	52.3%
WEST FLOW (28s)	39.1%	5.0%	3.6%	47.7%
	-----	-----	-----	-----
TOTAL	74.4%	14.2%	11.4%	100.0%

Note: 10/15/01: VFR1 and VFR2 are VMC. IFR1 is IMC.
10/15/01: VFR1, VFR2, and IFR1 refer to simulated procedures/conditions.

Fleet Mix Cost

The PDX Fleet Mix Cost is $ 1,660 per hour in the year 2000 dollars. It reflects the direct operating costs for the air carriers and non-scheduled aircraft operating at PDX.

The direct operating costs for the air carriers were for their 1st quarter 2000 costs, which were based on carrier Form 41 filings with DOT and published in *Aviation Daily*. When the 1st quarter costs were not available, the 1999 year-end costs were used. The operating costs for non-scheduled aircraft were developed using information provided by APO-110. The costs do not consider lost passenger time, disruption to airline schedules, or any other intangible factor.

Simulation Model

ADSIM, the Airfield Delay Simulation Model, was used for the simulations.

APPENDIX B

ACCEPTED MODEL INPUTS FOR THIS STUDY

ANNUAL & DAILY DEMANDS SIMULATED

Accepted by PDX Team on 1/16/03

The new terminal will not be needed until the 484,000 operational level. This study will look at 3 Future operational levels: Future 1, Future 1.5, (new) and Future 2. Future 1 and Future 2 correspond to the Future 1 and Future 2 demand levels in the 2001 Design Team Study.

Demand Level	Annual Operations	Daily Operations	Equivalent Days
Future 1	484,000	1,512	320
Future 1.5	554,000	1,730	320
Future 2	620,000	1,938	320

Note: (Annual Operations) / (Daily Operations) = Equivalent Days

PDX FLEET MIX

Accepted by PDX Team on 1/16/03

H Heavy		757		LJ Large Jet		LTP Large Turboprop		S+ Small+		S Small		Total		
74	4.9%	80	5.3%	720	47.6%	274	18.1%	212	14.0%	152	10.1%	1,512	100.0%	Future 1
86	5.0%	94	5.4%	832	48.1%	318	18.4%	236	13.6%	164	9.5%	1,730	100.0%	Future 1.5
97	5.0%	106	5.5%	940	48.5%	360	18.6%	261	13.5%	174	9.0%	1,938	100.0%	Future 2

Notes: Percentages are rounded to 1 decimal place.

The fleet mix for Future 1.5 was developed with the following assumptions:

- GA fleet mix percentages and number of operations are constant at all Future demands.
- Military fleet mix percentages and number of operations are constant at all Future demands.
- Air Carrier fleet mix percentages are constant at all demands. The number of Air Carrier operations changes at each demand.

Aircraft Classifications used were based on 1999 FAA separation standards.

OPERATIONAL PROCEDURES & PERCENT OCCURRENCE --Simulated

Accepted by PDX Team on 1/16/03
Updated on 2/10/04

For the Terminal Location Study, only the VFR1 condition will be simulated. This study measures the taxi travel times and number of runway crossings associated with the terminal location. Taxiway congestion is greatest in VFR1 because demand and taxiway delays are greatest in VFR1. When using the same runway assignments, the nominal travel times are the same in all weather conditions. There is less taxiway delay in VFR2 and IFR1 because the arrival rates are lower in those conditions and there is less taxiway congestion. **Therefore, only the EAST VFR1 simulations are required to represent East Flow and only the WEST VFR1 simulations are required to represent the West Flow. 2/10/04.**

Runway Configuration:	**Percent Occurrence**
EAST FLOW (10s)	52.3%
WEST FLOW (28s)	47.7%
TOTAL	100.0%

FLEET MIX COST

Accepted by PDX Team on 1/16/03

The PDX Fleet Mix Cost is $ 1,660 per hour in the year 2000 dollars. It reflects the direct operating costs for the air carriers and non-scheduled aircraft operating at PDX. **This cost was used in the 2001 study and will be used in this study.**

The direct operating costs for the air carriers were for their 1st quarter 2000 costs, which were based on carrier Form 41 filings with DOT and published in *Aviation Daily*. When the 1st quarter costs were not available, the 1999 year-end costs were used. The operating costs for non-scheduled aircraft were developed using information provided by APO-110. The costs do not consider lost passenger time, disruption to airline schedules, or any other intangible factor.

AIRLINE GROUPS AND ALLIANCES **Accepted by PDX Team on 6/26/03**

(Updated 4/8/03)

Future 2 -- 620,000 annual ops (969 daily arrivals)

Updated 4/8/03

New Name	Airline	Alliance	Terminal	Class Type	# ARR	Subtotal
A1	CO -- Continental Airlines	Star *	Existing	757/Large	48	
A1	DL -- Delta Airlines	Star *	Existing	Heavy/757/Large	46	
A1	D1 -- Delta Heavy & Int'l. flights	Star *	Existing	Heavy	17	
A1	HA -- Hawaiian Airlines	Star	Existing	Heavy	3	
A1	HP -- America West	Star	Existing	Large	17	
A1	UA -- United Airlines	Star	Existing	Heavy/757/Large	81	
A1	WN -- Southwest Airlines	Star	Existing	Large	80	
A2	UX -- United Airlines Express	Star	Existing	Small+	80	
A2	ZX -- Air Canada	Star	Existing	LTP	18	
		Star Total				**390**
B1	AA -- American Airlines	Other	New	Large	10	
B1	AS -- Alaska Airlines	Other	New	Large	128	
B1	HZ -- Horizon Airlines (Large jets)	Other	New	Large	78	
B1	NW -- Northwest Airlines	Other	New	Large	8	
B1	QQ -- Reno Airlines (bought by AA)	Other	New	Large	12	
B1	TW--Trans World Airlines(bought by AA)	Other	New	Large	8	
B2	QX -- Horizon Airlines (turbo props)	Other	New	LTP	160	
		Other Total				**404**
C1	Cargo Jets	Cargo	Cargo	Heavy/757/Large	23	
C2	Box-Haulers	Cargo	Cargo	Small+/Small	67	
		Cargo Total				**90**
GA	GA -- General Aviation	GA	GA	Large/Small+/Small	70	
		GA Total				**70**
MI	MI -- Military	MI	Military	Large/LTP/Small	15	
		MI Total				**15**
		GRAND TOTAL			**969**	**969**

Notes: * CO & DL were placed in Existing Terminal with
Star Alliance to balance ops between the 2 terminals.

A1 has the International flights including:
-- Lufthansa with 1 arrival per day in 2003.
-- Mexicana with 3 arrivals per week in 2003.

Horizon has 160 LTP (Large Turboprops)
United Express has 80 Small+
Air Canada has 18 LTP (Large Turboprops)

Notes: **The study will use "airline group names" associated with the alliance and the terminal location.** The Star Alliance will remain in the existing terminal because they have international flights and the customs facility is in the Existing Terminal. The other airlines (or Other Alliance) will go to the new terminal, the Decentralized Terminal or the Centralized Terminal.

We will not use the individual airline names as we did in the Design Team Study. We will use group names (Star, Other, Cargo, GA, and Military), so we can focus on the logical entities. For the Star Alliance, we will use the name "A1" to refer to jets and "A2" to refer to props & commuters. For the Other Alliance, we will use "B1" to refer to the jet operations and "B2" to refer to the props & commuters. Cargo flights will use "C1" for jets and "C2" for Box-Haulers (Cargo Feeders).

EXIT DATA FOR NEW RUNWAY – CENTRALIZED TERMINAL **Accepted by PDX Team on 6/26/03**

(Updated 4/8/03)

Runway 28X with Centralized Terminal – Estimated by Tech Center

Exit	X2	X3	X4/**X5**	X6		Values are based on similar exits
Distance	2400'rhs	4400'rhs	6200'hs	7900'hs	TOTAL	and motivation at PDX & EWR.
Heavy Usage			80%	20%	100%	
ROT			48	58	50 sec	
757 Usage		10%	85%	5%	100%	
ROT		42	48	58	48 sec	
Large Jet Usage		10%	90%		100%	
ROT		42	48		47 sec	
LTP Usage		90%	10%		100%	
ROT		44	50		45 sec	
Small+ Usage		90%	10%		100%	
ROT		44	50		45 sec	
Small Usage	10%	90%			100%	
ROT	34	45			44 sec	

Notes: Distance in feet from threshold

Runway 10X with Centralized Terminal – Estimated by Tech Center

Exit	X7	X6	X5/**X4**	X3		Values are based on similar exits
Distance	2400'rhs	4400'rhs	6200'hs	7900'hs	TOTAL	and motivation for 10X at PDX.
Heavy Usage			60%	40%	100%	Updated by PDX Tower on 4/8/03.
ROT			48	58	52 sec	
757 Usage			80%	20%	100%	Updated by PDX Tower on 4/8/03.
ROT			48	58	50 sec	
Large Jet Usage			90%	10%	100%	
ROT			48	58	49 sec	
LTP Usage			90%	10%	100%	
ROT			50	60	51 sec	
Small+ Usage			99%	1%	100%	ADSIM wants 2 exits.
ROT			50	60	50 sec	
Small Usage			99%	1%	100%	ADSIM wants 2 exits.
ROT			50	60	50 sec	

Notes: Distance in feet from threshold.

Legend:
% - Exit Utilization (percent)
s - Runway Occupancy Time (seconds)
h - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
* - Combination of h, rhs, and 90° exits

EXIT DATA FOR NEW RUNWAY – DECENTRALIZED TERMINAL **Accepted by PDX Team on 6/26/03**

(Updated 4/8/03)

Runway 28X with Decentralized Terminal – Estimated by Tech Center

Exit	X2	X3	X4/**X5**	X6	
Distance	2400’rhs	4400’rhs	6200’hs	7900’hs	TOTAL
Heavy Usage			80%	20%	100%
ROT			48	58	50 sec
757 Usage		10%	85%	5%	100%
ROT		42	48	58	48 sec
Large Jet Usage		10%	90%		100%
ROT		42	48		47 sec
LTP Usage		20%	80%		100%
ROT		44	50		49 sec
Small+ Usage		50%	50%		100%
ROT		44	50		47 sec
Small Usage		99%	1%		100%
ROT		45	55		45 sec

Notes: Distance in feet from threshold

Values are based on similar exits and motivation for 28X with Centralized Terminal.

LTP: Updated by PDX Tower on 4/8/03.

Small+: Updated by PDX Tower on 4/8/03.
S+ arrivals use Existing Terminal.

Small: Only Small Cargo arrivals.
ADSIM needs 2 exits.

Runway 10X with Decentralized Terminal – Estimated by Tech Center

Exit	X7	X6	X5/**X4**	X3	
Distance	2400’rhs	4400’rhs	6200’hs	7900’hs	TOTAL
Heavy Usage			80%	20%	100%
ROT			48	58	50 sec
757 Usage			90%	10%	100%
ROT			48	58	49 sec
Large Jet Usage			90%	10%	100%
ROT			48	58	49 sec
LTP Usage			95%	5%	100%
ROT			50	60	51 sec
Small+ Usage		1%	99%		100%
ROT		44	50		50 sec
Small Usage	1%	99%			100%
ROT	34	45			45 sec

Notes: Distance in feet from threshold.

Values are based on similar exits and motivation for 10X with Centralized Terminal.

LTP: Updated by PDX Tower on 4/8/03.

Small+: S+ arrivals use Existing Terminal.

Small: Small Cargo use this.
ADSIM needs 2 exits.

Legend:
% - Exit Utilization (percent)
s - Runway Occupancy Time (seconds)
h - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
* - Combination of h, rhs, and 90° exits

EXIT DATA FOR 10R/28L – CENTRALIZED TERMINAL **Accepted by PDX Team on 6/26/03**
(with taxiways realigned)

(Updated 5/30/03)

Runway 10R -- 1996 PDX STUDY (With 2000 Classes) – with CE/E realigned & moved 800' to the East

Exit	E	---	B5/F	B6/C6		
Distance	5400'		6900'*	8500'	TOTAL	
Heavy Usage			70%	30%	100%	
ROT			53	64	56 sec	
757 Usage	17%		81%	2%	100%	
ROT	46		53	64	52 sec	Updated 5/19/03
Large Jet Usage	17%		81%	2%	100%	
ROT	46		53	64	52 sec	Updated 5/19/03
LTP Usage	41%		54%	5%	100%	Updated 5/19/03 -- LTP treated
ROT	46		55	57	51 sec	as Medium in 1996 Study
Small+ Usage	41%		54%	5%	100%	Updated 5/19/03 -- Small+ treated
ROT	46		55	57	51 sec	as Medium in 1996 Study
Small Usage	93%		7%		100%	
ROT	53		60		53 sec	Updated 5/19/03

Note: Because aircraft would travel an additional 800' to Exit E, 6 seconds were added to the occupancy times for each aircraft class using Exit E. On 5/21/03, the Tower said that 6 seconds is reasonable.

Runway 28L -- 1996 PDX STUDY (With 2000 Classes) – with CE/E realigned & moved 800' to the East

Exit	B6/C6	B5/F	CE/E	B2		
Distance	2500'	4100'*	5600'	8500'	TOTAL	
Heavy Usage			80%	20%	100%	
ROT			51	61	53 sec	Updated 5/19/03
757 Usage		18%	80%	2%	100%	
ROT		39	43	61	43 sec	Updated 5/19/03
Large Jet Usage		18%	80%	2%	100%	
ROT		39	43	61	43 sec	Updated 5/19/03
LTP Usage	18%	78%	4%		100%	Updated 6/3/03 -- LTP treated
ROT	31	40	54		39 sec	as Medium in 1996 Study
Small+ Usage	18%	78%	4%		100%	Updated 6/3/03 -- Small+ treated
ROT	31	40	54		39 sec	as Medium in 1996 Study
Small Usage	12%	80%	8%		100%	
ROT	34	42	42		41 sec	Updated 5/19/03

Note: Because aircraft would travel 800' fewer to Exit E, the occupancy times for each aircraft class using Exit E were receded by 6 seconds. On 5/21/03, the Tower said that 6 seconds is reasonable.

RUNWAY CLEARANCE TIMES (in Seconds) -- WEST FLOW

Accepted by PDX Team on 6/26/03
Reviewed/Accepted by Tower on 7/11/03

Runway clearance times define the length of time an aircraft on a taxiway must wait before it can taxi across the runway.

Arrival on Runway: Length of time it takes the arrival to travel from threshold and go past the intersection, or the time it takes the arrival to exit the runway.
Departure on Runway: Length of time it takes the departure to travel from threshold and go past the intersection.
Arrival on Final: Length of time it takes aircraft on ground to taxi through the intersection.

Runway Clearance Times on 28L – West Flow (Centralized Terminal)

```
Runway Crossing Links – clearance times for aircraft on runway or on final --5/28/03
       TWY CE/E  -- 5,600’ from 28L threshold (realigned for Centralized Terminal)
                   Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                   51 45 45 45 45 45 –- Arrival on Runway (by class)
                   35 35 35 35 35 35 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
       RWY 3/21  -- 5,800’ from 28L threshold (realigned for Centralized Terminal)
                   Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                   55 45 45 45 45 45 –- Arrival on Runway (by class)
                   40 40 40 40 40 40 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
    28L THRESHOLD  Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                    5  5  5  5  5  5 -- Arrival on Runway (by class)
                    5  5  5  5  5  5 -- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
```

Runway Clearance Times on 28L – West Flow (Decentralized Terminal)

```
Runway Crossing Links – clearance times for aircraft on runway or on final --5/28/03
       TWY CE/E  -- 6,400’ from 28L threshold (realigned for Centralized Terminal)
                   Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                   57 49 49 49 49 49 –- Arrival on Runway (by class)
                   40 40 40 40 40 40 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
       RWY 3/21  -- 6,200’ from 28L threshold (realigned for Centralized Terminal)
                   Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                   57 49 49 49 49 49 –- Arrival on Runway (by class)
                   45 45 45 45 45 45 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
   28L THRESHOLD   Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                    5  5  5  5  5  5 –- Arrival on Runway (by class)
                    5  5  5  5  5  5 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
```

RUNWAY CLEARANCE TIMES (in Seconds) – 28X

Accepted by PDX Team on 9/25/03

Runway Clearance Times on 28X – West Flow (Centralized Terminal) -- There are none.

Runway Clearance Times on 28X – West Flow (Decentralized Terminal)

```
Runway Crossing Links – clearance times for aircraft on runway or on final -–9/16/03
X-4 & TWY CE/E  -- approximately 6,200’ from 28X threshold – same values used on 28L
                   Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                   57 49 49 49 49 49 –- Arrival on Runway (by class)
                   40 40 40 40 40 40 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
END OF NEW TAXIWAY, SOUTH OF 28X – APPROXIMATELY 2,100’ FROM 28X THRESHOLD
                -- Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                   20 20 20 20 20 20 –- Arrival on Runway (by class)
                   20 20 20 20 20 20 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
```

RUNWAY CLEARANCE TIMES (in Seconds) -- EAST FLOW Accepted by PDX Team on 9/25/03

Runway clearance times define the length of time an aircraft on a taxiway must wait before it can taxi across the runway.

Arrival on Runway: Length of time it takes the arrival to travel from threshold and go past the intersection, or the time it takes the arrival to exit the runway.
Departure on Runway: Length of time it takes the departure to travel from threshold and go past the intersection.
Arrival on Final: Length of time it takes aircraft on ground to taxi through the intersection.

EAST FLOW – CENTRALIZED TERMINAL (WITH C/E REALIGNED & MOVED 800' TO THE EAST)

Runway Clearance Times on 10R – East Flow (Centralized Terminal)

```
Runway Crossing Links – clearance times for aircraft on runway or on final -–9/16/03
Rwy 3/21 & TWY CE/E  -- approximately 5,400' from 10R threshold
                   Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                   47 47 47 47 47 54 –- Arrival on Runway (by class)
                   35 35 35 35 35 35 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
```

Runway Clearance Times on 10X – East Flow (Centralized Terminal) -- There are none.

EAST FLOW – DECENTRALIZED TERMINAL

Runway Clearance Times on 10R – East Flow (Decentralized Terminal)

```
Runway Crossing Links – clearance times for aircraft on runway or on final -–9/16/03
Rwy 3/21 & TWY CE/E  -- approximately 4,600' from 10R threshold
                   Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                   41 41 41 41 41 48 –- Arrival on Runway (by class)
                   30 30 30 30 30 30 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
```

Runway Clearance Times on 10X – East Flow (Decentralized Terminal)

```
Runway Crossing Links – clearance times for aircraft on runway or on final -–9/16/03
X-4 & TWY CE/E  -- approximately 6,200' from 10X threshold – same values used on 28X & 28L
                   Classes 1 thru 6 (in columns 1 thru 6) – times are in seconds
                   57 49 49 49 49 49 –- Arrival on Runway (by class)
                   40 40 40 40 40 40 –- Departure on Runway (by class)
                   30 30 30 30 30 30 –- Arrival on Final (by class)
```

RUNWAY DEPENDENCIES FOR SOUTHBOUND DEPARTURES ON 28L & 28X, and 10R & 10X **Accepted by PDX Team on 9/25/03**

3-Runway Case – West Flow

The dependencies between departures on 28X and 28L are the same as the dependencies between departures on 28L and 28R. The dependencies are due to the departure air crossovers. Only southbound props will depart on 28X. There is a dependency between southbound props departing 28X and southbound props departing 28L.

There is also a dependency between southbound props on 28R and southbound props on 28X. When there are southbound departures on 28X, the southbound props, which normally depart 28R, will depart 28L instead. By moving those southbound prop GA and commuter departures to 28L, the departing aircraft crosses only one active runway **IN THE AIR** instead of two active runways.

3-Runway Case – East Flow

The East Flow is similar to the West Flow. The dependencies between departures on 10X and 10R are the same as the dependencies between departures on 10R and 10L. The dependencies are due to the departure air crossovers. Only southbound props will depart on 10X. There is a dependency between southbound props departing 10X and southbound props departing 10R.

There is also a dependency between southbound props on 10L and southbound props on 10X. When there are southbound departures on 10X, the southbound props that normally depart 10L, will depart 10R instead. By moving those southbound prop GA and commuter departures to 28L, the departing aircraft crosses only one active runway **IN THE AIR** instead of two active runways.

APPENDIX C

ACCEPTED RESULTS

<u>ADSIM Calibration – Centralized and Decentralized – 2-Runway Case</u>

The Tech Center calibrated ADSIM by simulating the airfields (with 2 runways) for the Centralized and Decentralized Terminals, using the same runway assignments as an improvement modeled in the 2001 Design Team Study -- PKG (C1+B), N/S Taxiway and All Aircraft Can Diverge. The runway assignments, aircraft separations, and runway dependencies were identical. With 2 exceptions, the gate usage was the same as the PKG (C1+B) in the 2001 Design Team Study. The calibration gate usage was as follows:

- All Air Carriers used the Existing Terminal (gates 1 – 7 on the airfield maps in this data package).
- GA used gate 8.
- However, the Military and Cargo used the gate locations on the new airfields. The Military used gate 11 and Cargo used gate 13.

The difference between these simulations and those in the 2001 study were the Military and Cargo gate locations and the use of the long form of ADSIM instead of the short form. The long form of ADSIM simulated the complete taxiway network.

The following ADSIM results were compared:

- Arrival Air Delays
- Departure Runway Queue Delays.

The daily delays in minutes were as follows:

	Arrival Air Delays	**Departure Runway Queue Delays**
(C1+B) N/S Twy & All Diverge – 2001 Study	3,321 minutes	7,250 minutes
Centralized Terminal (Calibration, West Flow)	3,563 minutes	6,850 minutes
Decentralized Terminal (Calibration, West Flow)	3,543 minutes	7,122 minutes

The calibration results of the Centralized and Decentralized Terminals, West Flow, compared favorably to the results of the PKG (C1+B) in the 2001 study. Some differences are due to the different locations of the Military and Cargo operations between the 2001 study and this study. Some differences are due to the use of the long form of ADSIM to simulate the airfield network in this study. These differences change the times of certain events, such as the time a departure gets to the departure threshold and departs, which change the stochastic processes.

Since the new airfields for this Design Team included the N/S Taxiway and All Aircraft Can Diverge, it was logical to compare the results with PKG (C1+B) in the 2001 study.

DAILY DELAYS AND TRAVEL TIMES (in minutes)

				ARRIVALS				/	DEPARTURES				/ TOTAL /		TOTAL TRAVEL TIMES		
EXPERIMENT #			FLOW RATE	**AIR DELAY**	TAXI-IN DELAY	RWY-XNG DELAY	/HOLDING AREA /	/FLOW RATE	**RUNWAY DELAY**	TAXI-OUT DELAY	RWY-XNG DELAY	GTE-HLD RWY-CNG	GROUND DELAYS	/ARRIVAL /AIR	**ARRIVAL GROUND**	**DEPARTURE GROUND**	**TOTAL**
(0)	***CALIBRATION – CENTRALIZED -- Future 2 Demand (620,000 Annual Ops)***																
531C	WEST VFR1	TOTAL	969.0	**3563.3**	196.6	.0	.0	969.0	**6850.0**	1291.6	8.7	.0	**8346.9**	3552.1	3625.4	13914.0	**21091.5**
(0)	***CALIBRATION – DECENTRALIZED -- Future 2 Demand (620,000 Annual Ops)***																
531C	WEST VFR1	TOTAL	969.0	**3542.6**	159.3	20.1	.0	969.0	**7122.3**	1457.8	15.9	.0	**8775.4**	3533.4	4098.8	15113.3	**22745.5**

APPENDIX D

LIST OF ABBREVIATIONS

ADSIM	Airfield Delay Simulation Model
ALP	Airport Layout Plan
ARR	Arrival
ATC	Air Traffic Control
ATCT	Airport Traffic Control Tower
A&D	Arrival and Departure
Biz Jets	Business Jets
CAT	Category -- of instrument landing system
DEP	Departure
FAA	Federal Aviation Administration
GA	General Aviation
GPS	Global Positioning System
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
LDA	Localizer Directional Aid
NM	Nautical Miles
N/S	North/South
OAG	Official Airline Guide
PDX	Portland International Airport
PRM	Precision Runway Monitor
ROT	Runway Occupancy Times
RWY	Runway
SM	Statute Miles
TWY	Taxiway
TRACON	Terminal Radar Approach Control
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions