DOT/FAA/CT-TN95/40

PORTLAND INTERNATIONAL AIRPORT

DATA PACKAGE 6

Airport Capacity Enhancement Design Team Study

JULY 1995

Prepared by
Federal Aviation Administration
Technical Center
Atlantic City, New Jersey

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PORTLAND INTERNATIONAL AIRPORT (PDX)

DATA PACKAGE 6

AIRPORT CAPACITY ENHANCEMENT
DESIGN TEAM STUDY

JULY 1995

Prepared by:

U. S. Department of Transportation
Federal Aviation Administration
Technical Center
Atlantic City International Airport, New Jersey

FAA
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Atlantic City, N.J.

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LIST OF EXHIBITS

I. GENERAL DISCUSSION AND MODEL INPUTS

Accepted Model Inputs

The following model inputs, presented in the Data Package 5, were accepted by the Design Team at the May 10th meeting, These inputs will be used in the capacity analysis and in the simulations. Their details appear in Appendix A.

* Pairs of aircraft which can have the reduced A/A spacing.
* VFR2 and IFR1 factors of 1 will be used for the annualizations.

Status of PDX Inputs and Tasks

Exhibit 1 describes the status of the PDX inputs and tasks.

Airport Layout

Exhibit 2 presents the current airport layout for PDX, including runways, runway exits, taxiways, and gate areas.

Model Inputs

Exhibit 3 provides the departure-to-departure (D/D) runway dependencies due to departure air crossovers.

Exhibit 4 describes PDX operational procedures and minima for the existing airport.

Exhibit 5 presents VFR1, VFR2, and IFR1 runway configurations for PDX.

EXHIBIT 1

STATUS OF PDX INPUTS AND TASKS

INPUTS AND TASKS	STATUS
Model Inputs	DP6
D/D Runway Dependencies due to Departure Air Crossovers	DP6
ATC Separations (Existing Airport)	X
Noise Dependencies (Existing Airport)	X
Annual Demand Levels (1993 and Future Demands)	X
Demand Characteristics (1993 and Future Demands)	X
1993 Hour Counts	X
Future 1 and Future 2 Hour Counts	X
Operational Procedures and Minima (by configuration)	DP6
Capacity (Existing Airport & 1993 Demand)	
ALPs, Improvements, and Simulation Scenarios (Updated)	DP6
SIMMOD (Do-Nothing -- 1993 Demand)	
SIMMOD (Do-Nothing -- Future Demands)	
SIMMOD (Improvements -- 1993 Demand)	
SIMMOD (Improvements -- Future Demands)	
Fleet Mix Costs	
Annual Delay Costs and Savings	

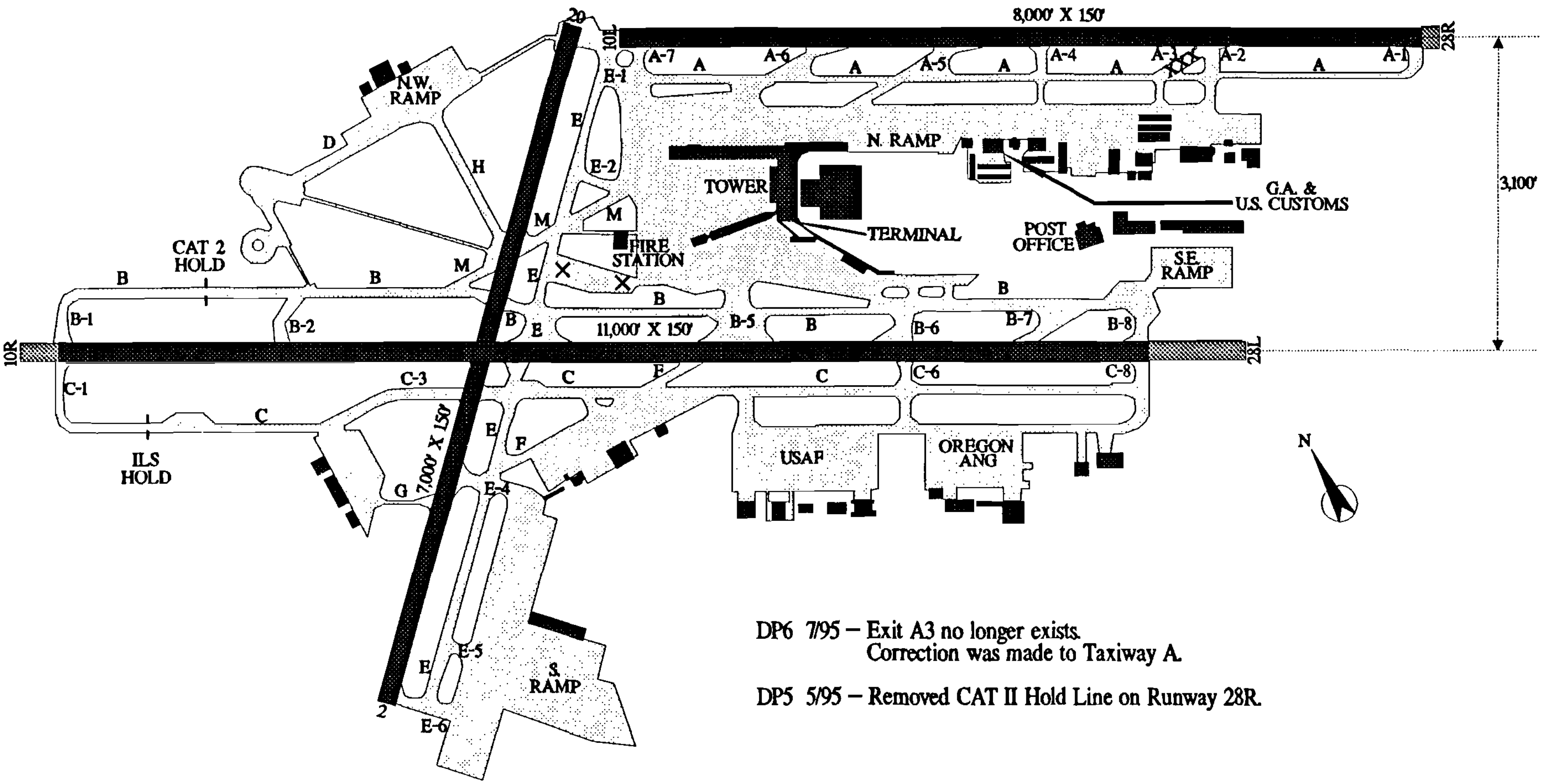
Notes:

X: **The item was previously accepted and appears in Appendix A of this data package.**

DPn: **Data Package n.**

EXHIBIT 2

PORTLAND AIRPORT LAYOUT



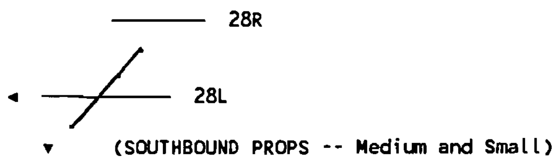
DP6 7/95 – Exit A3 no longer exists.
Correction was made to Taxiway A.

DP5 5/95 – Removed CAT II Hold Line on Runway 28R.

EXHIBIT 3

D/D RUNWAY DEPENDENCIES DUE TO DEPARTURE AIR CROSSOVERS -- PDX

WEST FLOW -- SOUTHBOUND AIR CROSSOVERS



SOUTHBOUND PROPS (Medium and 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 Small or any Large Turboprop (which is a Medium) can turn south immediately.

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

<u>28R/28L</u>		
Medium or Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 28L
	IFR1:	70 seconds for Prop to cross 28L & be verified by radar

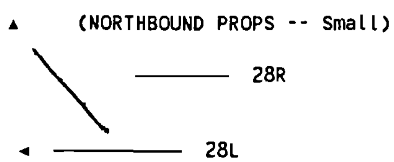
28L/28R: Departure on 28L Followed by *Southbound Departure on 28R* (D/D Separations & Offsets in Appendix A, pages A-8 & A-16)

<u>28L/28R</u>		
Heavy/Medium or Small:	VFR:	1.75 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.75 minutes (due to wake vortex & offset thresholds)
757/Medium or Small:	VFR:	1.25 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.25 minutes (due to wake vortex & offset thresholds)
Large/Medium or Small:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)
Medium northbound/Medium:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)
Medium southbound/Medium:	VFR:	45 seconds (due to offset thresholds)
	IFR1:	45 seconds (due to offset thresholds)
Medium/Small:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)
Small/Medium or Small:	VFR:	20 seconds (due to diverging paths & offset thresholds)
	IFR1:	45 seconds (due to diverging paths & offset thresholds)

EXHIBIT 3 (cont)

D/D RUNWAY DEPENDENCIES DUE TO DEPARTURE AIR CROSSOVERS -- PDX

WEST FLOW -- NORTHBOUND AIR CROSSOVERS



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*

<u>28R/28L</u>		
Heavy/Small:	VFR:	2 minutes (due to wake vortex)
	IFR1:	2 minutes (due to wake vortex)
		(D/D separations in Appendix A, page A-16)
757/Small:	VFR:	1.5 minutes (due to wake vortex)
	IFR1:	1.5 minutes (due to wake vortex)
		(D/D separations in Appendix A, page A-16)
Large/Small:	VFR:	50 seconds (D/D separations in Appendix A, page A-16)
	IFR1:	1 minute (D/D separations in Appendix A, page A-16)
Medium/Small:	VFR:	50 seconds (D/D separations in Appendix A, page A-16)
	IFR1:	1 minute (D/D separations in Appendix A, page A-16)
Small/Small:	VFR:	20 seconds (D/D separations in Appendix A, page A-16)
	IFR1:	1 minute (D/D separations in Appendix A, page A-16)

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

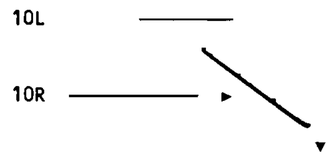
<u>28L/28R</u>		
Small/Any Aircraft:	VFR:	50 seconds for Prop to cross 28R
	IFR1:	70 seconds for Prop to cross 28R & be verified by radar

NOTE: Improvement Package (F), All Large Turbo Props Can Do Divergent Turns, will permit Medium aircraft to turn north immediately. For that simulation, the separation for a Medium aircraft will be the same as that of a Small.

EXHIBIT 3 (cont)

D/D RUNWAY DEPENDENCIES DUE TO DEPARTURE AIR CROSSOVERS -- PDX

EAST FLOW -- SOUTHBOUND AIR CROSSOVERS



(Southbound Props -- Medium or Small)

Southbound props (Medium and 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 Small or any Large Turboprop (which is a Medium) can south immediately.

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

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

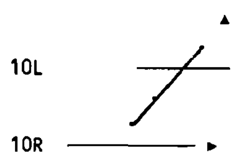
10R/10L: Departure on 10R Followed by *Southbound Departure on 10L* (D/D Separations & Offsets in Appendix A, pages A-9 & A-16)

<u>10R/10L</u>		
Heavy/Medium or Small:	VFR:	2.25 minutes (due to wake vortex & offset thresholds)
	IFR1:	2.25 minutes (due to wake vortex & offset thresholds)
757/Medium or Small:	VFR:	1.75 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.75 minutes (due to wake vortex & offset thresholds)
Large/Medium:	VFR:	1.25 minutes (due to offset thresholds)
	IFR1:	1.25 minutes (due to offset thresholds)
Large/Small:	VFR:	1 minute (due to offset thresholds)
	IFR1:	1.25 minutes (due to offset thresholds)
Medium northbound/Medium:	VFR:	2 minutes (due to offset thresholds)
	IFR1:	2 minutes (due to offset thresholds)
Medium southbound/Medium:	VFR:	1.25 minutes (due to offset thresholds)
	IFR1:	1.25 minutes (due to offset thresholds)
Medium northbound/Small:	VFR:	2 minutes (due to offset thresholds)
	IFR1:	2 minutes (due to offset thresholds)
Medium 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)

EXHIBIT 3 (cont)

D/D RUNWAY DEPENDENCIES DUE TO DEPARTURE AIR CROSSOVERS -- PDX

EAST FLOW -- NORTHBOUND AIR CROSSOVERS



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 Separations & Offsets in Appendix A, pages A-9 & A-16)

10L/10R		
Heavy/Small:	VFR:	1.66 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.66 minutes (due to wake vortex & offset thresholds)
757/Small:	VFR:	1.16 minutes (due to wake vortex & offset thresholds)
	IFR1:	1.16 minutes (due to wake vortex & offset thresholds)
Large/Small:	VFR:	20 seconds (due to offset thresholds & diverging paths)
	IFR1:	40 seconds (due to offset thresholds & diverging paths)
Medium/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 (F), All Large Turbo Props Can Do Divergent Turns, will permit Medium aircraft to turn north immediately. For that simulation, the separation for a Medium aircraft will be the same as that of a Small.

EXHIBIT 4

OPERATIONAL PROCEDURES AND MINIMA -- PDX

Based on PDX Airside Capacity Study (final report), March 1991, pgs A-9 thru A-13. Revised 10/94 to reflect new assumptions in Do-Nothing case.

VFR1: Ceiling ≥ 3,500' *and* Visibility ≥ 10 miles.
Occurs 73.1% of the year.
Visual (VFR1) separations.
Simultaneous visual approaches to both parallels by all aircraft types.
Although not permitted under noise abatement procedures, ATC rules would permit certain small aircraft to make simultaneous visual approaches to Runway 2 -- if they land and hold short of 10R/28L, the runways are dry, and there is no tailwind.

VFR2: Less than VFR1, *and*, Ceiling ≥ 2,000' *and* Visibility ≥ 5 miles.
Occurs 14.0% of the year.
IFR separations for A/A. Visual (VFR1) separations for others.
Simultaneous approaches may be permitted.
Do-Nothing simulations assume an ILS on 10R and 28R, **with a single CAT I (IFR1) arrival stream in West and East flows. However, any Small aircraft can land simultaneously on a non-precision parallel runway (10L/28L).**
Simulations for CAT I Improvements will enable more and larger aircraft to land simultaneously on 10L (or 28L). The restricted or unrestricted use of the new CAT I approach will determine the types of aircraft that can land simultaneously on the runway with the new precision approach.
Note: As in VFR1, ATC rules would permit certain small aircraft to land on Runway 2 when the runways are dry. VFR2 usually occurs in the winter when the runways are wet. **In reality, Runway 2 would not be used for arrivals in VFR2.**

IFR1: Less than VFR2, *and*, Ceiling ≥ 200' *and* Visibility ≥ 0.5 miles.
Occurs 11.2% of the year.
IFR separations are required. Our Do-Nothing simulations assume an ILS on 10R and 28R, **with a single CAT I (IFR1) arrival stream 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.
Occurs 0.6% of the year. IFR separations. Arrive on 10R, depart on 10R & 10L.

IFR3: Visibility < 0.25 miles *and* ≥ 0.125 miles.
Occurs 1.1% of the year. IFR separations. Arrive on 10R, depart on 10R.
Depart on 10R & 10L down to 600' RVR in a year, when 2 RVRs on 10L/28R will allow departures on both runways.

QUESTIONS/NOTES ON MINIMUMS:
10R and 28R: CAT I minimums are 200' and 1/2 mile.
28L MLS will be commissioned in 1995. MLS minimums will be 200' and 3/4 mile.
10L ILS will be commissioned in 1995. ILS minimums will be 270' and 1 mile (for 3° & 3.6° GS).

EXHIBIT 4 (cont)

OPERATIONAL PROCEDURES AND MINIMA -- PDX

Operational Procedures and Percent Occurrence By Runway Utilization

Based on PDX Airside Capacity Study (final report), 3/91, pgs 13 & 15, Tables 5 & 6. (The study presented tabulations of 10 years of Surface Airways Hourly Data (TD-1440) for 1/1/79 through 12/31/88, from the National Climatic Data Center, Asheville, NC.)

WEATHER:	VFR1	VFR2	IFR1	IFR2	IFR3	
MINIMA: Ceiling: Visibility:	VISUAL 3500' 10 miles	<VIS & ≥IFR1 2000' 5 miles	CAT I 200' 0.5 miles	CAT II 100' 0.25 miles	CAT III 0.125 miles	ALL WEATHER
EAST FLOW (10s)	34.7 %	9.1 %	7.7 %	0.6 %	1.1 %	53.2 %
WEST FLOW (28s)	38.4 %	4.9 %	3.5 %	0.0 %	0.0 %	46.8 %
TOTAL	73.1 %	14.0 %	11.2 %	0.6 %	1.1 %	100.0 %

Operational Procedures and Runway Utilization Simulated

At the January 18th meeting, the Design Team agreed that we will simulate only VFR1, VFR2, and IFR1 based on the list of improvements. Based on the above values, the Technical Center calculated the simulations and annualizations would be done as follows:

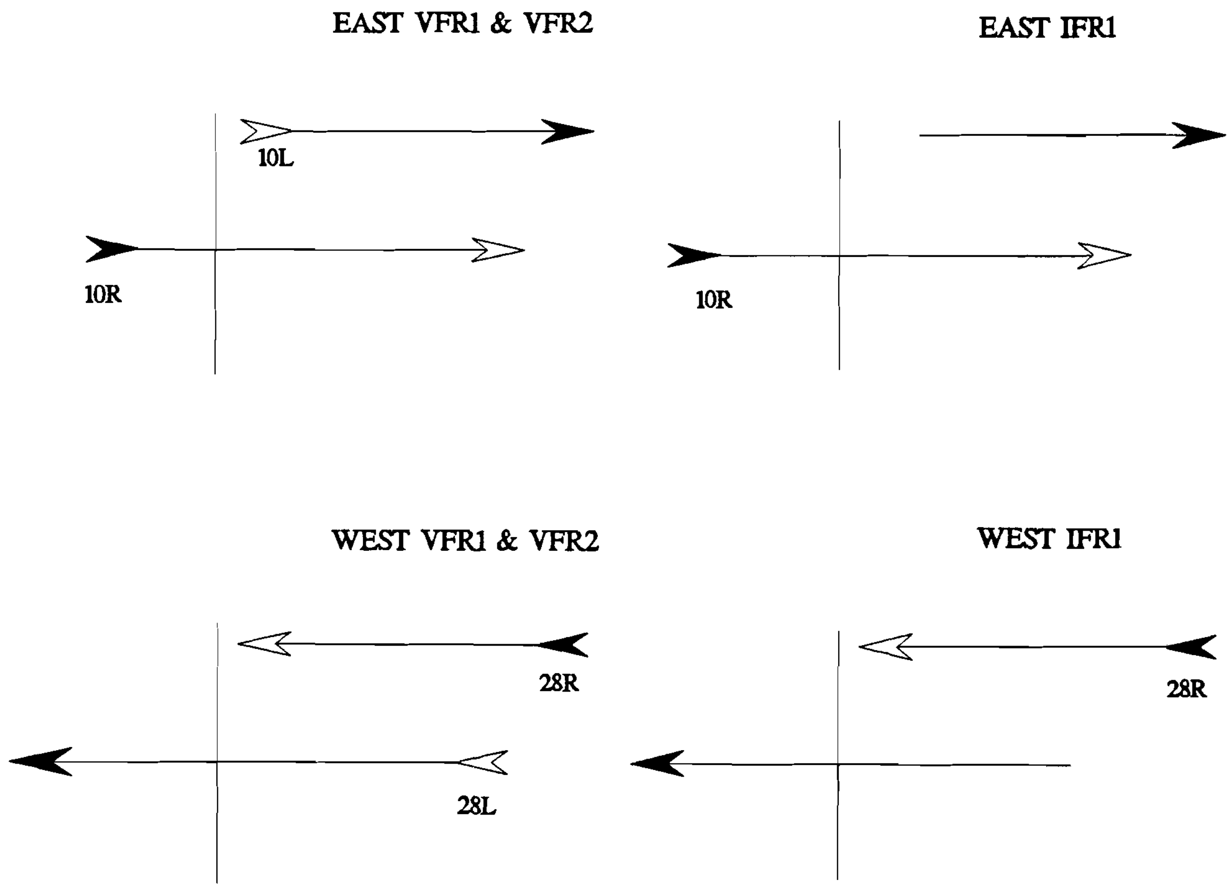
WEATHER:	VFR1	VFR2	IFR1	
MINIMA: Ceiling: Visibility:	VISUAL 3500' 10 miles	<VIS & ≥IFR1 2000' 5 miles	CAT I 200' 0.5 miles	ALL WEATHER
EAST FLOW (10s)	35.3 %	9.2 %	7.8 %	52.3 %
WEST FLOW (28s)	39.1 %	5.0 %	3.6 %	47.7 %
TOTAL	74.4 %	14.2 %	11.4 %	100.0 %

PDX Tower says: 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.

PDX DESIGN TEAM: The Technical Center compared the Port of Portland's 4 years of runway use data (1990-1993), presented at the May 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%. Therefore, the Technical Center recommends using the above values, *Operational Procedures and Runway Utilization Simulated*, for the SIMMOD annualizations.

At the March meeting, the Team agreed to round the percentages to integer values. However, the Technical Center suggests the Team review the percentages to determine how much error could be introduced into the annual delay/cost calculations by rounding the values. (For example, rounding the above numbers would result in 12% IFR1 rather than 11.4%. This would result in 2 additional full days of IFR1 being simulated and annualized, and thereby overstating annual costs and savings.)

EXHIBIT 5
RUNWAY CONFIGURATIONS – PDX
(PDX Do-Nothing – with 10R and 28R ILS)



NOTES: Only 10R and 28R have CAT I ILS.
In VFR2, only Small aircraft can land on 10L and 28L.

II. PROPOSED AIRPORT IMPROVEMENTS

Improvements

Exhibit 6 lists the potential improvements for PDX. These are options which could be studied, but not necessarily recommended. Several improvements were clarified by adding comments where appropriate. Some were combined and will be simulated as a package.

At the last meeting, the Design Team clarified several improvements.

Revised Comments on the 3.6° Glide Slope

Summary of responses from 10 airlines (247 arrivals) regarding use of 3.6° Glide Slope for their current fleet of AC/Commuter/AT (Air Carriers/Commuters/Air Taxis):

26	arrivals per day *prefer* 10L (26 commuters)
153	arrivals per day *can* take 10L if necessary (102 commuters, 1 BEC, 50 jets)
68	arrivals per day *cannot* take 10L (68 jets) (No response from Southwest, with 15 737s daily, or several other airlines)

Conclusions: **179 of the 247 arrivals are capable of using the 3.6° Glide Slope (GS) -- i.e., 72% of the flights of the airlines questioned can use the 3.6° GS. There are 328 AC/Commuter/AT arrivals in the 1993 aircraft schedule. If only those 179 arrivals (out of the 328) could use the 3.6° GS, then 55% of the 1993 AC/Commuter/AT fleet would be capable of using the 3.6° GS.**

All GA arrivals, 92 at each demand level, can use the 3.6° GS.

Simulation Scenarios

Exhibit 7 lists simulation scenarios for PDX.

At the May meeting, the PDX Tracon said they would implement the 2.5 NM minimum IFR spacing very soon. (PDX started using the reduced IFR spacing in mid-May.) Therefore, the Design Team agreed to calibrate SIMMOD at the 1993 demand using the 3 NM minimum IFR spacing and to simulate the 2.5 NM minimum IFR spacing as part of all improvements.

EXHIBIT 6

POTENTIAL IMPROVEMENTS -- PORTLAND

(Revised 5/10/95) **Models**

Airfield Improvements

1. **Improve exit taxiways on Runways 10R, 28L, and 28R.** — Narrate
   -- Some exits are too narrow. Some are not stressed enough.

2. **Build new exit taxiways for 10L and 28R.** — Compute
   -- Add angled exit(s). Enlarge fillets.
   -- Needed at higher demands to insure 2.5 NM minimum IFR spacing.
   Tech Center will compute expected occupancy times at F1 & F2 based
   on the types of aircraft landing on 10L & 28R at those demands.

3. **Build taxiway connecting Taxiway C to 10R/28L.** — Narrate
   -- See Port of Portland's *South Airfield Study.*

4. **Build taxiway exits B-4 & B-3 (with enlarged fillets) north of 10R/28L.** — SIMMOD
   -- B-4 -- acute angle and 5,550' from threshold of 10R.
   On 10R, gives commuters and narrowbodies easy access to ramp and Twy B.
   MED exit at B-4 (45 seconds) instead of B-5 (55 seconds).
   SML exit at B-4 (50 seconds) instead of B-5 (60 seconds).
   LRG & 757 -- 32% use B-4 (45 seconds) and 49% use B-5 (53 seconds).
   -- B-3 -- acute angle and 5,550' from threshold of 28L.
   Gives Large aircraft on 28L easier/quicker access to Twy E.
   Aircraft would use angled exit B-3 rather than 90° exit E.

4B. **Build a N/S taxiway connecting East ends of parallel runways.** — SIMMOD
   -- North/South taxiway will relieve ground congestion and enable runways to be
   assigned based on direction of flight rather than gate location.

5. **Build penalty boxes. (Where would they be located?)** — Narrate
   -- Neither RDSIM nor SIMMOD can simulate penalty boxes.

6. **Build departure pads on ends of all runways.** — Narrate
   -- ASC-100 provided a narrative which the Design Team accepted.

Facilities and Equipment Improvements

7. **CAT I Approaches (ILS, MLS, or GPS) on 10L & 28L.** — SIMMOD
   Required for Imp 13 & 14 (simultaneous or staggered approaches to the parallels).
   -- Will be simulated with restricted and unrestricted use of CAT I approaches.

8. **Install a PRM (Precision Runway Monitor). Required for Imp 13.** — SIMMOD
   (Required for simultaneous approaches to the parallels.)
   -- Will be simulated with restricted and unrestricted use of CAT I approaches.

EXHIBIT 6 (cont)

POTENTIAL IMPROVEMENTS -- PORTLAND

(Revised 5/10/95) **Models**

Facilities and Equipment Improvements (cont)

9. Use of Microwave Landing System (MLS) on 28L. SIMMOD
- -- Can affect flight paths aircraft follow in performing simultaneous procedures.
- -- Other alternatives can estimate delay savings from the use of simultaneous instrument approaches and departure procedures.
- **-- Only Horizon DH8 & D38 are MLS equipped. Use of MLS is restricted.** Affects 64 daily arrivals at 1993 demand.

10. Use of GPS approaches. SIMMOD
- -- Could affect flight paths which aircraft follow in performing simultaneous arrival and departure procedures. GPS could permit unrestricted use of 28R for simultaneous or staggered instrument approaches (see Imp 13 & 14).

12. Relocate or Replace ILS Glide Slopes on 10R and 28R. Evaluate
- -- Required for Imp 21. GPS could help.
- -- Affects CAT II/III operations. Usually occurs in fog which is CAT II.

Operational Improvements

13. Simultaneous (independent) CAT I approaches to parallel runways. SIMMOD
- **-- Requires Imp 8** -- PRM.
- -- Will be simulated with restricted and unrestricted use of CAT I approaches.
- -- GPS could permit unrestricted use of 28L.

14. 1.5 NM staggered CAT I approaches to parallel runways. SIMMOD
- **-- Requires Imp 7** -- CAT I ILS/MLS/GPS on 10L and 28L.
- -- Will be simulated with restricted and unrestricted use of CAT I approaches.
- -- GPS could permit unrestricted use of 28L.

15. Reduce minimum intrail IFR spacing to 2.5 NM (from 3 NM) between like class aircraft on final approach. SIMMOD
- -- i.e., Reduce longitudinal IFR spacing. Requires reduced occupancy times.
- **-- Implemented May 1995.**

16. Immediate north divergent turn for Large Turbo Props in both flow directions. SIMMOD
- -- Allows northbound and eastbound Large Turbo Props to avoid following the same initial departure heading as jets.
- **-- Will increase departure capacity and give more direct routing.**
- -- Large Turbo Props turn north at 3,000' (about 4 NM from the end of the runway). **The 1993 daily schedule has about 130 departures which are Large Turbo Prop commuters (Medium). Because of Noise restrictions, when a Large Turbo Prop is followed by a jet, the D/D separation is 2 minutes (instead of 1 minute).**

EXHIBIT 6 (cont)

POTENTIAL IMPROVEMENTS -- PORTLAND

(Revised 5/10/95) **Models**

Operational Improvements (continued)

19. Immediate divergent turns for all aircraft. SIMMOD

- **Requires Imp 16 & 18.**
- All aircraft could turn immediately after takeoff onto divergent courses. Will allow independent departures from both parallel runways in both flow.
- **Will increase departure capacity and give more direct routing.**

20. Peak period use of Runway 2 for arrivals by Small aircraft. SIMMOD

- Aircraft in SOIR Groups 1 and 2.
- These small aircraft can hold short of (or exit before) the south runway.

21. Reduce distance from ILS hold line to runway -- 10R & 28R. Evaluate

- **Requires Imp 12. Narrate and evaluate the benefit.**
- **When will 10R ILS hold line be moved?**
- Procedures would change when ceiling < 800' or visibility < 2 miles or < 2000' RVR. Affects CAT II/III operations because it occurs when there is fog.
- Relocation or replacement of the ILS glide slope antenna would reduce the arrival separations required to release a departure between consecutive arrivals. Currently, 7 NM to 8 NM spacing of arrivals is needed to release a departure.
- GPS could help.
- **Low RVR causes the problem. It usually occurs in fog, which occurs in IFR2.**
- **Therefore, it affects CAT II ops, not CAT I ops.**
- **RVRs planned for 10L/28R would allow aircraft to depart on the north runway with lower minimums. Then the hold line on 10R/28L would not be a problem, except for Heavies which prefer to depart on the longer runway.**

User Improvements/Options

24. Increased or decreased instrument operations at Troutdale and Pearson.

- Affects only IFR operations.
- **Troutdale (TTD) approach crosses arrivals to 28 and departures from 10.** Narrate
- **Pearson (60S) primarily affects arrivals to 10L in IFR. Pearson's affect on PDX will be simulated as restricted and unrestricted CAT I approaches to 10L at PDX.** SIMMOD
  Pearson is less of a problem for PDX than Troutdale.

25. Increased or decreased peaking operations during critical time periods. ?

EXHIBIT 6 (cont)

POTENTIAL IMPROVEMENTS -- PORTLAND

(Revised 5/10/95) Models

NOTES: DO-NOTHING assumes simultaneous, straight-in approaches are permitted.

On 9/28/94, the Design Team agreed that DO-NOTHING would assume a CAT I ILS on 10R and 28R, with a single IFR1 arrival stream in both West and East flows.

FAATC Notes on DO-NOTHING instrument approaches at PDX:

Only domestic approaches listed here.

CAT II/III ILS:	10R
CAT I ILS:	10R, 28R
LOC/DME:	20
LOC Backcourse:	10L
VOR:	28R
NDB:	28R, 28L
LORAN RNAV:	10R, 28R

EXHIBIT 7

SIMULATION SCENARIOS -- PORTLAND

Pkg	Description of Package	Simulate at These Demand Levels 1993	F1	F2
(0)	**DO NOTHING** (with 3 NM minimum IFR spacing) -- **CALIBRATION**	___	N	N
(A)	**2.5 NM Minimum IFR Spacing -- BASE-CASE**	___	___	___
(B)	**CAT I ILS on 10L -- Restricted Use** due to Pearson in VFR/IFR All Small & Medium aircraft, and some Large aircraft, can land on 10L with 3.6° GS (3.6° GS in *VFR* & IFR, CAT I minimums)			
	(B1) **1.5 NM Staggered IFR Approaches**	___	___	___
	(B2) **Independent IFR Approaches -- PRM**	___	___	___
(C)	**CAT I ILS on 10L -- Unrestricted Use** Any size aircraft can land on 10L (3.0° GS in VFR & IFR, CAT I minimums)			
	(C1) **1.5 NM Staggered IFR Approaches**	___	___	___
	(C2) **Independent IFR Approaches -- PRM**	___	___	___
(D)	**CAT I MLS on 28L -- Restricted Use** (only Horizon DH8 & D38 are MLS equipped, CAT I minimums)			
	(D1) **1.5 NM Staggered IFR Approaches**	___	___	___
	(D2) **Independent IFR Approaches -- PRM**	___	___	___
(E)	**CAT I ILS Capability on 28L -- Unrestricted Use** due to GPS (any aircraft can use 28L, CAT I minimums)			
	(E1) **1.5 NM Staggered IFR Approaches**	___	___	___
	(E2) **Independent IFR Approaches -- PRM**	___	___	___
(F)	**All Large Turbo Props Can Do Divergent Turns** (no departure noise restrictions for Large Turbo Props)	___	___	___
(G)	**All Aircraft Can Do Divergent Turns** (no departure noise restrictions for any aircraft)	___	___	___
(H)	**Box-Haulers Can Arrive on Runway 2 in Peak Periods** (5pm-7pm, box-haulers arrive on 2 & hold-short of 10R/28L)	___	___	___
(I)	**N/S Taxiway Connecting East Ends of Parallel Runways** (2 CAT I unrestricted approaches in 2 flows, 1.5 NM stagger, no departure noise restrictions)	N	N	___
(J)	**Reduced Arrival/Arrival Separations** due to GPS (due to reduced variability of approach speeds which reduces A/A buffers & seps)	___	___	___
(K)	**Build Exits B-4 and B-3 on 10R/28L**	___	___	___

Notes: Y (N) -- Do (Do Not) Simulate at this demand level.
With 3 Weather conditions, then $\geq$ 162 simulations if all improvements at all demand levels.
On 5/10/95, the Design Team agreed to simulate *2.5 NM minimum IFR spacing* as part of all improvements.

III. SIMMOD ANALYSIS

SIMMOD Experimental Design

Exhibit 8 contains the PDX Experimental Design for the 1993 demand level. Not shown are the experimental designs for the Future 1 and Future 2 demand levels.

SIMMOD Airspace Network

Exhibit 9 illustrates the SIMMOD PDX airspace network for the existing airport. The SIMMOD arrival airspace goes out about 6 NM. The SIMMOD departure airspace goes out about 4 NM. This simplified airspace structure will capture the delays associated with the PDX arrival and departure procedures -- including all departure noise restrictions.

The arrival airspace network can simulate simultaneous visual approaches in VFR1, independent IFR approaches in VFR2, and a single IFR approach in IFR1. This structure can be used for most improvement packages by modifying SIMMOD inputs such as aircraft separations, runway dependencies, and runway assignments. The only improvement which requires changes to the arrival airspace structure is Package (H), Box-Haulers Can Arrive on Runway 2 in Peak Periods.

The departure airspace network can simulate the existing departure noise restrictions at PDX for VFR1, VFR2, and IFR1. This structure can be used for most improvements. The following packages will need a new departure airspace network:

(F) All Large Turbo Props Can Do Divergent Turns
(with no departure noise restrictions for Large Turbo Props)

(G) All Aircraft Can Do Divergent Turns
(with no departure noise restrictions for any aircraft)

(I) N/S Taxiway Connecting East Ends of Parallel Runways
(with no departure noise restrictions)

SIMMOD Airfield Network

Exhibit 10 shows the SIMMOD PDX airfield network for the existing airport. This structure can be used for most improvements. The following improvements require changes to the airfield network:

(I) N/S Taxiway Connecting East Ends of Parallel Runways

(K) Build Exits B-4 and B-3 on 10R/28L

EXHIBIT 8

SIMMOD EXPERIMENTAL DESIGN -- PDX

		CONFIG 1 -- WEST	CONFIG 2 -- EAST	COMMENTS
		◄ ——— ◄ 28R ◄ ——— ◄ 28L VFR1 & VFR2	10L ► ——— ► 10R ► ——— ► VFR1 & VFR2	
		◄ ——— ◄ 28R ◄ ——— 28L IFR1	10L ——— ► 10R ► ——— ► IFR1	

PKG	1993 DEMAND 281,000 ANNUAL OPS	VFR1 39.1%	VFR2 5.0%	IFR1 3.6%	VFR1 35.3%	VFR2 9.2%	IFR1 7.8%	
(0)	DO-NOTHING (3 NM min IFR spacing)							CALIBRATION
(A)	2.5 NM MINIMUM IFR SPACING (it is part of all improvements)	=(0)			=(0)			BASE-CASE for Annualizing -- part of (A) thru (K)
(B)	CAT I ILS ON 10L--RESTRICTED USE (B1) 1.5 NM STAGG IFR APPROACH (B2) INDEPENDENT IFR APPROACHES	 =(0) =(0)			 =(0) =(0)			 Due to PRM
(C)	CAT I ILS ON 10L--UNRESTRICTED (C1) 1.5 NM STAGG IFR APPROACH (C2) INDEPENDENT IFR APPROACHES	 =(0) =(0)			 =(0) =(0)			 Due to PRM
(D)	CAT I MLS ON 28L--RESTRICTED USE (D1) 1.5 NM STAGG IFR APPROACH (D2) INDEPENDENT IFR APPROACHES	 =(0) =(0)			 =(0) =(0)			 Due to PRM
(E)	CAT I CAPABILITY ON 28L -- UNRESTRICTED USE DUE TO GPS (E1) 1.5 NM STAGG IFR APPROACH (E2) INDEPENDENT IFR APPROACHES	 =(0) =(0)			 =(0) =(0)			Unrestricted due to GPS Due to PRM
(F)	ALL LARGE TURBOPROPS CAN DIVERGE							No noise restriction--DEP
(G)	ALL AIRCRAFT CAN DIVERGE							No noise restriction--DEP
(H)	BOX-HAULERS CAN ARRIVE ON RWY 2		=(A)	=(A)		=(A)	=(A)	Arrive in Peak Periods
(I)	N/S TWY CONNECTING 2 N/S RWYS	Not Simulated at 1993 Demand						IMPROVEMENTS C1, E1, G
(J)	REDUCED A/A SEPARATIONS via GPS							Reduced seps due to GPS
(K)	BUILD EXITS B-4 & B-3 on 10R/28L		=(A)	=(A)				Reduced occupancy times

NOTES: 2.5 Minimum IFR spacing will be simulated as part of all improvement packages.
=(0): Same as PKG (0) for that configuration/procedure -- e.g., West VFR1.
=(A): Same as PKG (A) for that configuration/procedure -- e.g., West VFR2.

OPERATIONAL PROCEDURES & RUNWAY UTILIZATION SIMULATED

VFR1 = VISUAL SEPARATIONS (3,500' & 10 mile minimums)	: 74.4 %
VFR2= 2,000' AND 5 MILE MINIMUMS (IFR A/A Separations)	: 14.2 %
IFR1 = INSTRUMENT APPROACHES DOWN TO CAT I MINIMUMS	: 11.4 %
TOTAL	: 100.0%

1993, FUTURE 1, FUTURE 2 -- ALL AIRCRAFT SIMULATED IN IFR1

EXHIBIT 9

SIMMOD AIRSPACE AND AIRFIELD NETWORKS -- PDX

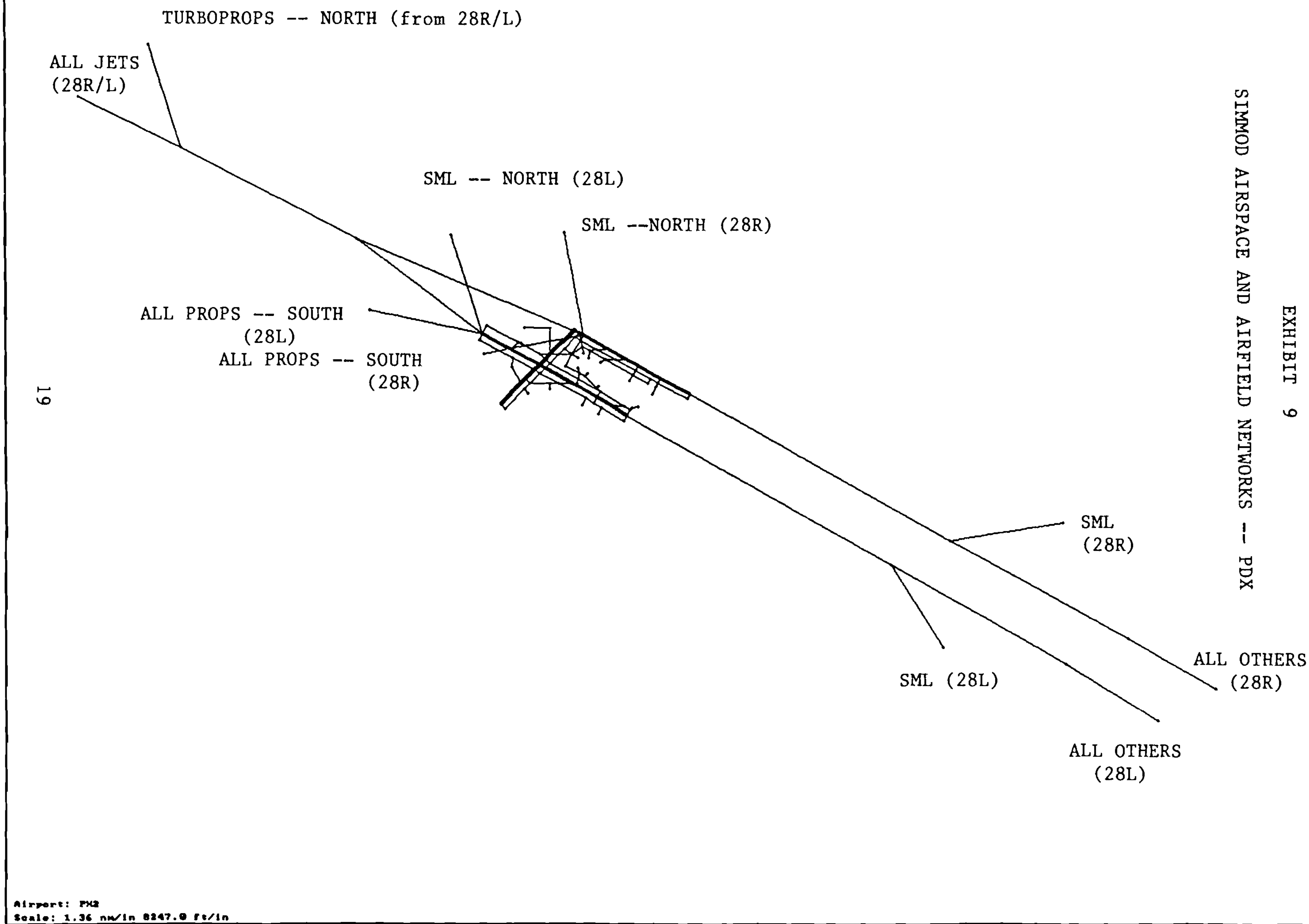
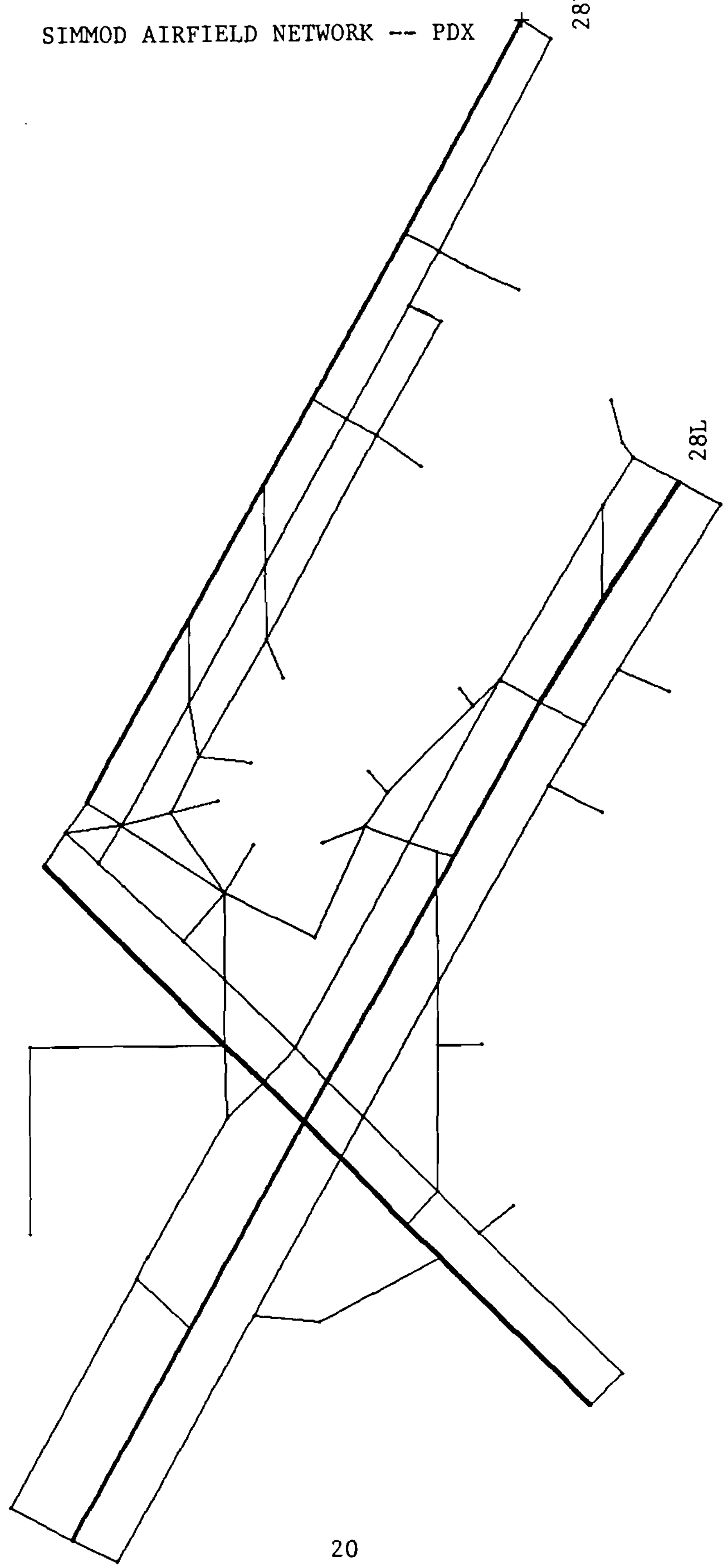


EXHIBIT 10

SIMMOD AIRFIELD NETWORK -- PDX



Airport: PX2
Scale: 0.23 nm/in 1424.7 ft/in

IV. DESIGN TEAM SCHEDULE

Exhibit 11 lists the meetings concerning the completion of significant tasks, outputs and target completion 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 progress of the study.

EXHIBIT 11

PDX DESIGN TEAM SCHEDULE

Event	Target Date	Actual Date	Targeted Purpose	Participants
1	05/18/94	05/18/94	Identify objective of study. Exchange information. Develop initial list of potential improvements.	FAA HQ, Region, Technical Center, and Airport Owners
2	07/14/94	07/14/94	Kickoff meeting. Determine scope of study. Review Technical Plan, including forecasts and potential improvements.	Design Team
3	07/19-22/94	07/19-22/94	On-site data collection. Establish parameters for analytical analysis.	FAA Technical Center
4	09/28/94	09/28/94	Determine scope of study. Select model. Review Data Package 1, including results of data collection, model inputs, assumptions, data requirements, forecasts, and potential improvements.	Design Team
5	11/16/94	11/16/94	Review Data Package 2, including model inputs, improvements, and simulation scenarios.	Design Team
6	01/18/95	01/18/95	Review Data Package 3.	Design Team
7	03/22/95	03/22/95	Review Data Package 4.	Design Team
8	05/10/95	05/10/95	Review Data Package 5.	Design Team
9	06/21/95	07/06/95	Review Data Package 6. (Revised on 5/10/95.)	Design Team
10	08/23/95	/ /	Review Data Package 7	Design Team
11	10/11/95	/ /	Review Data Package 8.	Design Team
12	11/30/95	/ /	Review Data Package 9.	Design Team
	• • •			
?	/ /		Publish final report.	FAA Headquarters

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

APPENDIX A

ACCEPTED MODEL INPUTS

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

PDX AIRCRAFT CLASSES — **ACCEPTED BY THE PDX DESIGN TEAM ON 9/28/94**

PDX AIRCRAFT CLASSES		DESCRIPTION OF PDX CLASSES
S	= SMALL	Small single or twin engine props (Classes 3 & 4)
M	= MEDIUM	Business jets & commuter props (e.g., DH7, DH8, SWM)
L	= LARGE	Large Class 2 jets, except 757 (e.g., air carrier jets -- B727, F28)
757	= 757	757 (a Class 2 jet)
H	= HEAVY	Heavy aircraft (Class 1)

Source of PDX Definitions: PDX Design Team redefined the standard classes.

757: On 7/14/94, the PDX Design Team agreed to use 4 NM as the separation for a 757. For all other purposes (e.g., exit usage, and approach speeds), the 757 will be treated as a Large Class 2 aircraft.

Small: On 9/28/94, the PDX Design Team agreed to combine Class 3 and 4 aircraft into the group "Small". The input data for Small would be the Class 3 input values defined in Data Package 1 because, in general, both types of small aircraft would operate similarly.

STANDARD CLASSES	TYPES OF AIRCRAFT
A (4)	**Small, single-engine aircraft weighing 12,500 lb. or less** (e.g., PA18, PA23, C180, C207) -- small, single-engine props
B (3)	**Small, twin-engine aircraft weighing 12,500 lb. or less** (e.g., PA31, BE55, BE99, C310, C402, CNA, D08) -- small, twin-engine props
C (2)	**Large aircraft weighing more than 12,500 lb. and up to 300,000 lb.** (e.g., CV34, CV58, CV99, DC4, DC6, DC7, L188, L49, DC9, B737, B727, B720, B707-120, BAC111, F28, F100, J31, SH6, **all small jets, & B757)**
D (1)	**Heavy aircraft weighing more than 300,000 lb.** (e.g., L1011, DC8-10,-20,-30,-40,-50,-60 series, DC10, B707-300,-400 series, B747, B767, VC10, A300, Concorde, IL62)

Source of Standard Definitions: Standard definitions with modifications made by the PDX Design Team.

PDX Design Team: The **critical factors in determining the aircraft class** should be the aircraft's approach speed and how arrivals are separated at the point of closest approach (at threshold, except for a slower aircraft following a faster aircraft). The PDX aircraft class definitions will be used to generate all the data presented by aircraft class during this study. At the September 28th meeting, the **PDX Design Team agreed to** use the five ***PDX Aircraft Classes*** -- **Heavy, 757, Large, Medium, and Small.**

LENGTH OF COMMON APPROACH ON FINAL — **ACCEPTED BY THE PDX DESIGN TEAM ON 9/28/94**

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 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.

Source: PDX Tower, July 1994. Class definitions adjusted in September 1994.

VFR	(All runways) -- 5 NM for Heavy, 757, Large, Medium -- 3 NM for Small
IFR	(All runways) -- 5 NM for all classes

APPROACH SPEEDS (Knots) -- PDX ATCT — **ACCEPTED BY THE PDX DESIGN TEAM ON 1/18/95**

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.

Source: PDX Tower, 1/18/95. Based on ARTS data for 7/20/94, the following were changed from standard values: Heavy (155 knots instead of 140), and 757 & Large (140 knots instead of 130).

Approach Speeds	Heavy	757	Large	Medium	Small
VFR (Knots)	155	140	140	130	110
IFR (Knots)	155	140	140	130	110

NOTE: Data Package 4, March 1995: Page 5 describes the affect of increased approach speeds on the aircraft separations.

OAG DATE — **ACCEPTED BY THE PDX DESIGN TEAM ON 9/28/94**

The PDX Design Team agreed to simulate Wednesday, July 20, 1994, as the average-busy-day in this study. Therefore, the OAG schedule, OAG hour counts, and the PDX tower counts from Arts data will be used to generate the 1993 PDX schedule and hourly counts.

ANNUAL & DAILY DEMAND — **ACCEPTED BY THE PDX DESIGN TEAM ON 11/16/94**

Source: 1993 Ops — PDX Tower and Port of Portland
Forecast — PDX Design Team, 9/28/94

PDX Design Team:
F1 has a 37.4% increase in traffic over 1993 while F2 has a 27.2% increase in traffic over F1.
F1 has 105,000 annual operations more than 1993 and F2 has 105,000 annual operations more than F1.

Demand Level	Annual Operations	Daily Operations	Equivalent Days
1993	281,000	878	320
Future 1	386,000	1,206	320
Future 2	491,000	1,534	320

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

PDX DEMAND CHARACTERISTICS — **ACCEPTED BY THE PDX DESIGN TEAM ON 11/16/94**

Source: 1993 Ops — PDX Tower, Port of Portland, and ARTS data
Forecast — PDX Design Team, 9/28/94

PDX Design Team: The number of AC/AT/Commuter ops at Future 1 increase 50% over 1993.
The number of AC/AT/Commuter ops at Future 2 increased 100% over 1993.
The number of Military ops and GA ops remained constant over all demand levels.

Annual Distribution of Traffic

DEMAND	AC/AT/COMMUTER		GENERAL AVIATION		MILITARY		TOTAL	
1993	210,000	75%	58,600	21%	12,400	4%	281,000	100%
FUTURE 1	315,000	82%	58,600	15%	12,400	3%	386,000	100%
FUTURE 2	420,000	86%	58,600	12%	12,400	<3%	491,000	100%

Daily Distribution of Traffic

AC/AT/Commuter		GA	MI		TOTAL	
656	(74.7%)	184 (21.0%)	38	(4.3%)	878 (100%)	1993
984	(81.6%)	184 (15.3%)	38	(3.1%)	1,206 (100%)	Future 1
1,312	(85.5%)	184 (12.0%)	38	(2.5%)	1,534 (100%)	Future 2

Overall Daily Fleet Mix -- By Class

Heavy	757	Large	Medium	Small	Total	
34 (3.9%)	34 (3.9%)	334 (38.0%)	310 (35.3%)	166 (18.9%)	878 (100%)	1993
51 (4.2%)	51 (4.2%)	482 (40.0%)	440 (36.5%)	182 (15.1%)	1,206 (100%)	Future 1
68 (4.4%)	68 (4.4%)	630 (41.1%)	570 (37.2%)	198 (12.9%)	1,534 (100%)	Future 2

NOTES: **PDX Tower and Port said Class 3 and 4 aircraft can and do operate in IFR1.**
1993: 166 Small ops = 92 Small-Twins ops and 74 Small-Single ops per day.
Future 1: 182 Small ops = 102 Small-Twins ops and 80 Small-Single ops per day.
Future 2: 198 Small ops = 112 Small-Twins ops and 86 Small-Single ops per day.

PDX DEMAND CHARACTERISTICS (cont) **ACCEPTED BY THE PDX DESIGN TEAM ON 11/16/94**

Air Carrier/Air Taxi/Commuter Daily Fleet Mix -- By Class

Heavy	757	Large	Medium	Small	Total	
34 (5.2%)	34 (5.2%)	296 (45.1%)	260 (39.6%)	32 (4.9%)	656 (100%)	1993
51 (5.2%)	51 (5.2%)	444 (45.1%)	390 (39.6%)	48 (4.9%)	984 (100%)	Future 1
68 (5.2%)	68 (5.2%)	592 (45.1%)	520 (39.6%)	64 (4.9%)	1,312 (100%)	Future 2

NOTE: Although the numbers of operations increase at the Future demand levels, the percentage by Class remains constant.
1993: 32 Small ops = 20 Small-Twin ops and 12 Small-Single ops per day.
Future 1: 48 Small ops = 30 Small-Twin ops and 18 Small-Single ops per day.
Future 2: 64 Small ops = 40 Small-Twin ops and 24 Small-Single ops per day.

GA Daily Fleet Mix -- By Class

Medium	Small	Total	
50 (27.2%)	134 (72.8%)	184 (100%)	1993, Future 1, Future 2

NOTE: 134 Small ops = 72 Small-Twin ops and 62 Small-Single ops per day.

MI Daily Fleet Mix -- By Class

Large	Total	
38 (100%)	38 (100%)	1993, Future 1, Future 2

NOTE: At the September 28th meeting, the Military and the Technical Center agreed that it would be reasonable to simulate all Military operations as Large. The PDX Design Team concurred.

CARGO LOCATIONS **ACCEPTED BY THE PDX DESIGN TEAM ON 3/22/95**

The Design Team agreed to stage the movement of cargo operations to the Air Trans Center as follows:

1993/1994:
- North Cargo Area: Federal Express (2 daily ops in OAG); Box-Haulers (total of 10 daily ops)
- South Cargo Area: EB & ER (total of 4 daily ops in OAG)
- Air Trans Center: Airborne, UPS, Salair, Burlington (total of 26 daily ops in OAG); Box-Haulers (total of 14 daily ops)

Future 1:
- South Cargo Area: EB & ER
- Air Trans Center: Airborne, UPS, Salair, Burlington, FedEx, Box-Haulers

Future 2:
- Air Trans Center: All cargo operators

AIRLINES SERVING PORTLAND (Based on Wednesday, 7/20/94) **ACCEPTED BY THE PDX DESIGN TEAM ON 11/16/94**

Source: OAG -- Wednesday, July 20, 1994

Airline	OAG Code	FAA Code	Terminal/Gates
AirBC	ZX	ABL	C14
Airborne Express	1F	ABX	Air Trans Center
Alaska	AS	ASA	B1-B4, C1, C2
American	AA	AAL	C6, C8 (also C4)
America West	HP	AWE	C7
Burlington Air Exp.	8W	ASW,ATN	Air Trans Center
Delta	DL	DAL	D4,D6,D8,D9-D14,E4,E5
DHL Airways	ER	DHL	South Cargo Area
Emery Worldwide	EB	EWW	South Cargo Area
Federal Express	FM	FDX	North Cargo Area
Horizon Air	QX	QXE	A -- up to 11 aircraft
Morris Air	KN	MSS	C10, C12
Northwest	NW	NWA	C3, C5, C7
Reno Air	QQ	ROA	C11, C13 (also C9)
Salair	8S	SKX,SIR	Air Trans Center
Southwest	WN	SWA	C10, C12
Trans World	TW	TWA	C4, D10 (also C5)
United/United Express	UA	UAL	E1-E5
United Parcel Service	5X	UPS	Air Trans Center
USAir	US	USA	C9
Westair (UA Express)	OE	WCA	E6 -- up to 4 aircraft

Updated 11/16/94

Not Included in table above:
6:30am - 7:30am: 12 Box-Hauler Departures per day -- time revised on 3/7/95
(5 use North ramp, 7 use Air Trans Center)
5:20pm - 6:20pm: 12 Box-Hauler Arrivals per day
(5 use North ramp, 7 use Air Trans Center)

NOTE: SDU (Sundance) was not in the OAG although SDU operates as UA Express.
The OAG has WCA (Westair) as UA Express. Sundance is owned by Westair.
ASW (Burlington Air Exp.) contracts out as ATN (Air Trans).
On October 4, 1994, Morris Air (KN) became part of Southwest (SW).

The PDX Design Team agreed to stage the movement of cargo operations to the Air Trans Center.

OAG COUNTS BY AIRLINE (Wednesday, 7/20/94) **ACCEPTED BY THE PDX DESIGN TEAM ON 11/16/94**

Source: OAG -- Wednesday, July 20, 1994

Added cargo notes on 11/16/94

AIRLINE	ARR	DEP	TOTAL	
AA	10	10	20	
AS	36	36	72	
DL	22	22	44	
EB	1	1	2	Cargo -- South Cargo in 1993 (DHL)
ER	1	1	2	Cargo -- South Cargo in 1993 (Emery)
FM	1	1	2	Cargo -- North Cargo in 1993 (FedEx)
HP	7	7	14	
KN	4	4	8	
NW	8	8	16	
OE	26	26	52	
QQ	10	10	20	
QX	112	112	224	
TW	4	4	8	
UA	23	23	46	
US	2	2	4	
WN	11	11	22	
ZX	5	5	10	
1F	4	4	8	Cargo -- Air Trans Center in 1993 (Airborne)
5X	7	7	14	Cargo -- Air Trans Center in 1993 (UPS)
8S	1	1	2	Cargo -- Air Trans Center in 1993 (Salair)
8W	1	1	2	Cargo -- Air Trans Center in 1993 (Burlington)
TOTAL	296	296	592	

Not Included in table above:
6:00am - 7:00am: 12 Box-Hauler Departures per day
(5 use North ramp, 7 use Air Trans Center)
5:20pm - 6:20pm: 12 Box-Hauler Arrivals per day
(5 use North ramp, 7 use Air Trans Center)

ARRIVAL AIRCRAFT LATENESS DISTRIBUTION -- PDX **ACCEPTED BY THE PDX DESIGN TEAM ON 1/16/95**

(Arrival Variability Distribution)

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 (minutes)	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.

MINIMUM GATE SERVICE TIMES -- PDX **ACCEPTED BY THE PDX DESIGN TEAM ON 3/22/95**

(Minimum Turn-Around Times)

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.

Heavy		757 & Large		Medium		Small	
Minutes	Cum. Prob.	Minutes	Cum. Prob.	Minutes	Cum. Prob.	Minutes	Cum. Prob.
45	0.12	25	0.25	20	0.25	10	0.16
50	0.31	35	0.59	25	0.59	15	0.56
60	0.43	45	1.00	30	1.00	20	0.64
65	0.55					25	1.00
85	0.88						
120	1.00						

Source: Heavy -- Based on values used in the 1994 & 1989 Seattle Design Team studies. On 1/31/95, maximum gate service time at PDX was changed to 120 minutes (versus 85 at SEA) based on comments from PDX airlines
Large & 757 -- Based on values used in the 1994 & 1989 Seattle Design Team studies. Maximum gate service time at PDX is 45 minutes (versus 60 at SEA) based on comments from airlines at PDX.
Medium -- Based on values used in the 1994 & 1989 Seattle Design Team studies. Maximum gate service time at PDX is 30 minutes (versus 45 at SEA) based on comments from airlines at PDX.
Small -- Values for Small were weighted by percent of small-twins and small-singles. The maximum gate service time at PDX was then reduced to 25 minutes (from 35 minutes). (The original values for small-twins and small-single were developed during the Newark Study and were used in the Charlotte, Dulles, and Cincinnati Design Team studies. Seattle used the small-single values for its Small aircraft).

EXIT PROBABILITIES -- WITH NEW CLASS DEFINITIONS — **ACCEPTED BY THE PDX DESIGN TEAM ON 1/18/95**

WHEN 10L & 28R ARE OPEN: 10R, 10L, 28R, 28L -- data observed by PDX Tower.

Runway 2 data observed by FAATC.

Data was adjusted so arrivals cannot exit onto an active runway.

RUNWAY EXITS on 10R -- Distance is from runway end.

	E	B5/F	B6/C6	TOTAL	
					PRIMARY ARRIVAL RUNWAY
Distance	4,600'	6,900'*	8,500'		**RUNWAY 10R 11,000'**
Heavy		70/53	30/64	100/56	**Adjusted by Tower & FAATC, 12/94**
Lg & 757	17/40	81/53	2/64	100/51	Large & 757
Medium	41/40	54/55	5/57	100/49	
Small	93/47	7/60		100/48	
Legend:	% /s	% /s	% /s	% /s	**Observed by PDX Tower**

RUNWAY EXITS on 10L -- Distance is from runway end.

	A5	A4	A2/A3	A1/END	TOTAL	
Distance	3,400'rhs	4,200'	5,900'*	8,000'		**RUNWAY 10L 8,000'**
Heavy			80/51	20/65	100/54	**Estimated by Tower & FAATC, 12/94**
Lg & 757	5/37	5/37	74/51	16/65	100/52	Large & 757
Medium	28/37	50/42	22/58		100/44	
Small	16/42	84/47			100/46	
Legend:	% /s	% /s	% /s	% /s	% /s	**Observed by PDX Tower**

RUNWAY EXITS on 2 -- Distance is from runway end.

	E4	C/CE	B	M	TOTAL	
Distance	2,200'	3,100'	4,400'	4,800'hs		**RUNWAY 2 7000'**
Medium			50/45	50/47	100/46	Medium can stop before intersection of 2 & 10R
Small	75/34	25/43			100/36	Small can exit before intersection of 2 & 10R
Legend:	% /s	% /s	% /s	% /s	% /s	**Observed by FAATC**

PDX Design Team: The data should reflect operations when the airport is busy. As agreed upon by the Design Team in September, values for Small are the values for Small-Twins (Class 3 aircraft).

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 PROBABILITIES -- WITH NEW CLASS DEFINITIONS (cont) **ACCEPTED BY THE PDX DESGIN TEAM ON 1/18/95**

RUNWAY EXITS on 28R -- Distance is from runway end.

	A2/A3	A4	A5	A6	A7/END	TOTAL
Distance	2,100'	3,800'	4,600'hs	5,900'hs	8,000'	
Heavy				80/44	20/63	100/48
Lg & 757		1/35	21/39	60/44	18/63	100/46
Medium	**	27/37	64/41	9/50	**	100/41
Small	5/24	84/43	11/42			100/42
Legend:	% /s	% /s	% /s	% /s	% /s	% /s

PRIMARY ARRIVAL RUNWAY

RUNWAY 28R
8,000'
Adjusted by Tower & FAATC, 12/94

Large & 757

RUNWAY EXITS on 28L -- Distance is from runway end.

	B6/C6	B5/F	CE/E	B2	TOTAL
Distance	2,500'	4,100'*	6,400'	8,500'	
Heavy			80/57	20/61	100/58
Lg & 757	**	18/39	80/49	2/61	100/47
Medium	18/31	78/40	4/60		100/39
Small	12/34	80/42	8/48		100/42
Legend:	% /s	% /s	% /s	% /s	% /s

RUNWAY 28L
11,000'
Adjusted by Tower & FAATC, 12/94

Large & 757

Adjusted by Tower & FAATC, 12/94

DEPARTURE PUSH **ACCEPTED BY THE PDX DESIGN TEAM ON 9/28/94**

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.

DEPARTURE RUNWAY OCCUPANCY TIMES (Seconds) **ACCEPTED BY THE PDX DESIGN TEAM ON 9/28/94**

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

Source: Standard values used in all design team studies.
Class definitions adjusted in September 1994.

Class	Heavy	757	Large	Medium	Small
Seconds	39	39	39	39	34

D/D Noise Dependency for Turboprop/Jet **ACCEPTED BY THE PDX DESIGN TEAM ON 11/16/94**

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.

WEST FLOW

◄ ——— 28R

◄ ———— 28L

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

28R/28L

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

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

28L/28R

Jet/Jet:	Use 0.75 minutes (0.25 minutes subtracted from std Jet/Jet) When Heavy is lead aircraft, subtract 0.25 minutes std Heavy/Jet) When 757 is lead aircraft, subtract 0.25 minutes std 757/Jet)
Turboprop/Turboprop:	Use 0.75 minutes (0.25 minutes subtracted from std TB/TB)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes subtracted from std TB/Jet)
Jet/Turboprop:	Use 0.75 minute (0.25 minutes subtracted from std Jet/TB) When Heavy is lead aircraft, subtract 0.25 minutes std Heavy/TB) When 757 is lead aircraft, subtract 0.25 minutes std 757/TB)

Note: FAATC updated arrows on 6/1/95.

EAST FLOW

10L ————▸

10R ————▸

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

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 std Heavy/Jet) When 757 is lead aircraft, subtract 0.34 minutes std 757/Jet)
Turboprop/Turboprop:	Use 0.66 minutes (0.34 minutes subtracted from std TB/TB)
Turboprop/Jet:	Use 2.00 minutes (0.00 minutes subtracted from std TB/Jet)
Jet/Turboprop:	Use 0.66 minutes (0.34 minutes subtracted from std Jet/TB) When Heavy is lead aircraft, subtract 0.34 minutes std Heavy/TB) When 757 is lead aircraft, subtract 0.34 minutes std 757/TB)

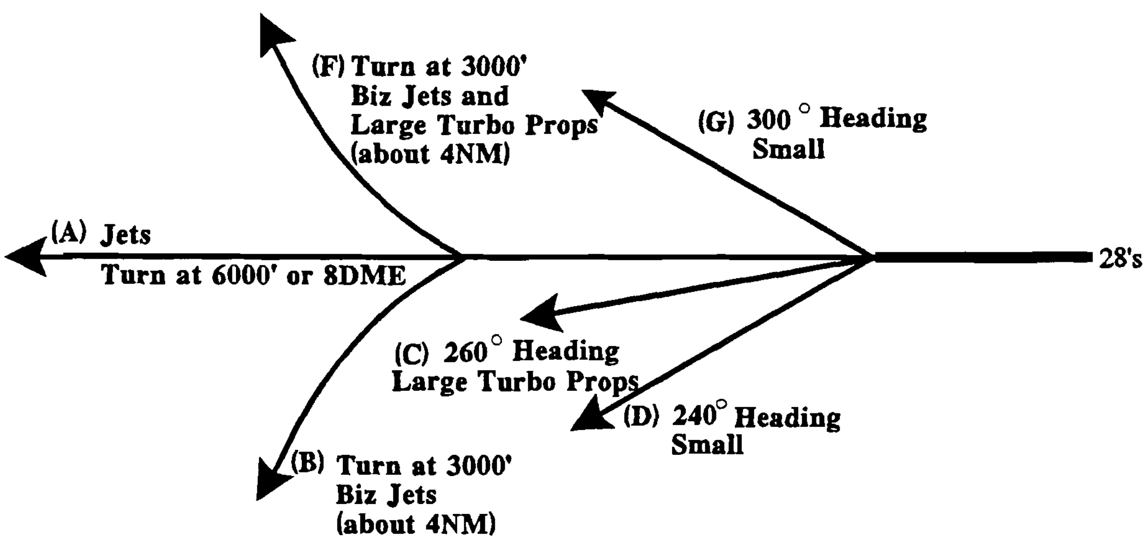
Note: FAATC updated arrows on 6/1/95.

PDX Noise Dependencies – West Flow (Same Runway)

VFR/IFR

Accepted by the PDX Design Team on 11/16/94

(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.

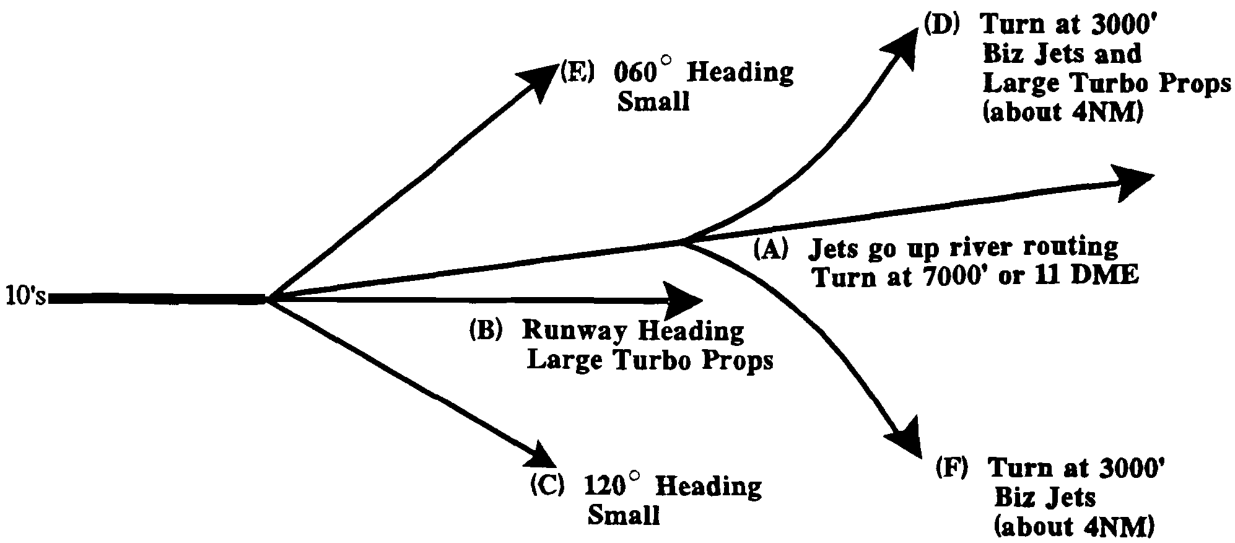
Note: Assume all Biz Jets are quiet because most are quiet.
WRT = with respect to.

PDX Noise Dependencies -- East Flow (Same Runway)

VFR/IFR

Accepted by the PDX Design Team on 11/16/94

(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.

HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS -- PDX

Source -- Exhibit 7, Data Package 4, March 1995

LOCAL HOUR	SCD-281 (1993) HOUR COUNTS			SCD-386 (FUTURE 1) HOUR COUNTS			SCD-491 (FUTURE 2) HOUR COUNTS		
	ARR	DEP	TOTAL	ARR	DEP	TOTAL	ARR	DEP	TOTAL
0	3	4	7	4	5	9	4	6	10
1	3	3	6	4	3	7	4	4	8
2	4	2	6	5	2	7	6	2	8
3	4	5	9	5	7	12	6	8	14
4	3	1	4	4	2	6	6	2	8
5	5	4	9	7	6	13	9	7	16
6	15	29	44	21	42	63	27	55	82
7	21	39	60 *	28	55	83 **	35	71	106 ***
8	24	33	57 *	31	44	75 **	38	56	94 ***
9	24	28	52 *	31	37	68	38	46	84
10	30	24	54 *	41	32	73 **	52	40	92 ***
11	32	25	57 *	46	35	81 **	59	45	104 ***
12	24	31	55 *	31	42	73 **	39	53	92 ***
13	25	26	51 *	35	37	72 **	45	47	92 ***
14	26	27	53 *	35	37	72 **	45	47	92 ***
15	20	21	41	26	27	53	32	34	66
16	24	29	53 *	32	40	72 **	41	51	92 ***
17	41	20	61 *	57	26	83 **	74	32	106 ***
18	26	33	59 *	36	47	83 **	46	60	106 ***
19	22	14	36	32	20	52	42	26	68
20	30	15	45	44	21	65	57	27	84
21	15	16	31	22	23	45	28	30	58
22	13	8	21	19	11	30	25	15	40
23	5	2	7	7	2	9	9	3	12
	439	439	878	603	603	1206	767	767	1534

NOTES: **Counts include AC (Air Carrier/Commuter/Air Taxi), GA, and MI.**
Counts were adjusted to reflect Box-Hauler operations at all demand levels.

1993 -- **Highest hour count is 61.**
11 hours have counts of at least 50. See *.
Between 7am and 7pm, the number of hourly ops ranges from 41 to 61.

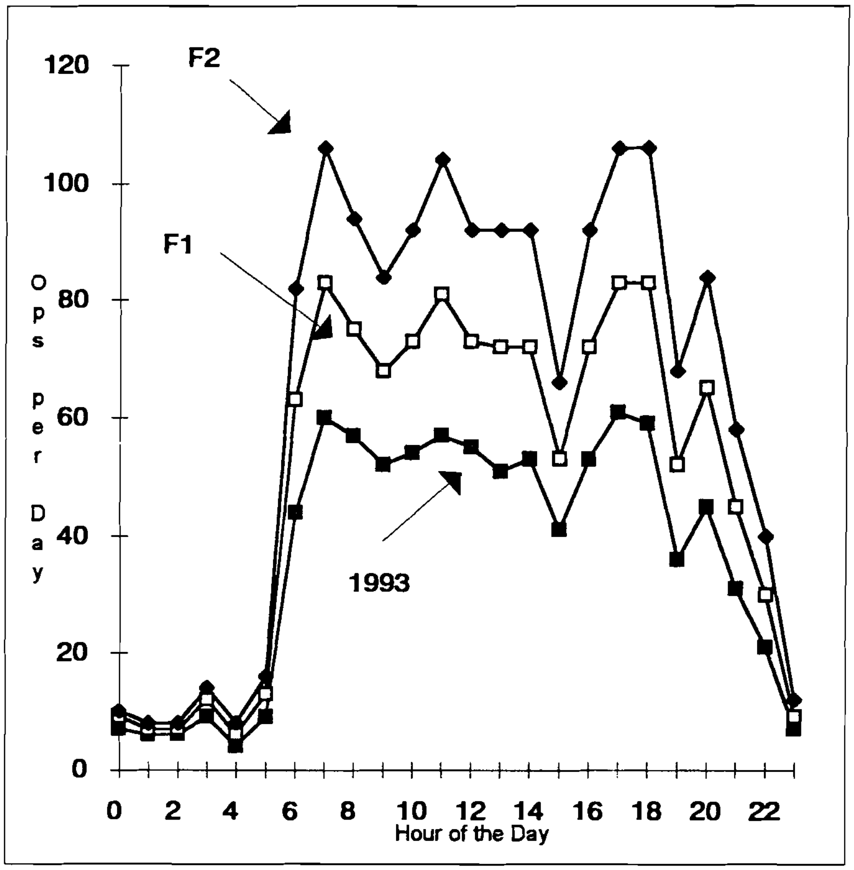
Future 1 -- **Highest hour count is 83.**
10 hours have counts of at least 70. See **.
Between 7am and 7pm, the number of hourly ops ranges from 53 to 83.

Future 2 -- **Highest hour count is 106.**
10 hours have counts of at least 90. See *.**
Between 7am and 7pm, the number of hourly ops ranges from 66 to 106.

CHART -- HOUR COUNT SUMMARY FOR 3 DEMAND LEVELS

Source -- Exhibit 8, Data Package 4, March 1995

HOUR	1993	F1	F2
0	7	9	10
1	6	7	8
2	6	7	8
3	9	12	14
4	4	6	8
5	9	13	16
6	44	63	82
7	60	83	106
8	57	75	94
9	52	68	84
10	54	73	92
11	57	81	104
12	55	73	92
13	51	72	92
14	53	72	92
15	41	53	66
16	53	72	92
17	61	83	106
18	59	83	106
19	36	52	68
20	45	65	84
21	31	45	58
22	21	30	40
23	7	9	12
	878	1206	1534



NOTES:

AC Counts -- Future 1 AC hour counts are 50% higher than 1993 AC hour counts.
Future 2 AC hour counts are double the 1993 AC hour counts.

GA Counts -- GA hour counts are the same at all 3 demand levels.

MI Counts -- MI hour counts are the same at all 3 demand levels.

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.

AVERAGE ARRIVAL/ARRIVAL SEPARATIONS

(when approach speeds are 155, 140, 140, 130, 110)

AVERAGE ARR/ARR SEPARATIONS IN NAUTICAL MILES

STANDARD VFR1 (VISUAL) SEPARATIONS

Report FAA-EM-78-8A
At Point of Closest Approach <<with missed approach buffer>>

A/A (NM)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	4.26	5.06	5.06	4.67	5.04
	757	4.26	4.55	4.55	4.25	4.25
	LG	3.40	3.19	3.19	2.97	3.39
	MED	3.40	3.19	3.19	2.97	3.39
	SM	3.40	3.19	3.19	2.97	2.66

STANDARD IFR SEPARATIONS

Report FAA-EM-78-8A
At Point of Closest Approach
With 3.0 NM Minimum on a Runway

A/A (NM)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	5.28	6.15	6.15	6.07	6.91
	757	5.28	5.15	5.15	5.07	4.91
	LG	4.28	4.15	4.15	4.07	4.91
	MED	4.28	4.15	4.15	4.07	4.91
	SM	4.28	4.15	4.15	4.07	3.91

AVERAGE ARR/ARR SEPARATIONS IN SECONDS (as used by the models)

STANDARD VFR1 (VISUAL) SEPARATIONS

Report FAA-EM-78-8A
At Point of Closest Approach <<with missed approach buffer>>

A/A (SECONDS)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	99	130	130	130	165
	757	99	117	117	117	139
	LG	79	82	82	82	111
	MED	79	82	82	82	111
	SM	79	82	82	82	87

STANDARD IFR SEPARATIONS

Report FAA-EM-78-8A
At Point of Closest Approach
With 3.0 NM Minimum on a Runway

A/A (SECONDS)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	122	158	158	168	226
	757	122	132	132	140	161
	LG	99	107	107	113	161
	MED	99	107	107	113	161
	SM	99	107	107	113	128

Notes: **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).

In DP4: A/A standard separations were modified to reflect the "non-standard" approach speeds of a Heavy, 757, & Large: 155, 140, & 140 knots (140, 130, & 130 are standard). The PDX Tower changed the A/A VFR separation for a 757/Small to 4.25 NM & 139 seconds (instead of 4.5 NM & 147 seconds). **DP4, Page 5, explains the effect of the increased approach speeds on A/A aircraft separations.**

2.5 NM Minimum Intrail IFR Spacing

Accepted by PDX Team on 5/10/95

Reducing the minimum intrail IFR spacing to 2.5 NM (from 3 NM) is permitted only between **similar** class, non-Heavy aircraft. Heavies & B-757s may participate only as trailing aircraft. When applying the reduced separation, a Medium is considered ***similar*** to a Large. The reduced A/A spacing is permitted for the following pairs of aircraft:

2.5 NM MINIMUM IFR SPACING IS PERMITTED

A/A		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	---	---	---	---	---
	757	---	---	---	---	---
	LG	Yes	Yes	Yes	Yes	---
	MED	Yes	Yes	Yes	Yes	---
	SM	Yes	Yes	Yes	Yes	Yes

Note: Reducing the minimum A/A spacing by 0.5 NM reduces the average A/A spacing by 0.5 NM.
Heavies and 757s can participate as trail aircraft only. The reduced separation for these aircraft was first permitted in 1991 -- by 7110.65F, 5-72f(3), 7/25/91.

AVERAGE DEPARTURE/ARRIVAL SEPARATIONS

(when approach speeds are 155, 140, 140, 130, 110)

AVERAGE DEP/ARR SEPARATIONS IN NAUTICAL MILES

STANDARD VFR1 (VISUAL) SEPARATIONS
Report FAA-EM-78-8A

D/A (NM)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	1.68	1.51	1.51	1.41	1.19
	757	1.68	1.51	1.51	1.41	1.19
	LG	1.68	1.51	1.51	1.41	1.19
	MED	1.68	1.51	1.51	1.41	1.19
	SM	1.46	1.32	1.32	1.23	1.05

STANDARD IFR SEPARATIONS
Report FAA-EM-78-8A

D/A (NM)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	2.00	2.00	2.00	2.00	2.00
	757	2.00	2.00	2.00	2.00	2.00
	LG	2.00	2.00	2.00	2.00	2.00
	MED	2.00	2.00	2.00	2.00	2.00
	SM	2.00	2.00	2.00	2.00	2.00

AVERAGE DEP/ARR SEPARATIONS IN (as used by the models)

STANDARD VFR1 (VISUAL) SEPARATIONS
Report FAA-EM-78-8A

D/A (SECONDS)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	39	39	39	39	39
	757	39	39	39	39	39
	LG	39	39	39	39	39
	MED	39	39	39	39	39
	SM	34	34	34	34	34

STANDARD IFR SEPARATIONS
Report FAA-EM-78-8A

D/A (SECONDS)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	46	51	51	55	65
	757	46	51	51	55	65
	LG	46	51	51	55	65
	MED	46	51	51	55	65
	SM	46	51	51	55	65

Notes: **DEP/ARR Standard Sigma = 4 Seconds. (Source: FAA-EM-78-8A)**
However, the models will not allow the DEP/ARR separations go below the departure runway occupancy time (39, 39, 39, 39, or 34 seconds -- based on the aircraft class).

VFR values were developed from the departure occupancy time and speed of arrival on final. In IFR, all aircraft use 2 NM.

In DP4: D/A standard separations were modified to reflect the "non-standard" approach speeds of a Heavy, 757, & Large: 155, 140, & 140 knots (140, 130, & 130 are standard).
DP4, Page 5, explains the effect of the increased approach speeds on D/A aircraft separations.

AVERAGE DEPARTURE/DEPARTURE SEPARATIONS

STANDARD VFR1 (VISUAL) SEPARATIONS
Report FAA-EM-78-8A

D/D (MINUTES)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	1.50	2.00	2.00	2.00	2.00
	757	1.50	1.50	1.50	1.50	1.50
	LG	1.00	1.00	1.00	1.00	0.83
	MED	1.00	1.00	1.00	1.00	0.83
	SM	0.83	0.75	0.75	0.75	0.58

STANDARD IFR SEPARATIONS
Report FAA-EM-78-8A

D/D (MINUTES)		TRAIL A/C HVY	757	LG	MED	SM
LEAD A/C	HVY	1.50	2.00	2.00	2.00	2.00
	757	1.50	1.50	1.50	1.50	1.50
	LG	1.00	1.00	1.00	1.00	1.00
	MED	1.00	1.00	1.00	1.00	1.00
	SM	1.00	1.00	1.00	1.00	1.00

Notes: **DEP/DEP Standard Sigma = 4.8 Seconds. (Source: FAA-EM-78-8A)**

AVERAGE ARRIVAL/DEPARTURE SEPARATIONS

STANDARD VFR1 (VISUAL) SEPARATIONS
Report FAA-EM-78-8A

A/D (MINUTES)		TRAIL A/C HVY	757	LG	MED	SM
LEAD	HVY					
A/C	757		BASED ON ROT			
	LG		FROM OBSERVED			
	MED		FIELD DATA			
	SM		1993 - 1994			

STANDARD IFR SEPARATIONS
Report FAA-EM-78-8A

A/D (MINUTES)		TRAIL A/C HVY	757	LG	MED	SM
LEAD	HVY					
A/C	757		BASED ON ROT			
	LG		FROM OBSERVED			
	MED		FIELD DATA			
	SM		1993 - 1994			

Note: **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.