DOT/FAA/CT-TN97/20

NEWARK

INTERNATIONAL AIRPORT

Data Package Number 4

Airport Capacity Enhancement Design Team Study

August 1997

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 Newark International Airport Capacity Enhancement Design Team Study.

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Newark International Airport (EWR)

Data Package Number 4

Airport Capacity Enhancement
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LIST OF EXHIBITS

1. POTENTIAL IMPROVEMENTS AND AIRPORT DIAGRAM

Exhibit 1 summarizes proposed improvements for the Airport Capacity Enhancement Design Team Study. The potential improvements are grouped as follows:

- Airfield
- Facilities and Equipment
- Operations
- User and Policy

The proposals for this Design Team study require detailed analysis of runways, taxiways, and gates. The Runway Delay Simulation Model (RDSIM) and/or Airfield Delay Simulation Model (ADSIM) will be used for simulating the Newark International Airport.

Exhibit 2 lists simulation scenarios for Newark.

Exhibit 3 presents a diagram of the existing airport.

The Experimental Design will consist of three demand levels (daily aircraft schedules). The runway configurations and traffic distributions may change for each demand level dependent upon the time frame of the runway extension efforts.

The Experimental Design normally includes runs for VFR and IFR conditions and for operations in both directions on each runway. The Design Team may decide that some of these runs can be eliminated if, for example, analysis of NE and SW runway operations produce nearly equivalent results. Combining improvements into logical packages may also help reduce the required experiments to a manageable number.

EXHIBIT 1 - POTENTIAL IMPROVEMENTS

(Revised on 8/26/97)

AIRFIELD IMPROVEMENTS **PROPOSED MODEL**

- **Taxiway System Improvements (Exits, Queuing, Hold Blocks, etc.).**
  - Alternative departure queue schemes for extended Runway 4L/22R.
  - Additional access to Runway 11/29 (between Y and RM) across drainage ditch.
  - Off-gate holding areas in addition to BALL PARK.

FACILITIES AND EQUIPMENT IMPROVEMENTS

- **LDA 24° Offset Approach**
  - **– to inboard runway (4L or 22R) by non-heavy aircraft & commuters.**
    - Allows parallel arrival streams during arrival peaks in less than VFR1 weather (i.e., down to 2,000' or 3,000' ceiling) in NE and SW flows.
    - **Can a 757 do an LDA approach?**
    - LDA offset to 4s does not affect Teterboro operations.
    - LDA offset to 22s affects Teterboro operations (arrivals to Runway 6) and reduces its capacity.
    - Perform capacity analysis to determine adverse impact on Teterboro arrival capacity.

OPERATIONAL IMPROVEMENTS

- **Parallel Simultaneous Visual Approaches (using wake vortex technology).**
  - LDA may aid this operation.
- **SCIA – Simultaneous Converging Instrument Approaches.**
  - In VFR2 & IFR1 – permits simultaneous approaches to 11 and either 22R or 22L.
  - Down to IFR1 minimums using FMS (which reduces TERPS criteria).
  - Down to IFR1 minimums using GPS.
- **DCIA – Dependent Converging Instrument Approaches.**
  - Possible improvement in 1998.
  - Look at ground movement alternatives for arrivals to 11 and 4R, and departures to 22L.
  - DCIA requires CRDA (Converging Runway Display Aid) and ASR-9.
  - In VFR2 – permits simultaneous approaches to 11 and either 22R or 22L .
  - In IFR1 – permits dependent approaches to 11 and either 22R or 22L.
  - Enables departures on 22 to be released more efficiently between successive arrivals on 11?
  - In SW flow, reduces the A/A separations on 11 (to 6 NM from 10NM) when landing on 22.
- **Reduce Minimum In-Trail IFR Separation to 2.0 NM – between similar class non-heavy aircraft.**

USER OR POLICY ALTERNATIVES

Notes: Wait for simulation results for longer term strategic type of alternatives:

- **Effect of fleet mix changes on EWR capacity and/or delay.**
- **Schedule or banking changes, such as more uniform distribution of traffic.**
- **Segregation of commuters.**
- **Gate sharing.**
- **Tilt rotor aircraft.**
- **Minimum size aircraft.**

EXHIBIT 2 - SIMULATION SCENARIOS (EWR)

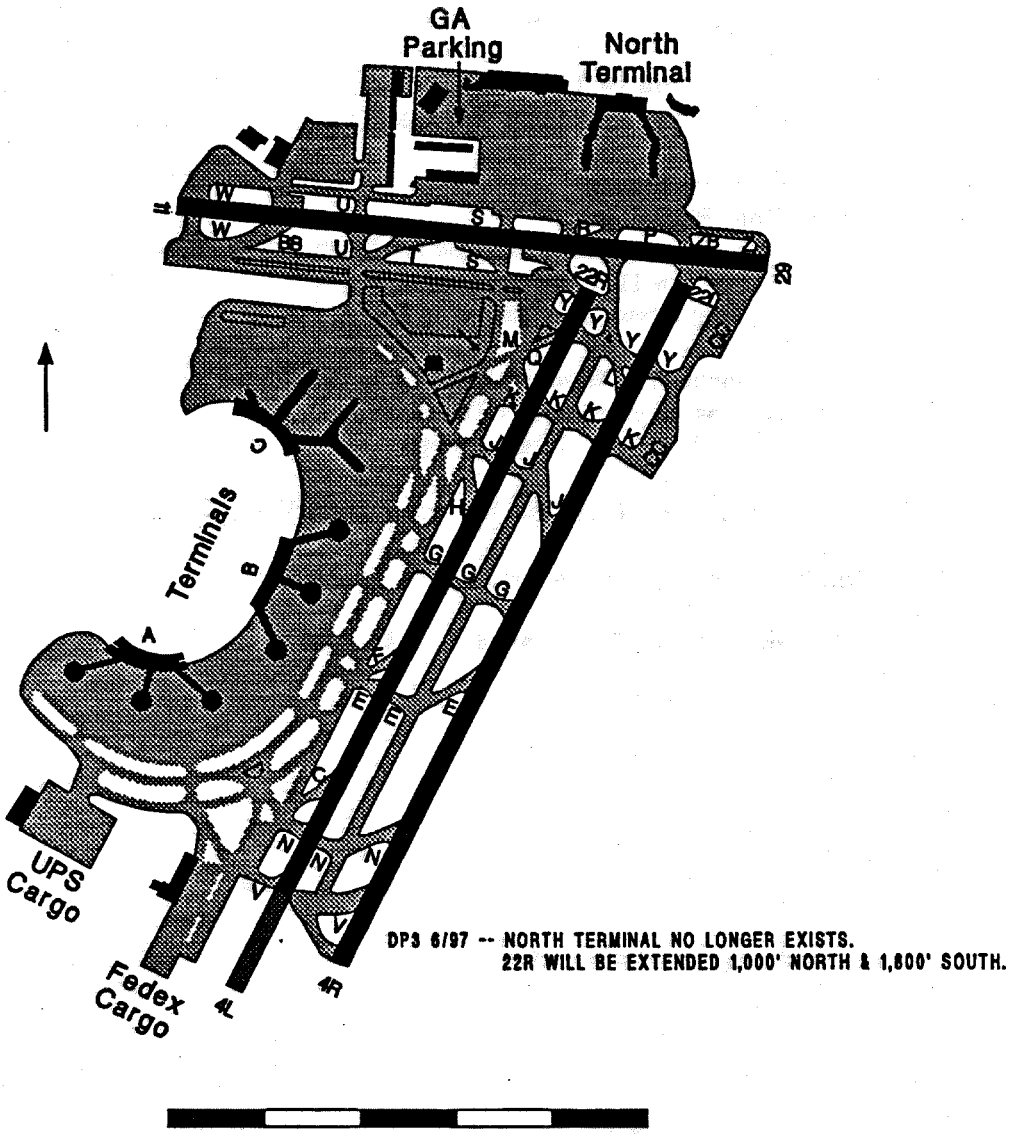
PKG	DESCRIPTION OF PACKAGE	SIMULATE AT THESE DEMAND LEVELS 1996	F1	F2
(0)	**CALIBRATION (with 2.5 NM minimum IFR spacing)**	Y	N	N
(A)	**NEW DO-NOTHING (with DCIA) – BASE-CASE** With Dependent Converging Instrument Approaches expected in 1998.	Y	Y	Y
(B)	**Taxiway System Improvements** Exits, Queuing, Hold Blocks, etc.			
	(B1) Alternate Departure Queuing Scheme for Extended 4L/22R	Y	Y	Y
	(B2) Additional Access to 11/29 across Drainage Ditch	Y	Y	Y
	(B3) Off-Gate Holding Areas in Addition to BALL PARK	Y	Y	Y
(C)	**LDA 24° Offset Approach to Inboard Runway by Non-Heavy Aircraft**			
	(C1) LDA Offset to 4s (does not affect Teterboro ops)	Y	Y	Y
	(C2) LDA Offset to 22s (affects Teterboro ops)	Y	Y	Y
(D)	**Parallel Simultaneous Visual Approaches (using Wake Vortex Technology)**	Y	Y	Y
(E)	**SCIA – Simultaneous Converging Instrument Approaches**	Y	Y	Y
(F)	**Reduce Minimum In-Trail IFR Separation to 2.0 NM** (Between similar class non-heavy aircraft)	Y	Y	Y

Notes: **Y (N) – Do (Do Not) Simulate at this demand level.**

The DCIA could be simulated as part of the New Do-Nothing Case (BASE-CASE) at EWR. Since it will be in place in 1998, does the Design Team want to do this? If so, the DCIA could become the New Do-Nothing Case used to compute the savings of all other improvements?

Similarly, should SCIA be considered part of the New Do-Nothing Case (BASE-CASE) at EWR?

EXHIBIT 3 - AIRPORT DIAGRAM (EWR)



Filename: T:\AIRPORTS\EWR\DP4\ALP-EWR4.GED

2. MODEL INPUTS

Accepted Model Inputs

The following model inputs were accepted by the Design Team at the last meeting. These inputs will be used in the capacity analyses and simulations. They are described in detail in Appendix A.

- Runway occupancy times and exit probabilities for the parallel runways.
- Aircraft separations -- VFR (Visual) and IFR (Radar).
- Approach speeds.
- Length of final common approach.
- Departure runway occupancy times.
- Arrival lateness distribution.
- Annual and daily demand.

Status of EWR Inputs and Tasks

Exhibit 4 describes the status of the EWR inputs and tasks.

Model Inputs

Exhibit 5 shows the runway exit usage and the arrival runway occupancy times (ROTs) for 11/29 by aircraft class.

Exhibit 6 presents EWR Calibration runway configurations.

Exhibit 7 describes Air Traffic Control (ATC) dependencies for parallel runways.

Exhibit 8 presents miscellaneous input data and questions -- LAHSO (Land and Hold Short Operations) and runway dependencies.

Exhibit 9 describes the operational procedures and minima for the various weather categories at EWR.

Exhibit 10 shows the weather categories and runway configurations by flow direction.

Exhibit 11 presents gate service times at EWR.

Exhibit 12 describes the simulated demand characteristics. **In July, the EWR Tower notified the Technical Center that the BA41 was reclassified as a "large" aircraft for ATC purposes. Consequently, the Technical Center revised the fleet mix on July 31 to reflect this change. This fleet mix in this data package has the BA41 classified as a LC (Large Commuter) instead of a MEDIUM (Small Commuter).**

Exhibit 13 shows the EWR airline gate assignments.

Exhibit 14 presents the EWR gate map.

EXHIBIT 4 - STATUS OF EWR INPUTS AND TASKS

INPUTS AND TASKS	STATUS
ALPs, Improvements, Simulation Scenarios	DP4
Aircraft Classifications	X
ATC Separations	X
Dependencies between Parallel Runways	DP4
Other Runway Dependencies	DP4
Operational Procedures and Minima (By Configuration)	DP4
Other Model Inputs	DP4
Annual Demand Levels (1996 and Future Demands)	DP4
Demand Characteristics (1996 and Future Demands)	DP4
1996 Hour Counts	
Future 1 and 2 Hour Counts	
Capacity Analysis (Existing Airport and 1996 Demand)	DP4
Sample of ADSIM Output	
ADSIM (Calibration -- 1996 Demand)	
ADSIM (Do-Nothing -- 1996 Demand)	
ADSIM (Do-Nothing -- Future Demands)	
ADSIM Improvements (1996 Demand)	
ADSIM Improvements (Future Demands	
Fleet Mix Costs	
Annual Delay Costs and Savings	

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

Dpn: Data Package n.

EXHIBIT 5 - RUNWAY EXIT DATA

Exit Utilization (percent) and Runway Occupancy Times (seconds)

Runway 11

	Exit Distance	S 3650'	R 4350'	P 4900'	ZA/ZB 5900'	Z 6600'	TOTAL
(H)	Utilization				60%	40%	100%
	ROT				56	64	59 sec
	Count				E	E	E
(757)	Utilization			30%	70%		100%
	ROT			48	56		54 sec
	Count			E	E		E
(LJ)	Utilization		10%	30%	60%		100%
	ROT		44	48	54		52 sec
	Count		E	E	E		E
(LC)	Utilization		100%				100%
	ROT		44				44 sec
	Count		1				1
(M)	Utilization	100%					100%
	ROT	43					43 sec
	Count	1					1
(S)	Utilization	100 %					100%
	ROT	43					43 sec
	Count	E					E

Runway 29

	Exit Distance	T 3700' hs	U 4550'	BB 5400'	W 6400'	TOTAL	
(H)	Utilization			60%	40%	100%	Revised on 7/15/97
	ROT			52	62	56 sec	
	Count			E	E	E	
(757)	Utilization			60%	40%	100%	
	ROT			52	62	56 sec	
	Count			E	E	E	
(LJ)	Utilization		20%	60%	20%	100%	
	ROT		40	52	60	51 sec	
	Count		E	E	E	E	
(LC)	Utilization	100%				100%	
	ROT	37				37 sec	
	Count	13				13	
(M)	Utilization	100%				100%	
	ROT	39				39 sec	
	Count	4				4	
(S)	Utilization	100%				100%	
	ROT	39				39 sec	
	Count	E				E	

Notes:

Distance in FT. from Threshold. Conditions were VFR and dry.
ROTs in total columns are calculated using weighted averages.

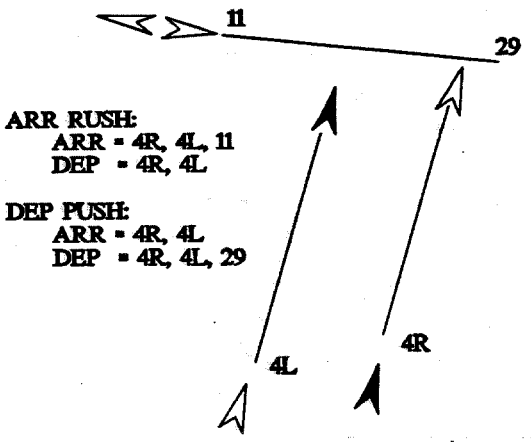
Legend:

hs - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
E - Estimate of Utilizations, ROTs, and Counts are for simulation purposes.

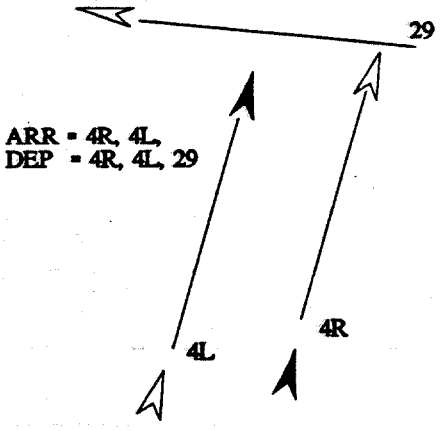
On 7/15/97, the Technical Center modified the values for Runway 29 based on the Tower's comment that most Heavies on Runway 29 take exit BB.

EXHIBIT 6 - RUNWAY CONFIGURATIONS (EWR CALIBRATION)

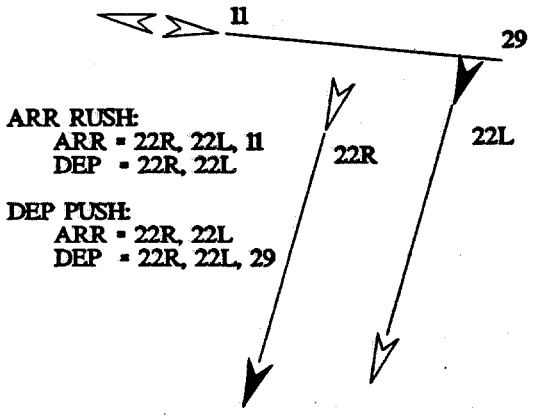
NE – VFR1 & VFR2



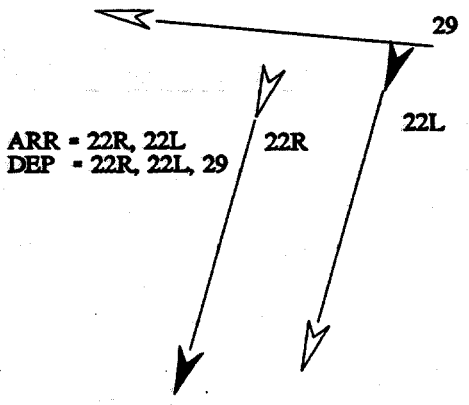
NE – IFR1



SW – VFR1 & VFR2



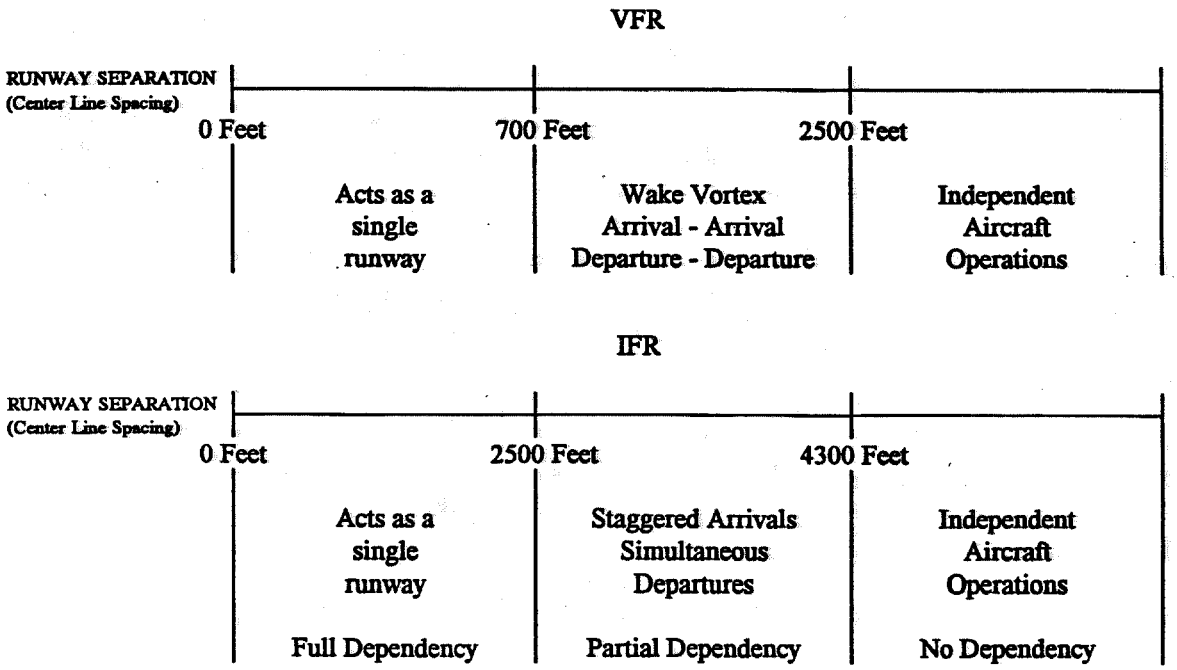
SW – IFR1



◄ = PRIMARY ARR OR DEP RUNWAY

Filename: T:\AIRPORTS\EWR\DP4\CON-EWR4.GED
Modified IFR1 on 7/10/97 -- Departures on 29. No Arrivals on 11.
CONFIG 1 = NE FLOW
CONFIG 2 = SW FLOW

EXHIBIT 7 - ATC DEPENDENCIES FOR PARALLEL RUNWAYS



Source: Based on the "Interpretation of Air Traffic Control Handbook" (7110.65F).

EXHIBIT 8 - MISCELLANEOUS INPUT DATA FOR EWR

LAND and HOLD SHORT OPERATIONS:

At the last meeting, the Design Team reviewed the new LAHSO Order, 7110.114, effective July 17, 1997. According to the order, very few of the LARGE COMMUTER and MEDIUM aircraft at EWR could land on 11 and hold short of 4/22. The Tower estimated only 5% of the LARGE COMMUTER and 10% to 15% of the MEDIUM could do so. Therefore, the team agreed only SMALL arrivals to 11 will be able to land and hold short of 4/22.

On August 20, the Tower corrected the above statement. The numbers referred to the percentages of aircraft, not the percentages of operations. The Tower said approximately 2/3 (two-thirds) of all LARGE COMMUTER arrivals and 12% of all MEDIUM arrivals could land and hold short.

The available landing distance for LAHSO operations on 11 is 4,550'. Aircraft which can land and hold short in that distance are: ATR-42, ATR-72, BA31, and DH7. Those which cannot hold short include: DH8, CL65 (regional jet), BA41, BE02, LR31, LR36, and E120. Regional jets are included in Class LC (LARGE COMMUTER).

The runway dependencies described on the following pages must be corrected to reflect this change.

For the simulations, the Technical Center believes it would be reasonable to make the following assumptions for runway dependencies: all SMALL can hold short, MEDIUM cannot hold short, and all LARGE COMMUTER can hold short. In the SW flow, the arrival delay can be appropriately captured by placing some of the LC arrivals on 22L instead of 11. In the NE flow, the departure delay can be appropriately captured by letting those LC aircraft land on 11; controllers try to expedite the departure or slow the arrival to avoid delaying the departure.

There were 49 arrivals to 11 on Thursday, 8/22/96, with an average of 8 arrivals per hour to 11 when the runway was used which was in the afternoon (between 1pm and 7pm). There were 83 arrivals to 11 on Tuesday, 8/19/97.

Because of the relatively small number of arrivals to 11, and even smaller number of LC which cannot hold short, the Technical Center believes it is reasonable to simulate all LC as holding short on 11 (with some minor adjustments of runway assignments in the SW flow).

VFR D/D SEPARATIONS ON 29:

The Do-Nothing simulations assume aircraft depart 29 from the intersection of Taxiway Romeo.

On August 20, the Tower told the Technical Center that approximately 1 in 10 Small GA departures fly VFR when departing on 29. Therefore, the Tower said the simulations should assume all departures in VFR-1 would use D/D radar separations. There should be a 1.6 minute Prop/Jet separation on 29 as well as on the parallels.

EXHIBIT 8 - MISCELLANEOUS INPUT DATA FOR EWR (Cont.)

DEPENDENCIES for PARALLEL RUNWAYS:

There are A/D and D/A dependencies between the parallel runways because they are closely spaced.

Wake vortex dependencies apply to A/A and D/D operations on EWR's closely spaced parallel runways – 4R/4L, 4L/4R, 22R/22L, and 22L/22R.

WAKE VORTEX DEPENDENCY APPLIES BETWEEN THESE TYPES OF AIRCRAFT

LEAD	*TRAIL—*	HVY	757	LJ	LC	MED	SM
HVY	*(7110.65–Heavy)*	YES	YES	YES	YES	YES	YES
757	*(7110.65–757)*	YES	YES	YES	YES	YES	YES
LJ	*(7110.65–Large)*	—	—	—	—	YES	YES
LC	*(7110.65–Large)*	—	—	—	—	YES	YES
MED	*(7110.65–Small)*	—	—	—	—	—	—
SM	*(7110.65–Small)*	—	—	—	—	—	—

A/A: VFR-1, VFR-2, IFR-1: Full Dependency for the above pairs of aircraft.

D/D: VFR-1, VFR-2, IFR-1: Full Dependency for the above pairs of aircraft.

A/D: VFR-1, VFR-2: N/A.

IFR-1: Landing assured for the above pairs of aircraft.
(12 seconds = 0.2 minutes.)
A departure can roll 12 seconds after the arrival crosses threshold.

D/A: VFR-1, VFR-2: N/A.

IFR-1: Full Dependency for the above pairs of aircraft.

EXHIBIT 8 - MISCELLANEOUS INPUT DATA FOR EWR (Cont.)

OTHER RUNWAY DEPENDENCIES

Dependencies Between 4R (or 4L) & 11 – NE Flow – Calibration

* **Arrival to 11 followed by an Arrival to 4R (or 4L):**
  Arrival to 4R (or 4L) followed by an Arrival to 11:
  VFR-1 & VFR-2: Independent operations.
  IFR-1: N/A because no arrivals to 11 in IFR-1.
  A/A separation: VFR-1 & VFR-2: N/A. IFR1: N/A.

* **Arrival to 11 followed by a Departure on 4R (or 4L):**
  VFR-1 & VFR-2: Only a SMALL can land on 11 and hold short of departure on 4. All other arrivals must stop or exit the runway before a departure on 4 can roll.
  IFR-1: N/A because no arrivals to 11 in IFR-1.
  A/D separation: VFR-1 & VFR-2: 1 minute when arrival is MEDIUM or larger.
  IFR1: N/A.

* **Departure on 4R (or 4L) followed by an Arrival to 11:**
  VFR-1 & VFR-2: A MEDIUM or larger arrival to 11 cannot cross the threshold until a departure on 4 crosses 11/29. If a departure takes 60 to 70 seconds to clear the intersection from the start of roll, the arrival should be 4 NM from threshold when the departure starts to roll. *Only a SMALL can land on 11 and hold short of departure on 4.*
  IFR-1: N/A because no arrivals to 11 in IFR-1.
  D/A separation: VFR-1 & VFR-2: 4 NM when arrival is MEDIUM or larger.
  IFR1: N/A.

* **Departure on 11 followed by a Departure on 4R (or 4L):**
  Departure on 4R (or 4L) followed by a Departure on 11:
  VFR-1 & VFR-2 & IFR-1: N/A because there are no departures on 11.
  D/D separation: N/A.

* **Departure on 11 followed by an Arrival on 4R (or 4L):**
  Arrival on 4R (or 4L) followed by a Departure on 11:
  VFR-1 & VFR-2 & IFR-1: N/A because there are no departures on 11.
  D/A separation: N/A.
  A/D separation: N/A.

EXHIBIT 8 - MISCELLANEOUS INPUT DATA FOR EWR (Cont.)

Dependencies Between 4R (or 4L) & 29 – NE Flow – Calibration

* **Departures on 29 use the intersection at Taxiway R.**
  Therefore, departures on 29 are independent of all arrivals and departures on 4R and 4L.
  Dependencies: N/A.

Dependencies Between 11 & 29 – NE & SW Flows – Calibration

* **Arrival to 11 followed by a Departure 29:**
  VFR-1 & VFR-2: An arrival to 11 must exit the runway before a departure on 29 can start its roll. (Source: Tracon.)
  IFR-1: N/A because no arrivals to 11 in IFR-1.
  A/D separation: VFR-1 & VFR-2: 1 minute. IFR1: N/A.

* **Departure on 29 followed by an Arrival to 11:**
  VFR-1 & VFR-2: When a departure on 29 starts its roll, an arrival to 11 must be 5 NM from threshold. (Source: Tracon.)
  IFR-1: N/A because no arrivals to 11 in IFR-1.
  D/A separation: VFR-1 & VFR-2: 5 NM. IFR1: N/A.

NOTE: **There are no dependencies associated with Arrivals on 29 or Departures on 11 because the Design Team agreed that these operations would not be simulated.**

EXHIBIT 8 - MISCELLANEOUS INPUT DATA FOR EWR (Cont.)

Dependencies Between 22R (or 22L) & 11 – SW Flow – Calibration

* **Arrival to 11 followed by an Arrival to 22R (or 22L):**
  VFR-1 & VFR-2: : A MEDIUM or larger arrival to 11 must exit the runway before an arrival to 22 can cross 11/29. *Only a SMALL can arrive on 11 and hold short of 22 .*
  IFR-1: N/A because no arrivals to 11 in IFR-1.
  A/A separation: **VFR-1 & VFR-2: Independent for SMALL arrival on 11.**
  Full Dependency for MEDIUM or larger arrival on 11.
  IFR1: N/A.

* **Arrival to 22R (or 22L) followed by an Arrival to 11:**
  VFR-1 & VFR-2: When an arrival to 22 clears 11/29, a MEDIUM or larger arrival to 11 can cross the threshold. *Only a SMALL can arrive on 11 and hold short of 22.*
  IFR-1: N/A because no arrivals to 11 in IFR-1.
  A/A separation: **VFR-1 & VFR-2: Independent for SMALL arrival on 11.**
  1 NM for MEDIUM or larger arrival on 11.
  IFR1: N/A.

* **Arrival on 11 followed by a Departure on 22R (or 22L):**
  Departure on 22R (or 22L) followed by an Arrival on 11:
  VFR-1 & VFR-2 & IFR-1: N/A because 11 and 22 do not intersect.
  D/A separation: **N/A.**
  A/D separation: **N/A.**

* **Departure on 11 followed by an Departure on 22R (or 22L):**
  Departure on 22R (or 22L) followed by a Departure on 11:
  VFR-1 & VFR-2 & IFR-1: N/A because there are no departures on 11.
  D/D separation: **N/A.**

* **Departure on 11 followed by an Arrival on 22R (or 22L):**
  Arrival on 22R (or 22L) followed by a Departure on 11:
  VFR-1 & VFR-2 & IFR-1: N/A because there are no departures on 11.
  D/A separation: **N/A.**
  A/D separation: **N/A.**

Dependencies Between 22R (or 22L) & 29 – SW Flow – Calibration

* **Departures on 29 use the intersection at Taxiway R.**
  Therefore departures on 29 are independent of all arrivals and departures on 22R/ 22L.
  Dependencies: **N/A.**

EXHIBIT 9 - WEATHER CATEGORIES AND MINIMA

(Operational Procedures and Minima – EWR CALIBRATION)

(Revised on 8/25/97)

At the June meeting, the Design Team stated CRDA is available but would not be used until 1998.

VFR-1: **77.5 %**
Ceiling ≥ 3,500' *and* Visibility ≥ 5 miles.
Visual (VFR-1) separations for A/A, A/D, and D/A.
D/D on all runways – Radar (IFR1) separations.
LARGE COMMUTERS (and smaller aircraft) depart 29 at Intersection Romeo.
Regional Jets cannot depart at Intersection Romeo. They depart on 4/22.
Simultaneous approaches to 11 and either 4R or 4L.
Simultaneous approaches to 11 and either 22R or 22L.
LARGE COMMUTER – 2/3 (two-thirds) can arrive on 11 and hold short of 4/22.
MEDIUM – 10 % to 15% can arrive on 11 and hold short of 4/22.
For simulation, only SMALL and LC can arrive on 11 and hold short of 4/22.
Class SMALL and LC arrivals on 11 can hold short of departure on 4.
This must be decided by the Design Team.

VFR-2: **14.2 %**
Less than VFR-1, *and*, Ceiling ≥ 1,000' *and* Visibility ≥ 3 miles.
Radar (IFR) separations for A/A & D/D on all runways.
Visual (VFR1) separations for A/D & D/A.
Simultaneous approaches may be permitted to 11 and either 4R or 4L.

IFR-1a: **4.1 %**
Less than VFR-2, *and*, Ceiling ≥ 600' *and* Visibility ≥ 2 miles.
These are the CAT I minima for Runway 11. Currently, there are no arrivals on 11 in IFR-1a.
IFR separations.

IFR-1b: **4.2 %**
Less than IFR-1a.
What percent of the time is EWR *below* IFR-1a (CAT I minima for 11) and *above* CAT I minima for 4/22?
IFR separations.

Note:			
	CAT I ILS:	Runway 11:	Minima are 604' & 2NM.
	CAT I ILS:	Runway 4/22 :	Minima are 200' and 3/8 NM.
	CAT II ILS:	Runway 4:	Minima are 162'/16'.

Source of weather categories, minimums, and percent occurrence: Based on EWR Study, 1995. The percentages were developed by Leigh Fisher Associates (LFA) for the 1995 Study. LFA tabulated the hourly weather data for January 1, 1981, through December 31, 1993, from the National Climatic Data Center, Asheville, North Carolina. The tabulations reflect percent of occurrence during daytime hours, 6am to 11pm.

EXHIBIT 10 - WEATHER CATEGORIES & CONFIGURATIONS (by Flow Direction)

EXISTING DAYTIME RUNWAY USE BY WEATHER CATEGORY (based on 1995 EWR Study)

		VFR-1	VFR-2	IFR-1a	IFR-1b	TOTAL
4, 11, 29	(winds permit LAHSOs on 11)	16.50%	5.80%	2.20%	2.30%	26.80%
4, 11, 29	(winds prevent LAHSOs on 11)	8.40%	0.60%	0.10%	0.00%	9.10%
4, 29	(winds prevent use of 11)	5.30%	0.20%	0.00%	0.00%	5.50%
	NE Flow Subtotal	**30.20%**	**6.60%**	**2.30%**	**2.30%**	**41.40%**
22, 11, 29	(winds permit LAHSOs on 11)	21.30%	4.30%	1.20%	1.30%	28.10%
22, 11, 29	(winds prevent LAHSOs on 11)	15.10%	2.00%	0.40%	0.30%	17.80%
22, 29	(winds prevent use of 11)	8.10%	0.80%	0.10%	0.10%	9.10%
	SW Flow Subtotal	**44.50%**	**7.10%**	**1.70%**	**1.70%**	**55.00%**
4 only or 22 only		1.90%	0.40%	0.10%	0.20%	2.60%
11 only or 29 only		0.90%	0.10%	0.00%	0.00%	1.00%
	TOTAL	**77.50%**	**14.20%**	**4.10%**	**4.20%**	**100.00%**

Notes from 1995 Study:

1. Runway use percentages were based on the following wind component restrictions:

	Max Crosswind	Max Tailwind
4 & 22	20 knots	Calm
11 with LAHSO	15 knots	4 knots
11 & 29 without LAHSO	15 knots	10 knots

2. Use of 11 & 29 restricted to LC/MED/SM aircraft when 4 or 22 were available for use.
3. Daytime hours are 6am to 11pm.
4. Winds prevent use of 29 approximately 1.5% of the year. Because of its small percent of occurrence, this configuration was not modeled explicitly in the 1995 study.

EXHIBIT 10 - WEATHER CATEGORIES & CONFIGURATIONS (Cont.)

TECHNICAL CENTER RECOMMENDATIONS FOR SIMULATIONS – BEFORE NORMALIZATION

Notes: VFR-1 combined the use of 11, with & without LAHSO.
VFR-2, IFR-1a, IFR-1b assume winds always permit use of 11.
Capture VFR-1 without 11 (13.4% per year).
Assume LAHSO permitted when 11 is used.
Capture critical delays and delay savings, while reducing unnecessary simulations.

		VFR-1	VFR-2	IFR-1a	IFR-1b	TOTAL
4, 11, 29	winds ***permit*** use of 11	24.90%	6.60%	2.30%	2.30%	36.10%
4, 29	winds ***prevent*** use of 11	5.30%	—	—	—	5.30%
	NE Flow Subtotal	**30.20%**	**6.60%**	**2.30%**	**2.30%**	**41.40%**
22, 11, 29	winds ***permit*** use of 11	36.40%	7.10%	1.70%	1.70%	46.90%
22, 29	winds ***prevent*** use of 11	8.10%	—	—	—	8.10%
	SW Flow Subtotal	**44.50%**	**7.10%**	**1.70%**	**1.70%**	**55.00%**
	TOTAL	**74.70%**	**13.70%**	**4.00%**	**4.00%**	**96.40%**

TECHNICAL CENTER RECOMMENDATIONS FOR SIMULATIONS – AFTER NORMALIZATION

Notes: The percentages in the above chart were normalized so they sum to 100%.
VFR-2, IFR-1a, IFR-1b assume winds always permit use of 11.
Capture VFR-1 without 11 (13.9% per year – normalized).
Assume LAHSO permitted when 11 is used.
Capture critical delays and delay savings, while reducing unnecessary simulations.

		VFR-1	VFR-2	IFR-1a	IFR-1b	TOTAL
4, 11, 29	winds ***permit*** use of 11	25.83%	6.85%	2.39%	2.39%	37.45%
4, 29	winds ***prevent*** use of 11	5.50%	—	—	—	5.50%
	NE Flow Subtotal	**31.33%**	**6.85%**	**2.39%**	**2.39%**	**42.95%**
22, 11, 29	winds ***permit*** use of 11	37.76%	7.37%	1.76%	1.76%	48.65%
22, 29	winds ***prevent*** use of 11	8.40%	—	—	—	8.40%
	SW Flow Subtotal	**46.16%**	**7.37%**	**1.76%**	**1.76%**	**57.05%**
	TOTAL	**77.49%**	**14.21%**	**4.15%**	**4.15%**	**100.00%**

EXHIBIT 11 - EWR AIRCRAFT GATE SERVICE TIMES

(Minimum Turn-Around Times in Minutes)

(Revised 8/20/97)

The gate service times (minimum turn-around times) represent the minimum time it takes to service an aircraft – from the time it arrives at the gate until pushback.

To simulate more realistic conditions, the departure time of a continuing arrival is adjusted to assure the aircraft meets its minimum turn-around time. If an aircraft arrives on time, its departure time is not adjusted.

Newark has many International flights which require lengthy turn-around times. Over half of the Heavy aircraft have minimum turn-around times which are at least 2 hours (120 minutes).

For Small aircraft (small twin and single engine props), the minimum turn-around time is for Small cargo operations.

H (All Heavies)		757		LJ		LC		M		S	
Cumulative		Cumulative		Cumulative		Cumulative		Cumulative		Cumulative	
Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.	Time	Prob.
45	0.19	45	0.22	30	0.31	20	0.16	15	0.29	45	1.00
50	0.25	50	0.87	35	0.88	30 *	1.00	20	0.41		
60	0.45	60 *	1.00	40	0.91			30	1.00		
90	0.55			45 *	1.00						
100	0.58										
120	0.73										
140	0.76										
150	1.00										

H (All Heavies) -- Updated 8/19/97.

* Note:

Five percent (5%) of 757s are International flights which have minimum turn-around times of 150 minutes. Two percent (2%) of Large Jets are International flights which have minimum turn-around times of 90 minutes. Four percent (4%) of Large Commuters are Air Canada flights which have minimum turn-around times of 55 minutes. These times may be used when simulating International operations.

Source: Provided by the Airlines Serving EWR in March 1997.

H – DOMESTIC		H – Int'l (Change Terminals)		H – Other Int'l (Terminal B)	
Cumulative		Cumulative		Cumulative	
Time	Prob.	Time	Prob.	Time	Prob.
45	0.55	120	0.19	60	0.33
50	0.73	140	0.28	90	0.61
60	1.00	150	1.00	100	0.71
				120	1.00

GATE SERVICE TIMES FOR HEAVIES

(used by ADSIM)

Source: Updated 8/20/97
H – Domestic: Domestic Airlines
H – Int'l: CO & Alitalia
H – Other Int'l: Other International Flights

EXHIBIT 12 - SIMULATED DEMAND CHARACTERISTICS

ANNUAL & DAILY DEMAND

DEMAND LEVEL	ANNUAL OPERATIONS	DAILY OPERATIONS	EQUIVALENT DAYS
1996	454,000	1,452	313
FUTURE 1	500,000	1,597	313
FUTURE 2	550,000	1,757	313

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

EWR DEMAND CHARACTERISTICS

Annual Distribution of Traffic

DEMAND	AIR CARRIER		COMMUTER/AIR TAXI		GA & MILITARY		TOTAL	
1996	323,000	71.1%	111,000	24.4%	20,000	4.4%	454,000	100.0%
FUTURE 1	350,000	70.0%	130,000	26.0%	20,000	4.0%	500,000	100.0%
FUTURE 2	379,000	68.9%	151,000	27.5%	20,000	3.6%	550,000	100.0%

NOTES: **1996 distribution was based on the 1996 CATER data & Port's statistics.**
Commuter & GA/MI counts were changed so that Air Taxis are included with Commuters.
FAA Technical Center developed the FUTURE 1 & FUTURE2 distributions based on the following growth assumptions of the Port's forecasts for EWR:

* The number of GA & MI annual operations would remain constant.
* 41.7% of the increase in annual operations would be Commuters/Air Taxis.
* 58.3% of the increase in annual operations would be Air Carriers.
* 1996 would have 421,000 Air Carrier/Commuter/Air Taxi annual operations.
* FUTURE 1 would have 467,000 Air Carrier/Commuter/Air Taxi annual operations.
* FUTURE 2 would have 517,000 Air Carrier/Commuter/Air Taxi annual operations.

Daily Distribution of Traffic

AIR CARRIER & COMMUTER/AIR TAXI		GA & MILITARY		TOTAL	
1,388	95.6%	64	4.4%	1,452	100.0%
1,533	96.0%	64	4.0%	1,597	100.0%
1,693	96.4%	64	3.6%	1,757	100.0%

EXHIBIT 12 - SIMULATED DEMAND CHARACTERISTICS (Cont.)

Overall – Daily Fleet Mix By Class **7/31/97-- Revised all mixes (BA41 is now a LC)**

H		757		LJ		LC		M		S		Total		
124	8.5%	118	8.1%	772	53.2%	304	20.9%	114	7.9%	20	1.4%	1,452	100.0%	Baseline
254	15.9%	284	17.8%	584	36.6%	336	21.0%	119	7.5%	20	1.3%	1,597	100.0%	Future 1
282	16.1%	314	17.9%	644	36.7%	370	21.1%	127	7.2%	20	1.1%	1,757	100.0%	Future 2

Air Carrier/Commuter/Air Taxi – Daily Fleet Mix By Class **7/31/97-- Revised all mixes (BA41 is now a LC)**

H		757		LJ		LC		M		S		Total		
124	8.9%	118	8.5%	768	55.3%	294	21.2%	80	5.8%	4	.3%	1,388	100.0%	Baseline
254	16.6%	284	18.5%	580	37.8%	326	21.3%	85	5.5%	4	.3%	1,533	100.0%	Future 1
282	16.7%	314	18.5%	640	37.8%	360	21.3%	93	5.5%	4	.2%	1,693	100.0%	Future 2

GA & Military – Daily Fleet Mix By Class

H		757		LJ		LC		M		S		Total		
0	.0%	0	.0%	4	6.3%	10	15.6%	34	53.1%	16	25.0%	64	100.0%	Baseline
0	.0%	0	.0%	4	6.3%	10	15.6%	34	53.1%	16	25.0%	64	100.0%	Future 1
0	.0%	0	.0%	4	6.3%	10	15.6%	34	53.1%	16	25.0%	64	100.0%	Future 2

NOTES: **7/31/97 – Fleet Mixes were revised at all demands; BA41 was reclassified as a Large--an LC in EWR study.**

Baseline Demand Characteristics developed from CATER data.

Overall fleet mix – from Cater data, Calendar Year 1996.

GA/MI fleet mix – from Cater data, 8/22/96 – assumed daily mix similar to annual mix.

AC/Commuter/AT fleet mix – computed from the other Baseline fleet mixes.

Future 1 Demand Characteristics developed as follows: – Revised 7/7/97

GA/MI fleet mix – same as GA/MI fleet mix in Baseline Demand.

AC/Commuter/AT fleet mix – estimated from forecast data provided by the Port.

Overall fleet mix – computed from the other Future 1 fleet mixes.

Future 2 Demand Characteristics developed as follows: – Revised 7/7/97

GA/MI fleet mix – same as GA/MI fleet mix in Baseline Demand.

AC/Commuter/AT fleet mix – same as Future 1 AC/Commuter/AT fleet mix.

Overall fleet mix – computed from the other Future 2 fleet mixes.

EXHIBIT 12 - SIMULATED DEMAND CHARACTERISTICS (Cont.)

There are several issues which the EWR Design Team must resolve for future demand levels.

Based on the fleet mixes described on the previous page, the following changes will occur from the 1996 demand to the Future 1 demand:

- The number of Large Jets (LJ) decreases by 188 operations.
- The number of 757s increases by 166 operations.
- The number of Heavies increase by 130 operations.

How will those changes be made in the schedule?

Will 166 of the Large Jets become 757s? If so, what airlines will be affected?

How many international flights will there be at Future 1 and Future 2? There were 46 International operations in the OAG for August 22, 1996.

How will those new International flights be distributed among the International carriers?

How many of those new International flights will arrive in Terminal B and depart from Terminal C, at the Future 1 and 2 demands?

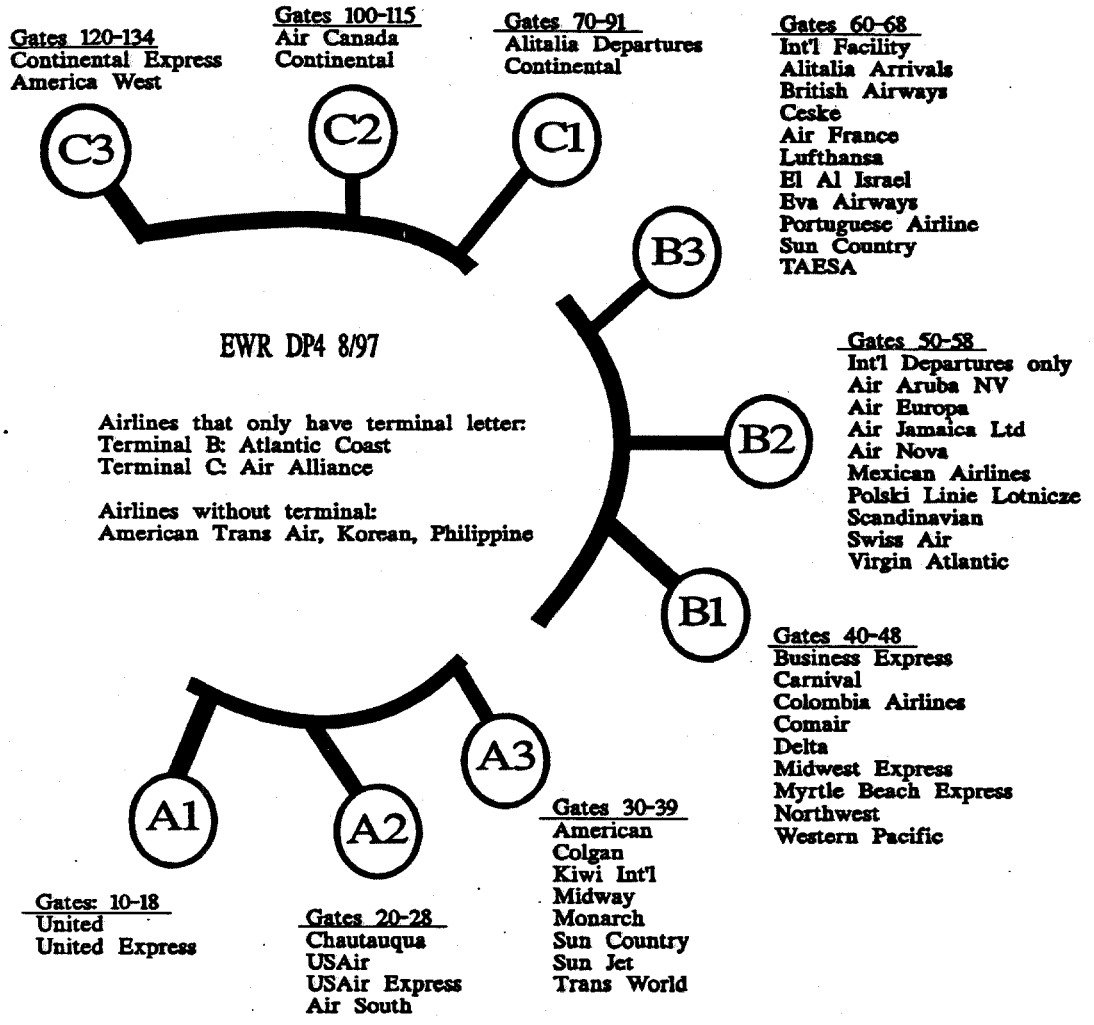
How many of those new International flights will arrive in Terminal A and depart from Terminal C, at the Future 1 and 2 demands?

EXHIBIT 13 - EWR AIRLINE GATE ASSIGNMENTS

AIRLINE(S)	OAG CODE	FAA CODE	TERMINAL/GATES
Air Alliance		AAQ	C2: C100-C115
AirBC	ZX	ABL	?
Air Canada	AC	ACA	C2: C100-C115
Air Canada Commuters	AC	ACA	C2: C100-C115
Air Nova	QK	ARN	C2: C100-C115
Alitalia	AZ	AZA	B3 & C1: B60-B68, C70*-C79
American	AA	AAL	A3: A30-A35
America West	HP	AWE	C3: C120 ?
America West Commuters	HP	AWE	C3: C120
Business Express		GAA	B1: B43-B48
Carnival	KW	CAA	B1: B40-B42
Chautauqua		CHQ	A2: A25-A26
Colgan Air	9X	CJC	A3: A36-A39
Comair		COM	B1: B43-B48
Continental	CO	COA	C1: C70*-C115
Continental Express	CO	BTA	C2: C120-C134
Delta	DL	DAL	B1: B43-B48
International Departures only			B:2 B51-B57 (Int'l)
International Facility			B3: B60-B68 (Int'l)
Jet Express	JI	YPX	?
Jet Train Corporation	LF	JTN	?
Kiwi International	KP	KIA	A3: A30-A35
Midway		MDW	A3: A30-A35
Midwest Air Express	YX	MEP	B1: B40-B42
Monarch		MON	A3: A36-A39
Myrtle Beach			B1: B40-B42
Northwest	NW	NWA	B1: B40-B42
Trans World Airlines	TW	TWA	A3: A36-A39
Scandinavian Airlines	SK	SAS	?
Sun Country (Charter)	SY	SCX	A3: A36-A39
Sun Jet		SJI	A3: A36-A39
SwissAir	SR	SWR	B1 & B2: B43-B48, B51-57
United	UA	UAL	A1: A10-A18
United Express (Atlantic Coast)	UA	UAL	A1: A10-A18
US Airways	US	USA	A2: A20-A24, A27-A28
USAir Express (Allegheny, Commutair, Henson)	US	USA	A2: A25-A26
Western Pacific		KMR	B1: B43-B48

Notes: **Updated 8/25/97. The Design Team will provide additions and corrections.**
* Gate C70 is not operational.
The International Facility is located in Terminal B. Not all International Carriers are shown.
Cargo operators: EB (Emery), ER (DHL), FX, 1A, 1F (Airborne), 1V, 5X (UPS), 8W.

EXHIBIT 14 - EWR GATE MAP



3. NEWARK CAPACITY ANALYSIS

The FAA Technical Center uses a form of the RDSIM simulation model to compute numbers reflective of airport capacity. In this model, the airport is presented with a one-hour schedule of uniformly distributed operations at ever increasing levels of demand. The proportion of arrivals and departures in this schedule can be specified to simulate different percentages of arrival and departure demand.

The model then computes the *flow rate* as the number of operations serviced during a one-hour period and the average *within hour delay* incurred by those aircraft.

The Technical Center performed a capacity analysis, while maintaining the airport's fleet mix. Capacities were computed for a 50-50 demand split, 50% arrivals and 50% departures, with balanced flow rates. An arrival priority was used as long as a 50-50 flow rate was maintained. If the arrival priority reduced the departure flow rate, the model inserted a departure between two arrivals in order to achieve a balanced flow.

The critical inputs to the capacity analysis were: fleet mix, runway usage, aircraft separations, runway dependencies, lengths of common approach, approach speeds, exit probabilities, and runway occupancy times.

Capacities are shown for balanced flow rates, and unbalanced flow rates when applicable. Unbalanced flow rates represent excess arrival or departure capacity.

Exhibit 14 describes the capacity runway use distributions, as well as the 1996 fleet mix. The exhibit shows the distribution of each aircraft class to each runway, for each configuration and weather condition.

Exhibit 15 presents capacity curves (flow rates versus average delay per operation) for Newark *for the parallel runways*. The capacity curves were developed for the existing airport using the 1996 fleet mix.

The curves show the 4-minute average arrival/departure delay capacities and the maximum throughput capacities. Maximum throughput capacities are theoretical because they are usually associated with very high delays. The 4-minute average arrival/departure delay capacity was considered by other Design Teams to be a more practical capacity.

The Technical Center will also do a capacity analysis of the parallels and 11/29. Which type of analysis is more meaningful to the Design Team?

- **parallels with arrivals on 11, and, parallels with departures on 29.**
- **parallels with arrivals on 11 and departures on 29.**

EXHIBIT 15 - CAPACITY RUNWAY USE DISTRIBUTIONS -- EWR

50/50 -- PARALLELS without 11/29

NE FLOW	VFR-1; VFR-2; IFR-1	ARR = 4R	DEP = 4L
SW FLOW	VFR-1; VFR-2; IFR-1	ARR = 22L	DEP = 22R

	RWY	ARRIVALS (by class)						DEPARTURES (by class)						
		HVY	757	LJ	LC	M	S	HVY	757	LJ	LC	M	S	
100%	4R (or 22L)	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
0%	4L (or 22R)	0%	0%	0%	0%	0%	0%	100%	100%	100%	100%	100%	100%	100%

50/50 -- PARALLELS with Arrivals on 11 (WX permitting)

NE FLOW	VFR-1; VFR-2	ARR = 4R, 11	DEP = 4L
	IFR-1	ARR = 4R	DEP = 4L
SW FLOW	VFR-1; VFR-2	ARR = 22L, 11	DEP = 22R
	IFR-1	ARR = 22L	DEP = 22R

VFR	RWY	ARRIVALS (by class)						DEPARTURES (by class)						
		HVY	757	LJ	LC	M	S	HVY	757	LJ	LC	M	S	
70%	4R (or 22L)	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0%	4L (or 22R)	0%	0%	0%	0%	0%	0%	100%	100%	100%	100%	100%	100%	100%
30%	11	0%	0%	0%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%

Note: 30% of EWR's fleet consists of LC, M, and S -- they are capable landing on 11. Therefore, the capacity analysis assumes 30% land on 11.

IFR **SAME RUNWAY USAGE as 50/50 -- with parallels only**

50/50 -- PARALLELS with Departures on 29 (N90 approval)

NE FLOW	VFR-1; VFR-2; IFR-1	ARR = 4R	DEP = 4L, 29
SW FLOW	VFR-1; VFR-2; IFR-1	ARR = 22L	DEP = 22R, 29

	RWY	ARRIVALS (by class)						DEPARTURES (by class)						
		HVY	757	LJ	LC	M	S	HVY	757	LJ	LC	M	S	
100%	4R (or 22L)	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
0%	4L (or 22R)	0%	0%	0%	0%	0%	0%	100%	100%	100%	0%	0%	0%	70%
0%	29	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	100%	100%	30%

Note: 30% of EWR's fleet consists of LC, M, and S -- they are capable of departing on 29 at the intersection of Taxiway Romeo. Therefore, the capacity analysis assumes 30% depart on 29.

EWR Fleet Mix (1996) simulated in capacity analysis:

HVY & 757 & LJ:	70%	(9% + 8% + 53%, respectively)
LC & M & S:	30%	(21% + 8% + 1%, respectively)

EXHIBIT 15 - CAPACITY RUNWAY USE DISTRIBUTIONS -- EWR (Cont.)

The Technical Center performed a 50/50 capacity analysis of the parallels, without 11/29, as shown on the previous page. In addition, the Technical Center will perform a capacity analysis of the parallels, with 11/29. Which type of analysis would be more meaningful, the method shown on the previous page or the method shown below?

50/50 -- PARALLELS with Arrivals on 11 and Departures on 29 (WX permitting and N90 approval)

NE FLOW	VFR-1; VFR-2	ARR = 4R, 11	DEP = 4L, 29
	IFR-1	ARR = 4R	DEP = 4L, 29
SW FLOW	VFR-1; VFR-2	ARR = 22L, 11	DEP = 22R, 29
	IFR-1	ARR = 22L	DEP = 22R, 29

VFR	RWY	ARRIVALS (by class)						DEPARTURES (by class)						
		HVY	757	LJ	LC	M	S	HVY	757	LJ	LC	M	S	
70%	4R (or 22L)	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0%	4L (or 22R)	0%	0%	0%	0%	0%	0%	100%	100%	100%	0%	0%	0%	70%
30%	11	0%	0%	0%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
0%	29	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	100%	100%	30%

Note: 30% of EWR's fleet consists of LC, M, and S -- they are capable of arriving on 11 and departing on 29 at the intersection of Taxiway Romeo. Therefore, the capacity analysis assumes 30% arrive on 11 and 30% depart on 29.

EWR TOWER -- Almost 21% of the EWR fleet is LARGE COMMUTER (Large Commuters and Regional Jets). Because LC are treated like LARGE aircraft, should we simulate the VFR operation (described above) as:

* **100% LC land on 11 (and 0% LC land on the parallel) --results in approximately 30% of all arrivals landing on 11.**

OR

* **50% LC land on 11 (and 50% LC land on the parallel) --results in approximately 20% of all arrivals landing on 11.**

OR

* **0% LC land on 11 (and 100% LC land on the parallel) --results in approximately 10% of all arrivals landing on 11.**

Similar questions must be addressed for MEDIUM (Small Commuters and Business Jets) arriving on 11. In addition, similar questions must be answered for LC and MEDIUM departures on 29.

The percentages of LC (Large Commuters and Regional Jets) and MEDIUM (Small Commuters and Business Jets) should reflect what one might expect in an hour, not in 24 hours.

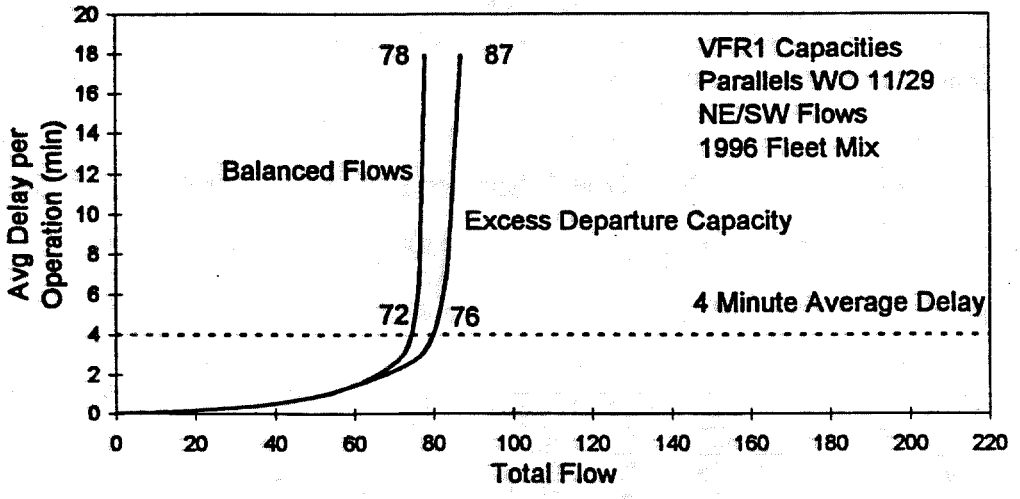
The capacity analysis should reflect the

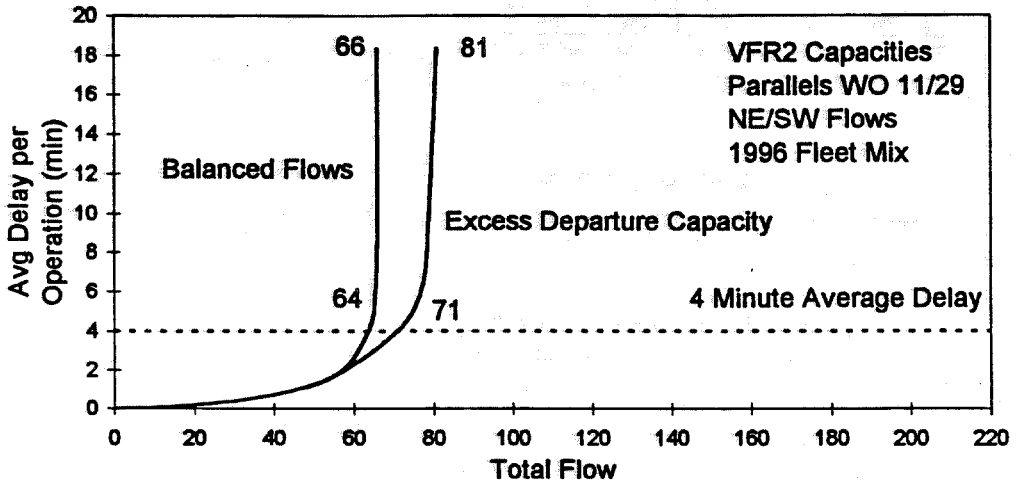
IFR	RWY	ARRIVALS (by class)						DEPARTURES (by class)						
		HVY	757	LJ	LC	M	S	HVY	757	LJ	LC	M	S	
70%	4R (or 22L)	100%	100%	100%	100%	100%	100%	0%	0%	0%	0%	0%	0%	0%
0%	4L (or 22R)	0%	0%	0%	0%	0%	0%	100%	100%	100%	0%	0%	0%	70%
0%	11	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
0%	29	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	100%	100%	30%

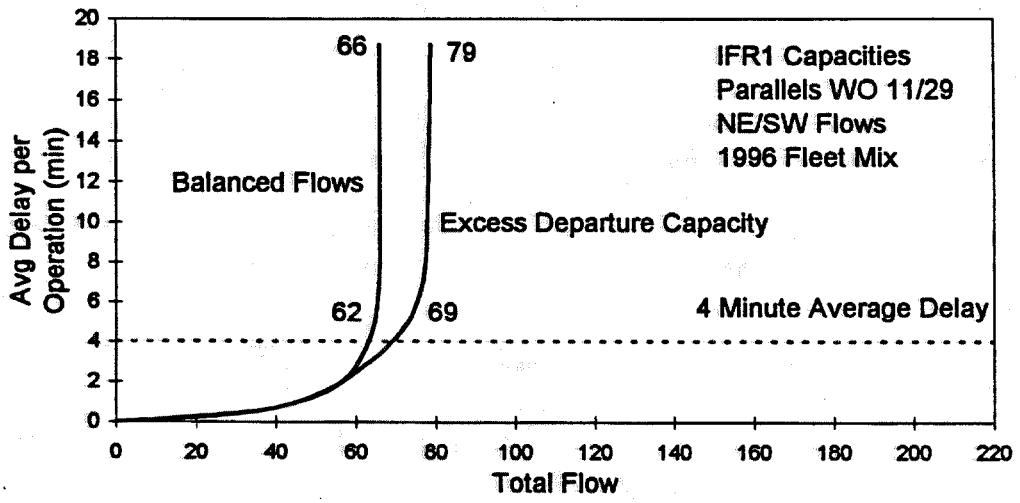
Note: 30% of EWR's fleet consists of LC, M, and S -- they are capable of departing on 29 at the intersection of Taxiway Romeo. Therefore, the capacity analysis assumes 30% depart on 29.

EXHIBIT 16 - PRELIMINARY CAPACITY ANALYSIS – EWR

(EWR Existing Airport – Current Fleet Mix – 50/50 Split – Parallels WO 11/29)







4. DESIGN TEAM SCHEDULE

Exhibit 17 lists the meetings concerning the completion of significant tasks, outputs, and target dates of the EWR 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 17 - DESIGN TEAM SCHEDULE

Date	Event	Objective	Task	Responsibility	Output
11/18/96	1.	Kick Off Meeting. Review Design Team Purpose. Identify Objectives & Potential Improvements.	Review Technical Plan, & 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.
12/9/96 thru 12/13/96	2.	Perform Data Collection.	On-Site Data Collection.	Tech Center.	Establish Parameters for Analysis.
1/14 /97	3.	Determine Scope of Study, Select Model. Review Results of Data Collection.	Review Results. Review Data Package 1.	Entire Design Team.	Agree on Inputs & Direction.
4/10/97	4.	Review Results of Data Collection, Model Inputs, & Potential Improvements.	Review Data Package 2.	Entire Design Team.	Agree on Inputs & Direction.
6/18/97	5.	Review Model Inputs & Potential Improvements.	Review Data Package 3 .	Entire Design Team.	Agree on Inputs & Direction.
8/28/97	5.	Review Inputs, Improvements, & Capacity Analysis.	Review Data Package 4 .	Entire Design Team.	Agree on Inputs, Direction, & Results.
/ /	6.	□ □ □			
/ /98	?.	Complete & Publish Final Report.	Publish & Distribute Final Report.	FAA HQ.	Final Report.

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

APPENDIX A

ACCEPTED MODEL INPUTS

AIRCRAFT CLASSIFICATIONS

Accepted by EWR Team on 4/10/97.
BA41 reclassified as LC – Revised on 7/31/97.

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.** Large jet aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., DC9, B737, B727, MD80).
LC	**= LARGE COMMUTER**	**Large Commuters. Includes Small Regional Jets.** Large commuter aircraft weighing more than 41,000 pounds and up to 255,000 pounds (e.g., ATR-42*, DH8, DH7, CRJ, BA41*, SF34*).
M	**= MEDIUM**	**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, BE90, C340, C441, AC21, BE20, C172, C210, DO27).

Notes:

Aircraft Classifications were agreed upon by Design Team at 4/10/97 meeting. They agreed to include Small Regional Jets in Class LC. At the Design Team's request, the Technical Center modified the list of aircraft types in Class LJ to include reflect the types of aircraft operating at EWR. For wake turbulence application, FAA Handbook 7110.65 considers LJ & LC as "large" and M & S as "small".

These aircraft classes will enable us to define the model inputs more accurately and more clearly by distinguishing the key differences in operational characteristics. Class names, rather than class numbers, will be used in the data packages. The following describes the new class names which will be used in the study and the class numbers used in previous documents.

HEAVY:	(old Class 1 in Data Pkg. 1)
757:	(old Class 2 in Data Pkg. 1)
LARGE JET:	(old Class 3 in Data Pkg. 1)
LARGE COMMUTER:	(old Class 3 in Data Pkg. 1)
MEDIUM:	(old Class 4 in Data Pkg. 1)
SMALL:	(old Class 5 & 6 in Data Pkg. 1)

The critical factor in determining aircraft class should be approach speeds and how arrivals are separated at the point of closest approach (at threshold, except for a "small" following a "heavy").

*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 LARGE COMMUTER in this study. **July 1997, the Tower told the Technical Center to reclassify the BA41 as LC for this study.**

Weights refer to maximum certified takeoff weights.

RUNWAY EXIT DATA – 4R and 4L **Accepted by EWR Team on 6/28/97.**

Exit Utilization (percent) and Runway Occupancy Times (seconds)

Runway 4R

	Exit Distance	G 3600'	J 4400' hs	K 5900'	L 6450' hs	Y 6750'	TOTAL
(H)	Utilization			42%	50%	8%	100%
	ROT			59	56	74	59 sec
	Count			5	6	1	12
(757)	Utilization		9%	56%	35%		100%
	ROT		34	60	56		56 sec
	Count		2	13	8		23
(LJ)	Utilization		17%	51%	31%	1%	100%
	ROT		33	54	52	71	50 sec
	Count		14	43	26	1	84
(LC)	Utilization	6%	69%		25%		100%
	ROT	36	35		56		40 sec
	Count	1	11		4		16
(M)	Utilization	7%	73%		20%		100%
	ROT	33	39		56		40 sec
	Count	1	11		3		15
(S)	Utilization	7%	93%				100 %
	ROT	36	40				40
	Count	E	E				E

Runway 4L

	Exit Distance	G 3600'	H 4500' hs	J 5150'	K 5950'	O 5950' hs	M 6750' rhs	Y 6750'	W 7400'	TOTAL
(H)	Utilization					90%		10%		100%
	ROT					48		74		51 sec
	Count					E		E		E
(757)	Utilization		10%	20%		70%				100%
	ROT		35	50		48				47 sec
	Count		E	E		E				E
(LJ)	Utilization		25%	50%		25%				100%
	ROT		35	50		50				46 sec
	Count		1	3		E				E
(LC)	Utilization	6%	70%	24%						100%
	ROT	36	36	52						40 sec
	Count	E	1	E						E
(M)	Utilization	20%	65%	15%						100%
	ROT	36	39	52						40 sec
	Count	E	E	E						E
(S)	Utilization	50%	50%							100%
	ROT	36	40							38 sec
	Count	E	E							E

Notes:

Distance in FT. from Threshold. Conditions were VFR and dry.
ROTs in total columns are calculated using weighted averages.

Legend:

hs - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
E - Estimate of Utilizations, ROTs, and Counts are for simulation purposes.

Estimated values for 4R/4L were generated by the FAA Technical Center and modified by the EWR Tower on 5/29/97.

RUNWAY EXIT DATA – 22R and 22L **Accepted by EWR Team on 6/28/97.**

Exit Utilization (percent) and Runway Occupancy Times (seconds)

Runway 22R

	Exit Distance	G 3400'	F 4600' hs	E 5000'	C 6350' hs	N 6950'	V 7700'	TOTAL
(H)	Utilization				90%	10%		100%
	ROT				50	74		52 sec
	Count				E	E		E
(757)	Utilization		10%		90%			100%
	ROT		42		48			47
	Count		E		E			E
(LJ)	Utilization	10%	20%		70%			100%
	ROT	36	40		49			46 sec
	Count	1	2		7			10
(LC)	Utilization		50%		50%			100%
	ROT		40		49			45 sec
	Count		E		E			E
(M)	Utilization		80%		20%			100%
	ROT		40		49			42 sec
	Count		E		E			E
(S)	Utilization		100%					100%
	ROT		38					38 sec
	Count		E					E

Runway 22L

	Exit Distance	G 3400'	E 4200' hs	N 6100' hs	V 7300' hs	TOTAL
(H)	Utilization			87%	13%	100%
	ROT			49	56	50 sec
	Count			13	2	15
(757)	Utilization		10%	90%		100%
	ROT		42	47		47 sec
	Count		3	28		31
(LJ)	Utilization		12%	85%	3%	100%
	ROT		34	44	53	43 sec
	Count		22	159	6	187
(LC)	Utilization	24%	56%	20%		100%
	ROT	36	32	45		36 sec
	Count	10	23	8		41
(M)	Utilization	2%	46%	52%		100%
	ROT	36	33	47		40 sec
	Count	1	20	23		44
(S)	Utilization		100%			100%
	ROT		35			35 sec
	Count		1			1

Notes:

Distance in FT. from Threshold. Conditions were VFR and dry.
ROTs in total columns are calculated using weighted averages.

Legend:

hs - High Speed Exit (angled exit)
rhs - Reverse High Speed Exit (reverse angled exit)
E - Estimate of Utilizations, ROTs, and Counts are for simulation purposes.

Estimated values for 22R/22L were generated by the FAA Technical Center and modified by the EWR Tower on 5/29/97.

EWR VFR (VISUAL) SEPARATIONS **Accepted by EWR Team on 6/28/97.**

All runways use radar D/D/ separations – Revised on 8/20/97.

(In-trail Separations on Same Runway)

A/A (NM)*	*LEAD ARR*	*TRAIL ARR*—	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65–Heavy)*	3.99	4.88	5.06	5.06	5.99	6.42	
	757	*(7110.65–757)*	3.99	4.24	4.24	4.24	4.36	4.32	
	LJ	*(7110.65–Large)*	3.18	3.08	3.19	3.19	4.36	4.32	
	LC	*(7110.65–Large)*	3.18	3.08	3.19	3.19	4.36	4.32	
	MED	*(7110.65–Small)*	3.18	3.08	3.19	3.19	3.19	3.38	
	SM	*(7110.65–Small)*	3.18	3.08	3.19	3.19	3.19	3.38	

D/D (MIN)	*LEAD DEP*	*TRAIL DEP*—	HVY	757	LJ	LC	MED	SM	for 11/29
	HVY	*(7110.65–Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00	
	757	*(7110.65–757)*	1.50	1.50	1.50	1.50	1.50	1.50	1.5 using radar
	LJ	*(7110.65–Large)*	1.00	1.00	1.00	1.00	1.00	0.83	
	LC	*(7110.65–Large)*	1.00	1.00	1.00	1.00	1.00	0.83	
	MED	*(7110.65–Small)*	1.00	1.00	1.00	1.00	1.00	0.58	
	SM	*(7110.65–Small)*	0.83	0.75	0.75	0.75	0.75	0.58	

Departures on all runways use Radar separations – Revised 8/20/97.

D/A (NM)	*LEAD DEP*	*TRAIL ARR*—	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65–Heavy)*	1.57	1.46	1.52	1.52	1.52	1.52	
	757	*(7110.65–757)*	1.57	1.46	1.52	1.52	1.52	1.52	
	LJ	*(7110.65–Large)*	1.57	1.46	1.52	1.52	1.52	1.52	
	LC	*(7110.65–Large)*	1.57	1.46	1.52	1.52	1.52	1.52	
	MED	*(7110.65–Small)*	1.57	1.46	1.52	1.52	1.52	1.52	
	SM	*(7110.65–Small)*	1.37	1.28	1.32	1.32	1.32	1.32	

A/D (Min.) separations are the Runway Occupancy Times (ROTs) from Observed Field Data of December 1996.

*Values include missed approach buffer, which is approximately 1 NM.

The A/A and D/A separations are based on the EWR approach speeds 145, 135, 140, 140, 140, 140. The D/D separations are based on departure occupancy times. D/A separations are based on departure occupancy times and arrival approach speeds. Therefore, Medium (Small Commuters) have the same separations as LC (Large Commuters). The A/A separations for Medium are based on the minimum separations of a Small and the missed approach buffer for a Medium, which has an approach speed of 140 knots.

Classes:

- HVY = Heavy
- 757 = 757
- LJ = Large Jet
- LC = Large Commuter (Large Commuters & Small Regional Jets)
- MED = Medium – Small Commuters & Business Jets (treated as Small for separations purposes)
- SM = Small twin & single engine props

EWR IFR (RADAR) SEPARATIONS **Accepted by EWR Team on 6/28/97.**

(In-trail Separations on Same Runway)

A/A (NM)*	*LEAD ARR*	*TRAIL ARR—*	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65--Heavy)*	5.20	6.12	6.16	6.16	7.16	7.16	
	757	*(7110.65--757)*	5.20	5.12	5.16	5.16	6.16	6.16	
	LJ	*(7110.65--Large)*	3.70	3.62	3.66	3.66	5.16	5.16	
	LC	*(7110.65--Large)*	3.70	3.62	3.66	3.66	5.16	5.16	
	MED	*(7110.65--Small)*	3.70	3.62	3.66	3.66	3.66	3.66	
	SM	*(7110.65--Small)*	3.70	3.62	3.66	3.66	3.66	3.66	

D/D (MIN)	*LEAD DEP*	*TRAIL DEP—*	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65--Heavy)*	1.50	2.00	2.00	2.00	2.00	2.00	
	757	*(7110.65--757)*	1.50	1.50	1.50	1.50	1.50	1.50	1.5 using radar
	LJ	*(7110.65--Large)*	1.00	1.00	1.00	1.00	1.00	1.00	
	LC	*(7110.65--Large)*	1.60	1.60	1.60	1.00	1.00	1.00	Includes Prop/Jet
	MED	*(7110.65--Small)*	1.60	1.60	1.60	1.00	1.00	1.00	Separation Based on
	SM	*(7110.65--Small)*	1.60	1.60	1.60	1.00	1.00	1.00	EWR/Data Collection

All departures use Radar separations.

D/A (NM)	*LEAD DEP*	*TRAIL ARR—*	HVY	757	LJ	LC	MED	SM	for all runways
	HVY	*(7110.65--Heavy)*	2.00	2.00	2.00	2.00	2.00	2.00	
	757	*(7110.65--757)*	2.00	2.00	2.00	2.00	2.00	2.00	
	LJ	*(7110.65--Large)*	2.00	2.00	2.00	2.00	2.00	2.00	
	LC	*(7110.65--Large)*	2.00	2.00	2.00	2.00	2.00	2.00	
	MED	*(7110.65--Small)*	2.00	2.00	2.00	2.00	2.00	2.00	
	SM	*(7110.65--Small)*	2.00	2.00	2.00	2.00	2.00	2.00	

A/D (Min.) separations are the Runway Occupancy Times (ROTs) from Observed Field Data of December 1996.

*Values include missed approach buffer, which is approximately 1 NM.

The A/A and D/A separations are based on the EWR approach speeds 145, 135, 140, 140, 140, 140.

WHO CAN USE THE REDUCED IFR SEPARATIONS (between similar class, non-Heavy aircraft):

LEAD	*TRAIL—*	HVY	757	LJ	LC	MED	SM
HVY	*(7110.65--Heavy)*	—	—	—	—	—	—
757	*(7110.65--757)*	—	—	—	—	—	—
LJ	*(7110.65--Large)*	YES	YES	YES	YES	—	—
LC	*(7110.65--Large)*	YES	YES	YES	YES	—	—
MED	*(7110.65--Small)*	YES	YES	YES	YES	YES	YES
SM	*(7110.65--Small)*	YES	YES	YES	YES	YES	YES

Classes:

- HVY = Heavy
- 757 = 757
- LJ = Large Jet
- LC = Large Commuter (Large Commuters & Small Regional Jets)
- MED = Medium – Small Commuters & Business Jets **(treated as Small for separations purposes)**
- SM = Small twin & single engine props

EWR APPROACH SPEEDS (Knots)

Accepted by EWR Team on 6/28/97.

The speed is given in knots for each class of aircraft flying along the common approach defined below. 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.

The approach speeds were developed from the ANAMS data at EWR. On 5/29/97, the EWR Tower reviewed these speeds and stated they were reasonable.

	Class	H	757	LJ	LC	M	S
EWR - 1997 Observed	Knots	145	135	140	140	140	140

LENGTH OF FINAL COMMON APPROACH (NM)

Accepted by EWR Team on 6/28/97.

For the simulations, the length of the final common approach is defined as the length along which speed control *cannot* be used to separate aircraft.

At the April meeting, the Design Team stated the approach lengths were 5NM. They also said there was a 3NM final in VFR1 for Class S aircraft arriving on Runway 11. The ANAMS data verified those approach lengths and the EWR Tower accepted them on 5/29/97.

The ANAMS data indicated that Class S aircraft on Runway 11 in VFR had an average speed of 137 knots. Because there are approximately 10 Class S arrivals per day at EWR and the simulations would generate the same results, the Technical Center recommends using 5NM and 140 knot for Class S arrivals on all runways in VFR.

	Class	H	757	LJ	LC	M	S
EWR	VFR	5	5	5	5	5	5
EWR	IFR	5	5	5	5	5	5

DEPARTURE RUNWAY OCCUPANCY TIMES (Sec)

Accepted by EWR Team on 6/28/97.

These are the minimum times a departure is on the runway. Runway crossing times and aircraft separations cannot violate these minimums. These values are used to develop the D/A (departure-to-arrival) separations. On 5/29/97, the EWR Tower stated these values are reasonable and provide the appropriate separations.

	Class	H	757	LJ	LC	M	S
Standard	Seconds	39	39	39	39	39	34

Source: Standard values used in most design team studies.

H = Heavy
757 = 757
LJ = Large Jet
LC = Large Commuter (Large Commuters & Small Regional Jets)
M = Medium – Small Commuters & Business Jets **(treated as Small for separations purposes)**
S = Small twin & single engine props

ARRIVAL AIRCRAFT LATENESS DISTRIBUTION **Accepted by EWR Team on 6/28/97.**

(Arrival Variability Distribution – Revised 6/12/97)

Amount by which actual arrival time at threshold exceeds expected arrival time at threshold (Minutes)	Distribution of aircraft lateness (%)	Cumulative (%)	
-30	0.8%	0.8%	
-20	2.0%	2.8%	
-15	3.2%	6.0%	Early
-10	6.4%	12.4%	
-5	10.9%	23.3%	
- 2	8.0%	31.3%	
0	5.5%	36.8%	On Time
5	12.8%	49.6%	
10	10.2%	59.8%	
15	8.9%	68.7%	
30	11.3%	80.0%	
45	6.1%	86.1%	Late
60	3.6%	89.7%	
75	7.1%	96.8%	
90	1.8%	98.6%	
120	1.4%	100.0 %	

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. This table is read as follows: 0.8% of the aircraft arrived at the threshold at least 30 minutes early; 2.0% arrived between 20-30 minutes early; and 2.8% arrived at least 20 minutes early; etc.

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

This distribution was presented in Data Package 3 and accepted by the Design Team on 6/28.97. It was developed from a 1996 Cater Delay Report by removing the average arrival taxi time. Thus, this distribution reflects the actual time at threshold versus expected time at threshold.

Source: 1996 EWR Cater Data -- Actual Time at Threshold versus Expected Time at Threshold.