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STUDY OF QUIET TURBOFAN STOL AIRCRAFT
FOR
SHORT-HAUL TRANSPORTATION

FINAL REPORT

VOLUME III

AIRPORTS

JUNE 1973

Prepared Under Contract No. NAS2-6994

for

ADVANCED CONCEPTS AND MISSIONS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MOFFETT FIELD, CALIFORNIA 94035

Douglas Aircraft Company - Long Beach

FOREWORD

This document is one of six volumes which comprises the final report of a contract study performed for NASA, "Study of Quiet Turbofan STOL Aircraft for Short-Haul Transportation", by the Douglas Aircraft Company, McDonnell Douglas Corporation.

The NASA technical monitor for the study was R. C. Savin, Advanced Concepts and Missions Division, Ames Research Center, California.

The Douglas program manager for the study was L. S. Rochte. He was assisted by study managers who prepared the analyses contained in the technical volumes shown below.

Volume I	Summary	
Volume II	Aircraft	L. V. Malthan
Volume III	Airports	J. K. Moore
Volume IV	Markets	G. R. Morrissey
Volume V	Economics	M. M. Platte
Volume VI	Systems Analysis	J. Seif

The participation of the airline subcontractors, (Air California, Allegheny, American and United), throughout the study was coordinated by J. A. Stern.

The one year study, initiated in May 1972, was divided into two phases. The final report covers both phases.

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SUMMARY

Results of the airport analysis in support of the NASA sponsored "Study of Quiet Turbofan STOL Aircraft for Short-Haul Transportation" are contained in this volume.

Over 200 airports were initially investigated within the Chicago, Northeast, California, Southern, Southeastern, and Northwest Regions to form a National STOL network. The final selected network includes a total of 94 airports -- 72 existing air carrier airports, 20 general aviation airports, and only 2 new urban STOLports. The selected airports are considered representative for STOL operations. System implementation and operation is not dependent on the specific airports selected, however.

Airport design and operational criteria were established using the baseline E.150.3000 systems analysis airplane. Differences resulting from other study aircraft configurations are cited in the individual report sections as applicable. Most existing air carrier airports were found to be generally compatible with STOL operations. General aviation airports are considered compatible to a lesser degree and will require a greater amount of modification. New urban STOLports should be tailored to short-haul operations and should include remote passenger check-in terminals and some form of mass passenger transit to reduce congestion and automobile emission levels.

Airport/aircraft tradeoffs were analysed with respect to reducing Indirect Operating Cost (IOC). The majority of tradeoff items considered (e.g., runway heating, fog dispersal, automated ticketing, reverse thrust,

and arresting barriers) were found to require additional research and development to analyze the IOC effect.

Airport and air traffic control implementation costs were developed for each of the 94 airports. The major cost associated with STOL implementation is the ATC equipment required for Category III operation. An example is presented in Table 2-17 of STOL operational costs, with and without the MLS Category III costs. Airport financing methods and sources were reviewed to determine their effect on system implementation and airline IOC.

User and non-user benefits were determined and are summarized in the Conclusions Section of the report. Non-user benefits were categorized according to National, Regional and Local classifications. The STOL short-haul system was found to have significant operational and economic advantages over a comparable short-haul CTOL system.

The various items associated with community acceptance (e.g., noise, emissions, congestion, land use, etc.) were analyzed in depth and the extent of the environmental impact of STOL operations was determined at twelve selected airports. These airports were specially selected with respect to location, type, land use, and community characteristics and are considered representative of other network airports of similar type. Special emphasis was placed on the sociological aspects of community acceptance. The need for extensive research in this field is emphasized.

Airspace, airport, and ground access congestion were investigated to determine operational constraints and methods of relief. Ground access congestion was found to be a major constraint at almost all high density airports. Solution to the problem rests with governmental agencies other than airport owners or sponsors.

The primary STOL airport implementation problems were found to be:

- The delay involved in preparing and processing Environmental Impact Statements (EIS).
- Airport development is usually low on the list of community funding priorities. Additional Federal funding assistance, or economic incentives, may be required to implement the STOL airport network.
- Almost universal community objection to any type of airport expansion or construction. Suggestions for achieving community acceptance and guidelines for public education programs are presented.

Candidate technology oriented R and D programs were defined. Critical areas requiring support are:

- Aircraft noise
- Aircraft emissions
- Wake turbulence effects
- Fog dispersion and snow removal.
- I.O.C. effects of new technological developments. (e.g., automated ticketing, baggage handling, people movers, etc.)

- In-depth research on the sociological aspects of community acceptance.

This report has been reviewed by the airline subcontractors. Comments are included in Section 12.0.

INTRODUCTION

This volume summarizes the results of the airport analysis accomplished under NASA Contract NAS 2-6994, "Study of Quiet Turbofan STOL aircraft for Short-Haul Transportation." The overall objectives of the study were to:

- o Determine the relationships between STOL characteristics and economic and social viability of short-haul air transportation.
- o Identify critical technology problems associated with the development and implementation of a STOL short-haul system.
- o Define representative aircraft configurations, characteristics, and costs.
- o Develop the route structure for a National STOL network.
- o Identify high payoff technology essential to improve STOL systems and their implementation.

This subject report analyzes the airport siting, design, cost, operation, and implementation aspects of a STOL short-haul system. Problem areas are identified and alternative solution or actions required to achieve system implementation by the early 1980's are recommended. Factors associated with ultimate community acceptance of the STOL program - noise, emissions, and congestion, were given special emphasis. Airline subcontractors provided operational data inputs and comments to provide maximum realism to the study results. Field surveys also were conducted at selected representative airports throughout the U.S. to obtain similar realistic up-to-the-minute information on environmental and community acceptance problems associated with STOLport implementation. Many of the results are equally applicable to CTOL airport operations and are so noted.

The initial Phase I study effort, initiated 8 May 1972, selected preliminary landing sites in three representative regions of the United States, evaluated aircraft site compatibility, and developed criteria and methodologies for determining system benefits and community acceptance. A physical and cost data base was established and air traffic control requirements were preliminarily defined.

The Phase II study expanded and refined the initial preliminary data and incorporated results of other concurrent study efforts as reported in the other volumes. Special emphasis was given to aircraft/airport tradeoffs and determination of the operational suitability and community acceptance problems of the STOLport sites selected for the national system network.

LIST OF SYMBOLS

AIA	Aerospace Industries Association
ARTCC	Air Route Traffic Control Center
ARTS	Automated Radar Terminal System
ATC	Air Traffic Control
ATCRBS	Air Traffic Control Radar Beacon System
AW	Augmentor Wing
CBD	Central Business District
CBR	California Bearing Ratio
c.g.	Center of gravity
CNEL	Community Noise Equivalent Level
CNR	Composite Noise Rating
CO	Carbon Monoxide
CTOL	Conventional Takeoff and Landing
DABS	Discrete Address Beacon System
DOT	Department of Transportation
EBF	Externally Blown Flap
EPNL	Effective Perceived Noise Level
EPNdB	Effective Perceived Noise Decibels
Fa	FAA Soil Subgrade Classification Number
FAA	Federal Aviation Administration
IBF	Internally Blown Flap
ICAO	International Civil Aviation Organization
IFR	Instrument Flight Rules
ILS	Instrument Landing System
IOC	Indirect-Operating Costs
IPC	Intermittant Positive Control
LAX	Los Angeles International Airport
MF	Mechanical Flap
MIT	Massachusetts Institute of Technology
MLGS	Microwave Landing Guidance System
MODE I	Existing Air Carrier Airports Only
MODE II	Existing Airports of All Types
MODE III	Existing Airports plus New STOLports

MODILS	Modular Instrument Landing System
NAFEC	National Aviation Facilities Experimental Center
NASA	National Aeronautics and Space Administration
NAS(P)	National Aviation System (Plan)
NAV	Navigational
NEF	Noise Exposure Forecast
NO_x	Nitrogen Oxides
O-D	Origin-Destination
PCA	Portland Concrete Association
PCI	Pounds Per Cubic Inch
PDILB	Computer Program to Evaluate Concrete Pavement Requirements by the PCA
PSI	Pounds Per Square Inch
QSEE	Quiet STOL Experimental Engine Program
SAE	Society of Automotive Engineers
SIMSOC	Simulated Society Study
SO_x	Sulfur Oxides
STOL	Short Takeoff and Landing
TALAR	Tactical Landing Approach Radar
UC	Unburned hydrocarbons
USB	Upper Surface Blowing
USGS	United States Geological Survey
VASIS	Visual Approach Slope Indicator System
VFR	Visual Flight Rules
VTOL	Vertical Takeoff and Landing

E .150 . 3000 .70 A

E	.150	. 3000	.70	A
E = EBF I = IBF A = AW U = USB M = MF C = CTOL	Passenger Payload	Field Length	Cruise Mach Number	A = Allison G = General Electric

STOL AIRPORTS

CODE	AIRPORT	CITY
ABQ	Albuquerque Sunport	Albuquerque
ACV	Arcata	Eureka
AGC	Allegheny County	Pittsburgh
AMA	Amarillo Air Terminal	Amarillo
AUS	Robert Mueller Municipal	Austin
BED	Hanscom Field	Boston
BEL*	Beltsville	Baltimore
BHM	Birmingham Municipal	Birmingham
BKL	Burke Lakefront	Cleveland
BNA	Nashville Metropolitan	Nashville
BOI	Boise Air Terminal	Boise
BUF	Greater Buffalo	Buffalo
CAE	Columbia Metropolitan	Columbia
CGX	Meigs	Chicago
CHS	Charleston Municipal	Charleston
CLT	Douglas Municipal	Charlotte
CMH	Port Columbus	Columbus
CPS	Bi-State Parks	St. Louis
CRP	Corpus Christi Int'l	Corpus Christi
CVG	Greater Cincinnati	Cincinnati
DAL	Dallas Love Field	Dallas
DAY	J. M. Cox	Dayton
DCA	Washington National	Washington
DEN	Stapleton International	Denver
DET	Detroit City	Detroit
DSM	Des Moines Municipal	Des Moines
ELP	El Paso International	El Paso
EMT	El Monte	El Monte
EUG	Mahlon Sweet Field	Eugene
FAT	Fresno Air Terminal	Fresno
FLL	Hollywood International	Ft. Lauderdale

*Code Used by Douglas Aircraft Company

CODE	AIRPORT	CITY
FTY	Fulton County	Atlanta
GDS *	Gen. D. Spain	Memphis
GEG	Spokane International	Spokane
GPF *	Gen. Patton Field	Los Angeles
GSO	Greensboro High Pt.	Greensboro
HFD	Hartford-Brainard	Hartford
HOU	Houston Hobby	Houston
HPN	Westchester County	New York
ICT	Wichita Municipal	Wichita
IND	Weir Cook	Indianapolis
ISP	Islip MacArthur	New York
JAN	A. C. Thompson Field	Jackson
JAX	Jacksonville International	Jacksonville
LAS	McCarran International	Las Vegas
LBB	Lubbock Regional	Lubbock
LGB	Daugherty Field	Long Beach
LIT	Adams Field	Little Rock
MAF	Midland Odessa Regional	Midland Odessa
MCO	McCoy Air Force Base	Orlando
MDW	Midway	Chicago
MIC	Crystal	Minneapolis-St. Paul
MKC	Kansas City Municipal	Kansas City
MKE	Gen. Mitchell Field	Milwaukee
MOB	Bates Field	Mobile
MOF *	Moffett Field	Mountain View
MRY	Monterey Pennisula	Monterey
MYF	Montgomery Field	San Diego
NEW	Lakefront	New Orleans
OAK	North Field	Oakland
OKC	Will Rogers World	Oklahoma City
OMA	Eppley Field	Omaha
OPF	Opa Locka	Miami
ORF	Norfolk Regional	Norfolk

* Code Used By Douglas Aircraft Company

CODE	AIRPORT	CITY
OWD	Norwood	Boston
PDK	Dekalb Peachtree	Atlanta
PDX	Portland International	Portland
PHF	Patrick Henry	Newport News
PHX	Phoenix Sky Harbor	Phoenix
PNE	North Philadelphia	Philadelphia
PVD	Greater Providence	Providence
RDU	Raleigh/Durham	Raleigh Durham
RHV	Reid Hillview	San Jose
RIC	R. E. Byrd International	Richmond
RNO	Reno International	Reno
ROC	Monroe County	Rochester
SAC	Sacramento Executive	Sacramento
SAT	San Antonio International	San Antonio
SAV	Savannah Municipal	Savannah
SBA	Santa Barbara Municipal	Santa Barbara
SDF	Standiford Field	Louisville
SEA	Seattle-Tacoma	Seattle
SEC*	Secaucus	New York
SHV	Shreveport Regional	Shreveport
SLC	Salt Lake City Int'l	Salt Lake City
SNA	Orange County	Santa Ana
SYR	C. E. Hancock	Syracuse
TLH	Tallahassee Municipal	Tallahassee
TOL	Toledo Express	Toledo
TPA	Tampa International	Tampa
TUL	Tulsa International	Tulsa
TUS	Tucson International	Tucson
TYS	McGhee Tyson	Knoxville
VNY	Van Nuys	Van Nuys

* Code Used By Douglas Aircraft Company

1.0 SITE SELECTION

1.1 Representative Regions - Phase I

Airport studies were conducted during Phase I for representative regions of the U.S., the purpose of which was to provide the methodology for the national network to be completed during Phase II, reference 1-1.

If STOL aircraft are to be used effectively in a short-haul transportation system, convenient terminal facilities must be available.

The STOLport is a planned environment at the origin point and destination point of an aircraft. It is tailored to the characteristics of the aircraft and convenience to the traveling public. These facilities must contribute their full share toward making air travel safe and efficient.

The STOL site requirements were developed from a long list. Figure 1-1 indicates the more important considerations in establishing STOLports, not necessarily in order of priority.

The airport operational modes were defined as follows:

- o MODE I - Existing air carrier airports only.
- o MODE II - Existing airports of all types.
- o MODE III - Existing airports plus special new STOLports.

The site selection effort was closely monitored by NASA and with the FAA contractors conducting studies related to STOL market assessment and STOL system definition and implementation.

In Phase I, the candidate aircraft examined in the systems analysis study, Table 1.1, did not materialize at one time. In each regional mode the aircraft were used to determine the important parametric STOL characteristics. These were expanded upon by using different U.S. Regions and operational modes. This effort involved such things as operational lifting concept, comparison of seat capacity, and operating field length.

The systems analysis studies also provided data on the frequency and numbers of peak-hour passengers which can be translated into gate position size, terminal size, and parking areas.

STOL SITE REQUIREMENTS

- PROXIMITY TO TRAFFIC-GENERATING CENTERS
- VEHICULAR AND MASS TRANSIT ACCESSIBILITY
- COMPATIBILITY OF AREA TO NOISE AND NEIGHBORING PROPERTY USES
- RELATIONSHIP OF AREA TO NORMAL AIR TRAFFIC PATTERNS
- AIRCRAFT PHYSICAL AND OPERATIONAL CHARACTERISTICS
- COST OF ACQUIRING AND DEVELOPING SITE

PR2-STOL-9853

Figure 1-1

Table 1-1

PHASE I - CANDIDATE AIRCRAFT

CALIFORNIA REGION

MODE I (3000 FT F/L)

M 100 0.74
E 100 0.70
M 200 0.74
E 200 0.70

MODE II (2000 FT F/L)

E 50 0.70
A 50 0.78
E 100 0.70
A 100 0.79
E 200 0.70
A 200 0.79

MODE III (3000 FT F/L)

M 50 0.71
M 100 0.74
M 200 0.74

NORTHEAST REGION

MODE I (1500 FT F/L)

A 50 0.77
E 100 0.70
A 100 0.77
A 200 0.76

MODE II (2000 FT F/L)

A 50 0.78
E 100 0.75
A 100 0.79
A 200 0.79

MODE III (1500 FT F/L)

A 100 0.77
E 100 0.70
A 200 0.76

CHICAGO REGION

MODE I (3000 FT F/L)

O 100 0.70
M 100 0.74
E 200 0.70
M 200 0.74

MODE II (8500 FT F/L) – CTOL

M 100 0.78 (2 ENGINES)
M 200 0.78 (2 ENGINES)

MODE II (2000 FT F/L) – STOL

O 100 0.70
E 200 0.70

PR2-STOL-9954B

1.1.1 California Region - The California Region was the first region examined for the three operational modes. Potential STOLports in the California Region were surveyed from reports, maps, and charts for analysis. Six airports were selected in the Los Angeles and San Francisco areas for the Mode I analysis. A STOL runway was located on the air carrier (CTOL) airports so that STOL operations could be conducted independent of CTOL operations.

The modal split between CTOL and STOL aircraft in Phase I of the study was based on STOL fares set at 1.0, 1.25, and 1.5 times the existing CTOL coach fares. For the case in which STOL fares are assumed to be equal to CTOL coach fares, an assumption was made that CTOL and STOL operations would have equal flight frequencies. The result of this assumption is a fifty-fifty modal split between CTOL and STOL passenger traffic. This is per a NASA request for Mode I - California Corridor.

In the California Region, a "shopping list" of STOLport sites was analyzed by the marketing patronage model for Modes II and III. The airports remaining are those noted in Figure 1-2. These were subjected to the systems analysis study. The locations of the airports studied in the California Region are shown in Figure 1-3. 1980 marketing data were utilized.

Based on data on the FAA Form 5010-1, the longest runway length of all California airports, is plotted on Figure 1-4. The 2000/3000 foot lengths indicate the preponderance of this type runway.

Based on the aircraft designs examined in the systems study, for the California Region for Modes I, II, and III, the number of gate positions required at each STOLport were computed for the various aircraft size configurations. For Modes II and III, the peak-hour O & D traffic and the number of peak-hour flights, also were determined. The results of this preliminary airport/aircraft compatibility analysis are listed in Table 1-2.

It should be mentioned there is no added area for unscheduled maintenance. In the Phase II study, maintenance areas will be included.

AIRPORT SITE SELECTION
CALIFORNIA REGION

MODE I

LOS ANGELES INTERNATIONAL
HOLLYWOOD - BURBANK
LONG BEACH
SAN FRANCISCO INTERNATIONAL
METROPOLITAN OAKLAND
SAN JOSE MUNICIPAL

MODE II

EL MONTE
SANTA MONICA MUNICIPAL
CRISSY FIELD
NORTH FIELD - OAKLAND
CHANDLER FIELD - FRESNO
SAN DIEGO - MONTGOMERY FIELD

MODE III

EL MONTE
LONG BEACH
*GEN. PATTON FIELD
SAN CARLOS
CONCORD - BUCHANAN FIELD
HAYWARD AIR TERMINAL

*NEW STOLPORTS

PR2-STOL-9854

Figure 1-2

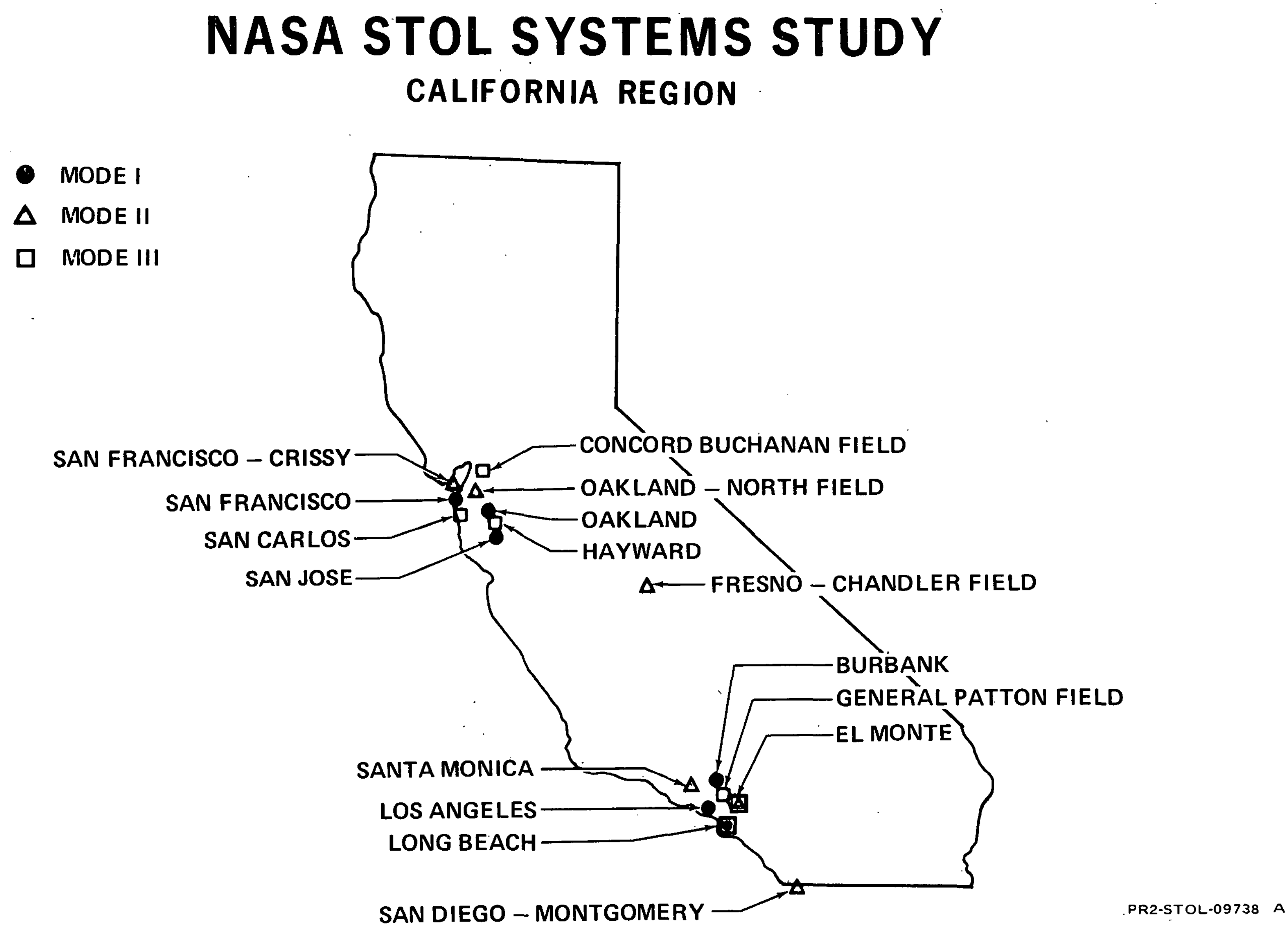

NASA STOL SYSTEMS STUDY
CALIFORNIA REGION
MODE I
MODE II
MODE III
SAN FRANCISCO – CRISSY
SAN FRANCISCO
SAN CARLOS
SAN JOSE
CONCORD BUCHANAN FIELD
OAKLAND – NORTH FIELD
OAKLAND
HAYWARD
FRESNO – CHANDLER FIELD
BURBANK
GENERAL PATTON FIELD
EL MONTE
SANTA MONICA
LOS ANGELES
LONG BEACH
SAN DIEGO – MONTGOMERY
PR2-STOL-09738 A

Figure 1-3

AIRPORTS OF RECORD ON FAA FORM 5010-1
BY LONGEST RUNWAY LENGTH FOR STATE OF CALIFORNIA

(CONCRETE AND ASPHALT)

AS OF 2-12-72

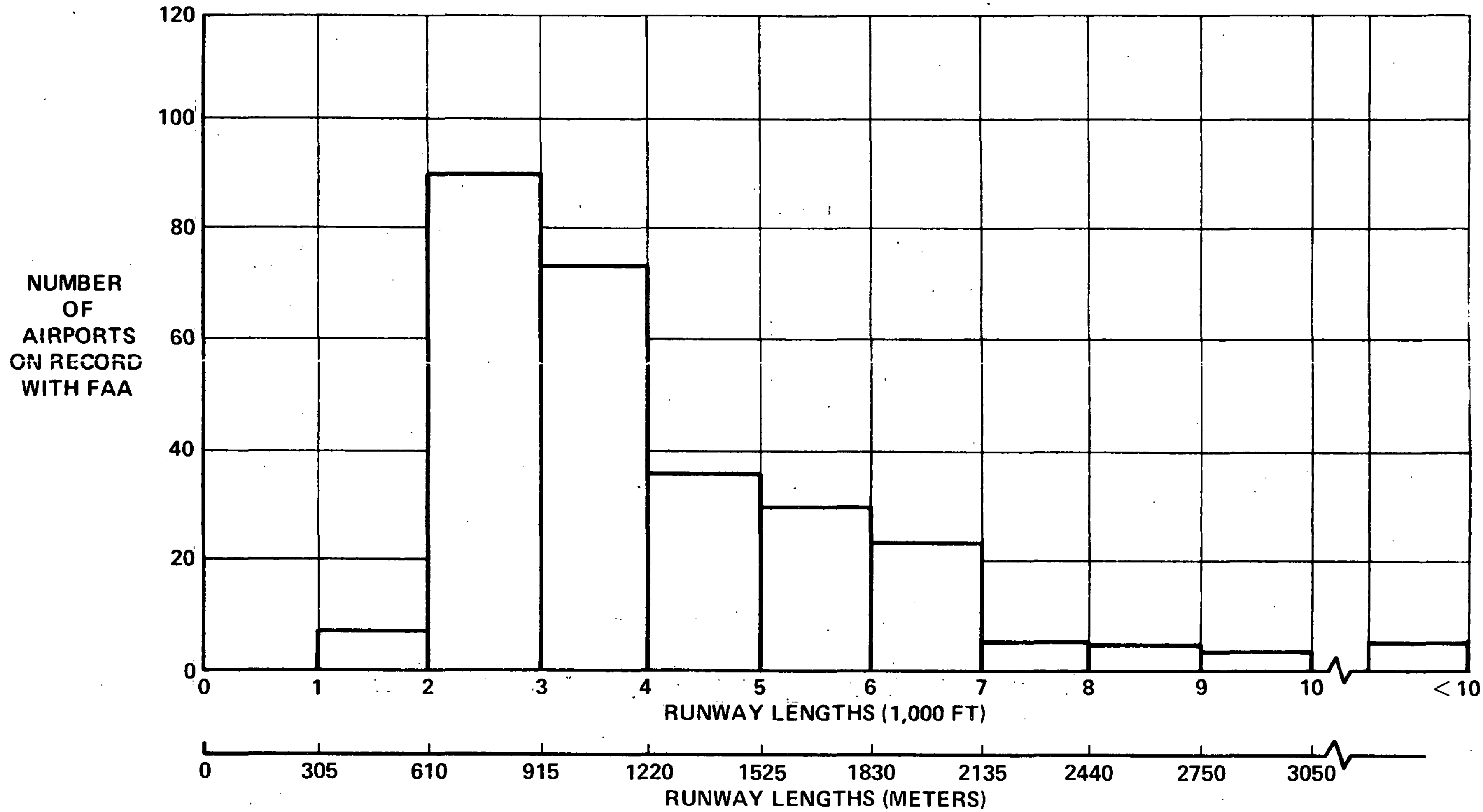


Figure 1-4

TABLE 1-2

GATE REQUIREMENTS
MODE I - CALIFORNIA REGION

Airport	Code	STOL O&D (1000 PAX)	Number - Gates Required 100 PAX STOL	200 PAX STOL
Los Angeles	LAX	4,680	6	3
Long Beach	LGB	717	1	1
Burbank	BUR	2,197	3	3
San Francisco	SFO	2,854	4	3
Oakland	OAK	2,531	4	3
San Jose	SJC	2,209	4	3

50-50 Traffic Split - 1980 Traffic

AIRPORT ACTIVITY SUMMARY
MODE II - CALIFORNIA REGION
200 PAX STOL

Airport	Code	STOL O&D (1000 PAX)	Peak-Hour O&D	Peak-Hour Flights	Number Gates Required
El Monte	EMT	1,050	372	3	2
Santa Monica Municipal	SMO	3,260	723	6	4
Montgomery Field	MYF	1,860	734	6	3
Crissy Field	CSY	2,720	721	6	3
North Field	OAK	1,640	549	5	3
Chandler Downtown	FCH	50	-	-	-

1980 Traffic

AIRPORT ACTIVITY SUMMARY
MODE III - CALIFORNIA REGION
200 PAX STOL

Airport	Code	STOL O&D (1000 PAX)	Peak-Hour O&D	Peak-Hour Flights	Number Gates Required
El Monte	EMT	1,600	504	4	2
Long Beach-Daugherty Field	LGB	3,090	708	6	3
General Patton Field	GPF	3,390	619	5	3
Concord-Buchanan Field	CCR	3,080	609	5	3
Hayward Air Terminal	HWD	2,740	611	5	3
San Carlos	SOL	2,260	601	5	2

1980 Traffic

1.1.2 Northeast Region - In the Northeast Region several potential STOLports were selected for operational Modes I, II, and III. These are presented in Figure 1-5. A map showing their location is given in Figure 1-6.

In the Mode I analysis, STOLports were located at Logan International, La Guardia, Philadelphia International, and Washington National airports. STOLport operations were conducted independent of the CTOL operations. In this analysis, the frequency distribution was based on a 1980 modal split of one-third STOL and two-thirds CTOL with NASA concurrence.

For Modes II and III analysis, traffic projections for 1985 were used. In Mode III, several new STOLports were added. The locations of new STOLports were determined from the market analysis.

The Modes II and III were evaluated by the marketing patronage model and those remaining were evaluated in the STOL systems analysis.

All Northeast Region airports included on FAA Form 5010-1 are plotted in Figure 1-7, by longest runway length. These data again show the large preponderance of available runway lengths from 2000/3000 feet.

In the Northeast Region the number of gate positions required at each STOLport were determined for the model used in the systems analysis study for Modes I, II, and III. The gate position requirements and peak-hour flights are summarized in Table 1-3.

1.1.3 Chicago Region - In the Chicago Region the Modes I, II/III were examined for potential STOLport locations. There were no new STOLports selected for this region, so the Modes II/III were combined. The Chicago Region airports are shown in Figure 1-8.

For the Mode I analysis, the frequency distribution was based on 1985 traffic with a modal split of one-third STOL traffic and two-thirds CTOL traffic. The Mode II/III evaluation also used 1985 traffic and STOLport traffic was estimated by the marketing patronage model. Figure 1-9 shows the potential STOLport locations.

For the Chicago Region, all airports on the FAA Form 5010-1 are plotted in Figure 1-10, by longest runway length. The Chicago Region

AIRPORT SITE SELECTION

NORTHEAST REGION

MODE I

LOGAN INTERNATIONAL

LA GUARDIA

WASHINGTON NATIONAL

PHILADELPHIA INTERNATIONAL

MODE II

HANSCOM FIELD

TETERBORO

NORTH PHILADELPHIA

BOLLING AFB

MODE III

HANSCOM FIELD

* SECAUCUS

BOLLING AFB

COLLEGE PARK

* D.C. UNION STATION

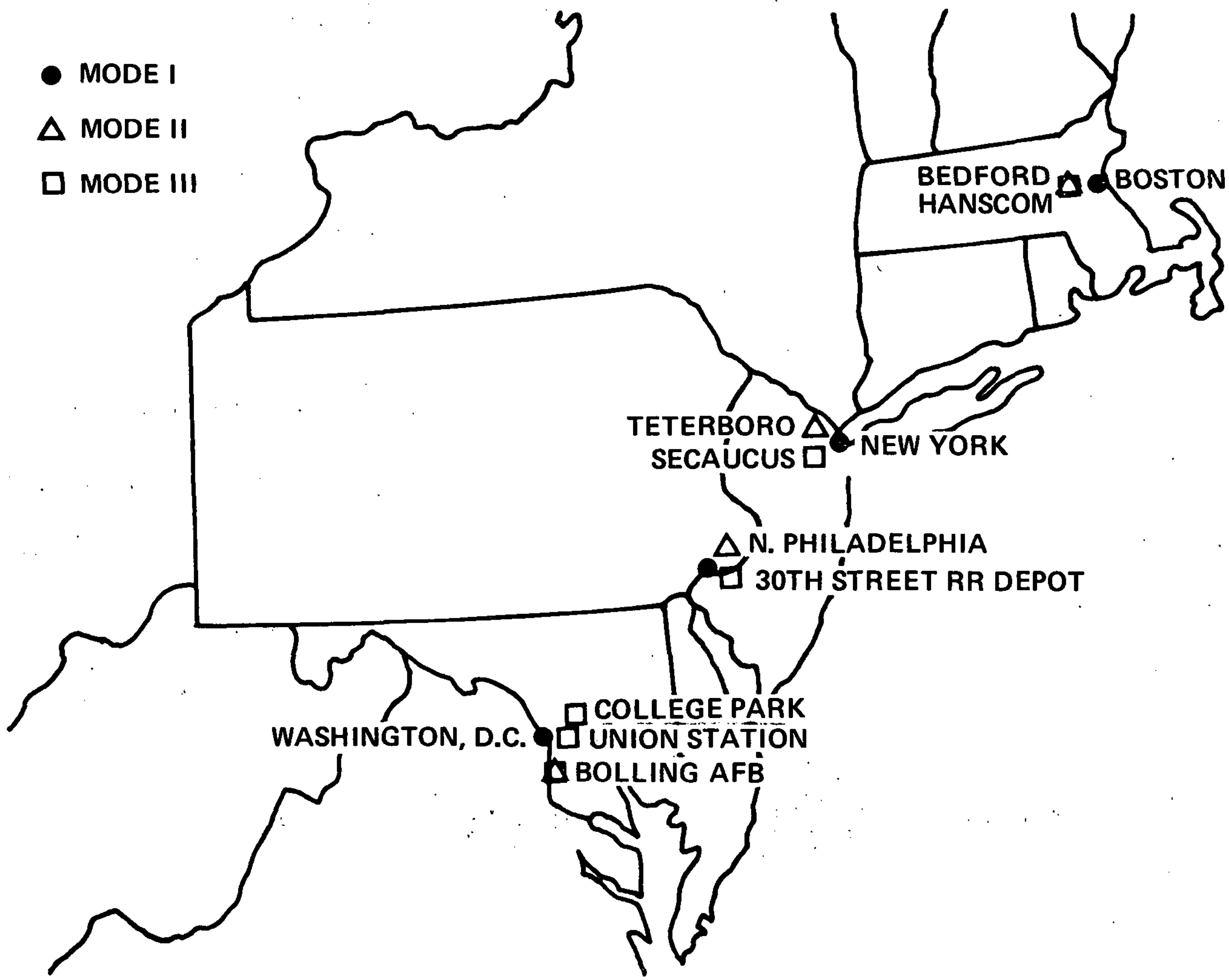
* 30TH STREET RR DEPOT

*NEW STOLPORTS

PR2-STOL-9855

Figure 1-5

NASA STOL SYSTEM STUDY
NORTHEAST REGION



PR2-STOL-1053

Figure 1-6

AIRPORTS OF RECORD ON FAA FORM 5010-1 BY LONGEST RUNWAY LENGTH FOR THE NORTHEAST REGION

(CONCRETE AND ASPHALT)

AS OF 2-12-72

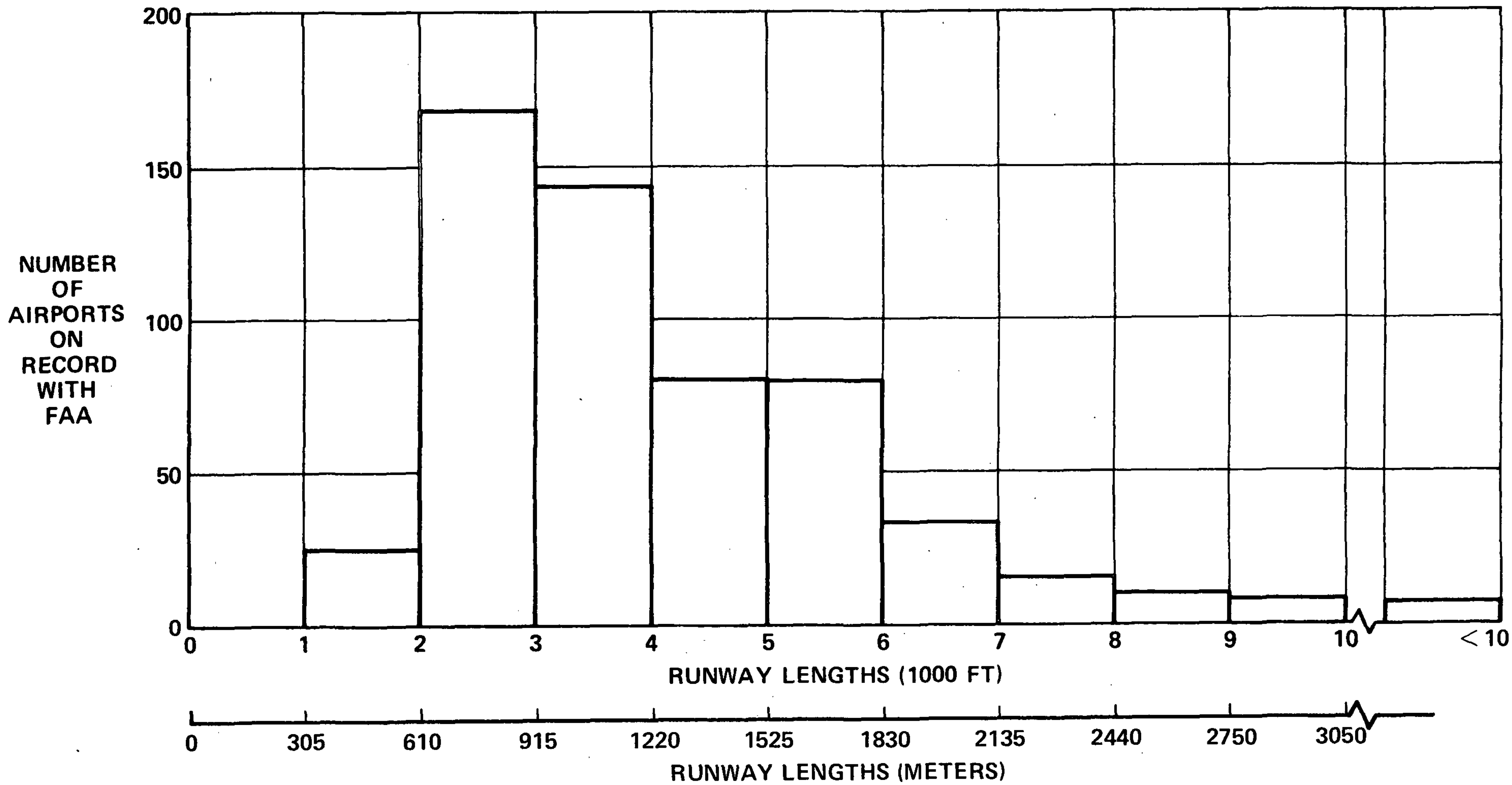


Figure 1-7

TABLE 1-3

AIRPORT ACTIVITY SUMMARY

NORTHEAST REGION

200 PAX STOL

Airport	Code	STOL O&D (1000 PAX)	Peak-Hour O&D	Peak-Hour Flights	Number Gates Required
		MODE I			
Boston-Logan International	BOS	2,584	717	6	3
New York-La Guardia	LGA	2,823	725	6	3
Philadelphia International	PHL	516	249	2	1
Washington National	DCA	1,877	730	6	2
1/3 STOL - 2/3 CTOL - 1980 Traffic					
		MODE II			
Boston-Hanscom Field	BED	2,630	1085	9	4
New York-Teterboro	TEB	2,515	1068	9	4
Philadelphia-No. Phila.	PNE	455	250	2	1
Washington-Bolling Field	BOF	1,460	826	7	3
1985 Traffic					
		MODE III			
Boston-Hanscom	BED	3,745	1694	14	5
New York-Secaucus	SEC	4,385	1940	16	5
Philadelphia-30th St. RR	RRD	655	360	3	1
Washington-College Park	CGS	100	137	1	1
Washington-Union Station	DCU	2,180	1078	9	3
Washington-Bolling Field	BOF	345	237	2	1
1985 Traffic					

AIRPORT SITE SELECTION

CHICAGO REGION

MODE I	MODE II/III
CHICAGO O'HARE	MEIGS FIELD
DETROIT WAYNE COUNTY	DETROIT CITY AIRPORT
CLEVELAND HOPKINS INTERNATIONAL	BERZ AIRPORT
ST. LOUIS LAMBERT INTERNATIONAL	BURKE LAKEFRONT AIRPORT
INDIANAPOLIS - WEIR COOK	BI-STATE PARKS AIRPORT
MILWAUKEE - MITCHELL FIELD	CRYSTAL AIRPORT
MINNEAPOLIS - ST PAUL WOLD CHAMBERLAIN	INDIANAPOLIS - WEIR COOK
	MILWAUKEE - MITCHELL FIELD

PR2-STOL-9856

Figure 1-8

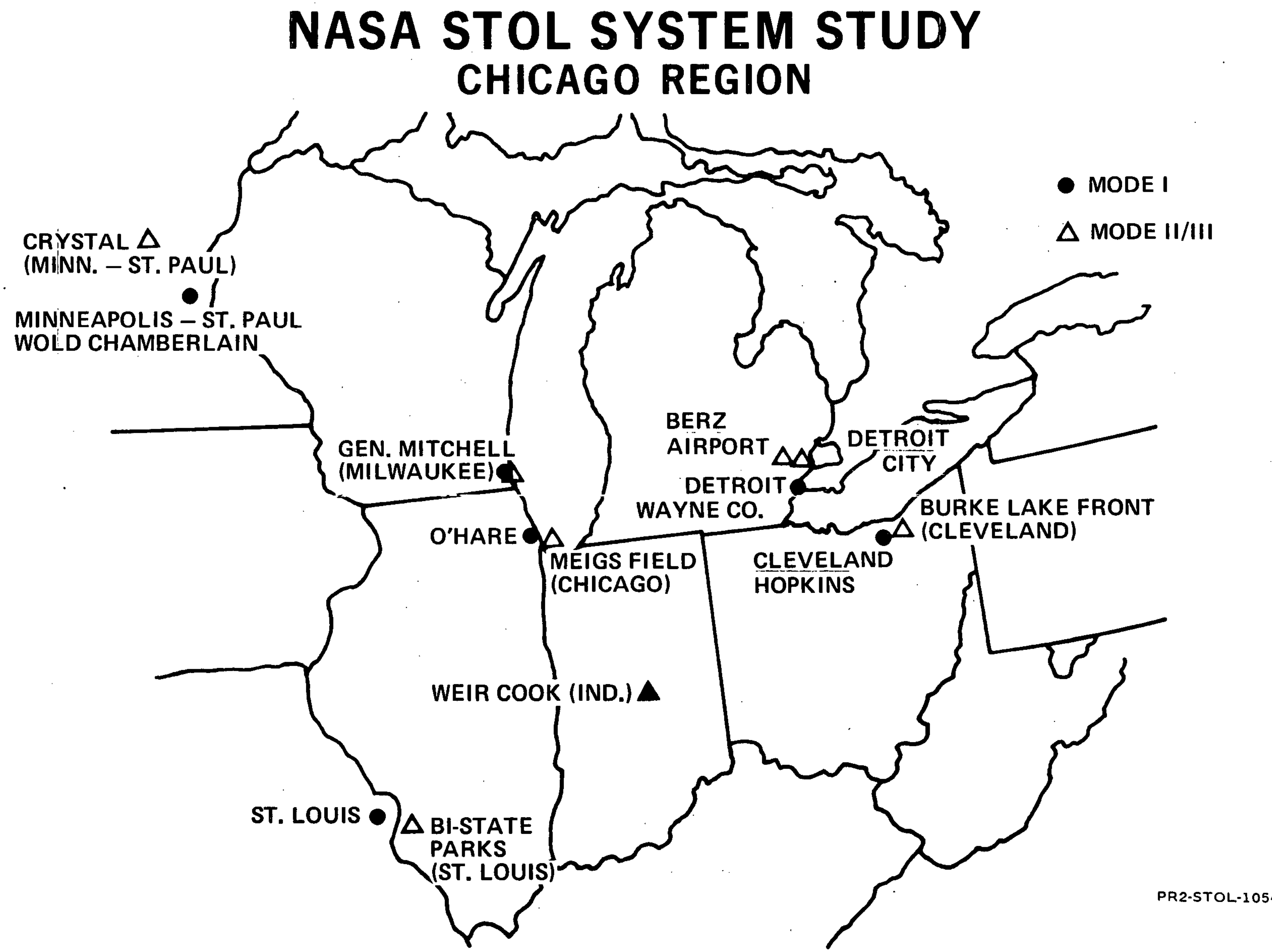

NASA STOL SYSTEM STUDY
CHICAGO REGION
MODE I
MODE II/III
CRYSTAL
(MINN. – ST. PAUL)
MINNEAPOLIS – ST. PAUL
WOLD CHAMBERLAIN
GEN. MITCHELL
(MILWAUKEE)
O'HARE
MEIGS FIELD
(CHICAGO)
BERZ
AIRPORT
DETROIT
CITY
DETROIT
WAYNE CO.
BURKE LAKE FRONT
(CLEVELAND)
CLEVELAND
HOPKINS
WEIR COOK (IND.)
ST. LOUIS
BI-STATE
PARKS
(ST. LOUIS)
PR2-STOL-1054

Figure 1-9

AIRPORT OF RECORD ON FAA FORM 5010-1 BY LONGEST RUNWAY LENGTH FOR THE CHICAGO REGION

(CONCRETE AND ASPHALT)

AS OF 2-12-72

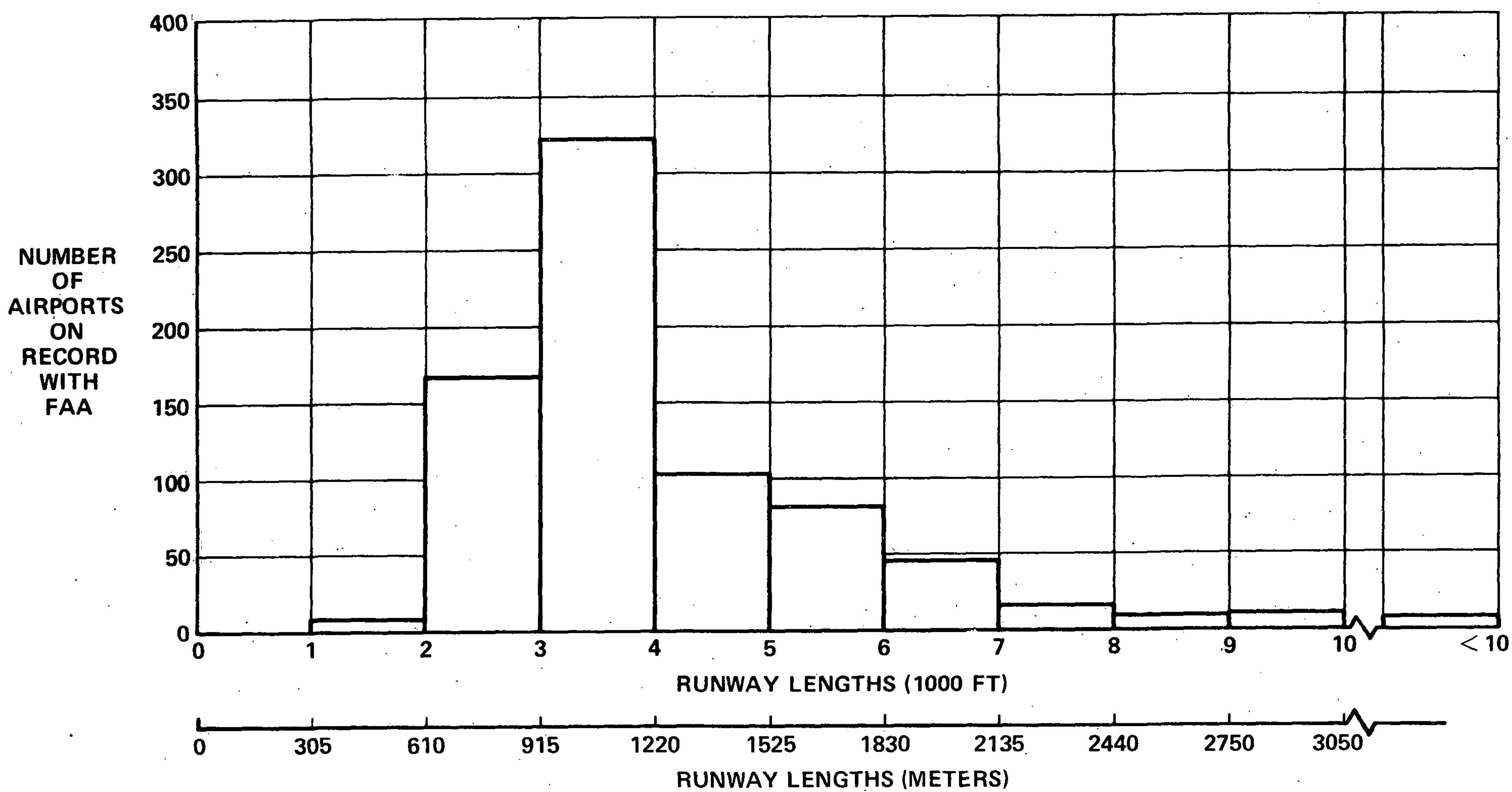


Figure 1-10

indicates the preponderance of runways between 3000/4000 feet which are somewhat longer than the California or Northeast Regions.

In the Chicago Region, the number of gates was determined for the various models investigated in the systems analysis study. The Mode II/III network in which Meigs was used as a potential STOLport has 20 peak-hour flights and would require eight gate positions to move the STOL traffic. Gate positions and the number of peak-hour O&D passengers and peak-hour flights are shown in Table 1-4.

Throughout the Phase I part of this contract several airport operational modes were evaluated (Table 1-5). This became an excellent way of looking at the operational modes of Phase II and the STOL national network. In the STOL airport siting for Phase II, the information gained from airport compatibility and the community acceptance analysis surveys proved very helpful.

For the purposes of this study the term "constrained" airport operation is used in Phase II. This term is subdivided as follows:

- Level 1, Congestion - Physical

  This is a specific form of constraint applied to the movement of people or vehicles, congested airports are those at which movement is restricted and delays or temporary stoppages occur in the movement (flow) of aircraft, airside/airport; people and baggage, terminal; or surface vehicular traffic, groundside, entering or leaving the airport across the airport boundary. This may occur either within the airport boundaries or on the network of surface streets providing community access to the airport. The Level 1 category is applied to those airports which now or in the future projection are congested to a saturation level. In this concept, no additional operations or expansion is possible.

- Level 2, Constrained - Physical

  Another form of physical congestion is less severe than Level 1. Operations occasionally are interrupted and delays occur at peak hours. However, there is sufficient area within the airport boundaries to permit the rearrangement

TABLE 1-4

AIRPORT ACTIVITY SUMMARY

CHICAGO REGION

100 PAX STOL

Airport	Code	STOL O&D (1000 PAX)	Peak-Hour O&D	Peak-Hour Flights	Number Gates Required
		MODE I			
Cleveland Hopkins	CLE	460	127	2	2
Detroit Wayne County	DTW	688	237	4	2
Indianapolis-Weir Cook	IND	252	223	4	2
Milwaukee-Gen. Mitchell	MKE	148	106	2	1
Minneapolis-St. Paul	MSP	742	299	5	2
Chicago-O'Hare	ORD	2,228	549	9	5
St. Louis-Lambert	STL	586	235	4	2

1/3 STOL - 2/3 CTOL - 1985 Traffic

Airport	Code	STOL O&D (1000 PAX)	Peak-Hour O&D	Peak-Hour Flights	Number Gates Required
		MODE II/III			
Burke Lakefront	BKL	1,220	319	5	3
Berg	7D2	760	190	3	2
Detroit City	DET	1,370	308	5	2
Indianpolis-Weir Cook	IND	730	205	3	1
Milwaukee-Mitchell Field	MKE	250	115	2	1
Minn.-St. Paul-Crystal	MIC	1,690	416	7	3
Meigs	CGX	5,900	1,209	20	8
Bi-State Parks	CGS	1,000	328	5	2

TABLE 1-5

STOL AIRPORT OPTIONS

AIRPORT TYPE	ADVANTAGE	DISADVANTAGE
AIR CARRIER	o INTERCONNECTING PASSENGERS o ENVIRONMENTAL APPROVAL EASIER o COMPATIBLE ATC FACILITIES o SHORTEST TIME TO IMPLEMENT o MANY FACILITIES EXIST	o INCREASED GROUND CONGESTION o NOT OPTIMIZED FOR STOL o LOWER PRIORITY OF FACILITIES o MODERATE ATC EXPENSE
GENERAL AVIATION	o AVIATION PRECEDENT o GOOD GROUND ACCESS o BASIC FACILITIES EXIST o FEW ATC FACILITIES	o QUESTIONABLE ENVIRONMENTAL APPROVAL o NEED MANY NEW FACILITIES o LONGER TIME TO IMPLEMENT o NOT OPTIMIZED FOR STOL o EXTENSIVE ATC EXPENSE
NEW SITE (GROUND LEVEL)	o CONVENIENT TO POPULATION CENTER o GOOD GROUND ACCESS o OPTIMIZED FOR STOL	o DOUBTFUL ENVIRONMENTAL APPROVAL o LONGEST TIME TO IMPLEMENT o HIGH COST-LAND SCARCITY o MAXIMUM ATC EXPENSE

or addition of facilities to restore free movement to aircraft for example at Van Nuys, California which includes a separate STOL runway and terminal in its long-range master plan of development.

- Level 3, Constrained - Social

  A special application of the word used in a social sense wherein restrictions (physical) are placed upon the kind and level of aircraft operations permitted at the airport. Typical constraints are applied in the form of anti-noise flight profile rules, permissible exhaust emission standards, or time-of-day operations restrictions such as prohibiting jet operations between 10:00 PM and 6:00 AM.

- Level 4, Congested/Constrained

  There are some airports in the U.S. at which there are both physical congestion arising from sheer volume of operational demands and also social constraint of Level 3 nature.

  These congested/constrained airports are included in Section 9.0 of this report and also the 1985 Scenario for Phase II, Volume VI.

1.2 National Study - Phase II

During the Phase II portion of this study the STOL Systems Scenario, presented in Volume VI, Systems Analysis, was used.

One of the primary 1985 objectives is to provide STOLports in order to reduce the noise levels found in-and-around the major hub airports, as well as smaller airports located in a noise sensitive community area. Another constraint for growth exists when considering limitations due to the airspace, the runway operations, and the terminal area problems such as aprons and gates, terminal parking areas, and local ground access and egress routes.

A fundamental area of study concerns the current and future constraints which will be most applicable to a 1985 STOL system and the effect upon the air transportation system as a whole. The congestion and constraints are treated in Volume VI and the resulting airports are reproduced in the Airport Congestion Relief section of this report.

In Phase II the number of airports were considerably expanded in the Chicago, Northeast and California Regions over the Phase I effort. Also included are the Southern, Southeast and Northwest Regions to consider for the STOL National network. The Hawaii Region was evaluated to determine the additional number of aircraft it would support and is presented in Volume VI.

In determining the potential STOLports to be used in the various regions, a number of documents were reviewed. These included Civil Aeronautics

Board data, Boeing STOLport survey, Northeast Corridor reports, Mitre reports, and other Douglas Company internal material for STOLport location. These are listed in the Bibliography.

Throughout the STOL network study we have selected an adequate number of existing airports which are favorably located to the traveler to support a STOL short-haul system for the 1985 time period.

In summary, over 200 airports throughout the U.S. were initially surveyed. The representative STOL network selected includes 92 existing airports and only 2 new STOLports (Secaucus and Gen. Patton Field). The STOL network operation is not necessarily dependent on these particular locations.

All of the STOL network airports selected generally comply with the established STOL site criteria presented in Figure 1-1, although some had a variation in community acceptance. The airports are near to the traffic-generating centers; located close to nearby freeways, state-roads, and local streets; and can be acquired with a minimum amount of facility cost.

Field surveys were conducted at twelve of the surveyed airports and in much greater detail regarding their activity as STOLports. They are reported on in the community acceptance portion of this report.

The approach taken throughout this study is that the STOL short haul O & D passenger is removed from the congested/constrained airport and is provided a better service from a STOLport. For the transfer passenger, a non-congested hub would be made available to by-pass the congested hub. The passenger would still be able to complete the same trip without stopping in the congested area. Placing a STOL runway in direct station-to-station competition with future CTOL flights would not provide any resulting advantage to the traveler.

The number of STOLports in the same city will be a minimum consistent with the estimated STOL passenger demand for the 1985 time period.

The six U.S. Regions are included as follows:

REGION	TABLE STOLports	FIGURE Regional Map
Chicago	1-6	1-11
Northeast	1-7	1-12
California	1-8	1-13
Southern	1-9	1-14
Southeast	1-10	1-15
Northwest	1-11	1-16

There is some overlap in the regional approach to selecting the network airports. While some city-pair airports provide service to major hub areas in two or three different regions these duplications are eliminated when looking at the national network. An example would be Bi-State Parks in St. Louis, being served from the Chicago Region, The Southern Region and also the Southeast Region. There are no duplications in Airport Cost, ATC requirements, etc.

TABLE 1-6

SELECTED STOL AIRPORTS
EXPANDED CHICAGO REGION - 1985

CITY	AIRPORT	CODE
BUFFALO	GREATER BUFFALO	BUF
CHICAGO	MEIGS	CGX
CHICAGO	MIDWAY	MDW
CINCINNATI	GREATER CINCINNATI	CVG
CLEVELAND	BURKE LAKEFRONT	BKL
COLUMBUS	PORT COLUMBUS	CMH
DAYTON	J. M. COX	DAY
DENVER	STAPLETON INT'L	DEN
DES MOINES	DES MOINES MUNICIPAL	DSM
DETROIT	DETROIT CITY	DET
INDIANAPOLIS	WEIR COOK	IND
KANSAS CITY	KANSAS CITY MUNICIPAL	MKC
MILWAUKEE	GEN MITCHELL FIELD	MKE
MINNEAPOLIS-ST PAUL	CRYSTAL	MIC
OMAHA	EPPLEY FIELD	OMA
PITTSBURGH	ALLEGHENY COUNTY	AGC
ROCHESTER	MONROE COUNTY	ROC
ST. LOUIS	BI STATE PARKS	CPS
TOLEDO	TOLEDO EXPRESS	TOL

1985
CHICAGO REGION - PHASE II

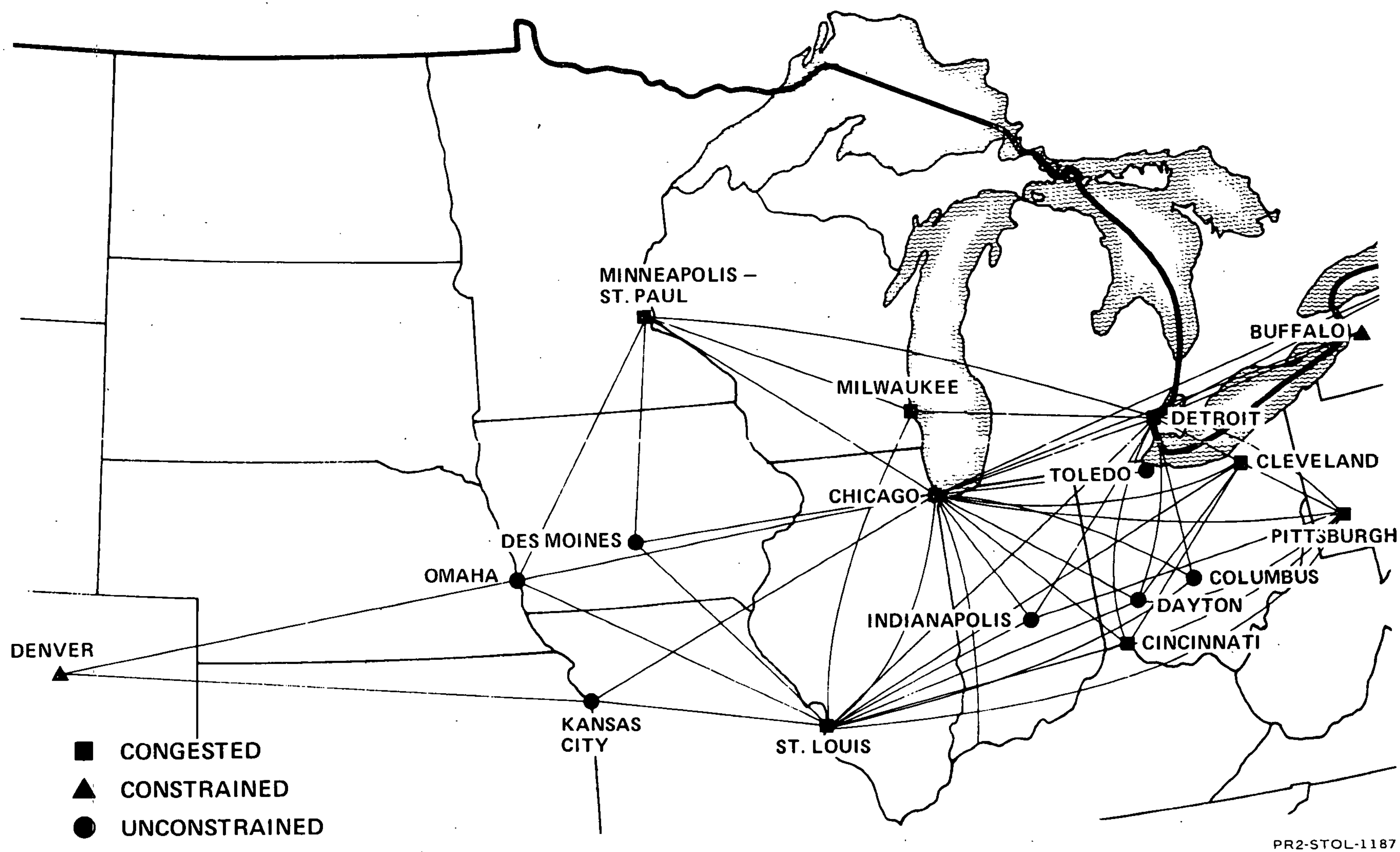


FIGURE 1-11

TABLE 1-7

SELECTED STOL AIRPORTS
EXPANDED NORTHEAST REGION - 1985

CITY	AIRPORT	CODE
BOSTON	HANSCOM FIELD	BED
BOSTON	NORWOOD	OWD
BUFFALO	GREATER BUFFALO	BUF
CINCINNATI	GREATER CINCINNATI	CVG
CLEVELAND	BURKE LAKEFRONT	BKL
COLUMBUS	PORT COLUMBUS	CMH
DETROIT	DETROIT CITY	DET
HARTFORD	HARTFORD-BRAINARD	HFD
NEW YORK	WESTCHESTER CO.	HPN
NEW YORK	ISLIP MACARTHUR	ISP
NEW YORK	SECAUCUS	SEC
NORFOLK	NORFOLK REGIONAL	ORF
PITTSBURGH	ALLEGHENY COUNTY	AGC
PHILADELPHIA	NO. PHILADELPHIA	PNE
PROVIDENCE	GR. PROVIDENCE	PVD
ROCHESTER	MONROE COUNTY	ROC
SYRACUSE	C. E. HANCOCK	SYR
WASHINGTON	WASHINGTON NATIONAL	DCA

1985
NORTHEAST REGION-PHASE II

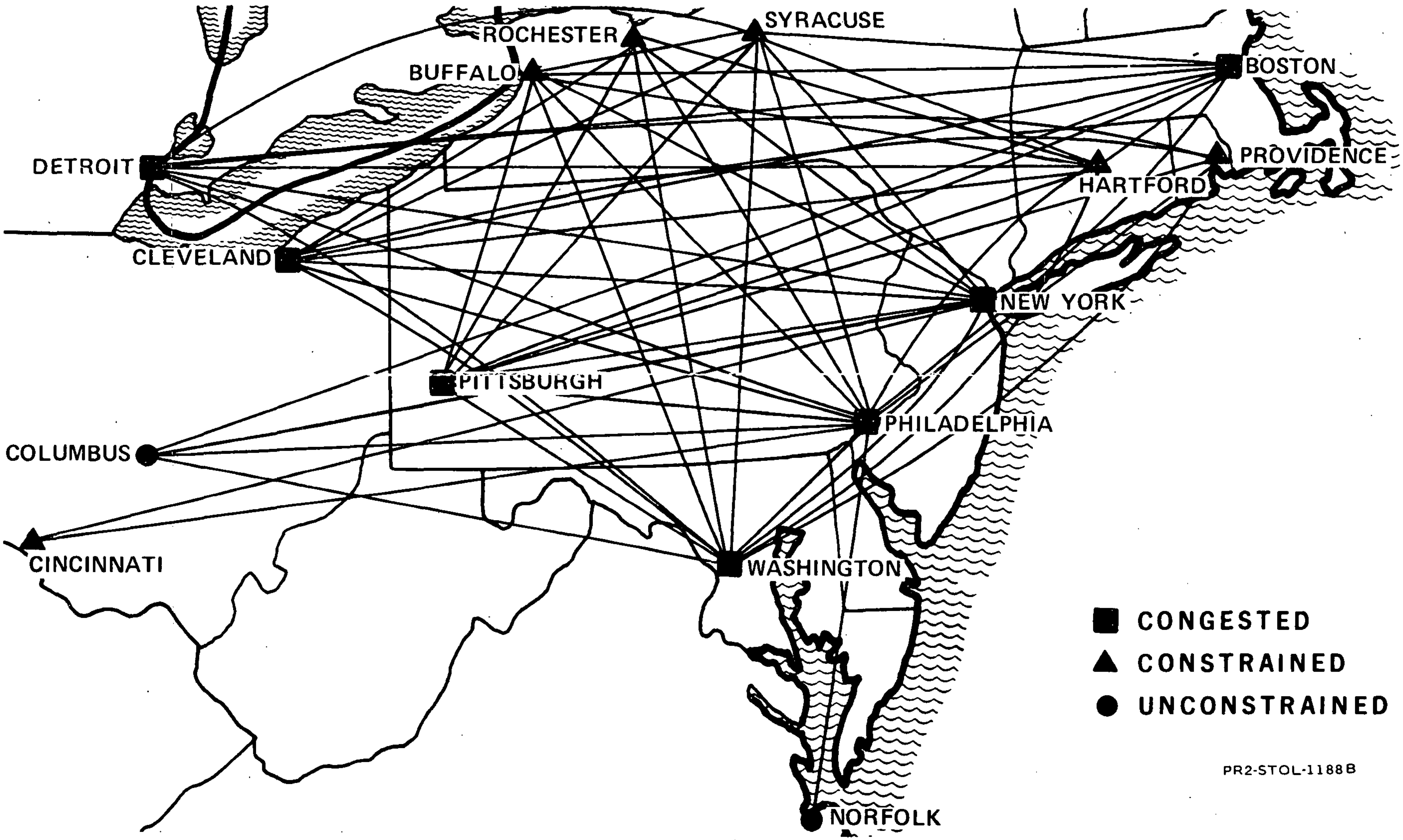


FIGURE 1-12

TABLE 1-8

SELECTED STOL AIRPORTS
EXPANDED CALIFORNIA REGION - 1985

CITY	AIRPORT	CODE
ALBUQUERQUE	ALBUQUERQUE SUNPORT	ABQ
DENVER	STAPLETON INT'L	DEN
EL MONTE	EL MONTE	EMT
EUREKA	ARCATA	ACV
FRESNO	FRESNO AIR TERMINAL	FAT
LAS VEGAS	MCCARRAN INT'L	LAS
LONG BEACH	DAUGHERTY FIELD	LGB
LOS ANGELES	GEN. PATTON FIELD	GPF
MONTEREY	MONTEREY PENINSULA	MRY
MOUNTAIN VIEW	MOFFETT FIELD	MOF
OAKLAND	NORTH FIELD	OAK
PHOENIX	PHOENIX SKY HARBOR	PHX
PORTLAND	PORTLAND INT'L	PDX
RENO	RENO INT'L	RNO
SACRAMENTO	SACRAMENTO EXEC	SAC
SALT LAKE CITY	SALT LAKE CITY INT'L	SLC
SAN DIEGO	MONTGOMERY FIELD	MYF
SAN JOSE	REID HILLVIEW	RHV
SANTA ANA	ORANGE COUNTY	SNA
SANTA BARBARA	SANTA BARBARA MUNI	SBA
TUCSON	TUCSON INT'L	TUS
VAN NUYS	VAN NUYS	VNY

1985
CALIFORNIA REGION - PHASE II

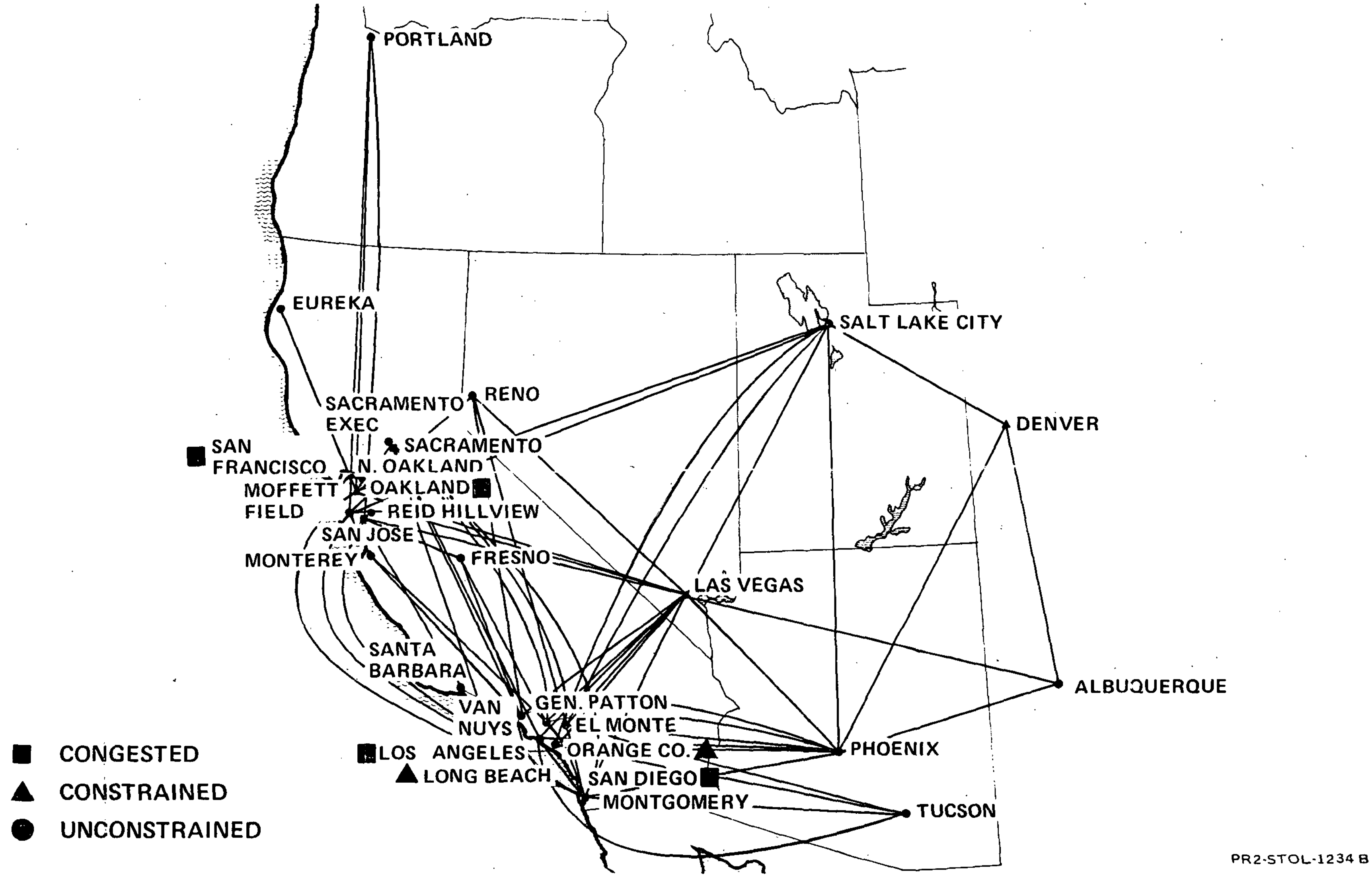


FIGURE 1-13

TABLE 1-9

SELECTED STOL AIRPORTS
SOUTHERN REGION - 1985

CITY	AIRPORT	CODE
ALBUQUERQUE	ALBUQUERQUE SUNPORT	ABQ
AMARILLO	AMARILLO AIR TERMINAL	AMA
AUSTIN	ROBERT MUELLER MUNICIPAL	AUS
CORPUS CHRISTI	CORPUS CHRISTI INT'L	CRP
DALLAS	DALLAS LOVE FIELD	DAL
DENVER	STAPLETON INT'L	DEN
EL PASO	EL PASO INT'L	ELP
HOUSTON	HOUSTON HOBBY	HOU
KANSAS CITY	KANSAS CITY MUNICIPAL	MKC
LITTLE ROCK	ADAMS FIELD	LIT
LUBBOCK	LUBBOCK REGIONAL	LBB
MEMPHIS	GEN. D. SPAIN	GDS
MIDLAND ODESSA	MIDLAND ODESSA REGIONAL	MAF
NEW ORLEANS	LAKEFRONT	NEW
OKLAHOMA CITY	WILL ROGERS WORLD	OKC
ST. LOUIS	BI STATE PARKS	CPS
SAN ANTONIO	SAN ANTONIO INT'L	SAT
SHREVEPORT	SHREVEPORT REGIONAL	SHV
TULSA	TULSA INT'L	TUL
WICHITA	WICHITA MUNICIPAL	ICT

1985
SOUTHERN REGION - PHASE II

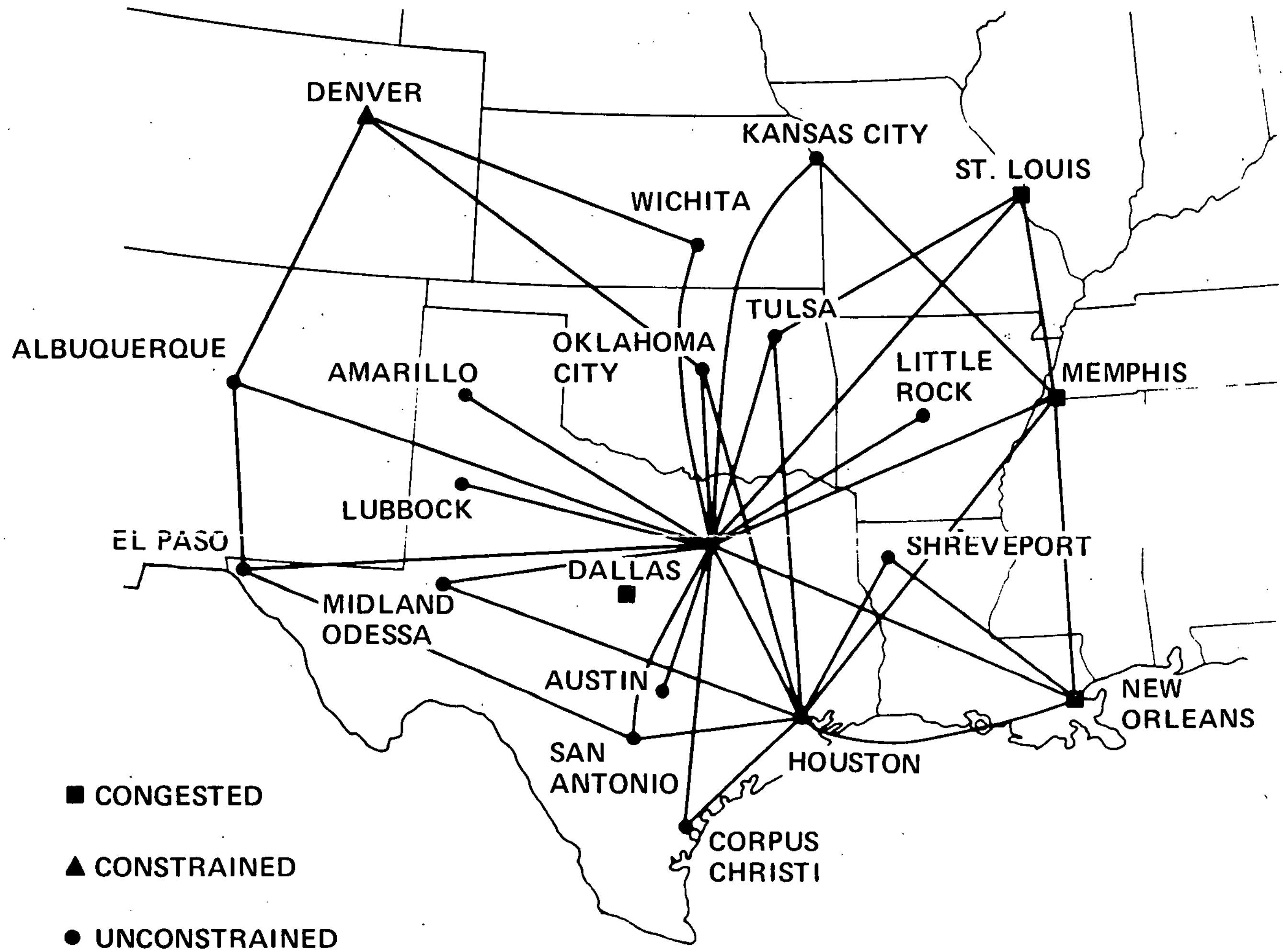


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FIGURE 1-14

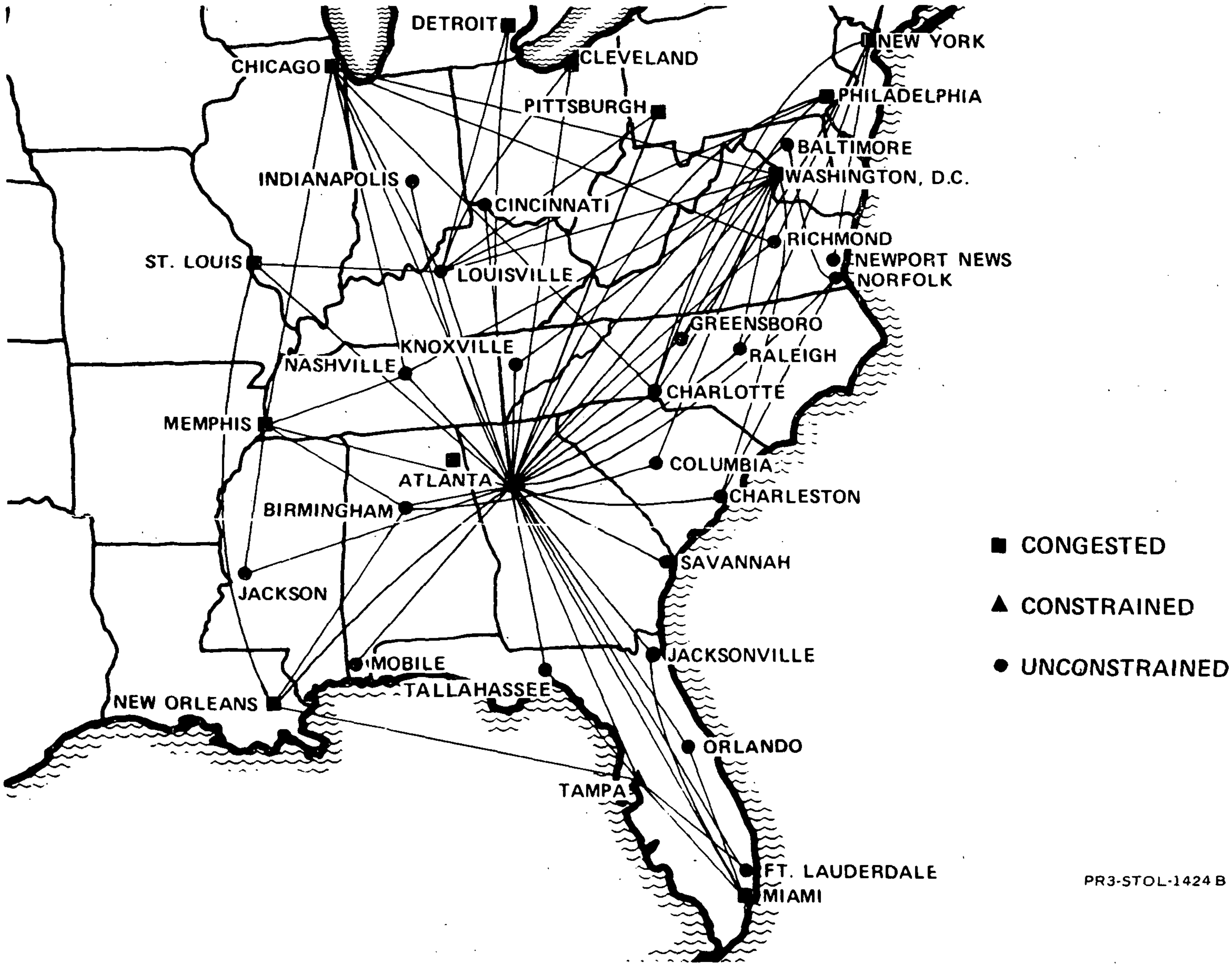
TABLE 1-10

SELECTED STOL AIRPORTS

SOUTHEAST REGION - 1985

CITY	AIRPORT	CODE
ATLANTA	DEKALB PEACHTREE	PDK
ATLANTA	FULTON CO.	FTY
BALTIMORE	BELTSVILLE	BEL
BIRMINGHAM	BIRMINGHAM MUNICIPAL	BHM
CHARLESTON	CHARLESTON MUNICIPAL	CHS
CHARLOTTE	DOUGLAS MUNICIPAL	CLT
CHICAGO	MEIGS	CGX
CINCINNATI	GREATER CINCINNATI	CVG
CLEVELAND	BURKE LAKEFRONT	BKL
COLUMBIA	COLUMBIA METROPOLITAN	CAE
DETROIT	DETROIT CITY	DET
FT. LAUDERDALE	HOLLYWOOD INTERNATIONAL	FLL
GREENSBORO	GREENSBORO HIGH PT.	GSO
INDIANAPOLIS	WEIR COOK	IND
JACKSON	A. C. THOMPSON FIELD	JAN
JACKSONVILLE	JACKSONVILLE INT'L	JAX
KNOXVILLE	MCGHEE TYSON	TYS
LOUISVILLE	STANDIFORD FIELD	SDF
MEMPHIS	GEN. D. SPAIN	GDS
MIAMI	OPA LOCKA	OPF
MOBILE	BATES FIELD	MOB
NASHVILLE	NASHVILLE METROPOLITAN	BNA
NEW ORLEANS	LAKEFRONT	NEW
NEW YORK	ISLIP MACARTHUR	ISP
NEW YORK	SECAUCUS	SEC
NEWPORT NEWS	PATRICK HENRY	PHF
NORFOLK	NORFOLK REGIONAL	ORF
ORLANDO	MCCOY AIR FORCE BASE	MCO
PHILADELPHIA	NO. PHILADELPHIA	PNE
PITTSBURGH	ALLEGHENY COUNTY	AGC
RALEIGH DURHAM	RALEIGH/DURHAM	RDU
RICHMOND	R. E. BYRD INT'L	RIC
ST. LOUIS	BI STATE PARKS	CPS
SAVANNAH	SAVANNAH MUNICIPAL	SAV
TALLAHASSEE	TALLAHASSEE MUNICIPAL	TLH
TAMPA	TAMPA INT'L	TPA
WASHINGTON, D. C.	WASHINGTON NATIONAL	DCA

1985
SOUTHEAST REGION - PHASE II



PR3-STOL-1424 B

FIGURE 1-15

TABLE 1-11

SELECTED STOL AIRPORTS
NORTHWEST REGION - 1985

CITY	AIRPORT	CODE
BOISE	BOISE AIR TERMINAL	BOI
EUGENE	MAHLON SWEET FIELD	EUG
OAKLAND	NORTH FIELD	OAK
PORTLAND	PORTLAND INTERNATIONAL	PDX
RENO	RENO INTERNATIONAL	RNO
SEATTLE	SEATTLE-TACOMA	SEA
SPOKANE	SPOKANE INTERNATIONAL	GEG

1985
NORTHWEST REGION - PHASE II

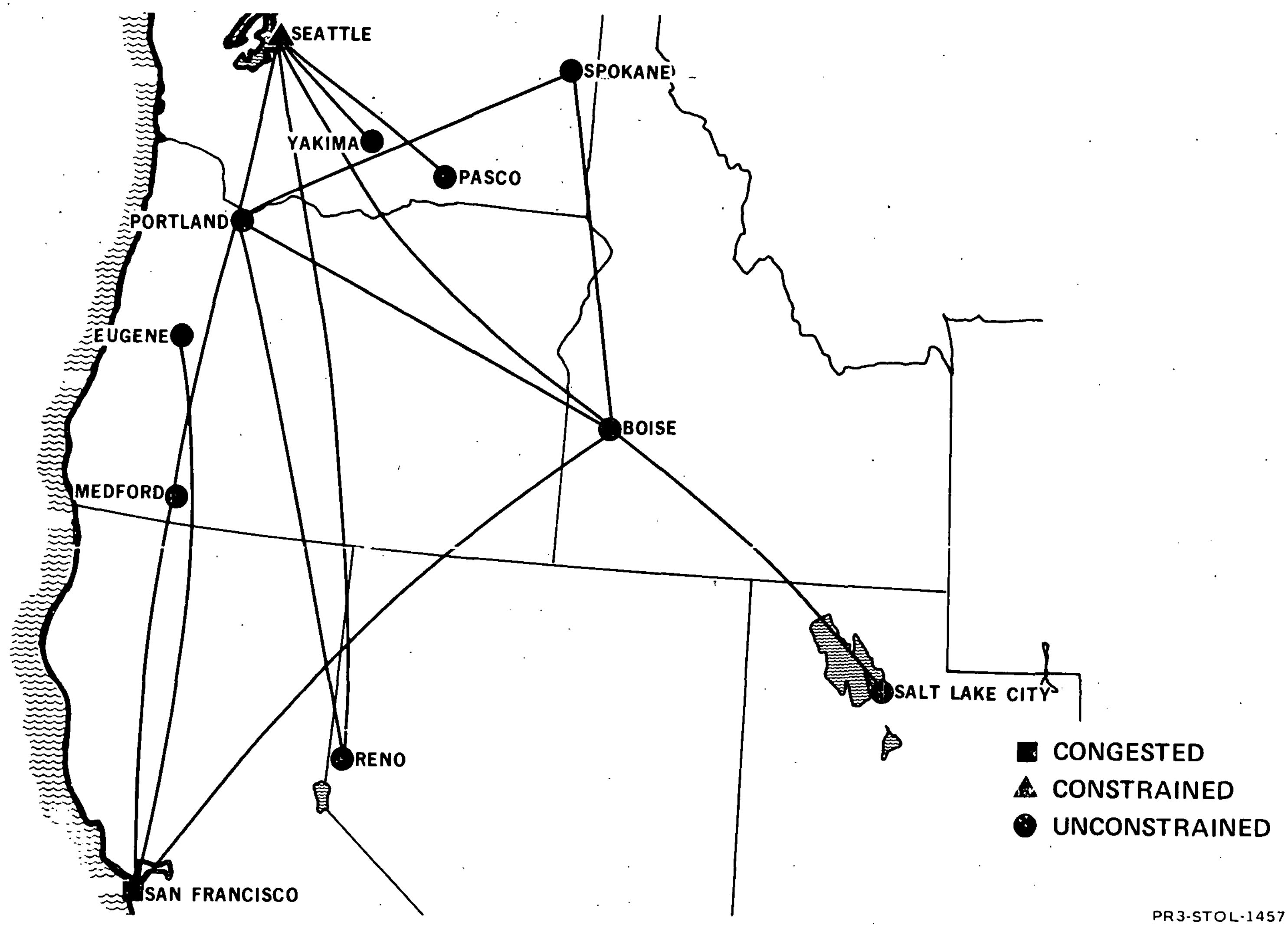


FIGURE 1-16

2.0 AIRPORT/AIRCRAFT COMPATIBILITY

2.1 Objectives and Output

The main objective of the airport/aircraft compatibility portion of the NASA STOL System Study is to evaluate the ability of the selected STOLport sites to adequately handle the projected STOL aircraft, the number of operations and the passenger demand in the 1985 time period. Accordingly, a study was conducted to determine STOLport requirements based on aircraft characteristics and to evaluate the sites required to support STOL service. In addition, pertinent data were compiled for the selected STOLport sites from airport master plans, FAA Airport Master Records (FAA Form 5010-1), FAA Air Traffic Activity summaries and other FAA/airport documents as part of the airport physical data base.

The main output of the airport/aircraft compatibility evaluation is to identify airport deficiencies, both on the airside and landside, that are associated with the introduction of STOL service in 1985. Costs to correct these deficiencies were determined during the costing phase.

Airport/aircraft compatibility is shown in the flow diagram on Figure 2-1, in relation with the overall airport system evaluation. The inputs and the outputs of the compatibility evaluation are shown in Figure 2-2. STOLport requirements are discussed in Section 2.2 with a detailed airport/aircraft compatibility evaluation discussed in Section 2.3.

2.2 STOLport Requirements

2.2.1 STOL Aircraft Evolution - The aircraft analysis studies have resulted in three distinct families of STOL aircraft. These are described as follows:

- Phase I Parametric Aircraft - over 200 parametric aircraft were generated during the Phase I effort. These aircraft represented a matrix of propulsive lift concepts, seating capacity and field length requirements. Propulsion data were provided by engine manufacturers under contract to NASA-Lewis. All of the Phase I aircraft were designed to achieve a 95 PNdB sideline noise level at 500 ft. (152 m). The Phase I aircraft were initially screened and 20 remained for the systems analysis.

AIRPORT STUDIES

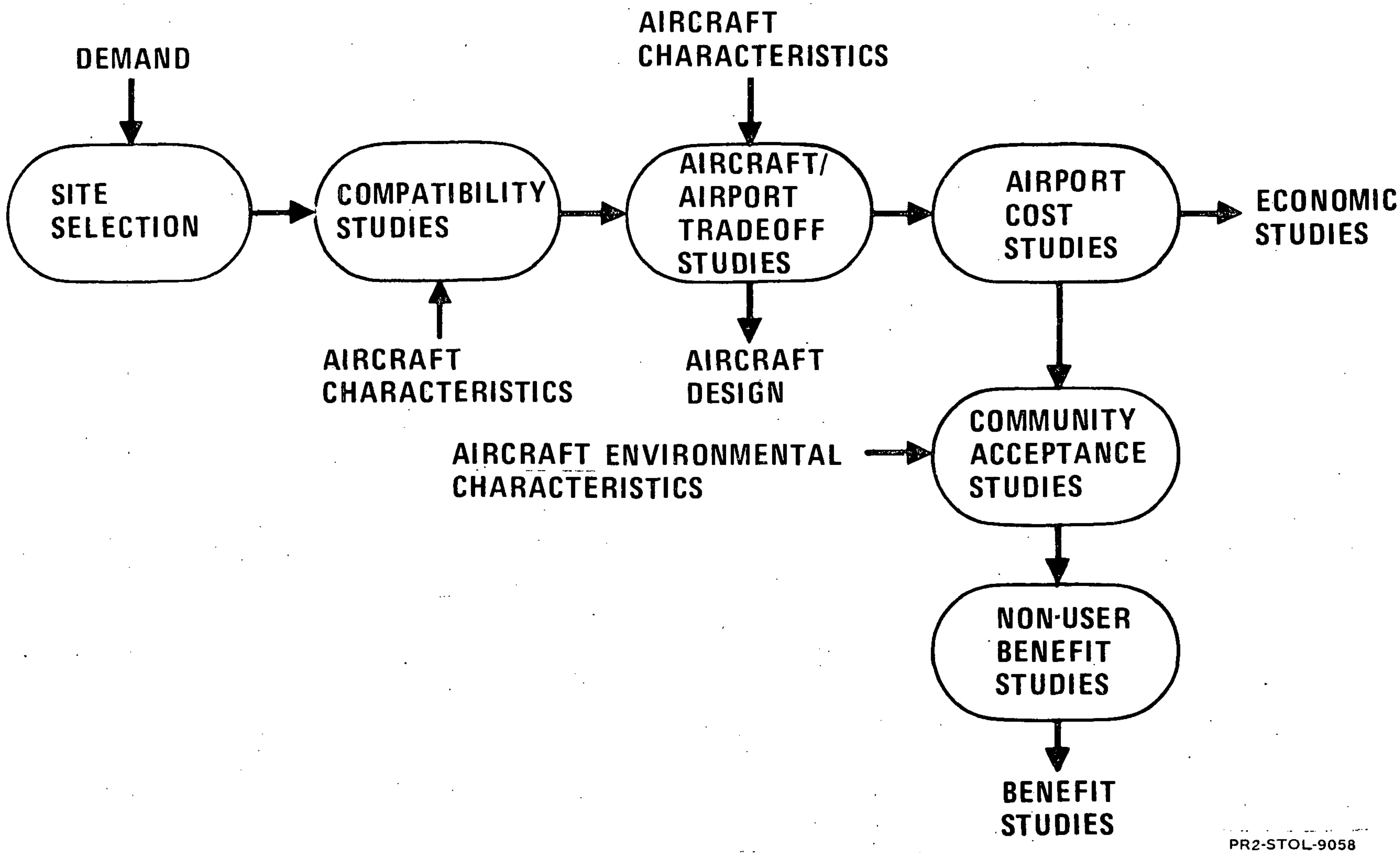


FIGURE 2-1

AIRPORT/AIRCRAFT COMPATIBILITY

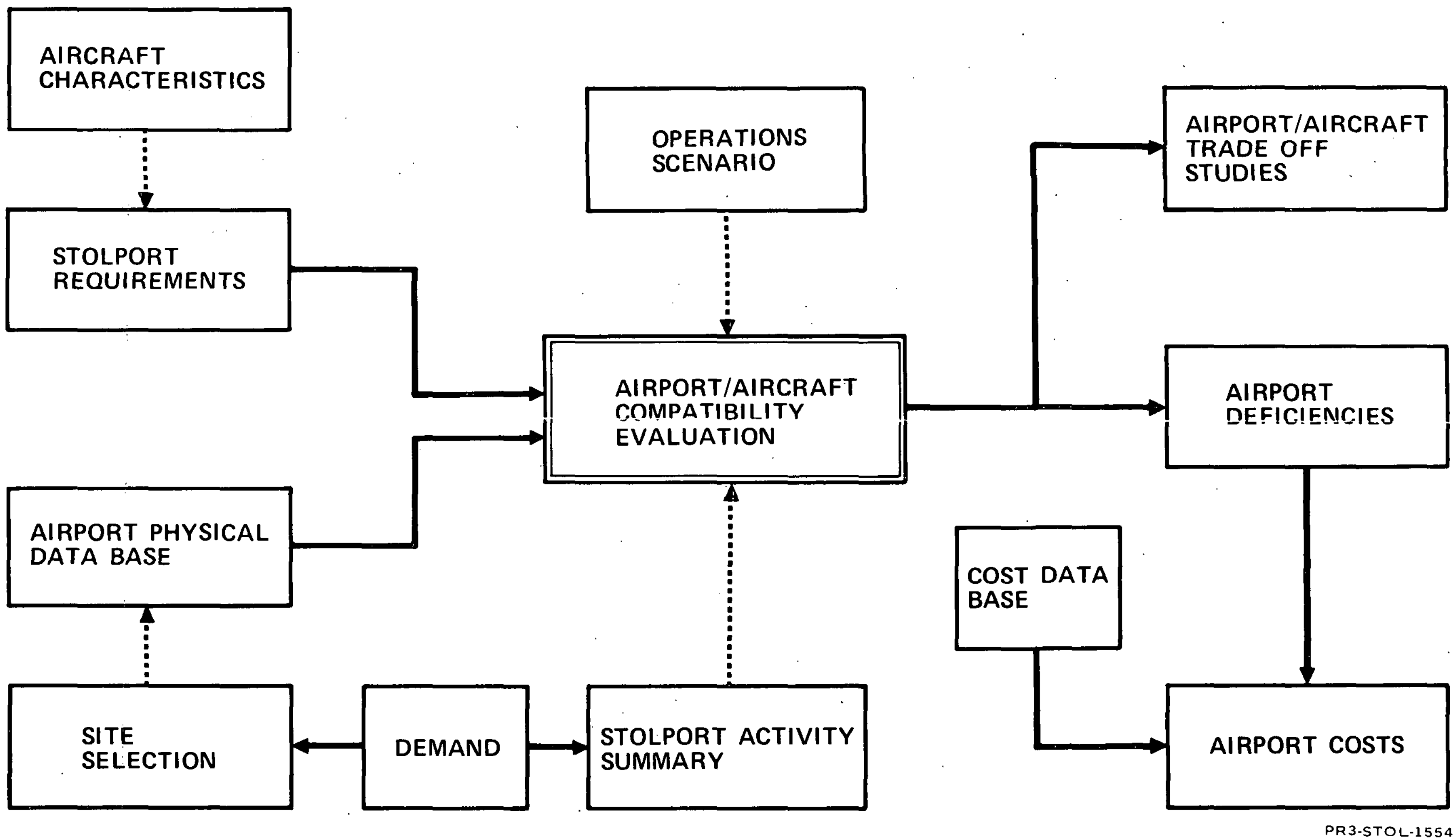


Figure 2-2

With further screening by systems analysis procedures and selection criteria, 8 aircraft were selected for detailed Phase II studies.

- Phase II Systems Analysis Aircraft - The 8 aircraft selected for detailed Phase II study are shown in Table 2-1. These aircraft were resized with the latest propulsion and aerodynamic data and represent a cross section of propulsive lift concepts, seating capacities and field length requirements. These aircraft were designed to the 95 EPNdB sideline noise criteria at 500 feet (152 m). Of these eight aircraft, the EBF 150 passenger 3000 feet (914 m) field length STOL is designated as the baseline aircraft for all system analysis evaluation.

- Phase II Aircraft Analysis Aircraft - Results of several aircraft tradeoff studies indicated that significant gains could be realized by specific design changes. The most significant change involved a small relaxation (1-1/2 to 2 units) of the 95 EPNdB sideline noise criteria at 500 feet (152 m). The results of the increased noise level aircraft were significant reductions in aircraft weight, engine thrust requirement and direct operating cost. These airplanes are referred to as Phase II final design aircraft.

2.2.2 Analytical Approach - The introduction of STOL operation in 1985 will have an impact on both the airside and landside requirements at an airport. Aircraft characteristics and operational concepts will be reflected in various airside requirements such as runway/taxiway areas and pavement strengths, runway capacity, ATC requirements, terminal ground servicing and the environment. STOL passenger demand and airline fleet schedules will affect landside requirements such as passenger processing areas, vehicle parking and surface accessibility. A list of the airside and landside requirements which will be determined is given below:

Table 2-1

CANDIDATE AIRCRAFT

FOR SYSTEMS ANALYSIS

FIELD LENGTH	PASSENGERS		
	100	150	200
2000		AUGMENTOR WING EXTERNALLY BLOWN FLAP OVER-THE-WING	
3000	EXTERNALLY BLOWN FLAP	EXTERNALLY BLOWN FLAP MECHANICAL FLAP	EXTERNALLY BLOWN FLAP
4000		MECHANICAL FLAP	

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- Airside
  - Runway length
  - Runway/taxiway width and separation distance
  - Gate and ramp area
  - Runway capacity
  - Crosswind limitations
  - Flotation
  - ATC requirements
  - Engine exhaust wake velocities and temperature
  - Airspace
  - Trailing vorticies effect
  - Environment
  - Maintenance
- Landside
  - Passenger baggage and cargo processing
  - Vehicle parking
  - Surface accessibility

The airside environmental aspects are discussed in Section 6 - Non-User Benefits and Community Acceptance. Maintenance concepts are discussed in Volume VI - Systems.

STOLport requirements will be determined for the 8 Phase II Systems Analysis aircraft, with emphasis placed on the baseline EBF 150 passenger 3000 ft. (914 m) field length STOL aircraft. Requirements will also be determined for the Phase II Aircraft Analysis EBF 150 passenger 3000 ft. (914 m) field length STOL and will be compared with the requirements of the baseline aircraft at the end of the Section 2.2.

2.2.3 Airside Requirements

2.2.3.1 STOL Aircraft Description. For a complete description of each aircraft in Phase II, reference is made to Volume II - Aircraft. General STOL characteristics in terms of aircraft dimensions and operational weights are summarized for the 8 systems analysis aircraft in Tables 2-2 and 2-3 respectively. A typical general arrangement layout for the baseline EBF 150 passenger STOL is shown as Figure 2-3.

Table 2-2

GENERAL AIRCRAFT CHARACTERISTICS - DIMENSIONS

PHASE II STOL AIRCRAFT

LIFT CONCEPT		EBF				MF		AW	USB
SEATING CAPACITY FIELD LENGTH (FT/M) MACH NUMBER – CRUISE		100 3000/914 0.67	150 3000/914 0.68	200 3000/914 0.70	150 2000/610 0.68	150 3000/914 0.71	150 4000/1219 0.76	150 2000/610 0.79	150 2000/610 0.70
AIRCRAFT LENGTH	FT–IN.	116–9	132-4	155–0	150–6	138–10	129–4	148–10	161–8
	M	35.59	40.21	47.24	45.87	42.32	39.42	45.36	49.28
AIRCRAFT HEIGHT	FT–IN.	34–2	41–8	48–6	54–7	43–4	38–0	52–8	60–1
	M	10.41	12.70	14.78	16.64	13.21	11.58	16.05	18.31
WING SPAN	FT–IN.	94–6	114–4	133–1	157–6	147–9	117–2	126–9	178–5
	M	28.80	34.85	40.56	48.01	45.03	35.71	38.63	54.38
STABILIZER SPAN	FT–IN.	39–2	44–6	53–4	57–11	50–0	40–0	59–10	78–4
	M	11.94	13.56	16.26	17.65	15.24	12.19	18.24	23.88
WHEEL BASE	FT–IN.	41–8	40–8	55–6	48–10	48–10	48–10	48–6	48–10
	M	12.70	12.40	16.92	14.88	14.88	14.88	14.78	14.88
WHEEL TREAD	FT–IN.	18–4	20–6	22–0	20–10	20–10	20–10	21–0	28–0
	M	5.59	6.25	6.71	6.35	6.35	6.35	6.40	8.53
WHEEL TREAD – TO OUTSIDE OF TIRES	FT–IN.	22–0	23–5	25–8	24–6	24–3	24–3	24–8	32–5
	M	6.71	7.14	7.82	7.47	7.39	7.39	7.52	9.88

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Table 2-3

GENERAL AIRCRAFT CHARACTERISTICS - WEIGHT

PHASE II STOL AIRCRAFT

LIFT CONCEPT		EBF				MF		AW	USB
SEATING CAPACITY		100	200	150	150	150	150	150	150
FIELD LENGTH (FT/M)		3000/914	3000/914	3000/914	2000/610	3000/914	4000/1219	2000/610	2000/610
MACH NUMBER – CRUISE		0.67	0.70	0.68	0.68	0.71	0.76	0.79	0.70
MAXIMUM RAMP WEIGHT	POUNDS	112,200	163,800	221,900	206,700	178,800	154,550	211,770	233,340
	KILOGRAMS	50,894	74,300	100,654	93,759	81,104	70,104	96,059	105,843
MAXIMUM TAKEOFF WEIGHT	POUNDS	111,700	163,300	221,400	206,200	178,300	154,050	211,270	232,840
	KILOGRAMS	50,667	74,073	100,427	93,532	80,877	69,877	95,832	105,616
MAXIMUM LANDING WEIGHT	POUNDS	111,700	163,300	221,400	206,200	178,300	154,050	211,270	232,840
	KILOGRAMS	50,667	74,073	100,427	93,532	80,877	69,877	95,832	105,616
ZERO FUEL WEIGHT	POUNDS	98,130	143,750	195,640	181,900	158,280	135,920	177,310	206,600
	KILOGRAMS	44,512	65,205	88,742	82,510	71,796	61,653	80,428	93,714
OPERATORS EMPTY WEIGHT	POUNDS	78,130	113,750	155,640	151,900	128,280	105,920	147,310	176,600
	KILOGRAMS	35,440	51,597	70,598	68,902	58,188	48,045	66,820	80,106
MAXIMUM FUEL CAPACITY	U.S. GALLONS	2,120	3,100	4,030	3,850	3,180	2,880	5,390	4,100
	LITERS	8,024	11,734	15,254	14,572	12,036	10,901	20,401	15,519

PR3-STOL-1649

GENERAL ARRANGEMENT
150 PASSENGERS - 3000 FT FIELD LENGTH
EBF

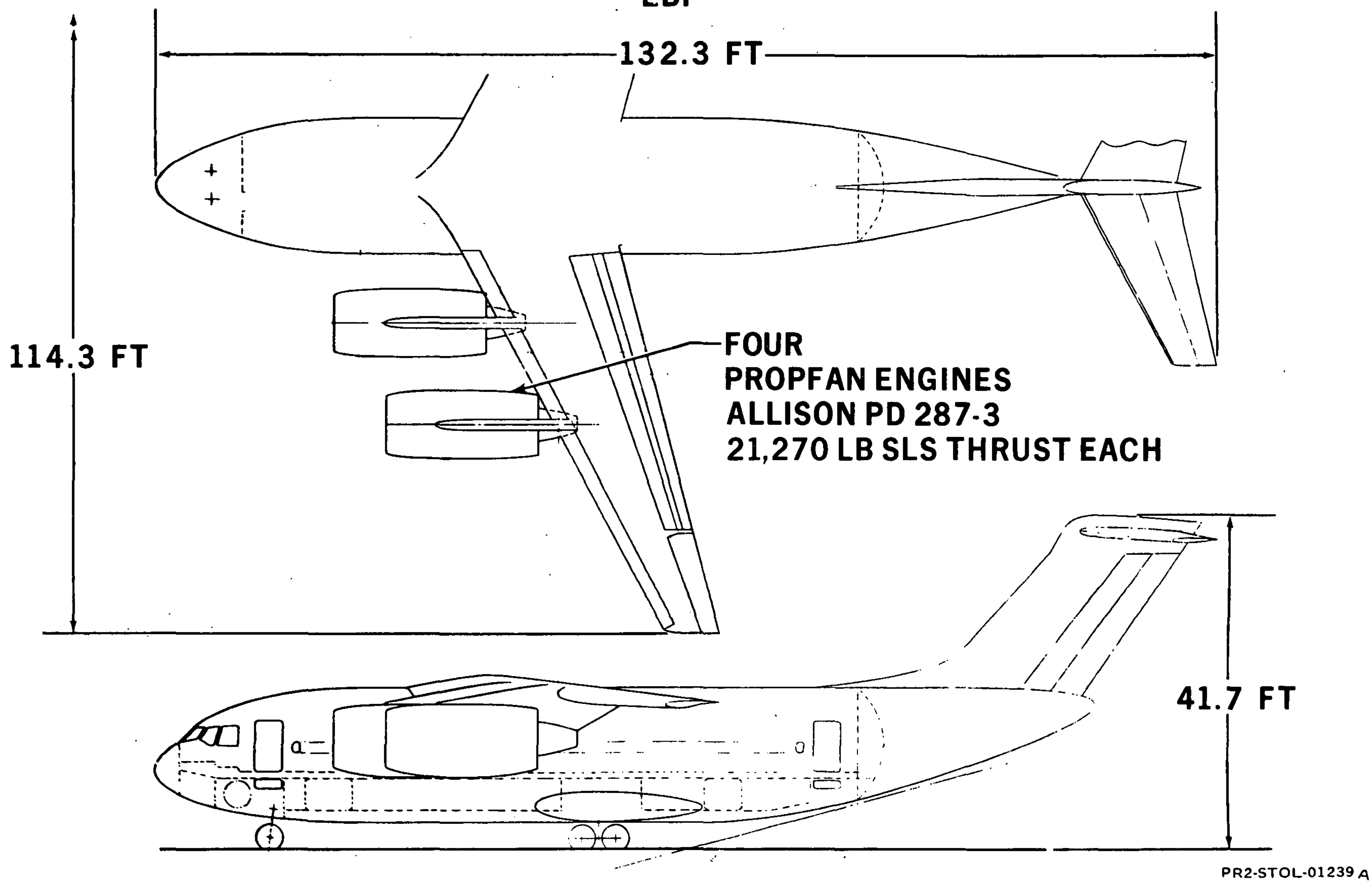


Figure 2-3

2.2.3.2 Runway Length. The Phase II matrix of STOL airplanes considered runway length requirements of 2000 ft. (610 m), 3000 ft. (914 m) and 4000 ft. (1219 m). The takeoff field length requirement is defined as the greater of:

- o 1.15 x all engine takeoff distance to a height of 35 ft. (10.7m).
- o Distance to 35 ft. (10.7m) height with critical engine failure at V_1.
- o Distance to accelerate to V_1 and then decelerate to a stop.

The landing field length is defined as the landing distance over a 35 ft. (10.7m) obstacle at the end of the runway divided by a 0.6 factor. The landing distance ground rules are shown on Figure 2-4. The overall field length requirement is governed by the longer of the takeoff length or the landing length.

For a more complete description of field length requirement and its derivation, reference is made to Volume II - Aircraft.

2.2.3.3 Runway/Taxiway Width and Separation Distance.

2.2.3.3.1 Runway Width. Statistical analysis of lateral touchdown dispersion for 96 simulated IFR landings of the Breguet 188-914S STOL aircraft conducted at NAFEC resulted in a mean lateral touchdown of -5 ft. (1.5m) and three standard deviations of 24 ft. (7.3m). The results are presented as Figure 2-5. The Breguet 188-941S utilized a 7-1/2 degree glideslope ($\pm$ 2 degree softness) on a 1500 ft. (457.2m) STOL strip marked on an existing runway at NAFEC. Runway width requirements presented on Fiqure 2-6 were determined considering this dispersion, the outside to outside landing gear tread dimension and the desire to maintain at least 15 ft. (4.6m) clearance between the outside edge of the outer main landing gear tire and the edge of the pavement. At STOLports which have a crosswind problem, it may be desirable to increase the required runway width by assuming a larger edge of pavement to tire clearance.

LANDING FIELD LENGTH DEFINITION

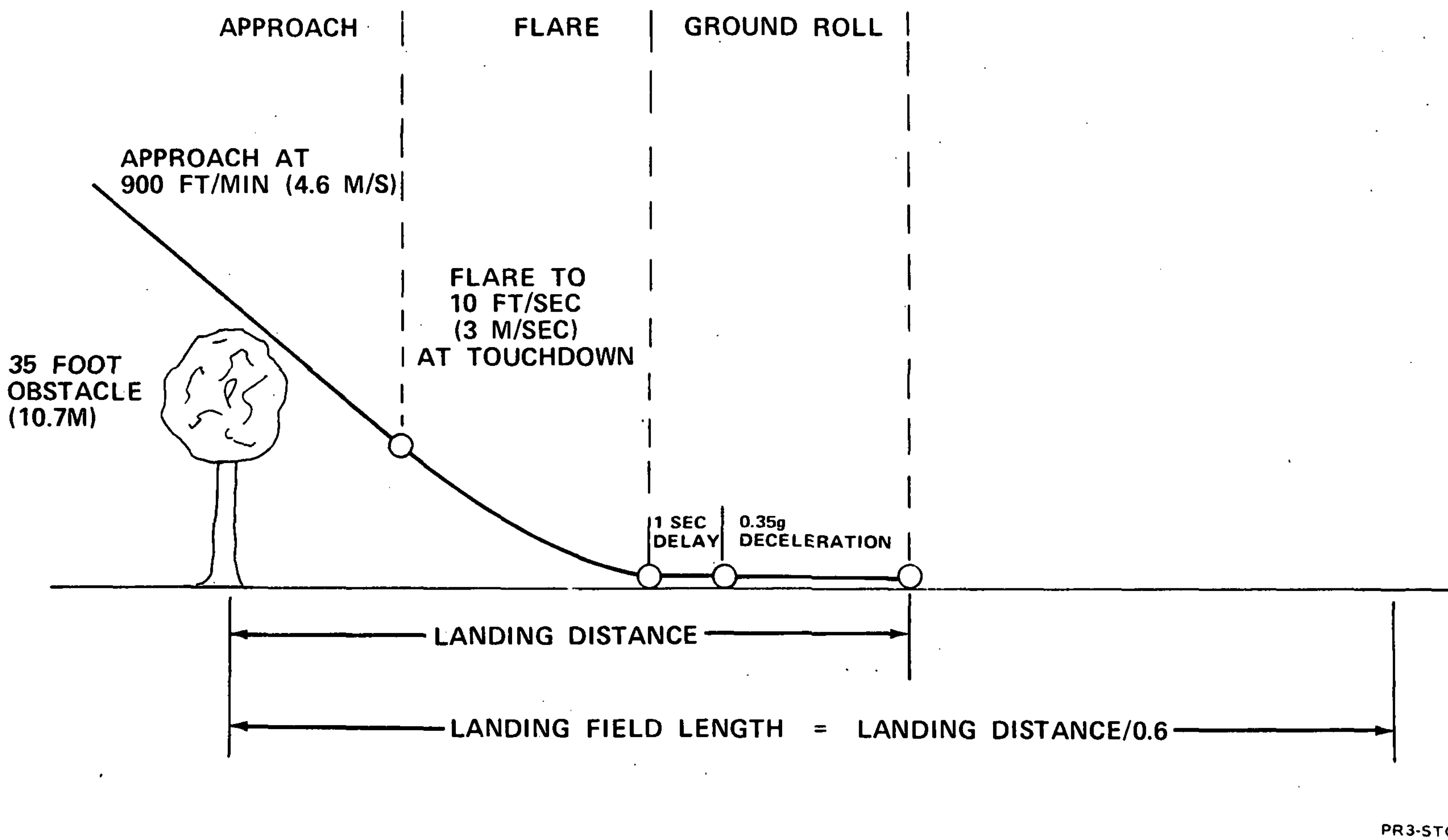


Figure 2-4

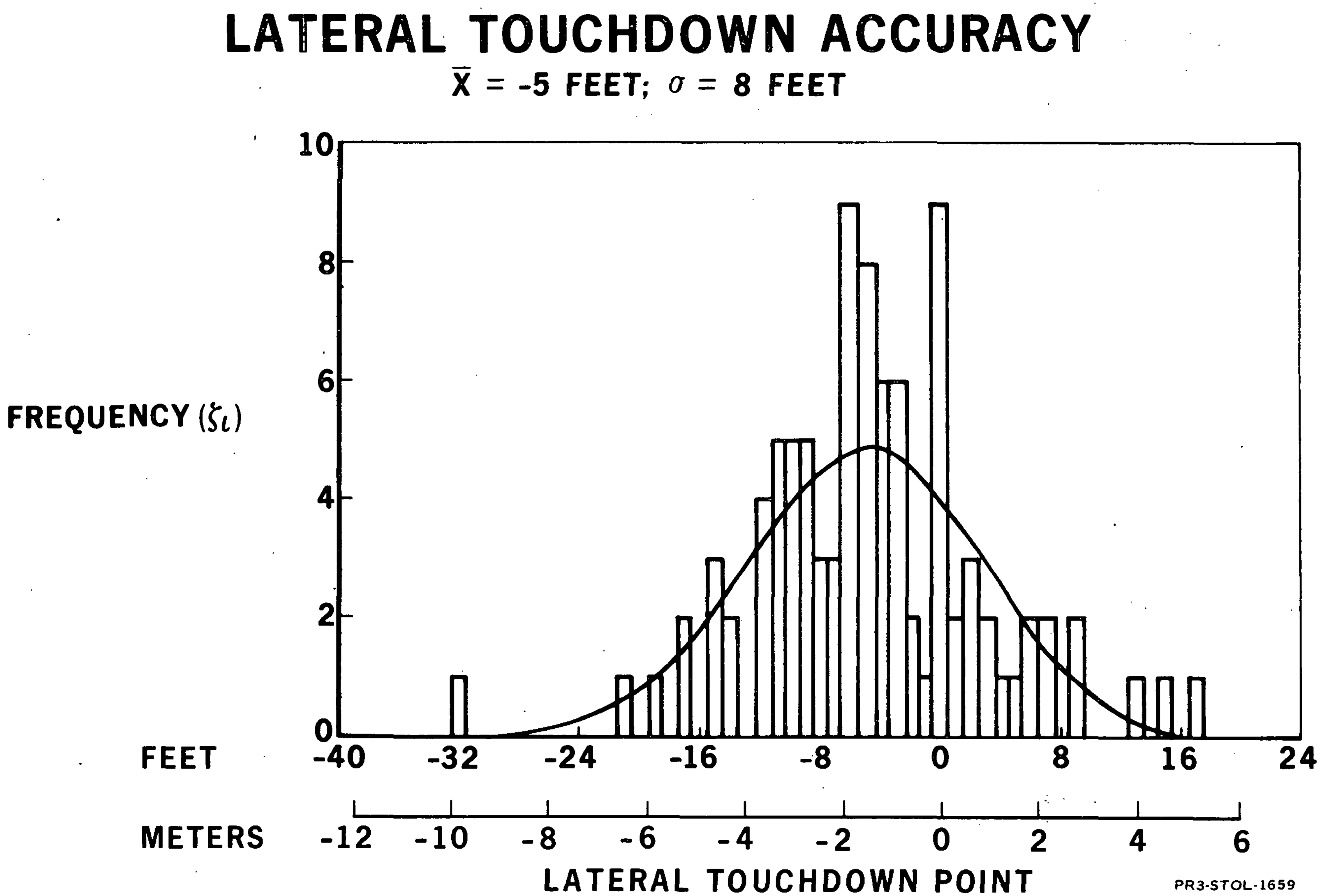

LATERAL TOUCHDOWN ACCURACY
X̄ = -5 FEET; σ = 8 FEET
FREQUENCY (ζl)
10
8
6
4
2
0
FEET
-40
-32
-24
-16
-8
0
8
16
24
METERS
-12
-10
-8
-6
-4
-2
0
2
4
6
LATERAL TOUCHDOWN POINT
PR3-STOL-1659

Figure 2-5

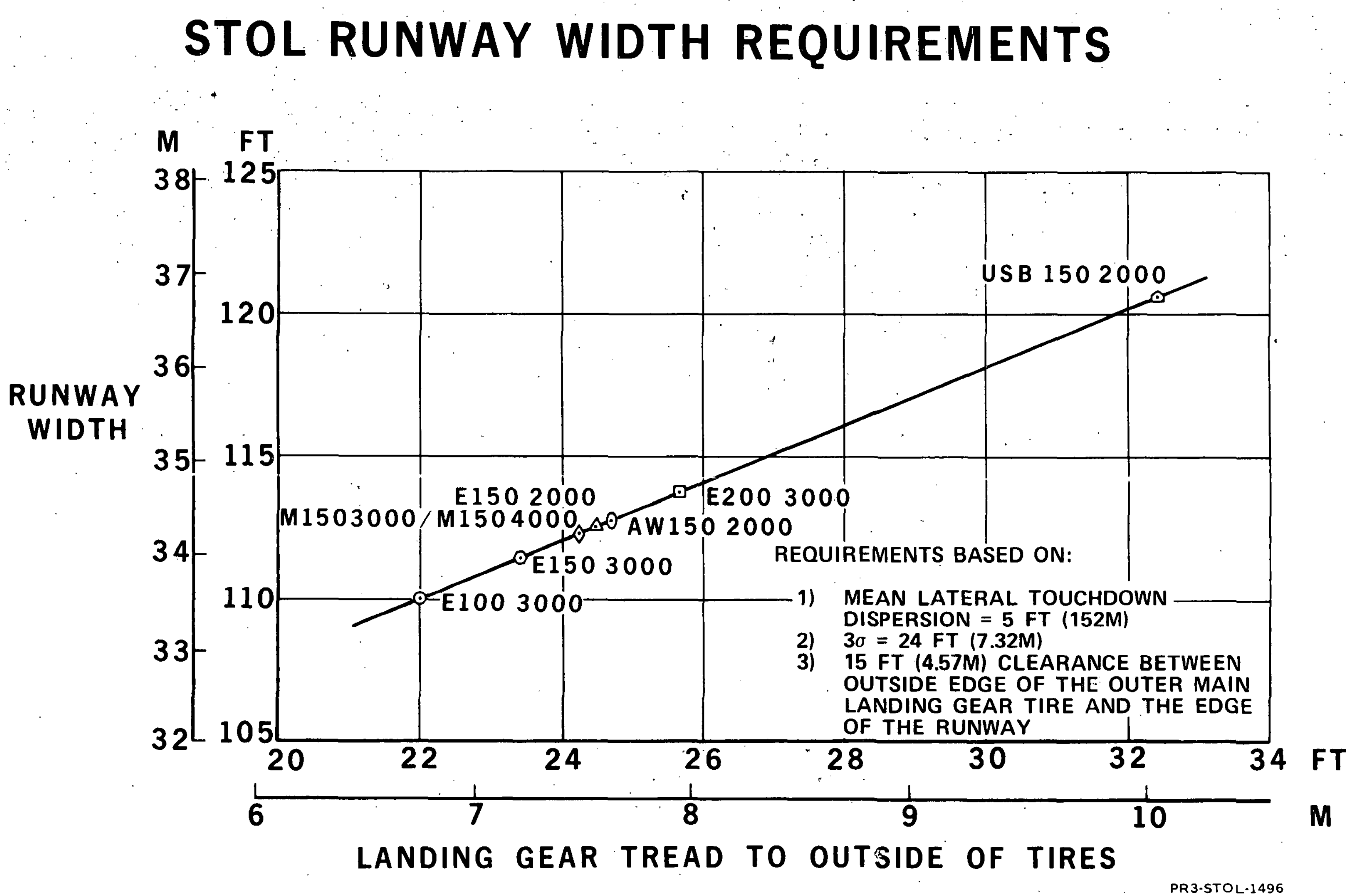

STOL RUNWAY WIDTH REQUIREMENTS
RUNWAY WIDTH
M
FT
38
37
36
35
34
33
32
125
120
115
110
105
USB 150 2000
E200 3000
E150 2000
M1503000/M1504000
AW150 2000
E150 3000
E100 3000
REQUIREMENTS BASED ON:
1) MEAN LATERAL TOUCHDOWN DISPERSION = 5 FT (152M)
2) 3σ = 24 FT (7.32M)
3) 15 FT (4.57M) CLEARANCE BETWEEN OUTSIDE EDGE OF THE OUTER MAIN LANDING GEAR TIRE AND THE EDGE OF THE RUNWAY
20
22
24
26
28
30
32
34
FT
6
7
8
9
10
M
LANDING GEAR TREAD TO OUTSIDE OF TIRES
PR3-STOL-1496

Figure 2-6

2.2.3.3.2 Taxiway Width. Taxiway width requirements shown in Figure 2-7 are based on the desire to maintain 15 ft. (4.6m) clearance between the outside edge of the outer main landing gear tire and the edge of the taxiway pavement with the aircraft taxiing down the center of the taxiway.

2.2.3.3.3. Runway/Taxiway Separation. Separation distances between runway and taxiways are presented in Figure 2-8. These requirements are based on the runway and taxiway widths shown on Figures 2-6 and 2-7. It is assumed that the outside edge of the outer main landing gear tire of passing aircraft are on the edge of both runway and taxiway pavements. The wing tip clearance of the two passing aircraft is 165 ft. (50.3m), which is typical of DC-8 Series 63 operation on CTOL airports designed to the FAA standard of 400 ft. (121.9m) separation.

2.2.3.3.4 Taxiway/Taxiway Separation. Separation distances between parallel taxiways are shown on Figure 2-9. These requirements are based on the desire to maintain 15 ft. (4.6m) clearance between wing tips of passing aircraft with the outside edge of the outer main landing gear tire on the edge of both taxiway pavements. The taxiway widths shown on Figure 2-7 were used in the determination of separation distance.

2.2.3.4 Gate and Ramp Area Requirements. It is assumed that STOL aircraft will be parked at the terminal in such a manner that towing in or out of the gate position will not be required. This requirement is necessary to provide the minimum turnaround and through stop terminal times. Parallel - power out parking is assumed for the initial requirements. As STOL service increases, it may be desirable to improve the efficiency of the ramp area utilization by nose-in tow-out parking.

Gate requirements are based on the desire to maintain 25 ft. (7.6m) aircraft to aircraft and building clearance during parking maneuvers. A 10 ft. (3.1m) forward travel of the nose gear straight ahead before and after the parked position is also assumed. The gate depth requirements are shown on Figure 2-10. Gate width requirements are shown on Figure 2-11.

Gate requirements for nose-in tow-out parking are also based on the desire to maintain 25 ft. (7.6m) aircraft to aircraft and building clearance during parking maneuvers. The gate depth and width requirements

STOL TAXIWAY WIDTH REQUIREMENTS

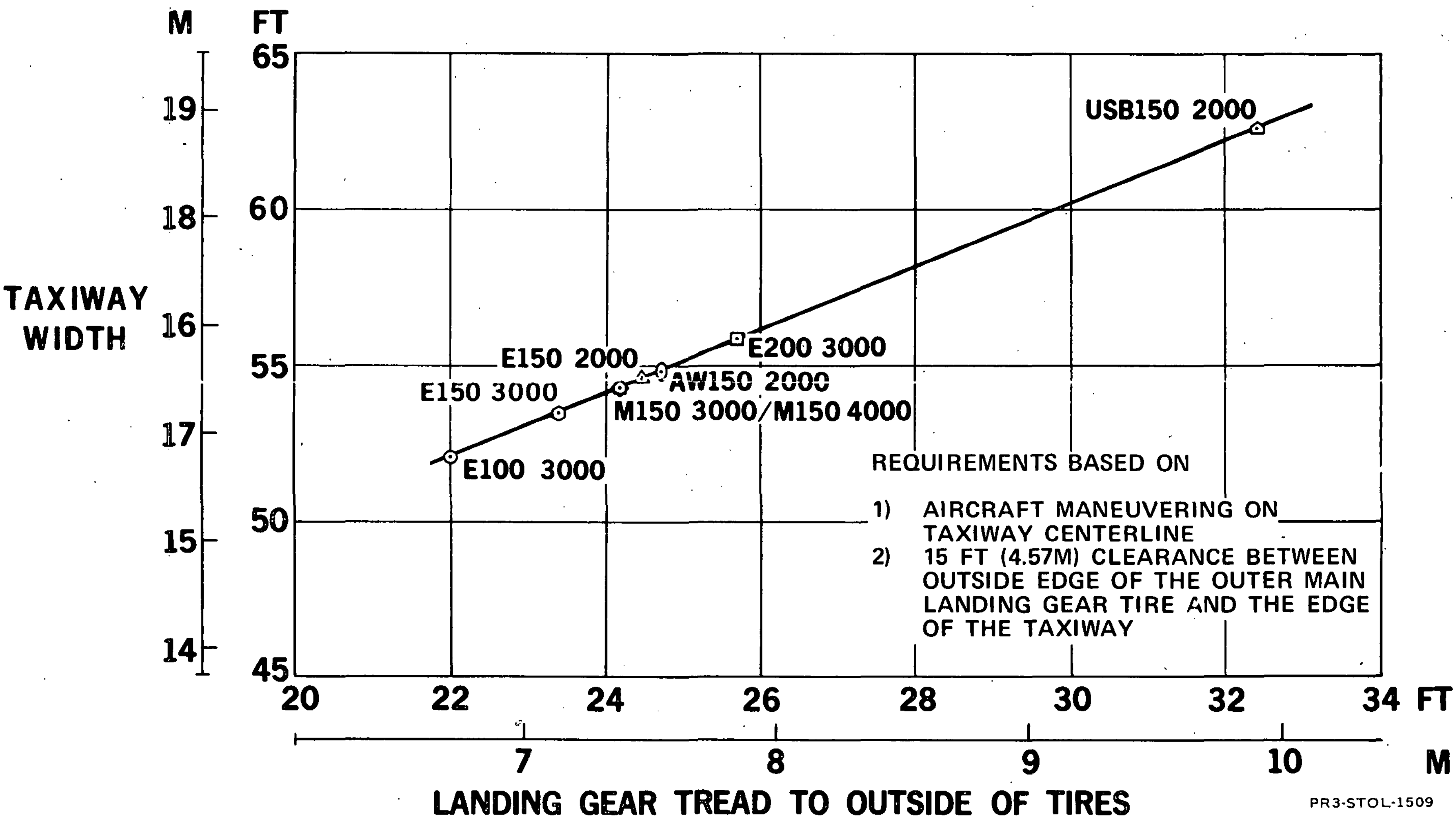


Figure 2-7

STOL RUNWAY/TAXIWAY SEPARATION REQUIREMENTS

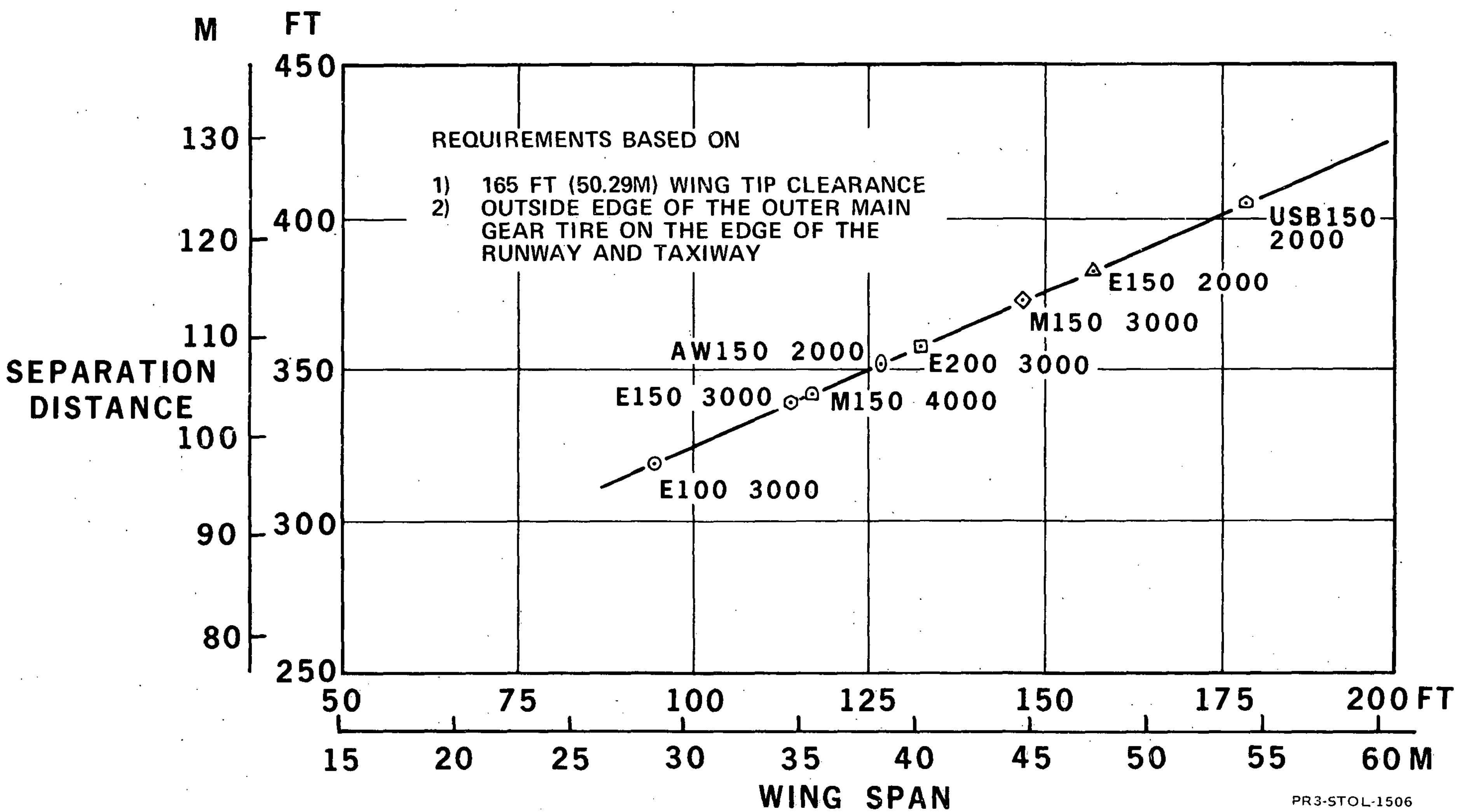


Figure 2-8

STOL TAXIWAY/TAXIWAY SEPARATION REQUIREMENTS

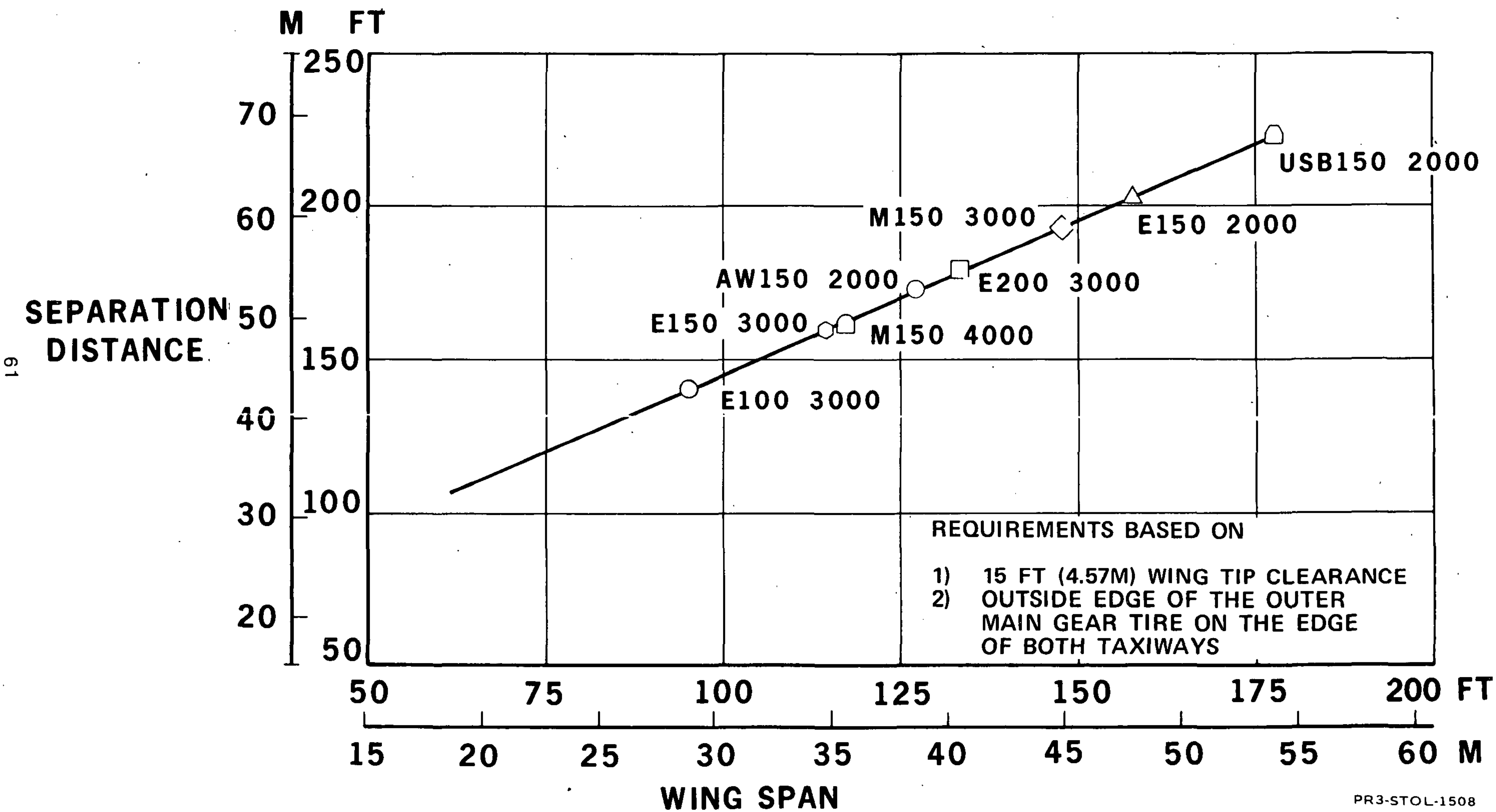


Figure 2-9

STOL GATE DEPTH REQUIREMENTS

PARALLEL - POWER OUT PARKING

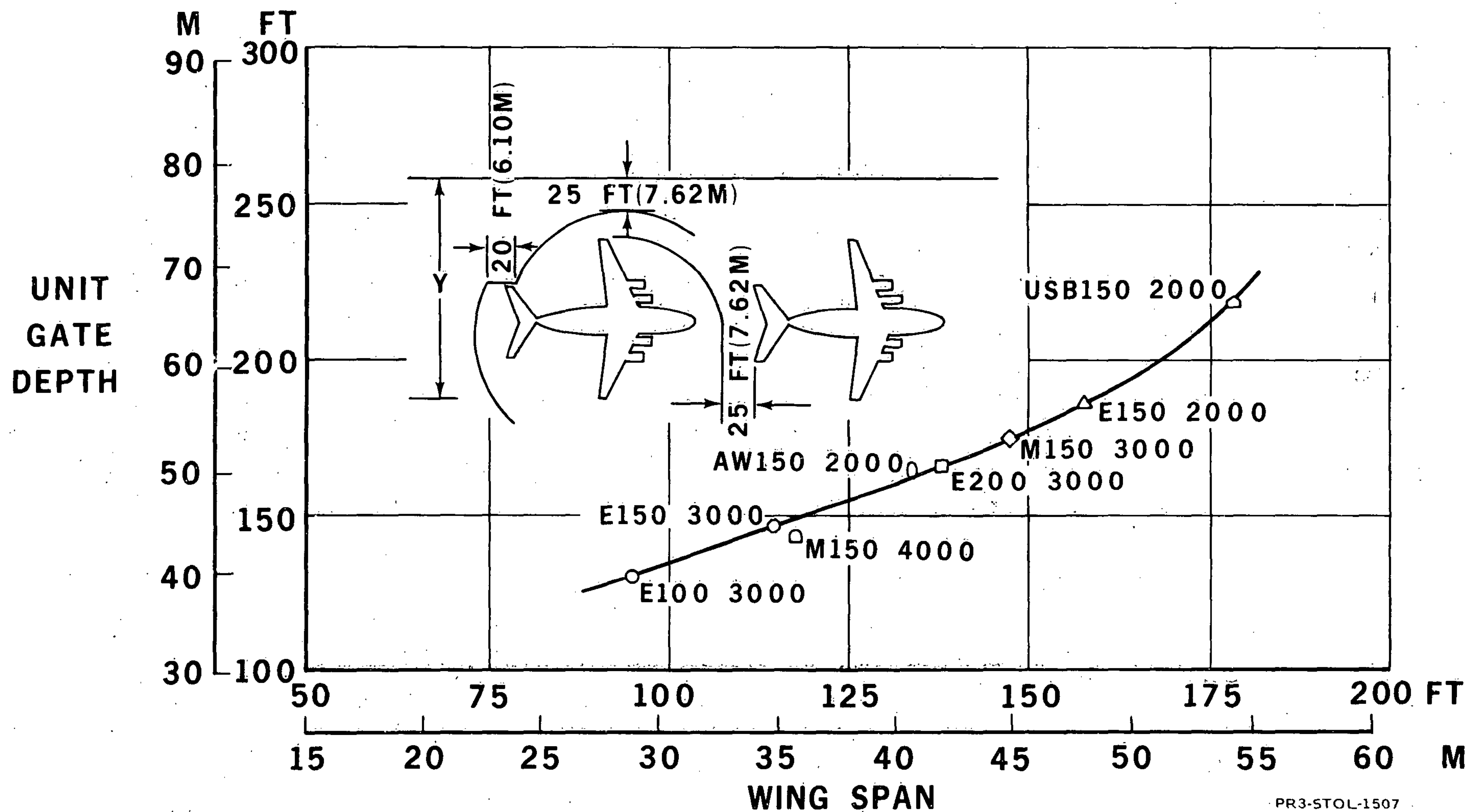


Figure 2-10

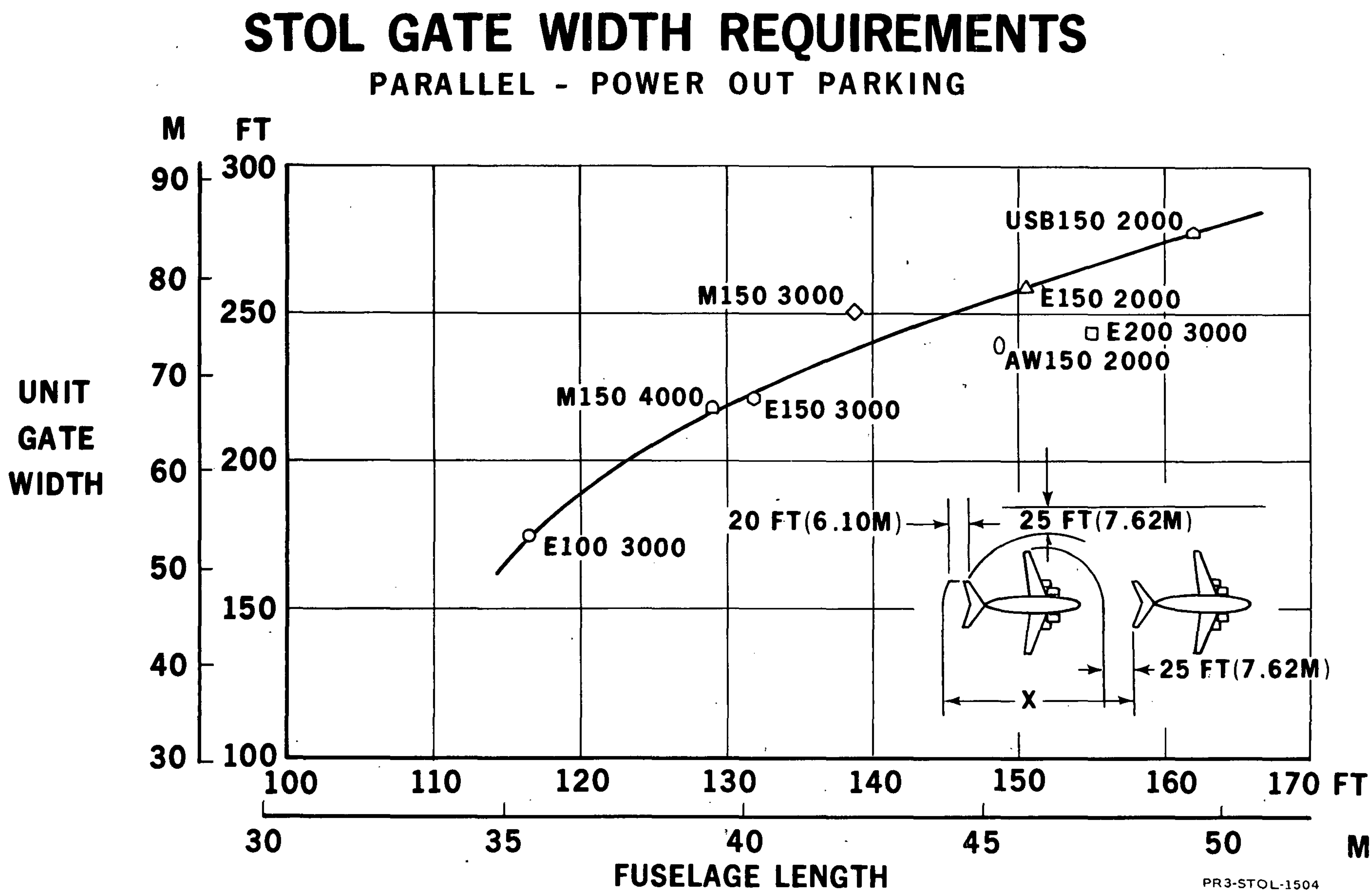

STOL GATE WIDTH REQUIREMENTS
PARALLEL - POWER OUT PARKING
UNIT GATE WIDTH
M
FT
90
80
70
60
50
40
30
300
250
200
150
100
USB150 2000
M150 3000
E150 2000
E200 3000
AW150 2000
M150 4000
E150 3000
E100 3000
20 FT(6.10M)
25 FT(7.62M)
25 FT(7.62M)
X
100
110
120
130
140
150
160
170 FT
30
35
40
45
50
M
FUSELAGE LENGTH
PR3-STOL-1504

Figure 2-11

are shown on Figures 2-12 and 2-13, respectively.

Ramp depth requirements are shown on Figure 2-14. The requirements are based on maintaining 25 ft. (7.6m) wing tip clearance between the taxiing aircraft and the stationary aircraft and 40 ft. (12.2m) wing tip clearance between the two moving aircraft.

2.2.3.5 Gate Occupancy Time and Terminal Ground Servicing

2.2.3.5.1 Gate Occupancy Time. To further realize additional time savings benefits to the STOL traveler, turnaround and through stop terminal operations should be kept at a minimum. Phase I airline fleet requirements were determined based on airline fleet schedules using a turnaround time of 30 minutes for all seating capacity aircraft. In Phase II, airline fleet schedules were derived considering the following gate occupancy time characteristics.

- Turnaround times of 20 minutes for 100 and 150 seat aircraft and 25 minutes for 200 seat aircraft.
- Through stop times of 15 minutes for 100 and 150 and 20 minutes for 200 seat aircraft, respectively.

The above turnaround and through stop times were deemed adequate for STOL operation in the 1985 time period by the consulting airlines associated with this study.

Figures 2-15 and 2-16 are the turnaround and through stop terminal operations for the baseline 150 passenger EBF STOL aircraft. They are also applicable to all 150 passenger aircraft in the Phase II study. The figures were constructed based on the system goals mentioned previously and with the following assumptions:

Turnaround Operation

- 100% passenger load factor deplaning and enplaning.
- APU inoperative - which requires ground power, air start and preconditioned air vehicles.
- No containerized baggage loading.
- 1.5 bags per passenger.

STOL GATE DEPTH REQUIREMENTS

NOSE-IN TOW-OUT PARKING

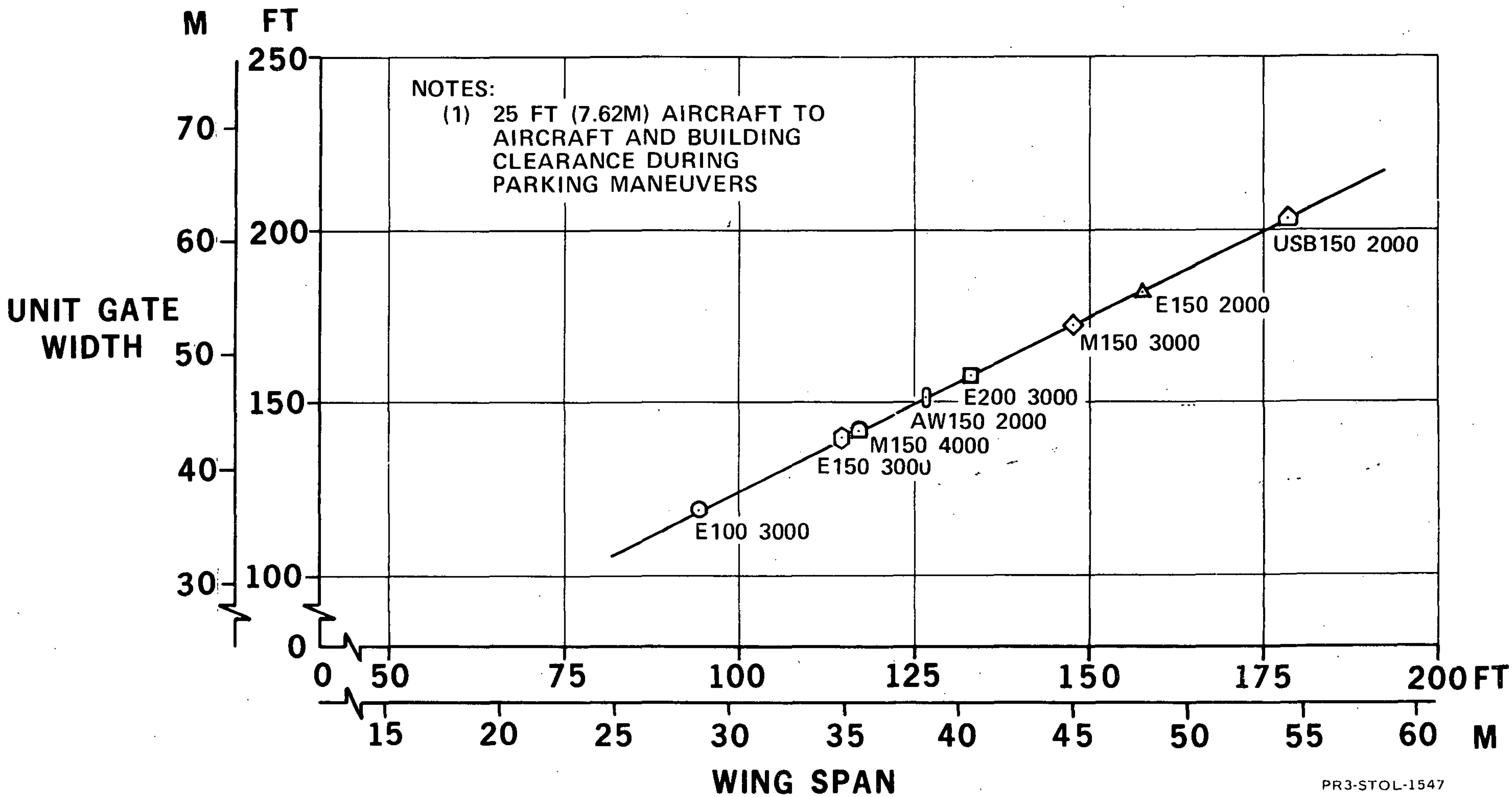


Figure 2-12

STOL GATE WIDTH REQUIREMENTS

NOSE-IN TOW-OUT PARKING

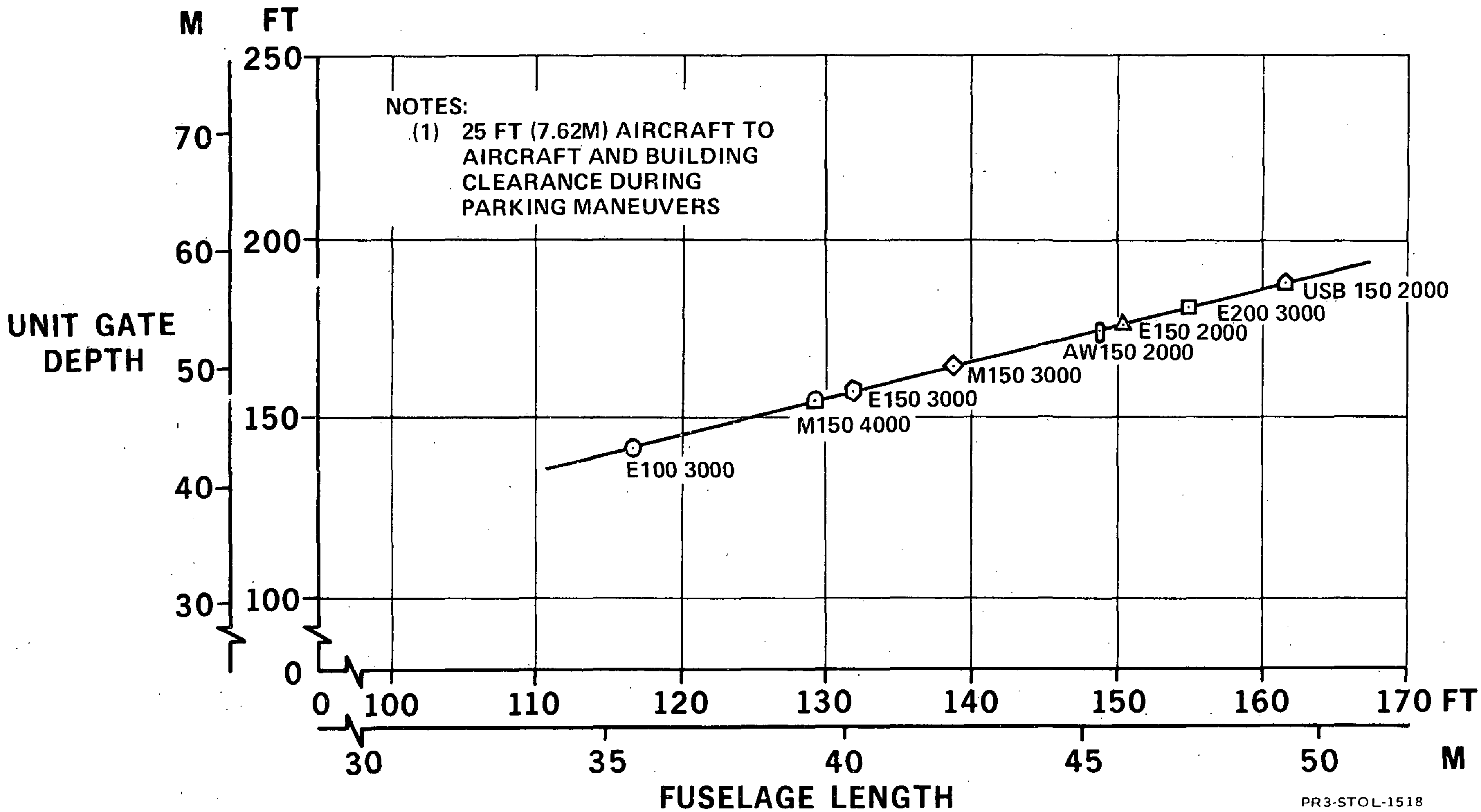


Figure 2-13

STOL RAMP DEPTH REQUIREMENTS

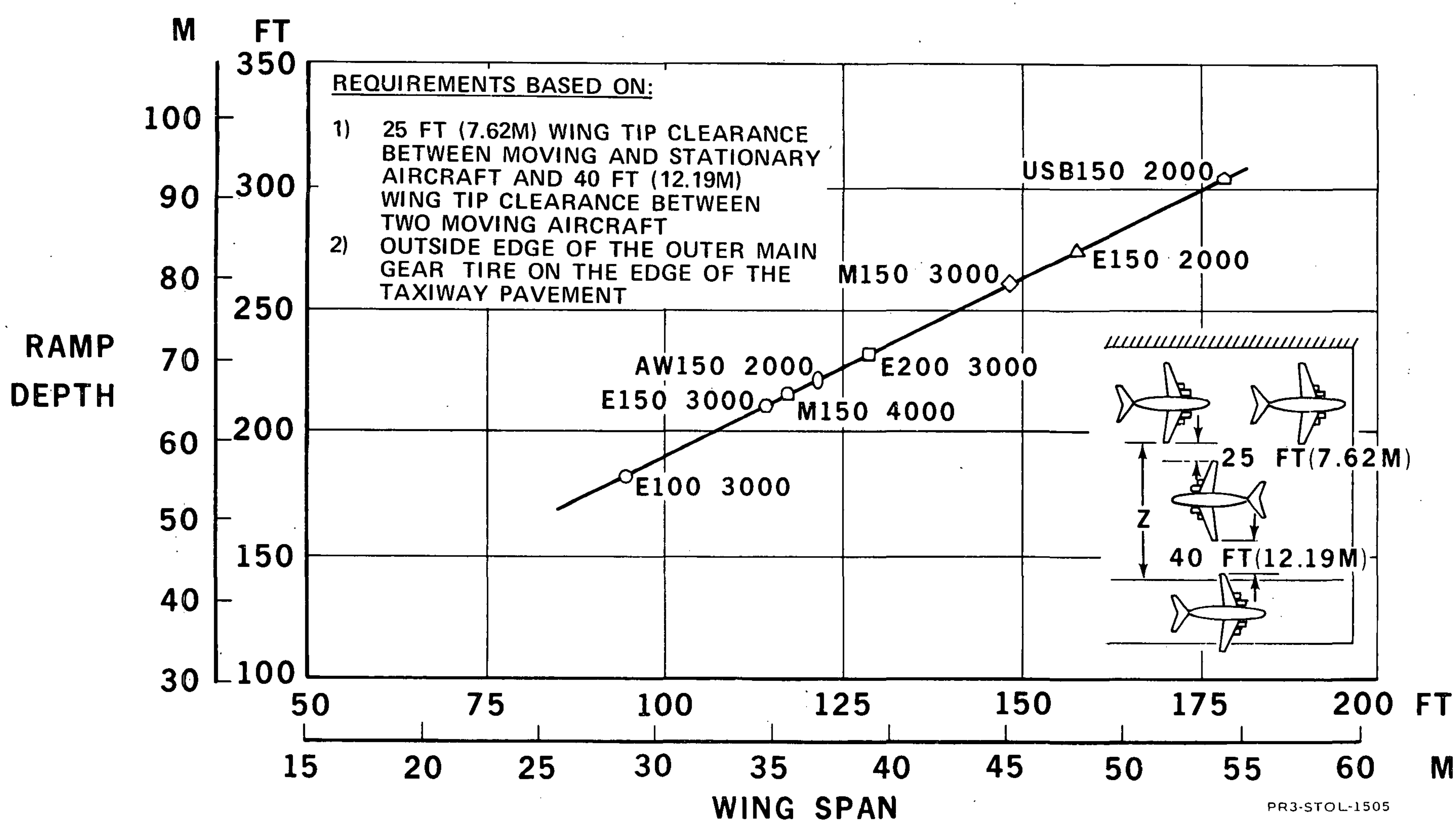


Figure 2-14

TERMINAL OPERATION - TURNAROUND STATION

EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

OPERATION	TIME (MIN)
ATTACH GROUND POWER	0.5
ENGINE RUNDOWN	1.0
EXTEND AIRSTAIRS	0.5
ATTACH AIR START	1.0
ATTACH CONDITIONED AIR	1.0
DEPLANE PASSENGERS (2 DOORS)	3.6
CHECK LOGBOOK	1.5
OFF-LOAD BAGGAGE (1)	6.8
BUFFET SERVICE	9.0
LAVATORY SERVICE	7.3
WATER SERVICE	8.4
CABIN SERVICE (2)	7.9
FUEL AIRCRAFT (3)	8.8
WALK-AROUND INSPECTION	9.0
LOAD BAGGAGE (1)	8.7
CHECK LOGBOOK	1.5
ENPLANE PASSENGERS (2 DOORS)	4.5
REMOVE CONDITIONED AIR	1.0
RETRACT AIRSTAIRS	0.5
MONITOR ENGINE START	3.0
REMOVE AIR START	1.0
REMOVE GROUND POWER	0.5
CLEAR AIRCRAFT FOR DEPARTURE	1.0

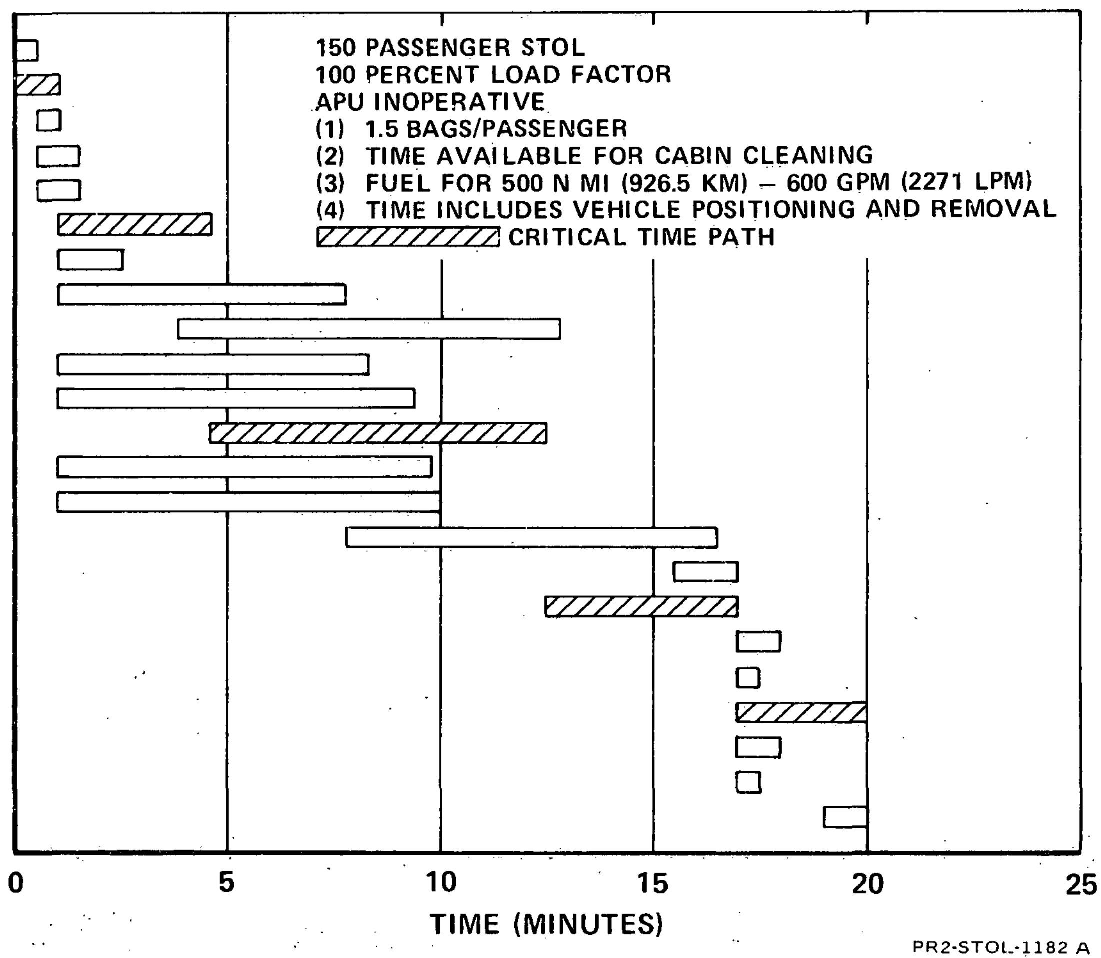
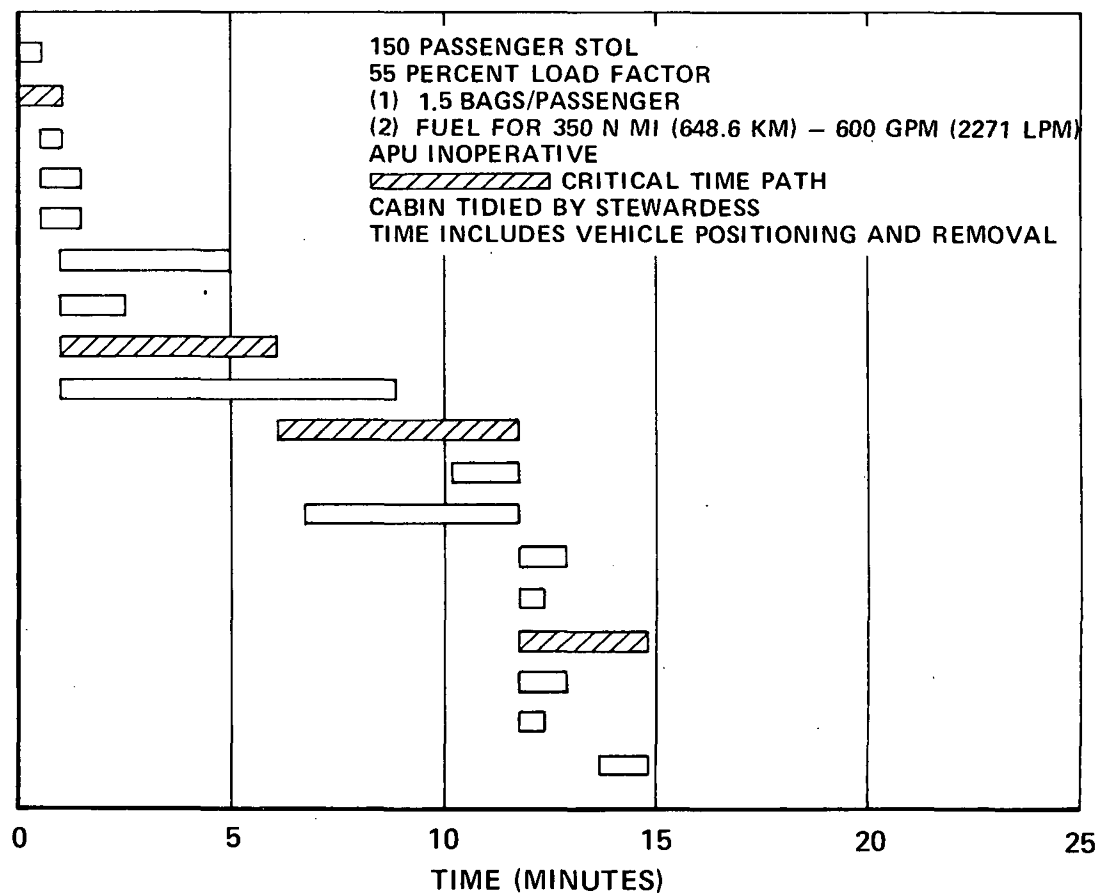


Figure 2-15

TERMINAL OPERATION - EN ROUTE STATION

EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

OPERATION	TIME (MIN)
ATTACH GROUND POWER	0.5
ENGINE RUNDOWN	1.0
EXTEND AIRSTAIRS	0.5
ATTACH AIR START	1.0
ATTACH CONDITIONED AIR	1.0
DEPLANE PASSENGERS (1 DOOR)	4.0
CHECK LOGBOOK	1.5
OFF-LOAD BAGGAGE (1)	5.1
FUEL AIRCRAFT (2)	7.9
LOAD BAGGAGE (1)	5.6
CHECK LOGBOOK	1.5
ENPLANE PASSENGERS (1 DOOR)	5.0
REMOVE CONDITIONED AIR	1.0
RETRACT AIRSTAIRS	0.5
MONITOR ENGINE START	3.0
REMOVE AIR START	1.0
REMOVE GROUND POWER	0.5
CLEAR AIRCRAFT FOR DEPARTURE	1.0



PR2-STOL-1183 A

Figure 2-16

o Fuel for 500 nautical miles (927 km) at 600 gallons per minute (2271 lpm).

o Cabin cleaning is performed on a deferred basis.

o Passenger loading and unloading via two doors.

Through Stop Operation

o 55% passenger load factor deplaning and enplaning.

o APU inoperative— requiring ground power, air start and preconditioned air vehicles.

o No containerized baggage loading.

o 1.5 bags per passenger.

o Fuel for 350 nautical miles (649 km) at 600 gallons per minute (2271 lpm).

o Passenger loading and unloading via one door.

The turnaround operation includes lavatory, potable water and buffet servicing. To achieve a fast turnaround, the lavatory and water servicing may be performed on an overnight servicing. Buffet servicing should be performed when needed. Thorough cabin cleaning should be done on an overnight servicing or when the aircraft is in the gate for a long period of time.

The critical time path for the turnaround operation is passenger loading and unloading and cabin cleaning. To achieve the 20 minute goal, the cabin cleaning is performed on a deferred basis with the attendants tidying the cabin when possible.

On a through stop servicing, the lavatory, potable water and buffet services are not provided. The critical time path now involves only the loading and unloading of baggage.

The unit times used in constructing the preceding time lines were obtained from a Douglas study on terminal servicing and point location for the DC-10 Series 10.

2.2.3.5.2 Terminal Ground Servicing. Because of the prerequisite of having fast terminal operations, STOL will be parked in the gate area in the parallel power out mode. As a consequence, most of the ground servicing points are located on the right-hand side of the airplane so that the passenger loading and unloading process on the opposite side is not impeded. Figures 2-17 and 2-18 show the turnaround and through stop ground servicing equipment arrangement for the baseline EBF aircraft. These comply with the time lines shown in the previous section.

From Figure 2-17, the amount of equipment required for a turnaround operation is as follows:

- o With the APU inoperative, an air start, ground power and preconditioned air truck vehicles are required.
- o 2 bulk loaders.
- o 2 cart tug vehicles
- o 6 bulk cargo carts.
- o If lavatory, buffet and potable water services are to be provided, one of each type of servicing vehicle is required.
- o 1 fuel truck.
- o 1 tow tug, if necessary.

GROUND SERVICING EQUIPMENT ARRANGEMENT

TURNAROUND (WITHOUT APU) EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

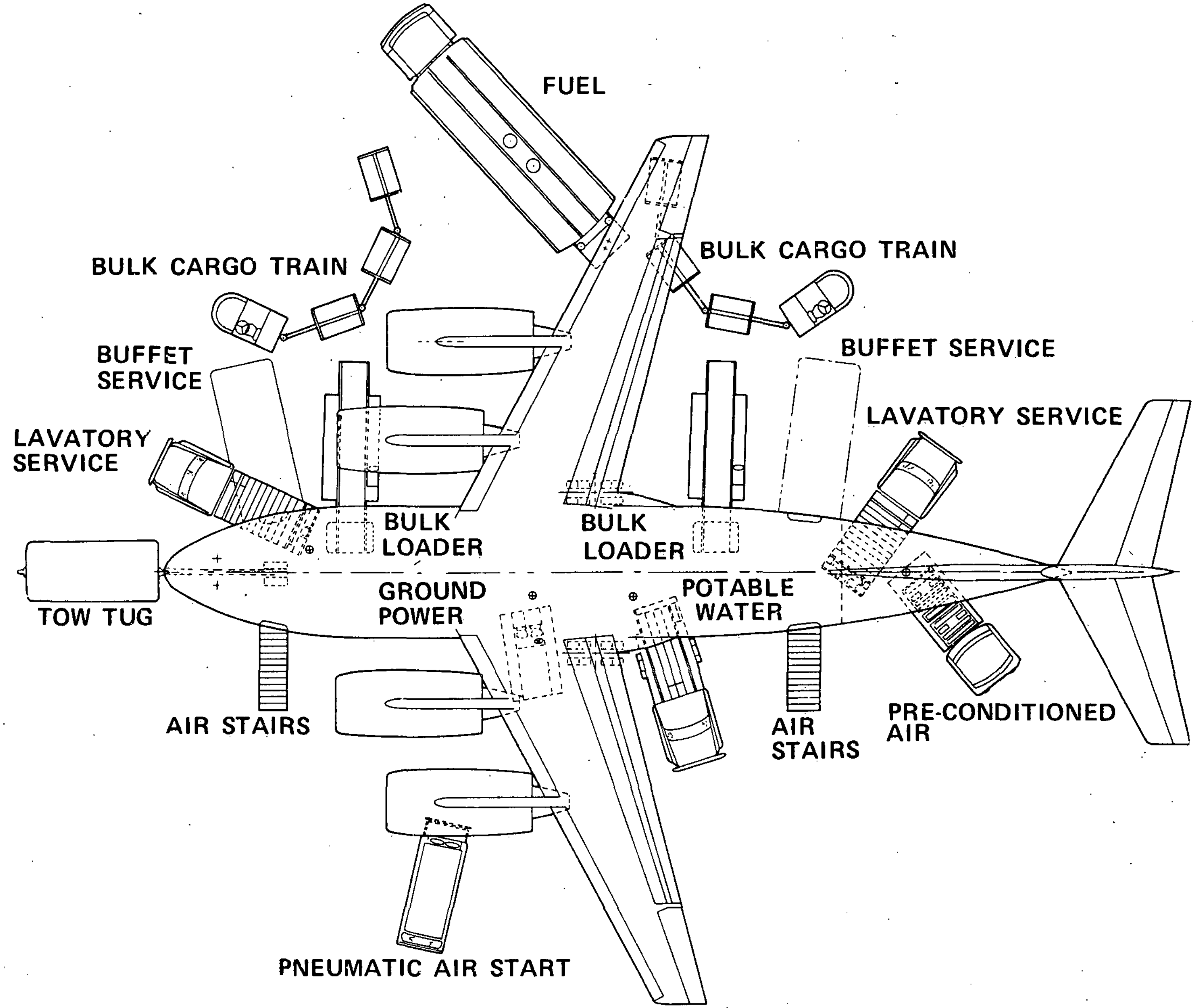


Figure 2-17

GROUND SERVICING EQUIPMENT ARRANGEMENT

THROUGH STOP (WITHOUT APU) EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

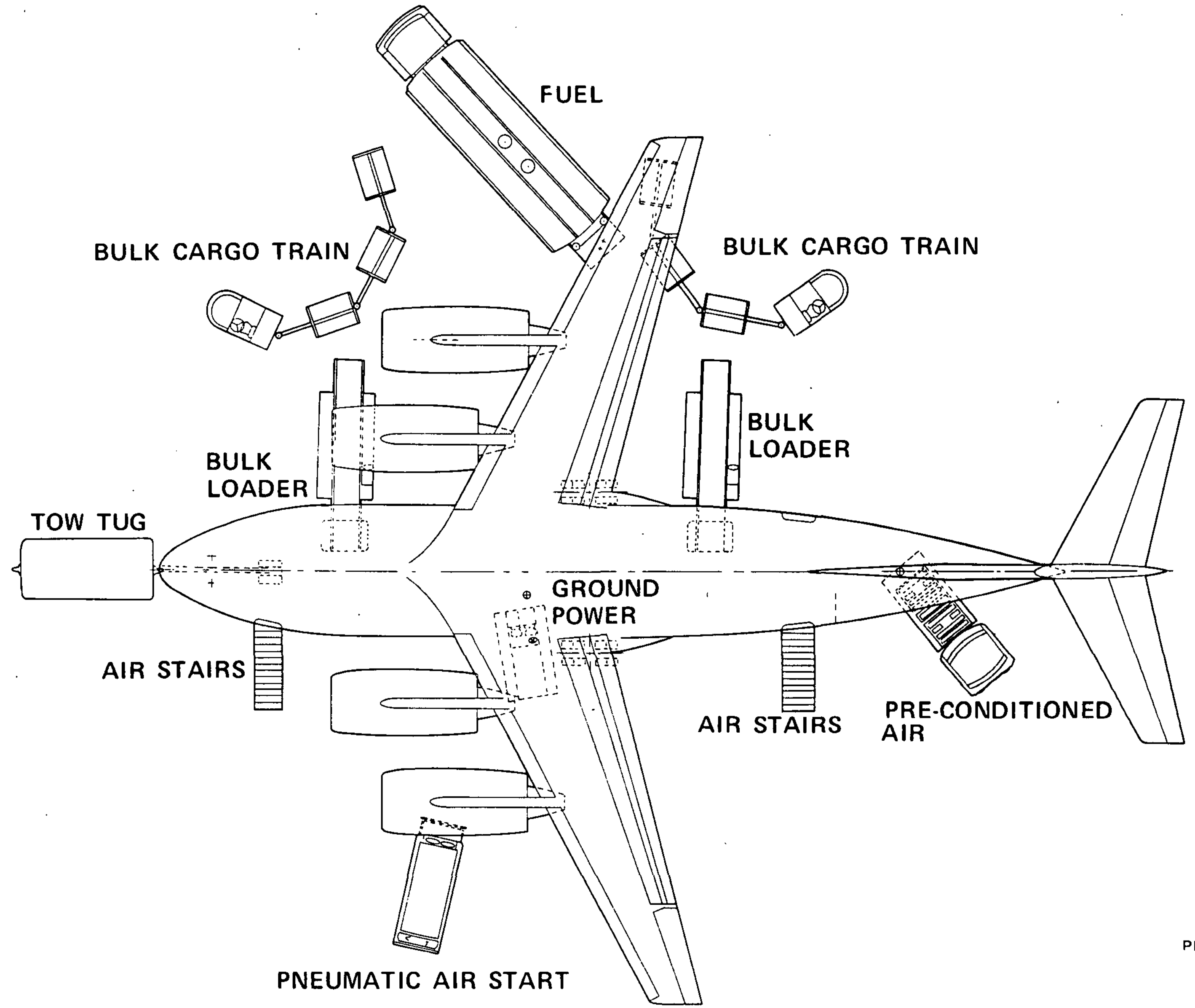


Figure 2-18

The amount of equipment required for a through stop operation is as follows:

- o With the APU inoperative, an air start, ground power and preconditioned air truck vehicles are required.
- o 2 bulk loaders.
- o 2 cart tug vehicles.
- o 6 bulk cargo carts.
- o 1 fuel truck.
- o 1 tow tug, if necessary.

2.2.3.6 Runway Capacity/Acceptance Rates.

2.2.3.6.1 Dedicated and Isolated STOL Runway. Runway capacity/acceptance rates are sensitive to both aircraft separation and accuracy of delivery to the approach gate. For STOL operation in 1985, it is assumed that the common approach path is 10 miles (16 km), the accuracy of delivery is 10 seconds and the nominal speed on final approach is 96 knots (177.8 km/hr.). Under these conditions, the runway capacity is 66 operations per hour using the standard in-trail separation criteria of 3 miles (4.8 m) and assuming that a takeoff can occur between two landings. Figure 2-19 shows the runway capacity as a function of in-trail separation.

A major factor which influences the required in-trail separation distance between two consecutive aircraft landings is the trailing edge vortex generated by the lead aircraft. The trailing edge vortex effect of the lift augmentation aircraft studied thus far have been found to be approximately equal to the current CTOL generation of wide-bodied aircraft (DC-10, L-1011, B-747) and will require the same separation distance.

STOL RUNWAY CAPACITY

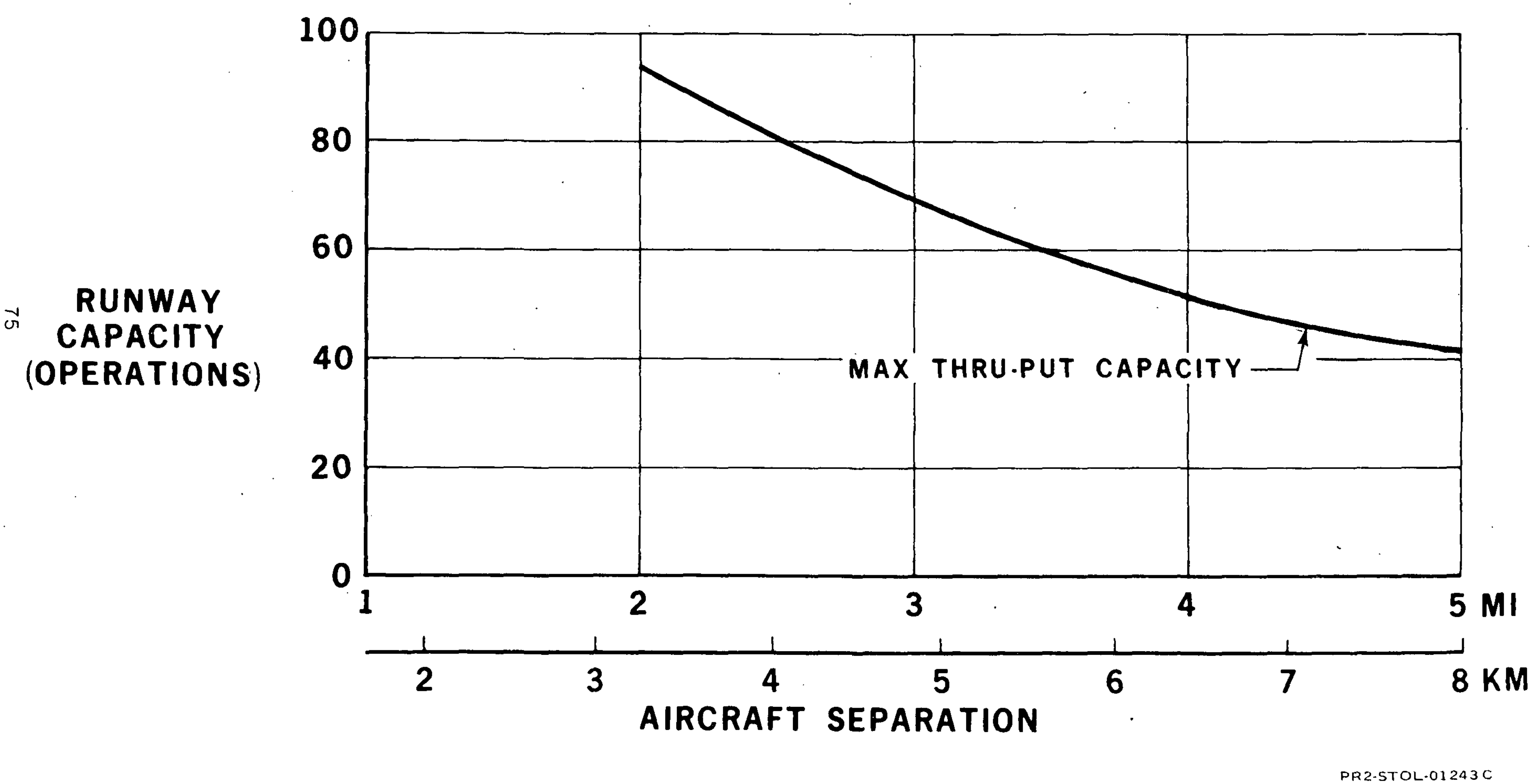


FIGURE 2-19

Current FAA regulations require an in-trail separation distance of 5 miles (8 km) for any CTOL aircraft following a wide-bodied jet upon landing. Based on this separation plus the assumptions mentioned above, the runway capacity is 42 operations per hour. The required 5 mile (8 km) separation distance also makes combined STOL and general aviation aircraft undesirable.

Since the vortex phenomena is a consequence of sustained aerodynamic flight, it cannot be eliminated. Research is being conducted to find ways of disorganizing and dispersing the strong vortex phenomena and, hopefully, a solution will be found that will lead to more desirable in-trail separation and a higher runway capacity.

2.3.3.6.2 CTOL/STOL Co-Shared Runway. In accordance with the guidelines set forth in the operations scenario, it would be feasible to co-share existing runways and ground terminal facilities at current CTOL airports if the projected frequency of service is 5 round trips or less and/or if one gate position at the terminal is required. The overall CTOL runway capacity is not severely effected with the introduction of STOL. Based on the assumptions listed in the previous section, the runway capacity for an all CTOL configuration is 88 operations per hour with a nominal approach speed of 130 knots (240.9 km/hr.) and with a three mile (4.8 km) in-trail separation. With the introduction of 10 percent STOL operations, the overall capacity is reduced from 88 to 81 operations per hour based on the following:

- Common path of 5 miles (8 km).
- Five mile (8 km) separation between consecutive STOL landings, a STOL-CTOL combination and a CTOL-STOL combination.
- Three mile (4.8 km) separation between two consecutive CTOL landings.

- Ten second error in accuracy of delivery to the gate.

The runway capacity is reduced from 88 to 75 operations per hour if the fleet mix using the runway is 20% STOL.

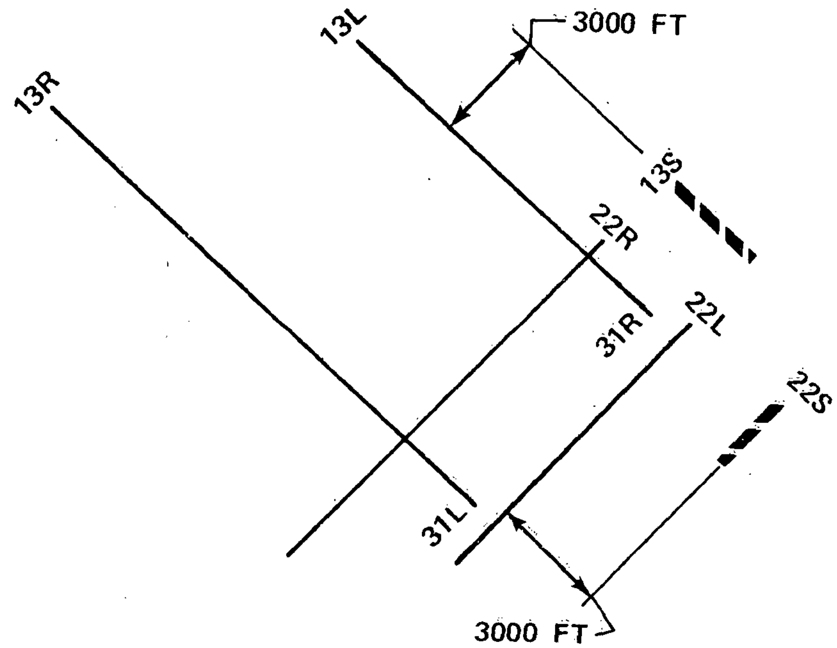
2.2.3.6.3 Separate STOL Runway on a CTOL Airport. In an effort to improve runway usage and to determine the probable runway capacity for STOL aircraft in the 1985 ATC environment, the FAA has recently completed a series of computer simulation studies at NAFEC. These studies introduced a single dedicated STOL runway into the existing ATC system for New York City and also simulated the positioning of two STOL runways at J.F.K. Airport (see Figure 2-20). All weather operations were simulated including IFR operations and the use of microwave landing systems with assumed lateral separation of 3000 ft. (914 m) on the final approach to the airport.

Using the dedicated single runway STOLport without making significant changes to the existing New York area operations, the STOLport and its arrival/departure routes were fitted into the present ATC system.

During operation of the simulation program, ATC controllers were able to maintain independent status of the STOLport and achieve a relatively consistent runway capacity/acceptance rate of 50 operations per hour arrival and departure using the 3 mile (4.8 km) in-trail separation criteria.

Simulation studies by NAFEC based on J.F.K. Airport, New York used two STOL and CTOL runways in a mixed mode approach configuration and the ATC controllers were able to intermix the approach traffic, but at a somewhat reduced rate for STOL aircraft. Using the 3 mile (4.8 km) in-trail separation criteria, the runway capacity/acceptance rates were 44 operations per hour for each runway, down from 50 operations per hour in the previous

STOL RUNWAY CONFIGURATION AT JFK



RUNWAY	AIRCRAFT MIX	CAPACITY – OPS PER HOUR ARR.	DEP.	TOTAL
13	CTOL ONLY	39	43	82
	CTOL/STOL			
	o STOL	22	22	44
	o CTOL	39	46	85
				129
22	CTOL ONLY	35	41	76
	CTOL/STOL			
	o STOL	18	26	44
	o CTOL	38	38	76
				120

PR3-STOL-1528

Figure 2-20

sample using the dedicated STOL airport runway. There appeared to be no significant impact on the CTOL level of activity during mixed mode operations, as shown on Figure 2-20.

A reduction of the in-trail separation criteria to two miles (3.2 km) could result in a signficant 20 percent increase in runway usage; however, further simulation studies need to be made to determine the feasibility of this method in STOL/CTOL mixed mode approach operations. In view of the large differences in the approach to touchdown speeds of STOL and CTOL aircraft, an additional study should be made into separation control to provide more precise positioning and to determine whether a time spacing of, as an example, 60 seconds between in-trail aircraft may not be better than the existing method of three miles (4.8 km) distance spacing. Wake turbulence is a factor that also must be considered.

2.2.3.7 Crosswind Limitation. Factors which affect runway orientation include neighboring airports which may create air traffic conflicts, airspace restricted areas, type of development in the area, obstructions—either natural or man-made and features of the site itself. But one of the most important factors in determining runway alignment is wind.

Wind conditions at existing airports or proposed sites are evaluated by the construction of wind roses. Wind data should be the most accurate and should be collected for a long period of time. Wind data can be obtained from the U.S. Weather Bureau if a recording station is located in the vicinity of the proposed site of an existing airport. At sites where no recording data is available, evaluation should be made of the best local information available or data collected from the site for a period of at least a year.

As a general criterion for CTOL airport planning, the FAA suggests that "runways should be oriented so planes may be landed at least 95 percent of the time with crosswind components not exceeding 15 mph (24 km/hr.)." For STOL, it is assumed that the 95 percent reliability will also be applicable.

For design purposes, the limiting value of crosswind velocity is established by the FAA. Current values are listed below:

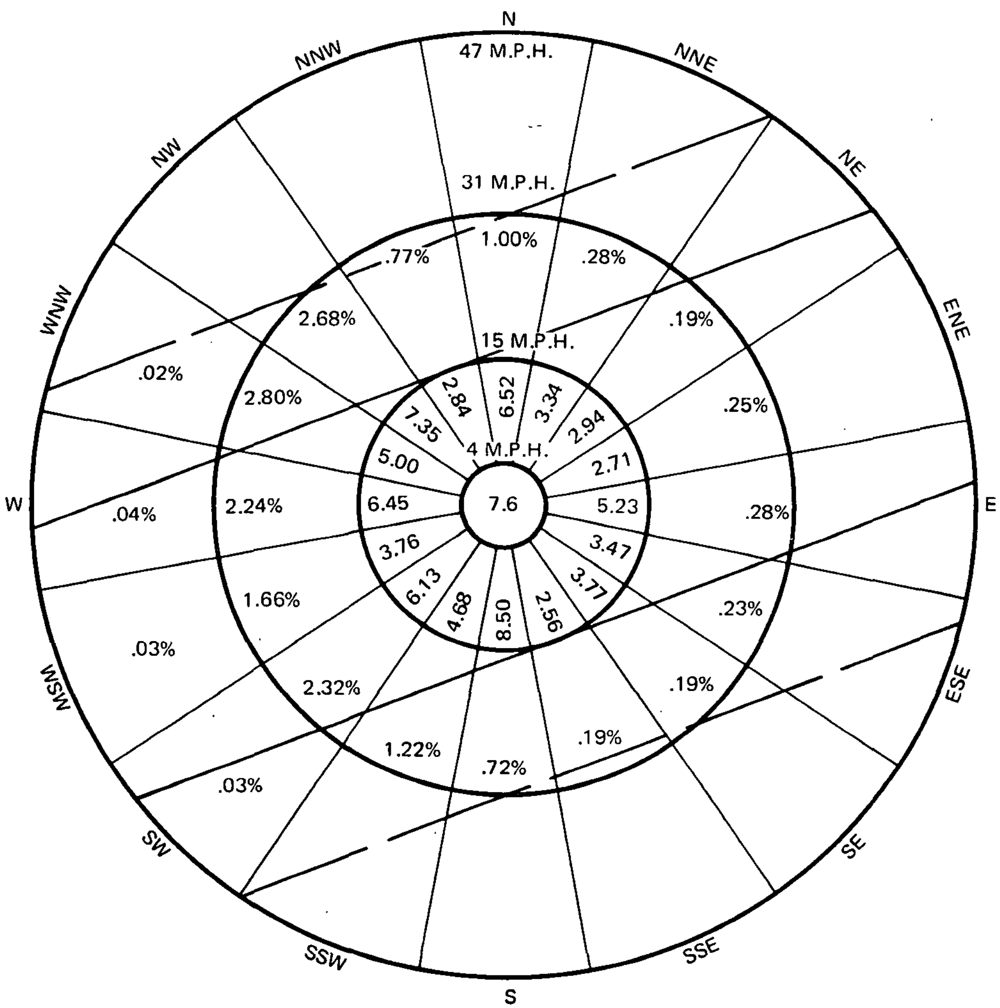
- o 13 knot (24.1 km/hr.) crosswind limitation for all airports except those built to VFR airport (AC 150/5300 standards.
- o 10 knot (18.5 km/hr.) crosswind limitation for VFR airports.

The Phase II study aircraft are designed to land in crosswinds up to 25 knots (46.3 km/hr.). But for the purpose of evaluating wind coverage of runways at the proposed STOLports, the current 13 knot (24.1 km/hr.) requirement will be used.

The STOL crosswind capability, if adopted as a design criteria, would increase the utilization of some runways at airports where crosswinds are a problem. As an example, at Detroit City Airport, runway 5/33 has a 13 knot (24.1 km/hr.) wind coverage capability 86.0 percent of the time. The wind coverage capability is 99.2 percent with the 25 knot (46.3 km/hr.) requirement. The Detroit City Airport wind rose is shown on Figure 2-21.

2.2.3.8 Flotation. Airfield pavement requirements are sensitive to aircraft weight, the number of wheels, wheel spacing and tire pressure. For the Phase II STOL aircraft, the nose and main gear tires are sized for pressures low enough to achieve acceptable tire wear. The main gear bogie

WIND ROSE
DETROIT CITY AIRPORT



FAA CRITERIA 86% COVERAGE
15 MPH
(24 KM/HR)

STOL DESIGN CRITERIA 99.2% COVERAGE
28.8 MPH
(46 KM/HR)

SOURCE: DETROIT CITY AIRPORT
MASTER PLAN

PR3-STOL-1589

Figure 2-21

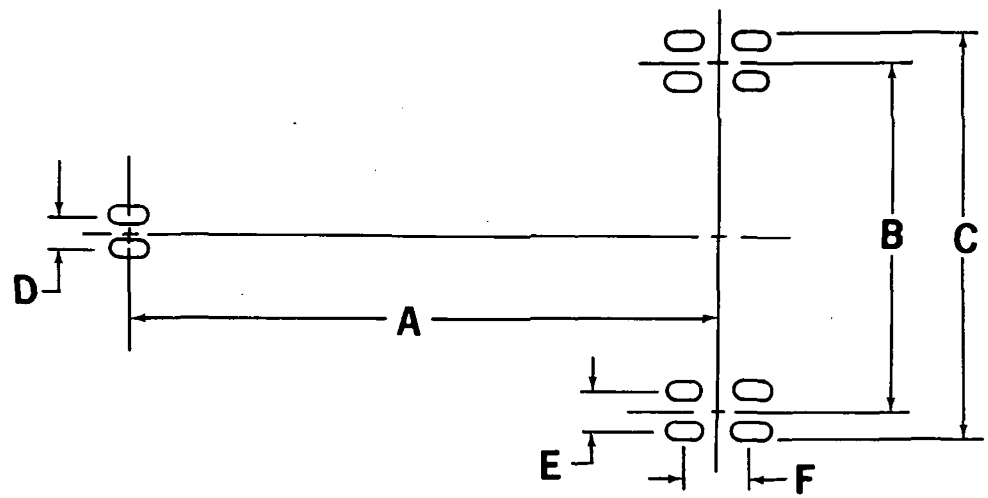
arrangement and the wheel spacing were selected to permit landing on any airfield currently used by a DC-9, such as one having runways with 10 inches (25.4 cm) of concrete of 25 inches (63.5 cm) of flexible pavement with a subgrade CBR rating of 9. Comparative landing gear geometry of the baseline STOL, the DC-9-30 and the B727-200 are shown as Figure 2-22.

The flotation requirements to support the baseline 150 passenger EBF STOL are presented as pavement design nomographs on Figures 2-23 and 2-24. For flexible (asphalt) pavements, the requirements were determined by the FAA flexible pavement design method. The rigid (concrete) pavement requirement were determined using the Portland Cement Association (PCA) computer program PDILB.

Figure 2-25 compares, for nominal concrete working stress and subgrade strength conditions, the concrete and asphalt pavement thickness requirements of the baseline EBF STOL aircraft and the DC-9-30 and the B727-200. The required pavement thicknesses are shown for a nominal aircraft center of gravity. As seen from Figure 2-25, the baseline EBF is far superior to the DC-9 and B727 on both concrete and asphalt pavements, primarily because of dual in tandem main landing gear configuration which emphasizes runway strength requirements.

The STOL pavement thicknesses shown in the comparison chart are the requirements for the ramp area, taxiways and runway ends. CTOL practice would permit the thickness of the runway center to be 90% of the requirement for runway ends. For STOL with the landing weight equal to the takeoff weight, it is recommended that the runway have a constant thickness throughout.

LANDING GEAR GEOMETRY



DESCRIPTION		AIRCRAFT		
		E150 3000 FT (914.4M)	DC-9-30	B727-200
WHEEL BASE (A)	FT/M	40.67/12.40	53.17/16.21	63.25/19.28
WHEEL TREAD (B)	FT/M	20.50/ 6.25	16.42/ 5.00	18.75/ 5.72
WHEEL TREAD – TO OUTSIDE OF TIRES (C)	FT/M	23.42/ 7.14	19.67/ 5.99	23.00/ 7.01
NOSE GEAR WHEEL SPACING (D)	FT/M	2.00/ 0.61	1.17/ 0.36	2.00/ 0.61
MAIN GEAR TWIN SPACING (E)	FT/M	2.00/ 0.61	2.08/ 0.63	2.83/ 0.86
MAIN GEAR TANDEM SPACING (F)	FT/M	4.17/ 1.27	N/A	N/A

N/A – NOT APPLICABLE

PR3-STOL-1453

Figure 2-22

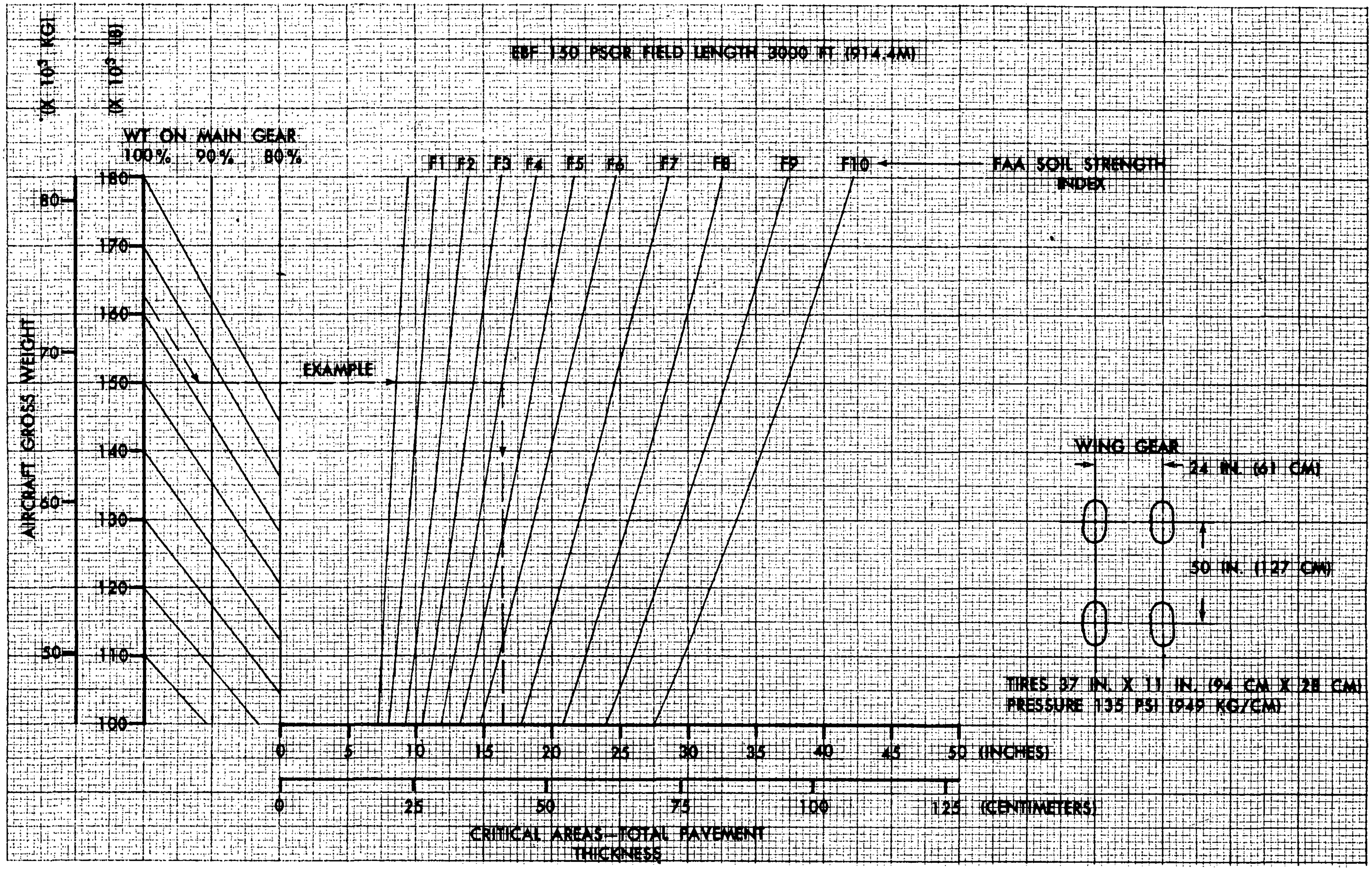


Figure 2-23 . **FLEXIBLE PAVEMENT DESIGN CHART FAA METHOD**

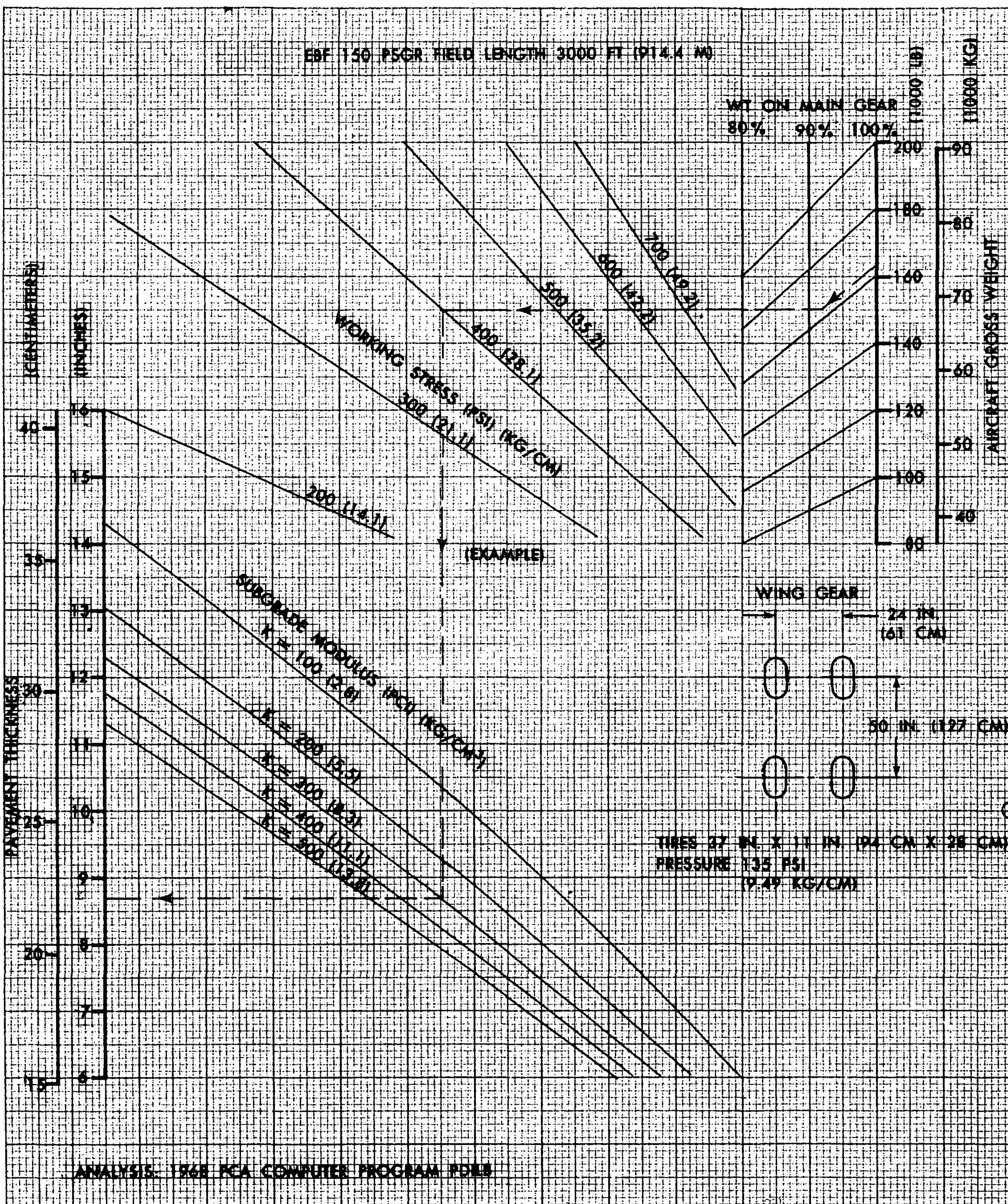
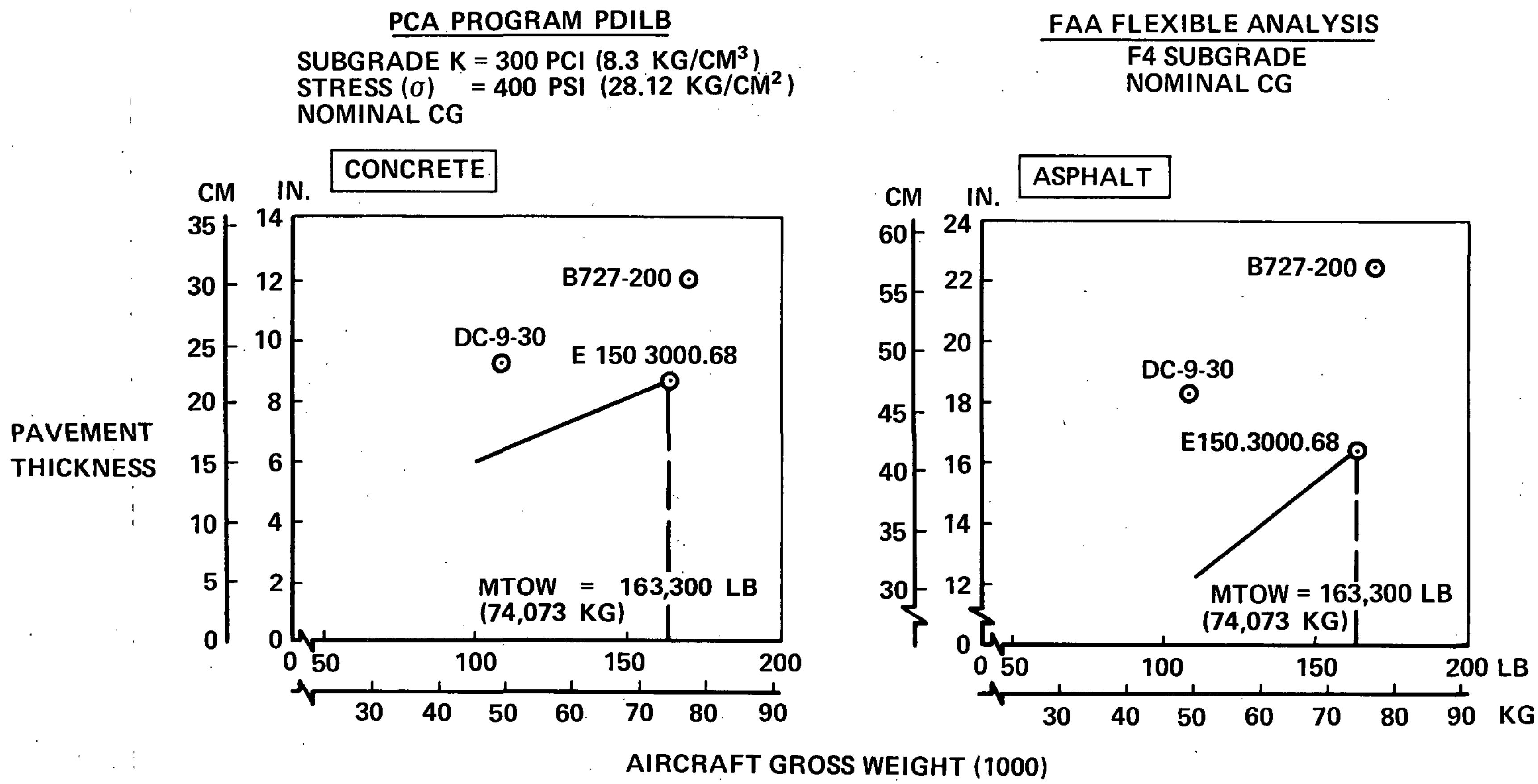


Figure 2-24 **RIGID PAVEMENT DESIGN CHART**

COMPARATIVE PAVEMENT THICKNESS REQUIREMENTS



PR3-STOL-1527

FIGURE 2-25

2.2.3.9 Terminal Area Air Traffic Control. Operating the STOL aircraft within the framework of the FAA's National Aviation System Plan will require it to function within the same air traffic control environment that will exist for CTOL aircraft in the 1980/85 time period.

The Upgraded Third Generation ATC System introduces several new capabilities of special significance to the users of ATC services, as well as improving the level of services provided by existing capabilities. These new capabilities include:

- Metering and Spacing Automation to achieve high runway utilization rates with a high level of safety at the busier airports.
- Intermittent Positive Control (IPC), a new advisory and separation service via data link to equipped VFR aircraft.
- Applications of Ground-Air-Ground Data Link to provide essential services automatically to equipped IFR aircraft. The required data link will be provided by the DABS; optional services may be provided by the VHF data link (ARINC System).
- Applications of Area Navigation (RNAV) to enhance the operation of the air traffic system or as a convenience to equipped IFR aircraft.
- Discrete Address Beacon System (DABS) to overcome basic limitations in the present ATCRBS and to provide a fully automatic, high capacity data link.
- Microwave Landing System (MLS) to overcome basic limitations of the present VHF Instrument Landing System and to provide precise 3-dimensional guidance information that will permit the derivation

of multiple flight paths and greater flexibility in approach and departure procedures. The latter capabilities are to support both conventional and V/STOL approaches to busy airports or airports with stringent noise abatement procedures.

The goals for the Third Generation ATC System were for the most part established by the Report of the Task Force on Air Traffic Control, Project Beacon (reference 2-1). These goals, established to meet the needs projected for the decade of the 1970's, included:

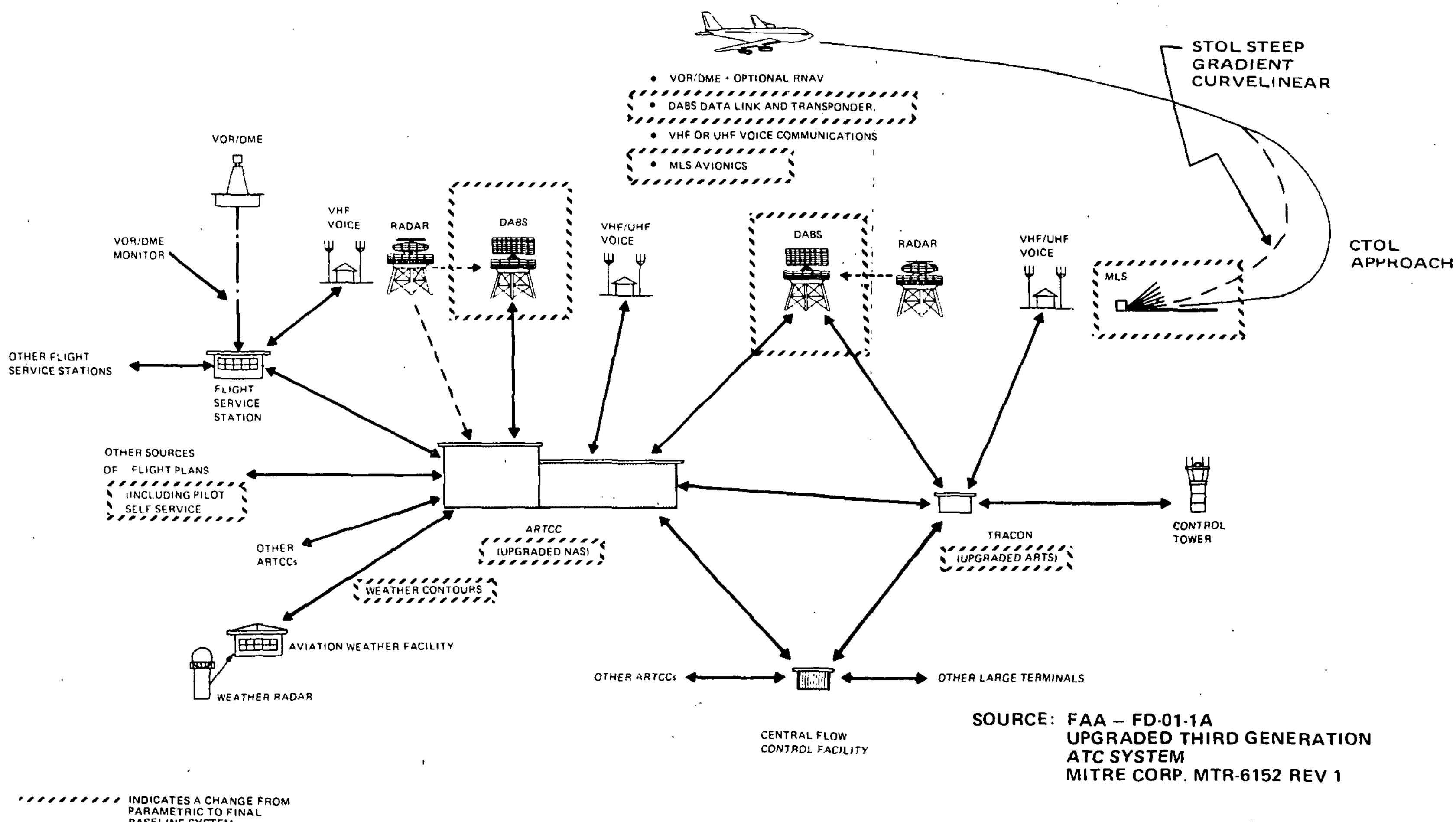
- Improved Safety
- Reduced Terminal Delays
- Avoidance of En Route Saturation
- Reduction of Controller Stress and Workload

The Department of Transportation's Air Traffic Control Advisory Committee was formed in the summer of 1968 for the purpose of recommending an ATC system for the 1980's and beyond. The Committee's final report (reference 2-2) cites "....three critical problems which urgently require solutions if aviation growth is to be accommodated:

- The shortage of terminal capacity.
- The need for new means of assuring separation.
- The limited capacity and increasing cost of ATC."

Substantial upgrading of the Third Generation System was recommended by the committee as the only practical way of meeting these problems in a timely and orderly manner. The recommendations of the ATCAC, together with the R&D programs already underway within the FAA to expand and improve the Third Generation System, provide the goals and objectives for the Upgraded Third Generation ATC System, Figure 2-26.

UPGRADED THIRD GENERATION CONUS ATC SYSTEM



SOURCE: FAA – FD-01-1A
UPGRADED THIRD GENERATION
ATC SYSTEM
MITRE CORP. MTR-6152 REV 1

PR3-STOL-1586 A

Figure 2-26

Reference to Table 2-4 shows the Phase II Third Generation ATC system now being developed for the 1980's.

In the 1980/85 centrally managed ATC system the responsibility for navigating STOL and CTOL aircraft will rest with the pilot and the responsibility for organizing a safe and expeditious flow of STOL and CTOL traffic into the terminal area will rest with the ATC controller. With the application of automatic controls, the controller on the ground and the STOL and CTOL pilots in the air, will manage the air traffic navigation and control using automatic, semi-automatic or manual methods based upon computer derived planning information.

During automatic operation the computer will determine and communicate ATC instructions to the STOL pilot. Semiautomatic operations will involve the automatic control of controller-delegated functions and/or require controller approval of computer derived ATC instructions before they are transmitted to the aircraft.

The STOL pilot will have the option to direct his aircraft in response to ATC clearances by an automatic, semiautomatic and manual operation. An automatic operation will allow ATC instructions to be fed directly into the airborne computer and simultaneously display instructions to the pilot. The ATC instructions will not control the STOL craft until verified by the pilot. Semiautomatic operations will require pilot acceptance of the displayed ATC instructions before they are given to the airborne computer. Manual operation relates to the pilot instructions without the aid of an automatic airborne device. The 1980/85 ground systems will be capable of communicating simulataneously via a universal air-ground digital communications system and a Discrete Address Beacon System (DABS) to accommodate

Table 2-4

ATC SYSTEM GENERATIONS*

SYSTEM \ GENERATION	THIRD	UPGRADED THIRD PHASE I	UPGRADED THIRD PHASE II
DEPLOYMENT YEARS	1971-1975	1976-1978	1979-1985
NAVIGATION & LANDING SYSTEMS			
AIRBORNE	POINT-TO-POINT PLUS SOME AREA NAVIGATION	MORE AREA NAVIGATION APPLICATIONS	SAME
GROUND STATIONS	VOR/DME/TACAN PLUS MORE ACCURATE VOR	SAME	OPTIONS INCLUDE WIDE AREA MLS, PVOR, OR HIGHER CAPACITY DME (PRESENT OR ONE-WAY)
LANDING AND TERMINAL	VHF/ILS PLUS LIMITED CATEGORY II AND III PLUS INTERIM V/STOL	SAME PLUS INITIAL MLS	INCREASED NUMBERS OF MLS RUNWAYS
AIRPORTS			
RUNWAY OPERATIONS	PARALLEL ILS (5000 FT/1524M)	DUAL LANE RUNWAYS	PRECISION MLS APPROACHES TO CLOSED-SPACED PARALLEL RUNWAYS (2500 FT/762M)
GROUND GUIDANCE AND CONTROL	INITIAL AUTOMATED AIRPORT GROUND TRAFFIC CONTROL (AGTC)	IMPROVED AUTOMATED AGTC	COMPREHENSIVE AUTOMATED AGTC
SURVEILLANCE			
MAIN SURVEILLANCE	BEACON (4096 CODE FOR ALTITUDE AND IDENTITY)	SAME	DISCRETE ADDRESS BEACON SYSTEM (DABS) INTRODUCED
BACKUP SURVEILLANCE	RADAR	SAME	SAME
AIR-GROUND COMMUNICATIONS			
MAIN COMMUNICATIONS	VHF/UHF VOICE	SAME	DABS DATA LINK AND VHF/UHF VOICE
BACKUP COMMUNICATIONS			
GROUND	BACKUP EMERGENCY COMMUNICATIONS (BUEC)	SAME	SAME
AIRBORNE	EMERGENCY BEACON CODE	SAME	UHF/VHF VOICE
DATA PROCESSING AND CONTROL			
FLOW CONTROL	CENTRALIZED-MANUAL	CENTRALIZED-AUTOMATED	CENTRALIZED-AUTOMATED
CLEARANCE PROCESSING	SIMPLIFIED MANUAL PROCEDURE	AUTOMATIC COORDINATION AND GENERATION	AUTOMATIC DELIVERY VIA OPTIONAL DATA LINK
SEPARATION & SEQUENCING	AUTOMATED AIDS TO CONTROLLER	AUTOMATED CONFLICT DETECTION & RESOLUTION	AUTOMATIC SAFETY COMMANDS VIA DATA LINK: IPC TO VFR ATC TO IFR
METERING & SPACING (PRECISE TIME SCHEDULING)	MANUAL, WHEN PERFORMED	AUTOMATED-VOICE CONTROL	AUTOMATED - DATA LINK CONTROL

ATC SYSTEM GENERATIONS (Continued)*

GENERATION / SYSTEM	THIRD	UPGRADED THIRD	
		PHASE I	PHASE II
DEPLOYMENT YEARS	1971-1975	1976-1978	1979-1985
GROUND-GROUND COMMUNICATIONS	AUTOMATED LINE AND MESSAGE SWITCHING	SAME	SAME
INTRAFACILITY	VIA CONTROLLER DISPLAY OR VOICE	SAME	SAME
INTERFACILITY	DIGITAL + VOICE	SAME	SAME
OCEANIC NAV & ATC			
SURVEILLANCE	PILOT REPORTS - VOICE	SAME PLUS SOME AUTOMATIC REPORTS	AUTOMATIC REPORTS VIA DATA LINK/ SATELLITE SURVEILLANCE
COMMUNICATIONS	HF VOICE (NON-ATC) PLUS SOME DEDICATED VHF	SAME	SAME PLUS "L" BAND DATA LINK AND VOICE VIA SATELLITE
CONTROL	MANUAL-SOME COMPUTER AIDS	MORE COMPUTER AIDS TO CONTROLLER	SAME
NAVIGATION	INERTIAL PLUS LORAN/OMEGA	SAME	SAME
FLIGHT SERVICES	MANUAL - RECONFIGURED	AUTOMATED AIDS TO FSS SPECIALISTS	PILOT SELF-SERVICE AUTOMATION (FLIGHT PLAN FILING & BRIEFING)

SOURCE: FAA-ED-01-1A
Upgraded Third Generation
ATC System
MITRE Corp. MTR-6152, Rev. 1

the different and varying needs of STOL and CTOL aircraft users.

In this time period, closely spaced non-conflicting flight paths will be established to maximize capacity in congested areas. STOL aircraft will need to be equipped with airborne guidance and control systems capable of accurately following such paths and each other. The number and use of closely spaced flight paths within any given area (arrival, departure, transition en route) will depend upon the associated ATC procedures and whether STOL aircraft diverge from or converge to a particular location and the amount of airspace that is available.

The ability of one STOL aircraft to follow another, referred to as "station keeping", will be utilized by ATC when in trail operations are required.

Improved avionics air data systems will allow the use of one thousand feet vertical separation criteria in both low and high altitude corridors.

Airborne computers, area navigation and microwave landing systems will provide the STOL aircraft pilot with the ability to follow any ATC assigned four dimensional flight path including high angle curvilinear approaches to touchdown.

The major potential air traffic control improvements in the next decade are defined in the FAA's National Aviation System Plan. The improvements having the greatest benefit for STOL aircraft operations will be:

- o The Microwave Landing Guidance System for terminal area approach and departure guidance.

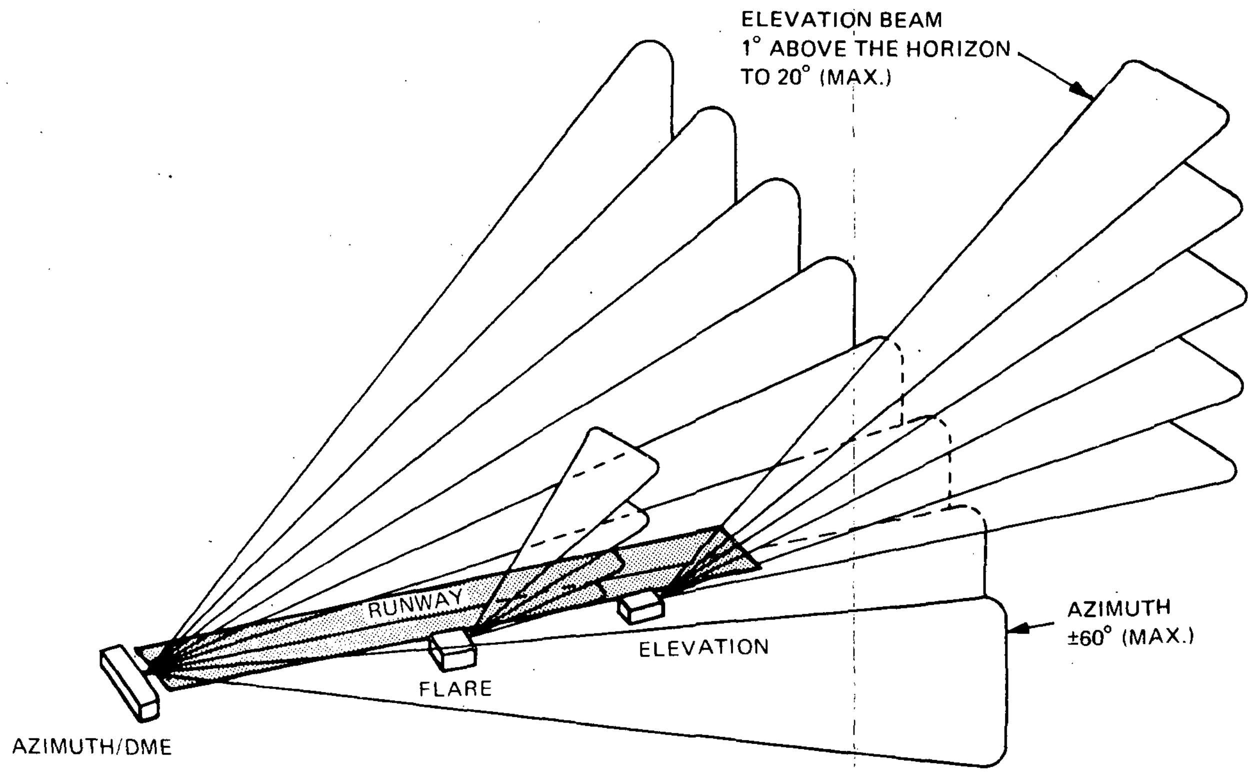
- Four dimensional area navigation, adding a time factor to latitude, longitude and altitude to provide more accurate waypoints in space.

- Air-ground-air data links for automatic uplink and downlink transmission of ATC messages, clearance and holding reports, altimeter settings and load control messages.

In addition, methods of aircraft collision avoidance will be adapted and put into operation and also various means of meeting the FAA's community noise abatement requirements in airport terminal areas will be developed.

2.2.3.9.1 Microwave Landing System. The Microwave Landing System (MLS) will provide a high integrity precise signal in space insensitive to dense airport environments and terrain independent for the formation of its beams. It will permit all weather operations with a high degree of safety and provide the capability for generating curved approaches to runways as a means for increasing airport capacity and for STOL operations. It will also permit reduced separation between parallel IFR runways down to 2,500 feet (762 m) and fulfill the operational needs of STOL aircraft for approach and landing services by providing a flexible glideslope beam of 1° to 20° as against the fixed 3° beam of the present VHF/UHF Instrument Landing System. The MLS antenna patterns shown in Figure 2-27 are representative of the encoded narrow horizontal and vertical beams which coupled with Distance Measuring Equipment (DME) will provide three-dimensional guidance information throughout the STOL aircraft's approach and flare to touchdown.

SCANNING - BEAM MLS ANTENNA RADIATION PATTERNS



NOTE: SCANNING BEAMS IN AZIMUTH & ELEVATION PERMIT THE DEFINITION OF PILOT-SELECTABLE 3-DIMENSIONAL APPROACH PATHS TO THE RUNWAY.

PR3-STOL-1587

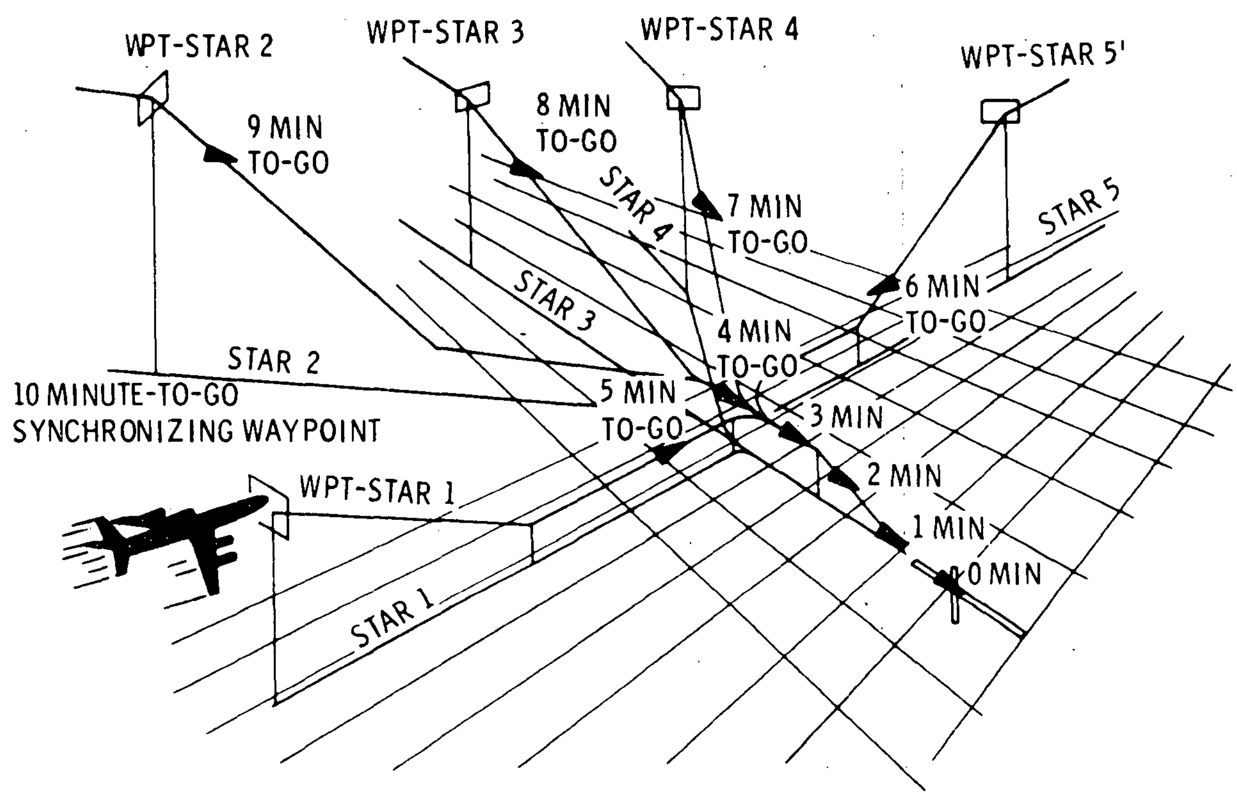
Figure 2-27

2.2.3.9.2 Area Navigation (RNAV). The use of area navigation for STOL aircraft in 1980/85 will lead to greater flexibility in the definition of route structures and to more efficient utilization of airspace. These improvements derive from the capability to navigate along routes not coincident with VOR radials, the capability to navigate along a route defined as parallel to another specified route, and the capability to, where VOR/DME locations permit, navigate with reduced cross course errors. By 1980, although RNAV will be a user option, STOL aircraft so equipped can expect to receive priority ATC service in both en route and high density terminal areas.

The ability of an RNAV equipped STOL aircraft to navigate precise vertical profiles provides a number of potential benefits; the use of a two segment final approach for noise abatement, the reduction of landing minimums for non-instrument runways and the ability to navigate optional flight profiles within ATC constraints with the reduction of STOL pilot workload. The use of area navigation for STOL approach and landing is inferior to using a microwave landing system at equipped airports; however, three and four dimensional area navigation will allow safe approaches to unequipped runways although at a somewhat higher landing minima.

When traffic levels and the degree of RNAV warrant it, an automated ground based metering and spacing system can schedule and control arriving STOL aircraft into an airport so that they are precisely and appropriately spaced upon arriving at their assigned runways. Figure 2-28 depicts what can be realized with STOL or CTOL aircraft using four dimensional area navigation (4D RNAV) in conjunction with air traffic control at an airport at which aircraft arrive continuously from different directions.

TIME-SYNCHRONIZED TERMINAL AREA NAVIGATION



PR3-STOL-1590

Figure 2-28

Each aircraft as it arrives in the greater terminal area contacts approach control and is given a specific time to land, say at intervals of one minute or less. Also, it will be given a standard terminal arrival route (STAR) to follow. On each of these arrival routes will be a waypoint designated as a sychronizing waypoint to be arrived at say precisely ten minutes before the assigned landing time. Beginning at this point, the position of the aircraft will be controlled as a function of time all the way to touchdown. Figure 2-28 shows the aircraft at intervals of one minute backed up along the final approach and then fanning out. On each one of the standard terminal arrival routes, one or more aircraft are synchronized to join the final approach path at one minute intervals or less behind the preceding aircraft. The approach controller's radar will monitor the position of individual STOL and CTOL aircraft to make sure that safe separation is maintained.

In the en route area, RNAV's greatest advantage is in the ability to fly direct routes between city-pairs and to provide multiple lanes for busy STOL and CTOL trunk routes. In order to exercise proper control over the en route corridors, the FAA is considering mandatory requirements for the carriage of RNAV equipment and currently 18,000 feet (5486 m) altitude is considered reasonable. Eventual lowering of the mandatory altitude to 14,500 feet (4420 m) by the 1980/85 time period is under study by the FAA.

The STOL aircraft mission profile predicates en route flight above 18,000 feet (5486 m) for 70% of average flight time between city-pairs. It seems, therefore, that area navigation equipment will be a mandatory requirement for STOL in 1980/85 in order to fly the planned mission profile in the enroute airspace.

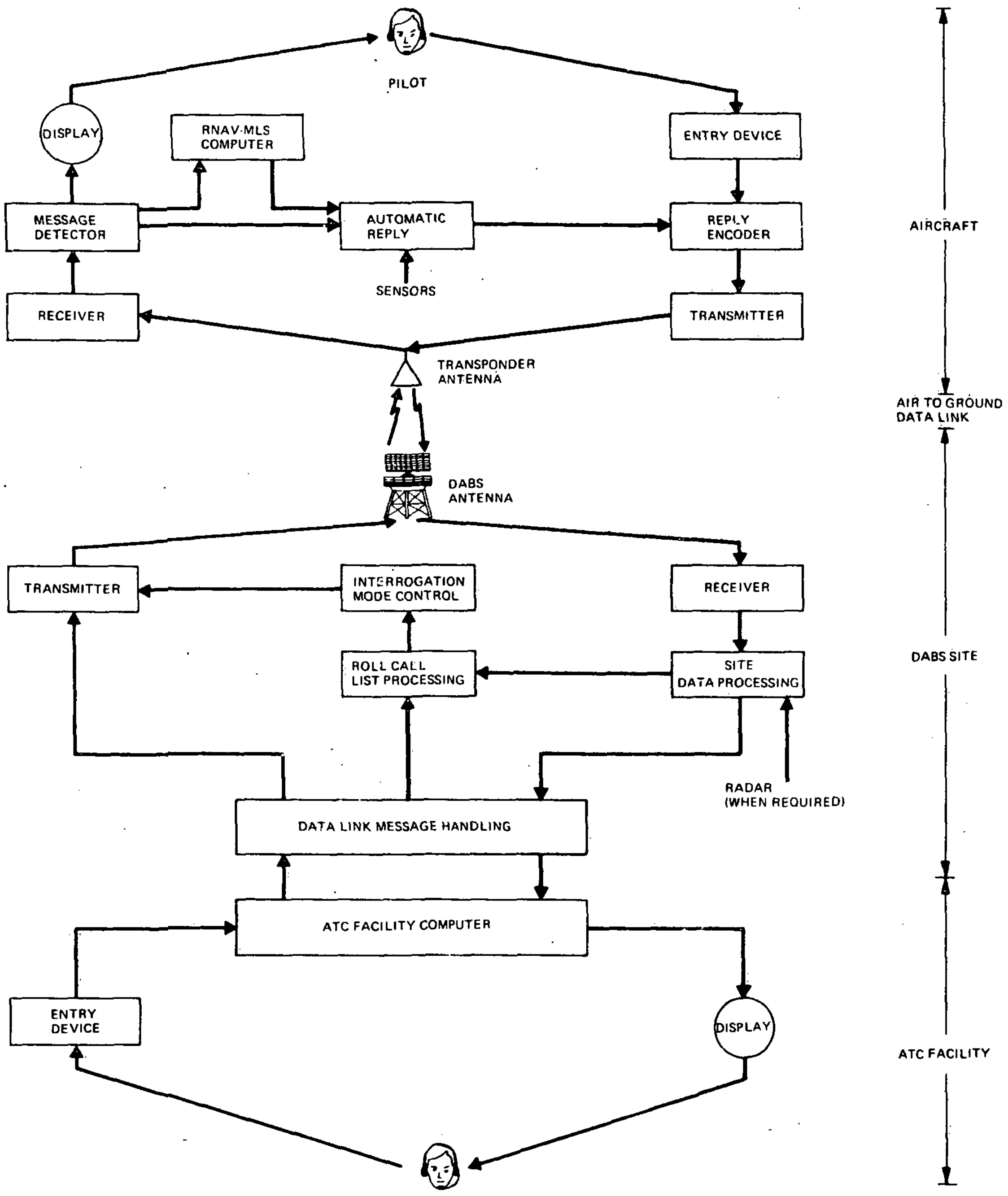
2.2.3.9.3 Air-Ground-Air Data Link (DABS). The Discrete Address Beacon System (DABS) which the FAA plans to have fully operational by 1980/85 makes possible the realization of a low cost high capacity air-ground-air data link. The DABS marks an important advance in surveillance and communications capabilities for air traffic control as it resolves problems inherent in the present ATC Beacon System (ATCRBS) and adds the significant feature that human intervention is not required to establish and maintain either surveillance or communications.

The basic DABS system is shown in Figure 2-29 which also illustrates the major aircraft and ATC data link components required to provide one uplink frequency for all site interrogators and one downlink frequency for all downlink transponders. Frequency switching is therefore not required for either surveillance or communications on the ground or in the STOL aircraft.

Each aircraft in a roll call is individually addressed and the uplink can be used to transmit short messages to the STOL aircraft as well as interrogate for downlink replies. Transmission of ATC messages, clearances and holding reports, automatic terminal service reports, altimeter settings and load control messages are some of the data that can be transmitted between STOL and the ground station by the two-way data link, supplementing the voice communications equipment now in use.

2.2.3.9.4 Collision Avoidance System (CAS). A reliable collision avoidance system for 1980/85 STOL aircraft operations is highly desirable because the increased volume of air traffic and the added complexity of arrival and departure routings together with noise abatement procedures in high density terminal areas will tend to divert the pilot's attention

BASIC DISCRETE ADDRESS BEACON SYSTEM



NOTE: HIGHEST AVIONICS LEVEL IS ILLUSTRATED.

Figure 2-29

PR3-STOL-1585

away from watching outside the cockpit for possible conflict situations with other aircraft because he is busy with other flight deck duties. Estimates have been made indicating that mid-air collision risk grows as the square of the rate of traffic growth giving a prediction of ten collisions per year involving air carrier aircraft by 1980 if no CAS is established.

The situation on CAS today is that the FAA considers its ground based system adequately able to provide pilot warning indication by 1975 for terminal area operations using the ARTS III (Automated Radar Tracking System). The ARTS III uses an associative type processor to correlate radar returns and simultaneously track air traffic converging on a terminal area, it will detect potential conflicts and call them to the attention of the air traffic controller who then alerts the pilots of the aircraft concerned. It is most probable that the FAA will recommend the use of ARTS III for this purpose when the system becomes fully operational instead of the airborne collision avoidance systems now being developed by equipment manufacturers in conjunction with the airlines.

For all aircraft, even if the FAA's computerized conflict prediction methods prove feasible, the airlines feel that some form of airborne CAS will still be necessary as a back-up to cover segments of the flight profile that are not covered or where the surveillance system is not operating.

The existing radar beacon system coverage for terminal areas will be expanded with the deployment of DABS by 1985 to include aircraft conflict prediction and collision avoidance warning. Hazard warnings to aircraft concerned will be provided by DAB's data-link under the FAA plan.

Airborne CAS methods have one major deficiency, they are cooperative systems. A CAS equipped aircraft is only protected from collision with a similarly equipped aircraft and a major problem is to develop inexpensive equipment for all classes of aircraft. As an approach to this the FAA have proposed a synchro-DABS for the 1980's which would allow transponder equipped aircraft to perform one way range measurements on other aircraft. DABS replies to ATC interrogations. This is similar to the existing time frequency CAS which are now available from manufacturers of airborne collision avoidance systems.

The FAA, Defense Department, and NASA have been asked by the U.S. Congress to evaluate and recommend a suitable airborne CAS by 30 March 1974 for use in the 1980's.

2.2.3.9.5 Airport Community Noise Abatement. Airport community noise due to aircraft operations is one of the more serious problems facing aviation today. Studies made at MDC have shown that for CTOL aircraft, a two segment approach into a terminal area can reduce the noise print on the ground by as much as 10 PNdB as it brings the aircraft in at a higher altitude and therefore with less noise. Reference to Figure 2-30 shows the flight profile followed by this method and Figure 2-31, a comparison of perceived noise levels measured on the ground during a two segment approach and a standard 2.5°/3° approach. It is recommended that the STOL aircraft follows a similar approach profile to flare and touchdown whenever possible in order that airport community noise can be reduced to the lowest possible level. It is anticipated that by the 1980/85 time period the STOL aircraft will have new technology quiet engines producing significantly less noise than those of today and this coupled with two segment approach procedures and a 6° or 7° glideslope can significantly reduce noise levels on the ground.

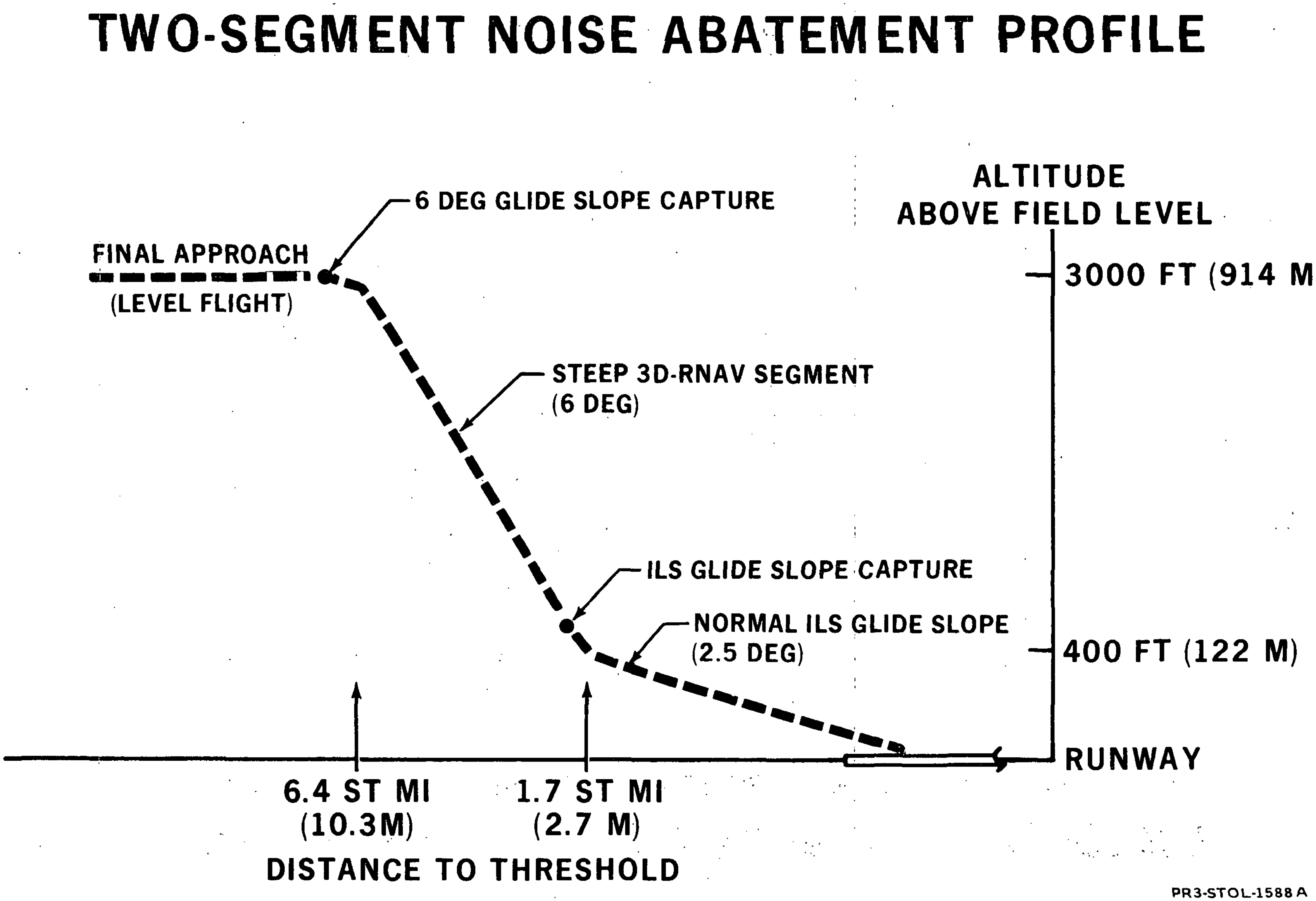
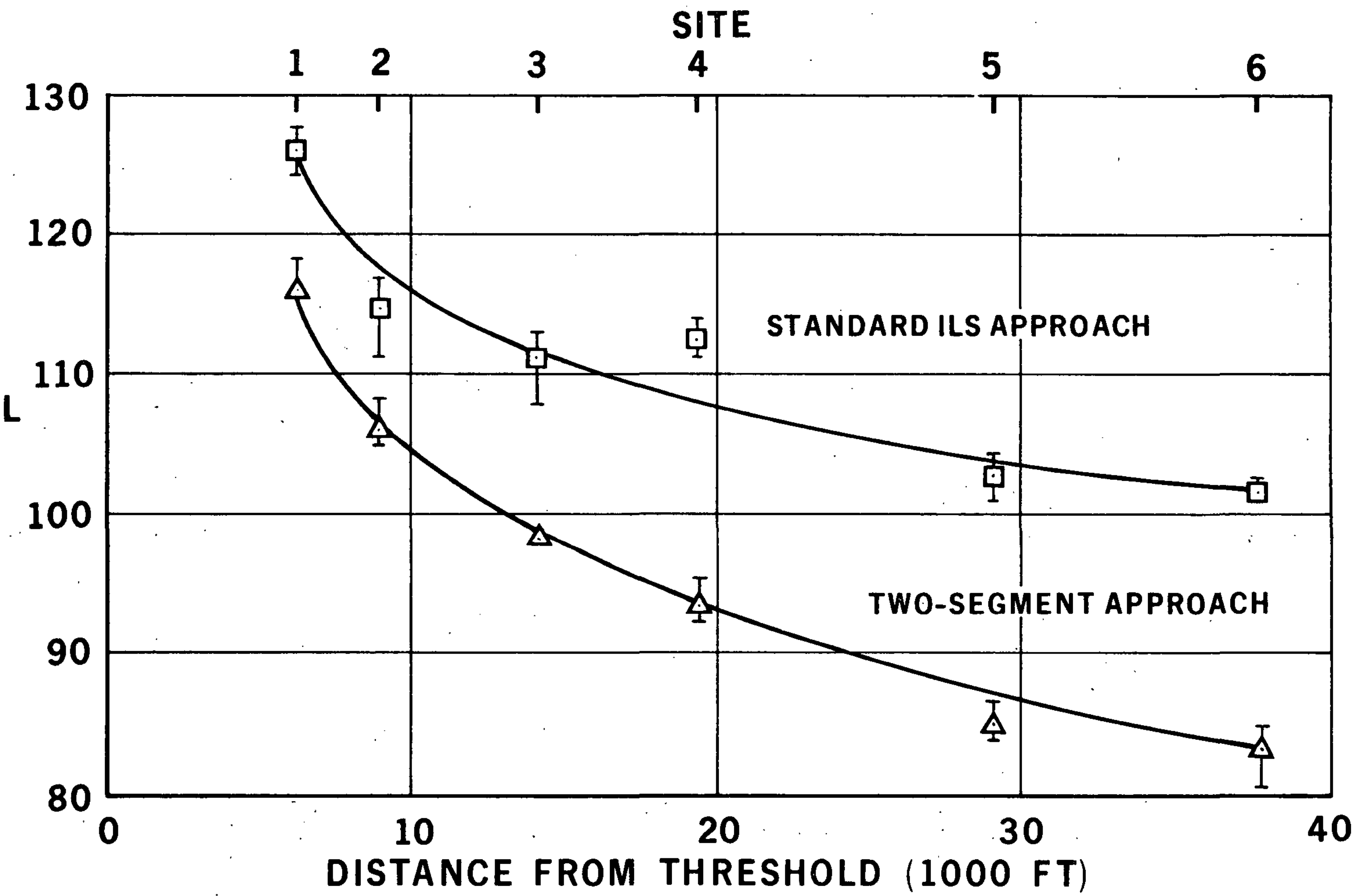

TWO-SEGMENT NOISE ABATEMENT PROFILE
6 DEG GLIDE SLOPE CAPTURE
ALTITUDE
ABOVE FIELD LEVEL
FINAL APPROACH
(LEVEL FLIGHT)
3000 FT (914 M)
STEEP 3D-RNAV SEGMENT
(6 DEG)
ILS GLIDE SLOPE CAPTURE
NORMAL ILS GLIDE SLOPE
(2.5 DEG)
400 FT (122 M)
RUNWAY
6.4 ST MI
(10.3M)
1.7 ST MI
(2.7 M)
DISTANCE TO THRESHOLD
PR3-STOL-1588 A

Figure 2-30

COMPARISON OF NOISE MEASURED ON GROUND

TWO SEGMENT APPROACH AND STANDARD ILS APPROACH



PR3-STOL-1623

Figure 2-31

Two segment approach methods have been developed for CTOL aircraft using various means of mechanization such as an area navigation system for controlled descent into an airport or a special vertical navigation system for controlled descent into an airport or a special vertical navigation computer coupled into the aircraft autopilot for controlled let down and flare onto the runway. The microwave landing system when it becomes available can also provide the required guidance for steep approaches into an airport for STOL aircraft.

2.2.3.9.6 Low Speed Performance. Low speed STOL aircraft maneuvering approaches in aircraft terminal areas when weather minimums are down to Category IIIA will be landing in conditions of zero "decision height" and a runway visual range of 200 feet (61 m) in worst case conditions. Table 2-5 shows the landing system categories and instrument landing system equipment presently defined for CTOL aircraft operations in low weather minimums. The FAA has under review, these landing category definitions to determine how suitable they are for STOL aircraft using high angle straight in or curvilinear approaches to a runway.

In addition to standard approach profiles, there are also missed approach profiles, covered by FAA procedures, which must be observed when for a number of reasons a STOL aircraft may have to abort a landing. A missed approach procedure is specified to start at the "decision height" of the landing category being used; it is possible however, that an aircraft will continue to descent through the decision height altitude while initiating a missed approach so that the procedure can apply to any STOL go-around regardless of altitude. Normally, the missed approach is initiated at the decision height in precision approaches and at a specified point in a non-precision approach. In either case, the STOL aircraft altitude must be

Table 2-5

CTOL LANDING SYSTEM CATEGORIES

CATEGORY	CATEGORY DEFINITIONS	
	DECISION HEIGHT	RUNWAY VISUAL RANGE
I	200 FEET (61 M)	2400 FEET (732 M)
II	100 FEET (30 M)	1200 FEET (366 M)
IIIA	NONE	700 FEET (213 M)
IIIB	NONE	150 FEET (46 M)
IIIC	NONE	0

NOTES:

<u>CATEGORY I</u> in addition to the landing system also includes an approach light system and runway visual range equipment.

<u>CATEGORY II</u> includes all of the equipment in Category I plus centerline runway lights, touchdown zone lights, and high intensity runway edge lights. For Category II, an inner marker is also required.

<u>CATEGORY III</u> includes all of the equipment in Category II plus additional avionics equipment.

sufficient to permit holding or continuing en route flight.

To ensure that obstructions which might penetrate a STOL aircraft landing or departure profile are provided with sufficient clearance, it is required that imaginary surfaces for the protection of the STOL airport are defined by the FAA for aircraft guidance during approach or departure. STOLport surface protection configurations are shown in Figure 2-32 and they have been designed on the basis of the microwave landing guidance system operational characteristics. The 15:1 slope for the approach/departure surface is predicated on adequate obstruction clearance for steep gradient approaches and for takeoff climb.

The STOL aircraft straight-in approach will be at 7° glideslope to flare and touchdown at a speed of up to 80 knots (148 km/hr.). STOL curvilinear approaches will allow aircraft maneuvers at a minimum of 1200 feet radius in the terminal area, while curvilinear departures may use a turn radius minumum of 1500 feet and a 15°/16° takeoff angle. Existing Flight Instrument Rules conditions provide a fixed 3° glideslope for aircraft approach and landing but this cannot be used by STOL due to the low gradient approach angle. By the 1980/85 time period, microwave landing guidance systems are expected to be operationally available and airports will be able to accomodate the STOL aircraft requirements of a 7° glideslope for approach and touchdown together with the necessary STOL-VASI (Visual Approach Slope Indicator) and runway lighting systems now being designed for STOLports.

2.2.3.9.7 Avionics Trade-off Study. The revised baseline avionics system will provide Category IIIA Fail Operational All Weather Operations (including Autoland). A trade-off study was made to reduce the avionics sophistication to meet the minumum requirements for Category II and IFR.

STOLPORT PROTECTION SURFACES

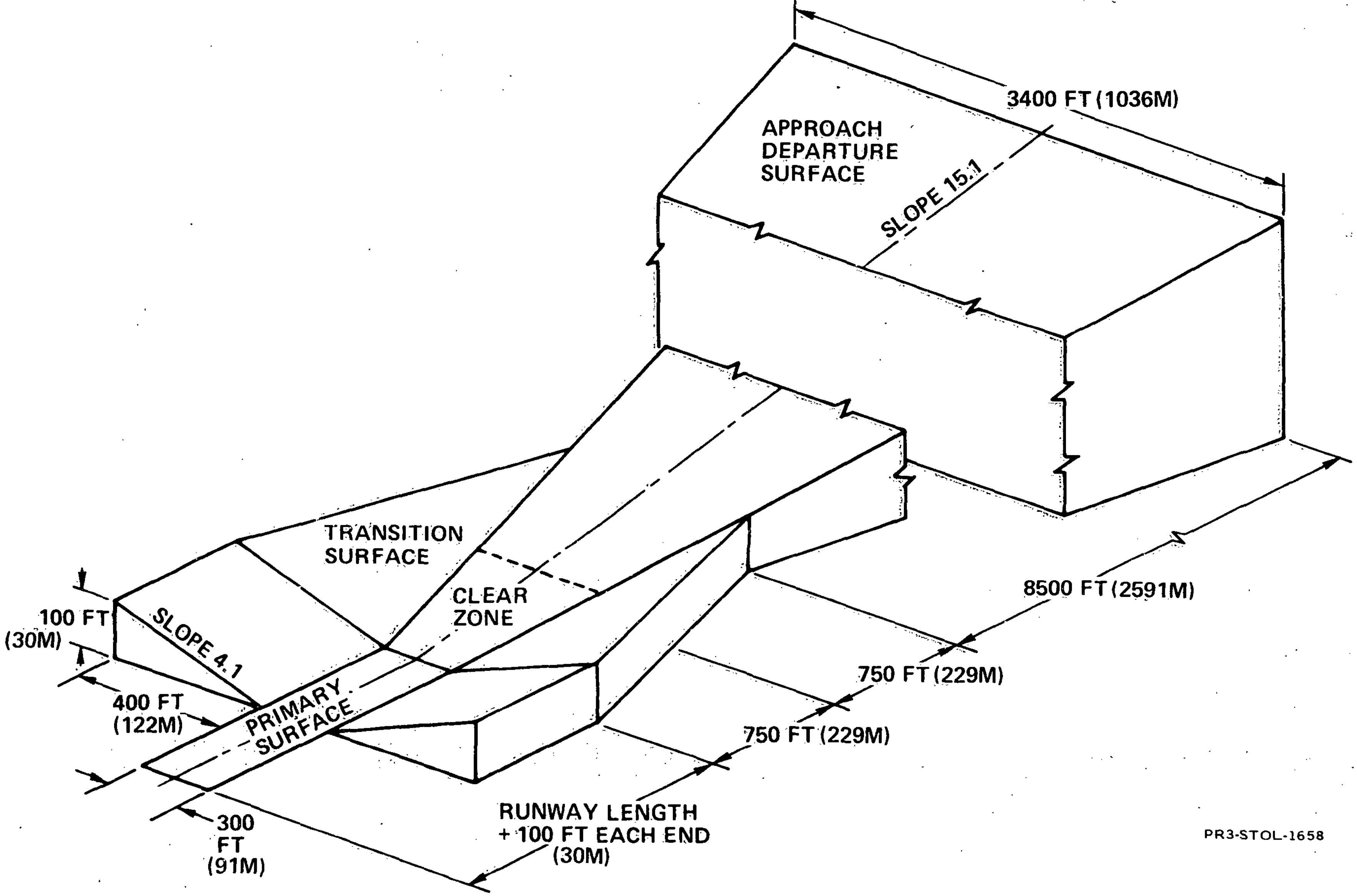


Figure 2-32

The reduction was achieved as follows:

Category II (Fail Safe)

- Third channel of the triplex flight guidance and control system deleted.
- Third vertical gyro deleted.
- Third air data computer deleted.
- One radio altimeter system deleted.

I.F.R.

- One flight guidance system deleted.
- Simple head-up display system only.
- Delete remaining radio altimeter system.
- One microwave landing system deleted.
- One ILS receiver deleted.

Table 2-6 provides a summary of the weight and cost savings per airplane by reducing the avionics sophistication.

To this delta total cost for each aircraft must be added the additional cost of changing from the MLS CAT III system on the ground to the MLS CAT II system. For 94 airports this delta cost amounts to $25,000,000.

Table 2-6

SUMMARY OF COST & WEIGHT SAVINGS FOR STOL AVIONICS

AVIONICS SUBSYSTEM	CAT III		CAT II		IFR		IFR (Less Weather Radar)	
	WEIGHT LB/KM	COST $	WEIGHT LB/KM	COST $	WEIGHT LB/KM	COST $	WEIGHT LB/KM	COST $
IFGCS	702/318	386,707	661/300	311,707	610/277	291,707	610/277	291,707
Comm & Nav	665/302	140,583	646/293	132,507	507/230	104,093	457/207	82,093
Engine Instruments & Misc. Cockpit Instruments	159/72	43,945	159/72	43,945	159/72	43,945	159/72	43,945
TOTALS	1,526/692	571,235	1,466/665	488,159	1,276/579	439,745	1,226/556	417,745

2.2.3.10 Engine Exhaust Wake Velocities and Temperatures. Engine exhaust wake velocities and temperatures may be critical particularly in the aircraft apon parking area in the terminal. Nose-in tow-out aircraft terminal parking minimizes excessive exhaust wake velocity effects. However, parallel power out aircraft parking within the terminal area requires extensive ground maneuvering in which excessive exhaust wake velocities would be critical with respect to ground handling personnel, passengers, ground servicing equipment and building facilities.

At the time of this study, the engine exhaust wake and temperature characteristics are unknown. However, this is an item of sufficent operational importance that should be studied when the engine parameters are known.

2.2.3.11 Airspace Requirements. The protection surfaces listed below shall be examined at each proposed STOLport site;

- Primary landing surface
- Clear zones
- Transition surfaces
- Approach surfaces

Penetration of any obstruction above these surfaces shall be plotted as to location and height. STOLport protection surface dimensions and slopes are described in Figure 2-32.

Evaluation of current airspace utilization will be required at all proposed STOLport sites to insure that there would be no conflict with existing traffic from the introduction of STOL service. VFR flight traffic patterns, IFR approach and departure paths and paths of flight for all other traffic should be gathered and used in planning needed flight paths for STOL aircraft in servicing each STOLport.

Air traffic patterns at all airports and instrument approach and departure routes are established by the Air Traffic Control branch of the FAA. Introduction of new service into any ground facility will require close coordination and approval of representatives of that agency.

Investigation of detailed airspace requirements with the introduction of STOL is beyond the scope of the study, but should be accomplished as part of the airport master planning function at the time of implementation.

2.2.3.12 Trailing Vortices Effect. The vortex strength behind a typical STOL aircraft considered in this study is only slightly less than that of the current wide-bodied jets. For instance, the vortex strength of the 150 passenger 3000 ft. (914 m) field length EBF aircraft is only 10 percent less than that of the DC-10 for typical approach conditions. Since the vortex strength varies inversely as the aircraft speed, the low approach speed of the STOL aircraft constitutes the primary contributor to the high wake turbulence behind it.

Special care must therefore be exercised in the separation of STOL aircraft in the airport area. The existence of these disturbances may also preclude the co-mingling of STOL aircraft with general aviation patterns. Additional research is necessary to determine the true impact of this phenomena.

2.2.4 Landside Requirements -

2.2.4.1 Terminals - Passenger, Baggage and Cargo Processing. Since STOL is intended to serve the short-haul market, it is assumed that less spacious terminal facilities will be required. Thus, the functional areas for STOL is assumed to be 80 percent of that required for CTOL. The required CTOL terminal area is based on the FAA Airport Terminal Buildings document dated September 1960. Total STOL terminal area requirements as a function of peak hour O and D demand is shown in Figure 2-33. The total area allocates space for the following:

- o Ticket lobby and passenger service counter.
- o Airline operations.
- o Baggage claim.
- o Waiting rooms.
- o Dining and kitchen facilities.
- o News, novelties and gifts.

In Phase II, it was assumed that STOL would not carry any cargo other than the personal baggage of the traveler. Therefore, area for terminal cargo processing was not considered in the STOL terminal design.

2.2.4.2 Vehicle Parking. Vehicle parking requirements at an airport can be classified as either unassigned or assigned. Unassigned parking requirements include space for taxicabs, buses, limousines, car rentals, valet and for public fee parking. Assigned parking requirements are for officials, visitors, press, airlines, government and employees. For airport design, the unassigned parking or the parking for the passenger, should be located

STOL PASSENGER PROCESSING

SPACE REQUIREMENTS

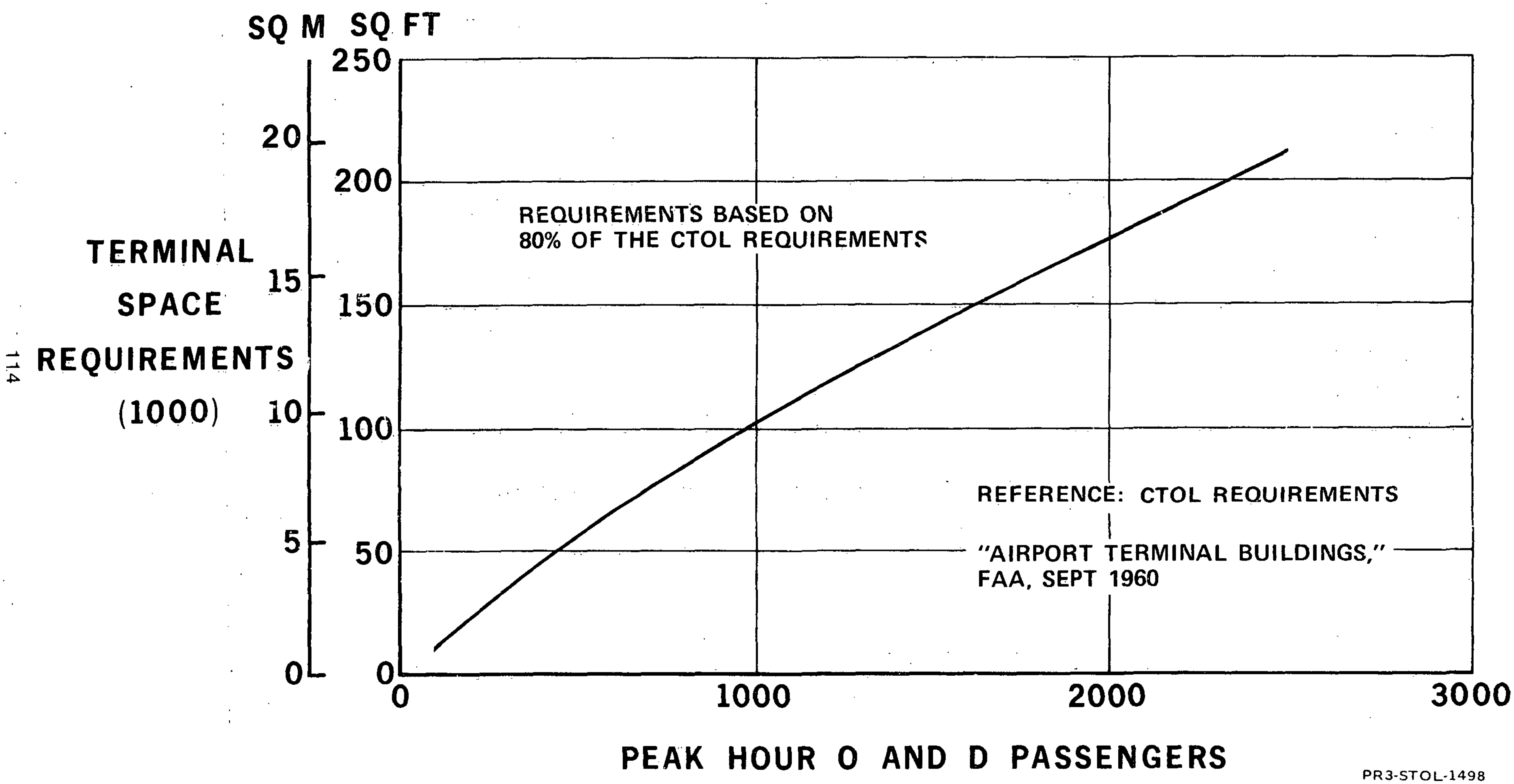


Figure 2-33

immediately adjacent to the terminal building so that walking distances are kept to a minimum. Separate parking areas should be provided for employees and car rentals. Parking requirements for car rentals should be determined by consultation with the rental concessionaire. It is desirable to locate the car rental parking area as close as possible to the terminal building.

Vehicle parking requirements at an airport can be influenced by the following:

- Annual passenger demand.
- Mass transportation facilities.
- Location of the airport in relation with traffic generating areas.
- Surface accessibility.

For the study, parking requirements will be based on the Los Angeles Department of Airports criteria of providing 700 unassigned and assigned spaces per million enplaning passengers.

2.2.4.3 Surface Accessibility. Vehicular traffic generated by passenger demand for STOL service will require evaluation of surface access route capacities in the area of the proposed STOLports.

Local and Regional Planning Authorities and State Highway Department offices are sources of data regarding traffic volumes and capacities of existing and planned surface access routes. Levels of passenger demand forecast for STOL service can be of significant impact on existing surface streets and freeways and such forecasts should be made available to responsible planning agencies for inclusion in general plans for transportation requirements of the area.

The levels and character of surface traffic generated by STOL service will be influenced by the size of the area to be served, the availability of rapid transit and other forms of transport. Coordination with local authorities will be necessary to effectively evaluate access requirements to satisfy passenger demand for STOL service.

The following standards are currently used by planning agencies in estimating capacities of surface streets and highways.

- Controlled access highways (freeways).
  2,000 vehicles per hour per lane.
- Uncontrolled access streets and roads.
  600 to 800 vehicles per hour per lane. Assignment of a traffic flow capacity within the ranges listed above, should be made after the evaluation of volume of traffic on crossing streets and the methods of traffic control in use.

Current planning criteria for vehicular traffic generated by passengers at major CTOL facilities is 1.13 vehicles entering and 1.13 vehicles departing the airport for every enplaned or deplaned passenger. It is recognized that STOL system characteristics may produce fewer cars parked per passenger by reason of delivery and pickup of the passenger at the STOL terminal. This practice may increase surface access traffic.

Detailed analysis of surface accessibility for each of the airports in the national system was not conducted during the Phase II study. Surface congestion from a community impact standpoint was determined for the twelve airports studied in Section 8 of this report.

2.2.5 EBF·150·3000 Aircraft Comparison - Baseline vs. Modified - Aircraft design weights and physical dimensions are summarized in Table 2-7 for the baseline and modified EBF 150 passenger field length 3000 ft. (914 m) STOL airplanes. A general arrangement diagram of the modified EBF is shown on Figure 2-34. The small relaxation (1-1/2 - 2 units) of the 95 EPNdB sideline noise criteria at 500 ft. (152 m) results in significant reductions in the aircraft design weights. The maximum ramp weight is reduced 8.7% from 163,800 lbs. (74,300 kg) to 149,530 lbs. (67,827 kg). The other design weights are reduced by approximately the same magnitude except for the maximum zero fuel weight, which is reduced by 17.2%. This is reflected in the signficant reductions in engine thrust requirement which leads to lower fuel consumption during flight operations.

The overall physical size of the aircraft did not change appreciably because of the slight increase in the sideline noise criteria. The only major significant change is a reduction of over 6 ft. (2 m) in wing span.

Table 2-8 is a comparative summary of airport airside requirements for both EBF configurations. The increase in runway and taxiway width requirements is reflected in the slightly longer wheel tread for the modified EBF.

The only significant change in airport requirements is flotation. The lower pavement thickness requirements is attributed to the reduction in aircraft weight and to the six inch (15 cm) increase in the dual spacing of the main landing gear tires.

From an airport airside requirements standpoint, it can be con-

EXTERNALLY BLOWN FLAP AIRCRAFT

150 PASSENGERS - 3000 FT (914 M) FIELD LENGTH

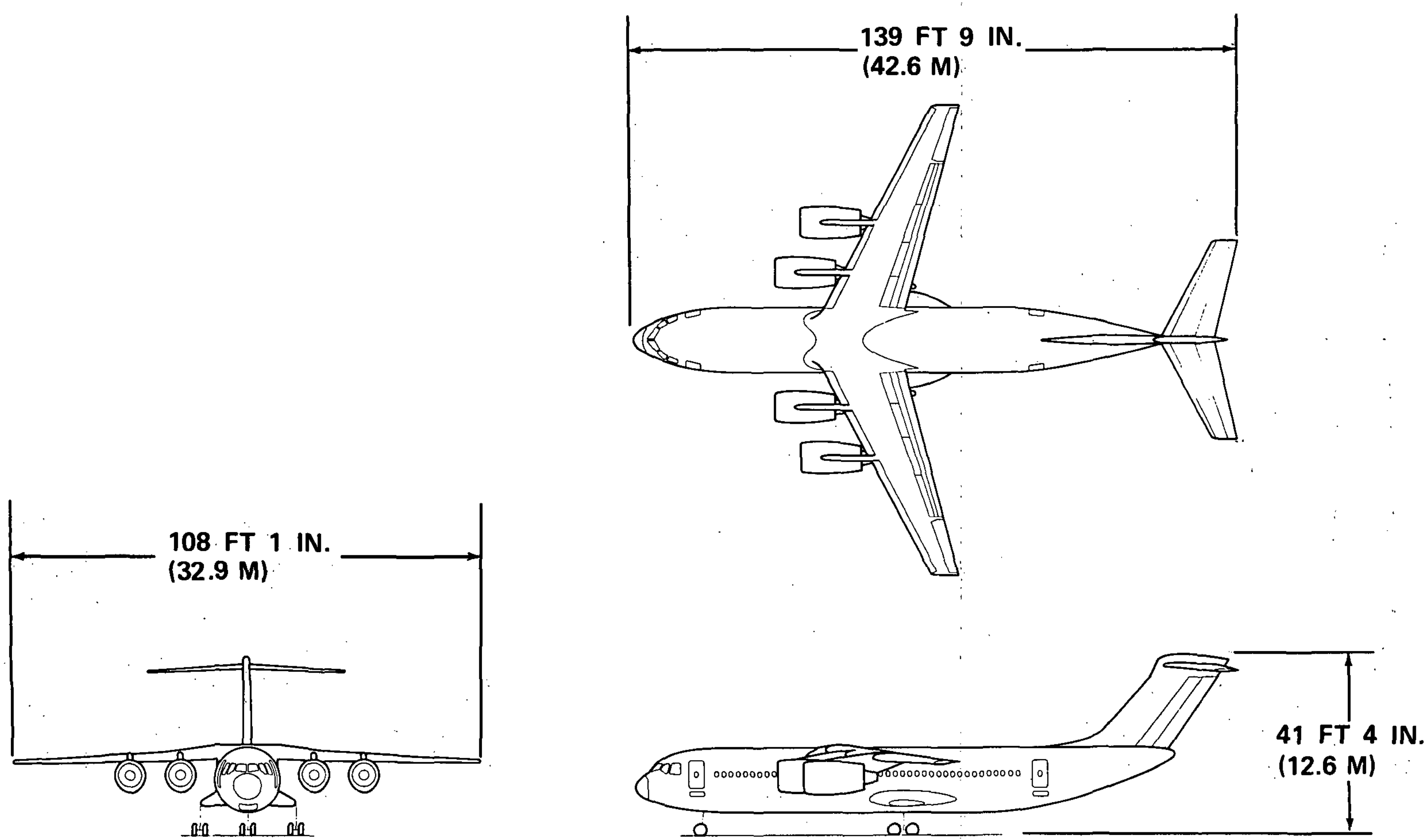


FIGURE 2-34

PR3-STOL-1512B

concluded that the baseline and modified EBF STOL aircraft are essentially identical, except for the lower pavement requirement of the modified aircraft due primarily to the reduced weight.

Table 2-7

STOL AIRCRAFT COMPARISON-CHARACTERISTICS

EBF 150 3000 BASELINE AND MODIFIED

	BASELINE	MODIFIED
Lift Concept	EBF	EBF
Seating Capacity	150	150
Field Length	3000	3000
Mach Number - Cruise	.68	.69
Max Ramp Weight - lbs/kg	163,800/74,300	149,530/67,827
Max Take-off Weight - lbs/kg	163,300/74,073	149,030/67,600
Max Landing Weight - lbs/kg	163,300/74,073	149,030/67,600
Max Zero Fuel Weight - lbs/kg	143,750/65,205	119,030/53,992
Operators Empty Weight - lbs/kg	113,750/51,597	102,610/46,544
Max Weight Empty - lbs/kg	110,900/50,304	99,770/45,256
Max Fuel Capacity - USG/liters	3,100/11,734	2,600/9,841
Aircraft Length - ft.-in/m	132-4/40.2	139-9/42.6
Aircraft Height - ft.-in/m	41-8/12.7	41-6/12.6
Wing Span - ft.-in/m	114-4/34.9	108-1/32.9
Stabilizer Span - ft.-in/m	44-6/13.6	45-9/13.9
Wheel Base - ft.-in/m	40-8/12.4	46-10/14.3
Wheel Tread - ft.-in/m	20-6/6.3	22-2/6.8
Wheel Tread - to outside of tires - ft.-in/m	23-5/7.1	25-8/7.8

Table 2-8

STOL AIRCRAFT COMPARISON - AIRPORT REQUIREMENTS
EBF 150 3000 BASELINE AND MODIFIED

	BASELINE	MODIFIED
Lift Concept	EBF	EBF
Seating Capacity	150	150
Field Length	3000	3000
Mach Number - Cruise	.68	.69
Runway Width - ft.-in/m	111-5/34.0	113-8/34.6
Taxiway Width - ft.-in/m	53-5/16.3	55-8/17.0
Runway/Taxiway Separation - ft.-in/m	338-4/103.1	332-2/101.2
Taxiway/Taxiway Separation - ft.-in/m	159-4/48.6	153-1/46.7
Gate and Ramp Area		
Gate Area (parallel power in parking) - $ft.^2/m^2$	32,444/3014	31,881/2957
unit width - ft.-in/m	221-1/67.4	220-8/67.3
unit length - ft.-in/m	146-9/44.7	144-3/44.0
Runway Capacity - Operations [STOL only, Std. day 5 mile (8 km) separation - approach speed 96 knots (110 km/hr)]	42	42
Crosswind Capability - knots/km/hr	25	25
Flotation		
(1) Flexible Pavement - in/cm FAA Analysis F4 Subgrade	16/41	14/36
(2) Concrete - in/cm PDILB Analysis σ=400 psi (8.3 kg/cm^3) K=300 pci (28.12 kg/cm^2)	8.3/21	7.5/19

Ground Servicing Equipment - The Modified EBF requires no additional GSE equipment compared to the baseline EBF. As far as ease of serviceability is concerned, the additional 8 ft. (3 m) of fuselage length will make the modified EBF easier to service.

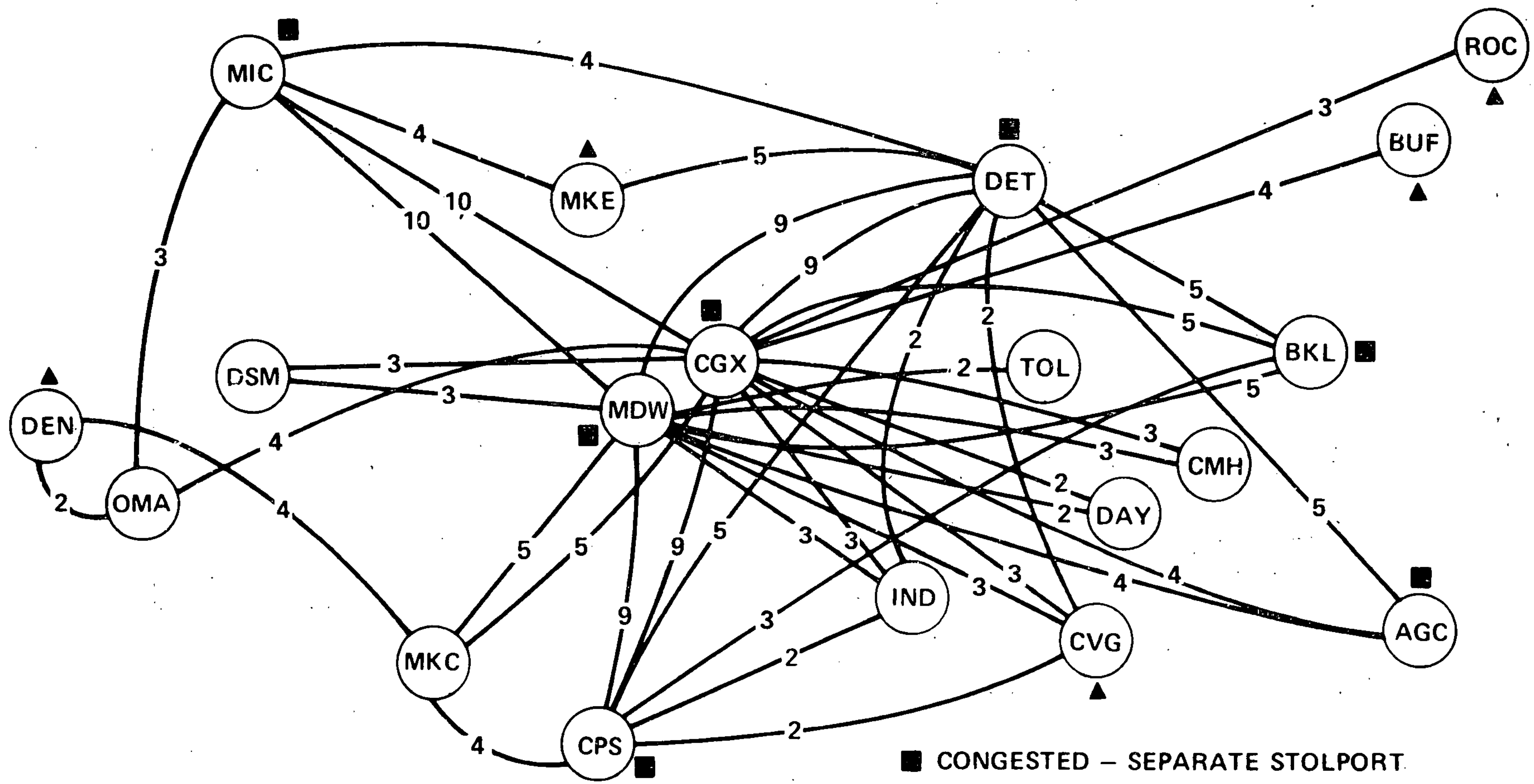
2.3 Airport/Aircraft Compatibility Evaluation

2.3.1 Airport Activity Summary. - For each of the six representative regions which comprise the baseline national short haul system, the EBF 150 passenger 3000 feet (914 m) field length aircraft was selected from the Phase II aircraft matrix as the baseline aircraft for all STOL system evaluation and analysis. To determine the daily flight schedule for each airport in any given region, the baseline aircraft performance data, the STOL patronage and the airport pair network are input into the airline fleet schedule planning and evaluation model. The output of the model includes the number of operations per day, aircraft arrival and departure times and the number of passengers enplaning and deplaning per flight. A regional summary of the number of daily round trips for each airport are presented as Figures 2-35 through 2-40 for the Chicago, Northeast, California, Southern, Southeast and Northwest regions respectively.

The daily flight schedule is used to determine the aircraft and passenger peaking characteristics and the number of gates required for each associated airport. As an example, the General Patton STOLport daily flight schedule is shown on Figure 2-41 as a function of time of day. The peak period of STOL activity will occur during the early evening with 6 departures and 1 arrival. Because of the assumed overall system aircraft load factor of 60%, the peak passenger activity will coincide with the peak aircraft activity. For General Patton Field, the peak passenger flow is 798.

Once the peak period activity is known, the number of gates required can now be determined. Figure 2-42 shows the aircraft time

1985
CHICAGO REGION - PHASE II
SUMMARY OF DAILY ROUND TRIPS EBF 150 PASSENGER CAPACITY



■ CONGESTED – SEPARATE STOLPORT

▲ CONSTRAINED – SEPARATE STOL RUNWAY

PR2-STOL-1272 B

Figure 2-35

1985
NORTHEAST REGION - PHASE II
SUMMARY OF DAILY ROUND TRIPS
EBF 150 PASSENGER CAPACITY

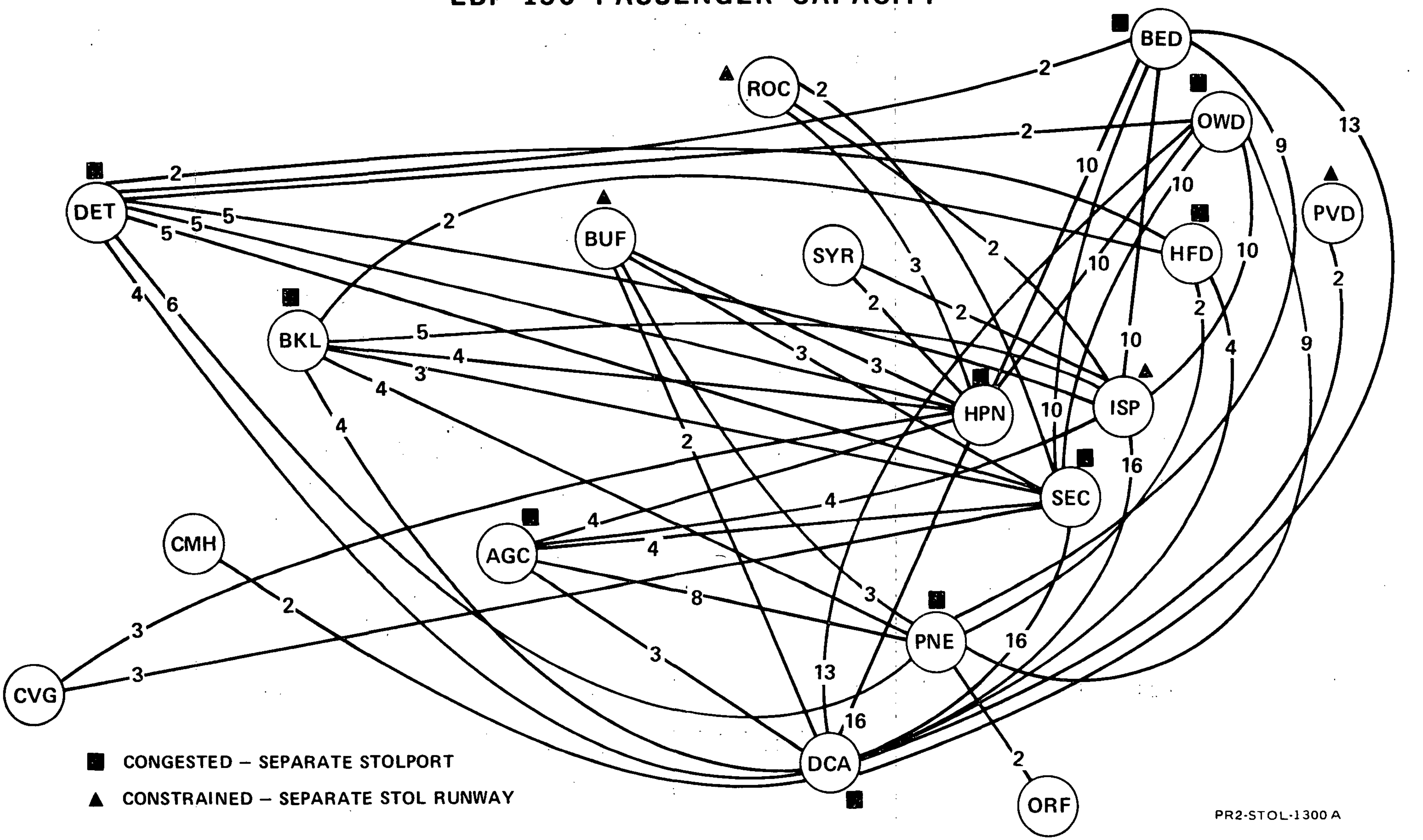
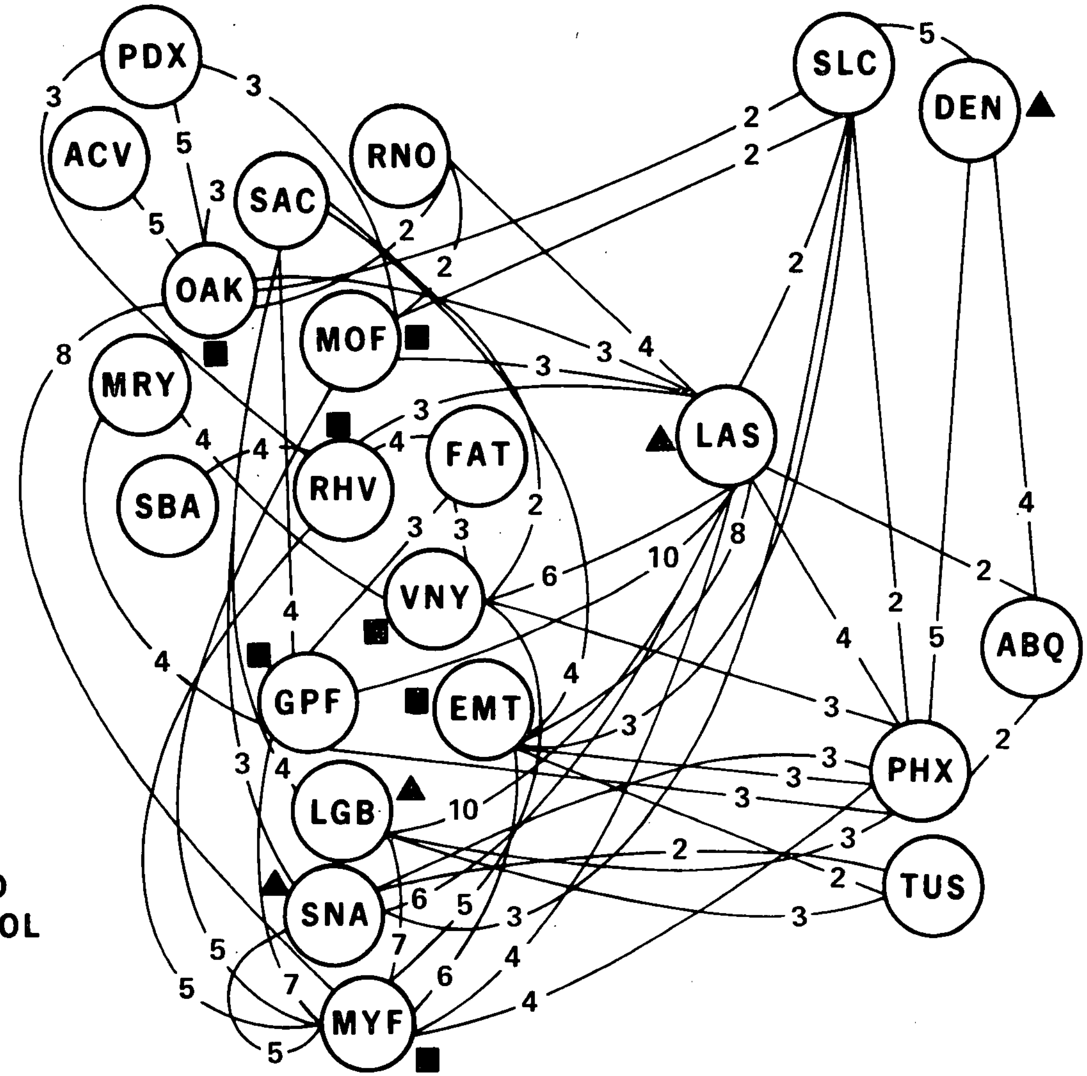


Figure 2-36

1985
CALIFORNIA REGION - PHASE II
SUMMARY OF DAILY ROUND TRIPS EBF 150 PASSENGER CAPACITY



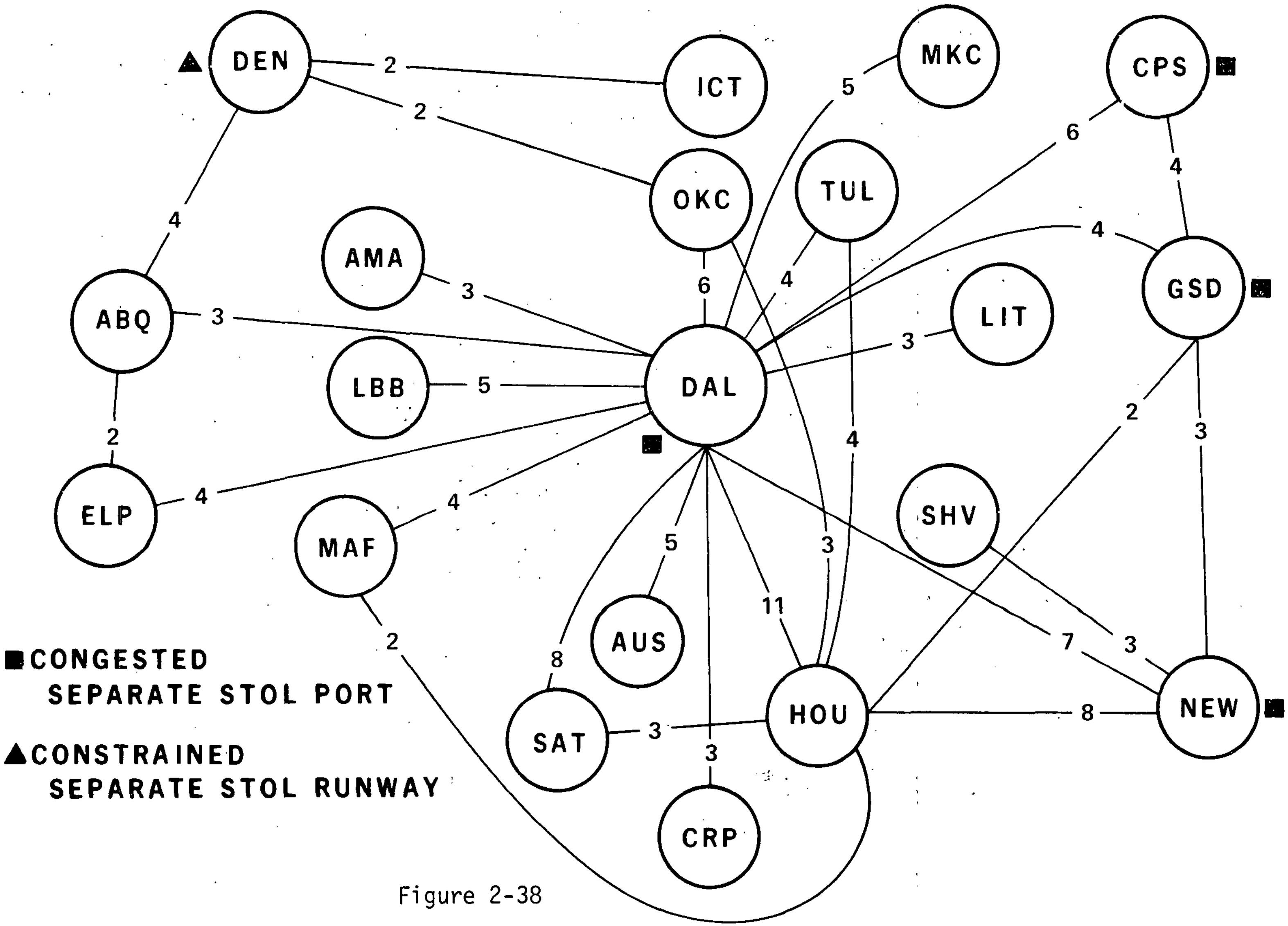
■ CONGESTED SEPARATE STOL PORT

▲ CONSTRAINED SEPARATE STOL RUNWAY

PR3-STOL-1650

Figure 2-37 .

1985
SOUTHERN REGION - PHASE II
SUMMARY OF DAILY ROUND TRIPS EBF 150 PASSENGER CAPACITY



PR3-STOL-1410B

Figure 2-38

1985
SOUTHEAST REGION - PHASE II
SUMMARY OF DAILY ROUND TRIPS
EBF 150 PASSENGER CAPACITY

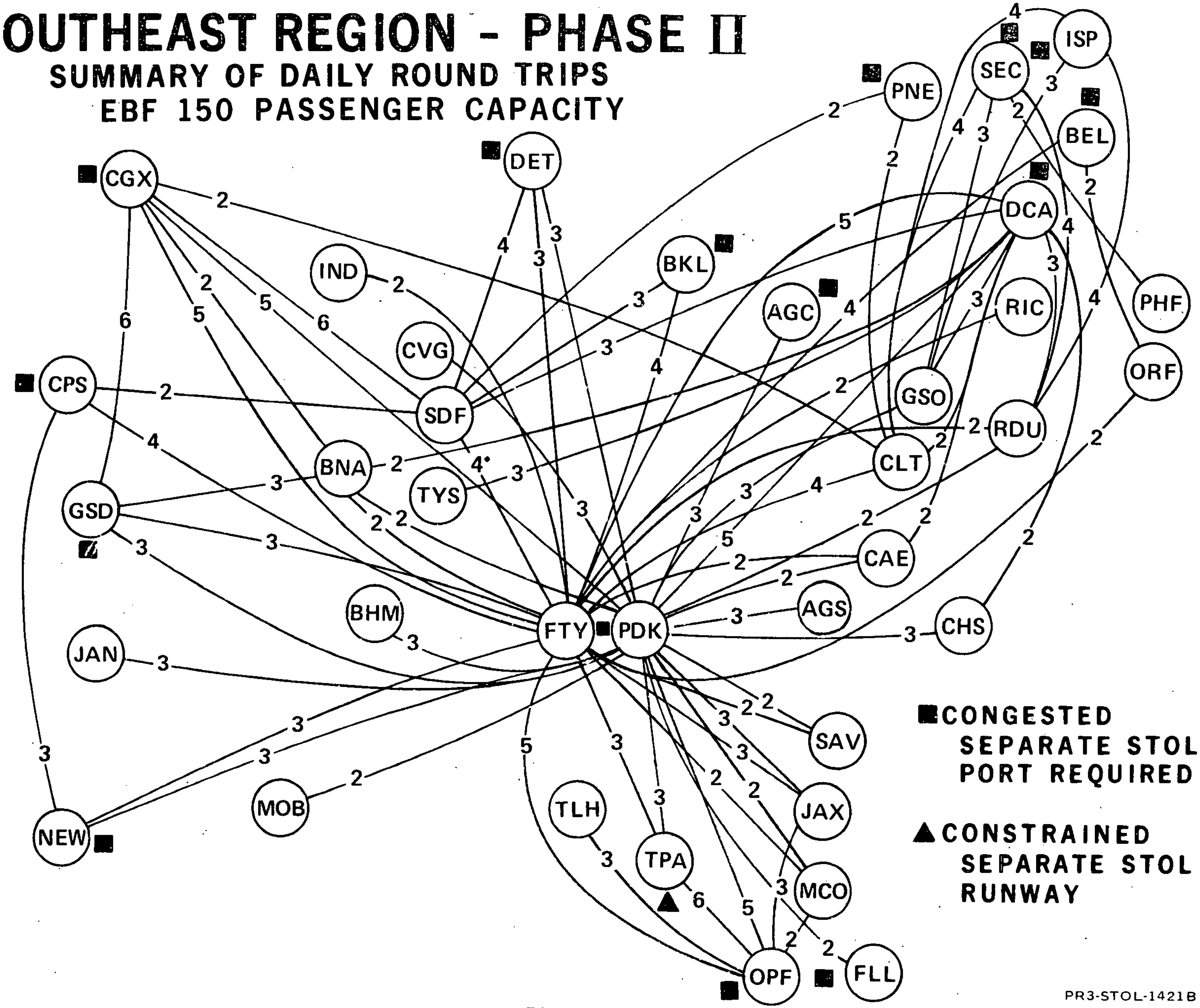
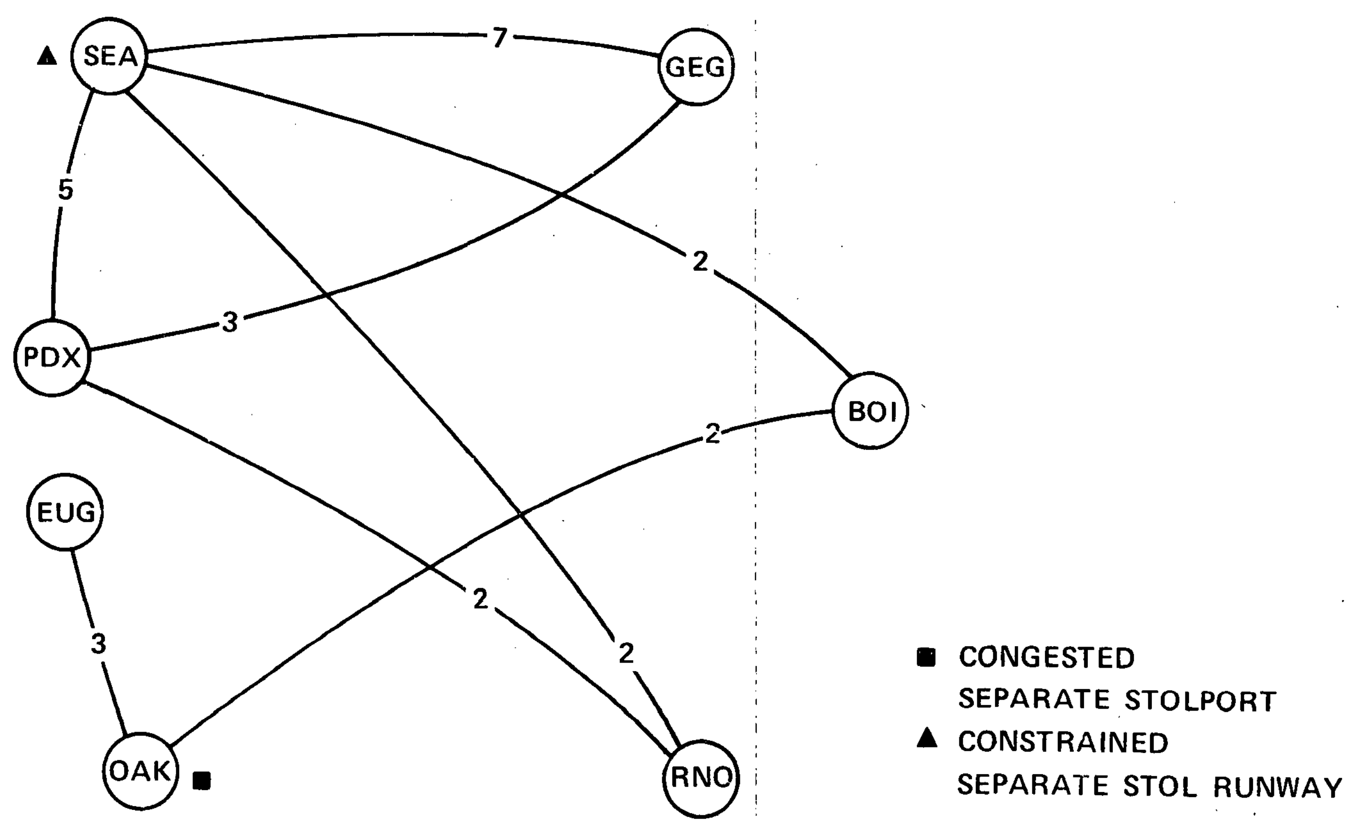


Figure 2-39

1985
NORTHWEST REGION - PHASE II
SUMMARY OF DAILY ROUND TRIPS EBF 150 PASSENGER CAPACITY



PR3-STOL-1454

Figure 2-40

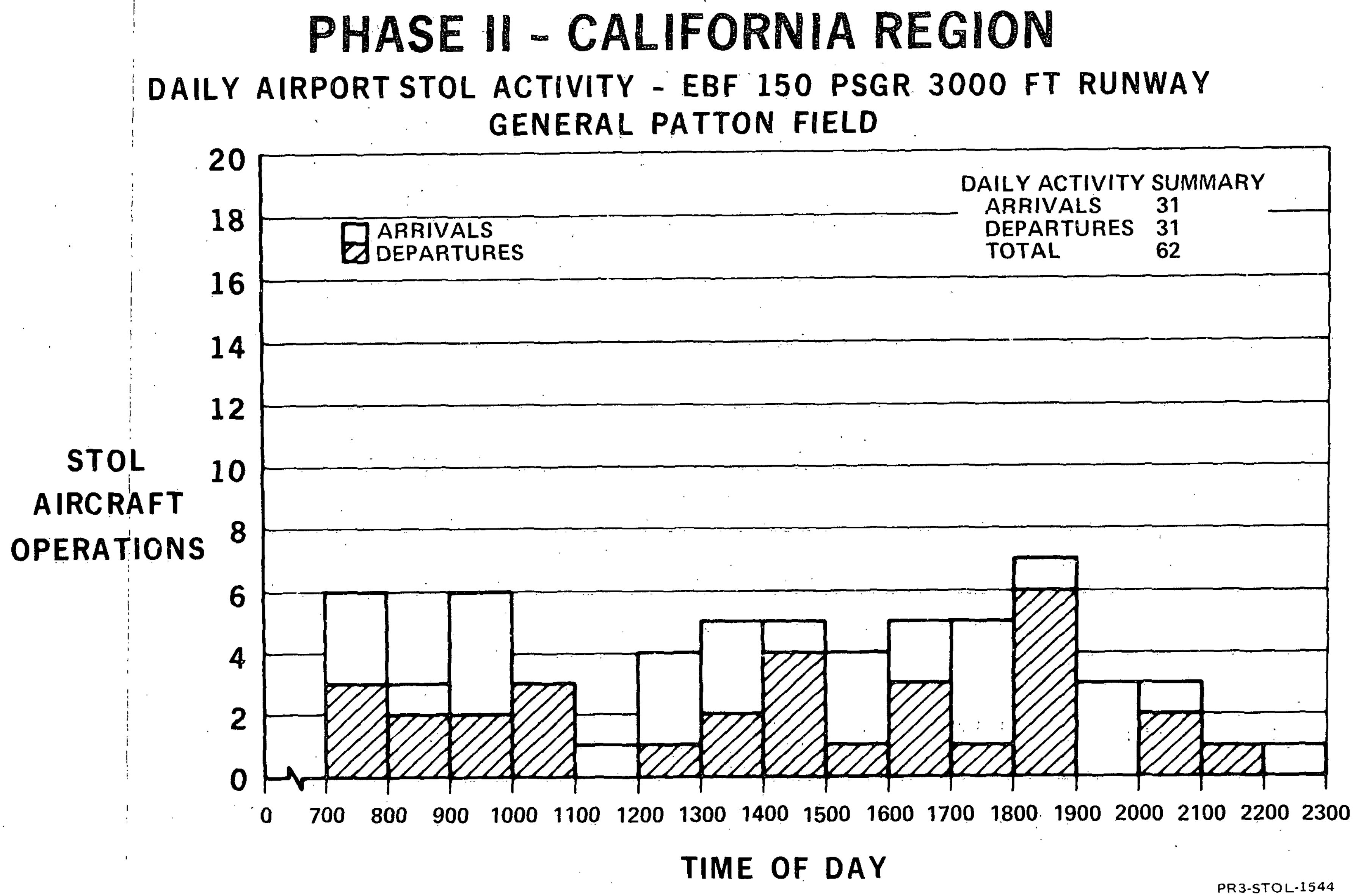

PHASE II - CALIFORNIA REGION
DAILY AIRPORT STOL ACTIVITY - EBF 150 PSGR 3000 FT RUNWAY
GENERAL PATTON FIELD
ARRIVALS
DEPARTURES
DAILY ACTIVITY SUMMARY
ARRIVALS 31
DEPARTURES 31
TOTAL 62
STOL AIRCRAFT OPERATIONS
20
18
16
14
12
10
8
6
4
2
0
0 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300
TIME OF DAY
PR3-STOL-1544

Figure 2-41

STOL GATE REQUIREMENTS

GENERAL PATTON FIELD (GPF)

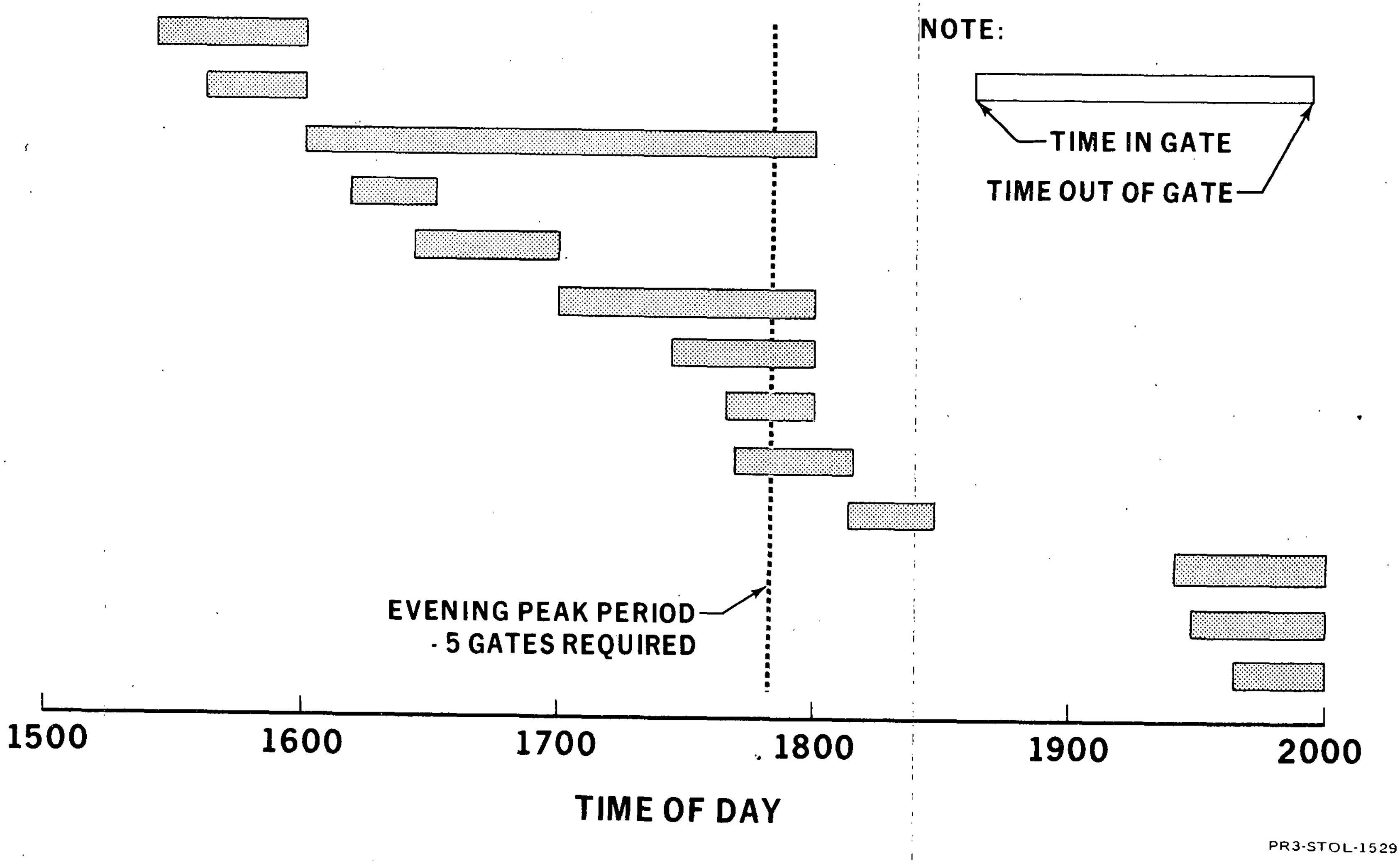


Figure 2-42

into and out of the gate for the afternoon and evening periods at General Patton Field. As indicated on Figure 2-42, the number of gates required is 5.

A regional summary of the peak hour flights, peak hour passengers and the number of gates required are presented in Tables 2-9 through 2-14.

2.3.2 Airport Data Base.

2.3.2.1 National Short-Haul System Airport Base. The airports that comprise the baseline national short-haul system network is obtained by combining the six representative regions that were studied in Phase II. For the six regions, the total number of airports is 123 and is detailed as follows:

o	Expanded Chicago Region	19 Airports
o	Expanded Northeast Region	18 Airports
o	Expanded California Region	22 Airports
o	Southern Region	20 Airports
o	Southeast Region	37 Airports
o	Northwest Region	7 Airports

Because of the overlap where one airport may be in two or more of the regions, the total number of airports in the national network is now reduced to 94. These airports are presented in Figure 2-43.

The network composition is a complete cross section of airports ranging from existing high dense, large hub air carriers to general aviation facilities. Also included are two new STOLport sites— General Patton Field (California) and Secaucus (Northeast). A summary of the types of airports and a breakdown of the airports into each of the three NASP system categories is shown as Table 2-15. A detailed summary is contained in Appendix 15-1.

Table 2-9

AIRPORT SUMMARY
EXPANDED CHICAGO REGION - 1985
EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

CITY	AIRPORT	CODE	PEAK HOUR FLIGHTS	PEAK HOUR PASSENGERS	GATES REQUIRED
BUFFALO	GREATER BUFFALO	BUF	2	189	1
CHICAGO	MEIGS	CGX	13	977	7
CHICAGO	MIDWAY	MDW	12	1393	8
CINCINNATI	GREATER CINCINNATI	CVG	4	434	2
CLEVELAND	BURKE LAKEFRONT	BKL	5	522	2
COLUMBUS	PORT COLUMBUS	CMH	3	288	1
DAYTON	J. M. COX	DAY	4	377	2
DENVER	STAPLETON INT'L	DEN	2	239	1
DES MOINES	DES MOINES MUNICIPAL	DSM	4	352	2
DETROIT	DETROIT CITY	DET	9	688	6
INDIANAPOLIS	WEIR COOK	IND	4	416	2
KANSAS CITY	KANSAS CITY MUNICIPAL	MKC	6	660	3
MILWAUKEE	GEN MITCHELL FIELD	MKE	4	455	2
MINNEAPOLIS – ST PAUL	CRYSTAL	MIC	6	751	4
OMAHA	EPPLEY FIELD	OMA	3	331	1
PITTSBURGH	ALLEGHENY COUNTY	AGC	3	299	2
ROCHESTER	MONROE COUNTY	ROC	2	183	1
ST. LOUIS	BI STATE PARKS	CPS	6	694	4
TOLEDO	TOLEDO EXPRESS	TOL	1	113	1

PR3-STOL-1446

Table 2-10

AIRPORT SUMMARY
EXPANDED NORTHEAST REGION - 1985
EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

CITY	AIRPORT	CODE	PEAK HOUR FLIGHTS	PEAK HOUR PASSENGERS	GATES REQUIRED
BOSTON	HANSCOM FIELD	BED	10	1187	5
BOSTON	NORWOOD	OWD	11	1003	5
BUFFALO	GREATER BUFFALO	BUF	4	288	3
CINCINNATI	GREATER CINCINNATI	CVG	2	173	2
CLEVELAND	BURKE LAKEFRONT	BKL	6	620	4
COLUMBUS	PORT COLUMBUS	CMH	1	135	1
DETROIT	DETROIT CITY	DET	7	514	4
HARTFORD	HARTFORD-BRAINARD	HFD	2	242	2
NEW YORK	WESTCHESTER CO.	HPN	11	1071	6
NEW YORK	ISLIP MACARTHUR	ISP	10	1203	6
NEW YORK	SECAUCUS	SEC	12	1305	6
NORFOLK	NORFOLK REGIONAL	ORF	1	123	1
PITTSBURGH	ALLEGHENY COUNTY	AGC	5	533	4
PHILADELPHIA	NO. PHILADELPHIA	PNE	8	801	5
PROVIDENCE	GR. PROVIDENCE	PVD	1	107	1
ROCHESTER	MONROE COUNTY	ROC	3	340	2
SYRACUSE	C. E. HANCOCK	SYR	2	173	1
WASHINGTON	WASHINGTON NATIONAL	DCA	17	1298	8

PR3-STOL-1451

Table 2-11

AIRPORT SUMMARY
EXPANDED CALIFORNIA REGION - 1985
EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

CITY	AIRPORT	CODE	PEAK HOUR FLIGHTS	PEAK HOUR PASSENGERS	GATES REQUIRED
ALBUQUERQUE	ALBUQUERQUE SUNPORT	ABQ	3	380	2
DENVER	STAPLETON INT'L	DEN	5	346	3
EL MONTE	EL MONTE	EMT	8	719	3
EUREKA	ARCATA	ACV	2	157	1
FRESNO	FRESNO AIR TERMINAL	FAT	3	349	2
LAS VEGAS	MCCARRAN INT'L	LAS	14	1567	8
LONG BEACH	DAUGHERTY FIELD	LGB	7	516	4
LOS ANGELES	GEN. PATTON FIELD	GPF	7	798	5
MONTEREY	MONTEREY PENINSULA	MRY	2	229	2
MOUNTAIN VIEW	MOFFETT FIELD	MOF	4	293	3
OAKLAND	NORTH FIELD	OAK	7	482	4
PHOENIX	PHOENIX SKY HARBOR	PHX	8	815	5
PORTLAND	PORTLAND INT'L	PDX	3	293	3
RENO	RENO INT'L	RNO	3	210	1
SACRAMENTO	SACRAMENTO EXEC	SAC	8	915	5
SALT LAKE CITY	SALT LAKE CITY INT'L	SLC	4	401	3
SAN DIEGO	MONTGOMERY FIELD	MYF	11	1303	6
SAN JOSE	REID HILLVIEW	RHV	5	500	3
SANTA ANA	ORANGE COUNTY	SNA	7	807	3
SANTA BARBARA	SANTA BARBARA MUNI	SBA	1	115	1
TUCSON	TUCSON INT'L	TUS	3	274	2
VAN NUYS	VAN NUYS	VNY	6	588	4

PR3-STOL-1450 A

Table 2-12

AIRPORT SUMMARY SOUTHERN REGION - 1985

EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

CITY	AIRPORT	CODE	PEAK HOUR FLIGHTS	PEAK HOUR PASSENGERS	GATES REQUIRED
ALBUQUERQUE	ALBUQUERQUE SUNPORT	ABQ	3	349	2
AMARILLO	AMARILLO AIR TERMINAL	AMA	2	171	1
AUSTIN	ROBERT MUELLER MUNICIPAL	AUS	2	148	1
CORPUS CHRISTI	CORPUS CHRISTI INT'L	CRP	1	129	1
DALLAS	DALLAS LOVE FIELD	DAL	17	2075	12
DENVER	STAPLETON INT'L	DEN	3	387	2
EL PASO	EL PASO INT'L	ELP	3	217	2
HOUSTON	HOUSTON HOBBY	HOU	6	509	4
KANSAS CITY	KANSAS CITY MUNICIPAL	MKC	1	133	1
LITTLE ROCK	ADAMS FIELD	LIT	1	113	1
LUBBOCK	LUBBOCK REGIONAL	LBB	2	211	1
MEMPHIS	GEN. D. SPAIN	GDS	4	322	3
MIDLAND ODESSA	MIDLAND ODESSA REGIONAL	MAF	4	394	2
NEW ORLEANS	LAKEFRONT	NEW	4	363	3
OKLAHOMA CITY	WILL ROGERS WORLD	OKC	3	320	1
ST. LOUIS	BI STATE PARKS	CPS	6	437	3
SAN ANTONIO	SAN ANTONIO INT'L	SAT	2	263	1
SHREVEPORT	SHREVEPORT REGIONAL	SHV	1	106	1
TULSA	TULSA INT'L	TUL	3	364	2
WICHITA	WICHITA MUNICIPAL	ICT	2	250	1

PR3-STOL-1449 A

Table 2-13

AIRPORT SUMMARY
SOUTHEAST REGION - 1985

EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

CITY	AIRPORT	CODE	PEAK HOUR FLIGHTS	PEAK HOUR PASSENGERS	GATES REQUIRED
ATLANTA	DEKALB PEACHTREE	PDK	13	1314	9
ATLANTA	FULTON CO.	FTY	16	1496	9
BALTIMORE	BELTSVILLE	BEL	2	194	1
BIRMINGHAM	BIRMINGHAM MUNICIPAL	BHM	1	97	1
CHARLESTON	CHARLESTON MUNICIPAL	CHS	2	171	1
CHARLOTTE	DOUGLAS MUNICIPAL	CLT	5	418	4
CHICAGO	MEIGS	CGX	6	735	4
CINCINNATI	GREATER CINCINNATI	CVG	1	105	1
CLEVELAND	BURKE LAKEFRONT	BKL	2	225	2
COLUMBIA	COLUMBIA METROPOLITAN	CAE	2	217	1
DETROIT	DETROIT CITY	DET	2	214	2
FT. LAUDERDALE	HOLLYWOOD INTERNATIONAL	FLL	1	105	1
GREENSBORO	GREENSBORO HIGH PT.	GSO	5	497	2
INDIANAPOLIS	WEIR COOK	IND	2	170	1
JACKSON	A. C. THOMPSON FIELD	JAN	1	90	1
JACKSONVILLE	JACKSONVILLE INT'L	JAX	3	206	2
KNOXVILLE	MCGHEE TYSON	TYS	2	205	1
LOUISVILLE	STANDIFORD FIELD	SDF	6	423	4
MEMPHIS	GEN. D. SPAIN	GDS	5	477	3
MIAMI	OPA LOCKA	OPF	6	436	4

PR3-STOL-1447

Table 2-13

AIRPORT SUMMARY
SOUTHEAST REGION - 1985
EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M) (CONTINUED)

CITY	AIRPORT	CODE	PEAK HOUR FLIGHTS	PEAK HOUR PASSENGERS	GATES REQUIRED
MOBILE	BATES FIELD	MOB	1	141	1
NASHVILLE	NASHVILLE METROPOLITAN	BNA	4	342	2
NEW ORLEANS	LAKEFRONT	NEW	4	339	2
NEW YORK	ISLIP MACARTHUR	ISP	3	211	2
NEW YORK	SECAUCUS	SEC	4	310	2
NEWPORT NEWS	PATRICK HENRY	PHF	1	96	1
NORFOLK	NORFOLK REGIONAL	ORF	2	188	1
ORLANDO	MCCOY AIR FORCE BASE	MCO	4	355	2
PHILADELPHIA	NO. PHILADELPHIA	PNE	3	319	2
PITTSBURGH	ALLEGHENY COUNTY	AGC	1	114	1
RALEIGH DURHAM	RALEIGH/DURHAM	RDU	6	486	3
RICHMOND	R. E. BYRD INT'L	RIC	2	171	1
ST. LOUIS	BI STATE PARKS	CPS	3	282	2
SAVANNAH	SAVANNAH MUNICIPAL	SAV	2	182	2
TALLAHASSEE	TALLAHASSEE MUNICIPAL	TLH	1	113	1
TAMPA	TAMPA INT'L	TPA	4	273	2
WASHINGTON, D.C.	WASHINGTON NATIONAL	DCA	7	700	4

PR3-STOL-1448 A

Table 2-14

AIRPORT SUMMARY
NORTHWEST REGION - 1985
EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)

CITY	AIRPORT	CODE	PEAK HOUR FLIGHTS	PEAK HOUR PASSENGERS	GATES REQUIRED
BOISE	BOISE AIR TERMINAL	BOI	3	344	1
EUGENE	MAHLON SWEET FIELD	EUG	1	127	1
OAKLAND	NORTH FIELD	OAK	3	302	1
PORTLAND	PORTLAND INTERNATIONAL	PDX	2	192	2
RENO	RENO INTERNATIONAL	RNO	3	273	2
SEATTLE	SEATTLE-TACOMA	SEA	3	299	3
SPOKANE	SPOKANE INTERNATIONAL	GEG	3	220	2

PR3-STOL-1452

NATIONAL SHORT HAUL NETWORK

AIRPORT BASE • 94 AIRPORTS

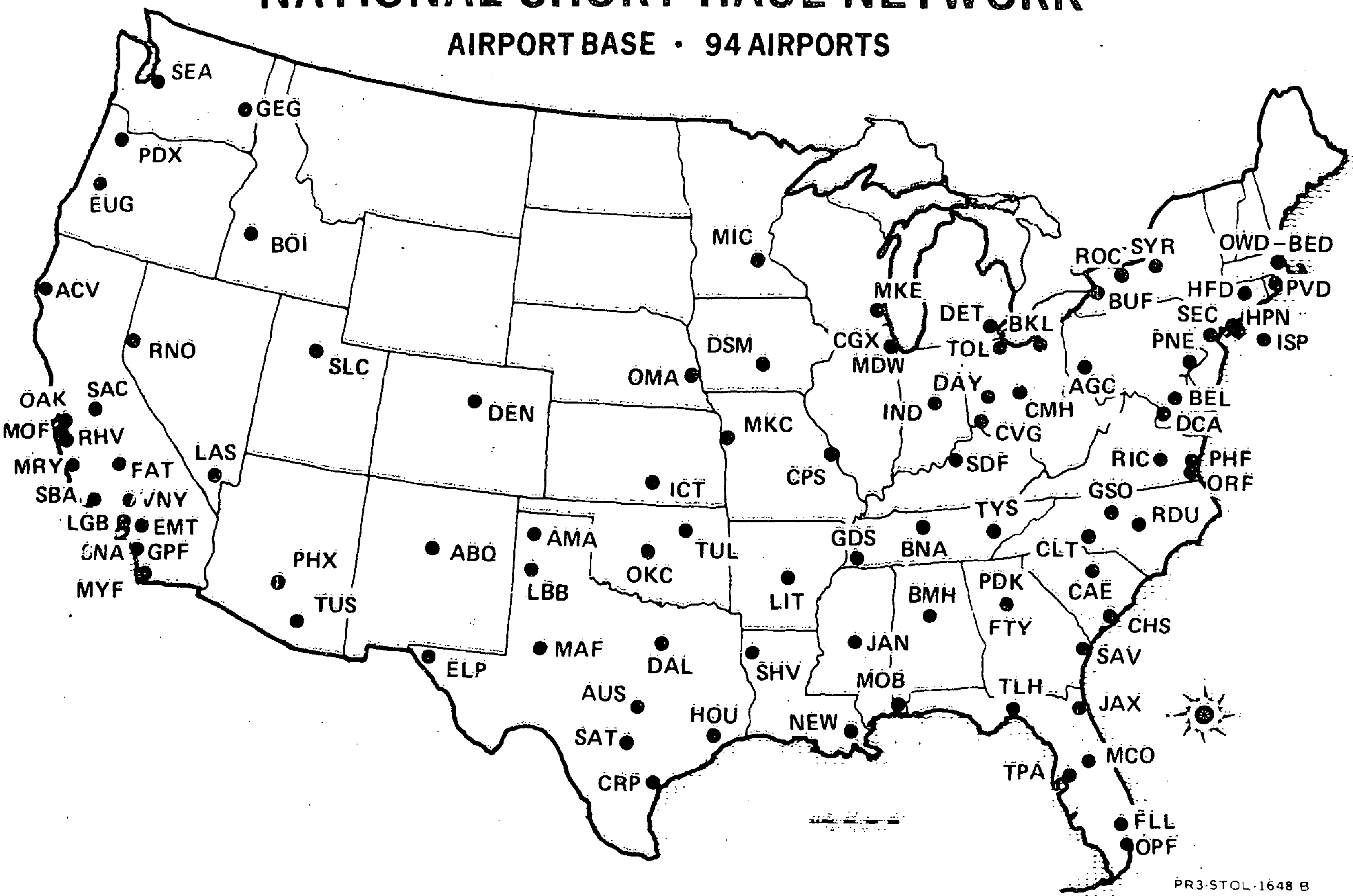


Figure 2-43

Table 2-15

SUMMARY: NETWORK COMPOSITION OF THE NATIONAL SHORT-HAUL SYSTEM

Total Number of Airports	94
Number of Existing Air Carrier (Mode I) Airports	72
Number of Existing General Aviation (Mode II) Airports	20
Number of New (Mode III) STOLports	2
Number of NASP Primary System Airports (over one million annual passengers - 1970 traffic)	29
High Density (more than 350,000 operations)	4
Medium Density (250,000 to 350,000 operations)	4
Low Density (less than 250,000 operations)	21
Number of NASP Secondary System Airports (50,000 to one million annual passengers - 1970 traffic)	41
High Density (more than 250,000 operations)	4
Medium Density (100,000 to 250,000 operations)	3
Low Density (less than 100,000 operations)	34
Number of NASP Feeder System Airports (Less than 50,000 annual passengers - 1970 traffic)	2
High Dense (more than 100,000 operations)	1
Medium Dense (20,000 to 100,000 operations)	1
Low Dense (less than 20,000 operations)	0

A superficial analysis of the Hawaii Region was conducted to yield a total United States domestic market. As shown on Figure 2-44, seven cities were selected for the representative network. The cities and their corresponding airports are as follows:

City	Airport Name	Code
Hilo	General Lyman Field	ITO
Honolulu	Honolulu International	HNL
Kahului	Kahului	OGG
Kailua-Kona	Ke-Ahole	KOA
Kamuela	Waimea-Kohala	MUE
Kaunakakai	Molokai	MKK
Lihue	Lihue	LIH

The airports were not studied in detail, and, therefore, are not considered as an integral part of the national short-haul network.

2.3.2.2 Airport Data Base. As a prerequisite of the airport/aircraft compatibility evaluation, relevant airport physical data were compiled for each of the 94 airports in the national system. Data was obtained from airport master records, FAA Airport Master Records (FAA Form 5010-1), FAA Air Traffic Activity summaries and other FAA/airport related documents included the following:

- o Airport elevation and the normal maximum temperature.
- o Runway length, width, composition, strength, gradient, wind coverage and approach ratios.
- o Taxiway width.
- o Runway/taxiway and taxiway/taxiway separation.

1985
HAWAII REGION-PHASE II

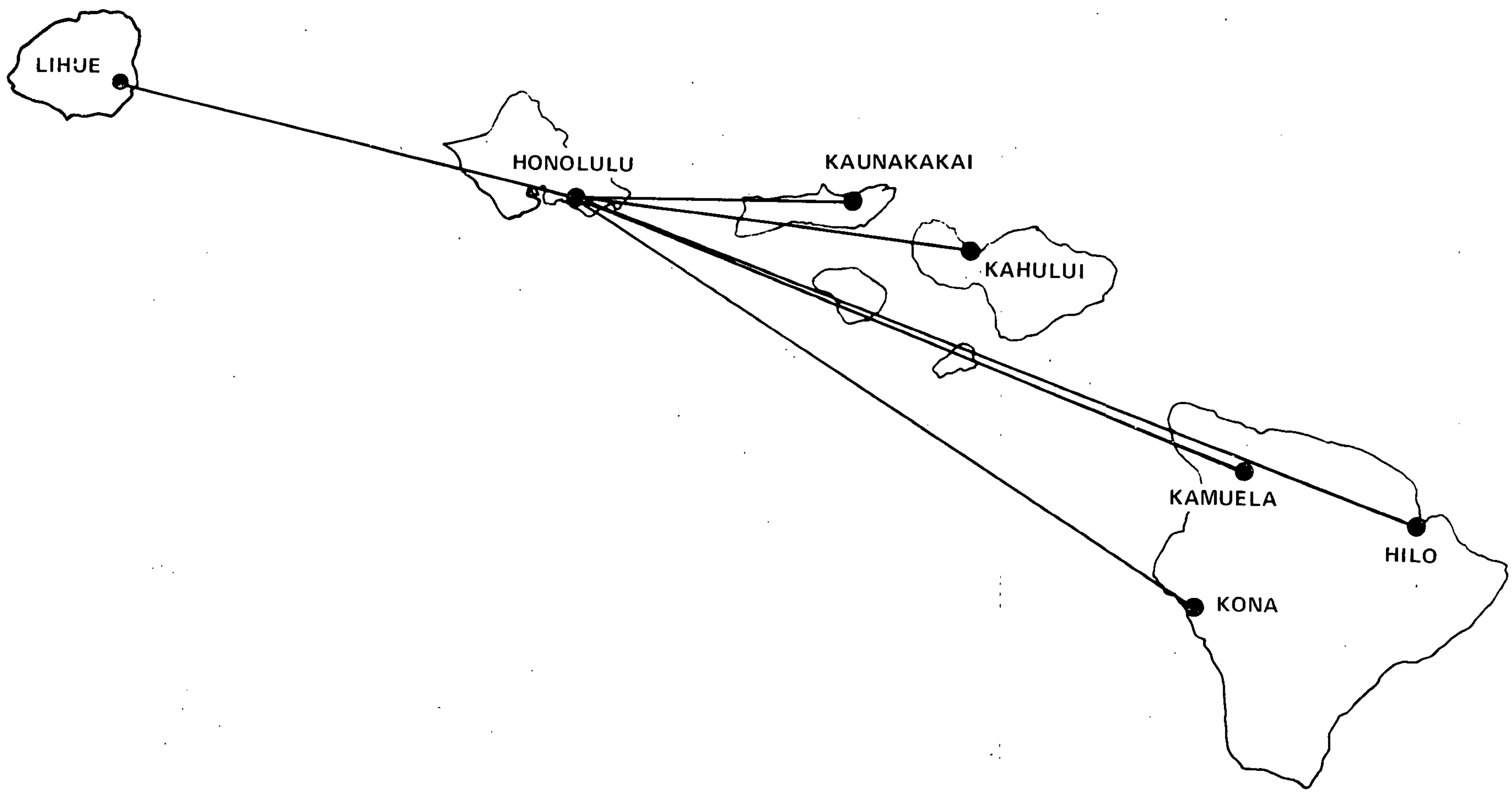


Figure 2-44

- o Largest and most frequent jet aircraft usage.

The airport data is tabulated in Appendix 15-2. ATC data was also compiled and will be presented as part of the airport/aircraft compatibility evaluation.

2.3.3 Airport Airside Compatibility - To insure the operational capability of the baseline STOL aircraft at each of the airports in the national short-haul system, an airport airside compatibility evaluation was conducted and is contained herein. Airport facilities that were analyzed are as follows:

- o Runways
- o Taxiways
- o Flotation
- o Runway Capacity
- o Wind Coverage
- o Ground Maneuvering
- o Gate Areas
- o ATC

2.3.3.1 Runways. The runways selected for STOL operation were based on the airport STOL activity criteria set forth in the operations scenario. They are as follows:

- o At general aviation airports that were selected as relievers for the congested major hubs, the longest and/or strongest runway was selected for STOL operation.
- o At air carrier airports which have 5 STOL daily round trips or less, the main CTOL runway was selected for STOL operation.

For a low activity level such as 5 round trips, it was assumed that STOL would co-share the same runway as CTOL.

- At air carrier airports with separate STOL facilities, an effort was made to select a secondary runway parallel to the main CTOL runway. Intersecting runways were avoided because of runway capacity constraints.

The runway selected at each airport in the national system is summarized in the airport data base, Appendix 15-2.

2.3.3.1.1 Runway Length Compatibility. The physical field lengths for the runways selected for STOL operation at each of the airports in the national system were corrected for elevation, temperature and runway gradient to make them comparable with the 3000 ft. (914 m) design field length requirement of the baseline EBF STOL. A summary of the effective runway lengths for the baseline national airport system is shown as Figure 2-45. Compared with the requirement for the baseline STOL, eight airports have runway lengths of 3000 feet (914 m) or less. Among the eight are the two new STOLports--General Patton Field and Secaucus. Their effective lengths are assumed to be 3000 ft. (914 m) for the study. The other six airports are as follows:

- Crystal (Minneapolis - St. Paul) - MIC
- Stapleton International (Denver) - DEN
- Fresno Air Terminal (Fresno) - FAT
- Montgomery (San Diego) - MYF
- Reid Hillview (San Jose) - RHV
- DeKalb Peachtree (Atlanta) - PDK

STOLPORT RUNWAY EFFECTIVE LENGTHS

NATIONAL SHORT-HAUL SYSTEM

94 AIRPORTS

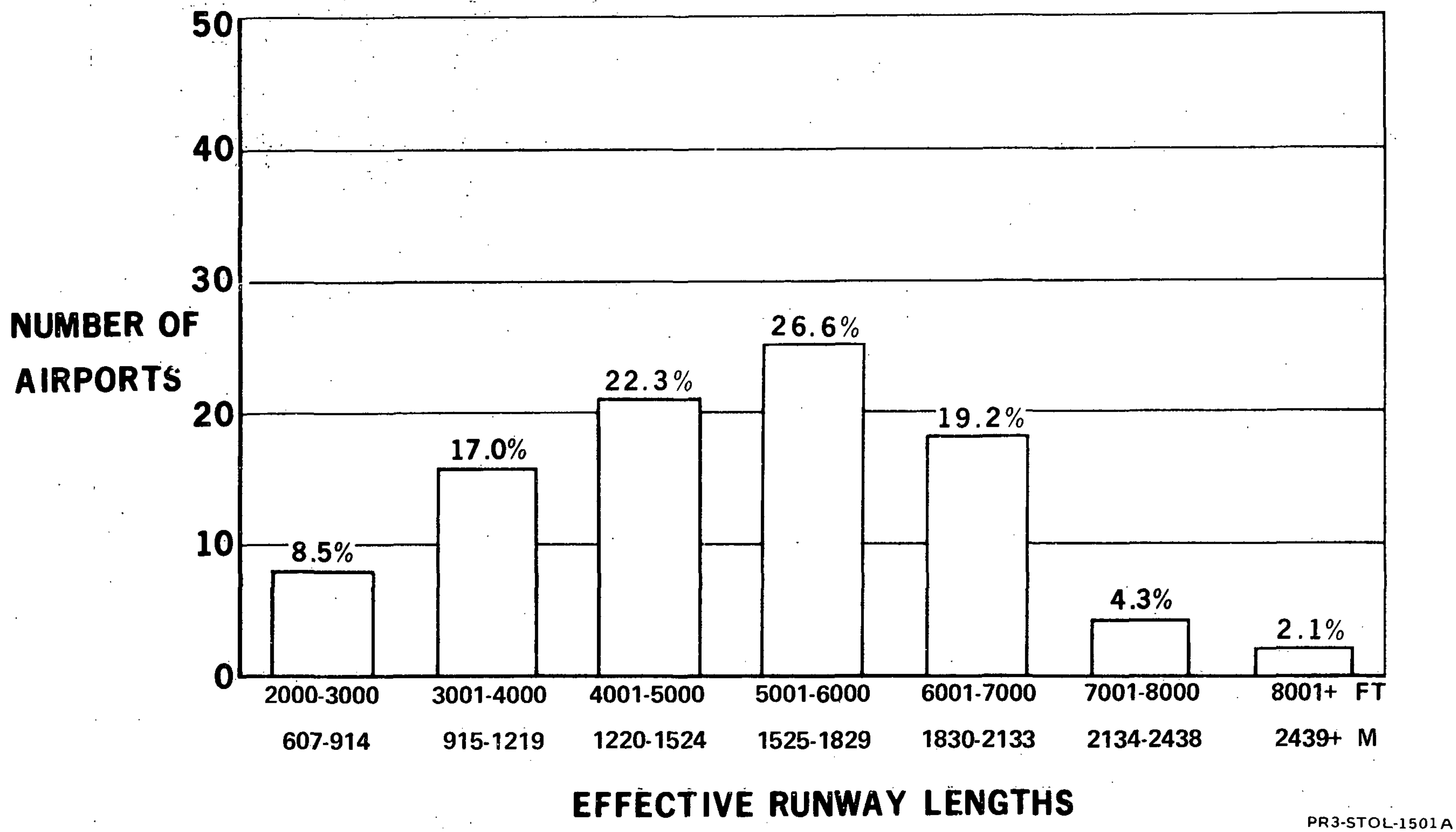


FIGURE 2-45

Of the six airports, four are general aviation. The other two (Denver and Fresno) are current air carrier airports.

2.3.3.1.2 Runway Width Compatibility. A summary of airport design standards is shown on Table 2-16 for the baseline STOL aircraft, Category I CTOL aircraft and for general utility airports. The runway width requirement for the baseline EBF STOL aircraft was determined to be 115 ft. (35 m) based on the application of the landing statistics determined for the Breguet 188-941S. It is desirable for the baseline STOL to make a 180 degree turn on this runway, and, from Figure 2-46, it can be easily accomplished.

The widths of the runways selected at each of the 94 national system airports are summarized as Figure 2-47. Excluding the two new STOLports, the following eight airports have runway widths less than the STOL requirement of 115 ft. (35 m).

- 75 ft. (23 m)
  - Crystal (Minneapolis-St. Paul) - MIC
  - El Monte (Los Angeles) - EMT
  - Fresno Air Terminal (Fresno) - FAT
  - Reid Hillview (San Jose) - RHV
  - General Dewitt Spain Downtown (Memphis) - GDS
- 100 ft. (30 m)
  - Bi State Parks (St. Louis) - CPS
  - Detroit City (Detroit) - DET
  - Fulton County (Atlanta) - FTY

Of the eight airports, Fresno Air Terminal and Detroit City are the only non general aviation airports.

Table 2-16

AIRPORT DESIGN STANDARDS

Airport Item	Category I*	EBF 150 3000 (Requirements)	Utility Airports - General Utility (B)**
Runway Width - ft/m	150/46	115/35	100/30
Taxiway Width - ft/m	50/15	55/17	40/12
Runway Centerline to Taxiway Centerline - ft/m	400/122	340/104	225/69
Taxiway Centerline to Taxiway Centerline - ft/m	200/61	160/49	--

* From FAA Advisory Circular AC 150/5335-1A Change 1 "Airport Design Standards - Airports Served by Air Carriers - Taxiways."

** From FAA Advisory Circular AC 150/5330-4A "Utility Airports"

180 DEGREE NORMAL TURNING RADIUS

EBF 150 PSGR FIELD LENGTH 3000 FT (914.4 M)

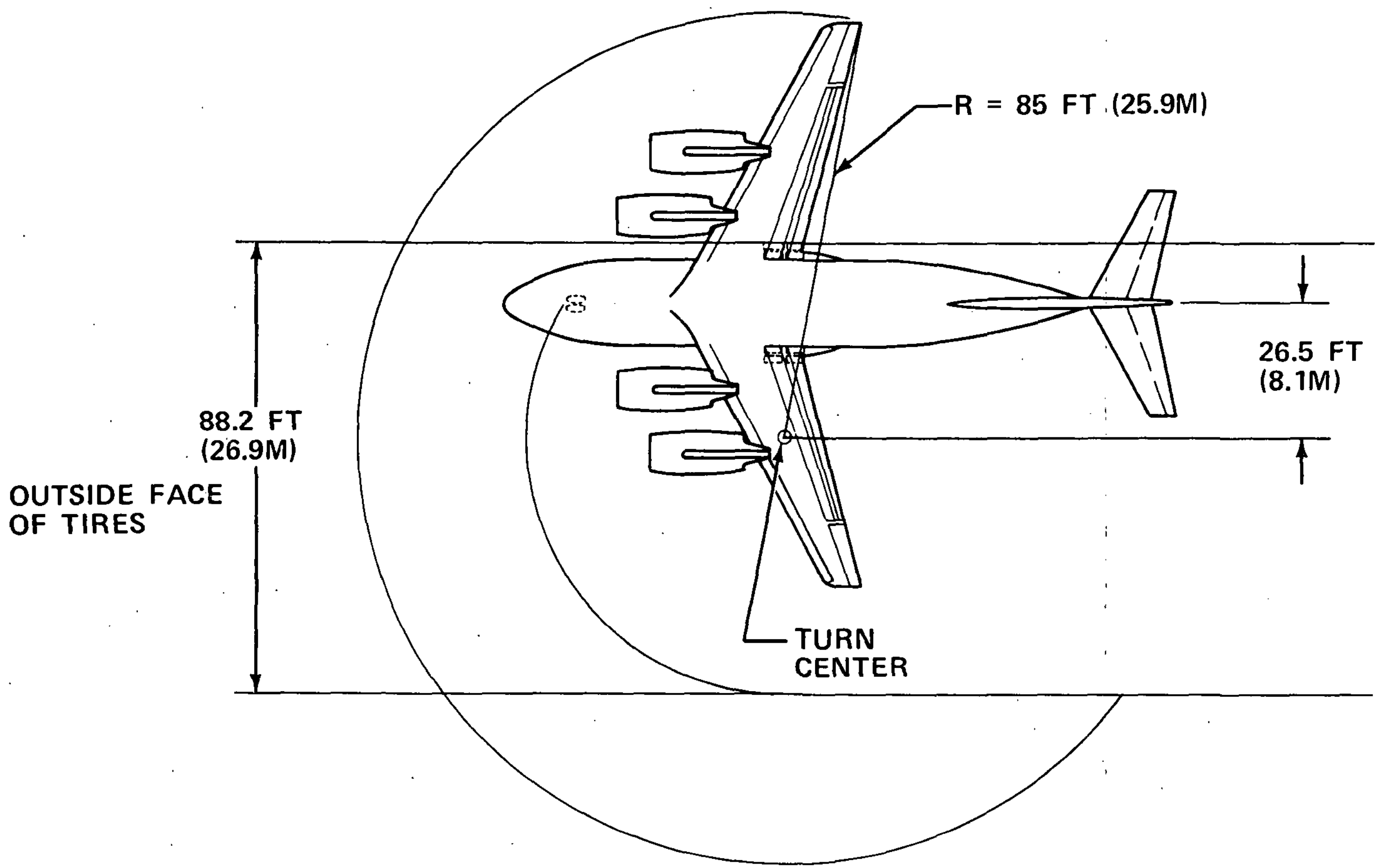


Figure 2-46

PR3-STOL-1584

SUMMARY STOLPORT RUNWAY WIDTHS

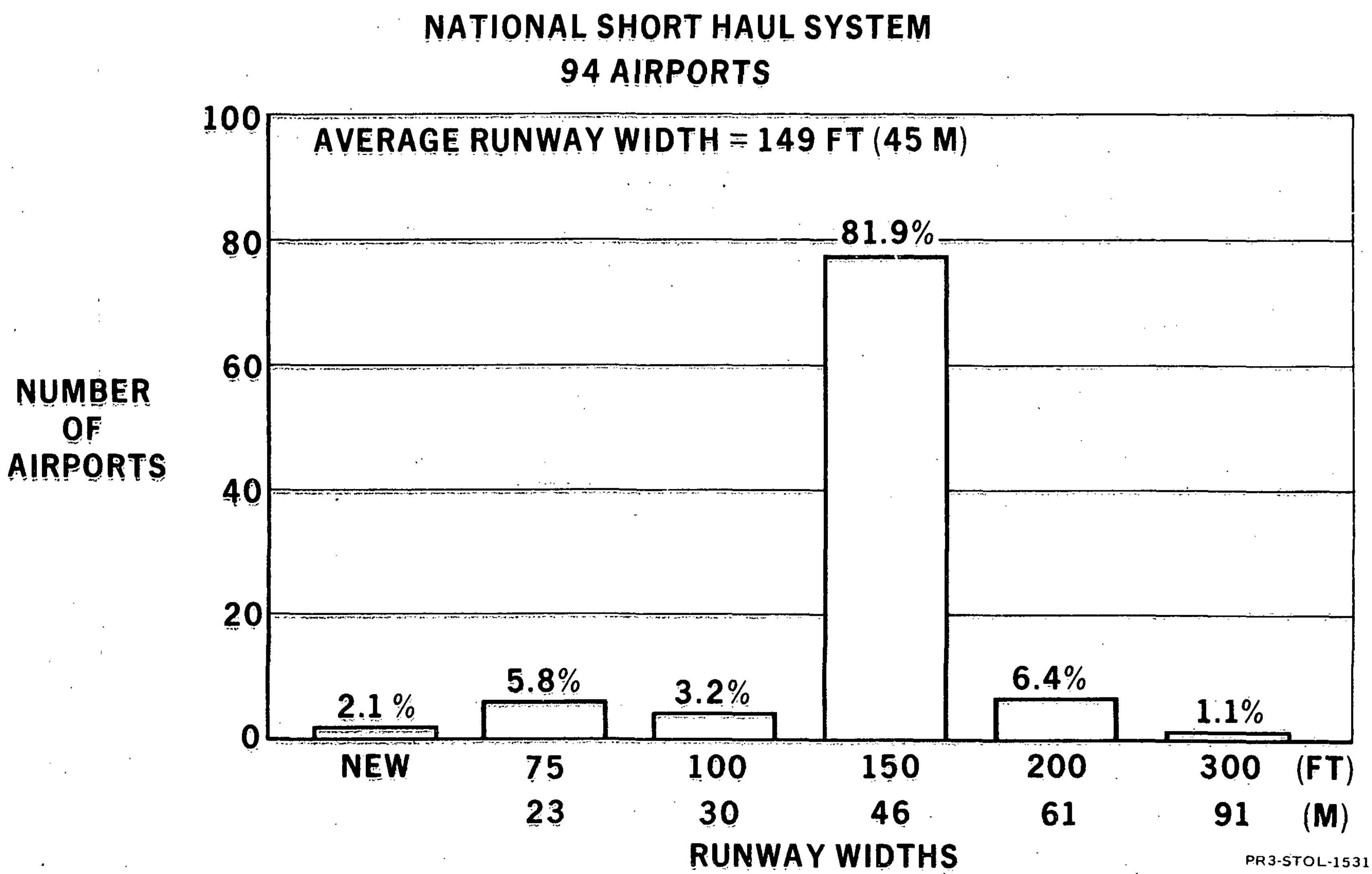


Figure 2-47

2.3.3.2 Taxiway Width Compatibility. The baseline STOL taxiway width requirement of 53.4 ft. (16.3 m) was determined based on the wheel tread to the outside face of the main landing gear tires and the desire to maintain at least 15 ft. (4.6 m) taxiway edge clearance when the aircraft is on the taxiway centerline.

Current FAA taxiway design criteria, in accordance with Advisory Circular AC 150/5335-1A, stipulates that existing short-haul CTOL aircraft like the DC-9 and the B727-200 can operate on taxiways that are 50 ft. (15.2 m) wide. Based on similar wheel tread geometries, it is felt that the baseline EBF STOL aircraft can also operate on a 50 ft. (15.2 m) taxiway. In this case, the taxiway edge clearance would only be 13.3 ft. (4.1 m).

A summary of the taxiway widths for each of the 94 national system airports is presented as Figure 2-48. Excluding the two new STOLports, the following six general aviation airports have taxiway widths that are less than 50 ft. (15.2 m):

- 30 Ft. (9.1 m)

  Crystal (Minneapolis-St. Paul) - MIC

- 40 Ft. (12.2 m)

  Hartford-Brainard (Hartford) - HFD

  El Monte (Los Angeles) - EMT

  Reid Hillview (San Jose) - RHV

- 45 Ft. (13.7 m)

  Bi State Parks (St. Louis) - CPS

  General Dewitt Spain Downtown (Memphis) - GDS

Taxiway to taxiway ground maneuvering capability for the baseline STOL aircraft is presented as Figure 2-49 for 50 ft. (15.2 m) taxiways. The

SUMMARY STOLPORT TAXIWAY WIDTHS

NATIONAL SHORT HAUL SYSTEM

93 AIRPORTS*

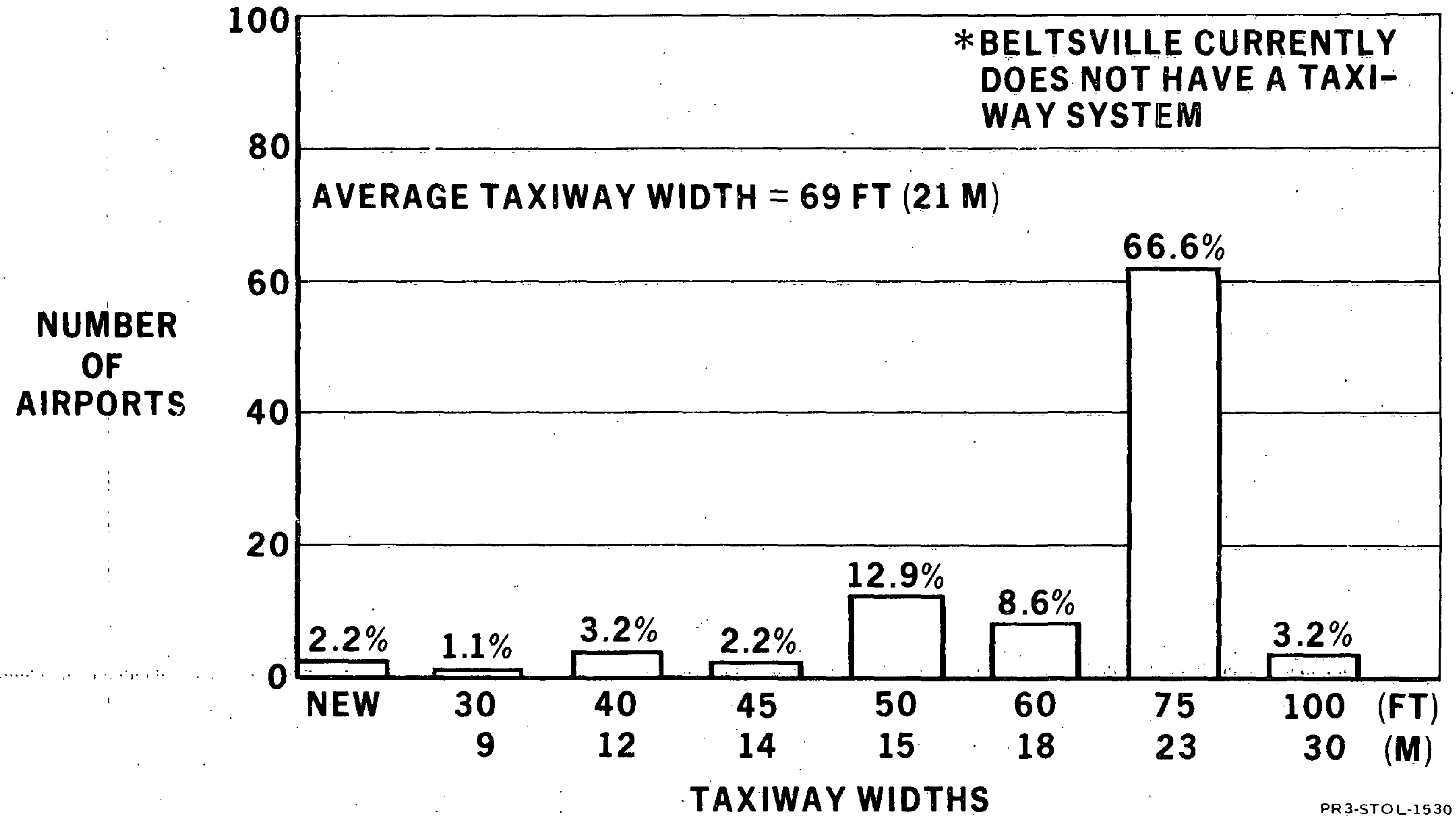
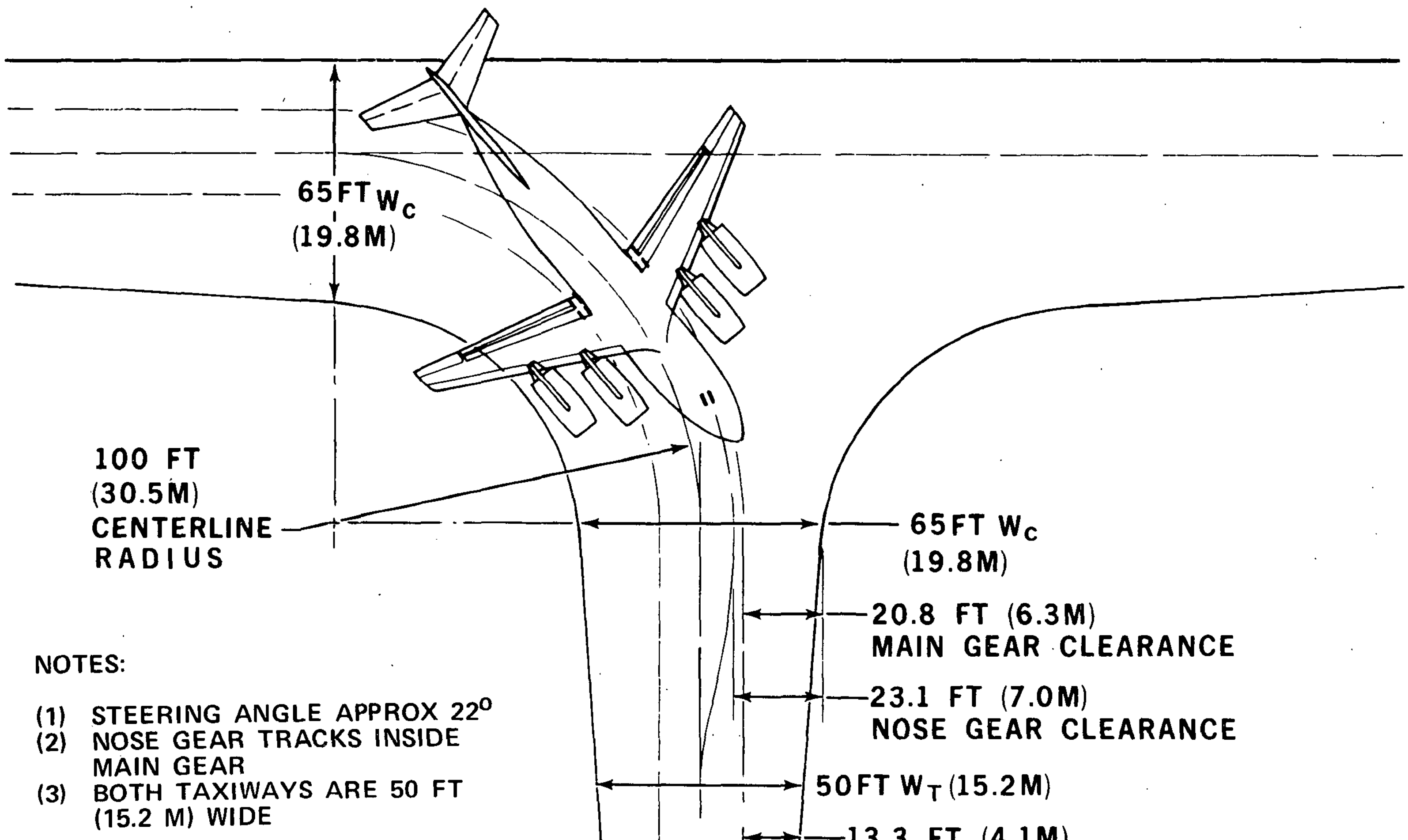


Figure 2-48

90 DEGREE TURN - TAXIWAY TO TAXIWAY

EBF 150 PSGR FIELD LENGTH 3000 FT (914.4M)



NOTES:

(1) STEERING ANGLE APPROX 22^{o}
(2) NOSE GEAR TRACKS INSIDE MAIN GEAR
(3) BOTH TAXIWAYS ARE 50 FT (15.2 M) WIDE

Figure 2-49

PR3-STOL-1456

65 ft. (19.8 m) taxiway width at the point of tangency and the 100 ft. (30.5 m) centerline turn radius are design standards set forth in the taxiway design advisory circular. The six deficient airports mentioned above cannot achieve this capability unless their taxiway widths are increased.

2.3.3.3 Parallel Runway/Taxiway and Taxiway/Taxiway Separation. In accordance with the FAA Advisory Circular on taxiway design, the minimum standard for runway/taxiway separation is 400 ft. (122 m) at airports which currently handle Category I (DC-9, B727) and Category II (DC-8, B707) aircraft (See Table 2-16). The baseline STOL separation requirement of 340 ft. (104 m) was based on the 165 ft. (50 m) wing tip clearance typical for DC-8-55 operation as determined in the previous section. Comparatively, the baseline STOL requirement is well within the minimum CTOL design criteria and should be compatible at all air carrier airports in the national short-haul system.

From Table 2-16, the STOL requirement is greater than the design criteria for general utility airports. Attention is now focused on the 20 general aviation airports in the system. Upon further examination, it was found that 15 airports have adequate runway/taxiway separation distances. The 5 airports that are deficient are:

- El Monte (Los Angeles) - EMT
- Hartford-Brainard (Hartford) - HFD
- DeKalb Peachtree (Atlanta) - PDK
- Crystal (Minneaspolis/St. Paul) - MIC
- General Dewitt Spain (Memphis) - GDS

The 160 ft. (49 m) taxiway/taxiway requirement of the baseline STOL EBF was found to be adequate at all the airports in the national system.

2.3.3.4 Runway Pavement Strength Compatibility. At an airport, the allowable aircraft gross weight, in the final analysis, is determined by the airport authority. Usually, in determining the merits of current or proposed landing gear configurations, it is necessary to use available airport pavement data to estimate allowable aircraft weights without benefit of the airport authority's evaluation. The most readily available data for use in estimating allowable weights are the published S, T and TT ratings.

The S, T and TT ratings are aircraft allowable gross weights which are based on typical tire pressures, landing gear wheel spacings and load distribution. They do not reflect variations which may degrade of improve the flotation qualities of an individual aircraft. For the compatibility analysis, it is the basic assumption that the S, T and TT ratings are established according to the procedures set forth in the FAA Advisory Circular AC 150/5320-6A Change 3, "Airport Paving."

Figure 2-50 shows the relation between TT ratings and allowable gross weights for the baseline EBF aircraft for both asphalt and concrete pavements. The concrete relationship is based a subgrade modulus (k) of 300 pci (8.3 kg/cm^3) and a concrete working stress (σ) of 400 psi (28.12 kg/cm^2). At maximum takeoff weight, the concrete twin tandem pavement rating requirement is 143,000 lbs. (64,865 kg). The asphalt relationship is based on an F4 subgrade strength rating. At maximum takeoff weight, the asphalt twin tandem rating requirement is 138,000 lbs. (62,597 kg).

Figure 2-51 presents a summary of the pavement strength ratings for 91 of the airports in the national short-haul system. Twin tandem strength data was not available for Norwood (OWD), North Philadelphia (PNE) and Moffett Field (MOF); but, the runways were found to be of sufficient

AIRCRAFT WEIGHT vs TT RATING

EBF 150 PSGR, FIELD LENGTH 3000 FT (914 M)

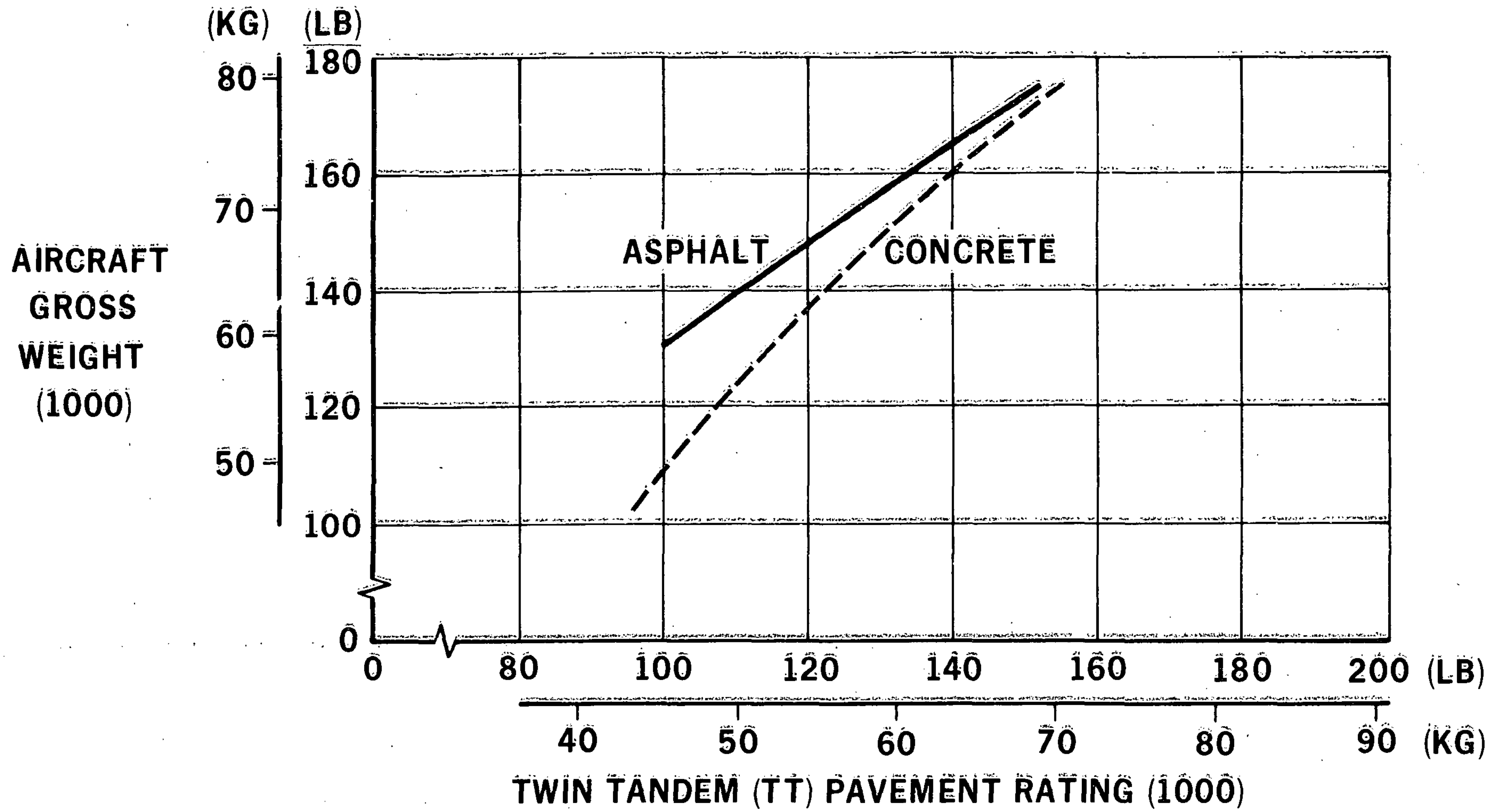


Figure 2-50

strength to support STOL activity.

From Figure 2-51, 30 runways have pavement strengths insufficient of supporting operation of the baseline STOL aircraft at maximum takeoff weight. But, because of the overall system aircraft load factor of 60% and of the aircraft not carrying cargo, maximum takeoff weight is never attained at any airport in the system. Comparing the maximum operational weights determined in the route analysis evaluation with the pavement ratings, it was found that 9 of the airports could support STOL operation without pavement rehabilitation.

The 21 airports which have insufficient pavement strength capability are as follows:

- o General Aviation Airports
  - Meigs (Chicago) - CGX
  - Crystal (Minneapolis-St. Paul) - MIC
  - Bi State Parks (St. Louis) - CPS
  - Detroit City (Detroit) - DET
  - Hartford-Brainard (Hartford) - HFD
  - El Monte (Los Angeles) - EMT
  - Montgomery (San Diego) - MYF
  - Reid Hillview (San Jose) - RHV
  - General Dewitt Spain (Memphis) - GDS
  - Lakefront (New Orleans) - NEW
  - Beltsville (Baltimore) - BEL
  - DeKalb Peachtree (Atlanta) - PDK
- o Air Carrier Airports
  - Islip MacArthur (New York) - ISP

SUMMARY
STOLPORT RUNWAY PAVEMENT STRENGTHS (TT)
NATIONAL SHORT HAUL SYSTEM
91 AIRPORTS*

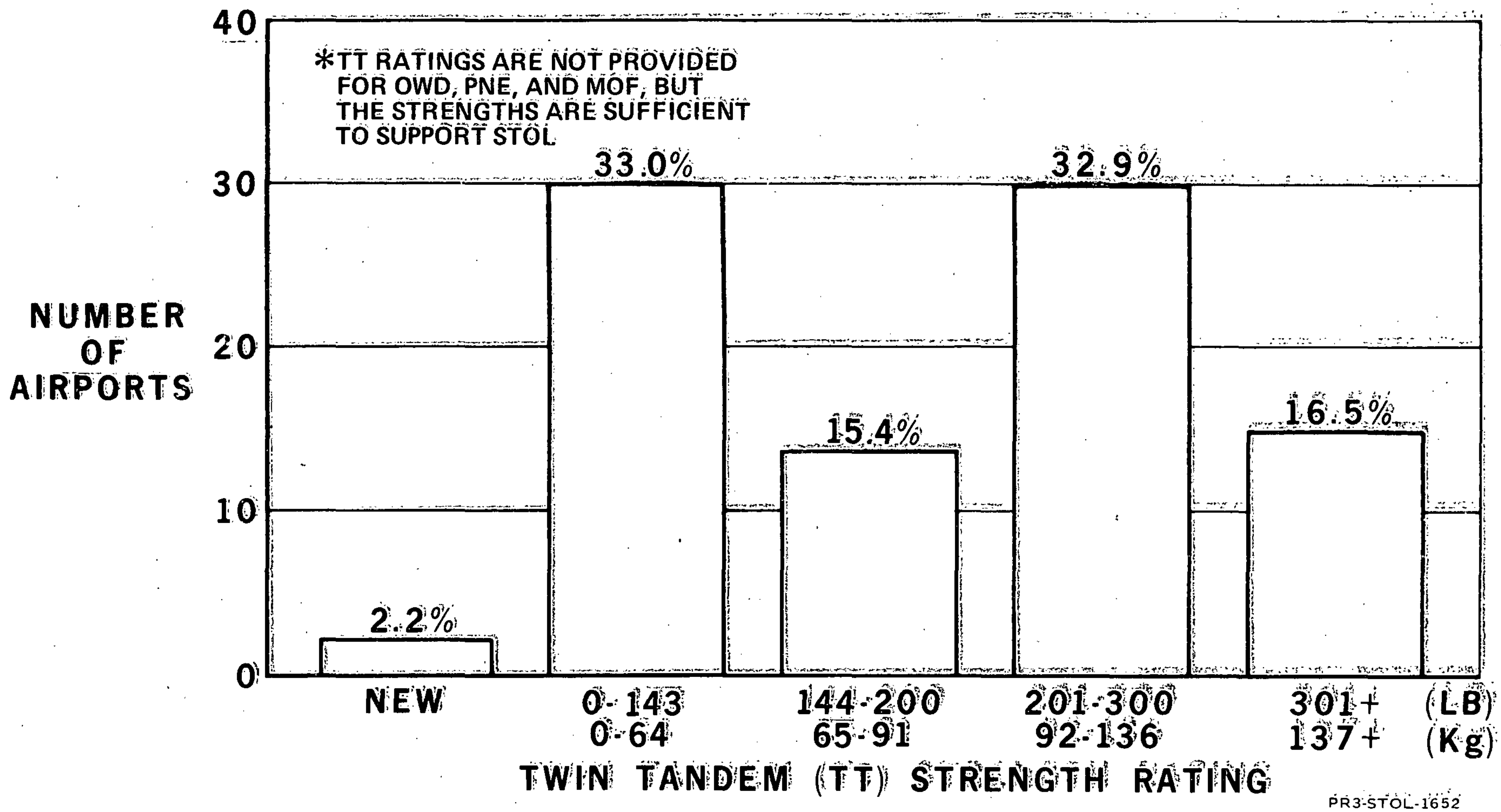


Figure 2-51

- Greater Providence (Providence) - PVD
- Stapleton International (Denver) - DEN
- Daugherty Field (Long Beach) - LGB
- Shreveport Regional (Shreveport) - SHV
- Standiford Field (Louisville) - SDF
- Birmingham Municipal (Birmingham) - BHM
- Raleigh/Durham (Raleigh/Durham) - RDU
- Savannah Municipal (Savannah) - SAV

2.3.3.5 Runway Capacity. Per the operations scenario, STOL operations will be planned for a single runway unless the analytical evaluation results in a level of operations which might require a second runway. To insure the validity of this assumption, the peak hour operations at each airport should not exceed the theoretical runway capacity of 42 operations determined in the STOLport requirements section. A summary of the peak hour movements is presented as Figure 2-52. From Figure 2-52, no additional STOL runways are required at any airport. The major hub of STOL activity will occur at Washington National Airport. Scheduled flights from the Northeast and Southeast regions result in a combined peak hour demand of 24 operations.

2.3.3.6 Wind Coverage Capability. A summary of the wind coverage capability of the runways selected for STOL operation is presented as Figure 2-53. As seen from Figure 2-53, 41.2% of the 85 airports for which data was available have STOL runways oriented such that planes can land at least 95% of the time in crosswinds not exceeding 15 mph (24 km/hr.).

The baseline EBF STOL aircraft was designed to land in crosswinds up to 25 knots (46.3 km/hr.). If this design point is accepted as an FAA

SUMMARY: PEAK HOUR FLIGHTS

NATIONAL SHORT HAUL SYSTEM

94 AIRPORTS

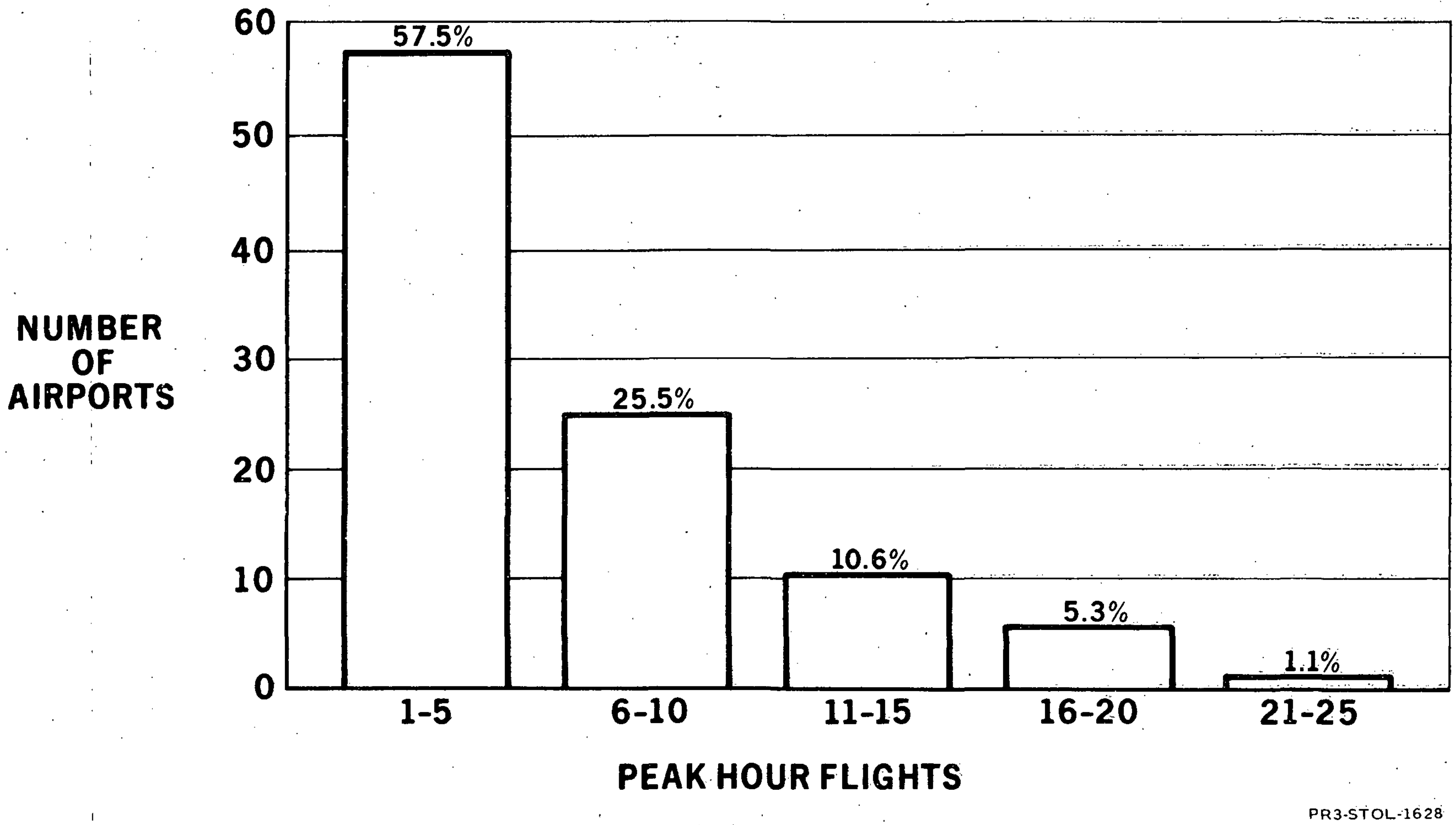
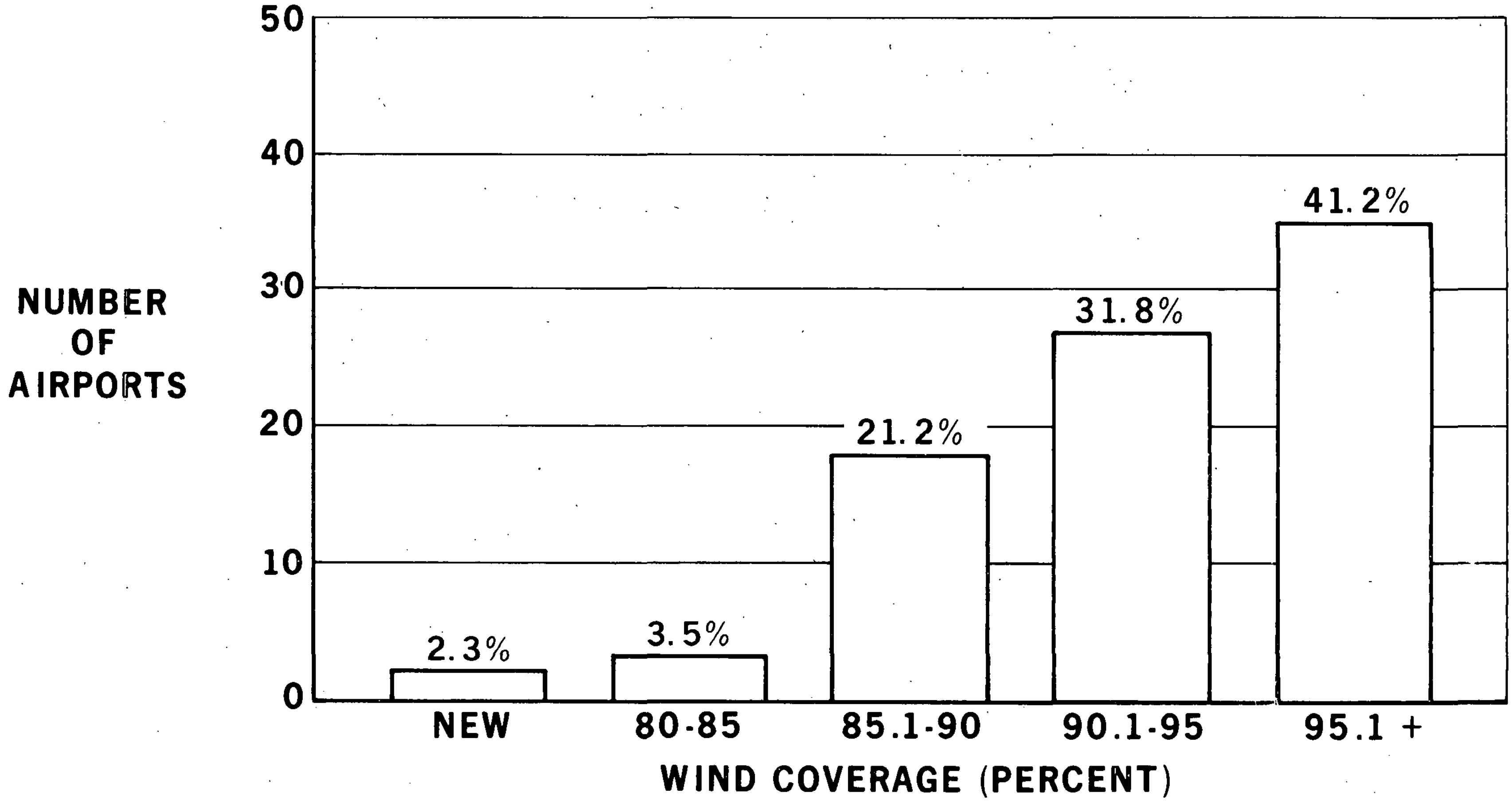


Figure 2-52

SUMMARY: STOLPORT RUNWAY WIND COVERAGE

NATIONAL SHORT HAUL SYSTEM

85 AIRPORTS*



*DATA NOT AVAILABLE FOR NINE AIRPORTS

PR3-STOL-1583

Figure 2-53

certification criteria, more STOL airports would be able to meet the suggested 95% reliability goal for runway orientation. The airports which are suspected of not achieving this goal currently have runway wind coverage reliability of less than 85%. These airports are as follows:

- o Islip MacArthur (New York) - ISP
- o Amarillo Air Terminal (Amarillo) - AMA
- o Tulsa International (Tulsa) - TUL

2.3.3.7 Gate Areas. Per the operations scenario, it is desirable to co-share terminal and gate facilities at uncontrained/uncongested air carrier airports. The minimum gate parking areas for parallel power out parking and nose in-tow out parking is shown as Figure 2-54. Compared with current short-haul aircraft parking requirements, the baseline STOL aircraft requires approximately 16% more gate area than a B727-200 and 57% more gate area than a DC-9-30 in the parallel power out parking mode. This is shown in Figure 2-55. In the nose in-tow out parking mode, the baseline STOL requires about the same parking area as the B727-200 and requires about 32% more than a DC-9-30. This is shown in Figure 2-56.

Based on the above comparison, it may be desirable to park in the nose in-tow out mode when STOL is to co-share an existing gate used by current short-haul aircraft. A disadvantage associated with this type of parking is the added increment in gate occupancy time for pushing the aircraft away from the terminal.

2.3.3.8 Air Traffic Control. To meet the FAA's criteria for installation of government furnished air traffic control equipment, an airport control tower must record 50,000 or more itinerant operations per year, 10,000

STOL MINIMUM GATE PARKING SPACE REQUIREMENTS

EBF 150 PSGR FIELD LENGTH 3000FT (914.4M)

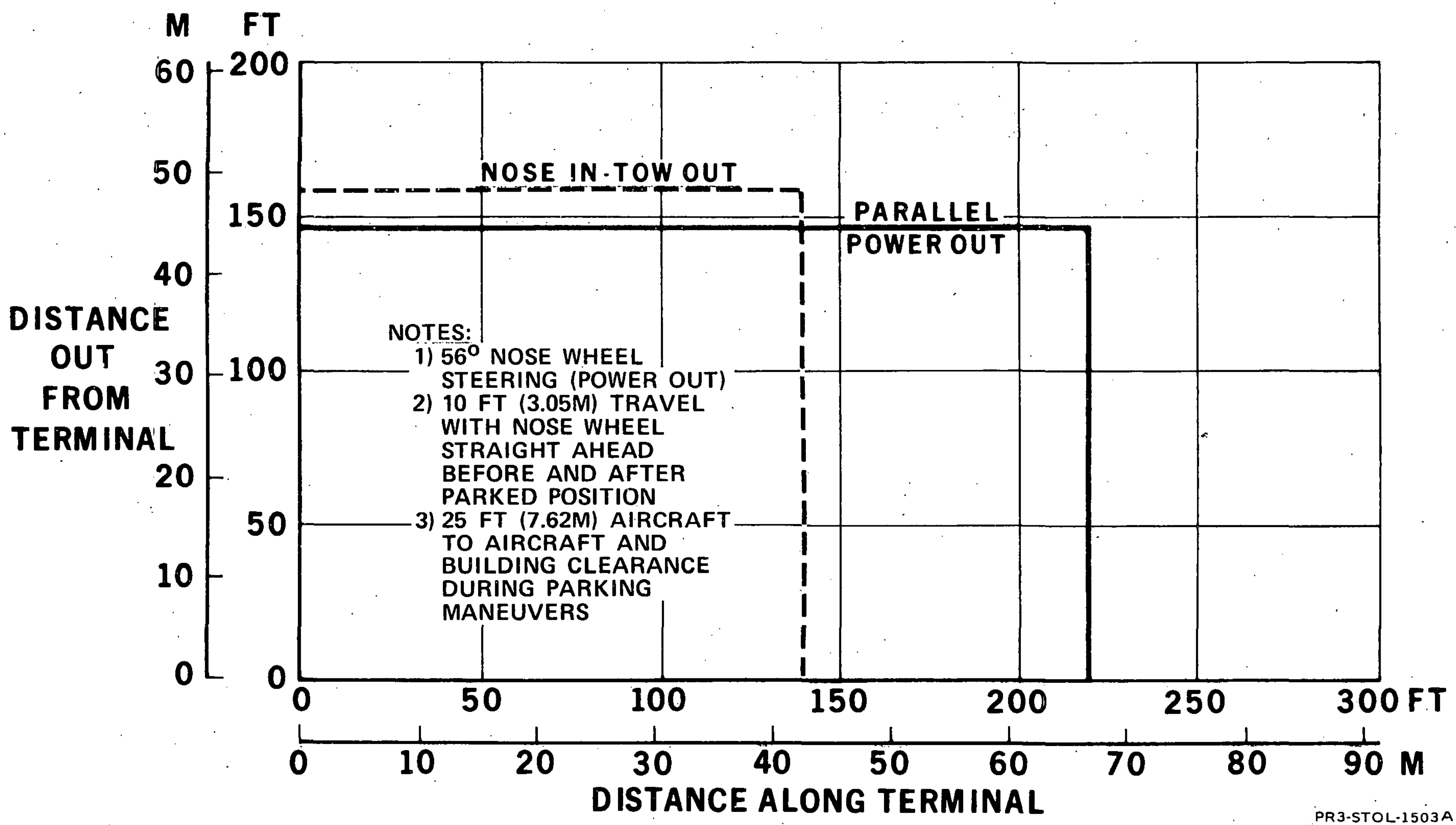
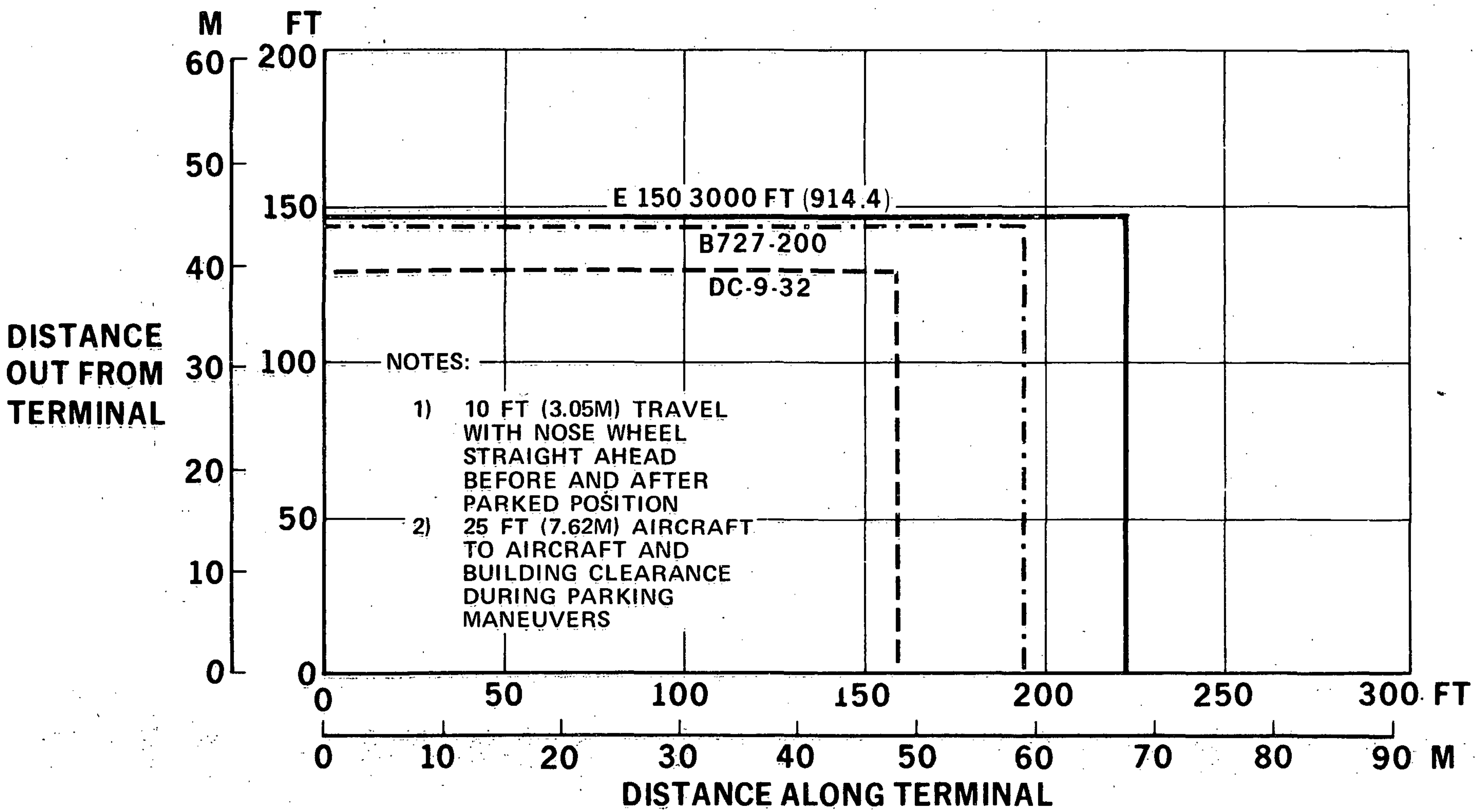


FIGURE 2-54

COMPARATIVE MINIMUM GATE PARKING SPACE REQUIREMENTS

PARLLEL - POWER OUT

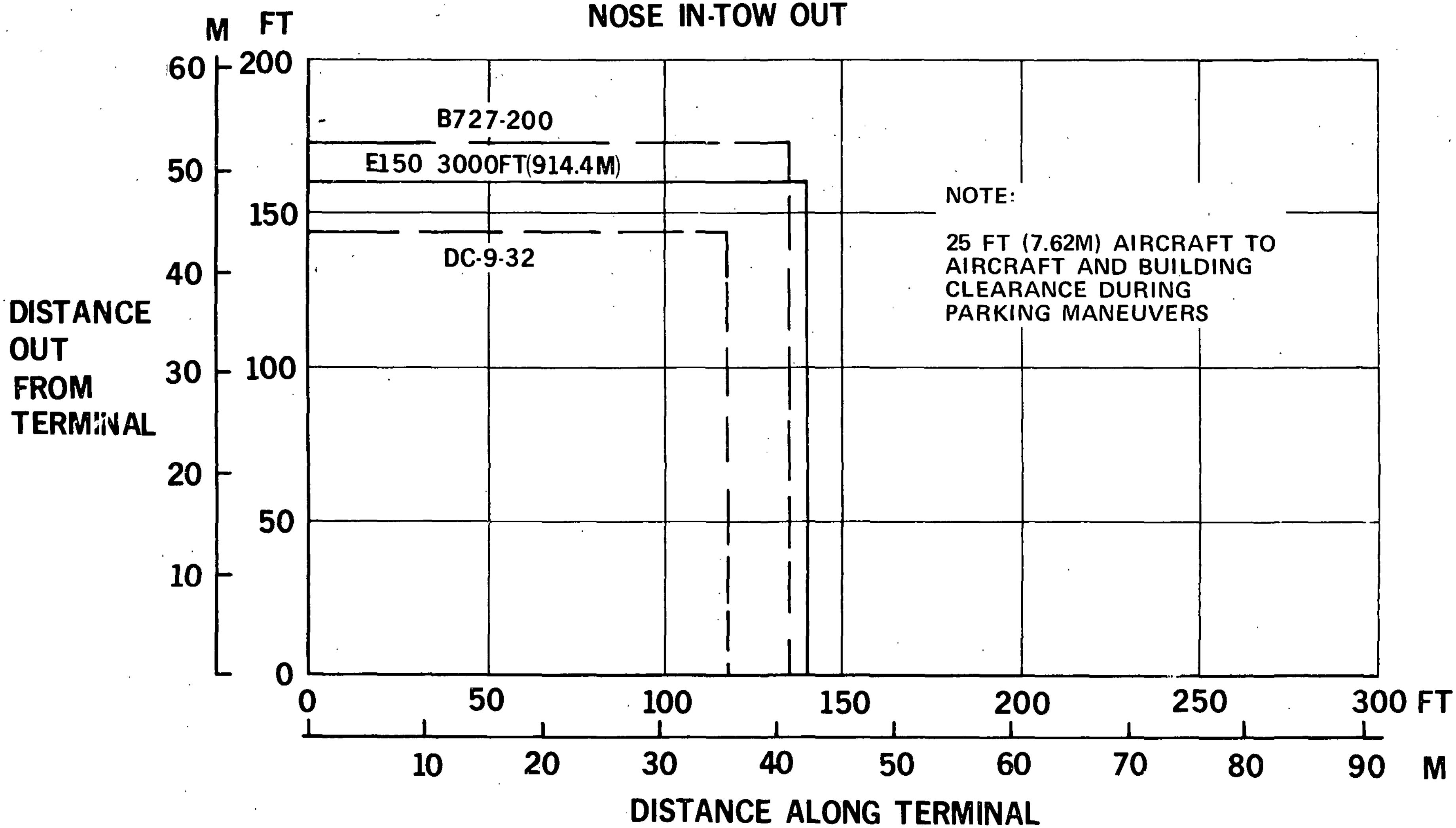


PR3-STOL-1500

Figure 2-55

COMPARATIVE MINIMUM GATE PARKING SPACE REQUIREMENTS

NOSE IN-TOW OUT



PR3-STOL-1497

Figure 2-56

of which must be scheduled air carrier flights. To qualify for an ILS, an airport must record a minimum of 700 IFR operations in any one year for a Category II system a minimum of 5,000 IFR operations. These qualifications were obtained from Reference 2-1.

To determine the required ATC equipment to support aircraft activity in the 1985 time period, an estimate of the activity levels was made for each airport in the national system. The following assumptions were made:

- o STOL activity based on the output of the airline fleet planning and evaluation model.
- o The 1985 CTOL traffic growth was assumed to be 160% of the 1970 traffic which was obtained from Reference 2-2.
- o The STOL and CTOL operations were summed to determine the 1985 activity level.

The additional ATC requirements at an airport were determined by comparing the existing ATC equipment with what is required based on the detail proposal, reference 1-1, and the 1985 air carrier projections including the STOL short-haul traffic. The Chicago Region is presented in Table 2-17 For this region a STOL short-haul runway is basically used. It is outfitted with a MLS CAT III system and all the costs are absorbed by the STOL system. All other STOL costs have been applied to provide a "worst case" situation for STOL activity.

Another case is presented which would provide STOL a "least cost" situation. The STOL/CTOL activity is commingled on the same runway at existing (CTOL) airports. The estimated STOL/CTOL peak hour traffic is noted in line 33 on Table 2-17, and for each airport we do not reach the IFR

TABLE 2-17
CHICAGO REGION
STOL AIR TRAFFIC CONTROL COSTS
1985

1 CITY	BUFFALO	CHICAGO	CHICAGO	CINCINNATI	CLEVELAND	COLUMBUS	DAYTON	DENVER	DES MOINES	DETROIT
2 AIRPORT	GREATER BUFFALO	MEIGS	MIDWAY	GREATER CINCINNATI	BURKE LAKEFRONT	PORT COLUMBUS	J. M. COX	STAPLETON INT'L	DES MOINES MUNICIPAL	DETROIT CITY
3 CODE	BUF	CGX	MDW	CVG	BKL	CMH	DAY	DEN	DSM	DET
4 CTOL										
5 EQUIPMENT INSTALLED										
6 CTOL AIR CARRIER OPERATIONS - 1970	71,930	15,503	43,553	93,349	5,686	61,544	59,052	174,335	32,588	19,273
7 INSTRUMENT LANDING SYSTEM - CAT. I	(1) 5/23	--	(1) 31L/13R	(1) 18/36	--	(1) 13/31	(1) 6L/24R	(1) 8R/26L	(1) 12L/30R	--
8 INSTRUMENT LANDING SYSTEM - CAT. II	--	--	--	--	--	--	--	--	--	--
9 D.M.E. AT I.L.S. LOCALIZER	--	--	(1)	--	--	--	--	--	--	--
10 V.A.S.I.-VISUAL APPROACH SLOPE INDICATOR	(1)	--	(1)	(1)	--	(1)	(1)	(1)	(1)	--
11 R.E.I.L.-RUNWAY END IDENTIFICATION LIGHTS	(1)	(1)	(2)	(1)	(1)	(1)	(2)	(2)	(2)	(2)
12 A.L.S.F.-STANDARD APPROACH T.D.Z. LIGHTS	(1)	(1)	(2)	(1)	(1)	(2)	(2)	(2)	(1)	(2)
13 RUNWAY VISUAL RANGE TRANSMISSOMETER	(1)	--	(1)	(1)	--	(2)	--	(1)	--	--
14 VORTAC (NAVAID)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
15 AIRPORT SURVEILLANCE RADAR	(1)	--	--	--	--	(1)	(1)	(1)	--	--
16 AIRPORT BEACON	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
17 CONTROL TOWER	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
18 STOL - 1985										
19 TO BE INSTALLED										
20 CTOL AIR CARRIER GROWTH (1.6 × (1))	115,807	24,960	70,120	150,292	9,154	99,086	95,074	280,679	52,467	31,030
21 STOL GROWTH	3,200	48,776	43,000	7,340	12,800	5,330	3,830	5,130	4,720	31,200
22 TOTAL OPERATIONS	119,007	73,736	113,120	157,632	21,954	104,416	98,904	285,809	57,187	62,230
23 STOL RUNWAY ORIENTATION	13/31 5/23	18/36 18/36	4R/22L 4R/22L	9L/27R 9L/27R	6R/24L 6L/24R	10L/28R 10L/28R	6R/24L 6R/24L	8L/26R 8L/26R	5/23 12L/30R	07/25 15/33
24 MICROWAVE LANDING SYSTEM-CAT. IIIA	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584
25 D.M.E. AT M.L.S. LOCALIZER	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45
* 26 V.A.S.I.-VISUAL APPROACH SLOPE INDICATOR	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80
27 R.E.I.L.-RUNWAY END IDENTIFICATION LIGHTS	(1) 12	--	(1) 12	(1) 12	(1) 12	(1) 12	(1) 12	(1) 12	--	--
28 A.L.S.F.-STANDARD APPROACH/T.D.Z. LIGHTS	--	--	--	--	(1) 220	--	--	--	--	--
* 29 V/STOL APPROACH LIGHT SYSTEM	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58
30 RUNWAY VISUAL RANGE TRANSMISSOMETER	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53
31 CEILOMETER	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40
32 STOL AIR TRAFFIC CONTROL COSTS	872	860	872	872	1092	872	872	872	860	860
33 ESTIMATED STOL/CTOL PEAK-HOUR TRAFFIC	33	20	31	43	6	29	27	78	16	17

1 CITY	INDIANAPOLIS	KANSAS CITY	MILWAUKEE	MINNEAPOLIS -ST. PAUL	OMAHA	PITTSBURGH	ROCHESTER	ST. LOUIS	TOLEDO
2 AIRPORT	WEIRCOOK	KANSAS CITY MUNICIPAL	GEN. MITCHELL FIELD	CRYSTAL	EPPLEY FIELD	ALLEGHENY COUNTY	MONROE COUNTY	BI-STATE PARKS	TOLEDO
3 CODE	IND	MKC	MKE	MIC	OMA	AGC	ROC	CPS	TOL
4 CTOL									
5 EQUIPMENT INSTALLED									
6 CTOL AIR CARRIER OPERATIONS - 1970	91,532	133,572	73,817	0	47,867	0	56,750	0	19,355
7 INSTRUMENT LANDING SYSTEM - CAT. I	(1) 4L/22R	(1) 18/36	(1) 1L/19R	--	(1) 14R/32L	(1) 10L/28R	(1) 4/22	--	(1) 7/25
8 INSTRUMENT LANDING SYSTEM - CAT. II	--	--	--	--	--	--	--	--	--
9 D.M.E. AT I.L.S. LOCALIZER	--	--	--	--	--	--	--	--	--
10 V.A.S.I.-VISUAL APPROACH SLOPE INDICATOR	(1)	--	(1)	--	(1)	(1)	(1)	--	(1)
11 R.E.I.L.-RUNWAY END IDENTIFICATION LIGHTS	(1)	(1)	(2)	(1)	(1)	(2)	(2)	--	(1)
12 A.L.S.F.-STANDARD APPROACH T.D.Z. LIGHTS	(1)	(1)	(2)	(1)	(1)	(2)	(2)	(1)	(1)
13 RUNWAY VISUAL RANGE TRANSMISSOMETER	(1)	--	(1)	--	--	(2)	(1)	--	(1)
14 VORTAC (NAVAID)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
15 AIRPORT SURVEILLANCE RADAR	(1)	--	--	--	--	(1)	(1)	--	--
16 AIRPORT BEACON	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
17 CONTROL TOWER	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)	(1)
18 STOL - 1985									
19 TO BE INSTALLED									
20 CTOL AIR CARRIER GROWTH (1.6 × (1))	137,367	215,051	118,845	0	76,615	0	91,368	0	31,162
21 STOL GROWTH	5,900	12,100	5,250	24,100	6,250	11,200	3,150	27,400	1,220
22 TOTAL OPERATIONS	153,267	227,151	124,095	24,100	82,865	11,200	94,518	27,400	32,382
23 STOL RUNWAY ORIENTATION	13R/31L 13R/31L	3/21 18/36	1R/19L 1R/19L	13L/31R 13L/31R	14L/32R 17/35	5/23 9/27	1/19 04/22	12/30 12/30	16/34 17/25
24 MICROWAVE LANDING SYSTEM-CAT. IIIA	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584	(1) 584
25 D.M.E. AT M.L.S. LOCALIZER	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45	(1) 45
* 26 V.A.S.I.-VISUAL APPROACH SLOPE INDICATOR	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80	(1) 80
27 R.E.I.L.-RUNWAY END IDENTIFICATION LIGHTS	(1) 12	(1) 12	(1) 12	(1) 12	(1) 12	(1) 12	(1) 12	(1) 12	(1) 12
28 A.L.S.F.-STANDARD APPROACH/T.D.Z. LIGHTS	--	(1) 220	--	(1) 220	--	--	--	(1) 220	--
* 29 V/STOL APPROACH LIGHT SYSTEM	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58	(1) 58
30 RUNWAY VISUAL RANGE TRANSMISSOMETER	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53	(1) 53
31 CEILOMETER	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40	(1) 40
32 STOL AIR TRAFFIC CONTROL COSTS	872	1092	872	1092	872	872	872	1092	872
33 ESTIMATED STOL/CTOL PEAK-HOUR TRAFFIC	42	62	34	7	23	3	26	8	9

( ) NUMBER INSTALLED

22 = 20 + 21

32 = SUM OF [24 THRU 31] × $1,000 (QUOTED IN 1972 DOLLARS)

* = Co-mingling STOL/CTOL Aircraft will only require these items to be installed.

capacity. The MLS CAT III is assumed to be paid for by the CTOL activity and only the VASI and the V/STOL approach system are necessary for STOL flights. The cost of installing MLS, VASI, and approach systems at the twenty general aviation network airports and the two special STOLports, of course, must be borne by the STOL system.

In the latter approach, the scheduling problem also must be considered. The runways and taxiways will all be capable of supporting a STOL flight. These costs have not been included in the Volume V - Economics summary.

The total cost of ATC equipment in the first instance (all costs borne by the STOL system) for the Chicago Region is approximately $19 million. The costs borne by the STOL system in the second instance (ATC equipment costs funded by the existing CTOL system) is approximately $2.5 million—a reduction of $16.5 million. A similar cost reduction would be applicable to other regions in the network.

2.3.4 <u>Summary - Airport Airside Deficiencies</u> - A summary of the airport airside deficiencies determined in the previous sections, excluding the ATC analysis, are summarized in Table 2-18. The costs required to correct these deficiencies will be determined in Section 4.

Table 2-18

AIRPORT DEFICIENCIES

AIRPORT	CITY	CODE	RUNWAYS LENGTH	RUNWAYS WIDTH	RUNWAYS STRENGTH	TAXIWAY WIDTH	RUNWAY/TAXIWAY SEPARATION
CRYSTAL	MINNEAPOLIS-ST PAUL	MIC	●	●	●	●	●
STAPLETON INT'L	DENVER	DEN	●		●		
FRESNO AIR TERMINAL	FRESNO	FAT	●	●			
MONTGOMERY	SAN DIEGO	MYF	●		●		
REID HILLVIEW	SAN JOSE	RHV	●	●	●	●	
DEKALB PEACHTREE	ATLANTA	PDK	●		●		●
EL MONTE	LOS ANGELES	EMT		●	●	●	●
GENERAL DEWITT SPAIN	MEMPHIS	GDS		●	●	●	●
BI STATE PARKS	ST LOUIS	CPS		●	●	●	
DETROIT CITY	DETROIT	DET		●	●		
FULTON COUNTY	ATLANTA	FTY		●			
HARTFORD-BRAINARD	HARTFORD	HFD			●	●	●
MEIGS	CHICAGO	CGX			●		
LAKEFRONT	NEW ORLEANS	NEW			●		

AIRPORT DEFICIENCIES (CONT)

AIRPORT	CITY	CODE	RUNWAYS LENGTH	RUNWAYS WIDTH	RUNWAYS STRENGTH	TAXIWAY WIDTH	RUNWAY/TAXIWAY SEPARATION
BELTSVILLE	BALTIMORE	BEL			●		
ISLIP MACARTHUR	NEW YORK	ISP			●		
GREATER PROVIDENCE	PROVIDENCE	PVD			●		
DAUGHERTY FIELD	LONG BEACH	LGB			●		
SHREVEPORT REGIONAL	SHREVEPORT	SHV			●		
STANDIFORD FIELD	LOUISVILLE	SDF			●		
BIRMINGHAM MUNI	BIRMINGHAM	BHM			●		
RALEIGH/DURHAM	RALEIGH/DURHAM	RDU			●		
SAVANNAH MUNI	SAVANNAH	SAN			●		

● DEFICIENCY

3.0 AIRPORT/AIRCRAFT TRADEOFF STUDIES

For conventional CTOL aircraft there has been a continual decrease in the DOC. STOL technology has not yet developed to the extent necessary for maintaining these low levels of DOC. While the conventional aircraft DOC has been reduced, the CTOL IOC of the airlines has been increasing very rapidly such that, today, the IOC is larger than the DOC and is continuing to increase. For STOL to be economically viable it is necessary that this growth in IOC must not only be stopped, but that sufficient reductions must be accomplished to offset at least a portion of the current higher DOC for STOL. A STOL transportation system should be operated significantly different from the CTOL transportation system. See Figure 3-1.

Several airport/aircraft tradeoff studies were proposed for examination. Throughout the tradeoff studies it became evident that very little was known about the future of such systems like fog dispersal, the microwave landing systems, handling systems, thrust reversers,etc. Most of the items covered in this section have been recommended for further additional research and development. See Section 11.0.

RATIO OF IOC TO DOC

AVERAGE OF TRUNK CARRIERS
CAB ACCOUNTS

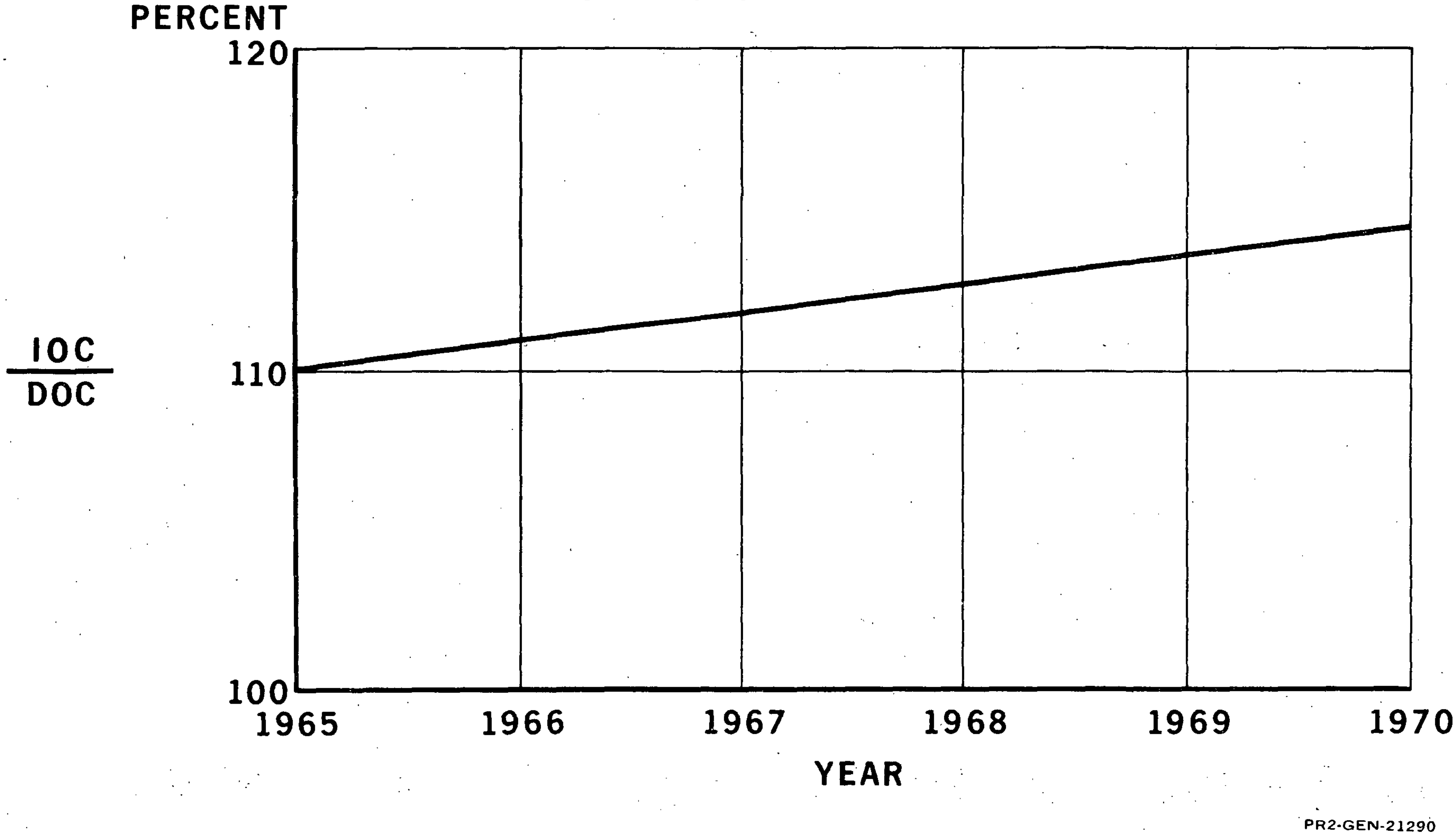


FIGURE 3-1

3.1 Crossed, Heated, and Grooved Runways

Safety aspects on the runway surfaces for the STOL commercial aircraft are very important.

For many years NASA/FAA have been studying the causes and evaluating new methods for rating, predicting and alleviating the slipperiness of airport runways. The results of this research have indicated that such tire parameters as inflating pressure, tread design, tread rubber compound and construction, together with such pavement factors as texture, configuration, and foreign contaminates, combined to determine the maximum friction coefficient available between the tire and the runway surface. In addition to parameters associated with the tires and the runway surface, aircraft braking performance is also affected by characteristics of the aircraft such as the gear geometry, the braking system, operating ground speeds and weights, and so forth. The solutions are either to work on the wheel, the water, or the runway.

Research has shown that the poor braking and cornering performance associated with wet runways is the result of the three following factors:

- o Dynamic Hydroplaning - that condition which exists on a flooded surface when high aircraft speeds result in the planing of the aircraft's tires on top of the water.
- o Viscous Hydroplaning - that condition which exists on a smooth surface when a thin film of water reduces the friction between the aircraft's tires and the runway at certain speeds.
- o Reverted Rubber Skidding - that condition which exists

on wet pavements under locked wheel circumstances that results in excessive treating of the rubber which reverts to an unvulcanized state and forms a protective seal under the untrapped water beneath the tire. The water becomes steam under the intense frictional forces. The newest type of skidding was discovered by NASA and is distinguished by the leaving of a white streak on the runway.

Pavement surfaces common to most current runways are categorized in Figure 3-2 together with their texture and their ability to alleviate the hydroplaning and skidding on each runway surface.

Runway grooving, from the operational viewpoint, is the best method of decreasing hydroplaning, poor directional control, and unsafe braking conditions.

There are other runway contaminants as noted in Figure 3-3 that will create traction problems.

Heating of the STOL runway may be a possible method of providing a guaranteed friction surface under all operating weather conditions. Reference 3-1, describes a hot fluid system and also an electrical heat system used for a runway described in reference 3-2. The runway criteria are as follows:

- o 100 feet wide by 2,000 feet long, grooved, concrete runway.
- o Runway is located on ground (not on top of a building).
- o Runway is to be heated to prevent snow or ice formation.
- o The runway will be subjected to a maximum load as imposed by an airplane having a maximum landing weight of 100,000 pounds, dual wheels, wheel track of about 16 feet, and a wheel base

SUMMARY OF TECHNIQUES FOR IMPROVING TIRE-RUNWAY TRACTION

<table>
<tr><th rowspan="3">TECHNIQUE</th><th colspan="4">EFFECTIVENESS FOR</th></tr>
<tr><th colspan="2">DYNAMIC HYDROPLANING</th><th>THIN FILM LUBRICATION</th><th>REVERSED RUBBER SKID</th></tr>
<tr><th>DAMP TO WET</th><th>FLOODED</th><th>DAMP TO FLOODED</th><th>DAMP TO FLOODED</th></tr>
<tr><td>TIRE TREAD DESIGN</td><td></td><td></td><td></td><td></td></tr>
<tr><td>GROOVED</td><td>GOOD</td><td>NONE</td><td>FAIR</td><td>NONE</td></tr>
<tr><td>GROOVED AND WIPED</td><td>GOOD</td><td>NONE</td><td>GOOD</td><td>NONE</td></tr>
<tr><td>RUNWAY SURFACE TEXTURE</td><td></td><td></td><td></td><td></td></tr>
<tr><td>SMOOTH</td><td>POOR</td><td>NONE</td><td>NONE</td><td>NONE</td></tr>
<tr><td>FINE (SANDPAPER)</td><td>FAIR</td><td>NONE</td><td>EXCELLENT</td><td>NONE</td></tr>
<tr><td>FINE AND OPEN</td><td>GOOD</td><td>NONE</td><td>EXCELLENT</td><td>NONE</td></tr>
<tr><td>POROUS</td><td colspan="4">← UNKNOWN →</td></tr>
<tr><td>PAVEMENT GROOVING</td><td></td><td></td><td></td><td></td></tr>
<tr><td>LONGITUDINAL</td><td>GOOD</td><td>GOOD</td><td>GOOD</td><td>UNKNOWN</td></tr>
<tr><td>TRANSVERSE</td><td>EXCELLENT</td><td>GOOD</td><td>GOOD</td><td>EXCELLENT*</td></tr>
<tr><td>AIR JETS</td><td>EXCELLENT</td><td>GOOD</td><td>POOR</td><td>UNKNOWN</td></tr>
<tr><td>ADVANCED WHEEL BREAKING SYSTEM</td><td>UNKNOWN **</td><td>NONE</td><td>UNKNOWN **</td><td>UNKNOWN **</td></tr>
<tr><td colspan="5">*TRACK TESTS SHOWED TIRE DAMAGE UNDER YAWED ROLLING CONDITIONS
**INITIAL ANALYSIS INDICATES IMPROVEMENTS FEASIBLE</td></tr>
</table>

PR3-STOL-1621

FIGURE 3-2

PROBLEMS CREATED BY RUNWAY CONTAMINANTS

PROBLEM / CONTAMINANT		LOSS OF BRAKING TRACTION	REDUCTION OF LATERAL TRACTION	SPRAY INGESTION AND IMPINGEMENT	LOSS OF SURFACE TEXTURE	WHEEL SPINUP DELAYED AT TOUCHDOWN
WATER		√	√	√	—	√
SLUSH		√	√	√	√	√
SNOW AND ICE		√	√	√	√	√
DUST/OIL/WATER MIXTURE		√	√	√	—	√
RUBBER DEPOSITS	DRY	—	—	—	√	—
	WET	√	√	√	√	√

FIGURE 3-3

PR3-STOL-J606

of 56 feet.

The following were assumed:

- o Site available at no cost to this estimate.
- o Reasonably accessible site, in a drainable area, without any unusual soil conditions.
- o All utilities available at the site.

This analysis was made to develop design concepts and make cost estimates for a heated grooved runway. Each airport must be examined where such a system might be installed to determine its effect on the airport costs.

3.2 Fog Dispersal

At Orly Airport near Paris, France, an installation called Turbo-clair, is the first large-scale commercial test of thermal fog dispersion. A dozen jet fighter engines are buried in a row alongside the main runway. As the hot exhaust rises, it causes the air temperature to rise several degrees and evaporates the droplets of fog. So far, it has shown that it can open a runway "window" 900 yards (274 m) long and lift a zero ceiling to 180 Ft. (55 m) or more.

Thirteen airport seeding programs operate in the U.S. during the fog season, helping pilots see approach paths and landing lights. They tend to have their greatest success in clearing cold fog, a vapor that forms in below-freezing air and is easily dispersed when seeded with dry ice. The prime problem is warm fog, the grey wet mass that forms at 32 degrees F. or higher and rapidly smothers runways at the main coastal cities. Warm fog accounts for 95% of the fog-induced snarls at the nation's airports, and costly chemicals have to be used to get rid of it. The chemicals, unless carefully chosen, will also corrode aircraft, and their use rapidly raises the hackles of environmentalists. A recent fog-seeding experiment at Seattle-Tacoma and Spokane Airports, reference 3-3, showed significant increase in visibility when fog was below 32 degrees F. was chemically seeded but not when the fog temperature was above that level.

Ultimately, sophisticated-but-costly-electronic systems may allow planes to land in the thickest of fogs. All systems may give way to electronics that would take over the pilot's job and bring the plane down to the runway. The airlines, which would face having to put still more costly electronic gear into their planes, are hesitant. At this point, the commercial airlines are taking a close look at ground-based fog-dispersal ideas and "are taking a skeptical look at the cost benefits of the electronic systems."

There are other systems that are being used to dispel fog. The use of pine trees along the sides of a highway were experimented with by the DOT in New Jersey. They were only partly successful because there was only a partial movement of the air mass to condense the small fog droplets on the trees.

Dispersal methods attempting to store and use solar energy appear to be impossible at this time. Although the use of supersonic and electrical sweepouts has been proven successful in the laboratory, they are considered unsuccessful and impractical in small field tests. Various other mechanical methods of dispersal, such as the employment of soap bubbles, are sound in theory but impossible to apply.

This subject has been recommended for further research.

3.3 Ground Support Equipment and Ground Processing

For STOL short-haul aircraft there should be a minimum dependency upon ground support equipment. This will vary due to the nature and type of the various airports and the operating conditions if minimum ground time is desirable. Achievements will result in fewer ground personnel, less ground congestion, and will increase safety.

The impact on IOC's of system productivity in terms of passengers per airline employe further highlights the differences in company structure and operations. A review of the 1971 CAB data updated to 1972 economics and excluding cargo handling, for ten interstate trunk carriers shows a range of indirect operating costs per passenger of $15.00—$25.00. The regional interstate carriers (who are typical of short-haul operators) exhibit a significantly lower range of IOC's, $11.00—$17.00. An analysis of the Chicago Region results in an IOC per passenger of $11.00 which is representative of the lower limit demonstrated by the local carriers. On the whole, the STOL system will have to be more efficient than the average regional carrier; but, no more efficient than the best regional carrier. Results of the regional intrastate carriers exhibit IOC's well above the levels achieved by the intrastate carriers— i.e., a range of $4.00—$5.50 per passenger.

Each STOLport should be examined in the context of this title and the airline providing service to determine the effects on the indirect operating cost.

3.4 Automated Ticketing

Several plans for automated ticketing have been considered and it should be remembered that whatever a STOL short-haul system can use, a CTOL system can also use. The reduction of Indirect Operating Costs are negligible.

A plan for automated ticketing would have its greatest value in a high density schedule— no reservations plan. The subcontracting airlines provided the following information.

- Machine ticket operated by an agent - would be more efficient and create cost savings in other areas of ground operations.
- Machine ticket operated by passenger - high initial cost but effective use of equipment would prove cheaper in the long run.

The economic value is of great benefit and the enhancement of available passenger services will produce a significant benefit to an airline. Some of the advantages are noted below:

- Increase the efficiency with which passengers at ticket counters are processed by increasing the speed and accuracy with which the Fare Quote/Ticketing functions are performed. Special cases would be handled by a ticket agent.
- Reduce ticket agent occupied time in performance of Ticketing/Fare Quote functions, resulting in personnel savings.
- Reduce ticket agent occupied time in the performance of the sales reporting functions, resulting in more accurate,

faster reporting while at the same time reducing overall personnel requirements.

- Reduce Reservations Agents average telephone call time by further mechanizing the Fare Quote functions.
- Provide significantly faster and more accurate Revenue Accounting information.
- Union problems may develop which would increase maximum cost.

This item has been left open for further research and development activity.

3.5 Passenger and Baggage Handling

The activities carried out at an airport in a single day can be categorized into several hundred separate areas; but, the real function of an airport is the bringing together and servicing of the aircraft and the passenger. If this action does not take place, or takes place only after delay and inconvenience, the airport's function has been seriously impaired.

The airlines presented a mixed feeling on passenger and baggage security check which must be conducted by each airline in processing anything taken aboard by the traveler. A business traveler will most likely have carry on baggage and will want to be processed in a minimum amount of time.

Much work must be done in this area to better serve the traveler.

3.6 Reverse Thrust

Thrust reversing to zero speed is required to achieve the field lengths reported for the STOL aircraft used in this study. These study aircraft are generally landing critical, as discussed in Volume II, when using a 0.32g average deceleration during the landing ground roll.

Current thrust reverser technology is not capable of reversing at speeds below approximately 60 knots (111 km/hr) without causing severe operational problems such as reingestion. Since the current STOL aircraft approach at approximately 75 knots (139 km/hr) the current reverser technology is not acceptable for use.

There are no reverser weight or cost penalties for aircraft such as the EBF which use variable pitch prop fan engines since reversed thrust is obtained by rotating the fan blades into reverse pitch. Those aircraft without variable pitch engines would experience some reduction in weight and operating cost due to thrust reverser elimination. Direct operating cost reductions of 1 to 4% may be possible. Other advantages associated with thrust reverser elimination include:

- Less chance of engine foreign object damage.
- Reduced noise during the landing ground roll since the engines would be at idle rather than full reverse thrust.
- Elimination of thrust reverser maintenance. (This is offset, however, by significantly increased brake system maintenance.)

The airline subcontractors indicate that a commercial STOL transport aircraft would not be acceptable without thrust reversers even if runways can be kept free of water, snow and ice. Thrust reversers are required as a safety device in the event of brake system failure, and unless some other backup deceleration device, such as a tail hook and arresting gear are provided, thrust reversing capability must be included. This is an area requiring further research and technology development.

3.7 Arresting/Safety Barriers

Emergency arresting equipment is being developed and tested by several companies within the United States and several foreign countries.

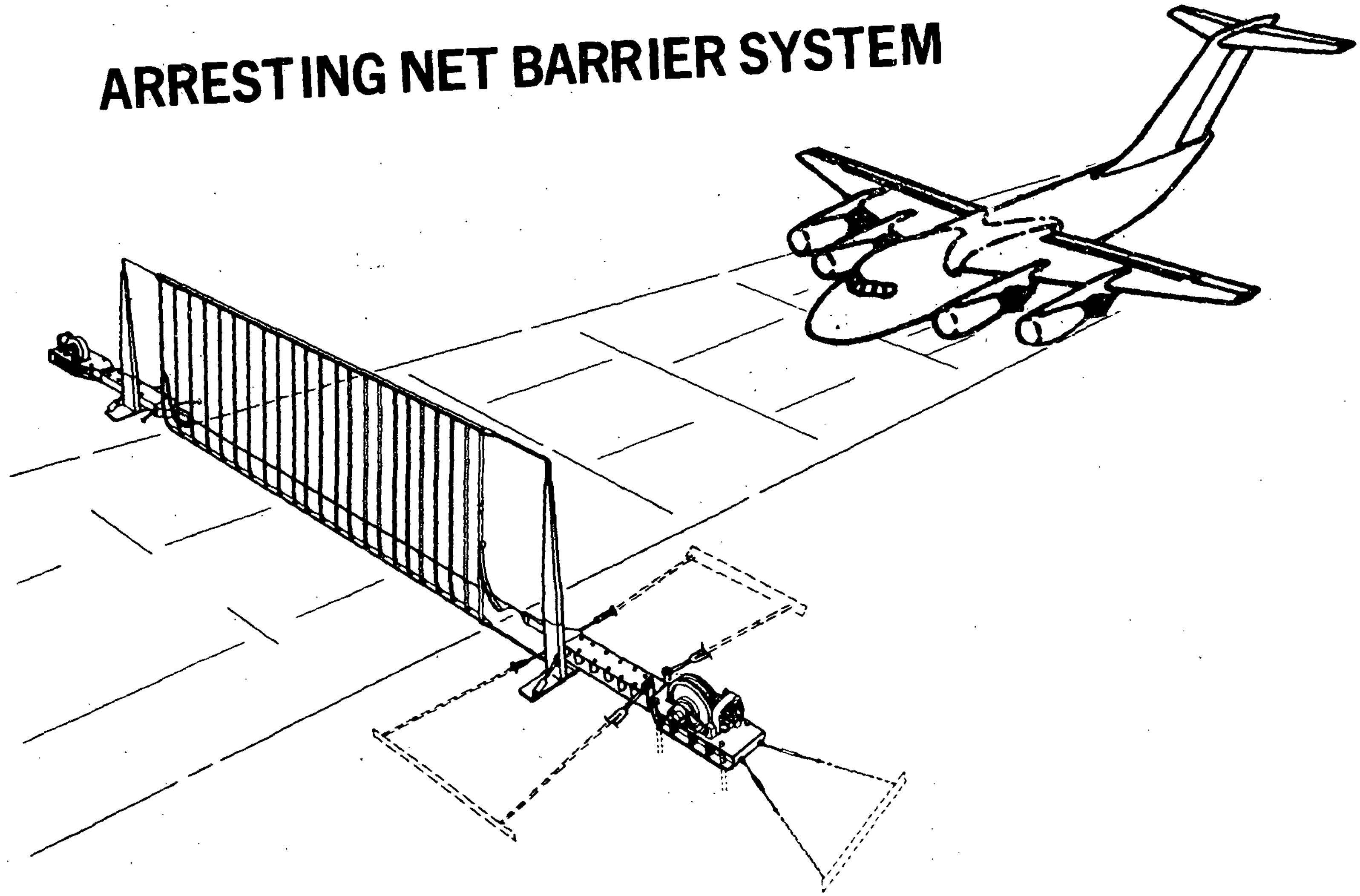
The G+W/AERAZUR Barrier System utilizes the multiple net principle for engaging hookless aircraft. By combining the G + W Model 500S Energy Absorbers and Model 61QS Stanchions with the Aerazur SF-24 Net, an extremely reliable barrier with a very high degree of flexibility for a large range of different aircraft types has been created. Refer to Figure 3-4.

The most important features of this barrier are:

- Very smooth engagements with retardation forces evenly distributed over the wing area and main landing gear.
- The high aerodynamic drag of the arrestor net adds to the total performance of the brakes.
- The barrier is insensitive to assymmetric engagements.
- Adverse engagements such as nose wheel hook-up of net verticals do not adversely influence the overall operation of the barrier.
- The composite barrier system presents a cheap and simple, yet an extremely reliable device for emergency arrestment of aircraft.

A net barrier is being given strong consideration for arrestment of large commercial jet operations. However, most concerned agencies and operators are adverse to having a barrier of any sort in a permanently raised position.

ARRESTING NET BARRIER SYSTEM



PR3-STOL-1610B

Figure 3-4

Methods of mechanization of net systems are as follows:

- o A remote control device actuated from the control tower. A control tower operator would not be authorized to erect the barrier on his own initiative. The pilot must request erection of the net.
- o Erection can be accomplished automatically by use of a computer system which measures aircraft ground speed and deceleration. As the aircraft passes over a pedal device, photoelectric cells record the time differential between the passage of the nose landing gear and the main landing gear. If the resulting computer relationship between aircraft speed and deceleration exceeds preestablished values the system automatically erects the net barrier.
- o Investigation is underway for use of remote control radio signals from the aircraft to erect the net barrier.

Present net barrier capabilities must be improved to meet airline requirements as follows:

- o Nets can be stored in the runway and be protected from being damaged by aircraft landing or taxiing above.
  The system can be electrically heated to be operational in cold weather.
- o After aircraft arrestment, the net would lean against the aircraft's wings and the top of the fuselage so that emergency exits would be free for quick evacuation of passengers.

After an arrestment by a net barrier, the aircraft would have to be pulled to the side of the runway and the net removed. A new net would have to be installed and the barrier's brake re-coiled. The elapsed time to accomplish this would depend upon the competence of the maintenance team. It is estimated that this total operation will require a minimum of 30 minutes; however, it is not necessary that the affected runway be closed during the entire operation, since runway usage is dependent upon clearing the arrested aircraft from the runway. In most cases, the main CTOL runway would be available for use in such an emergency, especially if the airport is not very busy.

In addition, other systems, such as a retractable pendant cable, are being developed for future STOL tests by the FAA. The cables being checked have possibilities of stopping a STOL aircraft by either catching on the main landing gear or by a retractable tail-hook (this adds extra weight to the STOL aircraft). Refer to Figure 3-5.

The advantages of this system are:

- o Can be contained within a runway slot to prevent damage by airport maintenance vehicles.
- o Cable can be rewound in about 3 minutes for next use.
- o Aircraft can be completely disengaged from cable for its next operation.
- o If cable is above the ground, then the pilot has control over his recovery.

All of the barrier and hook arresting systems have a 1200 ft. (365.8 m) runout and should be placed on runways where such runouts can be made.

ARRESTING CABLE SYSTEM

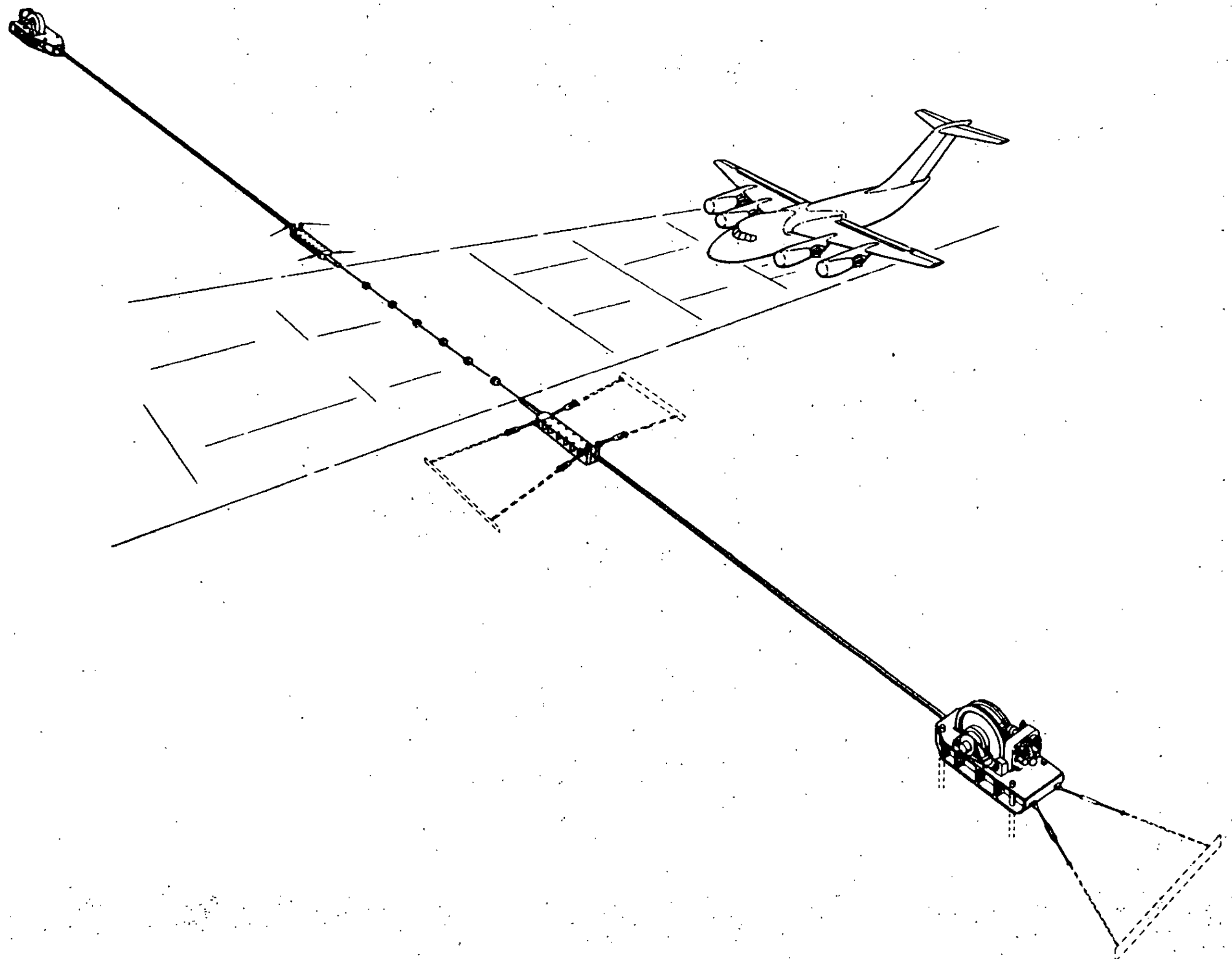


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Figure 3-5

4.0 AIRPORT COSTS

4.1 Objectives and Output

The main objective of the airport costing study is to determine the expenditure required to correct the deficiencies identified during the airport airside compatibility evaluation using the baseline E.150.3000 STOL aircraft. Airport landside requirements based on STOL passenger demand and scheduled flight frequencies will be identified and the cost to update or provide additional facilities will be determined. The expanded Chicago Region is considered as the baseline case and a detailed analysis will be presented herein. Costs for the airports in the other five regions will be presented as a summary in Section 4.4.

The airport costs associated with updating an airport to adequately handle the projected STOL aircraft and passenger demand in the 1985 time period will be used as follows:

- o The airport costs, combined with airport revenue information, will be used in developing landing fee schedules for STOL operation.
- o The airport costs will also be utilized to determine the airport oriented portion of IOC associated with STOL operations. This subject is discussed in Volume V - Economics.

4.2 Airport Cost Data Base

As a prerequisite of the airport cost evaluation, an airport cost data base was compiled consisting of relevant information necessary to upgrade a facility to handle STOL operations. Airport cost data was collected from the following:

- Cost information provided by a major air carrier airport.
- FAA Airport and Airway System Cost Elements document.
- Military Construction Pricing Guide - 1969.

Table 4-1 shows a comparative summary of costs for some of the more common airport facilities using data from each of the above sources. For a complete list of cost information, reference is made to Appendix 15.3 for the air carrier airport data and to each respective document for the other data.

Cost information on air traffic control equipment and ground handling equipment shown in Tables 4-2 and 4-3 were obtained from cognizant groups within Douglas Aircraft Company. They reflect the most recent or estimated costs available. Maintenance costs are discussed in Volume VI - Systems.

4.3 Unit Cost Derivation

4.3.1 Airside

Unit costs for the following airport airside items were derived based on the information contained in the airport cost data base:

- Pavements
- Gates/Aprons
- Ground Handling Equipment
- ATC

Unit costs for new asphalt and concrete pavements are determined in Table 4-4 and 4-5, respectively. These costs are applicable to runways,

Table 4-1

SUMMARY AIRPORT COST DATA BASE

CATEGORY	AIR CARRIER AIRPORT	FAA	MILITARY
Land	--	$720-6900/acre	--
Runways			
Asphalt (Sq. Yd.)	$7.87-8.32 (4")	$11.32	$11.57 (4")
Concrete (Sq. Yd.)	$19.20-20.07 (12")	--	$14.10
Service Roads	$7.92-7.76 (3" Sq. Yd.)	$ 5.20/Linear Ft.	$ 6.77 (3" Sq. Yd.)
Lighting			
Runway			
Edge Lights	$225/Fixture + $3.00 Linear Ft.	$ 9.53/Linear Ft.	$54.58 Lunear Ft.
Center Lights	$250/Fixture + $3.00 Linear Ft.	$18.00/Linear Ft.	$266,915
Taxiway			
Edge Lights (Linear Ft.)	--	$ 6.14	$36.37
Touchdown	Included In Runway	3000' @ $58/Ft.	--
Apron	--	$2100	--
Wind Tee			
Controlled	--	$15,600	--
Uncontrolled	--	$ 3,500	--

Table 4-1

SUMMARY AIRPORT COST DATA BASE (CONT)

CATEGORY	AIR CARRIER AIRPORT	FAA	MILITARY
Rotating Beacon	--		
36"	--	$6700	--
10"	--	$1900	--
Wind Cones	--	$700-1900	--
Taxiway Turnoff Signs	--	$500/Sign	--
Runway Markings	Included in Runway Cost	$.24 to $1.70	--
Segmented Circle	--	$1300	--
Fences (Linear Ft.)			
Security		$ 3.00	--
Perimeter		$ 0.75	
Buildings			
Terminal (DAC - $15/Sq. Ft.)	$30/Sq. Ft.	--	--
Trailers (DAC - $12.50/Sq. Ft.)	$15/Sq. Ft.	--	--
Hangars and Shops	--	$26.30/Sq. Ft.	$27.58-28.40 Sq.Ft.
Snow Removal	--	$20.00/Sq. Ft.	--
Fire Station	--	$28.25/Sq. Ft.	$32.20-35.80/Sq.Ft.
Parking Areas	$6.97 to 7.19/Sq. Yd (2")		--
Multiple Parking Total Cost/Car Space	$1160-2100		

Table 4-2

TERMINAL ATC COSTS

EQUIPMENT	COST/SYSTEM
Instrument Landing Systems (VHF)	
Category I	$156K
Category II	$261K
Category III	$536K
Microwave Landing Systems (MLS)	
Category I	$128K
Category II	$326K
Category III	$584K
DME at ILS Localizer	$ 45K
Approach Light Systems	
ALSF Standard Approach Light System (Includes TDZ Lights)	$220K
MALSR Medium Intensity Approach Lights	$ 74K
V/STOL Approach Light System	$ 58K
REIL Runway End Identification Lights	$ 12K
VASI/STOL Visual Approach Slope Indicator	$ 80K
Runway Visual Range Transmissometer	$ 53K
Ceilometer	$ 40K
VORTAC (NAVAID)	$100K
Airport Surveillance Radar	$1,100K
ASDE Radar	$1,000K
Airport Beacon	$ 15K
Control Tower	$ 500K

Table 4-3

GROUND SERVICE EQUIPMENT COSTS

ITEM	Unit Costs ($)
Lavatory Truck	16,000
Pneumatic Air Start	31,000
Potable Water Truck	16,000
Preconditioned Air Truck	30,000
Electrical Cart	18,000
Tow Vehicle	30,000
Cabin Cleaning Truck	24,000
Bulk Loader	16,000
Cart Tug Vehicle	3,600
Bulk Cargo Carts	4,800
Tow Bar	2,000

Table 4-4

UNIT PAVEMENT COST - ASPHALT

Items to Consider for a New Pavement

1. Thickness
2. Subgrade Preparation
3. Contingencies

1. For the baseline EBF 150 3000 aircraft, the required asphalt pavement thickness is 17 inches based on an F4 subgrade. It is assumed that the pavement will consist of 4 inches of asphalt concrete over 13 inches of base and subbase.

a. 4" asphalt concrete		\$2.03/yard
b. 4" crush rock base		\$1.21/yard^2
c. 9" select subbase		\$0.60/yard^2
2. Subgrade preparation		\$0.40/yard^2
3. Contingencies (10%)		\$0.42/yard^2
	TOTAL	\$4.66/yard^2

Table 4-5

UNIT PAVEMENT COST - CONCRETE

Items to Consider for a New Pavement

1. Thickness
2. Subgrade Preparation
3. Contingencies

1. For the baseline EBF 150 3000 aircraft the required concrete pavement thickness is 9 inches based on a concrete working stress of 400 psi and a subgrade modulus of 300 pci		
a. 9" Portland cement concrete		\$14.60/yard^2
b. No subbase is required		
2. Subgrade Preparation		\$ .40/yard^2
		\$15.00/yard^2
3. Contingencies (10%)		\$ 1.50/yard^2
	TOTAL	\$16.50/yard^2

taxiways, gates and aprons. Cost of excavation is not included but is assumed to be $1.00 per cubic foot ($35.31 per cubic meter) of material removed. For existing runways that were found to be deficient in pavement strength, the cost of the pavement overlay is a function of the thickness necessary to meet the STOL requirements. This cost will be determined at individual airports where an overaly is required.

Unit gate costs, Table 4-6 were determined based on the physical gate area requirements of the baseline EBF.150.3000 STOL aircraft. Consideration is given to gate departure lounges, whose requirements are determined from Figure 4-1 . The baseline STOL is assumed to be parked in the parallel power out mode at the terminal.

Ground handling equipment costs for 2, 4, 6, and 8 gate facilities are shown on Tables 4-7 through 4-10. These costs were derived based on what is thought to be sufficient equipment to handle the peak hour aircraft demand. Ground handling costs for the odd numbered gate facilities can be obtained by interpolation. These costs are airline related and are interpreted in Volume VI - Systems.

Costs for additional STOL related ATC equipment were determined previously for each of the six representative regions.

4.3.2 Landside

Unit costs for terminals and parking facilities were determined based on the data contained in the airport cost data base. For the cost study, it is assumed that the terminal building costs is $30 per square foot ($323 per square meter).

Table 4-11 summarizes the derived unit parking costs for ground

TABLE 4-6

TERMINAL COSTS

UNIT GATE COSTS

Items Necessary:

1. Gate hold room - terminal
2. Aisleway for hold area - terminal
3. Gate area - concrete
4. Taxilane - asphalt
5. Utilities - contingencies

1. Hold Room -		
1650 $feet^2$ required	- \$30/$feet^2$	\$49,500
2. Gate Area - Concrete		
depth - 150 feet		
width -- 225 feet		
total area = 33,750 feet		
concrete - 9" pavement		
	-\$1.83/$feet^2$	\$61,765
3. Aisleway in Terminal-		
25 feet wide		
225 feet long		
total area = 5625 $feet^2$		
	-\$30/$feet^2$	\$168,750
4. Taxilane - Asphalt-		
225 feet long		
210 feet wide		
total area = 47,250 $feet^2$		
	-\$.52/$feet^2$	\$24,570
		\$304,585
5. Utilities - contingencies (10%)		30,459
	Total	\$335,000

STOL DEPARTURE GATE LOUNGE

SPACE REQUIREMENTS

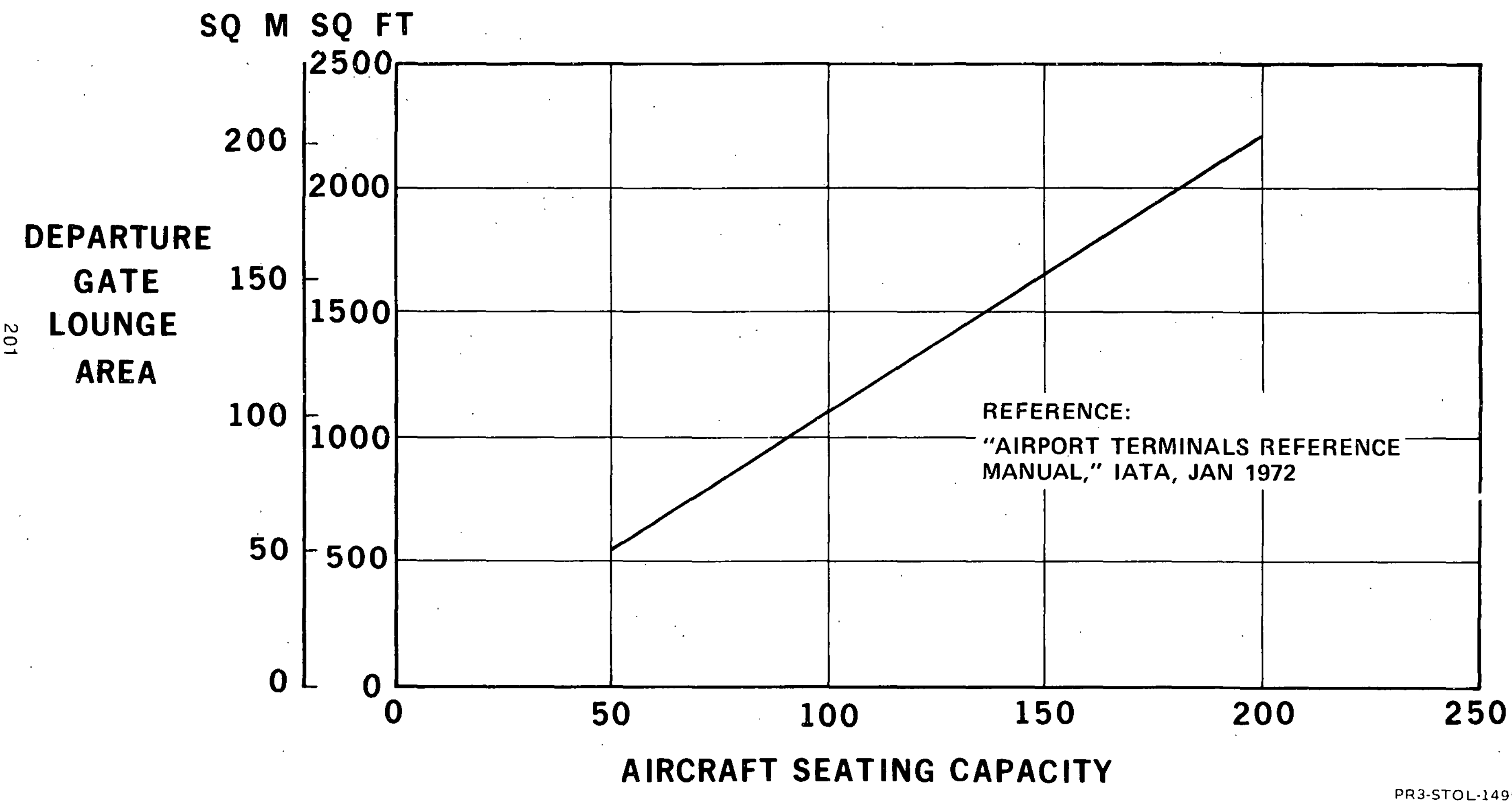

FIGURE 4-1

TABLE 4-7

GROUND HANDLING EQUIPMENT COSTS
2 GATE FACILITY

ITEM	UNIT COSTS ($)	UNIT REQUIRED	TOTAL COST ($)
Lavatory Truck	16,000	1	16,000
Potable Water Truck	16,000	1	16,000
Preconditioned Air Truck	30,000	1	39,000
Elecyrical Cart	18,000	1	18,000
CAbin Cleaning Truck	24,000	1	24,000
Bulk Loader	16,000	2	32,000
Cart Tug Vehicle	3,600	2	7,200
Bulk Cargo Carts	4,800	2	9,600
Tow Bar	2,000	1	2,000
			144,800

TABLE 4-8

GROUND HANDLING EQUIPMENT COSTS
4 GATE FACILITY

ITEM	UNIT COSTS ($)	UNIT REQUIRED	TOTAL COST
Lavatory	16,000	2	$ 32,000
Potable Water Truck	16,000	1	16,000
Preconditioned Air Truck	30,000	1	30,000
Electrical Cart	18,000	1	18,000
Cabin Cleaning Truck	24,000	2	48,000
Bulk Loader	16,000	3	48,000
Cart Tug Vehicle	3,600	6	21,600
Bulk Cargo Carts	4,800	6	28,800
Tow Bar	2,000	1	2,000
			$254,000

TABLE 4-9

GROUND HANDLING EQUIPMENT COSTS
6 GATE FACILITY

ITEM	UNIT COSTS ($)	UNIT REQUIRED	TOTAL COST ($)
Lavatory Truck	16,000	3	$48,000
Potable Water Truck	16,000	2	32,000
Preconditioned Air Truck	30,000	1	30,000
Electrical Cart	18,000	1	18,000
Cabin Cleaning Truck	24,000	4	96,000
Bulk Loader	16,000	8	128,000
Cart Tug Vehicle	3,600	8	28,800
Bulk Cargo Carts	4,800	8	38,400
Tow Bar	2,000	1	2,000
			421,000

TABLE 4-10

GROUND HANDLING EQUIPMENT COSTS

8 GATE FACILITY

ITEM	UNIT COSTS ($)	UNITS REQUIRED	TOTAL COST ($)
Lavatory Truck	16,000	3	$48,000
Potable Water Truck	16,000	3	48,000
Preconditioned Air Truck	30,000	1	30,000
Electrical Cart	18,000	1	18,000
Cabin Cleaning Truck	24,000	3	72,000
Bulk Loader	16,000	10	160,000
Cart Tug Vehicle	3,600	10	36,000
Bulk Cargo Carts	4,800	10	48,000
Tow Bar	2,000	1	2,000
		TOTAL	$462,000

TABLE 4-11
UNIT PARKING COSTS

<u>Items to Consider</u>

1. Thickness of pavement
2. Subgrade preparation
3. Stripping
4. Contingencies
5. Area per parking stall

1. Thickness - It is assumed that the pavement thickness will consist of 3 inches of asphalt concrete over a 4 inch crush rock base.	
a. 3" asphalt concrete	$1.52/yard^2
b. 4" crushed rock base	$1.11/yard^2
2. Subgrade preparation	$0.40/yard^2
3. Stripping	$0.50/yard^2
	$3.53/yard^2
4. Contingencies (10%)	$ .35/yard^2
	$3.88/yard^2

5. The parking area per stall is assumed to be 35 yard^2. The cost per stall is $136.00

level parking only. From reference 4-1, it is assuming that the parking area per stall is 317 square feet (29 square meters) based on 60 degree - drive in parking. Multilevel parking structures were not considered in the Phase II study.

4.4 Airport Cost Evaluation

4.4.1 Chicago Region

4.4.1.1 Airside Analysis - From the airport/aircraft compatibility evaluation studies conducted in Section 2 of this report, it was found that 5 airports in the expanded Chicago Region were deficient in runway/taxiway related items. A recap of the airports and the deficiencies are shown as Table 4-12. The cost to correct these deficiencies are also contained in Table 4-12.

Additional pavement requirements and the related costs were determined as follows:

- For runways/taxiways that need additional length or width, it was assumed that the required pavement be constructed of full depth asphalt or concrete in accordance with the thickness used in the unit cost derivations of the previous subsection.
- For pavements which require strengthening, the pavement TT rating was converted into a pavement thickness by assuming nominal subgrade conditions and concrete stress and in using the pavement design charts contained in the FAA Advisory Circular AC 150/5320-6A Change 3, "Airport Paving." The difference in thickness required by the baseline EBF.150.3000

TABLE 4-12

AIRPORT RUNWAY DEFICIENCIES AND COSTS

DEFICIENCIES

Airport		Runway	Runway Deficiency		
Name	Code	Number	Length	Strength	Width
Chicago Meigs	CGX	18/36		X	
Bi State Parks	CPS	12/30		X	X
Stapleton Int'l.	DEN	8L/26R		X	
Detroit City	DET	15/33		X	X
Crystal	MIC	13L/31R	X	X	X

COSTS

Airport		Airport Costs			
Name	Code	Length	Strength	Width	Total
Chicago Meigs	CGX		176,000		$176,000
Bi State Parks	CPS		231,000	47,000	278,000
Stapleton Int'l.	DEN		263,000		263,000
Detroit City	DET		214,000	44,000	258,000
Crystal	MIC	23,600	141,600	75,000	240,200

Total = $1,215,200

aircraft and the airfield pavement was considered as the amount of overlay necessary to achieve compatibility.

At general aviation facilities with a runway strength deficiency, it was assumed that the taxiway system would also require strengthening. The airports which are deficient in taxiway width and/or strength are shown on Table 4-13 along with the associated cost to upgrade the facility to the baseline STOL requirements.

Table 4-14 presents a summary of the number of gate positions required and the associated costs for each of the airports in the baseline expanded Chicago Region. The number of gates required were determined from the daily schedule output of the airline fleet schedule and planning model.

4.4.1.2 Landside Analysis - Table 4-15 shows the STOL terminal building space requirements based on peak hour passenger demand for the airports in the expanded Chicago Region. The unit building costs of $30 per square foot ($323 per square meter) of area was determined previously. Airport parking requirements and costs are shown on Table 4-16.

4.4.1.3 Total Regional Costs - For the expanded Chicago Region, the cost analysis was conducted independent of the operations scenario. Since this region was the first to be evaluated by the system analysis procedures and, also, because it is centrally located within the continental United States, it was felt that the majority of airports would overlap into other adjacent regions. The other five representative regional costs were determined based on the operations scenario. A summary of the total regional costs is given on Table 4-17. In the Chicago Region, the cost for additional facilities did not include Chicago Midway and Kansas City Municipal airports. At these

TABLE 4-13

AIRPORT TAXIWAY DEFICIENCIES AND COSTS

DEFICIENCIES

Airport		Taxiway	
Name	Code	Width	Strength
Chicago Meigs	CGX		X
Bi State Parks	CPS	X	X
Detroit City	DET		X
Crystal	MIC	X	X

COSTS

Airport		Airport Costs		
Name	Code	Width	Strength	Total
Chicago Meigs	CGX		$ 40,000	$ 40,000
Bi State Parks	CPS	9,000	37,000	46,000
Detroit City	DET		189,000	189,000
Crystal	MIC	26,000	26,000	52,000

Total = $327,000

TABLE 4-14

GATE FACILITIES COSTS
EXPANDED CHICAGO REGION

CITY	AIRPORT	CODE	PEAK HR FLIGHTS	GATES REQ'D	COST
BUFFALO	GREATER BUFFALO	BUF	2	1	$335,000
CHICAGO	MEIGS	CGX	13	7	2,345,000
CHICAGO	MIDWAY	MDW	12	8	2,680,000
CINCINNATI	GREATER CINCINNATI	CVG	4	2	670,000
CLEVELAND	BURKE LAKEFRONT	BKL	5	2	670,000
COLUMBUS	PORT COLUMBUS	CHM	3	1	335,000
DAYTON	J. M. COX	DAY	4	2	670,000
DENVER	STAPLETON INT'L	DEN	2	1	335,000
DES MOINES	DES MOINES MUNCIPAL	DSM	4	2	670,000
DETROIT	DETROIT CITY	DET	9	6	2,010,000
INDIANAPOLIS	WEIR COOK	IND	4	2	670,000
KANSAS CITY	KANSAS CITY MUNICIPAL	MKC	6	3	1,005,000
MILWAUKEE	GEN MITCHELL FIELD	MKE	4	2	670,000
MINNEAPOLIS - ST PAUL	CRYSTAL	MIC	6	4	1,340,000
OMAHA	EPPLEY FIELD	OMA	3	1	335,000
PITTSBURGH	ALLEGHENY COUNTY	AGC	3	2	670,000
ROCHESTER	MONROE COUNTY	ROC	2	1	335,000
ST LOUIS	BI-STATE PARKS	CPS	6	4	1,340,000
TOLEDO	TOLEDO EXPRESS	TOL	1	1	335,000

TABLE 4-15

TERMINAL FACILITIES COSTS
EXPANDED CHICAGO REGION

CITY	AIRPORT	CODE	PEAK HR PAX	TERMINAL SPACE FT^2/M^2	COST
BUFFALO	GREATER BUFFALO	BUF	189	23,000/2,137	$ 690,000
CHICAGO	MEIGS	CGX	977	100,000/9,290	3,000,000
CHICAGO	MIDWAY	MDW	1393	134,000/12,449	4,020,000
CINCINNATI	GREATER CINCINNATI	CVG	434	50,000/4,645	1,500,000
CLEVELAND	BURKE LAKEFRONT	BKL	522	57,500/5,342	1,725,000
COLUMBUS	PORT COLUMBUS	CMH	288	34,000/3,159	1,020,000
DAYTON	J. M. COX	DAY	377	43,000/3.995	1,290,000
DENVER	STAPLETON INT'L	DEN	239	28,000/2,601	840,000
DES MOINES	DES MOINES MUNICIPAL	DSM	352	41,000/3,809	1,230,000
DETROIT	DETROIT CITY	DET	688	74,000/6,875	2,220,000
INDIANAPOLIS	WEIR COOK	IND	416	47,000/4,366	1,410,000
KANSAS CITY	KANSAS CITY MUNICIPAL	MKC	660	72,000/6,689	2,160,000
MILWAUKEE	GEN MITCHELL FIELD	MKE	455	51,000/4,738	1,530,000
MINNEAPOLIS - ST PAUL	CRYSTAL	MIC	751	80,000/7,432	2,400,000
OMAHA	EPPLEY FIELD	OMA	331	39,000/3,623	1,170,000
PITTSBURGH	ALLEGHENY COUNTY	AGC	299	35,000/3,252	1,050,000
ROCHESTER	MONROE COUNTRY	ROC	183	22,500/2,090	675,000
ST LOUIS	BI STATE PARKS	CPS	694	75,000/6,968	2,250,000
TOLEDO	TOLEDO EXPRESS	TOL	113	15,000/1,394	450,000

TABLE 4-16

PARKING FACILITIES COSTS
EXPANDED CHICAGO REGION

CITY	AIRPORT	CODE	ANNUAL O & D	SPACES REQ'D	COSTS
BUFFALO	GREATER BUFFALO	BUF	234,000	164	$22,000
CHICAGO	MEIGS	CGX	4,428,000	3,100	$424,000
CHICAGO	MIDWAY	MDW	8,330,000	5,831	798,000
CINCINNATI	GREATER CINCINNATI	CVG	690,000	483	66,000
CLEVELAND	BURKE LAKEFRONT	BKL	1,222,000	855	117,000
COLUMBUS	PORT COLUMBUS	CMH	352,000	246	34,000
DAYTON	J. M. COX	DAY	256,000	179	25,000
DENVER	STAPLETON INT'L	DEN	442,000	309	42,000
DES MOINES	DES MOINES MUNICIPAL	DSM	340,000	238	33,000
DETROIT	DETROIT CITY	DET	2,962,000	2,073	284,000
INDIANAPOLIS	WEIR COOK	IND	694,000	486	67,000
KANSAS CITY	KANSAS CITY MUNICIPAL	MKC	1,232,000	862	118,000
MILWAUKEE	GEN MITCHELL FIELD	MKE	576,000	403	55,000
MINNEAPOLIS-ST PAUL	CRYSTAL	MIC	2,080,000	1,456	199,000
OMAHA	EPPLEY FIELD	OMA	560,000	392	54,000
PITTSBURGH	ALLEGHENY COUNTY	AGC	844,000	591	81,000
ROCHESTER	MONROE COUNTY	ROC	176,000	123	17,000
ST LOUIS	BI STATE PARKS	CPS	2,222,000	1,555	213,000
TOLEDO	TOLEDO EXPRESS	TOL	128,000	90	12,000

TABLE 4-17

AIRPORT COSTS

(× $1000)

	CHICAGO REGION	NORTHEAST REGION	CALIFORNIA REGION	SOUTHERN REGION	SOUTHEAST REGION	NORTHWEST REGION	TOTAL
RUNWAYS	$1,215	$ 2,002	$ 1,014	$ 442	$ 1,332	$ 0	$ 6,005
TAXIWAYS	327	927	340	268	333	0	2,195
GATES/APRONS	13,735	18,090	23,785	11,390	21,775	2,680	91,455
TERMINAL BUILDINGS	24,450	28,830	37,425	16,965	30,240	3,600	141,510
PARKING	1,281	2,670	2,855	1,340	2,313	181	10,640
ATC	20,868	10,255	21,028	18,326	25,333	5,128	100,938
TOTAL	$61,876	$62,774	$86,447	$48,731	$81,362	$11,589	$352,743

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airports, facilites do exist which are currently not being utilized.

4.4.2 New STOLport - General Patton Field - A cost study was undertaken to determine a "ball park" estimate of the airport related costs for a new STOL airport. The General Patton site in the expanded California Region was selected as being representative. The following items were considered:

- o Land Acquisition Costs not Included.
- o Runways
- o Taxiways
- o Gates/Aprons
- o Fuel Storage
- o Terminal ATC
- o Terminal Building Space
- o Parking Facilities
- o Internal Access System.

Table 4-18 presents a summary of the total estimated costs. A detailed analysis is given in Appendix 15.4.

Table 4-18

STOLPORT REQUIREMENTS AND COSTS*

General Patton Field (GPF)

(1)	Runway -	
	3000 Ft. (914 m) long X 115 Ft. (35 m) wide	$1,150,000
(2)	Taxiway -	
	6000 Ft. (1829 m) total length X 55 Ft. (17 m) wide	$ 810,000
(3)	Gates -	
	5 Gates	$1,675,000
(4)	Terminal ATC Costs -	$1,487,000
(5)	Fuel Storage - 400,000 gallons (1,514,000 liters)	$ 160,000
(6)	Terminals - 84,400 Ft.^{2} (7841 m^2)	$2,532,000
(7)	Parking Facilities for 1400 cars	192,000
(8)	Internal Access Road - 4 lanes; 1 mile (1.6 km)	155,000
	Total	$8,161,000

* Cost does not include real estate, site preparation, demolition, utilities nor external access road costs.

5.0 AIRPORT FINANCES

5.1 Income

During Phase II, the STOLport income has been reviewed. It should be noted here that a STOLport motive is profit-income greater than expenses. Part of this income is derived from the landing fees which the airlines have to pay.

5.1.1 Aviation Revenues:

- o Rent - Manufacturers & Airline Co.
- o Leasing Ground Areas - Manufacturers, Airlines, Others
- o Renting - Buildings in Terminals & Cargo Areas
- o Landing Fees - Airline Landing Fees & Other Flight Fees
- o Gasoline Commission - Gasoline Commission

5.1.2 Non-Aviation Revenues

- o Transportation Fees - U-Drive, Buses & Limousines, Hotel/Motel Services, Tram Fees
- o Concessions - Auto Park, Restaurants, Bars, Insurance Counters, Vending Machines, Newstands, and Other Terminal Sights
- o Utilities - Water, Electricity, Utilities, Work Done for Others, Observation Deck, Other Sales and Services
- o Miscellaneous - Refunds and Reimbursements, and Other Miscellaneous N/A Revenues
- o Interest - Interest and Other Non-Operating Revenue

5.2 Expenses

The STOLport expenses have been reviewed in a similar manner as the income for Phase II.

o Maintenance & Repair	- Runways, Taxiways, Aprons, Security in Field Areas, etc., Roads, Streets, Walks, Parking Areas, Landscaping, Buildings, Autos, Trucks, Heavy Equipment, Office Equipment.
o Cost of Sales and Services	- Water, Electricity, Work Done for Others, etc.
o Ground Operating Expenses	- Including Insurance
o Administrative Expense	- Salaries, Vacation and Sick Time, Workmans' Compensation, Advertising and Publicity
o Concession Expense	- Auto Parks, Coin Operated Locks, etc.
o Depreciation	
o Interest on Bonds	

Figure 5-1 illustrates the financial balance between the income and expenses of an airport.

The work accomplished on airport finances has been summarized in Volume V - Economics (Indirect Operating Costs). A detailed study must be done to separate STOL and CTOL costs and to determine an appropriate landing fee for the STOL short-haul activity at each airport.

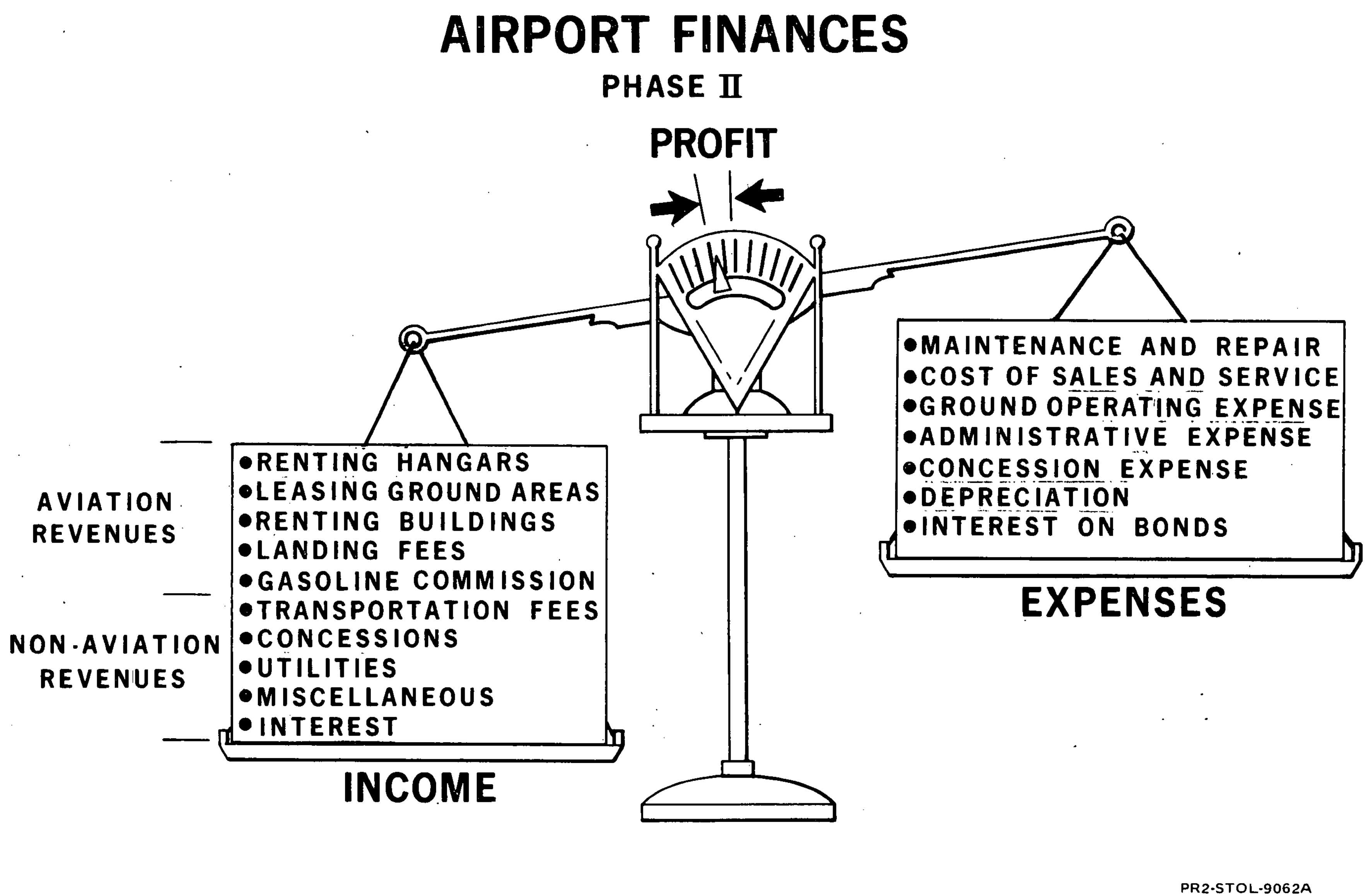

AIRPORT FINANCES
PHASE II
PROFIT
AVIATION REVENUES
NON-AVIATION REVENUES
●RENTING HANGARS
●LEASING GROUND AREAS
●RENTING BUILDINGS
●LANDING FEES
●GASOLINE COMMISSION
●TRANSPORTATION FEES
●CONCESSIONS
●UTILITIES
●MISCELLANEOUS
●INTEREST
INCOME
●MAINTENANCE AND REPAIR
●COST OF SALES AND SERVICE
●GROUND OPERATING EXPENSE
●ADMINISTRATIVE EXPENSE
●CONCESSION EXPENSE
●DEPRECIATION
●INTEREST ON BONDS
EXPENSES
PR2-STOL-9062A

Figure 5-1

5.3 Sources of Airport Financing

Adequate airport facilities to support the rapid growth of the 1985 STOL short-haul system will require significant amounts of capital.

5.3.1 Sources of Federal Government Financing - Federal funding became available in 1946 after a Federal Airport Act established a federal policy of monetary aid for civil airport development.

In 1970 the Airport and Airway Development Act was passed which increased federal matching funds.

Federal matching grants are administered by the Federal Aviation Administration under the National Airport Systems Plan. The maximum federal participation for an eligible project is 50 percent of the airport costs less terminal building and parking lots.

There is a new Senate Bill (S.38 before the 93d Congress - 1st Session) to amend the Airport and Airway Development Act of 1970 to increase the United States share of allowable project costs under such an act. This Act would allow:

- 50 per centum for sponsors whose airports enplane not less than 1.00 per centum of the total annual passengers enplaned by air carriers certified by the CAB.
- 75 per centum for sponsors whose airports enplane less than 1.00 per centum of the total annual number of passengers enplaned by air carriers certificated by the CAB.
- 50 per centum of the allowable costs thereof of public use facilities in terminal buildings.

Passage of this Act would reduce the airline/community costs involved in establishing a short-haul system.

5.3.2 Sources of State and Local Financing - At the state level, the amount of financial participation in local airport development varies considerably. Less than half the states do not participate at all. Other, more progressive states contribute as much as 25 percent of the construction costs of airports. Where states participate at the 25 percent level, the federal program pays 50 percent and the local area 25 percent. If the state does not participate, the local area must pay 50 percent of the costs.

There are a number of sources of airport financing available to the state and local agencies. The sources include:

- Aviation fuel tax.
- User tax for airport facilities.
- Labor and parts tax on certified aircraft parts.
- Aircraft registration fee.
- Aircraft property tax.
- Transportation tax.
- General tax fund.
- Private capital.
- General obligation bond.
- Revenue bond.

Many times airport expansion has been delayed because of lack of funding. At the same time, construction costs have increased drastically due to inflation, which is mainly due to rising material and building costs.

The typical municipality relies heavily on borrowing funds at reasonable interest rates in the bond market. The most predominate type of bond has been the general obligation bond. Since a general obligation bond obligates the entire resources of the local government to back the bond, the investment is considered to be a low risk type and, in the past, a low interest rate has been achieved for financing. This is a disadvantage because these bonds usually have no investor appeal.

Many local municipalities have used revenue bonds to finance portions of their airport development. The interest rate on revenue bonds is generally higher than it is for general obligation bonds, and in most cases the use of revenue bonds is restricted to components of the airport which are good revenue producers, such as terminal buildings, hangars, etc. In some states, a municipality may not issue revenue bonds. However, a city or group of cities may form a trust and issue revenue bonds through the trust.

The Treasury Department will exert a major influence upon the tax-exempt status of airport bonds and much new airport financing will be effected by the rulings of the Treasury Department.

These sources of airport financing would provide most of the STOL airport costs that are outlined in Table 4-17.

6.0 SYSTEM BENEFITS AND COMMUNITY ACCEPTANCE

A major objective of the STOL systems study as defined by NASA was to "determine the relationships between the quiet turbofan STOL aircraft characteristics and the economic and social viability of short-haul air transportation." Accordingly, an in-depth analysis of the benefits of a national STOL system and its impact on the nation and local community was undertaken as an integral part of the systems study. An extensive analysis of the problems associated with local community acceptance also was undertaken since the social viability of the system ultimately will be determined at the "grass roots" level of the local communities in which the STOLports will be located. It is hoped these studies will provide meaningful guidelines to insure full public acceptance of the national STOL system.

6.1 Study Objectives

The primary objectives of the system benefits and community acceptance analyses are to:

- Identify the national, regional and local benefits of a STOL short-haul transportation system.
- Determine the factors involved in community acceptance of a national STOL system.

An underlying objective of the study was to develop a systematic procedure for comparison and evaluation of the many technical, economic, social, and political factors involved in community acceptance of transportation systems. Only through a comprehensive systems study can the complex relationships between the various disciplines and technologies be examined and their relative importance evaluated. This study has strongly validated the necessity of taking a "total systems look" at short-haul transportation and the community acceptance problems involved in implementing the system.

The study also recognizes the need to develop a methodology which can be applied to any type of transportation system and is therefore structured to include consideration of all relevant environmental and economic criteria, many of which may not be directly applicable to a STOL system per se.

Many prior studies have investigated various environmental and economic considerations of individual transportation system elements or actions; however, it is believed the subject study is the first to consider the full environmental impact and anticipated community acceptance of a total transportation system. No established methodology for a comprehensive analysis of this type has been found in the literature. This study effort, therefore, could be classified as a pioneering effort — and as such, incorporates the results of a number of approaches to develop a sound methodology having an acceptable degree of validity. Emphasis has been placed on the sociological aspects of the problem— a factor which has been neglected in most prior studies.

6.2 End Items

The analysis was designed to provide the following:

1. Development of a methodology for non-user benefits analysis.
2. A list of benefits (and disbenefits) categorized by national, regional, and local (community) impact.
3. Development of a methodology for evaluating community acceptance of STOL operations.
4. Identification of airport site selection criteria which affect community acceptance of STOLports.
5. Identification of candidate research and development programs in the field of community acceptance.
6. Development of aircraft and operational guidelines for improving public acceptance.
7. Recommended guidelines for public education programs.

The initial Phase I effort was directed primarily at development of an analysis methodology which has universal application to any airport site location and which would identify the key community acceptance problems associated with a specific site. Special consideration has been given to key items associated with community acceptance — noise, emissions, congestion, and land use.

The subsequent Phase II effort applied the methodology to various STOLport locations selected for the short-haul system network in an attempt to identify those having a low probability of achieving public acceptance. A total of twelve airports, each with special location, operational, and community characteristics were selected for in-depth field studies. The results obtained from the case study airports are considered to be generally applicable to other similarly classified airports in the network.

6.3 Study Approach

The study approach developed considers the non-user benefit factors of the system as an "impact" on the community; and the community acceptance factors as a "reaction." Accordingly, the first step was to develop some means of identifying, classifying, and quantifying the "impact" and the "reaction" criteria.

Work flow and interaction between the two analysis efforts are shown in the study approach diagram of Figure 6-1. Factors which must be considered in the "impact," or benefits analysis, fall within two broad categories; Environmental and Economics. Likewise, the "reaction" or community acceptance factors have been categorized either as Social or Political.

6.3.1 Approach - System Benefits Analysis - A time-phased work flow diagram which defines the major steps followed in the system benefits analysis is shown in Figure 6-2. The categorization of the major factors considered has been described earlier. The continuous process of reiteration and review is not shown for reasons of clarity. The shaded blocks indicate the primary outputs of the benefit analysis.

6.3.2 Approach - Community Acceptance Analysis - A similar work flow diagram describing the community acceptance analysis is shown in Figure 6.3. Categorization of the key considerations in the community acceptance analysis was developed concurrently with those of the benefits analysis since they are mutually dependent; however, in application the benefit analysis results were input at the midpoint of community acceptance analysis as shown in the diagram. The primary outputs of the community acceptance analysis are indicated by the shaded blocks. The detailed methodology developed for community

COMMUNITY ACCEPTANCE - NON-USER BENEFITS STUDY APPROACH

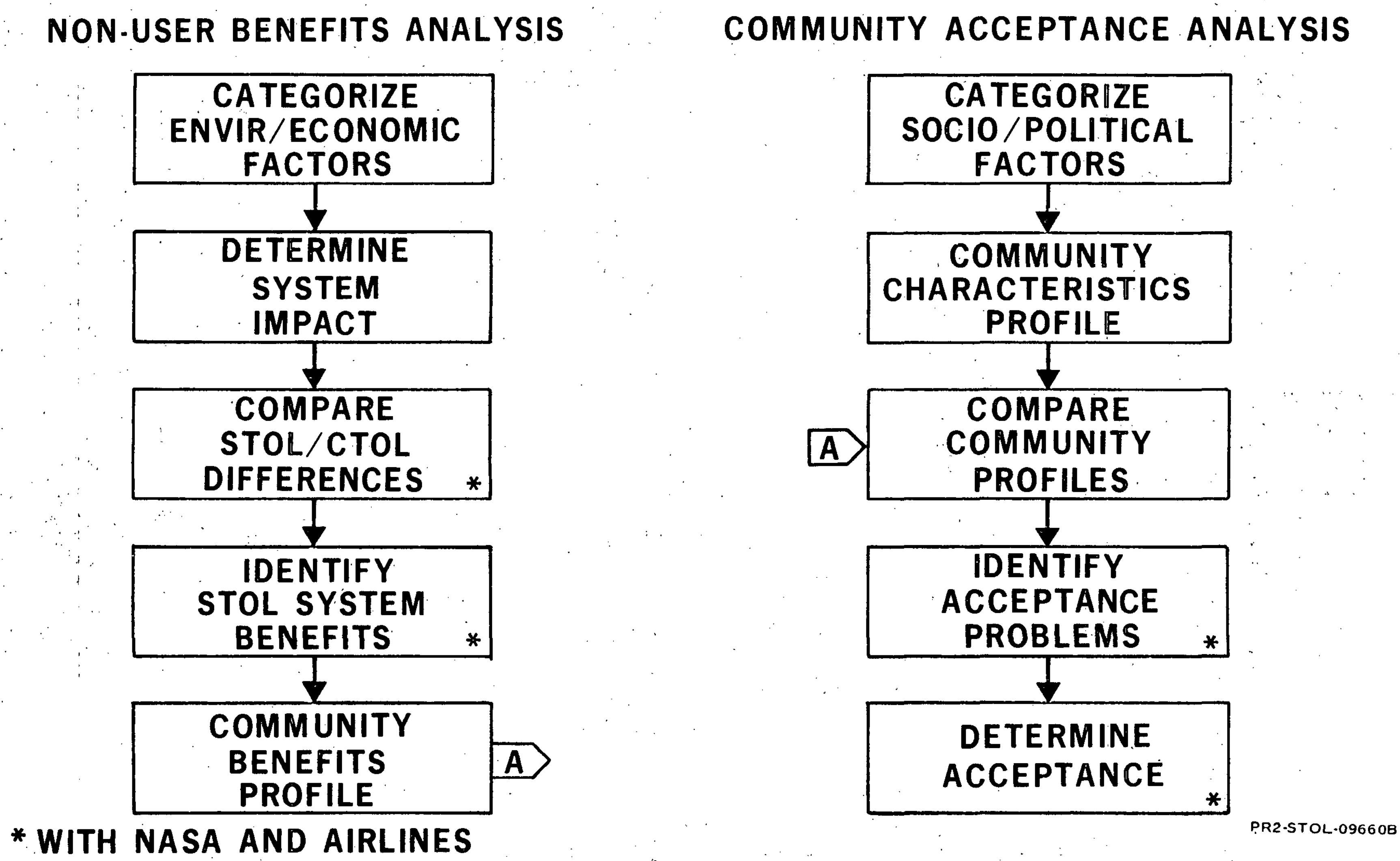


FIGURE 6-1

METHODOLOGY-SYSTEM BENEFITS ANALYSIS

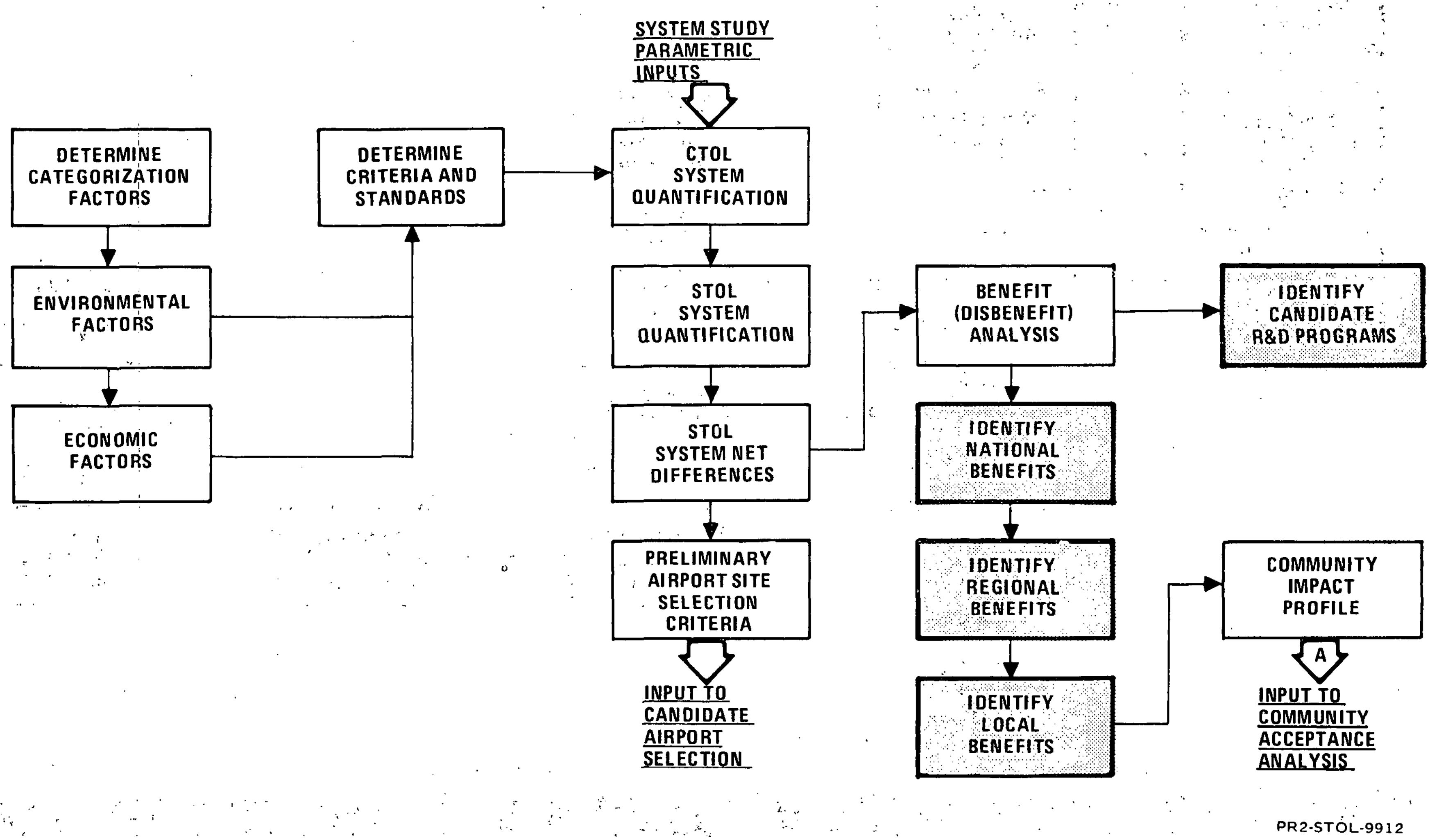


FIGURE 6-2

METHODOLOGY-COMMUNITY ACCEPTANCE ANALYSIS

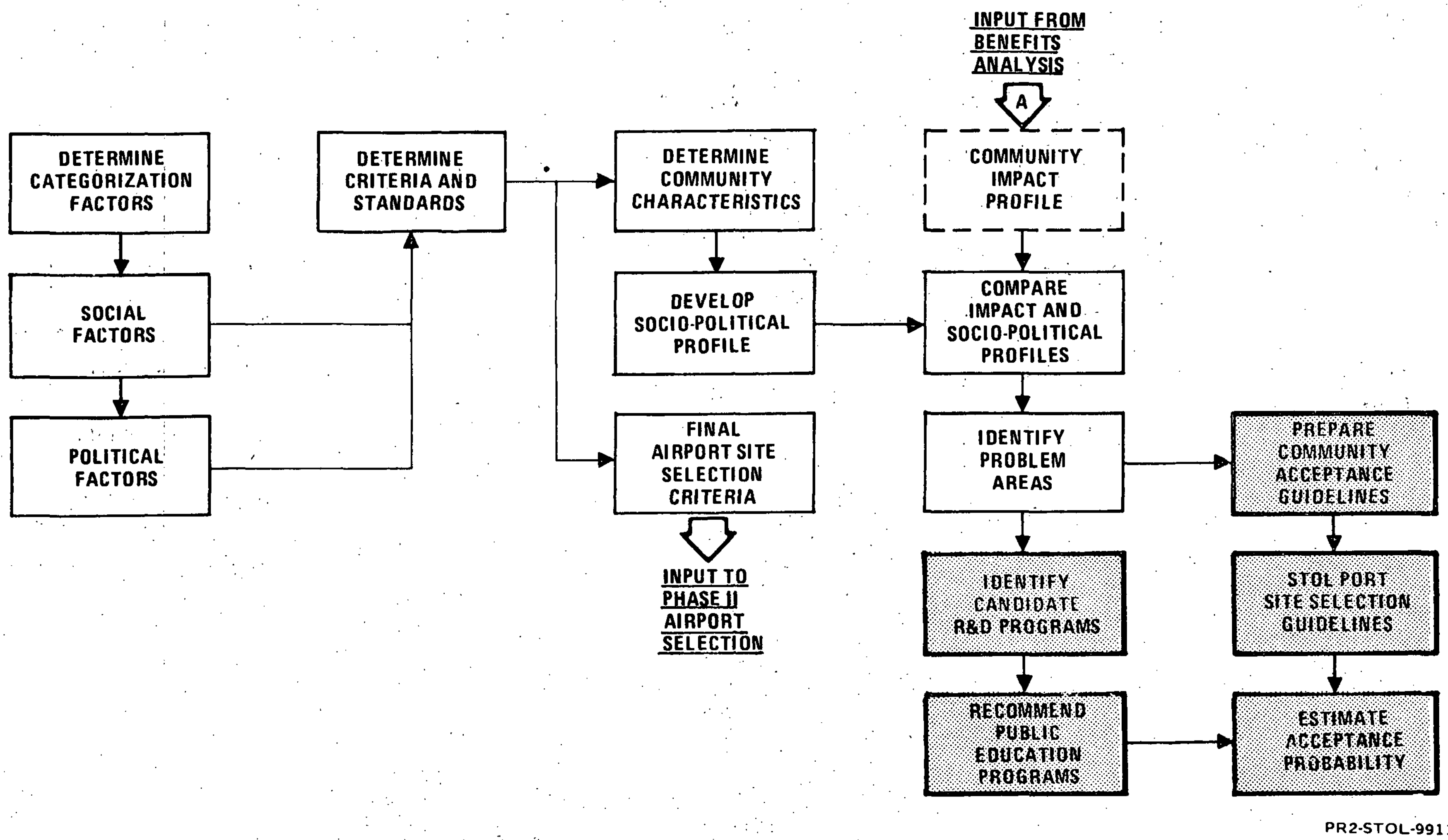


FIGURE 6-3

analysis is described in a subsequent section of this report.

6.4 Evaluation Criteria

The major environmental, economic, social, and political (or institutional) factors which must be considered in both the system benefits and community acceptance analyses are listed by major category in Figure 6-4. The list was developed to include all aircraft types and therefore includes several considerations not applicable to short-haul subsonic aircraft (e.g., radiation, biological factors, etc.). The major factors influencing system implementation and acceptance are individually discussed in the body of the report. Evaluation criteria have been quantified wherever possible using normally accepted standards; however, measurement standards for many of the environmental and social considerations have not yet been developed. Subjective judgements have been applied to these considerations and quantification was made on a relative basis.

Identification and classification of the social characteristics of a community is a difficult task. While much has been done to describe the social and psychological characteristics of an individual, to the best of our knowledge, very little has been done to develop similar criteria for a sociological description of a community as a whole. It is even difficult to arrive at a terminology which adequately describes the important subcategories. Also, determination of community attitudes and values is extremely difficult since these are constantly changing, both with respect to relative importance as well as in level or degree. For example, in the not too distant past, economic and growth considerations of the community usually were predominant, while in recent years environmental and social considerations appear to be dominant in most communities. Levels of environmental pollution considered acceptable ten years ago are no longer acceptable today — and today's standards probably will be considered inadequate ten years from now. Examination of the recent history of environmental, economic, social, and political issues of a community was determined to be the best source of information on current community attitudes and facilitated determination of developing trends.

Analysis of the socio-political factors of a community requires examination on a community by community basis. Since communities vary in

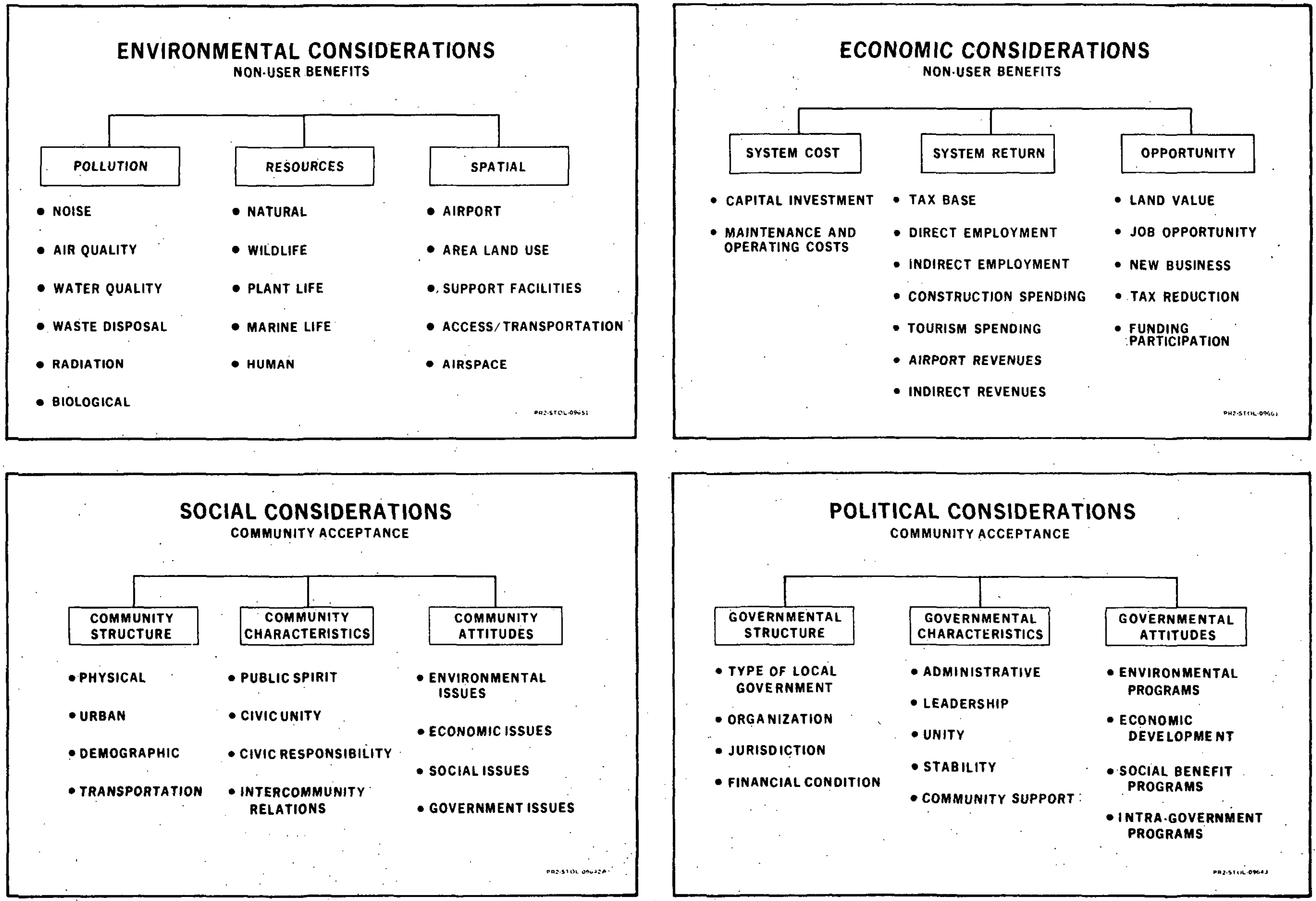

ENVIRONMENTAL CONSIDERATIONS
NON-USER BENEFITS
POLLUTION
• NOISE
• AIR QUALITY
• WATER QUALITY
• WASTE DISPOSAL
• RADIATION
• BIOLOGICAL
RESOURCES
• NATURAL
• WILDLIFE
• PLANT LIFE
• MARINE LIFE
• HUMAN
SPATIAL
• AIRPORT
• AREA LAND USE
• SUPPORT FACILITIES
• ACCESS/TRANSPORTATION
• AIRSPACE
ECONOMIC CONSIDERATIONS
NON-USER BENEFITS
SYSTEM COST
• CAPITAL INVESTMENT
• MAINTENANCE AND OPERATING COSTS
SYSTEM RETURN
• TAX BASE
• DIRECT EMPLOYMENT
• INDIRECT EMPLOYMENT
• CONSTRUCTION SPENDING
• TOURISM SPENDING
• AIRPORT REVENUES
• INDIRECT REVENUES
OPPORTUNITY
• LAND VALUE
• JOB OPPORTUNITY
• NEW BUSINESS
• TAX REDUCTION
• FUNDING PARTICIPATION
SOCIAL CONSIDERATIONS
COMMUNITY ACCEPTANCE
COMMUNITY STRUCTURE
• PHYSICAL
• URBAN
• DEMOGRAPHIC
• TRANSPORTATION
COMMUNITY CHARACTERISTICS
• PUBLIC SPIRIT
• CIVIC UNITY
• CIVIC RESPONSIBILITY
• INTERCOMMUNITY RELATIONS
COMMUNITY ATTITUDES
• ENVIRONMENTAL ISSUES
• ECONOMIC ISSUES
• SOCIAL ISSUES
• GOVERNMENT ISSUES
POLITICAL CONSIDERATIONS
COMMUNITY ACCEPTANCE
GOVERNMENTAL STRUCTURE
• TYPE OF LOCAL GOVERNMENT
• ORGANIZATION
• JURISDICTION
• FINANCIAL CONDITION
GOVERNMENTAL CHARACTERISTICS
• ADMINISTRATIVE
• LEADERSHIP
• UNITY
• STABILITY
• COMMUNITY SUPPORT
GOVERNMENTAL ATTITUDES
• ENVIRONMENTAL PROGRAMS
• ECONOMIC DEVELOPMENT
• SOCIAL BENEFIT PROGRAMS
• INTRA-GOVERNMENT PROGRAMS

FIGURE 6-4

character and value standards, as do individuals, each community must be individually analyzed. The case study analysis has shown, however, that certain general traits or characteristics exist. Those are discussed in subsequent sections of the report. Identification of the political and institutional characteristics of a community was found to be essential since action to implement the airport element of a transportation system ultimately must be taken by local political bodies.

6.5 Airport Categories

The various types of short-haul airports considered were classified according to the configuration categories listed below to insure that all possible situations were considered. Air carrier airports were classified by FAA National Airports System Plan (NASP) criteria.

A. Existing primary system air carrier airports.

B. Existing secondary system air carrier airports.

C. Existing feeder system air carrier airports.

D. Existing general aviation airports.

E. Existing military airports.

F. Existing joint-use (military/civil) airports.

G. New urban CBD (Central Business District) STOLports.

H. New suburban STOLports.

I. New elevated STOLports.

J. New offshore (or floating) STOLports.

The airport data summaries of Appendices 15.1 and 15.8 reflect these classifications.

7.0 SYSTEM BENEFITS ANALYSIS

The overall benefits and disbenefits of a STOL system are relatively easy to identify on a total basis. Classification of benefits by national, regional, and local categories, however, requires translation of the broad benefits-disbenefits into many specific impacts for each of the three categories. These may differ significantly. For example, what may be considered a benefit on a national or regional basis may be a disbenefit to a local community. Also, benefits and disbenefits vary from community to community depending on their characteristics and attitudes. The analysis attempts to resolve this problem by separating the benefits into environmental, economic, social, and institutional classifications and relating them to national, regional, and community goals where possible. It must be recognized that most goals, or objectives, are highly time-sensitive, especially those of a region or local community. Very few communities have resolved their local differences of opinion on major community issues or have defined their desires relative to future structure, character, or goals. An understanding of community desires or goals is an essential prerequisite to determining whether an impact factor ultimately should be considered a benefit or a disbenefit to a specific community.

7.1 Basic Assumptions

Definition of the market and operational assumptions applicable to the STOL system was found to be necessary in order to apply consistent judgements throughout the analysis. It was determined early in the study that certain items could be either a local benefit or disbenefit dependent on operating level assumptions. The following underlying assumptions supporting the analysis are consistent with the operational assumptions developed in other volumes of the report.

- CTOL will continue to serve a large portion of interconnecting airline traffic.
- STOL operations will interface with but will be independent of CTOL operations at existing major hub airports.

- o STOLports will reduce demand at major CTOL hub airports by diversion of a large portion of short-haul traffic.
- o STOL operations at existing non-hub or general aviation airports will be additive to current types of operations. Some current operations may be converted from CTOL to STOL.
- o Operations at new STOLports (other than existing airports) will be limited exclusively to STOL and/or VTOL aircraft.
- o All impact comparisons are relative to existing or expanded short-haul CTOL systems or advanced surface systems.

7.2 Methodology - Benefits Analysis

A matrix chart which considers both user and non-user benefits was developed since in most instances the same impact consideration applied to each — but in different form and degree. The matrix also facilitated examination of the benefits and disbenefits as they applied to various user and non-user sub-categories. User benefits were translated into passenger, airline, airport, and manufacturer categories. Although the latter three groups are not users in the literal sense, they are functionally related and accrue benefits. Non-user benefits were translated into national, regional, and local categories. The local category was further separated into two sub-categories; (1) communities with an existing airport; and (2) communities not previously exposed to aircraft operations as it was found the benefits (and/or disbenefits) could differ considerably between the two situations. The matrix also permitted individual examination by impact category — enviornmental, economic, social and institutional. The analysis matrix is reproduced in Appendix 15.5 of this volume and includes both user and non-user benefits. The designated benefits include outputs not only from the airports analysis but also from all other elements of the study — Market, Aircraft, Economics, and Systems Analysis. The matrix does not attempt to establish relative importance or priority of the various benefit items.

7.3 User Benefits

Primary user benefits are summarized in Figure 7-1, in order of relative importance. The degree to which the benefits are ultimately realized is dependent on how effectively and efficiently the short-haul system is implemented and operated.

7.4 Non-User Benefits

Primary non-user benefits also are summarized in Figure 7-1. The major system benefits are listed under national, regional, and local (community) categories. Under certain circumstances, locating a new airport in a community where no airport currently exists could be considered a disbenefit to the local community. The overall regional benefits of such action, however, may be significant with the net result that many more individuals are benefited compared to the relative few who are inconvenienced.

Establishment of a consistent criteria or standard for determining whether an item is a national, regional, or local benefit also was found to be essential, since in many instances the decision is one of degree. For example, the study determined a new short-haul system would provide both employment and economic opportunities. The opportunities (i.e., benefits) would exist primarily at the local level— and to a lesser degree at the regional level. Although additional employment and economic opportunities also would exist at the national level, their impact on the nation's GNP and employment levels would be almost imperceptible. The following criteria therefore were established:

National Benefit - Those items which contribute to the achievement of established national goals, or which result in a measurable change in national statistics as published in the "U.S. Statistical Abstract."

Regional Benefit - Those items which contribute to the established goals or general welfare of a state, a recognized geographical area, or a politically defined region. A Standard Metropolitan Statistical Area (SMSA) was arbitrarily established as the smallest individual area included in the regional classification.

Local Benefit - Those items which contribute to the established goals or general welfare of an individual city, borough, county, or community smaller than a SMSA (or various combinations of the above). For example, some airports impact on as many as ten or more local communities, some legally or politically defined— others not.

A comparison of STOL versus CTOL aircraft operational characteristics was prepared as an initial step in the analysis. This comparison is summarized in Appendix 15.5. Both user and non-user benefits basically originated from the short field capability and relatively low approach speed characteristics of the STOL aircraft.

PRIMARY USER BENEFITS

- REDUCED TOTAL TRAVEL TIME FOR SHORT-HAUL PASSENGERS.
- REDUCTION IN DELAYS DUE TO AIRPORT SURFACE TRAFFIC CONGESTION.
- POTENTIAL REDUCTION IN TOTAL TRIP COST FOR SHORT-HAUL AND INTERCONNECTING PASSENGERS.
- INCREASED TRAVEL CONVENIENCE FOR SHORT-HAUL PASSENGERS.

PRIMARY NON-USER BENEFITS

	NATIONAL	REGIONAL	LOCAL
• REDUCED CONGESTION AT MAJOR HUB AIRPORTS.	X	X	X
• EXTENDED LIFE OF MAJOR CTOL AIRPORTS.	X	X	X
• REDUCED AIRLINE DELAY COST.	X	X	
• SIGNIFICANT REDUCTION IN NOISE IMPACT.		X	X
• LOWEST ENVIRONMENTAL IMPACT OF ANY COMPARABLE SHORT-HAUL TRANSPORTATION SYSTEM-AIR OR SURFACE.	X	X	X
• POTENTIAL EMPLOYMENT AND ECONOMIC OPPORTUNITIES.		X	X

FIGURE 7-1

8.0 COMMUNITY ACCEPTANCE ANALYSIS

The many environmental, economic, social and political considerations involved in evaluating community acceptance have been discussed in the previous section. This section examines the key problems and issues and attempts to establish their relative importance with respect to implementation of a new short-haul transportation system. The methodology developed for community acceptance analysis is applied to selected case study airports to establish acceptance criteria which would be applicable to all other airports within the system network.

8.1 Problem Definition

The implementation problem lies primarily in the development of the necessary airport facilities. The constraint is community and environmentalist objections to airport activity in either undeveloped or urbanized areas. Key issues, in the order named, are Noise, Pollution, and Congestion. The prior benefits analysis has shown the many benefits which can be achieved through implementation of a new short-haul air transportation system. However, the problem of a local community acceptance appears to be the major hurdle to be overcome. Though it would appear most people are in favor of technological advancement in the field of air transportation, their underlying concern is expressed as — "don't put the airport in my community!"

The problems of establishing new airport facilities are many. Fraser (reference 8-1) identifies three generally accepted constraints on airport development: (1) environmental; (2) behavioral; and, (3) political. Environmental constraints consist of those pertaining to the degradation of the environment and include attitudes toward clean air, noise, and similar items. Behavioral constraints arise from public agencies' attitudes toward putative goals. Political constraints include such dispositions as those relating to the preservation of American economic hegemony and "home rule."

There are several reasons for the objections to the development of STOLports including the concern for the "quality of our environment," especially in connection with noise and air pollution. Lundquist (reference 8-2), states: "The airport is no longer a good neighbor and there's strong public opposition to something that causes noise and pollution in the area. We've (the FAA) been entirely unsuccessful in trying to sell a new airport." However, technology is changing. The STOL aircraft designs analyzed in this study are significantly quieter and virtually pollutant free in comparison to current CTOL aircraft. Therefore, by the early or mid-1980's many of the community's current objections to airports may no longer be valid. This does not mean that the problem of community acceptance can be laid to rest— as these problems are diminished others will rise to the forefront. Hopefully, if all the problem areas can be anticipated and eliminated or reduced, true community acceptance ultimately can be achieved.

8.1.1 <u>Airport/Community Problems</u> - Prior to the advent of jet aircraft, public support of airports was enthusiastic and positive. Airplanes were considered exciting and glamorous. Those individuals traveling by aircraft were thought to be very fortunate and the object of envy. Many towns and cities actually competed to build an airport which would bring people, merchandise and prosperity. However in recent years, a complete reversal of public support has occurred. In many cities throughout the country, individuals and organized groups are bringing civil action against both publicly and privately-owned airports. The suits are based on the complaints of noise, air pollution, and other environmental/ecological issues resulting from the burgeoning air transportation system. In fact, at many major city airports, community pressure is strong enough to endanger the actual survival of the airport facility (e.g. Orange County). The issue of air transportation now has become so controversial that some states require all airport issues be placed on the ballot for decision. Because of the current citizen unrest concerning airport developments and the recently required Environmental Impact Statement — serious constraints to STOLport implementation are already evident.

Although increasing opposition has become a fact to airport operators and planners, there exists no conclusive data indicating the attitudes and behavioral intentions of the general population. From study of public hearing transcripts and interviews with transportation planners it would appear the majority of the opposition stems from a small, highly vocal, minority of the population. Lantner (reference 8-3) concurs with these findings and has defined the origins of public opposition based on national, regional, and local affliations.

There are many reasons for public opposition to airport development; some of these have been previously listed above in the discussion on legal action suits. But the facts must be considered. A real problem exists for some people — those who are directly exposed to high noise levels created by aircraft. Although this is not a new problem for our society (e.g., railroads, elevated commuters, freeways, etc.) the amplitude of the noise has increased beyond previously experienced levels for many people. In addition, many of the persons currently exposed to the high noise levels and other airport associated problems, perceive no direct personal benefit from air transportation systems. While these people may frequently use freeway systems and possibly other commuter systems (e.g., buses, trains, subways) they rarely use airplanes. The large majority of people who travel by air do not live in the immediate, noise affected area of the airport. And, while there may be indirect benefits to those living around an airport facility— these benefits are recognized by only a few communities (e.g., Midway Airport-Chicago).

Public concern over possible depreciation in property values also is a major deterrent to airport expansion or construction. Although numerous economic studies have shown that commerical land values in the vicinity of an airport increase significantly with expanded operations of major air carrier airports, residential land values do not increase proportionately— and in some instances actually decrease. Experience has shown that residential land within the severe noise impact zone of an aircraft runway is not always saleable. Home purchase and/or expansion loans also are difficult to obtain in a noise impacted area. The public concern, especially those people in the immediate noise impacted airport vicinity, is well-founded. The testimony of truly inconvenienced homeowners at public hearings undoubtedly sways a large number of persons who are not in any way affected by aircraft noise.

There are also many possible reasons for the opposition to airport development which have not yet been fully documented. Currently, there is a trend for a change in the values of the population. These trends, however, have not been fully studied — but it is known some organizations have been formed on the national level to stop technological progress, inhibit population growth, and return to earlier levels of technical satisfaction. In fact, one group which is international in organization states: "This is a time when man's ability to survive seems to be in doubt. In many cases science is accused as the culprit....man must control science if he is to survive...."

8.1.2 Public Credibility - One of the major problem areas in air transportation planning and development is "public credibility." This issue, more than any other arises at almost all public hearings on transportation projects. Many factors are involved in determining whether the public accepts statements of industry and government related to air transportation systems. It would appear the public is wary of the planning officials and seemingly is losing confidence in the ultimate value of scientific enterprise. Louis Harris (reference 8-4) states: "only 27% of those polled in 1966 believed the airlines were genuinely concerned about aircraft pollution problems." Harris further points to the drop in public confidence in scientists—in 1966, 56% had "a great deal of confidence in them" compared to only 32% in 1971. Also, similar findings on credibility can be shown in the transcripts of almost any public hearing on an airport development issue— a general lack of confidence in the sincerity of industry and government (reference 8-5). Often elected public representatives increase the "credibility gap." In one case, a Port Authority announced the need for acquisition of only three houses in an airport expansion program; later, after the first plan had been approved, it was announced that more houses would be condemned. It was at this time a local representative of the public charged the Port Authority with, "lying since last year for they had assured us that they would only take three houses..." The Authority answered progress had caused a need for more facilities (reference 8-3). An FAA official (reference 8-6) reports that when tape recordings of more "quiet" aircraft (e.g., DC-10 or L-1011) are submitted to public hearings, the attendees frequently refuse to believe their validity. Also, in one instance in which a tape recording of loud aircraft noise was played by a public attendee at a hearing, aviation officials presiding at the public hearing questioned it's validity. Therefore, it can be seen the "credibility gap" is fostered by both sides.

The promotion of public credibility can only be accomplished from an "honest" base. The public is far more sophisticated today than ever before and demands to be treated in an open and honest way. The data on public credibility is quite sparse in the literature— especially that related to aviation and airport development. However, there are two separate instances which demonstrate the need to increase public credibility; one is the Bay Area Rapid Transit (BART) program, and the other is the Chelsea STOLport project. In both of these instances the major credibility contribution was communication— in one case, excellent communication; in the other poor communication. The BART officials took a straight forward and honest approach with the citizenry— soliciting the public's aid in solving early planning problems (reference 8-7). The Chelsea STOLport project was an excellent example of what can happen through ignoring the need for early communication with the public. The citizens at Chelsea were not brought into the early planning phases of the STOLport project planned for the Hudson River. When a press release describing this project was issued by a federal agency, the issue "burst within Chelsea like a grenade" (reference 8-8). A citizens group for the preservation of Chelsea already existed and was well-organized—to the point of putting into immediate action demonstrations and other public opposition statements that successfully forestalled further STOLport planning activites. Had these individuals been consulted in the beginning of the planning— perhaps fewer constraints would have been imposed. The BART system succeeded— Chelsea was killed! The BART program provided valuable guidelines in the methods of establishing public credibility. BART's success and Chelsea's failure demonstrates the benefits (and costs) of public/government/industry "action" programs. It also demonstrates the benefits of being "proactive" rather than "reactive" in transportation system planning. The public can exert a powerful force— the direction of this force depends largely upon the issue and of the credibility of the proposing group.

As noted earlier, lack of credibility can be fostered from both sides of the fence. With this in mind, "how does one convince the public that the STOLport will be a good neighbor and that the STOL aircraft will be significantly quieter and less polluting than today's aircraft?" It is suggested that industry and government must first gain the confidence of the public to become credible in the eyes of the population. If the public are told that three houses will be condemned to implement the airport— and 15 houses are actually torn up— how can the public give credit to the planners?

The old adage "seeing is believing" also is considered applicable to STOL system implementation. Public hearings have demonstrated that people do not believe that quieter and relatively pollutant free aircraft can be built. Although this belief can be (and must be) countered in part by a well planned public education program on behalf of both industry and government; it still will not achieve the degree of public acceptability needed. A series of nationwide public flight demonstrations of a quiet STOL aircraft appears to be essential to overcome the lack of public credibility in the air transportation industry.

8.1.3 Governmental Support - Early in this country's history the ideal form of government was seen as direct community participation in the decision-making process. As the country grew and the population increased the decision-making was gradually turned over to a few elected representatives. There now seems to be an increasing desire on the part of community members to once again become part of the decision-making process. This may have resulted from increased leisure, advancements in education, and/or dissatisfaction with many of the problems apparent in today's civilization. Discounting the reasons, planning, funding and development of many public programs may depend directly upon whether the major elements in the community are satisfied that the program in question is in their best interest. As will be seen later in the results of interviews conducted with many airport and local community officials, the urgent need for understanding the community's attitudes, interests, and behavioral intentions, is being increasingly appreciated in all regions of the country.

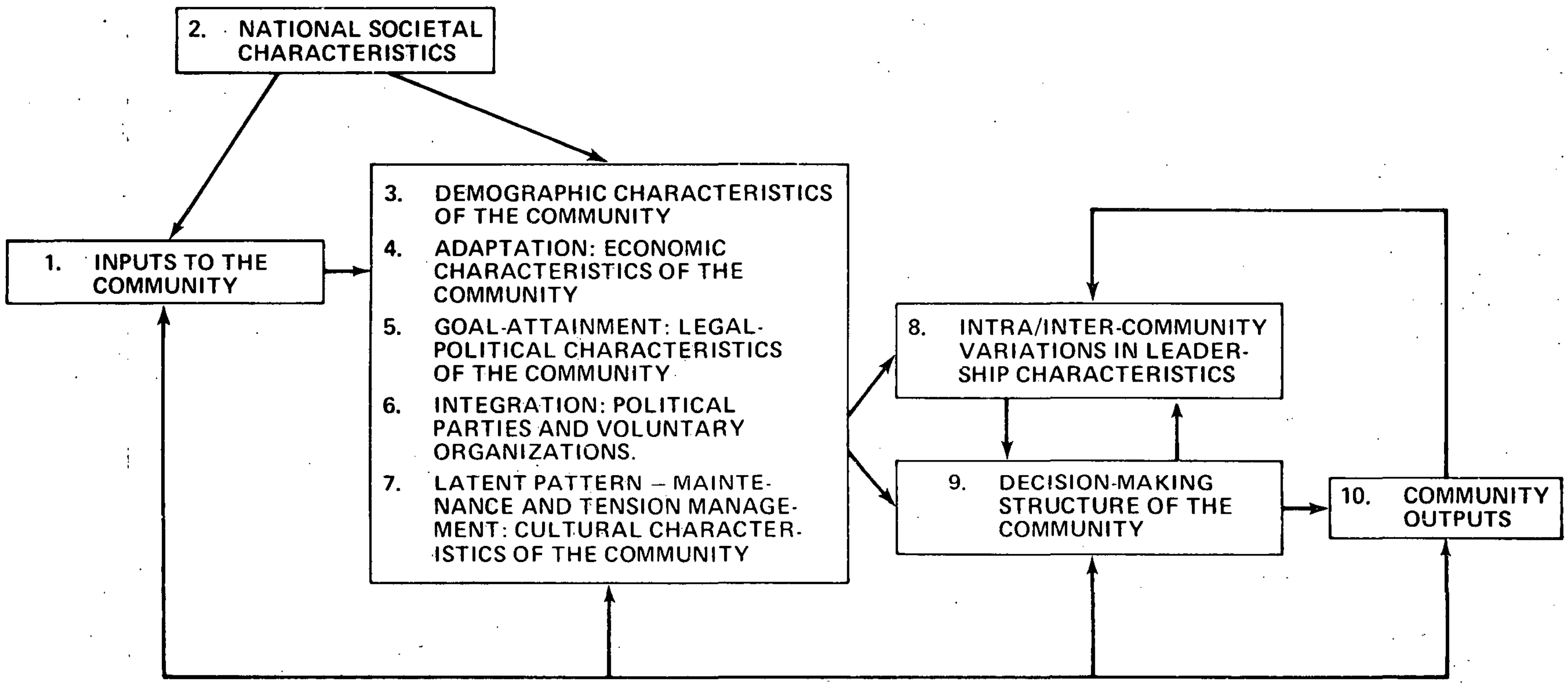
Very little understanding of the ultimate goals, objectives, and methods of obtaining community involvement and support for programs such as STOLport development has been acquired. There is a serious need for intensive study to obtain appropriate guidance. Governmental funding and political support at the national, regional, and local levels to study community related issues is vital to the effective implementation of a

STOLport system (Ref 8-9). There are some studies being conducted related to community and airport development (e.g., Southern California Association of Governments' (SCAG) Regional Airport System Study). Most of these studies have or are being conducted using the public hearing as the primary means of collecting data regarding community acceptance. However, SCAG is conducting an opinion poll which is expected to provide different data than that collected only at public hearings— but the analysis has not yet been completed. The approach being taken by SCAG is a proactive one yet it is extremely limited in scope. In-depth community studies must be initiated which consider one community at a time. These studies are both time-consuming and costly— yet they are essential if we are to solve the transportation implementation problem.

In the past, many government and industry officials have stated that a "low" public profile is required in the areas of aviation development. It is suggested the political structures of both industry and government have, for too long, kept the "low profile" in community problem interaction— thus, reinforcing the lack of credibility attributed to them by the public (reference 8-3). It has been shown in studies of social behavior (references 8-10 and 8-11) that ambiguous stimulus relationships often create tension in the subject(s); this tension is often reduced by the subject "discounting," i.e., rationalizing or denial, of the factual evidence. (Theory of Cognitive Dissonance.) Following this idea, it may be far more profitable— in a social sense— for the government and industry to become more open in their involvement with transportation project planning. Governmental agency support in the form of funding community research— with the community's full knowledge, is urgently needed.

8.1.4 Community Characteristics - Identification and classification of the characteristics of a community is an especially difficult task. The difficulty primarily lies in the choice of variables of interest. Clark (reference 8-12) suggested a set of ten fundamental variables make up the process of community decision-making. These variables, shown in Figure 8-1, include leadership, acceptance of national societal goals, demographics, socio-political characteristics, and decision-making structure. It was with these variables in mind the present study was conducted. Early, and ambitious study plans called for the development of a community "profile"

FUNDAMENTAL VARIABLES IN COMMUNITY DECISION MAKING



ADAPTED FROM CLARK (1971)

PR2-STOL-1046

FIGURE 8-1

analysis— however, it was not possible to accomplish this task in total. It was determined, however, that a wide variation exists across communities located in different locales of the country (e.g., Boston versus Chicago). This variation consisted not only of local political structural differences, but also of community "action groups." One common relationship was observed across communities— if the airport project affected more high-status persons, there was more active behavior (pro or con) in regard to the project. This finding is similar to that reported by Brown (reference 8-13) and Clark (reference 8-12).

8.1.5 Community Goals - Even though technological advancement will reduce potential objections to airports on the basis of environmental pollution, other problems may arise to impede implementation of STOLport systems in urban communities. It is not unreasonable to assume, as in many recent transportation projects, the affected community will demand multilateral considerations be made prior to STOLport implementation. All too often, political initiation of a transportation project has ended in unfinished freeways, or silent-standing structures due to a lack of, or total disregard of, community members and community goal considerations.

8.1.6 Analytical State-of-the-art - Determination of probable community acceptance represents a problem an order-of-magnitude greater in complexity than determination of system benefit. Not only is community acceptance extremely time-sensitive, but it also varies significantly between different geographical sections of the country as well as between specific metropolitan regions and local communities. While the state-of-the-art in predicting individual behavior is fairly advanced, very little research has been done on predicting social behavior of an entire region or community.

It is quite apparent that if the STOLport is to become a viable element within the National Air Transportation System, extensive research must be conducted on community response. Not only must a method be devised to define the proposed STOLport "air-shed community" characteristics, but also a method to assess community member response to STOLport implementation. Therefore, a prime objective of this research project was to develop an appropriate methodology. It is hoped this project will lay the groundwork for a method of systematic evaluation of the community acceptance probability of future development projects of all types. Such an evaluation is essential to provide an early indication of the economic and social viability of a major transportation system prior to its actual implementation.

8.2 Community Analysis Methodology

The following methodology was developed during the course of the study for evaluation of the sociological and political characteristics of a community. Substantiating reasons for the choice of community research methods are presented.

8.2.1 Research Methods - There is much confusion concerning research methodology in community related issues, e.g., floridation, highway development, airport development. Three of the more common research methods are discussed below.

1. The Public Hearing is a frequently used method of studying communities in transportation projects. The problems with the public hearing method are that all too often the community representatives are ill-informed regarding the issue; harbor preconceived assumptions; and although the public hearing is in keeping with the democratic process— it all too frequently turns into a chaotic arena of uncontrollable conflict.

2. Select Representatives Group is a method where a small group of prominent individuals assumed to be representatives of the community are involved in a decision process regarding an issue. However, this method is tantamount to excluding the public (community members). The opinions and behavioral intentions of the polity may diverge greatly from those of the "select" group.

3. Public Opinion Polling is a method quite commonly used to assess community attitudes and opinions on a particular issue. The pitfalls with this method are similar to the public hearing and the select representatives methods. It has also been shown recently that the correlation between "attitudes" and "behavior" may be extremely

spurious (Wicker, reference 8-14). The researcher may obtain highly negative attitudes, or favorable ones— but is unable to make statements as to the probable "actions" an individual would take regarding the issue.

The methodology developed in this research program attempted to circumvent many of the problems listed in the above three common methods of community study. The basic research philosophy utilized was that suggested by Runkel and McGrath (reference 8-15) which considers empirical research as an open system, a continous process made up of highly interdependent activities, as shown in Figure 8-2.

In determining the fundamental sets of variables in community decision-making, the suggested approach of Clark (reference 8-12) was followed. Basically, the approach defines the characteristics of the community related to ten variables, (see Figure 8-1).

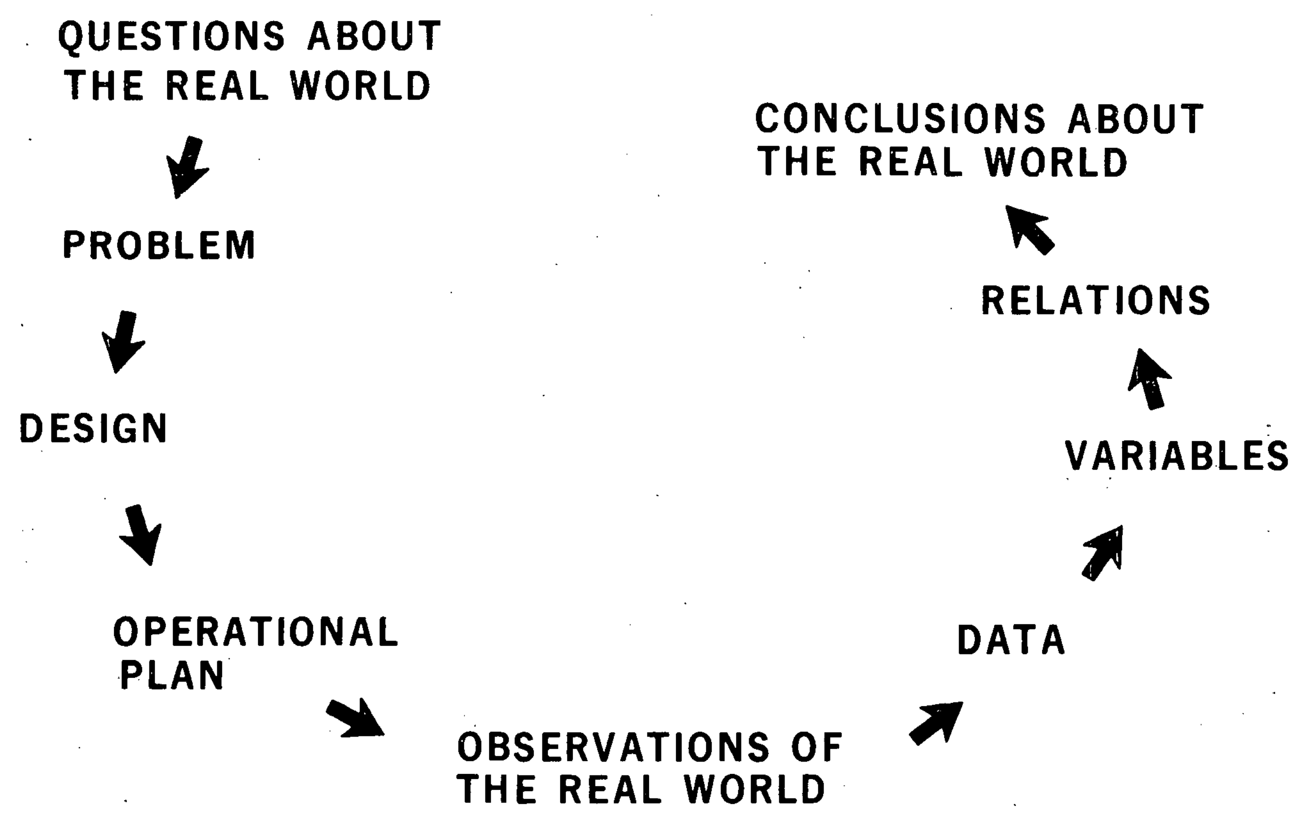
For the question of community member response to proposed STOLport implementation, an assessment technique based on "behavioral intentions" was devised. Behavioral intentions have been suggested by Azien and Fishbein (reference 8-16) as being more highly related to actual or potential behavior than "attitude" measures.

The behavioral intention assessment approach is taken to measure not what the community members' attitudes are regarding STOLports, but rather to determine what "action" (behavior) would the members take regarding STOLport implementation.

The operational plan was to first collect data from the community agencies, planning commissions— etc., and community leaders as to the ten fundamental sets of variables previously described in Figure 8-1. These data were categorized and quantified in summary statements for each community.

The integration of these distinctly different, but related data allows the development of an overall "community profile" as related to STOLport implementation. This statistical profile approach allows more confidence in predicatability regarding any one selected community in which a STOLport possibly would be implemented. Study results are presented later in this volume after examination of the key environmental issues affecting STOLport development.

THE CYCLE OF EMPIRICAL RESEARCH



SOURCE: RUNKEL AND McGRATH (1972)

PR2-STOL-1049

FIGURE 8-2

8.3 Airport/Community Issues

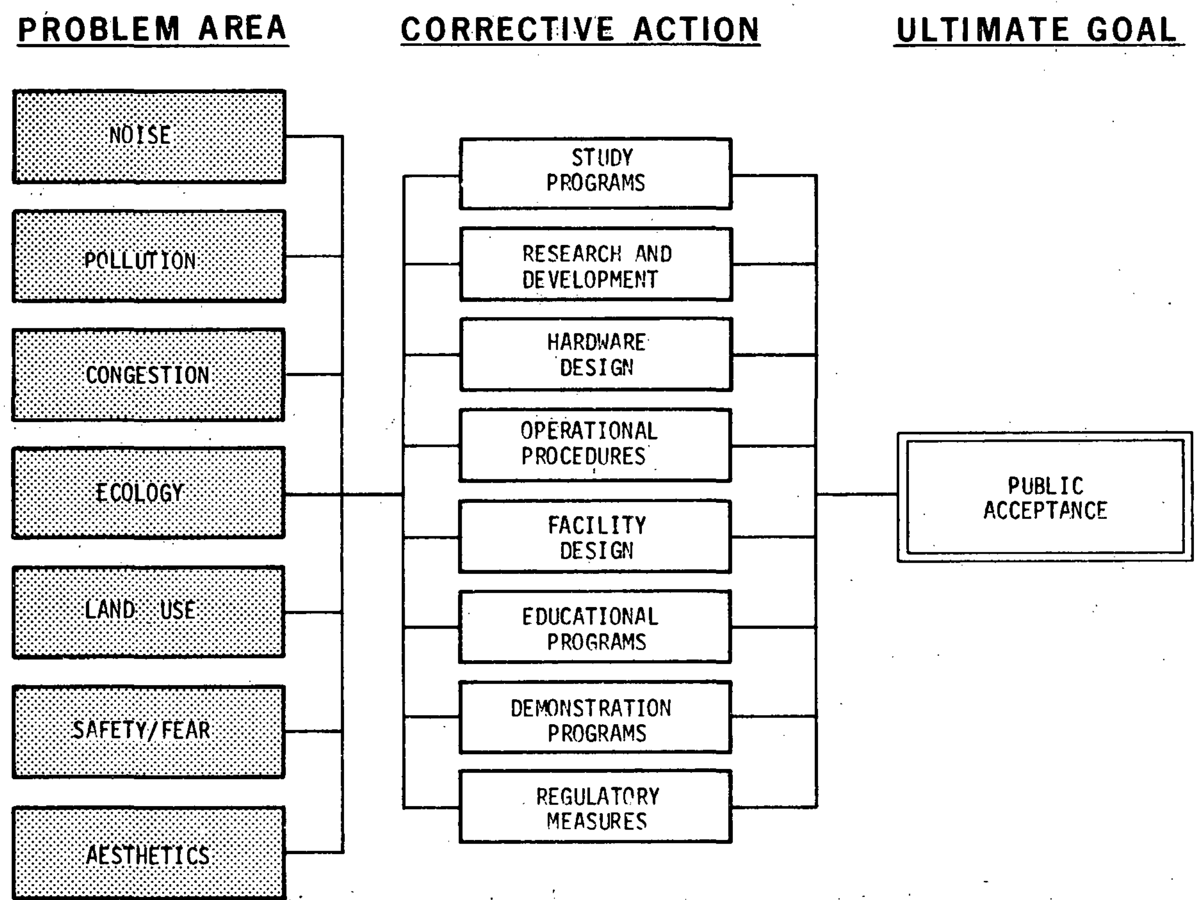
The factors involved in achieving public (or community) acceptance are shown in Figure 8-3, in the order of current relative overall importance. It must be recognized, however, that the relative importance may differ community to community depending on the sensitivity of the issue at the moment or upon the specific goals of the individual community. Each of the factors is discussed with respect to its effect on short-haul air transportation.

Community acceptance is difficult to define and even more difficult to quantify except on a very subjective basis. Much progress has been made in the past few years in attempting to identify and measure specific problem areas such as aircraft noise. Yet, in spite of this work by many agencies, organizations and individuals, we have not to date established a universally accepted method of measurement--nor do we know how quiet an aircraft must be to achieve "community acceptance." Hopefully, the results of this study will provide some incremental guidelines and design criteria. Their validation, however, must await actual system operation.

8.3.1 Aircraft Noise - The many aviation industry tasks involved in achieving ultimate community acceptance of aircraft and airport noise are diagrammed in Figure 8-4. The shaded blocks identify those associated with STOL aircraft and operations. Acoustical considerations affecting aircraft design have been discussed in the Aircraft Report, Volume II. The noise considerations affecting airport design, aircraft operations, and community acceptance are discussed below.

8.3.1.1 Noise Characteristics - The acoustic energy generated by the aircraft and its propulsion system is a primary consideration in evaluating both environmental impact and community acceptance of a STOL system. Adverse affects include possible hearing damage, disruption of normal activity, and general annoyance. Any characteristic of the noise differing from that to which the community has been accustomed will trigger complaints. Aircraft engine noise whether on the ground or in the air is basically generated by two sounds: one is the low frequency "roar" caused by the mixing of

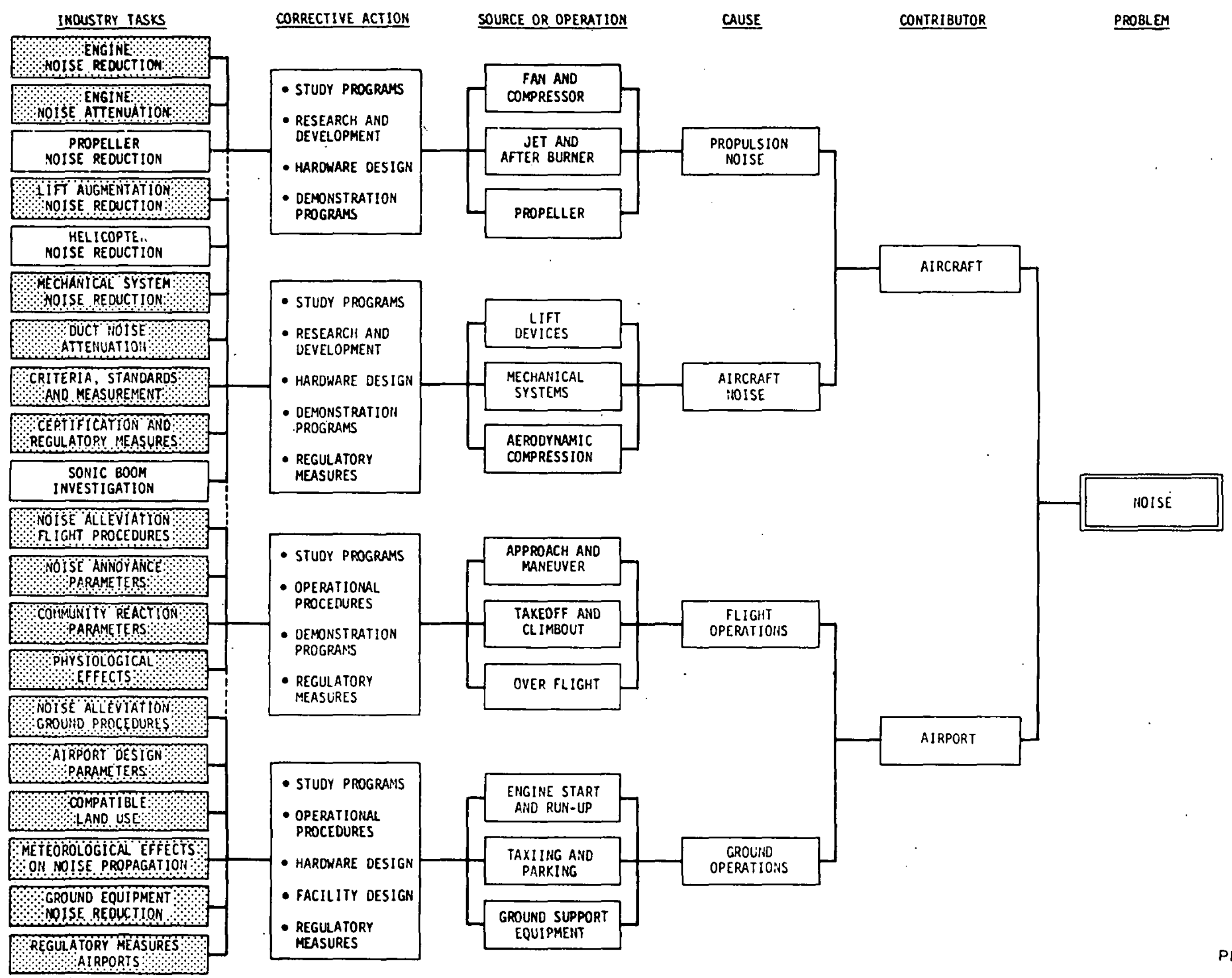
ENVIRONMENTAL PROBLEM AREAS



PR3-STOL-1579 A

FIGURE 8-3

ENVIRONMENTAL CONSIDERATIONS-NOISE



PR3-STOL-1573

FIGURE 8-4

high-velocity exhaust gases with the relatively stable air around the aircraft, and the other is the high-pitched whine generated by the fan and compressor section of fan engines.

8.3.1.2 Noise Sources - Noise from turbofan engines consist of turbomachinery noise, combustion noise, and jet exhaust noise. Turbomachinery noise is produced by the fluctuating pressure fields of the various rotor and stator assemblies; it contains broadband and discrete frequency spectral components that are radiated from the inlet, fan discharge, and turbine discharge ducts. Combustion noise consists of low-frequency broadband components radiated from the turbine discharge duct. Jet exhaust noise is generated outside the engine within the jet efflux and contains acoustical energy over a wide range of frequencies. Estimates of the maximum perceived noise levels for these sources were based on data supplied by the engine manufacturers, and supplemented by Douglas-developed techniques for predicting aircraft flyover noise levels.

Noise radiated from the inlet is a maximum in the forward quadrant and decreases rapidly in the aft quadrant after the airplane has passed the closest point of approach to the observer. The maximum values of the noise from the fan discharge, turbine discharge, and jet noise sources occur in the aft quadrant of acoustic angles between 100 degrees and 130 degrees from the inlet.

Another possible source of noise in STOL aircraft is that generated by lift augmentation systems. Lift noise can vary significantly depending on the type of lift system, its air flow characteristics, direction of air deflection, and aircraft shielding effects. Lift noise is discussed in depth in Volume II - AIRCRAFT.

8.3.1.3 Evaluation Criteria - Aircraft noise normally is evaluated by two sets of criteria, Single Event and Composite. Single event noise usually is measured by Effective Perceived Noise Level in units of EPNdB. This criterion considers both the spectral and temporal aspects of a particular flyover noise signature. Studies have indicated that an EPNL of about 90 EPNdB may be considered the threshold of annoyance in an average residential community and accordingly is the upper recommended limit for long term residential exposure. Composite noise ratings, which take into account the frequency of aircraft operations, the time of day of occurrence, and representative mix of different types of aircraft, provide the best method of determining the total aircraft noise impact of an airport for land use planning. A number of rating methods have been developed, the most common of which are CNR, CNEL, and NEF. All involve relatively complex calculations and are highly dependent on specific aircraft mix and operational assumptions. The NEF methodology developed by the U.S. Department of Transportation is most universally used. The NEF has been adopted by the U.S. Department of Housing and Urban Development (HUD) for compatible land use planning.

8.3.1.4 Noise Evaluation Methodology - The EPNL single event contours provide the best method of comparing specific aircraft types. EPNL contours for 95, 90, 85, 80 and 75 EPNdB were developed for each of the selected STOL configurations. Aircraft noise comparisons of the various STOL aircraft configurations studied are discussed in another volume of the study report (VOLUME II - AIRCRAFT) and are reproduced in that report.
All community noise evaluations have been made using the "Systems Analysis Baseline Aircraft" E.150.3000.

The methodology used for evaluating community noise acceptance under various land use conditions generally follows that recommended by HUD in the recently published "Aircraft Noise Impact Planning Guidelines for Local Agencies," (reference 8-17). The methodology has been modified to the extent that the area within the airport boundary, as well as that over water, is excluded from the impact area. Land use, degree of urbanization (population density) and the number of schools, churches, etc., within the 90 EPNdB contour area were the key community acceptance considerations applied in the subject evaluation.

Superimposing the 90 and 95 EPNdB contours over a specific airport vicinity map permits determination of the approximate numbers of people and human activities that would be adversely affected at each prospective site location. Standard U.S.G.S. 7.5 minute topographic maps were used for this purpose since they not only show a reasonable amount of community detail (residential areas, churches, schools, etc.) but also are to a convenient scale (1:24,000) and facilitate direct comparison of different airports and prospective site locations. The contours were applied using predominant runway use direction and do not reflect possible bi-directional operations.

For community impact evaluation the 90 EPNl single event contours were converted into NEF values using the chart of Figure 8-5. The chart relates the total number of flights per day to NEF values (assuming a ratio of 90% daytime and 10% nighttime movements). In order to isolate the specific impact of STOL operations at an airport, operations of other aircraft types were excluded. This simplification is considered valid for the purpose of the study since it eliminates all variables due to aircraft mix forecast assumptions. The number of flights were based on forecast 1985 operational levels of STOL aircraft at the airports examined. NEF values would be reduced approximately by 4 NEF if there are no nighttime operations.

8.3.1.5 Noise Abatement Flight Procedures - Special aircraft operating techniques hold considerable promise in further reducing noise footprint area -- also in tailoring flight procedures to reduce noise impact in special airport situations. Further research should be conducted to isolate the individual effect of gear and flap retraction schedules, power changes, etc. on footprint area.

A curvilinear flight track during approach does not appear necessary due to the relatively small impact area of the inherently steep approach gradient of the STOL aircraft examined. A curvilinear flight track takeoff, however, was desirable to avoid noise sensitive areas at several airports examined in the study.

A standard flight maneuver of initiating a 5000 ft. radius (1524 m.) 15 degree climbing turn at an altitude of 500 ft. (152 m) after takeoff was found adequate in all cases examined. The footprint area increase due to the turn maneuver was determined to be less than 3% and is considered negligible.

8.3.1.6 Airport Noise Containment - Superimposing the E.150.3000 95 and 90 EPNdB noise footprints over a typical CTOL runway envelope for a 4000 ft. (1219 m.) or a 5000 ft. (1524 m.) runway, Figure 8-6, shows the 95 EPNdB contour to be completely contained within the FAA runway and clear zone

NEF AS A FUNCTION OF DAILY AIRCRAFT OPERATIONS

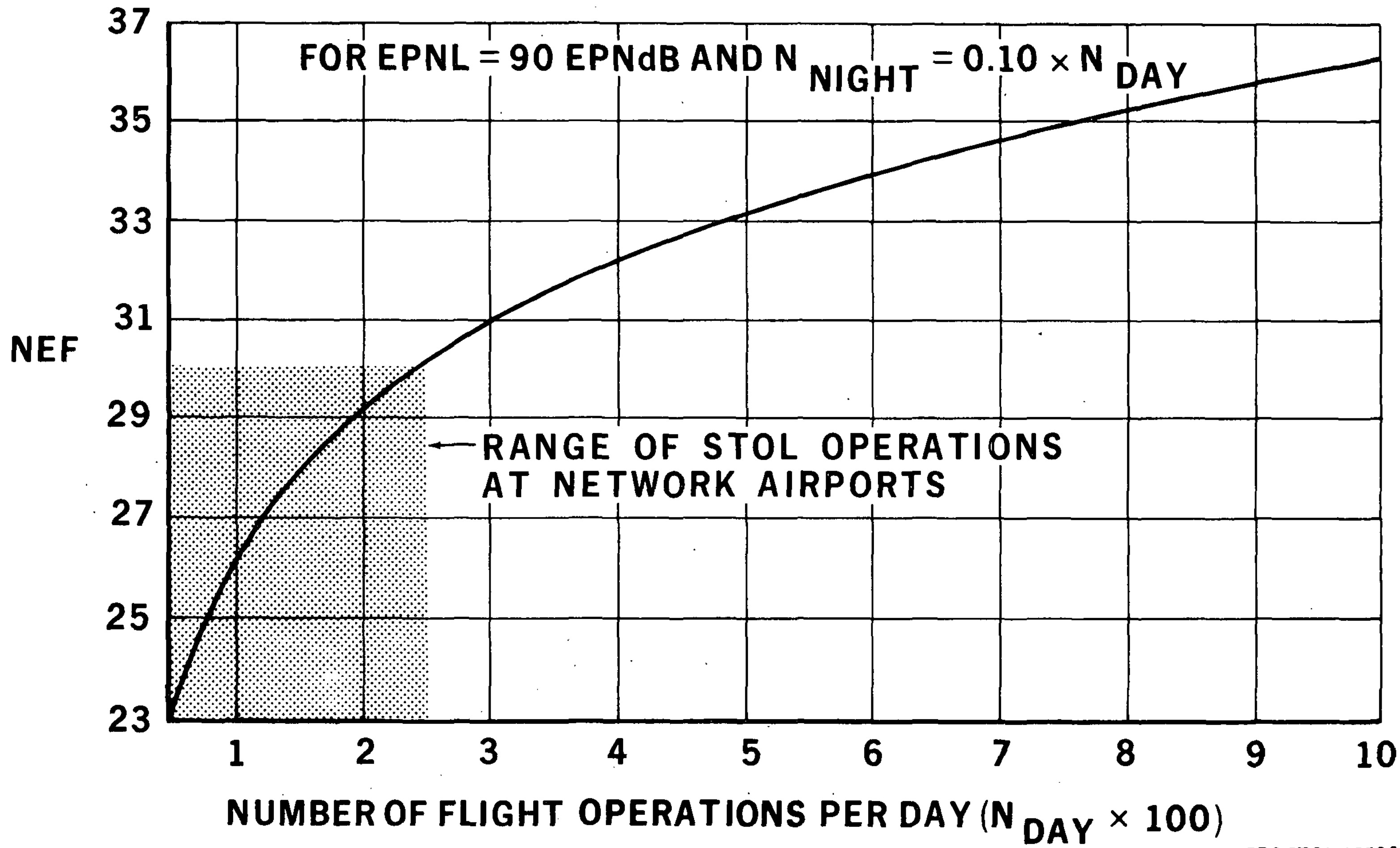
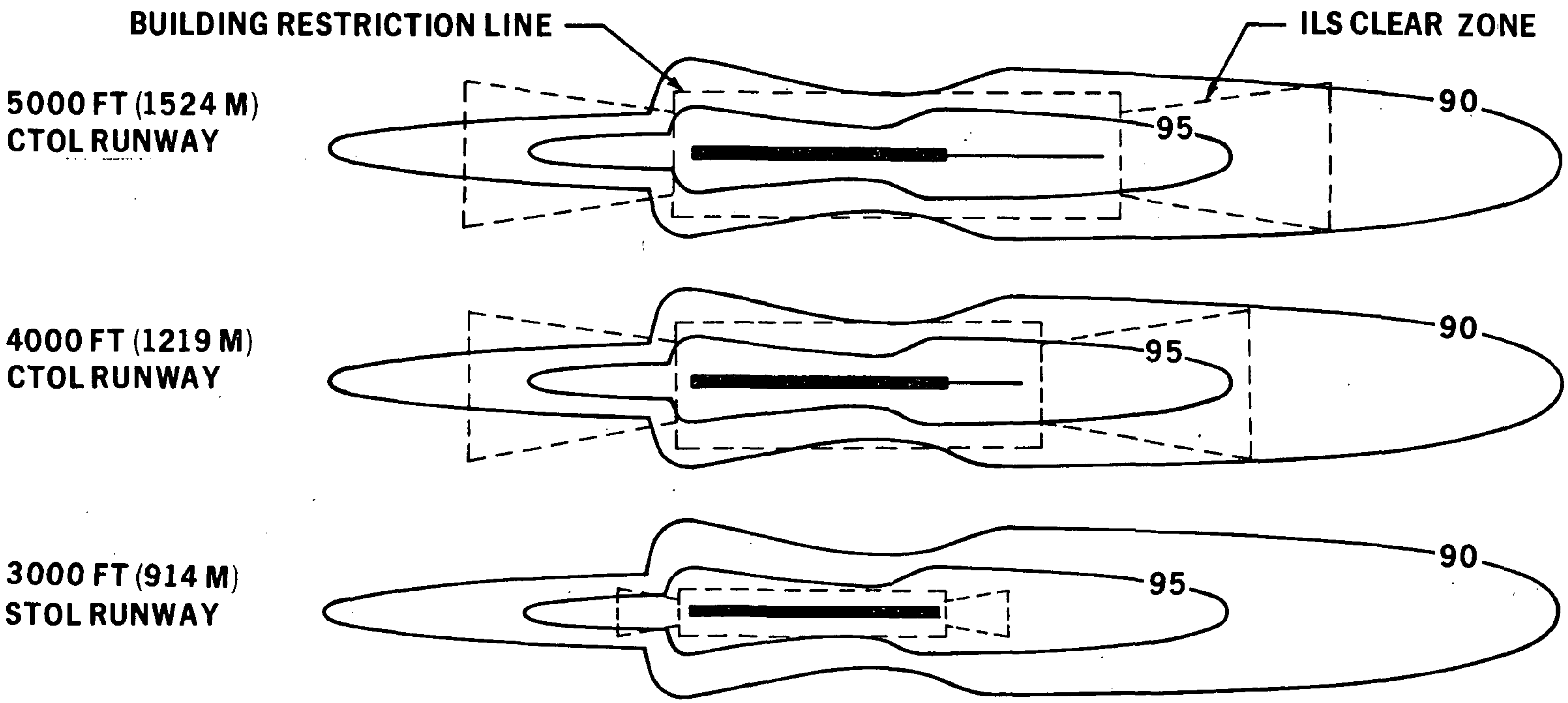


Figure 8-5

NOISE FOOTPRINT CONTAINMENT

FAA STD. RUNWAY ENVELOPE

E·150·3000



AIRPORT TYPE	RUNWAY AND CLEAR ZONE AREA	P15 EPNdB FOOTPRINT AREA	95 EPNdB CONTAINMENT	90 EPNdB FOOTPRINT AREA	90 EPNdB CONTAINMENT	
CTOL 5000 FT (1524m)	344 (139)	134 (54)	100%	474 (192)	73%	ACRES (HECTARES)
CTOL 4000 FT (1219m)	309 (125)	134 (54)	100%	474 (192)	65%	ACRES (HECTARES)
STOL 3000 FT (914m)	58 (23)	134 (54)	44%	474 (192)	12%	ACRES (HECTARES)

PR3-STOL-1564 A

FIGURE 8-6

envelope as defined by Table 8-1. The major portion of the 90 EPNdB footprint also is airport contained. As shown, the noise impact on the community outside the airport boundary is primarily in the takeoff flight path and indicates that future STOL noise reduction effort should concentrate primarily on reducing takeoff noise.* Improving the aircraft climbout characteristics is believed to be the most feasible approach. The 90 EPNdB contours shown are considered conservative since the contours were generated on the basis of maximum takeoff gross weight. Under normal average operating conditions with a reduced fuel load for a 200 n.mi. (370 km) mission and a 60% passenger load factor, the footprint area would be decreased by approximately 13%. Figure 8-7 shows the variation in 90 EPNdB footprint area as a function of climb and approach flight path gradient for the baseline E.150.3000 airplane.

A similar comparison of the noise contours on a typical STOLport runway envelope with a 3000 ft. (914.4 m.) runway length (see Figure 8-6) shows that both the 95 and 90 exceed the STOLport runway and clear zone envelope by a significant amount. The 95 EPNdB footprint is approximately 44% contained within the envelope and the 90 EPNdB footprint is only 12% contained. Accordingly, a noise buffer zone around the periphery of a STOLport designed to AC 150/5300-8 dimensional criteria is considered essential.

A summary of the airport areas of all airports in the system network, Figure 8-8, shows that the areas of over 85% of the network airports exceed 500 acres (202 hectares), and would probably contain the major portion of the 474 acre (192 hectares) E.150.3000 90 EPNdB noise footprint.

Review of the airport network composition data (Figure 8.8 App. 15.1) shows that the average area of the 72 network air carrier CTOL airports is 2032 acres (1659 hectares), and the average air carrier CTOL runway length is 5442 feet (1659 m.). The average area of the 20 general aviation airports in the network is only 596 acres (241 hectares) and the average G.A. runway length is 4244 ft. (1294 m.). This would indicate that the external noise impact area of an air carrier airport would be minimal -- but that the noise impact area at a general aviation airport may be a problem depending on the length/width ratio of the airport boundary.

*An exception would be STOL aircraft requiring a high thrust level for powered lift during approach.

TABLE 8-1

PRECISION RUNWAY DIMENSIONS - GENERAL TRANSPORT AIRCRAFT

	STOL(1) FT. (METERS)			CTOL(2)(3) FT. (METERS)	
Runway Length	1500'(457.2)	2000'(689.6)	3000'(914.4)	4000'(1219.2)	5000'(1524.0)
Runway Width	100'(30.5)	100'(30.5)	100'(30.5)	150'(45.7)	150'(45.7)
Centerline to Property Line	--	--	--	500'(152.4)	750'(228.6)
Centerline to Building Restriction Line	300'(91.4)	300'(91.4)	300'(91.4)	750'(228.6)	750'(228.6)
Runway End to Clear Zone	100'(30.5)	100'(30.5)	100'(30.5)	200'(61.0)	200'(61.0)
Clear Zone Length	750'(228.6)	750'(228.6)	750'(228.6)	2500'(762.0)	2500'(762.0)
Clear Zone - Inner Width	300'(91.4)	300'(91.4)	300'(91.4)	1000'(304.8)	1000'(304.8)
Clear Zone - Outer Width	532'(162.2)	532'(162.2)	532'(162.2)	1750'(533.4)	1750'(533.4)
Safety Area Width	200'(61.0)	200'(61.0)	200'(61.0)	--	--
Safety Area Width (Elevated)	300'(91.4)	300'(91.4)	300'(91.4)	--	--
Safety Area Length	1700'(518.2)	2200'(670.6)	3200'(975.4)	--	--

(1) FAA AC150/5300-8

(2) FAA AC150/5300-6

(3) FAA Part 77

NOISE FOOTPRINT AREA vs FLIGHT PATH ANGLE

BASELINE AIRCRAFT E-150-3000

90 EPNdB NOISE CONTOUR - CONSTANT THRUST

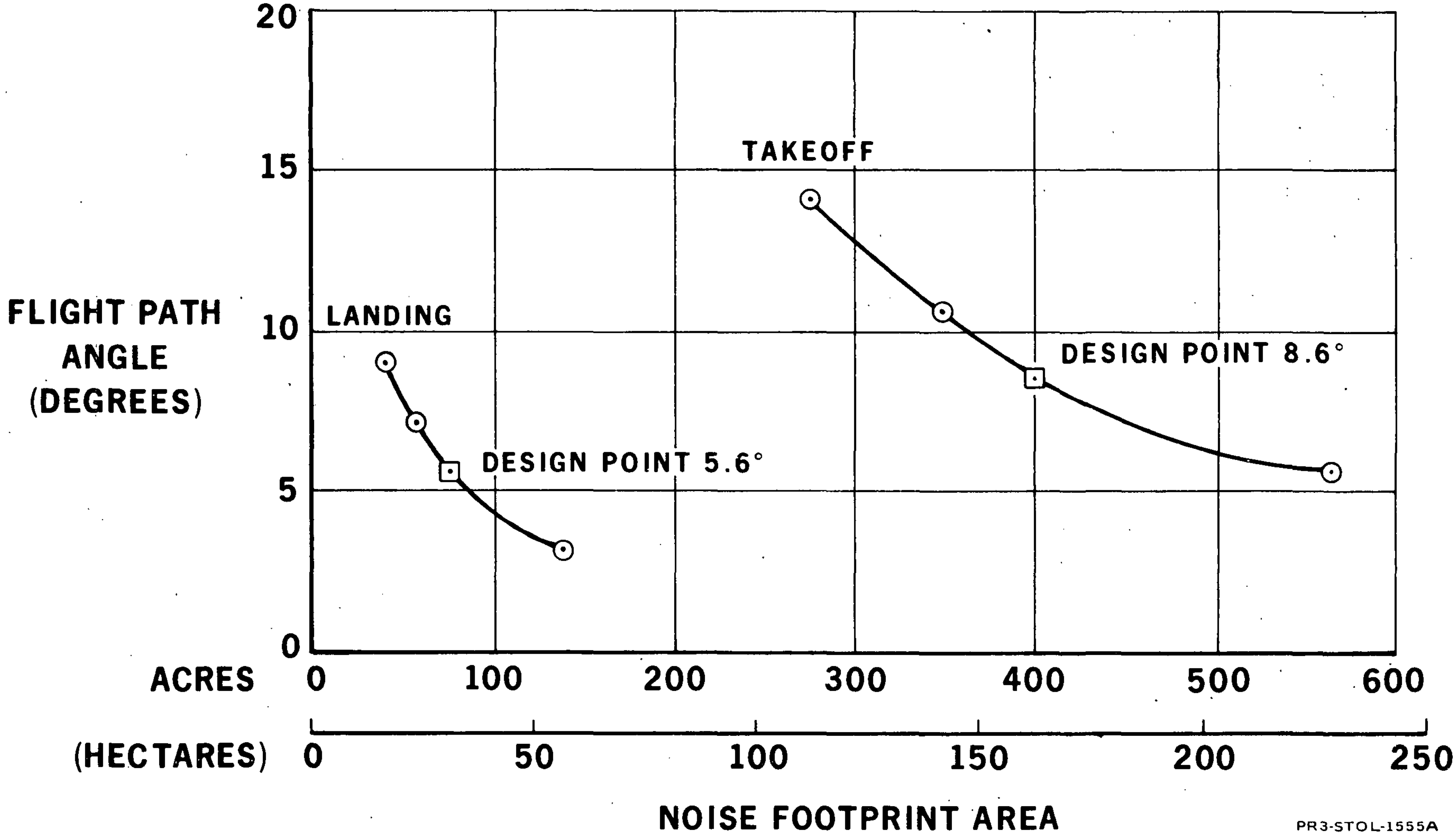


FIGURE 8-7

SUMMARY: STOLPORT AREAS

89 AIRPORTS*

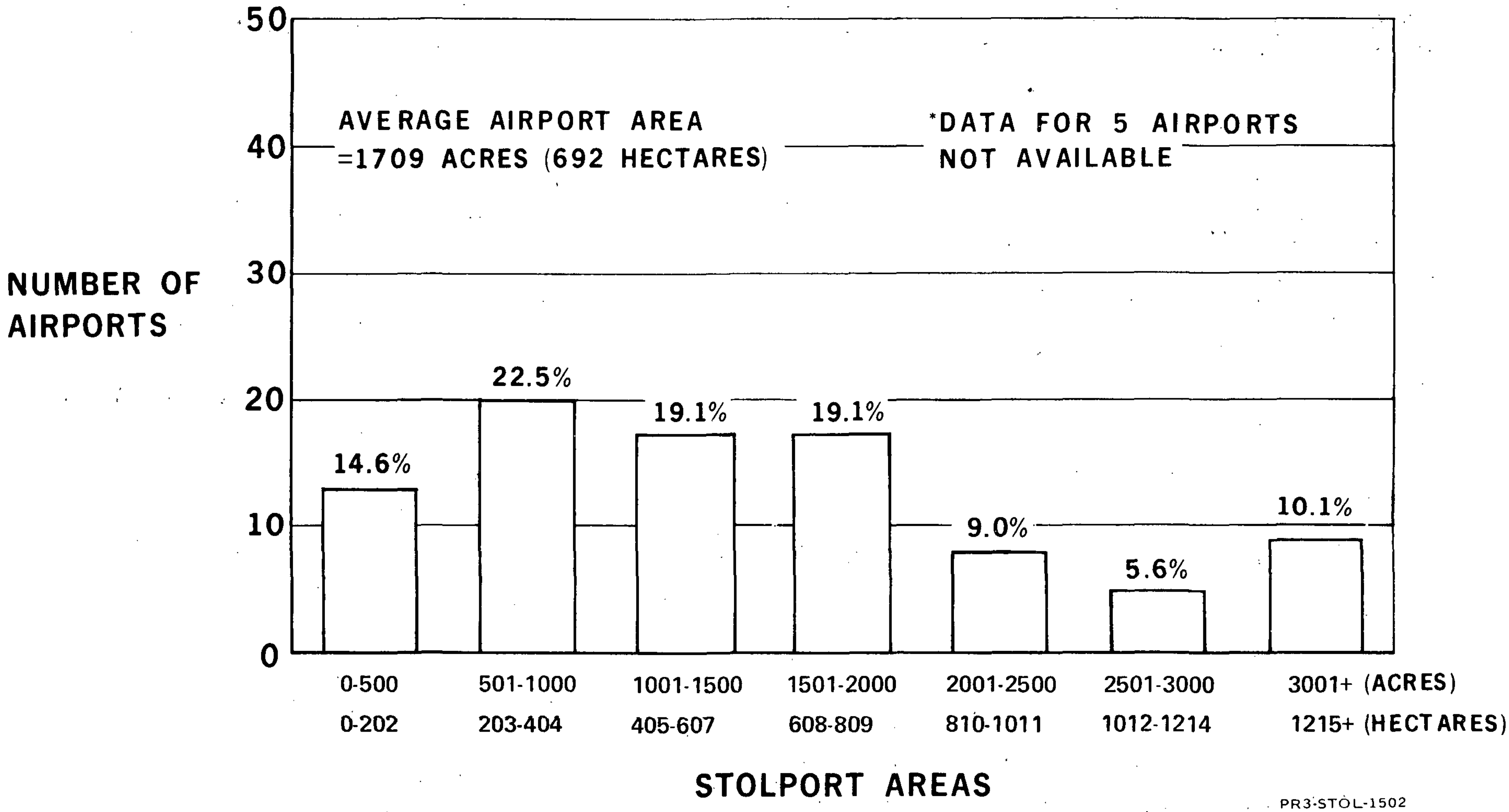


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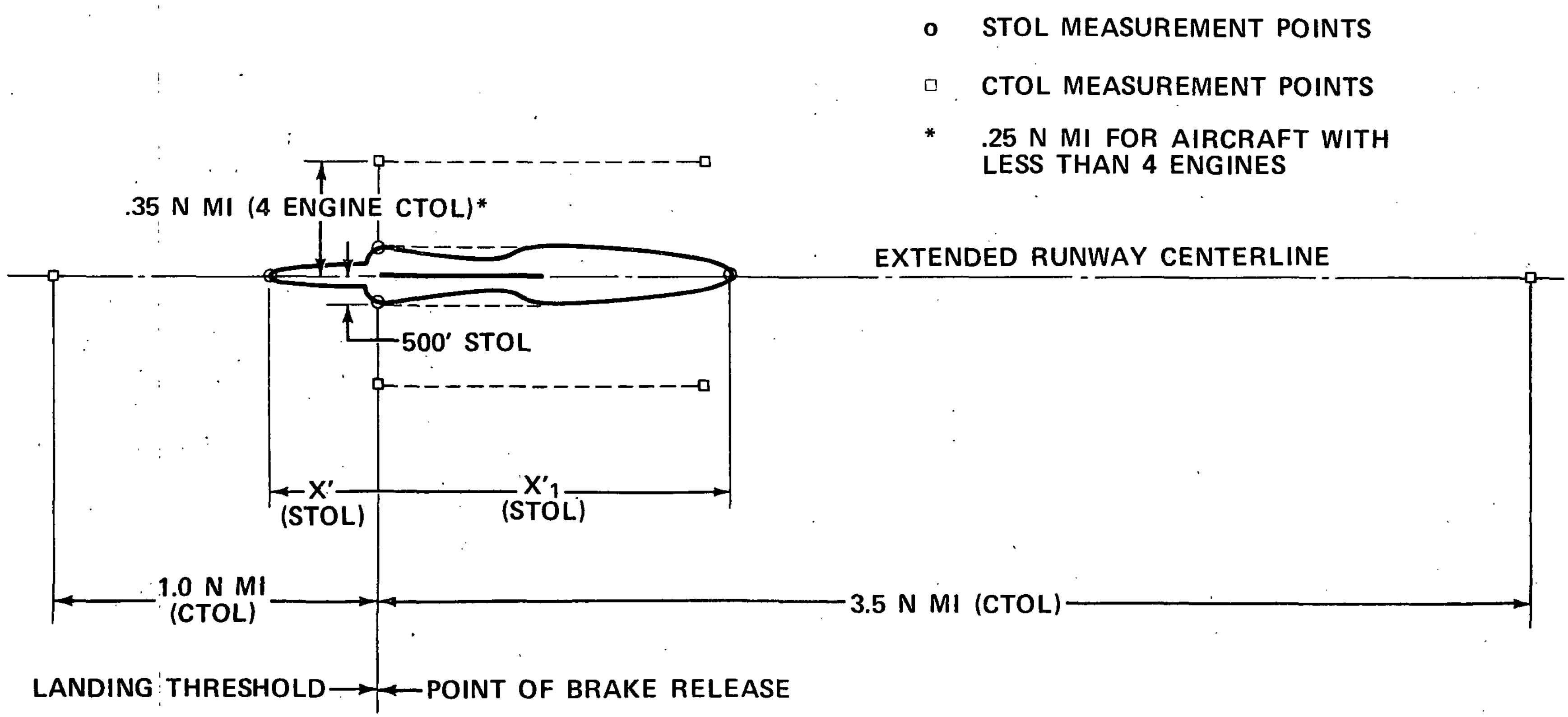
FIGURE 8-8

These findings were subsequently verified in the noise impact determination conducted for selected representative case study airports (see Figure 8-22) which revealed that on an average the 95 EPNdB footprint of the system analysis E.150. 3000 aircraft was approximately 95% contained within the airport boundary, excluding clear zone areas. The 90 EPNdB footprint was 65% contained. This would indicate that the NASA specified noise criterion of 95 EPNdB at 500 ft. (152 m) sideline is a valid criterion with respect to minimizing community noise impact.

8.3.1.7 Noise Criteria for Airport Design - A discussion of the aircraft design noise criteria and resultant single event footprint comparison is contained in the Aircraft Report, Volume II. The variation in noise footprint area of the various aircraft decisions analyzed resulting from the single point (95 EPNdB at 500 ft. (152 m) sideline design criterion also is discussed in that report.

For purposes of airport design and land use regulation, the single point sideline criterion is considered inadequate. A three point measurement criteria for STOL aircraft is recommended to provide a definitive planning tool for airport design and compatible land use regulations. Constraining the noise footprint by establishing a control point on the extended runway centerline for both approach and takeoff conditions similar to the measurement method specified in FAR Part 36, is proposed. It is suggested that distances applicable to STOL aircraft, as diagrammed in Figure 8-9, be developed and implemented through a revision to the FAA FAR Part 36 aircraft certification specifications. Noise levels of the E.150.3000 baseline aircraft at current FAR Part 36 measuring points are shown in Figure 8-10. The sensitivity of the 95 EPNdB sideline noise criterion with respect to noise footprint area is emphasized in Figure 8-11, which compares the noise footprint area of the E.150.3000 system analysis airplane to that of the E.150.3000M aircraft (reduced acoustical treatment). As explained in Volume II - AIRCRAFT, the acoustical treatment of the E.150.3000 study aircraft was reduced when it was found that excessive treatment was required to lower the engine noise to the approximate level of the EBF flap interaction noise. Relaxing the sideline criterion by only one percent resulted in a footprint area increase of 20% as shown in the above noted figure.

PROPOSED STOL NOISE CERTIFICATION MEASUREMENT POINTS - FAR PART 36



PR3-STOL-1560

FIGURE 8-9

STOL NOISE AT FAR PART 36 MEASUREMENT POINTS

E-150-3000 BASELINE AIRCRAFT

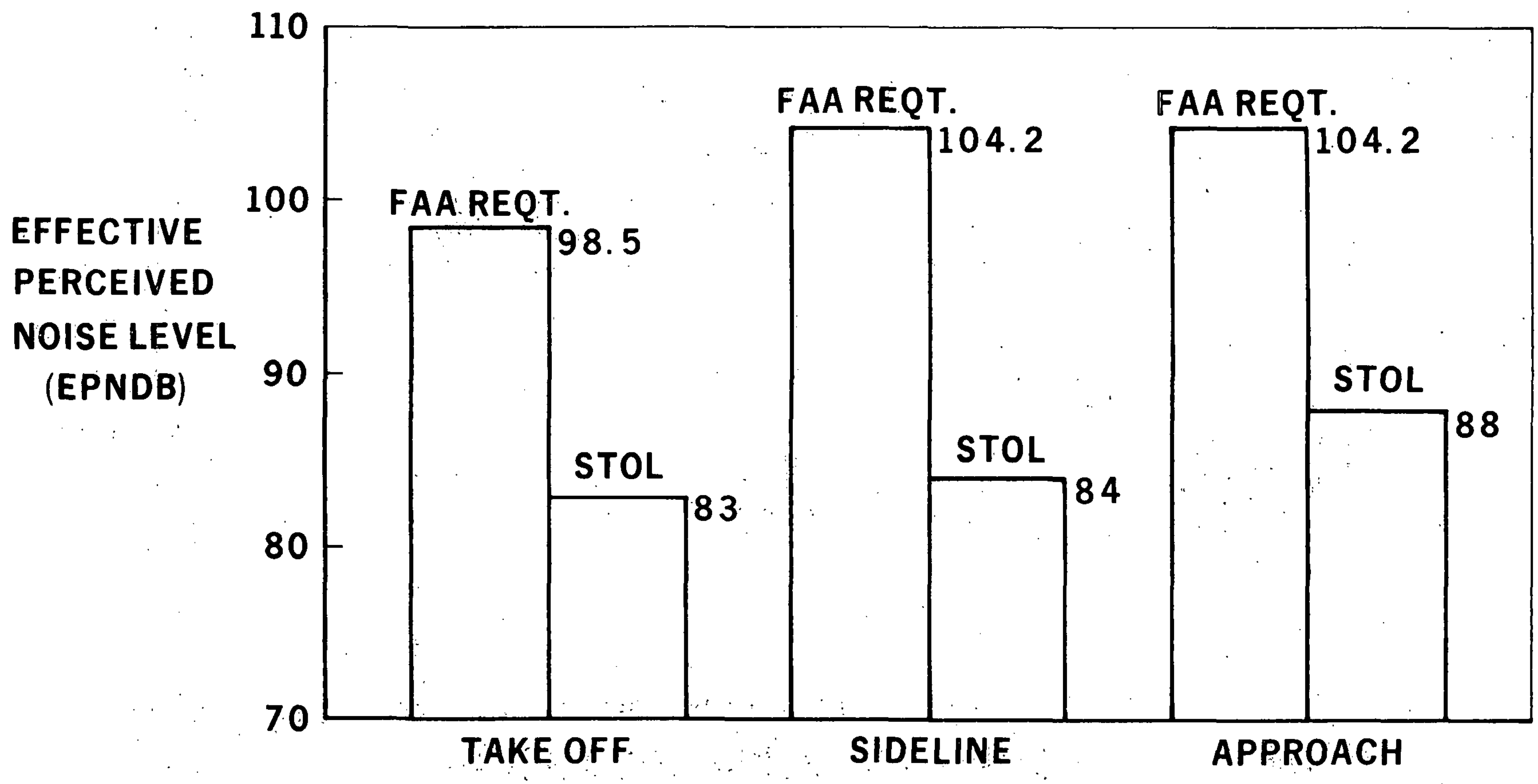


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FIGURE 8-10

NOISE FOOTPRINT COMPARISON

E · 150 · 3000 vs E · 150 · 3000 M

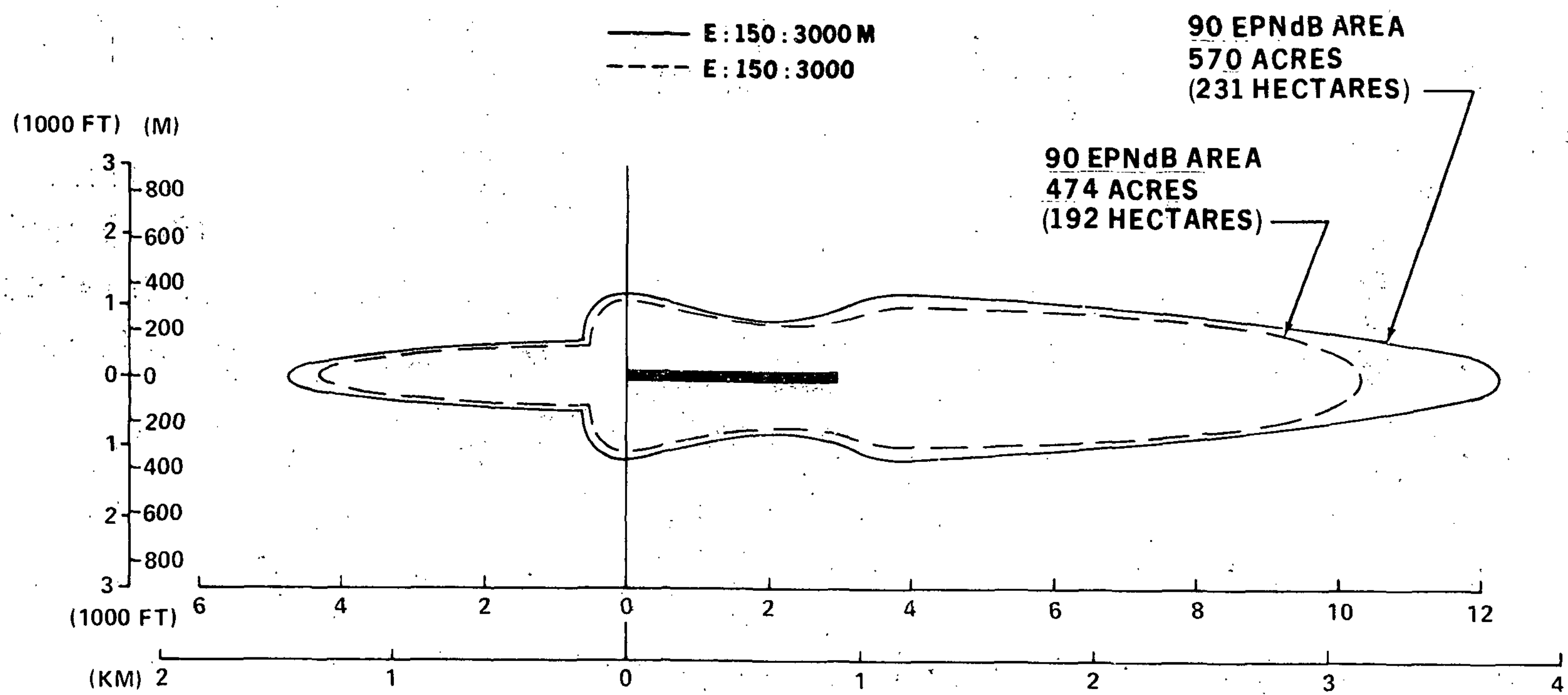


Figure 8-11

90 EPNdB FOOTPRINT COMPARISON

EXISTING AND FUTURE SHORT-HAUL AIRCRAFT

EXISTING CTOL - 28,700 ACRES (11, 615 HECTARES)
1980 ADVANCED CTOL - 928 ACRES (376 HECTARES) (3.2% OF EXISTING CTOL)
1980 STOL (E-150 - 3000) - 474 ACRES (192 HECTARES) (1.6% OF EXISTING CTOL)

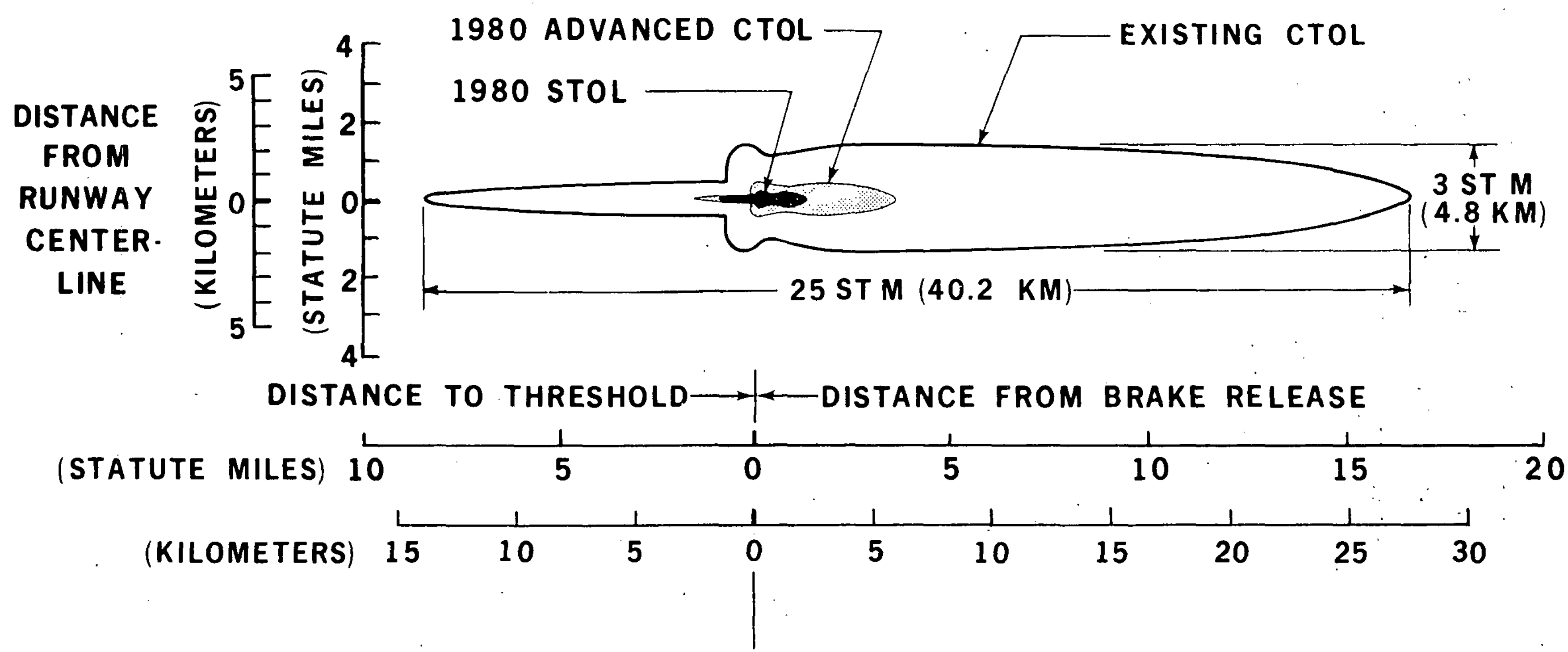


FIGURE 8-12

Based on community acceptance considerations relaxing the sideline criterion by itself would not present a problem since relatively few airports are sideline noise critical. However, unless the overall noise footprint area can be reduced through other aircraft design or performance changes; or by flight operating techniques as previously discussed, relaxation of the 95 EPNdB at 500 ft. (152.4 m.) sideline criterion is undesirable with respect to community impact considerations.

8.3.1.8 Technological Progress - A graphic comparison of the single event noise footprint of existing and future short-haul aircraft is presented in Figure 8-12. The 90 EPNdB single event noise signature of the Systems Analysis E.150.3000 aircraft is compared with an Advanced Technology CTOL aircraft (designed to FAR Part 36 minus 10 EPNdB), and a representative existing CTOL short-haul aircraft of the size range. The degree of noise reduction attained by the baseline STOL aircraft is emphasized by the fact that the STOL footprint area is less than 2% of the current model aircraft and is approximately one-half that of a representative 1980 CTOL design.

8.3.1.9 Conclusions - Aircraft/Airport Noise:

- o The NASA specified aircraft acoustical design criterion of 95 EPNdB at 500 ft. (152.4 m.) sideline distance is an adequate lower aircraft design limit with respect to community noise impact.

- o The 95 EPNdB noise footprint of all systems aircraft studied is completely contained within the FAA precision runway and clear zone envelope specified for air carrier airports. The 90 EPNdB footprint, which is considered the community complaint threshold, is largely contained within the same envelope.

- o The 95 EPNdB footprint of the systems analysis E.150.3000 baseline aircraft was over 95% contained within the boundaries of the twelve representative case study airports examined, exclusive of clear zone areas. The 90 EPNdB footprint was 65 % contained.

- o The takeoff noise lobe was determined to be the most critical from the standpoint of community impact for all aircraft types studied. Research should be conducted to further reduce takeoff noise footprint area through aircraft performance or operational techniques.

- o At several of the twelve case study airports actually surveyed, noise sensitive areas could be avoided by a slight climbing turn initiated at 500 ft. (152.4 m.) altitude after takeoff.

- o The single point sideline noise criterion does not provide the degree of footprint control required for airport design and land use regulation. A three point measurement criteria, similar to FAR Part 36, would provide more effective control of the takeoff and approach lobes.

8.3.1.10 Recommendations - Aircraft/Airport Noise:

- o A three point measurement criteria similar to that required by FAR Part 36 should also be applied to STOL, but with reduced measurement point distances.
- o The noise goal of 95 EPNdB at 500 ft. (152.4 m) sideline should be retained, however, some relaxation should be permitted provided the total footprint area is not increased over that resulting from the specified sideline requirement.
- o A suitable noise buffer zone should be established as a design requirement for STOLports with runway lengths under 4000 ft. (1219 m).
- o Additional research should be conducted to reduce takeoff noise footprint area through improved aircraft performance or operational techniques.

8.3.2 Aircraft/Airport Pollution - The many factors involved in analysis of the environmental impact of aircraft and airports are shown in Figure 8-13. Those applicable to STOL aircraft flight and ground operations are indicated by the shaded blocks. Liquid and solid waste disposal also apply to STOL operations, however, they are not discussed since the problems are identical to those conventional air carrier aircraft.

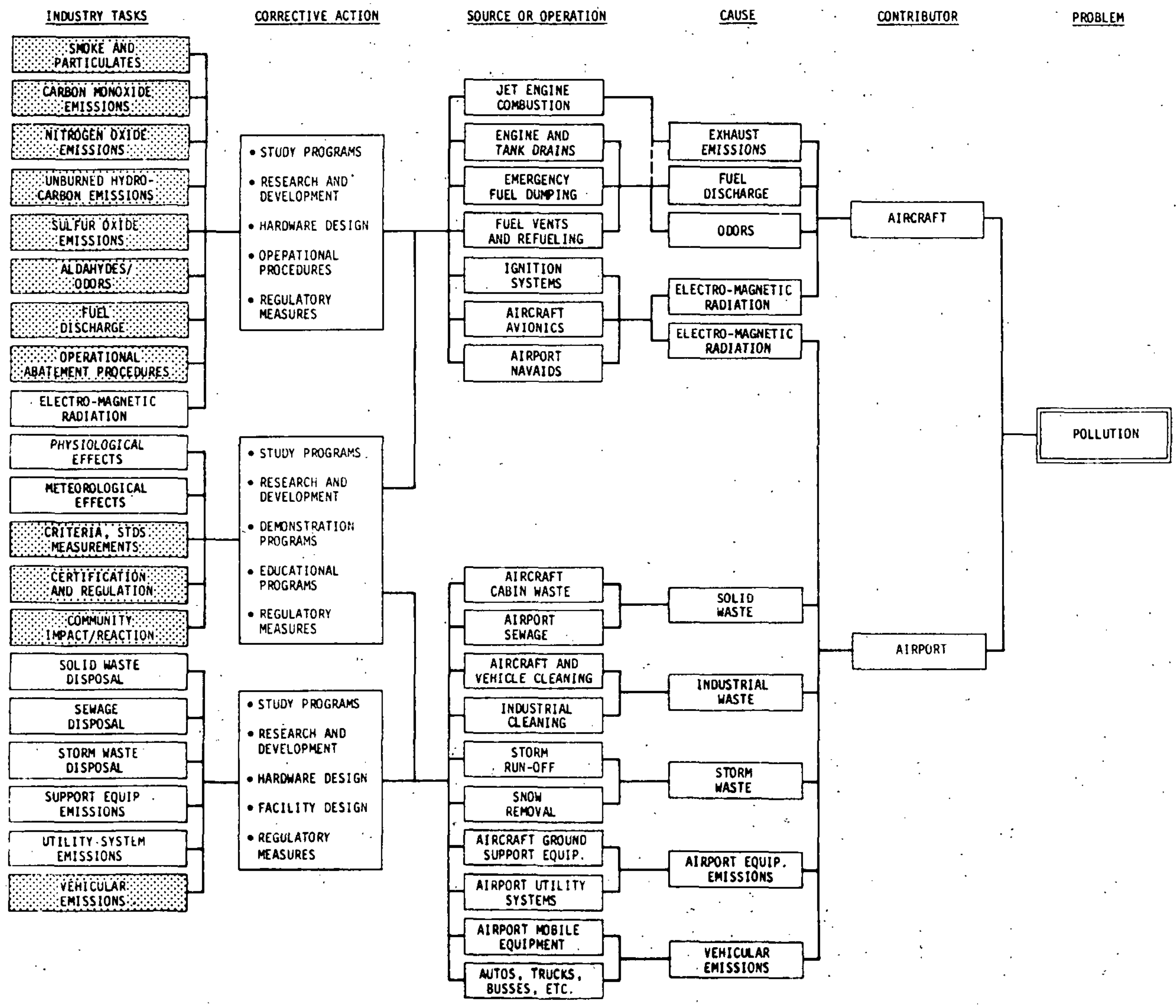
The environmental impact of aircraft pollutants can be evaluated on a comparative basis in order to formulate a judgement of its relative magnitude. Federal Air Quality Standards have been formulated by the EPA and promulgated to the states as a basis for environmental planning. These standards provide a basis for comparison or judgement concerning the relative cleanness of one environment versus another. When considering the impact of a new emitter in an existing environment, however, there is still an open question whether the available margins between existing low pollutant levels and the standards can be considered available for use by the first polluter. Quoting directly from reference 8-18.

> "The U.S. Supreme Court ruled last month that it would consider the case of Sierra Club vs. Ruckelshaus, and a stay of execution will remain in effect until the case is decided by the Court. EPA had asked the Justice Department to seek a Supreme Court appeal of the District Court decision that required EPA to promulgate regulations preventing "significant deterioration" of air quality in areas where the air is already cleaner than required by Federal standards."

The present study makes use of the Air Quality Standards as a basepoint for comparison only. No attempt is made to evaluate STOL aircraft emissions on the basis of available margins, not only because it may be inappropriate, but also because background levels at a generalized airport are difficult to define in a meaningful way.

8.3.2.1 STOL Aircraft Emissions. The systems analysis baseline aircraft configuration (E.150.3000) selected as a representative for this study has a takeoff gross weight of 163,300 pounds (74,200 kg.). It has four Allison PD-287-3 engines with 21,270 (94,700 Newtons) of takeoff thrust each. An externally blown flap is used for lift augmentation.

ENVIRONMENTAL CONSIDERATIONS-POLLUTION



PR3-STOL-1575

FIGURE 8-13

8.3.2.1.1 Sulfur Dioxide (SO_2) has not been treated by the EPA as an aircraft pollutant of enough significance to justify the imposition of emission standards, and rightly so. Figure 8-14 shows average sulfur contents of jet fuel over the eleven years 1960 to 1970 inclusive. The data are plotted from reference 8-19. The samples were tested in accordance with ASTM D1266 in the oil company laboratories. The products of several companies are represented and each point plotted represents the average of the analyses of fuel from several sources.

This shows approximately 0.06% of sulfur in the domestically used fuels (JET A and JET A1). Since SO_2 has twice the molecular weight of sulfur the emission index of SO_2 could not be more than 1.2 (.54kg) pounds of SO_2 per 1000 pounds (454 kg) of fuel burned which is very low by any standards. For this reason oxides of sulfur have not been of great concern as an aircraft engine emission.

8.3.2.1.2 Aircraft Emission Standards proposed by the EPA (reference 8-20) for the class T2 engine [6000 -29,000 (26,700 - 129,000 Newtons lb. takeoff thrust] to be met by January 1, 1979 are as follows:

Carbon monoxide (CO)	2.1 EPAU*
Unburned hydrocarbons (HC)	0.4 EPAU
Nitrogen oxides (NOX)	3.2 EPAU
Smoke	25 S.N.**
Residual fuel venting	Not permitted

$$\text{* EPAU = EPA units} = \frac{\text{lb pollutant per LTO cycle}}{\text{1000 lb (454 kg) thrust hours per LTO cycle}}$$

** S.N. = SAE Smoke Number (reference 8-21).

The LTO (landing and takeoff) cycle is based on a mixing zone between ground level and a 3000 foot (915 m) inversion boundary (reference 8-22. The cycle is defined by reference 8-20 follows:

Mode	Thrust % of Takeoff	Time in Mode Minutes	Time in Mode Hours
Taxi/idle (in & out)	idle	26	.433
Takeoff	100	.7	.01167
Climbout	85	2.2	.0367
Approach	40	4.0	.0667

SULFUR CONTENT OF JET FUEL

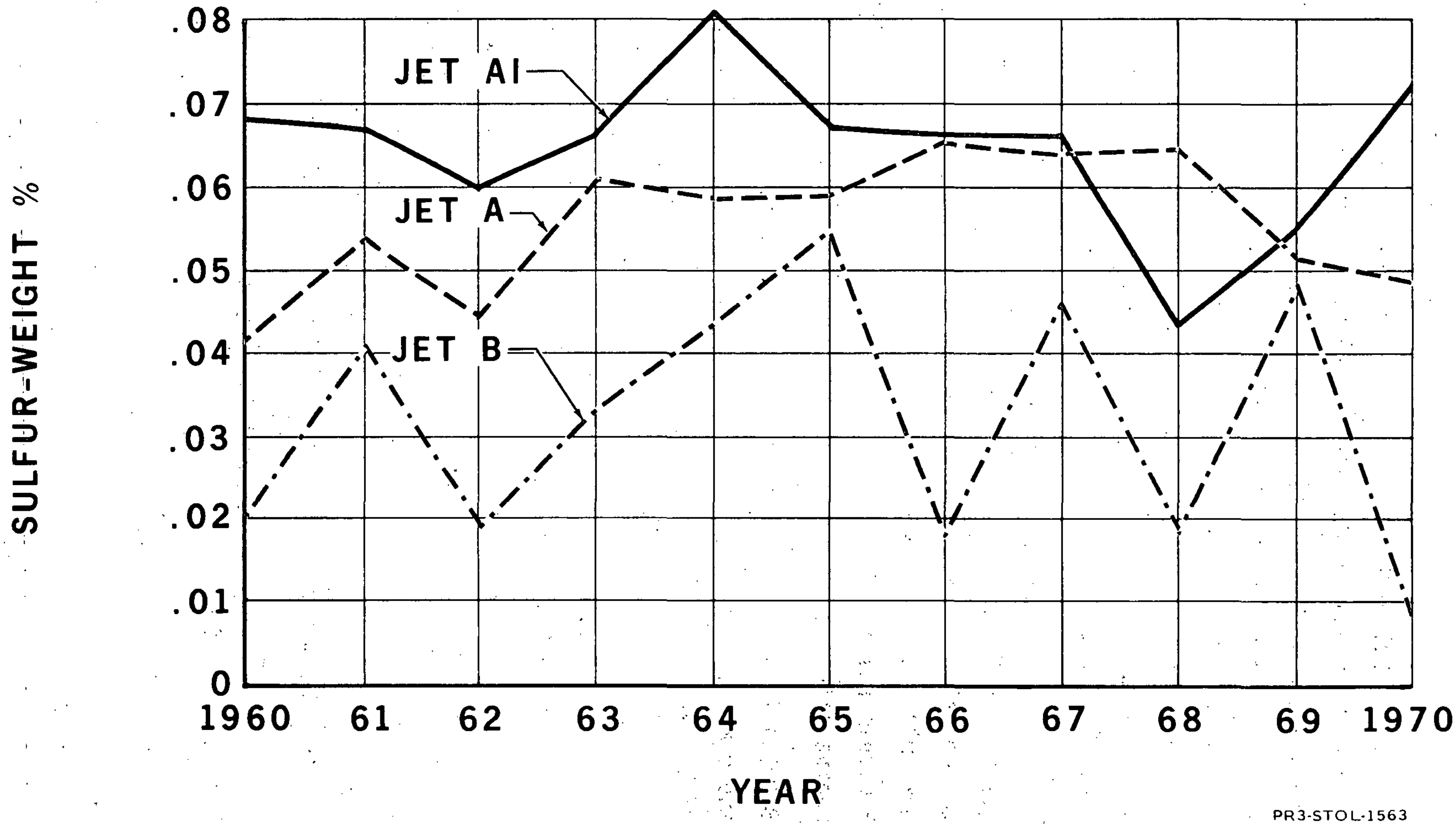


FIGURE 8-14

8.3.2.1.3 Smoke, Fuel Vapor and Odor: The EPA has proposed an SAE Smoke Number (S.N.) standard of 25 for class T2 engines for January 1, 1979. For engines of the size considered in this study, a Smoke Number of 25 is judged to be approximately at the threshold of visibility. If smoke is defined as a visual experience, then such a standard lays the problem completely to rest and there is no reason to believe that it cannot be achieved in any new engine developed for the 1980 time period. However, if the problem is re-defined on the basis of "particulates" then the threshold of visibility, though important from the standpoint of public acceptance, is an artificial standard when applied to impact on air quality. The engine company in this case indicates that a Smoke Number of 15 can be achieved. This should reduce at least the carbonaceous content of the particulates substantially below that required by the EPA. Particulate emissions from jet engines, if aerosols are included, have proven to be difficult to measure and have not been considered by the EPA to be significant enough to justify a standard. They are not therefore considered as part of this study.

The proposed EPA Emission Standards (reference 8-20) prohibit the venting of dump cans after January 1, 1974. The engine system for the STOL airplane will be designed in a manner that will preclude such venting.

The commonly used domestic jet fuels, Jet A and Jet A-1, have a vapor pressure of approximately 0.09 psia (0.06 Newtons/cm^2) at 100°F (38°C), as compared to approximately 2.7 psia (1.85 N/cm^2) for Jet B and 6.5 psia (4.48 N/cm^2 for aviation gasoline. The possible evaporation of Jet A fuel from storage and handling is so low that it is not considered a significant contributor to air pollution. If, because of the increasing cost of petroleum there is a future shift toward the use of Jet B, then the problem of evaporation should be rexamined. However the proposed EPA Emission Standards are based on the use of Jet A. The use of Jet B may produce a significant change in engine emissions as well, which would also have to be rexamined. This study is based on the use of Jet A throughout, so that no treatment of evaporation as a pollutant is in order.

The state-of-the-art of odor measurement and source evaluation has not reached the point where meaningful projections can be made for a STOL airplane. The impact of odors will not therefore be discussed as part of this study.

8.3.2.1.4 Gaseous Emissions: CO, HC, NOX: Assuming the idle thrust to be 5% of takeoff thrust, the EPAU equation can be simplified as follows:

$$E_i = \frac{1000\ E_{ci}}{.433(.05F_T) + .01167F_T + .0367(.85F_T) + .0667(.4F_T)}$$

or $$E_i = \frac{1000\ E_{ci}}{.09117\ F_T}$$

where E_i is the emission rate in EPAU's of pollutant i.

E_{ci} is the pounds of pollutant i emitted per LTO.

F_T is the engine takeoff thrust (in pounds).

Substituting E_{si} (emission standard) for E_i, and solving for E_{ci}:

$$E_{ci} = .09117\ \frac{F_T}{1000}\ E_{si}$$

For a 4-engine airplane with takeoff thrust, F_T = 21,270 lbs/(94,700 Newton) engine, the above becomes

$$E_{ci} = .09117 \times 85\ E_{si} = 7.75\ E_{si}$$

$E_{c(CO)}$ = 7.75 (2.1) = 16.27 lb/cycle (7.39 kg./cycle)

$E_{c(HC)}$ = 7.75 (0.4) = 3.10 lb/cycle (1.41 kg./cycle)

$E_{c(NOX)}$ = 7.75 (3.2) = 24.80 lb/cycle (11.27 kg./cycle)

The LTO cycle used as the basis for the emission standards was formulated as applicable to current jet transports, such as the DC-8 and DC-9 when operating in and out of large airports. However, due to the requirements for steeper climb and glide angles for the STOL aircraft, and shorter taxi distances under less congested ground conditions, the LTO cycle would not be the same as for conventional transports. For the STOL case, the LTO cycle enumerated below would be more appropriate:

Mode	Thrust % of Takeoff	Time in Mode Minutes
Taxi/idle (in & out)	5	5
Takeoff	100	0.65
Climb	80	1.3
Approach	65	3.5

It may be noted that though the times required for climb and approach under the 3000 ft. (915 m) inversion boundary have been reduced compared to the conventional transport case, and the climb thrust has been reduced by a small percentage, the approach thrust has been considerably increased. It is therefore concluded that the standard cycle value for NOX emitted, namely 24.80 lb. (11.27 kg.), is a useable approximation.

However, there is a clear reduction in taxi/idle time which should be taken into account. Assuming that 90% of the CO and HC emissions are ascribable to the taxi/idle mode, the revised quantities of allowable pollutants per cycle will be:

$$E_{c(CO)} = \frac{5}{26} \; \frac{1}{.90} \times 16.27 = 3.475 \text{ lb/cycle } (1.58 \text{ kg./cycle})$$

$$E_{c(HC)} = \frac{5}{26} \; \frac{1}{.90} \times 3.10 = 0.662 \text{ lb/cycle } (0.301 \text{ kg./cycle})$$

The resulting values are retabulated below:

$$E_{c(CO)} = 3.475 \text{ lb/cycle } (1.58 \text{ kg./cycle})$$

$$E_{c(HC)} = 0.662 \text{ lb/cycle } (0.301 \text{ kg./cycle})$$

$$E_{c(NOX)} = 24.80 \text{ lb/cycle } (11.27 \text{ kg./cycle})$$

Figure 8-15 compares the above STOL emissions with the proposed EPA standards.

8.3.2.2 Total Aircraft and STOLport Emissions. Automotive emissions will contribute some to the impact of the airport, since the operation of the airport will require the transport of passengers, and airline or airport employees.

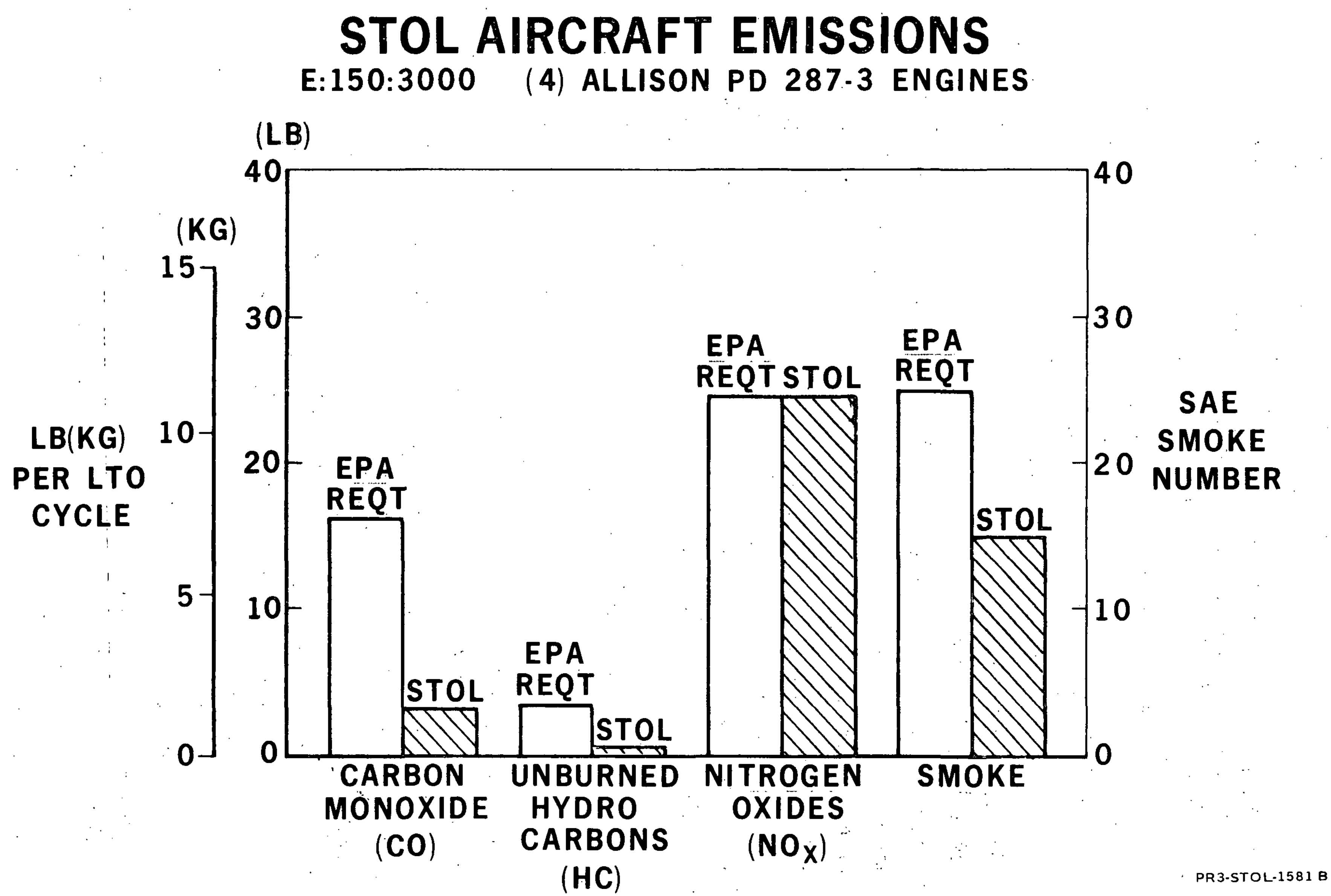

STOL AIRCRAFT EMISSIONS
E:150:3000 (4) ALLISON PD 287-3 ENGINES
LB(KG) PER LTO CYCLE
(KG)
15
10
5
0
(LB)
40
30
20
10
0
EPA REQT
STOL
CARBON MONOXIDE (CO)
UNBURNED HYDRO CARBONS (HC)
NITROGEN OXIDES (NO_X)
SMOKE
SAE SMOKE NUMBER
PR3-STOL-1581 B

FIGURE 8-15

The airplane has a capacity of 150 passengers, and can be expected to operate on the average at no more than 60% load factor, which means 90 passengers per operation, or 180 per LTO cycle. This means 180 automobile trips, assuming one passenger per car. In addition, 20 vehicle round trips per cycle are estimated for related airline and airport support activities, including ground support equipment, making a total of 200 vehicle trips per aircraft LTO cycle. Although some passengers will use public transportation such as limousines or buses, it is estimated this will be offset by an equivalent number of visitors going to the airport in private automobiles.

For purposes of estimating automotive emissions it will be assumed that one mile (1.61 km) traveled into the airport and one mile (1.61 km) return can be ascribed to the airport operation. The automotive emission standards (reference 8-23) are as tabulated below:

	Standard (grams/vehicle mile)		
Pollutant	1973-1974	1975	1976
Carbon monoxide (CO)	39.0	3.4	3.4
Hydrocarbons (HC)	3.4	0.41	0.41
Nitrogen oxides (NOX)	3.0	3.0	0.4

In order to make a fair comparison between automobiles and STOL aircraft it will be assumed that the automobile manufacturers can meet the 1976 standards. The problem then becomes one of evaluating the mix of cars in the various categories; those meeting the 1973-74 standards, those meeting the 1975-1976 standards, and those which are uncontrolled. For the sake of simplicity it will be assumed that the 1973-1974 standards are a reasonable representation of the average for 1980.

On the above basis, converting from grams to pounds, one automobile traversing two miles, in going to and from the airport will emit pollutants as follows:

$E_{(CO)}$ = .1717 lb/vehicle/2 mi. (78.0 g/vehicle/3.2 km)

$E_{(HC)}$ = .0150 lb/vehicle/2 mi. (6.8 g/vehicle/3.2 km)

$E_{(NOX)}$ = .0132 lb/vehicle/2 mi. (6.0 g/vehicle/3.2 km)

The amount of pollutants emitted per LTO cycle including both air and related ground traffic will be:

$$E_{(CO)} = 3.475 + 200\ (.1717) = 37.81 \text{ lb/cycle } (17.17 \text{ kg})$$

$$E_{(HC)} = 0.662 + 200\ (.0150) = 3.66 \text{ lb/cycle } (1.663 \text{ kg.})$$

$$E_{(NOX)} = 24.80 + 200\ (.0132) = 27.44 \text{ lb/cycle } (12.46 \text{ kg})$$

The system analysis indicates the following frequency distribution of STOL LTO cycles at the airports studied:

	Maximum	Minimum	Average
Daily	120	10	45
Peak Hour	12	1	4.5

Based on the daily maximum of 120 LTO cycles and the daily average of 45 cycles, the emissions per day will be:

	Emissions (lb/day)		
	Max.Day	Avg.Day	Max.Day 6-9AM*
$E_{(CO)}$	4540(2060 kg)	1703(773 kg)	1136(516 kg)
$E_{(HC)}$	439(199 kg)	165(75 kg)	110(50 kg)
$E_{(NOX)}$	3295(1497 kg)	1236(561 kg)	824(374 kg)

*The peak morning hours are assumed to accommodate 30 LTO cycles on the maximum day.

8.3.2.3 Impact Assessment. A number of investigators have attempted to model analytically the impact of airport related emissions on the local air in a manner that would permit estimating of the air quality anywhere in the neighborhood of the airport. However, attempts to verify such models experimentally have been frustrated by the vagaries of weather, wind and background pollution levels from other urban sources. Studies of "emission inventories," directed toward estimating the types and amounts of emissions from various sources have been conducted with some success. Such studies, though they do not provide a direct assessment of the effect on air quality, they do provide comparisons of the relative amounts of pollutants contributed by various sources. As a part of this study, comparisons by emission inventory and by effect on air quality are presented on a simplified basis.

8.3.2.3.1 Emissions Inventory: It will be assumed that the general area around the regional airport has no emissions from industrial sources. The pollution sources other than the STOL operations at the airport will therefore be automotive traffic near the airport and other airplane operations at the airport. The other airplane operations at the airport can range from zero to almost any amount, depending on the demands on the particular airport, and the air traffic developed prior to the initiation of STOL operations. Other-than-STOL aircraft operations will therefore not be considered and comparisons will be made on the basis of surrounding automotive traffic. The Orange County Airport, southeast of Los Angeles, is used as a representative example. A simplified map of the airport and surrounding roadways is shown by Figure 8-16. The related traffic numbers in Table 8-2 were taken from reference 8-24.

It appears fair to say that most regional airports will be near metropolitan areas and will therefore have a major thoroughfare such as a freeway or turnpike nearby. Also it may be assumed that since the airport blocks out two or three square miles which cannot be used for normal ground traffic development, then the surface streets immediately adjacent to the airport, in order to carry the traffic around the airport, will bear a higher-than-normal amount of traffic.

In the above respects the Orange County Airport appears to be typical, except that it may be exposed to a more highly developed freeway system than most STOLports. Therefore, to keep the comparison reasonable, only one freeway and two surface streets will be considered, to wit:

Roadway	Vehicles/Day
San Diego Freeway	67,000
MacArthur Blvd. (South)	25,000
Palisades Road	26,000
Total	118,000

This results in the following emissions, utilizing a two-mile stretch of each road:

$$E_{(CO)} = 118{,}000 \times .1717 = 20{,}260 \text{ lb./day } (9200 \text{ kg/day})$$

ORANGE COUNTY AIRPORT

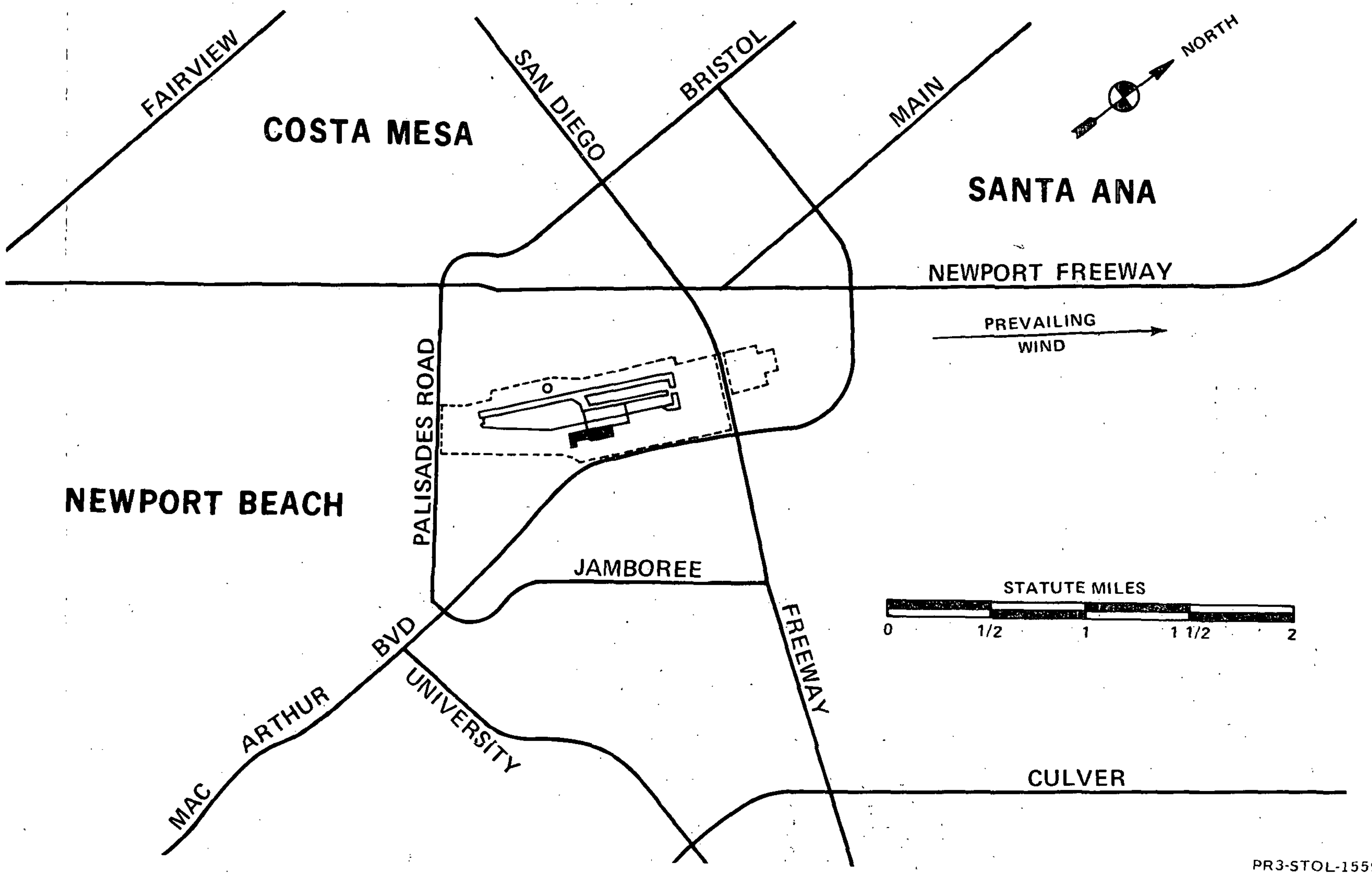


FIGURE 8-16

TABLE 8-2 AVERAGE DAILY VEHICLE TRAFFIC NEAR THE ORANGE COUNTY AIRPORT

Source: Orange County Road Department, Traffic Division

Roadway	Vehicles/Day
MacArthur Blvd.	
South of San Diego Freeway	25,000*
North of San Diego Freeway	17,000
San Diego Freeway	67,000
Newport Freeway	
South of San Diego Freeway	45,000
North of San Diego Freeway	63,000
Palisades Road	26,000
Campus Drive	10,000
Red Hill	10,000

*Peak 4:40 - 6:00 PM

$E_{(HC)}$ = 118,000 X .0150 = 1.770 lb./day (804 kg/day)

$E_{(NOX)}$ = 118,000 X .0132 = 1,558 lb./day (707 kg/day)

The ratios of STOL related emissions to background traffic related emissions for the maximum STOL day and the average STOL day are as follows:

	Max. Day	Avg. Day
$R_{(CO)}$	.224	.0841
$R_{(HC)}$	.248	.0933
$R_{(NOX)}$	2.112	.793

As may be seen from the above, the STOL operations account for considerably less emissions of CO and HC than the surrounding automotive traffic. The amount of NOX emitted by the aircraft appears to be roughly comparable to the amount emitted by automotive traffic. However, in the case of NOX, the aircraft cannot be considered as local emitters to the extent shown because nearly all of the NOX is distributed over the takeoff and approach paths. Automotive emissions are somewhat less dispersed since they are emitted only at ground level.

8.3.2.3.2 Air Quality: Another way to evaluate the impact of the STOL operation is to consider the impact on air quality using a simplified model. Consider that all the emissions for one day are accumulated over the area occupied by the airport and are completely mixed with the air under the inversion boundary. It is assumed then that overnight the accumulated pollutions are dissipated and next morning the sink is ready to start receiving the next day's emissions. The NOX emissions will not be considered in such a model because NOX could be appropriately discussed only on the basis of a much larger air volume which would be very difficult to define.

The airport system study shows an average regional airport area of 1700 acres (688 hectares), or: 43,560 X 1,700 = 7.40×10^7 ft.^{2}.

The volume over the airport is then:

$$3000 \times 7.40 \times 10^7 = 2.22 \times 10^{11} \text{ ft}^3 \text{ or } 6.29 \times 10^9 \text{ m}^3$$

Converting the emitted pollutants to milligrams:

	Pollutants mg/day		
	Max. Day	Avg. Day	Max. Day 6-9 AM
CO	2.06×10^9	7.75×10^8	5.16×10^8
HC	1.993×10^8	7.50×10^7	5.00×10^7

The corresponding concentrations above the airport in milligrams per cubic meter are:

	Max. Day	Avg. Day	Max. Day 6-9 AM
CO	.327	.123	.0820
HC	.0317	.0119	.00795

The applicable air quality standards (from reference 8-22) in milligrams per cubic meter are:

CO	40 mg/m^3	-	one hour, once per year
HC	.16 mg/m^3	-	3 hours, (6-9AM) once per year

Note that the unburned hydrocarbons are non-toxic and non-irritant in concentrations normally experienced outside of closed spaces. The only real significance of the HC emissions is related to their participation in the photochemical reaction to produce the oxidants which are the irritating constituents of smog.

The hours during the middle of the day when the ultraviolet radiation is highest are most effective in producing the oxidants. Unburned hydrocarbons released to the atmosphere during the afternoon rush hours will remain innocuous if carried away during the night. Therefore, the air quality standard has been expressed only in terms of the morning rush hours, and the comparison used here is based on the same time period.

The fractions of the respective air quality standard values ascribed to the two pollutants are:

Pollutant	Ratio	Condition
CO	.00818	Maximum day
HC	.0496	Max. day (6-9 AM)

It should be kept in mind that the above analysis carries the implicit assumption that the peak daily operating load at the airport will occur at a time when there are very stable (temperature inversion) weather conditions. In the Los Angeles basin where such conditions exist most of the year, the chance of such coincidence is almost a certainty. However, in other parts of the country, the reverse may be true.

It may also be noted that the air quality standards for HC and NOX have been set independently of each other, though it is generally accepted that the interaction between the two under sunlit conditions produces the irritating oxidants in smog.

8.3.2.4 Conclusions - Aircraft/Airport Pollution:

- The carbon monoxide emissions related to STOL operations do not appear to make a serious contribution to degradation of air quality. Furthermore, over 90% of the emissions at an average STOLport are produced by related ground traffic which will benefit by whatever improvements are made in that area.
- The unburned hydrocarbon emissions may have an impact something of the order of 5 to 25% during the maximum day, over 80% of which is attributable to related automotive traffic.
- A direct comparison of NOX emissions of aircraft versus other sources is difficult to make because of the fact that the emissions are distributed over an area which is hard to define.

8.3.2.5 Recommendations - Aircraft/Airport Pollution:

- People in communities around regional airports are likely to react strongly to engine generated odors. It is recommended that additional research be directed toward determining the causes of odors related to aircraft ground operations.
- Additional research should be undertaken to determine not only the amounts of particulates from aircraft operations, but the types of particulates, so that some assessment can be made of the relative importance of carbonaceous and non-carbonaceous aircraft emissions, as distinguished from dust

blown up from the airport runways. This may be important in determining where to place the emphasis related to abatement of particulates, with combustor design, or airport operations. The amount of runway dust blown into the air may be influenced by the STOL concept selected.

- The presence of irritating oxidants in the urban atmosphere has been ascribed to the interaction of hydrocarbons (HC) and nitrogen oxides (NOX) in the presence of sunlight. It may be easier to reduce emissions of hydrocarbons than NOX, and such action may be sufficient to reduce smog irritants. It is recommended that additional studies be made to determine the impact of NOX on the environment, in the presence of varying amounts of reactive hydrocarbons.

- It is recommended that engine combustor design, research and development be continued on a high priority basis, directed toward the reduction of all jet engine emissions. Special emphasis should be placed on the reduction of nitrogen oxides emissions.

- One possible way to control NOX emissions is to restrict the cycle pressure ratio of the engines. However, restricting the pressure ratio below that required by other considerations will have a serious impact on the performance of the airplane, and therefore the direct operating costs to the airlines. A study should be made to assess direct operating costs as a function NOX control by pressure ratio variations.

- General studies of STOL air pollution environmental impact are difficult to make without statistical data on weather and other conditions at potential STOLport sites, such as the percentage of time a temperature inversion exists, frequency and strength of winds, the proximity of urban concentrations and the direction of winds with respect to such concentrations. It is recommended that such studies be made so that environmental impact studies can be made for specific areas that can be related to a statistical frequency of occurrence.

8.3.3 Airport Access Congestion - The factors associated with total airport traffic congestion are shown in Figure 8-17. Airport airside congestion, i.e., that associated with en route and terminal area air traffic control and runway acceptance rates, is discussed in Section 9.0 of this report. Likewise, the on-airport passenger baggage flow is similarly covered. This section is primarily concerned with the problems of airport access and associated ground traffic congestion which is a major existing constraint at many large hub airports. Los Angeles International and Boston Logan are two examples of airports where ground access is the primary physical constraint to future development. While diversion of short-haul air traffic to reliever airports will offer significant relief of access congestion at major hub airports, it will not entirely solve the ground congestion problem.

8.3.3.1 Access Route Jurisdiction. A major deterrent to highway and surface street construction and improvement is the fact that jurisdictional control rests with local and state agencies other than those responsible for airport development. The need for providing satisfactory access routes to the airport, however, is beginning to be recognized as a key problem in many cities and states and the degree of coordination between the highway and traffic authorities and airport management is rapidly improving. A high degree of coordinated planning between various controlling agencies will be essential to the implementation of STOL airports.

8.3.3.2 Remote Terminal Concept. The tremendous advantages of off-airport ticketing and passenger and baggage check-in facilities have not yet been recognized. This concept offers an ultimate solution to two major existing airport problems. Moving already ticketed passengers to the airport in

ENVIRONMENTAL CONSIDERATIONS-CONGESTION

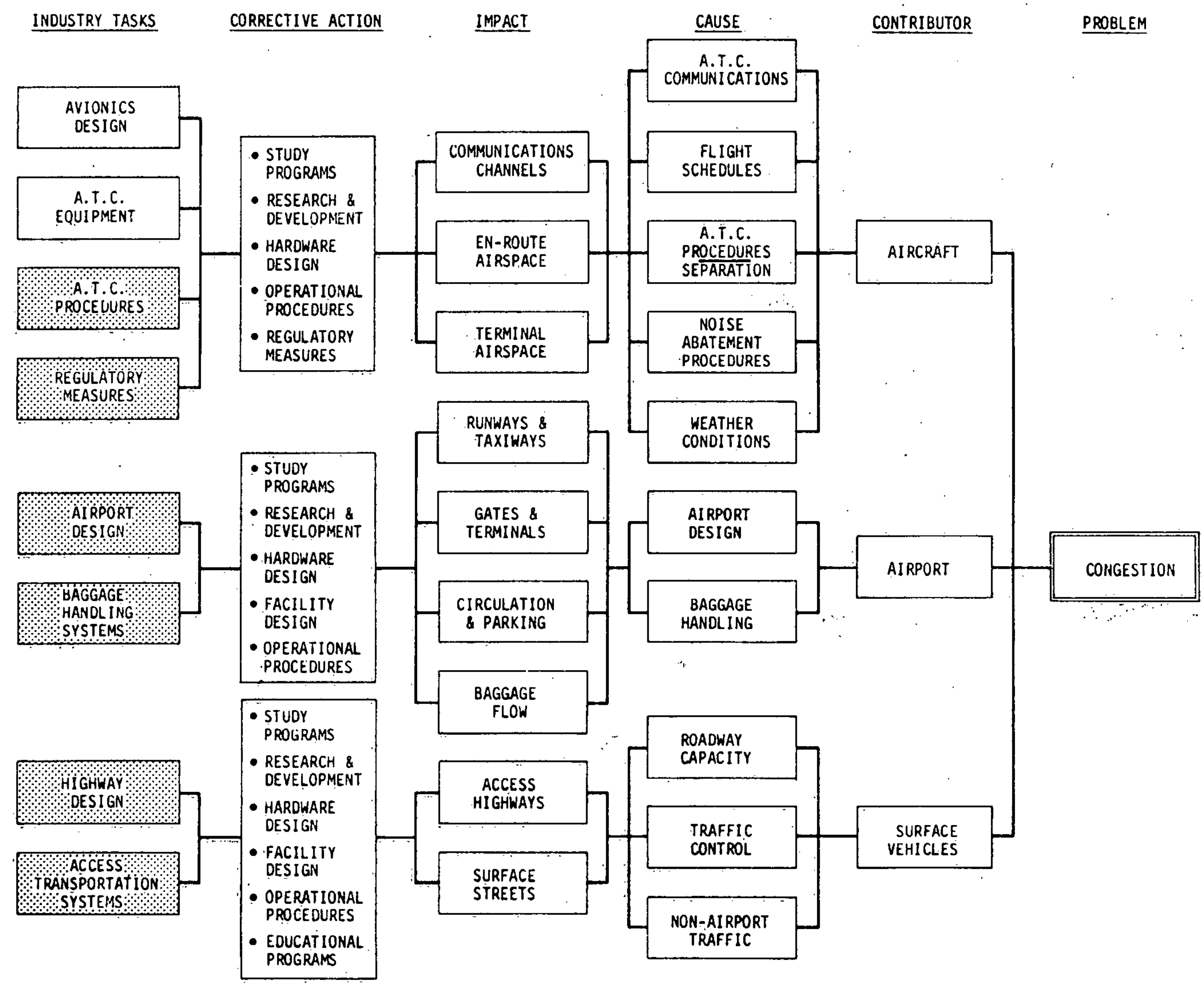


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FIGURE 8-17

large groups (by bus or transit) will greatly reduce access traffic congestion, especially at peak hour periods, and also will reduce the on-airport parking area requirements. Another, and perhaps greater advantage of the concept is the reduction of automobile emissions in the vicinity of the airport. As previously disccused in Section 8.3.2, an aircraft of 150 passenger capacity requires approximately 200 automobiles to support each landing-takeoff cycle. The extent of traffic congestion and air pollution relief possible with the remote terminal concept is obvious. In the past there have been two problems which have delayed its adoption. The airport managements were interested in developing large on-airport parking facilities to obtain maximum parking revenue. Also, the airport airline tenants did not wish to duplicate costly passenger and baggage check-in facilities (since some ticketing capability must remain on airport to handle interline transfers and emergency traffic).

The development of high density STOLports, especially those located in highly urbanized areas, offers an ideal opportunity to adopt the remote terminal concept at minimum expense. Its development is strongly recommended. Meigs Field in Chicago, the Secaucus site in New Jersey, North Field in Oakland, and the General Patton site in Los Angeles should be prime considerations. The same concept also could be applied to Washington National.

8.3.3.3 Access at Network Airports. A survey of ground access routes at all 92 network airports was accomplished using U.S.G.S. topographic maps. The survey indicated that a great majority of the network airports already are serviced by existing highways, freeways, or expressways located within a two mile (3.2 km) radius of the airport. Existing off-ramps and surface street access appeared satisfactory in most areas. Investigation of detailed capacity improvements necessary to support projected traffic levels is beyond the scope of the study, but should be accomplished as part of the airport master plan development at the time of implementation.

8.3.3.4 Conclusions and Recommendations - Airport Access Congestion:

1. Ground traffic congestion at major hub airports can be signficantly relieved by diversion of short-haul air traffic to STOL airports.

2. The remote terminal concept offers doubly-effective relief to existing CTOL airports and future STOLports by significantly reducing both access congestion and automobile emission levels.

3. Existing highway and surface street access routes appear to be adequate at the large majority of network airports.

4. It is recommended the remote ticketing and check-in concept be adopted at STOLports in highly urbanized areas.

8.3.4 Airport Environment/Ecology - The primary environmental impact of airports and related developments on natural resources and ecology are diagrammed in Figure 8-18. The impacts are primarily associated with airport site selection and new airport construction; however, they also must be considered in all airport development projects affecting runway or taxiway extension or improvements as explained in paragraph 8.3.4.2 below.

8.3.4.1 Environmental Impact Statements. The National Environmental Policy Act of 1969, Public Law 91-190, was passed by Congress with an effective date of January 1, 1970. The implementation section of the act required the following federal actions: (Direct quote)

All agencies of the Federal Government shall:

(A) Utilize a systematic, interdisciplinary approach

(B) Identify and develop methods and procedures, in consultation with the Council on Environmental Quality, which will insure that presently unquantified environmental amenities and values may be given appropriate consideration in decision-making along with economic and technical considerations

(C) Include in every recommendation or report on proposals for legislation and other Federal actions significantly affecting the quality of the human environment a detailed statement on:

1. The environmental impact of the proposed action.
2. Adverse environmental effects which cannot be avoided.
3. Alternatives to the proposed action.
4. The relationship between local short-term environmental uses and long-term productivity.
5. Irreversible or irretrievable commitments of resources involved .

ENVIRONMENTAL CONSIDERATIONS-ECOLOGY

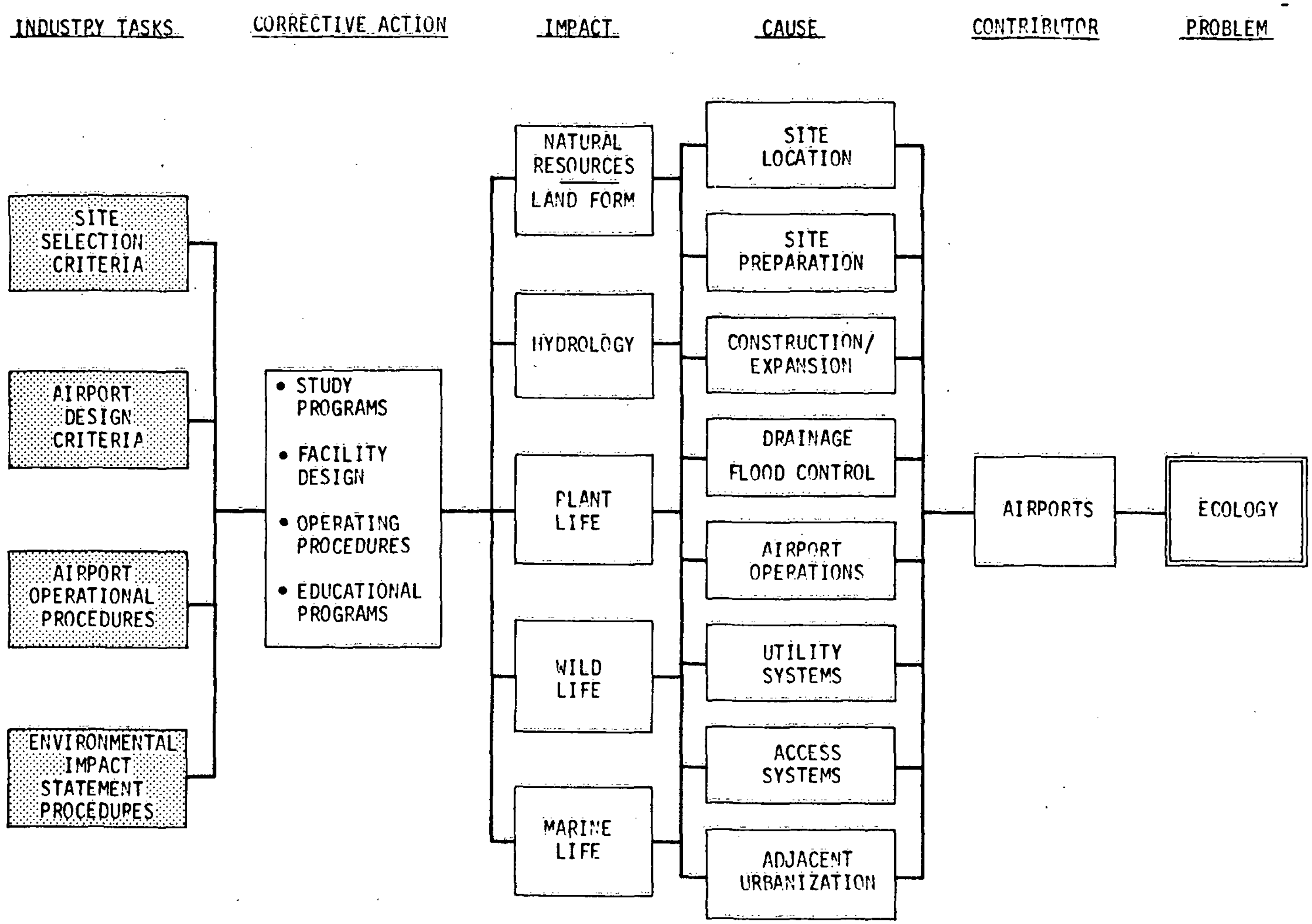

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FIGURE 8-18

Prior to making the detailed statement the responsible federal official shall consult with and obtain the comments of any federal agency which has jurisdiction or special expertise with respect to environmental impact involved.

(D) Study, develop, and describe appropriate alternatives to recommended courses of action which involves unresolved conflicts concerning alternative uses of available resources.

(E) Recognize the worldwide and long-range character of environmental problems and lend support to international cooperative efforts.

(F) Make environmental advice and data available to states, counties, municipalities, institutions, and individuals.

(G) Initiate and utilize ecological information in the planning and development of resource-oriented projects.

(H) Assist the Council on Environmental Quality. (Unquote)

The act was further implemented through presidential mandate by Executive Order 11514 (35 F.R. 4247) of March 1970. The Airports and Airways Act of 1970, Public Law 91-258, Section (f) also required environmental consideration be included in the National Airport System Plan (NASP) and made public hearings mandatory on all federally-sponsored airport development programs (Section 16(d).

8.3.4.2 Requirement for Public Hearing. On 4 January 1971, the Federal Aviation Administration issued Advisory Circular 150/5100-7 which established guidelines for the conduct of public hearings on airport matters. AC150/5100-7 was later superseded by AC150/5100-7A, dated 25 February 1972, which advised that public hearing requirements apply to all airport development projects that involve the following:

a. Location of an airport. A project that involves the location of an airport may be —

(1) The initial project to acquire land for the purpose of developing an airport thereon.

(2) The intial project for overall site preparation.

b. An Airport Runway. A project that involves an airport runway may be —

(1) A project for site preparation for a new runway.

(2) A project that includes both site preparation and construction of a new runway.

(3) A project to relocate or change the alignment of an existing runway.

c. A Runway Extension. A project that involves a runway extension may be —

(1) A project to prepare the site for the extension of an existing runway.

(2) A project that includes both site preparation and construction of the runway extension.

(3) A project that would change the location of a runway extension, including extension beyond the site preparation area.

8.3.4.3 Approval Time Span. The combined requirements for preparation of Environmental Impact Statements (E.I.S.) and the subsequent conduct of public hearings has effectively stalled airport expansion and/or construction projects throughout the nation. Preparation of E.I.S. documentation involves from 6 months to 2 years, and the subsequent approval process through local airport agencies, state clearing houses, and various federal agencies requires an even longer period— approximately 2 to 3 years. The FAA recently advised that a total of 26 federal agencies currently are involved in the federal E.I.S. approval process. There is no question as to the need for protecting environmental quality— yet the bureaucratic process involved in obtaining project authorization is far too lengthy and time consuming.

8.3.4.4 Energy Resource Impact. Perhaps the most important single future resource problem associated with an air transportation system is the pending energy crisis arising from a shortage of fossil fuel. Fuel shortages are a current constraint on air carrier operation in some areas and undoubtedly will be more so in the future. The problem is generally applicable to all air transportation systems— short-haul and long-haul, CTOL and STOL.

8.3.4.5 Environmental Comparison - Other Modes. A comparison of the land area requirements of the STOL air transportation system versus other comparable short-haul transportation systems— rail and highway— was made to determine the relative environmental impact on land resources. The comparison shows that the land area required for the STOL system is 32% of a comparable intercity rail system, and only 24% of a comparable intercity highway system. The calculations were based on the following:

- Two STOLports, one at each terminal city, with an average area of 1709 acres (692 hectares) require a total land area of 3418 acres (1383 hectares), see Figure 8-8.
- According to Santa Fe engineers, a two track mainline rail system requires a clearance right-of-way of from 100 to 200 ft. (30 m to 61 m). A median value of 150 ft. (46 m) was assumed.

- A four lane intercity highway clearance right-of-way varys from 90 to 310 ft. (27 m to 94 m) (reference 4-1). A median value of 200 ft. (61 m) was assumed.

- STOLport Area = 1709 X 2 X 43,560 = 148,888,080 Sq. Ft. (13,831,703 Sq. M)

- Equivalent Rail Right-of-way = 148,888,080 ÷ 150 = 992,587 Ft. (302,540 M)

  992,587 ÷ 5280 = 188 St. Mi. (302 km) of track

- Equivalent Highway Right-of-way = 148,888,080 ÷ 200 = 744,440 Ft. (226,905 M)

  744,440 ÷ 5280 = 141 St. Mi. (227 km) of highway

- Intercity Distance = 575 St. Mi. (925 km) (STOL design mission distance)

- STOL % of Rail = 188 ÷ 575 = 32%

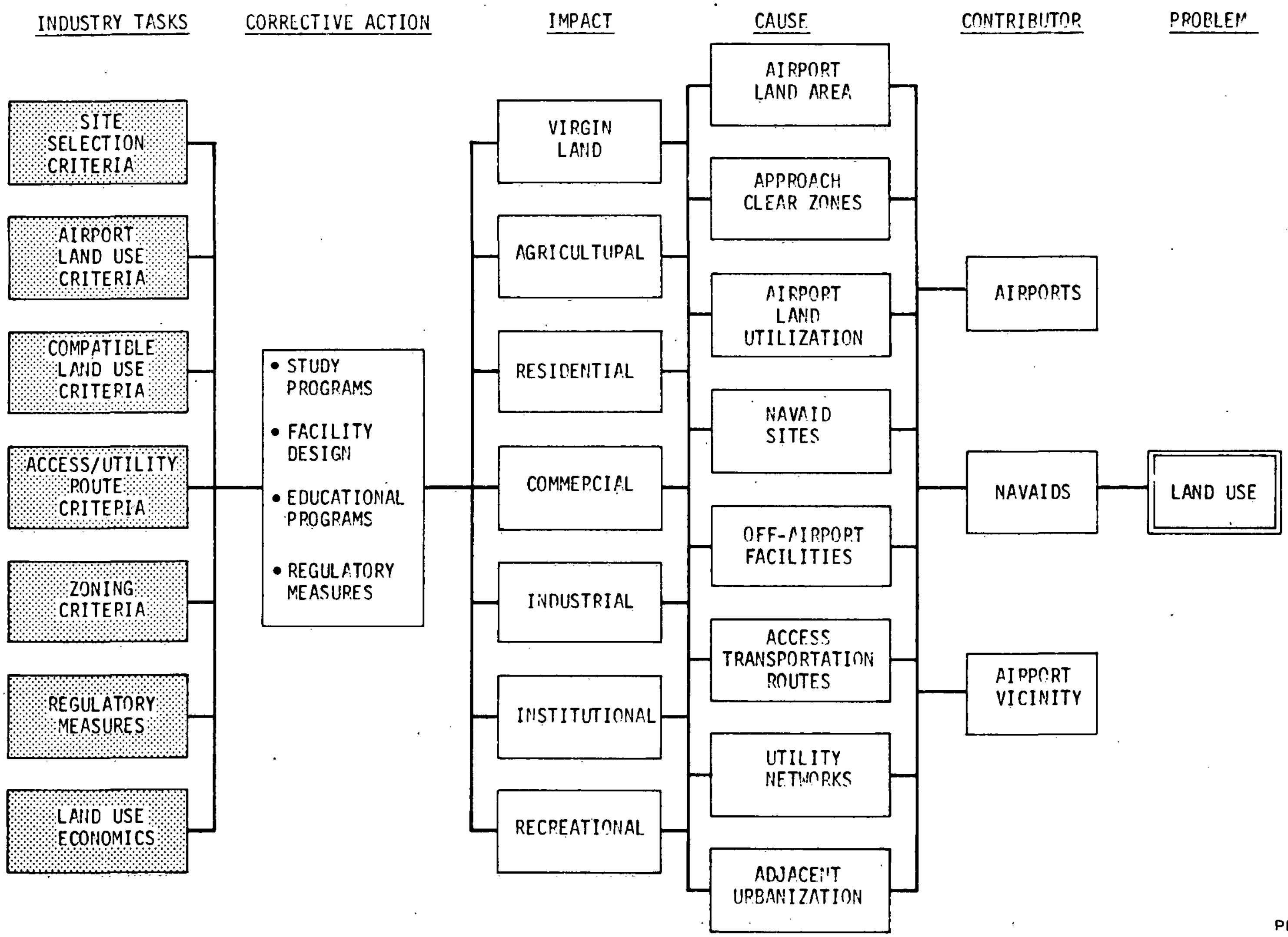
- STOL % of Highway = 141 ÷ 575 = 24%

8.3.5 Airport Land Use - Land use considerations applicable to airport development and operations are diagrammed in Figure 8-19. It is important to note that in the past, airport land use considerations were based almost entirely upon noise impact. Recent land use developments in the vicinity of large hub airports, however, tend to disregard noise impact and emphasize economic advantages of airport proximity (e.g., the expansion of hotels, office buildings, and airport related businesses in the vicinity of Los Angeles International, Chicago O'Hare, etc.). Current land values in the immediate vicinity of LAX exceed $650,000 per acre. (Reference 8-15)

The shortage of land within the airport boundaries, due to parking, cargo, maintenance, and terminal area requirements is forcing secondary airport functions (i.e., cargo terminals, postal facilities, and even parking) to off-airport locations. Well-planned location of these functions around the periphery of an airport also helps create a noise-buffer zone. Remote parking facilities reduce on-airport traffic congestion as well.

8.3.5.1 Noise Compatibile Land Use. The subject of airport compatible land use (with respect to noise compatibility) is adequately covered in the previously mentioned HUD Land-Use Planning Guidelines (reference 8-17). The relatively quiet STOL aircraft analyzed in this study will result in NEF values in the range of 23 to 30 NEF which is well within the acceptable range recommended by HUD for residential land use. The STOL daily operational levels at most network airports are in the 20-100 range which according to the NEF conversion chart (see Figure 8-5) will result in NEF values in the 24 to 26 range— very close to the ambient noise level of an average urban area.

ENVIRONMENTAL CONSIDERATIONS-LAND USE



PR3-STOL-1578

FIGURE 8-19

Douglas research studies, as well as those of other organizations, have not yet established a specific NEF upper limit for community noise acceptance. Recent data indicates an adaptive tolerance may be applicable to areas long exposed to aircraft noise (e.g., Los Angeles International, and Chicago Midway); however, much more research is necessary to provide complete validation. The noise tolerance level varies significantly community-to-community and must be investigated on a community by community basis. Land use planning for noise compatibility should be applied accordingly.

8.3.5.2 Land Use Zoning and Regulation. As with airport access planning, land use regulation and zoning is controlled by local agencies other than the airport operating or sponsoring agency. The control often is widely fragmented among numerous cities, counties, and jurisdictional districts— all subject to local political pressures and not always pro-aircraft. Future STOL airports, with their significantly lower noise impact area should greatly reduce the number of involved jurisdictional agencies, thereby simplifying the overall problem of compatible land use regulation. Land use compatibility is much easier accomplished in developed areas than in established urbanized areas involving extensive rezoning or relocation.

8.3.5.3 Conclusions and Recommendations - Airport Land Use:

1. Location of secondary airport functions off-airport, or around the airport periphery, will provide space for expansion of essential airport functions; create a noise buffer zone; and, provide noise compatible land use.

2. There is an increasing trend evidenced in land use around existing high-density airports that economic considerations may outweigh noise considerations in the future. STOL, with its low community noise impact, will accelerate this trend.

3. The relatively low noise impact area of STOL operation will reduce the number of jurisdictional agencies involved in land use zoning and regulation at an average airport.

4. Continued research is needed to establish the upper noise limit for community acceptance (and compatible land use planning).

8.3.6 Airport Issues - Fear/Safety - Safety considerations are fundamental to commercial air transportation. Figure 8-20 shows the major safety considerations of aircraft design and operation. The shaded blocks indicate those directly applicable to STOL aircraft and airport operations. The psychological problem of community concern over fear of aircraft crashes could be an issue with respect to future STOL operations.

8.3.6.1 Community Concern-Fear. The recent Tracor study on community reaction to airport noise conducted for NASA (reference 8-26) found those persons highly annoyed by aircraft noise also were highly fearful of aircraft crashes. This finding is further supported in a later study (reference 8-27), conducted by Douglas at LAX, where nearly 30% of the sampled subjects living in the approach-path reported fear responses. It is apparent there is some concern by airport-community residents regarding the safety of life and property of those who live in the aircraft flight-path.

Only limited data are available on the problem of community's "fear" responses to aircraft flyover. Currently, the emphasis of complaint is on aircraft noise— not safety. However, with the signficant strides being made in jet engine technology, noise may one day become a less salient community issue. Will then "safety" become the salient issue? It is a possibility from a socio-psychological point of view, the suggestion that complaints of fear of safety may increase when complaints of aircraft noise are eliminated, may be one of consequence.

8.3.6.2 Conclusions and Recommendations. Community member concern over the possibility of aircraft crashes is a possible issue in achieving public acceptance of a STOL system. It is recommended that further socio-psychological

ENVIRONMENTAL CONSIDERATIONS-FEAR/SAFETY

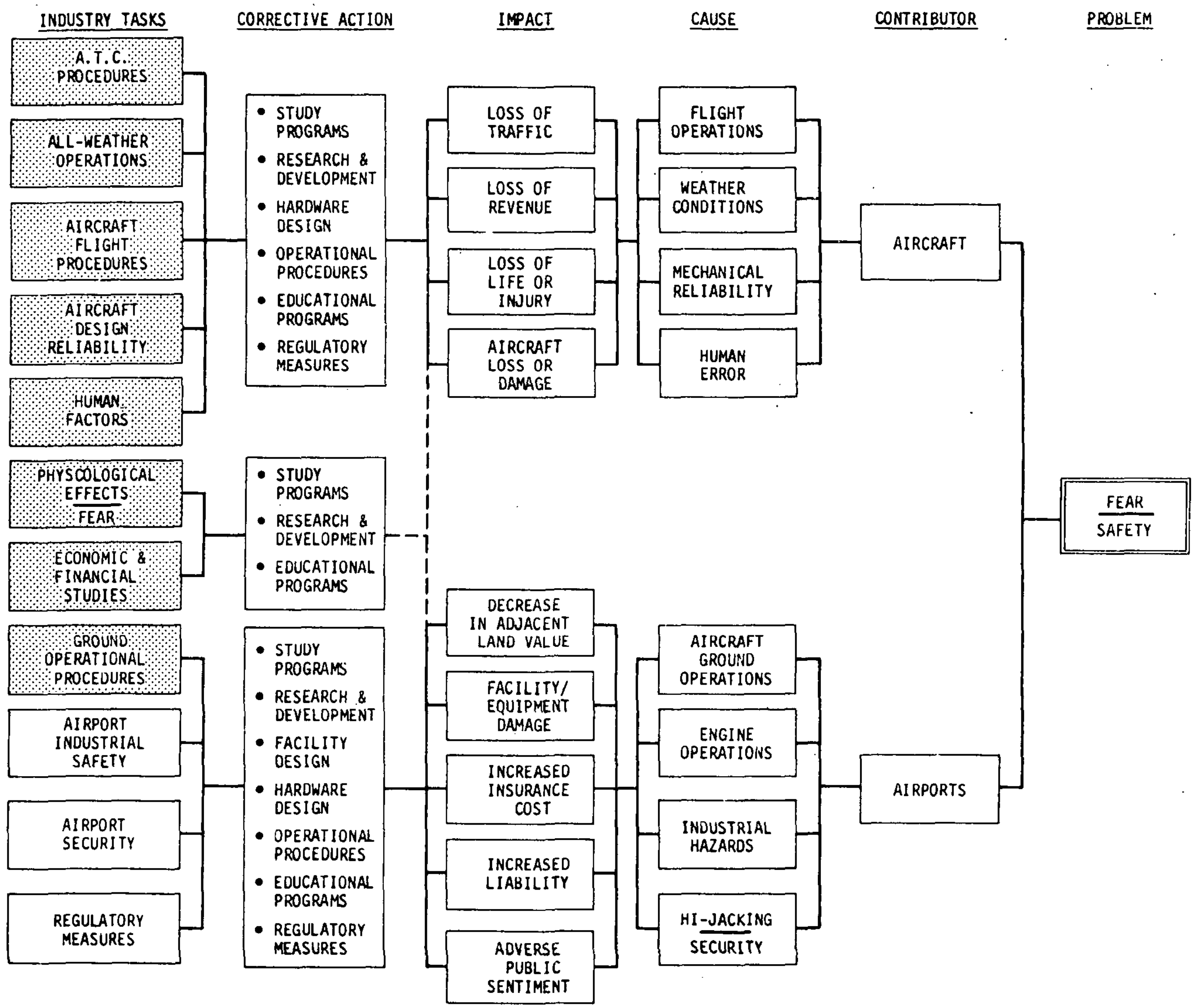


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FIGURE 8-20

studies be conducted to determine the magnitude of the problem and possible methods of alleviation.

8.3.7 Airport Aesthetics - Aesthetic considerations with respect to airport design are shown in Figure 8-21. Most modern airports are examples of excellent contemporary architectural functional design. Los Angeles International, Dulles International, and the new Kansas City International, Houston International, and Dallas-Ft. Worth International airports are outstanding in this regard. Reid-Hillview Airport in San Jose and Montgomery Field in San Diego are excellent examples of aesthetically designed general aviation facilities.

On the other hand, some terminal building designs, although aesthetically pleasing, are architectural momuments— grossly over-designed, often under-utilized, and frequently far more costly than necessary. Others resemble military and industrial installations with little aesthetic appeal. This is especially true of airports and facilities constructed prior to the 1960's.

8.3.7.1 STOL Airport Design. The construction of new STOLports and the expansion or construction of new STOL facilities at existing airports offers an excellent opportunity to apply good functional design practices and create an aesthetically pleasing airport. Aesthetic design is an essential element in achieving community acceptance of a STOLport.

ENVIRONMENTAL CONSIDERATIONS-AESTHETICS

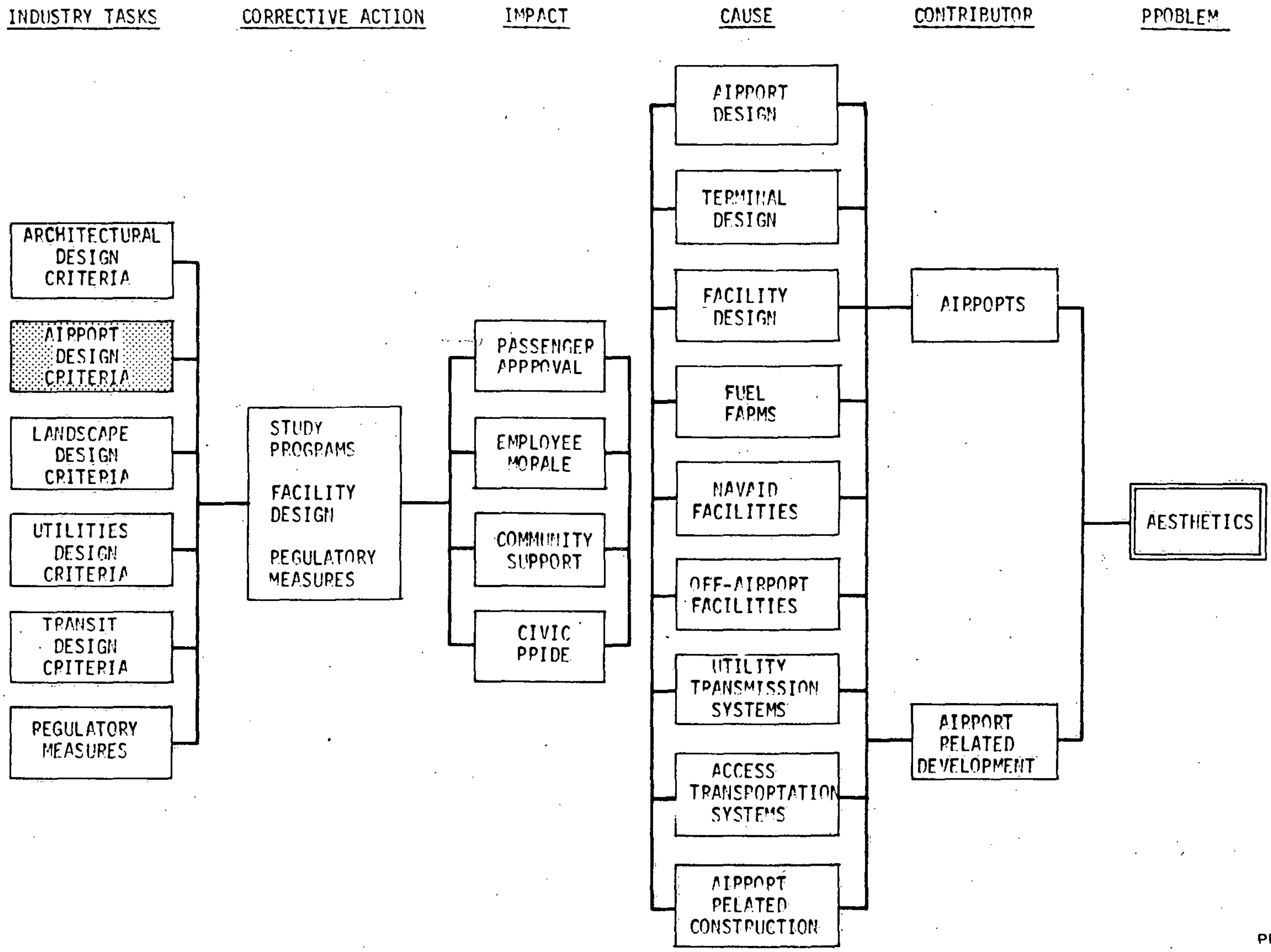

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FIGURE 8-21

8.4 Community Acceptance Field Surveys

The need to obtain the most current information on community reaction as well as first-hand opinions of those directly involved "on the firing line" of community problems was recognized early in the study. It also was recognized that certain differences in public action existed in various geographical sections of the country. Accordingly, a series of airport/community field interviews were undertaken in various regions of the country to provide "real world" realism to the study and strengthen its validity. Extensive interview comments are reproduced in Appendix 15.7.

8.4.1 Regulatory Agency Contacts - Key governmental agencies involved with airport and transportation problems also were visited to obtain up-to-date information on current and anticipated noise and environmental regulations, public education programs, etc. A list of agencies visited is contained in Appendix 15.6.

8.4.2 Airport Selection Criteria - A matrix was developed to facilitate comparison of all airports selected for the National STOL network. Airports within the California, Chicago, and Northeast Regions were analyzed with respect to adjacent community characteristics. All airports were categorized accordingly. Selection criteria included airport type, current operational levels, adjacent land use, access routes and capacities, and community physical characteristics. An underlying consideration also was the airport's relative importance to a national air transportation system. Airports selected for community evaluation and their respective selection categories are shown in Figure 8-22.

8.4.3 Field Interview Questions - The surveys were, in general, conducted on site and consisted of interviews with airport administrators,

AIRPORTS SELECTED FOR COMMUNITY EVALUATION

ADJACENT LAND USE / AIRPORT TYPE	RESIDENTIAL	RES/INDUSTRIAL	INDUSTRIAL
PRIMARY CTOL (>1,000,000 PSGR/YR)	WASHINGTON NATIONAL	BOSTON LOGAN	-
SECONDARY CTOL (50,000 TO 1,000,000)	CHICAGO MIDWAY	ORANGE COUNTY (SANTA ANA)	NORTH OAKLAND
GENERAL AVIATION	EL MONTE (LOS ANGELES)	MONTGOMERY FIELD (SAN DIEGO)	MEIGS FIELD (CHICAGO)
MILITARY/JOINT USE	-	HANSCOM FIELD (BEDFORD)	NAS MOFFETT FIELD (MOUNTAIN VIEW)
NEW CBD SITE	-	-	GENERAL PATTON (LOS ANGELES)
NEW SUBURBAN SITE	-	SECAUCUS (NEW JERSEY)	-

PR2-STOL-1223 C

FIGURE 8-22

airport managers, port authority personnel, and engineering personnel connected with the airport operation. The type of questions asked included:

Are there any "special interest" groups within the community you believe would be in favor of a STOLport implementation proposal?

Are there any groups which would oppose a STOLport proposal?

Is there any one person or group who, in your opinion, is or would be more influential than others in terms of community decision-making?

Have there been any public hearings on airport issues or other transportation projects in this community?

What programs have been established to provide a public/airport official interaction?

What do you believe it would take to sway the community members who now oppose airports?

The asking of these questions normally led to a much broader discussion which was always profitable. A complete listing of the airport/communities and the associated personnel interviewed is contained in Appendix 15-6.

8.4.4 Field Interview Comments - A summary of airport interview comments and observations is reproduced in Appendix 15-7. The information is presented in narrative form to reflect actual comments received since the spoken statements more reflect the true feeling of the person interviewed and almost without exception, the interviewees were both outgoing and outspoken in their comments— and all expressed serious concern over the urgency of solving airport community acceptance problems. A summary of airport administrator comments is presented in Figure 8-23. One comment requires clarification. The desire for a 2000 ft. (610 m.) field length expressed by several airport authorities was primarily based on the feeling that a 2000 ft. runway was needed to achieve minimum community noise impact. The comment was not based on aircraft operational considerations or airport land constraint.

8.4.5 Field Survey Results - Key findings of the community acceptance field surveys can be summarized as follows:

- Early identification of specific local community variables (attitudes, behavioral intentions, demographics, etc.) is essential to effective airport development planning.
- In-depth community research on airport development is virtually non-existent.
- Public hearings appear to be the primary method used to obtain community public opinion on airport development proposals— and in general, "anti-airport" groups dominate the meeting.
- Some "community representatives" working groups have been formed at several airport locations; however, there seems to be generally two problems: (1) lack of community "representativeness," and (2) lack of governmental decision-making power.
- There appears to be an emotional level in community reaction beyond which further attempts at communication and persuasion are extremely difficult.

SUMMARY - AIRPORT ADMINISTRATOR COMMENTS COMMUNITY ACCEPTANCE SURVEYS

- AIRCRAFT NOISE IS THE NUMBER ONE ENVIRONMENTAL PROBLEM AND IS A THREAT TO SURVIVAL OF SOME HIGH ACTIVITY AIRPORTS
- POLLUTION AND GROUND ACCESS TRAFFIC CONGESTION ARE OF SECONDARY IMPORTANCE
- ELIMINATING NOISE AT SOURCE - AIRCRAFT AND ENGINE - IS CONSIDERED THE ONLY PRACTICAL SOLUTION
- AIRPORTS LOOK TO STOL AS THE MOST PROMISING SOLUTION TO NOISE AND CONGESTION PROBLEMS - AND URGE EARLY IMPLEMENTATION THROUGH FEDERAL REGULATORY ACTION
- 2000-FT FIELD LENGTH DESIRED TO MINIMIZE NOISE FOOTPRINT AND FACILITATE URBAN SITE LOCATION
- LOCAL COMMUNITY OPPOSITION BASED ON ENVIRONMENTAL CONSIDERATIONS HAS EFFECTIVELY STALLED ALL AIRPORT EXPANSION AND CONSTRUCTION IN ALL AREAS SURVEYED
- ALL ADMINISTRATORS STRESSED THE NEED FOR IN-DEPTH COMMUNITY RESEARCH
- URGENT NEED FOR TOTAL INDUSTRY PUBLIC RELATIONS PROGRAM - GOVERNMENT, MANUFACTURERS, AIRLINES, AND AIRPORTS - TO EDUCATE THE PUBLIC AT LARGE ON AVIATION BENEFITS

PR2-STOL-1291

Figure 8-23

- Referendum ballots appear to suffer where airport projects are concerned, due to inadequate planning and lack of understanding of the community attitudes and behavioral intentions prior to voting. Many states now require airport issues be settled by referendum.

- Continuing public education and community involvement programs appear to be essential throughout all planning and implementation phases of an airport development project.

- The community acceptance problem of aircraft noise is highlighted by this comment from the aviation director of the Massachusetts Port Authority: "If STOL's going to be quiet— you'd better start telling the public about it right now. However, they probably won't believe you!"

8.5 Community Analysis Results

Network airports within each region were summarized in matrix form to identify pertinent locational, physical, and operational characteristics. FAA Forms 5010-1 and FAA Airport Activity Summaries provided the majority of the base data. Adjacent land use, degree of urbanization, access routes, and general community physical characteristics have been similarly summarized for airports in each of the network regions using U.S.G.S. topographic maps.

Analysis of numerous airport complaint records obtained from literature search, prior company research, airline inputs, and the recent field surveys has indicated that certain community characteristics are closely associated with complaints. These have been categorized as:

- Community Type - Single family residential, with high level of personal ownership.
- Degree of Urbanization - Mature, highly urbanized.
- Socio-Economic Level - Higher than average income level.

Accordingly, these characteristics were given primary emphasis in the analysis and must be determined for each airport community, existing or planned. A significant factor which also must be determined is the current degree of traffic congestion, ambient noise level, and relative air pollution level of each community. This information must be obtained from specific contacts or field surveys.

8.5.1 <u>STOL Noise Impact Determination</u> - The impact of the 95 and 90 EPNdB noise footprints of the systems analysis E·150·3000 baseline aircraft on the eleven representative case study airports was evaluated. The selection criteria for the airports chosen for community acceptance analysis is discussed in Section 8.4.2 of this report. The airports analyzed were

- Washington National
- Oakland-North Field
- NAS Moffett Field
- Orange County
- Chicago Midway
- Hanscom Field
- Meigs Field
- El Monte
- Montgomery Field
- General Patton Site
- Secaucus Site
- Boston Logan

The noise footprints were superimposed on a standard U.S.G.S. 7.5' topographic map. One and two statute mile (1.6 and 3.2 km.) radius circles, divided into four quadrants, (e.g., NE-1, and NE-2) also were superimposed on the map with the center point located on the airport geographical reference point (ARP). The quadrant overlay facilitates systematic community evaluation since only the particular quadrant sections impacted need be analyzed. This impact identification method also is applicable to other impact analysis. (e.g., access, congestion, land use, population density, pollution, etc.). A summary of the community noise impact at each of the twelve representative airports is reported in the following discussions.

8.5.2.1 Boston Logan. Logan International is classified as a Primary System High Density air carrier airport and as such was selected as being representative of the existing major air carrier network airport for purposes of this study. Logan is the northern terminus of the Northeast Corridor air traffic which accounts for over 40% of its total operations.

The airport is located within one mile (air distance) from the Boston Central Business District (CBD). However, it is separated from downtown Boston by the Boston Inner Harbor ship channel. Primary access to the airport is by two one-way two-lane vehicular tunnels under the harbor (Sumner-Callahan Tunnels), and by a longer route to the north over the Mystic River Bridge. These routes also serve the entire East Boston area and accordingly are very highly congested during the morning and evening peak hours. Access traffic is a major constraint. Therefore, any alleviation of surface traffic by diversion of short-haul air traffic to other airports will significantly improve Boston Logan's capacity to handle long-haul domestic and international air traffic.

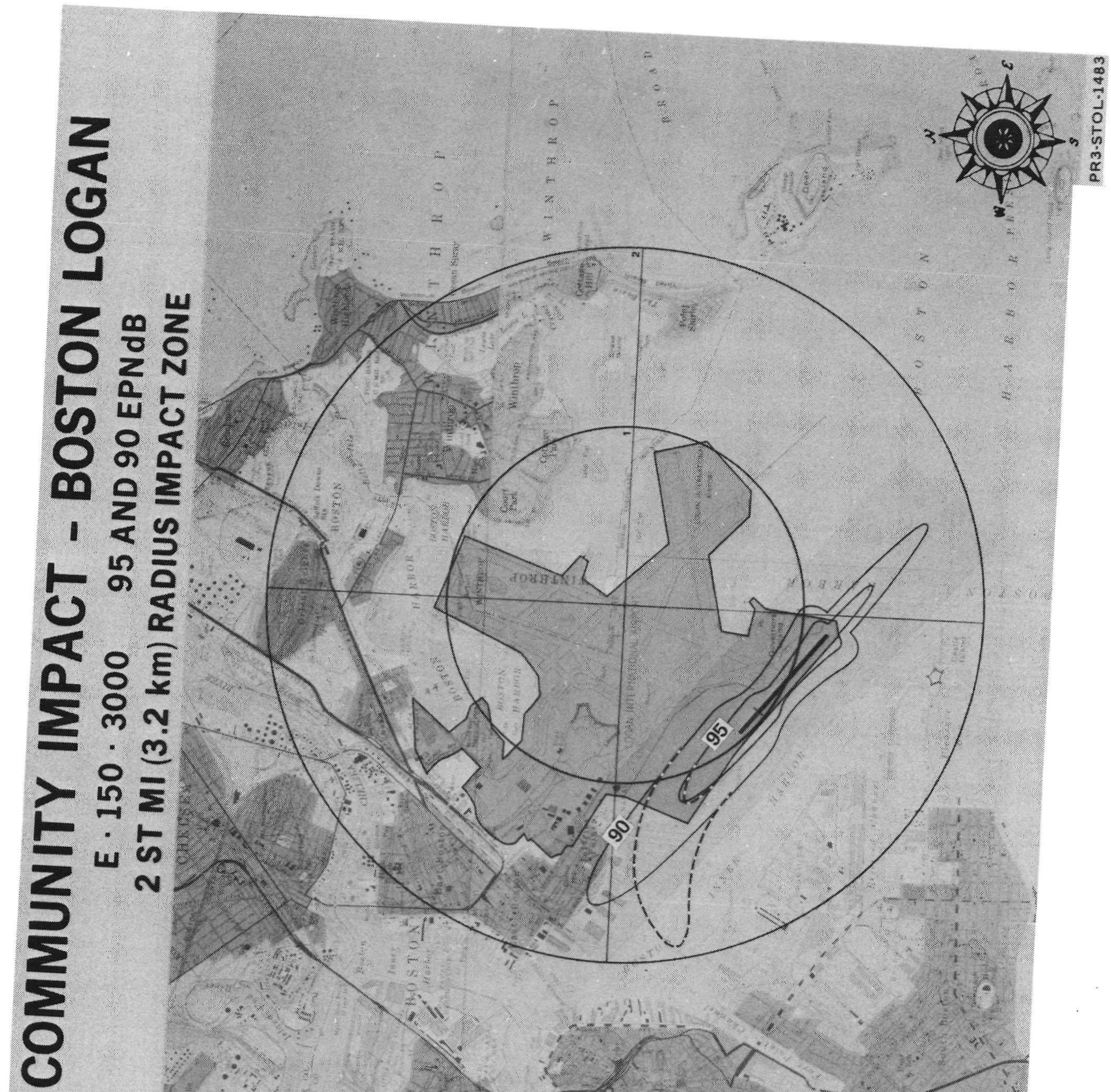
A large marsh area to the south of the airport (Bird Island Flats) adjacent to the inner harbor ship channel is currently being filled for use as a cargo terminal area. A STOL runway (15/33), 3850 ft. (1173 m.) in length is being constructed (subject to pending approval of an environmental impact statement and public hearing). It is planned to use the new runway for both general aviation and STOL operations.

Boston Logan has a long history of noise problems. Runway 33 departures pass directly over East Boston, the Boston downtown (City Hall) area, and Chelsea— all densely populated. Runway 4 departures result in severe noise impact on Winthrop, a high socio-economic level community to the east of the takeoff area. Noise complaints, primarily from aircraft ground operations and taxiing, also are received from the Jefferies Point area at the Southwest corner of the airport. Aircraft noise, therefore, is a major issue at Boston Logan (see Appendix 15-7 for additional discussion).

Air Quality also is an environmental issue in the Boston area. The EPA, in Appendix A, to their Proposed Standards for Control of Air Pollution from Aircraft and Aircraft Engines, (reference 8-20), lists Boston as a Priority I Air Quality Control Region for hydrocarbons and carbon monoxide. Surface traffic in the vicinity of Boston Logan is a major source of emissions due to its close proximity to the highly urbanized downtown area and major expressways— Highway 1, and the Massachusetts Turnpike intersections. Although aircraft emissions account for only a minor part of the total emissions in the area, the reduced emission levels of STOL operations will provide some improvement in air quality over CTOL operations (see Section 8.3.2).

The community noise impact of STOL operations at Boston Logan is shown in Figure 8-24. The 95 EPNdB footprint of the E·150·3000 systems analysis aircraft using the STOL runway 15/33, is completely contained within the airport boundary. The 90 EPNdB footprint, using a straight departure path, impacts slightly on the noise sensitive Jefferies Point area. By using the curvilinear departure described in Section 8.3.1.5, the 90 EPNdB footprint is completely contained within the airport and adjacent harbor ship cnannel.

The STOL system network operation analysis assumes that the 1985 short-haul O&D traffic will be diverted to Hanscom and Norwood to



COMMUNITY IMPACT - BOSTON LOGAN
E · 150 · 3000 95 AND 90 EPNdB
2 ST MI (3.2 km) RADIUS IMPACT ZONE
95
90
PR3-STOL-1483

Figure 8-24

provide relief at Logan. It is possible, however, that STOL may be initially operated from Logan. STOL also possibly may be used to serve interline traffic from the two reliever STOLports.

Although Logan was not included as a STOL airport in the short haul system network, it was considered in the community acceptance analysis as an excellent example of the congestion, noise, and air quality relief possible with STOL operations.

8.5.2.2 Hanscom Field. Laurence G. Hanscom Field is a joint-use military airport located near Bedford at the Western boundary of the Boston metropolitan area. The airport is operated by the Massachusetts Port Authority, which also operates Boston Logan,and is considered as a reliever for Logan. The field is located in the center of a fairly large military reservation. Hanscom is classified as a Feeder System High-Density airport according to the NASP classification criteria. Although air carrier activity accounts for less than 1% of total aircraft operations, general aviation accounts for over 95% of the total operations.

The airport is relatively close to State Highway 128, the main peripheral highway which encircles the entire Boston area. The Massachusetts Turnpike (U.S.90) a major interstate artery, intersects Highway 128 approximately nine miles south of Hanscom Field. Masspike provides a direct connection to the Boston Central Business District as well as to the Callahan and Sumner tunnels which are the primary access route to and from Boston Logan Airport. The large majority of electronics and aerospace research and manufacturing firms within the Boston area are located on Highway 128 between Masspike and Hanscom. Highways 2 and 2A provide an excellent access route from Cambridge (M.I.T., Harvard, Boston University, D.O.T. Transportation Systems Center, etc.) which are a major source of short-haul air passengers. Ground access congestion at peak hours is quite severe in the vicinity of the airport due to its close proximity to large electronic manufacturing plants, and the City of Bedford. Congestion could be relieved considerably by improving the existing roadways leading to the airport.

Although Boston itself is considered by the EPA to be a Priority I area with respect to hydrocarbons and carbon monoxide, the local air quality near Bedford is believed to be relatively uncontaminated, the area being semi-rural. The addition of high levels of commercial air traffic at Hanscom would result in some reduction in local air quality primarily due to increased surface traffic (see Section 8.3.2.2). However, since existing air quality is relatively high, the slight increase probably would pose no real problem.

Existing runway 5/23 was selected as a STOL runway due to its proximity to the existing terminal area. As shown in Figure 8-25, the 95 EPNdB footprint of the E·150·3000 systems analysis aircraft, when using runway 5, is essentially within the field boundary. Approximately 54% of the 90 EPNdB footprint also is airport contained. The approach lobe extends over a hilly sparsely populated area; however, the departure lobe impacts on Hartwell Road and extends into the outskirts of Bedford. Use of a curvilinear departure path (see Section 8.3.1.5) significantly minimizes the impact on the urbanized areas. Use of runway 11/29 would result in over 85% airport containment of the 90 EPNdB footprint, with practically no impact on urbanized areas and may be preferable from community noise considerations. Based on estimated STOL operational levels the NEF value of the 90 EPNdB contour shown would be approximately 26, which is on the upper limit of the "clearly acceptable" level for residential impact, as defined by HUD.

Summarizing the above evaluation, STOL operations at Hanscom Field will:

- o Result in some increase in surface traffic congestion, however, this can be alleviated by local roadway improvments.

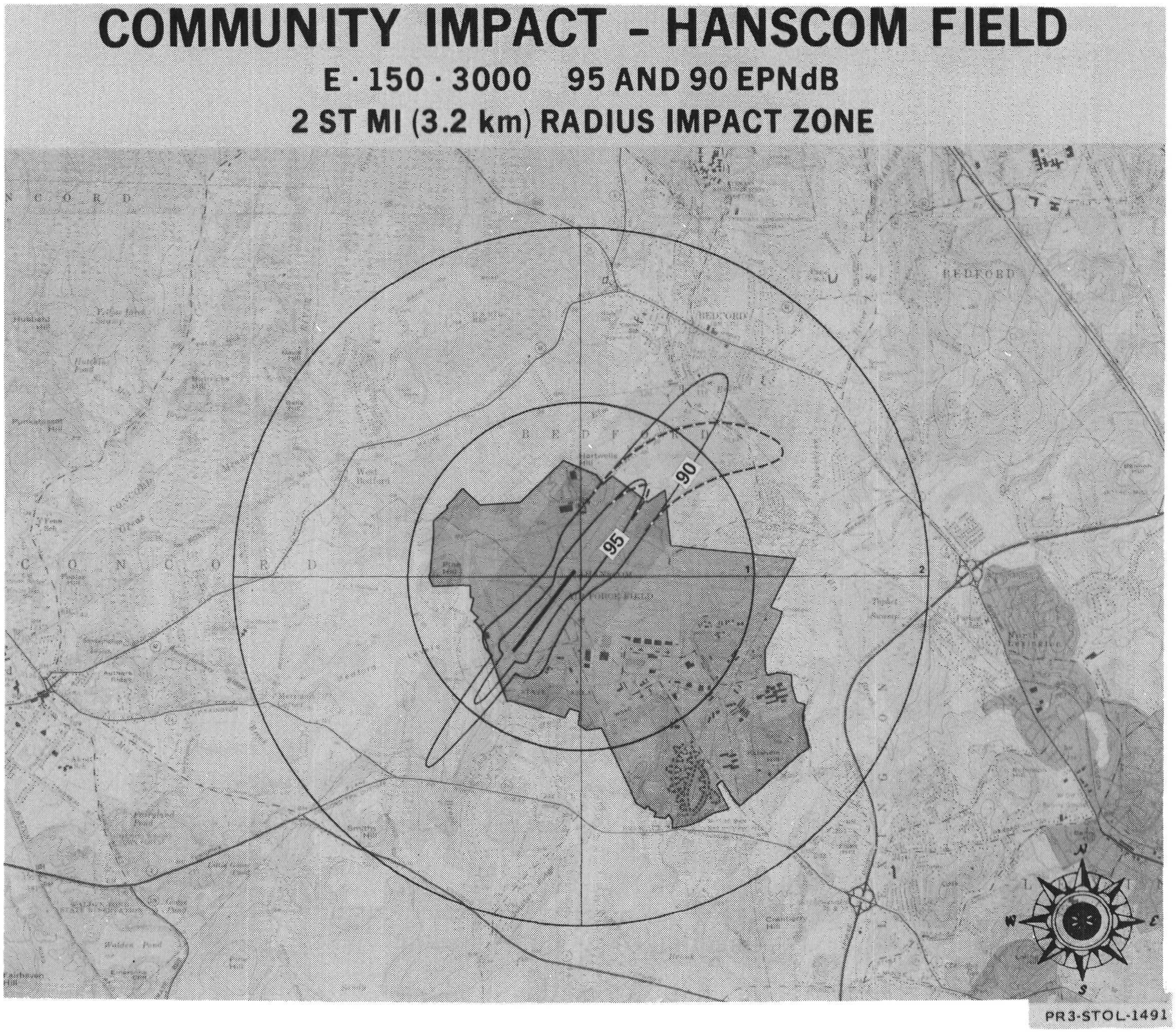

COMMUNITY IMPACT - HANSCOM FIELD
E · 150 · 3000 95 AND 90 EPNdB
2 ST MI (3.2 km) RADIUS IMPACT ZONE
95
90
1
2
CONCORD
BEDFORD
N
S
E
W
PR3-STOL-1491

Figure 8-25

- Result in a slight, but almost immeasurable increase in air pollution in the localized area due to increased automobile traffic. STOL, with lower emission levels than CTOL, will provide an overall reduction in total aircraft emissions within the Boston Metropolitan area (assuming an equivalent number of STOL versus CTOL movements of like size aircraft).
- Result in relatively low aircraft noise levels (in the NEF 25-27 range) with minimum impact on the adjoining community.

Community acceptance problems are anticipated, however, due to existing community concern over commerical expansion of the airport.

8.5.2.3 Oakland International. Oakland International Airport is classified as a Secondary System, High-Density Airport. Oakland International not only serves the entire east bay region of the San Francisco bay area but also serves as a long and short-haul reliever for San Francisco International. The airport handles a large percentage of cargo flights as it is in close proximity to many of the major industrial complexes of the bay area. The majority of air carrier traffic utilizes the primary ILS runway 11/29 at the south end of the field with approaches and departures over the bay. The older section of the airport, North Field, has two shorter parallel runways, 9R/27L and 9L/27R. Runway 27R currently has Category I all-weather capability and was selected as the preferred runway for STOL operations. STOL operations at Oakland, therefore, would be separated from CTOL and would use separate facilities.

North Oakland was selected as the primary high-density STOLport to serve both East Bay (Oakland, Alameda, Berkeley, Vallejo) short-haul traffic and San Francisco short-haul traffic. The North Field area is less than two statute miles (3.2 km.) from two major transportation arteries leading into San Francisco— the Nimitz Freeway and BART (Bay Area Rapid Transit). A major station point (Coliseum) of the BART system is located near the main entrance roadway to the airport, and a major off-ramp connects the Nimitz Freeway with the airport. The BART system, when fully operable will provide approximately 5 minutes service to downtown San Francisco.

Review of the many STOLport site studies conducted in the San Francisco area revealed that all of the potential sites near the San Francisco CBD area presented severe airspace, access, runway alignment, noise and/or community dislocation problems. North Oakland exhibits very few of these problems and was selected as the preferred site to serve downtown San Francisco. Although surface access congestion is high on the Nimitz Freeway, use of the BART system will eliminate a major portion of access delays currently encountered by air passengers during peak hours. Using transit not only will minimize traffic congestion, but also will provide a significant reduction of automotive emissions within the region.

San Francisco is classed as a Priority I air quality control area by the EPA (reference 8-20). Many industrial plants are located near the airport as are major traffic arteries. A study of the region's air quality problems (reference 8-28) notes the Oakland Airport is located downwind of many non-aviation related air pollution sources in San Francisco and Oakland, and that the aviation pollution potential of Oakland Airport is considered marginal.

The reduced emission levels of STOL aircraft and operations should provide a significant reduction in aircraft emissions (over conventional CTOL aircraft) as noted in Section 8.3.2.

The noise impact of STOL operations at the Oakland Airport is shown in Figure 8-26. The E·150·3000 baseline aircraft 95 EPNdB takeoff lobe impacts slightly on a new residential area to the west of the runway. However, using a curvilinear departure path (see Section 8.3.1.5) this noise sensitive area can be completely avoided with the lobe diverted over a golf course. NEF value of the 90 EPNdB footprint shown, based on estimated 1985 STOL operational levels is approximately 25. This is within the "clearly acceptable" range defined by HUD (reference 8-17).

In summary, it is concluded that STOL operations at Oakland

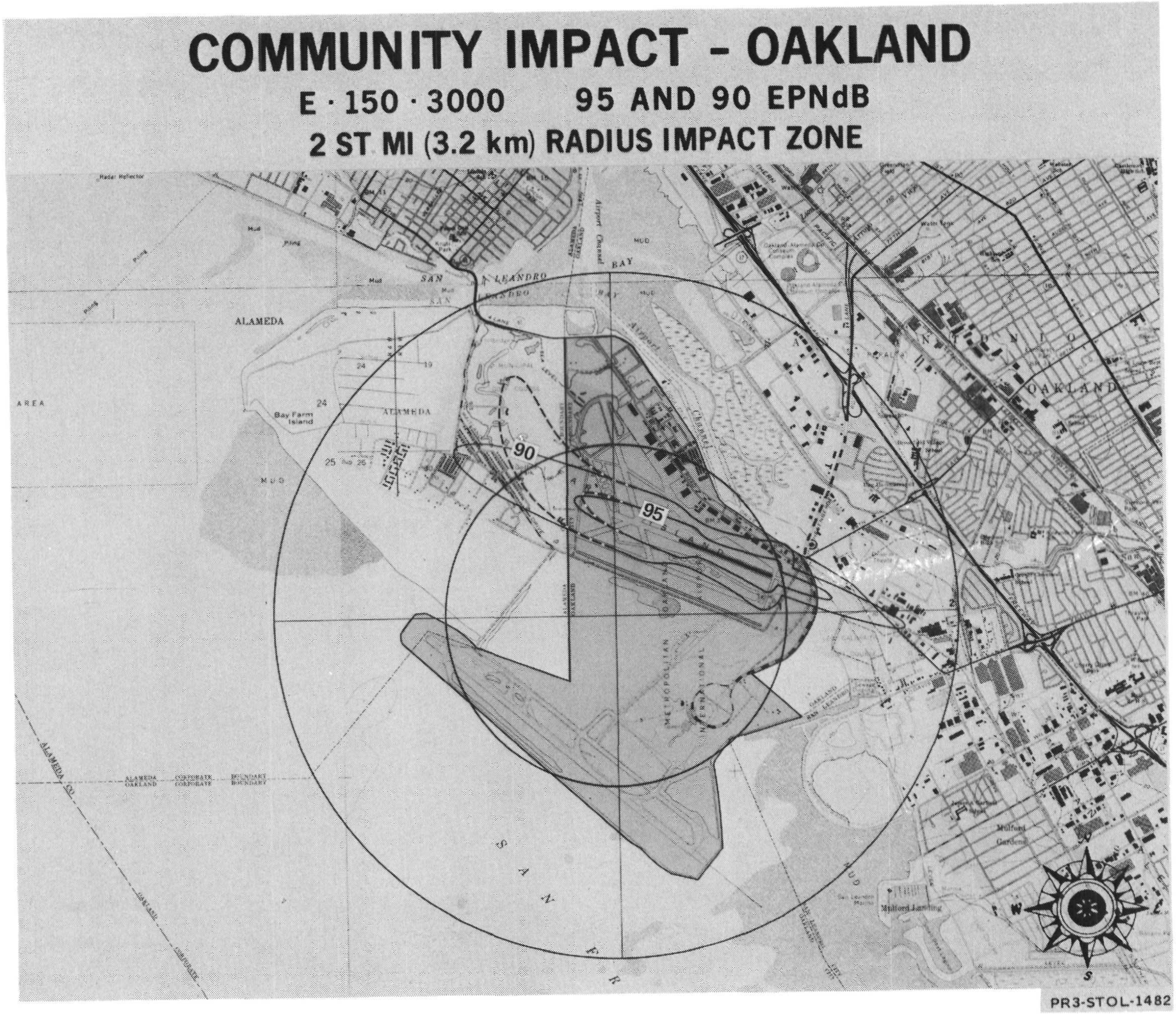

COMMUNITY IMPACT - OAKLAND
E · 150 · 3000 95 AND 90 EPNdB
2 ST MI (3.2 km) RADIUS IMPACT ZONE
ALAMEDA
Bay Farm Island
OAKLAND
SAN LEANDRO
Airport Channel
BAY
MUD
METROPOLITAN
INTERNATIONAL
90
95
Mulford Gardens
Mulford Landing
PR3-STOL-1482

Figure 8-26

International will:

- o Provide access congestion relief.
- o Reduce both aircraft and automotive pollution levels.
- o Result in only very minor noise impact on the neighboring communities. The noise impact is considered to be within the completely acceptable range.

8.5.2.4 Moffett Field. N.A.S. Moffett Field is a military airport located on the lower San Francisco Peninsula near the community of Mountain View. The airport is approximately midway between San Francisco and San Jose and is conveniently located near the major air traffic generation center of the lower San Francisco Bay Area. The airport, originally developed by the Navy as a dirigible base, is the home of NASA Ames Research Center, and also is an active Navy base for large land-based aircraft. The airport has excellent runways which are presently under utilized. Commercial airline operations were conducted at Moffett Field several years ago when San Jose Airport runways were temporarily closed.

The primary access route is the Bayshore Freeway extending from San Jose north to San Francisco and connecting to Oakland via the Bay Bridge. The freeway parallels the South shore of San Francisco Bay and is the main artery collector for all the cities along the peninsula (San Mateo, Redwood City, Menlo Park, Palo Alto, Mountain View, Sunnyvale). The freeway is presently highly congested and a second parallel artery (Route 280) was recently constructed approximately five miles west of the Bayshore Freeway. Route 280 also will serve Moffett Field.

Due to the increasing level of automobile traffic along the peninsula, airport access congestion will remain a problem through the forseeable future at any airport location on the south shore of the bay.

The EPA considers the region as a Priority I control area for HC and CO contamination. The recent Bay Area Regional Air Pollution Control District Study on Aircraft Emissions (reference 8-28) states that the Mountain View area (Moffett Field) "has high pollution potential." Any increase in air or automobile surface traffic will have some impact on the air quality of the South Basin area. The STOL aircraft contribution will be relatively insignificant, however, the supporting automobile traffic could result in a significant air pollution increase. Extension of the BART system south toward San Jose may ultimately provide some degree of air quality improvement.

The community noise impact of STOL operations at Moffett Field is shown in Figure 8-27. The 95 EPNdB footprint of the E·150·3000 systems analysis airplane is entirely contained within the field boundary. The approach lobe of the 90 EPNdB footprint extends over the Bay Shore Freeway (a high source of ambient noise) and impacts on approximately 10 acres (4 hectares) of the Sunnyvale golf course. The takeoff lobe extends slightly beyond the field boundary over the uninhabited salt evaporation beds to the north. The 90 EPNdB footprint is approximately 93% contained within the airport boundary and does not impact on any permanent structures. STOL noise therefore should not present a problem.

In summary, introduction of STOL operations into Moffett Field will provide congestion relief at both San Francisco and San Jose Airports, but will undoubtedly face community opposition with respect to surface traffic congestion and air pollution. Community acceptance of noise impact is not expected to be a critical problem at this location.

The study did not investigate the problem of joint military-civil use of the airfield. In the event Moffett Field should receive further consideration as a potential site for commercial STOL operations, this subject should be investigated in-depth.

COMMUNITY IMPACT - MOFFETT FIELD

E · 150 · 3000 95 AND 90 EPNdB

2 ST MI (3.2 km) RADIUS IMPACT ZONE

Figure 8-27

8.5.2.5 Chicago Midway. Midway Airport was one of the first designated air carrier airports in the nation. Dedicated in 1927, as Chicago Municipal, the airport was the hub of the developing air transportation network in the Midwest Region. The airport also was an en route stop for the early transcontinental routes served by the DC-3's. In the 1930's, 40's, and 50's, Midway was rated as the world's busiest airport. Many of the nations early airlines were headquartered there, including United and American.

With the opening of O'Hare in 1960, the airlines transferred operations to the new airport and Midway reverted to a general aviation airport. United was the first carrier to return in 1964. Others followed and short-haul airline activity gradually increased to its present level. Approximately thirteen airlines now operate short-haul flights from Midway, however, activity is relatively light and the airport is highly underutilized. In recent months, in order to relieve O'Hare and stimulate economic activity at Midway, (in response to citizen group requests) the Chicago Department of Aviation petitioned the CAB to transfer up to 20% of O'Hare's short-haul operations to Midway. A hearing was recently held and the CAB is currently considering the application. Favorable action is anticipated. Midway is currently classified a NASP Secondary System - Medium Density airport.

Midway is one of the smallest of the nation's air carrier airports with a total area of only 640 acres. Residential and commercial structures completely surround the airport on all sides with houses extending right up to the city streets bordering the airport. As the airport was built prior to the advent of all-weather operations, the airport has no ILS clear zone areas extending beyond the field boundary.

The airport has two sets of primary diagonal parallel runways 4/22 L and R, and 13/31 L and R; also, two shorter general aviation runways 9R/27L and 18R/36L. The latter is not now operational. Air carriers normally operate from runway 31L, however, runway 4R is used at times during the winter months due to wind conditions. Since current Midway operations are predominantly short-haul, these same runways were used for the STOL impact evaluation.

As shown in Figure 8-28, the 95 EPNdB footprint of the E·150·3000 systems analysis airplane is almost entirely contained within the airport boundaries when using either of the diagonal runways. The approach lobe impacts slightly on the residential areas of the southeast and southwest corners of the airport. The 90 EPNdB footprint is only approximately 48% contained within the airport, with the departure lobes extending approximately 3/4 of a mile (1.2 km) into the surrounding residential communities. Several schools also are within or immediately adjacent to, the impact area of runway 31.

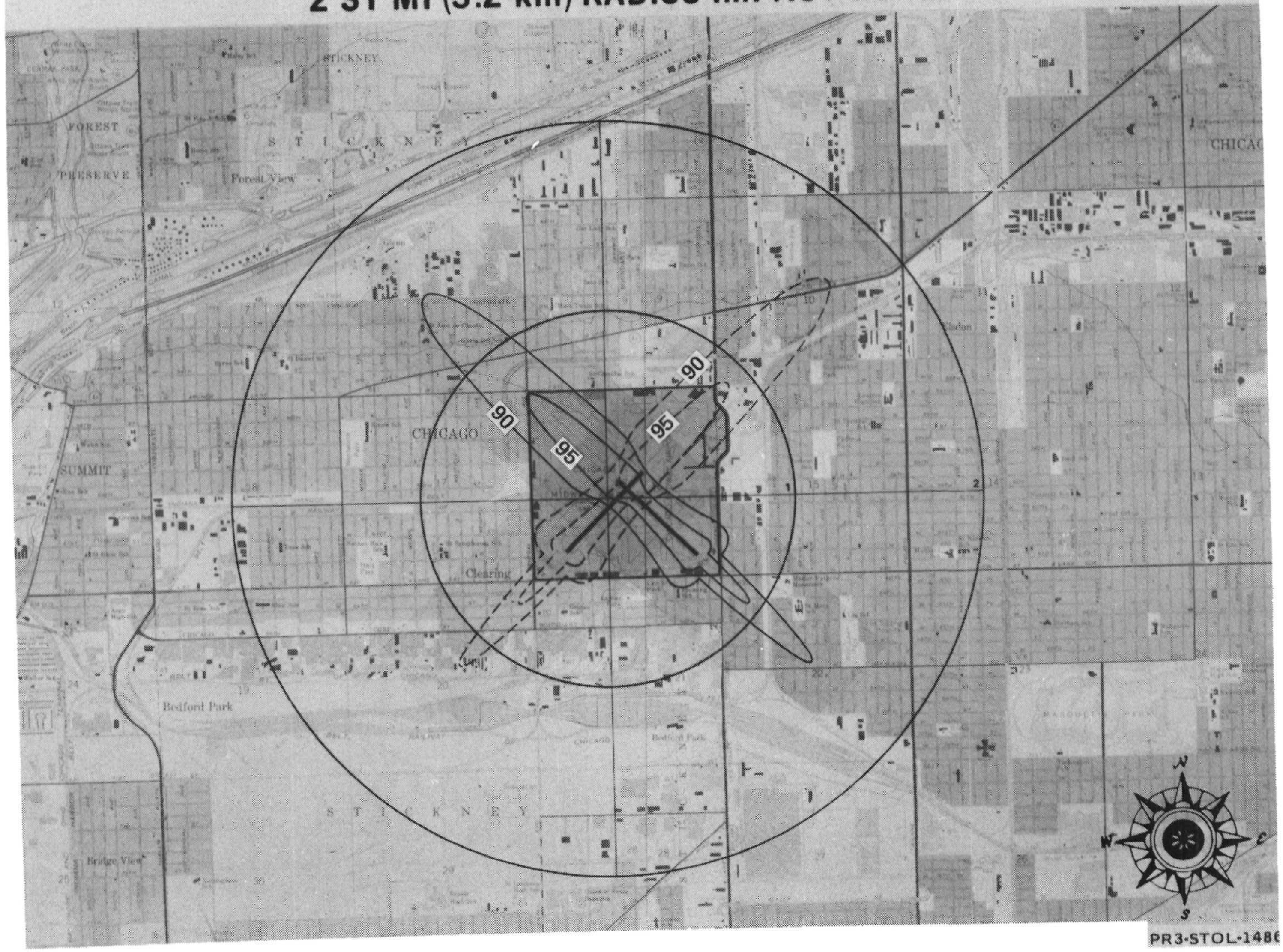
If STOL replaces CTOL operations at Midway, a significant reduction in aircraft noise would result. Based on estimated 1985 STOL operational levels, the NEF value of the 90 EPNdB contour shown would be approximately 27. This is in the midpoint of the "normally acceptable" range for residential areas as defined by HUD in reference 8-17.

Midway is approximately 10 miles (16 km) from the main Chicago Loop (CBD) area. The Southwest Expressway which funnels into the downtown Loop area passes within 2 miles (3.2 km) of Midway to the north. A major four lane north-south surface street, Cicero Avenue, connects directly with the airport terminal area. Congestion on the expressway and connecting surface

COMMUNITY IMPACT - CHICAGO MIDWAY

E · 150 · 3000 95 AND 90 EPNdB

2 ST MI (3.2 km) RADIUS IMPACT ZONE



PR3-STOL-148

Figure 8-28

streets is relatively high due to normal traffic. An increase in Midway operational levels, CTOL or STOL, will result in additional congestion. Since Midway has only limited parking area, remote ticketing terminals undoubtedly will be required. As stated in Section 8.3.3.2, this should provide a major reduction in access congestion and automobile emissions.

Air pollution levels in the South Chicago area currently are quite high due to its proximity to many large industrial plants and major expressways. EPA has classified the Chicago Region (O'Hare) as Priority I for HC and CO emissions (reference 8-20) Midway undoubtedly would be similarly classified. Replacement of CTOL operations with STOL will provide a significant reduction in total aircraft emissions at the airport (see Section 8.3). As noted above, a much greater improvement in air quality also is possible if the remote terminal concept is used and supporting automobile traffic is kept to a minimum.

Summarizing the above impact evaluation, STOL operations at Midway will:

- Have no greater impact on surface access congestion than a comparable number of CTOL operations. Adoption of remote terminals and use of transit, buses, or limousine for passenger transportation will provide significant congestion relief of either STOL or CTOL operations.
- Reduce total aircraft emissions in comparison with a similar number of CTOL operations. A significant additional reduction in the total airport emissions is possible with the adoption of a remote terminal concept as noted above.

- o Will significantly reduce community noise impact compared to CTOL operations. Noise impact will still be a problem; however, the community may be willing to accept the relatively low STOL noise levels. (See Appendix 15-7 for a discussion on Chicago Midway community reaction.)

8.5.2.6 Meigs Field. Chicago's Merrill C. Meigs Field is considered ideal for high density STOL operations. The airport is located on the old Chicago Worlds Fair site; a land fill on the western shore of Lake Michigan. It is within five minutes driving time from the city's main traffic generation point— The Chicago Loop area. Due to its offshore location, the airport has relatively little noise impact on the adjacent highly urbanized land areas. The location has one further advantage— it is located near Soldiers Field Stadium and the McCormick Place Exhibition Hall and adjacent parking lots. The sports stadium is used only infrequently and could be jointly utilized for airport parking and terminals without compromising its present purpose. As shown in Figure 8-29, the airport is separated from the mainland by the Burnham Park Harbor Yacht Marina which is approximately 500 ft. (152 m) in width at the present terminal location at midpoint along the runway. Conversion to a major high density STOLport could be accomplished by locating the ticketing terminal adjacent to Soldiers Field and transporting passengers to the airport by aerial tram or through a concourse tunnel under the marina.

Meigs Field is classed as a general aviation airport primarily serving itinerant corporate and private G.A. aircraft. Approximately eight third-level carriers and air taxi operators currently operate from Meigs. The airport's single 3950 ft. (1204 m) runway, 18/36, is reputedly the "world's busiest single runway," with approximately 83,000 movements recorded in 1971. Maximum day operations in 1971 were 528. A second parallel runway could easily be added by extending the fill area farther into Lake Michigan. This could be accomplished with minimal environmental impact.

Primary access to Meigs (and to Soldiers Field) is by Lake Shore Drive, a major ten lane traffic artery which extends along the western shore of Lake Michigan and connects with other expressways to O'Hare and Midway. Present access from the expressway is by a short connector street at the North end of Soldiers Field, which also serves Adler Planetarium and Burnham Park Harbor.

The prevailing on-shore winds from Lake Michigan keeps the air fairly clear of traffic smog in the immediate airport area; however, the pollutant levels of the entire Chicago area are relatively high. EPA has classified the Chicago area as Priority I with respect to HC and CO emissions (reference 8-20).

The noise impact of the E·150·3000 systems analysis STOL aircraft is shown in Figure 8-29. The 95 EPNdB footprint extends beyond the airport boundary in both approach and departure lobes, however, the off-airport impact is entirely over water. Using a straight-in approach and departure, the 90 EPNdB footprint takeoff lobe impacts slightly on the uninhabited shoreline area and a section of Lake Shore Drive. By using a curvilinear departure path on climbout, as described in Section 8.3.1.5, the land impact can be completely avoided. Based on the estimated 1985 STOL operational levels, the 90 EPNdB contour translates into a NEF value of approximately 29. This possibly could result in slight noise interference with Adler Planetarium lectures. The planetarium is located just outside the 90 EPNdB approach lobe as indicated on the community impact map. The single structure planetarium could be soundproofed if necessary.

In summary, Meigs is considered an ideal location for a high density STOLport. Meigs Field community impact conclusions are as follows:

- o STOL operations will have essentially no noise impact on the adjacent area, with the possible exception of

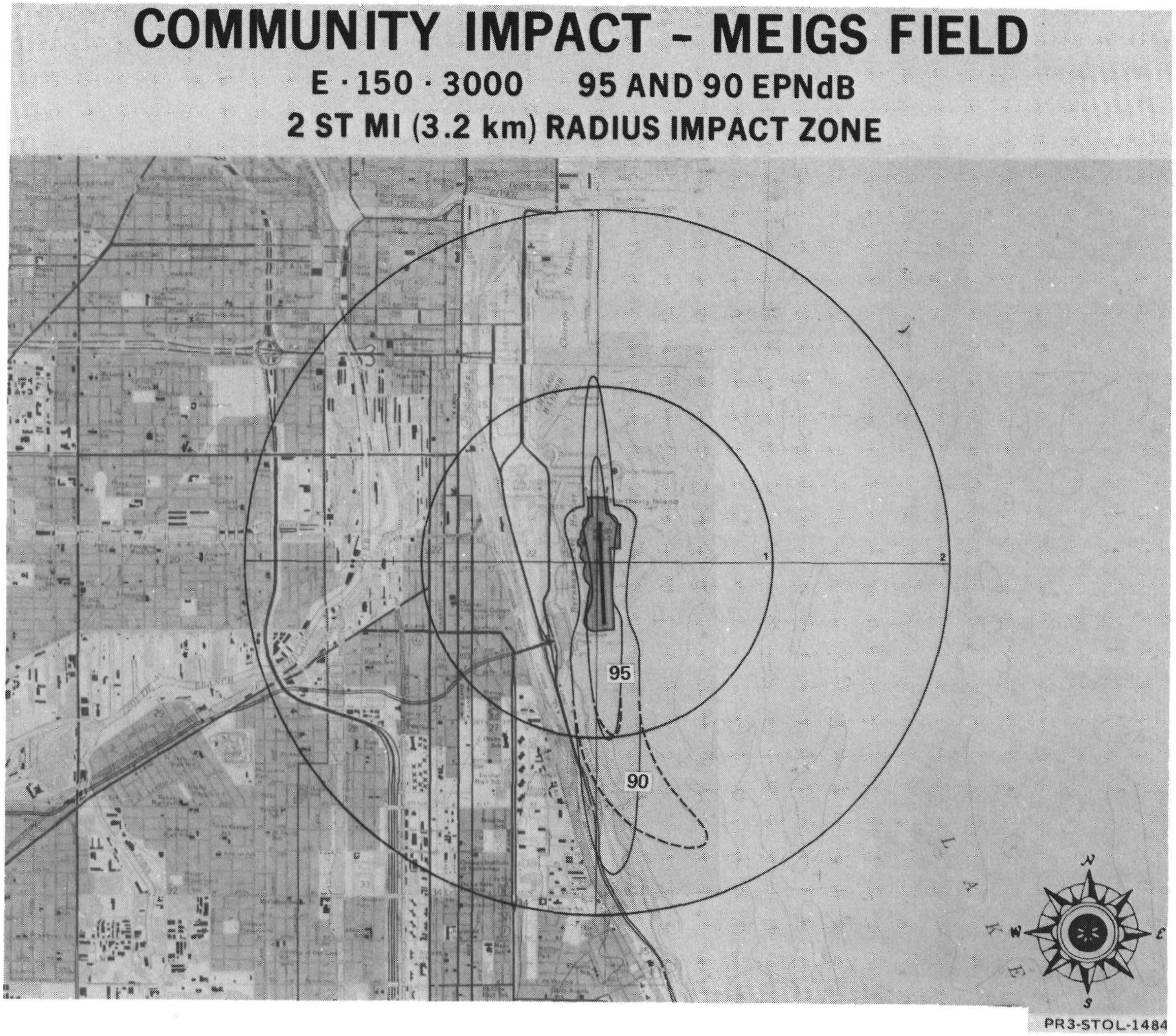

COMMUNITY IMPACT - MEIGS FIELD
E · 150 · 3000 95 AND 90 EPNdB
2 ST MI (3.2 km) RADIUS IMPACT ZONE
95
90
1
2
L A K E
PR3-STOL-1484

Figure 8-29

Adler Planetarium.

- Access is within five minutes of the Chicago Loop, and traffic congestion does not appear to be a major problem.
- The low emission levels of STOL aircraft will result in significantly less aircraft pollution than comparable CTOL aircraft operations. Remote parking and terminal location would greatly reduce airport related automotive emissions.
- Relatively no community opposition with respect to environmental impact is anticipated.

8.5.2.7 Orange County. The Orange County Airport near Santa Ana is perhaps one of the newest and most controversial airports in the nation. The airport serves both short-haul air carrier and general aviation operations and is currently a major reliever of LAX traffic. According to NASP classification, Orange County is rated as a Secondary System, High Density airport. Three air carriers, Air California, Air West, and Golden West Airlines operate from Orange County Airport. Air California's corporate headquarters are located on the field. Based general aviation aircraft are primarily corporate-owned, and a few are jet powered.

Aircraft noise has been a major problem at Orange County and strict noise abatement procedures are in effect. The high socio-economic community of Newport Beach is located to the south of the airport with many costly privately owned residences located within the present high noise impact zone. The airport was one of the first in the U.S. to install noise monitoring equipment. Every takeoff and landing now is monitored. Noise complaints have been so frequent and vociferous that the County Supervisors and the Airport Administration have limited the number of daily flights of both second level carriers operating jets. Night operations (11 pm - 7 am) are prohibited. These restrictions are a severe constraint both operationally and economically.

The airport lies within the intersections of two major arteries (the San Diego and Newport Beach Freeways) and McArthur Boulevard, and is so situated that further expansion is impossible. Access is excellent from all directions and at present relatively uncongested. The airport serves the entire South Central Los Angeles basin and coastline area. This region is one of the fastest growing areas of the U.S.

Orange County Airport's location at the southwest coastal end of the Los Angeles basin makes it subject to high smog and air pollution levels a large percent of the time. STOL aircraft, with their relatively low emission characteristics should significantly reduce aircraft emissions compared to an equivalent number of CTOL flights. Airport related automobile traffic is the major source of airport pollutants. An extensive discussion of STOL airport air quality impact on Orange County Airport is contained in Section 8.3.

The airport's primary runway, 01L/19R is approximately 5700 ft. (1737 m) in length and at present is non-instrumented. As shown in Figure 8-30, the 95 EPNdB contour of the systems analysis E•150•3000 airplane using runway 19R is completely contained within the airport boundary. The approach lobe of the 90 EPNdB contour extends slightly beyond the field boundary to the North. As shown, the takeoff lobe extends over an arroyo at the upper end of Newport Bay, which is bordered by residential property on both sides. The impact, however, is minimal compared to that of current jets. Existing community reaction to jet aircraft noise is so severe that not only are airline operations severely constrained, but the actual survival of the airport as an air carrier facility is threatened (see discussion in Appendix 15-7).

Based on the 1985 estimated level of STOL operations at Orange County Airport the NEF value of the 90 EPNdB contour is only 23 which is well within the clearly acceptable level as defined by HUD in reference 8-17.

Summarizing the overall community impact of STOL operations at Orange County Airport it is concluded that STOL will:

- Reduce community noise impact by a significant amount over existing levels.

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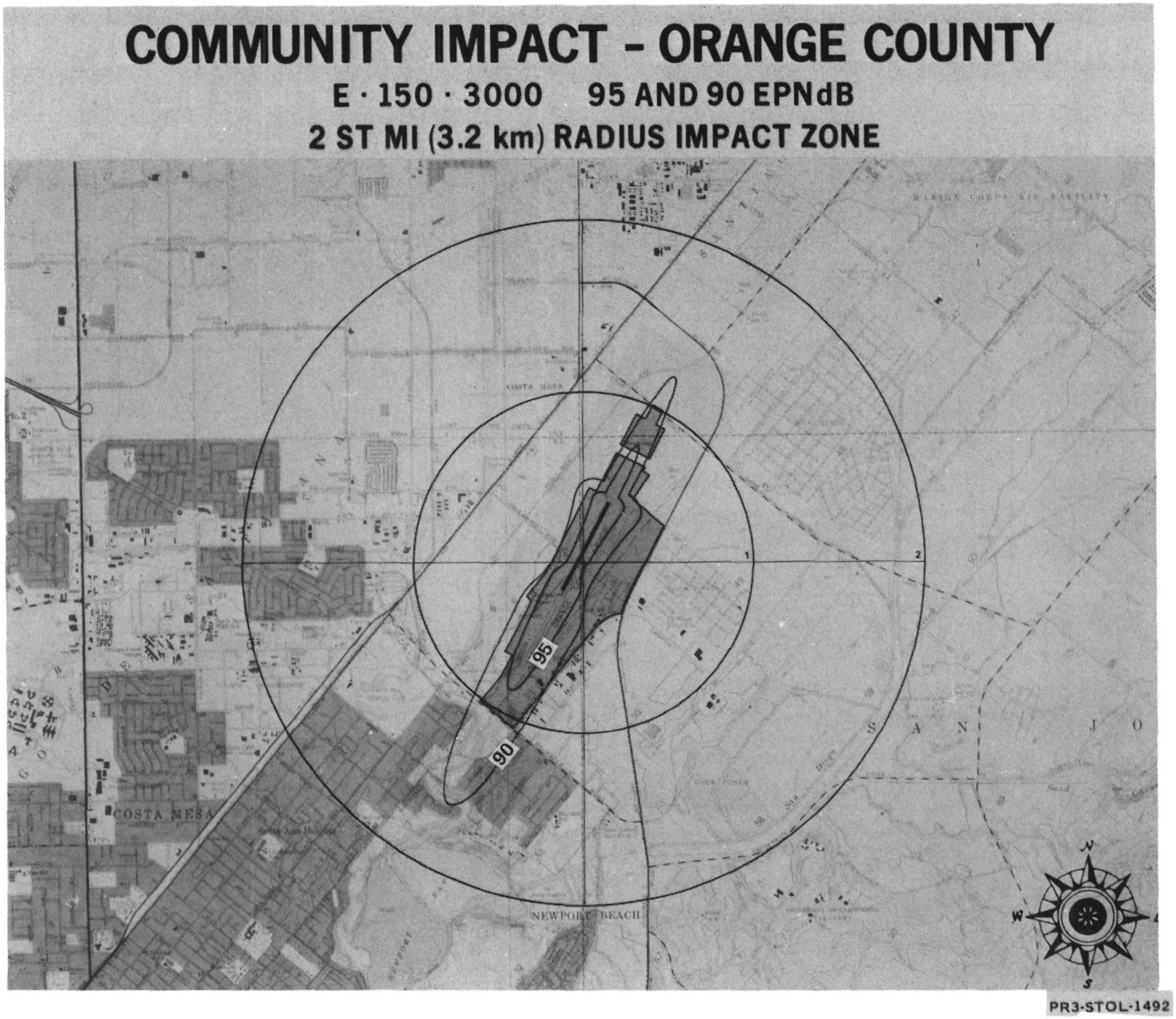

COMMUNITY IMPACT - ORANGE COUNTY
E · 150 · 3000   95 AND 90 EPNdB
2 ST MI (3.2 km) RADIUS IMPACT ZONE
95
90
1
2
COSTA MESA
NEWPORT BEACH
S A N J O
N
W
S
PR3-STOL-1492

Figure 8-30

- Result in an improvement in air quality in the vicinity of the airport, if CTOL operations are replaced by STOL.
- Not result in severe local traffic congestion.

Community acceptance of STOL operations at Orange County Airport even with the reduced impact noted above, is considered questionable— at least with the present community attitudes and highly organized action groups. Early introduction of the relatively quiet DC-10 and L-1011 at Orange County Airport may result in some softening of the present anti-airport attitudes of the local community.

8.5.2.8 El Monte. The El Monte Airport is a small general aviation airport located in the San Gabriel Valley section of the Los Angeles metropolitan area. As a STOLport, this airport would serve the communities of El Monte, Arcadia, Pasadena, Altadena, Ontario, Covina, Pomona, and Whittier. Santa Anita race track is approximately five miles (8 km) to the north. At the present time there is no scheduled air carrier service, although Golden West Airlines recently operated a scheduled air taxi service from the field. The airport is presently limited to aircraft of 12,500 lbs. (5670 kg) gross weight and jet operations are prohibited. The airport was selected for community evaluation as being representative of a G.A. airport with close sideline residential areas on both sides of the runway. The field area is only 89 acres (36 hectares) and the effective length of the single runway 01/19 is 3252 ft. (991 m).

Access routes connecting El Monte with other cities in the San Gabriel Valley and the Los Angeles CBD are the San Bernardino and Pomona Freeways to the south and the Foothill Freeway to the north. The San Bernardino Freeway passes within one mile (1.6 km) of the airport. The freeway has reserved bus lanes between Los Angeles CBD and El Monte which is the eastern terminus of the special access route. Route 605 Freeway is a major north-south artery to the east of the airport. Surface streets connect the airport and the freeways, with El Monte Boulevard being the main north-south route. Surface street and freeway congestion in the area is at present fairly high and would require improvement if a high level of STOL operations were introduced at the airport.

The airport's location, within the Eastern Los Angeles basin results in relatively high levels of air pollution occurring frequently during the year. Smog concentrations also are high in the area. EPA (reference 8-20) rates the Los Angeles basin as a Priority I area for HC and CO reduction. Introduction of additional air traffic, with its supporting automotive traffic would add to the area's existing air quality problems.

Some noise complaints have been received from the current level of G.A. operations, with most complaints received from the higher socio-economic community of Arcadia to the North. The noise impact of STOL operations at El Monte is shown in Figure 8-31. Only approximately 50% of the 95 EPNdB footprint is contained within the boundaries of the small field. The 90 EPNdB footprint is only 20% contained; however, the impacted areas primarily extend over industrial sites and the Rio Hondo Wash. One school and some residential areas are also impacted. The takeoff lobe extends over both Valley Boulevard and San Bernardino Freeway and impacts over an area with already high ambient noise. As shown, a curvilinear departure path (see Section 8.3.1.5) would direct the takeoff lobe over the Rio Hondo Wash and would result in a large decrease in community noise impact. Using 1985 estimates of STOL operations, the equivalent NEF value of the 90 EPNdB contour is 23. This is well within the "clearly acceptable" level as defined by HUD guidelines (reference 8-17).

It is concluded that STOL operations at El Monte Airport will result in the following community impact:

- o An increase in local ground traffic with relatively high local surface street congestion.
- o An increase in the already high air pollution levels. The STOL aircraft with low emission characteristics

COMMUNITY IMPACT - EL MONTE

E · 150 · 3000 95 AND 90 EPNdB

2 ST MI (3.2 km) RADIUS IMPACT ZONE

Figure 8-31

would have only very minor air quality impact - however, the increased levels of supporting automobile traffic would undoubtedly contribute to the area's existing air quality problems.

- Even though the airport is relatively small, the noise levels of STOL operations would not result in a significant community impact. The noise currently experienced in the Arcadia area would be considerably reduced.

- Community acceptance of STOL operations at El Monte is considered questionable due to congestion and pollution considerations.

- Mixed STOL and general aviation operations at this single runway airport are considered undesirable, especially at the 1985 STOL operational levels envisaged, due to wake vortex problems. General aviation aircraft possibly could be relocated to adjacent airports (e.g., Fullerton, Brackett, or Cable).

8.5.2.9 Montgomery Field. - Montgomery Field is in an excellent location to serve the entire Metropolitan San Diego area. The airport could serve as the southern terminus of the California Corridor short-haul airport network and would provide significant air and ground congestion relief at the San Diego Lindbergh Field. This airport is a relatively large,500-acre (202 hectares), general aviation airport located on Kearney Mesa approximately 5 miles (8 km) north of the San Diego CBD. The airport is near the current population center of the entire San Diego area. The field is approximately fi ve miles (8 km) south of the Miramar Naval Air Station which has a high level of military aircraft activity. Montgomery facilities are excellent and a new terminal was only recently completed. The airport has three runways, 05/23, and 10/28 L and R. Runway 28R is the preferred runway for STOL operations. The physical lengths of the runways are 3400 feet (1036 m). The airport is surrounded by light industrial plants and is within less than 2 miles (3.2 km) of the large Convair Kearney Mesa facility.

Montgomery Field is adjacent to a major north-south freeway, Route 395, which extends from San Diego north to Riverside and beyond. A newly constructed Freeway (Route 805) just north of the Airport connects the San Diego and Route 395 Freeways. Access, therefore, is excellent from all sections of the San Deigo Metropolitan Area and adjoining communities. The freeways and surface streets in the area are relatively uncongested.

At the present time the San Diego Area is relatively free of air pollution, however, since the area is one of the nation's fastest growing communities, this could change by 1985. The air-quality impact by STOL operations at Montgomery Field would be relatively insignificant.

Since current operations at Montgomery Field are all light propeller aircraft, airport noise has not been a major problem. Military operations at nearby Miramar Naval Air Station result in a relatively high ambient aircraft noise level in the general area, which tends to mask the G. A. aircraft noise at Montgomery. Noise complaints to date have been relatively few. As shown in Figure 8-32, approximately 70% of the 95 EPNdB footprint of the E.150.3000 systems analysis aircraft is within the airport boundary, and approximately half of the 90 EPNdB footprint is airport-con tained. The take-off lobes of both contours extend over an industrial area, northwest of the field. The area, however, is adjacent to the Route 395 Freeway and has a high ambient noise level. The forward portion of the 90 EPNdB take-off lobe extends over a gravel pit area at the edge of the mesa. Essentially, no residential areas are impacted -- at least at the present state of area development. Based on 1985 estimated levels of STOL operations at Montgomery, the 90 EPNdB contour translates into a NEF of 27 which is in the "clearly acceptable" range for industrial and manufacturing areas as defined by HUD in reference 8-17. Aircraft noise, therefore, is not considered to be a significant deterrent to STOL operations at Montgomery.

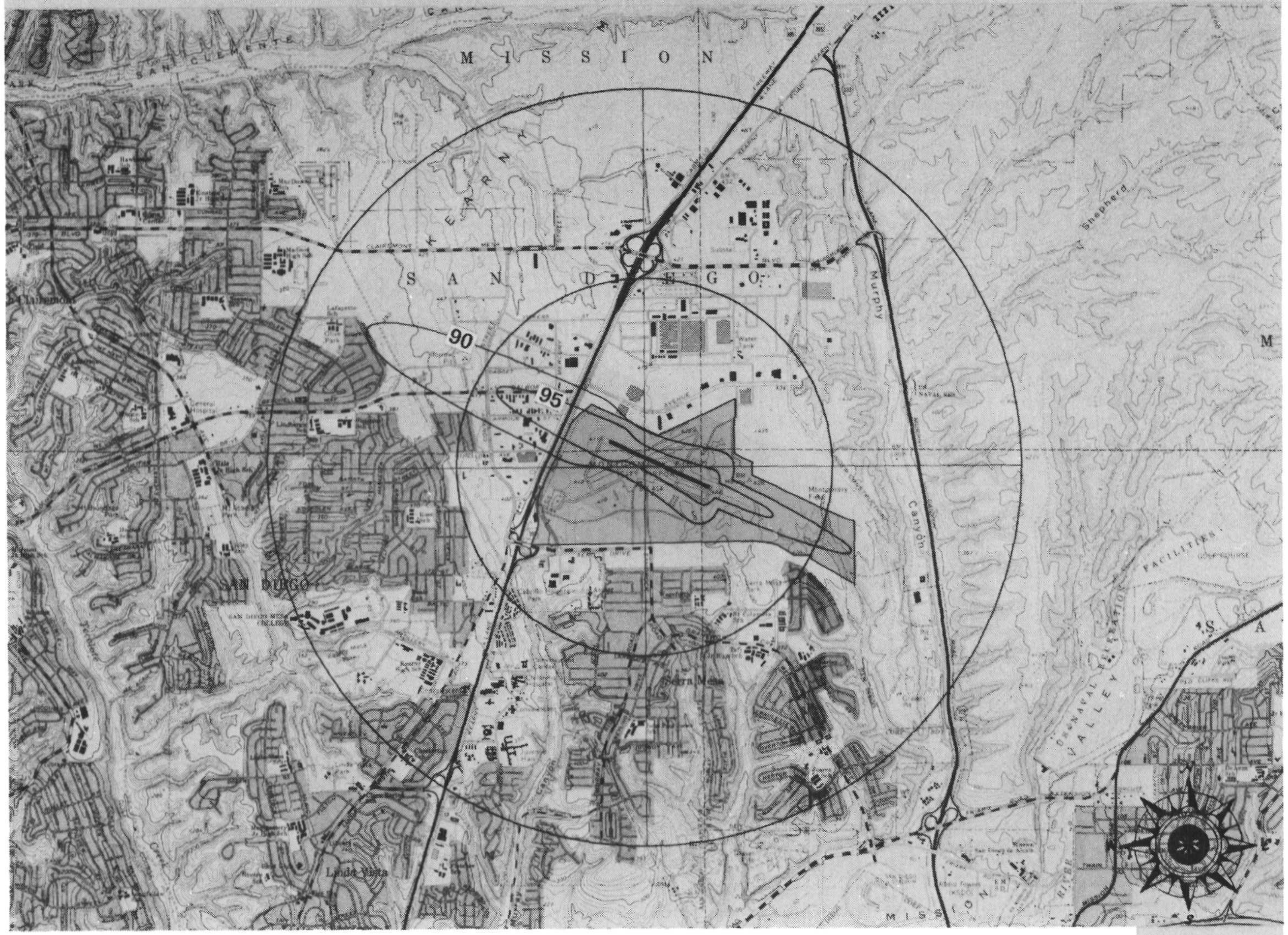
Community impact of STOL operations at Montgomery Field can be summarized as follows:

- o Aircraft noise impact, although large in area, will not affect large numbers of people. The noise level is within the "clearly acceptable range" for existing land use.
- o Access congestion is not anticipated due to the excellent freeway system in the San Diego area and immediate airport vicinity.

COMMUNITY IMPACT - MONTGOMERY FIELD

E · 150 · 3000 95 AND 90 EPNdB

2 ST MI (3.2 km) RADIUS IMPACT ZONE



PR3-STOL-1489

Figure 8-32

o Air pollution impact would be minimal and would primarily result from increased passenger automobile traffic.

8.5.2.10 General Patton STOLport. The General George S. Patton Military Reservation is a prospective STOLport site in the City of Commerce district of Los Angeles. The site was initially investigated as a STOLport location by the Aerospace Corporation, as discussed in reference 8-29. The site houses an existing Army Reserve Material Base and was originally developed during World War II as Cheli Air Force Station. A large clearing is located at the center of the reservation and is of sufficient size to permit construction of a 3000 ft. (915 m) strip. The site is within approximately seven miles of the Los Angeles CBD and has excellent surface access. The Long Beach Freeway runs adjacent to the western and southern boundaries of the base, and the Santa Ana Freeway is less than one mile (1.6 km) to the north. Major surface streets, Atlantic Avenue, Eastern Avenue, and Slauson Avenue also run adjacent to the property. The Los Angeles River, a 400 ft. (122 m) wide flood control channel, also could be used as a right-of-way for a future transit system connecting the STOLport site with the high traffic generation area of the Los Angeles CBD. The relatively small area of this compact urban site (approximately 360 acres,or 146 hectares) would not provide adequate parking area for high density STOL operations. Adoption of the remote terminal concept (see Section 8.3.3.2), therefore is considered mandatory at this highly urbanized site to relieve congestion— and also to reduce supporting automobile traffic pollution levels.

The STOL runway was tentatively located parallel to the existing warehouse structures as shown. The threshold was located approximately 500 ft. (152 m) from the Eastern Avenue boundary. Approaches and takeoffs would be in a west-northwest direction, as shown in Figure 8-33.

The 95 EPNdB footprint of the E·150·3000 systems analysis airplane

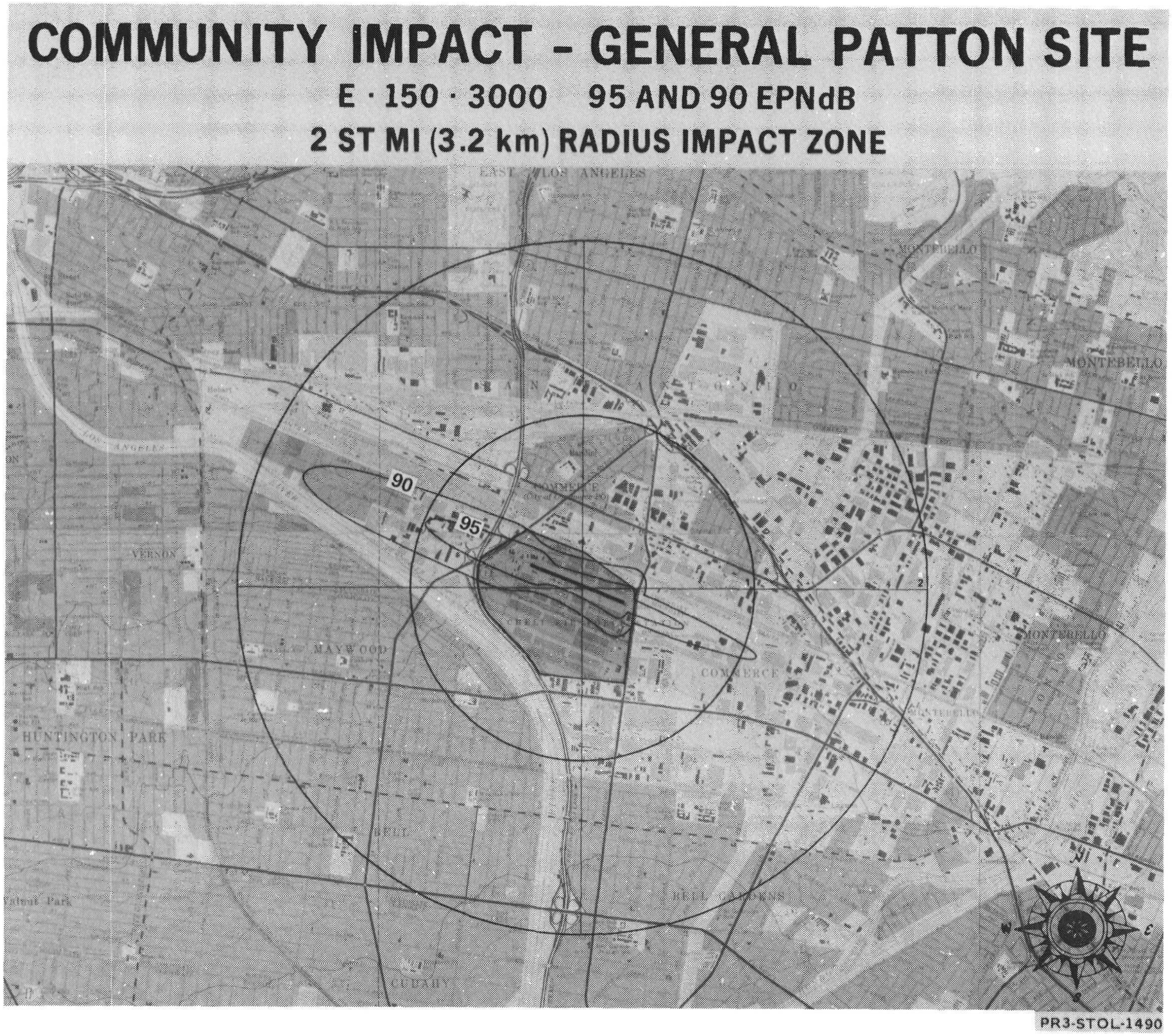

COMMUNITY IMPACT - GENERAL PATTON SITE
E · 150 · 3000 95 AND 90 EPNdB
2 ST MI (3.2 km) RADIUS IMPACT ZONE
EAST LOS ANGELES
MONTEBELLO
COMMERCE
MAYWOOD
VERNON
HUNTINGTON PARK
BELL
BELL GARDENS
CUDAHY
90
95
PR3-STOL-1490

Figure 8-33

is approximately 60% contained within the site boundary. Containment of the 90 EPNdB footprint is approximately 36%. The approach and takeoff lobes of both contours impact on the adjacent industrial/commercial areas. Using the 1985 projected STOL operational levels, the 90 EPNdB contour translates into a NEF value of less than 25. According to HUD guidelines, reference 8-17, this level is within the "clearly acceptable" range for industrial/commercial land use.

No adverse community noise reaction is anticipated as the entire area is highly industrialized and contains no residential property. The ambient noise level of the immediate vicinity is believed to be approximately 85 to 90 dBA due to proximity of heavy truck traffic on the adjacent freeway and surface streets. Further investigation as to site availability, prevailing wind direction, and runway construction and obstruction clearances should be conducted in the future if the site ultimately is given serious consideration. Similarly, the joint military-civil use of the site was not investigated.

The prospective site is located in the center of the Los Angeles basin, and as such, is subject to frequent temperature inversions and relatively high air pollution levels. EPA classes the Los Angeles area as a Priority I with respect to HC and CO emissions. The close proximity of major industrial plants and freeway traffic also results in relatively high ambient air pollution levels in the immediate site vicinity. Any addition, therefore, to existing air pollution could be a problem. Aircraft emissions are considered negligible, as discussed in Section 8.3; however, supporting automobile traffic could result in a significant increase in local air pollution. Adoption of the previously noted remote terminal concept would eliminate the major portion of the airport related ground traffic emissions, and is strongly recommended.

Summarizing the above, development of the General Patton Military Reservation as a high density STOLport will:

- o Have relatively no impact on the relatively high ambient noise level of the area. Aircraft NEF values are well within the acceptable range as defined by HUD.
- o Add to the area's existing high traffic congestion— unless the ticketing terminals are remotely located and some form of mass transit is used for passenger transport.
- o STOL aircraft will have minimal impact on the area's air quality, however, pollution from supporting automobile traffic could be a significant source of additional air pollutants. Again— adoption of a remote terminal concept will hold airport related surface traffic emissions to a minimum, and is strongly recommended.
- o Due to the existing industrial character of the adjacent communities, adverse community reaction is not anticipated.

8.5.2.11 Secaucus STOLport. A site near Secaucus, New Jersey has been tentatively selected by the Port of New York and New Jersey Authority, as a prospective STOLport location to serve both Manhattan and New Jersey short-haul air traffic. The site is located in a relatively undeveloped area of the New Jersey meadowlands west of Jersey City. The site is bordered by the Pennsylvania Central Railroad on the West and by the New York-Susquehanna and Western R.R. and Interstate Route 19 on the East. The location is approximately midway between the Holland and Lincoln Tunnels connecting New Jersey and Manhattan. Development of the New Jersey meadowland is currently the subject of a major political and environmental controversy (see Appendix 15-7 for a discussion of the area's community acceptance problems). The site, however, is well situated with respect to the major air traffic generation center of Manhattan Island provided adequate vehicular access routes are concurrently developed.

Runway alignment length and locations are highly tentative. The Port Authority has advised that the runway alignments would generally follow · La Guardia and Newark since air traffic must be coordinated between all major airports in the area. The Authority also has advised that runway lengths of 2000 ft. are presently planned. This length is considered inadequate for the 3000 ft. (915 m) field length required for the E·150·3000 baseline aircraft used for community evaluation in this study. It would appear, however, from the limited information available, that 3000 ft. (915 m) runways could be constructed on the site.

For purposes of this study, two diagonal intersecting 3000 ft. (915 m) runways 4/22 and 13/31 were located in the approximate center of the site as shown in Figure 8-34. It again should be emphasized that the

COMMUNITY IMPACT - SECAUCUS SITE

E · 150 · 3000   95 AND 90 EPNdB

2 ST MI (3.2 km) RADIUS IMPACT ZONE

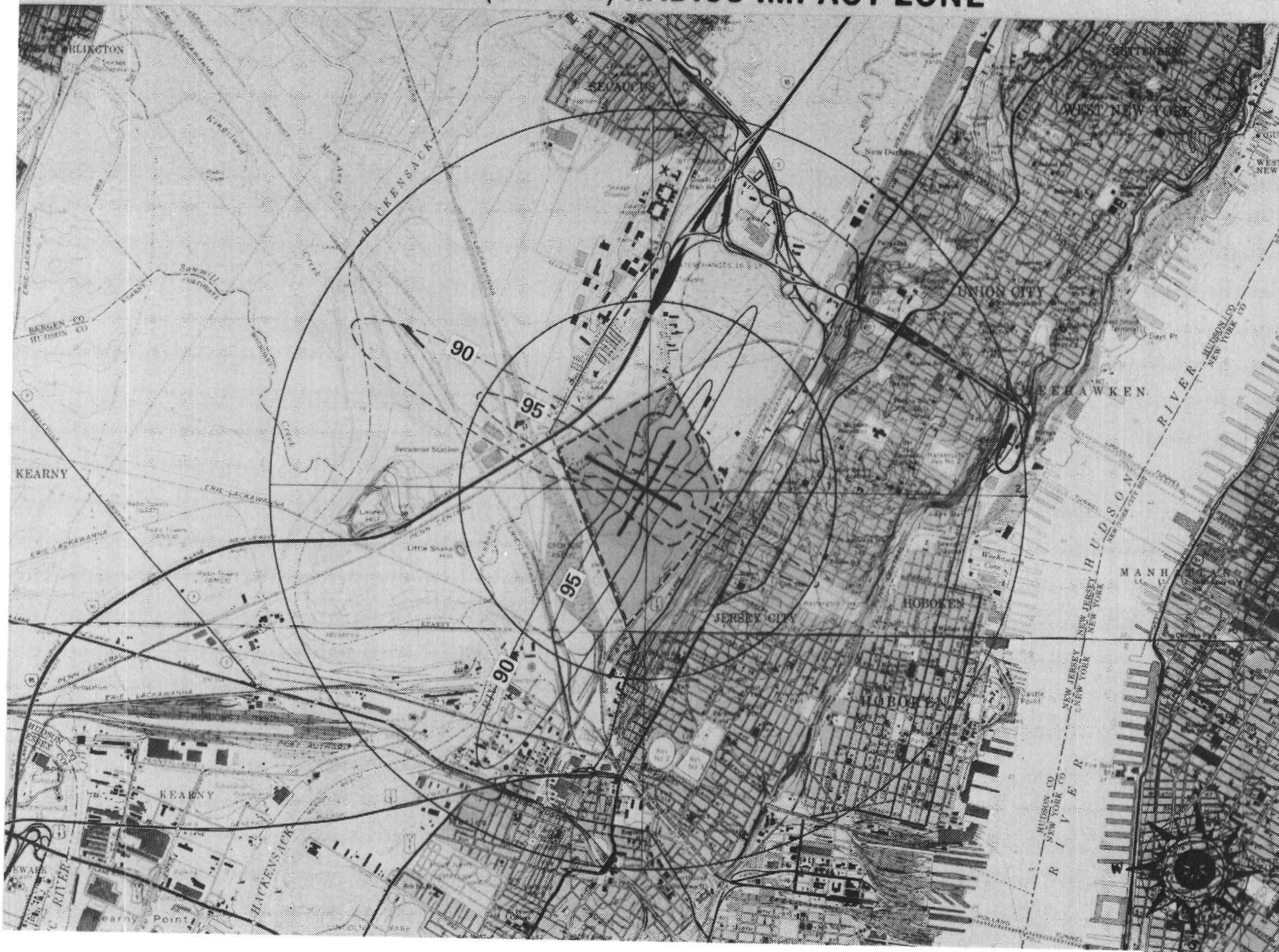


Figure 8-34

site location and runway configuration is only approximate and is highly tentative. It also was assumed that runway 22 would be the preferred use runway and runway 31 would be alternatively used dependent on wind conditions. As shown, the 95 EPNdB noise footprint of the E·150·3000 systems analysis airplane is approximately 50% contained within the site boundary and the 90 EPNdB footprint is approximately 38% contained. Both the approach and takeoff lobes extend beyond the site boundaries. The approach lobes, when operating from runway 22, are over presently undeveloped areas and the takeoff lobes are over railroad yards and a highly industrialized area on the bank of the Hackensack River near the Pulaski Skyway. The 1985 planned STOL operational levels translate the 90 EPNdB contour into a NEF value of approximately 28, which is in the "clearly acceptable" range as defined by HUD (reference 8-17) for industrial land impact.

When using runway 31 the approach lobe extends over the Hackensack River bluffs and impacts on approximately one block just to the west of Washington Park in Jersey City. The takeoff lobe extends over the New Jersey Turnpike and the Erie-Lackawanna tracks to the west. As previously mentioned, the relatively low 28 NEF impact is within the "clearly acceptable" range for industrial land use, and is in the "moderately acceptable" range for residential land use. Based on the above operational assumptions, community noise does not appear to be a major problem at this site location.

The relatively small site will require some method of surface access transportation other than automobile for the major portion of passenger traffic. Adoption of the remote terminal concept (Section 8.3.3.2) would appear to be a feasible method of reducing both ground traffic congestion and vehicular emissions at this location. As noted in Section

8.3.2, STOL aircraft emission levels are quite low and would have a relatively insignificant effect on local air quality.

Conclusions relative to community acceptance of the impact of high density STOL operation at the prospective Secaucus site are as follows:

- Although fairly large areas are impacted by STOL noise, the noise levels are quite low and are considered in the "acceptable" range as defined by HUD guidelines.

- The extent of community impact of surface vehicular traffic and resultant exhaust emissions is entirely dependent on the airport design concept ultimately chosen. Separation of passenger processing and aircraft operational functions by using remote passenger check-in terminal and some form of mass transit is considered essential for a STOLport in a highly urbanized location such as Secaucus.

- The overall problem of community acceptance is extremely complex at this location as the airport is only one element of a total area development plan. Ultimate acceptance of the Secaucus airport site is highly dependent on the final outcome of environmental impact studies, political considerations, and public hearings of the total area development.

8.5.1.12 Washington National. Due to its key role as the southern terminus of the Northeast Corridor air transportation network and its extreme importance to the national short-haul air transportation network, Washington National Airport was added to the list of airports originally selected for community acceptance surveys. Washington National's close proximity to the many government agency offices in D.C., and nearby Virginia and Maryland make it an ideal location for regional short-haul operations. Aircraft noise has been a serious problem at National for many years. For a long period jet operations were prohibited, however, the restriction was relaxed in 1966 and short and medium range operations of B-727 and smaller sized jet aircraft were permitted.

Surface traffic congestion, especially during peak morning and evening hours, is presently severe on the main airport access routes. Conversion from CTOL to STOL operations at National will have essentially no affect on access congestion. Existing traffic congestion problems must be solved prior to the 1980's if Washington National is to function as a high density short-haul airport.

Conversion from CTOL to STOL operations will significantly reduce aircraft emissions as noted in Section 8.3.2. However, exhaust emissions from supporting automobile traffic will not be affected since ground transportation requirements are a function of the total number of passengers transported, — and are independent of aircraft type (other than passenger capacity).

The community noise impact of STOL operations will be significantly lower than that of comparable advanced generation CTOL aircraft. As shown in Volume II - AIRCRAFT, the 90 EPNdB footprint area of the E·150·3000 system analysis airplane is approximately 50% less than that of the representative 1980 advanced technology CTOL aircraft studied.

The 95 and 90 EPNdB footprints of the E·150·3000 systems analysis airplane, when operating from the primary ILS runway 18/36, are shown in Figure 8-35. The 95 EPNdB footprint is almost entirely contained within the airport boundaries with only a small portion of the approach lobe extending over the mud flat area south of the runway. The approach lobe of the 90 EPNdB footprint also impacts over water. The 90 EPNdB takeoff lobe extends slightly beyond Gravelly Point and a short section of the Mt. Vernon Memorial Highway (Interstate I) below the Rochambeau Bridge. This area could be avoided completely by a curvilinear departure path (see Section 8.3.1.5), however, a special noise abatement maneuver is believed unnecessary since the ambient highway noise probably exceeds that of the STOL aircraft at that location.

The STOL network analysis estimates a level of 240 daily STOL operations at Washington National in 1985. At this operational level the 90 EPNdB contour is equivalent to an NEF value of 30 (reference Figure 8.5). Even if this operational level were doubled, the NEF of the STOL aircraft would not exceed 33. The noise impact of STOL operations at Washington National, therefore, is considered "clearly acceptable" from the standpoint of community acceptance according to HUD guidelines (reference

In summary, converting from CTOL to STOL short-haul operations at Washington National will:

- o Reduce noise impact by approximately 50 percent.
- o Result in a significant reduction in aircraft emissions.
- o Will not affect either surface congestion or automotive

COMMUNITY IMPACT - WASHINGTON NATIONAL

E · 150 · 3000 95 AND 90 EPNdB

2 ST MI (3.2 km) RADIUS IMPACT ZONE

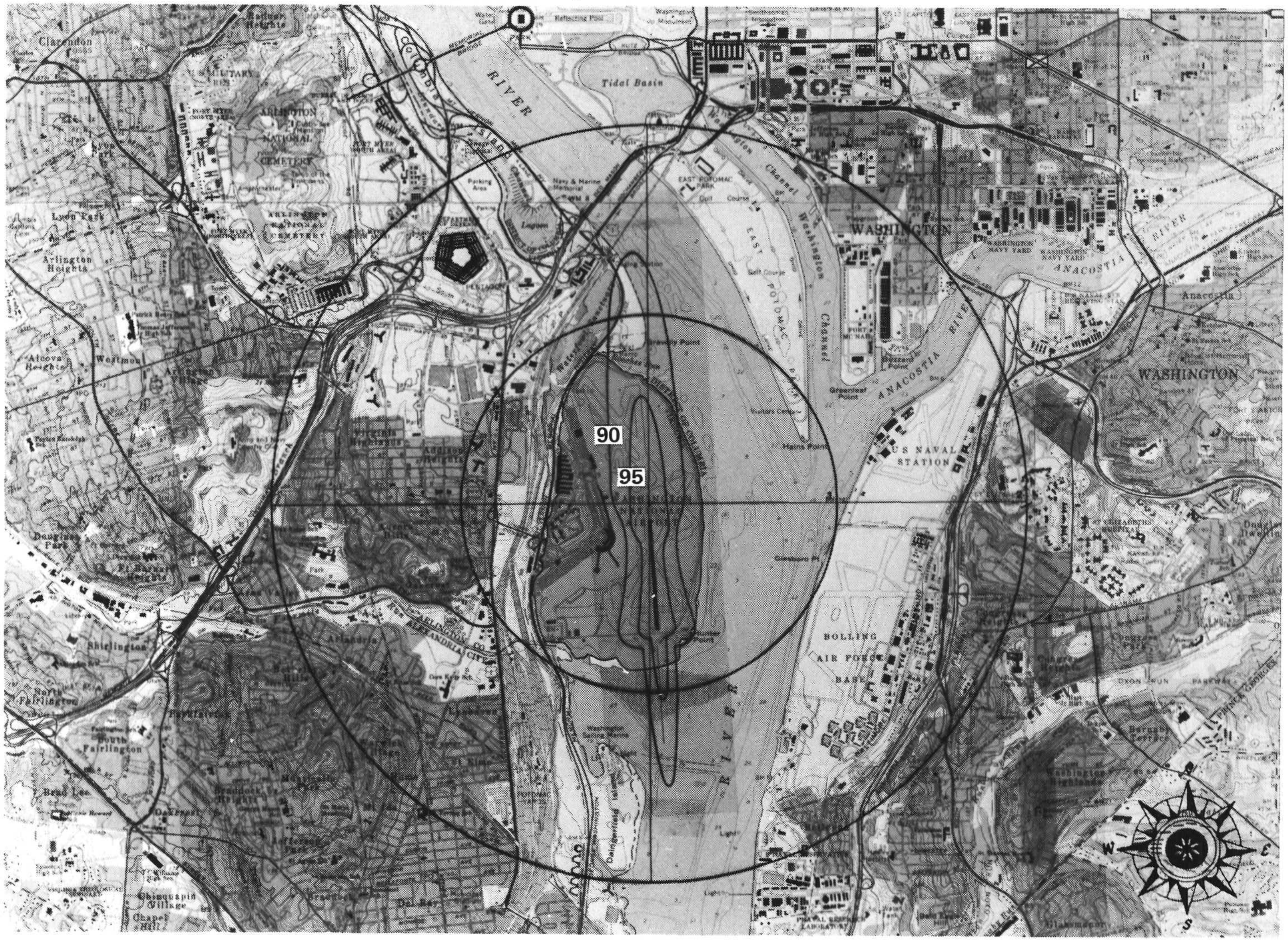


FIGURE 8-35

pollution levels. This must be accomplished by some form of mass transit and remote check-in terminals.

8.5.3 Analysis Matrix - Summary charts of the analysis matrix used to evaluate community impact and acceptance probability of the twelve case study airports are presented in Appendix 15-8. The first matrix summarizes the airport operational characteristics; the second summarizes the key factors associated with STOL local community impact; and the third is a rating sheet which compares the impacts and anticipated community attitudes to forecast acceptance probability. It should be emphasized that many of the ratings are highly subjective. This study has shown that much additional research is required before it is possible to quantify such items as emissions impact, community attitudes, adaptive levels, etc. The results of the analysis, however, are in close agreement with the findings and opinions obtained during the field surveys. The methodology therefore, although simplistic, appears sound. Quantification of both impacts and attitudes would permit a better assessment and weighting of the STOL system attributes and the ultimate use of decision theory in the analysis. (See Bibliography for Decision Theory references.)

Results of the matrix analysis of the twelve study airports indicates that community acceptance of six of the airports is considered "probable" or "highly probable." Acceptance of five others is considered "questionable," and acceptance of one is considered "unlikely." A public education program, as outlined in Section 8.7, should result in a significant improvement in acceptance probability.

8.5.4 Conclusions - Results of the community acceptance analysis conducted on the twelve case study airports are summarized in Figure 8-36. The conclusions incorporate results of both the matrix analysis and field surveys. It should be emphasized that final community acceptance probability determination must be made on a community-by-community basis and requires in-depth research within each specific community.

8.5.5 Recommendations - The following actions are recommended to achieve public acceptance of STOL airports by the 1985 time period.

- Immediate establishment of the STOL short-haul transportation program as a national goal.
- Full cooperation of all federal agencies in expediting the

processing of environmental impact statements, ADAP funding requests, and essential certification and regulation procedures.

- A coordinated planned public education program on the part of government, manufacturers, airlines, and airport operators to acquaint the public on the environmental and economic benefits of a new short-haul air transportation system.
- A nationwide series of public demonstrations of a <u>quiet</u> STOL airplane to counteract existing lack of public credibility.
- Early involvement of local communities and governing bodies in the airport implementation planning process.
- Economic incentives and/or assistance should be provided to local communities where undue hardships would be encountered.

CONCLUSIONS - COMMUNITY ACCEPTANCE ANALYSIS

- o INTRODUCING STOL OPERATIONS AT AN EXISTING HIGH DENSITY AIR CARRIER OR MILITARY AIRPORT WILL PROVIDE NOISE RELIEF AND SHOULD CAUSE NO ACCEPTANCE PROBLEM.
- o INTRODUCING STOL OPERATIONS AT EXISTING GENERAL AVIATION AIRPORTS WILL IN MOST INSTANCES RESULT IN COMMUNITY OBJECTIONS DUE TO:
  - INCREASED OPERATIONAL LEVELS
  - INCREASED GROUND TRAFFIC AND CONGESTION
  - INCONVENIENCE TO GENERAL AVIATION ACTIVITIES
  - POTENTIAL DISPLACEMENT OF GENERAL AVIATION
- o CONSTRUCTION OF NEW STOLPORTS WILL FACE STRONG COMMUNITY OPPOSITION — ESPECIALLY IN HIGHLY URBANIZED LOCATIONS.
- o NEW STOLPORTS CAN NOT BE LOCATED IN RESIDENTIAL AREAS.
- o ACCEPTANCE PROBABILITY VARIES ACCORDING TO:
  - INDIVIDUAL COMMUNITY GOALS
  - EXTENT OF COMMUNITY DISLOCATION
  - COMMUNITY SOCIO-ECONOMIC LEVEL
  - PRIOR NOISE CONDITIONING ADAPTIVE LEVELS
  - DEGREE OF COMMUNITY ORGANIZATION
- o A WELL-PLANNED COORDINATED INDUSTRY/GOVERNMENT PUBLIC EDUCATION PROGRAM IS ESSENTIAL TO OBTAIN PUBLIC SUPPORT FOR THE PROJECT.

FIGURE 8-36

8.6 Candidate Community Research Programs

Successful STOL system implementation is heavily dependent upon obtaining answers to two basic questions:

a. How can communities be selected that will accept and support a STOLport?

b. What action should be taken to ensure the continued support of the STOLport by the surrounding population?

Both of these questions have received little systematic attention in the past. Fortunately, some promising approaches have been developed for other applications which are at least analogous to the present situation. Investigations should be supported, however, to validate these approaches in this new application. Too little work has been devoted to these topics to expect immediate success from existing knowledge.

1. Community Selection Criteria. The problem may be analogous to the highly developed personnel selection process. This process consists of:

   a. Defining the requirements for success.

   b. Selecting a sample of factors, characteristics, skill, aptitudes, etc., which can be hypothesized as being correlated with success.

   c. Devising or choosing tests of these factors.

   d. Applying the tests to a random sample.

   e. Correlating test scores with measured success.

f. Developing a weighted function relating factors found to be correlated to success.

g. Validating the obtained function with a new sample.

If success is defined as STOLport acceptance and the community is viewed as an individual, a similar approach could be applied to STOLport selection.

2. Alternative Approaches to Community Selection. More intensive studies to investigate the feasibility of this or other possible approaches to STOLport site selection should be initiated. These studies could be phased to insure cost-effectiveness of the approach. The phases might include:

   a. An investigation to define community factors possibly related to acceptance.

   b. Surveys of selected representative communities to obtain a weighted selection function of community acceptance.

   c. Cross-validation of the above weighted selection functions.

3. Ensuring Community Support. Anecdotal evidence previously cited (e.i., BART in San Francisco) indicates one method which has been successfully used to obtain support of potentially controversial transportation plans is to inform the public of the preliminary plans and get them involved early in the planning process. Somewhat relevant experimental evidence of the universality of this as a successful approach has been obtained by Coch and French (reference 8-30).

Methods for effectively accomplishing community involvement are not well defined or understood. It seems appropriate, therefore. to support the development of a handbook for community planners which documents specific guidelines to be followed in securing community involvement. The government would gain increased credibility and support by requiring plans for community involvement be developed prior to authorizing funding support for airport planning or construction.

4. Community Attitudes. In-depth social-psychological research is needed on community member attitudes and behavioral intention with respect to both development of new airports and expanded use of existing airports. Such research should provide meaningful guidelines for public education programs. It is imperative that the vast "middle of the road" population be researched as to their motivations regarding transportation issues.

5. Noise Adaptation. There is increasing evidence that persons subjected to frequent aircraft noise over long periods of time often become adapted to fairly high noise levels. Research on adaptive characteristics of people exposed to frequent aircraft noise occurrence, is recommended. It is suggested Chicago Midway and Orange County Airport be studied due to significant differences in community behavior discovered in the subject study.

6. Methodology Validation. The subject study barely scratched the surface with respect to methodology validation. The methodology appears technically sound; however, much greater depth of analysis is required to provide solid validation support.

7. Public Hearing. Research is needed to examine the decision process related to public hearings. Answers are needed to the following questions:

- How are the decisions formulated and made?
- Who makes the ultimate decision?
- To what extent is the decision influenced by the hearing?
- Who attends public hearing?
- What is the composition of hearing attendees? (i.e., elected representatives, homeowners, action groups, etc.).
- What percentage of the population is represented?

8. Citizen Participation. A related study to the above should investigate citizen participation in public affairs to provide answers to the following:

- Who participates and for what reason?
- Who attends and for what reason?
- What method of citizen participation is most effective?

9. Social Power Structure. In each community there appears to be a local power structure which is not evident on the surface but which often is a key factor in the community decision process. The concept of "social power" needs study as it relates to airport development. The field surveys of the subject study found strong evidence that the underlying "power structure" was a controlling factor in some airport communities.

10. Implementation Process. Research is needed to better understand the implementation process involved in transportation development

at the local level. Air transportation is unique with respect to comparable short-haul transportation systems. It is the only system in which a major element (the airport) <u>is wholly controlled at the local political level— and accordingly, is highly vulnerable to local political action</u>. Research should be conducted to determine the controlling elements (and relative degree of control) in the decision process of local communities.

8.7 Guidelines for Public Education Programs

The study and field surveys have confirmed that little effort seems to be made, either by the original sponsors of an airport project, or the airport administrators, to gain public understanding or build majority support for the airport project before it is introduced to public hearing. There also appears to be little communication between elected representatives and their constituents, so that officials are never sure which of many competing voices actually represents the majority. -- And, there appears to be even less communication between the aviation industry and the public.

Communication lags between industry-government and the public has undoubtedly created much of the existing confusion and thus reinforces opposition to airport development. Kolk (reference 8-8) has noted:

> "When the airline industry was born, much of the popular distrust and opposition currently showered on it was being aimed at the railroads. ...The public once went out of its way to encourage this spirited youngster (airplane operators). Cities prided themselves on the development of airfields and other facilities to develop air transportation and generally cushioned the airline operators from complaints by airport neighbors. ...Today, though they have fulfilled (their) promise, the airlines have nonetheless earned for their efforts the popular mistrust accorded big business."

Kolk concluded his paper by noting the airport noise problem was created largely through ignorance. He cites several types of ignorance:

(1) ignorance of basic knowledge about noise and how to control it; (2) ignorance of the effect we (the aviation industry) were having on communities until it was a significant problem; and (3) once identified as a problem— ignorance of appropriate methods of coping with the community reaction.

Kolk continues the discussion of ignorance and lack of communication summating with the statement of need for community and technical studies. In agreement, Standfield (reference 8-31), in a recent editorial statement in Airport World magazine, suggests the time has come for all segments of the aviation industry and government to join hands in the development of an education program for public dissemination. The subject community acceptance studies have concluded that a massive, industry-wide public education is essential to gain public acceptance of the program.

8.7.1 Preliminary Steps - The following preliminary steps should be taken in formulating the necessary public education program.

How is an education program developed?

First, industry and government make funds available to develop educational methods for public/aviation issue interaction. Second, qualified individuals must conduct preliminary studies to properly define the problem areas prior to establishing any education program. Proactive planning in educational research is necessary for the achievement of a successful program.

What type of information is needed?

Questions to ask prior to generating any information would be: "What is the population and what do they know and what don't they know about aviation and airports?" Depending on the level of sophistication (assume they know little) of the receiving public, various techniques can be suggested. Glaser and Resnick (reference 8-32) and Gagne and Rohwer (reference 8-33) offer reviews of instructional techniques and present a comprehensive bibliography on the subject. Coupled with these reviews which present both basic and applied principles of education— one should consider the social aspects of the problem such as the ecological, environmental, and moral issues related to airport planning.

<u>When should an educational program be initiated?</u>

Cogan and Dela Barre (reference 8-34) state that public hearings are totally inadequate as an educational technique. If the public must wait until a public hearing is held to become acquainted with the issues— it is generally too late. To date, almost all hearings on airport projects throughout the country have ended in defeat at the hands of the opposition. In the case at hand— the implementation of a new short-haul air transportation system— the required public education program must be initiated immediately if the public's current opposition to airport projects is to be overcome in time for planned system operation in the early 1980's.

8.7.2 <u>Suggested Guidelines</u> - Cogan and Dela Barre suggest six ingredients to an adequate and effective citizen education (participation) program. These six guidelines are:

1. Direct communications to the right people. Do not direct communications to just activist or special interest groups.

2. Make sure the information to be communicated is complete, full, and accurate— and easily understood by a non-technical audience.

3. When the public is contacted make sure they feel a part of the process— and that they have an active and cooperative part. Basically, attempt to generate positive feelings about the situation, not apprehension.

4. Time the program well. Present the educational and participative programs so that understanding of issues will be more complete during early planning stages. It is often too late for such a program after the public hearing. The time and dollars wasted when public works construction is halted is well worth the necessary early-pre-hearing effort.

5. Make sure that the public knows their opinion has an impact. All too often the planning programs are continued even in the face of public (opinion) opposition, and, are rejected after much effort has been expended. Public opinion disclosure can be used as a major part of the communication problem expressed in Item 1, above.

6. Finally, budget the required money, manpower, and time in an efficient manner. As Cogan and Dela Barre point out— don't over-promise and don't under-deliver. In fact, Cogan and Dela Barre state in their Seattle Transit study 20% of the planning budget was allocated to citizen

participation programs. For an average $500,000 transportation project plan, roughly $100,000 should be allocated for citizen participation programs.

The establishment of an educational-participation program for the public, if done correctly, will bring about a more harmonious relationship between the aviation industry, government, and the communities. Social psychologists have known for some time the importance of "anticipation" in decision processes which affect the community (residential or working community). The now famous "Pajama Factory" study demonstrates the effectiveness of incorporating the employees in the decision-making process in which the outcome affects not only the employee but the total company (reference 8-30). We must include the public in aviation planning. Although the various industry and government segments are quite aware of the efforts and progress achieved in the quest to fly a non-objectionable airplane— the public is not (reference 8-35). To the general public the DC-10 and the L-1011 are still jet airplanes, just bigger than DC-9's and smaller than 747's, <u>and STOL is only an acronym for another government agency!</u>

9.0 AIRPORT CONGESTION RELIEF

Airport congestion and/or constraints must be given serious consideration for the 1985 time period. These terms are defined in the Systems Scenario of Volume VI - Systems Analysis.

In 1985, we are concerned about the physical congestion or constraint applied to the movement of people or aircraft within the vicinity of an airport. On the airside of the airport, there are people and baggage; there are temporary delays in the landing or takeoff of an aircraft; there are problems within the terminal area airspace; and no gates available for aircraft arrival. On the landside of the airport, there are the vehicular parking problems and the network of surface streets for access and egress to the airport. An example is shown in Figure 9-1 .

A special short-haul system that can operate in parallel with, but not interfere with, the long-haul system can have a significant beneficial impact on airport congestion.

The Mitre Corporation in reference 9-1 has made an interesting study on airport capacity. The capacity of an airport is a complex quantity for which they developed two operating scenarios. The first, Scenario A, assumes all traffic, at each of the congested airports, would be carried by the conventional airline system. The second, Scenario B, presents the lower level of congestion that would occur at the congested airports if a major part of the short-haul traffic were to be diverted onto a STOL carrier system of the type that was developed for the Northeast Corridor system.

An estimate of each airport's IFR hourly capacity, with current aircraft mix, was used as the value of C for 1969. Details of the expansion

AIRPORT CONGESTION PROBLEM AREAS
1980

	GROUND ACCESS AND EGRESS	TERMINALS AND PARKING	APRONS AND GATES	AIRSPACE	*RUNWAYS - ACFT OPN		
					**PANCAP FY 1970 (1000)	ACTUAL 1970 (1000)	FCST 1982 (1000)
LOS ANGELES	✓	✓	✓		420	576	744
SAN FRANCISCO	✓	✓	✓	✓	330	397	547
BOSTON	✓				288	329	437
LA GUARDIA	✓	✓	✓	✓	260	333	425
CHICAGO	✓	✓	✓		430	671	876

INDICATES MAJOR CONSTRAINT

*FROM FAA/CAB DOCUMENTATION - CONSISTENT WITH FAA-FISCAL YEARS 1971-1982
NO HELICOPTER AIRLINE PASSENGERS

**PRACTICAL ANNUAL CAPACITY

PR2-STOL-9965B

FIGURE 9-1

plans of each airport are not available, and the expansion plans for most airports do not define the facilities in 1985 with any confidence. The base scenario chosen, therefore, assumes that there will be no additions to runway systems other than those currently under construction, with the exception of the addition of high speed exit configurations necessary for implementing the FAA's Increased Capacity Airport Program.

It is clear that, under the FAA's ten-year Increased Capacity Airport Program, new equipment and procedures will lead to increases in the aircraft handling capacity of the major airports. Refer to Section 2.2.3.9. The increases will be significant by 1975 and considerable by 1985. The program is not yet formulated to a point that would permit capacity improvements to be forecast for each individual airport. A general increase, therefore, over the 1970 values of aircraft handling capacity, of 20% by 1975 and 70% by 1985 is applied to each airport. These improvements are developed in Table 9-1 . That part of the increase in capacity, derived from each of six principle elements of the Increased Capacity Airport Program, and judged to be additive to the 1970 aircraft handling capacity are summed to give the total increment in capacity for 1975 and 1985. The increments are judged to be conservative.

Table 9-2 compares the projected passenger delays for ten major airports and the New York hub in 1985 under these two operating scenarios.

The same 1985 factor from Table 9-1 was applied by Douglas Aircraft Company to current airport activity. The 1985 number obtained was

TABLE 9-1

GENERAL PERCENT INCREASE IN AIRCRAFT HANDLING CAPACITY (C) EFFECTED BY THE FAA'S INCREASED CAPACITY AIRPORT PROGRAM

PROGRAM ELEMENT	PERCENT INCREASE OVER 1970 C	
	by 1975	by 1985
1. Construction and effective use of high-speed exits and entrances	0	0
2. Separation of aircraft by performance	10	10
3. Two-mile longitudinal separation	0	30
4. Computer aided spacing	10	10
5. Ground Guidance and Control	0	5
6. Higher Levels of Automation	0	10
Total increase over 1969 aircraft handling capacity	20%	70%

TABLE 9-2

PROJECTED PASSENGER DELAYS IN 1985

Airport	Average Delay/Passenger (Minutes)	
	Scenario A	Scenario B
LGA	60	18
LAX	25	6.9
SEA	22	13
ORD	7.4	4
NY HUB	7.2	2.2
JFK	6.8	2.0
ATL	5.8	4.6
SFO	5.1	2.1
EWR	4.4	1.7
BOS	2.9	1.0
DEN	2.4	N/A

then compared to the 1985 projected activity at each of these airports. From this comparison it was assumed that approximately 20 percent of the traffic for each of the congested hubs must be placed on a short-haul airport to help relieve congestion. This is fully explained in the Systems Evaluation, Volume VI.

Many airports have been evaluated as to their constrained operation for the 1985 time period. These have been evaluated by the CAB and FAA reports, airline consultants and study analyses. These airports are presented in Table 9-3 .

For each of the congested hubs, the STOLports selected for relief are presented in Table 9-4 .

Improved access and egress routes are vital to any airport. The Los Angeles International airport is one of the most overcrowded areas since it does not have a mass transit system to service the airport.

Boston's Logan International airport is located closer to the central business district than any other major airport in the United States. Although it is only 2 air miles from the airport administration building to Boston's City Hall, the airport is nearly isolated from the people it serves, both air travelers and those who work there. Direct land access is from the Northwest only. The terminals and parking area, the aprons and gates, and the airspace all present transportation interfacing problems. Volume VI presents several intra-airport transportation systems for consideration.

The FAA will be concerned with the airspace problems which must be adaptable to both the STOL/CTOL flying specified RNAV routes between various city-pairs.

An example of the congestion relief possible at major high density hub airports by diversion of short-haul origin-destination traffic to outlying STOLports is shown in the tabular chart of Appendix 15.10. Air traffic congestion relief at three of the nation's most congested airports was determined to be as follows:

Chicago O'Hare	-	12% reduction
Boston Logan	-	24% reduction
Los Angeles International	-	14% reduction

The appendix chart also examined the impact of the assumed level of STOL operations on both VFR and IFR capacity of the various reliever STOLports. In instances where operations exceed rated acceptance capacity, methods of increasing capacity are noted.

TABLE 9-3

Level 1, Congested - Physical	Airport
Albany/Schenectady, New York	Albany County
Atlanta, Georgia	Atlanta Municipal
Baltimore, Maryland	Friendship International
Boston, Massachusetts	Logan International
Chicago, Illinois	O'Hare International
Cleveland, Ohio	Hopkins International
Detroit, Michigan	Detroit Metropolitan/Wayne County
Hartford, Connecticut	Bradley-Windsor Locks
Los Angeles, California	Los Angeles International
Memphis, Tennessee	Memphis International
Miami, Florida	Miami International
Minneapolis/St. Paul, Minnesota	Wold Chamberlain Field
New Orleans, Louisiana	Moissant International
New York, New York	Kennedy International
New York, New York	LaGuardia Field
New York, New York	Newark International
Philadelphia, Pennsylvania	Philadelphia International
Pittsburgh, Pennsylvania	Greater Pittsburgh
San Diego, California	Lindbergh International
San Francisco, California	San Francisco International
San Jose, California	San Jose Municipal
St. Louis, Missouri	Lambert Field
Washington, D.C.	Washington National

Level 2, Constrained - Physical	Airport
Buffalo, New York	Greater Buffalo
Denver, Colorado	Stapleton International
Las Vegas, Nevada	McCarran International
Milwaukee, Wisconsin	Mitchell Field
Oakland, California	Oakland International
Providence, Rhode Island	Greater Providence
Rochester, New York	Monroe County
Seattle, Washington	Seattle/Tacoma International
Syracuse, New York	Hancock Field
Tampa, Florida	Tampa International

Level 3, Constrained - Social	Airport
Burbank, California	Burbank/Hollywood
Boston, Massachusetts	Logan International
Dallas, Texas	Love Field
Denver, Colorado	Stapleton International
Los Angeles, California	Los Angeles International
Long Beach, California	Daugherty Field
Miami, Florida	Miami International
Minneapolis/St. Paul	Wold Chamberlain Field
New York, New York	Kennedy International
Santa Ana, California	Orange County
San Diego, California	Lindbergh International
San Francisco, California	San Francisco International
San Jose, California	San Jose Municipal
St. Louis, Missouri	Lambert Field
Washington, D.C.	Washington National

TABLE 9-3

Level 4, Congested/Constrained - Social	Airport
Boston, Massachusetts	Logan International
Denver, Colorado	Stapleton International
Los Angeles, California	Los Angeles International
Miami, Florida	Miami International
Minneapolis/St. Paul, Minnesota	Wold Chamberlain Field
New York, New York	Kennedy International
San Diego, California	Lindbergh International
San Francisco, California	San Francisco International
San Jose, California	San Jose Municipal
St. Louis, Missouri	Lambert Field
Washington, D.C.	Washington National

TABLE 9-4

1985 RELIEF FOR CONGESTED AIRPORTS

CONGESTED AREA	AIRPORT	STOL RELIEF
ATLANTA, GEORGIA	ATLANTA MUNICIPAL	DEKALB PEACHTREE FULTON CO.
BOSTON, MASSACHUSETTS	LOGAN INTERNATIONAL	HANSCOMB FIELD NORWOOD
CHICAGO, ILLINOIS	O'HARE INTERNATIONAL	MEIGS MIDWAY
CLEVELAND, OHIO	HOPKINS INTERNATIONAL	BURKE LAKEFRONT
DETROIT, MICHIGAN	DETROIT METROPOLITAN/ WAYNE CO.	DETROIT CITY
LOS ANGELES, CALIFORNIA	LOS ANGELES INTERNATIONAL	EL MONTE DAUGHTERY FIELD GEN. PATTON FIELD ORANGE CO. VAN NUYS
MEMPHIS, TENNESSEE	MEMPHIS INTERNATIONAL	GEN. D. SPAIN
MIAMI, FLORIDA	MIAMI INTERNATIONAL	OPA LOCKA
MINNEAPOLIS/ST. PAUL, MINNESOTA	WOLD CHAMBERLAIN FIELD	CRYSTAL
NEW ORLEANS, LOUISIANA	MOISSANT INTERNATIONAL	LAKEFRONT
NEW YORK, NEW YORK	KENNEDY/LAGUARDIA/NEWARK	WESTCHESTER CO. ISLIP MACARTHUR SECAUCUS
PHILADELPHA, PENNSYLVANIA	PHILADELPHIA INTERNATIONAL	NORTH PHILADELPHIA
PITTSBURGH, PENNSYLVANIA	GREATER PITTSBURGH	ALLEGHENY CO.
SAN DIEGO, CALIFORNIA	LINDBERGH INTERNATIONAL	MONTGOMERY FIELD
SAN FRANCISCO, CALIFORNIA	SAN FRANCISCO INTERNATIONAL	MOFFETT FIELD NORTH FIELD-OAKLAND
SAN JOSE, CALIFORNIA	SAN JOSE MUNICIPAL	REID-HILLVIEW
ST. LOUIS, MISSOURI	LAMBERT FIELD	BI STATE PARKS
WASHINGTON, D.C.	WASHINGTON NATIONAL	WASHINGTON NATIONAL

10.0 AIRPORT IMPLEMENTATION PROBLEMS

We are facing an airport crisis; today many of our major terminals are already operating at capacity. In order to relieve the constraints at these major hubs, and to provide a quiet STOL short-haul system, with fewer STOL aircraft emissions and better community acceptance, the NASA study must look at the implementation problems for the study aircraft.

From the study there are an adequate number of existing airports which are favorable located to the traveler to support a STOL short-haul system for the 1985 time period. Over 200 airports were initially surveyed. The representative network selected includes 92 existing airports and only 2 new STOLports. The network operation is not necessarily dependent on these particular locations. These site locations are considered to be representative of the type applicable for a STOL short-haul system operation.

Major implementation problems anticipated in development of the STOL airport network are as follows:

Airports

- o The delay and uncertainty resulting from the requirement for filing an Environmental Impact Statement (E.I.S.) and conduct of a public hearing.
- o The difficulty of obtaining funds to expand or construct airports. Airports usually are low on the list of priorities for community improvement or development. Many communities also can not afford the 50% share specified for ADAP funding.

There is a new Senate Bill (S.38 before the 93d Congress - 1st Session) to amend the Airport and Airway Development Act of 1970 to increase the United States share of allowable project costs under such an act. This Act would allow:

- o 50 per centum for sponsors whose airports enplane not less than 1.00 per centum of the total annual passengers enplaned by air carriers certified by the CAB.
- o 75 per centum for sponsors whose airports enplane less than 1.00 per centum of the total annual number of passengers enplaned by air carriers certificated by the CAB.
- o 50 per centum of the allowable costs thereof of public use facilities in terminal buildings.

Passage of this Act would reduce the airline/community costs involved in establishing a short-haul system.

The airline would be concerned with terminal facility airline use, new hangars, ground support equipment, salaries, and other costs.

Airport Access

A fundamental problem is one of jurisdictional responsibility. The airport sponsor, or authority, normally has no jurisdiction over street or highway construction or improvements. Coordination between the various local and state agencies involved is essential. Again, project priority may present a problem in some instances.

Air Traffic Control

- o Full STOL system operation is dependent on FAA implementation of the necessary air traffic control improvements. Within the time span required. Microwave ILS is the pacing item, and is critical if Category III operations are required.

Community Acceptance

o The following actions are considered necessary to achieve public acceptance of STOL airports by the 1985 time period.

- Immediate establishment of the STOL short-haul transportation program as a national goal.
- Full cooperation of all federal agencies in expediting the processing of environmental impact statements, ADAP funding requests, and essential certification and regulation procedures.
- A coordinated planned public education program on the part of government, manufacturers, airlines, and airport operators to acquaint the public on the environmental and economic benefits of a new short-haul air transportation system.
- A nationwide series of public demonstrations of a Quiet STOL airplane to counteract existing lack of public credibility.
- Early involvement of local communities and governing bodies in the airport implementation planning process.
- Economic incentives should be provided to local communities.

11.0 CANDIDATE TECHNOLOGY R&D PROGRAMS

The research areas recommended apply to both the STOL and CTOL aircraft. Areas of responsibility should be assigned such as NASA, FAA, DOT, and others. The following airport oriented research and development programs are recommended in the study.

1. Investigation of trailing vortex effects of large lift-augmentation STOL aircraft to determine safe separation distances on landing approach.

2. Reduction of aircraft noise on takeoff through aircraft performance improvements and flight operational techniques.

3. Continued research is needed to establish a firm upper noise limit for community acceptance— and compatible land use planning.

4. A comparison of the economic and environmental advantages of remote ticketing and passenger check in facilities versus centralized (on-airport) facilities.

5. People in communities around regional airports are likely to react strongly to engine generated odors. It is recommended that additional research be directed toward determining the causes of odors related to aircraft ground operations.

6. Additional research should be undertaken to determine not only the amounts of particulates from aircraft operations, but the types of particulates, so that some assessment can be made of the relative importance of carbonaceous and non-carbonaceous aircraft emissions, as distinguished from

dust blown up from the airport runways. This may be important in determining where to place the emphasis related to abatement of particulates, with combustor design, or airport operations. The amount of runway dust blown into the air may be influenced by the STOL concept selected.

7. The presence of irritating oxidants in the urban atmosphere has been ascribed to the interaction of hydrocarbons (HC) and nitrogen oxides (NOX) in the presence of sunlight. It may be easier to reduce emissions of hydrocarbons than NOX, and such action may be sufficient to reduce smog irritants. It is recommended that additional studies be made to determine the impact of NOX on the environment, in the presence of varying amounts of reactive hydrocarbons.

8. It is recommended that engine combustor design, research and development be continued on a high priority basis, directed toward the reduction of all jet engine emissions. Special emphasis should be placed on the reduction of nitrogen oxides emissions.

9. One possible way to control NOX emissions is to restrict the cycle pressure ratio of the engines. However, restricting the pressure ratio below that required by other considerations will have a serious impact on the performance of the airplane, and

therefore the direct operating costs to the airlines. A study should be made to assess direct operating costs as a function NOX control by pressure ratio variations.

10. General studies of STOL air pollution environmental impact are difficult to make without statistical data on weather and other conditions at potential STOLport sites, such as the percentage of time a temperature inversion exists, frequency and strength of winds, the proximity of urban concentrations and the direction of winds with respect to such concentrations. It is recommended that such studies be made so that environmental impact studies can be made for specific areas that can be related to a statistical frequency of occurrence.

11. It is unclear whether the future STOL short-haul airports should have a Category III Microwave Landing System. A study should be made of the cost-benefits of the MLS Category II and III systems for use in the STOL short-haul market. (Note airline comments, Section 12.0)

12. Fog is the major cause of low ground visibility. Additional research is required on fog dispersal systems to improve their performance and to reduce their costs. Results should be compared to, for example, what an MLS Category III system can do during such weather.

13. A method should be investigated for removing of ice and snow for STOLports located in such an area. Heated runways are feasible and will be tested by the FAA in

the near future.

14. The Indirect Operating Costs (IOC) associated with STOL commercial airline operations appears to be an area for fruitful study. These costs show dramatic differences between various CTOL airline operations. Studies are needed to examine ways of reducing the STOL IOC which may lead to research and development in new automated ways of interfacing the passenger and his baggage with the aircraft. This would include ticketing, baggage handling, and people-movers.

15. Airport noise, congestion, and costs prevent the air transportation system from adequately meeting the transportation needs of any region under study.

    A cost/benefit analysis should be done, in some form, for each 1985 aircraft/airport/airspace configuration for each short-haul airport (each airport will present different problems), to provide the "best" regional short-haul system.

16. Thrust reversing should be examined for STOL-type engines in order to improve on a friction coefficient for STOL aircraft.

12.0 AIRLINE COMMENTS

In order to obtain an airline cross section in this STOL evaluation and to ensure airline realism in this study several airlines were contracted by the Dougaas Aircraft Company. The airlines were two trunk lines (American and United Air Lines), a local carrier (Allegheny Airlines) and a California intra-state airline (Air California).

Throughout the study a close contact has been kept with the above airlines and their comments have been very helpful in performing this work.

The airlines were asked to comment on the STOL - 1985 Air Traffic Control ground rules that were submitted in the Proposal, Reference 1-1. Their comments are summarized in Figure 12-1.

Table 12-1

STOL AIR TRAFFIC CONTROL

AIRLINE COMMENTS

- CAT II LANDING PROCEDURES PREFERRED IN 1980
- CAT III TOO COSTLY
- INTERIM SYSTEMS CONSIDERED UNDESIRABLE CAN INDUCE A PROLIFERATION OF SUBSTANDARD SYSTEMS
- DESIRE LOW COST ONBOARD EQUIPMENT WITH LESS DEPENDENCE ON GROUND EQUIPMENT
- AREA NAVIGATION - CTOL/STOL INTEGRATION
- TWO-WAY DATA LINK - COST EFFECTIVENESS QUESTIONABLE

PR2-STOL-10009A

13.0 CONCLUSIONS

The major study conclusions, with respect to airport selection, operation, and implementation are summarized below. Results of the system benefits and community acceptance analysis also are summarized. Additional, more detailed conclusions are contained in the individual sections of the report.

SITE SELECTION

- There is a relatively large number of favorably located existing airports to support a STOL short-haul system for the 1980-1985 period.

  Over 200 airports throughout the U.S. were initially surveyed. The representative network selected includes 92 existing airports and two new STOLports. The network operation is not necessarily dependent on these particular locations. The site locations selected are considered to be representative of the type applicable for a STOL short-haul system.

- Introducing STOL operations at an existing high density air carrier or military airport will provide some degree of noise relief and should result in a reduction of noise complaints.

  Noise relief will result from replacement of noisy short-haul conventional aircraft with significantly quieter STOL aircraft. The extent of noise relief is dependent on the number of noisy flight operations replaced by STOL flights.

- Introducing STOL operations at existing general aviation airports will in most instances result in community objections due to:
    - Increased noise and pollution levels.
    - Increased operational levels.
    - Increased ground traffic.
    - Inconvenience to general aviation activities.
    - Potential displacement of general aviation.
- Construction of new STOLports will face strong community opposition — especially in highly urbanized locations.
- It will be very difficult to locate a new STOLport in a residential area.

    Community objections have essentially halted the construction of new airports wherever located. It will be extremely difficult to obtain environmental clearance for an airport in a residential community.

- Where STOL flights are in direct competition with CTOL flights (i.e., using the same airports and runways) there is no resulting advantage to the traveler.

    The advantages of STOL can best be achieved by separating STOL and CTOL operations wherever possible. STOL flights at a major hub airport also may detract traffic from other STOL airports in the region.

AIRPORT IMPLEMENTATION

- Full STOL system operation is dependent on incorporation of the necessary airport, ATC, runway, terminal, and access improvements on a timely basis.

- The basic technical capabilities to be developed in the FAA's currently planned R&D program in support of air traffic control for CTOL operations are considered adequate to support STOL operations.

    Microwave ILS is the only mandatory equipment needed to support STOL operations in addition to normal CTOL ATC equipment. Airline subcontractors agreed.

- Most general aviation airport runways and taxiways will require widening and strengthening to accommodate STOL aircraft of the type studied.

    Eight of the twenty general aviation airports in the selected network have adequate runway width and strength.

- The requirement of filing Environmental Impact Statements (E.I.S.) has effectively stopped needed airport development or expansion at all airports surveyed.

    Preparation and processing an E.I.S. takes from one to five years at the present time.

    Public hearings are desirable, but are a major deterrent unless they occur very early in the planning process.

- o At some locations, remote or off-airport location of passenger check-in terminals and use of some form of public transportation (limousine, bus, transit, etc.) will reduce surface traffic congestion and related ground vehicle emissions.

STOL OPERATIONS

- o The trailing vortex effect of the lift augmentation aircraft studied is approximately equal to that of the current generation of wide-bodied CTOL aircraft and will require the same expanded operational separation distances.

  Existing data shows the STOL types studied have the same trailing vortex characteristics as the DC-10, L-1011, and B-747. Separation distance must be considered in combining STOL and general aviation operations.

ATC PROCEDURES

- o STOL will require special criteria for Category I, II, and III precision approaches.
  - Decision Height (DH)
  - Runway Visual Range (RVR)

AIRCRAFT NOISE - COMMUNITY IMPACT

- o The NASA specified aircraft acoustical design criterion of 95 EPNdB at 500 ft. (152.4 m) sideline distance appears to be an adequate lower aircraft design goal with respect to community noise impact. Continued research, however, is required to validate the preliminary conclusion.

- The single point sideline noise criterion does not provide the degree of footprint control required for airport design and land use regulation.

- The 95 EPNdB noise footprint of the aircraft studied is completely contained within the FAA precision runway and clear zone envelope specified for air carrier airports. The 90 EPNdB footprint is largely contained within the same envelope.

- The 95 EPNdB footprint of the E.150.3000 baseline aircraft was over 95% contained within the boundries of the twelve representative case study airports examined, exclusive of clear zone areas. The 90 EPNdB footprint was 65% contained.

- The takeoff noise lobe was determined to be the most critical from the standpoint of community impact for all aircraft types studied.

- At several of the twelve study airports surveyed, noise sensitive areas could be avoided by a slight climbing turn initiated at a safe altitude after takeoff.

AIRCRAFT EMISSIONS - COMMUNITY IMPACT

- STOL aircraft emissions (those subject to EPA Air Quality Regulation) are significantly lower than similar emissions of a CTOL aircraft of the same size and capacity. (With the exception of nitrogen oxides.)

The reduction in aircraft emissions is primarily due to the shorter ground operational time of STOL aircraft.

- o Exhaust emissions of airport related automobile traffic account for approximately 90% of the total emissions at an average STOLport.

STOL SYSTEM BENEFITS

- o Primary user benefits of a national short-haul air transportation system are:
  - Increased traveler convenience
  - Reduced travel time
  - Less travel delay
  - Potential reduction in total trip cost.
- o Primary non-user benefits are:

	National	Regional	Local
- Reduced congestion of major hub airports.	X	X	X
- Extended life of major CTOL airports.	X	X	X
- Significant reduction in total number of people affected by aircraft noise.		X	X

	National	Regional	Local
- Lowest overall environmental impact of any type of short-haul transportation--air or surface.	X	X	X
- Potential employment and economic opportunities.		X	X

COMMUNITY ACCEPTANCE

- o Major community acceptance problem areas are:
  - Concern over aircraft noise.
  - Concern of air quality.
  - Concern over traffic congestion.
  - Underlying fear/safety concern.
  - Lack of government/industry credibility with the public.
  - Concern over property value deterioration.
- o The ultimate survival of several of the major air carrier airports surveyed is severely challenged by organized community action.

  Examples are:
  - Orange County
  - Boston Logan
- o The following actions are considered necessary to achieve public acceptance of STOL airports by the 1985 time period, if STOL is

to be implemented.

- Immediate establishment of the STOL short-haul transportation program as a national goal.

- Full cooperation of all federal agencies in expediting the processing of environmental impact statements, ADAP funding requests, and essential certification and regulation procedures.

- A coordinated planned public education program to make the public aware of the environmental and economic benefits of a new short-haul air transportation system.

- A nationwide series of public demonstrations of a <u>quiet</u> STOL airplane to counteract existing lack of public credibility.

- Early involvement of local communities and governing bodies in the airport implementation planning process.

- Economic incentives should be provided to local communities where undue hardship or higher priority development requirements exist.

14.0 REFERENCES

Reference

1-1 Technical Proposal for Study of Quiet Turbofan STOL Aircraft for Short-Haul Aircraft, Douglas Aircraft Company Proposal 72D-03IT, dated 17 March 1972.

2-1 Aviation Forecasts - Fiscal Years 1972-1983, FAA, September 1971.

2-2 Report of the DOT Air Traffic Control Advisory Committee, Volume 1, DOT, December 1969.

3-1 Heated Grooved Runway Study for STOLport, LWP-1056.

3-2 Planning and Design Criteria for Metropolitan STOLports, FAA Advisory Circular AC 150/5300-8, November 1970.

3-3 Effectiveness of Fog Dispersal Techniques at Seattle-Tacoma and Spokane International Airports, FAA Report RD-72-92, AD 752-931.

4-1 Baerwald, John E., Traffic Engineering Handbook, Third Edition, Institute of Traffic Engineers, 1965.

Reference

8-1 Fraser, Robert C. Institutional Factors in Civil Aviation. Joint DOT-NASA Civil Aviation R&D Policy Study: Contractors Report. Department of Transportation, Washington, D.C., DTO TST-10-1; NASA CR-1807, January 1971.

8-2 Lundquist, Gustav E. FAA Activity in V/STOL Development. In the Society of Experimental Test Pilots 1971 Report to the Aerospace Profession - Fifteenth Symposium Proceedings, September 16-18, 1971, Beverly Hilton - Beverly Hills, California.

8-3 Lantner, Gary. Community Opposition to Airport Development; Airport Location and Planning -- Volume 9. Boston: MIT Industrial Relations Program 1972.

8-4 Harris, Louis. Rising Consumer Expectations of the Airline Industry. A paper presented to the IATA Public Relations Conference, March 14, 1972.

Reference

8-5 Gillfillan, Walter E., Study Director, Southern California Regional Airport Systems Study, Personal Communication, January, 1973.

8-6 Wilkinson, Frank, Deputy Chief, Washington Airports District Office -- FAA, Personal Communication, November, 1972.

8-7 Dahms, Lawrence D. Asst. General Manager Planning and Public Service, Bay Area Rapid Transit (BART), Personal Communication, January, 1973.

8-8 Kolk, F.W. Noise: A Triumph of Ignorance? Astronautics & Aeronautics, October, 1972.

8-9 Mayo, Louis H. Social Impacts of Civil Aviation and Implications for R&D Policy. Joint DOT and NASA Report: DOT TST-10-6; NASA CR-1988, Sept., 1971.

Reference

8-10 Hudson, B. B. Anxiety in Response to the Unfamilar, In, D. W. Chapman (Ed.) Human Behavior in Diaster: A New Field of Social Research. J. Social Issues, 1954, 10, No. 3.

8-11 Hudson, B. B., et. al. Group responses to Threat: Perception and Learning under Stress. J. Social Psychology, 67, Oct. 1965.

8-12 Clark, Terry N. Community Structure and Decision Making; Comparative Analysis, Scranton, Pa., Chandler Publishing Co., 1968.

8-13 Brown, E. J. The Self as Related to Formal Participation in Three Pennsylvania Rural Communities. Rural Sociology, 1953, 18, 313-320.

8-14 Wicker, A. W. Attitudes vs. Actions: The Relationship of Verbal and Overt Behavioral Responses to Attitude Objects. Journal of Social Issues. 25:41-78, 1969.

8-15 Runkel, Philip J. and McGrath, Joseph E. Research on Human Behavior: A Systematic Guide to Method. N.Y.; Holt, Rinehart and Winston, Ind., 1972

Reference

8-16 Ajzen, Icek and Fishbein, Martin. The Prediction of Behavior from Attitudinal and Normative Variables. Journal of Experimental Social Psychology. 1970, 6, 466-487.

8-17 Aircraft Noise Impact Guidelines for Local Agencies. U.S. Department of Housing and Urban Development (HUD), November 1972, NTIS PB-213 020.

8-18 EPA Citizens' Bulletin, U.S. Environmental Protection Agency, February, 1973.

8-19 Aviation Turbine Fuels, 1970, Mineral Industry Surveys, Petroleum Products Survey No. 69, Ella Mae Shelton, Bureau of Mines.

8-20 Aircraft and Aircraft Engines, Proposed Standards for Control of Air Pollution, EPA, Federal Register, Vol. 37, No. 239, December 12, 1972.

8-21 Aircraft Gas Turbine Engine Exhaust Smoke Measurement, Aerospace Recommended Practice (ARP) 1179, May 4, 1970.

Reference

8-22 Aircraft Emissions: Impact on Air Quality and Feasibility of Control. Prepared by EPA, July, 1972 and released December, 1972 in conjunction with Proposed Emission Standards (reference 1).

8-23 Exhaust Emission Standards and Test Procedures (Motor Vehicles), EPA, Federal Register Vol. 36 No. 128, July 2, 1971.

8-24 Measurement of Air Pollutant Concentrations at O'Hare International Airport, Chicago, and Orange County Airport, California, by Celesco Industries for the Argonne National Laboratory, March 30, 1972.

8-25 The Economic Impact of Los Angeles International Airport on its Market Area. Waldo & Edwards, Inc., November, 1971.

8-26 Community Reaction to Airport Noise, Vol. I, Tracor Inc. NASA Contractor Report CR 1761, July 1971.

8-27 Burrows, A. A. and Zandrin, D. M. Aircraft Noise and the Community: Some Recent Survey Findings, Douglas Aircraft Co. Technical Paper No. 5891, April 26, 1971.

Reference

8-28 Aviation Effect on Air Quality, San Francisco Bay Region, Regional Airport Systems Study, Association of Bay Area Government (ABAG), February, 1971.

8-29 Technical Report - Western Region Short-Haul Transportation Program, Definition Phase Report, Volume 2, Aerospace Corporation, July 1970.

8-30 Coch, L. and French, J.R.P. Jr. Overcoming Resistance to Change. In Proshansky & Seidenberg (Eds.) Basic Studies in Social Psychology, New York: Holt, Rinehart and Winston, Inc. 1965.

8-31 Standfield, Robert I. Editorial. Airport World, January, 1973.

8-32 Glaser, Robert and Resnick, Lauren B. Instructional Psychology. In, Annual Review of Psychology, Vol. 23, 1972, 207-276.

8-33 Gagne, Robert M. and Rohwer, W. D. Jr. Instructional Psychology. In, Annual Review of Psychology, Vol. 20, 1969, 381-418.

Reference

8-34 Cogan, A. M. and Dela Barre, W. A. Citizens -- A Vital Part of Transportation Planning. ASCE National Transportation Meeting Reprint No. 1776, July, 1972.

8-35 Ford, Frederick C. "Psychological" noise reduction. Airport World, February 1973.

9-1 Analyses of Short-Haul Air Transportation, The Mitre Corporation, July 1972.

15.0 APPENDICES

AIRPORT STUDY TEAM

The Airport Study Team drew upon the resources of the entire McDonnell Douglas Corporation. Personnel were assigned to the team based upon prior participation in on-going commercial short-haul transportation studies. The following specialists contributed to the study effort as indicated:

W. B. Altman, Jr.	Community Research
J. M. Beattie	Air Traffic Control
W. E. Dunbar	Aircraft Emissions
M. R. Jong	Airport/Aircraft Compatibility
L. H. Quick	Systems Benefits & Community Acceptance
H. C. True	Acoustics

15.1 Network Composition of the National Short-Haul System

Total Number of Airports		94
Number of NASP Primary System Airports		29
(Over One Million Annual Passengers - 1970 Traffic)		
High Density Airports (more than 350,000 operations)		4
Dallas Love Field (Dallas)	DAL	
Stapleton International (Denver)	DEN	
Hollywood International (Ft. Lauderdale)	FLL	
Phoenix Sky Harbor (Phoenix)	PHX	
Medium Density Airports (250,000 to 350,000 operations)		4
Port Columbus (Columbus)	CMH	
Washington National (Washington, D.C.)	DCA	
Salt Lake City International(Salt Lake City)	SLC	
Low Density Airports (less than 250,000 operations)		21
Albuquerque Sunport (Albuquerque)	ABQ	
Nashville Metropolitan (Nashville)	BNA	
Greater Buffalo (Buffalo)	BUF	
Douglas Municipal (Charlotte)	CLT	
Greater Cincinnati (Cincinnati)	CVG	
J. M. Cox (Dayton)	DAY	
El Paso International (El Paso)	ELP	
Weir Cook (Indianapolis)	IND	
Jacksonville International (Jacksonville)	JAX	
McCarran International (Las Vegas)	LAS	
General Mitchell Field (Milwaukee)	MKE	

Will Rogers World (Oklahoma City)	OKC	
Eppley Field (Omaha)	OMA	
Norfolk Regional (Norfolk)	ORF	
Portland International (Portland)	PDX	
Monroe County (Rochester)	ROC	
Standiford Field (Louisville)	SDF	
Seattle Tacoma (Seattle)	SEA	
C. E. Hancock (Syracuse)	SYR	
Tampa International (Tampa)	TPA	
Tulsa International (Tulsa)	TUL	
Number of NASP <u>Secondary</u> System Airports		41
(50,000 to One Million Annual Passengers - 1970 Traffic)		
High Density Airports (more than 250,000 operations)		4
Westchester County (White Plains)	HPN	
Daugherty Field (Long Beach)	LGB	
Oakland Metropolitan (Oakland)	OAK	
Orange County (Santa Ana)	SNA	
Medium Density Airports (100,000 to 250,000 operations)		34
Amarillo Air Terminal (Amarillo)	AMA	
Robert Mueller Municipal (Austin)	AUS	
Birmingham Municipal (Birmingham)	BMH	
Boise Air Terminal (Boise)	BOI	
Columbia Metropolitan (Columbia)	CAE	
Charleston Municipal (Charleston)	CHS	
Corpus Christi International (Corpus Christi)	CRP	
Detroit City (Detroit)	DET	

Des Moines Municipal (Des Moines)	DSM
Mahlon Sweet Field (Eugene)	EUG
Fresno Air Terminal (Fresno)	FAT
Greensboro High Point (Greensboro)	GSO
Wichita Municipal (Wichita)	ICT
Islip MacArthur (Islip)	ISP
A. C. Thompson Field (Jackson)	JAN
Lubbock Regional (Lubbock)	LBB
Adams Field (Little Rock)	LIT
Midland Odessa Regional (Midland Odessa)	MAF
McCoy Air Force Base (Orlando)	MCO
Chicago Midway (Chicago)	MDW
Bates Field (Mobile)	MOB
Moffett Field (Mountain View)	MOF*
Monterey Peninsula (Monterey)	MRY
Patrick Henry (Newport News)	PHF
Greater Providence (Providence)	PVD
Raleigh/Durham (Raleigh/Durham)	RDU
R. E. Byrd International (Richmond)	RIC
Reno International (Reno)	RNO
Savannah Municipal (Savannah)	SAV
Santa Barbara Municipal (Santa Barbara)	SBA
Tallahassee Municipal (Tallahassee)	TLH
Toledo Express (Toledo)	TOL
Tucson International (Tucson)	TUS
McGhee Tyson (Knoxville)	TYS

Low Density Airports (less than 100,000 operations)		3
Arcata (Eureka)	ACV	
Spokane International (Spokane)	GEG	
Shreveport Regional (Shreveport)	SHV	
Number of NASP Feeder System Airports		2
(Less than 50,000 Annual Passengers - 1970 Traffic)		
High Dense Airports (more than 100,000 operations)		1
Hanscom Field (Boston)	BED	
Medium Dense Airports (20,000 to 100,000 operations)		1
Burke Lakefront (Cleveland)	BKL	
Low Dense Airports (less than 20,000 operations)		0
Number of General Aviation Airports		20
Allegheny County (Pittsburgh)	AGC	
Beltsville (Baltimore)	BEL**	
Chicago Meigs (Chicago)	CGX	
Bi State Parks (St. Louis)	CPS	
El Monte (El Monte)	EMT	
Fulton County (Atlanta)	FTY	
General Dewitt Spain Downtown (Memphis)	GDS	
Hartford-Brainard (Hartford)	HFD	
Houston Hobby (Houston)	HOU	
Crystal (Minneapolis-St. Paul)	MIC	
Kansas City Municipal (Kansas City)	MKC	
Montgomery Field (San Diego)	MYF	
Lakefront (New Orleans)	NEW	
Opa Locka (Miami)	OPF	

Norwood (Boston)	OWD	
DeKalb Peachtree (Atlanta)	PDK	
North Philadelphia (Philadelphia)	PNE	
Reid Hillview (San Jose)	RHV	
Sacramento Executive (Sacramento)	SAC	
Van Nuys (Van Nuys)	VNY	
Number of New (Mode III) STOLports		2
General Patton Field (Los Angeles)	GPF	
Secaucus (New York)	SEC	

* Moffett Field is currently a military air facility; but for the study, it is classified as a medium density secondary airport.

** Beltsville is classified as a general aviation field although it is currently owned by the United States Department of Agriculture.

APPENDIX 15.2

AIRPORT DATA BASE

AIRPORT DATA SUMMARY – CHICAGO REGION

IDENTIFICATION				HUB	ELEVATION (FT/M)	TEMPERATURE NORMAL MAX (°F/°C)	STOL RUNWAY						WIND COVERAGE	APPROACH RATIOS		RUNWAY STRENGTH X10³ (LB/Kg)			TAXIWAY WIDTH (FT/M)	RUNWAY/ TAXIWAY SEPARATION (FT/M)	MOST FREQUENT JET AIRCRAFT (AUG OAG)	LARGEST AIRCRAFT (AUG OAG)
CODE	CITY	AIRPORT NAME	STATE				NUMBER	LENGTH (FT/M)	EFFECTIVE GRADIENT	CORRECTED LENGTH (FT/M)	WIDTH (FT/M)	COMPOSITION		END #1	END #2	SINGLE	TWIN	TWIN TANDEM				
BUF	BUFFALO	GREATER BUFFALO INTERNATIONAL	NEW YORK	L	+ 723/220	70/21	5/23	8100/2469	0.61%	6820/2079	150/46	CONCRETE	98.0%	(5) 25-1	(23)50-1	70/32	90/41	149/68	75/23	385/117	BAC 1-11/727	DC-10
CGX	CHICAGO	MERRILL C. MEIGS	ILLINOIS	L	+ 592/180	84/29	18/36	3948/1203	0.10%	3305/1007	150/46	ASPHALT	86.4%	(18)20-1	(36)50-1	40/18	55/25	--	50/15	310/94	TWIN OTTERS	--
MDW	CHICAGO	CHICAGO MIDWAY	ILLINOIS	L	+ 619/189	84/29	4R/22L	6100/1859	0.13%	5210/1588	150/46	ASPH/CONC	90.5%	(4R)17-1	(22L)11-1	100/45	175/79	265/120	75/23	--	727/737	727S
CVG	CINCINNATI	GREATER CINCINNATI	OHIO	L	+ 890/271	85/29	9L/27R	5499/1676	0.41%	4092/1247	150/46	ASPHALT	90.7%	(9L)24-1	(27R)50-1	100/45	165/75	260/118	75/23	--	DC-9S/727	DC-8S
BKL	CLEVELAND	BURKE LAKEFRONT	OHIO	L	+ 585/178	82/28	6L/24R	6200/1890	0.40%	5111/1558	150/46	ASPHALT	--	(6L)40-1	(24R)19-1	68/31	82/37	133/60	75/23	750/229	CONVAIR 440	--
CMH	COLUMBUS	PORT COLUMBUS INTERNATIONAL	OHIO	M	+ 816/249	86/30	10L/28R	6000/1829	0.04%	4610/1405	150/46	ASPHALT	96.3%	(10)48-1	(28)50-1	100/45	160/73	275/125	75/23	390/119	DC-9S/727	DC-8F
DAY	DAYTON	J M COX DAYTON MUNI	OHIO	M	+1008/307	88/31	6R/24L	7000/21[illegible]4	0.11%	5556/1694	150/46	ASPH/CONC	89.1%	(6) 50-1	(24)45-1	100/45	170/77	305/138	75/23	440/134	DC-9S/727S	DC-8F
DEN	DENVER	STAPLETON INTERNATIONAL	COLORADO	L	+5330/1625	87/31	8L/26R	6486/1977	0.29%	2975/907	150/46	ASPH/CONC	90.6%	(8) 40-1	(26) 4-1	45/20	60/27	--	75/23	540/165	727/727S	DC-10
DET	DETROIT	DETROIT CITY	MICHIGAN	L	+ 625/191	83/28	15/33	5091/1552	0.06%	4312/1314	100/30	ASPHALT	86.0%	(15)50-1	(33)20-1	35/16	45/20	60/27	75/23	470/143	CONVAIR 440	--
DSM	DES MOINES	DES MOINES MUNICIPAL	IOWA	M	+ 957/292	86/30	12L/30R	9000/2743	0.51%	6966/2123	150/46	ASPH/CONC	89.5%	(12L)50-1	(30R)50-1	100/45	150/68	258/117	75/23	530/162	727S/727	720
IND	INDIANAPOLIS	INDIANAPOLIS - WEIR COOK	INDIANA	M	+ 797/243	86/30	13R/31L	7604/2318	0.21%	6233/1900	150/46	CONCRETE	88.5%	(13)29-1	(31)50-1	80/36	115/52	200/91	100/30	--	DC-9S/DC-9	707
MKC	KANSAS CITY	KANSAS CITY MUNICIPAL	MISSOURI	L	+ 758/231	91/33	18/36	7000/2134	0.23%	5501/1677	150/46	ASPH/CONC	95.2%	(18) 6-1	(36)19-1	48/22	73/33	136/62	75/23	--	727/727S	707
MKE	MILWAUKEE	GENERAL MITCHELL FIELD	WISCONSIN	M	+ 722/220	79/26	1R/19L	4182/1275	0.18%	3453/1052	150/46	CONCRETE	89.0%	(1) 50-1	(19)35-1	100/45	150/68	255/116	75/23	--	727/DC-9S	DC-8S
MIC	MINNEAPOLIS-ST PAUL	CRYSTAL	MINNESOTA	L	+ 869/265	83/28	13L/31R	3263/995	0.02%	2703/824	75/23	ASPHALT	90.6%	(13L)16-1	(31R)25-1	13/6	25/11	--	30/9	--	--	--
OMA	OMAHA	EPPLEY AIRFIELD	NEBRASKA	M	+ 983/300	90/32	17/35	6001/1839	0.08%	4751/1448	150/46	CONCRETE	94.5%	(17)17-1	(35)22-1	100/45	184/83	346/157	75/23	390/119	727/707	DC-8
AGC	PITTSBURGH	ALLEGHENY COUNTY	PENNSLY	L	+1252/382	83/28	09/27	6500/1981	0.03%	5215/1590	150/46	CONCRETE	--	(9) 50-1	(27)47-1	90/41	120/54	216/95	50/15	300/91	--	--
ROC	ROCHESTER	ROCHESTER-MONROE CO.	NEW YORK	M	+ 560/171	83/28	04/22	8000/2438	0.41%	6639/2024	150/46	ASPHALT	87.4%	(4) 50-1	(22)45-1	100/45	130/59	218/99	75/23	390/119	BAC 1-11/727	DC-10
CPS	ST LOUIS	BI-STATE PARKS	ILLINOIS	L	+ 413/126	91/33	12/30	5500/1676	0.08%	4697/1432	100/30	ASPHALT	92.9%	(12)50-1	(30)50-1	35/16	45/20	65/29	45/14	--	--	--
TOL	TOLEDO	TOLEDO EXPRESS	OHIO	S	+ 684/208	84/29	07/25	8700/2652	0.11%	7196/2193	150/46	ASPH/CONC	95.3%	(17)50-1	(25)50-1	100/45	125/57	223/101	60/18	395/120	DC-9S/727S	727S

AIRPORT DATA SUMMARY – NORTHEAST REGION

IDENTIFICATION							STOL RUNWAY							APPROACH RATIOS		RUNWAY STRENGTH X10³ (LB/Kg)							
CODE	CITY	AIRPORT NAME	STATE	HUB	ELEVATION (FT/M)	TEMPERATURE NORMAL MAX (°F/°C)	NUMBER	LENGTH (FT/M)	EFFECTIVE GRADIENT	CORRECTED LENGTH (FT/M)	WIDTH (FT/M)	COMPOSITION	WIND COVERAGE	END #1	END #2	SINGLE	TWIN	THIN TANDEM	TAXIWAY WIDTH (FT/M)	RUNWAY/TAXIWAY SEPARATION (FT/M)	MOST FREQUENT JET AIRCRAFT (AUG OAG)	LARGEST AIRCRAFT (AUG OAG)
BED	BOSTON	L. G. HANSCOM FIELD	MASS.	L	+ 133/41	82/28	11/29	7000/2134	0.13%	6077/1852	200/61	CONCRETE	95.9%	(11) 4-1	(29) 2-1	78/35	100/45	190/86	75/23	750/229	GEN. AVIATION	--
OWD	BOSTON	NORWOOD MEMORIAL	MASS.	L	+ 50/15	80/27	10/28	4000/1219	0.06%	3512/1070	150/46	ASPH/CONC	86.7%	(10)20-1	(28)22-1	63/29	110/50	--	50/15	150/46	GEN. AVIATION	--
BUF	BUFFALO	GREATER BUFFALO INTERNATIONAL	NEW YORK	L	+ 723/220	70/21	5/23	8100/2469	0.61%	6820/2079	150/46	CONCRETE	98.0%	(5) 25-1	(23)50-1	70/32	90/41	149/68	75/23	385/117	BAC 1-11/727	DC-10
CVG	CINCINNATI	GREATER CINCINNATI	OHIO	L	+ 890/271	85/29	9L/27R	5499/1676	0.41%	4092/1247	150/46	ASPHALT	90.7%	(9L)24-1	(27R)50-1	100/45	165/75	260/118	75/23	--	DC-9S/727	DC-8S
BKL	CLEVELAND	BURKE LAKEFRONT	OHIO	L	+ 585/178	82/28	6L/24R	6200/1890	0.40%	5111/1558	150/46	ASPHALT	--	(6L)40-1	(24R)19-1	68/31	82/37	133/60	75/23	750/229	CONVAIR 440	--
CMH	COLUMBUS	PORT COLUMBUS INTERNATIONAL	OHIO	M	+ 816/249	86/30	10L/28R	6000/1829	0.04%	4610/1405	150/46	ASPHALT	96.3%	(10)48-1	(28)50-1	100/45	160/73	275/125	75/23	390/119	DC-9S/727	DC-8F
DET	DETROIT	DETROIT CITY	MICHIGAN	L	+ 625/191	83/28	15/33	5091/1552	0.06%	4312/1314	100/30	ASPHALT	86.0%	(15)50-1	(33)20-1	35/16	45/20	60/27	75/23	470/143	CONVAIR 440	--
HFD	HARTFORD	HARTFORD-BRAINARD	CONNECT	M	+ 19/6	83/28	02/20	4418/1347	0.16%	3878/1182	150/46	ASPHALT	89.0%	(2) 17-1	(20)17-1	30/14	43/20	70/32	40/12	310/94	GEN. AVIATION	--
ISP	ISLIP	ISLIP MAC ARTHUR	NEW YORK	L	+ 98/30	81/27	06/24	6000/1829	0.17%	5754/1754	150/46	ASPH/CONC	83.4%	(6) 50-1	(24)40-1	32/15	56/25	92/42	50/15	140/43	BAC1-11/C580	727
SEC	NEW YORK	SECAUCUS	NEW YORK	L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
ORF	NORFOLK	NORFOLK REGIONAL	VIRGINIA	M	+ 27/8	86/30	05/23	6000/1829	0.12%	5213/1589	150/46	ASPHALT	94.4%	(5) 50-1	(23)45-1	95/43	143/65	270/122	75/23	490/149	737/727	727S
AGC	PITTSBURGH	ALLEGHENY COUNTY	PENNSLY	L	+1252/382	83/28	09/27	6500/1981	0.03%	5215/1590	150/46	CONCRETE	--	(9) 50-1	(27)47-1	90/41	120/54	210/95	50/15	300/91	GEN. AVIATION	--
PNE	PHILADELPHIA	NORTH PHILADELPHIA	PENNSLY	L	+ 120/37	85/29	06/24	7000/2134	0.10%	6070/1850	150/46	ASPHALT	--	(6) 13-1	(24)50-1	100/45	--	--	50/15	260/79	GEN. AVIATION	--
PVD	PROVIDENCE	T. F. GREEN STATE	RHODE IS.	M	+ 56/17	82/28	05L/23R	4975/1516	0.04%	4430/1350	150/46	CONCRETE	92.1%	(5) 24-1	(23) 7-1	33/15	45/20	93/42	75/23	245/75	DC-9S/727	727S
ROC	ROCHESTER	ROCHESTER-MONROE CO.	NEW YORK	M	+ 560/171	83/23	04/22	8000/2438	0.41%	6639/2024	150/46	ASPHALT	87.4%	(4) 50-1	(22)45-1	100/45	130/59	218/99	75/23	390/119	BAC 1-11/727	DC-10
SYR	SYRACUSE	CLARENCE E. HANCOCK	NEW YORK	M	+ 421/128	83/28	14/32	6480/1975	0.22%	5491/1674	150/46	ASPHALT	91.7%	(14)31-1	(32)30-1	72/33	102/46	140/64	75/23	465/142	BAC 1-11/727	DC-10
HPN	WHITE PLAINS	WESTCHESTER CO.	NEW YORK	L	+ 439/134	85/29	16/34	6550/1996	0.06%	5798/1767	150/46	ASPH/CONC	96.0%	(16)50-1	(34)28-1	85/39	153/69	270/122	60/18	465/142	CONVAIR 580/	C580
DCA	WASHINGTON DC	WASHINGTON NATIONAL	D.C.	L	+ 15/5	87/31	18/36	6870/2094	0.03%	6026/1837	200/61	ASPHALT	93.9%	(18)17-1	(36)50-1	110/50	200/91	360/163	75/23	--	727/DC-9S	727S

AIRPORT DATA SUMMARY – CALIFORNIA REGION

IDENTIFICATION				HUB	ELEVATION (FT/M)	TEMPERATURE NORMAL MAX (°F/°C)	STOL RUNWAY						WIND COVERAGE	APPROACH RATIOS		RUNWAY STRENGTH X10³ (LB/Kg)			TAXIWAY WIDTH (FT/M)	RUNWAY/TAXIWAY SEPARATION (FT/M)	MOST FREQUENT JET AIRCRAFT (AUG OAG)	LARGEST AIRCRAFT (AUG OAG)
CODE	CITY	AIRPORT NAME	STATE				NUMBER	LENGTH (FT/M)	EFFECTIVE GRADIENT	CORRECTED LENGTH (FT/M)	WIDTH (FT/M)	COMPOSITION		END #1	END #2	SINGLE	TWIN	TWIN TANDEM				
ABQ	ALBUQUERQUE	ALBUQUERQUE SUNPORT	N. MEXICO	M	+5352/1631	93/34	17/35	8993/2741	0.08%	6429/1960	200/91	ASPHALT	90.3%	(17)50-1	(35)50-1	100/45	200/91	350/159	75/23	425/130	DC-9/727S	C880
ACV	ARCATA - EUREKA	ARCATA	CALIFORNIA	N	+ 218/66	61/16	13/31	5999/1828	0.66%	5470/1667	150/46	ASPHALT	98.3%	(13)50-1	(31)36-1	60/27	155/70	280/127	50/15	280/85	DC-9S	DC-9S
DEN	DENVER	STAPLETON INTERNATIONAL	COLORADO	L	+5330/1625	87/31	8L/26R	6486/1977	0.29%	2975/907	150/46	ASPH/CONC	90.0%	(8) 40-1	(26) 4-1	45/20	60/27	--	75/23	540/165	727/727S	DC-10
EMT	EL MONTE	EL MONTE	CALIFORNIA	L	+ 290/88	89/32	01/19	3994/1217	0.42%	3252/991	75/23	ASPHALT	100%	(1) 21-1	(19)35-1	12.5/6	--	--	40/12	180/55	GEN. AVIATION	--
FAT	FRESNO	FRESNO AIR TERMINAL	CALIFORNIA	S	+ 332/101	99/37	11R/29L	2967/904	0.04%	2395/730	75/23	ASPHALT	99.6%	(11)50-1	(29)50-1	100/45	155/70	255/116	60/18	480/146	737/DC-8S	DC-8S
GPF	LOS ANGELES	GENERAL PATTON FIELD	CALIFORNIA	L	NEW	SITE	--	--	--	--	--	--	--	--	--	--	--	--	--	--	NEW	--
LAS	LAS VEGAS	McCARRAN INTERNATIONAL	NEVADA	L	+2171/661	104/40	1R/19L	7500/2286	1.07%	4710/1436	150/46	ASPHALT	97.0%	(1) 35-1	(19)46-1	60/27	100/45	172/78	75/23	490/149	737/DC-9S	747
LGB	LONG BEACH	LONG BEACH - DAUGHERTY FIELD	CALIFORNIA	L	+ 58/18	82/28	7R/25L	5420/1652	0.39%	4650/1417	150/46	ASPHALT	98.9%	(7) 22-1	(25)50-1	35/16	55/25	85/39	75/23	--	737	DC-10
MOF	MOUNTAIN VIEW	MOFFETT FIELD NAS	CALIFORNIA	N	+ 29/9	78/26	14R/32L	7513/2290	0%	6844/2086	--	--	--	--	--	--	--	--	--	--	C135/C131	C135
MRY	MONTEREY	MONTEREY PENINSULA	CALIFORNIA	S	+ 244/74	75/24	06/24	4000/1219	0.13%	3580/1091	150/46	ASPHALT	96.3%	(6) 16-1	(24) 3-1	60/27	110/50	200/91	50/15	300/91	DC-9S/737	727
MYF	SAN DIEGO	MONTGOMERY FIELD	CALIFORNIA	M	+ 423/129	79/26	10L/28R	3400/1036	0.26%	2906/886	150/46	ASPHALT	99.1%	(10)35-1	(28)50-1	12/5	--	--	50/15	520/158	GEN. AVIATION	--
OAK	OAKLAND	METROPOLITAN OAKLAND	CALIFORNIA	L	+ 6/2	74/23	9R/27L	6210/1893	0.00%	5750/1753	150/46	ASPHALT	90.0%	(9) 28-1	(27)50-1	130/59	150/68	230/104	75/23	--	737/727S	DC-8F
PDX	PORTLAND	PORTLAND INTERNATIONAL	OREGON	M	+ 26/8	79/26	02/20	7030/2143	0.10%	6316/1925	150/46	ASPHALT	89.5%	(2) 31-1	(20)34-1	170/77	200/91	340/154	75/23	--	727/727S	DC-10
PHX	PHOENIX	PHOENIX SKY HARBOR INTERNATIONAL	ARIZONA	L	+1128/344	106/41	08L/26R	8750/2667	0.23%	6350/1935	150/46	ASPH/CONC	98.8%	(8) 40-1	(26)40-1	80/36	160/73	280/127	75/23	390/119	727S/DC-9S	747
RHV	SAN JOSE	REID HILLVIEW OF SANTA CLARA COUNTY	CALIFORNIA	M	+ 133/41	84/29	13L/31R	3101/945	0.38%	2626/800	75/23	ASPHALT	99.5%	(13)50-1	(31)20-1	17/8	--	--	40/12	140/43	GEN. AVIATION	--
RNO	RENO	RENO INTERNATIONAL	NEVADA	M	+4411/1344	92/33	07/25	6150/1875	0.16%	3692/1125	150/46	ASPHALT	94.0%	(7) 46-1	(25)40-1	60/27	170/77	260/118	75/23	390/119	727/737	DC-8S
SAC	SACRAMENTO	SACRAMENTO EXECUTIVE	CALIFORNIA	M	+ 21/6	95/35	02/20	6003/1830	0.10%	4980/1518	150/46	ASPHALT	93.3%	(2) 38-1	(20)22-1	200/91	200/91	400/181	50/15	900/274	GEN. AVIATION	--
SBA	SANTA BARBARA	SANTA BARBARA MUNICIPAL	CALIFORNIA	S	+ 10/3	74/23	07/25	6048/1843	0.02%	5590/1704	150/46	ASPHALT	98.6%	(7) 37-1	(25)33-1	110/50	160/73	245/111	60/18	300/91	737/727	727
SLC	SALT LAKE CITY	SALT LAKE CITY INTERNATIONAL	UTAH	M	+4226/1288	92/33	16L/32R	8562/2610	0.09%	3980/1213	150/46	ASPH/CONC	95.2%	(16)50-1	(34)39-1	60/27	170/77	260/118	75/23	475/145	737/727	DC-8S
SNA	SANTA ANA	ORANGE COUNTY	CALIFORNIA	L	+ 54/17	86/30	1L/19R	5700/1737	0.28%	4890/1491	150/46	ASPHALT	98.4%	(1) 37-1	(19)50-1	70/32	95/43	150/68	75/23	800/244	737/DC-9S	DC-9S
TUS	TUCSON	TUCSON INTERNATIONAL	ARIZONA	M	+2630/802	99/37	03/21	7000/2134	0.17%	4580/1396	150/46	ASPHALT	92.6%	(3) 40-1	(21)36-1	60/27	80/36	130/59	75/23	590/180	727S/DC-9S	727S
VNY	VAN NUYS	VAN NUYS	CALIFORNIA	L	+ 800/244	90/32	16R/34L	8000/2438	0.70%	6038/1840	150/46	ASPH/CONC	98.4%	(16)30-1	(34)38-1	80/36	110/50	175/79	50/15	400/122	GEN. AVIATION	--

AIRPORT DATA SUMMARY – SOUTHERN REGION

IDENTIFICATION				HUB	ELEVATION (FT/M)	TEMPERATURE NORMAL MAX (°F/°C)	STOL RUNWAY						WIND COVERAGE	APPROACH RATIOS		RUNWAY STRENGTH X10³ (LB/Kg)			TAXIWAY WIDTH (FT/M)	RUNWAY/ TAXIWAY SEPARATION (FT/M)	MOST FREQUENT JET AIRCRAFT (AUG OAG)	LARGEST AIRCRAFT (AUG OAG)
CODE	CITY	AIRPORT NAME	STATE				NUMBER	LENGTH (FT/M)	EFFECTIVE GRADIENT	CORRECTED LENGTH (FT/M)	WIDTH (FT/M)	COMPOSITION		END #1	END #2	SINGLE	TWIN	TWIN TANDEM				
ABQ	ALBUQUERQUE	ALBUQUERQUE SUNPORT	N. MEXICO	M	+5232/1631	93/34	17/35	8993/2741	0.08%	6429/1960	200/61	ASPHALT	90.3%	(17)50-1	(35)50-1	100/45	200/91	350/159	75/23	425/130	DC-9/727S	C-880
AMA	AMARILLO	AMARILLO AIR TERMINAL	TEXAS	S	+3605/1099	93/34	03/21	13500/4115	0.03%	10710/3264	300/91	CONCRETE	81.9%	(3) 50-1	(21)50-1	100/45	200/91	400/181	75/23	1060/323	DC-9/727S	727S
AUS	AUSTIN	ROBT. MUELLER MUNICIPAL	TEXAS	S	+ 632/193	96/36	12R/30L	7270/2216	0.77%	5412/1650	150/46	ASPHALT	95.1%	(12)50-1	(30)50-1	75/34	90/41	140/64	60/18	330/101	DC-9/727/727S	727S
CRP	CORPUS CHRISTI	CORPUS CHRISTI INTERNAT'L.	TEXAS	S	+ 43/13	94/34	17/35	6080/1853	0.03%	5120/1561	150/46	ASPHALT	89.8%	(17)50-1	(35)50-1	150/68	170/77	245/111	75/23	590/180	727/DC-9	727S
DAL	DALLAS	DALLAS LOVE FIELD	TEXAS	L	+ 487/148	95/35	13L/31R	7751/2363	0.13%	6151/1875	150/46	CONCRETE	92.0%	(13)30-1	(31)39-1	100/45	200/91	350/159	75/23	390/119	727/727S	747
DEN	DENVER	STAPLETON INTERNATIONAL	COLORADO	L	+5330/1625	87/31	8L/26R	6486/1977	0.29%	2957/901	150/46	ASPH/CONC	90.6%	(8) 40-1	(26) 4-1	45/20	60/27	---	75/23	540/165	727/727S	DC-10
ELP	EL PASO	EL PASO INTERNATIONAL	TEXAS	M	+3956/1206	95/35	08/26	9008/2746	0.37%	6983/2128	150/46	ASPHALT	97.0%	(8) 50-1	(26)50-1	100/45	180/82	350/159	75/23	590/180	727S/DC-9	DC-10
HOU	HOUSTON	WILLIAM P. HOBBY	TEXAS	L	+ 48/15	93/34	17/35	4500/1372	0.07%	3810/1161	150/46	CONCRETE	87.7%	(17)50-1	(35)44-1	80/36	105/48	175/79	75/23	---	737/720	720
MKC	KANSAS CITY	KANSAS CITY MUNICIPAL	MISSOURI	L	+ 758/231	91/33	18/36	7000/2134	0.23%	5501/1677	150/46	ASPH/CONC	95.2%	(18) 6-1	(36)19-1	48/22	73/33	136/62	75/23	---	727/727S	707
LIT	LITTLE ROCK	ADAMS FIELD	ARKANSAS	S	+ 257/78	93/34	04/22	7000/2134	0.06%	5833/1778	150/46	ASPHALT	97.1%	(4) 23-1	(22)25-1	70/32	95/43	150/68	75/23	450/137	DC-9S/727S	727S
LBB	LUBBOCK	LUBBOCK REGIONAL	TEXAS	S	+3269/996	92/33	17R/35L	8500/2591	--	7083/2159	150/46	ASPHALT	---	(17)50-1	(35)50-1	100/45	170/77	350/159	75/23	370/113	DC-9/727	727S
GDS	MEMPHIS	GEN. DEWITT SPAIN-DOWNTOWN	TENN.	M	+ 224/68	91/33	16/34	3800/1158	0.00%	3214/979	75/23	ASPHALT	97.0%	(16)20-1	(34)15-1	25/11	---	---	45/14	190/60	GEN.AVIATION	---
MAF	MIDLAND	MIDLAND-ODESSA REGIONAL AIR TERMINAL	TEXAS	S	+2870/875	94/34	16R/34L	7529/2295	0.29%	5930/1807	150/46	ASPHALT	86.8%	(16)40-1	(34)40-1	106/48	170/77	320/145	75/23	390/119	DC-9/727S	727S
NEW	NEW ORLEANS	LAKEFRONT	LOUIS.	L	+ 9/3	92/33	17/35	5890/1795	0.09%	4800/1463	150/46	ASPHALT	96.0%	(17)50-1	(35)40-1	60/27	70/32	110/50	75/23	370/113	GEN.AVIATION	---
OKC	OKLAHOMA CITY	WILL ROGERS WORLD	OKLA.	M	+ 294/394	94/34	12/30	6500/1981	0.17%	4811/1466	150/46	ASPH/CONC	86.9%	(12)50-1	(30)50-1	140/64	200/91	340/154	75/23	390/119	727/727S	DC-10
SAT	SAN ANTONIO	SAN ANTONIO INTERNATIONAL	TEXAS	M	+ 809/247	94/34	03/21	7502/2287	0.26%	5885/1794	150/46	ASPH/CONC	87.4%	(3) 50-1	(21)50-1	95/43	120/54	180/82	75/23	490/149	727/727S	727S
SHV	SHREVEPORT	SHREVEPORT REGIONAL	LOUIS.	S	+ 257/78	94/34	05/23	4821/1469	0.17%	3806/1160	150/46	CONCRETE	88.6%	(5) 45-1	(23)50-1	55/25	70/32	120/54	75/23	490/149	DC-9S/DC-9	727
CPS	ST. LOUIS	BI STATE PARKS	ILLINOIS	L	+ 413/126	91/33	12/30	5500/1676	0.08%	4697/1432	100/31	ASPHALT	92.9%	(12)50-1	(30)50-1	35/16	45/20	65/29	45/14	---	GEN.AVIATION	---
TUL	TULSA	TULSA INTERNATIONAL	OKLA.	M	+ 676/206	93/34	12/30	6360/1939	0.32%	4829/1472	150/46	CONCRETE	82.9%	(12) -	(30)40-1	50/23	125/57	215/98	75/23	---	727/727S	DC-10
ICT	WICHITA	WICHITA MUNICIPAL	KANSAS	S	+1332/406	93/34	1R/19L	7300/2225	0.01%	5572/1698	150/46	CONCRETE	92.5%	(1) 50-1	(19)50-1	100/45	175/79	300/136	75/23	440/134	727S/727	727S

AIRPORT DATA SUMMARY – SOUTHEAST REGION

IDENTIFICATION							STOL RUNWAY								APPROACH RATIOS		RUNWAY STRENGTH $X10^3$ (LB/Kg)						
CODE	CITY	AIRPORT NAME	STATE	HUB	ELEVATION (FT/M)	TEMPERATURE NORMAL MAX (°F/°C)	NUMBER	LENGTH (FT/M)	EFFECTIVE GRADIENT	CORRECTED LENGTH (FT/M)	WIDTH (FT/M)	COMPOSITION	WIND COVERAGE	END #1	END #2	SINGLE	TWIN	TWIN TANDEM	TAXIWAY WIDTH (FT/M)	RUNWAY/ TAXIWAY SEPARATION (FT/M)	MOST FREQUENT JET AIRCRAFT (AUG OAG)	LARGEST AIRCRAFT (AUG OAG)
PDK	ATLANTA	DEKALB-PEACHTREE	GEORGIA	L	+1002/305	89/32	02L/20R	3739/1140	0.38%	2882/878	150/46	ASPHALT	89.7%	(2) 21-1	(20)28-1	20/9	--	--	50/15	200/61	GEN. AVIATION	--
FTY	ATLANTA	FULTON COUNTY	GEORGIA	L	+ 840/256	89/32	08R/26L	5796/1767	0.25%	4587/1398	100/34	ASPHALT	92.9%	(8) 35-1	(26)18-1	105/48	121/55	198/90	60/18	495/151	GEN. AVIATION	--
BEL	BALTIMORE	BELTSVILLE/USDA	MARYLAND	O	+ 159/49	86/30	08/26	4378/1334	0.27%	3658/1115	150/46	ASPHALT	--	(8)33-1	(26)14-1	--	--	--	NONE	--	GEN. AVIATION	--
BHM	BIRMINGHAM	BIRMINGHAM MUNICIPAL	ALABAMA	S	+ 643/196	91/33	18/36	4855/1480	0.58%	3560/1085	150/46	ASPH/CONC	93.4%	(18) 8-1	(36)21-1	55/25	75/34	120/54	75/23	440/134	DC-9S/DC-9	DC-8S
CHS	CHARLESTON	CHARLESTON AFB - MUNICIPAL	S.CAROLINA	S	+ 45/14	89/32	03/21	7000/2134	0.33%	5870/1789	150/46	ASPH/CONC	97.5%	(3) 32-1	(21)37-1	65/29	150/68	320/145	100/34	340/104	DC-9S/727S	727S
CLT	CHARLOTTE	DOUGLAS MUNICIPAL	N.CAROLINA	M	+ 748/228	88/31	18/36	7845/2391	0.32%	6255/1907	150/46	ASPH/CONC	95.5%	(18)37-1	(36)47-1	75/34	95/43	150/68	75/23	390/119	DC-9S/727	DC-8S
CGX	CHICAGO	MERRILL C. MEIGS	ILLINOIS	L	+ 592/180	84/29	18/36	3948/1203	0.10%	3305/1007	150/46	ASPHALT	86.4%	(18)20-1	(36)50-1	40/18	55/25	--	50/15	310/94	TWIN OTTERS	--
CVG	CINCINNATI	GREATER CINCINNATI	OHIO	L	+ 890/271	85/29	9L/27R	5499/1676	0.41%	4092/1247	150/46	ASPHALT	90.7%	(9) 24-1	(27)50-1	100/45	165/75	260/118	75/23	--	DC-9S/727	DC-8S
BKL	CLEVELAND	BURKE LAKEFRONT	OHIO	L	+ 585/178	82/28	6L/24R	6200/1890	0.40%	5111/1558	150/46	ASPHALT	--	(6) 40-1	(24)19-1	68/31	82/37	155/70	75/23	750/229	CONVAIR 440	--
CAE	COLUMBIA	COLUMBIA METROPOLITAN	GEORGIA	S	+ 236/72	92/33	11/29	7551/2302	0.08%	6149/1874	150/46	ASPH/CONC	95.3%	(11)41-1	(29)50-1	72/33	128/58	235/107	75/23	740/226	DC-9S/DC-9	DC-8S
DET	DETROIT	DETROIT CITY	MICHIGAN	L	+ 625/191	83/28	15/33	5091/1552	0.06%	4312/1314	100/34	ASPHALT	86.0%	(15)50-1	(33)20-1	35/16	45/20	60/27	75/23	470/143	CONVAIR 440	--
FLL	FT LAUDERDALE	FT. LAUDERDALE-HOLLYWOOD INTL	FLORIDA	L	+ 10/3	90/32	13/31	6020/1835	0.07%	5145/1568	150/46	ASPHALT	94.8%	(13)18-1	(31)25-1	90/41	150/68	300/136	75/23	400/122	727/727S	DC-10
GSO	GREENSBORO	GREENSBORO-HIGH POINT WINSTON SALEM REGIONAL	N.CAROLINA	M	+ 926/282	87/31	14/32	6380/1945	0.40%	4981/1518	150/46	ASPHALT	94.0%	(14)34-1	(32)50-1	123/56	170/77	244/111	75/23	390/119	DC-9S/727	727S
IND	INDIANAPOLIS	INDIANAPOLIS-WEIR COOK	INDIANA	M	+ 797/243	86/30	13R/31L	7604/2318	0.21%	6233/1900	150/46	CONCRETE	88.5%	(13)29-1	(31)50-1	80/36	115/52	200/91	100/30	--	DC-9S/DC-9	707
JAN	JACKSON	ALLEN C. THOMPSON FIELD	MISSISSIPPI	S	+ 345/105	93/34	15R/33L	6608/2014	0.20%	5320/1622	150/46	CONCRETE	98.3%	(15)50-1	(33)27-1	130/59	165/75	300/136	75/23	840/256	DC-9S/DC-9	DC-9S
JAX	JACKSONVILLE	JACKSONVILLE INTERNATIONAL	FLORIDA	M	+ 29/9	92/33	13/31	7701/2347	0.04%	6526/1989	150/46	CONCRETE	92.2%	(13)50-1	(31)50-1	100/45	160/73	265/120	75/23	540/165	DC-9S/727S	747
TYS	KNOXVILLE	McGHEE TYSON	TENNESSEE	S	+ 981/299	90/32	04R/22L	4998/1523	0.08%	4602/1403	150/46	CONCRETE	98.6%	(4) 50-1	(22)50-1	50/23	70/32	140/64	75/23	--	DC-9S/737	727S
SDF	LOUISVILLE	STANDIFORD FIELD	KENTUCKY	M	+ 497/151	89/32	06/24	5001/1524	0.44%	3991/1216	150/46	CONCRETE	--	(6) 16-1	(24)25-1	43/20	56/25	108/49	75/23	--	DC-9S/727	DC-8F
GDS	MEMPHIS	GEN DEWITT SPAIN DOWNTOWN	TENNESSEE	M	+ 224/68	91/33	16/34	3800/1158	0.00%	3214/980	75/23	ASPHALT	97.0%	(10)20-1	(34)15-1	25/11	--	--	45/14	190/60	GEN. AVIATION	--
OPF	MIAMI	OPA LOCKA	FLORIDA	L	+ 9/3	90/32	9L/27R	8000/2438	0.01%	6872/2095	200/61	ASPHALT	94.9%	(9) 43-1	(27)50-1	96/44	155/70	290/132	75/23	540/165	GEN. AVIATION	--
MOB	MOBILE	BATES FIELD	ALABAMA	S	+ 218/66	91/33	09/27	4989/1521	0.06%	4197/1279	150/46	ASPHALT	94.0%	(9) 50-1	(27)33-1	70/32	87/39	139/63	75/23	390/119	DC-9/727S	727S
BNA	NASHVILLE	NASHVILLE METRO	TENNESSEE	M	+ 597/182	91/33	02R/20L	4040/1231	0.53%	3146/959	150/46	ASPH/CONC	98.1%	(2) 50-1	(20)50-1	60/27	84/38	128/58	75/23	360/110	DC-9S/727S	727S
NEW	NEW ORLEANS	LAKEFRONT	LOUISIANA	L	+ 9/3	92/33	17/35	5890/1795	0.09%	4800/1463	150/46	ASPHALT	96.0%	(17)50-1	(35)40-1	60/27	70/32	110/50	75/23	370/113	GEN. AVIATION	--
PHF	NEWPORT NEWS	PATRICK HENRY	VIRGINIA	S	+ 41/13	86/30	02/20	5025/1532	0.08%	4374/1333	150/46	CONCRETE	--	(2) 30-1	(20)40-1	85/39	120/54	215/98	75/23	560/171	727/727S	727S
ISP	NEW YORK	ISLIP MAC ARTHUR	NEW YORK	L	+ 98/30	81/27	06/24	6000/1829	0.17%	5754/1754	150/46	ASPH/CONC	83.4%	(6) 50-1	(24)40-1	32/15	56/25	92/42	50/15	--	BAC 1-11/C580	727
SEC	NEW YORK	SECAUCUS	NEW JERSEY	L	NEW	SITE	--	--	--	--	--	--	---	--	--	--	--	--	--	--	NEW	--
ORF	NORFOLK	NORFOLK REGIONAL	VIRGINIA	M	+ 27/8	86/30	05/23	6000/1829	0.12%	5213/1589	150/46	ASPHALT	94.4%	(5) 50-1	(23)45-1	95/43	143/65	270/123	75/23	490/149	727/737	727S
MCO	ORLANDO	MC COY AFB	FLORIDA	M	+ 96/29	92/33	18L/36R	12000/3658	0.01%	10171/3100	200/61	ASPHALT	94.6%	(18)50-1	(36)50-1	165/75	200/91	400/181	75/23	690/210	727/DC-9S	DC-10
PNE	PHILADELPHIA	NORTH PHILADELPHIA	PENNSLY	L	+ 120/37	85/29	06/24	7000/2134	0.10%	6070/1850	150/46	ASPHALT	--	(6) 13-1	(24)50-1	100/45	--	--	50/15	260/79	BEECH TURBO	--
AGC	PITTSBURGH	ALLEGHENY COUNTY	PENNSLY	L	+1252/382	83/28	09/27	6500/1931	0.03%	5215/1590	150/46	CONCRETE	--	(9) 50-1	(27)47-1	90/41	120/54	210/95	50/15	300/91	GEN. AVIATION	--
RDU	RALEIGH-DURHAM	RALEIGH-DURHAM	N.CAROLINA	M	+ 435/133	90/32	14/32	4498/1371	0.24%	3660/1116	150/46	ASPHALT	95.8%	(14)42-1	(32)31-1	20/9	--	--	75/23	--	DC-9S/727	727S
RIC	RICHMOND	RICHARD EVELYN BYRD INTL	VIRGINIA	M	+ 167/51	87/31	02/20	6606/2014	0.20%	4328/1319	150/46	ASPHALT	--	(2) 40-1	(20)50-1	125/57	160/73	240/109	60/18	645/196	737/DC-9S	DC-8S
SAV	SAVANNAH	SAVANNAH MUNICIPAL	GEORGIA	S	+ 50/15	91/33	09/27	9000/2743	0.35%	7464/2275	150/46	ASPH/CONC	94.6%	(9) 50-1	(27)50-1	40/18	60/27	110/50	--	--	DC-9S/727	DC-8F
CPS	ST LOUIS	BI STATE PARKS	ILLINOIS	L	+ 413/126	91/33	12/30	5500/1676	0.08%	4697/1432	100/34	ASPHALT	92.9%	(12)50-1	(30)50-1	35/16	45/20	65/29	45/14	--	GEN. AVIATION	--
TLH	TALLAHASSEE	TALLAHASSEE MUNICIPAL	FLORIDA	S	+ 81/25	91/33	18/36	6071/1850	0.39%	5003/1525	150/46	ASPHALT	95.9%	(18)50-1	(36)50-1	80/36	150/68	270/123	60/18	445/136	DC-9/DC-9S	727S
TPA	TAMPA	TAMPA INTERNATIONAL	FLORIDA	M	+ 27/8	99/32	09/27	7000/2134	0.20%	5923/1805	150/46	ASPHALT	94.7%	(9) 50-1	(27)50-1	75/34	85/39	140/64	75/23	500/152	727S/727	747
DCA	WASHINGTON D.C.	WASHINGTON NATIONAL	D.C.	L	+ 15/5	87/31	18/36	6870/2094	0.03%	6026/1838	200/61	ASPHALT	93.9%	(18)17-1	(36)50-1	110/50	200/91	360/163	75/23	--	727/DC-9S	727S

AIRPORT DATA SUMMARY – NORTHWEST REGION

IDENTIFICATION				HUB	ELEVATION (FT/M)	TEMPERATURE NORMAL MAX (°F/°C)	STOL RUNWAY						WIND COVERAGE	APPROACH RATIOS		RUNWAY STRENGTH X10³ (LB/Kg)			TAXIWAY WIDTH (FT/M)	RUNWAY/TAXIWAY SEPARATION (FT/M)	MOST FREQUENT JET AIRCRAFT (AUG OAG)	LARGEST AIRCRAFT (AUG OAG)
CODE	CITY	AIRPORT NAME	STATE				NUMBER	LENGTH (FT/M)	EFFECTIVE GRADIENT	CORRECTED LENGTH (FT/M)	WIDTH (FT/M)	COMPOSITION		END #1	END #2	SINGLE	TWIN	TWIN TANDEM				
BOI	BOISE	BOISE AIR TERMINAL-GOWEN FLD.	IDAHO	S	+ 2858/871	90/32	10L/28R	7400/2256	0.43%	4690/1430	150/46	ASPHALT	97.0%	(10) 50-1	(28)36-1	60/27	145/66	230/104	75/23	425/130	DC-9S/727S	727S
EUG	EUGENE	MAHLON SWEET FIELD	OREGON	S	+ 365/111	82/28	16/34	6200/1890	0.09%	5341/1628	150/46	ASPHALT	97.4%	(16) 50-1	(34)50-1	75/34	100/45	160/73	50/15	---	DC-9S/737	DC-9S
OAK	OAKLAND	METROPOLITAN OAKLAND INTERNATIONAL - NORTH FIELD	CALIF.	L	+ 6/2	74/23	9R/27L	6210/1893	0.00%	5750/1753	150/46	ASPHALT	90.0%	(9) 28-1	(27)50-1	130/59	150/68	230/104	75/23	---	737/727S	DC-8F
PDX	PORTLAND	PORTLAND INTERNATIONAL	OREGON	M	+ 26/8	79/26	02/20	7030/2143	0.10%	6316/1925	150/46	ASPHALT	89.5%	(02) 31-1	(20)34-1	170/77	200/91	340/154	75/23	---	727/727S	DC-10
RNO	RENO	RENO INTERNATIONAL	NEVADA	M	+4411/1344	92/33	07/25	6105/1861	0.16%	3692/1125	150/46	ASPHALT	94.0%	(7) 46-1	(25)40-1	60/27	170/77	260/118	75/23	400/122	727/737	DC-8S
SEA	SEATTLE	SEATTLE-TACOMA INTERNAT'L.	WASH.	L	+ 428/130	76/24	16R/34L	9424/2872	0.72%	7790/2374	150/46	CONCRETE	95.2%	(16) 50-1	(34)40-1	100/45	200/91	350/159	75/23	650/198	727S/727	747
GEG	SPOKANE	SPOKANE INTERNATIONAL	WASH.	M	+ 2372/723	82/28	07/25	8199/2499	0.17%	5973/1821	150/46	ASPH-CONC	92.8%	(7) 36-1	(25)40-1	40/18	80/36	150/68	75/23	680/207	727/DC-9S	727S

15.3 Airport Cost Data Base

15.3.1 Air Carrier Airport Costs

1. Asphalt Runways, Taxiways and Apron Paving

   Total Cost/Sq. Yd. - $7.87 to $8.32 (4" Thick)

2. Concrete Pavements

   15" - $22.20 to $23.07/Sq. Yd.

   12" - $19.20 to $20.07/Sq. Yd.

   10" - $17.20 to $18.07/Sq. Yd.

3. Service Roads - 3" A.C.

   $7.42 to $7.76/Sq. Yd.

4. Lighting

   Edge Lights - $225/Fixture + $3.00/Linear Ft.

   Centerline Lights - $250/Fixture + $3.00/Linear Ft.

5. Terminal Buildings - $30/Sq. Ft.

6. Trailers - $15/Sq. Ft.

7. Parking Areas - with 4" Crush Rock Base

   2" A.C. - $2.01 to $2.23/Sq. Yd.

   3" A.C. - $2.46 to $2.80/Sq. Yd.

8. Multiple Parking

   Total Cost/Car Space - $1160 - $2110

15.3.2 FAA Airport and Airway System Cost Elements

1. Land (Cost/Acre)

   New Airports - $720 - $2800

   Existing Airports - $730 - $6900

2. <u>Airport Paving</u>

$4.28 (utility) - $11.32 (trunk airport) Sq. Yd.

3. <u>Runway Lighting</u>

Cost: (Dollars/Linear Foot)

Hi-intensity edge lighting - $9.53

4. <u>Taxiway Lighting</u>

Cost: (Dollars/Linear Foot)

Medium Intensity - $6.14

5. <u>Touchdown Zone Lighting</u>

Cost: (Dollars/Linear Foot)

3000' @ $58/Ft.

6. <u>Runway Centerline Lights</u>

Cost: (Dollars/Linear Ft.) - $18.00

7. <u>Apron Lighting</u>

Cost: $2100

8. <u>Wind Tee</u>

Controlled - $15,600

Uncontrolled - $ 3,500

9. <u>Rotating Beacon</u> - 36" + 10"

36" - $6700

10" - $1900

10. <u>Wind Cones</u>

	8 Ft.	12 Ft.
Lighted	$1200	$1900
Unlighted	$ 700	$1200

11. Taxiway Turnoff Signs

$550/Sign

12. Boundary Markers

$60 Each

13. Runway Markings

Cost: (Dollars per Linear Foot)

Basic	- $ .24
Non Precision Instrument	- $ .95
Precision Instrument	- $1.70

14. Runway Grooving

Cost: (Dollars per Square Foot) - $.12

15. Segmented Circle Cost

$1300

16. Security-Perimeter Fences

Cost: (Dollars per Linear Foot)

Perimeter	- $ .75
Security	- $3.00

17. Roads (Service)

Cost: (Dollars/Mile)- $27,500

(Dollars/Linear Foot) - $5.20

18. Buildings

Fire/Rescue	- $28.25/Sq. Ft.
Maintenance	- $26.30/Sq. Ft.
Snow Removal	- $20.00/Sq. Ft.

15.3.3 Military Construction Pricing Guide

1. Runways, Taxiways, Aprons

   Asphalt

4" A.C. Surface; 6" Base, 20" Sub-base	$11.57/Sq. Yd.
3" A.C. Surface; 6" Base, 15" Sub-base	$ 9.70/Sq. Yd.

   Concrete

24" Portland Cement Concrete	$22.87/Sq. Yd.
17" Portland Cement Concrete	$18.15/Sq. Yd.
12" Portland Cement Concrete	$14.10/Sq. Yd.

2. Lighting

   Runway Edge Lighting (500W) - $54.58/Centerline Linear Ft.

   Runway Centerline and Touchdown Zone Lighting -

   Total Cost - $266,915

   Taxiway Edge Lighting - $36.37/Centerline Linear Ft.

3. Hangars - With Shops

   On One Side - $28.40/Sq. Ft.

   On Both Sides - $27.58/Sq. Ft.

4. Fire Station

   2 Stalls - $35.80/Sq. Ft.

   5 Stalls - $32.20/Sq. Ft.

5. Roads

   Flexible

   3" A.C. 6" Base - $6.77/Sq. Yd.

   2-1/2" A.C. 6" Base - $6.40/Sq. Yd.

   2" A.C. 6" Base - $5.74/Sq. Yd.

Rigid

9" Concrete	-	\$11.70/Sq. Yd.
8" Concrete	-	\$10.29/Sq. Yd.
7" Concrete	-	\$ 9.11/Sq. Yd.
6" Concrete	-	\$ 8.10/Sq. Yd.

15.4 New STOLport Costs - General Patton Field

A cost study was undertaken to determine a "ball park" estimate of the airport related costs associated with a new STOL airport. The General Patton site in the expanded California Region was selected as being representative. The following items were considered:

- Runways
- Taxiways
- Gates/Aprons
- Fuel Storage
- Terminal ATC
- Terminal Building Space
- Vehicle Parking Facilities
- Internal Access System.

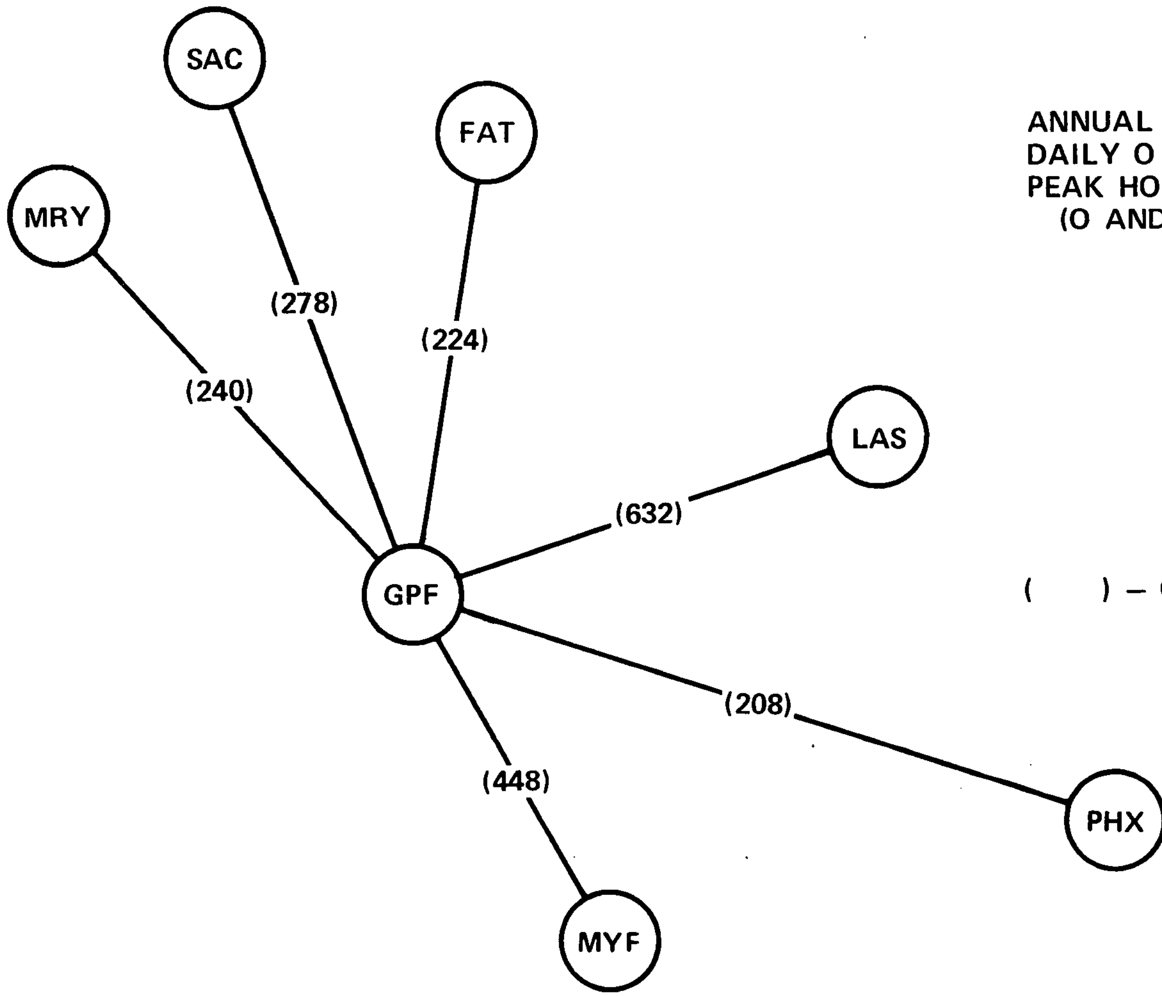
15.4.1 1985 STOL Demand - General Patton Field was selected as one of the short-haul reliever sites for the congested Los Angeles International Airport in the expanded California Region. The STOL demand, as determined from the baseline marketing input, is shown on Figure 15.4-1 as a function of airport pair origin and destination annual traffic. From the airline fleet schedule planning and evaluation model, the daily flight schedule is shown on Figure 15.4-2 as a function of time of day. For the evening peak period five gate positions are required at the terminal as determined by Figure 15.4-3.

15.4.2 Runways and Taxiways -

15.4.2.1 Runway Width and Length. The baseline EBF 150 passenger STOL aircraft has a design point field length requirement of 3000 Ft. (914 m). The

1985 STOL DEMAND

GENERAL PATTON FIELD (GPF)



ANNUAL STOL O AND D	=	2,030,000
DAILY O AND D	=	5,561
PEAK HOUR DEMAND (O AND D)	=	798

( ) – O AND D DEMAND PER YEAR

PR3-STOL-1533

Figure 15.4-1

PHASE II - CALIFORNIA REGION

DAILY AIRPORT STOL ACTIVITY - EBF 150 PSGR 3000 FT RUNWAY
GENERAL PATTON FIELD

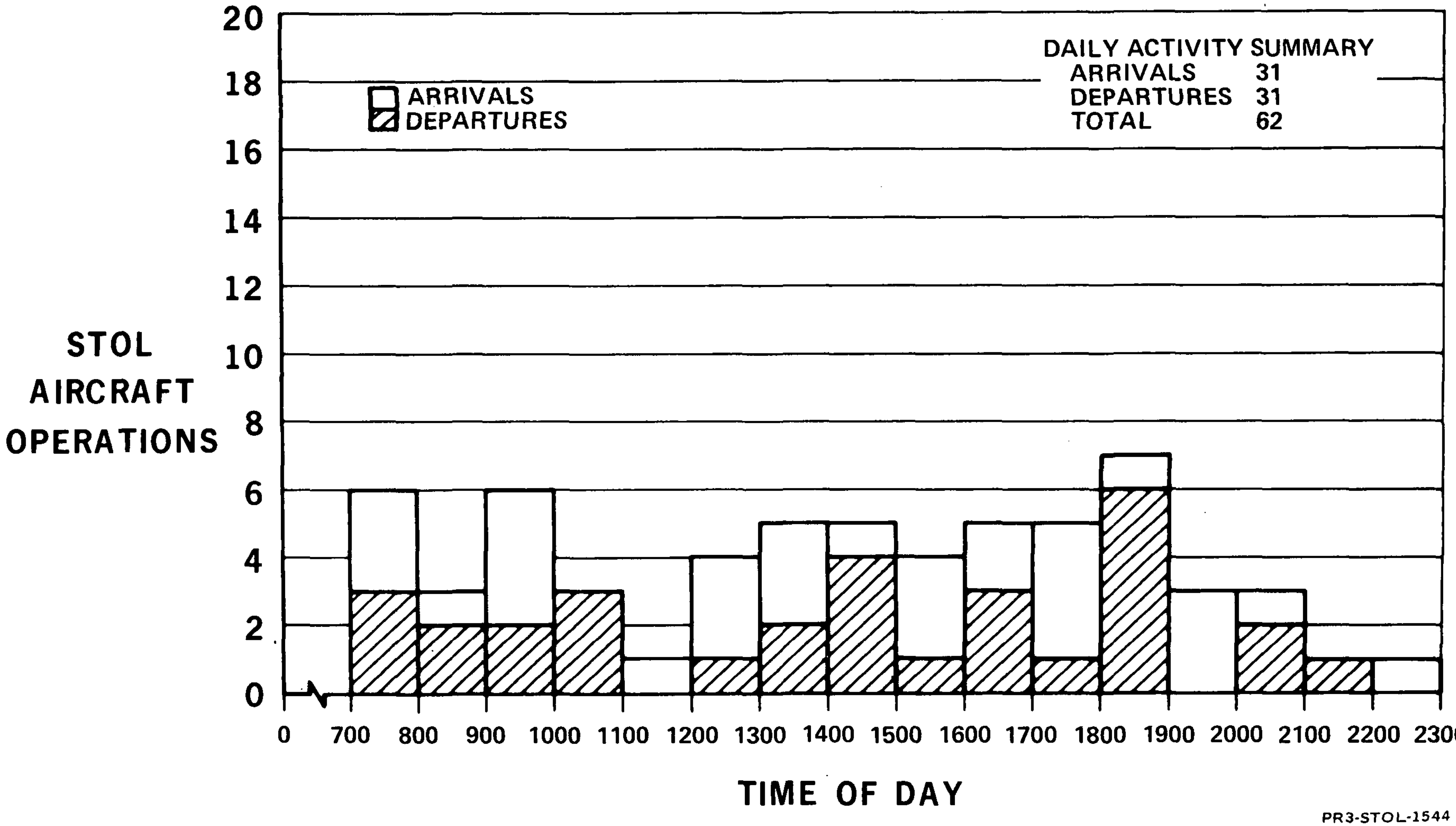


Figure 15.4-2

STOL GATE REQUIREMENTS

GENERAL PATTON FIELD (GPF)

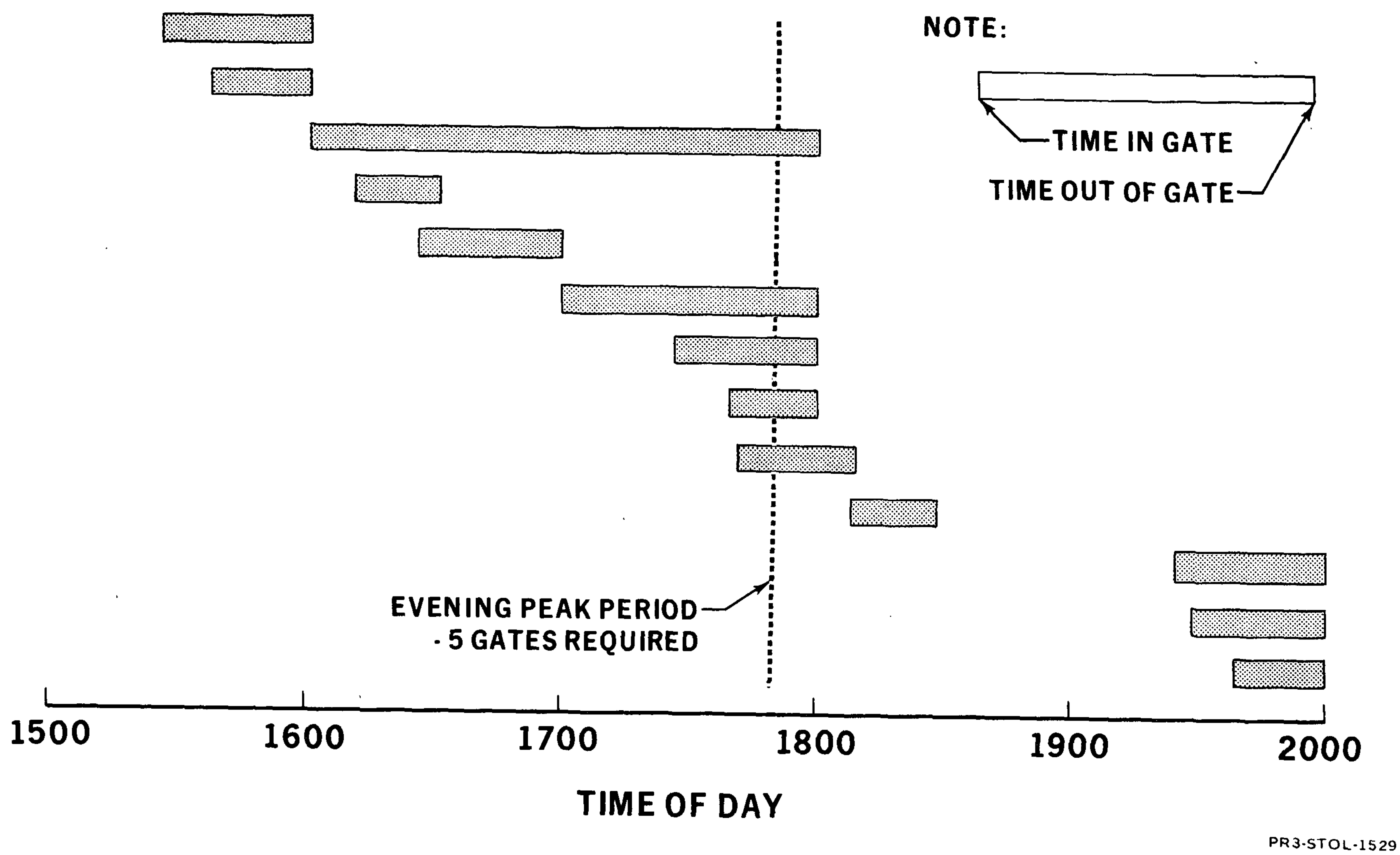


Figure 15.4-3

Table 15.4-1

RUNWAY AND TAXIWAY COSTS

Runways

1.	Excavation - 9,600 cubic yards		$ 9,600
2.	Concrete - 9 inches thick 3000 feet long 115 feet wide		635,000
3.	Shoulders - 3 inches asphalt concrete over a 4 inch crush rock base		56,000
4.	Allowance for drainage		30,000
5.	Stripping		20,000
6.	Lighting - edge centerline		275,000 68,000
			$1,043,600
7.	Contingencies - 10%		104,360
		TOTAL	$1,150,000

Taxiways

1.	Excavation - 17,315 cubic yards		$ 17,315
2.	Asphalt - Full depth - 17 inches 6000 feet total length 55 feet wide		172,000
3.	Shoulders - 3 inches asphalt concrete over a 4 inch crush rock base		120,000
4.	Allowance for drainage		54,000
5.	Centerline stripping		1,000
6.	Edge lighting		$369,000
			$733,315
7.	Contingencies - 10%		73,332
		TOTAL	$810,000

runway width was determined using the results from the statistical analysis of lateral touchdown dispersion for 96 simulated IFR landings of the Breguet 188-941S aircraft conducted at NAFEC. The mean lateral touchdown accuracy was 5 Ft. (2 m). Three standard deviations were 24 Ft. (7 m). The runway width for the baseline STOL is 115 Ft. (35 m) considering this dispersion, the outside to outside gear tread dimension and the desire to maintain at least 15 Ft. clearance between the outside of the outer main landing gear tire and the edge of the pavement.

In addition to the full depth pavement of the runway, 25 Ft. (8 m) of shoulder should be placed on both sides of the runway. Usually shoulders are constructed with a stabilized bituminous material strong enough to withstand the wheel loadings of maintenance and ground support equipment.

15.4.2.2 Taxiway Width. The taxiway width requirement for the baseline STOL aircraft is 55 Ft. (17 m) based on 15 Ft. (5 m) clearance between the outside edge of the outer main landing gear tire and the edge of the taxiway pavement with the aircraft taxiing down the center of the taxiway. In addition, 25 Ft. (8 m) shoulders should be placed on both sides of the taxiway.

For General Patton Field, it is assumed that the amount of taxiway length will be twice the runway requirement. Thus, 6000 Ft. (1829 m) of taxiway pavement will be required.

The runway and taxiway pavement costs are summarized in Table 15.4-1.

15.4.3 Gates and Aprons - From the output of the airline fleet schedule planning and evaluation model, it was determined that 5 gates were required to handle the peak aircraft demand. As determined in the unit cost derivation, the price per gate is $335,000. The total gate cost is $1,675,000.

15.4.4 Fuel Storage Requirements - Underground fuel storage requirements were determined based on the following assumptions:

- o Fuel supply to be replenished once a week.
- o Fuel capacity of the baseline STOL is 3100 gallons (11,734 liters). It was assumed that each aircraft will be refueled upon landing to 60% of its capacity, or 1860 gallons (7040 liters).
- o Per the daily flight schedule, 217 landings will occur per week at the General Patton site. Thus, the fuel consumption is 400,000 gallons (1,514,000 leters).

From the Military Construction Pricing Guide, the cost to provide a 400,000 gallon (1,514,000 liters) facility is $160,000. This price includes excavation, foundations and backfill.

15.4.5 Terminal ATC - A study was conducted to determine the terminal ATC requirements for the General Patton site in the 1985 time period. Table 15.4-2 summarizes the equipment and the associated costs necessary to handle the projected STOL activity demand.

15.4.6 Terminal Building Space - Based on the peak hour STOL demand of 798 passengers, the required amount of terminal building area was determined to be 84,400 square feet (7841 square meters). Using the unit terminal cost of $30 per square foot ($323 per square meter), the total expenditure is $2,532,000.

Table 15.4-2

TERMINAL ATC REQUIREMENTS AND COSTS

General Patton Field (GPF)

Equipment		Approximate Cost/System
Instrument Landing System (Localizer and Glideslope) CAT IIIa		$ 584,000
DME (Distance Measuring Equipment) at ILS Localizer		45,000
VASIS (Visual Approach Slope Indicator System)		80,000
REIL (Runway End Indication Lights)		12,000
V/STOL Approach Light System		58,000
Runway Visual Range Transmissiometer		53,000
Ceilometer		40,000
VORTAC (Very high frequency Omnidirectional Range - Tactical Air Navigation)		100,000
Airport Beacon		15,000
Control Tower		500,000
	Total	$1,487,000

15.4.7 Vehicle Parking - Based on the requirement of 700 parking spaces per million O and D passengers, there is a need for 1400 parking positions for the General Patton STOLport. A total expenditure of $192,000 is required based on the unit cost derived in Section 4.

15.4.8 Internal Access System - Capacities for major urban arterial highways can range from 500 to 1000 vehicles/lane/hour. The difference in the range of roadway capacity can be attributed to variations in lane widths, service speeds, crossing traffic, the amount of trucks and buses in the traffic mix and to restrictions due to the lack of appropriate lateral clearances. For the study, it is assumed that the roadway capacity for access roads within the airport proper is 600 vehicles/lane/hour.

To determine the maximum number of vehicles traveling into and out of the airport, a factor of 1.13 vehicles per O and D passenger was applied to the peak hour passenger demand. Thus, the peak hour traffic generated by the General Patton site is 902 vehicles. Accordingly, the 1.13 factor was applied to the peak inbound and outbound passengers, resulting in a peak inbound traffic of 775 vehicles and a peak outbound traffic of 548 vehicles.

The number of lanes required is determined as follows:

$$\begin{aligned}\text{number of lanes (one way)} &= \frac{\text{peak inbound/outbound traffic}}{\text{roadway capacity}} \\ &= \frac{775}{600} \\ &= 2 \text{ lanes (one way)} \\ &= 4 \text{ lanes (two way)}\end{aligned}$$

A typical roadway cross section may consist of the following:

- 12 foot (4 m) wide lanes
- 16 foot (5 m) median strip
- 1 foot (0.3 m) clearance between median and the fast lane
- No allowance for vehicle parking

The 16 foot (5 m) median strip consists of a 11 foot (3 m) left-hand turn pocket and a 5 foot (2 m) nose for traffic control devices. The median serves three purposes:

- Furnishes a left-hand turning lane.
- Controls head on and side collisions.
- And allows greater flow capability for through traffic.

The total cross-sectional width is determined as follows:

Total Width = (# lanes) (lane width) + median width + median/roadway clearance

= 66 Feet (20 m)

An estimated cost for this roadway is given in Table 15.4-3.

Table 15.4-3

ROADWAY COSTS

Items to Consider:

(1) Thickness of Pavement

(2) Subgrade Preparation

(3) Stripping

(4) Contingencies

(1)	Thickness - It is assumed that the roadway pavement thickness will consist of 4 inches of asphalt concrete over a 4 inch aggregate base	
	(a) 4" asphalt concrete	$ 2.03/yard^2
	(b) 4" aggregate base	1.11/yard^2
(2)	Subgrade Preparation	.50/yard^2
(3)	Stripping - minimal	- 0 -
		$ 3.64/yard^2
(4)	Contingencies - 10%	.36/yard^2
		$ 4.00/yard^2

(5) Total area to be paved:

5280 Ft. X 66 Ft.

= 348,480 Ft.^{2}

= 38,720 Yd.^{2}

(6) Total Cost = $155,000

APPENDIX 15.5

SYSTEMS BENEFIT MATRIX

The following three charts were developed during the course of the system benefits analysis as discussed in Section 7.2 of this report. Criteria for determination of the national, regional, and local classification of the non-user benefits are described in Section 7.4. The first chart isolates the fundamental aircraft operational advantages (and disadvantages) of lift augmented STOL aircraft compared to conventional CTOL. All system benefits accrue directly or indirectly as a result of these fundamental performance advantages.

The following user and non-user benefits matrices categorize the basic STOL benefits established by the study. The source study report volume and section are referenced for each listed benefit. The basic benefits are then translated into the secondary and/or indirect benefits applicable to system passengers, operators, and institutions.

The appendix charts do not attempt to establish relative priority of system benefits. Benefits, however, are listed in order of relative importance on the summary charts of Figure 7-1 in the body of the report.

STOL BENEFITS ANALYSIS

AIRCRAFT COMPARISON - STOL VS CTOL

SOURCE DOCUMENT - AIRCRAFT VOLUME II

STOL* ADVANTAGES (COMPARED TO CTOL)	STOL* DISADVANTAGES (COMPARED TO CTOL)
1. Shorter field length. (Table 2-10) 2. Reduced air and ground maneuver time resulting from shorter field lengths. 3. Slower approach speeds resulting in steeper descent gradient. (Table 8-1) and (Table 2-10) 4. Increased flight maneuverability resulting from lower flight speeds. 5. Lower noise footprint area. (Table 2-13) 6. Lower exhaust emissions (at airports) due to reduced ground maneuver times. * Lift augmented aircraft.	1. Increased wake vortex effects due to lower flight speeds. 2. Increased complexity and weight due to lift augmentation. (Section 2.2.3), (Appendix D, Table 2-11) 3. Lower inherent low speed stability. (Appendix F) 4. Greater reliance on stability and control augmentation devices. (SCAS) (Appendix F) 5. Increased D.O.C., especially at extended ranges. (Section 3.7) 6. Reduced ride qualities due to lower wing loading. (Appendix G-1), (Section 3.6)

(+) = Benefit
(-) = Disbenefit
(±) = Dependent on location

STOL SYSTEM BENEFITS MATRIX - USER (AND OPERATOR) BENEFITS

CATEGORY	ADVANTAGES - STOL VS CTOL		USER BENEFITS	OPERATOR BENEFITS		
	Basic STOL Benefits	Reference	Passengers	Airports	Airlines	Manufacturers
ENVIRONMENTAL	• Minimal airport land area	III-8.3.4	—	(+)Increase in available airports (+)Reduced land acquisition cost	(+)Improved operational efficiency (+)Reduced ground taxi time	—
	• Low community noise impact	III-8.3.1	—	(+)Improved community relations (+)Decreased legal liability.	(+)Improved public image	(+)Improved public image
	• Low aircraft emission levels	III-8.3.2	—	(+)Improved community relations.	(+)Improved public impage	(+)Improved public image
	• Low block fuel burn	VI-6.1	—	—	(+)Reduced annual fuel cost.	—
SOCIAL	• Airport near traveler O&D	IV-6.0	(+)Increased traveler convenience (+)Improved transportation choice	—	(+)Increased patronage potential.	—
	• Potential air and ground congestion relief	III-8.3.3 VI-7.0	(+)Reduced access delays (+)Increased air and ground safety.	(+)Increase in available capacity (+)Extended life-major airports (+)Reduced air traffic control workload.	(+)Reduction in "no show" passengers (missed flights) (+)Increased air safety.	—
ECONOMIC	• Reduced total trip time	IV-11.7	(+)Potential reduction in surface travel cost.	—	—	—
	• Reduced delay time	IV-6.1	(+)More productive use of time.	—	(+)Reduced aircraft delay cost (+)Reduced schedule disruption	—
	• Increase in G.N.P.	V-4.4.1	—	—	(+)Favorable economic climate	(+)Favorable economic climate
	• Potential increase in balance of payments.	V-4.4.3	—	—	—	(+)Export sales potential (+)Potential licensing agreements
	• Increased employment and economic opportunity.	V-4.4.2	—	(+)Increased revenue potential	(+)Increased business potential	(+)Increased business potential
INSTITUTIONAL	• Improved technology base	VI-7.0	—	—	—	(+)Increased technical capability
	• Improved National Transportation System	VI-7.0	—	(+)More efficient operation.	(+)New business opportunities	(+)New business opportunities.
	• Improved national prestige	VI-7.0	—	—	—	(+)Increased export potential

(+) = Benefit
(-) = Disbenefit
(±) = Dependent on location

STOL SYSTEM BENEFITS MATRIX - NON-USER BENEFITS

CATEGORY	ADVANTAGES STOL VS CTOL		NON-USER BENEFITS (DISBENEFITS)			
	Basic STOL Benefits	Reference	National	Regional	Local - Existing Airport	Local - New Airport Site
ENVIRONMENTAL	• Minimal airport land area	III-8.3.4	(+)Minimal overall environmental impact (+)Increased land conservation.	(+)Minimal land use (+)Minimal land removal from tax roles	(+)Efficient use of existing facilities	(±)Minimal community dislocation
	• Low community noise impact	III-8.3.1	(+)Conformance to national goals	(+)Improved airport environment	(±)Minimal noise impact	(-)Local incr. in aircraft noise
	• Low aircraft emission levels	III-8.3.2	(+)Conformance to national goals	(+)Improved regional air quality.	(±)Minimal air quality impact	(-)Local decrease in air quality
	• Low block fuel burn.	VI-6.1	(+)Conservation of national energy resources.	—	—	—
SOCIAL	• Airport near traveler O&D	IV-6.0	(+)Improved air mail service	(+)Improved regional air transportation system.	(±)Asset (or liability) to community dependent on community goals.	(±)Asset (or liability) dependent on community goals.
	• Potential air and ground congestion relief.	III-8.3.3 VI-7.0	(+)Increased air transportation efficiency (+)Increased air and ground safety. (+)Extended life of major airports	(+)Reduced ground traffic congestion. (+)Increased air and ground safety. (+)Extended life of major airports.	(±)Reduced (or increased) local ground traffic (±)Increased (or reduced) local traffic safety. (+)Extended life of major airports.	(-)Potential increase in local ground traffic. (-)Potential decrease in local traffic safety.
ECONOMIC	• Reduced total trip time	IV-11.7	(+)Improved transportation efficiency.	(+)Improved transportation efficiency.	—	—
	• Reduced delay time	IV-6.1	(+)Improved transportation efficiency.	(+)Improved regional transportation	—	—
	• Increase in G.N.P.	V-4.4.1	(+)Improved national economy	(+)Improved regional economy (+)Increased business opportunity.	(+)Improved local economy (+)Increased business opportunity	(+)Improved local economy (+)Increased business opportunity
	• Potential increase in balance of payments	V-4.4.3	(+)Increased monetary strength	—		
	• Increased employment and economic opportunity	V-4.4.2	—	(+)Increased regional employment	(+)Increased local employment	(+)Increased local employment
INSTITUTIONAL	• Improved technology base	VI-7.0	(+)Maintain technical leadership	—	—	—
	• Improved National Transportation System	VI-7.0	(+)Improved public transportation	(+)Improved public transportation	(+)Improved public transportation	(+)Improved public transportation
	• Improved national prestige	VI-7.0	(+)Maintain international posture.	—	—	—

15.6 AGENCIES AND AUTHORITIES INTERVIEWED — COMMUNITY ACCEPTANCE INVESTIGATION

WASHINGTON, D.C. AREA

U. S. Dept. of Transportation - Office of the Secretary

National Aeronautics and Space Agency

Environmental Protection Agency

Federal Aviation Administration - Washington Airports District Office, Falls Church, Virginia

Dept. of Transportation - Office of Noise Abatement

Dept. of Health, Education and Welfare

NEW YORK AREA

Port of New York Authority

Office of the Mayor - Office of Midtown Planning

Department of City Planning - Transportation Office

BOSTON AREA

Massachusetts Port Authority

CHICAGO AREA

Chicago Department of Aviation

Meigs Field

Midway Airport

CALIFORNIA AREA

San Francisco - Oakland

Metropolitan Oakland Municipal Airport

Port of Oakland

Bay Area Rapid Transit District (BART)

Palo Alto

FAA Control Tower personnel

Stanford University

Moffett Field

NASA Advanced Concepts and Missions Division

San Jose

San Jose Municipal Airport

Reid Hillview Airport

Los Angeles

Southern California Association of Governments (SCAG)

San Diego

Montgomery Field

APPENDIX 15.7
COMMUNITY ACCEPTANCE FIELD SURVEY REPORT

The results of community acceptance field surveys conducted at selected representative regional areas and airports are summarized in this appendix. The information is presented in narrative form to reflect actual statements insofar as possible. The interview team consisted of an experienced airport planner and a social psychologist with an extensive background in aviation safety research. A discussion of the airport selection criteria and community acceptance study methodology is contained in Section 8.4 of the AIRPORTS Study Report, Volume III.

Field surveys were conducted in the following airport communities.

Washington, D.C./Falls Church, Virginia
New York City, New York/Secaucus, New Jersey
Boston, Massachusetts
Chicago, Illinois
San Francisco, Oakland, San Jose, California
Santa Ana, California
San Diego, California
El Monte, California

The surveys were, in general, conducted on site and consisted of interviews with airport administrators, airport managers, port authority personnel, and engineering personnel connected with the airport operation. The type of questions asked included:

Are there any "special interest" groups within the community you believe would be in favor of a STOLport implementation proposal?

Is there any one person or group who, in your opinion, is or would be more influential than others in terms of community decision-making?

Have there been any public hearings on airport issues or other transportation projects in this community?

What programs have been established to provide a public/airport official interaction?

What do you believe it would take to sway the community members who now oppose airports?

The asking of these questions normally led to a much broader discussion which was always profitable. A complete listing of the airport/communities and the associated personnel interviewed is contained in Appendix .

Washington, D.C./Falls Church, Virginia

Personnel in the Washington Airports District Office--FAA indicated that in Fairfax county several airport sites have been proposed in the last ten years. Every one of the proposals has been rejected. Primarily the opposition has been community members representing environmental protection groups, e.g. Friends of the Earth, Audobon Society, Sierra Club, Aware Citizens, etc.

Aside from airport development problems, opposition has been voiced on highway projects (Route 66) on the grounds of ecological upset. Generally it was observed that the same people attended the hearings whether it be on airport development or other public projects.

Buckley, W.Va. put an airport development bond issue on a recent ballot. A 2/3 supporting vote was required to pass the issue--56% was received.

Washington, D.C./Falls Church, Virginia (con't)

However, property tax bills were received by the voters just two weeks prior!

FAA personnel suggested the Orlando, Fla. Disney World air shuttle service, and the Houston, Texas air shuttle service as existing STOLport facilities at which community response data might be collected. It was also suggested that the Miami STOLport and the Chelsea STOLport project failures be studied as to community opposition.

FAA personnel also suggested Washington National Airport as a potential STOL service facility. It was considered that the problems associated with community opposition these might nave less impact than the problems voiced by "high-up" governmental officials, (e.g. congressmen or senators)

In general, all individuals interviewed indicated a need for more data on community interaction and airport development projects. Most of those interviewed believed both government and industry were lacking in their approach to transportation planning where the community is concerned. It was expressed that potential failure exists for future aircraft development, e.g. STOL, unless the community can be satisfied as to issues of "noise", safety, etc.

Personnel of the Urban Mass Transit Authority (UMTA) related their experiences with the Bay Area Rapid Transit (BART) and believed the development of STOLports may suffer similar problems. The problem being one of community opposition. It was suggested that some carry-over (of approach) could be seen for STOL projects based on the BART implementation planning program.

Though some problems continue to exist for BART, the success of the project is in part due to "early" planning which included community education and involvement programs.

Other individuals within the Department of Transportation (DOT) indicated "aircraft noise" to be the primary complaint issue voiced by the community.

<u>New York City, New York/Secaucus, New Jersey</u>

Currently the Port of New York Authority and the FAA are jointly funding a consultant feasibility study for a STOLport in Secaucus, N.J. (the meadowlands) which is located just across the Hudson from Manhattan. The study contains a section on "social impact," but not on the community member response level. Personnel of the Authority were very interested in the type of program suggested by McDonnell Douglas. Apparently, many questions about public reaction have been raised.

There seems to be several problems with the development of a STOLport in the meadowlands. The environmental groups are urging saving the area as a game refuge; the governor of N.J. wants to construct a 200 million dollar sports center and convert the lower valley into an industrial complex. Though a contingent of conservationists regularly protest the development plans— there seems to be very little known about the opinions of the majority membership of the surrounding communities.

New York City, New York/Secaucus, New Jersey (con't)

Individuals at the Midtown Planning Offices and the New York City Planning Department related their experiences in urban development projects. There appear to be several approaches thus far taken in dealing with the community: actual compensation through reciprocal property improvements; incentive zoning plans; educational meetings; and other community member involvement programs. In general, there has been little or no documentation of the programs. There has not been any "in-depth" community research conducted--at least not published.

All together, the individuals interviewed believed the implementation of a STOLport facility in the New York area to be loaded with problems. Several proposals have been offered to develop offshore airports, inland airports, and to expand the capabilities of existing airports--all have been turned down. Even the Pan Am Building heliport was shut down due to complaints of noise disturbance by surrounding building tenants. Most of the planners believed the only solution to the STOL project is to initiate early community relations programs and above all - "make the STOL engines quiet!"

Boston, Massachusetts

The Massachusetts Port Authority (Massport) is in a rather perilous political position. The mayor of Boston is anti-airport and thus encourages his appointed "little city mayors" in the battle to shut down Boston-Logan Airport. "Capital Hill" for Massachusetts is just a stone's throw from the airport--thus a lot of complaints are taken directly to the state government.

Boston appears to be quite interesting regarding community action and airport development. As found in other airport locations surveyed--Boston-Logan is currently struggling for survival. Many community members actually want to shut the airport down--no more airplanes!!

There has been some attempt by the Massport officials at establishing a community study project but with little success. The Massport officials admitted there was very little known about the "real" needs of the community. It was also believed that a well designed community study would help the Massport understand the community better and to develop public affairs programs.

The aviation director of Massport indicated the real problem was the airplanes not the airports--but the complaints are sent to the airports!! And, in general, the complaints are about noise. "If STOL's are going to be quiet--you'd better start telling the public about it right now. However, they probably won't believe you."

The Massport and Boston-Logan Airport personnel believed the STOL aircraft may be the solution to today's airport community problems. The problem is the STOL aircraft is the design of tomorrow. All of the individuals contacted offered continued assistance in the McDonnell Douglas study program.

The Boston-Logan Airport area may be an extremely important test site for an in-depth community acceptance study. The socio-economic-political structure of Boston appears unique compared to other geographical areas where STOLports have been proposed.

Chicago, Illinois

There seems to be an interesting contradiction to the usual finding concerning Midway Airport--virtually no complaints about noise! At least this is what

Chicago, Illinois (con't)

was related by the Commissioner of Airports and the Assistant Director of Aviation and verified by FAA tower personnel.

Though O'Hare International is the recipient of many complaints--the community surrounding Midway has petitioned to increase the airline operations--at least by 20%. The fact that this petition still exists after the recent aircraft crash which destroyed several homes and killed many people, demonstrates a type of "adaptation" to airports which should be studied.

The Midway Airport community should be studied and the results compared with those of Boston-Logan. There are similarities in the socio-economic structures and even possibly related political aspects. The BIG DIFFERENCE is community members of the Boston area want to get rid of the airport--Chicago Midway community wants to increase aircraft traffic!

As with all other individuals interviewed, the Chicago officials offered continued support of the community study project--BUT they don't think there is a community opposition problem in the Chicago Midway area. What they do think (especially the commissioner) is that the manufacturers have "sold out"to the airlines--and that the government is too weak in their stand on noise abatement. In fact, he doesn't believe a STOL aircraft will ever be built--yet, he is an active proponent of the STOL (quiet) concept!

San Francisco/Oakland/San Jose, California

All individuals interviewed in the San Francisco area expressed similar views, (1) aircraft noise is the Number One issue used in the opposition to airport development, (2) air pollution and surface traffic congestion run

San Francisco/Oakland/San Jose, California (con't)

close seconds and, (3) more emphasis should be placed on community oriented research programs.

The BART planners were very emphatic about the need for early community involvement in transportation projects. It was indicated that the current success of BART is credited to the early involvement of community members in the early planning stages. The San Jose Municipal Airport personnel have taken BART's lead and initiated similar community programs which have been helpful in implementing runway and facilities expansion plans.

Comparing the Oakland Port Authority to the Port Authorities of New York, and Massachusetts--there appear to be wide variations in "power." The Oakland Authority appears to have very little political power and operates on a limited budget provided by the city--not the state. Therefore, unlike the Authorities of New York, and Massachusetts--the Oakland Authority has limited impact on the community transportation issue resolution.

In the San Francisco Bay area it would appear the BART planners and the personnel at the San Jose Municipal Airport are the more progressive in establishing community involvement programs.

Santa Ana, California

The Orange County Airport at Santa Ana may well be one of the most controversial airport-communities surveyed in this study. There is a well organized social movement in the Santa Ana area, especially in Newport Beach, to (for all practical purposes) "shut-down" the airport. Currently, the airlines are limited in the number of daily operations and some leases are in jeopardy. There are nearly thirty million dollars worth of damage suits presently filed against the airport. The airport personnel indicated several public hearings had been held in the Orange County area related to transportation projects. Each of the hearings have been well attended--primarily by those opposing any airport (or freeway) development. One group of concerned citizens created a slogan which was printed on bumper stickers, "Airports = Death + Taxes."

The airport has one of the few noise monitoring systems in the country and currently uses it quite effectively in interacting with community noise abatement groups. Recently, a demonstration was made of a Lockheed 1011 and B-727 in a fly-over noise comparison. The community attendees were impressed with the quietness of the L-1011 and indicated acceptance of the L-1011's noise profile. However, it was suggested by a community representative that when operating the quiet 1011 or DC-10 out of Orange County--the number of already limited daily operations should be reduced due to the larger capacity of these type aircraft!

Presently, the Orange County Supervisors have ordered the County Airport Commission to hold public hearings on a series of proposals aimed at reducing jet noise levels. It was also suggested by one of the supervisors that an overall impact statement be prepared and be paid for out of airport enterprise funds. The study would cost between $50,000 and $75,000 (a similar study was done recently for San Jose Airport for $45,000). It might be added that an impact study was conducted by the citizens of Newport Beach which was published in January 1972. As of the writing of

Santa Ana, California (con't)

this report a citizens group have petitioned Orange County government to relocate the Orange County Airport. It would appear a few very vocal individuals are leading the opposition; these individuals are primarily from Newport Beach and are of high-status socio-economically. The primary complaint is levied on aircraft noise with traffic congestion and unwanted urbanization following in close order. The airport administration believe one solution to the problem would be to institute more efficient community education/involvement programs--and make airplanes QUIETER!

San Diego, California

Currently, the airport/community of Montgomery Field in San Diego is operating civil-general aircraft with approximately 300,000 operations per year. The location of the Montgomery Field Airport is ideal to the STOL system network and in fact, the airport runway marks the center of population in the San Diego City metropolitan area.

There appear to be no real community related problems currently with the airport. However, recently a local priest established an "inquiry" held at the local Catholic Church. About 100 people attended representing the PTA, and other citizen "action" groups. The inquiry was on a proposed runway extension plan and about the airport's plans in general. The airport personnel presented a briefing on the runway extension plan and attempted to establish a rapport with the community members as to aviation's place in transportation and commerce--all of which were (reportedly) unsuccessful. The airport personnel interviewed reported the people attending the meeting were hostile and "had their minds made-up" before they even showed up; they

San Diego, California (con't)

really didn't listen to the presentation (which admittedly was not too well prepared).

Noise complaints have been few and very erratic in origin. And, at the present time there is no organized group which is "anti-airport" but the community is building up all around the airport and the number of aircraft operations is increasing. The airport personnel believed the study McDonnell Douglas is conducting on community acceptance of airports to be important and agreed to help in any way possible--including a survey of public attitude in the community.

A problem in San Diego is that there is no centralized airport authority and the Montgomery Field personnel believe the establishment of this authority is mandatory in the very near future to resolve conflicts between various local airport agencies.

El Monte, California

El Monte Airport is a small field civil-general aviation facility. An interview with airport personnel revealed that it is likely the local commercial interest would be in favor of the facility being developed as a STOLport. In general, the only "anti-airport" groups currently active are a Taxpayers Association and a local radio station.

There is an inter-community conflict regarding the airport. Arcadia, a small community just north of the El Monte Airport, has a mayor who was elected on a "Stop El Monte Airport" platform. This platform was established around a noise issue. A large number of complaints are recorded for the

El Monte, California (con't)

airport; the complaints based on flyover noise of small general aviation aircraft.

The city of El Monte may be a good area to study relevant to transportation projects as the RTD freeway bus system was recently established there. The public hearings regarding the RTD would provide valuable data which could be used to predict community response to a STOLport proposal.

The primary emphasis made by the airport personnel was to develop good community relations programs. It was also suggested that it would be "dangerous" to hold a public hearing prior to researching the major issues of conflict. It would also appear that an "inter-community" relations program is needed, e.g. between El Monte and Arcadia. This suggestion is not uncommon, for there appears a similar need between Santa Ana and Newport Beach regarding the Orange County Airport.

SUMMARY

The following short statements summarize the findings of the community acceptance field survey.

- o Early identification of specific local community variable (attitudes, behavioral intentions, demographics, etc.) is essential to effective airport development planning.

- o In-depth community research on airport development is virtually non-existent.

- o Public hearings appear to be the primary method used to obtain community public opinion on airport development proposals--and in general, "anti-airport" groups dominate the meeting.

- Some "community representatives" working groups have been formed at several airport locations; however, there seems to be generally two problems: (1) lack of community "representativeness", and (2) lack of governmental decision-making power.

- There appears to be an emotional level in community reaction beyond which further attempts at communication and persuasion are extremely difficult.

- Referendum ballots appear to suffer where airport projects are concerned, due to inadequate planning and lack of understanding of the community attitudes and behavioral intentions prior to voting day; also, many states now are requiring airport issues be settled by referendum.

- Continuing public education and community involvement programs appear to be essential throughout all planning and implementation phases of an airport development project.

The one observation listed above which has overall saliency is that <u>early identification of community-related variables is essential to the potential success of any airport development project</u>. The most important needed data would be that behavioral intentions of the community regarding a proposal for airport development.

Appendix 15.8

Community Acceptance Evaluation Matrix

The following three charts summarize the key elements of the matrix work sheets used for community acceptance evaluation. The charts present the airport characteristics, STOL community impact, and community acceptance evaluation of the twelve selected case study airports discussed in Section 8.4. A brief description of the evaluation criteria and considerations is included in the attached table.

I. AIRPORT CHARACTERISTICS MATRIX

AIRPORT CHARACTERISTICS							ESTIMATED 1985 ACTIVITY				
Column(1)	(2)	(3)	(4)	(5)	(6)	(7)**	(8)	(9)	(10)	(11)	(12)
FAA Site No.	Airport	City Code	Type Class	Area Acres (Hectares)	STOL Runway	Runway Length Ft (M)	Annual Air Carrier Operations	Percent of Total	CTOL Daily Operations	STOL Daily Operations	STOL Peak Hr. Operations
8778	Boston Logan	BOS	A	2430 (983)	15S/33S	3430 (1045)	337,1000	65%	924	0	0
8750	Hanscom Field	BED	F	1125 (455)	5/23	4383 (1336)	1,135	0.2%	3	109	10
1971	Oakland	OAK	B	13,135 (5316)	9L/27R	5750 (1753)	107,100	18%	293	66	10
----	Moffet Field Nas.	MOF	E	1500(E) (607)	14R/32L	8120 (2475)	0	0	0	30	4
4507	Midway	MDW	B	640 (259)	13R/31L	5210 (1588)	70.100	24%	192	116	12
4504	Meigs Field	CGX	D	76 (31)	18/36	3305 (1007)	25,000	19%	68	186	19
2230	Orange County	SNA	B	519 (210)	01L/19R	4890 (1490)	26,300	4%	72	44	7
1539	El Monte	EMT	D	89 (36)	01/19	3532 (1077)	0	0	0	52	8
2166	Montgomery Field	MYF	D	500 (202)	10L/28R	2906 (886)	0	0	0	112	11
----	Gen. Patton Site	GPF	G	360(E) (146)	----	3000(E) (914)	0	0	0	62	7
----	Secaucus Site	SEC	H	360(E) (146)	04/22	2000* (610)	0	0	0	146	11
3001	Washington Natl.	DCA	A	650 (263)	18/36	6026 (1837)	342,000	67%	937	240	24

(E) Data not available - MCD estimate
* 3000' required for STOL, see discussion - Section 8.5.2.11
** Effective Runway lengths shown

II. IMPACT EVALUATION MATRIX

	Community Noise Impact						Air Quality Impact			Congestion Impact		
(2)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Airport	Land Impact Area Acres(Hect)	% of Footprint	Impacted Land Use	Degree of Urbanization	Equivalent NEF	Ambient Noise	Existing Air Pollution	STOL LTO Cycles	Supporting Vehicles Trips	Primary Access	Secondary Access	Surface Traffic Congestion
Boston Logan	(24% reduction in short-haul traffic resulting from diversion to outlying area STOLports)											
Hanscom Field	217 (88)	46%	Residential	Low	26	Low	Low	55	10,900	Expressway	Surf. St.	High
Oakland	172 (70)	36%	Recreational	Low	25	Low	High	33	6,600	Expressway	Connector	High
Moffet Field NAS	10 (4)	2%	Recreational	None	23	High	High	15	3,000	Expressway	Connector	High
Midway	247 (100)	52%	Residential	High	27	High	High	58	11,600	Expressway	Surf. St.	High
Meigs Field	20 (8)	4%	Recreational	Low	29	Low	High	93	18,600	Expressway	Connector	Moderate
Orange County	150 (61)	32%	Residential	Low	23	Low	High	22	4,400	Expressway	Connector	Moderate
El Monte	385 (156)	80%	Industrial	Moderate	23	Moderate	High	26	5,200	Expressway	Surf. St.	High
Montgomery Field	230 (93)	48%	Industrial	Low	27	High	Moderate	56	11,200	Expressway	Connector	Low
Gen. Pattor. Site	302 (122)	64%	Industrial	High	25	High	High	31	6,200	Expressway	Connector	High
Secaucus Site	290 (117)	62%	Industrial	Low	28	High	High	73	14,600	Expressway	Connector	High
Washington Natl.	30 (12)	6%	Recreational	None	30	Low	High	120	24,000	Highway	Connector	High

III COMMUNITY ACCEPTANCE MATRIX

	Community Characteristics						Impact Rating				Acceptance Rating		
Airport	(25) Conformance To Goals	(26) Home Owner-Ship	(27) Socio-Econ. Level	(28) Adaptive Level	(29) Organiz. Level	(30) Financial Cability	(31) Noise Impact	(32) Pollution Impact	(33) Congestion Impact	(34) Community Dislocation	(35) Impact Rating	(36) Attitude Rating	(37) Community Acceptance
Boston Logan	—	—	—	—	—	—	—	—	—	—	—	—	—
Hansom Field	-	-	-	+	+	+	-	-	-	+	-	(=)	Questionable
Oakland	+	+	+	+	-	+	+	-	-	+	(=)	+	Probable
Moffett Field NAS.	-	-	-	+	-	+	+	-	-	+	(=)	-	Questionable
Midway	+	-	+	+	+	+	+	-	-	+	-	+	Probable
Meigs Field	+	+	+	+	+	+	+	-	-	+	(=)	+	Quite Probable
Orange County	-	-	-	+	-	+	+	+	-	+	+	-	Questionable
El Monte	+	-	+	+	-	-	-	-	-	-	-	(=)	Unlikely
Montgomery Field	+	+	+	+	+	+	+	-	-	+	(=)	+	Quite Probable
Gen. Patton Site	+	+	+	+	+	+	-	-	-	-	-	+	Questionable
Secaucus Site	+	+	+	+	-	+	-	-	-	+	+	-	Questionable
Washington Nat'l.	+	+	-	+	+	+	+	+	-	+	+	+	Quite Probable

(+) Indicates beneficial impact, or favorable community attitude.

(-) Indicates non-beneficial impact, or unfavorable community attitude.

(=) Indicates equivalent beneficial and non-beneficial impacts, or indeterminate attitude.

Airport and Community Evaluation Items

Listed on Matrix Evaluation Charts

	Column	Heading	Description
Chart I	(1)	FAA Site No.	Site number as listed on FAA Form 5010-1, FAA Airport Master Record.
	(2)	Airport	The official name of the airport as listed on FAA Form 5010-1.
	(3)	City Code	The city code adopted by the FAA, CAB, and Official Airline Guide (OAG).
	(4)	Type Class	The airport category listed in Section 6.5 of this report.
	(5)	Area	The airport field area in acres as listed on FAA Form 5010-1. The metric equivalent is listed in (hectares).
	(6)	STOL Runway	The runway selected for STOL operations for purposes of this study. Runway designations are listed on FAA Form 5010-1.
	(7)	Runway Length	The effective length (corrected for gradient and altitude effect) of the selected STOL runway. Length is in feet and (meters).
	(8)	Annual Air Carrier Operations	The annual 1985 forecast total of air carrier operations at the noted airport. The forecast was developed using the 1970 base data reported in the FAA "Airport Activity Statistics for Calendar Year 1970." A 3% compounded historical annual operations growth rate was projected to 1985. (1985 = 1970 X 1.6).

	Column	Heading	Description
	(9)	Percent of Total	The air carrier percentage of forecast total aircraft operations (of all types aircraft). The 1970 percentage was used for the 1985 projection.
	(10)	CTOL Daily Operations	The estimated number of 1985 average daily operations of CTOL (conventional) air carrier aircraft (Annual total ÷ 365).
	(11)	STOL Daily Operations	The estimated number of 1985 average daily operations of STOL aircraft as developed in this report. (See Appendix 15-2).
	(12)	STOL Peak Hour Operations	The estimated number of 1985 peak hour operations of STOL aircraft as developed in this report. (See Appendix 15-2.)
Chart II	(13)	Land Impact Area	The land area outside the airport field boundary (water areas excluded) impacted by the 90 EPNdB noise footprint of the E.150. 3000 aircraft.
	(14)	Percent of Footprint	The ratio of the Land Impact Area (Column 13) to the total 90 EPNdB footprint area (474 acres) of the above noted STOL aircraft.
	(15)	Impacted Land Use	The predominant land use of the Land Impact Area (Column 13).
	(16)	Degree of Urbanization	The relative degree of urbanization (buildings, developments, etc.) within the Land Impact Area (Column 13).
	(17)	Equivalent NEF	The approximate NEF value of the 90 EPNdB contour of the E.150.3000 airplane, developed from the number of daily STOL operations (Column 11) and the NEF conversion chart of Figure 8-5.

Column	Heading	Description
(18)	Ambient Noise	A subjective estimate of the ambient noise within the Land Impact Area (Column 13).
(19)	Existing Air Pollution	A subjective estimate of the existing air pollution levels of the immediate airport vicinity. Regions considered critical by the EPA are noted in reference 8-20.
(20)	STOL LTO Cycles	An LTO cycle is defined by the EPA (ref. 8-20) as one combined landing and takeoff. (Column 11 ÷ 2).
(21)	Supporting Vehicle Trips	The number of automotive vehicle trips required to support STOL aircraft operations at the noted airport. (See Section 8.3.2.2). This is equivalent to Column 11 X 100.
(22)	Primary Access	The primary surface access route from the main air traffic generation center to the airport.
(23)	Secondary Access	The access route from the primary route to the airport proper.
(24)	Surface Traffic Congestion	A subjective judgement of the surface (street or highway) traffic congestion on either (or both) the primary or secondary access routes.

Chart II Columns (25) through (37) are subjective judgements of the impact and community characteristics noted on Chart II. The (+),(-), and (=) ratings are explained at the bottom of Chart II.

Column	Heading	Description
(25)	Conformance to Goals	A judgement as to whether STOL operations at the noted airport are in agreement with declared (or undeclared) objectives of the specific communities around the airport, (See Section 8.1.5).
(26)	Home Ownership	The degree of home ownership by individuals living within the impact area.
(27)	Socio-Economic Level	The average economic, educational, and social levels of persons living (or employed) within the impact area.
(28)	Adaptive Level	The degree to which persons within the impact area have become adapted to aircraft noise (See discussion Section 8.6, item 5).
(29)	Organization Level	The extent of organization of local community members (chartered or unchartered groups) to protest (or support) local community developments.
(30)	Financial Capability	The ability of the local community (or airport sponsor) to finance airport development or expansion. (Exclusive of state or federal funding.)
(31)	Noise Impact	A subjective combining of the noise impact items of Columns 13 through 18.
(32)	Pollution Impact	A subjective combining of the pollution impact items of Columns 19, 20, and 21.
(33)	Congestion Impact	A subjective combining of the congestion impact items of Cols. 22, 23, and 24.

Column	Heading	Description
(34)	Dis-location	A subjective judgement of the extent of physical dislocation of people, homes, buildings, streets, etc., caused by STOL airport construction, expansion, or operation.
(35)	Impact Rating	An algebraic combining of the ratings of Columns 31 through 34.
(36)	Attitude Rating	An algebraic combining of the ratings of columns 25 through 30.
(37)	Community Acceptance	A descriptive statement of acceptance probability developed from the arithmetical sum of the ten (+) and (-) items of columns 25 through 34. (e.g., six (+) items = 60%) All items were given equivalent weighting since it is not possible to prejudge their relative importance out to the 1985 time frame. > 80% = Highly Probable 80% = Quite Probable 70% = Probable 40 - 60% = Questionable 30% = Unlikely < 20% = Very unlikely

Appendix 15.9 Bibliography

15.9.1 STOL Systems - General

1. Airline View of STOL System Requirements: American Airlines Report AAL-ER & D-56, DOT Report No. DOT-OS-10075, Feb. 1972.

2. Cheeseman, Judd, Lilley, Social and Industrial Implications of V/STOL Transportation Systems, Univ. of Southampton (Eng.).

3. Campbell, H. S. et al. Alternative Development Strategies for Air Transportation in the New York Region, 1970-1980. RAND Memorandum Report RM-5815-PA, August 1969.

4. Campbell, H. S. et al. Systems for Air Transportation Serving the New York Metropolitan Area, 1975-1980. RAND Memorandum Report RM-5819-PA, August 1969.

5. Kirkwood, T. F. and Katten, S. L., The Potential of V/STOL Aircraft for Passenger Travel in the New York Region. RAND Memorandum Report RM-5816-PA, August 1969.

6. Definition Phase Report, Vol. 2, Technical Report - Western Region Short Haul Transportation Program. Aerospace Corporation. July 1970.

7. Summary and Recommendations - NASA/MIT Workshop on Short Haul Air Transport. MIT FTL R71-4, October 1971.

8. Analysis of Short-Haul Transportation. Mitre Corporation Report MTR 6209, July 28, 1972, NASA Contract NASW 2381.

9. System Planning Function for FAA V/STOL Program Office, Progress Report No. 3, Battelle Columbus Laboratories. DOT Contract FA 72 WA-2820.

10. Civil Aviation Research and Development Policy Study, (CARD) DOT/NASA Study Report, DOT-TST-10-4, NASA SP-285, March 1971.

11. Short-Haul Interurban Air Systems, 1975-1985.

12. Sheffel, David, The Development of Short-Haul Air Transportation Improvements. AIAA Paper 73-7 (FAA).

15.9.2 Aircraft/Airport Operations

1. "Heated Grooved Runway Study for STOL Port," LWP-1056.

2. "Concepts, Design and Description for the Upgraded Third Generation Air Traffic Control System," Report No. FAA-ED-01-1A (MTR 6152, Rev. 1), August 1972, Prepared for DOT/FAA by Mitre Corp.

15.9.3 Aircraft Noise

1. Zamarin, Langdon, Gabriel, A Summary of Two Community Surveys on Effects of Aircraft Noise. Report No. MDC J5033, IRAD Final Report, March 1971.

2. Langdon, L. E., Literature Review and Annoted Bibliography on Rating Sounds for Annoyance, Report No. DAC 67666. January 1969.

3. Human Response to Noise. MCD Human Factor. R & D Plan, 1972.

4. Branch, M. D. Outdoor Noise and the Metropolitan Environment. A Case Study of Los Angeles with Special Reference to Aircraft, 1970.

5. Airports and the Community, National Industrial Pollution Control Council (NIPCC) Sub-Council Report, February, 1972.

6. Impact of Aircraft Operations at Long Beach Airport on Long Beach Schools. Bolt Beranek and Newman, Inc. Report 2087. April 1971.

7. Noise Abatement: Summary of the Issues, Library of Congress Research Service TA 365, 70-259 SP. Nov. 4, 1970.

8. Noise: Effects and Problems of Control, Selected Annotated References 1966-1971. Library of Congress Research Service TA 365, 71-1926.

9. Community Reaction to Airport Noise. Vol. I, Tracon, Inc. NASA Contractor Report CR-1761, July 1971.

10. Enzberger, H., and Lee, H. Q. Technique for Calculating Optimum Takeoff and Climbout Trajectories for Noise Abatement. NASA TN D-5182. 1969.

11. Paullin, R. L. and Miller, J.S.F. Aircraft Noise Abatement - The Prospects for a Quieter Environment. AIAA Paper 69-800. July 1969.

12. Paullin, R.H.L. The FAA and Aircraft Noise Control. June 1968.

13. Becker, William B. Aircraft Noise and the Airlines. Paper 720621. International Conference on Transportation and the Environment, May/June 1972.

14. Hinton, Lloyd. Aircraft Noise as a Continuing National Problem. Paper 720622. International Conference on Transportation and the Environment. May/June 1972.

15. Progress Report on Miami International Airport Noise Management Program. Dade County Port Authority. Nov. 15, 1971.

16. Aircraft Noise Research Needs. Proposed AIR 1079, Society of Automotive Engineers (SAE) undated.

17. Brastow, Albert A. and Alford, William J. Advanced Subsonic Transport Technology. ASTRONAUTICS & AERONAUTICS, August 1972.

Aircraft Noise (contd.)

18. Dawson, L. G. and Sills, T. D. An End to Aircraft Noise? AERONAUTICAL JOURNAL, May 1972.

19. Aviation Noise Regulations and Projections, Regional Airport Systems Study (ABAG) Bolt, Beranek, and Newman, August 1971.

20. Inglewood's Noise Monitoring Program - Report on Phase I City of Inglewood Dept. of Planning and Development. Sept. 30, 1971.

21. A Comparison of Aircraft Approach Angles of Los Angeles and San Diego International Airports. City of Inglewood. June 1972.

22. Bresnahan, Robt. J., The Noise Factor in Airport Operation - Residential Complaints. ITTE, Univ. of Calif. Airport Management Course notes, April 1971

23. Federal Aviation Regulations, Volume III, Part 36 Noise Standards: Aircraft Type Certification, December 1, 1969.

24. Duggan, John M., Aircraft Noise - A Forward Look. Airport World, October 1972.

25. HUD Noise Assessment Guidelines, BBN Report 2176, August 1971. G.P.O. Stock No. 2300-1194

26. Third Federal Aircraft Noise Abatement Plan - Fy 1971-72, January 1972. Dept. of Transportation, G.P.O. Stock No. 5000-0054

27. Kolk, Franklin W., Noise - A Triumph of Ignorance. 1972 Wright Brothers Lecture, Astronautics and Aeronautics, October 1972.

28. Lyon, Richard H. et al, Modeling of V/STOL Noise in City Streets. MIT Mechanical Engineering Dept., November 1971.

29. Little, J. W., and Mabry, J. E., Human Reaction to Aircraft Engine Noise. AIA Paper No. 68 548.

30. McPike, A. L., The Generation and Suppression of Aircraft Noise. SAE Paper 710304, February 1971 (1971 SAE/DOT Conf. Proceedings).

31. Borsky, Paul H., Noise as Perceived by the Community. SAE Paper 710313, February 1971 (1971 SAE/DOT Conf. Proceedings).

32. Burrows, A. A. and Zamarin D. M., Aircraft Noise and The Community: Some Recent Survey Findings. Douglas Aircraft Paper 5891, 26 April 1971

33. Montanus, Neal R., The Problem of Aircraft Noise. ASCE Preprint 1953, July 1972.

Aircraft Noise (contd.)

34. Boettger, Wolfgang A., A Survey of Aircraft Noise Standards and Monitoring Systems at International Airport. (City of Inglewood) July 1972.

35. Johnson, G. W., V/STOL Community Annoyance Due to Noise: Proposed Indices and Levels. University of Toronto - York University Joint Program, Research Report No. 6, June 1972.

36. "Noise Measurements During Two-Segment Approaches at Los Angeles International Airport," Feb. 1972, Report 2208, Bolt Beranek and Newman, Inc.

15.9.4 Aircraft/Airport Pollution

1. Parker, J., Pollution from Airports, Heathrow 1970-71, Warren Spring Laboratory, British Dept. of Trade and Industry.

2. Exhaust Emission from Gas Turbine Aircraft Engines. National Industrial Pollution Control Council, Sub Council Report, February 1971.

3. McHugh, Edward W. Pollution Control in Aviation. ITTE, University of Calif. Airport Management Course Notes. April 1971.

4. Bristol, Carlton W., Jr., The Aircraft Engine Manufacturers Place in Control of Noise and Air Pollution. ITTE, Univ. of Calif. Airport Management Course Notes, April 1971.

5. Air Pollution of Tokyo and Osaka International Airports. Summary of Investigation Report by Prof. Saburo Yanagisawa of Kew Univ. 1971.

6. Miller, S. H. The Airlines Viewpoint: The Environment. Paper Presented at 11th Annual IATA Public Relations Conference, London.

7. Aviation Effect on Air Quality in the Bay Region. Bay Area Regional Airport Systems Study. Bay Area Air Pollution Control District, February 1971.

8. Ferri, Antonio, Better Marks on Pollution for the SST. Article in ASTRONAUTICS AND AERONAUTICS, July 1972.

9. Platte, H. and Bastress, E. K. The Impact on Aircraft Emissions Upon Air Quality. Paper 720610, International Conference on Transportation and the Environment, May/June 1972.

10. Rote, D. M. et al. Monitoring and Modeling of Airport Air Pollution. Paper 720611, International Conference on Transportation and the Environment. May/June 1972.

11. Bristol, C. W., Jr., Gas Turbine Engine Emission Characteristics and Future Outlook. SAE Paper 710319.

12. A Study of Aircraft Gas Turbine Engine Exhaust Emissions, Aerospace Industries Association, August 1971.

13. Benheim, Milton A., et al. Advanced Propulsion - Cleaner and Quieter. AERONAUTICS & ASTRONAUTICS, August 1972.

14. Shelton, E. M., Aviation Turbine Fuels, 1970, Petroleum Products Survey No. 69, Mineral Industry Surveys, U.S. Bureau of Mines.

15. McAdams, H. T. Analysis of Aircraft Exhaust Emission Measurements: Statics, Cornell Aeronautical Laboratory Report No. NA-5007-K-2, November 19, 1971.

Aircraft/Airport Pollution (contd.)

16. Progress Report Task Group #6. Southern Calif. Airspace Utilization Committee. FAA Western Region WE-517, 20 October 1971.

17. Dierker, Fred H. Airports and Water Quality Control. ITTE, Univ. of Calif., Airport Management Course Notes, April 1971.

18. Jet Air Pollution Declines Steadily. ICAO Bulletin, April 1972. Article by Wm. J. Osmus (ATA).

19. George, R. E., et al, Jet Aircraft Operations: Impact on The Air Environment. Journal of the Air Pollution Control Association, Vol. 22, No. 7, July 1972.

20. Heywood, John B. et al., Jet Aircraft Pollutant Production and Dispersion. AIAA Paper No. 70-115 (M.I.T.)

21. Fay, James A., Air Pollution from Future Giant Jetports. MIT Fluid Mechanics Laboratory, May 1970.

22. Sallee, G. P., Status Report on Aircraft and Airports as Sources of Pollution. SAE Paper 710318, February 1971 (SAE/DOT Conf. Proceedings 1971).

23. Fay, James A, and Haywood, John B., The Dispersion of Pollutants from Aircraft. SAE Paper 710322, February 1971 (SAE/DOT Conf. Proceedings 1971).

24. Megonnell, Wm. H., Regulation of Pollutant Emissions from Aircraft - Today and Tomorrow. SAE Paper 710337, (SAE/DOT 1971 Conf. Proceedings).

25. Aircraft Emissions: Impact on Air Quality and Feasibility of Control. U. S. Environmental Profection Agency, December 1972.

26. Von Kann, Clifton F., The Airlines and Pollution. ASCE Preprint 1761, July 1972.

27. Exhaust Emission Standards and Test Procedures (Motor Vehicles), EPA, Federal Register Vol. 36, No. 128, July 2, 1971.

28. Measurement of Air Pollutant Concentrations at O'Hare International Airport, Chicago, and Orange County Airport, California, by Celesco Industries for the Argonne National Laboratory, March 30, 1972.

15.9.5 Environmental Impact

1. Sears, James D. The Environmental Policy Act of 1969 - Its Import and Impact. ITTE, University of California Airport Management Course Notes, April 1971.

2. Grosh, Charles G. The Federal Aviation Administration and the Environment. ITTE, Univ. of Calif., Airport Management Course, April 1971.

3. Sutherland, R. J. Environmental and Ecological Problems of the Aviation Industry. Report submitted to the Industry Working Group - American Airlines. Undated.

4. Block, Jacques V., Airports and Environment. Paris Airport Authority. Report 5.1971.

5. Interim Instructions for Processing Airport Development Actions Affecting the Environment. FAA 5050.2, dated 7 Dec. 1970.

6. Schimpelor, Chas. C. The Airport and Environmental Control Paper 710321, Louisville and Jefferson County Air Board (undated).

7. Hoyt, Joseph B. Man and the Earth. 2nd Edition 1967, Prentice-Hall.

8. Environmental Quality - The First Annual Report of the Council on Environmental Quality. August 1970.

9. Environmental Quality - The Second Annual Report of the Council on Environmental Quality. August 1971.

10. Leopold, Luna B. et al. A Procedure for Evaluating Environmental Impact. U.S. Dept. of Interior, Geological Survey Circular 645. 1971.

11. Environmental Pollution, A Challenge to Sciences and Technology. Report of the Subcommittee on Science, Research and Development. 1966, Rev. August 1968.

12. The Biosphere. SCIENTIFIC AMERICAN, September 1970

13. FAA Advisory Circular 150/5100-7A, dated 25 February 1972, Requirement for Public Heavings in the Airport Development Aid Program.

14. The Airlines and the Environment - Air Transportation of Reprint from AIR TRANSPORT 1972.

15. Environmental Pollution - A Challenge to Science and Technology. Report of Subcommittee on Science, Research, and Development, Rev. August 1968. 89th Congress. Second Session Serial S (G.P.O.).

Environmental Impact (contd.)

16. SAE/DOT Conference Proceedings. Conference on Aircraft and the Environment (Part 2) February 8-10, 1971

17. SAE/EPA/DOT Conference Proceedings, International Conference on Aircraft and the Environment, May 31, June 2, 1972.

18. Barth, Delbert S., Effects of Air Pollution on Man and His Environment. SAE Paper 7.0326, February 1971. (1971 SAE/DOT Conf. Proceedings).

19. Bacon, Robert F., Airport Planning for Environmental Quality, SAE Paper 710341. February 1971 (1971 SAE/DOT Conf. Proceedings).

20. Abstract Report - Environmental, Social, and Economic Impact of the Proposed 1972-1977 Capital Improvement Program for the San Jose Municipal Airport. Bechtel Corporation, November 1972.

21. Blumenthal, V. L. et al., Aircraft Environmental Problems. AIAA Paper 73-5, January 1973. (The Boeing Company).

22. Montanus, Neal R., Air Transportation Systems Problems - The Airport Operators View. AIAA Paper 73-6 (Port Authority of New York and New Jersey).

23. Niemann, Bernard J., Jr., and Miller, Alan H., Transportation - Minimizing Environmental Impacts, ASCB Preprint 1942, July 1972.

24. Summary of Major Findings and Recommendations: Study of Critical Environmental Problems (SCEP Work Group Report) MIT July 30-31, 1970.

15.9.6 Airport Land Use

1. Environmental Development Guide, General Plan Program, Los Angeles Regional Planning Commission. 1972.

2. Garrett, Wilmer J., The Noise Factor in Airport Operation - Land Use Planning. ITTE, Univ. of Calif. Airport Management Course Notes, April 1971.

3. Lockwood, Bert J. The Noise Factor in Airport Operation - Noise Measurement. ITTE, Univ. of Calif. Airport Management Course Notes, April 1971.

4. The Effect on Aviation on the Physical Environment and Land Uses of the Bay Region. Regional Airport Systems Study (ABAG). Wilsey & Ham, 1971.

5. Environmental Studies Airport Noise and Land Use Analysis: Regional Airport Systems Study (ABAC), October, 1971.

6. Sief, Joseph, Costs of Land Use Change to Effect Noise Compatibility at Los Angeles International Airport. Report MDC 14109, Nov. 1971.

7. Johnson, Arthur E., Airport Land Use Study, MDC Report J0948, December 1970.

8. McGrath, Dorn C., Jr., Airports in the 70's - A Retrospective View. Paper presented at AIAA 6th Annual Meeting, Anaheim, Calif. Oct. 22, 1969.

9. Land Use Planning Relating to Aircraft Noise. Technical Report of Bolt, Beranek & Newman, Inc. for the FAA. October, 1964. Also Appendix A Supplement, dated May, 1965.

10. Westchester - Playa Del Rey Development Plan - Final Report, Development Research Associates, August, 1971.

11. Tondel, Lyman M., Jr., Legal and Related Aspects of Airport Land Use Planning. ATA Committee Paper presented at International Conference on the Reduction of Noise and Disturbance Council by Civil Aircraft, London, November, 1960.

12. Airport Access, Regional Airport Systems Study (BASAR) Wilbur Smith & Associates, September, 1971.

13. Toward a New Environmental Ethic. U. S. Environmental Protection Agency, Sept. 1971, U.S. GPO Stock No. 5500-0031.

14. Land-Use Planning Protects Airport and Community. ICAO Bulletin April 1972. Article by Pierre J. Levasseur.

15. Air Transportation Background and Policy Study - San Diego Region. A. D. Little, Inc. report prepared for the San Diego Comprehensive Planning Organization, December 1969.

16. Aircraft Noise Impact Planning Guidelines for Local Agencies PB-213.020. Report prepared by Wilsey and Ham, and Bolt, Beranek, & Newman, for the U. S. Dept. of Housing and Urban Development, November 1972.

15.9.7 Airport Economic Impact

1. External Costs and Benefits Analyses, Northeast Corridor Transportation Project, Resource Management Corp., Dec. 1969.

2. Burkhart, Miner, Public Expenditure, 1971, (Textbook) L. C. 76-91725, Aldine - Atherton Publishers, Chicago, Ill.

3. Foster, Joseph A. The Airport - A Center of Economic Gravity Paper presented at 1972 International Congress of Transportation Conferences, June 1, 1972.

4. The Economic Impact of Los Angeles International Airport on its Market Area. Waldo & Edwards, Inc. November 1971.

5. Economic Impact of Los Angeles International Airport on the City of Los Angeles, Economics Research Associates, July, 1968.

6. The Economic Impact of Van Nuys Airport on its Market Area, Waldo & Edwards, Inc., November, 1971.

7. The Economic Impact of Ontario International Airport on its Market Area. Waldo & Edwards, Inc. November 1971.

8. Dallas/Ft. Worth Regional Airport Economic Impact, North Central Texas Council of Governments. February 1970.

9. Kansas City's Airline Industry - Impact on the Heart of America, Reprint from article in Kansas Citian of May 1971

10. Greater Pittsburgh Airport - What it Means to Southwestern Pennsylvania. Air Transportation Association Brochure, December 1970.

11. San Francisco's Bay Area Airports - A Billion Dollar Boost for The Bay Economy. ATA Brochure (undated).

12. New Orleans International Airport - A $121,049,000. Bonus for the Greater New Orleans Area. Brochure prepared by the Management Center, College of Business Administration, Loyola University (undated).

13. McClure, Paul T. The Effect of Jet Noise on the Value of Real Estate. AIAA Paper 69-802, July 1969.

14. Stapleton International Airport - A $148,000.00 Plus for the Denver Metro Area. ATA Brochure (undated).

15. Logan Airport - The Hub of Boston's Business. ATA Brochure (undated).

16. Rhode Island and T. F. Green Airport - A Vital Economic Partnership. ATA Brochure (undated).

15.9.7 Airport Economic Impact (contd.)

17. The Airport - A Community Asset. ATA Brochure containing remarks of Joseph A. Foster before the American Institute of Real Estate Appraisers, Nov. 7, 1969.

18. Capital Cost Analysis or Airport Alternatives; Economic Studies Regional Airport Systems Study (BASAR) Bechtel Inc., October, 1971.

19. Aerospace and the U.S. Economy, Its Role, Contributions, and Critical Problems. Aerospace Industries Association of America, Inc. Nov. 1971.

20. Foster, Joseph A. Excerpts of Information on Land Values around airports. Air Transport Association of America, July 1969.

21. Aircraft Noise Effects on Property Values. City of Inglewood (Calif.) Environmental Standards Circular, February 1972.

22. deNeufville, Richard, Yajina, Takastic, Economic Impact on Airport Development. Transportation Research Forum. May, 1972.

23. Costs and Benefits of Transportation Planning, Highway Research Record No. 314, Highway Research Board, 1970.

24. Aviation Cost Allocation Study - Benefits, Working Paper No. 9. D.O.T. Office of Policy Review, October, 1972.

25. Aviation Cost Allocation Study - Socio-Economic Benefits of the Airport and Airway System, Working Paper No. 15, D.O.T. Office of Policy Review, December, 1972.

15.9.8 Institutional, Legal, Regulatory

1. Institutional Factors in Civil Aviation. A. D. Little Report to Joint DOT-NASA Civil Aviation R & D Policy Study (CRAD) NASA CR-1807, Jan. 1971.

2. Noise Control, Legislation and Enforcement. City of Inglewood (Calif.) Sept. 27-29, 1971.

3. Christopher, Warren, Legal Aspects of Aircraft Noise and Sonic Boom in the United States, SAE Paper 710333, February, 1971.

4. Short-Haul Regulatory Policy, Remarks of Robert G. Cook, Chief, Licensing Division II, Bureau of Operating Rights, Civil Aeronautics, Board, Before the National Short-Haul Air Transportation Meeting. February 7, 1973.

5. Stevenson, G. M. Jr., The Politics of Airport Noise, Durbury Press, Belmont, California, 1972 L.C. 75-173314.

15.9.9 Community Acceptance

1. Anderson, Homer B. Airport and Community Interface. Paper 710310 Louisville & Jefferson County Air Board (undated).

2. Innovations in Community Involvement - A Case Study Behavior Science Corporation, 1971.

3. Hitt, Ellis F. et al. Plan for Selecting Secondary Short-Haul Airports. July 21, 1972. Report Prepared for FAA by Battelle Institute under FAA Contract DOT FA72WA-2820.

4. Ransone, Robin K. STOLports Must Be Good Neighbors, AIRPORT FORUM, June 1972.

5. Regional Airport Systems Study - Final Plan Recommendation Association of Bay Area Governments (ABEC), June 1972.

6. Clark, Terry N., Community Structure and Decision-Making: Comparative Analysis. Scranton, Penn.: Chandler Publishing Company, 1968.

7. Fraser, Robert C. (Project Director) Institutional Factors in Civil Aviation. Joint DOT-NASA Civil Aviation R & D Policy Study: Contractors Report. Department of Transportation, Washington, D.C., DOT TST-10-1; NASA CR-1807, January 1971.

8. Lundquist, Gustav E. FAA Activity in V/STOL Development. In The Society of Experimental Test Pilots 1971 Report to the Aerospace Profession -- Fifteenth Symposium Proceedings, September 16-18, 1971, Beverly Hilton -- Beverly Hills, Calif.

9. Runkel, Philip J., and McGrath, Joseph E. Research on Human Behavior: A Systematic Guide to Method. N.Y.; Holt, Rinehart and Winston, Ind., 1972.

10. Wicker, A. W. Attitudes vs. Action: The Relationship of Verbal and Overt Behavioral Responses to Attitude Objects. Journal of Social Issues. 25:41-78, 1969.

11. Ajzen, Icek and Fishbein, Martin. The Prediction of Behavior from Attitudinal and Normative Variables. Journal of Experimental Social Psychology. 1970, 6, 466-487.

12. Incorporating Community Values into the Planning and Evaluation of Airport Development Projects, FAA-AV-72-2, Urban Systems Corporation.

13. Lantner, Gary H. Community Opposition to Airport Development. MIT Civil Engineering Dept. R-72-1, January, 1972.

14. Goedike, Wm. Communities Act to Reduce the Impact of Jet Aircraft Noise. SAE Paper 710348 (SAE/DOT 1971 Conf. Proceedings).

15. Soncie, Gary A. Aviation, the Environment, and the Public Interest. SAE Paper 710351, Feb 1971 (SAE/DOT 1971, Conf. Proceedings).

15.9.9 Community Acceptance (contd.)

16. External Impacts of an Intraurban Transportation System in the San Francisco Bay Area - Summary Report. RAND Corp. R-1074-NASA, October, 1972.

17. Effects of a V/STOL Commuter Transportation System on Road Congestion in the San Francisco Bay Area. RAND R-1075-NASA, October 1972.

18. Distribution of Primary Benefits and Costs of Intraurban Air Transportation in the San Francisco Bay Area, RAND R-1076-NASA, October 1972.

19. Long-Run Effects of an Intraurban Air Transportation System on Residential Location and Commuting in the San Francisco Bay Area, RAND R-1077-NASA. October 1972.

20. Study of Aircraft in Intraurban Transportation Systems - San Francisco Bay Area, NASA Contractor Report, The Boeing Company, NASA Cr 2006, March 1972.

21. Study of Aircraft in Intraurban Systems - San Francisco Bay Area, NASA Contractor Report CR-114347, The Boeing Company, September 1971.

22. Study of an Intraurban Travel Demand Model Incorporating Commuter Preference Variables. NASA CR 114418, The Boeing Company, December 1971.

23. Social Impacts of Civil Aviation and Implications for R&D Policy, Prepared by Geo. Washington University under NASA Contract NSR 09-010-069 for the Joint DOT-NASA Civil Aviation Policy Study (CARD), September 1971.

24. Kuhlthan, A. R., and Jacobson, I. D., Investigation of Traveler Acceptance Factors in Short-Haul Air Carrier Operations. Univ. of Virginia, STOL Program Technical Report 403205, July 1972.

25. Lee, W. and Jacobson, I. D. Characteristics of the Air Traveler - A Selective Review. University of Virginia, STOL Memorandum Report 403204, June 1972.

26. La Porte, T., and Metlay, D. Notes on Attitudes Toward Technology. (U.C. Berkeley).

27. Cogan, A. M., and Dela Barre, W. A. Citizens - A Vital Part of Transportation Planning. ASCE Preprint 1767 July 1972.

28. Harris, Louis, Rising Consumer Expectations of the Airline Industry. A paper presented to the IATA Public Relations Conference, March 14, 1972.

29. Glaser, Robert and Resnick, Lauren B. Instructional Psychology. In, Annual Review of Psychology, Vol. 23, 1972, 207-276.

30. Mayo, Louis H. Social Impacts of Civil Aviation and Implications for R&D Policy. Joint DOT and NASA Report: DOT TST-10-6; NASA CR-1988, Sept., 1971.

15.9.9 Community Acceptance (contd.)

31. Brown, E. J., The Self as Related to Formal Participation in Three Pennsylvania Rural Communities. Rural Sociology, 1953, 18, 313-320.

32. Hudson, B. B., Anxiety in Response to the Unfamiliar, In, D. W. Chapman (Ed.) Human Behavior in Diaster: A New Field of Social Research. J. Social Issues, 1954, 10, No. 3.

33. Hudson, B. B., et. al., Group responses to Threat: Perception and Learning under Stress. J. Social Psychology, 67, Oct. 1965.

34. Ford, Frederick C. "Psychological" Noise Reduction. Airport World, February 1973.

35. Coch, L. and French, J.R.P. Jr. Overcoming Resistance to Change. In Proshansky & Seidenberg (Eds.) Basic Studies in Social Psychology, New York: Holt, Rinehart and Winston, Inc. 1965.

36. Standfield, Robert I. Editorial. Airport World, January, 1973.

37. Gagne, Robert M. and Rohwer, W. D. Jr., Instructional Psychology. In, Annual Review of Psychology, Vol. 20, 1969, 381-418.

38. Community Reaction to Airport Noise, Vol. I, Tracor Inc. NASA Contractor Report CR 1761, July 1971.

39. Burrows, A. A. and Zandrin, D. M., Aircraft Noise and the Community: Some Recent Survey Findings, Douglas Aircraft Co. Technical Paper No. 5891, April 26, 1971.

40. EPA Citizens' Bulletin, U. S. Environmental Protection Agency, February, 1973.

41. Aviation Turbine Fuels, 1970, Mineral Industry Surveys, Petroleum Products Survey No. 69, Ella Mae Shelton, Bureau of Mines.

42. Aircraft and Aircraft Engines, Proposed Standards for Control of Air Pollution, EPA, Federal Register, Vol. 37, No. 239, December 12, 1972.

43. Aircraft Gas Turbine Engine Exhaust Smoke Measurement, Aerospace Recommended Practice (ARP) 1179, May 4, 1970.

15.9.10 Methodology

1. de Neufville, R. and Keeney, R. L. Use of Decision Analysis in Airport Development for Mexico City, MIT Civil Engr. Systems Laboratory, February, 1972.

2. Sheavin, W. J. Assessment of STOLport Locations with Multiple Attributes, Stanford University, July 1972.

3. Pardee, Frederick S., New Developments in Transportation Analysis: Evaluation of Mixes of Modes in Alternative Regional Environments, The RAND Corporation, Paper No. 4425, July 1970.

4. Raiffa, Howard, Preferences for Multi-Attributed Alternatives, RAND Memorandum RM-5868 DOT/RC April, 1969.

5. Pardee, F. S. et al. Measurement and Evaluation of Transportation System Effectiveness, RAND Memorandum RM-5869-DOT, September 1969.

6. Schlaifer, Robert "Analysis of Decisions Under Uncertainty", McGraw-Hill, 1969.

7. Luce, R. Duncan, and Raiffa, Howard. Games and Decisions - Introduction and Critical Survey. John Wiley & Sons, 1957.

8. Raiffa, Howard. Decision Analysis: Introductory Lectures on Choices Under Uncertainty. Addison - Wesley. 1970.

9. Jacobson, I. D., and Kuhlthan, A. R., Mathematical Modeling to Determine Criteria for Evaluating Human Acceptance of Transportation Systems, Univ. of Virginia STOL Technical Report 403206, August 1972.

APPENDIX 15.10

CONGESTION RELIEF POSSIBLE WITH STOL

AIRPORT		1970 ANNUAL OPERATION			1985 CTOL OPERATIONS			1985 STOL		1985 TOTAL OPERATIONS			VFR RUNWAY CAPACITY			IFR RUNWAY CAPACITY			REMARKS
		TOTAL OPERATIONS	AIR CARRIER OPERATIONS	% OF TOTAL	ANNUAL AIR CARRIER(1)	AVERAGE DAY	PEAK HOUR	AVERAGE DAY	PEAK HOUR	ANNUAL TOTAL	AVERAGE DAY	PEAK HOUR	PEAK HOUR CTOL & STOL	FAA VFR PHOCAP	PERCENT UNDERCAPACITY	COMBINED CTOL & STOL	FAA IFR PHOCAP	PERCENT UNDERCAPACITY	
O'HARE	(ORD)	641,390	598,973	93	960,000	2620	252	0	0	---	---		---	---	---	---	---	---	12% REDUCTION IN OPERATIONS
MEIGS	(CAX)	80,027	15,503	19	24,960	68	7	186	19	128,000	50	35	54	76	---	26	52	0	POSSIBLE WITH STOL SYSTEM
MIDWAY	(MDW)	182,348	45,553	24	70,120	192	19	116	12	292,000	800	80	92	152	---	31	60	0	
TOTAL STOL								302											
LOGAN	(BOS)	323,425	209,379	65	337,100	924	92	0	0	---	---		---	---	---	---	---	---	24% REDUCTION IN OPERATIONS
HANSCOM	(BED)	301,379	705	0.2	1,135	3	1	109	10	482,000	1320	132	142	76	(66)* or 46%	11	60	0	POSSIBLE WITH STOL SYSTEM *Addition Close Parallel Increases Capacity to 152.
NORWOOD	(OWD)	231,993	0	0	0	0	0	108	11	370,000	1000	100	111	125	---	11	70	0	
TOTAL STOL								217											
LOS ANGELES	(LAX)	544,025	415,719	76	665,000	1820	132	0	0	---	---		---	---	---	---	---	---	14% REDUCTION IN OPERATIONS POSSIBLE WITH STOL SYSTEM
LONG BEACH	(LGB)	529,221	4,697	1.0	7,510	21	2	54	7	847,000	2320	232	239	217	(22) or 9%*	9	87	0	*30% Increase Possible by Eliminating Touch and Go Training Flights.
PATTON	(GPF)	0	0	0	0	0	0	62	7	22,600	62	7	7	45	---	7	42	0	
ORANGE CO.	(SNA)	472,709	16,362	4	26,343	72	7	44	7	756,000	2070	207	214	152	(62) or 29%*	14	63	0	*Requires Relocation of 30% of General Aviation Activity.
VAN NUYS	(VNY)	575,784	0	0	0	0	0	46	6	920,000	2520	252	258	175	(83) or 32%*	6	71	0	*40% Increase Possible by Eliminating Touch and Go Training Flights.
EL MONTE	(EMT)	221,315	0	0	0	0	0	52	8	354,000	1000	100	108	99	(9) or 8%*	8	53	0	*30% Increase Possible by Eliminating Touch and Go Training Flights.
TOTAL STOL								258											