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An evaluation of the reliever airports in the Northwest Mountain Region of the Federal Aviation Administration.

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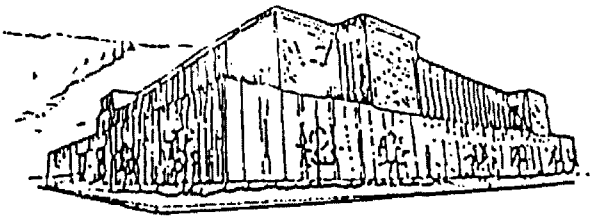

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AN EVALUATION OF THE RELIEVER AIRPORTS IN THE NORTHWEST MOUNTAIN REGION OF THE FEDERAL AVIATION ADMINISTRATION

by

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CHAPTER 1

STATEMENT OF THE PROBLEM

Aviation is often broken down into three categories: a commercial operation (take-off or a landing) is one that serves the ticket purchasing passenger, a military operation is one authorized for military purposes, and other operations fall into the category of general aviation. As an integral part of the aviation system, general aviation provides vital services to businesses and the local community. These include emergency medical transportation, delivery of parts for equipment, and private transportation. Most general aviation aircraft are smaller and slower than the aircraft used by the air carrier industry and, as a result, they tend to increase congestion at busy commercial airports.

To address the congestion caused by general aviation operations, the federal government established a program to fund general aviation airport development in metropolitan areas under the Airport and Airway Development Act of 1970. The program, which is still in place, is commonly referred to as the "reliever program" and the airports that receive funding under the program are called "reliever" airports. Reliever airports are general aviation airports that relieve congestion at busy commercial airports by attracting general aviation activity away from these airports and by providing general aviation access to metropolitan areas.

The need for the continuation of the reliever program is now in question. A report prepared by the U.S. General Accounting Office (GAO)[1] suggests that the reliever airport

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[1]Airport Improvement Program, Reliever Airport Set-Aside Funds Could be Redirected, U.S. General Accounting Office Report to the Chairman, Subcommittee on Transportation and Related Agencies, Committee on Appropriations, U.S. Senate, June 1994.

designation should be eliminated because general aviation traffic is not a "major factor in congestion and delays and ... the decline of general aviation traffic has meant an oversupply of general aviation capacity now exists among the reliever airports."[2] The GAO report concludes that "The reliever airport set-aside funds could be redirected" to better uses.

In addition, the Federal Aviation Administration (FAA) has been criticized for its management of the program. A report released by the U.S. Department of Transportation's Office of the Inspector General (OIG) concludes that "The Federal Aviation Administration (FAA) system of controls over designation and improvement of reliever airports is not adequate."[3] The OIG could find no connection between the federal funds put into reliever airports and the diversion of general aviation traffic from the commercial service airport. OIG recommends that FAA strengthen its internal control over the reliever program to insure that cost effective projects are funded.

Reports such as the GAO's and OIG's tend to have credibility, and decisions to reduce funding or curtail programs tend to get made based on these reports. The considerable skepticism about the reliever program's ability to relieve congestion at commercial service airports has, in fact, led to reduced funding for the program. The U.S. Congress in the latest amendment to the federal airport funding program[4] reduced the funds set aside for reliever airports from 10 percent of the airport funding program to five percent of total funding available for airport development. This means the funds available annually for reliever airport development have been reduced from approximately $200 million to $100 million.

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[2]OAG Report, p. 14.

[3]Report on Audit of Utilization of Reliever Airports, Federal Aviation Administration, Report No. R4-FA-2-206, p, ii.

[4]The title of the new funding program is the "Federal Aviation Administration Act of 1994," P.L. 103 -305.

However, the conclusions contained in the GAO and OIG reports are based on questionable evidence. The GAO report merely uses anecdotal information, and a citation from another report, to conclude that general aviation is no longer a capacity consideration in metropolitan areas and that a surplus capacity not exists. The statistical information included in the report is based on aggregate figures for the nation rather than on individual metropolitan areas, and the study does not investigate changes over time in airport usage. Additionally, the report writers appear to have little knowledge of how an airport system functions in metropolitan areas and ignore the important role that reliever airports contribute to those systems.

In view of the inadequacies of these reports, this paper examines the four major metropolitan airport systems in the Northwest Mountain Region of the FAA to assess the effectiveness of the reliever airport program. It examines the hypothesis that general aviation operations have shifted from the commercial service airports to the reliever airports and that the reliever airports do in fact play an important role in each system. Each metropolitan system is described, and the change in general aviation operations at the air carrier airport, the reliever airports, and the other airports in each system between 1975 and 1990 are studied to determine the effectiveness of each reliever system in shifting general aviation operations from the commercial service airport to the reliever airport. Recommendations regarding the system improvements are also offered. Additionally, a priority system is suggested for determining the relative importance of each reliever airport in these four metropolitan areas. This priority system can be used to assist with the distribution of federal funds.

The paper is organized as follows. Chapter 2 describes the background of federal funding for airport development. Chapter 3 provides an inventory of the four metropolitan airport systems under study. Chapter 4 offers an analysis of several aspects of each system

to determine its effectiveness. Chapter 5 suggests a priority system for distributing federal funds based on the factors that are most important in a metropolitan system. Lastly, Chapter 6 provides recommendations for system improvements based on the analysis in previous chapters.

CHAPTER 2

BACKGROUND OF FEDERAL AIRPORT FUNDING AND STUDY SCOPE AND METHODOLOGY

Background of the Airport Improvement Program

To promote the development of an airport system to meet the nation's needs, the Federal government initiated a grants-in-aid program for state and local governments shortly after World War II. This early program, the Federal-Aid Airport Program, was authorized by the Federal Airport Act of 1946. In 1970, a more comprehensive program was established with the passage of the Airport and Airway Development Act. This program was funded from the newly established Airport and Airway Trust Fund. The Trust Fund's revenues came from taxes on such items as airline fares, air freight, and aviation fuel.

The most recent grant program, the Airport Improvement Program (AIP), was established by the Airport and Airway Improvement Act of 1982 and amendments contained in the Airport and Airway Safety and Capacity Expansion Act of 1987. This legislation authorized funding for the AIP through fiscal year 1993 from the Trust Fund for airport development, airport planning, and noise compatibility planning and programs. On August 8, 1994, Congress passed an amendment to the Airport and Airway Improvement Act of 1982 to continue airport funding through fiscal year 1996.

The National Plan of Integrated Airport Systems (NPIAS)

In order for an airport to receive federal funds for development, the airport must be included in the NPIAS. The NPIAS identifies the national airport system, together with the

airport developments and costs necessary to expand and improve the system to meet the present and future needs of civil aeronautics. The Plan is compiled and managed by the Federal Aviation Administration (FAA). Once an airport has been included in the Plan, it is eligible for federal funding.

Certain entry criteria exist for including an airport in the NPIAS. Airports eligible to be included fall into two categories: commercial service and general aviation. A commercial service airport is "any public-use airport which receives scheduled passenger service aircraft and annually enplanes 2,500 or more revenue passengers as determined by the FAA."[5] Enplaned passengers are originating, stopover, and transfer passengers of U.S. scheduled and unscheduled commercial air carriers.[6]

A future airport can be included in the NPIAS as a commercial service airport if it is forecast by the FAA to receive scheduled passenger service and annually enplane 2,500 or more passengers within 10 years. In the same vein, an existing airport can be included in the NPIAS as commercial service if it is forecast to receive scheduled passenger service and enplane 2,500 passengers or more within a 10 year period. In other words, entry into the NPIAS can be based on either forecasted or existing operations.

The eligibility of general aviation airports for inclusion in the NPIAS is more complicated. General aviation airports are all the airports except those designated as commercial service. General aviation airports are divided into two categories: those that are designated as "reliever" airports and those that are not. A reliever airport can be included in the Plan if it provides substantial capacity or instrument flight training relief. Substantial capacity is evidenced by a

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[5]U. S. Department of Transportation, FAA, Field Formulation of the National Plan of Integrated Airport Systems, FAA Order 5090.3B, p. 5.

[6]U.S. Department of Transportation, FAA, Terminal Area Forecast, FY 1993-2005, FAA-APO-93-9, July 1993, p. A1.

minimum activity level. The reliever airport must have or be forecast to have at least 50 based aircraft, or 25,000 annual itinerant operations, or 35,000 local operations. A local operation is an arrival or departure of an aircraft which operates in the local traffic pattern or within the sight of the tower and are known to be departing for or arriving from flights in local practice areas within 20-mile radius of the airport. An itinerant operation is all aircraft arrivals and departures other than the local operations described above.[7] Evidence of instrument flight training relief is the installation or proposed installation of a precision instrument landing system (ILS). A precision ILS provides electronic instrument guidance to the pilot to permit exact alignment and angle of descent of a properly equipped aircraft on final approach for landing.

The airport being relieved must be a commercial service airport in a standard metropolitan area with a population of at least 250,000 persons, or it must enplane at least 250,000 annual passengers and operate at 60 percent or more of its capacity. The NPIAS states that the purpose of a reliever airport is to relieve airport congestion at the commercial service airport, but it provides no definition of congestion relief. The NPIAS that states the reliever airport is intended to relieve congestion at the commercial service airport in a metropolitan area by providing general aviation with an attractive alternative to using the commercial airport. The NPIAS describes an "attractive alternative" as an airport that provides similar services and access as the commercial service airport. For example, the runway should be adequate length and strength to serve comparable aircraft as the relieved airport. In summary, an airport can be designated as a reliever airport if it is in a large enough city, the commercial airport serving that city meets the activity and congestion criteria, it has a

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[7]U.S. Department of Transportation, FAA, Airport Master Plans, Advisory Circular 150/5070-6A, p. 22.

minimum activity level, and it provides an attractive alternative to the commercial service airport.

Other general aviation airports are eligible to be included in the NPIAS if they have at least 10 based aircraft and are a minimum distance from the nearest airport included in the Plan. There is no distance requirement for reliever airports. They can be close together and serve the city, unlike other general aviation airport, which must be separated by at least 30 miles and serve different communities.

Another distinction between general aviation airports, relievers and commercial service airports is the type of ownership required for inclusion into the NPIAS. A general aviation airport, other than a reliever airport, must be publicly owned to be eligible for federal funding. Relievers and commercial service airports can be privately owned. This is important because privately owned airports are sometimes designated as relievers simply to make them eligible for federal funding, not because they meet the objectives of the reliever program.

Why the "Reliever" Designation is Important

Funds have been set aside within the federal airport improvement program for reliever airports since the early 1960s. The Airport and Airway Improvement Act of 1982 provided that a minimum of ten percent of the AIP funds be reserved for reliever airports. In recent years, there have been nearly $200 million available for reliever airports annually. An airport designated as a reliever has access to significantly more funds than other general aviation airports. Therefore, designation as a reliever is an advantage, because there are more funds available for them.

Another reason why the "reliever" designation is important is that it permits the funding of several airports within the same metropolitan area. All other general aviation airports must be a minimum distance apart and serve different communities to be eligible for federal funding. If

the reliever program were eliminated, only one airport in a metropolitan area could be funded. Numerous airports that are important to the national airport system would go unfunded. Allowing these airports to go unfunded would have a negative impact on the national airport system. Federal funding for airport development is important to the system for two reasons: it provides funding for, and control over, airport development. Airport operators make commitments in order to receive federal grants. These commitments help assure that the airport will remain open and that it is developed and maintained to an established standard.

The federal airport standards that must be met to receive funds emphasize safety and assure consistency throughout the country. For example, federal funding assures that the pavement marking in Tennessee is the same as the pavement marking in Kansas, so that a pilot from anywhere can understand the marking. This is critical to operating a safe and efficient national airport system. Therefore, the federal funding has the dual benefit of providing funds to develop airports and preserving a safe, efficient airport system.

In short, providing funds to reliever airports insures that active, important airports in the national system are developed and maintained to federal standards. Elimination of the current reliever airport designation could make some airports no longer eligible for federal funding and degrade the national system.

Scope and Study Methodology

Very little research has been conducted on reliever airports, and the research that has been conducted is by organizations that count on finding problems to maintain their credibility. Organizations such as the GAO and OIG typically focus on one aspect of a potential program, identify problems, and make broad recommendations for change. These auditors, generally, lack the expertise to fully understand the programs they evaluate. As a result, they often

overlook important factors and make recommendations without a full understanding of what is involved.

As noted in Chapter 1, the research that has been conducted by GAO and OIG on the reliever airports seems to follow this pattern. Both reports focus on the fact that there is no direct connection between funds being put into the reliever airports and the general aviation activity at the commercial airports being relieved. The GAO recommends that the reliever set-aside be eliminated because it could not establish the connection between reliever airports and congestion relief. However, the GAO does not provide any analysis of how their recommendation could impact the system.

The GAO and OIG do not seem to understand that the reliever airports are serving an important function in the national aviation system and that federal funds assure the system is developed and maintained to a standard. The 1990 NPIAS lists 285 reliever airports and 2,432 other general aviation airports. The reliever airports are approximately ten percent of the total number of general aviation airports. However, 29 percent of the total civil aircraft fleet is based at reliever airports.[8] This means that, typically, the reliever airports have significantly more based aircraft and activity than other general aviation airports. Therefore, based on activity, the contribution of the typical reliever airport to the national aviation system is more than the other general aviation airports. The GAO and OIG ignore this important contribution of the reliever airports to the national aviation system.

This paper examines the contribution of the reliever airports in four metropolitan areas. The boundaries of the metropolitan areas are identified as well as the commercial service airport, the reliever airports, and other general aviation airports with significant activity levels in

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[8]U.S. Department of Transportation, FAA, National Plan of Integrated Airport Systems 1990-1999, March 4, 1991, p. 4.

each metropolitan area. The general aviation activity within the metropolitan area is organized by category of airport and presented in graph form. The underlying research hypothesis is that the majority of the general aviation activity in the metropolitan area is occurring at the reliever airports. Organizing the operational data by airport type has not been attempted before and it may go a long way in demonstrating the important role that the reliever airports play in the national aviation system.

This study also looks at the operational data longitudinally. The negative results of the GAO's study are not surprising given the variables it chose to test and the fact that it only looked at one year's data. The development of airports and shifts in aircraft operations from one airport to another occurs over a period of several years. Reliever airports must provide an attractive alternative in order to entice aircraft users, because airport choice is not regulated. Therefore, to determine if the reliever airports have been effective, it is necessary to look at the change in aircraft operations within a metropolitan area over a long time frame. This paper determines if the reliever airports in four metropolitan areas have helped relieve congestion at the commercial service airport by examining the change in the general aviation activity in each metropolitan area between 1975 and 1990. Congestion relief is assumed if the general aviation activity has shifted from the commercial service airport to the reliever airports. Finally, this paper takes the results of the three areas of analysis (operations organized by airport type, change to general aviation operations from 1975 to 1990, and the priority system described in Chapter 6), to develop recommendations on the reliever airport system in each metropolitan area.

CHAPTER 3

DESCRIPTIVE INVENTORY OF FOUR AIRPORT SYSTEMS

Introduction

This paper examines metropolitan airport systems in Denver, Colorado; Seattle, Washington; Salt Lake City, Utah; and Portland, Oregon. The purpose of this chapter is to provide background information describing where each of these systems fits in the national picture and its relationship to the other systems in the Northwest. A description of each airport used in the study is provided, including its activity level, ownership, facilities, and distance to the city center and the commercial service airport. This information provides the basis for the analysis in Chapter 4.

General System Information

The four metropolitan airport systems examined in this study include the large and medium hub airports in the FAA's Northwest Mountain Region. Large hub airports are defined by the FAA as those airports which, in the most recent year, boarded one percent or more of the total national enplanements.[9] In 1991, for example, these airports served over 4.8 million passengers each. A medium hub airport is defined as an airport that boarded between 0.25

[9]Enplanements are originating, stopover, and transfer passengers of U.S. scheduled and unscheduled commercial air carriers.

and 0.99 percent of the total national enplanements.[10] In 1991, there were 30 large hub airports and 39 other airports that fit in the medium hub category.[11]

The Northwest Mountain Region of the FAA includes 7 states: Washington, Oregon, Idaho, Colorado, Wyoming, Utah, and Montana. The large hub airports in this region are Stapleton International Airport in Denver, Colorado; Seattle-Tacoma International Airport in Seattle, Washington; and Salt Lake City International Airport in Salt Lake City, Utah. The medium hub airport in this region is Portland International Airport in Portland, Oregon. Table 1 shows the national rank based on the number of enplaned passengers and number of operations at each of these four major air carrier airports in 1992. An "operation" is either a take-off or a landing.

Table 1: 1992 Enplaned Passengers and Operations at the Major Air Carrier Airports in the Northwest Mountain Region[12]

Airport	Rank	Enplanements (000)	Operations (000)
Denver	6	12,314	491
Seattle	20	7,696	340
Salt Lake City	25	5,470	302
Portland	39	3,164	265

Table 1 indicates that Denver is the busiest hub in the region and the highest in the national rankings. Seattle and Salt Lake City are both large hub airports but on the small end

[10]U.S. Department of Transportation, FAA, "Program Control and Reporting Procedures Airport grant-in-aid Programs," Order 5100.20B, October 27, 1989, p. 10.

[11]Terminal Area Forecasts: Fiscal Years 1993-2005, p. 15.

[12]U. S. Department of Transportation, FAA, 1993 Aviation System Capacity Plan, Table A-1.

of the large hub spectrum category nationally. Although Portland is one of the larger medium hubs in the country, it would need to enplane an additional 1.5 million passengers, about a 50 percent increase, to be in the large hub category.

Aircraft Activity Level in Each System

Excluding military operations, aircraft operations are divided into two categories, general aviation and air carrier. Table 2 is a compilation of the air carrier and general aviation activity in each of the areas in this study. Commercial service airports have a combination of air carrier and general aviation operations, all of which are included in Table 2. The reliever and other airports included in this study are almost exclusively used by general aviation operators with some minor exceptions such as military flights or diverted air carrier flights. Therefore, to simplify the data, only the general aviation operations at the general aviation airports are included in Table 2.

Table 2: Summary of Each Area's Air Carrier and General Aviation (GA) Annual Operations[13]

Area	Air Carrier Ops (000)	GA Ops (000)	Total Ops(000)
Seattle	331	1030	1361
Denver	455	813	1268
Portland	192	800	992
Salt Lake City	216	247	463

The number of general aviation operations in each area exceeds the number of air carrier operations. Most people's exposure to the aviation system is limited to that of an air carrier passenger; most people are unaware of the general aviation activity levels. Table 2

[13]The data is from the most recent Terminal Area Forecast (TAF) developed by the FAA if the airport is included in the TAF. Other wise the data is the most recent FAA Form 5010 for the location. Details of data sources are in Appendices.

shows how significant general aviation operations are. Airports that serve general aviation are thus very important in the national system.

Selection Criteria for Systems Studied

The number of enplanements constituted the primary criterion for selecting the metropolitan airport systems for study. The systems selected are the four busiest air carrier airports in the Northwest Mountain region. Each airport has more than one designated reliever airport and has or is experiencing some level of congestion. There is a significant drop in enplanements when one examines the next busiest site in the region, Spokane International Airport, Spokane, Washington. Spokane is ranked 87th nationally based on number of enplaned passengers. Because it enplanes about one-fourth the number of passengers as Portland, it was not selected for study. The four airport systems selected are similar in terms of "complexity". It is possible to make comparisons between them in ways that would not have been possible if smaller, less complex systems had been included in the study.

Selection Criteria for Airports Studied

This study examines the airport systems in four metropolitan areas. Each of these systems consists of the major air carrier airport, all of the designated reliever airports, and other general aviation airports. Typically, there are other general aviation airports in the vicinity of a city which have not been designated as relievers. Depending on the size and the number of these other airports, the operations and based aircraft associated with the airport can be a significant portion of the activity in a metropolitan area. Therefore, it is important to include these airports in an analysis of a metropolitan area. Another reason to include these airports in the study is to draw comparisons between these airports and the designated relievers. To ensure valid comparisons, only the larger, more active airports are included.

These airports are within a 30 statute mile radius of the central business district (CBD) of the metropolitan area being studied, are open to the public, and have more than 50 based aircraft.[14]

The 30 mile criterion is somewhat arbitrary. Using the Sectional Aeronautical Chart published by the National Oceanic Service, the public-use airports that are in the same vicinity as the reliever airports, the commercial service airport, and the CBD of each city being studied were noted. Since these airports were generally within 30 miles of the CBD, a 30 mile circle was drawn from the center of each metropolitan area being studied. The circle was not drawn around the major air carrier airport, but rather around the city center that these airports serve. People using reliever and other general aviation airports want to go to the city to conduct business. As a result there is typically no relationship between the activity at an airport and its distance from the commercial service airport. The more important relationship is the airport's distance from the city center.

The Seattle area, in contrast to the other three areas in this study, is a long thin corridor lying between the mountains to the east and the Puget Sound to the west. As a result, drawing a circle around Seattle does not capture the entire metropolitan area to the north and south. There are active airports to the north and south of the 30 mile radius, such as Arlington, with more than 400 based aircraft, which were not included in this study. In an effort to be consistent with the other areas in the study, airports outside the 30 mile circle were not included in the study. However, two airports, one on Vashon Island and another on the Olympic Peninsula, are not included in the study even though they are within 30 miles of downtown Seattle. Due to the geography of Puget Sound, these airports have poor ground access to Seattle. As a result, these airports are not part of the metropolitan area's airport system.

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[14]A based aircraft is an aircraft permanently stationed at an airport.

All of the other general aviation airports selected for study are "public-use" airports within the 30 mile circle. A public-use airport is one which is open to the public even if it is privately owned. Private-use airports are not included in this study because their use is restricted by their owners. Thus, their operations are not comparable to reliever airports which must be open to the public.

The "50 based aircraft" criterion was selected because that is the minimum number of based aircraft allowable for an airport to be designated as a reliever. For this reason, the 50 based aircraft limit provides a realistic comparison between these general aviation airports and the reliever airports. Also, an airport with 50 based aircraft tends to have approximately 15,000 to 20,000 annual operations, which is greater than one percent of the operations in each system. An airport with fewer operations than that would not contribute enough to the metropolitan system to justify including it in the study. Table 3 provides a summary of the number of airports in each metropolitan area in this study.

Table 3: Number of Airports in Each Area by Category

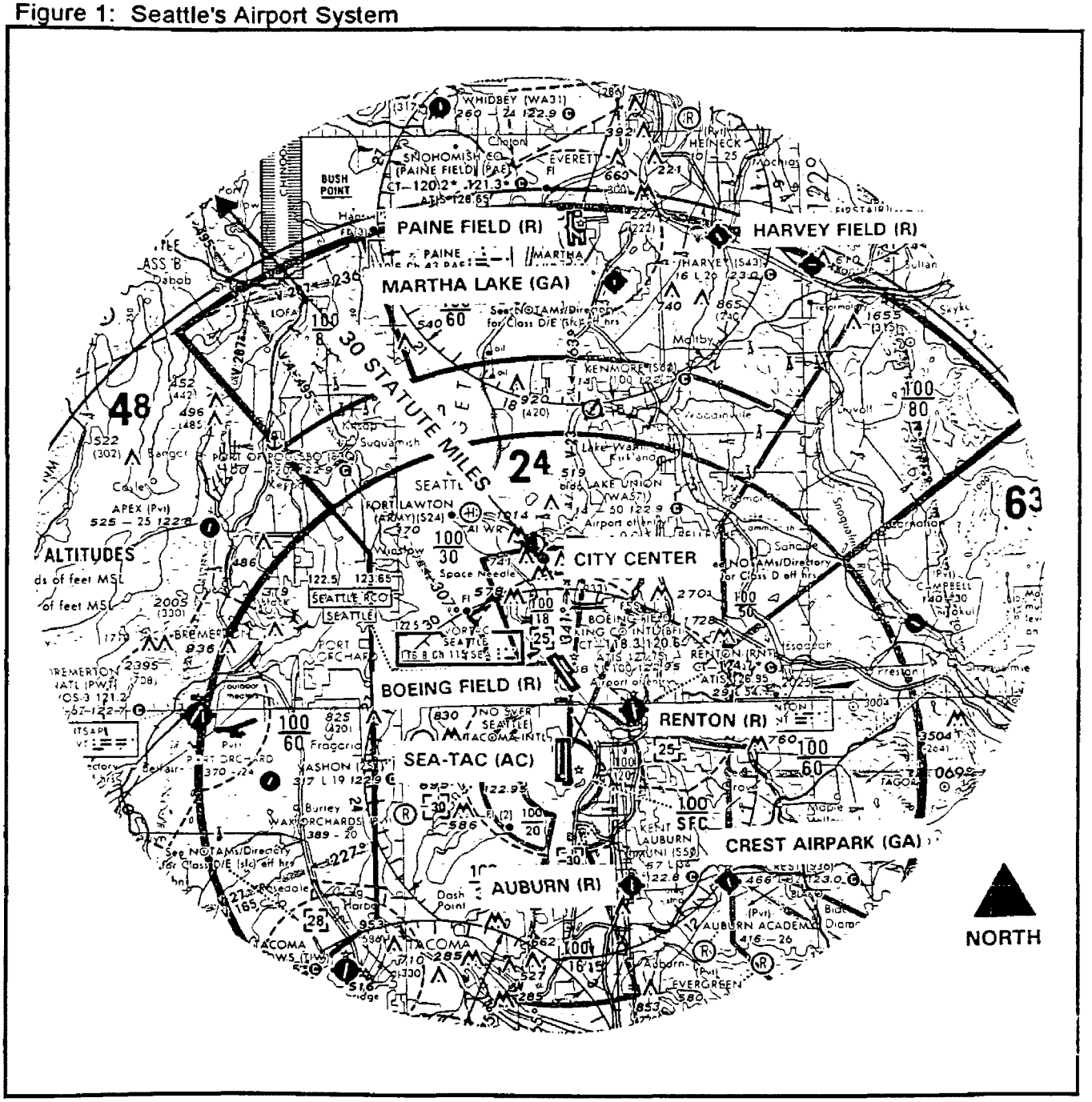
Area	Air Carrier	Relievers	Other GA Airports
Denver	**1**	**4**	**2**
Seattle	**1**	**5**	**2**
Salt Lake City	**1**	**3**	**0**
Portland	**1**	**3**	**6**

The Seattle System

Seattle's airport system includes one air carrier airport, five relievers, and two other general aviation airports. Figure 1 shows the location of each airport and its relationship to Seattle. Because there are several seaplane bases and privately owned airports in the area,

the numbers in this study do not capture all of the activity in the area. In 1991, there were a total of 1,361,000 operations in the area. In 1991, there were 2,298 based aircraft in the area.

Figure 1: Seattle's Airport System



Air Carrier Airport

The air carrier airport serving the Seattle Metropolitan Area is Seattle-Tacoma International Airport, commonly referred to as "Sea-Tac". The airport is owned and operated

by the Port of Seattle which has the same boundaries as King County. It is located approximately 10 miles south of the center of Seattle. In 1993, there were approximately 339,500 aircraft operations at Sea-Tac. Two per cent were general aviation operations; the remainder, except for a handful, were air carrier operations.[15]

Sea-Tac has two parallel runways with sufficient strength and width to handle the largest and heaviest aircraft currently being manufactured. It has a control tower and three runway ends with Instrument Landing Systems (ILS). An ILS is the electronic equipment used to guide the aircraft to the runway when the pilot can not see the runway due to weather conditions. The airport is equipped with the most sophisticated radar and lighting systems available with today's technology.

Reliever Airports

There are five airports designated as reliever airports for Sea-Tac; King County International (Boeing Field), Snohomish County (Paine Field), Harvey Field, Renton Municipal, and Auburn Municipal. Boeing Field is owned and operated by King County. Paine Field is owned and operated by Snohomish County. Renton is owned by the city of Renton. Boeing Field, Paine Field and Renton serve a wide mixture of aircraft that is not typical of a reliever because the Boeing Company, which manufactures airliners, has a significant presence at each of these airports. These airports are commonly used by the larger aircraft in the fleet, such as a Boeing 747, as well as the smaller aircraft typically found at a reliever airport, such as a Cessna 172. In addition to Boeing aircraft, Boeing Field and Paine Field are used by other sophisticated aircraft such as corporate jets and freight haulers. Occasionally, both airports are used for flights that have been diverted from Sea-Tac due to poor weather conditions. While Renton has a significant Boeing Company presence, it does not serve the sophisticated aircraft

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[15]Port of Seattle, Seattle, Washington, "Seattle-Tacoma International Airport Activity Report, 1993," April 1994, p.

mix that Boeing Field and Paine Field do because it has only one short runway and does not have an ILS due to the surrounding terrain.

Auburn and Harvey Field are used exclusively by the small end of the aircraft spectrum. Harvey Field is a privately owned, public-use airport, approximately 30 miles north east of the center of Seattle. It has a short turf runway, with powerlines at both ends, limiting the size and weight of the aircraft that can safely use the airport. Auburn is a single paved runway, owned and operated by the city of Auburn. Neither Harvey nor Auburn have any electronic landing systems. For this reason, they are usable only when the cloud layer is greater than 1000 feet above the ground surface and the visibility is greater than three miles.

Other General Aviation Airports

There are two other airports in the Seattle area with more than 50 based aircraft: Crest AirPark and Martha Lake. Both are privately owned, public-use airports. As with Harvey Field and Auburn, they are single runway airports that serve the small end of the fleet.

Harvey Field, Crest AirPark, and Martha Lake have not received any federal funds for airport development. Harvey and Crest Airpark have been studied to determine what improvements would be necessary to bring the airport up to federal standards. Neither owners of Crest nor Harvey were willing to make the changes required at their airports to meet the federal standards and they have not accepted any federal funds under the Airport Improvement Program.

Table 4 is a summary of the services at each airport in the area. An "X" in a box means that airport has that facility. The ranking is based on the level of sophistication of the services at the airport in relation to the other airports in the area. Table 4 shows that Sea-Tac is the most sophisticated and Martha Lake is the least. Full strength runway means that the airport has a runway strengthened for the heavier aircraft in the fleet. The airports with an ILS have

precision instrument approach capability, meaning that both vertical and horizontal guidance is available to the pilot. "Tower" refers to an Air Traffic Control Tower.

Table 4: Summary of Facilities at Airports in the Seattle Area

Airport	Publicly Owned	Level of Services Ranking	Full Strength Runway	ILS Equipped	Tower
Sea-Tac	X	1	X	X	X
Boeing Field	X	2	X	X	X
Paine Field	X	3	X	X	X
Renton	X	4	X		X
Auburn	X	5			
Crest		6			
Harvey		7			
Martha Lake		8			

Table 5 shows the straight line distance in statute miles between the airports in the study and the center of Seattle, and the straight line distance between Sea-Tac and the airports in the study. These distances were measured from the Seattle Sectional Chart.

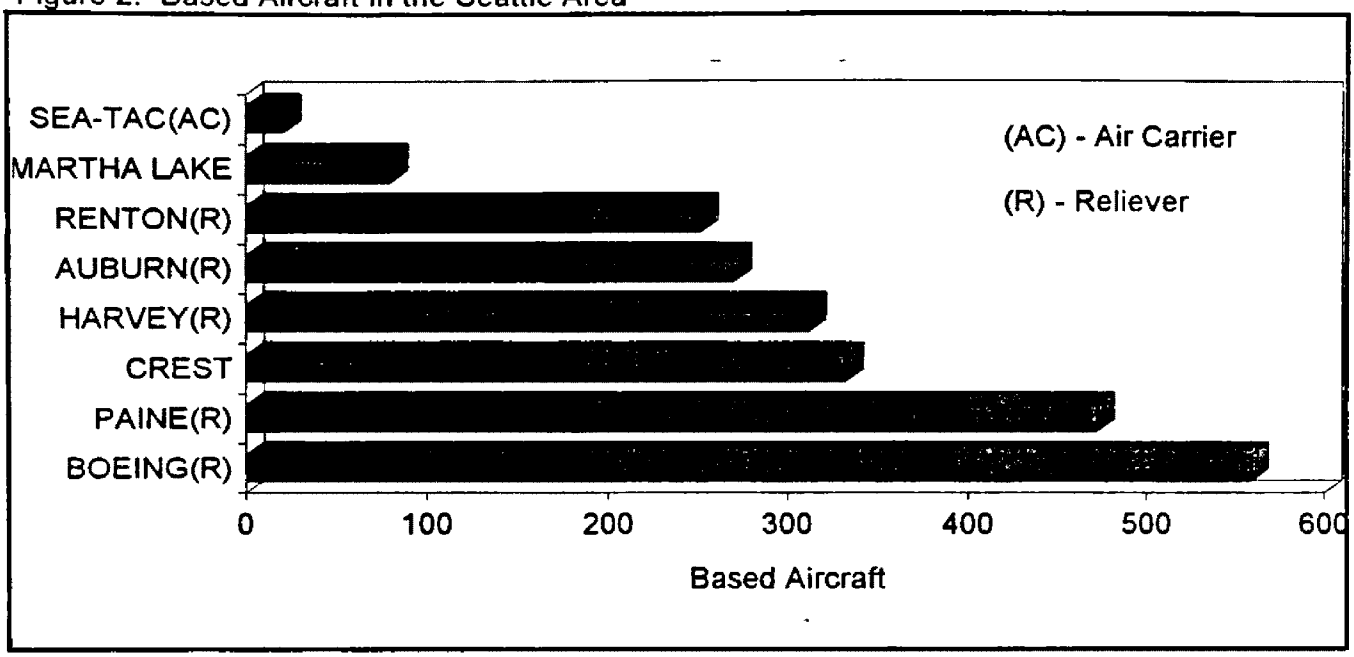
Table 5: Distances from Airports to Seattle and to Sea-Tac in Statute Miles (SM)

Airport	Distance to city (SM)	Distance to Sea-Tac (SM)
Sea-Tac	10	0
Harvey	23	33
Paine Field	20	33
Crest	22	11
Auburn	20	9
Martha Lake	19	29
Renton	10	5
Boeing Field	6	5

Based Aircraft

Figure 2 shows the number of based aircraft at each airport in the system. A based aircraft is an aircraft permanently stationed at an airport. Figure 2 shows that very few aircraft are based at Sea-Tac. Although this is typical of a commercial service airport unless there is an airline based at the airport, the number of based aircraft at Sea-Tac is lower than what is found at other commercial service airports.

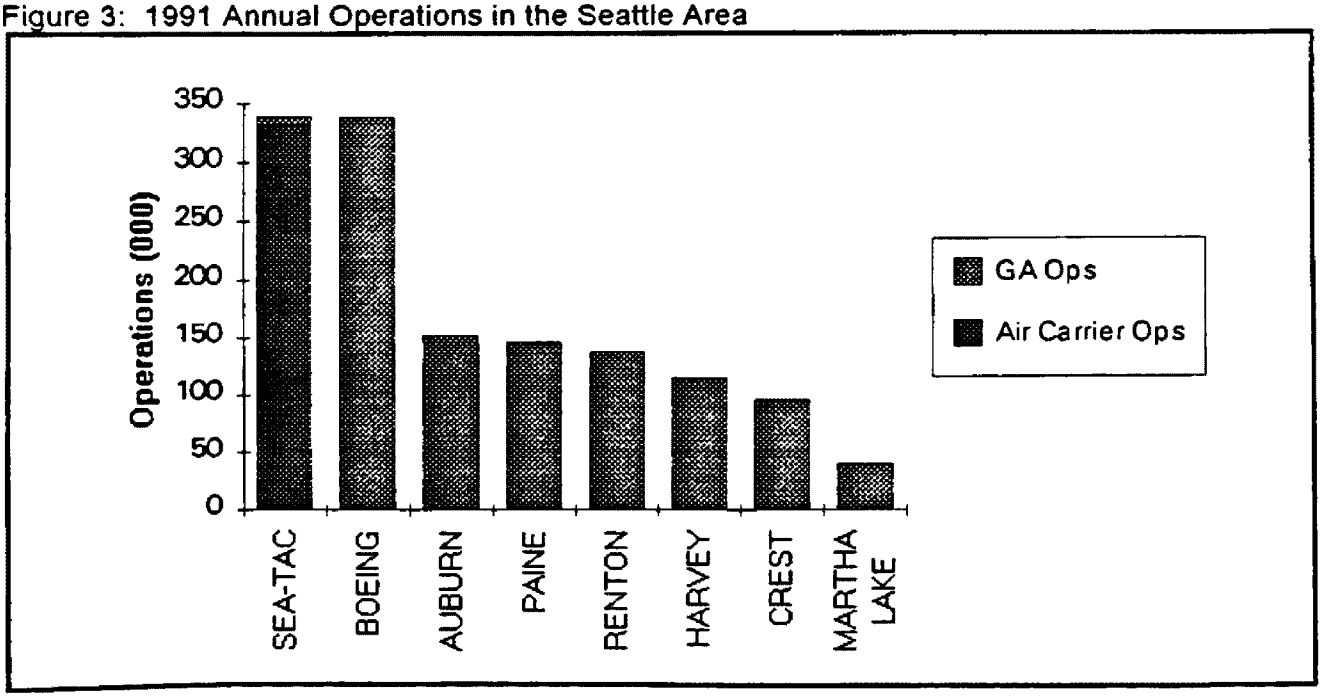
Figure 2: Based Aircraft in the Seattle Area



Operational Data

Figure 3 shows the number of general aviation operations at each airport in the study in 1991. The total number of operations in the area in 1991 was 1,361,000.

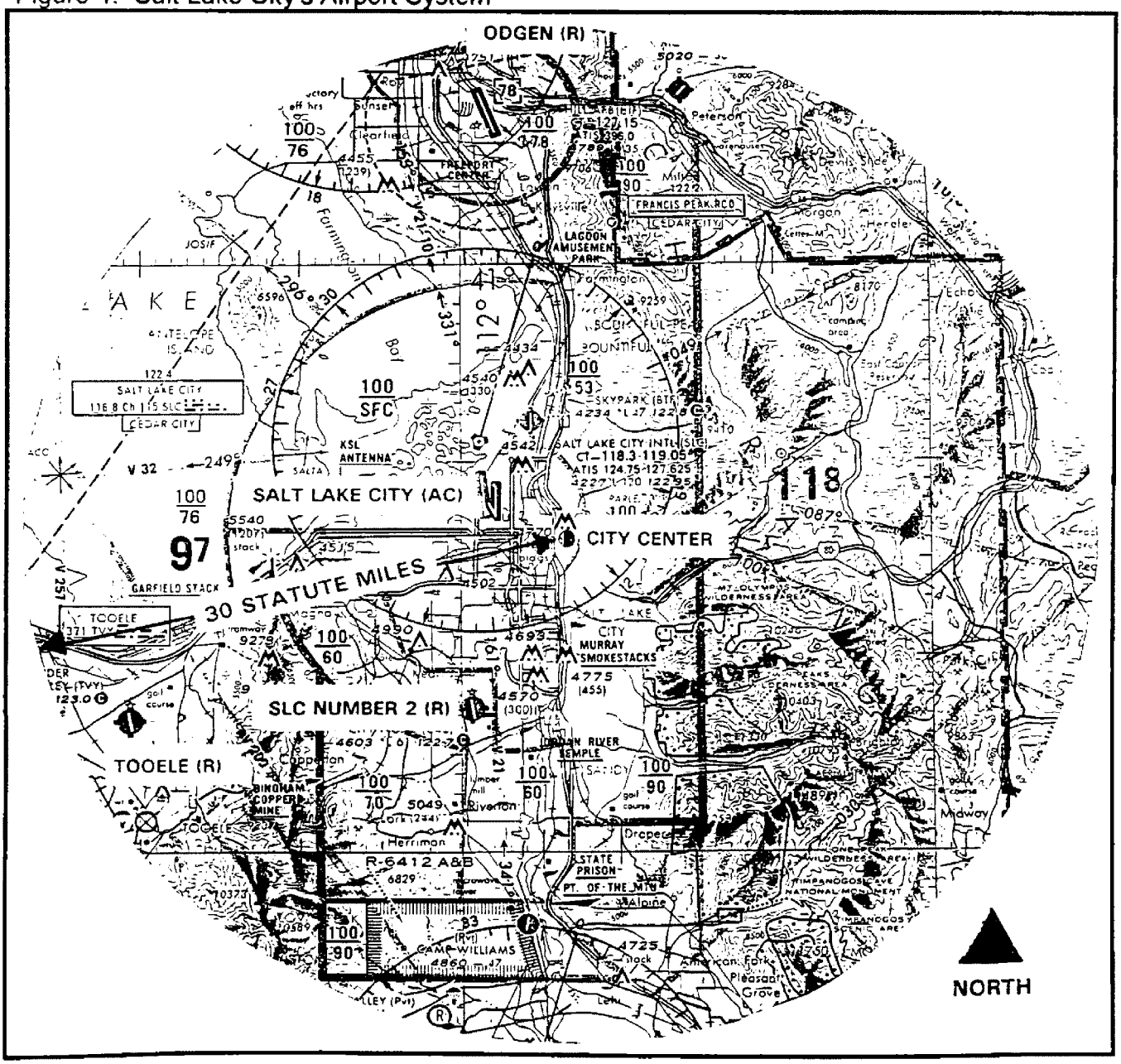
Figure 3: 1991 Annual Operations in the Seattle Area



The Salt Lake City System

The Salt Lake City area airport system includes one air carrier airport and three relievers. Figure 5 shows these airports and their relationship to Salt Lake City. In 1991, there were a total of 463,000 operations in the area. In 1991, there were 903 based aircraft in the area.

Figure 4: Salt Lake City's Airport System



Air Carrier Airport

Salt Lake City International Airport is the major air carrier serving the Wasatch Metropolitan Area and the State of Utah. It is owned by Salt Lake City Corporation and operated by the Salt Lake City Airport Authority. The airport is approximately three miles east of the Salt Lake City central business district. In 1993, there were approximately 330,000 operations.[16] Based on historical trends from the 1988 Master Plan Update, 30 percent of the those operations were general aviation, 60 percent were air carrier operations, and the remaining ten percent were a combination of military and freight operations.[17]

The runway system at Salt Lake City International consists of three runways. Two nearly parallel runways are oriented in a north-south direction; the third runway is oriented in a northwest/southeast alignment and is located between the parallel runways. The two north-south runways are capable of handling the largest and heaviest aircraft in the fleet. Salt Lake is served by an air traffic control tower and has three runways equipped with ILS.

Reliever Airports

There are three airports designated as reliever airports for Salt Lake City International: Ogden-Hinkley (Ogden), Salt Lake City Muni Number 2 (Number 2) and Tooele. Ogden is owned and operated by Ogden City Corporation and is the most sophisticated reliever airport for Salt Lake City. It has three runways, one of which is adequate for jet aircraft. It also has an instrument approach, so it is usable in most weather conditions.

Number 2 is owned by Salt Lake City Corporation and operated by the Salt Lake City Airport Authority. It is approximately ten miles south of Salt Lake City. It is a single runway airport that is constructed to serve aircraft weighing 12,500 pounds or less. It serves the

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[16] U. S. Department of Transportation, FAA, Administrator's Fact Book, April-May 1994, p. 33.

[17] Salt Lake City Airport Authority, Salt Lake City, Utah, "Airport Master Plan Update, Salt Lake City International Airport, Final Report, December 1988."

smallest, least sophisticated portion of the fleet. Tooele, the third reliever airport for Salt Lake City, is comparable to Number 2. It has been recently purchased by the Salt Lake City Corporation and is currently being studied to determine if it can accommodate an instrument approach.

Other General Aviation Airports

There are no other airports that serve the general aviation fleet in the Salt Lake City area. There is a privately owned, public use strip, SkyPark, which has had over one hundred based aircraft in the past. Currently, it has less than ten,[18] and is therefore not included in this study. Table 6 provides a summary of the services at each airport in the area.

Table 6: Summary of Facilities at Airports in the Salt Lake City Area

Airport	Publicly Owned	Level of Services Ranking	Full Strength Runway	ILS Equipped	Tower
Salt Lake	X	1	X	X	X
Ogden	X	2	X	X	X
Salt Lake No. 2	X	3			
Tooele	X	4			

Table 7 shows the straight line distance in statue miles between the airports in the study and the center of Salt Lake City, and the straight line distance between Salt Lake City International Airport and the airports in the study. These distances were measured from the Salt Lake Sectional Chart.

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[18]FAA Form 5010, 1991 for SkyPark, Salt Lake City, Utah

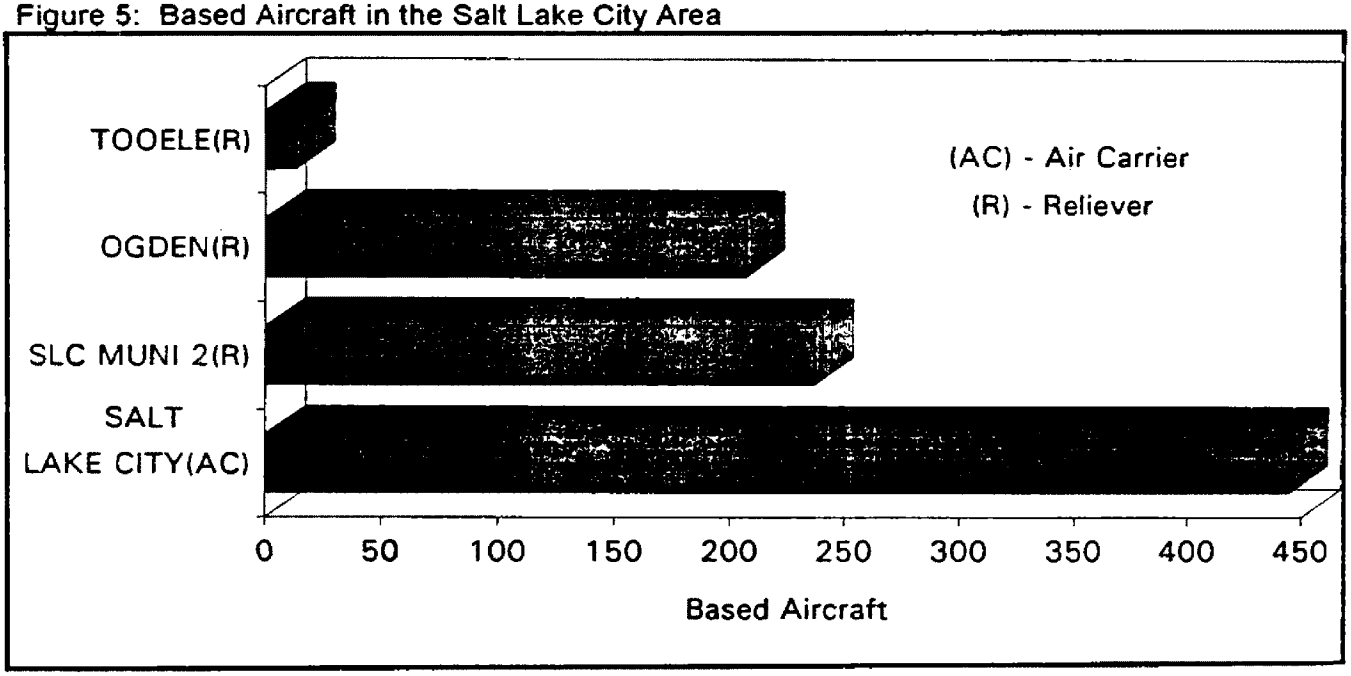
Table 7: Distances from Airports to Salt Lake City and to Salt Lake City International

Airport	Distance to city (SM)	Distance to SLC (SM)
Salt Lake	**4**	**0**
Tooele	**26**	**24**
Salt Lake No. 2	**11**	**12**
Ogden	**28**	**31**

Based Aircraft

Figure 5 shows the number of based aircraft at each airport in the system.

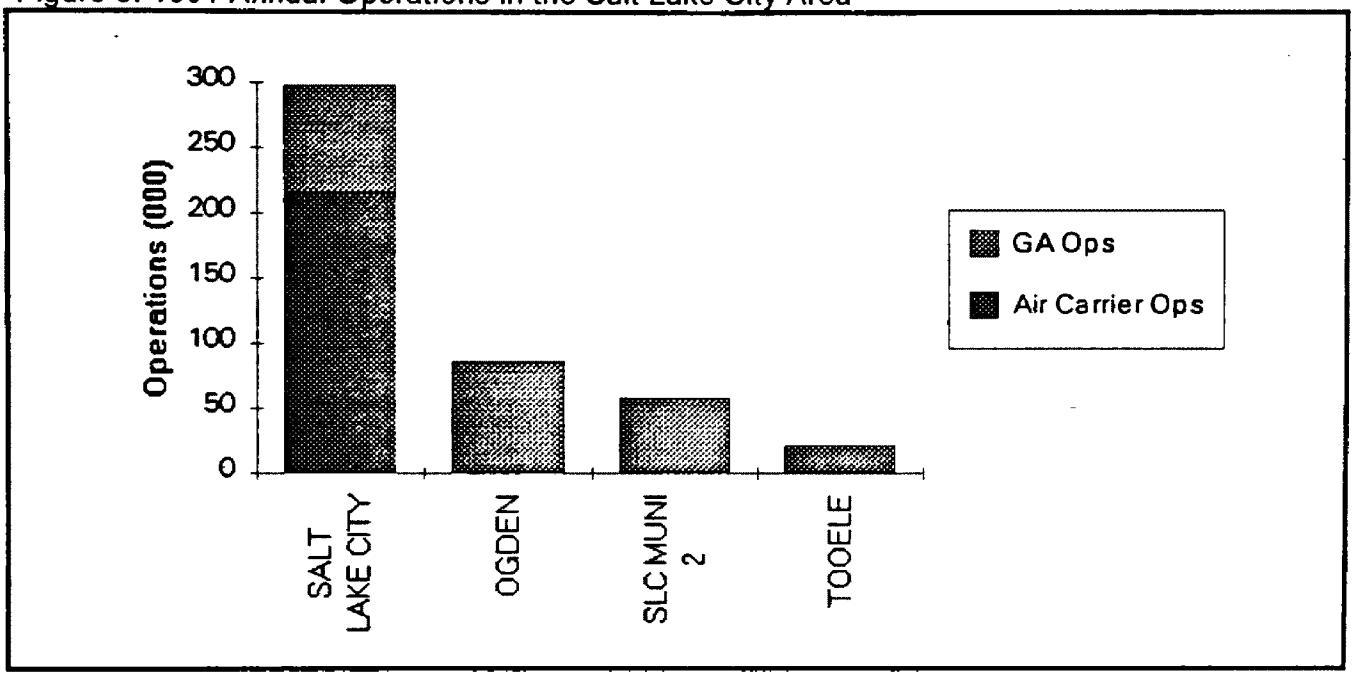
Figure 5: Based Aircraft in the Salt Lake City Area



Operational Data

Figure 6 shows the number of general aviation and air carrier operations at each airport in the study. In 1991, there were a total of 463,000 operations.

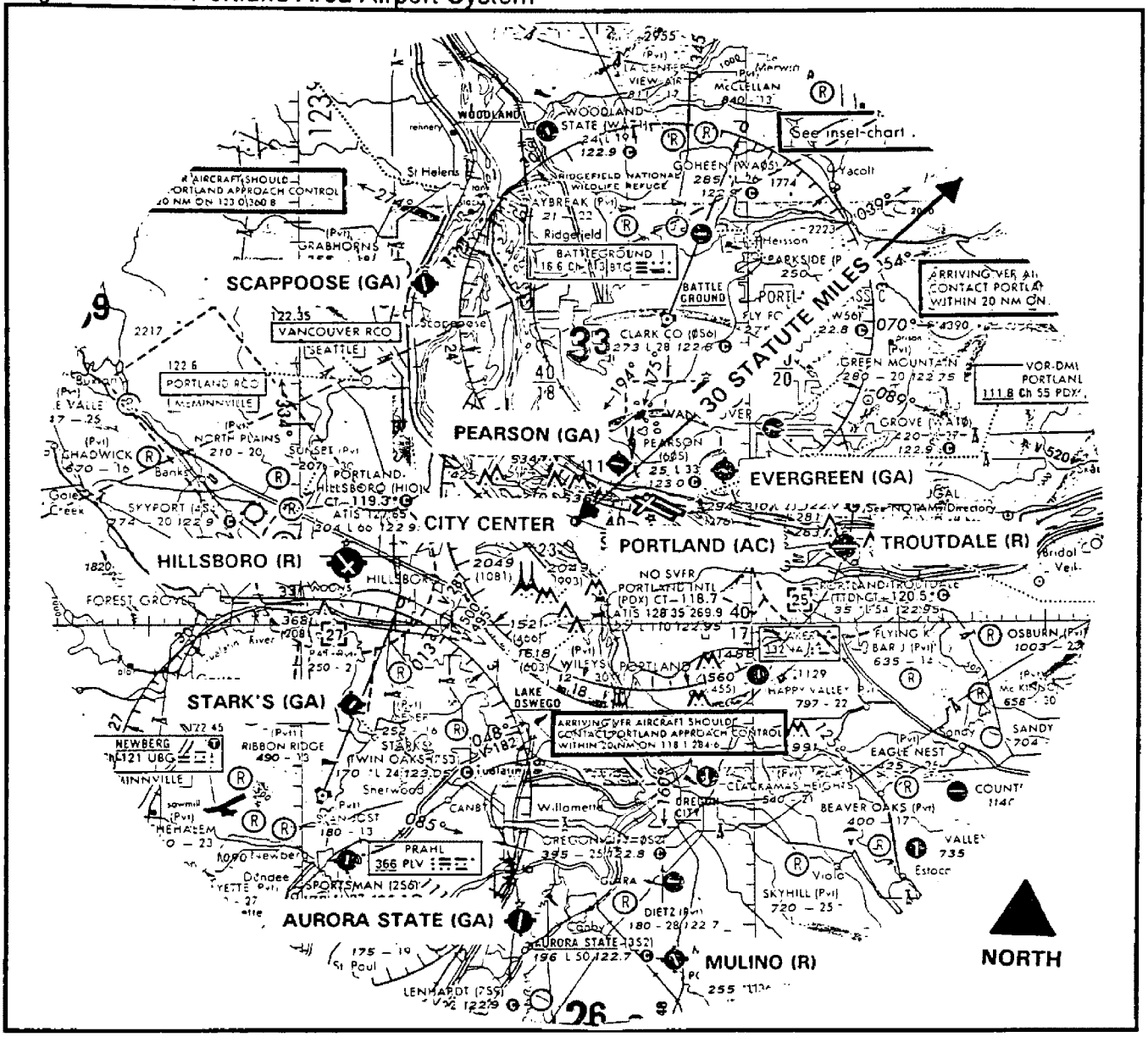
Figure 6: 1991 Annual Operations in the Salt Lake City Area



The Portland System

The Portland area airport system includes one air carrier airport, three relievers, and six other general aviation airports. Figure 7 shows these airports and their relationship to Portland. In 1991, there were a total of 948,000 operations in the area. In 1991, there were 1,531 based aircraft in the area.

Figure 7: The Portland Area Airport System



Air Carrier Airport

Portland International Airport is the major air carrier airport serving the Portland, Oregon area and the surrounding five counties, four in northern Oregon and one in southwest Washington State. It is owned and operated by the Port of Portland and is located approximately five miles northeast of downtown Portland. In 1991, there were approximately

264,300 aircraft operations.[19] Twenty-two percent of those operations were general aviation, 72 percent were air carrier, and the remaining 6 percent were military and freight.[20]

The runway system at Portland consists of three runways, including two principal runways that run parallel in an east-west direction. The two east-west runways are capable of handling the largest and heaviest aircraft in the fleet. Portland has a control tower and two runway ends equipped with an ILS.

Reliever Airports

There are three airports designated as relievers for Portland: Hillsboro, Troutdale, and Mulino. All of the existing reliever airports are owned and operated by the Port of Portland. Hillsboro is the most sophisticated airport in this group with one of two runways equipped with an ILS. It also has a control tower. Troutdale is the next most sophisticated airport. It has a single runway with a non-precision approach. A non precision is an electronic approach to guide aircraft to the runway that only has horizontal guidance. A precision approach, which is provided by an ILS, has both vertical and horizontal guidance. Troutdale also has a control tower. Mulino is a single runway airport without any electronic guidance or control tower. It is the least sophisticated of Portland's relievers and typical of an airport serving the smallest aircraft within the fleet. Additionally, the NPIAS includes a future airport, to be built north of the Washington State border, as a fourth reliever for Portland.

Other General Aviation Airports

There are six other airports within a 30 mile radius of Portland that have greater than 50 based aircraft and are open to the public. They include Clark County, Pearson AirPark, and Evergreen which are north of the Washington state line. Aurora State, Scappoose and Stark's

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[19]Port of Portland, Portland, Oregon, "Portland International Airport, Master Plan Update, Executive Summary, April 1993", p. 2.

[20]Terminal Area Forecasts: Fiscal Years 1993-2005, p. 10.

Twin Oaks are in Oregon and west of Portland. All of these airports have single paved runways (Evergreen has several turf runways). They only have visual approaches, because they have no electronic guidance equipment. Aurora State is owned and operated by Oregon State. Scappoose is owned by the Port of St. Helens. Pearson AirPark is owned and operated by the Port of Camas-Washougal, Washington. Scappoose, Pearson AirPark, and Aurora State have received federal funds for development from the general aviation funds. Evergreen, Stark's Twin Oaks, and Clark County are privately owned. They are not eligible for federal funds unless they are designated as reliever airports. Clark County and Evergreen have been studied as possible reliever airports, but the sites are not developable to federal standards. Therefore, they have not been given any further consideration.

Table 8: Summary of Facilities at Airports in the Portland Area

Airport	Publicly Owned	Level of Services Ranking	Full Strength Runway	ILS Equipped	Tower
Portland	X	1	X	X	X
Hillsboro	X	2	X	X	X
Troutdale	X	3	X	X	X
Pearson	X	4			
Mulino	X	5			
Aurora State	X	6			
Scappoose	X	7			
Evergreen		8			
Stark's Twin Oaks		9			

Table 9 shows the straight line distance in statute miles (SM) between the airports in the study and the center of Portland, and the straight line distance between Portland International Airport and the airports in the study. These distances were measured from the Seattle Sectional Chart.

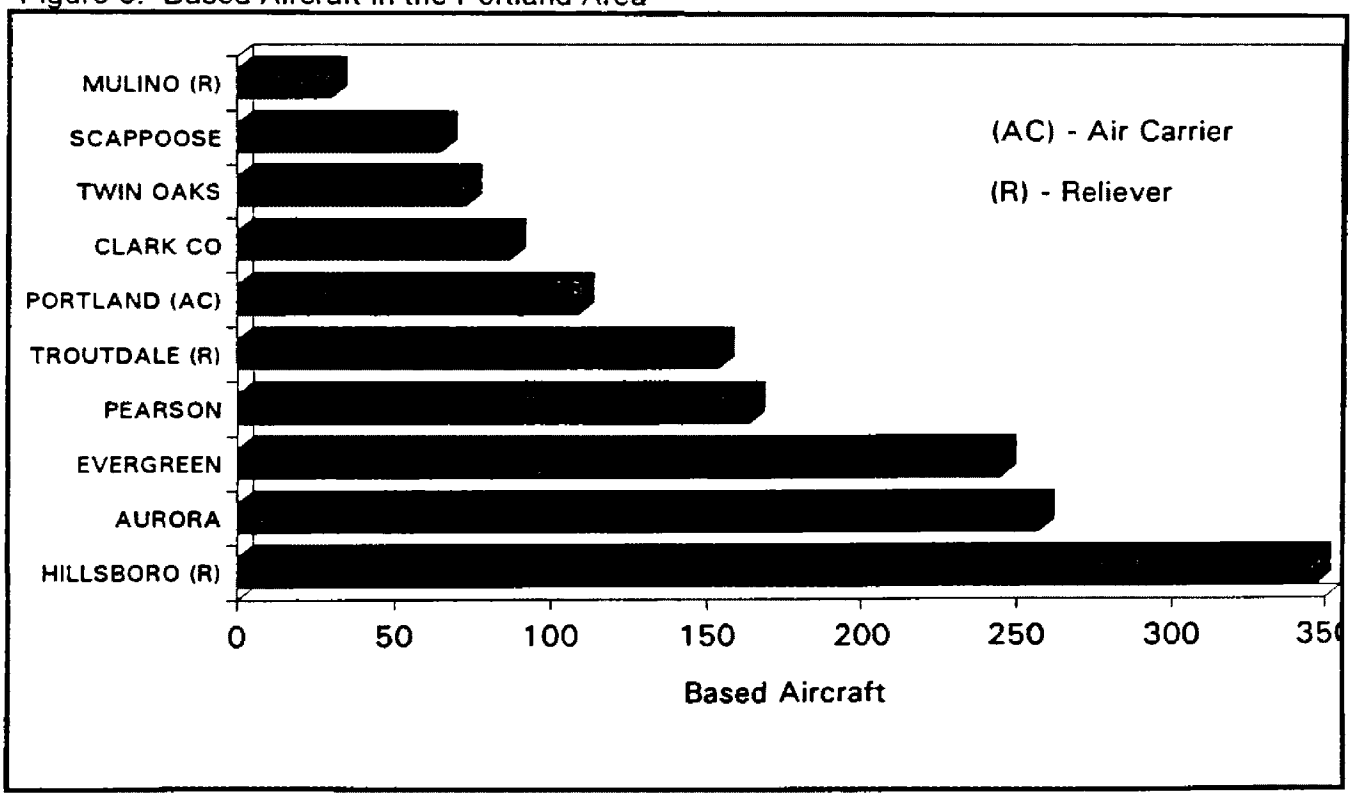
Table 9: Distances from Airports to Portland and to Portland International

Airport	Distance to city (SM)	Distance to PDX (SM)
Portland	5	0
Mulino	22	27
Aurora State	20	25
Scappoose	19	18
Stark's Twin Oaks	14	20
Troutdale	14	10
Hillsboro	12	16
Evergreen	10	4
Pearson	7	2

Based Aircraft

Figure 8 shows the number of based aircraft at each airport in the system.

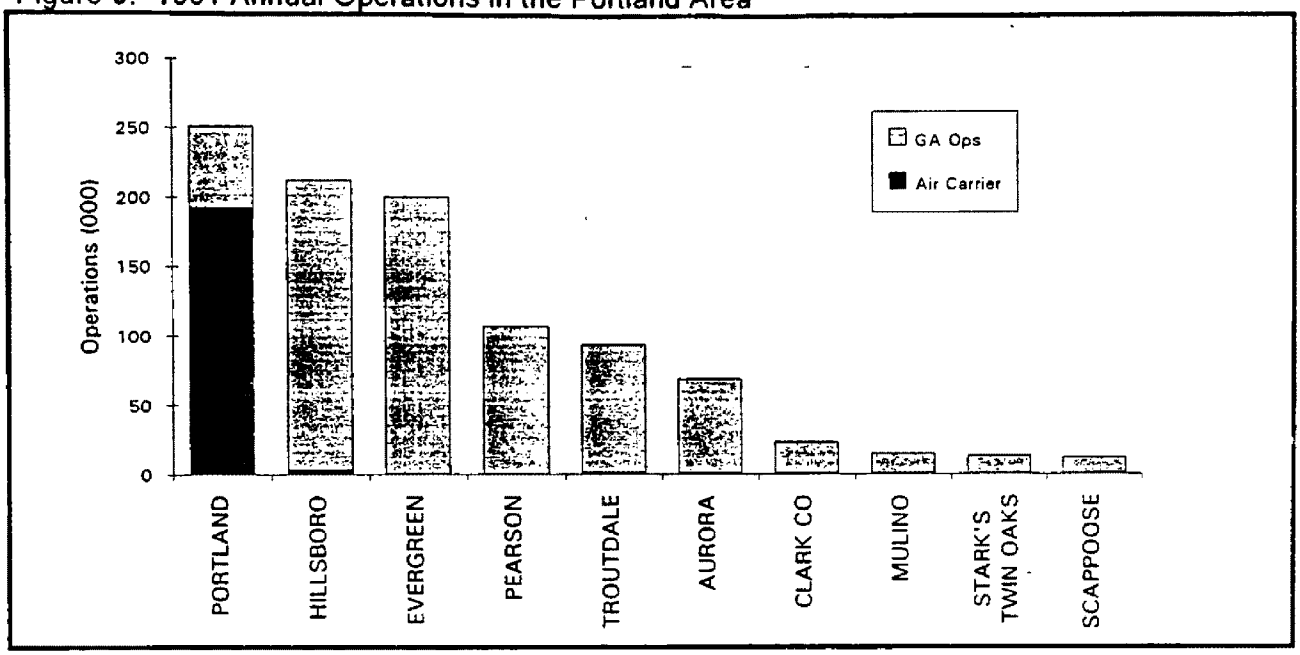
Figure 8: Based Aircraft in the Portland Area



Operational Data

Figure 9 shows the number of air carrier and general aviation operations at each airport in the study. In 1991, the total number of operations in the area was 992,000.

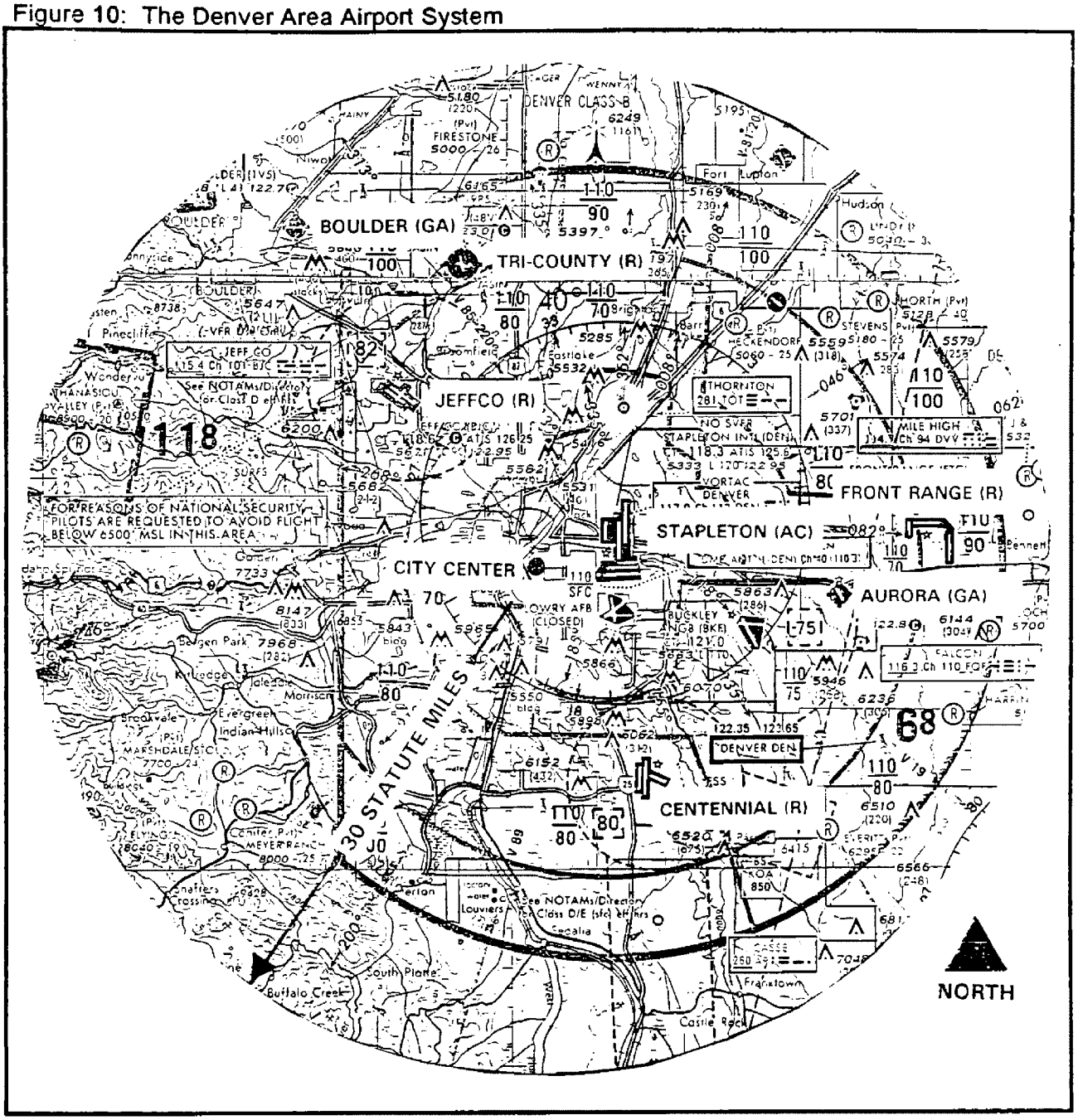
Figure 9: 1991 Annual Operations in the Portland Area



The Denver System

The Denver area airport system includes one air carrier airport, four relievers and two other general aviation airports. Figure 10 shows these airports and their relationship to Denver. In 1991, there were a total of 1,268,000 operations in the area. In 1991, there were 1,824 based aircraft in the area.

Figure 10: The Denver Area Airport System



Air Carrier Airport

Denver Stapleton International Airport (Stapleton) is the primary air carrier airport serving the Denver area. It is located approximately six miles from downtown Denver. The airport is equipped with six runways, three north-south and three east-west, the longest of which is 12,000 feet. It has 6 runway ends equipped with ILS and a control tower.

Due to its geographic location, Stapleton is a major transportation hub in the national air transportation system for flights connecting between the east and west coasts and other major metropolitan centers. In 1992, Stapleton was the fourth busiest airport in the country in the number of operations and enplaned passengers. Stapleton is scheduled to be replaced by the new Denver International Airport in the second half of 1994. The new Denver International Airport will be located approximately 18 miles northeast of the central business district. Stapleton will close and be converted to another land use.

Stapleton is predominately an air carrier airport, with 90 percent of the airport's activity in 1989 being performed by air carrier aircraft. The general aviation activity accounted for 8.3 percent of the airport's activity; the remainder of the activity is military and cargo haulers. The total number of operations in 1989 was 468,600.[21]

Reliever Airports

Four airports have been designated by the FAA as reliever airports for Stapleton: Centennial, Front Range, Jefferson County, and Tri-County. Centennial and Jefferson County are the two most sophisticated reliever airports in the Denver area. Centennial is owned and operated by the Arapahoe County Public Airport Authority. Jefferson County is owned and operated by the Jefferson County Airport Authority. Both airports are adequately sized to handle jets, have at least one runway equipped with an ILS, and have control towers.

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[21]U.S. Department of Transportation, FAA, Denver Hub/Other Colorado Airports, FAA Aviation Forecasts, FAA-APO-90-10, October 1990, p. 5.

The other two relievers are less sophisticated, but are still well equipped. Front Range is approximately 22 miles east of Denver and is owned by Adams County and is operated by Front Range Airport Authority. It is within three miles of the new Denver International Airport and has been seriously considered as the major cargo airport for the Denver area after Stapleton closes. At this time those plans have been set aside and a significant cargo facility has been built at the new Denver airport. The result of past plans has been the development of Front Range beyond what would have been expected; for example, it has two runway ends equipped with ILS. A control tower was planned for the facility, but for the time being those plans have been set aside also.

The fourth reliever airport, Tri-County Airpark, is 20 miles north of downtown Denver. It is privately owned. It is the least sophisticated reliever airport, sized for aircraft weighing 12,500 pounds or less. It has no electronic guidance or a control tower.

Other General Aviation Airports

The other two general aviation airports selected to be included in this study are Aurora Airport and Boulder Municipal. Aurora is open to the public, yet privately owned. Boulder Municipal is owned and operated by the City of Boulder. Both of these airports handle the smallest aircraft in the fleet. Neither airport has a control tower or any instrument runway ends.

Table 10: Summary of Facilities at Airports in the Denver Area

Airport	Publicly Owned	Level of Services Ranking	Full Strength Runway	ILS Equipped	Tower
Stapleton	X	1	X	X	X
Centennial	X	2	X	X	X
JeffCo	X	3	X	X	X
Front Range	X	4		X	
Tri-County	X	5			
Boulder	X	6			
Aurora		7			

Table 11 shows the straight line distance in statute miles between the airports in the study and center of Denver and the straight line distance between Stapleton International Airport and the airports in the study. These distances were measured from the Denver Sectional Chart.

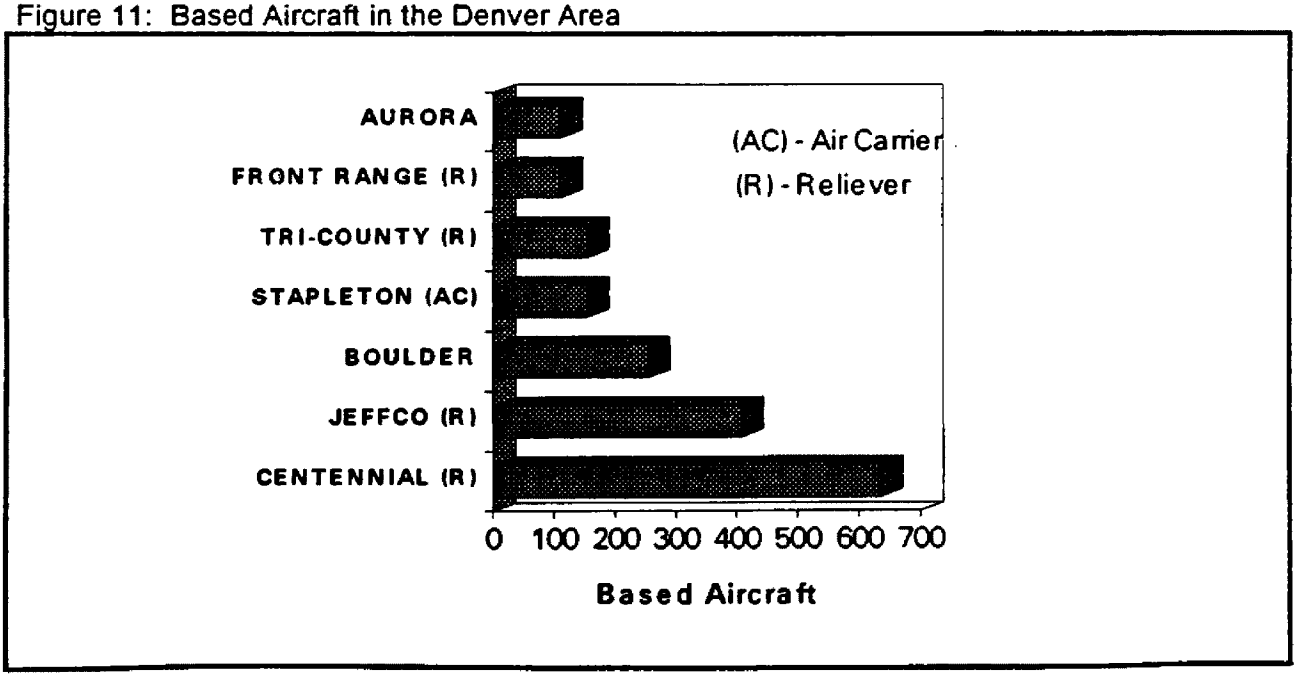
Table 11: Distances from Airports to Denver and to Stapleton

Airport	Distance to city (SM)	Distance to Stapleton (SM)
Stapleton	5	0
Front Range	24	19
Boulder	23	25
Aurora	18	14
Tri-County	18	14
Centennial	14	13
JeffCo	12	14

Based Aircraft

Figure 11 shows the number of based aircraft at each airport in the system.

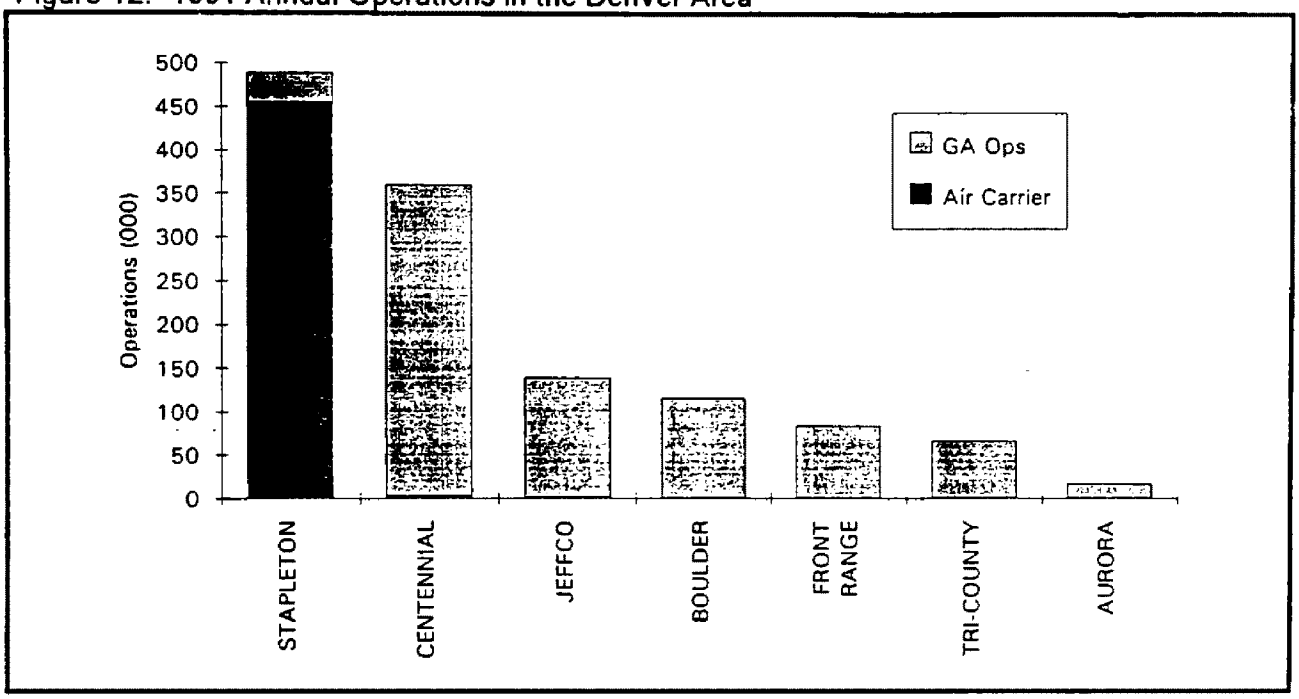
Figure 11: Based Aircraft in the Denver Area



Operational Data

Figure 12 shows the air carrier and general aviation operations at each of the airports in the Denver system. In 1991, there were 1,268,000 operations in the Denver area.

Figure 12: 1991 Annual Operations in the Denver Area



Having identified the relationship of the reliever airports and the other general aviation to the primary airport in each system, the next chapter assesses the effectiveness of reliever airports in reducing congestion.

CHAPTER 4

EFFECTIVENESS OF RELIEVER AIRPORTS

Reliever Airport Designation Guidance

The guidance provided in the NPIAS regarding the sophistication, location, and number of reliever airports for a metropolitan area is brief and imprecise. The NPIAS recommends at least one reliever airport be sited with respect to the city center served and developed such that it has "equivalent user conveniences" as the relieved airport. If additional reliever airports are needed, they may be less sophisticated and either be sited in relationship to the aircraft owners or be in an area suited for instrument training. No more precise guidance is given on the number of reliever airports needed, the location of the airports or the area that reliever airports should serve.

In addition to the guidance given above, the NPIAS identifies the two objectives which should be met by the reliever program: 1) the reliever program should provide additional general aviation access to the community and 2) relieve congestion at the commercial service airport . It is based on these vague guidelines and objectives that each FAA region designates reliever airports. There is no methodology in place to determine whether airports have been appropriately designated as relievers.

The lack of precise guidelines has left the FAA open to criticism. FAA is unable to defend itself because little research has been conducted on reliever airports. This chapter examines the effectiveness of reliever programs in the four major metropolitan areas of the Northwest Mountain region. The effectiveness of the reliever program is examined by looking at how well the two objectives of the program have been met.

Objective One: General Aviation Access

The simplest way to determine if the first objective has been met is to organize the general aviation activity in each metropolitan area by airport type. The objective is to provide general aviation access in a metropolitan area. Organizing the number of general aviation operations by airport type (commercial service, reliever and other general aviation) indicates where the activity is taking place. The other general aviation airports are the airports selected to be included in the study by the criteria provided in Chapter 3. Figure 13 shows the percentage of general aviation operations in 1991 that were conducted at the commercial service airport, the relievers, and the other general aviation airports in each metropolitan area. Percentages were used because they normalize the data and allow comparisons among metropolitan areas.

Figure 13: Percentage of 1991 GA Operations at Airport Types in Each Area

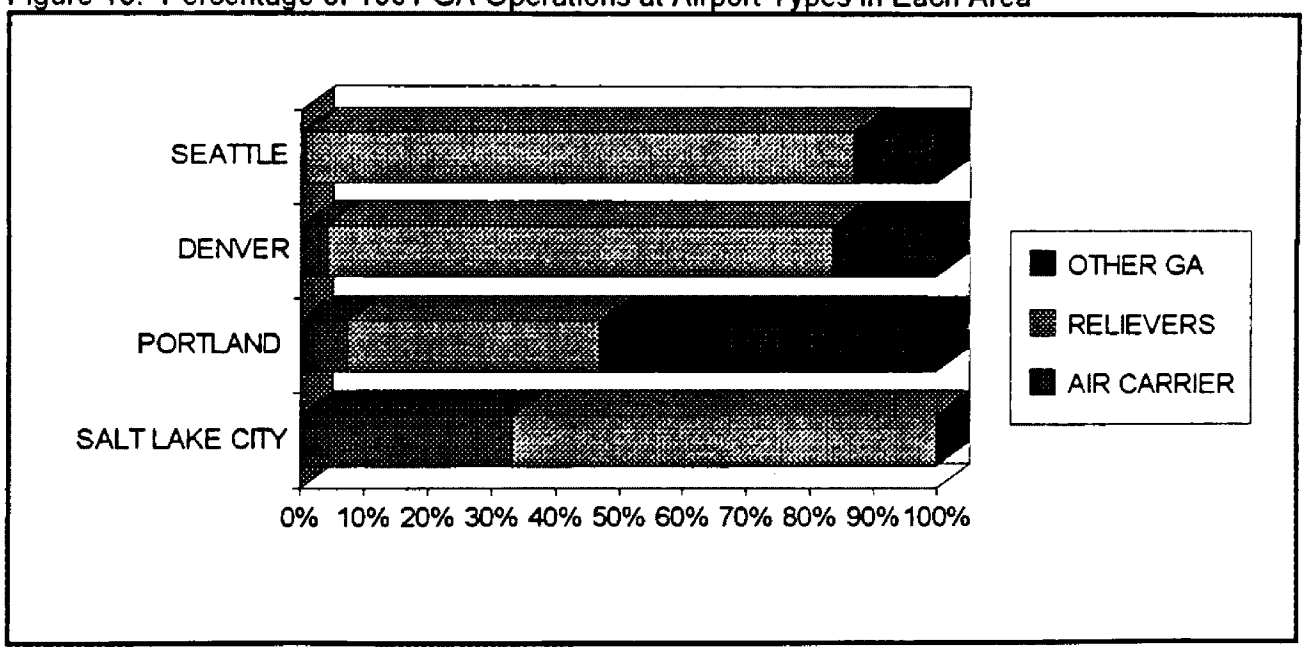


Figure 13 illustrates that the majority of the general aviation operations are at the reliever airports in each area except Portland. In the Portland area, two of the most utilized airports are Pearson and Evergreen. These are north of the Washington state line. Evergreen

is a privately owned airport that can not be developed to federal standards. The owners have stated that the airport will close in the near future. Pearson is publicly owned, yet it is scheduled to close in 2020 because it is an historical site. Knowing that these two airports are scheduled to close, a "new" reliever airport has been designated in the NPIAS for southern Washington, but it has not been built. This airport is expected to take the Pearson and Evergreen traffic. If this airport is developed, the majority of Portland area operations would be at reliever airports.

The contribution of the reliever airports to each system is demonstrated by Figure 13. They are clearly providing general aviation access. For example, there were more than 1 million general aviation operations in the Seattle area in 1991 (See Table 2). Eighty-five percent of these operations were conducted at reliever airports. This is a significant number of operations and these airports are making an important contribution to the system.

Objective Two: Reliever Congestion at the Commercial Service Airport

If the reliever program has been effective in providing an attractive general aviation alternative to the commercial service airport, then some of the general aviation activity should have moved from the commercial service airport to the reliever airports since the reliever airport program was initiated. This section examines the change in operations from 1975 to 1990.

The measure of general aviation activity used in this chapter is number of annual operations. The two possible measurements of activity is number of operations or number of based aircraft. The number of based aircraft is probably a more accurate number than the number of operations at non-towered locations because it can be counted through the number of leased tiedowns spots and hangars. Number of operations, on the other hand, is an estimate. At the towered airports, by contrast, operational counts are more accurate because

they are actual counts, whereas the number of based aircraft can vary greatly through out the year.

Another reason for using the number of operations is that the number of operations per based aircraft could have changed from 1975 to 1990. For example, it is possible that the number of operations per based aircraft went down in the early 1980's due to the rising cost of fuel. Given that there are problems with the use of both indicators, it was decided that since operations are central to the issue of congestion, number of operations would be used in this study.

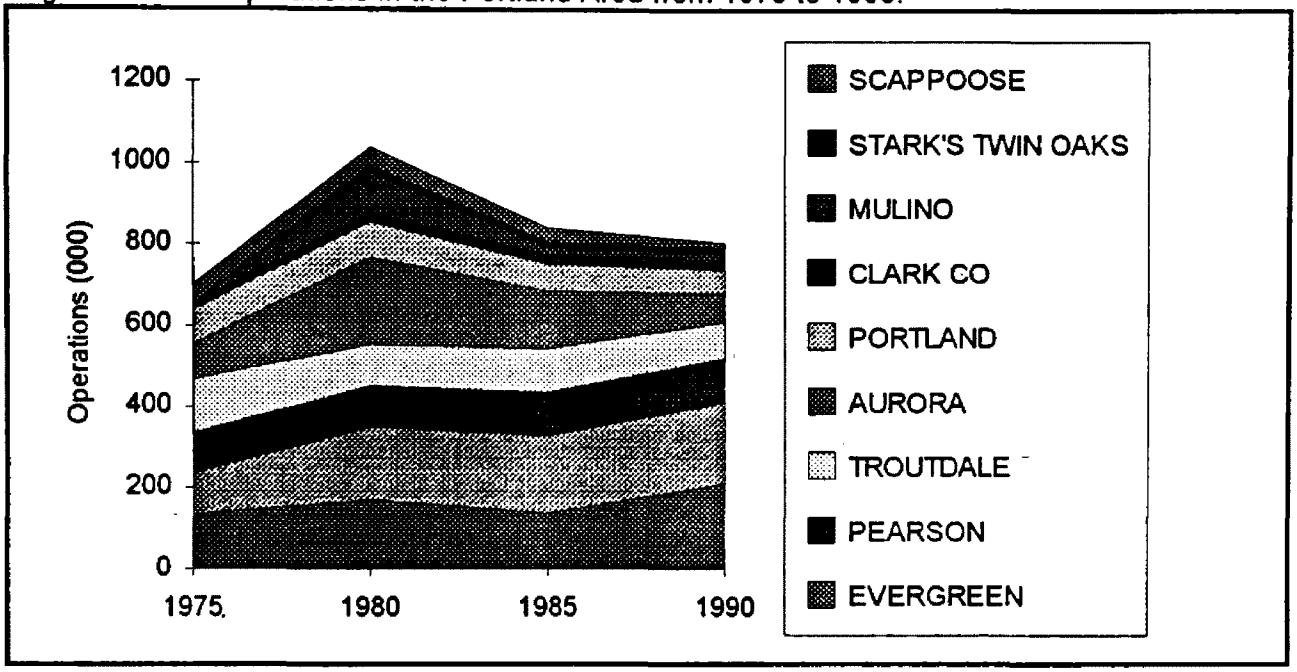
The years from 1975 to 1990 are used because the data is the most consistent for these years. Data for years prior to 1975 is difficult to obtain. No 1975 data was available at five locations: Tri-County and Front Range in the Denver Area; Stark's Twin Oaks and Mulino in the Portland Area; and Tooele in the Salt Lake City Area. (Data source details are provided in the Appendices.) In the operation profiles presented in Figures 14 and 15, the number of operations at these locations was assumed to be zero in 1975. Since they are the lower activity airports in each system, the lack of data for that year does not impact the profile significantly. None of the data from those sites were used in Table 12, nor in the analysis presented below. 1990 was selected because there are data available for all the airports in that year.

Operational Changes in Each System

General aviation operations have changed between 1975 and 1990. Figure 14 shows a profile of general aviation operations in Portland. This profile is typical of Denver and Salt Lake City in that there is a marked increase in operations between 1975 and 1980, a marked decline between 1980 and 1985, and a nominal increase or no growth between 1985 and 1990. The profiles for Salt Lake City and Denver are provided Appendices B and C, respectively.

These profiles trace the trend of general aviation operations nationally; they rose rapidly before 1980, declined, and now are increasing slightly.

Figure 14: GA Operations in the Portland Area from 1975 to 1990.



Given this trend, the interest in reducing spending on reliever airports is understandable. The rapid growth of operations in the early 1970's that stimulated the need for the reliever program is no longer occurring. However, the decline in the 1980's is also no longer occurring. Commercial operations in each of these metropolitan areas is increasing, and each system is experiencing growth in total operations. It is still important to continue to increase the total airport capacity in each metropolitan area to accommodate future growth.

The Portland operation profile is typical of the national trend described in the GAO report. The Seattle profile, Figure 15, shows a different history than the other three. This profile is important because it shows that generalizations do not apply to all locations. Seattle's profile shows a marked increase in operations between 1985 and 1990. Elimination or reduction of the reliever program may have a stronger negative impact on Seattle than the other three metropolitan areas because it is experiencing growth.

Figure 15: GA Operations in the Seattle Area from 1975 to 1990.

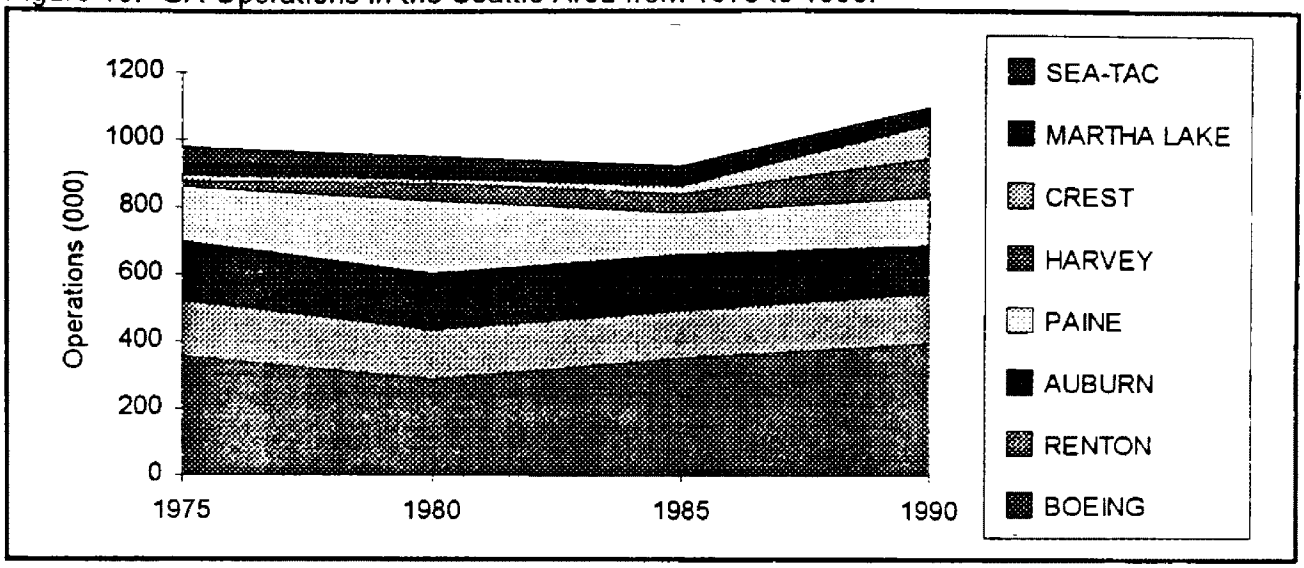


Table 12 presents the percent change in operations from 1975 to 1990 in each metropolitan area. The change in operations in each system was calculated by using data for each location in the study in which data was available for 1975 and 1990. To calculate the change in each system, the total operations for 1975 and 1990 were summed based on data available for each area. The total 1975 operations were subtracted from the 1990 operations. This is the change in the system. The percentage change in the system found on Table 12 was calculated by dividing the change in the system by the total number of 1975 operations.

Table 12: Percent Change in GA Operations from 1975 to 1990

Metropolitan Area	Percent Change
Seattle	**+12**
Portland	**+10**
Salt Lake City	**-3**
Denver	**-9**

Individual Airport Changes

The change in the number of operations at each airport is shown in Figures 16, 17, 18, and 19. The figures simply show the number of annual GA operations at each airport in the system in 1975 and 1990.

Figure 16: 1975 and 1990 GA Operations for Denver Area Airports

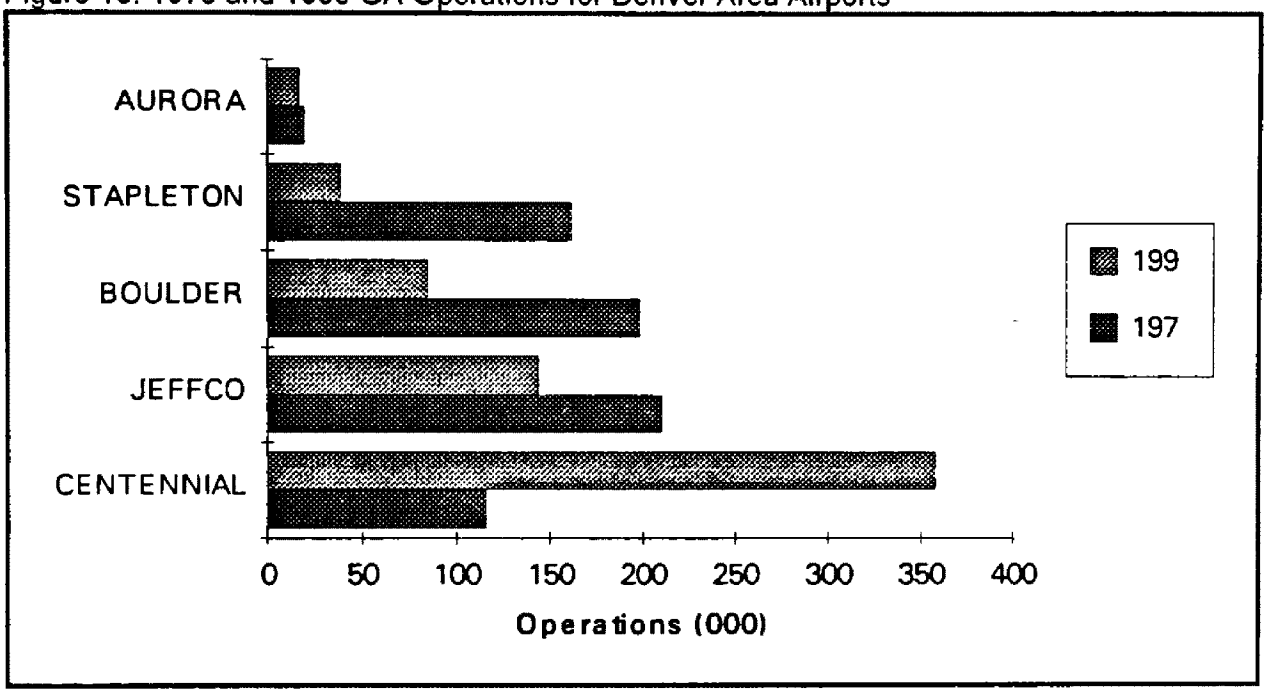


Figure 17: 1975 and 1990 GA Operations for Portland Area Airports

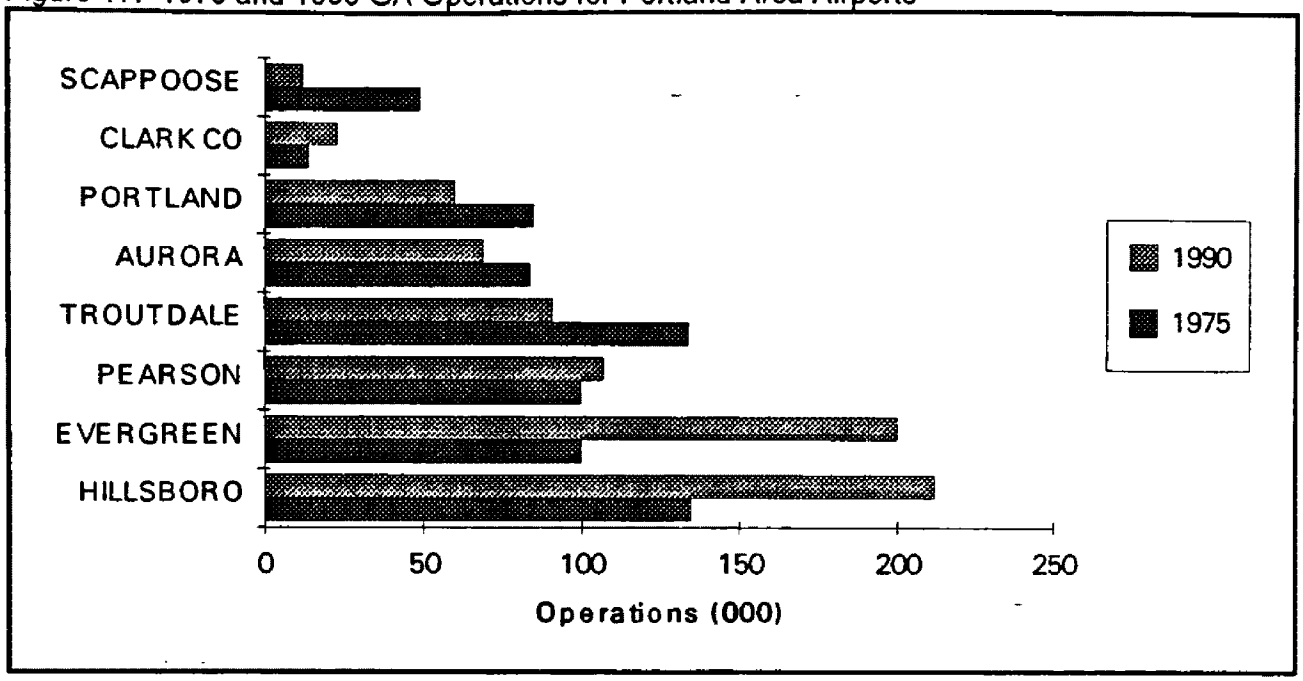


Figure 18: 1975 and 1990 GA Operations for Seattle Area Airports

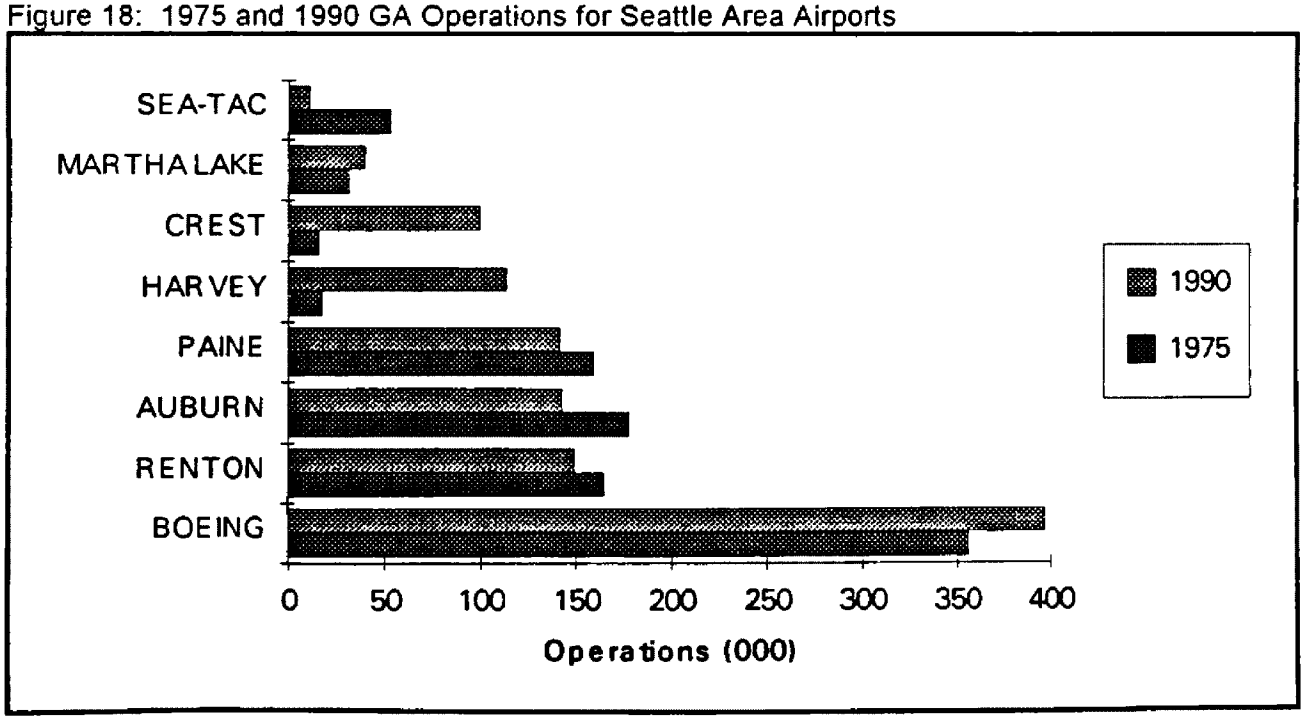
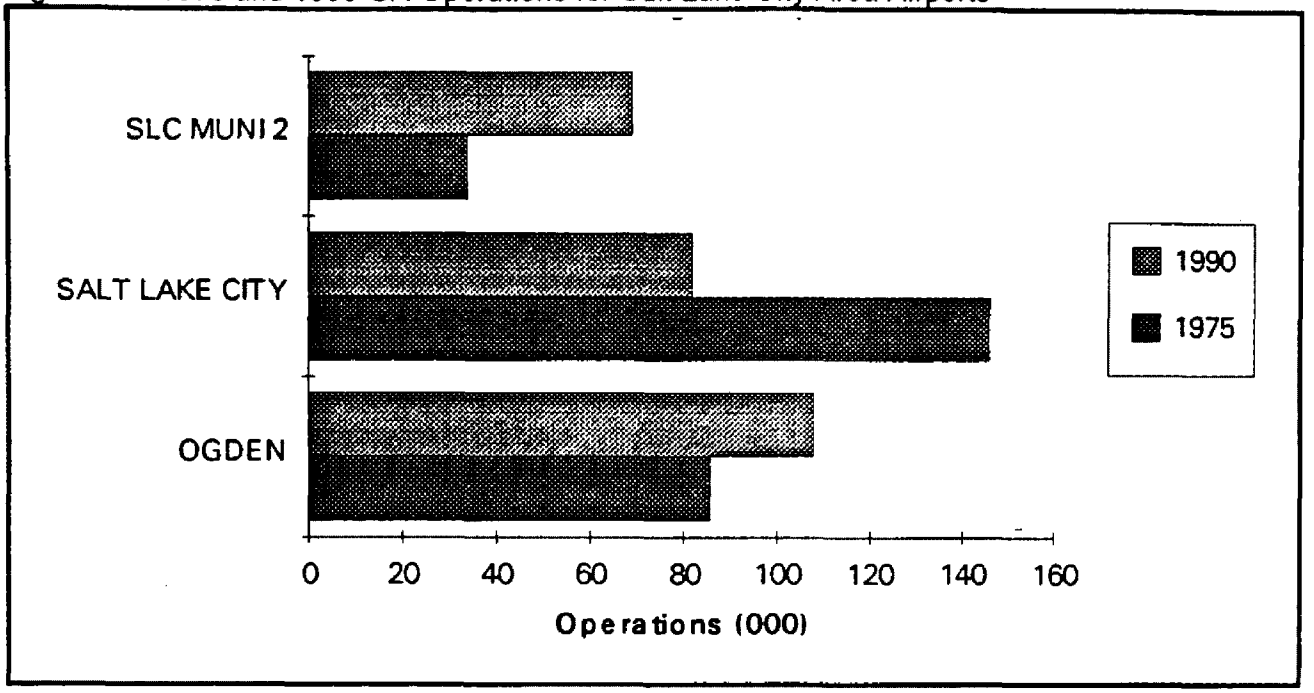


Figure 19: 1975 and 1990 GA Operations for Salt Lake City Area Airports



Relationship Between System Change and Airport Change

Figures 16, 17, 18 and 19 show the change in number of operations at each airport. However, these figures do not show the relationship between the change at each airport and the system change. This is an important relationship in determining if relievers have been effective. It is important to know how the change in operations at each reliever airport varies from the change in the system. If the reliever airports have been effective, we would expect general aviation operations to have shifted from the commercial service airport to the reliever airports between 1975 and 1990. This means that decreases in the general aviation operations at the commercial service airports should be greater than decreases in system operations as a whole, or that increases should be less than increases for the system as a whole. Conversely, decreases in operations at the reliever airports should be less than decreases in the system as a whole, or increases should be greater than increases in the system as a whole. Figures 20, 21, 22, and 23 compare the system change to the change in

general operations at each airport within each system. Note that the operations in Figures 20, 21,22, and 23 are general aviation operations only. The total of operations at each of the commercial service airports has increased from 1975 to 1990.

Figure 20: Change in GA Operations at Denver Airports from 1975 to 1990.

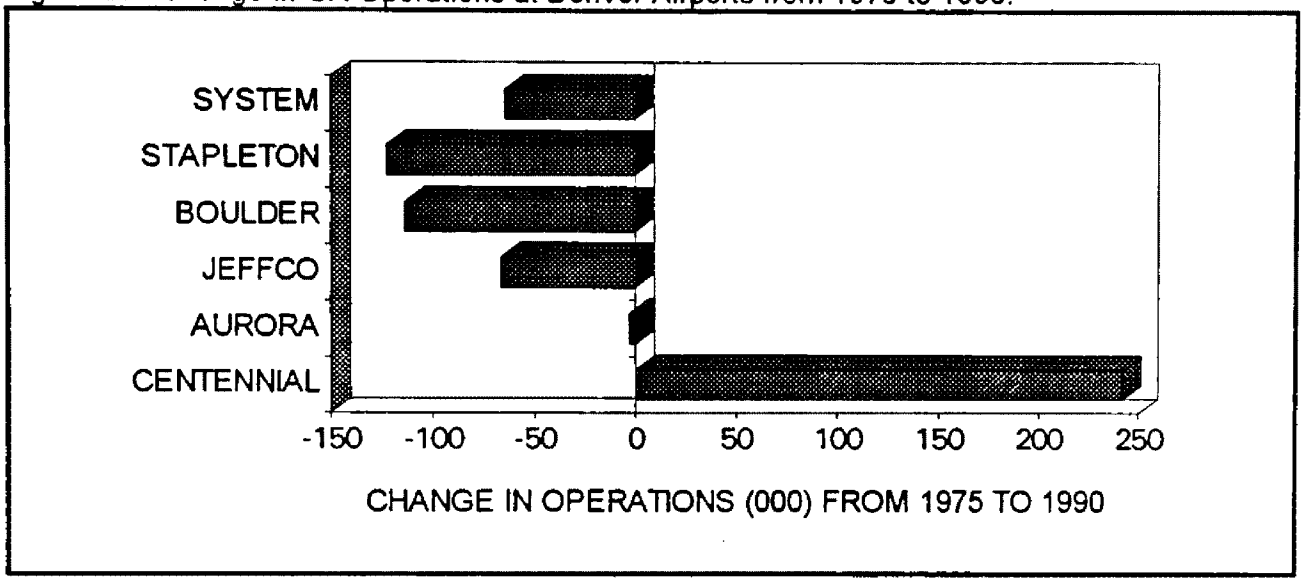


Figure 21: Change in GA Operations at Portland Airports from 1975 to 1990.

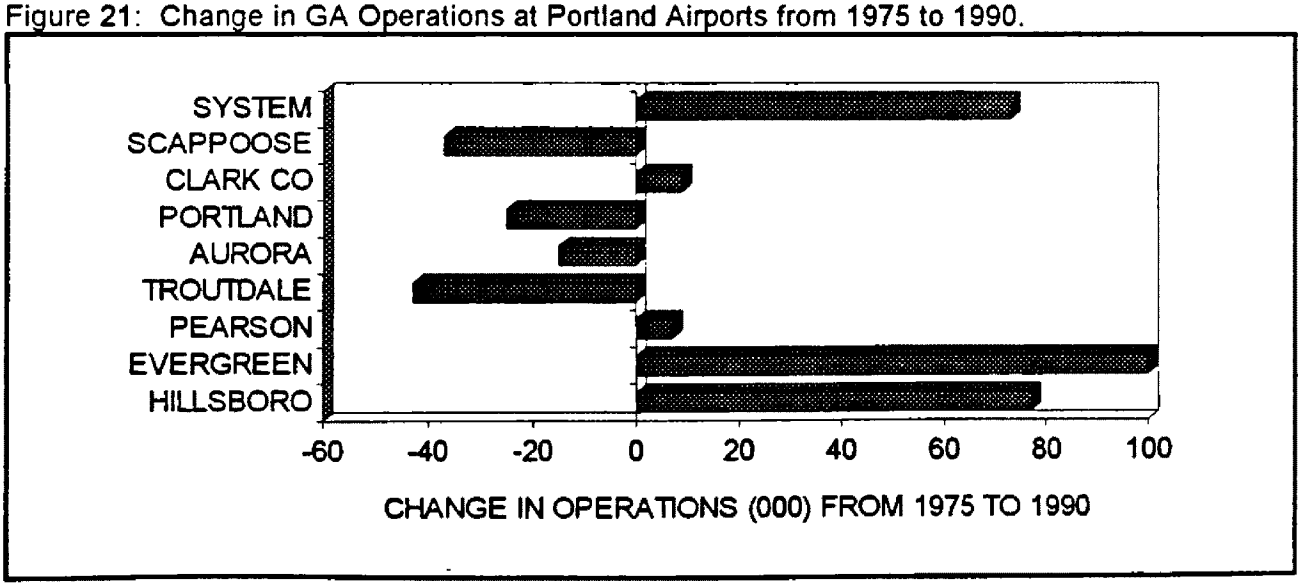


Figure 22: Change in Operations at Seattle Airports from 1975 to 1990.

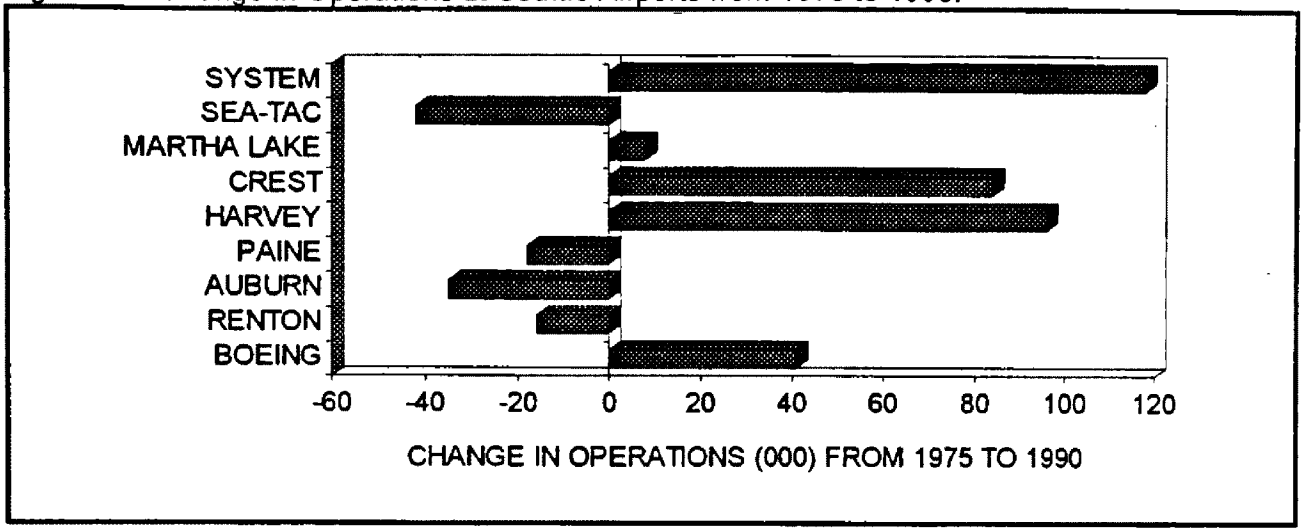
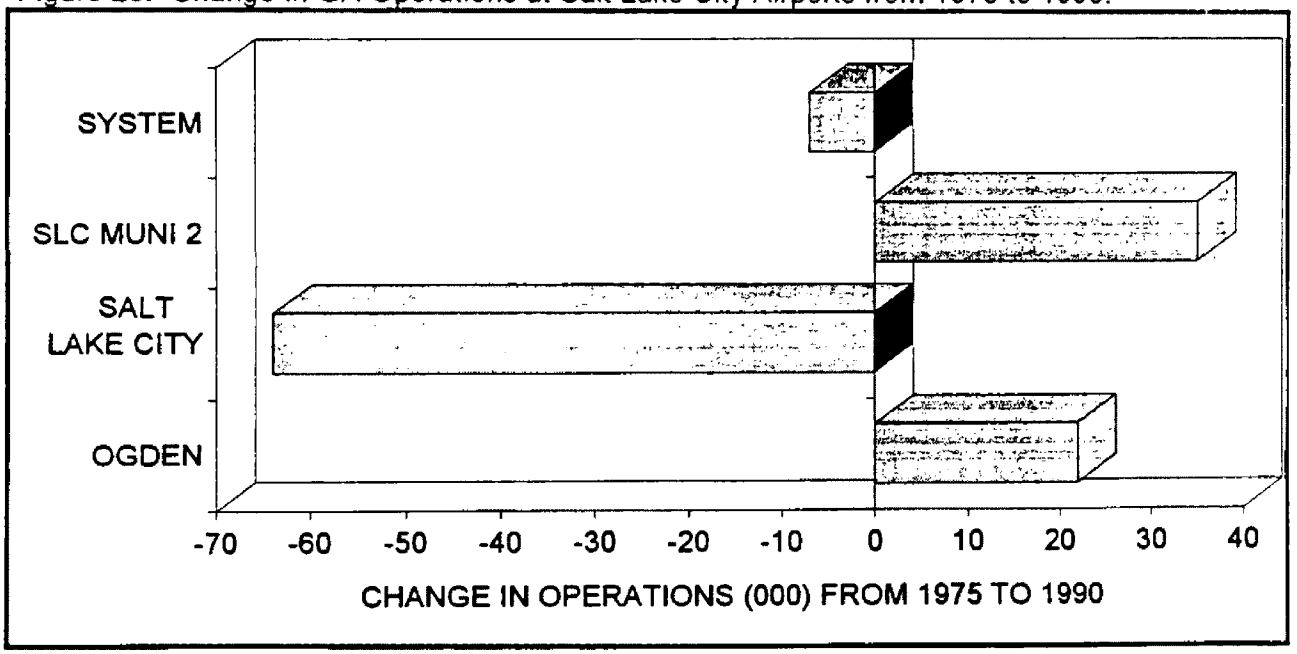


Figure 23: Change in GA Operations at Salt Lake City Airports from 1975 to 1990.



Findings

1. At all commercial service airports, general aviation operations shifted to other airports within each system. In the two systems in which the number of operations increased, the number of general aviation operations at the commercial service airports decreased. Since

the change at the commercial service airport is opposite from the change in the system as a whole, it is obvious that operations have moved away from the commercial service airport. In the two systems in which the number of operations decreased, the number of operations at the commercial service airport decreased at a rate higher than for the system as a whole. This, too, demonstrates a shift in operations since operations to other airports.

2. General aviation operations increased at one reliever within each system. The reliever airport in each system that experienced an increase in operations is the one closest to the city center and the most sophisticated, except for Salt Lake City. In Salt Lake City, the closest reliever airport to the city center and the most sophisticated reliever airport are two different airports. Salt Lake Muni 2 experienced greater growth than Ogden. Ogden is the more sophisticated airport, but is 28 miles from Salt Lake City.

3. Only one reliever airport in each system experienced growth, except for Salt Lake City, in which two reliever airports experienced growth. Both Ogden and Salt Lake Muni 2 have experienced increases in the number of operations. Harvey Field in the Seattle area is designated as a reliever airport and shows a significant increase in operations from 1975 to 1990. However, this airport has never received federal funds for development, so the designation is meaningless at this point. That is why it is not counted as a reliever that has experienced growth.

4. Only one of the other airports that increased in operations has received federal funds. Pearson AirPark in the Portland area is the only airport, other than the relievers discussed above, that had more operations in 1990 than 1975 and received federal funds.

5. Except for the reliever airports and Pearson Airport, all of the airports that experienced growth are privately owned.

In short, the data clearly indicate that a least one reliever airport in each system has reduced congestion at the central commercial airport.

Chapter 5

PRIORITY SYSTEM

As noted in earlier chapters, the Office of the Inspector General (OIG) has expressed concerns regarding the FAA's management of the reliever program. The criticisms centered around FAA not having quantitative measures of the benefits derived from the federal dollars spent. OIG recommended tighter controls and more objective methods to determine which projects to fund. This chapter establishes a priority system to rank the reliever airports in the four major metropolitan areas in the Northwest Mountain Region of the FAA. The purpose of the priority system is to help FAA officials more objectively select reliever airports to receive federal funds.

Currently, the FAA has a priority system which establishes the relative importance of airport development projects as long as the projects and the airports differ significantly. Projects which are safety related receive the highest priority, followed by projects to preserve the system, then projects to bring a facility up to federal standards, and lastly, projects to expand airports. Projects are also prioritized based on the activity level at the airport; the more active airports are given a higher priority. Based on these parameters, a number is calculated that represents the priority of the project.

Projects are then organized by category of funding source, such as commercial service, reliever, or other general aviation. Projects within each category are ordered by priority. Projects are funded down the list until the money within that category is spent.

There is little room for discretionary judgment in this process unless two projects have the same priority and there is only enough money to fund one of the projects and not the other. None the less, there are several projects each year with the same priority because the priority system is not sensitive enough to distinguish between similar projects and airports. To address

this problem, this chapter develops a priority system to rank the reliever airports within the Northwest Mountain region. Although it does not respond completely to the criticisms of the OIG, implementation of this priority system would eliminate one subjective judgment in the funding process.

The priority system is based on two levels of importance: the importance of the airport within its system and the system's importance within the region. Each reliever airport is ranked within its system based on its general aviation activity level, overall activity level, and the number of annual instrument operations. Then each system is ranked based on the congestion of the commercial airport, the number of enplaned passengers, and the total number of operations within the system. Finally, the rankings within each system, and the system itself, are combined to give each reliever a ranking within the region.

Rank of Each Airport Within Its System

Three criteria are used to rank each reliever airport within its system: general aviation activity, overall activity, and the number of annual instrument operations. All of the operational data used in this chapter are from the Terminal Area Forecasts, FY 1993-2005.[22] Operational data 1991 are used. All of the raw data are normalized by dividing each airport's value for a particular criterion by the highest value for that criterion within the system. The normalized data are totaled giving each criterion an equal rating. The totaled values are normalized by dividing the highest total into each airports' total. The result is that the highest priority airport within the system is ranked "1" and each of the other airports is a fraction depending on its activity level. The following sections provide detailed descriptions of each criterion.

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[22] U.S. Department of Transportation, Federal Aviation Administration, Terminal Area Forecasts, FY 1993 -2005, FAA-APO-93-9, July 1993.

General Aviation Activity

The level of general aviation activity at a reliever airport is a measure of its attractiveness to general aviation users and its importance to the aviation system. The higher the number of general aviation operations, the higher the rating. The highest number of annual general aviation operations at a reliever airport within each system is divided into the number of annual operations at the others to determine the ranking. The airport with the highest number of general aviation operations receives a "1" rating and all the other airports within the system receive a fraction of one, depending are their activity level.

Overall Operational Activity

The level of overall activity is a measure of the airport's importance to the system. The overall activity is the total number of operations in 1991, including any military and commercial flights. Each airport's ranking is calculated the same way as the general aviation activity ranking is calculated, except that the total number of operations is used rather than the number of general aviation operations.

Instrument Operations

One important feature of a reliever airport is its ability to accommodate instrument operations. This is likely to be an important criterion for an aircraft operator in deciding to use the reliever airport over the commercial airport. An aircraft operator with an instrument flight rating and an adequately equipped aircraft can fly in weather conditions that are beyond the capability of the average general aviation pilot. However, the general aviation aircraft is likely to be slower than the commercial aircraft so it is desirable to have the general aviation operator use a reliever airport. This is more important in poor weather conditions because aircraft must be spaced further apart and require more direction from air traffic control. This increased spacing and control means that fewer aircraft can use a runway in poor weather than in good weather, thus if more general aviation aircraft use a reliever airport, the more room is available for

commercial aircraft at the commercial airport. The more instrument operations conducted at a reliever airport, the more important the reliever airport is to the system. To rank the airports, the highest number of instrument operations conducted at one reliever airport within the system is divided into the number of instrument operations at all the other reliever airports. The airport with the highest number of instrument operations has a rating of "1"; all of the other airports are a fraction of the highest, indicating its importance.

Table 13: Ranking of Denver's Reliever Airports

Airport	GA Ops Ranking	Ops Ranking	Instrument Ops Ranking	Total	Final Ranking
CENTENNIAL	1.00	1.00	1.00	3.00	1.00
JEFFCO	0.39	0.38	0.22	0.99	0.33
FRONT RANGE	0.24	0.23	0.00	0.47	0.16
TRI-COUNTY	0.19	0.18	0.00	0.37	0.12

Table 14: Ranking of Seattle's Reliever Airports

Airport	GA Ops Ranking	Ops Ranking	Instrument Ops Ranking	Total	Final Ranking
BOEING	1.00	1.00	1.00	3.00	1.00
PAINE	0.43	0.43	0.41	1.24	0.41
RENTON	0.41	0.38	0.09	0.88	0.29
AUBURN	0.45	0.43	0.00	0.87	0.29
HARVEY	0.34	0.31	0.00	0.65	0.14

Table 15: Ranking of Portland's Reliever Airports

Airport	GA Ops Ranking	Ops Ranking	Instrument Ops Ranking	Total	Final Ranking
HILLSBORO	1.00	1.00	1.00	3.00	1.00
TROUTDALE	0.44	0.45	0.07	0.96	0.32
MULINO	0.07	0.07	0.00	0.14	0.05

Table 16: Ranking of Salt Lake City's Reliever Airports

Airport	GA Ops Ranking	Ops Ranking	Instrument Ops Ranking	Total	Final Ranking
OGDEN	0.98	1	1	2.98	1.00
SLC MUNI 2	1.00	0.98	0	1.98	0.66
TOOELE	0.24	0.24	0	0.48	0.16

Rank of Systems

The system importance is relevant in determining the overall importance of each reliever, because the reliever's importance is dependent on the system's impact on the national system. Each system is ranked on three criteria to determine its importance: congestion, number of enplaned passengers, and total number of operations within the system. The criteria for determining the system importance are related to the system's impact on the national aviation system.

Congestion

The measure of congestion in this study is a percentage of the annual service volume. The annual service volume as defined in FAA Advisory Circular 150/5060-5, Airport Capacity and Delay, is "a reasonable estimate of the airport's annual capacity" in terms of operations.[23] The annual service volume accounts for differences in runway use, aircraft mix, weather conditions, etc., that would be encountered over a year's time. The congestion value used in this study is the current number of annual operations at the commercial service airport divided by its annual service volume. This value is the amount of annual airport capacity currently being used.

The annual service volume for each airport is in the NPIAS. The 1991 total annual operations from the 1993 Terminal Area Forecasts are used. The highest percentage of annual service volume being used for all the systems is divided into the other system's congestion measure to establish each system's congestion ranking. It is possible for the annual operations at an airport to exceed the annual service volume, because the annual service volume is only an estimate.

Enplaned Passengers

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[23] U.S. Department of Transportation, Federal Aviation Administration, FAA Advisory Circular 150/5060-3, Airport Capacity and Delay, September 23, 1983.

A commercial service airport's level of activity, in terms of annual passenger enplanements, is a measure of the airport's impact on the national system. The more enplaned passengers, the more impact the airport has on the system. The total 1991 enplaned passengers for each air carrier airport was taken from the 1993 Terminal Area Forecasts. These data are normalized and ranked by dividing each air carrier airport's enplaned passengers by the highest number of enplaned passengers.

System Operations

The total number of system operations is an indication of the importance of the system. The higher the number of operations, the more important the system. The total number of operations for each system is the number of operations reported in Chapter 2, which includes the air carrier operations and the general aviation operations at all of the airports within each system included in this study. This number was normalized and ranked by dividing the highest number of operations into each system's operations.

Final System Ranking

A value for each of these criteria is calculated for each system. That value is normalized by dividing the highest value of all the systems into the values of the other systems. The three normalized values are totaled and again normalized to determine the ranking of each system. The system rankings are presented in Table 17.

Table 17: Ranking of Each System

Area	ASV Rank	Enp Rank	GA Rank	Total	Ranking
Denver	1.00	1.00	0.93	2.93	1.00
Seattle	0.65	0.63	1.00	2.27	0.78
Portland	0.58	0.26	0.73	1.57	0.54
Salt Lake	0.67	0.44	0.34	1.45	0.49

Reliever Airport Priority

The final system ranking is added to each reliever airport's final ranking to determine each reliever airport's overall ranking among the four metropolitan areas. Table 18 shows the final ranking of the reliever airports within the Northwest Mountain Region of the FAA. The highest priority airport is at the top of the table and the lowest priority airport is at the bottom of the table. The resultant order of the airports is consistent with what one would intuitively expect. The top four airports are the most sophisticated and highest activity reliever airports in each system. The two airports at the bottom of the list are the two least active and sophisticated relievers airports in the region. The order of the remaining airports appears to be reasonable, although it is surprising that Troutdale in the Portland area falls so low in the list. This is primarily due to the low number of operations that occur there. Since the order at the top and bottom appears to be reasonable, the criteria selected and the methodology used to determine the priority is assumed to be acceptable.

Table 18: Final Ranking of Each Reliever Airport

Airport	Within System Rank	System Rank	Final Rank
CENTENNIAL	1.00	1	2.00
BOEING	1.00	0.78	1.78
HILLSBORO	1.00	0.54	1.54
OGDEN	1.00	0.49	1.50
JEFFCO	0.33	1	1.33
PAINE	0.42	0.78	1.20
SLC MUNI 2	0.67	0.49	1.16
FRONT RANGE	0.15	1	1.15
TRI-COUNTY	0.12	1	1.12
RENTON	0.30	0.78	1.08
AUBURN	0.29	0.78	1.07
HARVEY	0.22	0.78	1.00
TROUTDALE	0.32	0.54	0.86
TOOELE	0.16	0.49	0.65
MULINO	0.05	0.54	0.59

Impact of Major System Changes

There are two major changes at the commercial service airports in Denver and Salt Lake City that may have an impact on the order of the reliever airports. The changes are the new Denver airport scheduled to open sometime in 1995 and an additional runway at Salt Lake City International Airport scheduled to be completed in 1996. Both of these projects will increase the annual service volume or capacity of these airports, therefore decreasing their "ASV" ranking and their resultant system ranking. Since the congestion at these airports will go down, the importance of the reliever airports will also go down.

Table 19 shows each system's rank with the new "ASV" ranking. The ASV used were for the New Denver Airport and with the new runway at Salt Lake City. The number are estimates. Table 20 shows the final reliever airport rankings.

Table 19: Ranking of Each System with New Denver Airport and expanded Salt Lake City

Area	ASV Rank	Enp Rank	GA Rank	Total	Ranking
Denver	1.00	1.00	0.93	2.93	1.00
Seattle	0.96	0.63	1.00	2.59	0.88
Salt Lake	0.71	0.44	0.34	1.49	0.51
Portland	0.86	0.26	0.73	1.85	0.63

Table 20: Final Ranking of Each Reliever Airport

Airport	Within System Rank	System Rank	Final Rank
CENTENNIAL	1.00	1	2.00
BOEING	1.00	0.88	1.88
HILLSBORO	1.00	0.63	1.63
OGDEN	1.01	0.51	1.52
JEFFCO	0.33	1	1.33
PAINE	0.42	0.88	1.30
SLC MUNI 2	0.67	0.51	1.18
AUBURN	0.29	0.88	1.17
RENTON	0.29	0.88	1.17
FRONT RANGE	0.15	1	1.15
TRI-COUNTY	0.12	1	1.12
HARVEY	0.22	0.88	1.10
TROUTDALE	0.32	0.63	0.95
MULINO	0.05	0.63	0.68
TOOELE	0.16	0.51	0.67

The capacity increase at Denver and Salt Lake City does not the chance the order of the airports very much. The top seven remain in the same order. In the middle of the table, the Seattle airports gain a little in the ranking and the Denver airports drop a little. Since the "ASV" ranking is one factor out of six being rated, changes in this factor should not alter the priority list dramatically. The changes that do occur are consistent with what one would expect.

Chapter 6

RECOMMENDATIONS

The recommendations offered below are based upon the information presented in the first five chapters. The first five are general recommendations that apply to the reliever airport program as a whole. These recommendations are followed by recommendations that apply uniquely to the Seattle, Portland and Salt Lake City area systems.

System Recommendations

1. A reliever program or a similar program must remain in place so that more than one airport within each metropolitan area can be federally funded. If the reliever program is eliminated without a replacement, the current reliever airports would no longer be eligible for funding. These airports are providing the majority of general aviation access to the metropolitan areas. They must be supported if they are to continue to contribute to the national airport system as they do today.

2. The number of reliever airports should be based on the number of existing and forecasted general aviation operations in a metropolitan area. The definition of metropolitan area must be determined. The thirty statute mile radius circle is probably satisfactory for most areas. The number of general aviation operations within that area should be counted. The total number of annual general aviation operations should be divided by 150 and 200 thousand to determine a high and low cut-off for determining the number of reliever airports needed. 150 and 200 thousand operations is an estimate of a visual single-runway airport capacity serving a mix of aircraft that typically use a reliever airport. Table 21 presents the recommended number of reliever airports for each metropolitan area in this study. The number of general aviation operations is used to develop Table 21 are presented in on Table 3.

Table 21: Recommended Number of Relievers for Each System.

Area	Low Number of Reliever Airports	High Number of Reliever Airports	Actual Number of Reliever Airports
Seattle	5	7	5
Denver	4	5	4
Portland	4	5	3
Salt Lake City	1	2	3

This number of reliever airports assumes that it is desirable for all general aviation aircraft to use federally funded airports. It is assumed that it is better to have more smaller airports strategically located around the metropolitan area than larger airports. It also is assumed that the relievers can be located so that they attract an equal share of the market. In some locations, such as Seattle which is a long thin north-south corridor, it may not be possible to locate five airports to equally serve the area. It may be better to have larger capacity airports, e.g. airports with more runways, than to have more smaller airports. That decision can be made after studying an area in detail. Initially, Table 21 can be used as guide.

3. *One reliever airport, the one closest to the city center, should have facilities* comparable to the commercial service airport. Due to the demands on this airport, its capacity should be maximized to assure that it is an "attractive alternative" to the commercial service airport. The analysis in Chapter 4 indicated that this type of reliever airport experienced growth in general aviation operations even in areas where the number of general aviation operations decreased between 1975 and 1990. It is assumed that the demand for this type of airport close to the city center will continue to rise.

4. The reliever airport system should be a combination of the sophisticated airport recommended above and small unsophisticated airports. Other than the large reliever airport close to the city center, the other relievers did not experience growth. The simplest, least sophisticated airports experienced growth. This suggests that the needs of most general aviation aircraft operators are met by a visual, simple airport.

5. FAA should conduct a study to determine why the general aviation activity has grown at the privately-owned airports and not at the federally-funded airports. One explanation is that it is more economical to use privately-owned airports. If this is the case, perhaps the expense of meeting federal standards, or complying with federal obligations, is so high that the federally funded airports can not compete with the privately owned airports.

Recommendations for the Seattle System

1. Harvey Field and Crest Airpark should be treated the same way; they should be both designated as reliever airports or Harvey Field should be taken out of the NPIAS as a reliever. The status of these two airports is basically the same; both are privately owned and have been studied to determine the steps necessary to bring the airports up to federal standards. Both airport operators have rejected offers of federal assistance because they do not want to make required changes. The operators of Harvey Field got further along in the process than the operators of Crest Airpark. As a result, their airport was designated as a reliever airport. Since then they have decided not to accept any federal funds and Harvey Field has not been removed from the NPIAS.

2. A site for an additional reliever airport to serve the Seattle area should be found. Since Crest Air park and Harvey are privately owned, their operation is at the discretion of the operator. Neither operator has accepted federal funds that would assure its longevity, hence either field could close at any time. For several years, there has been speculation that Harvey Field will close soon. Both of the airports support a large portion of the general aviation activity in the Seattle area. Having either one close would impact the other airports in the region. It is important to recognize that these airports could close and have contingency plans in place to support the general aviation activity if either airport closed.

Recommendation for the Portland System

1. A site for an additional reliever should be found north of Portland to accommodate the aircraft currently using Evergreen. The owner has indicated that the airport will soon close. Recent attempts by Washington State Aeronautics Division to lease this airport so that it will remain open have failed. Evergreen is the second most active general aviation airport in the Portland area and has experienced the most growth between 1975 and 1990. A replacement airport, which could be designated as a reliever airport for Portland, should be built.

Recommendation for the Salt Lake City System

1. Instrument capability should be developed at Salt Lake Muni 2 or Tooele if feasible. This work is under way, but the outcome is unknown. If it is feasible to get instrument operations at either one of these airports, Ogden should no longer be designated as a reliever of Salt Lake City International once instrument operations are established. Table 21 indicates that two airports are adequate to relieve Salt Lake City. Ogden is designated as a reliever airport because it is equipped with an ILS and is relieving instrument training operations from Salt Lake City. However Ogden is nearly thirty miles away from the Salt Lake City center and exists to serve the city of Ogden, primarily. Once instrument capability is established at either of the other two reliever airports, the reliever designation for Ogden is no longer needed.

APPENDIX A

SEATTLE DATA

SEATTLE DATA

AIRPORTS INCLUDED IN THE STUDY

AIR CARRIER

SEATTLE-TACOMA INTERNATIONAL

RELIEVERS

RENTON
KING COUNTY INTERNATIONAL (BOEING FIELD)
SNOHOMISH COUNTY (PAINE FIELD)
AUBURN MUNICIPAL
HARVEY FIELD

OTHER GENERAL AVIATION AIRPORTS

MARTHA LAKE
CREST AIRPARK

AIRPORTS WITHIN 30 SM BUT NOT IN STUDY DUE TO LOCATION

WHIDBEY (ISLAND)
TACOMA NARROWS (OLYMPIC PENINSULA)
VASHON (ISLAND)

AIRPORTS WITHIN 30 SM BUT NOT IN STUDY DUE TO INSUFFICIENT BASED AIRCRAFT OR OPERATIONS

FIRSTAIR (14,535 ANNUAL OPS)

BASED AIRCRAFT

Airport	1991	1990	1985	1980	1975
AUBURN	270	270		211	155
PAINE	472	443		397	256
RENTON	252	252		251	186
BOEING	559	548	612	629	356
SEA-TAC	21	4	4		
**MARTHA LAKE	80				
HARVEY	312	312		243	171
**CREST	332				

Date Sources:

1991: Terminal Area Forecasts, U.S. DOT, FAA, FAA-APO-93-9, FY 1993-2005 (Except Martha Lake and Crest).

Martha Lake and Crest: Respective 1992 FAA Form 5010

OPERATIONAL DATA

Airport	1991 A.C. OPS.	1991	1990	1985	1980	1975
AUBURN	0	152	143	168	168	178
PAINE	0	146	142	124	214	160
RENTON	0	137	149	139	146	165
BOEING	0	338	397	353	288	356
SEA-TAC	331	8	11	20	30	53
**MARTHA LAKE	0	40	40	37	35	32
HARVEY	0	114	114	53	51	18
**CREST	0	95	100	25	15	16

Data Sources:

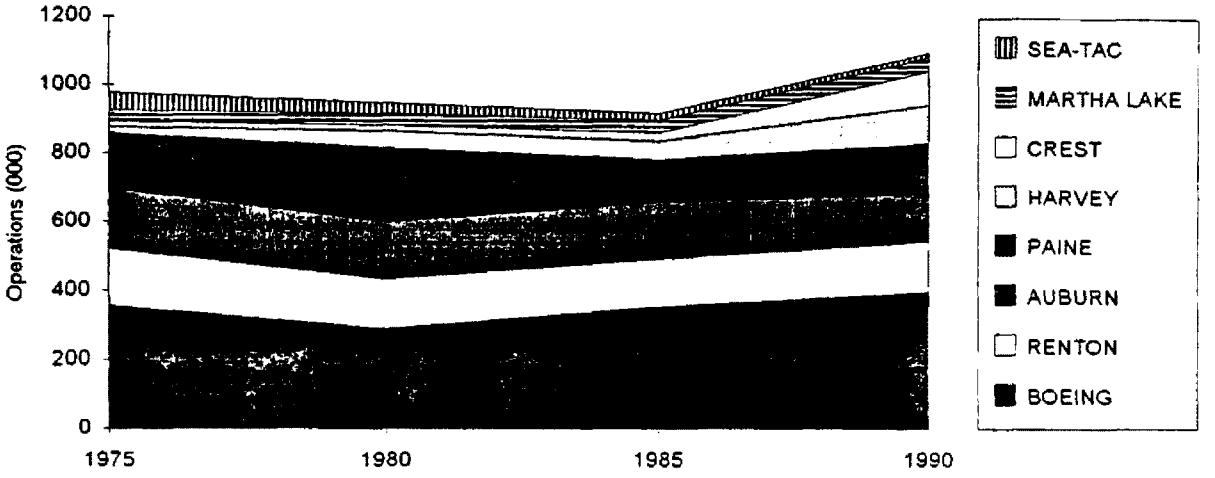
1985, 1990, and 1991: Terminal Area Forecasts, U.S. DOT, FAA, FAA-APO-93-9, FY 1993-2005 (Except Martha Lake and Crest).

Martha Lake and Crest: Respective FAA Form 5010's corresponding to year and location.

1980 and 1975: Respective FAA Form 5010's corresponding to year and location (Except Martha Lake).

Martha Lake: Interpolated from FAA Aviation Forecasts, Seattle-Tacoma International, U.S. DOT, FAA, December 1979

GA Operations in the Seattle Area from 1975 to 1990



APPENDIX B

SALT LAKE CITY DATA

SALT LAKE CITY DATA

AIRPORTS INCLUDED IN THE STUDY

AIR CARRIER

SALT LAKE CITY INTERNATIONAL

RELIEVER

TOOELE
SALT LAKE CITY MUNICIPAL NO. 2
OGDEN-HINKLEY

OTHER GENERAL AVIATION AIRPORTS

N/A

AIRPORTS WITHIN 30 SM BUT NOT IN STUDY DUE TO INSUFFICIENT BASED AIRCRAFT OR OPERATIONS

SKYPARK (9 BASED AIRCRAFT)
MORGAN COUNTY (30 BASED AIRCRAFT)

BASED AIRCRAFT

Airport	1991	1990	1985	1980	1975
OGDEN	207	204	252	247	190
SLC MUNI 2	237	237	229	147	73
SALT LAKE CITY	445	445	662	502	380
*TOOELE	13				

Data Sources:

1991: Terminal Area Forecasts, U.S. DOT, FAA, FAA-APO-93-9,FY 1993-2005

All other based aircraft data from respective FAA Form 5010's corresponding to year and location.

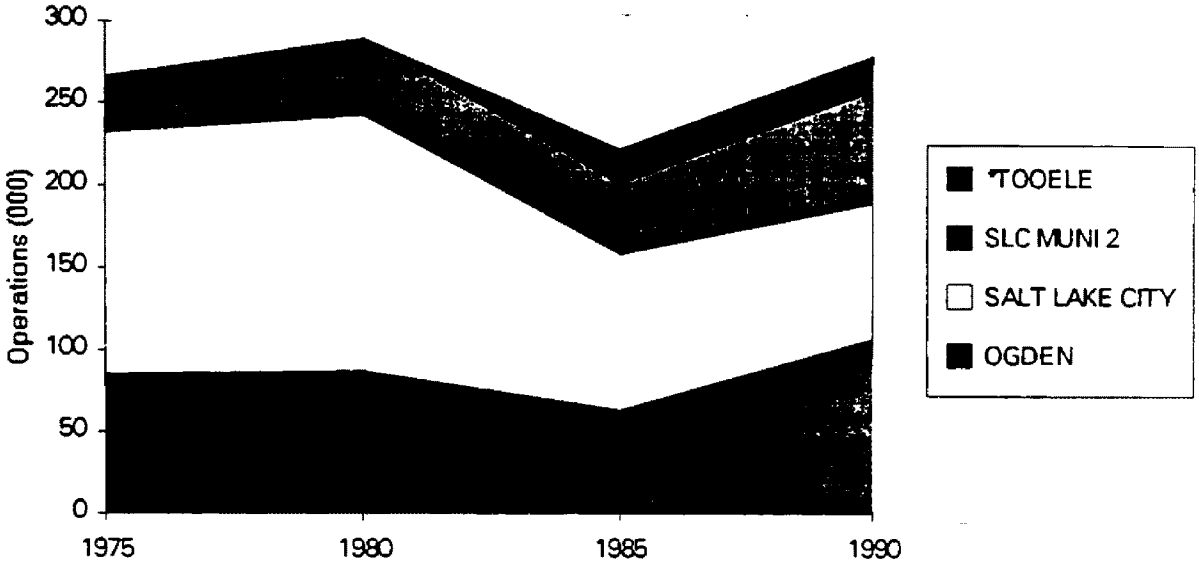
OPERATIONAL DATA

Airport	1991 A.C. OPS.	1991	1990	1985	1980	1975
OGDEN	0	86	108	64	88	86
SLC MUNI 2	0	58	69	43	47	34
SALT LAKE CITY	216	82	82	95	155	146
TOOELE	0	21				

1985, 1990, and 1991: Terminal Area Forecasts, U.S. DOT, FAA, FAA-APO-93-9,FY 1993-2005

All other operational data from respective FAA Form 5010's corresponding to year and location.

GA Operations in the Salt Lake City Area from 1975 to 1990



APPENDIX C

PORTLAND DATA

PORTLAND DATA

AIRPORTS INCLUDED IN STUDY

AIR CARRIER

PORTLAND INTERNATIONAL

RELEIVERS

HILLSBORO
TROUTDALE
MULINO

OTHER GENERAL AVIATION

PEARSON AIRPARK
EVERGREEN
SCAPPOOSE
AURORA STATE
CLARK COUNTY
STARK'S TWIN OAKS AIRPARK

AIRPORTS WITHIN 30 SM BUT NOT IN STUDY DUE TO INSUFFICIENT BASED AIRCRAFT OR OPERATIONS

GROVE (45 BASED AIRCRAFT)
GOHEEN (NOT IN STATE SYSTEM PLAN)
WOODLAND STATE (20 BASED AIRCRAFT)
SPORTSMAN AIRPARK (33 BASED AIRCRAFT)
VALLEY VIEW (NOT IN STATE SYSTEM PLAN)
COUNTRY SQUIRE (22 BASED AIRCRAFT)

BASED AIRCRAFT

Airport	1991	1990	1985	1980	1975
HILLSBORO	347	351	-	255	225
MULINO	30	155			
PORTLAND	109	109	116	184	100
TROUTDALE	154	155	280	250	163
***CLARK CO	87	85	81	80	50
SCAPPOOSE	65	48	50	63	53
STARK'S TWIN OAKS	73	55	66	66	0
PEARSON	164	160		169	168
***EVERGREEN	245	244		206	180
*AURORA	257	208		180	123

Data sources:

1991: Terminal Area Forecasts, U.S. DOT, FAA, FAA-APO-93-9, FY 1993-2005 (Except Clark Co., Scappoose, Stark's Twin Oaks, Evergreen, Aurora).

Aurora: National Plan of Integrated Airport Systems, 1990 -1999, U.S. DOT, FAA

Evergreen and Stark's: Respective FAA Form 5010

Scappoose: Scappoose Industrial Airpark, Master Plan Report, Scappoose, OR, April 1991

Clark County: Washington State Aeronautics Division, Washington State Airport System Plan-Inventory and Forecasts (1990)

OPERATIONAL DATA

Airport	1991 A.C. OPS.	1991	1990	1985	1980	1975
HILLSBORO	0	209	212	139	171	135
MULINO	0	15	16	16	100	
PORTLAND	192	59	60	69	90	85
TROUTDALE	0	93	91	108	102	134
***CLARK CO	0	23	23	22	21	14
SCAPPOOSE	0	12	12	34	44	49
STARK'S TWIN OAKS	0	13	13	16	16	
PEARSON	0	107	107	107	100	100
***EVERGREEN	0	200	200	190	180	100
*AURORA	0	69	69	140	214	84

Data Sources:

1985, 1990 and 1991: Terminal Area Forecasts, U.S. DOT, FAA, FAA-APO-93-9, FY 1993-2005 (Except Clark Co., Scappoose, Stark's Twin Oaks, Evergreen, Aurora).

1980 and 1975: Respective FAA Form 5010's corresponding to year and location (Except for Stark's and Clark Co.).

Aurora, 1991, 1990: National Plan of Integrated Airport Systems, 1990 -1999, U.S. DOT, FAA 1985; Averaged between 1990.

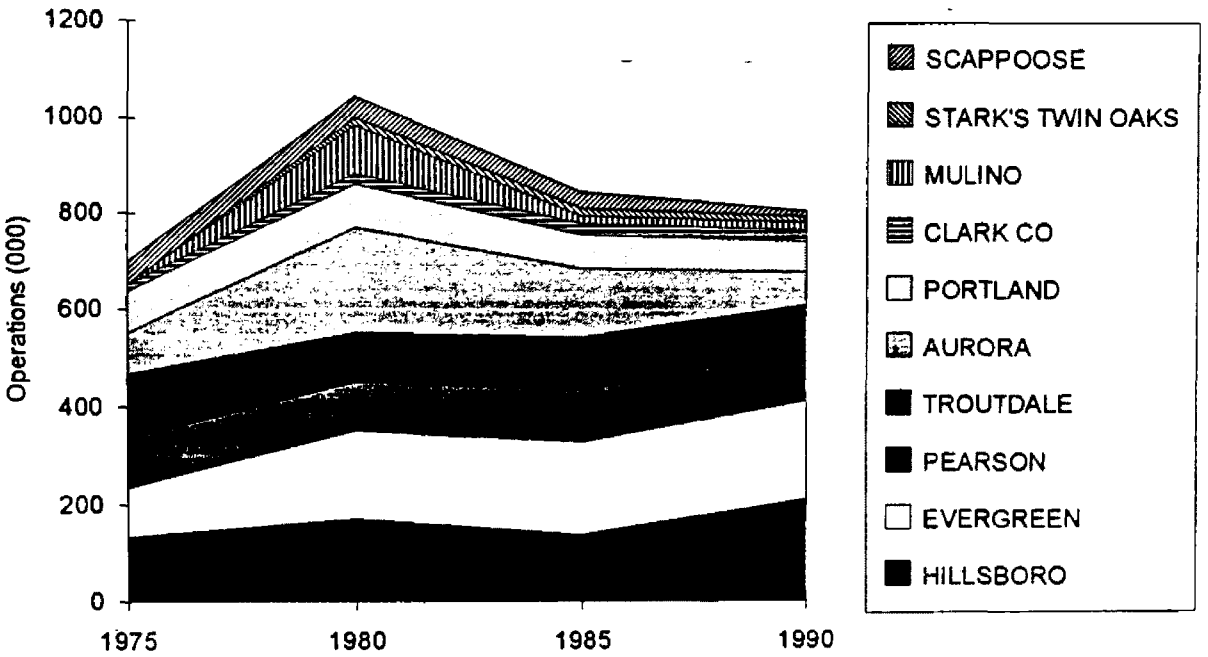
Evergreen: 1990, and 1991: Respective FAA Form 5010; 1985; Averaged between 1990 and 1980.

Stark's: 1991; FAA Form 5010: 1990; Oregon State System Plan (1991): 1985, 1980, and 1975; Scappoose Industrial Airpark, Master Plan Report, Scappoose, OR, April 1991.

Scappoose: 1991, 1990, and 1985; Scappoose Industrial Airpark, Master Plan Report, Scappoose, OR, April 1991.

Clark County: 1991;Washington State Aeronautics Division, Washington State Airport System Plan-Inventory and Forecasts (1990): 1990, 1985, 1980, and 1975; Scappoose Industrial Airpark, Master Plan Report, Scappoose, OR, April 1991.

GA Operations in the Portland Area from 1975 to 1990



APPENDIX D

DENVER DATA

DENVER DATA

AIRPORTS INCLUDED IN THE STUDY

AIR CARRIER

STAPLETON INTERNATIONAL

RELIEVERS

CENTENNIAL
FRONT RANGE
JEFFERSON COUNTY
TRI-COUNTY

OTHER GENERAL AVIATION AIRPORTS

BOULDER
AURORA

AIRPORTS WITHIN 30 SM BUT NOT IN STUDY DUE TO INSUFFICIENT BASED AIRCRAFT OR OPERATIONS

PLATTE VALLEY (28 BASED AIRCRAFT)

BASED AIRCRAFT

Airport	1991	1990	1985	1980	1975
BOULDER	253	253		220	119
JEFFCO	408	408		502	658
STAPLETON	154	165	373	268	242
CENTENNIAL	635	635		781	209
FRONT RANGE	110	121			
TRI-COUNTY	154	154		165	
AURORA	110	73		151	60

Data Sources:

1991: Terminal Area Forecasts, U.S. DOT, FAA, FAA-APO-93-9, FY 1993-2005 (Except Tri-County and Aurora)

Tri-County and Aurora: Respective FAA Form 5010 for locations and years.

OPERATIONAL DATA

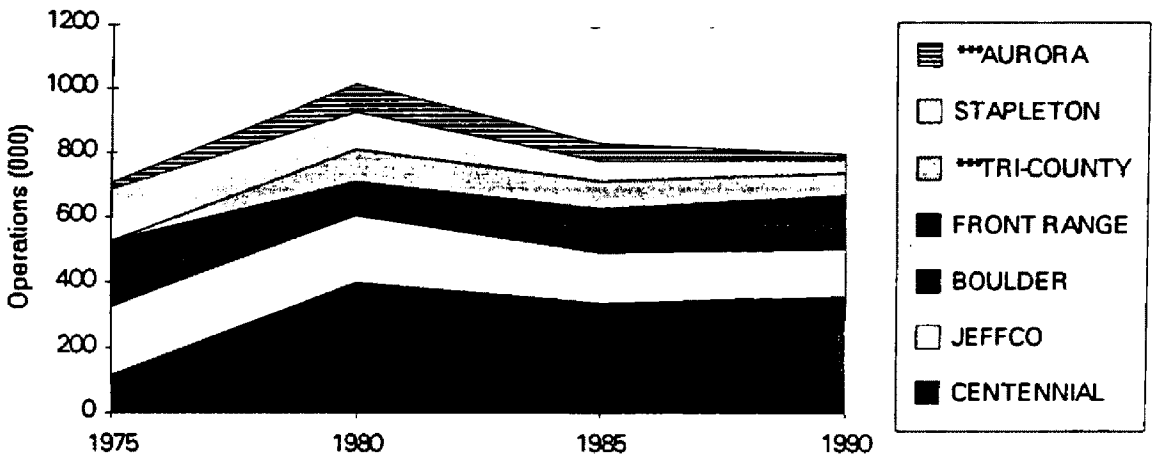
Airport	1991 A.C. OPS.	1991	1990	1985	1980	1975
BOULDER	0	116	85		103	199
JEFFCO	0	138	144	154	204	211
STAPLETON	455	34	39	60	114	162
CENTENNIAL	0	357	358	338	400	116
FRONT RANGE	0	84	80	40		
TRI-COUNTY	0	67	67		100	
AURORA	0	17	17		88	20

Data Sources:

1991: Terminal Area Forecasts, U.S. DOT, FAA, FAA-APO-93-9, FY 1993-2005 (Except Tri-County and Aurora)

Tri-County and Aurora: Respective FAA Form 5010 for locations and years.

GA Operations in the Denver Area from 1975 to 1990



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