DRAFT

ENVIRONMENTAL ASSESSMENT

FOR

PROPOSED CHANGES TO AIR TRAFFIC ARRIVAL AND DEPARTURE ROUTES AT SEATTLE-TACOMA INTERNATIONAL AIRPORT

Seattle, Washington

Prepared by

Federal Aviation Administration
Air Traffic Division
Seattle, Washington

DECEMBER 1989

DRAFT

ENVIRONMENTAL ASSESSMENT

FOR

PROPOSED CHANGES TO AIR TRAFFIC ARRIVAL AND DEPARTURE ROUTES AT SEATTLE-TACOMA INTERNATIONAL AIRPORT

Seattle, Washington

Prepared by

Federal Aviation Administration
Air Traffic Division
Seattle, Washington

DECEMBER 1989

This environmental assessment becomes a Federal document when evaluated and signed by the responsible FAA official.

____

Responsible FAA Official   Date

For further Information Contact:

Mr. Richard Prang
Federal Aviation Administration
17900 Pacific Highway South
Mail: C-68966
Seattle, WA 98168
(206) 431-2530

Summary

I. Purpose and Need

This is an assessment of the environmental effects of proposed alterations to arrival traffic patterns at the Seattle-Tacoma International Airport in order to reduce congestion and improve efficiency in airspace surrounding that facility.

When adverse weather, such as low ceilings and visibilities require instrument approaches to the airport, the arrival capacity of the airport is symmetrical. That is, approximately 36 aircraft per hour can arrive whether runways 16 or 34 are in use. Arrival delays are similar whether landings are conducted to the north or to the south.

In contrast, during periods of peak demand and optimum weather conditions, south arrival capacity is much lower (42/hour), than north arrival capacity (56/hour). Delays, when landing south, are significantly greater than when landing north. No reason for this disparity can be found in the layout of the airport. Therefore, the inefficiencies are caused by the use of the airspace, and more particularly,the requirement that turbojet aircraft landing to the south be routed through Elliott Bay, to the northwest of the airport.

In periods of high demand, if weather or airport conditions improve, the present high altitude route structure and holding airspace used by the Seattle Air Route Traffic Control Center (ARTCC) does not permit that facility to adjust the arrival rate in a timely fashion. At present, it may take as much as thirty minutes to effect a substantial increase in the metered arrival rate at the airport. This can account for as many as 20 arrival opportunities per event.

a. Background

Since 1970, the FAA has worked with local governments and the Port of Seattle to establish local air traffic control procedures which, in many cases subordinated air traffic efficiency to noise abatement procedures which limited turbojet aircraft overflights to certain areas of the Seattle Metropolitan Area.

Prior to 1980, these procedures were used with few delays because the demand for air traffic service seldom approached capacity. In 1980, the FAA's Approach Control Facility (TRACON) handled approximately 255,000 instrument operations per year.

By the summer of 1989, the TRACON was handling as many as 326,125 airport operations and 524,072 total instrument operations per year using the noise abatement procedures which had not changed substantially since the early 1970's. Substantial delays are being incurred. During June, July and August of 1989, 5,409 aircraft experienced 1,303 flight hours of arrival delay.

b. Recent Air Traffic System Improvements

Airspace has been realigned by addition of ARTCC sectors in the Seattle Area and the incorporation of the Tacoma/McChord Air Force Base area into the Seattle TRACON.

Equipment has been improved in both TRACON and ARTCC and substantial numbers of personnel have been added to the complement of both facilities. It is believed that any further improvement in system efficiency will have to come from more complete and efficient use of available airspace.

II. Alternatives Considered

During the past decade, a number of airspace configurations and revised procedures have been proposed to improve the efficiency of the Sea-Tac Airport. Most of these have not been implemented because they were incompatible with the noise abatement procedures agreed to in the early 1970's.

In September 1989, a work group formed by the Seattle TRACON and the Seattle ARTCC simulated each of thirteen alternative airspace and procedure plans to evaluate the relative efficiency and safety of each. They were able to eliminate six of the alternatives as unworkable or unsafe. The remaining seven were ranked as to efficiency; ranging from a static flow arrangement in which arrival streams are presented at the corners of the terminal airspace irrespective of direction of landing, through the "do nothing" option.

Preferred Alternative

The Alternative presented in Demonstration #3 showed clear advantages in safety, simplicity, efficiency, and may actually generate less aircraft noise, though patterns of distribution will change outside the 65 DNL contour. It provides for as many as 56-60 aircraft arrivals per hour in good weather conditions in either north or south traffic operations.

III Affected Environment

The environment affected by the present and proposed air traffic routings to and from Seattle-Tacoma International Airport encompasses the entire Puget Sound basin.

IV Environmental Consequences

The noise impacts of aircraft operations at Seattle-Tacoma International Airport in both north and south flow conditions have been assessed for the current and proposed operational scenarios. The standard Federal noise measurement methodology was used which is the Day-Night Sound Level DNL (a 24 hour cumulative measure of noise exposure). Proposed changes associated with any of the alternatives occur beyond the ends of the current DNL 65 and greater noise exposure contours and at altitudes above 3000 feet above ground, therefore the DNL 65 and greater noise exposure contours will not change. Given that the DNL 65 and greater noise contours do not change as a result of the implementation of the proposed action, all locations outside of the DNL 65 contour remain compatible with the airport.

Table of Contents

I. Purpose and Need

This is an assessment of the environmental effects of proposed alterations to arrival traffic patterns at the Seattle-Tacoma International Airport (SEA-TAC) in order to reduce congestion and improve efficiency in airspace surrounding that facility.

When adverse weather, such as low ceilings and visibilities require instrument approaches to the airport, The arrival capacity of the airport is symmetrical. That is, approximately 36 aircraft per hour can arrive whether runways 16 or 34 are in use. Arrival delays are similar whether landings are conducted to the north or to the south.

In contrast, during periods of peak demand and optimum weather conditions, south arrival capacity is much lower (42/hour), than north (56/hour). Delays, when landing south, are significantly greater than when landing north. No reason for this disparity can be found in the layout of the airport, and it must be assumed that the inefficiencies are caused by the requirement that turbojet aircraft landing to the south be routed through Elliott Bay, to the northwest of the airport.

In periods of high demand, if weather or airport conditions improve, the present high altitude route structure and holding airspace used by the Seattle Air Route Traffic Control Center (ARTCC) does not permit that facility to adjust the arrival rate in a timely fashion. At present, it may take as much as thirty minutes to effect a substantial increase in the metered arrival rate at the airport. This can account for as many as 20 arrival opportunities per event.

Background

Historical Perspective: Air Traffic Operations

Local authorities and the FAA responded to public concern over aircraft noise as early as 1961. Terminal procedures were developed as a cooperative effort between the community, the airport operator (Port of Seattle), the airlines and the FAA. By 1970, arrival and departure route restrictions had become an integral element of Air Traffic Control (ATC) local operating procedures. These procedures required that jet aircraft, arriving and departing Sea-Tac, be routed over Puget Sound to the maximum extent possible consistent with safety. In addition, strict adherence to specified altitudes and routes was required when these aircraft were routed over populated areas. Issues of efficiency were subordinated to noise abatement procedures. These procedures were not rooted in any specific measure of noise, but often involved simply moving the aircraft overflight track away from the complaining group or individual.

Prior to 1979, the demand for Puget Sound airspace and airport resources seldom approached capacity. Seattle Approach Control, the FAA's Terminal Air Traffic Control (TRACON) facility, was handling approximately 255,000 instrument operations per year. Those delays which occurred were caused by reduced runway capacity and increased aircraft separation requirements during periods of reduced visibility. Automated radar tracking and flight data processing computers, introduced in the early 70's, had equipped Air Traffic Control with the tools to efficiently handle projected growth.

By 1980, traffic volume was exceeding system capacity in many areas of the country. A coordinated system of traffic flow management between major air carrier airports was implemented. Preferred arrival, departure and enroute tracks were established and volume restrictions applied in high-density areas. The Pacific Northwest, a historically low-density area, was only slightly affected.

Following deregulation, the air carriers, in response to an expanded marketplace, accelerated the rate at which they added aircraft to the national fleet. Sea-Tac became one of a number of national airline hubs, large regional terminals fed by multiple, converging "commuter" or regional routes which connect with national carriers. Airspace saturation became a reality during high demand periods.

The controller strike of 1981 brought mandatory limitations on access to the ATC system through national flow control along with an enhanced flow management system and philosophy. Enroute control sectors were modified to more equally distribute traffic volume and action was taken to reduce and simplify controller workload wherever possible.

In April of 1983, Standard Instrument Departure (SID) routes were implemented in Seattle airspace to feed the modified enroute structure. Studies were under way to develop standardized terminal feeder routes (static flow), essential to volume management and a single route from the northwest was implemented in March of 1985. The airspace analysis then shifted its emphasis to inbound routes from the east and southeast but existing terminal procedures could not accommodate changes in this area and the options available were regarded as either too cumbersome, or incompatible with existing noise abatement constraints. Revised east side routes were dropped from further consideration.

In 1986, it became increasingly clear that a serious decline in safety was likely to occur if action was not taken to alleviate congestion in the Seattle north flow departure situation, particularly in the area of Elliott Bay and in the high altitude routes in Central Oregon. In the latter area, aircraft bound for the Reno, Los Angeles, Phoenix market were routinely required to proceed out Elliott Bay then via Olympia, Newburg and Klamath Falls, crossing through the heavy stream of aircraft inbound to Seattle from the south. To correct this unacceptable situation, these aircraft were redistributed to the east side of the Seattle metropolitan area through expanded use of an existing departure route. Development of new routes for these aircraft was precluded by existing noise abatement restrictions.

Unprecedented growth continued into 1987 and the year ended with total instrument operations of more than 459,000 in the Seattle terminal airspace; 292,042 operations were conducted at the Sea-Tac Airport. Every possible feeder route had been addressed and standardized but the congestion over Puget Sound had only become more acute. By the summer of 1988, Seattle Approach Control had grown to become one of the busiest facilities in the nation but the fundamental procedures framework, unchanged for over fifteen years, could not support airspace demand.

In the Summer of 1989, Sea-Tac Airport experienced unprecedented delays, 5,409 aircraft experienced a total of 1,303 flight hours of arrival delays in the months of June, July and August. The 12 month total of instrument operations conducted by Seattle TRACON reached 524,072 at the end of the summer. Airport operations were 326,153, an increase of 25% in 33 months.

Current Perspective

Air Carrier Scheduling:

Demand for air traffic service is not spread through the 24-hour day. Airline ticket sales and scheduling respond to people's desire to travel at specific times: departing at the beginning of the business day, arriving home for supper, avoiding the normal hours of sleep, etc.

At several times during the operating day, demand for services alternate between arrival "banks" and departure "banks". This occurs because of the marketing strategy used increasingly by air carrier and air taxi companies over the last decade. Under the "hub-and-spoke" system, large numbers of aircraft, an "arrival bank," arrive at an airport in a brief period, exchange passengers and then leave as another compact "departure bank", creating peaks of demand, and delays.

Airport Configuration:

The Sea-Tac Airport is located twelve miles south of the Seattle central business district. The airport is generally bounded on the north by State Highway 518; on the east by U.S. Highway 99; on the south by South 200th Street and on the west by State Highway 509.

The airport consists of two parallel runways aligned in a north-south direction (158°/338° magnetic). The runway system is oriented to take advantage of the prevailing wind. Runway 16L/34R is the east parallel and Runway 16R/34L the west. The runways are of similar length and both are suitable for use by all aircraft commonly used in air carrier operations.

The greater length of Runway 16L/34R affords no appreciable benefit to arriving aircraft but is significant for departing heavily loaded long-range aircraft. The airport has a downhill gradient from north to south which, during neutral conditions, causes south heading runways (South Flow) to be preferable. This factor and the prevailing wind account for the use of South Flow procedures approximately 60% of the time.

Runway centerlines are separated by 800 feet, a limiting characteristic during Instrument Meteorological Conditions (IMC) but much less so during Visual Meteorological Conditions (VMC). Airport capacity in terms of aircraft operations (landings and departures) that can be accommodated during a period is dependent on two other basic factors. These are airport facilities, including runways, taxiways and aircraft servicing areas, and the traffic control system's ability to position aircraft to access airport facilities.

Air Traffic Control Improvements:

The ability of the Air Traffic Control system to meet the demand for services is affected by several variables, relatively few of which are under the control of those operating the system.

Variables which are not readily subject to the control of the FAA are weather, scheduling of aircraft, location of the airport, further reduction of separation standards, national demographics and travel marketing, etc.

Variables which can be influenced by the FAA are staffing, employee proficiency, equipment acquisition, airport construction, procedures and routings. (These can be summarized as three factors: people, equipment, space.)

As with any other economic decision, any attempt to increase efficiency or productivity involves manipulating these three factors to assure the best mix. As any one of the factors is increased, the benefit derived from each additional increment decreases. That is, assigning more and more people helps less and less unless you also give them more equipment, and more space in which to perform their work, and so on.

Airport expansion and relocation have been considered repeatedly over the years. In the summer of 1988, the Puget Sound Council of Governments and the Commissioners of the Port of Seattle commissioned a study of alternate sites for the airport, but acknowledged that even if a site were to be found, development and construction lead time would be at least ten years.

While addition of another runway at the present location is feasible, it will probably not improve capacity or efficiency unless route modifications can be made to bring the aircraft to the runway more efficiently.

There have been numerous incremental improvements to air traffic equipment at Seattle TRACON and Seattle ARTCC which have enhanced the ability of the system to handle aircraft, the most significant of these being the installation of the Host Computer system at the Seattle ARTCC, which provided greatly enhanced computer memory and capability.

Seattle TRACON has assumed control of airspace formerly controlled from McChord Air Force Base and realigned sectors to use space and control equipment more efficiently. Seattle ARTCC has established new sectors to the north and northeast of the Seattle terminal airspace.

Controller staffing has been expanded considerably. The Seattle Tower and TRACON increased from 57 in 1984 to 93 at present; Seattle ARTCC from 200 to 243.

Despite these changes, which have improved system safety, working conditions, and efficiency in certain areas, experience has shown that there are certain "bottlenecks" which are not likely to be further improved by addition of people or equipment. These lie in the geographical area of Central Puget Sound, and along those high altitude routes into the Seattle Area from the east and southeast.

High Altitude Issues (Seattle ARTCC):

At present, when a runway change occurs at Sea-Tac, the arrival and departure flows in the enroute structure to the east of Seattle change also. That is, the Seattle ARTCC has to deflect the stream of arriving aircraft from one corner of the terminal airspace to another. For example, when a change is made from a Runway 34 configuration to a runway 16 configuration, the stream of arrivals which had been entering Seattle terminal airspace at a point 30 miles southeast of the Sea-Tac Airport has to be moved to a point approx. 30 miles northeast of the airport.

This instability of routes not only has the clear potential for confusion at the time of runway changes, it has continuous effects which are less obvious but equally undesirable:

(1) Enroute traffic metering and holding of Seattle arrival aircraft takes place at a point east of Ephrata, approximately 120 miles from the airport, in order to avoid areas of potential conflict near the ARTCC-TRACON boundary. This makes it difficult to provide a steady efficient flow, particularly in adverse weather, when weather and airport capacity are changing rapidly.

(2) Two side-by-side arrival flows from the east are not feasible because of insufficient airspace to establish an additional sector in the arrival quadrant (The northeast in a runway 16 configuration.) Having a single enroute sector work two arrival flows leaves unresolved existing workload

issues in the sectors immediately east of Seattle TRACON airspace.

(3) In the South flow in particular, there is a continual need to cross aircraft in the departure stream from Seattle to the Upper Midwest and the Northeastern Seaboard through the arrival stream from the Southeastern and South Central U.S. These two busy traffic flows intersect in the area of Eastern Washington and Idaho at a very awkward angle. These aircraft are in climb or descent, and closing at speeds approaching 1200 miles per hour, compounding the already difficult task of the enroute controller.

Low Altitude Issues (Seattle TRACON)

At Sea-Tac, when the landing direction is north, maximum efficiency is achieved because aircraft can be positioned to advantage on either side of the parallel final approach courses of both runways. The finals can be entered by aircraft on either side of the course at any point from the outer marker to the south boundary of approach control airspace without transiting another control sector. And more important, the final approach course can be reached from a position in the traffic pattern that allows the pilot and controller to establish spacing relative to other aircraft already on final. During periods of optimum weather, this positioning advantage makes it possible to achieve and sustain an arrival rate (AAR) of 56 aircraft per hour.

In a south flow, however, procedures designed primarily to mitigate aircraft noise in certain locations north and east of downtown Seattle restrict airspace use and preclude efficient positioning of turbojet aircraft for the landing sequence. These procedures stipulate that arrivals (turbojet) from the south, east and north " ... shall be vectored over Puget Sound and through Elliott Bay." In addition, aircraft from the east " ... shall be vectored through (westbound to Puget Sound) the final approach at or above 8,000." The effect of these procedures is to afford access to the final approach course for turbojets only through Elliott Bay. The impact of these provisions on arrival efficiency is to limit the AAR in a south flow to 42 during optimum weather conditions.

The dramatic difference between north and south flow

AAR's during optimum weather, results from the limited use of airspace east and north of Sea-Tac which precludes the equal concentration of turbojet aircraft on both sides of the final approach course and efficient access to the final. As it is, all turbojet aircraft, irrespective of direction of origin, must be routed to the final on a base leg through Elliott Bay making it difficult to utilize both finals and both runways. This is particularly true in the case of an all turbojet grouping in the aircraft stream. When two or more turbojets are sequenced from the west side to the final, visual separation is established west of Elliott Bay or before the aircraft turn to final so that the maximum concentration of aircraft on the final can be achieved. However, when visual separation must be established before the turn to final, it is much less efficient because of:

(1) The difficulty of maintaining station visually when the preceding aircraft or the aircraft alongside is maneuvering.

(2) The perspective of the individual pilot which limits his ability to make tactical decisions which maximize system efficiency.

It is difficult to assign a value to decreased efficiency of the operation described, in terms of lost arrival opportunities. However, during evaluations, it appears the interval is approximately two miles greater than when the spacing is established by the controller behind or alongside an aircraft already on final. Given a theoretical arrival capacity of 56 per hour, and an actual capacity of 42, this factor must bear a considerable portion of the blame.

High turbojet densities and present south flow procedures require a disproportionate concentration of aircraft in the airspace west and north of Sea-Tac. A high concentration of aircraft poses a considerable problem for efficiency by requiring the controller to focus more attention to maintaining required separation between aircraft and less to sequence efficiency.

The division of airspace along the Seattle Rwy 16 localizer in the south flow means that in visual approach weather the East Arrival controller must route aircraft under his control through the West Controller's airspace for a significant distance to position the aircraft in Elliott Bay. By continuing this, we are engaging in a practice which increases exposure to the risk of error and cuts very close to the actions prohibited by FAA Handbook 7110.65, para 2-14, and 2-15. Attempts have been made to alleviate this situation through sectorization, but have been unsuccessful because of the geographical and operational constraints on the size of the West Arrival sector and the workload of the West Arrival controller. (See Demonstration #13 below.)

The cumulative effect of all these individual inefficiencies is represented by the difference between the acceptance rates for the two configurations in optimal weather: 42 in the South Flow, and 56 in the North.

4. Summary

System efficiency is a product of a complex interplay of many factors, some of which are beyond the control of the FAA.

Maximizing efficiency requires the proper mix of those factors which are under the control of the FAA, that is equipment, personnel, and airspace. Large increases have been made in the areas of personnel and equipment. Any further incremental improvement in system efficiency will require better use of the airspace serving the Seattle Area.

Any attempt to revise routes and procedures should be made in such a way as to provide for present needs and increased demand, at least to the 56-60 operations per hour theoretically possible without new airport construction. Revisions should be made simultaneously in the terminal and enroute airspace.

II. Alternatives Considered

A. Non-Procedural Change:

Changes which could resolve or alleviate this problem through means other than re-routing aircraft flows, such as capital improvements and air carrier scheduling modifications, are not obtainable within the foreseeable future.

It is not likely that additional runway surface capacity can be available prior to the year 2000. The Port of Seattle, owner and operator of Sea-Tac Airport, has initiated studies of airport expansion (i.e., additional runways) and has commissioned a search for potential sites for a replacement or reliever airport for Sea-Tac. Even if one of these alternatives were selected, the acquisition of property, development, and construction of new facilities would probably require ten years or more.

While the FAA has the authority to regulate schedules, as well as to request voluntary agreements from the airlines, to aid in the reduction of delays, it does not believe that invocation of these powers would be appropriate in this instance.

Airline schedules have been regulated only at high density airports. Seattle-Tacoma International Airport does not fall into this category. The FAA has initiated discussions among airlines only where airline scheduling practices have created peak demands that exceed airport capacity and caused unacceptable operating delays. The unacceptable element of delays at Sea-Tac stems not from airline scheduling practices, but from constraints on FAA's utilization of the navigable airspace.

Moreover, this alternative would not solve the congestion concerns posed by the current procedures employed to route aircraft in the terminal airspace. Therefore modification of airline schedules is not a feasible alternative.

B. Procedural Change:

This section reports on 13 simulations of air traffic control procedures developed, run and analyzed by personnel of the Seattle TRACON and the Seattle ARTCC to compare various possible methods for routing traffic in the vicinity of the Seattle-Tacoma International Airport. The alternatives explored during these simulations included several which had been developed over the past decade but not implemented as well as others developed by the team at the time of the simulations.

1. Simulation Methodology

The simulations were conducted over a period of approximately two weeks using the Seattle TRACON Enhanced Target Generator, a training simulator function of the ARTS IIIA system in use at major terminal air traffic facilities. This simulator creates artificial RADAR targets on a radar display exactly like those in use at the control facility. These targets are "flown" by simulator operators at another display nearby, and produce a realistic control environment in which varying routes, procedures and conditions can be entered by the operators.

The data from which the targets were built was obtained from the actual traffic during the late morning arrival "bank" of August 24, 1989, During this period, the Seattle Airport was able to accept 56 arrivals per hour and the actual aircraft, fleet mix, points of entry into the terminal airspace and times were used. Only flight numbers or call signs were changed for the benefit of the simulator operators.

The Enhanced Target Generator has certain inherent limitations which must be borne in mind while reviewing the following results:

a. High arrival speeds and lack of pilot-induced variables can skew arrival rates.

b. The target generator is limited to 64 aircraft tracks, which limits it to a run of approximately one hour of heavy traffic. Each simulation included some departures to demonstrate the feasibility of proposed routings, but the 64 track limitation precluded the simultaneous operation of heavy arrival and heavy departure demand. The study emphasis was placed on improving arrival capacity, and the assumption is that departures will initially use existing routes until reaching 3,000', then be routed between the arrival routes.

c. Conclusions regarding noise impact are not possible other than general observations regarding the location of the ground tracks. Altitudes flown and descent rates can be observed, but they are only computer generated approximations of median rates and do not represent the range of possibilities, given different aircraft and pilot-induced variables.

The possibilities ranged from a scenario using existing procedures and constraints to ones which permitted "clean slate" development of all routes above 3,000' above ground level with arrival flows entering the area over fixed points which are not runway or weather sensitive. In between these, the study group found alternatives which were possible though awkward; possible though inefficient and costly; impossible and dangerous; and several which were possible but unlikely to provide any benefit to the FAA or the community.

DEMONSTRATION #1

Airspace simulation was conducted on September 12, 1989, using the following conditions:

1. South Flow.

2. Existing Seattle arrival procedures, NAVAIDS, and noise abatement restrictions.

3. Good weather permitting Visual Bay Approaches and ready visual identification and separation of aircraft.

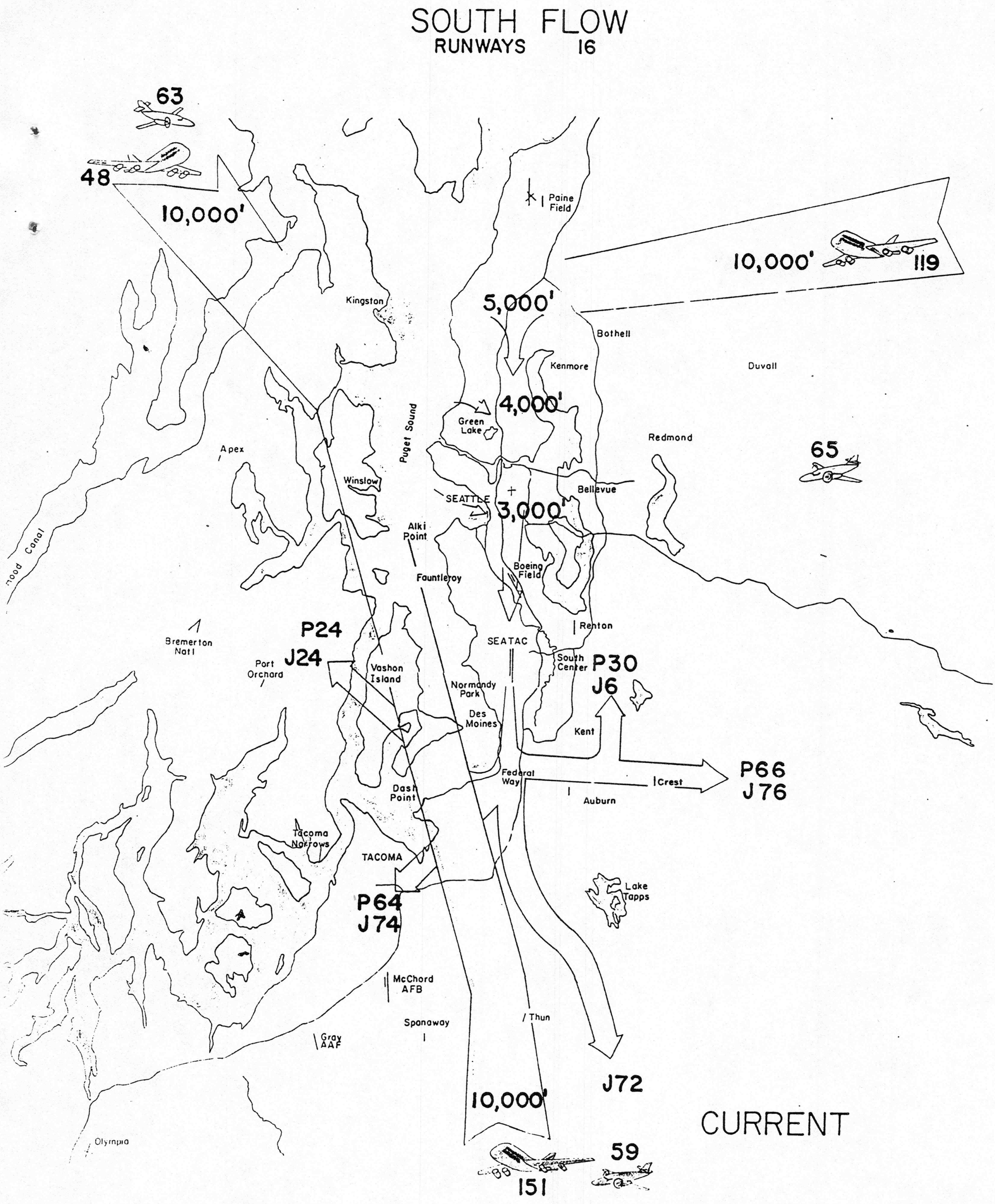
4. This scenario had an unrepresentative fleet mix, high in turbojets, but provided good refresher on procedures presently in place.

OBSERVATIONS:

a. Flow rates approximately equal to north flow (56-60) can be achieved but only with extensive use of visual separation. Phenomena such as haze, scattered cloud, sun glare will effect the rate.

b. High flow rates cause a steady erosion of noise abatement procedures. In this simulation, Arrival East controller very quickly was forced to suspend use of Elliott Bay for his traffic and went straight-in from the Seattle 338/17.

c. Use of this arrival rate for more than 15 minutes will almost assure a stretching of the final; an estimated 60% of westside arrivals will miss Elliott Bay. While these procedures include all of the noise mitigation measures developed over the past twenty years, they do so at the expense of capacity. Any attempt to exceed 36-42 operations per hour can be successful only if one



DEMONSTRATION #1

abandons noise mitigation in favor of system efficiency.

d. This configuration could probably not be mated with the static ARTCC arrival routes which are proposed to relieve the high altitude issues described on page 10 above. Instability and inefficiency problems with the enroute structure will continue.

DEMONSTRATION #2

Airspace simulation was conducted on September 12, 1989, using the following conditions:

1. Existing Seattle arrival procedures, NAVAIDS, and noise abatement restrictions except as noted below:

   a. All arriving turboprops and FAR 36 Stage III turbojets may be assigned routes east of Seattle Runway 16 Final approach course (east downwind), and will not be required to recross the runway 16 localizer.

   b. East downwind turbojets will not descend below 8,000 until north of the Highway 520 Bridge and will intercept final at or above 5,000' and at 17 DME or more.

2. Good weather permitting Visual Bay Approaches and ready visual identification and separation of aircraft.

3. This problem had an unrepresentative fleet mix, high in turbojets.

OBSERVATIONS:

a. Arrival controllers commented on smoothness of operation, stated that integration of turboprops into flow would be easy.

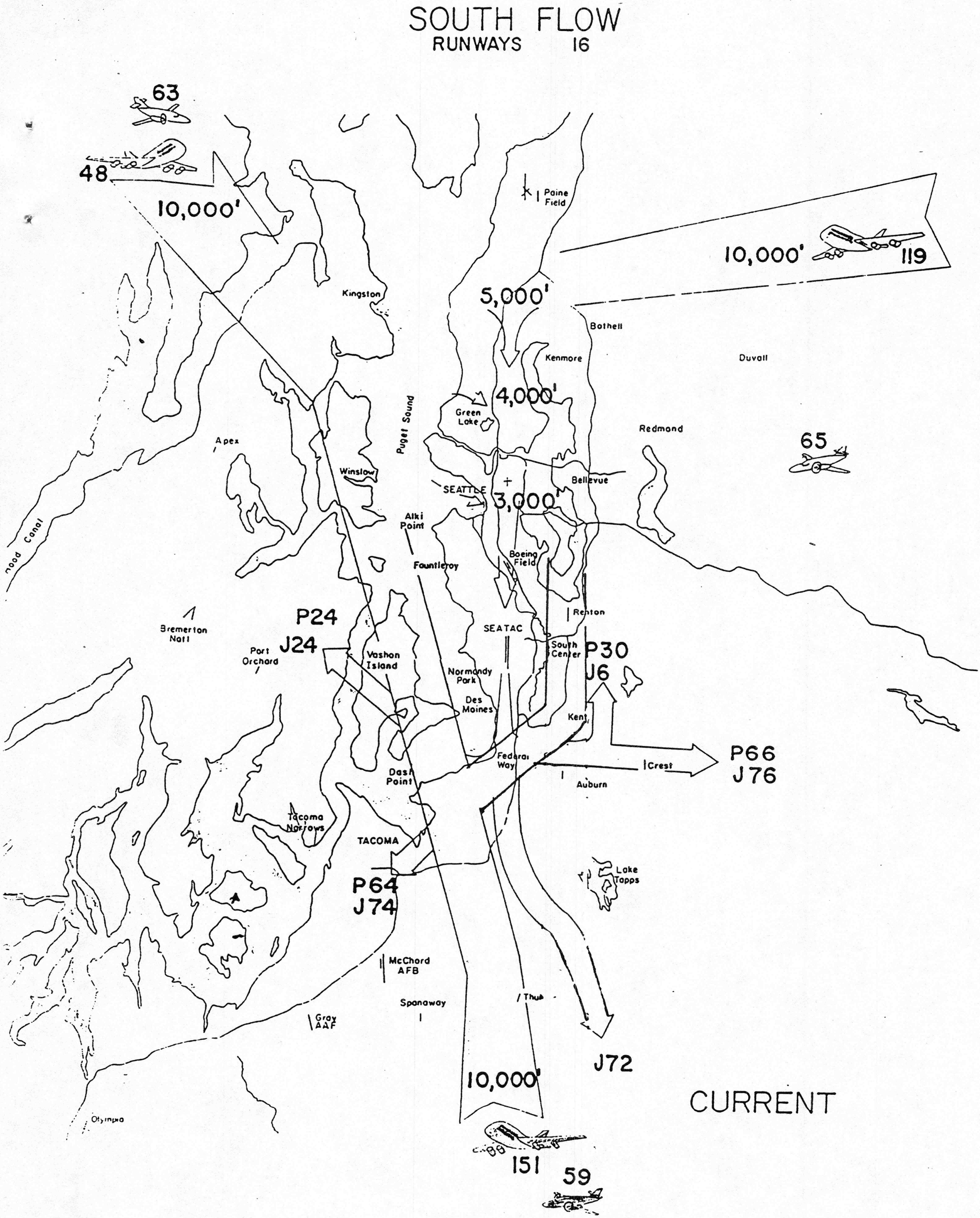
b. This configuration could probably not be mated with the static ARTCC arrival routes which are proposed to relieve the high altitude issues described on page 10 above. Instability and inefficiency problems with the enroute structure will continue.

c. Possibility of demand imbalance adverse to west side arrival controller no greater than at present. Imbalance adverse to east side controller can be promptly reduced by shifting some aircraft to west side.

d. Some lost arrival opportunities will continue to occur due to the noise abatement requirement to turn on from the east outside the Seattle 338/17, but better positioning of turboprops and more orderly arrival flows will reduce this inefficiency.

e. This procedure will create turbojet arrival flight tracks along the east side of Lake Washington where none presently exist. Under all but the heaviest traffic load, these will be in a long low-thrust descent, and will involve only the quietest aircraft in the fleet. West side residents (Vashon, West Seattle, Magnolia, Queen Anne, Ballard) will experience significantly fewer overflights.

f. Some difficulties and inaccuracies will be experienced in sorting Stage II from Stage III aircraft from the flight plan data presented to the system. Sometimes different production numbers of the same aircraft fall on different sides of the Stage II/III divide.



DEMONSTRATION #2

DEMONSTRATION #3

Airspace simulation was conducted on September 12, 1989, using the following conditions:

1. South Flow.

2. Use proposed "Price Alternative" design with the downwind legs approximately eight miles on either side of the airport.

3. Turbojet arrivals from the east and southeast must remain at or above 5,000 until turning final outside the SEA 338/17.

4. Weather 1,500 broken with 8 miles visibility, permitting sidesteps near the outer marker.

5. Metered arrival rate of approximately 52 per hour.

OBSERVATIONS

a. This problem was taken from actual traffic in a period when demand was greatest from the east, a situation which is likely to occur in at least one arrival bank each day. This configuration permits balancing of workload by having the flow from the southeast cross just south of the airport to merge with the arrival stream from Olympia. Metering should assure that no three arrival flows are heavily used simultaneously.

b. Smoothness of arrival flows was noted. "Long leg" arrivals from the southeast and southwest had ample time for descent, speed reductions in preparation for merge with "short legs". This procedure will create turbojet arrival flight tracks along the east side of Lake Washington where none presently exist. Under all but the heaviest traffic load, these will be in a long low-thrust descent. In the South Flow simulations, arriving aircraft were over Renton at 10,000' and made an uninterrupted descent to the final approach course at 5,000' in the vicinity of the Evergreen Point Bridge. West side residents (Vashon, West Seattle, Magnolia, Queen Anne, Ballard) will experience significantly fewer overflights.

c. Proximity of the downwind legs to the airport permits easy adjustment of the location of the turn from downwind to base leg as demand increases and decreases.

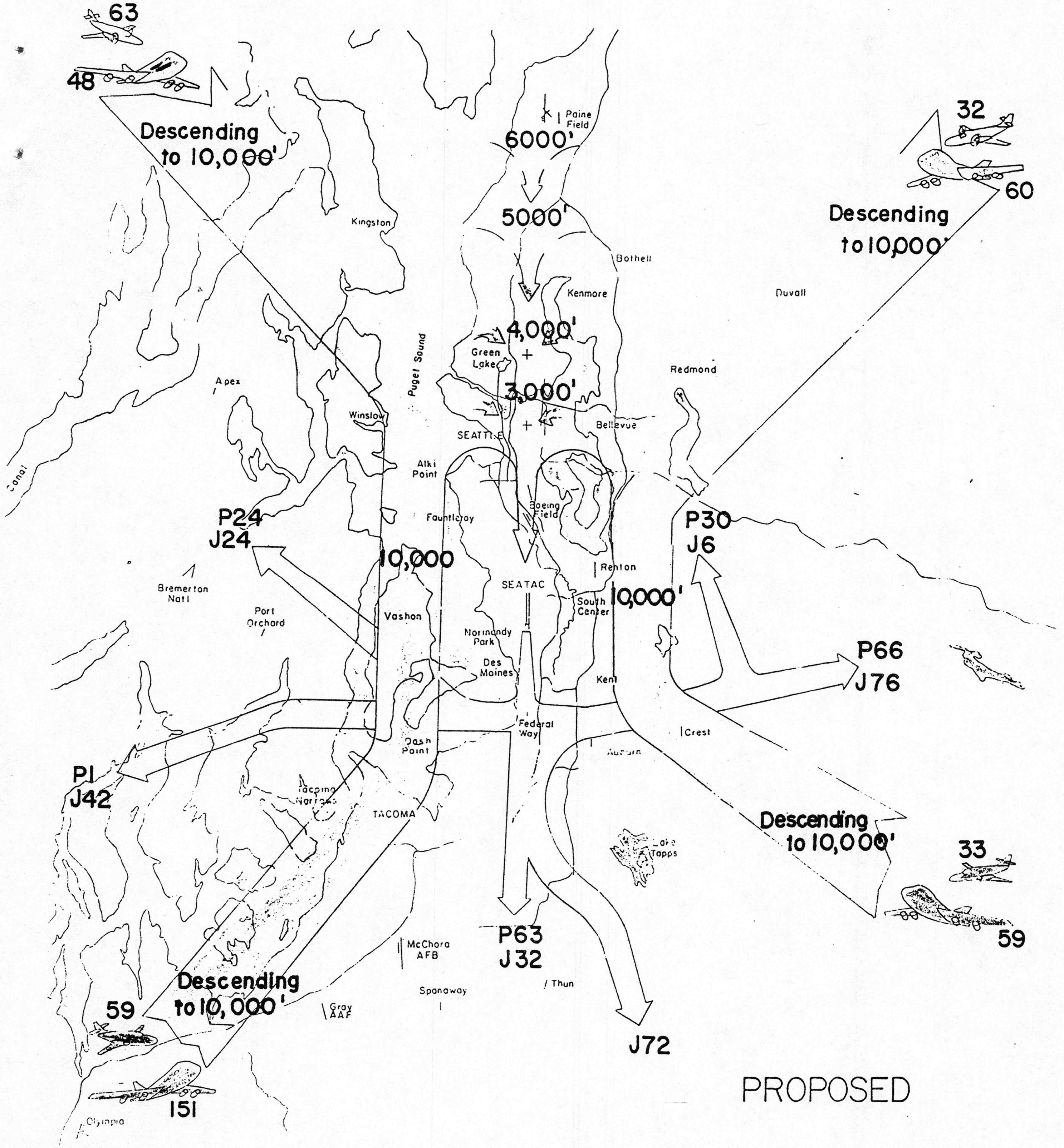
d. High flow rates (52 per hour) were achieved, but only by the liberal use of sidesteps and some visual separation. Actual rates in the weather used for this simulation would probably be in the low 40's.

The inability of the simulator to replicate conditions with sufficient accuracy to predict exact arrival rates has already been noted, but in optimum weather this configuration should be limited only by the runway capacity, permitting 56 to 60 arrivals per hour.

e. These procedures are designed to mate with the enroute changes proposed by Seattle ARTCC to relieve the high altitude issues described on page 10, above.

f. Some lost arrival opportunities will continue to occur if controllers are required to turn aircraft onto the localizer from the east outside the Seattle 338/17. When this requirement was removed from the test, efficiency increased.

SOUTH FLOW
RUNWAYS 16



DEMONSTRATION #3

DEMONSTRATION #4

Airspace simulation was conducted on September 13, 1989, using the following conditions:

1. South Flow.

2. Four arrival streams with eastside downwind outside the King County Metropolitan Area. Aircraft inbound along the Seattle 101 Radial turn northbound when passing HUMPP intersection (Seattle 101/25).

3. Meet existing Seattle turbojet arrival noise constraints.

4. Good weather permitting Visual Bay Approaches and ready visual identification and separation of aircraft.

5. Turbojets from southeast and northeast intercept final approach course at 5,000' or above and at 17DME miles or greater, without crossing runway 16 centerlines. Turbojets from the southwest and northwest will use existing Elliott Bay Procedures.

6. Metered flow of 52 per hour.

OBSERVATIONS

a. Because arrival streams are metered at the Terminal/ARTCC boundary, it would be likely that a group of closely spaced arrivals could be metered into the Southeast arrival gate; vectored on the wide downwind to the northeast corner of the terminal airspace, and there meet the next group of closely spaced metered arrivals. Use of this configuration would require that metering programs be modified to preclude this.

b. East Arrival controller may need to spread the downwind stream after passing abeam the airport to integrate it with the east arrival stream. Altitude restrictions are feasible, but specific ground track is probably not possible north of the Seattle 060 Radial in moderate to heavy traffic. This will cause some overflights in the northeast part of the Metropolitan area

c. This configuration makes it extremely difficult to depart Seattle to the east.

1) The arriving turbojet stream will be descending to 14,000' when handed-off by the ARTCC, necessitating restricting the departures to 13,000' or below until approximately 30 miles east (45 flying miles). While inefficient, this is probably achievable.

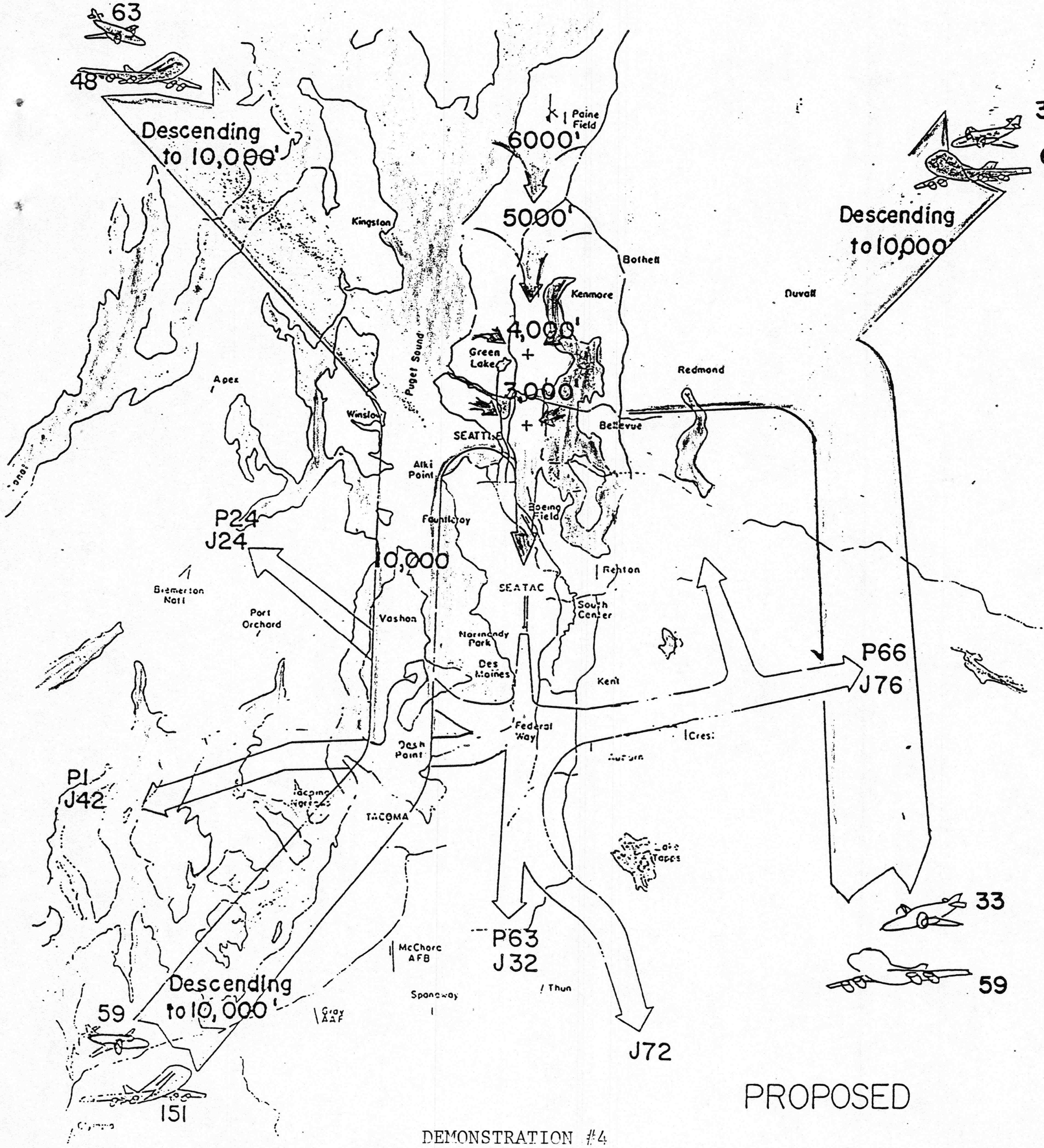
2) The turboprop/reciprocating arrival route underlies the turbojet stream at 10,000', which is the MEA/MVA in this area. It is extremely difficult to get the departing commuter/light-twin type aircraft above this 10,000 traffic in order to go east at 11,000' or 12,000'.

d. At these arrival rates, it will be impossible to carry the east arrival traffic across the localizer to join the Elliott Bay routing. Some lost arrival opportunities will continue to occur due to the noise abatement requirement to turn on from the east outside the Seattle 338/17, but the balanced and more orderly arrival flows may reduce this inefficiency.

e. These procedures could be mated with the enroute changes proposed by Seattle ARTCC to relieve the high altitude issues described on page 10, above.

f. Noise mitigation is emphasized in this plan. All tracks avoid those areas of the eastside which have traditionally had few turbojet overflights in the South Flow. They will now experience none. This will be done at the cost of making all arrivals from the east fly an arrival route which is from 10 to 30 miles longer than some of the other proposals. These miles will occur at a relatively low altitude and result in higher fuel consumption, air pollution, and will increase arrival noise exposure in the rural areas of Eastern King County. There are fuel consumption and air pollution penalties imposed on the departures under this plan, as spelled out in c.1), above.

SOUTH FLOW
RUNWAYS 16



PROPOSED

DEMONSTRATION #4

DEMONSTRATION #5

Airspace simulation was conducted on September 13, 1989, using the following conditions:

1. South Flow.

2. Four arrival stream configuration with no downwind leg east of the airport.

3. Arrival flow from the southeast on the 101 Radial remains at 10,000' or above until crossing over the Seattle VOR to join westside flow inbound from Olympia.

4. Visual Bay weather

5. Metered flow rate of 52 per hour.

OBSERVATIONS

a. These procedures could be mated with the enroute changes proposed by Seattle ARTCC to relieve the high altitude issues described on page 10, above.

b. Stream will have to be vectored south of the VOR to prevent two streams merging in the blind area near the RADAR antenna.

c. This configuration does not balance workload between two feeders. Extreme congestion is likely to occur over the Vashon area due to merging the two busiest arrival flows. Partial relief could be achieved by routing turboprops up the eastside, but complexity could be overwhelming.

1) west feeder would routinely handoff northeastbound

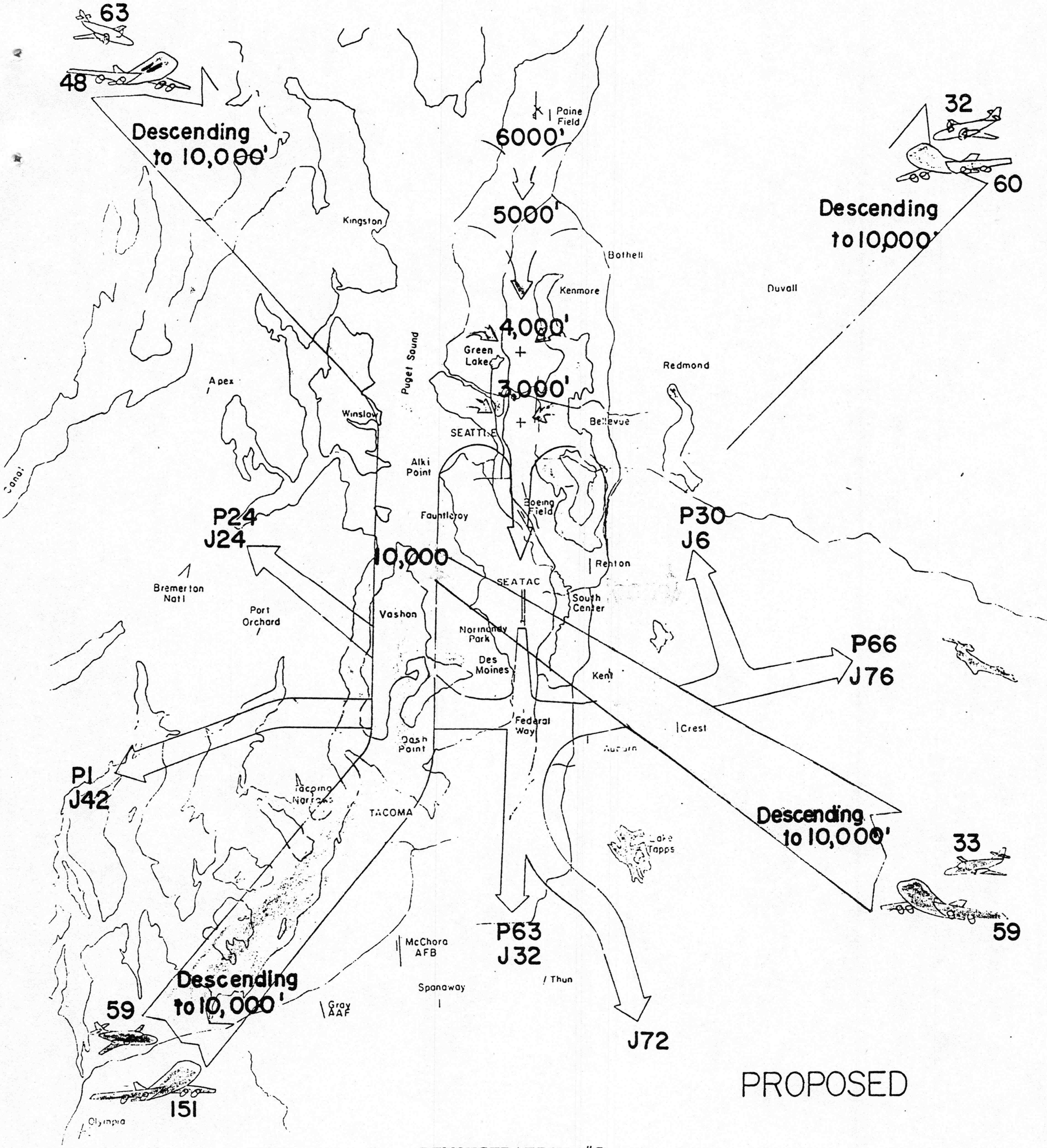
turboprops to east feeder approx. five miles south of the VOR, at 10,000', to be merged with the northwestbound turboprops on the 101 radial.

2) East feeder would routinely handoff westbound turbojets to west feeder approximately five miles south of the VOR at 11,000, to be merged with the northbound jets from Olympia.

d. West feeder airspace would be of approximately the same dimensions as at present. Additional workload introduced by bringing traffic from the southeast would probably render this completely unworkable at arrival rates in excess of 36 per hour.

e. Noise mitigation is good as long as demand stays below 36 arrivals per hour. Most turbojets will make minimum power descent and be routed away from areas which have traditionally been spared from overflights by arrival procedures.

SOUTH FLOW
RUNWAYS 16



DEMONSTRATION #5

DEMONSTRATION #6 -

Airspace simulation was conducted on September 13, 1989, using the following conditions:

1. North Flow.

2. Arrival flow in the northeast quadrant turns south at the SEA 020/25 to join the inbound flow from the southeast in the vicinity of the SEA 101/25 in order to remain east of the King County Metropolitan Area. This is the north flow equivalent of Demonstration #4.

3. Turbojets on the east downwind remain at 14,000' until passing the departure stream near the SEA 069Radial. Turboprops pass under the departure stream at 10,000'.

4. Good weather permitting ready visual identification and separation of aircraft.

5. Metered flow of 52 per hour.

OBSERVATIONS.

a. Relatively large space available to Arrival East controller in the southeast quadrant makes sequencing of this relatively large volume of aircraft feasible, as is true presently. In the event of large numbers of aircraft inbound on the 101 radial simultaneously with aircraft on the 25-mile downwind, the controller can turn one flow to the southwest or south to parallel or even diverge from the other until making staggered base leg turns.

b. This configuration makes it extremely difficult to depart Seattle to the east.

1) The arriving turbojet stream will be descending to 14,000' when handed-off by the ARTCC, necessitating restricting the departures to 13,000' or below until approximately 30 miles east (45 flying miles). While inefficient, this is probably achievable.

2) The turboprop/reciprocating arrival route underlies the turbojet stream at 10,000', which is the MEA/MVA in this area. It is extremely difficult to get the departing commuter/light-twin type aircraft above this 10,000 traffic in order to go east at 11 or 12,000'.

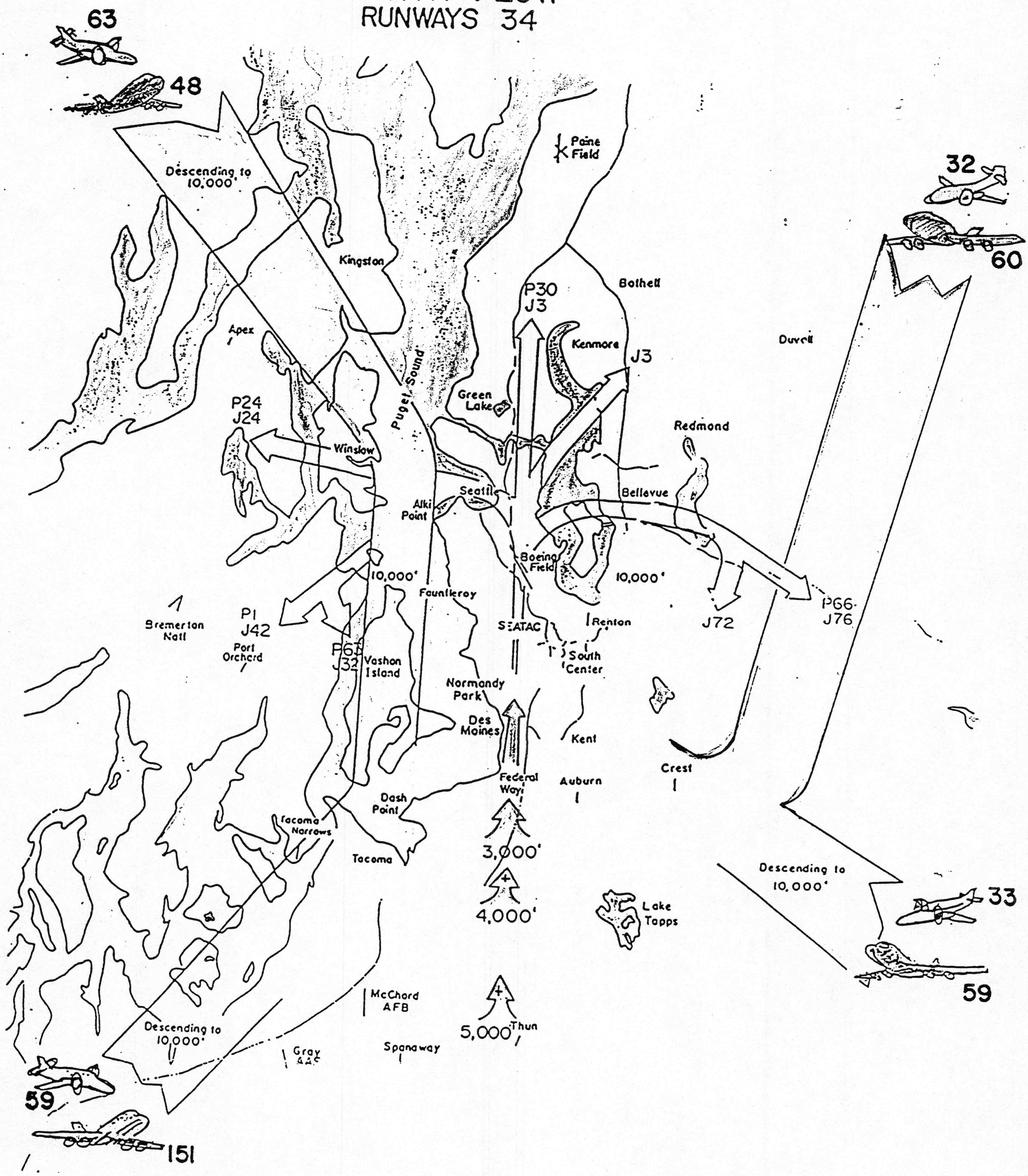
3) The situation described in 2) above could be alleviated by bringing the turboprop arrival flow in on the 020 radial and placing them on a more conventional downwind approximately 8 miles east of the airport. (See Demonstration #10 for this modification.)

c. It was attempted to balance flows by taking the arrival flow in the northeast quadrant across the north edge of the terminal airspace toward LOFAL to join the west downwind flow. This flow conflicted with Elliott Bay departure flows.

d. These procedures could be mated with the enroute changes proposed by Seattle ARTCC to relieve the high altitude issues described on page 10, above.

e. Noise mitigation is emphasized in this plan. All tracks avoid those areas of the eastside which have traditionally had very few turbojet overflights. This will be done at the cost of making all arrivals from the northeast fly an arrival route which is from 10 to 20 miles longer than some of the other proposals. These miles will occur at a relatively low altitude and result in higher fuel consumption, air pollution, and will increase arrival noise exposure in the rural areas of Eastern King County. There are additional fuel consumption and air pollution penalties imposed on departures by this plan, as spelled out in b.1), above.

NORTH FLOW
RUNWAYS 34



DEMONSTRATION #6

DEMONSTRATION #7

Airspace simulation was conducted on September 15, 1989, using the following conditions:

1. North Flow.

2. Four arrival flow configuration, with the arrival flow in the northeast quadrant crossing VOR to join the westside arrival flow. (This is the north flow equivalent of Demonstration #5.

3. Good weather permitting ready visual identification and separation of aircraft, simultaneous operations on Runways 34L/R.

4. Metered flow of 52 per hour.

OBSERVATIONS:

a. Crossing at VOR causes loss of radar contact at critical time in sequencing. Flow should actually cross near Boeing Field.

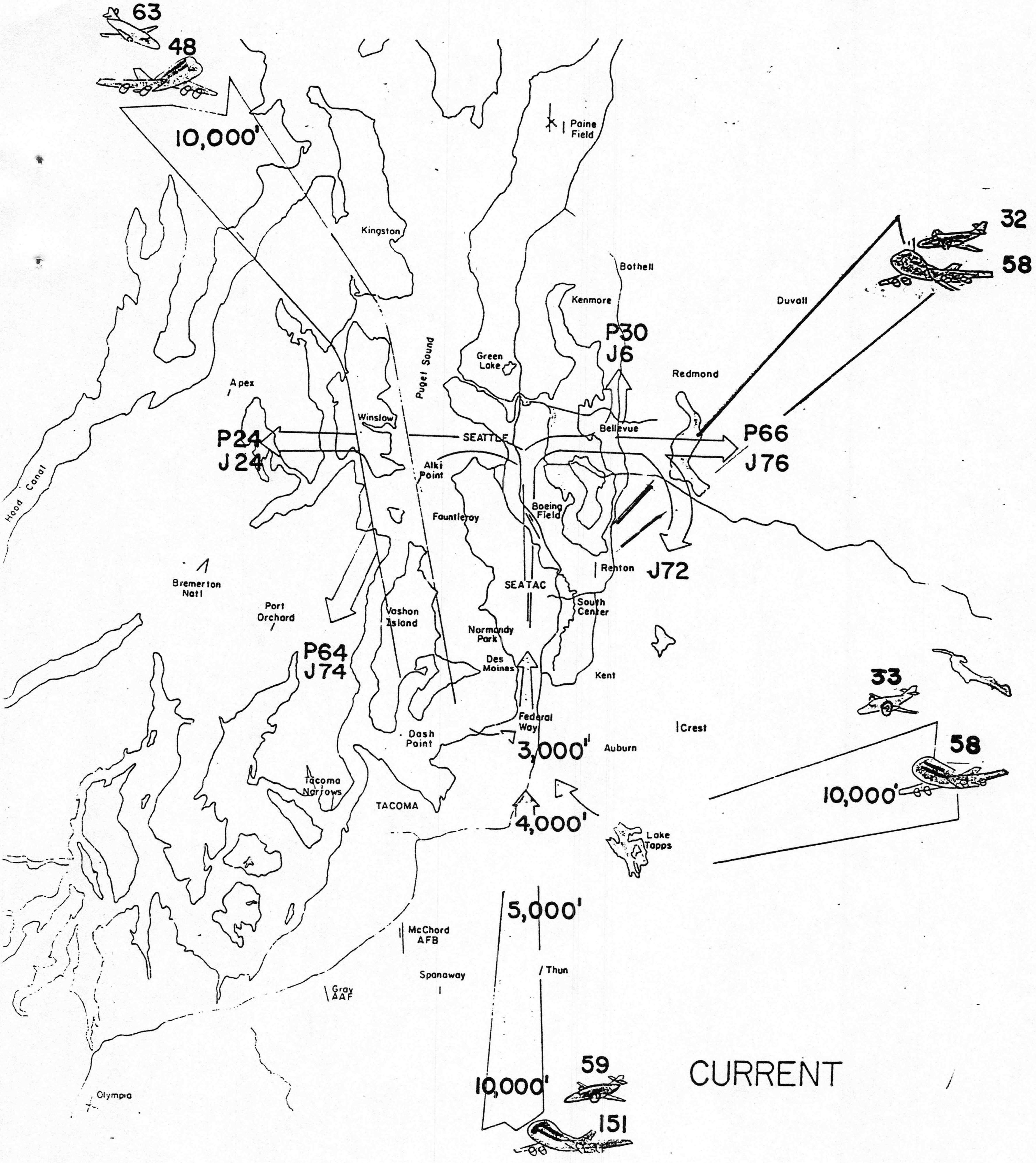
b. Fairly smooth operation. At present, arrival "banking" at Sea-Tac comes in alternating areas. The bank used for this simulation is heavily weighted in the two east gates, in which case this configuration would permit some workload balancing on both sides of the Runway 34 final.

If this configuration were adopted, some entirely different design concept would probably be needed for the South Flow operation. Demonstration #5, the south equivalent of this one, failed at rates over 36/hour.

c. These procedures could be mated with the enroute changes proposed by Seattle ARTCC to relieve the high altitude issues described on page 10, above.

d. This arrangement will cause turbojet overflights in the Kirkland, Redmond, Bellevue areas. Any change in overflight or noise distribution in these areas should be made in pursuit of a more efficient alternative, such as Demonstration 3, above.

NORTH FLOW
RUNWAYS 34



DEMONSTRATION #7

DEMONSTRATION #8

Airspace simulation was conducted on September 15, 1989, using the following conditions:

1. North Flow.

2. Three arrival flow configuration in which arrival/departure gates on the east side of terminal airspace are runway sensitive, as at present. Simultaneous side-by-side arrival flows in the southeast quadrant from sectors 1 and 31.

3. Good weather permitting simultaneous operations on Runways 34L/R, with ready visual identification and separation of aircraft.

4. Metered rate of 52 arrivals per hour.

OBSERVATIONS

a. A large area is available to the southeast in which to "fan" arrivals or establish upwind or downwind legs to merge traffic with inbounds from south and northwest, in good weather.

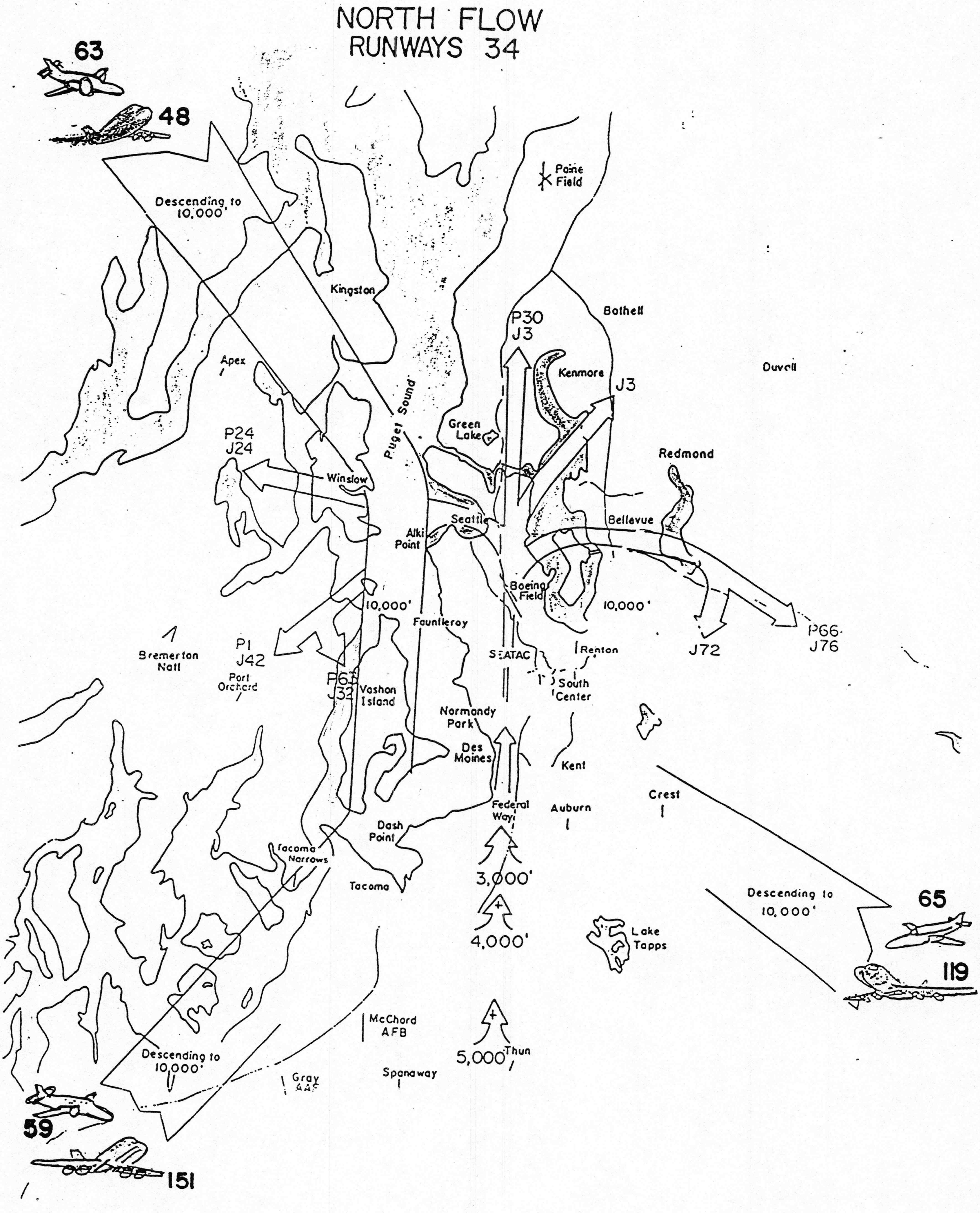
b. Pilot nav parallel routes could probably be established.

c. Leaves entire northeast quadrant available for the use of the departure controller; enroute crossovers are minimal.

d. This option requires "flip/flop" in runway changes, resultant instability of sector boundaries, enroute structure.

e. Sector 1/31 boundary would be displaced southward to the vicinity of the 101 radial. The establishment of a corridor permitting Sector 31 (which is primarily northeast of Seattle) to present an arrival flow in the eastsoutheast area would preclude the use of metering and holding fixes in close proximity to terminal airspace, markedly reducing the effectiveness and accuracy of arrival metering.

f. This plan is noise neutral. It restricts nearly all aircraft to areas which are affected by aircraft overflights under present north flow procedures. The problems occur with attempts to apply this design concept to the south flow operation, as in Demonstration #9 below.



DEMONSTRATION #8

DEMONSTRATION #9

Airspace simulation was conducted on September 15, 1989, using the following conditions:

1. South Flow.

2. Three arrival flow configuration in which arrival/departure gates on the east side of terminal airspace are runway sensitive, with simultaneous side-by-side arrival flows in the northeast quadrant from sectors 1 and 31.

3. Honor all existing Seattle turbojet noise constraints.

4. Good weather permitting the use of Visual Bay procedures, ready identification and separation of aircraft. Metered arrival rate of 52 per hour.

OBSERVATIONS

a. In periods of high demand, it may be necessary to deflect the sector 1 arrival stream toward the VOR, establishing an upwind-downwind situation in the Redmond Bellevue areas.

b. Pilot nav parallel routes could probably be established.

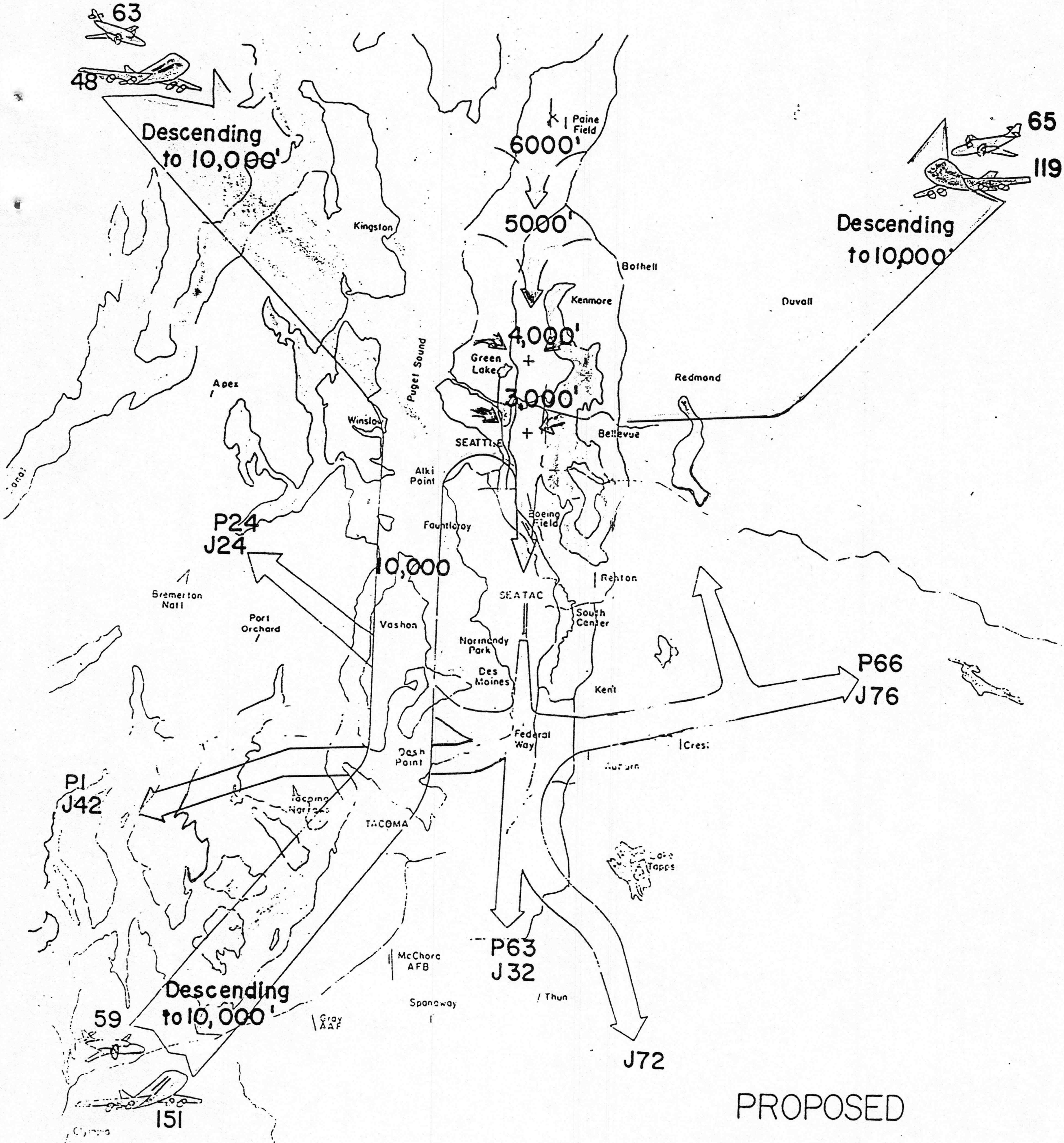
c. Sector 1/31 boundary would be displaced northward to the vicinity of the 030 radial. The establishment of a corridor permitting Sector 1 (which is primarily southeast of Seattle) to present an arrival flow in the northeast quadrant would preclude the use of metering and holding fixes in close proximity to terminal airspace, markedly reducing the effectiveness and accuracy of arrival metering.

d. Leaves entire southeast quadrant available for the use of the departure controller.

e. This option requires "flip/flop" of arrival/departure gates in runway changes, resultant instability of sector boundaries, enroute structure. Enroute crossover problems east of Ephrata and Ellensburg, involving high altitude, high speed aircraft crossing at very shallow angles may not be acceptable. These would involve large numbers of arrivals from the direction of Denver, Dallas, Atlanta, crossing with departures to Minneapolis, Chicago, New York Complex.

f. This operation works only at arrival rates of 42 or less. Any attempt to increase above that number results in the same erosion of noise abatement as in the present Seattle South Flow configuration. Aircraft from the east have to be turned-on to the ILS from the east and aircraft from the west have to abandon the Elliott Bay procedure. See Demonstration #1.

SOUTH FLOW
RUNWAYS 16



PROPOSED

DEMONSTRATION #9

DEMONSTRATION #10

Airspace simulation was conducted on September 19, 1989, using the following conditions:

1. South Flow.

2. Four Arrival Streams with eastside downwind outside the King County Metropolitan Area. Aircraft inbound along the Seattle 101 Radial turn northbound when passing HUMPP intersection (Seattle 101/25), except that turboprop aircraft continue inbound on the 101 radial to join a downwind eight miles east of the airport.

3. Meet existing Seattle turbojet arrival noise constraints.

4. Good weather permitting Visual Bay Approaches and ready visual identification and separation of aircraft.

5. Turbojets from southeast and northeast intercept final approach course at 5,000' or above and at 17DME miles or greater, without crossing runway 16 centerlines.

6. Metered arrival rate of 52 per hour.

OBSERVATIONS

a. Because arrival streams are metered at the Terminal/ARTCC boundary, it would be likely that a group of closely spaced arrivals could be metered into the Southeast arrival gate; vectored on the wide downwind to the northeast corner of the terminal airspace, and there meet the next group of closely spaced metered arrivals. Use of this configuration would require that metering programs be modified to preclude this.

b. This configuration operated smoothly, and is capable of handling relatively high demand. The long, wide downwind and base legs create obvious inefficiencies from the perspective of the aircrews, causing as much as 25 extra flying miles in periods of low arrival demand.

c. It was found that if two eastside downwind legs are created for noise abatement, as in this simulation, the outer one could not be moved much closer than 25 miles if we are to have any area available for the departures to go north.

d. East Arrival controller may need to fan the downwind stream after passing abeam the airport to integrate it with the east arrival stream. Altitude restrictions are feasible, but specific ground track is probably not possible north of the Seattle 060 Radial.

e. Gate balancing from the east side to the west side is probably not possible for turbojets in this configuration.

f. An attempt to bring aircraft across the localizer for noise abatement or balancing resulted in excessive work for the east feeder as well as unacceptable congestion in the Edmonds-Kingston-Winslow area.

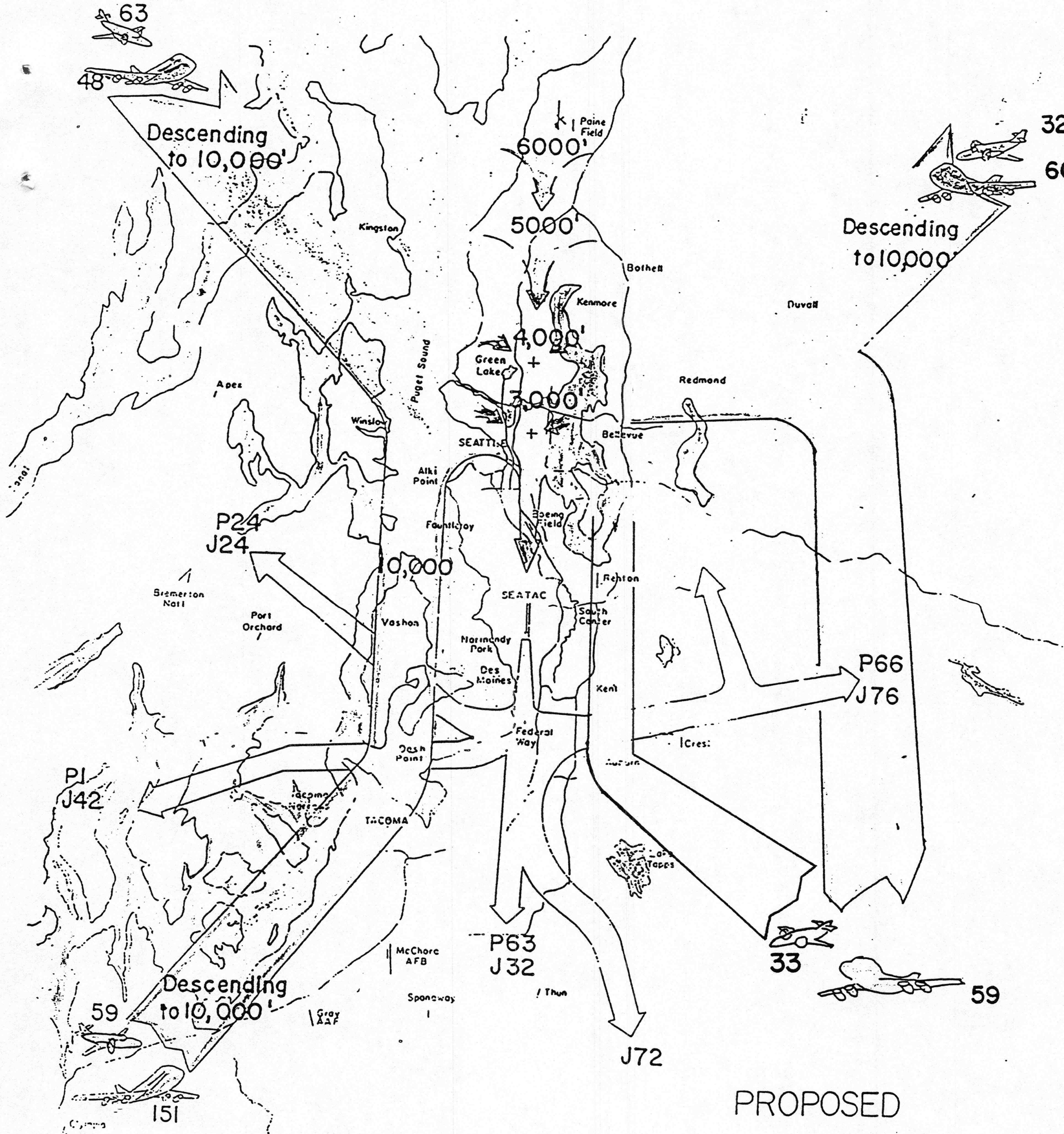
g. The arriving turbojet stream will be descending to 14,000' when handed-off by the ARTCC, necessitating restricting the departures to 13,000' or below until approximately 30 miles east (45 flying miles). This will cause increase noise exposure in the rural areas of Eastern King County, higher fuel consumption and air pollution, but it is operationally feasible.

h. Some lost arrival opportunities will continue to occur due to the noise abatement requirement to turn on from the east outside the Seattle 338/17. Turboprops from the near downwind will fill some of these opportunities.

i. The workgroup agreed that of all the alternatives short of Alternative #3, this seems the most palatable from the point of view of the controller. This plan is however, grossly inefficient. It involves extended flight at low altitude near mountainous terrain for both arrivals and departures, with resultant high fuel consumption and increased air pollution.

While it maximizes noise abatement for those areas on the east side of Lake Washington which have not experienced south flow turbojet overflights, aircraft noise would be introduced into new areas in the vicinity of North Bend, Snoqualmie, and Carnation. Its efficiency and operational acceptability would be markedly enhanced if FAR 36 Stage III turbojets were added to the turboprops on the near eastside downwind leg.

SOUTH FLOW
RUNWAYS 16



PROPOSED

DEMONSTRATION #10

DEMONSTRATION #11

Airspace simulation was conducted on September 19, 1989, using the following conditions:

1. South Flow.

2. No changes to present terminal airspace boundaries or location of arrival or departure handoffs.

3. Place turboprops on eastside of 16 finals whenever possible, including inbound flows from Eastern Washington, Victoria/Bellingham/Vancouver, Portland via 158 radial.

4. Honor all existing noise abatement constraints.

5. Good weather permitting full use of simultaneous arrivals to runways 16L/R; ready visual identification and separation of aircraft.

OBSERVATIONS

a. High arrival rates are feasible, but only if eastside arrivals intercept the ILS from the east instead of crossing to the west side to enter through Elliott Bay. If Turbojets are required to use Elliott Bay from the east, rates over 36 will cause congestion north of Elliott Bay, rates over 42 cannot be achieved except in periods of unusually low turbojet concentration in the fleet mix.

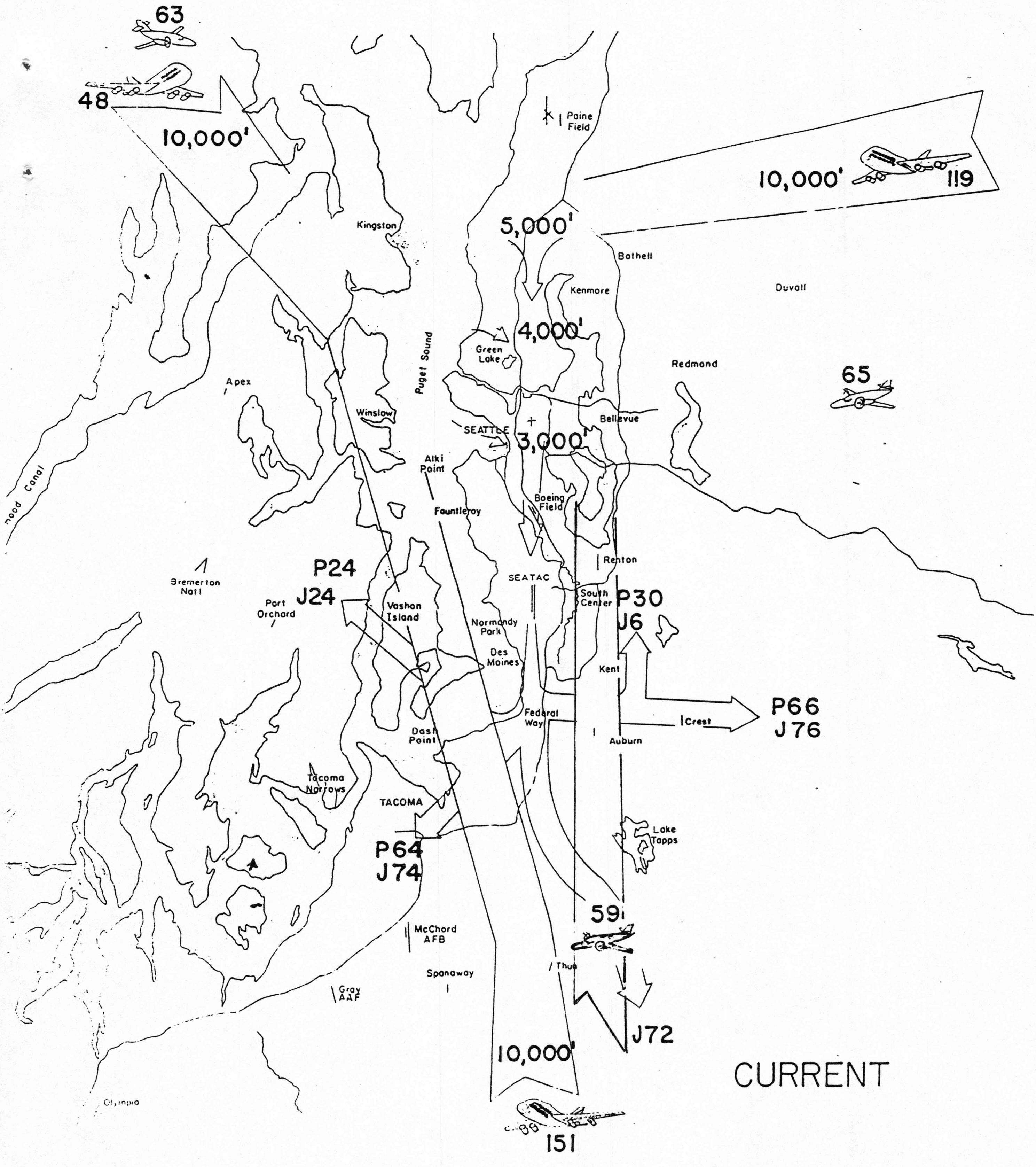
b. Requirement to turn turbojets onto final from east outside the SEA 338/17 causes lost arrival opportunities, some of these will be filled from the west side, or with turboprops.

c. Noise mitigation is emphasized at the expense of system efficiency. All areas of the Eastside presently protected from turbojet overflight will continue to receive this benefit. There will be a small increase in turboprop activity.

d. In high rates, arrivals from the northeast may have to be brought toward Redmond and Bellevue to join turboprop downwind as is sometimes case at present.

d. This configuration could not be mated with the static ARTCC arrival routes which are proposed to relieve the high altitude issues described on page 10, above. Instability and inefficiency problems with the enroute structure will continue.

SOUTH FLOW
RUNWAYS 16



DEMONSTRATION #11

DEMONSTRATION #12

Airspace simulation was conducted on September 19, 1989, using the following conditions:

1. South Flow.

2. No changes to present terminal airspace boundaries or location of arrival or departure handoffs.

3. Place turboprops and all FAR 36 Stage III complying jets on eastside of 16 finals whenever possible, including inbound flows from E. Washington, Victoria/Bellingham/Vancouver, Portland via 158 radial.

4. Honor all other existing noise abatement constraints.

5. Good weather permitting full use of simultaneous arrivals to runways 16L/R; ready visual identification and separation of aircraft.

OBSERVATIONS

a. High arrival rates are feasible, but only if eastside arrivals intercept the ILS from the east instead of crossing to the west side to enter through Elliott Bay. This configuration is preferred to the one in Demonstration 11 due to the greater ability to balance demand between the two downwinds.

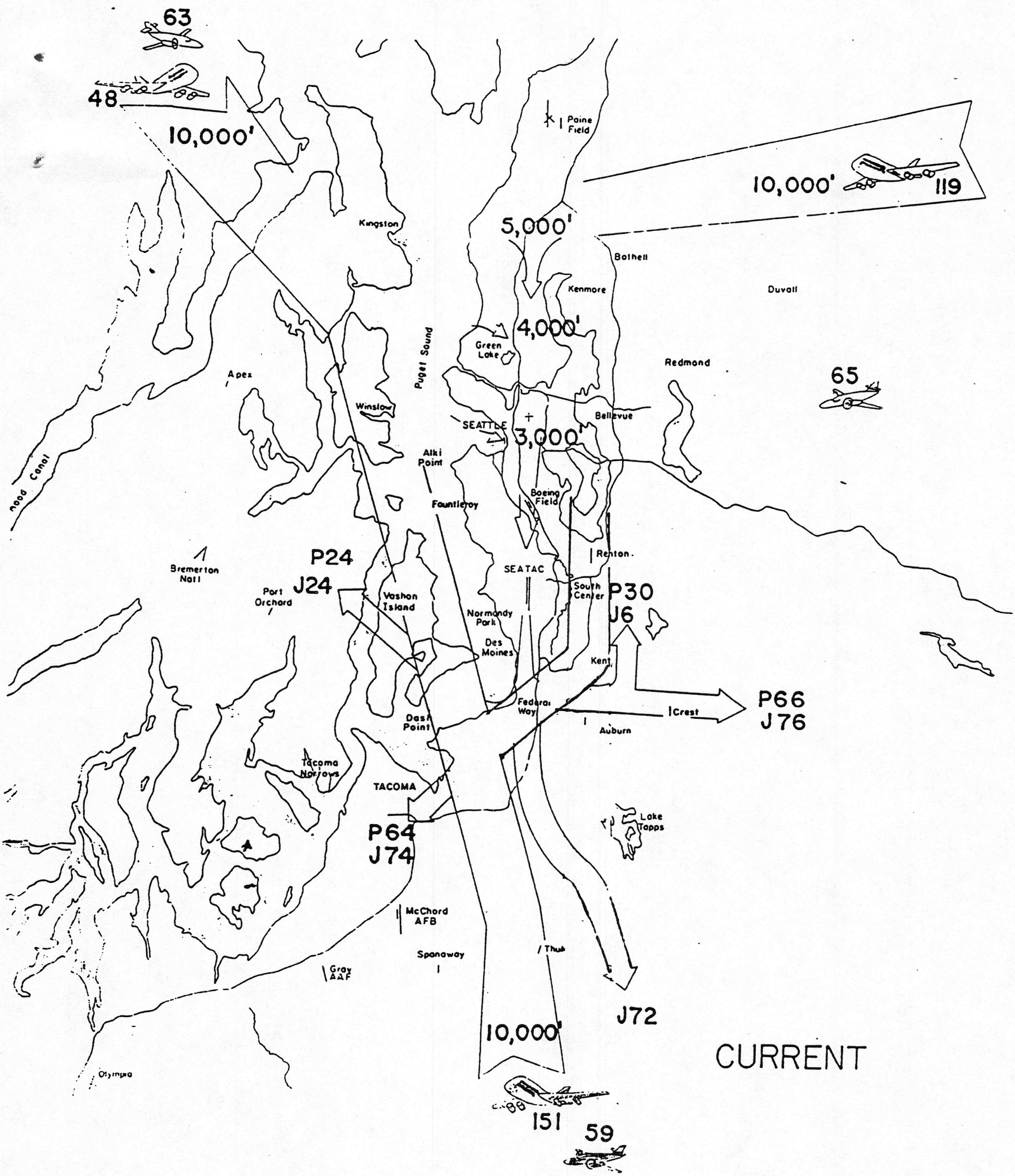
b. This configuration seems to lend itself to a single feeder, two final arrangement. Feeder works the aircraft along the 158 radial, balances workload between the final controllers; assigns initial speeds, altitudes, merges some flows, assures aircrews have airport info.

c. Requirement to turn turbojets onto final from east outside the SEA 338/17 causes lost arrival opportunities, some of these will be filled from the west side; some by turboprops.

d. There is ample space for departures.

e. This configuration could not be mated with the static ARTCC arrival routes which are proposed to relieve the high altitude issues described on page 10 above. Instability and inefficiency problems with the enroute structure will continue.

SOUTH FLOW
RUNWAYS 16



DEMONSTRATION #12

DEMONSTRATION #13

Airspace simulation was conducted on September 19, 1989, using the following conditions:

1. South Flow.

2. Assume Seattle ARTCC arrival routes are as proposed, with fixed arrival flows in four corners of the terminal airspace.

3. Alter Seattle TRACON internal airspace to divide arrival airspace along the 307 radial, East and West feeder controllers establish turbojet aircraft either side of the 307 radial, provide airspace for a final controller to place aircraft on a modified final approach course which passes through Elliott Bay.

4. Honor all other existing noise abatement constraints.

5. Good weather permitting full use of simultaneous arrivals to runways 16L/R; ready visual identification and separation of aircraft.

OBSERVATIONS

a. Four fixed arrival routes would require use of the "wide turbojet downwind" as demonstrated in 4 and 10 above with resulting limitations. This plan is grossly inefficient. It involves extended flight at low altitude near mountainous terrain for both arrivals and departures, with resultant high fuel consumption and increased air pollution.

While it maximizes noise abatement for those areas on the east side of Lake Washington which have not experienced south flow turbojet overflights, aircraft noise would be introduced into new areas in the vicinity of North Bend, Snoqualmie, and Carnation.

This procedure would have severe adverse effect on all of Bainbridge Island, Poulsbo, and Silverdale. Aircraft would be paralleling the 307 radial outbound on both sides at approximately 5,000' in a high drag/high power configuration, awaiting the final sequence.

b. Eastside downwind from the southeast would have to fly approximately 70 miles prior to turning final for the airport. The potential for excessive demand and span of control for the East Feeder position is large.

c. West Feeder has severely constricted airspace due to Seattle Departures, McChord operations; would have difficulty achieving all initial tasks before passing control of aircraft to final controller.

d. Final controller would probably have to take arrivals from the northwest direct from Seattle ARTCC; would have no maneuvering room in which to sequence these aircraft.

e. Downwind aircraft would often require lost communication instructions while pointed toward the Olympic Range.

f. If the turbojet inbound on the 307 radial fails to establish visual contact with the turboprops inbound along the 338 radial as they enter Elliott Bay, a missed approach and re-sequence may be needed. The final controller would not have sufficient airspace to encompass this maneuver; aircraft would have to be handed back to feeder, with the possibility of pointouts to other operating positions.

Discussion of Alternatives

Analysis of the simulations and observations in III, above, resulted in the following ranking of procedures proposed by Seattle ARTCC and TRACON to achieve greater efficiency and safety for Seattle-Tacoma Airport Traffic. These are listed in descending order of desirability. All alternatives below Alternative G, which is essentially, "Make no changes," were regarded as ineffective or unsafe and were not ranked. Please refer to the individual demonstrations above for details of these alternatives.

Alternative A -- "The Price Alternative" see Demonstration #3:

Seattle ARTCC makes route and sector changes needed to eliminate high altitude crossings east of Ephrata, Washington, effecting Seattle arrivals and departures. Fixed non-runway-sensitive arrival flows will be established over Olympia, JAKSN (40 miles NE of Seattle VOR), RADDY (39 SE of Seattle VOR), and JAWBN (42 NW of Seattle VOR).

Seattle TRACON continues all arrivals inbound to join symmetrical downwind legs on either side of airport approximately 8 miles out, turns aircraft to final at or above 3,000' AGL, except where present procedures permit a lower final approach intercept.

Departing turbojet aircraft turn as needed leaving 3,000' AGL, and proceed via Paine, Tatoosh, or the Seattle 227, 069 or 143 radials, as dictated by their destination.

Alternative B "Modified Price" See Demonstration #3:

Seattle ARTCC makes changes as summarized in Alternative A.

Seattle TRACON makes arrival changes as summarized in Alternative A, except in the south flow where it continues to use Elliott Bay Procedures from the west side of the airport and keeps turbojets high on the east downwind, turning to the base and final legs 17 miles or more north of the SEA VOR, as is presently required.

Departing turbojet aircraft turn as needed leaving 3,000' AGL, and proceed via Paine, Tatoosh, or the Seattle 069, 227, or 143 radials, as dictated by their destination.

<u>Alternative C "3-Downwind Option"</u>. See Demonstration #10:

Seattle ARTCC makes changes as summarized in Alternative A.

Seattle TRACON makes arrival changes as summarized in Alternative A above, but routes all east side noisy jets (those not in compliance with FAR 36 Stage III standards) downwind east of the populous area of King County and base leg approximately 17 miles north of the Seattle VOR.

Departing turbojet aircraft turn as needed leaving 3,000' AGL, and proceed via Paine, Tatoosh, or the Seattle 069, 227, or 143 radials, as dictated by their destination.

<u>Alternative D "Far Downwind"</u> See Demonstration #10:

Seattle ARTCC makes changes as summarized in Alternative A.

Seattle TRACON makes changes as summarized in Alternative A above, but routes all east side turbojets downwind east of the populous area of King County and base leg approximately 17 miles north of the Seattle VOR.

Departing turbojet aircraft turn as needed leaving 3,000' AGL, and proceed via Paine, Tatoosh, or the Seattle 069, 227, or 143 radials, as dictated by their destination.

<u>Alternative E "Flip-Flop"</u> See Demonstration #12:

Seattle ARTCC arrival and departure routings remain unchanged; Eastside gates change from arrival to departure status with runway change at SEA-TAC.

Seattle TRACON segregates arrival flows so that most turboprops and FAR 36 Stage III turbojets pass east of the airport, and all FAR 36 Stage I and II turbojets pass west of the airport on downwind. In the south flow it continues to use Elliott Bay Procedures from the west side of the airport and keeps turbojets high on the east downwind, turning to the base and final legs 17 miles or more north of the SEA VOR, as is presently required.

<u>Alternative F "Straight-In"</u> See Demonstration #2:

Leave all ARTCC and terminal routings as at present except:

In south flow (runway 16) situation, allow all turbojet aircraft which arrive from the east through the DUVAL gate to turn inbound on the runway 16 final approach course at the SEA 338/17, as is now allowed under certain conditions.

<u>Alternative G "No Change"</u> See Demonstration #1:

Make no changes in the present routings, airspace and noise mitigation practices.

Preferred Alternative

Although any of the Alternatives listed in IV., above can be made to work, the operational advantages of Alternative A (Demonstration 3) are clear after the thirteen simulations. This configuration is the only one which offers all of the following advantages :

a. Capacity is symmetrical, arrival rate in optimal weather remains approximately 56 to 60 irrespective of direction of landing.

b. Arrival flows are carried on downwind legs equidistant from airport on either side, permitting filling of every arrival opportunity or "slot" with an aircraft.

c. Workload can be balanced between the two arrival feeder controllers, enhancing safety and efficiency.

d. In periods of light and moderate demand, most turbojets should be able to make quiet, low-thrust descent until reaching the final approach course. While the simulation does not provide empirical data with regard to noise levels at any location, the observed ground tracks and altitudes were consistent with a "keep-them-high" noise mitigation strategy.

e. This configuration will provide the needed changes in the Seattle ARTCC by stabilizing the route structure at the ARTCC/TRACON boundary, and enhancing the efficiency of arrival metering. It will also reduce exposure to the awkward high altitude crossing of Seattle departure and arrival flows.

It is not possible to define "flight tracks or flight corridors" as rigid paths in the sky, but rather as representative average flows. The actual path that an aircraft will traverse will vary according to the effects of many factors such as: aircraft type (size, weight, speed, navigational equipment, etc.), meteorological conditions (wind direction and velocity, visibility, ambient air temperature), pilot technique, and operational procedures.

Air traffic considerations can also cause the assignment of aircraft to various departure runways and routes other than those depicted. Some of these variables are: airspace loading, aircraft type, local weather, enroute weather, runway closures, navigational aid outages, and workload balancing. Exhibits 3,4,5,and 6 should not be construed as finite flight tracks, but rather an artist's conception of the Preferred Alternative described in detail immediately below.

Establishment of the Preferred Alternative procedures (see alternative A and demonstration 3, above) will require the following implementing directives:

1. Seattle ARTCC shall make route and sector changes needed to eliminate high altitude crossings east of Ephrata, Washington, effecting Seattle arrivals and departures. As a minimum, these changes shall include:

   a. Turbojet Arrival Flows: Fixed non-runway sensitive arrival flows will be over the Olympia VORTAC, the JAKSN Intersection (Seattle VORTAC 020 radial/40-mile DME fix), the RADDY Intersection (Seattle VORTAC 101 radial/39-mile DME fix), and JAWBN Intersection (Seattle VORTAC 307 radial/42-mile DME fix).

   b. Turbojet Departure Flows: Fixed non-runway sensitive departure flows will be over the Paine VOR, the Tatoosh VORTAC, and along the Seattle VORTAC 069, 143, and 227 radials.

2. Seattle ATCT shall establish turbojet departure flows to join Seattle ARTCC departure flows over the Paine VOR, the Tatoosh VORTAC, and along the Seattle VORTAC 069, 143, and 227 radials. Departure procedures shall include, as a minimum:

a. SOUTH FLOW: Traffic permitting, Turbojet aircraft departing Runways 16, shall not be turned (radar vectored) until the aircraft is at or above 3,000 feet MSL and is at least 5 nautical miles south of the airport.

b. NORTH FLOW: Traffic permitting:

1). Turbojet aircraft departing runway 34 and making a right turn east or southeast bound shall be turned off the initial departure course, only after the aircraft is at or above 4,000 feet MSL and has reached the Seattle VORTAC 8-mile DME arc.

2). Maximize use of the Duwamish Industrial Corridor for noise mitigation by assuring that turbojet aircraft departing runway 34 and making a left turn northwest or southwest bound be turned off the initial departure course at Boeing Field/King County Airport and radar vectored over Elliott Bay then to join the appropriate departure route.

3. ACTION: Seattle ATCT shall implement arrival flows in accordance with procedures defined in Seattle Tower Airspace Study "Seattle Arrival and Departures Routes; Simulation, Analysis, Recommendations", under Alternative A (page 43). Turbojet Arrival Flows will be from over the Olympia VORTAC, the

JAKSN Intersection (Seattle VORTAC 020 radial/40-mile DME fix), the RADDY Intersection (Seattle VORTAC 101 radial/39-mile DME fix), and the JAWBN Intersection (Seattle VORTAC 307 radial/42-mile DME fix). As a minimum, arrival procedures will include:

a. North and South Flows:

1). For the purpose of noise mitigation, arriving aircraft will be kept as high as possible consistant with optimum descent profiles and operational dictates.

2). To the extent possible, arriving turboprop aircraft will follow the same approximate flight tracks as turbojet aircraft, to reduce adverse noise effects of random routing at low altitudes.

b. South Flow:

1). During south flow visual approach conditions, when there is no conflicting traffic, turbojet arrivals from the Northwest and Southwest arrival fixes will be placed on a right-base leg over Elliott Bay to reduce adverse noise effects on Westside neighborhoods and assure maximum use of the Duwamish River industrial corridor.

2). During south flow operations, turbojet arrivals from the Northeast and Southeast arrival fixes will be positioned so as to be established on the Runway 16 final approach course, no closer to the airport than State Route 520 (11.0 nautical miles north) and no lower than 5,000 feet MSL, to assure a stabilized, low-power approach and minimize flight at low altitude.

3). Traffic permitting, turbojet aircraft on the "Long Leg" tracks, will be turned to a downwind leg at the

Seattle VORTAC 101 radial/8-mile DME fix or the 8-mile DME fix on a direct course from the Olympia VORTAC to the Seattle VORTAC, at or above 11,000 feet MSL, as appropriate.

c. North Flow: Traffic permitting, turbojet aircraft on the "Long Leg" tracks, will be turned to a downwind leg at the Seattle VORTAC 020 radial/8-mile DME fix or the Seattle VORTAC 307 radial/8-mile DME fix, at or above 11,000 feet MSL, as appropriate.

III Affected Environment

The environment affected by the present and proposed air traffic routings to and from the Seattle-Tacoma International Airport encompasses the entire Puget Sound Basin. The proposed air traffic changes would establish new arrival routes over an area from Olympia to Dash Point (north of Tacoma) and from an area northeast of Duvall to Lake Sammamish (see Exhibits 4 and 6 respectively).

Comparison of Exhibits 3 (current north flow) and 4 (proposed north flow) and exhibits 5 (current south flow) and 6 (proposed south flow) will illustrate the general differences between current and proposed air traffic routings.

IV Environmental Consequences

This section of the environmental assessment presents anticipated environmental impacts associated with alternatives to the proposed action. The discussion to follow is limited to the topics of noise, energy resources, and air quality because only these three topics apply to aircraft arrival and departure procedures.

NOISE

Introduction

The noise impacts of aircraft operations at Seattle-Tacoma International Airport in both north and south flow conditions have been assessed for the current and proposed operational scenarios. The standard Federal noise measurement methodology was used which is the Day-Night Sound Level DNL (a 24 hour cumulative measure of noise exposure).

The Day-Night Sound Level (DNL) was developed after years of research by numerous scientific groups as a single number measure of community noise exposure (Ref 5). The DNL and particularly DNL 65 has been adopted formally by the Department of Transportation, the Department of Defense, the Environmental Protection Agency, the Veterans Administration, and the Department of Housing and Urban Development as the metric for assessing the cumulative impact of various sources of noise (Ref 1). Federal Aviation Regulation (FAR) Part 150 Airport Noise Compatibility Planning (Ref 2) also requires the use of DNL and DNL 65 in assessing the noise impact caused by aircraft operations at airports and establishing the threshold level of significant noise impact.

DNL is the average noise level over a 24-hour period, except that noises occurring during night time (10:00 p.m. through 7:00 a.m.) are increased or penalized by 10 dB. This nighttime "weighting" is to account for the added sensitivity to noise during the nighttime hours.

FAR Part 150 also established a set of land use compatibility guidelines for determining the suitability of certain land uses within specific ranges of DNL. Exhibit 1 presents the land use/DNL relationship used in determining whether or not a land use is considered, by the FAA, as compatible with a nearby airport. Exhibit 1 indicates that all land uses in noise environments of DNL 65 or less are compatible with airport operations.

Environmental Impacts

No-Action Alternative

During the past year, the Port of Seattle has completed a re-evaluation of the noise exposure contours produced by the operation of Sea-Tac. That re-evaluation considered updated aviation forecasts, flight paths, and runway use distribution. The results of that re-evaluation were made public during numerous public meetings regarding the assumptions and results of the study. Exhibit 2 presents the 1988 DNL 80, 75, 70, and 65 Noise Contours for the current operations at Sea-Tac.

The complete assumptions used to produce Exhibit 2 are contained in the 1989 Noise Exposure Map Documentation for Sea-Tac International Airport prepared for the Port of Seattle by Coffman Associates (Reference 3). The FAA Seattle Airports District Office has evaluated the assumptions used and believes them to be reasonable. The FAA therefore believes Exhibit 2 to be the best available data depicting the current (1988) noise exposure contours for Sea-Tac.

Selecting the No-Action alternative would result in continuation of the present environmental impacts shown in Exhibit 2.

Other Alternatives Evaluated

In addition to the No-Action and Preferred alternatives, five other alternatives (see demonstrations #3, 10, 12, and 2) were evaluated from an environmental perspective. In all cases, alternative arrival and departure route changes occurred beyond either the north or south ends of the existing 1988 DNL 65 noise exposure contour. Therefore, the DNL 65 and greater noise contours will not change.

Given that the DNL 65 and greater noise contours do not change, all locations outside of the DNL 65 contour remain compatible with the airport.

Preferred Alternative

For the proposed changes in north or south flow patterns to affect the noise contours presented in Exhibit 2, the changes would have to take place within the DNL 65 contour since it is aircraft flight in this area that produces the noise depicted by the noise contours. Exhibit 2 presents noise contours using the current operational flows.

Proposed Action-North Flow

In a northerly direction, the DNL 65 contour (from Exhibit 2) ends approximately 6.25 miles north of the north end of the runways. Examining Exhibits 3 (present) and 4 (proposed) we see that any change in the traffic pattern occurs approximately 7 miles north of the north end of the runways. Therefore the proposed changes north of the airport will not change the DNL 65 or greater contours.

In a southerly direction, the DNL 65 contour (from Exhibit 2) ends approximately 6.82 miles south of the south end of the runways. Comparing the nearest turns from base leg to final leg of the approach from the south in Exhibits 3 and 4, we see that the turns occur, in both cases, south of Federal Way and south of the south end of the DNL 65 contour. Therefore, the proposed changes south of the airport will not change the DNL 65 or greater contours.

Proposed Action-South Flow

In a southerly direction, the DNL 65 contour (from Exhibit 2) ends approximately 6.82 miles south of the south end of the runways. Examining Exhibits 5 (present) and 6 (proposed) we see that the point where departure turns are initiated is the same for either current or proposed south flow alternatives. Therefore the proposed changes south of the airport will not change the DNL 65 or greater contours.

In a northerly direction, the DNL 65 contour (from Exhibit 2) ends approximately 6.25 miles north of the north end of the runways. Examining Exhibits 5 and 6 we see that the point where arrival turns on to the final approach are initiated is the same for either current or proposed south flow alternatives. Therefore the proposed changes north of the airport will not change the DNL 65 or greater contours.

Conclusion

Given that the DNL 65 and greater noise contours do not change as a result of the implementation of the proposed action, all locations outside of the DNL 65 contour remain compatible with the airport.

ENERGY RESOURCES AND AIR QUALITY

No-Action Alternative

Continued use of the present arrival and departure routes will result in no change in energy resource consumption or air quality impacts.

Other alternatives considered and the Preferred Alternative

There is no quantitative data available on the amount of fuel consumed and the resulting air quality effects of any of the alternatives explored. There are, however, known operational characteristics of turbojet aircraft from which certain conclusions about fuel consumption are drawn. These conclusions are:

1) Turbojet engines are less efficient at lower altitudes.

2) Procedures which prolong flight are less desirable.

3) Arrival procedures which require level flight at high power settings are undesirable, while arrival procedures predicated on a constant descent profile are highly efficient.

4) Departure procedures which restrict turbojet aircraft to lower altitudes for extended distances are inefficient.

Optimum turbojet descent and departure procedures are based on the operational conclusions detailed above. Design guidelines for procedural development of fuel efficient operations are contained in the Agency directive outlining local flow traffic management and optimum descent procedures (Reference 4). Under the procedures of demonstration scenarios 4, 6, 10, and 13, arrival traffic from the east would require 25 to 45 miles of level flight within the low altitude stratum for downwind leg. Under existing procedures (Demonstration #1), extended low-altitude, level-flight maneuvering of arriving traffic becomes commonplace during periods where demand exceeds 42 aircraft per hour. Demonstrations 4, 10, and 13, procedures necessitate restricting departing east-bound turbojets to 13,000 feet, or below, for 45 flying miles.

EXHIBIT 1

LAND USE COMPATIBILITY* WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVELS

Land Use	*Yearly Day-Night Average Sound Level (L_{dn}) in Decibels*					
	Below 65	*65-70*	*70-75*	*75-80*	*80-85*	*Over 85*
Residential						
Residential, other than mobile homes and transient lodgings	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
Public Use						
Schools	Y	N1)1	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Governmental services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
Commercial Use						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail—building materials, hardware and farm equipment	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade—general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
Manufacturing And Production						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Numbers in parentheses refer to notes.

* The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

KEY

SLUCM	Standard Land Use Coding Manual.
Y (Yes)	Land Use and related structures compatible without restrictions.
N (No)	Land Use and related structures are not compatible and should be prohibited.
NLR	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
25, 30, or 35	Land used and related structures generally compatible; measures to achieve NLR or 25, 30, or 35 dB must be incorporated into design and construction of structure.

NOTES FOR EXHIBIT 1

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10 or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR of 25 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(3) Measures to achieve NLR of 30 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

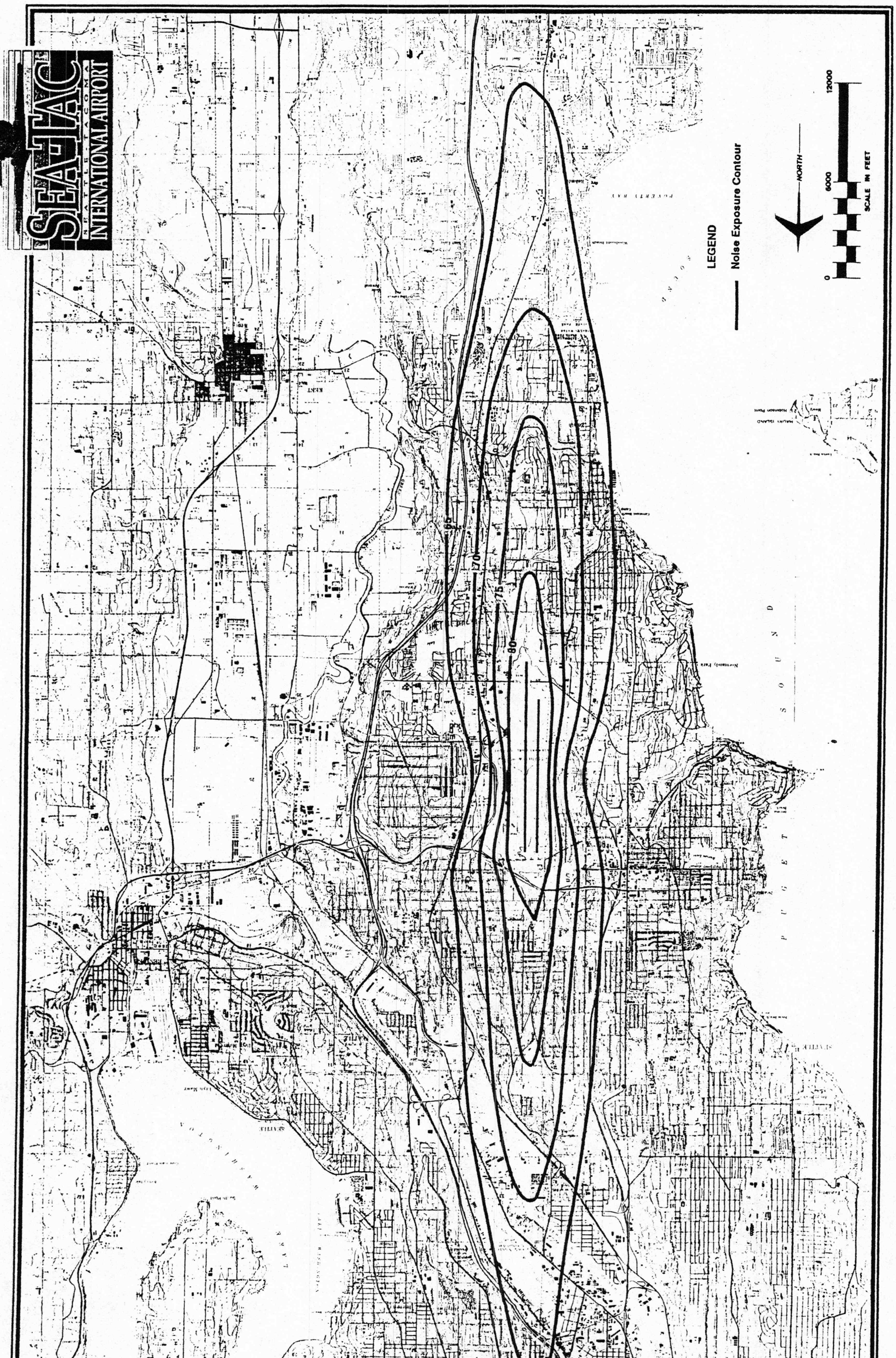
(4) Measures to achieve NLR of 35 dB must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require an NLR of 25.

(7) Residential buildings require an NLR of 30.

(8) Residential buildings not permitted.



6/89

Exhibit 2
1988 NOISE CONTOURS

EXHIBIT 3

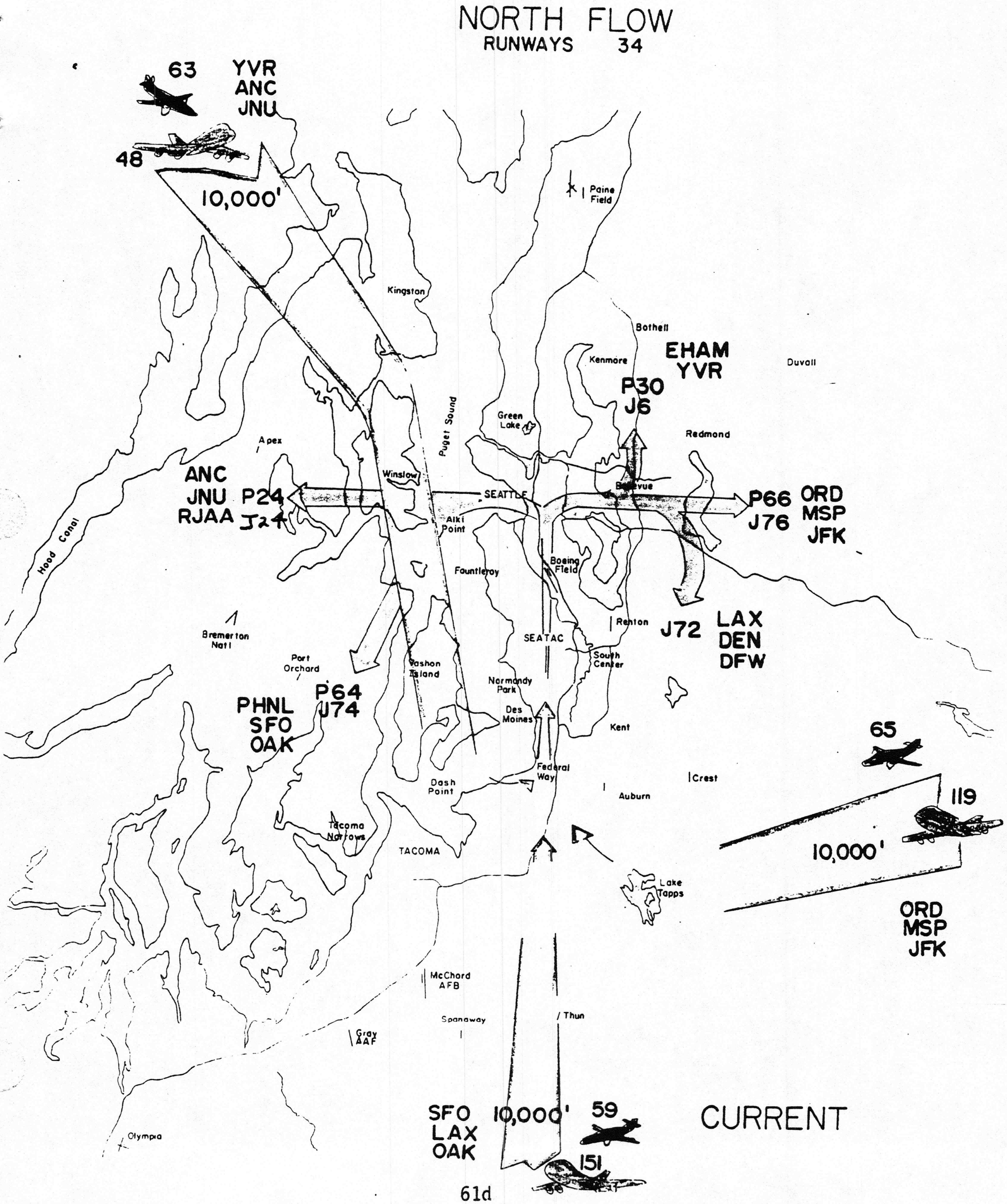
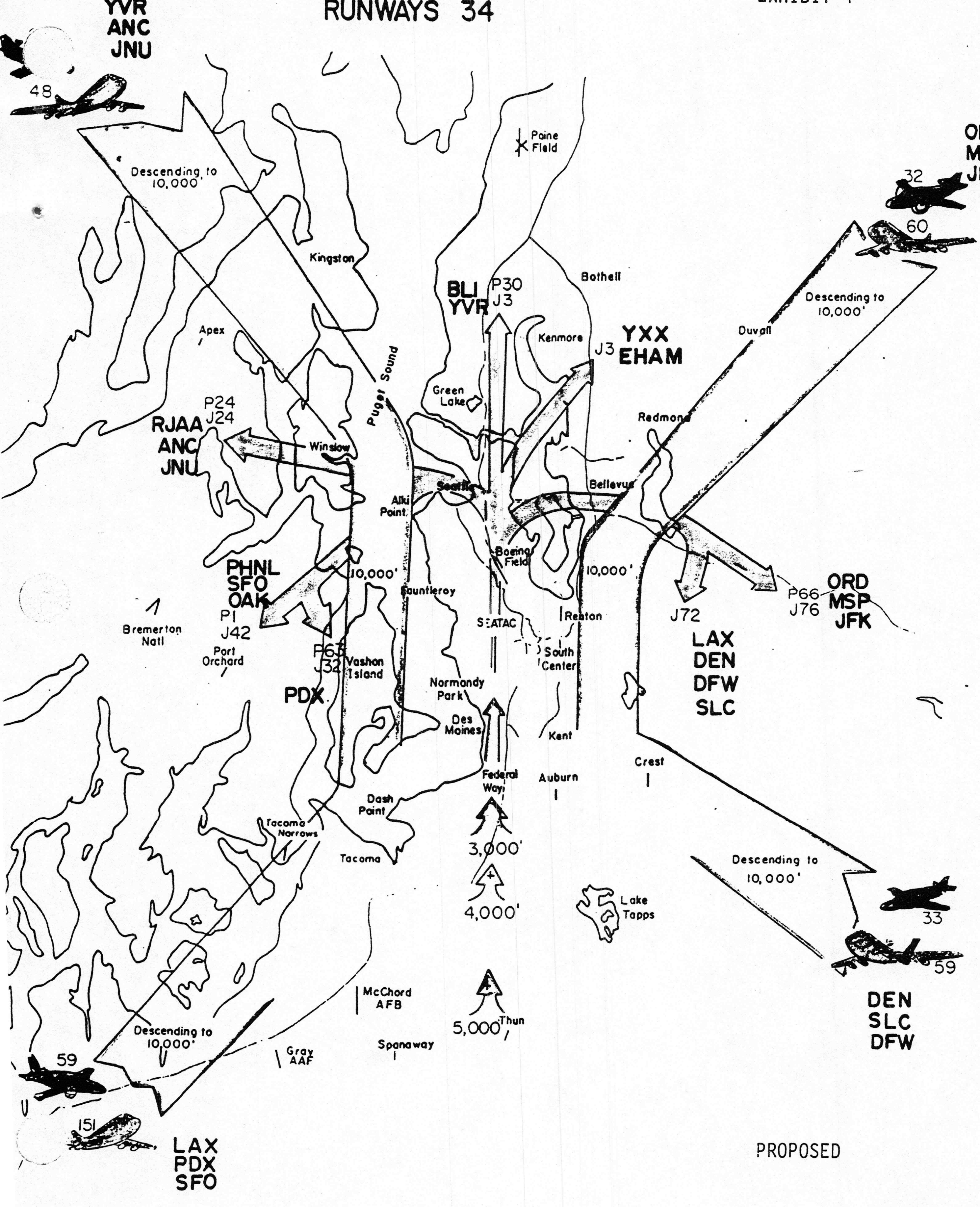

NORTH FLOW
RUNWAYS 34
63
YVR
ANC
JNU
48
10,000'
Paine Field
Kingston
Bothell
Kenmore
EHAM
YVR
Duvall
P30
J6
Green Lake
Puget Sound
Apex
Redmond
ANC
JNU
RJAA
P24
J24
Winslow
SEATTLE
Bellevue
P66
J76
ORD
MSP
JFK
Hood Canal
Alki Point
Fauntleroy
Boeing Field
Bremerton Nat'l
Renton
J72
LAX
DEN
DFW
SEATAC
South Center
Port Orchard
Vashon Island
P64
J74
PHNL
SFO
OAK
Normandy Park
Des Moines
Kent
65
Federal Way
Dash Point
Crest
Auburn
119
Tacoma Narrows
TACOMA
10,000'
Lake Tapps
ORD
MSP
JFK
McChord AFB
Spanaway
Thun
Gray AAF
SFO
LAX
OAK
10,000'
59
151
CURRENT
Olympia

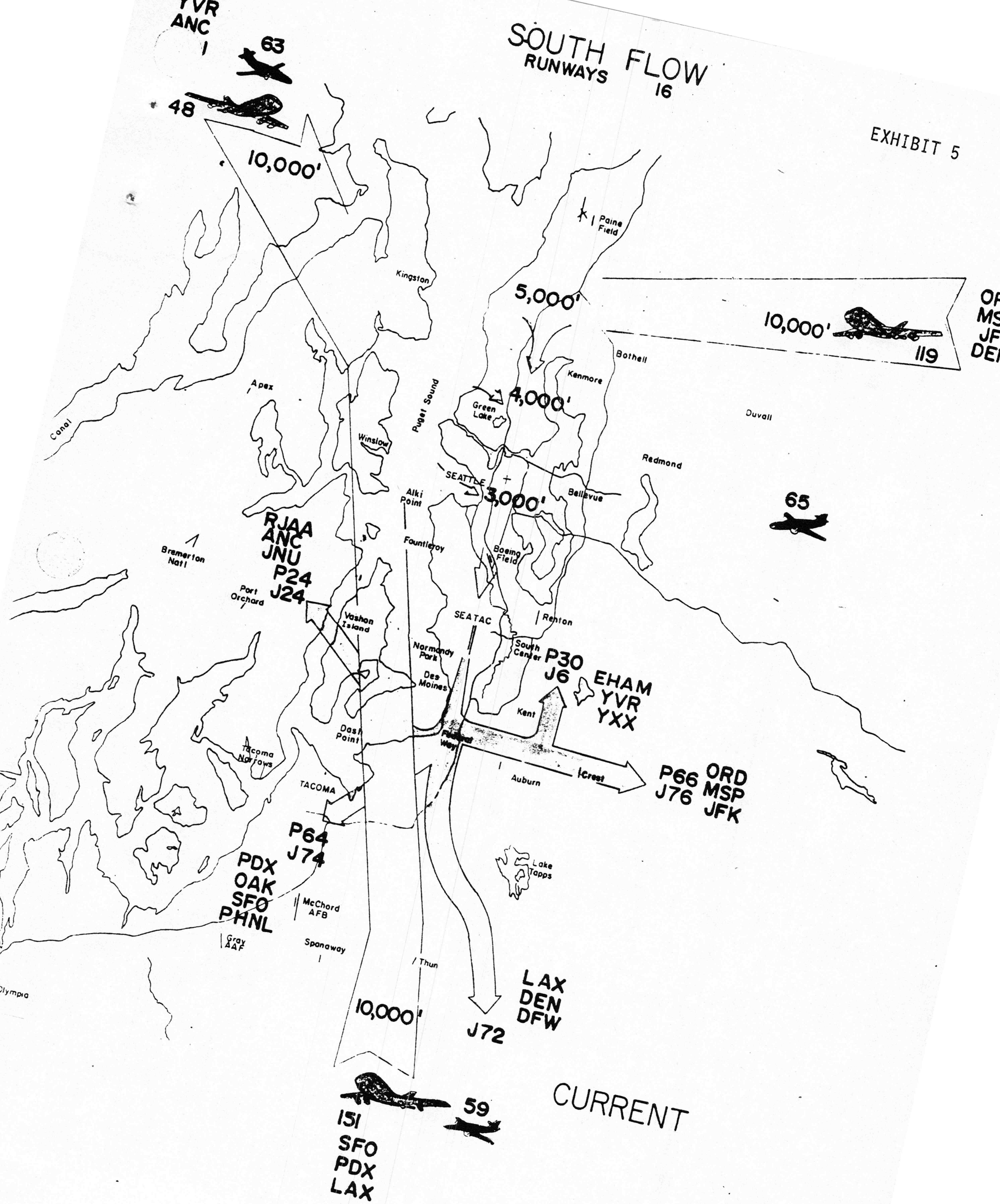
EXHIBIT 4

NORTH FLOW RUNWAYS 34



PROPOSED

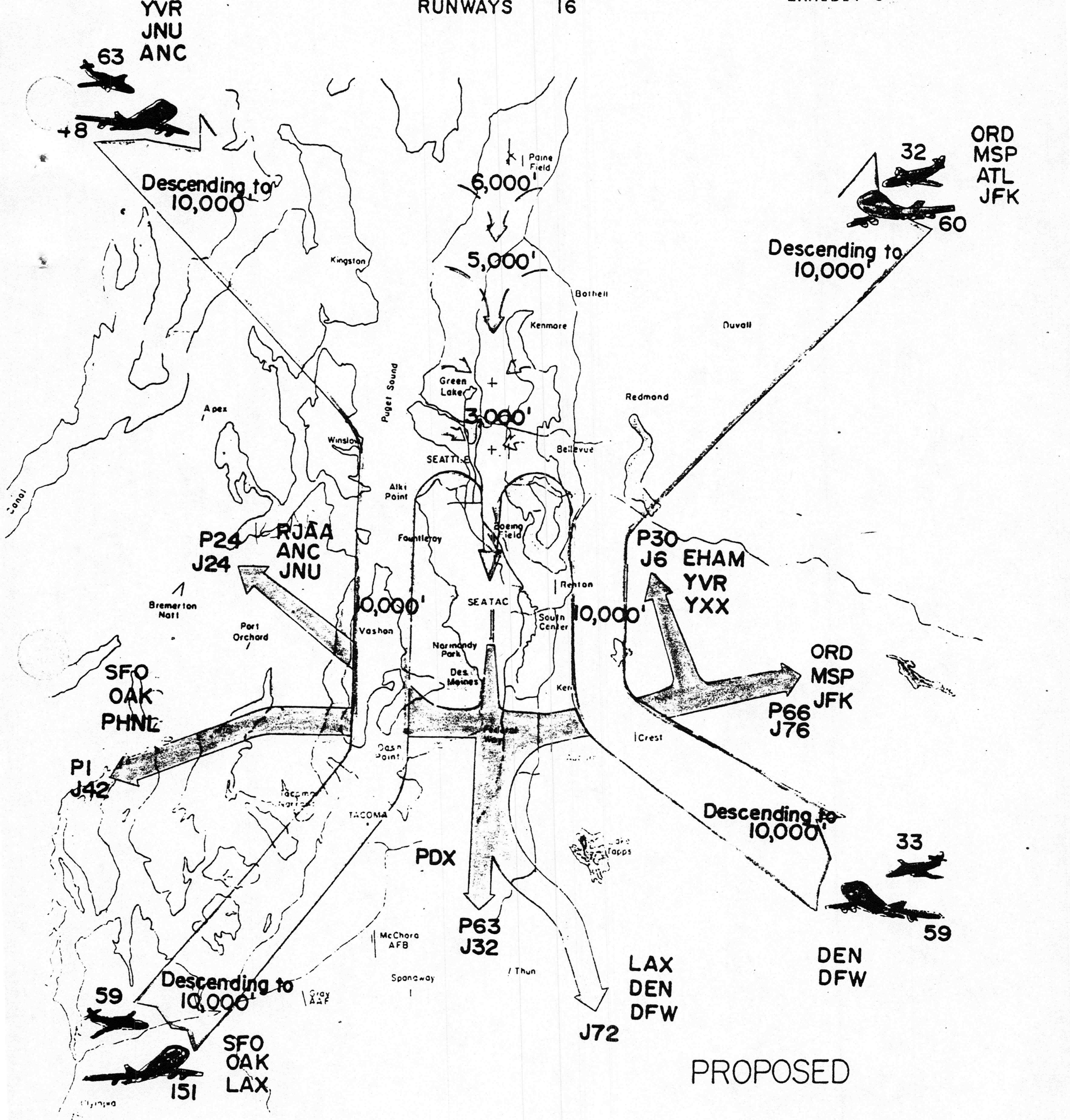
EXHIBIT 5


SOUTH FLOW
RUNWAYS 16
CURRENT
YVR
ANC
I
63
48
10,000'
Paine Field
Kingston
5,000'
10,000'
119
Bothell
Kenmore
4,000'
Green Lake
Apex
Canal
Puget Sound
Winslow
Duvall
Redmond
SEATTLE
3,000'
Alki Point
Bellevue
65
RJAA
ANC
JNU
P24
J24
Bremerton Natl
Fauntleroy
Boeing Field
Port Orchard
Vashon Island
SEATAC
Renton
Normandy Park
South Center
P30
J6
EHAM
YVR
YXX
Des Moines
Kent
Dash Point
Federal Way
Tacoma Narrows
Auburn
Crest
P66
J76
ORD
MSP
JFK
TACOMA
P64
J74
PDX
OAK
SFO
PHNL
Lake Tapps
McChord AFB
Gray AAF
Spanaway
Thun
Olympia
LAX
DEN
DFW
10,000'
J72
59
151
SFO
PDX
LAX

SOUTH FLOW

RUNWAYS 16

EXHIBIT 6



PROPOSED

V. LIST OF PREPARERS AND AGENCIES AND PERSONS CONTACTED

This section lists: 1) those individuals who assisted in the preparation of this environmental assessment and 2) those agencies and persons contacted during preparation of this environmental assessment.

LIST OF PREPARERS

FAA Environmental Team

William T. Butler, B.A., Political Science, University of Colorado, 1972. Air Traffic Control Specialist assigned to the Air Traffic Division Staff, Northwest Mountain Region. Prior Experience: 19 years as an air traffic control specialist, including service in two Air Route Traffic Control Centers, six control towers and approach controls; including eight years experience in development of air traffic control procedures. EA Responsibilities: Review of operational feasibility of proposed arrival and departure procedures and text preparation.

Dennis G. Ossenkop, B.S., Interdisciplinary (Engineering, Physics, Mathematics), Portland State University, 1965; M.B.A., University of Puget Sound, 1979. Regional Environmental Officer, Northwest Mountain Region, Airports Division. Prior experience: 3 years with U.S.E.P.A.(environmental evaluation and noise control) and 11 years experience with FAA in development of environmental and noise compatibility program documentation. EA responsibilities: Environmental text preparation, noise.

Regina R. Belt, A.B., Mathematics, Smith College, 1977; J.D., American University, 1982. Prior experience: Two years as general attorney, in FAA Northwest Mountain Region, four years as trial attorney, U.S. Department of Justice, Land and Natural Resources Division, Washington, D.C., four years as law clerk and paralegal, U.S. Department of Justice, Land and Natural Resources Division, Washington, D.C. EA responsibilities: Legal review of EA.

LIST OF AGENCIES AND PERSONS CONTACTED

Aviation Industry and Airport Users:

Jerry Ackerson
George Bagley, Horizon Airlines
Neil Bennett, Air Transport Association
Bill Chatham, Regional Chambers of Commerce
Bill Lax, Federal Express
Harry Lehr, Alaska Airlines
John McNamara, Air Transport Association
Ed Nielson, United Airlines
Michael Oswald, Airline Pilots Assn.
Art Thomas, Horizon Airlines
Paul Weigand, Puget Sound Power & Light

Bellevue Journal-American

Bogan and Associates

Eastside Caucus:

Sigrid Guyton, Eastside Citizens Against Noise
Ted Misselwitz
Bob Rudolph, Eastside Citizens Against Noise
Paul Sanders

Kitsap County:

Jim Decker, Bainbridge Island, representing County Commissioners

Magnolia Community Club

Mestre-Greve

Mount Baker Community Club

Northeast District Council

North/Northwest Caucus:

Alan Ament
John Musgrave, Southwest District Council
Don Padelford, Seattle Noise Abatement Group
Paul Purcell

Part 150 Caucus:

Don Bell
Kris Hansen
Irene Jones
Terry Rogers

Pierce County:

Bruce Thun, Manager, Pierce County Airport

Queen Ann Community Council

Ravenna-Bryant Community Council

City Council, City of Seattle

Seattle Community Council Federation

Commissioners, Port of Seattle

Staff, Port of Seattle:

Andrea Beatty-Riniker, Director of Aviation
Gary LeTellier, Deputy Director of Aviation
Diane Summerhays

Seattle Post-Intelligencer

Seattle Times

Snohomish County:

Bill Dolan, Aviation Supervisor

South/Southwest Caucus:

Bob Edgar
Alan Twidt
Bill Whisler, Des Moines City Council
John Whitlock, Vashon Island Community Council

Washington Congressional Delegation:

Senator Gorton
Congressman Chandler
Congressman Miller

Staff members to:

Senator Adams

Congressman McDermott

VI REFERENCES

1. Guidelines for Considering Noise in Land Use Planning and Control, June 1980, Federal Interagency Committee on Urban Noise.

2. Federal Aviation Regulation, Part 150, Airport Noise Compatibility Planning, February 28, 1981.

3. Seattle-Tacoma International Airport Noise Exposure Map Update, 1989, Coffman Associates, Inc. for The Port of Seattle.

4. FAA Order 7110.88, Local Flow Traffic Management-Optimum Decent Procedures, May 8, 1981, FAA

5. Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with An Adequate Margin of Safety, March 1974, U.S. Environmental Protection Agency.

Appendix A - Glossary

This Glossary was compiled to promote a common understanding of the terms used in this document and were excerpted or paraphrased from those listings in The Airman's Information Manual (AIM) dated June 1, 1989.

ABEAM - An aircraft is "abeam" a fix, point, or object when the fix, point, or object is approximately 90 degrees to the right or left of the aircraft track. Abeam indicates a general position rather than a precise point.

ADDITIONAL SERVICES - Additional services are provided to the extent possible contingent only upon the controller's capability to fit them into the performance of higher priority duties and on the basis of limitations of the radar, volume of traffic, frequency congestion, and controller workload.

AIRCRAFT CLASSES - For the purposes of Wake Turbulence Separation Minima, ATC classifies aircraft as Heavy, Large, and Small as follows:

1. Heavy - Aircraft capable of takeoff weights of 300,000 pounds or more whether or not they are operating at this weight during a particular phase of flight.

2. Large - Aircraft of more than 12,500 pounds, maximum certificated takeoff weight, up to 300,000 pounds.

3. Small - Aircraft of 12,500 pounds or less maximum certificated takeoff weight. (Refer to AIM).

AIRMAN'S INFORMATION MANUAL/AIM - A primary FAA publication whose purpose is to instruct airmen about operating in the National Airspace System of the U.S.

AIR NAVIGATION FACILITY - Any facility used in, available for use in, or designed for use in, aid of air navigation, including landing areas, lights, any apparatus or equipment for disseminating weather information, for signaling, for radio-directional finding, or for radio or other electrical communication, and any other structure or mechanism having a similar purpose for guiding or controlling flight in the air or the landing and take-off of aircraft. (See Navigational Aid).

AIRPORT - An area on land or water that is used or intended to be used for the landing and takeoff or aircraft and includes its buildings and facilities, if any.

AIRPORT ELEVATION/FIELD ELEVATION - The highest point of an airport's usable runways measured in feet from mean sea level. (See Touchdown Zone Elevation).

AIRPORT SURVEILLANCE RADAR/ASR - Approach control radar used to detect and display an aircraft's position in the terminal area. ASR provides range and azimuth information but does not provide elevation data coverage of the ASR can extend up to 60 miles.

AIRPORT TRAFFIC AREA - Unless otherwise specifically designed in FAR Part 93, that airspace within a horizontal radius of 5 statute miles from the geographical center of any airport at which a control tower is operating, extending from the surface up to, but not including, an altitude of 3,000 feet above the elevation of an airport. Unless otherwise authorized or required by ATC, no person may operate an aircraft within an airport traffic area except for the purpose of landing at or taking off from an airport within that area. ATC authorizations may be given as individual approval of specific operations or may be contained in written agreements between airport users and the tower concerned.

AIR ROUTE TRAFFIC CONTROL CENTER/ARTCC - A facility established to provide air traffic control service to aircraft operating on IFR flight plans within controlled airspace and principally during the en route phase of flight. When equipment capabilities and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft.

AIRSPEED - The speed of an aircraft relative to its surrounding air mass. The unqualified term "airspeed" means one of the following:

1. Indicated Airspeed - The speed shown on the aircraft airspeed indicator. This is the speed used in pilot/controller communications under the general term "airspeed>" (Refer to FAR PART 1).

2. True Airspeed - The airspeed of an aircraft relative to undisturbed air. Used primarily in flight planning and en route portion of flight. When used in pilot/controller communications, it is referred to as "true airspeed" and not shortened to "airspeed."

AIR TRAFFIC - Aircraft operating in the air or on an airport surface, exclusive of loading ramps and parking areas.

AIR TRAFFIC CLEARANCE/ATC CLEARANCE - An authorization by air traffic control, for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace.

AIR TRAFFIC CONTROL/ATC - A service operated by appropriate authority to promote the safe, orderly and expeditious flow of air traffic.

AIR TRAFFIC CONTROL SPECIALIST/CONTROLLER - A person authorized to provide air traffic control service. (See Air Traffic Control, Flight Service Station).

ALPHANUMERIC DISPLAY/DATA BLOCK - Letters and numerals used to show identification, altitude, beacon code, and other information concerning a target on a radar display.

ALTITUDE - The height of a level, point, or object measured in feet Above Ground Level (AGL) or from Mean Sea Level (MSL). (See Flight Level).

1. MSL Altitude - Altitude expressed in feet measured from mean sea level.

2. AGL Altitude - Altitude expressed in feet measured above ground level.

3. Indicated Altitude - The altitude as shown by an altimeter. On a pressure or barometric altimeter it is altitude as shown uncorrected for instrument error and uncompensated for variation from standard atmospheric conditions.

ALTITUDE READOUT/AUTOMATIC ALTITUDE REPORT - An aircraft's altitude, transmitted via the Mode C transponder feature, that is visually displayed in 100-foot increments on a radar scope having readout capability.

ALTITUDE RESTRICTION - An altitude or altitudes, stated in the order flown, which are to be maintained until reaching a specific point or time. Altitude restrictions may be issued by ATC due to traffic, terrain, or other airspace considerations.

APPROACH CLEARANCE - Authorization by ATC for a pilot to conduct an instrument approach. The type of instrument approach for which a clearance and other pertinent information is provided in the approach clearance when required.

APPROACH CONTROL FACILITY - A terminal ATC facility that provides approach control service in a terminal area.

APPROACH CONTROL SERVICE - Air traffic control service provided by an approach control facility for arriving and departing VFR/IFR aircraft and, on occasion, en route aircraft. At some airports not served by an approach control facility, the ARTCC provides limited approach control service. (Refer to AIM).

APPROACH GATE - An imaginary point used within ATC as a basis for vectoring aircraft to the final approach course. The gate will be established along the final approach course 1 mile from the outer marker (or the fix used in lieu of the outer marker) on the side away from the airport for precision approaches and 1 mile from the final approach fix on the side away from the airport for nonprecision approaches. In either case when measured along the final approach course, the gate will be no closer than 5 miles from the landing threshold.

APPROACH SEQUENCE - The order in which aircraft are positioned while on approach or awaiting approach clearance. (See Landing Sequence).

APPROACH SPEED - The recommended speed contained in aircraft manuals used by pilots when making an approach to landing. This speed will vary for different segments of an approach as well as for aircraft weight and configuration.

ARRIVAL TIME - The time an aircraft touches down on arrival.

AUTOMATED RADAR TERMINAL SYSTEMS/ARTS - The generic term for the ultimate in functional capability afforded by several automation systems. Each differs in functional capabilities and equipment. ARTS plus a suffix roman numeral denotes a specific system. A following letter indicates a major modification to that system. In general, an ARTS displays for the terminal controller aircraft identification, flight plan data, other flight associated information; e.g., altitude, speed, and aircraft position symbols in conjunction with his radar presentation. Normal radar co-exists with the alphanumeric display. In addition to enhancing visualization of the air traffic situation, ARTS facilitate intra/inter-facility transfer and coordination of flight information.

AUTOMATIC ALTITUDE REPORTING - That function of a transponder which responds to Mode C interrogations by transmitting the aircraft's altitude in 100-foot increments.

AUTOMATIC TERMINAL INFORMATION SERVICE/ATIS - The continuous broadcast of recorded noncontrol information in selected terminal areas. Its purpose is to improve controller effectiveness and to relieve frequency congestion by automating the repetitive transmission of essential but routine information; e.g., "Los Angeles information Alfa. One three zero zero Coordinated Universal Time. Weather, measured ceiling two thousand overcast, visibility three, haze, smoke, temperature seven one, dew point five seven, wind two five zero at five, altimeter two niner niner six. I-L-S Runway Two Five Left approach in use, Runway Two Five Right closed, advise you have Alfa."

BEARING - The horizontal direction to or from any point, usually measured clockwise from true north, magnetic north, or some other reference point through 360 degrees.

BELOW MINIMUMS - Weather conditions below the minimums prescribed by regulation for the particular action involved; e.g., landing minimums, takeoff minimums.

CEILING - The heights above the earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as "broken," "overcast," or "obscuration," are not classified as "thin" or "partial".

CHARTED VISUAL FLIGHT PROCEDURE (CVFP) APPROACH - An approach wherein a radar-controlled aircraft on an IFR flight plan, operating in VFR conditions and having an ATC authorization, may proceed to the airport of intended landing via visual landmarks and altitudes depicted on a charted visual flight procedure.

CONFLICT ALERT - A function of certain air traffic control automated systems designed to alert radar controllers to existing or pending situations recognized by the program parameters that require his immediate attention/action.

CONFLICT RESOLUTION - The resolution of potential conflictions between IFR aircraft and VFR aircraft that are radar identified and in communication with ATC by ensuring that radar targets do not touch. Pertinent traffic advisories shall be issued when this procedure is applied. Note: This separation procedure will not be provided utilizing fully digitized radar systems.

CONTACT -

1. Establish communication with (followed by the name of the facility and, if appropriate, the frequency to be used).

2. A flight condition wherein the pilot ascertains the attitude of his aircraft and navigates by visual reference to the surface.

CONTACT APPROACH - An approach wherein an aircraft on an IFR flight plan, having an air traffic control authorization, operating clear of clouds with at least 1 mile flight visibility and a reasonable expectation of continuing to the destination airport in those conditions, may deviate from the instrument approach procedure and proceed to the destination airport by visual reference to the surface.

CONTROLLED AIRSPACE - Airspace designated as a control zone, airport radar service area, terminal control area, transition area, control area, continental control area, and positive control area within which some or all aircraft may be subject to air traffic control.

TYPES OF U.S. CONTROLLED AIRSPACE:

1. Control Zone - Controlled airspace which extends upward from the surface of the earth and terminates at the base of the continental control area. Control zones that do not underlie the continental control area have no upper limit. A control zone may include one or more airports and is normally a circular area with a radius of 5 statute miles and any extensions necessary to include instrument approach and departure paths.

2. Airport Radar Service Area/ARSA - Regulatory airspace surrounding designated airports wherein ATC provides radar vectoring and sequencing on a full-time basis for all IFR and VFR aircraft. The service provided in an ARSA is called ARSA service which includes: IFR/IFR - standard IFR separation; IFR/VFR - traffic advisories and conflict resolution; and VFR/VFR - traffic advisories and, as appropriate, safety alerts. The AIM contains an explanation of ARSA. The ARSA's are depicted on VFR aeronautical charts.

3. Terminal Control Area/TCA - Controlled airspace extending upward from the surface or higher to specified altitudes, within which all aircraft are subject to operating rules and pilot and equipment requirements specified in FAR Part 91. TCA's are depicted on Sectional, World Aeronautical, En Route Low Altitude, DOD FLIP, and TCA charts. (Refer to FAR Part 91, AIM).

4. Transition Area - Controlled airspace extending upward from 700 feet or more above the surface of the each when designated in conjunction with an airport for which an approved instrument approach procedure has been prescribed; or from 1,200 feet or more above the surface of the earth when designated in conjunction with airway route structures or segments. Unless otherwise specified, transition areas terminate at the base of the overlying controlled airspace. Transition areas are designed to contain IFR operations in controlled airspace during portions of the terminal operation and while transiting between the terminal and en route environment.

5. Control Area - Airspace designated as Colored Federal airways, VOR Federal airways, control areas associated

with jet routes outside the continental control area (FAR 71.161), additional control areas (FAR 71.163), control area extensions (FAR 71.165), and area low routes. Control areas do not include the continental control area, but unless otherwise designated, they do include the airspace between a segment of main VOR Federal airway and its associated alternate segments with the vertical extent of the area corresponding to the vertical extent of the related segment of the main airway.

6. Continental Control Area - The airspace of the 48 contiguous States, the District of Columbia and Alaska, excluding the Alaska peninsula west of Long. 160 degrees 00' 00" "W" at and above 14,500 feet MSL, but does not include:

   a. The airspace less than 1,500 feet above the surface of the earth; or

   b. Prohibited and restricted areas, other than the restricted areas listed in FAR Part 71.

7. Positive Control Area/PCA - Airspace designated in FAR, Part 71 within which there is positive control of aircraft. Flight in PCA is normally conducted under instrument flight rules. PCA is designated throughout most of the conterminous United States and its vertical extent is from 18,000 feet MSL to and including flight level 600. In Alaska PCA does not include the airspace less than 1,500 feet above the surface of the earth nor the airspace over the Alaska Peninsula west of longitude 160 degrees West.

CONTROLLED DEPARTURE TIME (CDT) PROGRAMS - These programs are the flow control process whereby aircraft are held on the ground at the departure airport when delays are projected to occur in either the en route system or the terminal of intended landing. The purpose of these programs is to reduce congestion in the air traffic system or to limit the duration of airborne holding in the arrival center or terminal area. A CDT is a specific departure slot shown on the flight plan as an expected departure clearance time (EDCT).

DEPARTURE CONTROL - A function of an approach control facility providing air traffic control service for departing IFR and, under certain conditions, VFR aircraft. (See Approach Control) (Refer to AIM).

DEPARTURE TIME - The time an aircraft becomes airborne.

DIRECT - Straight line flight between two navigational aids, fixes, points, or any combination thereof. When used by pilots in describing off-airway routes, points defining direct route segments become compulsory reporting points unless the aircraft is under radar contact.

DISPLACED THRESHOLD - A threshold that is located at a point on the runway other than the designated beginning of the runway.

DISTANCE MEASURING EQUIPMENT/DME - Equipment (airborne and ground) used to measure, in nautical miles, the slant range distance of an aircraft from the DME navigational aid.

DME FIX - A geographical position determined by reference to a navigational aid which provides distance and azimuth information. It is defined by a specific distance in nautical miles and a radial, azimuth, or course (i.e., localizer) in degrees magnetic from that aid.

DME SEPARATION - Spacing of aircraft in terms of distances (nautical miles) determined by reference to distance measuring equipment (DME).

EN ROUTE AIR TRAFFIC CONTROL SERVICES - Air traffic control service provided aircraft on IFR flight plans, generally by centers, when these aircraft are operating between departure and destination terminal areas. When equipment, capabilities, and controller workload permit, certain advisory/assistance services may be provided to VFR aircraft.

EXPECTED DEPARTURE CLEARANCE TIME/EDCT - The runway release time assigned to an aircraft in a controlled departure time program and shown on the flight progress strip as an EDCT.

FINAL - Commonly used to mean that an aircraft is on the final approach course or is aligned with a landing area.

FINAL APPROACH COURSE - A published MLS course, a straight line extension of a localizer, a final approach radial/bearing, or a runway centerline all without regard to distance.

FINAL APPROACH FIX/FAF - The fix from which the final approach (IFR) to an airport is executed and which identifies the beginning of the final approach segment. It is designated on Government charts by the Maltese Cross symbol for nonprecision approaches and the lightning bolt symbol for precision approaches.

FLIGHT INSPECTION/FLIGHT CHECK - Inflight investigation and evaluation of a navigational aid to determine whether it meets established tolerances.

FLIGHT LEVEL - A surface of constant atmospheric pressure which is related to a specific pressure datum, 1013.2 hPa (1013.2 mb), and is separated from other such surfaces by specific pressure intervals.

FLOW CONTROL - Measures designed to adjust the flow of traffic into a given airspace, along a given route, or bound for a given aerodrome (airport) so as to ensure the most effective utilization of the airspace.

GATE HOLD PROCEDURES - Procedures at selected airports to hold aircraft at the gate or other ground location whenever departure delays exceed or are anticipated to exceed 15 minutes. The sequence for departure will be maintained in accordance with initial call-up unless modified by flow control restrictions. Pilots should monitor the ground control/clearance delivery frequency for engine startup advisories or new proposed start time if the delay changes.

GENERAL AVIATION - That portion of civil aviation which encompasses all facets of aviation except air carriers holding a certificate of public convenience and necessity from the Civil Aeronautics Board and large aircraft commercial operators.

GLIDESLOPE/GLIDEPATH - Provides vertical guidance for aircraft during approach and landing. The glideslope/glidepath is based on the following:

1. Electronic components emitting signals which provide vertical guidance by reference to airborne instruments during instrument approaches such as ILS/MSL, or

2. Visual ground aids, such as VASI, which provide vertical guidance for a VFR approach or for the visual portion of

an instrument approach and landing.

GLIDESLOPE/GLIDEPATH INTERCEPT ALTITUDE - The minimum altitude to intercept the glideslope/path on a precision approach. The intersection of the published intercept altitude with the glide-slope/path, designated on Government charts by the lightning bolt symbol, is the precision FAF; however, when ATC directs a lower altitude, the resultant lower intercept position is then the FAF.

GO AROUND - Instructions for a pilot to abandon his approach to landing. Additional instructions may follow. Unless otherwise advised by ATC, a VFR aircraft or an aircraft conducting visual approach should overfly the runway while climbing to traffic pattern altitude and enter the traffic pattern via the crosswind leg. A pilot on an IFR flight plan making an instrument approach should execute the published missed approach procedure or proceed as instructed by ATC; e.g., "Go around"

GROUND DELAY - The amount of delay attributed to ATC, encountered prior to departure, usually associated with a CDT program.

HANDOFF - An action taken to transfer the radar identification of an aircraft from one controller to another if the aircraft will enter the receiving controller's airspace and radio communica-tions with the aircraft will be transferred.

HIGH SPEED TAXIWAY/EXIT/TURNOFF - A long radius taxiway designed and provided with lighting or marking to define the path of aircraft, traveling at high speed (up to 60 knots), from the runway center to a point on the center of a taxiway. Also refer-red to as long radius exit or turn-off taxiway. The high speed taxiway is designed to expedite aircraft turning off the runway after landing, thus reducing runway occupancy time.

IFR AIRCRAFT/IFR FLIGHT - An aircraft conducting flight in accordance with instrument flight rules.

IFR CONDITIONS - Weather conditions below the minimum for flight under visual flight rules.

ILS CATEGORIES -

1. ILS Category I - An ILS approach procedure which provides for approach to a height above touchdown of not less than 200 feet and with runway visual range of not less than 1,800 feet.

2. ILS Category II - An ILS approach procedure which provides for approach to a height above touchdown of not less than 100 feet and with runway visual range of not less than 1,200 feet.

3. ILS Category III -

    a. IIIA - An ILS approach procedure which provides for approach without a decision height minimum and with runway visual range of not less than 700 feet.

    b. IIIB - An ILS approach procedure which provides for approach without a decision height minimum and with runway visual range of not less than 150 feet.

    c. IIIC - An ILS approach procedure which provides for approach without a decision height minimum and without runway visual range minimum.

INITIAL APPROACH FIX/IAF - The fixes depicted on instrument approach procedure charts that identify the beginning of the initial approach segment(s).

INSTRUMENT APPROACH PROCEDURE/IAP/INSTRUMENT APPROACH - A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually. It is prescribed and approved for a specific airport by competent authority.

1. U. S. civil standard instrument approach procedures are approved by the FAA as prescribed under FAR, Part 97 and are available for public use.

2. U. S. military standard instrument approach procedures are approved and published by the Department of Defense.

3. Special instrument approach procedures are approved by the FAA for individual operators but are not published in FAR, Part 97 for public use.

INSTRUMENT FLIGHT RULES/IFR - Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan.

INSTRUMENT LANDING SYSTEM/ILS - A precision instrument approach system which normally consists of the following electronic components and visual aids:

1. Localizer.

2. Glideslope.

3. Outer Marker.

4. Middle Marker.

5. Approach Lights.

INSTRUMENT RUNWAY - A runway equipped with electronic and visual navigation aids for which a precision or nonprecision approach procedure having straight-in landing minimums has been approved.

INTERSECTION -

1. A point defined by any combination of courses, radials, or bearings of two or more navigational aids.

2. Used to describe the point where two runways, a runway and a taxiway, or two taxiways cross or meet.

INTERSECTION - DEPARTURE/INTERSECTION TAKEOFF - A takeoff or proposed takeoff on a runway from an intersection.

JET ROUTE - A route designed to serve aircraft operations from 18,000 feet MSL up to and including flight level 450. The routes are referred to as "J" routes with numbering to identify the designated route; e.g., J105.

LANDING MINIMUMS/IFR LANDING MINIMUMS - The minimum visibility prescribed for landing a civil aircraft while using an instrument approach procedure. The minimum applies with other limitations set forth in FAR Part 91 with respect to the Minimum Descent Altitude (MDA) or Decision Height (DH) prescribed in the instrument approach procedures as follows:

1. Straight-in landing minimums - A statement of MDA and visibility, or DH and visibility, required for a str-

aight-in landing on a specified runway, or

2. Circling minimums - A statement of MDA and visibility required for the circle-to-land maneuver.

Descent below the established MDA or DH is not authorized during an approach unless the aircraft is in a position from which a normal approach to the runway of intended landing can be made and adequate visual reference to required visual cues is maintained.

LANDING SEQUENCE - The order in which aircraft are positioned for landing.

LATERAL SEPARATION - The lateral spacing of aircraft at the same altitude by requiring operation on different routes or in different geographical locations. (See Separation).

LOCALIZER - The component of an ILS which provides course guidance to the runway.

LOCALIZER USABLE DISTANCE - The maximum distance from the localizer transmitter at a specified altitude, as verified by flight inspection, at which reliable course information is continuously received.

LOCAL TRAFFIC - Aircraft operating in the traffic pattern or within sight of the tower, or aircraft known to be departing or arriving from flight in local practice areas, or aircraft executing practice instrument approaches at the airport.

LONGITUDINAL SEPARATION - The longitudinal spacing of aircraft at the same altitude by a minimum distance expressed in units of time or miles.

LOST COMMUNICATIONS/TWO-WAY RADIO COMMUNICATIONS FAILURE - Loss of the ability to communicate by radio. Aircraft are sometimes referred to as NORDO (No Radio). Standard pilot procedures are specified in FAR Part 91. Radar controllers issue procedures for pilots to follow in the event of lost communications during a radar approach when weather reports indicate that an aircraft will likely encounter IFR weather conditions during the approach.

LOW APPROACH - An approach over an airport or runway following an instrument approach or a VFR approach including the go-around maneuver where the pilot intentionally does not make contact with the runway.

METERING - A method of time-regulating arrival traffic flow into a terminal area so as not to exceed a predetermined terminal acceptance rate.

METERING FIX - A fix along an established route from over which aircraft will be metered prior to entering terminal airspace. Normally, this fix should be established at a distance from the airport which will facilitate a profile descent 10,000 feet above airport elevation (AAE) or above.

MINIMUM CROSSING ALTITUDE/MCA - The lowest altitude at certain fixes at which an aircraft must cross when proceeding in the direction of a higher minimum en route IFR altitude (MEA).

MINIMUM DESCENT ALTITUDE/MDA - The lowest altitude, expressed in feet above mean sea level, to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard instrument approach procedure where no electronic glide slope is provided.

MINIMUM OBSTRUCTION CLEARANCE ALTITUDE/MOCA - The lowest published altitude in effect between radio fixes on VOR airways, off-airway routes, or route segments which meets obstacle clearance requirements for the entire route segment and which assures acceptable navigational signal coverage only within 25 statute (22 nautical) miles of a VOR.

MINIMUM RECEPTION ALTITUDE/MRA - The lowest altitude at which an intersection can be determined.

MINIMUM SAFE ALTITUDE/MSA -

1. The minimum altitude specified in FAR Part 91 for various aircraft operations.

2. Altitudes depicted on approach charts which provide at least 1,000 feet of obstacle clearance for emergency use within a specified distance from the navigation facility upon which a procedure is predicated. These altitudes will be identified as Minimum Sector Altitudes or Emergency Safe Altitudes and are established as follows:

    a. Minimum Sector Altitudes - Altitudes depicted on approach charts which provide at least 1,000 feet of obstacle clearance within a 25-mile radius of the navigation facility upon which the procedure is predicated. Sectors depicted on approach charts must be at least 90 degrees in scope. These altitudes are for emergency use only and do not necessarily assure acceptable navigational signal coverage.

MINIMUM SAFE ALTITUDE WARNING/MSAW - A function of the ARTS III computer that aids the controller by alerting him when a tracked Mode C-equipped aircraft is below or is predicted by the computer to go below a predetermined minimum safe altitude. (Refer to AIM).

MINIMUMS/MINIMA - Weather condition requirements established for a particular operation or type of operation; e.g., IFR takeoff or landing, alternate airport for IFR flight plans, VFR flight, etc.

MINIMUM VECTORING ALTITUDE/MVA - The lowest MSL altitude at which an IFR aircraft will be vectored by a radar controller, except as otherwise authorized for radar approaches, departures, and missed approaches. The altitude meets IFR obstacle clearance criteria. It may be lower than the published MEA along an airway or J-route segment. It may be utilized for radar vectoring only upon the controller's determination that an adequate radar return is being received from the aircraft being controlled. Charts depicting minimum vectoring altitudes are normally available only to the controllers and not to pilots.

MISSED APPROACH -

1. A maneuver conducted by a pilot when an instrument approach cannot be completed to a landing. The route of flight and altitude are shown on instrument approach procedure charts. A pilot executing a missed approach prior to the Missed Approach Point (MAP) must continue along the final approach to the MAP. The pilot may climb immediately to the altitude specified in the missed approach procedure.

2. A term used by the pilot to inform ATC that he is executing the missed approach.

3. At locations where ATC radar service is provided, the pilot should conform to radar vectors when provided by

ATC in lieu of the published missed approach procedure.

MOVEMENT AREA - The runways, taxiways, and other areas of an airport/heliport which are utilized for taxiing/hover taxiing, air taxiing, takeoff, and landing of aircraft, exclusive of loading ramps and parking areas. At those airports/heliports with a tower, specific approval for entry onto the movement area must be obtained from ATC.

NAS STAGE A - The en route ATC system's radar, computers and computer programs, controller plan view displays (PVDs/Radar Scopes), input/output devices, and the related communications equipment which are integrated to form the heart of the automated IFR air traffic control system. This equipment performs Flight Data Processing (FDP) and Radar Data Processing (RDP). It interfaces with automated terminal systems and is used in the control of en route IFR aircraft.

NATIONAL AIRSPACE SYSTEM/NAS - The common network of U.S. airspace; air navigation facilities, equipment and services, airports or landing areas; aeronautical charts, information and services; rules, regulations and procedures, technical information, and manpower and material. Included are system components shared jointly with the military.

NEGATIVE - "No," or "permission not granted," or "that is not correct."

NONDIRECTIONAL BEACON/RADIO BEACON/NDB - An L/MF or UHF radio beacon transmitting nondirectional signals whereby the pilot of an aircraft equipped with direction finding equipment can determine his bearing to or from the radio beacon and "home" on or track to or from the station. When the radio beacon is installed in conjunction with the Instrument Landing System marker, it is normally called a Compass Locator.

NONPRECISION APPROACH PROCEDURE/NONPRECISION APPROACH - A standard instrument approach procedure in which no electronic glide slope is provided; e.g., VOR, TACAN, NDB, LOC, ASR, LDA, or SDF approaches.

NONRADAR - Precedes other terms and generally means without the use of radar, such as:

1. Nonradar Approach - Used to describe instrument approaches for which course guidance on final approach is not provided by ground-based precision or surveillance radar. Radar vectors to the final approach course may or may not be provided by ATC. Examples of nonradar approaches are VOR, NDB, TACAN, and ILS/MSL approaches.

2. Nonradar Approach Control - An ATC facility providing approach control service without the use of radar.

3. Nonradar Arrival - An aircraft arriving at an airport without radar service or at an airport served by a radar facility and radar contact has not been established or has been terminated due to a lack of radar service to the airport.

4. Nonradar Route - A flight path or route over which the pilot is performing his own navigation. The pilot may be receiving radar separation, radar monitoring, or other ATC services while on a nonradar route.

5. Nonradar Separation - The spacing of aircraft in accordance with established minima without the use of radar; e.g vertical, lateral, or longitudinal separation.

NOTICE TO AIRMEN/NOTAM - A notice containing information (not known sufficiently in advance to publicize by other means) concerning the establishment, condition, or change in any component (facility, service, or procedure of, or hazard in the National Airspace System) the timely knowledge of which is essential to personnel concerned with flight operations.

OFFSET PARALLEL RUNWAYS - Staggered runways having centerlines which are parallel.

OUTER MARKER/OM - A marker beacon at or near the glide slope intercept altitude of an ILS approach. It is keyed to transmit two dashes per second on a 400 Hz tone, which is received aurally and visually by compatible airborne equipment. The OM is normally located four to seven miles from the runway threshold on the extended centerline of the runway.

PARALLEL ILS/MLS APPROACHES - Approaches to parallel runways by IFR aircraft which, when established inbound toward the airport on the adjacent final approach courses, are radar-separated by at least 2 miles.

PARALLEL RUNWAYS - Two or more runways at the same airport whose centerlines are parallel. In addition to runway number, parallel runways are designated as L (left) and R (right) or, if three parallel runways exist, L (left), C (center), and R (right).

PREFERENTIAL ROUTES - Preferential routes (PDR's, PAR;s, and PDAR's) are adapted in ARTCC computers to accomplish inter/intra-facility controller coordination and to assure that flight data is posted at the proper control positions. Locations having a need for these specific inbound and outbound routes normally publish such routes in local facility bulletins, and their use by pilots minimizes flight plan route amendments. When the workload or traffic situation permits, controllers normally provide radar vectors or assign requested routes to minimize circuitous routing. Preferential routes are usually confined to one ARTCC's area and are referred to by the following names or acronyms:

1. Preferential Departure Route/PDR - A specific departure route from an airport or terminal area to an en route point where there is no further need for flow control. It may be included in a Standard Instrument Departure (SID) or a Preferred IFR Route.

2. Preferential Arrival Route/PAR - A specific arrival route from an appropriate en route point to an airport or terminal area. It may be included in a Standard Terminal Arrival (STAR) or a Preferred IFR Route. The abbreviation "PAR" is used primarily within the ARTCC and should not be confused with the abbreviation for Precision Approach Radar.

3. Preferential Departure and Arrival Route/PDAR - A route between two terminals which are within or immediately adjacent to one ARTCC's area. PDAR's are not synonymous with Preferred IFR Routes but may be listed as such as they do accomplish essentially the same purpose. (See Preferred IFR Routes, NAS Stage A).

PREFERRED IFR ROUTES - Routes established between busier airports to increase system efficiency and capacity. They normally extend through one or more ARTCC areas and are designed to achieve balanced traffic flows among high density terminals. IFR clearances are issued on the basis of these routes except when severe weather avoidance procedures or other factors dictate otherwise. Preferred IFR Routes are listed in the Airport/Facility Directory. If a flight is planned to or from an area having such routes but the departure or arrival point is not listed in the Airport/Facility Directory, pilots may use that part of a Preferred IFR Route which is appropriate for the departure or arrival point that is listed. Preferred IFR Routes are correlated with SID's and STAR's and may be defined by airways, jet routes, direct routes between NAVAID's, Waypoints, NAVAID radials/DME, or any combinations thereof.

PROFILE DESCENT - An uninterrupted descent (except where level flight is required for speed adjustment; e.g., 250 knots at 10,000 feet MSL) from cruising altitude/level to interception of a glide slope or to a minimum altitude specified for the initial or intermediate approach segment of a nonprecision instrument approach. The profile descent normally terminates at the approach gate or where the glide scope or other appropriate minimum altitude is intercepted.

QUOTA FLOW CONTROL/QFLOW - A flow control procedure by which the Central Flow Control Function (CFCF) restricts traffic to the ARTC Center area having an impacted airport, thereby avoiding sector/area saturation.

RADAR/RADIO DETECTION AND RANGING - A device which, by measuring the time interval between transmission and reception of radio pulses and correlating the angular orientation of the radiated antenna beam or beams in azimuth and/or elevation, provides information on range, azimuth, and/or elevation of objects in the path of the transmitted pulses.

1. Primary Radar - A radar system in which a minute portion of a radio pulse transmitted from a site is reflected by an object and then received back at that site for processing and display at an air traffic control facility.

2. Secondary Radar/Radar Beacon/ATCRBS - A radar system in which the object to be detected is fitted with cooperative equipment in the form of a radio receiver/transmitter (transponder). Radar pulses transmitted from the searching transmitter/receiver (interrogator) site are received in the cooperative equipment and used to trigger a distinctive transmission from the transponder. This reply transmission, rather than a reflected signal, is then received back at the transmitter/receiver site for processing and display at an air traffic control facility.

RADAR ADVISORY - The provision of advice and information based on radar observations.

RADAR APPROACH - An instrument approach procedure which utilizes Precision Approach Radar (PAR) or Airport Surveillance Radar (ASR).

RADAR APPROACH CONTROL FACILITY - A terminal ATC facility that uses radar and nonradar capabilities to provide approach control services to aircraft arriving, departing, or transiting airspace controlled by the facility (see Approach Control Service). Provides radar ATC services to aircraft operating in the vicinity of one or more civil and/or military airports in a terminal area. The facility may provide services of a ground controlled approach (GCA); i.e., ASR and PAR approaches. A radar approach control facility may be operated by FAA, USAF, US Army, USN, USMC, or jointly by FAA and a military service. Specific facility nomenclatures are used for administrative purposes only and are related to the physical location of the facility and the operating service generally as follows:

Radar Approach Control/RAPCON (Air Force/FAA)

Terminal Radar Approach Control/TRACON (FAA)

RADAR CONTACT -

1. Used by ATC to inform an aircraft that it is identified on the radar display and radar flight following will be provided until radar identification is terminated. Radar service may also be provided within the limits of necessity and capability. When a pilot is informed of "radar contact," he automatically discontinues reporting over compulsory reporting points.

2. The term used to inform the controller that the aircraft is identified and approval is granted for the aircraft to enter the receiving controllers airspace.

RADAR ENVIRONMENT - An area in which radar service may be provided.

RADAR FLIGHT FOLLOWING - The observation of the progress of radar identified aircraft, whose primary navigation is being provided by the pilot, wherein the controller retains and correlates the aircraft identity with the appropriate target or target symbol displayed on the radar scope.

RADAR IDENTIFICATION - The process of ascertaining that an observed radar target is the radar return from a particular aircraft.

RADAR IDENTIFIED AIRCRAFT - An aircraft, the position of which has been correlated with an observed target or symbol on the radar display.

RADAR SERVICE - A term which encompasses one or more of the following services based on the use of radar which can be provided by a controller to a pilot of a radar identified aircraft.

1. Radar Monitoring - The radar flight-following of aircraft, whose primary navigation is being performed by the pilot, to observe and note deviations from its authorized flight path, airway, or route. When being applied specifically to radar monitoring of instrument approaches; i.e., with precision approach radar (PAR) or radar monitoring of simultaneous ILS/MLS approaches, it includes advice and instructions whenever an aircraft nears or exceeds the prescribed PAR safety limit or simultaneous ILS/MSL no transgression zone.

2. Radar Navigational Guidance - Vectoring aircraft to provide course guidance.

3. Radar Separation - Radar spacing of aircraft in accordance with established minima.

RADAR SURVEILLANCE - The radar observation of a given geographical area for the purpose of performing some radar function.

RADAR TRAFFIC ADVISORIES - Advisories issued to alert pilots to known or observed radar traffic which may affect the intended route of flight of their aircraft.

RADIAL - A magnetic bearing extending from a VOR/VORTAC/TACAN navigation facility.

RECEIVING CONTROLLER/FACILITY - A controller/facility receiving control of an aircraft from another controller/facility.

RUNWAY - A defined rectangular area on a land airport prepared for the landing and takeoff run of aircraft along its length. Runways are normally numbered in relation to their magnetic direction rounded off to the nearest 10 degrees; e.g., Runway 01, Runway 25.

RUNWAY IN USE/ACTIVE RUNWAY/DUTY RUNWAY - Any runway or runways currently being used for takeoff or landing. When multiple runways are used, they are all considered active runways.

SEGMENTS OF AN INSTRUMENT APPROACH PROCEDURE - An instrument approach procedure may have as many as four separate segments depending on how the approach procedure is structured.

1. Initial Approach - The segment between the initial approach fix and the intermediate fix or the point where the aircraft is established on the intermediate course or final approach course.

2. Intermediate Approach - The segment between the intermediate fix or point and the final approach fix.

3. Final Approach - The segment between the final approach fix or point and the runway, airport, or missed approach point.

4. Missed Approach - The segment between the missed approach point or the point of arrival at decision height and the missed approach fix at the prescribed altitude.

SEPARATION - In air traffic control, the spacing of aircraft to achieve their safe and orderly movement in flight and while landing and taking off.

SEPARATION MINIMA - The minimum longitudinal, lateral, or vertical distances by which aircraft are spaced through the application of air traffic control procedures.

SHORT RANGE CLEARANCE - A clearance issued to a departing IFR flight which authorizes IFR flight to a specific fix short of the destination while air traffic control facilities are coordinating and obtaining the complete clearance.

SHORT TAKEOFF AND LANDING AIRCRAFT/STOL AIRCRAFT - An aircraft which, at some weight within its approved operating weight, is capable of operating from a STOL runway in compliance with the applicable STOL characteristics, airworthiness, operations, noise, and pollution standards.

SIDESTEP MANEUVER - A visual maneuver accomplished by a pilot at the completion of an instrument approach to permit a straight-in landing on a parallel runway not more than 1,200 feet to either side of the runway to which the instrument approach was conducted.

SIGMET/WS/SIGNIFICANT METEOROLOGICAL INFORMATION - A weather advisory issued concerning weather significant to the safety of all aircraft. SIGMET advisories cover severe and extreme turbulence, severe icing, and widespread dust or sandstorms that reduce visibility to less than 3 miles.

SIMULTANEOUS ILS/MLS APPROACHES - An approach system permitting simultaneous ILS/MLS approaches to airports having parallel runways separated by at least 4,300 feet between centerlines. Integral parts of a total system are ILS/MLS, radar, communications, ATC procedures, and airborne equipment.

SPECIAL USE AIRSPACE - Airspace of defined dimensions identified by an area on the surface of the earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon aircraft operations that are not a part of those activities. Types of special use airspace are:

1. Military Operations Area (MOA) - An MOA is an airspace assignment of defined vertical and lateral dimensions established outside positive control areas to separate/-segregate certain military activities from IFR traffic and to identify for VFR traffic where these activities are conducted.

2. Restricted Area - Airspace designated under FAR, Part 73, within which the flight of aircraft, while not wholly prohibited, is subject to restriction. Most restricted areas are designated joint use and IFR/VFR operations in the area may be authorized by the controlling ATC facility when it is not being utilized by the using agency. Restricted areas are depicted on en route charts. Where joint use is authorized, the name of the ATC controlling facility is also shown. and AIM).

3. Warning Area - Airspace which may contain hazards to nonparticipating aircraft in international airspace.

STANDARD INSTRUMENT DEPARTURE / SID - A preplanned instrument flight rule air traffic control departure procedure printed for pilot use in graphic and/or textual form. SID's provide transition from the terminal to the appropriate enroute structure.

STANDARD TERMINAL ARRIVAL ROUTE / STAR - A preplanned instrument flight rule air traffic control arrival procedure published for pilot use in graphic and/or textual form. STAR's provide transition from the en route structure to an outer fix or an instrument approach fix / arrival waypoint in the terminal area.

STRAIGHT-IN APPROACH--IFR - An instrument approach wherein final approach is begun without first having executed a procedure turn, not necessarily completed with a straight-in landing or made to straight-in landing minimums.

STRAIGHT-IN APPROACH--VFR - Entry into the traffic pattern by interception of the extended runway centerline (final approach course) without executing any other portion of the traffic pattern.

TARGET - The indication shown on a radar display resulting from a primary radar return or a radar beacon reply.

TERMINAL RADAR SERVICE AREA/TRSA - Airspace surrounding designated airports where in ATC provides radar vectoring, sequencing, and separation on a full-time basis for all IFR and participating VFR aircraft. Service provided in a TRSA is called Stage III Service. The AIM contains an explanation of TRSA. TRSA's are depicted on VFR aeronautical charts. Pilot participation is urged but is not mandatory.

THRESHOLD - The beginning of that portion of the runway usable for landing.

TOUCHDOWN -

1. The point at which an aircraft first makes contact with the landing surface.

2. Concerning a precision radar approach (PAR), it is the point where the glide path intercepts the landing sur-

face.

TOWER/AIRPORT TRAFFIC CONTROL TOWER/ATCT - A terminal facility that uses air/ground communications, visual signaling, and other devices to provide ATC services to aircraft operating in the vicinity of an airport or on the movement area. Authorizes aircraft to land or takeoff at the airport controlled by the tower or to transit the airport traffic area regardless of flight plan or weather conditions (IFR or VFR). A tower may also provide approach control services (radar or nonradar). (See Airport Traffic Area, Airport Traffic Control Service, Approach Control/-Approach Control Facility, Approach Control Service, Movement Area, Tower En Route Control Service/Tower to Tower)

TOWER EN ROUTE CONTROL SERVICE/TOWER TO TOWER - The control of IFR en route traffic within delegated airspace between two or more adjacent approach control facilities. This service is designed to expedite traffic and reduce control and pilot communication requirements.

TRACK - The actual flight path of an aircraft over the surface of the earth.

TRAFFIC -

1. A term used by a controller to transfer radar identification of an aircraft to another controller for the purpose of coordinating separation action. Traffic is normally issued (a) in response to a handoff or point out, (b) in anticipation of a handoff or point out, or (c) in conjunction with a request for control of an aircraft.

2. A term used by ATC to refer to one or more aircraft.

TRAFFIC ADVISORIES - Advisories issued to alert pilots to other known or observed air traffic which may be in such proximity to the position or intended route of flight of their aircraft to warrant their attention. Such advisories may be based on:

1. Visual observation.

2. Observation of radar identified and nonidentified aircraft targets on an ATC radar display, or

3. Verbal reports from pilots or other facilities.

TRAFFIC PATTERN - The traffic flow that is prescribed for aircraft landing at, taxiing on, or taking off from an airport. The components of a typical traffic pattern are upwind leg, crosswind leg, downwind leg, base leg, and final approach.

1. Upwind Leg - A flight path parallel to the landing runway in the direction of landing.

2. Crosswind Leg - A flight path at right angles to the landing runway off its upwind end.

3. Downwind Leg - A flight path parallel to the landing runway in the direction opposite to landing. The downwind leg normally extends between the crosswind leg and the base leg.

4. Base Leg - A flight path at right angles to the landing runway off its approach end. The base leg normally extends from the downwind leg to the intersection of the extended runway centerline.