City and County of San Francisco
Department of City Planning

SAN FRANCISCO INTERNATIONAL AIRPORT MASTER PLAN
Final
Environmental Impact Report

86.638E
SCH #90030535

Volume III: Appendices

Draft EIR Publication Date: July 11, 1991
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August 29, 1991, 1:30 p.m. or later, City Hall, Room 282, San Francisco
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Final EIR Certification Date: May 28, 1992

Changes from the text of the Draft EIR are indicated by solid dots (●) at the beginning of each revised section, paragraph, graphic or table. A dot next to the page number indicates that all text on the page is new or substantially revised.

SAN FRANCISCO INTERNATIONAL AIRPORT
● FINAL EIR

TABLE OF CONTENTS BY CHAPTER

SAN FRANCISCO INTERNATIONAL AIRPORT
●FINAL EIR

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF TABLES

TABLE OF CONTENTS (Continued)

LIST OF TABLES (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES (Continued)

TABLE OF CONTENTS (Continued)

LIST OF TABLES (Continued)

TABLE OF CONTENTS (Continued)

LIST OF FIGURES

TABLE OF CONTENTS (Continued)

LIST OF FIGURES (Continued)

● XII. APPENDICES

City and County of San Francisco **Department of City Planning**

NOTICE THAT AN
ENVIRONMENTAL IMPACT REPORT
IS DETERMINED TO BE REQUIRED

Date of this Notice: August 11, 1989

Lead Agency: City and County of San Francisco, Department of City Planning
450 McAllister Street - 6th Floor, San Francisco, CA 94102

Agency Contact Person: Barbara W. Sahm Telephone: (415) 558-6378

Project Title: 86.683E: San Francisco International Airport Master Plan

Project Sponsor: San Francisco International Airport Project Contact Person: John Costas

Project Address: San Francisco International Airport

City and County: San Francisco

Project Description: The project would be the San Francisco International Airport (SFIA) Master Plan. The proposed SFIA Master Plan would be a physical/management design plan focusing on the accommodation of facilities through the development of improved land use and circulation patterns for all airport-owned lands excluding the undeveloped West of Bayshore site. Principal projects considered in the SFIA Master Plan include: 1) new International Terminal, 2) transportation/transit center, 3) consolidation of cargo facilities, 4) consolidation of administrative facilities, 5) overall circulation system, 6) hotel/commercial/airport support development on airport lands, 7) consolidation of airline maintenance and administrative facilities.

THIS PROJECT MAY HAVE A SIGNIFICANT EFFECT ON THE ENVIRONMENT AND AN ENVIRONMENTAL IMPACT REPORT IS REQUIRED. This determination is based upon the criteria of the Guidelines of the State Secretary for Resources, Section 15063 (Initial Study), 15064 (Determining Significant Effect), and 15065 (Mandatory Findings of Significance), and the following reasons, as documented in the Environmental Evaluation (Initial Study) for the project, which is attached.

Deadline for Filing of an Appeal of this Determination to the City Planning Commission: August 21, 1989. An appeal requires: 1) a letter specifying the grounds for the appeal, and; 2) a $75.00 filing fee.

Barbara W. Sahm
Barbara W. Sahm,
Environmental Review Officer

SEM174

Proposed San Francisco International Airport Master Plan
Initial Study
Case # 86.683E

I. PROJECT DESCRIPTION

Project Location

The 2,400-acre San Francisco International Airport (SFIA) is the principal commercial air passenger and cargo facility in the Bay Area, handling approximately 30 million annual passengers. Although located on unincorporated land within San Mateo County, the airport is owned by the City and County of San Francisco.

SFIA is surrounded by the City of South San Francisco to the north; the Cities of San Bruno and Millbrae to the west; the City of Millbrae to the south; and San Francisco Bay to the east. (See Figure 1.)

The airport land is traversed near the Western perimeter by U.S. Highway 101 (Bayshore Freeway). Most of the land west of the freeway remains undeveloped. In addition, approximately 80 acres east of the freeway are undeveloped. The airport complex, including runways, passenger facilities, and airline maintenance facilities, occupies the larger area east of the Bayshore Freeway. Approximately 260 acres of airport land remain undeveloped. The majority of this acreage, approximately 180 acres lies in the area west of the Bayshore Freeway.

Project Description

The forecast of aviation activity at SFIA estimates that by 1991 the volume of passengers using SFIA will be 36 million annually, and by the year 2006 it will increase to 51.3 million passengers annually.[1] In order to accommodate the expected growth in aviation activity at SFIA, the Airports Commission has proposed preparation of a SFIA Master Plan. The Plan will be a blueprint for the use of airport lands in the short-term (5 years) and long-term (20 years). The proposed SFIA Master Plan will involve land use reconfiguration and consolidation of facilities at SFIA. The proposed SFIA Master Plan will be a physical/management design plan focusing on the accommodation of facilities through the development of improved land use and circulation patterns for all airport-owned lands excluding the undeveloped West of Bayshore site.

The Five-Year Capital Projects Plan will provide funding for the improvement of the infrastructure at the airport and construction of new facilities to accommodate expected growth in aviation activity at SFIA. The Five-Year

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1 Forecast of Aviation Activity at SFIA was prepared by Thompson Consultants International for the San Francisco Airports Commission and is found in the SFIA Master Plan Working Paper "A" (1987).

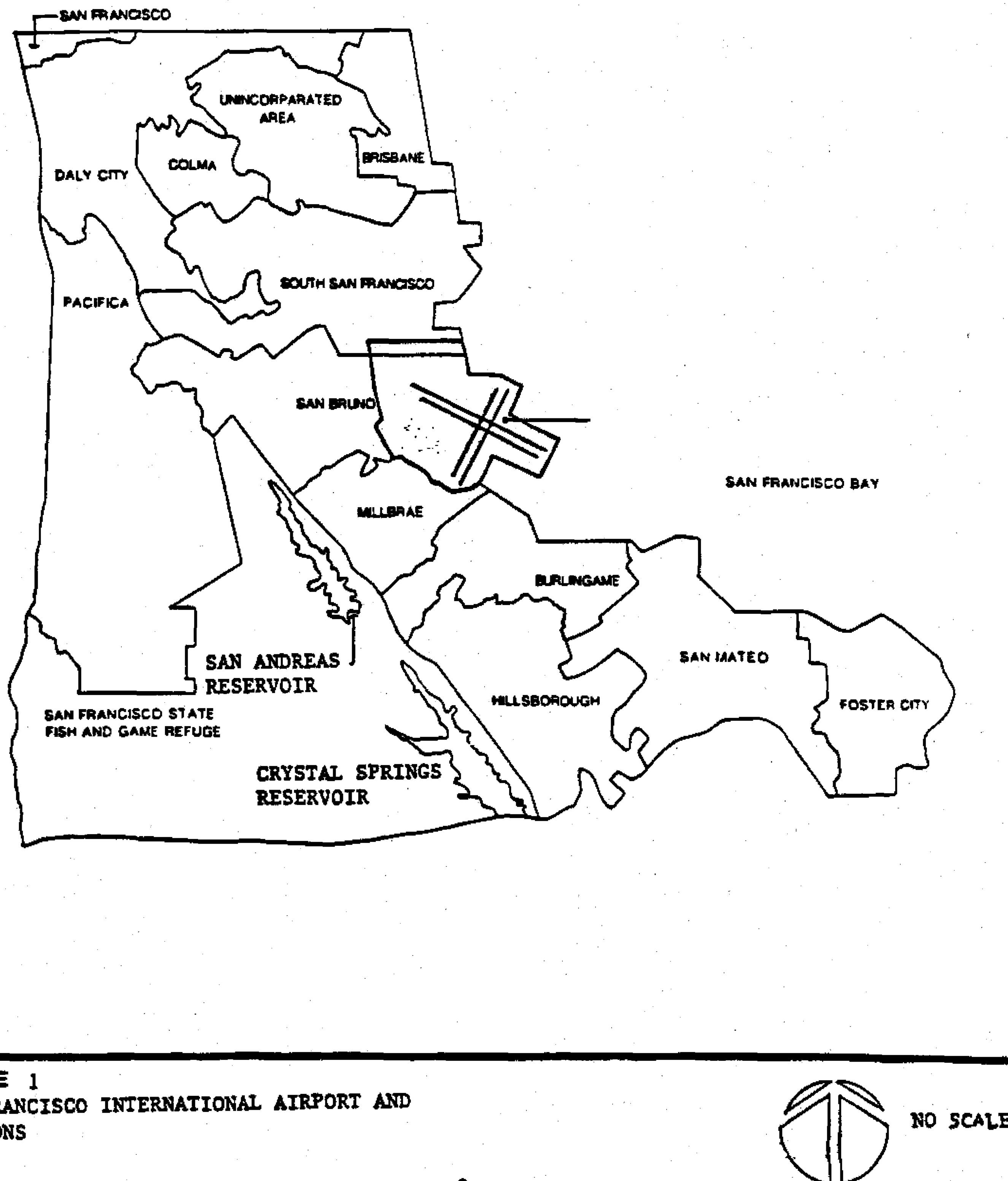

FIGURE 1
SAN FRANCISCO INTERNATIONAL AIRPORT AND ENVIRONS

Capital Plan which is updated and approved by the Airport Commission annually, will reflect additional capital improvements necessary to implement the SFIA Master Plan if the SFIA Master Plan is approved.

The size and specific locations of the developments that would occur as a result of the SFIA Master Plan have been identified as near term (to 1996) and long term (to 2006) projects and are described in SFIA Master Plan Working Paper B, Daniel, Mann, Johnson, and Mendenhall (DMJM), June 1988. The principal projects considered in the SFIA Master Plan include:

1. New International Terminal.
2. Transportation/transit center at SFIA.
3. Consolidation of cargo facilities.
4. Consolidation of airport administrative facilities.
5. Overall circulation system.
6. Hotel/commercial/airport support development on airport lands.
7. Consolidation of airline maintenance and administrative facilities.

II. SUMMARY OF POTENTIAL ENVIRONMENTAL EFFECTS

A. EFFECTS FOUND TO BE POTENTIALLY SIGNIFICANT

The proposed SFIA Master Plan is examined in this Initial Study to identify potential effects on the environment. Effects that have been determined to be potentially significant and will be analyzed in an environmental impact report include: transportation, noise, relationship of the proposed SFIA Master Plan to and its effects on adjacent land uses, population and housing, air quality, public services and utilities, hazardous materials, cultural resources and energy.

B. EFFECTS FOUND TO BE INSIGNIFICANT

The following potential impacts were determined either to be insignificant or mitigated through measures included as part of the project. These items require no further analysis in the EIR:

Visual: All projects identified in the SFIA Master Plan would be located east of the Bayshore Freeway. The project area is separated from neighboring population centers by the Freeway, the West of Bayshore open space, and the Peninsula Commute Service tracks. The new facilities would be constructed among existing Airport structures and be subject to FAA height restrictions. No public open space exists on Airport Commission land east of the Bayshore Freeway.

Biology: The West of Bayshore open space area owned by the Airport Commission is the habitat of the San Francisco garter snake, an endangered species. This open space area has been excluded from SFIA Master Plan development. Additionally, the Bay shoreline would not be affected by SFIA development since the current runway configuration will be retained in the SFIA Master Plan. Because open spaces and Bay shoreline would not be affected by SFIA Master Plan development, biological effects require no further analysis.

III. ENVIRONMENTAL EVALUATION CHECKLIST

A. COMPATIBILITY WITH EXISTING ZONING AND PLANS	Not Applicable	Discussed
1) Discuss any variances, special authorizations, or changes proposed to the City Planning Code or Zoning Map.	X	
2) Discuss any conflicts with any other adopted environmental plans and goals of the City or Region.		X

Surrounding Jurisdictions

The airport is surrounded by the City of South San Francisco to the north; the Cities of San Bruno and Millbrae to the West; the City of Millbrae to the south; and the San Francisco Bay to the east. (See Figure 1.) The area north of the airport is within the City of South San Francisco and it is zoned as industrial. Lands adjacent to the airport and within San Bruno and Millbrae are zoned low to medium residential.

Airport Land Use Commission (ALUC)

The ALUC, established by State mandate, has authority to specify how land near SFIA is to be used based on safety and noise considerations. Cities affected by SFIA noise and safety considerations, and thus guided by the ALUC Airport Land Use Plan (ALUP), are: Brisbane, South San Francisco, Daly City, Colma, San Bruno, Millbrae, Burlingame, San Mateo, Foster City, Hillsborough, and Pacifica. The ALUP sets height restrictions for new constructions, and standards for buildings near the airport, including soundproofing requirements. Although ALUC has no authority over SFIA operations, it reviews any substantive change in development plans made by the San Francisco Airports Commission.[2] Specifically, in addition to preparation, adoption and implementation of the airport land use plan for airport environs, the San Mateo County ALUC has a role in monitoring progress on implementation of recommendations of the Airport Land Use Plan. ALUC's community perspective and intergovernmental organization place the Committee in an excellent position to monitor communities to ensure the ALUP is implemented and to work cooperatively with the SFIA to reduce adverse effects of the Airport on its neighbors.

Residential land uses are considered more noise-sensitive than commercial or industrial uses. Around the airport, ALUC policy allows residential development without noise insulation in areas up to 65 CNEL. In areas 65 to 70 CNEL, noise insulation is required.

Compatibility of the proposed project with surrounding land uses, zoning, and public policies of the surrounding jurisdiction will be discussed in the EIR.

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2 "Airport Land Use Plan," Regional Planning Committee, San Mateo County, page II B-15, 1981.

Federal Aviation Administration (FAA)

The FAA regulates aviation noise and flight operational procedures (including aviation safety). Increase in projected aviation activity at SFIA could generate noise levels that exceed FAA standards. FAA policy on noise exposure and aviation safety will be discussed in the EIR.

Regional and Local Plans

<u>Metropolitan Transportation Commission (MTC) and Association of Bay Area Governments (ABAG)</u>: Developed a Regional Airport Plan which allocates future volumes of air passengers to the three regional airports (San Francisco, Oakland and San Jose).[3] SFIA is expected to exceed its allocated volume of passengers.

<u>Bay Conservation Development Commission (BCDC)</u>: The project is also subject to BCDC permits because it is located on the waterfront. It is therefore required to respond to BCDC policies.

<u>San Mateo County</u>: Although located on unincorporated land in San Mateo County, the airport is owned by the City and County of San Francisco and it therefore is not directly subject to land use regulations of San Mateo County. SFIA is classified as a special urban area in the San Mateo County General Plan.

The EIR will provide a discussion of the proposed SFIA Master Plan as it relates to these regional plans and their policies.

B. ENVIRONMENTAL EFFECTS - Could the project:

1) Land Use	YES	NO	DISCUSSED
a) Disrupt or divide the physical arrangement of an established community?	___	X	X
Have any substantial impact upon the existing character of the vicinity?	X	___	X

The proposed SFIA Master Plan is a physical/management design plan that focuses on the accommodation of facilities through the development of land use and circulation patterns for all airport-owned lands. Land use recommendations emanating from the proposed SFIA Master Plan would be limited to airport lands, and as such, there would be no disruption or division of any established community. The project's relationship to surrounding land uses will be discussed in the EIR.

3 "Regional Airport Plan," ABAG/MTC, 1980.

2) Visual Quality

		YES	NO	DISCUSSED
a)	Have a substantial, demonstrable negative aesthetic effect?	___	X	X
b)	Substantially degrade or obstruct any scenic view or vista now observed from public areas?	___	X	X
c)	Generate obtrusive light or glare substantially impacting other properties?	___	X	X

The residential subdivisions of Belle-Air (in San Bruno), Marino Vista Park and Bayside Manor (in Millbrae) are adjacent to the currently vacant West of Bayshore site. Since the proposed Master Plan does not include the West of Bayshore area, the SFIA Master Plan would not generate visual impacts that would affect the aforementioned residential areas. The project area is separated from neighboring population centers by the Freeway, the West of Bayshore open space, and the Peninsula Commute Service tracks. The new facilities would be constructed among existing Airport structures and be subject to FAA height restrictions. No public open space exists on Airport Commission land east of the Bayshore Freeway. As a result, the EIR will not discuss potential visual effects and mitigation measures.

3) Population

		YES	NO	DISCUSSED
a)	Induce substantial growth or concentration of population?	X	X	X
b)	Displace a large number of people (involving either housing or employment)?	___	X	___
c)	Create a substantial demand for additional housing in San Francisco, or substantially reduce the housing supply?	___	X	___

The 350 firms and organizations operating at the airport employ about 31,000 persons, making SFIA the largest employer in the county. Employee residences are distributed throughout the Bay Area with 38% residing in San Mateo County, 23% residing in San Francisco, 13% residing in Alameda County, and 10% residing in Santa Clara County. The other 16% live in other counties in the Bay Area.[4]

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4 Airports Commission, SFIA, Economic Impact of San Francisco International Airport, 1987.

As indicated above, SFIA employees reside throughout the nine counties in the Bay Area. The project would not be expected to create a demand for housing in excess of market supply capacity. However, because of the expected increase in employment at SFIA and because job/housing balance is a regional concern, population and housing impacts will be discussed in the EIR. Additionally, the EIR will discuss employment as it relates to employee commute patterns and potential impacts on traffic.

4) Transportation/Circulation	YES	NO	DISCUSSED
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system?	X		X
b) Interfere with existing transportation systems, causing substantial alterations to circulation patterns or major traffic hazards?	X		
c) Cause a substantial increase in transit demand which cannot be accommodated by existing or proposed transit capacity?		X	X
d) Cause a substantial increase in parking demand which cannot be accommodated by existing parking facilities?	X		

Increase in employment and airport operations could potentially increase demand on existing transportation systems. In particular, the construction of a new International Terminal and Transportation Center, including related access ramps, could change the existing circulation system.

Airport traffic contributes to congestion on the Bayshore Freeway and local arterial roads near the airport. Airport-related traffic accounts for 25% of the traffic on Bayshore Freeway, and 20 to 40% of traffic on Old Bayshore Highway, Millbrae Avenue, and San Bruno Avenue in the vicinity of the airport.[5] In addition, the growth in air freight operations has resulted in more truck traffic to and from the airport.[5] Truck traffic from San Francisco International Airport comprises about 15% of the truck traffic on the Bayshore Freeway in the vicinity of the airport. Traffic-related effects of the proposed SFIA Master Plan will be analyzed in the EIR. Mitigation measures will also be discussed.

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5 San Mateo County General Plan 1986.

5) Noise	YES	NO	DISCUSSED
a) Increase the ambient noise levels for adjoining areas?	X		X
b) Violate Title 24 Noise Insulation Standards, if applicable?		X	
c) Be substantially impacted by existing noise levels?		X	

The predominant noise source at SFIA is from aircraft operations. The Airports Commission collects aviation noise data which are regularly submitted to the State for review. Noise monitoring requirements for airports in California are contained in Title 21, Subchapter 6, of the California Administrative Code. Airports that have areas impacted by noise levels greater than 65 dB Community Noise Equivalent Level (CNEL) are required to operate a noise monitoring system that collects noise level data for at least 48 weeks per year.

The Airport Noise Mitigation Action Plan (ANMAP) is a program at SFIA designed to reduce noise at SFIA and its environs. The ANMAP consists of a package of noise-reducing actions including aircraft noise monitoring, flight procedure changes, aircraft noise limits and restrictions, and economic incentives. These actions combined with a new generation of aircraft with quieter engines have reduced aviation noise at SFIA. While the noise level has been reduced, the number of flight operations has increased.

The proposed Master Plan, if approved and implemented, would permit further increase in number of flights and possible noise increases. The EIR will analyze aviation and traffic-related noise impacts of the proposed SFIA Master Plan on land uses within SFIA and in surrounding areas. Mitigation measures will be discussed.

6) Air Quality/Climate	YES	NO	DISCUSSED
a) Violate any ambient air quality standard or contribute substantially to an existing or projected air quality violation?			X
b) Expose sensitive receptors to substantial pollutant concentrations?	X		
c) Permeate its vicinity with objectionable odors?		X	
d) Alter wind, moisture or temperature (including sun shading effects) so as to substantially affect public areas or change the climate either in the community or region?		X	

The major sources of air pollutants from San Francisco International Airport are motor vehicle and aircraft emissions. Other sources of emissions include ground support equipment such as service vehicles, heat generation plants, and fueling operations. The major air pollutants associated with airport operations are carbon monoxide, hydrocarbons, and nitrogen oxides. No public open spaces that exist on Airport Commission land would be shaded by proposed development. Aircraft and traffic-induced air quality impacts related to the SFIA Master Plan will be analyzed and mitigation measures discussed in the EIR.

7) Utilities/Public Services	YES	NO	DISCUSSED
a) Breach published national, state or local standards relating to solid waste or litter control?	___	X	___
b) Extend a sewer trunk line with capacity to serve new development?	___	X	___
c) Substantially increase demand for schools, recreation or other public facilities?	___	X	___
d) Require major expansion of power, water or communications facilities?	X	___	X

The proposed project could potentially increase demand for public services and utilities on the site and increase water and energy consumption. For example, increases in the number of passengers, increase in airport operations and concomitant increases in employment would generate increased solid waste, wastewater, and the demand for public services. The effect of the increased demand for public services and utilities will be analyzed in the EIR and mitigations will be discussed.

8) Biology	YES	NO	DISCUSSED
a) Substantially affect a rare or endangered species of animal or plant or habitat of the species?	___	X	X
b) Substantially diminish habitat for fish, wildlife or plants, or interfere substantially with the movement of any resident or migratory fish or wildlife species?	___	X	X
c) Require removal of substantial numbers of mature, scenic trees?	___	X	X

The West of Bayshore Airport Commission land has been identified as the habitat of the San Francisco garter snake, which is on the list of endangered species. Pursuant to Section 7 of the Endangered Species Act of 1973, CALTRANS and the Federal Highway Administration requested interagency consultation with the U.S. Fish and Wildlife Service (USFWS).
The USFWS, under the Endangered Species Act of 1973, is required to ensure that the continued existence of any endangered or threatened species is not jeopardized as a result of a Federally-funded or authorized action. This Act applies to projects which adversely modify or destroy habitat critical to these species.

The area west of the Bayshore Freeway between Millbrae Avenue and San Bruno Avenue has been identified as habitat of the San Francisco Garter Snake (Thamnophis sirtalis tetrataenia), a federally and state listed endangered species. The San Francisco Garter Snake occurs from the San Francisco/San Mateo County line south to Ano Nuevo Point on the coast in fresh water creeks and marshes with adjoining upland areas. The Millbrae population is the only known population of this species on the eastern side of San Francisco Peninsula; it is also thought to be the largest and most vigorous population[6]. This site, therefore, represents critical habitat for this species. The Millbrae population was subject of a two year study from 1983-85, which identified ecological and life history aspects of this population[7]. Management of this species is the responsibility of the USFWS and the California Department of Fish and Game.

Impacts to the West of Bayshore will not be evaluated in the EIR since this area is excluded from SFIA Master Plan development.

		YES	NO	DISCUSSED
9)	Geology/Topography			
a)	Expose people or structures to major geologic hazards (slides, subsidence, erosion and liquefaction)?	___	X	X
b)	Change substantially the topography or any unique geologic or physical features of the site?	___	X	___

Geology

SFIA is about 8.6 feet above mean sea level (San Francisco City Datum). Soils at the site are composed of sedimentary layers of three types of soil material over bedrock. The uppermost layer is the younger bay mud, which is a soft to slightly preconsolidated grey, silty clay containing shells and organic

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6 U.S. Fish and Wildlife Service, Recovery Plan for the San Francisco Garter Snake, 1985.

7 Wharton, Brode and Knudsen, Ecological and Life History Aspects of the San Francisco Garter Snake at the San Francisco International Airport Study Site, 1988.

materials. The lowest layer or older bay mud is firm clay consisting of silt. Sandwiched between the uppermost layer or younger bay mud and the lowest layer or older bay mud is a layer of fine-grained sand.

The engineering properties of the younger bay mud make it most troublesome of the sediments in the Bay. Foundation problems arise from the nature of the younger bay mud, which is generally a soft, silty clay that has a high water content and is weak and highly compressible. Additionally, landfill has been added to the project site through 1969. The most recent landfills have been utilized to prepare the sites for two construction projects in 1969, the Pan Am Food Service Center and Flying Tigers Cargo Center, neither of which were built[8]. The nature of the landfill as it relates to soil stability and to the possible presence of methane gas pockets will be examined in the EIR.

Seismology

The major geologic effect of concern at San Francisco International Airport is earthquake damage. To appreciate the potential effect, an understanding of the behavior of Bay area soil and fill materials is required. Given this understanding, the potential effects can be estimated.

Moderate to strong earthquakes may produce a variety of effects, including surface faulting, vertical displacement, ground shaking, lurch cracking of alluvial or fill materials, compaction or liquefaction of soils and landslides, as well as tsunamis or seiches. The specific local effects from an earthquake depend as much, if not more, on the condition of the soil than on distance from the epicenter or magnitude of the quake. In general, earthquake waves in passing from more dense solid rock to less dense alluvial and water saturated material tend to increase in amplitude and acceleration.

Ground shaking, due to earthquakes, produces different effects on different soil types. Generally, in cohesionless soils, compaction of soils with low clay content result in ground settlement; in saturated soils, high water pressures reduced by ground vibration cause an upward flow of water which liquefies these soils; this liquefaction phenomenon is rather common in earthquakes of moderate to large magnitude.

In the area of the SFIA, the fill materials would act somewhat differently than underlying bay mud and sand deposits to earthquake induced ground motions. In the event of an earthquake, the sand seams in the bay mud may liquefy. The magnitude of the effect would depend on the density of the deposit and the intensity and duration of the earthquake. Fill materials are likely to settle substantially in the event of an earthquake. This would lead to differential settlements of buildings that they support. Fill materials can also liquefy, undergoing lateral movements, or develop slides.

The closest active faults to the SFIA area are the San Andreas Fault, about three miles southwest of SFIA, and the Hayward and Calaveras Faults, about 15

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8 Leong, Mel; Assistant Deputy Director - Environmental Control, San Francisco International Airport; telephone communication, February 27, 1989.

and 30 miles east of SFIA respectively. In the event of an earthquake on the San Andreas Fault, a magnitude of 8.3 on the Richter Scale shock would close SFIA for a period of weeks. A magnitude of 7.0 on the Richter Scale would close SFIA for several days. An earthquake on the Hayward Fault with a magnitude of 8.3 would close down SFIA for less than one week. A magnitude of 7.0 on the Hayward Fault would delay operations for only a few hours. In the event of a seiche or tsunami, the part of Runway 28R that extends into the Bay could be flooded.

During the implementation phase of the Master Plan, the project sponsor would follow the recommendations of structural and foundation reports to be prepared for any construction on the site. While the airport will review the plans for specific construction projects, its building code, San Francisco International Airport Tenant Improvement Guide, 1988, uses the same seismic engineering standards as those within the 1985 Uniform Building Code. These standards include earthquake-resistant design and material specifications that are designed to allow for some structural damage to buildings but not for collapse during a major earthquake. This topic requires no further discussion in the EIR.

10) Water	YES	NO	DISCUSSED
a) Substantially degrade water quality, or contaminate a public water supply?	___	X	X
b) Substantially degrade or deplete ground water resources, or interfere substantially with ground water recharge?	___	X	___
c) Cause substantial flooding, erosion or siltation?	___	X	___

Hydrology

The water table in the airport area is approximately five feet above sea level in winter months and drops several feet during the drier summer months. The water table has posed a problem for previous construction activities at SFIA. However, proper construction methods and dewatering of the construction site have permitted previous construction activities to proceed without affecting surrounding structures. Therefore, issues related to SFIA Master Plan Facility Construction will not be addressed in the EIR. Potential contamination and its effect on water quality will be analyzed in the EIR[8].

There exists the possibility of groundwater contamination from use of hazardous materials at SFIA.

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8 Leong, Mel, Assistant Deputy Director - Environmental Control, San Francisco International Airport; telephone communication, February 27, 1989.

11) Energy/Resources	YES	NO	DISCUSSED
a) Encourage activities which result in the use of large amounts of fuel, water, or use these in a wasteful manner?	X		
b) Have a substantial effect on the potential extraction or depletion of a natural resource?		X	X

Construction and operation of the proposed facilities would result in increased energy consumption, especially the "people-mover" system. Pacific Gas and Electric Company (PG&E) supplies all of SFIA's electricity and natural gas used for space conditioning, lighting, information processing, and various operations machinery. Potential impacts of the project on energy resources will be discussed in the EIR.

12) Hazards	YES	NO	DISCUSSED
a) Create a potential public health hazard or involve the use, production or disposal of materials which pose a hazard to people, animal or plant populations in the area affected?	X		
b) Interfere with emergency response plans or emergency evacuation plans?		X	
c) Create a potentially substantial fire hazard?		X	

Aviation fuel storage and a network of pipelines are located at the airport. SFIA has contingency plans in case of fire or plane crash. The proposed SFIA Master Plan by itself would not create a public health hazard, would not interfere with existing emergency response plans, nor overburden emergency service capacity. However, fuel spills have occurred on Airport Commission lands in the past and an analysis of these hazardous materials, including potential effect on groundwater, will be studied in the EIR. Additionally, the effect of new pipelines and fuel storage locations will be examined.

13) Cultural	YES	NO	DISCUSSED
a) Disrupt or adversely affect a prehistoric or historic archaeological site or a property of historic or cultural significance to a community or ethnic or social group; or a paleontological site except as a part of a scientific study?		X	

b) Conflict with established recreational, educational, religious or scientific uses of the area?	___	X	___
c) Conflict with the preservation of buildings subject to the provisions of Article 10 or Article 11 of the City Planning Code?	___	X	___

A cultural resource search of SFIA was conducted by the California Archaeological Inventory. Archival and field study was recommended to identify and evaluate possible cultural resources that may be of historic or architectural value. These will be evaluated in the EIR.

C. OTHER	YES	NO	DISCUSSED
Require approval of permits from City Departments other than Department of City Planning or Bureau of Building Inspection, or from Regional, State or Federal Agencies?	X	___	X

New maintenance, cargo, airline support, ground transportation, and International Terminal would be constructed on Airport Commission lands east of the Bayshore Freeway as part of the Master Plan. Permits for construction activities at SFIA must be obtained from the Bay Conservation Development Commission for any facility that is within 100 feet of the Bay shoreline[9].

D. MITIGATION MEASURES	YES	NO	DISCUSSED
1) If any significant effects have been identified, are there ways to mitigate them?	X	___	X
2) Are all mitigation measures identified above included in the project?	X	___	___

Environmental issues determined to have no significant impact or to have been mitigated are: visual and biological.

E. ALTERNATIVES TO THE PROPOSED PROJECT.

In accordance with the State CEQA guidelines Section 15126, an EIR must consider and analyze alternatives to the proposed project. A "No Project" alternative, which describes the impacts related to retaining existing conditions and facilities at SFIA without modifying or constructing new facilities, and a Reduced Scale alternative, a lesser degree of buildout in terms of the number of facilities and/or total square footage to be constructed, would be incorporated into the EIR analysis. Additionally, a

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9 Leong, Mel: Assistant Deputy Director - Environmental Control, San Francisco International Airport; telephone communication, February 27, 1989.

third alternative, a maximum buildout or greater total square footage than the proposed project, would also be included.

F. MANDATORY FINDINGS OF SIGNIFICANCE	YES	NO	DISCUSSED
1) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or pre-history?	X		
2) Does the project have the potential to achieve short-term, to the disadvantage of long-term, environmental goals?		X	
3) Does the project have possible environmental effects which are individually limited, but cumulatively considerable? (Analyze in the light of past projects, other current projects, and probable future projects.)	X		
4) Would the project cause substantial adverse effects on human beings, either directly or indirectly?	X		

Potential impacts of the proposed project on traffic, ambient noise, land use, population and housing, air quality, utilities/public services, energy, hazardous materials, cultural resource and measures to mitigate these impacts will be discussed in the EIR.

The project would contribute to cumulative effects in the areas of transportation, air quality and noise. The project could potentially degrade ambient air quality and could increase the level of ambient noise; both impacts could cause adverse effects on human beings either directly or indirectly. These potential impacts and mitigation measures will be discussed in the EIR.

C. ON THE BASIS OF THIS INITIAL STUDY

___ I find the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared by the Department of City Planning.

___ I find that although the proposed project could have significant effect on the environment, there WILL NOT be a significant effect in this case because the mitigation measures, numbers _________, in the discussion have been included as part of the proposed project. A NEGATIVE DECLARATION will be prepared.

✓ I find that the proposed project MAY have significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

Barbara W. Sahm

BARBARA W. SAHM
Environmental Review Officer

for

DEAN L. MACRIS
Director of Planning

DATE: July 20, 1989

APPENDIX B. PROJECT DESCRIPTION

TABLE B.1: NEAR-TERM SFIA MASTER PLAN PROJECTS (1990-1996) - TERMINAL

Project/Facility Number	Facility Name	Existing 1990	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	1996 Total/c/
1.0 TERMINAL								
	North Terminal /d/	1,161,000					1,161,000	1,161,000
	Int'l. Terminal /e/	120,000					120,000	120,000
	South Terminal /f/	571,900					571,900	571,900
1.1.1	International Terminal (New) /g/			250,000	250,000			250,000
1.1.3	Boarding Area G (New)			500,000	500,000			500,000
1.1.2	Boarding Area A	185,600	(185,600)	500,000	314,400			500,000
1.2.2	Boarding Area B	92,000	(60,000)	400,000	340,000		32,000	432,000
1.2.1	Boarding Area D	490,000				490,000		490,000
SUBTOTAL TERMINAL (NEAR-TERM PLAN)		2,620,500	(245,600)	1,650,000	1,404,400	490,000	1,884,900	4,024,900

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = Existing 1990 square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 1996 = Construct square feet + Remodel square feet + No Change square feet OR Existing 1990 square feet + Net New Construction square feet.
/d/ New International Terminal Levels 4 - 8 to include an additional 100,000 square feet of hotel and concession space and an additional 160,000 square feet of administration/office space. These are listed under functional areas 8.0 and 7.0, respectively.
/e/ Includes Boarding Area E and Boarding Area F square feet.
/f/ Does not include Boarding Area D square feet (together, the International Terminal/Boarding Area D = 610,000 square feet).
/g/ Includes Boarding Area C square feet, but does not include Boarding Area A and Boarding Area B square feet (together, the South Terminal/Boarding Areas A, B and C = 849,500 square feet).

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SF Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: LONG-TERM SFIA MASTER PLAN PROJECTS (1997-2006) - TERMINAL

Project/Facility Number	Facility Name	1996 Total	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	2006 Total/c/
1.0 TERMINAL								
	North Terminal /d/	1,161,000					1,161,000	1,161,000
	Int'l. Terminal /e/	120,000					120,000	120,000
	South Terminal /f/	571,900					571,900	571,900
	International Terminal	250,000					250,000	250,000
	Boarding Area G	500,000					500,000	500,000
	Boarding Area A	500,000					500,000	500,000
1.2.1	Boarding Area B	432,000	(32,000)	104,000	72,000		400,000	504,000
	Boarding Area D	490,000					490,000	490,000
SUBTOTAL TERMINAL (LONG-TERM PLAN)		4,024,900	(32,000)	104,000	72,000		3,992,900	4,096,900
NEAR-TERM Demolish, Construct, Net New Construction, Remodel			(245,600)	1,650,000	1,404,400	490,000		
TOTAL MASTER PLAN Demolish, Construct, Net New Construction, Remodel			(277,600)	1,754,000	1,476,400	490,000		

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = 1996 Total square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 2006 = Construct square feet + Remodel square feet + No Change square feet OR 1996 Total square feet + Net New Construction square feet.
/d/ Includes Boarding Area E and Boarding Area F square feet.
/e/ Does not include Boarding Area D square feet.
/f/ Includes Boarding Area C square feet, but does not include Boarding Area A and Boarding Area B square feet.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: NEAR-TERM AND LONG-TERM SFIA MASTER PLAN PROJECTS (1990-1996 and 1997-2006) - AIRLINE SUPPORT

Project/Facility Number	Facility Name	Existing 1990	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	1996 Total/c/
2.0 AIRLINE SUPPORT (NONTERMINAL)								
	Catering:							
	52 Host International	31,690					31,690	31,690
2.1	62 United Airlines Catering	13,800	(13,800)	60,000	46,200			60,000
	Supporting Facilities:							
	31 United Warehouse	12,544					12,544	12,544
2.2.1-.2	38 American GSE	2,500	(2,500)	10,000	7,500			10,000
	45 Delta Warehouse	7,200					7,200	7,200
	90 ASII/Evergreen	12,544	(12,544) /d/		(12,544)			
	93 Pan Am Crew Baggage Holding	1,500	(1,500) /e/		(1,500)			
SUBTOTAL NONTERMINAL AIRLINE SUPPORT (NEAR-TERM PLAN)		81,800	(30,300)	70,000	39,700		51,500	121,500
TOTAL MASTER PLAN Demolish, Construct, Net New Construction, Remodel			(30,300)	70,000	39,700			

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = Existing 1990 square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 1996 = Construct square feet + Remodel square feet + No Change square feet OR Existing 1990 square feet + Net New Construction square feet.
/d/ Replacement area in proposed North Field Cargo/Maintenance Facility, under Functional Area 5.0
/e/ Replacement area in proposed Pan Am Maintenance/Administration/Cargo Facility, under Functional Area 3.0.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: NEAR-TERM SFIA MASTER PLAN PROJECTS (1990-1996) - AIRLINE MAINTENANCE

Project/Facility Number		Facility Name	Existing 1990	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	1996 Total/c/
3.0 AIRLINE MAINTENANCE									
		Major:							
	1-12	United Maint. Ctr.	2,870,950					2,870,950	2,870,950
	Line:								
3.1/3.1.4		East Field Maint. Hangar (New)			495,000	495,000			495,000
	32	Hangar (Vacant)	16,000	(16,000)		(16,000)			
	33	American Maintenance	392,240					392,240	392,240
3.1.2	39	Qantas Maint. Hangar	168,761	(168,761)	/d/	(168,761)			
	42	Continental Maint. Hangar	26,825					26,825	26,825
	45,47	Delta Maintenance	136,875					136,875	136,875
3.1.1	60	United Service Center	90,000	(90,000)	/d/	(90,000)			
3.2	65	Pan Am Maintenance	161,825	(161,825)	262,500 /e/	100,675			262,500
3.1.3	67	TWA Service	9,800	(9,800)	/d/	(9,800)			
	84	JAL Maint. Building	9,000	(9,000)	/f/	(9,000)			
	51	Northwest Maint. Hangar	36,000					36,000	36,000
SUBTOTAL AIRLINE MAINTENANCE (NEAR-TERM PLAN)			3,918,300	(455,400)	757,500	302,100		3,462,900	4,220,400

/a/ Net New Construction = Construct square feet minus Demolish square feet.

/b/ No Change = Existing 1990 square feet minus (Demolish square feet + Remodel square feet).

/c/ Total 1996 = Construct square feet + Remodel square feet + No Change square feet OR Existing 1990 square feet + Net New Construction square feet.

/d/ Function to be accommodated in new East Field Maintenance Hangar.

/e/ Facility to include replacement area for Building 93 (Pan Am Crew Baggage Holding) and Building 64 (Pan Am Administration), in Functional Areas 2.0 and 8.0, respectively.

/f/ Replacement area in new North Field Cargo/Maintenance facility (Functional Area 5.0).

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: LONG-TERM SFIA MASTER PLAN PROJECTS (1997-2006) - AIRLINE MAINTENANCE

Project/Facility Number	Facility Name	1996 Total	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	2006 Total/c/
3.0 AIRLINE MAINTENANCE								
	Major:							
1-12	United Maint. Ctr.	2,870,950					2,870,950	2,870,950
	Line:							
	East Field Maint. Hangar	495,000					495,000	495,000
33	American Maintenance	392,240					392,240	392,240
42	Continental Maint. Hangar	26,825	(26,825) /d/		(26,825)			
45,47	Delta Maintenance	136,875					136,875	136,875
65	Pan Am Maintenance/ Administration/Cargo	262,500					262,500	262,500
51	Northwest Maint. Hangar	36,000					36,000	36,000
SUBTOTAL AIRLINE MAINTENANCE (LONG-TERM PLAN)		4,220,400	(26,800)		(26,800)		4,193,600	4,193,600
NEAR-TERM Demolish, Construct, Net New Construction, Remodel			(455,400)	757,500	302,100			
TOTAL MASTER PLAN Demolish, Construct, Net New Construction, Remodel			(482,200)	757,500	275,300			

/a/ Net New Construction = Construct square feet minus Demolish square feet.

/b/ No Change = 1996 Total square feet minus (Demolish square feet + Remodel square feet).

/c/ Total 2006 = Construct square feet + Remodel square feet + No Change square feet OR 1996 Total square feet + Net New Construction square feet.

/d/ Replacement area in West Field Cargo Maintenance Center (Functional Area 5.0).

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: NEAR-TERM AND LONG-TERM SFIA MASTER PLAN PROJECTS (1990-1996 and 1997-2006) - GENERAL AVIATION

Project/Facility Number		Facility Name	Existing 1990	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	1996 Total/c/
4.0 GENERAL AVIATION									
4.1/4.1.3		Fixed Base Operator (FBO) Facility (New)			90,000	90,000			90,000
4.1.1	40	FBO: Butler	48,112	(48,112) /d/		(48,112)			
4.1.2	54	Chevron, USA Hangar	40,000	(40,000)		(40,000)			
SUBTOTAL GENERAL AVIATION (NEAR-TERM PLAN)			88,100	(88,100)	90,000	1,900			90,000
TOTAL MASTER PLAN Demolish, Construct, Net New Construction, Remodel				(88,100)	90,000	1,900			

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = Existing 1990 square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 1996 = Construct square feet + Remodel square feet + No Change square feet OR Existing 1990 square feet + Net New Construction square feet.
/d/ Function to be accommodated in new FBO Facility.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: NEAR-TERM SFIA MASTER PLAN PROJECTS (1990-1996) - AIR FREIGHT

Project/Facility Number		Facility Name	Existing 1990	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	1996 Total/c/
5.0 AIR FREIGHT									
5.1		West Field Cargo/ Maintenance (New) /d/							324,000
5.1.1		Building 1			108,000	108,000			
5.1.2		Building 2			108,000	108,000			
5.1.3		Building 3			54,000	54,000			
5.1.4		Building 4			54,000	54,000			
5.3/5.3.3		North Field Cargo/ Maintenance (New)			432,000	432,000			432,000
5.3.1	16	Flying Tigers Hangar	108,036	(108,036) /e/		(108,036)			
	43	U.S. Air Mail Facility	168,000					168,000	168,000
5.3.2	83	JAL Cargo Building	78,000	(78,000) /f/		(78,000)			
	41	Airborne Cargo Bldg.	60,000					60,000	60,000
	46	Delta	21,000					21,000	21,000
	53	Cargo Building No. 7	55,296	(55,296) /g/		(55,296)			
	55	Northwest Orient Cargo	114,550					114,550	114,550
	56	American Airlines Cargo	71,400					71,400	71,400
	57	U.S. Air Cargo	6,356					6,356	6,356
5.2	58	United Cargo	113,720		36,280 /h/	36,280		113,720	150,000
5.4	68	TWA Cargo	71,387				71,387		71,387
SUBTOTAL AIR FREIGHT (NEAR-TERM PLAN)			867,700	(241,300)	792,300	551,000	71,400	555,000	1,418,700

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = Existing 1990 square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 1996 = Construct square feet + Remodel square feet + No Change square feet OR Existing 1990 square feet + Net New Construction square feet.
/d/ Facility to include replacement area for Building 42 (Continental Maintenance Hangar), in Functional Area 3.0.
/e/ Demolition of the Flying Tigers Hangar is in the approved SFIA Five-Year Capital Projects Plan. Function to be accommodated in new North Field Cargo Maintenance facility.
/f/ Function to be accommodated in new North Field Cargo Maintenance facility.
/g/ Function to be accommodated in new West Field Cargo Maintenance facility.
/h/ Addition to existing facility.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: LONG-TERM SFIA MASTER PLAN PROJECTS (1997-2006) - AIR FREIGHT

Project/Facility Number	Facility Name	1996 Total	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	2006 Total/c/
5.0 AIR FREIGHT								
5.4	West Field Cargo/ Maintenance	324,000					324,000	486,000
5.4.1	Building 7 (New)			54,000	54,000			
5.4.2	Building 8 (New)			54,000	54,000			
5.4.3	Building 9 (New)			54,000	54,000			
	North Field Cargo/ Maintenance	432,000					432,000	432,000
5.5	43 U.S. Air Mail Facility	168,000		132,000 /d/	132,000		168,000	300,000
	41 Airborne Cargo Bldg.	60,000	(60,000)		(60,000)			
	46 Delta	21,000					21,000	21,000
	55 Northwest Orient Cargo	114,550					114,550	114,550
	56 American Airlines Cargo	71,400					71,400	71,400
	57 U.S. Air Cargo	6,356					6,356	6,356
	58 United Cargo	150,000					150,000	150,000
	68 TWA Cargo	71,387					71,387	71,387
SUBTOTAL AIR FREIGHT (LONG-TERM PLAN)		1,418,700	(60,000)	294,000	234,000		1,358,700	1,652,700
NEAR-TERM Demolish, Construct, Net New Construction, Remodel			(241,300)	792,300	551,000	71,400		
TOTAL MASTER PLAN Demolish, Construct, Net New Construction, Remodel			(301,300)	1,086,300	785,000	71,400		

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = 1996 Total square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 2006 = Construct square feet + Remodel square feet + No Change square feet OR 1996 Total square feet + Net New Construction square feet.
/d/ Addition to existing facility.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: NEAR-TERM AND LONG-TERM SFIA MASTER PLAN PROJECTS (1990-1996 and 1997-2006) - AIRPORT SUPPORT

Project/Facility Number		Facility Name	Existing 1990	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	1996 Total/c/
6.0 AIRPORT SUPPORT									
	49	Engineering Building	30,800					30,800	30,800
		Maintenance:							
	50	Shops/Office	56,000					56,000	56,000
	48	Equipment Garage	20,000					20,000	20,000
	88	Bus Maintenance	5,000					5,000	5,000
		Crash, Fire and Rescue:							
6.2	17	Contingency Bldg. 1000	10,800	(10,800)	15,000 /d/	4,200			15,000
6.3	35	Fire Station No. 1	12,000	(12,000)	12,000				12,000
6.1	34	Fire Station No. 2	12,000	(12,000)	12,000 /e/				12,000
	28	Community College Flight School	26,200					26,200	26,200
SUBTOTAL AIRPORT SUPPORT (NEAR-TERM PLAN)			172,800	(34,800)	39,000	4,200		138,000	177,000
TOTAL MASTER PLAN Demolish, Construct, Net New Construction, Remodel				(34,800)	39,000	4,200			

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = Existing 1990 square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 1996 = Construct square feet + Remodel square feet + No Change square feet OR Existing 1990 square feet + Net New Construction square feet.
/d/ Replacement building to be known as "Multi-Purpose Facility."
/e/ Replacement of CFR Station #2, included in the approved SFIA Five-Year Capital Projects Plan, is ongoing.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: NEAR-TERM SFIA MASTER PLAN PROJECTS (1990-1996) - COMMERCIAL

Project/Facility Number	Facility Name	Existing 1990	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	1996 Total/c/
7.0 COMMERCIAL								
44	Bank of America	13,062					13,062	13,062
63	Hilton Inn	220,000					220,000	220,000
7.1	Chevron Gas Station	900	(900)	1,000	100			1,000
8.1	Hotel Space, Int'l. Terminal			100,000	100,000			100,000
SUBTOTAL COMMERCIAL (NEAR-TERM PLAN)		234,000	(900)	101,000	100,100		233,100	334,100

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = Existing 1990 square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 1996 = Construct square feet + Remodel square feet + No Change square feet OR Existing 1990 square feet + Net New Construction square feet.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: LONG-TERM SFIA MASTER PLAN PROJECTS (1997-2006) - COMMERCIAL

Project/Facility Number	Facility Name	1996 Total	Demolish	Net New Construct	Construction/a/	Remodel	No Change/b/	2006 Total/c/
7.0 COMMERCIAL								
44	Bank of America	13,062	(13,062) /d/		(13,062)			
63	Hilton Inn	220,000				220,000		220,000
	Chevron Gas Station	1,000					1,000	1,000
	Hotel Space, Int'l. Terminal	100,000					100,000	100,000
SUBTOTAL COMMERCIAL (LONG-TERM PLAN)		334,100	(13,100)		(13,100)	220,000	101,000	321,000
NEAR-TERM Demolish, Construct, Net New Construction, Remodel			(900)	101,000	100,100			
TOTAL MASTER PLAN Demolish, Construct, Net New Construction, Remodel			(14,000)	101,000	87,000	220,000		

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = 1996 Total square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 2006 = Construct square feet + Remodel square feet + No Change square feet OR 1996 Total square feet + Net New Construction square feet.
/d/ Replacement area under Project 8.2, New Office Building.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: NEAR-TERM SFIA MASTER PLAN PROJECTS (1990-1996) - ADMINISTRATION/OFFICE

Project/Facility Number		Facility Name	Existing 1990	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	1996 Total/c/
8.0 ADMINISTRATION/OFFICE									
8.1/8.1.2		International Terminal Levels 4,5,6,7 (New) /d/			160,000	160,000			160,000
	59	United Administration	92,216					92,216	92,216
8.1.1	64	Pan Am Administration	33,852	(33,852) /e/		(33,852)			
SUBTOTAL ADMINISTRATION/ OFFICE (NEAR-TERM PLAN)			126,100	(33,900)	160,000	126,100		92,200	252,200

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = Existing 1990 square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 1996 = Construct square feet + Remodel square feet + No Change square feet OR Existing 1990 square feet + Net New Construction square feet.
/d/ Airport offices located in existing international terminal would be relocated to the new international terminal.
/e/ Function to be accommodated under Project 3.2, Pan Am Maintenance/Administration/Cargo facility.

SOURCES: "Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: LONG-TERM SFIA MASTER PLAN PROJECTS (1997-2006) - ADMINISTRATION/OFFICE

Project/Facility Number	Facility Name	1996 Total	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	2006 Total/c/
8.0 ADMINISTRATION/OFFICE								
8.2	Office Building (New)			100,000	100,000			100,000
	International Terminal Levels 4,5,6,7	160,000					160,000	160,000
59	United Administration	92,216					92,216	92,216
SUBTOTAL ADMINISTRATION/ OFFICE (LONG-TERM PLAN)		252,200		100,000	100,000		252,200	352,200
NEAR-TERM Demolish, Construct, Net New Construction, Remodel			(33,900)	160,000	126,100			
TOTAL MASTER PLAN Demolish, Construct, Net New Construction, Remodel			(33,900)	260,000	226,100			

/a/ Net New Construction = Construct square feet minus Demolish square feet.
/b/ No Change = 1996 Total square feet minus (Demolish square feet + Remodel square feet).
/c/ Total 2006 = Construct square feet + Remodel square feet + No Change square feet OR 1996 Total square feet + Net New Construction square feet.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.1: NEAR-TERM AND LONG-TERM SFIA MASTER PLAN PROJECTS (1990-1996 and 1997-2006) - MISCELLANEOUS

Project/Facility Number	Facility Name	Existing 1990	Demolish	Construct	Net New Construction/a/	Remodel	No Change/b/	1996 Total/c/
10.0 MISCELLANEOUS								
10.1	U.S. Coast Guard Facilities							
	"A" Hangar	29,700	(29,700)	29,700				29,700
	"B" Admin. Building	12,021	(12,021)	12,021				12,021
	"C" Barracks	25,000	(25,000)		(25,000)			
	"D" Building	1,721	(1,721)	1,721				1,721
	"F" Building	14,000	(14,000)	14,000				14,000
	"H" Building	6,000	(6,000)	6,000				6,000
SUBTOTAL MISCELLANEOUS (NEAR-TERM PLAN)		88,400	(88,400)	63,400	(25,000)			63,400
TOTAL MASTER PLAN Demolish, Construct, Net New Construction, Remodel			(88,400)	63,400	(25,000)			

/a/ Net New Construction = Construct square feet minus Demolish square feet.

/b/ No Change = Existing 1990 square feet minus (Demolish square feet + Remodel square feet).

/c/ Total 1996 = Construct square feet + Remodel square feet + No Change square feet OR Existing 1990 square feet + Net New Construction square feet.

SOURCES: Table 6.3 and Appendix 12.5, *SFIA Final Draft Master Plan*, 1989; SFIA Airports Commission, 1990; U.S. Coast Guard, 1990; Environmental Science Associates, Inc., 1990.

TABLE B.2: NEAR-TERM MASTER PLAN (1990-1996) PROJECT SUMMARY/a/

FUNCTIONAL AREA		TOTAL NEW CONSTRUCTION	DEMOLISH EXISTING AREA	NET NEW CONSTRUCTION	REMODEL EXISTING BLDG.	COMMENTS
TERMINAL:						
1.1.1	International Terminal	250,000		250,000		Existing International Terminal converted to Domestic
1.1.2	Boarding Area A	500,000	185,600 (Demo 1a)	314,400		Replaces existing Boarding Area "A"
1.1.3	Boarding Area G	500,000		500,000		
1.2.1	Boarding Area D				490,000	
1.2.2	Boarding Area B - Phase I	400,000	60,000 (Demo 1b)	340,000		Replaces existing Boarding Area "B"
	Subtotal	1,650,000	245,600	1,404,400	490,000	
AIRLINE SUPPORT:						
2.1	United Airlines Catering	60,000	13,800 (Demo 2a, 2b)	46,200		Replaces existing catering
2.2	American GSE	10,000	2,500 (Demo 2c)	7,500		Replaces existing American GSE
	Subtotal	70,000	16,300	53,700		
AIRLINE MAINTENANCE:						
3.1	East Field Maintenance Hangar	495,000	90,000 (Demo 3a)			Replaces existing U.A. Service Ctr.
			16,000 (Demo 3c)			Replaces existing hangar
			168,761 (Demo 3d)	210,439		Replaces existing hangar
			9,800 (Demo 3f)			Replaces existing hangar
3.2	Pan Am Maint/Admin/Cargo Hangar	262,500	1,500 (Demo 2c)			Replaces existing Pan Am baggage
			161,825 (Demo 3b)			Replaces existing Pan Am Maint.
			33,852 (Demo 8a)	65,323		Replaces existing Pan Am Admin.
	Subtotal	757,500	481,700	275,800		

(Continued)

TABLE B.2: NEAR-TERM MASTER PLAN (1990-1996) PROJECT SUMMARY/a/ (Continued)

FUNCTIONAL AREA	TOTAL NEW CONSTRUCTION	DEMOLISH EXISTING AREA	NET NEW CONSTRUCTION	REMODEL EXISTING BLDG.	COMMENTS
GENERAL AVIATION:					
4.1 FBO	90,000	48,112 (Demo 4a) 40,000 (Demo 4b)	 1,888		Replaces existing G.A. Facilities
Subtotal	90,000	88,100	1,900		
AIRFREIGHT:					
5.1 West Field Cargo/Maint.	324,000	55,296 (Demo 5a)	268,704		Replaces existing Cargo Bldg. 7
5.2 U.A.L. Cargo Expansion	36,280		36,280		
5.3 North Field Cargo/Maint.	432,000	108,036 (Demo 5b)			Replaces existing Federal Express (Flying Tigers). Demo Project included in approved SFIA Five-Year Capital Projects Plan.
		9,000 (Demo 3e)			Replaces existing JAL Maintenance
		78,000 (Demo 5c)			Replaces JAL Cargo
		12,544 (Demo 2d)	224,420		Replaces existing cargo (Evergreen)
5.4 TWA Cargo & Maint.				71,387	Reconfigures/remodels existing facility. Includes demo projects 3f & 5d.
Subtotal	792,300	262,900	529,400	71,400	
AIRPORT SUPPORT:					
6.1 Crash/Fire/Rescue No. 2	12,000	12,000 (Demo 6c)			Replaces existing CFR #2. Replacement included in approved SFIA Five-Year Capital Projects Plan.
6.2 Multipurpose Ops. Facility	15,000	10,800 (Demo 6b)	4,200		Replaces existing Ops. Bldg.
6.3 Crash/Fire/Rescue Support Bldg.	12,000	12,000 (Demo 6d)			Replaces existing CFR Support
Subtotal	39,000	34,800	4,200		

(Continued)

TABLE B.2: NEAR-TERM MASTER PLAN (1990-1996) PROJECT SUMMARY/a/ (Continued)

FUNCTIONAL AREA	TOTAL NEW CONSTRUCTION	DEMOLISH EXISTING AREA	NET NEW CONSTRUCTION	REMODEL EXISTING BLDG.	COMMENTS
COMMERCIAL:					
7.1 Service Station	1,000	900 (Demo 7a)	100		
7.2 Hotel Space	100,000		100,000		New hotel space in levels 4-8 of new International terminal.
Subtotal	101,000	900	100,100		
ADMINISTRATION/OFFICE: (Airport, Airline, Tenant)					
8.1 International Terminal (Levels 4-8)	160,000		160,000		
Subtotal	160,000		160,000		
MISCELLANEOUS:					
10.1 U.S. Coast Guard Facilities	63,400	88,400	(25,000)		
Subtotal	63,400	88,400	(25,000)		
TOTAL NEAR TERM PLAN	3,723,200	1,218,700	2,504,500	561,400	

SOURCES: SFIA Airports Commission, May 1990; U.S. Coast Guard, June 1990; Environmental Science Associates, Inc.

TABLE B.2: LONG-TERM MASTER PLAN (1997-2006) PROJECT SUMMARY/a/

FUNCTIONAL AREA	TOTAL NEW CONSTRUCTION	DEMOLISH EXISTING AREA	NET NEW CONSTRUCTION	REMODEL EXISTING BLDG.	COMMENTS
TERMINAL:					
1.2 Boarding Area B - Phase II	104,000	32,000 (Demo lc)	72,000		Replaces existing Boarding Area "A"
Subtotal	104,000	32,000	72,000		
AIRFREIGHT:					
5.5 West Field Cargo/Maint.	162,000	26,825 (Demo 3g) 60,000 (Demo 5e)	 75,175		Replaces Bldg. 82 Maint. Hangar Replaces Existing Airborne Cargo
5.6 Mail Facility Expansion	132,000		132,000		
Subtotal	294,000	86,800	207,200		
COMMERCIAL:					
7.2 Hilton Hotel				220,000	
Subtotal				220,000	
ADMINISTRATIVE/OFFICE:					
8.2 Office Building	100,000	13,062 (Demo 7b)	86,938		
Subtotal	100,000	13,100	86,900		
TOTAL LONG TERM PLAN	498,000	131,900	366,100	220,000	
TOTAL MASTER PLAN	4,221,200	1,350,600	2,870,600	781,400	

/a/ All figures are in gross building square feet. Subtotals and totals are rounded to the nearest 100. Note: This summary table was provided by SFIA Airports Commission in May 1990; facility categorization does not correspond precisely to Draft Master Plan. Project Description Tables 3 - 6 and Appendix Table B.1 are based on Master Plan facility categorization; subtotals may therefore differ from this table. All totals correspond, however (new construction, demolish, net change, remodel).

SOURCES: SFIA Airports Commission, May 1990; U.S. Coast Guard, June 1990; Environmental Science Associates, Inc.

TABLE B-3: HISTORICAL ANNUAL PASSENGER TOTALS, BAY AREA AIR CARRIER AIRPORTS, 1960-1990

Year	San Francisco Int'l	Metro Oakland	San Jose Int'l	Buchanan Field	Sonoma County	Total
1960	4,637,035	334,440	80,731			5,052,206
1961	4,754,327	274,530	76,437			5,105,294
1962	5,036,092	312,884	109,261			5,458,237
1963	6,414,620	425,650	119,260			6,959,530
1964	7,459,461	491,730	124,360			8,075,551
1965	8,706,984	966,636	109,483			9,783,103
1966	10,145,309	1,209,729	416,850			11,771,888
1967	12,248,051	1,461,543	714,257			14,423,851
1968	13,544,414	1,818,220	1,071,434			16,434,068
1969	13,968,980	2,146,800	1,572,320			17,688,100
1970	13,867,941	2,055,180	1,595,154			17,518,275
1971	13,451,716	2,053,769	1,704,748			17,210,233
1972	14,676,025	2,080,793	1,886,401			18,643,219
1973	15,567,030	2,226,494	2,037,787			19,831,311
1974	16,201,138	2,295,871	2,146,157			20,643,166
1975	16,362,160	2,214,811	2,311,238			20,888,209
1976	17,564,033	2,164,243	2,662,140			22,390,416
1977	18,912,622	2,499,855	3,052,167			24,464,644
1978	21,519,923	2,788,176	3,398,579			27,706,678
1979	22,865,369	2,771,815	3,617,412			29,254,596
1980	21,338,383 /a/	2,417,100	2,876,920			26,632,403
1981	19,848,490	2,546,760	2,824,120			25,219,370
1982	21,028,790	2,852,110	3,051,180			26,932,080
1983	23,166,500	2,914,670	3,550,370			29,645,540
1984	24,192,900	3,618,760	3,900,200			31,711,860
1985	25,018,400 /a/	4,138,990	4,708,800		3,460 /e/	33,866,190
1986	28,874,068 /a/	3,800,770	5,659,140	86,874 /d/	30,751 /e/	38,451,603
1987	29,812,440	4,010,000	5,693,944	125,004 /d/	52,618 /e/	39,694,006
1988	30,506,790 /b/	3,832,241	5,744,223	120,245 /d/	44,739 /e/	40,248,238
1989	29,939,835	4,228,986	6,726,558	114,852 /d/	113,431 /e/	41,123,662
1990 /c/	30,387,922 /b/	5,261,164	7,090,268	101,476 /d/	130,336 /e/	42,971,166

NOTES:

/a/ *San Francisco International Airport Final Draft Master Plan*, Table 7.2.
/b/ *San Francisco International Airport Comparative Traffic Report*, respective years.
/c/ 1990 figures for Metropolitan Oakland and San Jose International Airports are for the 12 month period ending on the last day of the third quarter (all other figures are end of fourth quarter of indicated year).
/d/ Hal White, Buchanan Field Airport, April 1991.
/e/ Manager's Office, Sonoma County Airport, April 1991.

SOURCES: 1960-1979: Metropolitan Transportation Commission (MTC), from respective airport records; 1980-1990: MTC, from respective airport records, unless otherwise noted.

APPENDIX B

TABLE B-4

SAN FRANCISCO INTERNATIONAL AIRPORT
FIVE YEAR CAPITAL PROJECT PLAN
SEPTEMBER 18, 1989
ESTIMATED CONSTRUCTION COST

CONTRACT EXT	NEW/REV	DESCRIPTION	1989 PRIOR	1989/90	1990/91	1991/92	1992/93	1993/94	FUND	NOTE
988	R	Remodel Engineering Building	450,000						C	3
1011 B		Reconstruct T/W "C" to Plot 50 - Phase II	4,000,000						D	3
1017		Expand Electrical Distribution System, Phase II	4,300,000						C	3
1106	R	McDonnell Road Widening				1,000,000			A	
1289	R	Reconstruct Storm Drain Near East Underpass				500,000			D	
1527		Microwave Landing System				1,000,000			E	7
1553		Extend Taxiway L to Runway 19L		4,000,000					C	4,5
1556		Extend Taxiway V to Taxiway L			1,500,000				D	5
1558		Replace Elec Equip & Change Field Light Voltage	2,900,000						700	2,5
1559 C	R	Taxiway Repair & Reconstruction		1,300,000					D	3,5
1559 D		Taxiway Repair & Reconstruction				2,300,000			D	5
1559 E		Taxiway Repair & Reconstruction			1,900,000				E	5
1559 F	N	Taxiway Repair & Reconstruction					2,000,000		E	
1562		Reconstruct Serv Rd, North Access Road to T/W "C"		255,000					A	1,6
1563		Reconstruct CG Road at North Detention Pond			130,000				A	1,6
1602		Airport Land Use Master Plan	550,000						C	4
1643		Construct H/S Exit T/W "Z" at R/W 19L & T/W "F"			6,500,000				E	5
1644	R	Construct Fillets at R/W 10L & Taxiway L,T,N					2,000,000		E	5
1680 A		Parking Garage Restriping	500,000						B	1

TABLE B-4

SAN FRANCISCO INTERNATIONAL AIRPORT
FIVE YEAR CAPITAL PROJECT PLAN
SEPTEMBER 18, 1989
ESTIMATED CONSTRUCTION COST

CONTRACT	EXT	NEW/REV	DESCRIPTION	1989 PRIOR	1989/90	1990/91	1991/92	1992/93	1993/94	FUND	NOTE
1696		R	Drainage Improvements Lot B-1				800,000			E	
1697		R	Drainage Improvement Canal to DPS #2		1,480,000					E	1
1698			Drainage Improvement Tank Farm		250,000					E	
1721			Dike Reconstruction, Phase V		1,300,000					E	5
1723			New Firehouse No.2		2,500,000					E	5
1729			Cargo Building, Plot 42	200,000						E	
1730		R	North Access Road Realignment		300,000					A	5
1731		R	Demolition of Existing Structure, Plot 17		170,000					E	
1732			Utility Installation- 4th Fl., IT	150,000						E	
1739		R	Electronic Security Door System	2,150,000						C	1,5
1846	1	R	IT Conveyor Belt Improvements		270,000					D	1
1872			Equalization Tank at Sewage Treatment Plant		600,000					E	5
1876			Boarding Area E & F Roof Rehabilitation		600,000					C	1
1889			North Terminal & B/A E & F Carpet Replacement	850,000						D	2
1895		R	Taxiway A Centerline Lights & Upgrade of T/W Light			2,000,000				E	1,5
1896			Field Lighting Raceway System Improvement			22,600,000				E	1,5
1898		R	Repair of Sewage Treatment Plant			400,000				E	1,5
1907			North Terminal Water Proofing - NT Roof	4,000,000						A	3
1946			International Terminal Carpet Replacement	600,000						D	3

TABLE B-4

SAN FRANCISCO INTERNATIONAL AIRPORT
FIVE YEAR CAPITAL PROJECT PLAN
SEPTEMBER 18, 1989
ESTIMATED CONSTRUCTION COST

CONTRACT EXT	NEW/REV	DESCRIPTION	1989 PRIOR	1989/90	1990/91	1991/92	1992/93	1993/94	FUND	NOTE
1947		Replace 20" Water Main at North Oxidation Pond	200,000						C	3,5
1950		Lighting on N. Access Rd., McDonnell Rd., and R-2				600,000			E	5
1952	R	Overlay & Reconstruct Runway 28L		13,600,000					D	3,5
1953		Lower Level Roadway Improvements		1,000,000					E	1,5
1954	R	Security Film Installation on Glass - IT		200,000					A	1
1955		Digester for Sewage Treatment Plant		400,000					E	5
1956		Reloc. of 24" Effluent Line & Weir Struct. Plot 17		500,000					E	5
1957		Replace 20" & 12" Water Drains Looping at Garage		300,000					E	5
1958	R	Overlay & Reconstruct R/W 28R T/W P to West End			6,000,000				E	1,5
1959		Airport to United Cogeneration Plant Connection			2,500,000				E	
1960		Expand Electrical Distribution System, Phase III			3,000,000				E	
1961		Expansion of Central Plant		3,500,000					C	1,5
1962		Sedimentation Tanks at Sewage Treatment Plants				1,200,000			E	5
1963		Replac. Drain Lines to Drainage Pump Station #2	800,000						E	5
1977		Replacement of Cable 12 BANA-1	317,000						FAA	1
1982	R	Consolidated Airport Administrative Offices		900,000					A	1
1985		Replacement of Catwalks, Ducts, and Equipment, IT	3,000,000						C	1
1998	R	Elevator 210 Replacement - IT		500,000					E	1
2023 B		Traffic Barriers & Guard Shelter - Taxiway B	350,000						A	1

TABLE B-4

SAN FRANCISCO INTERNATIONAL AIRPORT
FIVE YEAR CAPITAL PROJECT PLAN
SEPTEMBER 18, 1989
ESTIMATED CONSTRUCTION COST

CONTRACT	EXT	NEW/REV	DESCRIPTION	1989 PRIOR	1989/90	1990/91	1991/92	1992/93	1993/94	FUND	NOTE
2023	C		Traffic Barriers & Guard Shelter - Post Office	276,000						A	1
2023	D		Traffic Barriers & Guard Shelter-Coast Guard Sta.	276,000						A	1
2024			Carpet Replacement - Engr. Bldg. & Airborne Conn.	222,000						FAA	3
2033			Emergency Lighting Units & Medical Equipment	234,000						A	3
2036			Security/Emergency Communications Equipment	264,000						D	4
2041		R	Crash/Fire/Rescue Engine Pumpers	285,000						C	
2044			Underground Tank Replacement - IT	435,000						C	4
2072			Mobile Baggage Scanner	350,000						B	
2084		N	Water Main Improvement			750,000				E	
2085		N	Rehabilitate Drainage Pump Station #2			500,000				E	
2092			Public Safety Communications Equipment	166,000						A	4
2101			Computer Generated Diagram & Fault Analysis	250,000						FAA	3
2102		R	Development of Parking Lot DD			7,500,000				D	1
2103		R	Vehicular Bridge From Lot D to Lot DD			3,170,000				D	1
2105			Purchase of Airline Improvements, B/A B	1,100,000						E	3
2106			Addition to B/A B		6,200,000					D	1
2128			Pavement Management System	125,000						C	3
2131			Police/Airfield Radio System	324,000						B	4
2132			Telephone System Conversion		180,000					E	4

TABLE B-4

SAN FRANCISCO INTERNATIONAL AIRPORT
FIVE YEAR CAPITAL PROJECT PLAN
SEPTEMBER 18, 1989
ESTIMATED CONSTRUCTION COST

CONTRACT EXT	NEW/REV	DESCRIPTION	1989 PRIOR	1989/90	1990/91	1991/92	1992/93	1993/94	FUND	NOTE
2133	R	Contingency Facility			1,500,000				E	
2137	R	International Terminal Flooring at Customs		300,000					C	2
2147	N	Police Locker Rooms - Boarding Area C		280,000					D	1
2154		Ground Transportation Information System		410,000					E	
2156		4TH Floor IT Press Room & Training Room	125,000						E	
2159		Police Tactical Radio System	302,000						B	4
2160		In-Transit Lounge		130,000					C	1
2163		Airport Fuel System		320,000					B	
2164		Extension of Elevator in the Center of the IT		400,000					E	1
2174	N	Changeable Message Sign		180,000					A	1
2195	N	North Field Public Access Road Paving		320,000					C	3
2196	N	Airport Perimeter Security Fence		330,000					C	3
2197	N	Electrical Improvements, North Field Road		330,000					D	3
2198	N	Accounting Office Work Station		175,000					C	1
2199	N	Taxiway C, Automated Security Gates		330,000					C	3
2234	N	Dual Agent Crash/Fire/Rescue Vehicle		350,000					A	2
2241	N	Dike Reconstruction, Phase 6				1,700,000			E	
2242	N	N. & S. Oxidation Ponds & Drainage Canals Waterprf			500,000				E	
2243	N	Drainage Pump Sta. 1A,1B & 1C Piling Replacement			300,000				E	

TABLE B-4

SAN FRANCISCO INTERNATIONAL AIRPORT
FIVE YEAR CAPITAL PROJECT PLAN
SEPTEMBER 18, 1989
ESTIMATED CONSTRUCTION COST

CONTRACT	EXT	NEW/REV	DESCRIPTION	1989 PRIOR	1989/90	1990/91	1991/92	1992/93	1993/94	FUND	NOTE
2247		N	Modernization of Fire Alarm System			600,000				E	
2248		N	International Terminal Doors		160,000					E	
2249		N	North Terminal Doors				430,000			E	
2254		N	Relocation of Budget Rental Car		1,200,000					E	I
2255		N	Relocation of Dollar Rental Car		300,000					E	I
9996			CONSTRUCTION TOTAL	30,051,000	45,820,000	61,350,000	9,530,000	4,000,000			
9997			AE&I	4,507,650	6,873,000	9,202,500	1,429,500	600,000			
9998			CONTINGENCY	2,253,825	3,436,500	4,601,250	714,750	300,000			
9999			TOTAL	36,812,475	56,129,500	75,153,750	11,674,250	4,900,000			

TABLE B-4

Notes to project schedule:

(1) Projects which are in design phase.
(2) Projects for which construction contracts have been awarded.
(3) Projects which are in construction.
(4) Projects which are 90% complete.
(5) Projects which are eligible for ADAP or AIP reimbursement.
(6) Projects which will receive ADAP or AIP reimbursement.
(7) Projects will not be funded without first returning to the Airline Affairs Committee and the Airports Commission for approval.
(8) Project will be funded from other projects appearing on the Plan relating to South Terminal Modernization & Renovation.

(A) Projects financed by the proceeds, and/or the interest earned on the proceeds, of the Series A Revenue Bonds.
(B) Projects financed by the proceeds, and/or the interest earned on the proceeds, of the Series B Revenue Bonds.
(C) Projects financed by the proceeds, and/or the interest earned on the proceeds, of the Series C Revenue Bonds.
(D) Projects financed by the proceeds, and/or the interest earned on the proceeds, of the Series D Revenue Bonds.
(E) Projects to be financed with the new Series E issue.
(G.O) Projects financed by the interest earned on the proceeds, of the 1967 General Obligation Bonds.
(700) Projects financed by the Fund 700 Capital Projects Fund.

R - Revised
N - New

APPENDIX C: NOISE

TABLE C-1: AVERAGE DAILY AIR CARRIER AIRCRAFT DEPARTURES, TRIP LENGTH AND AIRCRAFT TYPE, 1990/a/

Type of Aircraft	Departure Trip Length (Nautical Miles)/b/ 500 - 1,000	1,000 - 1,500	1,500 - 2,000	2,000 - 2,500	2,500 - 3,000	3,000 - 3,500	3,500+	Total
Stage 2/c/								
B-727 (all)	28.0	34.5	2.2	17.8	0.0	0.0	0.0	82.5
B-737 (-100,-200)/d/	35.4	21.2	0.0	0.0	0.0	0.0	0.0	56.6
B-747/e/	0.5	0.8	0.0	2.5	1.6	4.0	0.0	9.4
Stage 3/c/								
B-737-300	39.5	14.2	0.8	15.7	0.0	0.0	0.0	70.2
B-747	1.0	1.5	0.0	4.6	2.9	0.0	7.5	17.5
B-757 (all)	0.8	2.5	2.1	6.9	0.8	0.0	0.0	13.1
B-767 (all)	0.4	2.2	4.7	9.1	8.4	0.0	0.0	24.8
DC-8-71	0.7	0.8	0.0	2.7	3.4	0.0	0.0	7.6
DC-10,L-1011(all)	1.3	3.7	4.0	30.2	3.6	0.0	0.0	42.8
MD-80 series	20.5	9.0	1.0	11.3	0.0	0.0	0.0	41.8
Airbus (all types)	2.5	0.0	0.6	2.1	0.0	0.0	0.0	5.2
BAe-146	39.3	3.5	0.0	0.0	0.0	0.0	0.0	42.8
Total	169.9	93.9	15.4	102.9	20.7	4.0	7.5	414.3

NOTES:

/a/ Average daily aircraft departures are equal to annual departures divided by 365. Annual data for 1989 were used to represent 1990 conditions.

/b/ One nautical mile is equal to 6,076 feet.

/c/ Classification of aircraft as "Stage 2" or "Stage 3" refers to noise standards established by Federal Aviation Regulations Part 36.

/d/ Includes departures by DC-9 aircraft.

/e/ Earlier models of the B-747 are classified as Stage 2 aircraft.

SOURCES: Ken Eldred Engineering, from information provided by SFIA landing fee reports and the Metropolitan Transportation Commission; Environmental Science Associates, Inc.

● TABLE C-1A: 1990 AND ASSUMED FUTURE RUNWAY USE BY AIRCRAFT CATEGORY AND TIME OF DAY

		Percent Departures by Runway End								
Type	Time/a/	1R	1L	10L	10R	19L	19R	28L	28R	Total
B-747 Short Range/b/	Day	25%	24%	1%	0%	1%	0%	0%	49%	100%
	Evening	25%	24%	1%	0%	1%	0%	0%	49%	100%
	Night	25%	25%	10%	0%	0%	0%	0%	40%	100%
B-747 Long Range/c/	Day	0%	0%	0%	0%	0%	0%	0%	100%	100%
	Evening	0%	0%	0%	0%	0%	0%	0%	100%	100%
	Night	0%	0%	20%	0%	0%	0%	0%	80%	100%
All Others/d/	Day	46%	46%	2%	2%	0%	0%	2%	2%	100%
	Evening	46%	46%	2%	2%	0%	0%	2%	2%	100%
	Night	41%	41%	8%	8%	0%	0%	1%	1%	100%

/a/ Day= 7:00 a.m. to 7:00 p.m.; Eve.= 7:00 p.m. to 10:00 p.m.; Night= 10:00 p.m. to 7:00 a.m.
/b/ With destinations of 1,500 miles or fewer from SFIA.
/c/ With destinations greater than 1,500 miles from SFIA.
/d/ All other airline aircraft.

SOURCE: Ken Eldred Engineering and Environmental Science Associates, Inc., based on SFIA runway use data for 1989.

TABLE C-2: AIRCRAFT DEPARTURES AT SFIA BY PAIR OF RUNWAY ENDS, NIGHTTIME NOISE ABATEMENT RUNWAY USE, 1989

	Percent Aircraft Departures by Pair of Runway Ends/a,b/				
Type of Aircraft	1	10	19	28	Total
B-747	11%	68%	0%	21%	100%
All Others	34%	52%	2%	12%	100%
All Aircraft	41%	48%	2%	9%	100%

/a/ Occurring between 1:00 a.m. and 6:00 a.m. Based on sampling for five consecutive days each month.

/b/ Each of the four pairs of runway ends listed refers to the ends of the parallel runways 1-19 and 10-28 (e.g., "1" refers to Runways 1L and 1R).

SOURCE: Ken Eldred Engineering

TABLE C-3: COMPARISON OF CALCULATED AND MEASURED ANNUAL CNEL VALUES IN DECIBELS AT REMOTE MONITORING STATIONS, 1990 /a/

		CNEL Values (dBA)		
Station	City Location	Calculated/b/	Measured/c/	Difference/d/
1	San Bruno	71.7	72.4	(0.7)
2	San Bruno	55.5	53.4	2.1
3	South San Francisco	56.2	58.2	(2.0)
4	South San Francisco	68.8	70.7	(1.9)
5	San Bruno	63.7	64.6	(0.9)
6	South San Francisco	65.8	66.0	(0.2)
7	Brisbane	55.3	57.3	(2.0)
8	Millbrae	71.2	68.7	2.5
9	Millbrae	63.6	62.2	1.4
10	Burlingame	59.8	61.0	(1.2)
11	Burlingame	63.9	63.0	0.9
12	Foster City	62.5	61.7	0.8
13	Hillsborough	50.3	57.2	(6.9)
14	South San Francisco	54.2	54.2	0.0
15	South San Francisco	62.2	63.5	(1.3)
16	South San Francisco	57.4	58.4	(1.0)
17	South San Francisco	60.3	59.6	0.7
18	Daly City	63.1	63.8	(0.7)
19	Pacifica	58.7	59.2	(0.5)
20	Daly City	55.7	59.2	(3.5)
21	San Francisco	53.7	54.2	(0.5)
22	San Bruno	63.9	60.3	3.6
23	San Francisco	60.9	62.0	(1.1)
24	San Francisco	59.5	60.0	(0.5)
25	San Francisco	54.9	54.8	0.1
26	San Francisco	52.9	58.0	(5.1)
27	San Francisco	40.5	53.6	(13.1)

/a/ Remote monitoring stations are shown in Figure 21, Section III.C. Noise Setting, p. 162.
/b/ CNEL values calculated using the Integrated Noise Model. Values reflect aircraft operations at SFIA only.
/c/ Measured values reflect all aircraft operations recorded at remote monitoring stations.
/d/ Calculated values minus measured values.

SOURCE: Ken Eldred Engineering.

SINGLE-EVENT NOISE

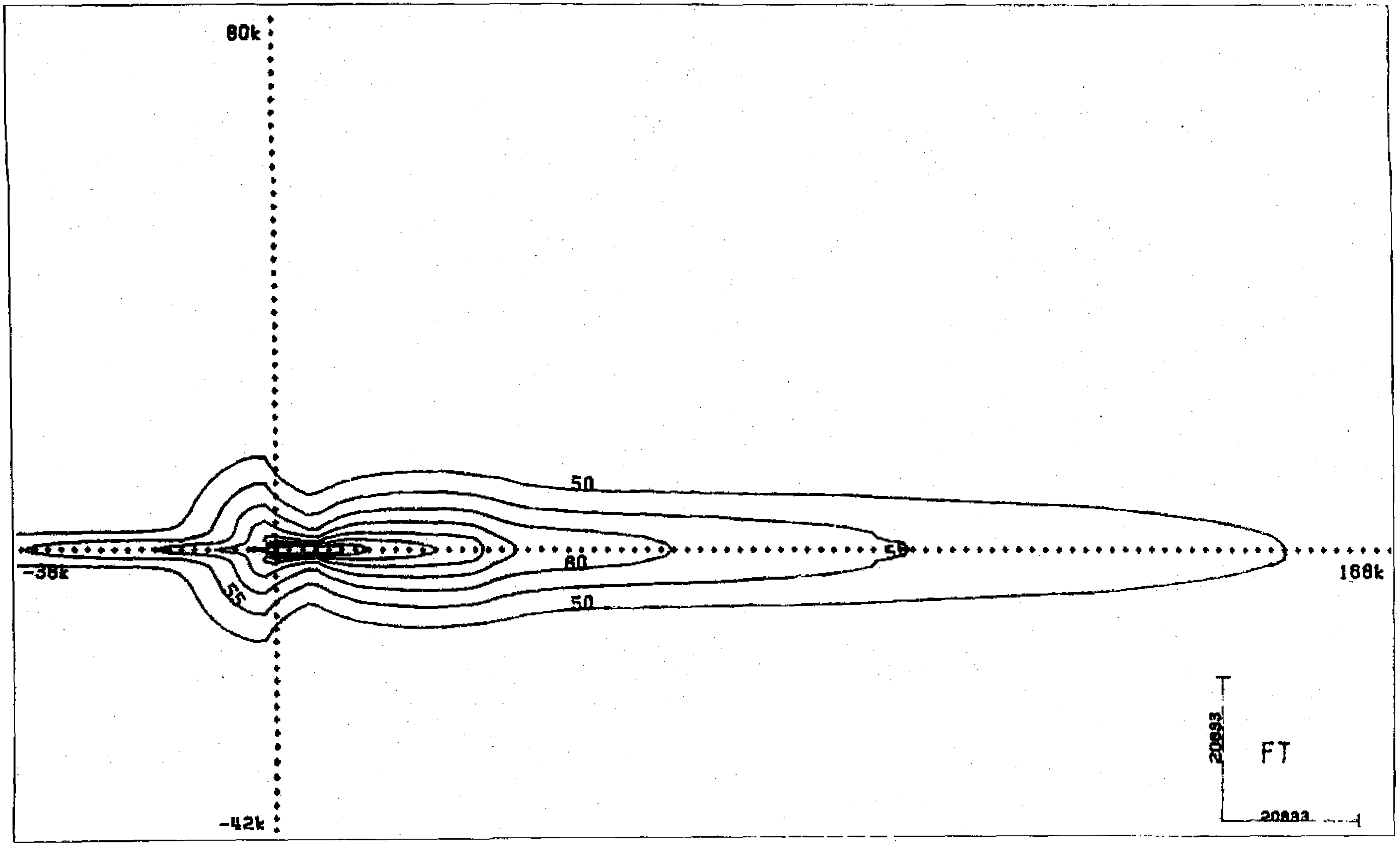
In order to analyze the single-event noise produced by the aircraft using SFIA, sound exposure level (SEL) contours were developed for four representative aircraft: the B-727-200; B-737-300; B-747-200; and B-767. Figures C-1 through C-4 show single-event SEL contours for these four aircraft. The contours are similar to the CNEL contours shown in Sections III.C. and IV.C. Noise, pp. 153-170 and 331-352, except that ● they represent single-event rather than cumulative noise levels. Each SEL contour represents the noise produced by one aircraft landing on and taking off from one runway. The long, narrow end of the contour represents the noise produced during landing; the rounder end of the contour represents the noise produced during takeoff.

The sound exposure level contours developed are generic (not site-specific), in that the areas that are shown as exposed to certain noise levels are calculated 1) based on distance from whatever runway an aircraft uses for takeoff or landing, and 2) given a set of assumptions about aircraft performance (for example, assuming that the aircraft continues straight out after takeoff). The actual single-event noise levels experienced in a particular area near SFIA would depend on the runway used, the weight of the aircraft, wind and weather conditions, the flight route and other operational procedures used by the aircraft pilot, and other factors.

Table C-4 shows the number of square miles within the contours of 80, 95, and 110 dB, SEL, for each of the four aircraft studied. As shown in Table C-4, the B-727-200, a Stage 2 aircraft, produces the largest single-event noise contours of the four aircraft. The B-737-300, a Stage 3 aircraft, produces the smallest single-event noise contours.

Table C-5 shows the sound exposure levels each of the aircraft produces at various distances from the beginning of takeoff. The noise levels shown would be experienced if the aircraft were flying directly overhead. Table C-6 shows the corresponding sound exposure levels for arriving aircraft, at various distances from the runway threshold. Table C-7 shows a comparison of the maximum takeoff and landing noise levels at a point 30,000 feet (about 5.7 statute miles) from the landing end of the runway (and 40,000 feet from the takeoff end, assuming a 10,000-foot runway). As shown in Table C-7, the takeoff and landing noise levels for the B-727-200 are different by over 10 dB, SEL, whereas the takeoff and landing noise levels for the B-767 are almost the same.

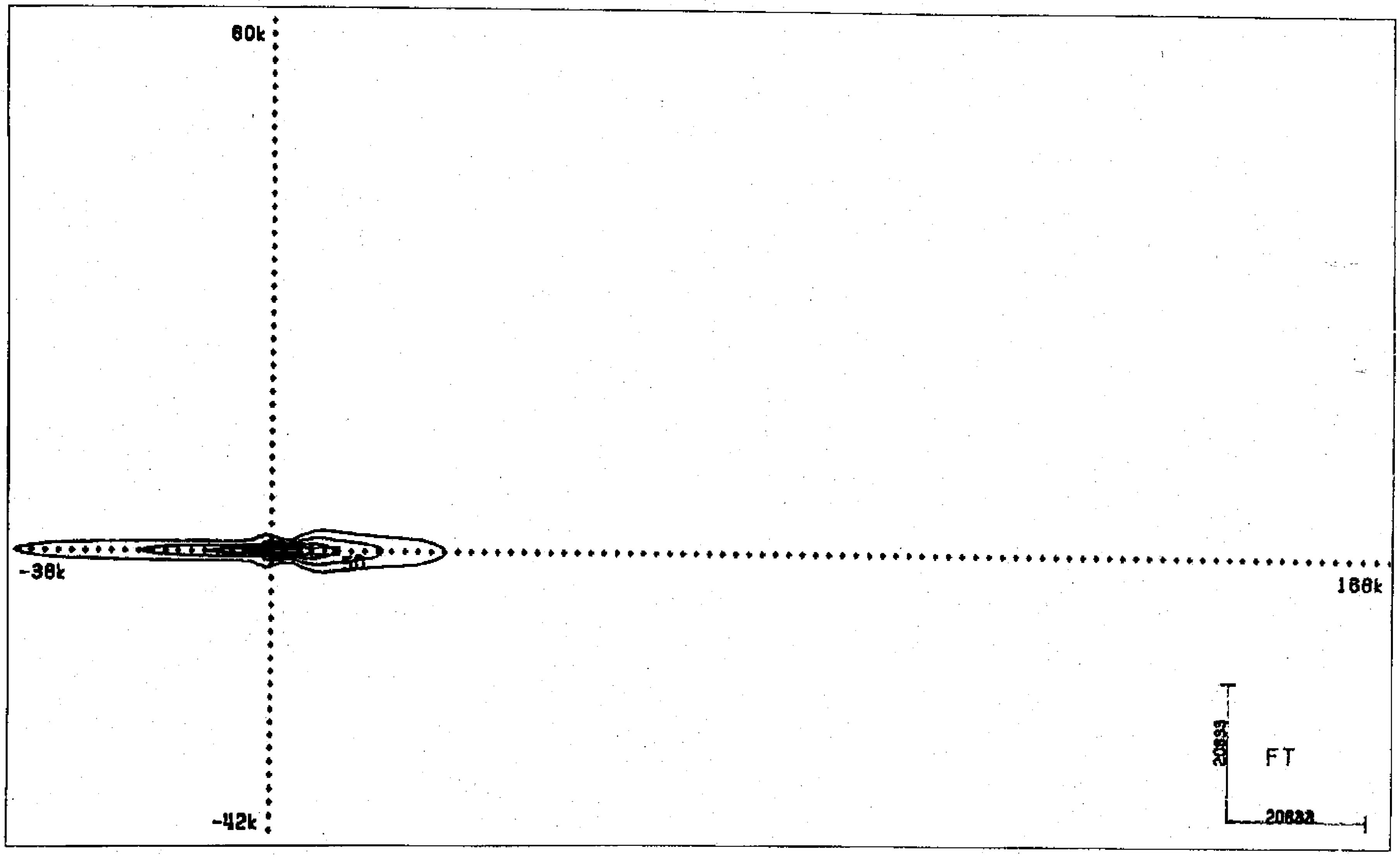
Using the data in Tables C-4 through C-7, the maximum sound exposure levels occurring at the remote monitoring stations and selected study sites were estimated. Table C-8 shows the results for the remote monitoring stations. As shown in Table C-8, the highest sound exposure levels are created by the B-727-200, at sites in San Bruno, Millbrae, and Burlingame. Table C-9 shows estimated sound exposure levels at the selected study sites. As shown in Table C-9, the sound exposure levels are generally lower at the selected study sites than at the remote monitoring stations, because the selected study sites are relatively far from SFIA.



NOTE: Contour reflects typical aircraft performance characteristics and the trip length most frequently used by this aircraft at SFIA.

SOURCE: FAA Integrated Noise Model Version 3.9, Ken Eldred Engineering

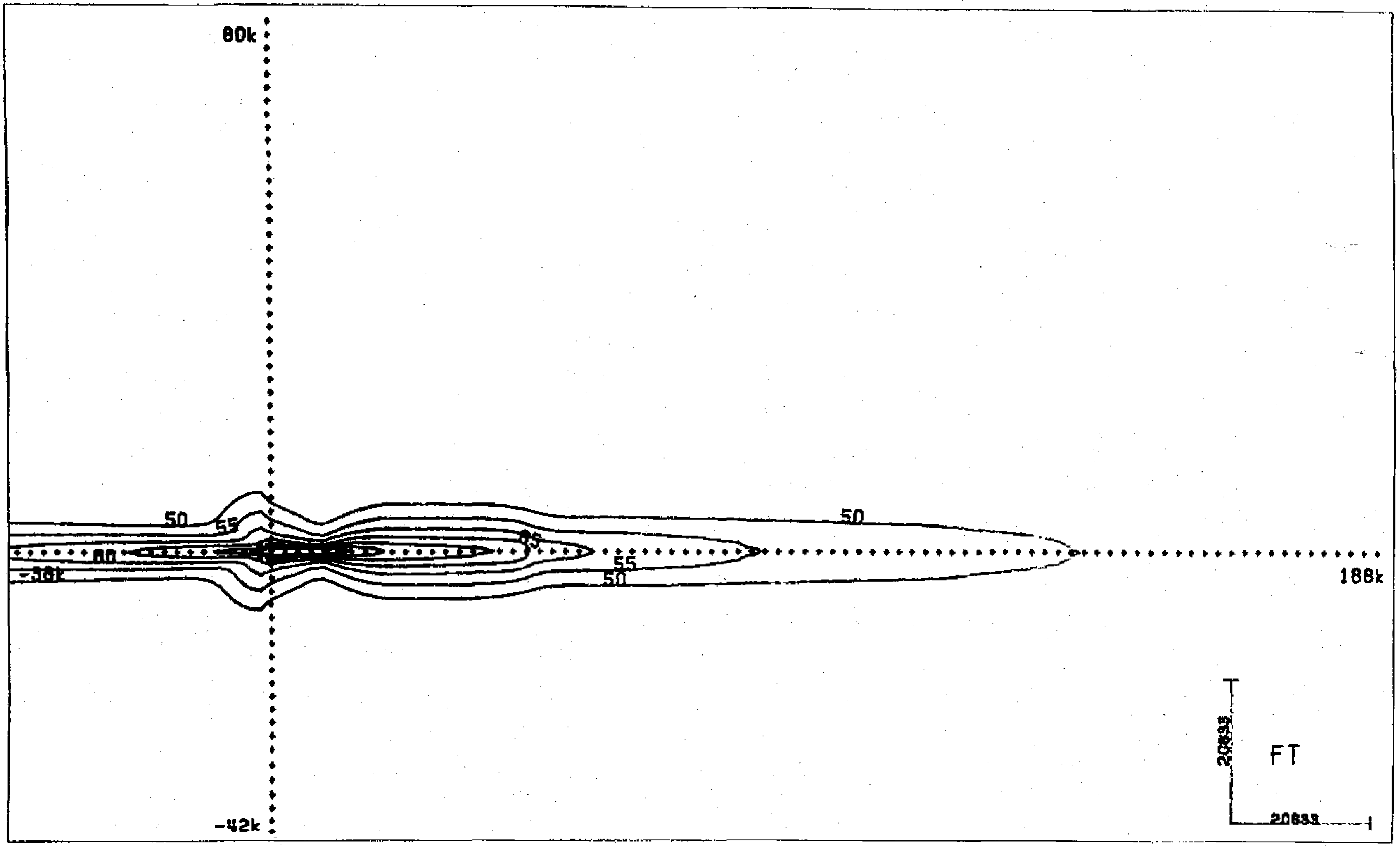
Figure C-1
Single Event Sound Exposure Contour, 727 (Q15)



NOTE: Contour reflects typical aircraft performance characteristics and the trip length most frequently used by this aircraft at SFIA.

SOURCE: FAA Integrated Noise Model Version 3.9, Ken Eldred Engineering

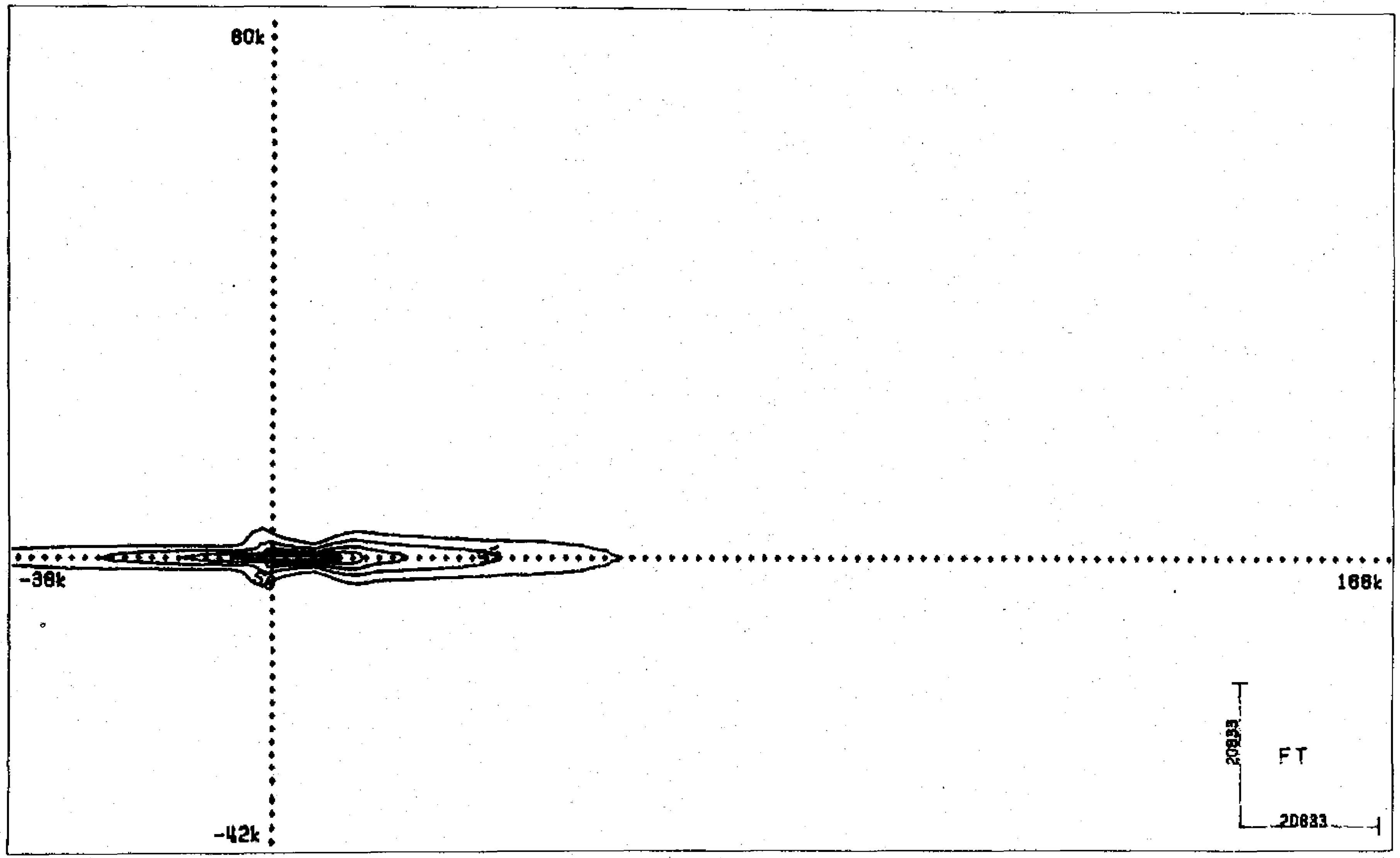
Figure C-2
Single Event Sound Exposure Contour, 737 (300)



NOTE: Contour reflects typical aircraft performance characteristics and the trip length most frequently used by this aircraft at SFIA.

SOURCE: FAA Integrated Noise Model Version 3.9, Ken Eldred Engineering

Figure C-3
Single Event Sound Exposure Contour,
747 (20B)



NOTE: Contour reflects typical aircraft performance characteristics and the trip length most frequently used by this aircraft at SFIA.

SOURCE: FAA Integrated Noise Model Version 3.9, Ken Eldred Engineering

Figure C-4
Single Event Sound Exposure Contour, 767 (CF6)

TABLE C-4: AREA WITHIN SOUND EXPOSURE LEVEL CONTOURS FOR REPRESENTATIVE AIRCRAFT USING SFIA

Sound Exposure Level (dB)	Area (in Square Miles) by Representative Aircraft Type/a/ B-727-200	B-747-200	B-767	B-737-300
80	105.7	59.8	15.4	7.8
95	9.6	6.2	0.9	0.3
110	0.7	0.4	0.2	0.1

/a/ Assuming a straight-out departure and typical aircraft performance characteristics. Trip lengths (related to aircraft weight) are those most frequently used by these aircraft at SFIA.

SOURCE: Ken Eldred Engineering.

TABLE C-5: SOUND EXPOSURE LEVELS AT VARIOUS TAKEOFF DISTANCES FOR REPRESENTATIVE AIRCRAFT USING SFIA

Distance From Start of Takeoff Roll (feet)	Sound Exposure Level (in dB) by Representative Aircraft Type/a/ B-727-200	B-747-200	B-767	B-737-300
15,000	109.4	106.4	92.6	86.2
21,000	106.0	103.3	89.6	82.2
25,000	104.6	102.2	88.1	80.5
30,000	101.9	100.8	86.3	78.7
40,000	94.0	92.8	83.1	75.3
50,000	92.0	89.5	80.5	72.7
70,000	88.4	85.6	76.9	68.5
100,000	84.5	82.1	73.2	65.3

/a/ Assuming a straight-out departure and typical aircraft performance characteristics. Trip lengths (related to aircraft weight) are those most frequently used by these aircraft at SFIA. Sound levels are those that would be heard on the ground directly under the aircraft.

SOURCE: Ken Eldred Engineering.

TABLE C-6: SOUND EXPOSURE LEVELS AT VARIOUS LANDING DISTANCES FOR REPRESENTATIVE AIRCRAFT USING SFIA

Distance From Runway Threshold (feet)	Sound Exposure Level (in dB) by Representative Aircraft Type/a/			
	B-727-200	B-747-200	B-767	B-737-300
5,000	97.4	102.7	95.9	94.0
15,000	91.2	97.1	89.2	87.1
30,000	86.6	92.7	83.7	82.0
50,000	82.4	88.4	79.2	77.5

/a/ Assuming arrival along a 3-degree glide slope and typical aircraft performance characteristics. Sound levels are those that would be heard on the ground directly under the aircraft.

SOURCE: Ken Eldred Engineering.

TABLE C-7: COMPARISON OF TAKEOFF AND LANDING SOUND EXPOSURE LEVELS FOR REPRESENTATIVE AIRCRAFT USING SFIA

Type of Operation and Distance (feet)	Sound Exposure Level (in dB) by Representative Aircraft Type/a/			
	B-727-200	B-747-200	B-767	B-737-300
Takeoff (40,000)/b/	96.9	92.8	83.1	78.7
Landing (30,000)/c,d/	86.6	92.7	83.7	82.0

/a/ Assuming straight-out departure or arrival along a 3-degree glide slope, and typical aircraft performance characteristics. For takeoffs, trip lengths (related to aircraft weight) are those most frequently used by aircraft at SFIA. Sound levels are those that would be heard on the ground directly under the aircraft.

/b/ From beginning of takeoff roll, assuming a 10,000-foot runway.

/c/ Values are higher than those in Table C-5 because aircraft flight destinations are assumed to be further away (making aircraft height higher and altitudes at distances shown lower).

/d/ From runway threshold.

SOURCE: Ken Eldred Engineering.

TABLE C-8: CALCULATED MAXIMUM SOUND EXPOSURE LEVELS AT REMOTE MONITORING STATIONS FOR REPRESENTATIVE AIRCRAFT USING SFIA

No. /b/	City Location	Sound Exposure Level (in dB) by Representative Aircraft Type/a/ B-727-200	B-747-200	B-767	B-737-300
1	San Bruno	112	106	92	88
2	San Bruno	107	102	88	84
3	South San Francisco	108	102	88	85
4	South San Francisco	108	103	89	85
5	San Bruno	110	105	91	87
6	South San Francisco	108	102	88	85
7	Brisbane	103	99	85	82
8	Millbrae	120	114	100	94
9	Millbrae	113	107	93	90
10	Burlingame	111	105	92	88
11	Burlingame	113	106	93	89
12	Foster City	95	90	82	77
13	Hillsborough	107	102	87	83
14	South San Francisco	106	101	86	83
15	South San Francisco	108	103	89	85
16	South San Francisco	103	98	85	81
17	South San Francisco	103	98	85	81
18	Daly City	100	96	84	80
19	Pacifica	98	94	83	79
20	Daly City	95	90	81	76
21	San Francisco	94	89	80	76
22	San Bruno	N/A	N/A	N/A	N/A
23	San Francisco	97	92	82	78
24	San Francisco	95	90	81	76
25	San Francisco	93	87	79	74
26	San Francisco	93	87	79	74
27	San Francisco	91	86	76	71

/a/ Assuming a straight-out departure and typical aircraft performance characteristics. Trip lengths (related to aircraft weight) are those most frequently used by these aircraft at SFIA.

/b/ Remote monitoring stations are shown in Figure 21, Section III.C. Noise Setting, p. 162.

SOURCE: Ken Eldred Engineering.

● TABLE C-9: CALCULATED MAXIMUM SOUND EXPOSURE LEVELS AT SELECTED STUDY LOCATIONS FOR REPRESENTATIVE AIRCRAFT USING SFIA

No. /b/	City Location	Sound Exposure Level (in dB) by Representative Aircraft Type/a/ B-727-200	B-747-200	B-767	B-737-300
A	SF-Visitacion Valley	96	91	82	77
B	SF-Mt. Davidson	94	90	81	76
C	SF-Ingleside	95	90	81	76
D	Albany	90	84	75	70
E	Kensington	89	84	75	70
F	Berkeley	90	85	77	71
G	Berkeley	90	84	75	70
H	Oakland	91	86	77	73
I	Berkeley	90	85	76	71
J	Orinda Village	90	84	75	70
K	Berkeley/Oakland	90	85	76	71
L	Oakland	90	85	76	71
M	Orinda	89	84	75	70
N	Walnut Creek	87	82	73	67
O	Richmond	88	83	74	68
P	Moraga	89	84	75	70
Q	Danville	88	82	73	68
R	Pacifica	92	87	78	74
S	Pacifica	91	85	77	72
T	Pacifica	93	88	79	74

/a/ Assuming a straight-out departure and typical aircraft performance characteristics. Trip lengths (related to aircraft weight) are those most frequently used by these aircraft at SFIA.

/b/ Study locations are shown in Figure 21, Section III.C. Noise Setting, p. 162.

SOURCE: Ken Eldred Engineering.

● TABLE C-10: SENSITIVE RECEPTORS WITHIN 65 to 70 and 70 to 75 dBA, CNEL NOISE CONTOURS/a/

1990 Existing Base

<u>70-75 dBA Contour</u>

Millbrae Nursery School
Millbrae Serra Convalescent Hospital
Sheltering Pines Convalescent Hospital

<u>65-70 dBA Contour</u>

Chadbourne School
Fire Station
Belle Air School
Avalon School
Taylor School*
Green Hills School*
South San Francisco High School*
Los Cerritos School*
El Rancho School*
Alta Loma School*
Lincoln School*
Millbrae City Hall
Millbrae City Library

1996 Project and No-Project Alternative

<u>65-70 dBA Contour</u>

Chadbourne School
Mills High School*
Peninsula Hospital*
Fire Station*
Belle Air School*
Avalon School*
South San Francisco High School*
Los Cerritos School*
Millbrae Nursery School
Millbrae Serra Convalescent Hospital
Sheltering Pines Convalescent Hospital
Millbrae City Hall
Millbrae City Library

● TABLE C-10: SENSITIVE RECEPTORS WITHIN 65 to 70 and 70 to 75 dBA, CNEL NOISE CONTOURS/a/ (CONTINUED)

2006 No Project Alternative

<u>65-70 dBA Contour</u>

Avalon School*
South San Francisco High School*
Los Cerritos School*
Sheltering Pines Convalescent Hospital*

2006 Project

<u>65-70 dBA Contour</u>

South San Francisco High School
Los Cerritos School
Southwood School
Avalon School*
Sheltering Pines Convalescent Hosptial*
Millbrae Serra Convalescent Hospital*

NOTES:

/a/ Other than residences.

*On border of contour.

SOURCE: Environmental Science Associates, Inc.

NOISE APPENDIX

DESCRIPTION OF NOISE AND ITS EFFECTS ON PEOPLE

Kenneth McK. Eldred

Index Page

1. INTRODUCTION

This appendix summarizes information on ways to describe environmental sound exposure with respect to people and on its effects in terms of interference with human activity and annoyance.

This information is primarily based on the U.S. Environmental Protection Agency "Levels Document"[1*] and on subsequent research and findings. The set of six descriptors provides for quantifying the instantaneous magnitude of sound and the total magnitude of sound exposure to a single event or to a collection of events.

The cumulative noise metric in this appendix is the Day-Night Sound Level (Ldn). This quantity very similar to the California Community Noise Equivalent Level (CNEL), except that CNEL contains a 5 dB penalty for the evening hours of 7:00-10:00pm, whereas Ldn does not. The result is that CNEL is usually slightly larger numerically than Ldn, usually by 0.1 to 1 dB. Except for this negligible difference, the human effects for a value of CNEL should be the same as those given here for Ldn.

The appendix contains information of the effects of noise on speech communication, sleep and annoyance, addressing the effect of background noise and single event noise as well as the cumulative value of intruding noise. Finally, it contains current land use recommendations with respect to noise.

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* The numbers in superscript refer to references at the end of the appendix text.

2. DESCRIPTION OF ENVIRONMENTALSOUND EXPOSURE

This section presents the set of descriptors that are most useful in quantifying sounds heard in residential neighborhoods and relating them to the various health effects. It then develops the simple relationships between sound exposures associated with various events heard during a defined time period and the resulting total cumulative sound exposure. Finally, it discusses longer term temporal factors which must be considered in defining the appropriate activity level and the typical expected difference between outdoor and indoor noise.

2.1 Descriptors[5]

There are a great many descriptors that have been advocated for the purpose of characterizing one or more attributes of environmental sound. Here we present a set of quantities that were developed originally by the United States Environmental Protection Agency, standardized by the national and international technical community and generally used today by the U.S. Government agencies, states and local authorities. These quantities allow for description of the:

- instantaneous magnitude of sound and the character of its frequency spectrum .
- magnitude of the total sound exposure associated with a single event such as an aircraft fly-by.
- magnitude of the average sound exposure in an hourly period which may be related to interface with human activity or health.
- magnitude of the 24-hour sound exposure with a night-time penalty weighting which may be related to noise impact.

Table 1 lists the principal descriptors and gives a short definition and principal use for each of the quantities that provide the basis for discussion of sound in this document. The following paragraphs provide further information on each of these quantities.

TABLE 1

Principal Descriptors of Environmental Sound

Quantity	Symbol Abbreviation	Short Definition	Principal Uses
Sound Level	L	Mean square value of A-weighted sound pressure level at any time re. a reference pressure.	Describes magnitude of a sound at a specific position and time.
Sound Exposure	SE	Time integral of the mean square A-weighted sound pressure re. a mean square reference pressure and 1-second duration (pasques).	Describes magnitude of all of the sounds at a specific position accumulated during a specific event, or for a stated time interval.
Sound Exposure Level	SEL	10 x logarithm of sound exposure.	Decibel form of sound exposure.
Equivalent Sound Level	L_{eq}	Level of a steady sound which has the same sound exposure level as does a time-varying sound over a stated time interval.	Describes average (energy) state of environment. Usually employed for durations of: 1 hr {L_{eq}(1)}, 8 hr {L_{eq}(8)}, or 24 hr {L_{eq}(24)}.
Day/night Sound Level	Ldn	Equivalent sound level for a 24-hour period with a +10 dB weighting applied to all sounds occurring between 10 pm and 7 am.	Describes average environment in residential situations; accounting for effect of nighttime noises, and often is averaged over a 365-day year.
Day/night Sound Exposure	DNSE	Linear Day/night sound exposure for a 24-hour period with a 10 times weighting applied to all sounds occurring between 10 pm and 7 am.	Linear analogue to Day/night Sound Level is very useful for adding up or comparing constituent parts of the total sound environment.

Sound Level (L_A)

The instantaneous magnitude of a sound may be described by its sound level which accounts both for the magnitude of its pressure fluctuations and their distribution in the frequency spectrum.

The distribution of sound energy as a function of frequency is termed the "frequency spectrum." See Figure 1 for an example. The frequency spectrum is important to the measurement of the magnitude of sounds because the human ear is more sensitive to sounds at some frequencies than at others. For example, the human ear hears best in the frequency range of 1000 to 5000 cycles per second (or Hertz) than at very much lower or higher frequencies. Therefore, in order to determine the magnitude of a sound on a scale that is proportional to its magnitude as perceived by a human, it is necessary to weight that part of the sound energy spectrum humans hear most easily more heavily when adding up the total sound magnitude as perceived. Figure 2 illustrates this concept of weighting the physical sound spectrum to account for the frequency response of the ear.

The most popular form of frequency weighting, called A-weighting, is incorporated in the definition of sound level. A-weighting, which was developed in the 1930's for use in a sound level meter, accomplishes the weighting by an electrical network which works in a manner similar to the bass and treble controls on a hi-fi set. Its major effect is to deemphasize low frequency sounds, e.g. to roll off the bass response. A-weighting has been used extensively throughout the world to measure the magnitudes of sounds of all types. Because of its universality, it was adopted by EPA and other government agencies for the description of sounds in the environment.

The unit used to measure the magnitude of sound level is the decibel. In the phrase, "The sound level is so many decibels," its use is analogous to the use of "inch" in the phrase, "The length is so many inches" or to "degree" in the phrase, "The temperature on the celsius scale is so many degrees." However, unlike the scales of length and temperature, which are linear scales, the sound level scale is logarithmic. By definition, therefore, the level of a sound which has 10 times the mean square sound pressure of the reference sound is 10 decibels (or dB) greater than the reference sound, and one which has 100 times (or 10 x 10) the mean square sound pressure of the reference sound is 20 dB greater (10 + 10) dB.

This use of a logarithmic scale for sound is convenient because sound pressures of normal interest extend over a range of 10 million to 1. Since the mean square sound pressure is proportional to the square of sound pressure, it extends over a typical range of 100 million million (a 100 trillion) to 1. This huge number, 100 trillion (or 100,000,000,000,000, with 14 zeros after the 1) is much more conveniently represented on the logarithmic scale as 140 dB (14 x 10).

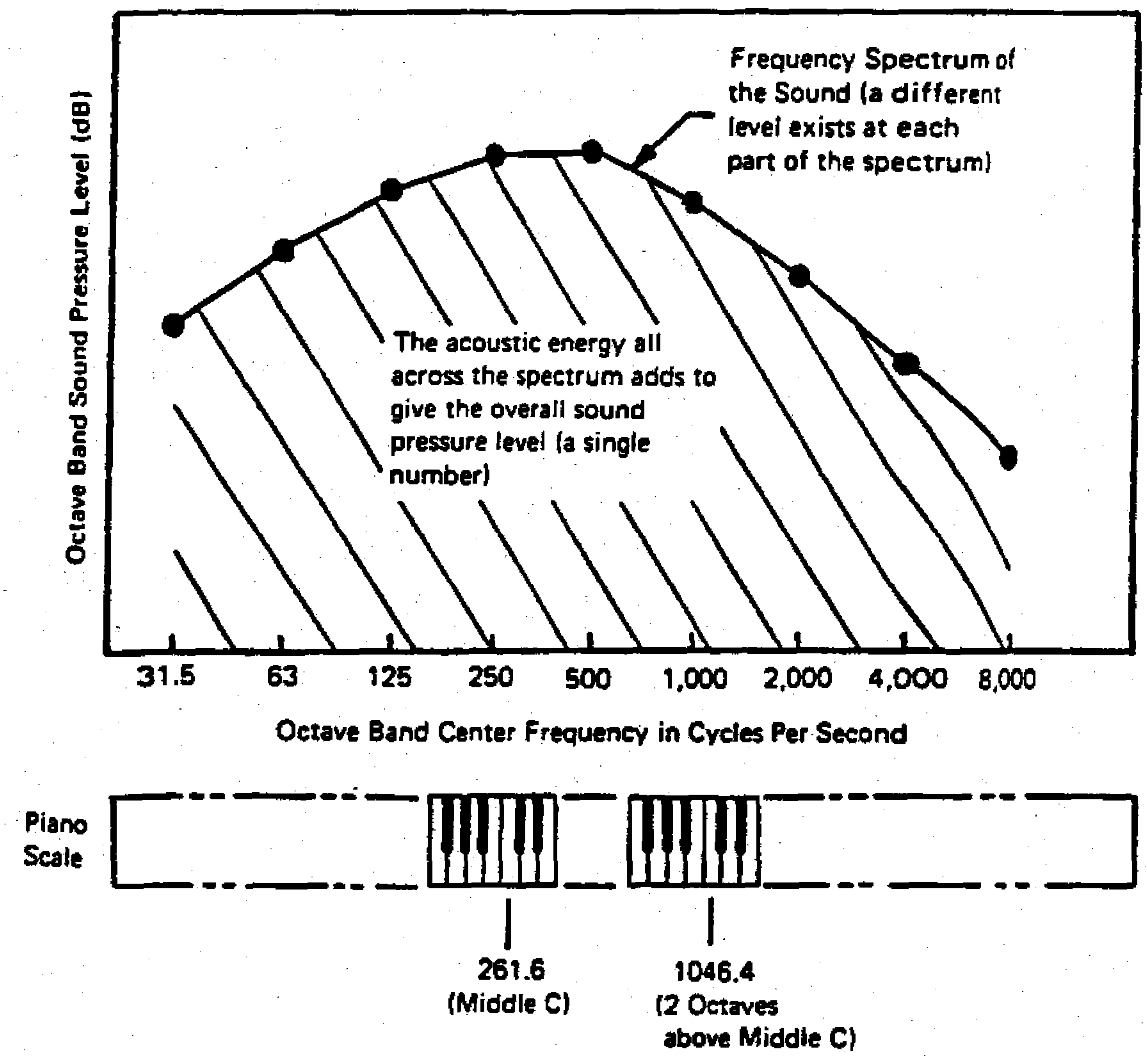

Figure 1: **Example of a Frequency Spectrum of a Sound**

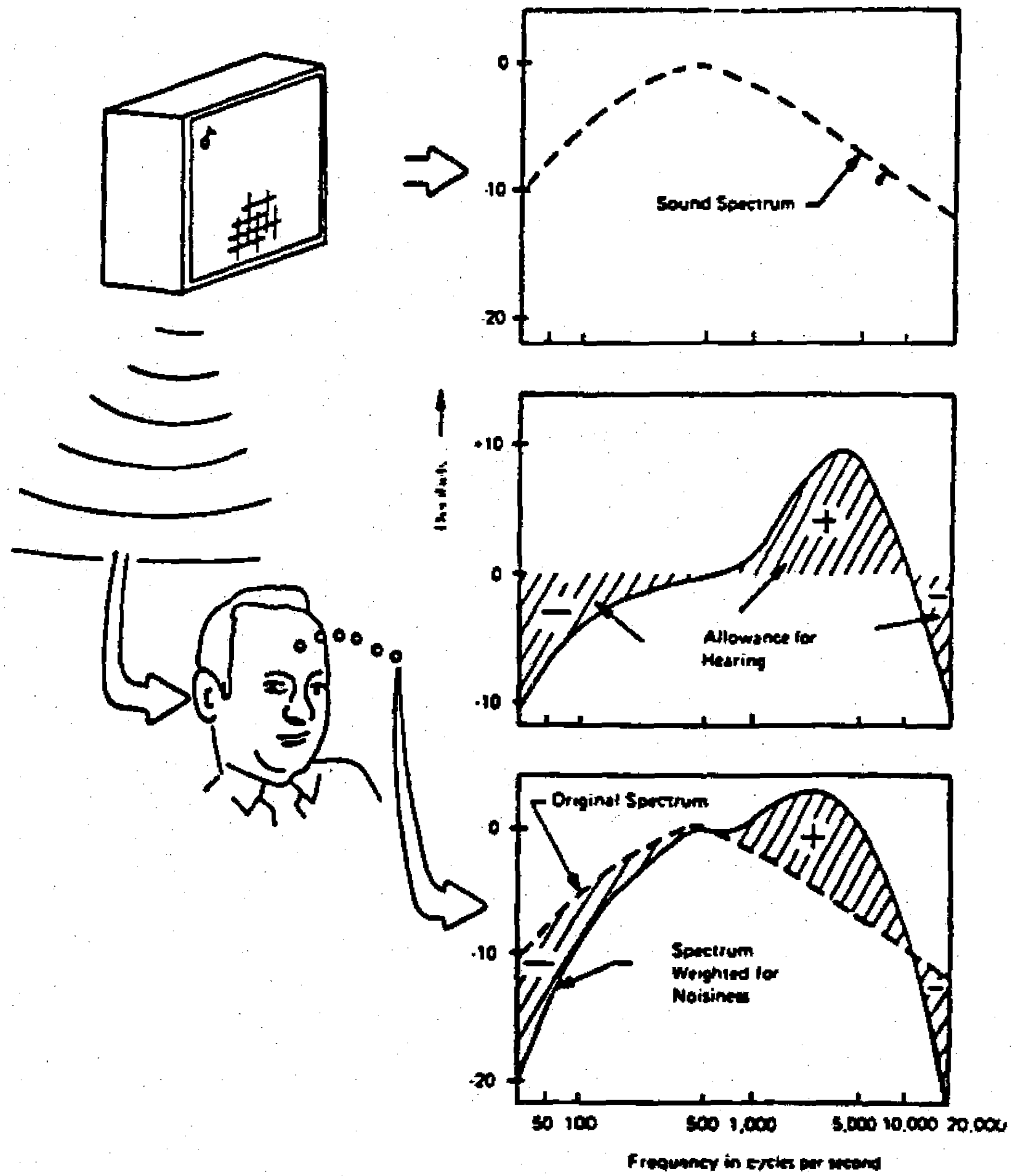

Figure 2: Weighting the Measured Sound Spectrum to Account for the Frequency Response of the Ear

The use of the logarithmic decibel scale requires somewhat different arithmetic than we are accustomed to using with linear scales. For example, if two similar but independent noise sources operate simultaneously, the measured mean square sound pressure from the two sources will add together to give a value twice that which would result from either source operating alone. The resulting sound pressure level in decibels from the combined sources will be only 3 dB higher than the level produced by either source alone, since the logarithm of 2 is 0.3 and 10 times 0.3 is 3. In other words, if we have two sounds of different magnitude from independent sources, then the level of the sum will never be more than 3 dB above the level produced by the greater source alone. If the two sound sources produce individual levels that are different by 10 dB or more, than adding the two together produces a level that is not significantly different from that produced by the greater source operating alone.

The zero value on the A-weighted sound level scale (sound level, for short) is the reference pressure of 20 micro-newtons per square meter. This value was selected because it approximated the smallest sound pressure that can be detected by a human. The average sound level of a whisper at a 1-meter distance from the person who is whispering is 40 dB; the sound level of a normal voice speaking 1 meter away is 57 dB; a shout, 1 meter away, is 85 dB. Other examples of sound levels are illustrated in Figure 3.

Sound Exposure (SE)[6,7]

Sound exposure is the analogous non-logarithmic arithmetic quantity to sound exposure level. It provides the basis for describing the total sound exposure during a stated period of time. This includes a wide variety of environmental noise situations in which the magnitude of the sound is constantly changing with time. Sound exposure is the linear time integral of the mean square sound pressure, having the dimension of pressure squared x time. Its units are pascal squared seconds (pasques for short).

Sound Exposure Level (SEL)

The sound exposure level characterizes the total sound associated with a single event during a stated time period. The sound level during a discrete event varies with time, rising from a residual level to a maximum value and then falling back to the residual level, as illustrated in Figure 4. The total sound exposure associated with such an event is a function of the duration of the event and its maximum sound level. Since both of these factors are relevant to the effect of the sound on people, the sound exposure level has been found to be the most appropriate and useful descriptor for most types of single event sounds including aircraft fly-bys.

Figure 5 shows an example of the time history of the ambient noise in a suburban neighborhood. The large changes in sound level, which occur as the result of diverse discrete events, demonstrate the difficulty of selecting a single value of the sound level time history to characterize the total sample. To account for all of these sounds, the cumulative sound exposure, or sound exposure level, allows the summation of all of these individual sounds into a single total value for each sample in a manner that can be correlated with the probable effect of these sounds on people.

Equivalent Sound Level (Leq)

The equivalent sound level during a stated time period is the level of a steady sound which has the same sound exposure as does the actual sound. The major virtue of the equivalent sound level is that its magnitude correlates well with the effects on humans that result from a wide variation in types of environmental sound levels and time patterns. It has been proven to provide good correlation between noise and speech interference and the risk of noise-induced hearing loss. It also is the basis for the principal quantity used to describe the total outdoor noise environment, the Day-night Sound Level.

The equivalent sound level for the hour which contained most of the ten-minute sample in Figure 5 was 57 dB and the corresponding sound exposure level was 92.6 dB (a sound exposure of 0.72 pasques).

Day-night Sound Level (Ldn)

The Day-night Sound Level is defined as the A-weighted equivalent sound level for a 24-hour period with a +10 dB weighting applied to the equivalent sound levels measured during the nighttime hours of 10:00 pm to 7:00 am. The nighttime weighting acts to increase the levels measured in nighttime by 10 dB. Hence, an environment that has a measured daytime equivalent sound level of 60 dB and a measured nighttime equivalent sound level of 50 dB has weighted nighttime sound level of 60 dB (50 + 10) and a Day-night Sound Level of 60 dB.

The Day-night Sound Level is the primary descriptor of cumulative noise in the outdoor environment, correlating well with overall community reaction to noise and to the results of social surveys of annoyance to aircraft noise. It has been adopted throughout the federal government and is now embodied in numerous federal regulations and guidelines. Its magnitude has been related to most of the effects of noise on people to an extent unmatched by any other descriptor. Therefore, it has the highest utility in evaluating environmental noise with respect to people.

For some applications and noise abatement measures, it can be useful to separate the daily exposure into more time periods, e.g. daytime, evening and nighttime, depending on the noise activities and lifestyle of the population. Some countries and the state of California have adopted such variations from Ldn. However, the standardized Ldn used here results in the best overall comparability of various residential noise environments.

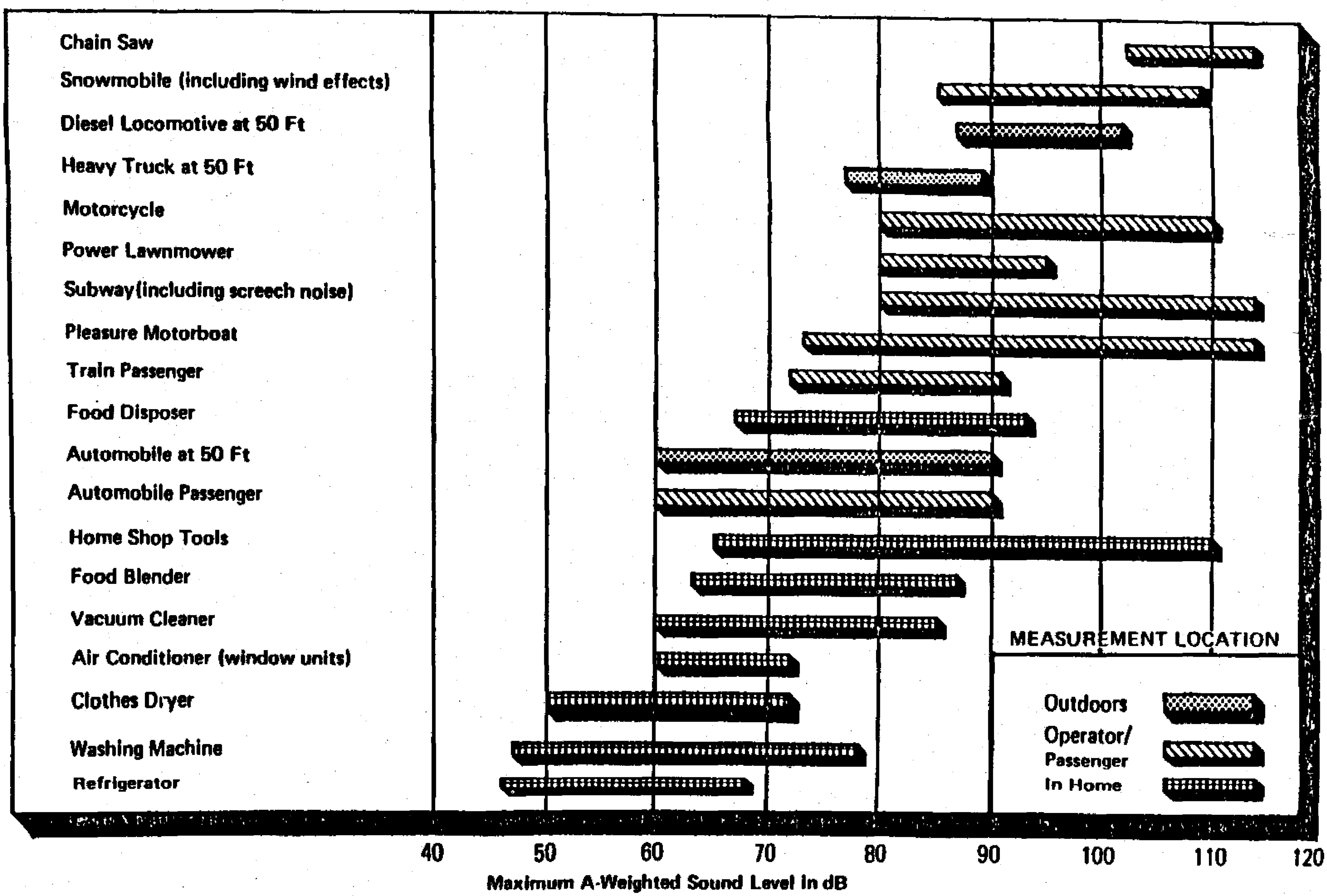

Figure 3: Typical Range of Common Sounds

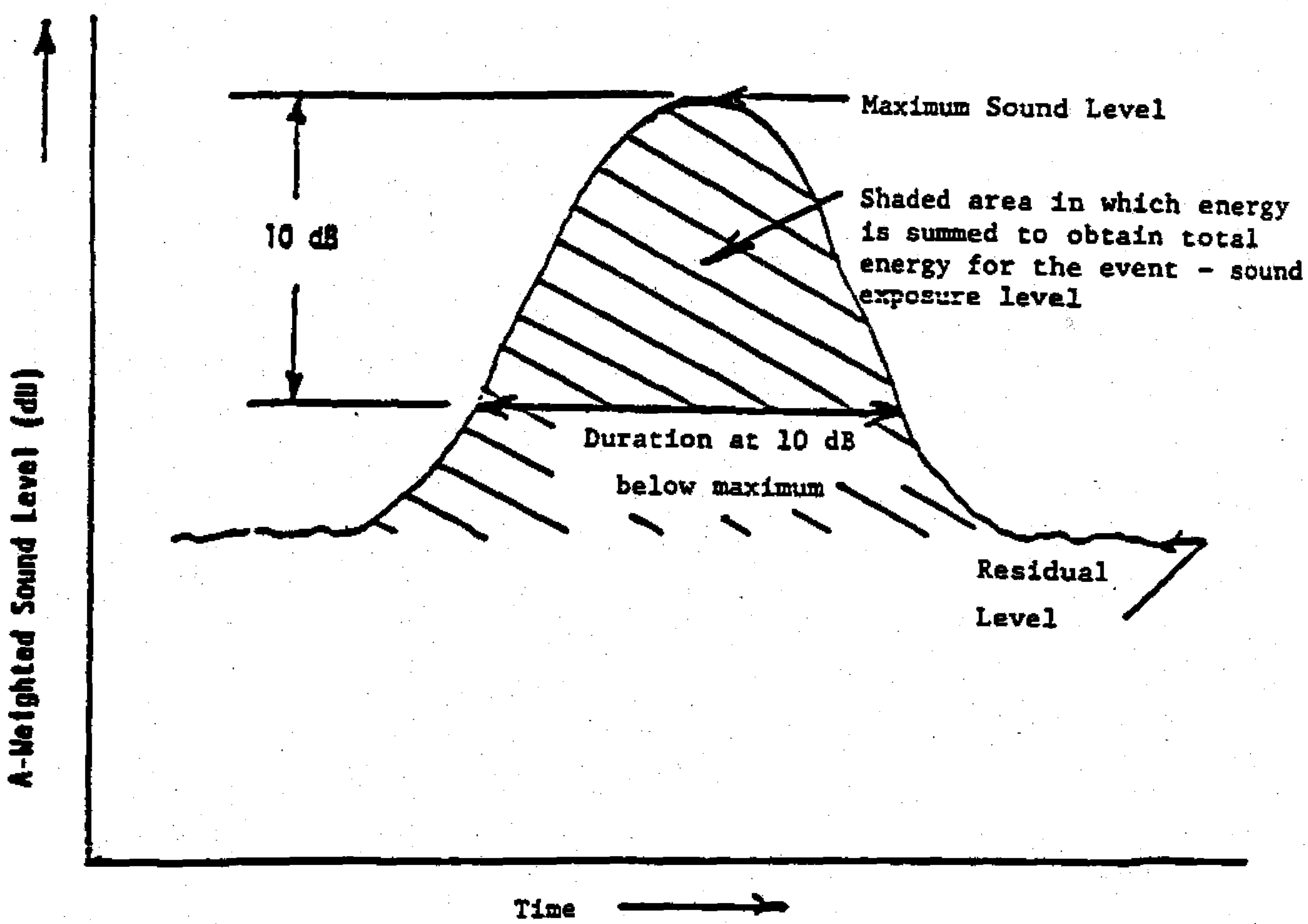

Figure 4: **Time History of Sound Level of a Single Event Sound**

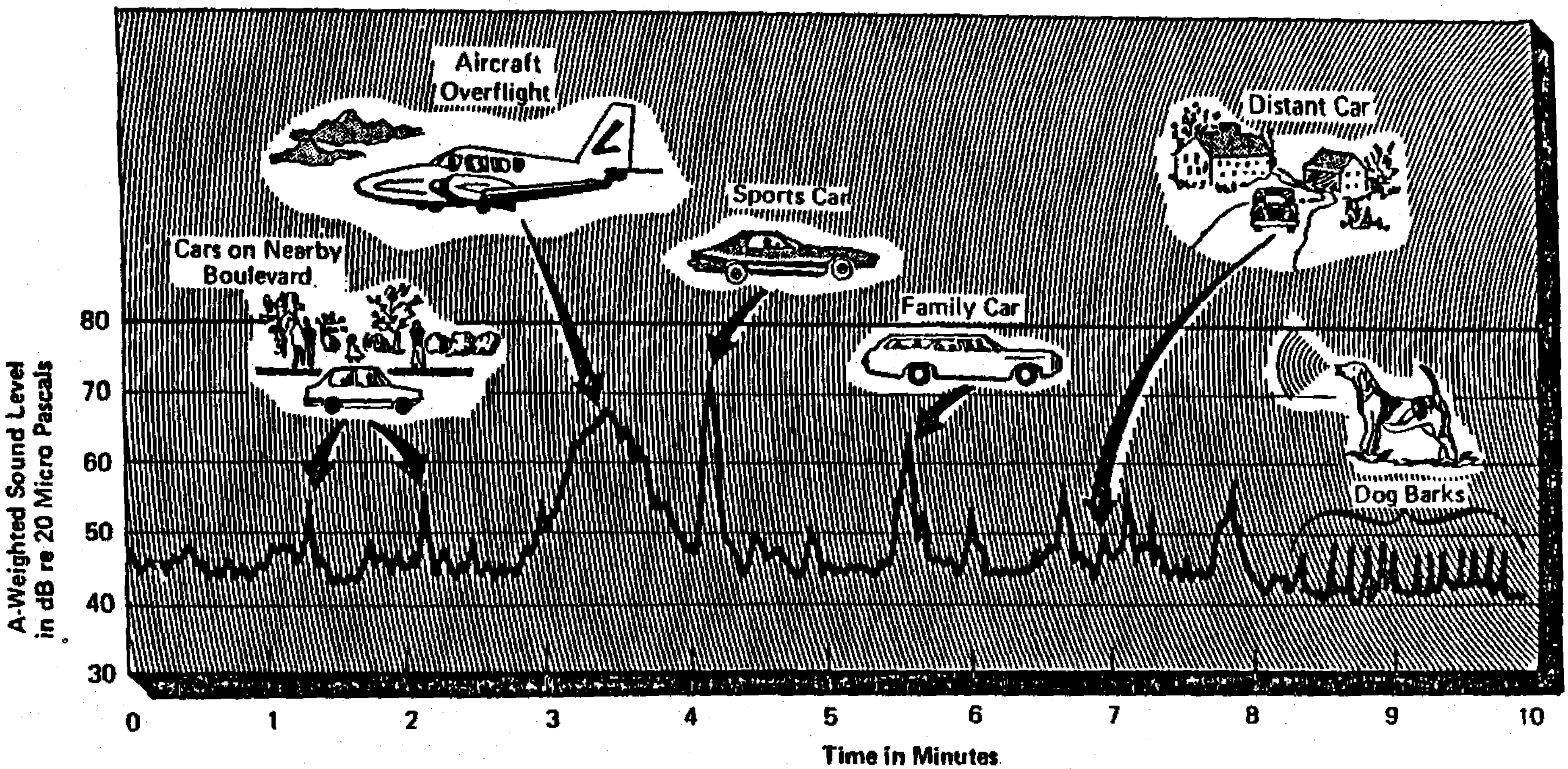

Figure 5: **Typical Outdoor Sound Measured on a Quiet Suburban Street**

Day-Night Weighted Sound Exposure (DNSE)

An alternative cumulative noise descriptor that corresponds with the Day-night Sound Level is the Day-night Weighted Sound Exposure. Its units are pascal-squared seconds, pasques for short. The range of primary interest for DNSE is 1 to 1,000 pasques, equivalent to Ldn values of 45 to 75 dB.

Figure 6 illustrates the direct relationship between the logarithmetic Day-night Sound Level scale and the Day-night Sound Exposure scale. A value of 1 pasque is equivalent to an Ldn of 45 dB which is a very quiet environment such as found on a farm in California. The value of 10 pasques is equivalent to an Ldn of 55 dB which is the level proposed by the US Environmental Protection Agency (EPA) as protective of the "public health and welfare with an adequate margin of safety" (see Section 4.1). Such a level is often found in suburban neighborhoods. The value of 100 pasques is equivalent to an Ldn of 65 dB, a level considered by the FAA and various other agencies to be the threshold of possibly significant noise problems, and is the minimum value of Ldn required for eligibility for sound proofing under FAA grant programs. Finally, a value of 1,000 pasques is equivalent to an Ldn of 75 dB, the level which it is generally recognized as the maximum cumulative level fit for residential living, even with sound proofing applied to the residential units.

2.2 The Cumulative Sound Exposure from Single Events

The cumulative sound exposure resulting from a series of sound events is calculated by adding up the sound exposures of the individual events. For example, if there were three events with sound exposures of 4, 9 and 23 pasques, then the cumulative sound exposure is calculated by adding 4 + 9 + 23 to obtain 36 pasques.

This simple arithmetic property of sound exposure is very useful when examining the possible effects of alternative noise mitigating measures. For example, a 30 percent reduction in the operations on a ~~specific reduction in the operations on a~~ specific runway leads to a 30 percent reduction in the cumulative sound exposure from those operations. The ability of this technique can be easily seen in the examples in Table 2.

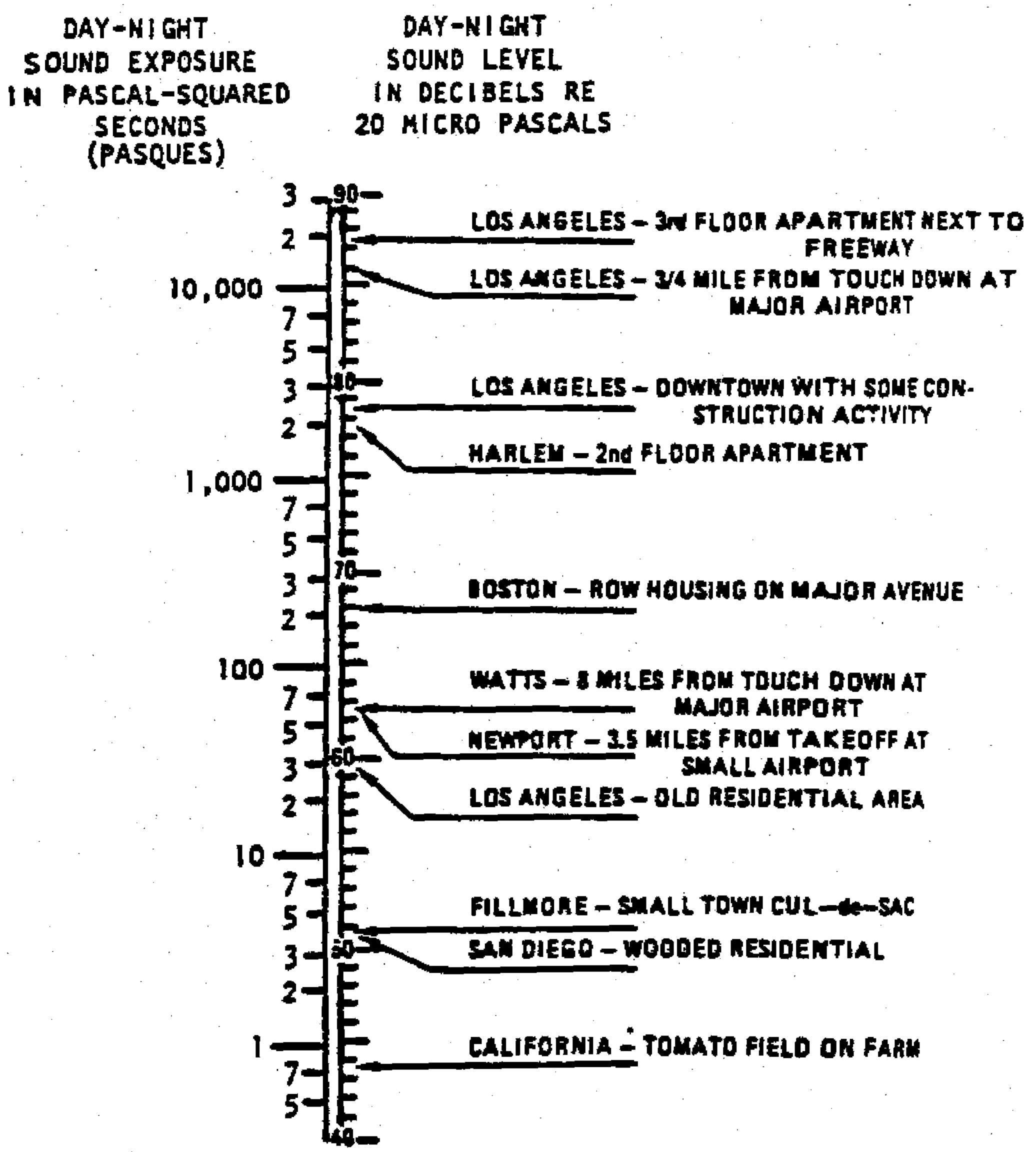

Figure 6: **Examples of 24-hour Day-night Weighted Cumulative Noise Measurements with Both Day-night Weighted Sound Exposure and Day-Night Sound Level Scales**

TABLE 2

Examples of the Use of Day/night Weighted Sound Exposure (DNSE)

Example 1: Contributions of departures on five runways to sound exposure at a specific location (at a typical large commercial airport)

Departure Runway	Ldnp* (decibels)	DNSE (pasques)	% Total Exposure	No. Ops.	DNSE per Operation (pasques)
08	64.4	95	20	45	2.11
14	62.5	61	13	75	.81
23	66.9	169	37	100	1.69
26	64.2	91	20	78	1.17
32	61.1	45	10	60	.75
TOTAL:	71.3	461	100	358	1.29

TABLE 2 (continued)

Example 2: Contribution of departures from various aircraft on all runways to sound exposure at a specific location (at a typical large commercial airport)

Aircraft Type	Ldnp* (decibels)	DNSE (pasques)	% Total Exposure	No. Ops.	DNSE per Operation (pasques)
727	69.9	338	72	152	2.22
DC9	64.2	89	19	113	0.79
747	60.5	38	8	23	1.67
DC10	51.6	5	1	41	0.12
767	47.6	2	Neg.	29	0.07
TOTAL:	71.3	472	100	358	1.32

* Ldnp is the partial value of Ldn associated with the indicated operation

The day-night weighted sound exposure may also be used to include the effect of the population impacted by alternative proposals in attempting to decide which proposal should be selected. For example, assume that the noise from airfield operations impacted two apartment properties; Apartment A with a population of 500 people, and Apartment B with a population of 100 people, and that the current DNSE values are 10 pasques and 40 pasques, respectively. Thus at Apartment A there are 500 people living in an area which has a DNSE of 10 pasques, and at Apartment B there are 100 people with a DNSE of 40 pasques. One can calculate in each area the total population weighted DNSE by multiplying the number of people exposed by their DNSE. Thus, at Apartment A, population-weighted DNSE is 5,000 people pasques and at Apartment B it is 4,000 people pasques. Then the total current impact in terms of cumulative sound exposure is simply the sum of the population-weighted DNSE's or 9,000 people pasques in this example. Alternatives with proposed noise mitigations could be similarly evaluated and their totals compared with that of the current operation, to give one type of single number comparative measure.

This technique can be applied to the estimated national population affected by noise from aircraft operations at civilian airports. The results are shown in Table 3.

TABLE 3

Estimated Population Impact of Aircraft Noise Based on Population Weighted by Day-Night Sound Exposure

DNL Interval (dB)	Population (millions)	Average DNSE (pasques)	Population Weighted DNSE (people pasques)	% of Total Above Ldn = 55 dB
			615	
80-85	.1	6150.0	388	20.9
75-80	.2	1940.0	615	13.2
70-75	1.0	615.0	660	20.9
65-70	3.4	194.0	418	22.4
60-65	6.8	61.5	248	14.2
55-60	12.8	19.4	2944	8.4
				100.0

The results indicate that about 21 percent of the population-weighted DNSE occurs at very high values of DNSE (DNSE greater than 3,000 pasques and the corresponding Ldn greater than 80 dB). Further, 78 percent of the national impact as measured by this metric occurs at values of DNSE greater than 100 (Ldn greater than 65 dB).

2.3 Locational and Temporal Modifying Factors

The usual definition of the noise environment is given in terms of the outdoor noise level and for cumulative noise, a "typical" 24-hour day. Often, the evaluation of noise effects on people involve the noise indoors, rather than outdoors, which may require a transition from outdoors to indoors. Also, the determination of a "typical" day may involve evaluating many temporal operational aspects of the sources of noise, including daily, weekly, and seasonal patterns. These aspects are discussed in the following paragraphs.

2.3.1 Outdoor to Indoor Noise Reduction

The majority of the existing data regarding levels of environmental noise in residential areas has been obtained outdoors. Such data are useful in characterizing the neighborhood noise environment, evaluating the noise of identifiable sources and relating the measured values with those calculated for planning purposes. For these purposes, the outdoor noise levels have proved more useful than indoor noise levels because the indoor noise levels contain the additional variability of individual building sound level reduction. This variability among dwelling units results from type of construction, interior furnishings, orientation of rooms relative to the noise, and the manner in which the dwelling unit is ventilated.

Data on the reduction of aircraft noise afforded by a range of residential structures indicate that houses can be approximately categorized into "warm climate" and "cold climate" types. Additionally, data are available for typical open-window and closed-window conditions. These data indicate that the sound level reduction provided by buildings within a given community has a wide range due to differences in the use of materials, building techniques, and individual building plans. Nevertheless, for planning purposes, the typical reduction in sound level from outside to inside a house can be summarized as follows in Table 4.

TABLE 4

Sound Level Reduction due to Houses* in Warm and Cold Climates, with Windows Open and Closed

	Windows Open	Windows Closed
Warm Climate	12 dB	24 dB
Cold Climate	17 dB	27 dB
Approximate National Average	15 dB	25 dB

* (Attenuation of outdoor noise by exterior shell of the house)

The approximate national average "window open" condition corresponds to an opening of 2 square feet and a room absorption of 300 sabins (typical average of bedrooms and living rooms). This window open condition has been assumed throughout this report in estimating conservative values of the sound levels inside dwelling units which result from outdoor noise. The results indicate that a reduction of 15 dB is appropriate for the "window open" conditions and a reduction of 25 dB for the "window closed" condition. Higher values could be appropriate for houses with well-fitted storm windows or sound proofing treatment. These values are appropriate for estimating the indoor noise from outdoor noise measurements or for translating indoor noise criteria to the outdoors.

2.3.2 Temporal Factors

The work of the US Environmental Protection Agency in correlating the Ldn with the effects of cumulative noise in community neighborhoods, used the concept of "annual average day" as the "typical" day. This definition is unambiguous and it is usually simple to calculate the desired quantity since annual statistics are readily available for most sources of interest.

In some cases where the operation of the noise source is invariant, such as an electrical power transformer, selection of definition for typical day requires little effort. However, where there are major temporal changes in operations serious consideration of the scheme for defining a typical day is required. Some examples might include:

- Operation of snow making and grooming machines at a ski resort which occurs only in the winter.
- Operation of sports car racing that occurs only on Friday and Saturday evenings for four months of the year.
- Operation of Commercial airplanes at a civilian airport which has significantly fewer flights from midnight Friday through Saturday at noon.
- Highway traffic in a summer resort area where the population in the high season is ten times that in the off season.
- Operation of aircraft over a community which only occurs when the weather conditions dictate use of a specific runway configuration.
- Operation at military air bases or training areas, where activity is dictated by various operational requirements.

For some of these examples, such as the regular daily variation of commercial airplane schedules, the typical day is defined as an "average busy day." It may be calculated by selecting one of the days during the week (Thursday has been used in several civilian airport studies); or by a more complex calculation procedure. For example, U.S. DOD procedures use as a busy day, a day when the number of operations is greater than one-half the average annual day (the annual number of operations divided by 365). From those busy days the "average busy day" is calculated.

For some of the other examples it is more appropriate to estimate the noise for two definitions of a typical day, the annual average day and an average day during the period when the noise occurs. Thus, for a source that operates only in one season, a typical day would be selected to represent average day operations in that season. Similarly, for a flight track that is only used under certain weather conditions, a day may be selected in which it is assumed that the flight track is used for the entire 24 hours. Alternatively, a typical day could be defined to have the average usage on the days when the flight track is used. These additional analyses are often helpful in understanding the impacts as perceived by the residents.

3. INTERFERENCE WITH HUMAN ACTIVITIES AND ANNOYANCE[1,3,8,9,10,11]

3.1 Activity Interference

This section discusses the two forms of activity that are frequently cited as susceptible to interference by noise. These are speech communications and sleep.

3.1.1 Interference with Speech Communication[1,2,3,12,13]

Speech communication has long been recognized as an important requirement of any human society. Interference with speech communication disturbs normal domestic or educational activities, creates an undesirable living environment, and can sometimes, for these reasons, be a source of significant annoyance. The principal concerns in residential neighborhoods are the effects of noise on face-to-face conversation outdoors and indoors, telephone use, and radio or television enjoyment.

The chief effect of intruding noise on speech is to mask the speech sounds and thus reduce intelligibility. The important contributions to intelligibility in speech sounds cover a range in frequency from about 200 to 6,000 Hz, with a dynamic level range of about 30 dB, throughout the frequency band. The intelligibility of speech will be nearly perfect if all these contributions are available to a listener for his understanding. Much of the acoustic energy in speech is contained in the lower part of this frequency range. However, important information required to differentiate between speech sounds is contained in the higher frequency range. To the extent that intruding noise masks out or covers some of these contributions, the intelligibility deteriorates more readily the higher the noise level, particularly if the noise frequencies coincide with the important speech frequencies.

Results of speech research define the levels of noise that will produce varying degrees of masking as a function of average noise level and the distance between talkers and listeners. Other factors such as the talker's enunciation, the familiarity of the listener with the talker's language, the room acoustics, the listener's motivation and, of course, the normality of the listener's hearing also influence intelligibility.

For outdoor speech communication, Table 5 shows distances between speaker and listener for satisfactory outdoor speech at two levels of vocal effort in steady background noise levels. In other words, if the noise levels in the table are exceeded, the speaker and listener must either move closer together or expect reduced intelligibility. The loss of intelligibility as a function of noise level for normal voice level with a 2-meter communication distance is given in Figure 7.

TABLE 5

Steady A-weighted Sound Levels that Allow Communication with 95 Percent Sentence Intelligibility Over Various Distances Outdoors for Different Voice Levels

VOICE LEVEL	COMMUNICATION DISTANCE (Meters)					
	0.5	1	2	3	4	5
Normal Voice	72	66	60	56	54	52
Raised Voice	78	72	66	62	60	58

For indoors, the effects of masking normally-voiced speech are summarized in Figure 8, which assumes the existence of a reverberant field in the room. This reverberant field is the result of reflections from the walls and other boundaries of the room. These reflections enhance speech sounds so that the decrease of speech level with distance found outdoors occurs only for spaces close to the talker indoors. For typical living rooms, the level of the speech is more or less constant throughout the room at distances greater than 1.1 meters from the talker. The distance from the talker at which the level of speech decreases to a constant level in the reverberant part of the room is a function of the acoustic absorption in the room. The greater the absorption, the greater the distance over which the speech will decrease and the lower the level in the reverberant field for a given vocal effort. The absorption in a home will vary with the type and amount of furnishings, carpets, drapes and other absorbent materials, being generally least in bathrooms and kitchens and greatest in living rooms and bedrooms.

As shown in Figure 8, the maximum sound level that will permit relaxed conversation with 100 percent sentence intelligibility throughout the room is 45 dB. People have a considerable capability to vary their voice levels to overcome noise and achieve desired communication. This ability works well over a range of levels of steady noises, but is less useful if the interfering noises are intermittent. Figure 9 shows necessary voice levels limited by noise conditions. The communication distance is given on the ordinate, the sound level and the parameters are voice level. At levels above 50 dB, people raise their voice level as shown by the "expected" line if communications are not vital or by the "communicating" line if communications are vital. Below and to the left of the"normal voice line, communications are at an Articulation Index of 0.5, 98 percent sentence intelligibility. At a shout, communications are possible except above and to the right of the "impossible" area line.

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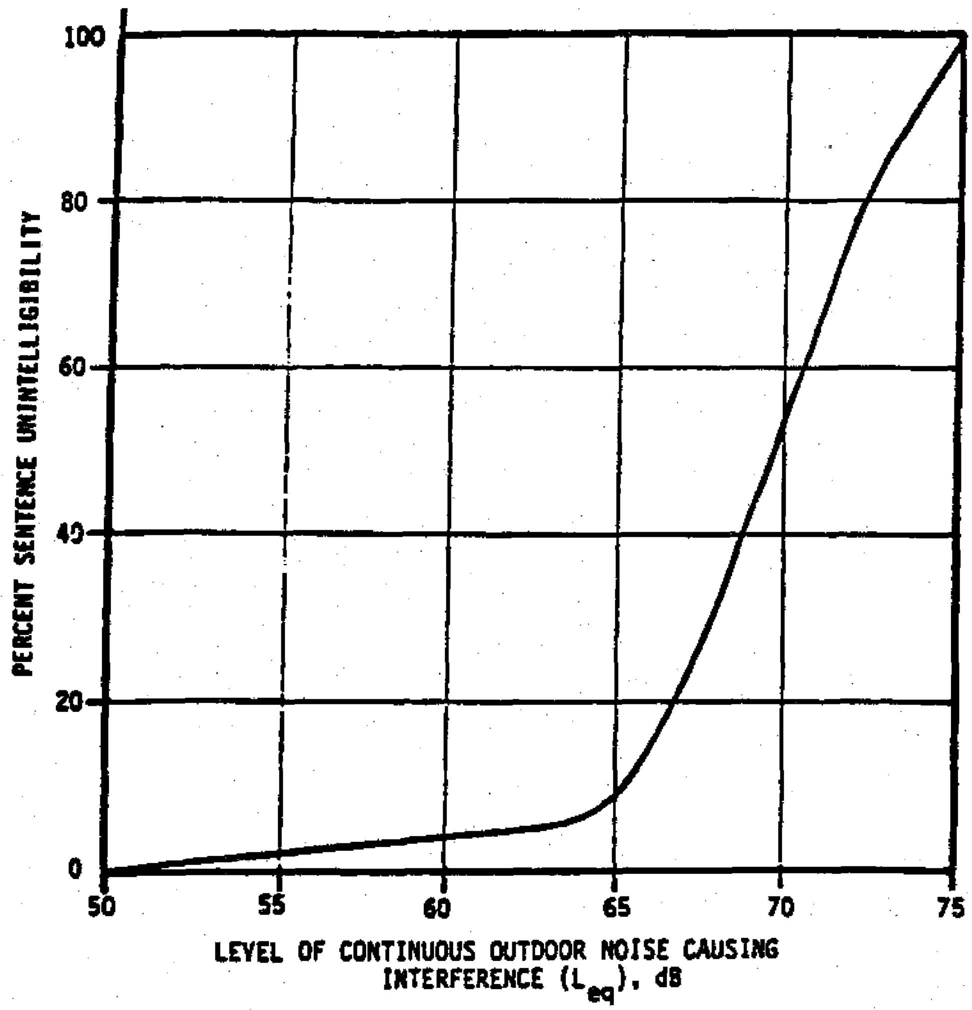

Figure 7: **Criteria for Outdoor Speech Interference for Normal Voice Level at a 2-meter Communication Distance**

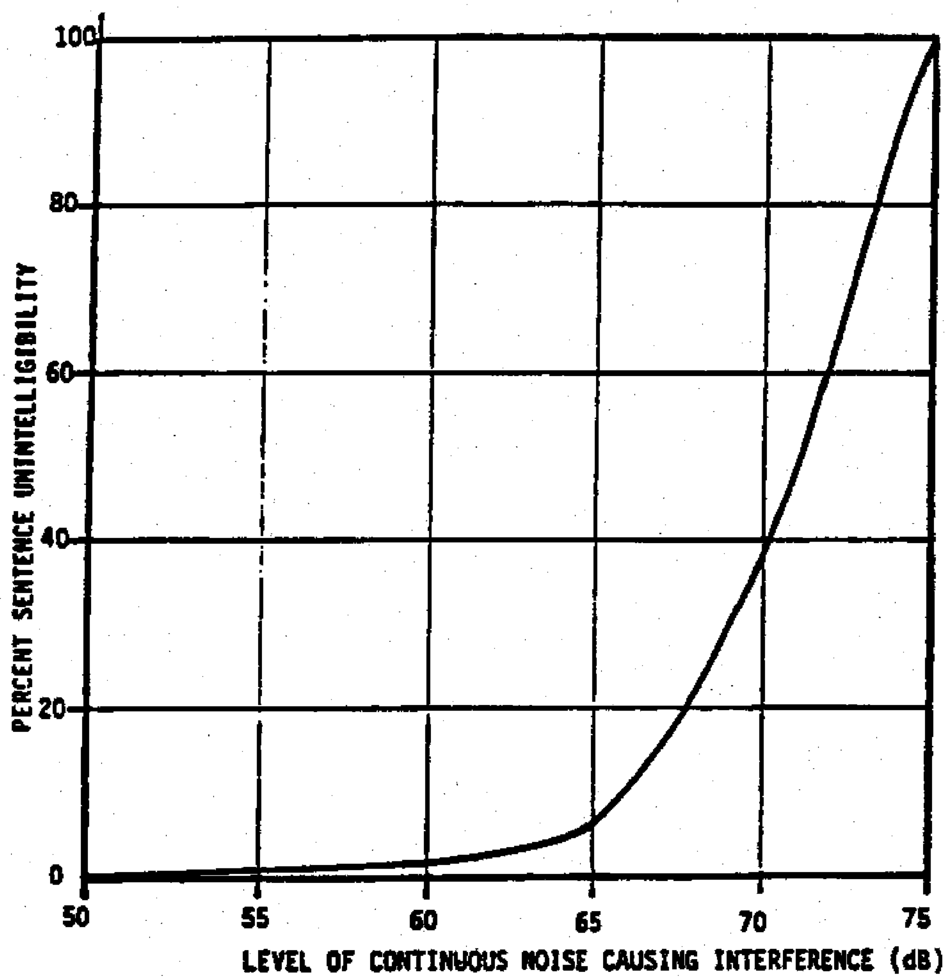

Figure 8: **Criteria for Indoor Speech Interference for Relaxed Conversation Distance in a Typical Living Room.**

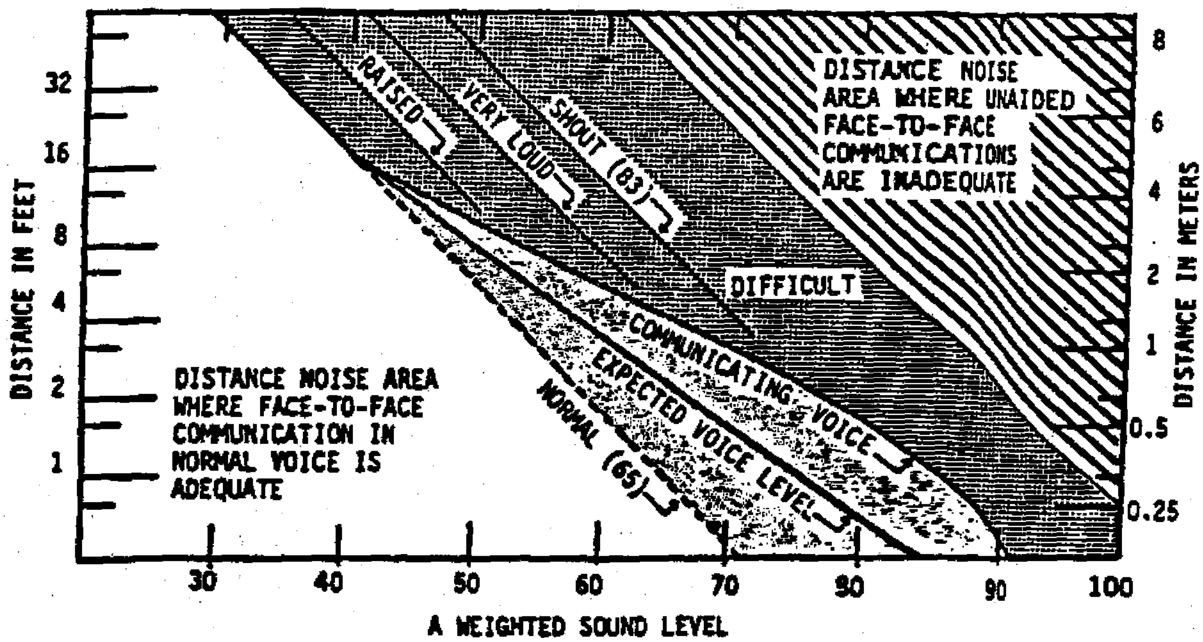

Figure 9: Necessary Voice Levels as Limited by Ambient Noise for Selected Communication Distances for Satisfactory Face-to-face Conversation

3.1.2 Rest and Sleep Interference[17,18,19,20]

Noise interference with rest, relaxation and sleep is a major cause of annoyance. Interferences result primarily from intermittent rather than steady noise, and are often associated with single event sounds such as the passing by of transportation vehicles.

Noise can make it difficult to fall asleep. Noise levels associated with single events can create momentary disturbances of natural sleep patterns by causing shifts from deep to lighter stages. Such noises may even cause awakening which the person may or may not be able to recall. However, regardless of recall, a person whose sleep has been disturbed severely may feel lethargic and nervous during his waking hours.

Generally, the higher the noise level, the greater the probability of a response. In one series of experiments, it was found that there was a 5 percent probability of subjects being awakened by maximum sound levels of 40 dB at the ear and a 30 percent probability at 70 dB. If EEG changes are also considered, these probabilities increase to 10 percent at 40 dB and 60 percent at 70 dB. arousal from sleep depends on the sleep stage, the time of the night and the age of the individual, among other factors.

Examples of criteria pertaining to sleep disturbance are displayed in Figures 10 and 11. These figures, which were adapted from a summary and analysis of recent experimental sleep data as related to noise exposure, show a relationship between frequency of response (disruption or awakening) and the sound level of an intrusive noise. In Figure 10, the frequency of sleep disruption (as measured by changes in sleep stage, including behavioral awakening) is plotted as a function of the Sound Exposure Level. Similarly, the frequency of awakening is shown in Figure 11. These data show that the probability of two types of sleep disturbance, within certain statistical limits, may be predicted by physical indices of noise exposure.

These sound exposure levels are measured in the vicinity of the sleeping person. Fifteen dB should be added to translate them to outdoor levels for the case of open windows and 25 dB should be added to obtain the corresponding outdoor SEL's for typical closed windows. Thus, Figure 10 indicates a 50 percent probability of disturbance with an outdoor sound exposure level of 89 dB with windows open and 99 dB with windows closed. The corresponding numbers for a 50 percent probability of awakening from Figure 11 are 107 dB with windows open and 117 dB with windows closed. These and other examples are summarized below in Table 9.

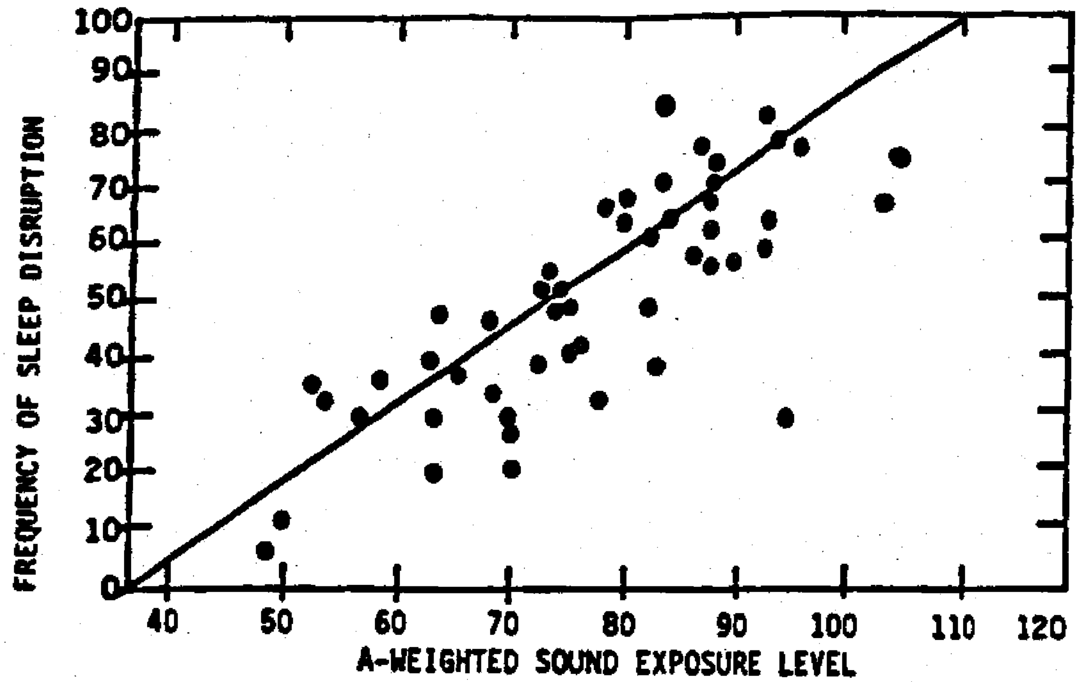

Figure 10: **Probability of a Noise Induced Sleep Change as a Function of Sound Exposure Levels Measured Near the Sleeping Person**

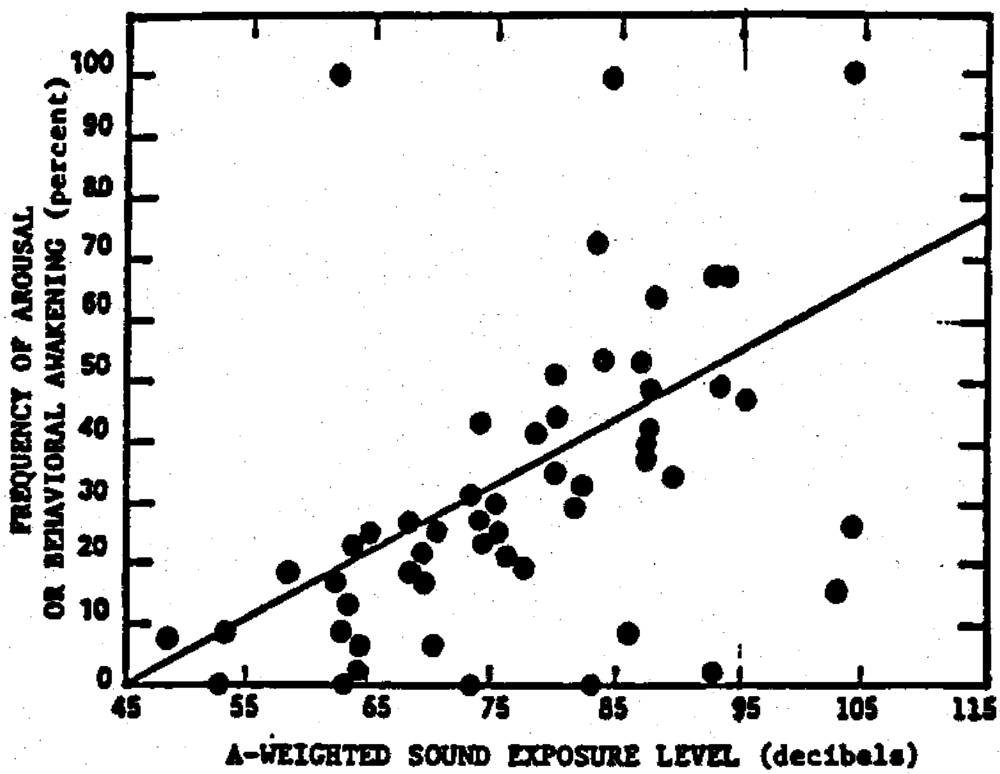

Figure 11: **Probability of a Noise Induced Awakening as a Function of Sound Exposure Levels Measured Near the Sleeping Person**

3.2 Annoyance[1,2,4,11,14,15,16]

Noise is defined as "unwanted sound." Its most common effect on people is the stimulation of an annoyance reaction. Such a reaction implies a judgement as to the desirability of the sound to the listener within the existing contextual frame of reference. This judgement includes both acoustic and non-acoustic factors.

A recent proposed model for annoyance to noise identifies two principal acoustic factors as:

- the magnitude of an intrusive sound considering its frequency and temporal characteristics, and

- the characteristics of the reference noise distribution that exists without the presence of the intrusive noise.

These two factors determine the potential detectability of the intruding sound.

The model also contains several non-acoustic factors, including the listener's:

- degree of concentration, and

- affective state which describes the mood and attitude of the listener toward the noise/sound when the intrusion occurs.

Clearly, if the listener is engaged in a task requiring high concentration, it is less likely that a sound with low potential detectability is heard. However, if a sound is heard which interrupts the concentration required to accomplish the task, annoyance is a likely result. Further, if the listener's attitude toward the source of the sound is negative, the annoyance reaction is likely to be stronger.

When interviewed on their annoyance to noises of different types, people are likely to remember specific instances when they were most strongly annoyed by noise intrusion. Similarly, for individuals who complain about noise, an actual complaint action is often triggered by a noisy event which caused a strong annoyance reaction.

There is a great variation among individuals in their annoyance reaction to a specific sound, and in their annoyance to entire classes of sounds. However, the average values of long term integrated adverse responses to noise have considerably greater uniformity. Studies of annoyance in this context are largely based on the results of sociological surveys. Such surveys have been conducted among residents of a number of countries including the United States. Although it is known that the long-term annoyance reaction to a certain environment can be influenced to some extent by the experience of recent individual annoying events, the sociological surveys are designed to reflect, as much as possible, the integrated response to living in a certain environment and not the response to isolated events.

The results of sociological surveys are generally stated in terms of the percentage of respondents expressing differing degrees of disturbance or dissatisfaction due to the noisiness of their environments. Some of the surveys go into a complex procedure to construct a scale of annoyance. Others report responses to the direct question of "how annoying is the noise?" Each social survey is related to some kind of measurement of the noise levels to which the survey respondents are exposed, enabling correlation between annoyance and outdoor noise levels in residential areas. Figure 12 compares the results of 12 major sociological surveys, seven concerning aircraft, four from street traffic, and one from a railroad. The lines for each survey represent the mean responses across all survey cells. The actual average responses of individuals within each cell have a ± 6 dB data spread around their grand mean values. It is clear from this synthesis of the results from both traffic and aircraft noise situations that the responses to both appear to be similar for the same values of Ldn.

Very low and fast flying military aircraft in military training areas or on military training routes can pose a special problem due to the high onset rate of the fly-over (see Section 3.2.2). Due to the startle or surprise, they can contribute directly to the perceived annoyance. As a result, the U.S. Air Force procedures add for onset rates faster than 15 db per second a penalty to the measured or estimated sound exposure level (SEL). The penalty increases for onset rate from 15 to 30 dB per second to a maximum value of 5 dB for onset rates beyond 30 dB per second. This value has been confirmed by preliminary laboratory annoyance studies with such fly-over noise. It is recommended for incorporation into the SELs and Ldns used for predicting annoyance responses according to Figure 12.[44]

A second method of assessing the annoyance resulting from noise is to study cases of community reactions. These reactions can be measured by a scale which extends from "no observed reaction," through varying degrees of complaint activity to actual legal or political action. Objections have been made to the use of this type of data as a surrogate for annoyance. These objections are based on two principal issues. First, there may be considerable distortion of the number of complaints caused by a few energetic complainants. Second, a variety of socio-economic factors may intervene between the reaction of annoyance to noise and the action of filing a complaint.

The first of these factors can be overcome by careful review of cases to assume that the degree of complaint actually is determined by the number of complainants responding soon after the onset of the noise situation. The second biasing factor probably exists to some unknown degree. However, there is no reason to believe that this factor is not uniform across all degrees of reaction. Further, although the magnitude of this bias cannot be assessed with existing data, the cases examined in the following paragraphs involve people with diverse economic characteristics.

A series of fifty-five case histories of community noise problems were analyzed. Approximately one-half of the cases involved steady state industrial and residential noises, and the other one-half consisted of multiple single event transportation and industrial noises. The basic Ldn Data are summarized in Figure 13 as a function of the magnitude of

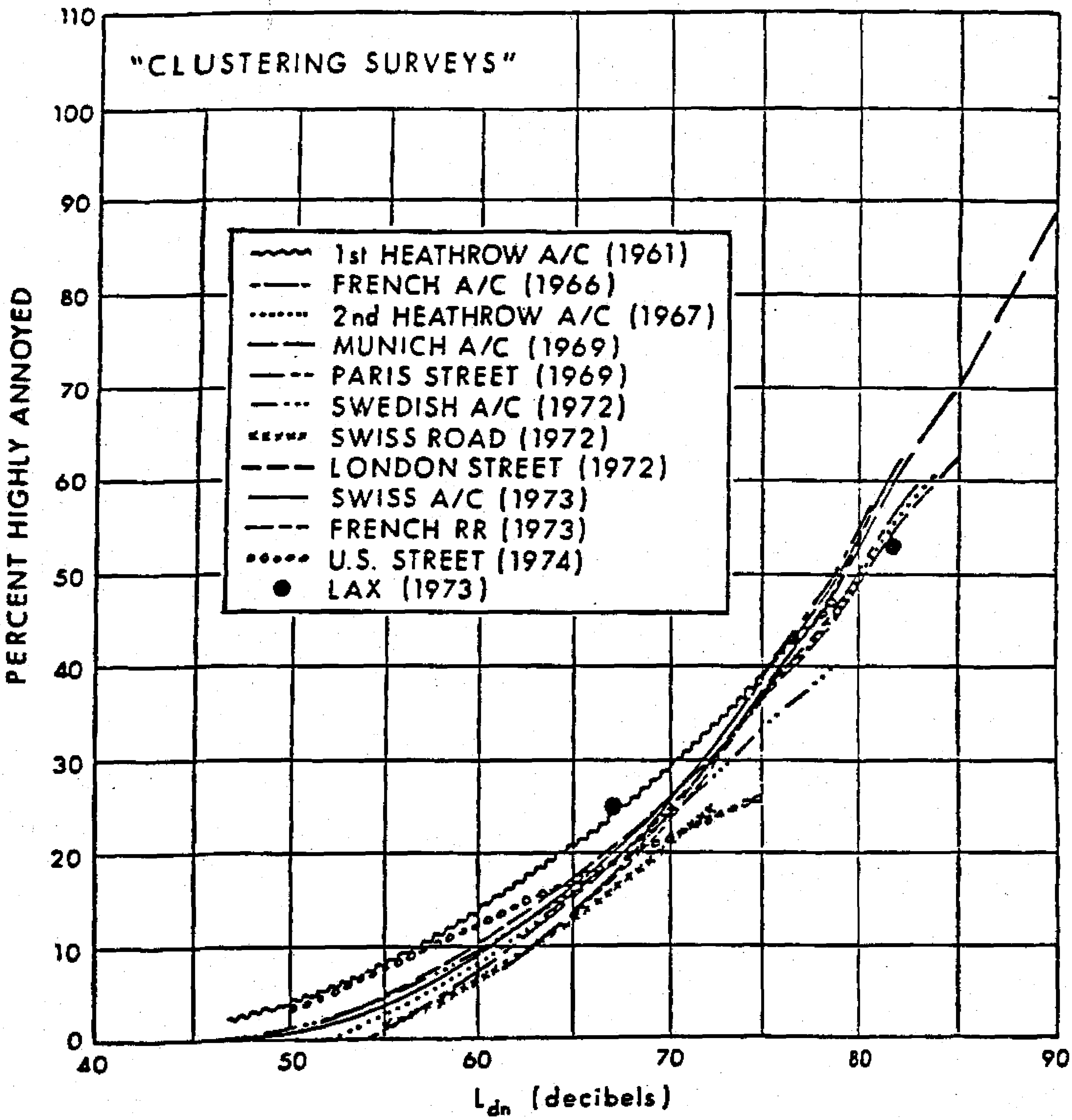

Figure 12: **Summary of Annoyance Data from 12 Surveys**

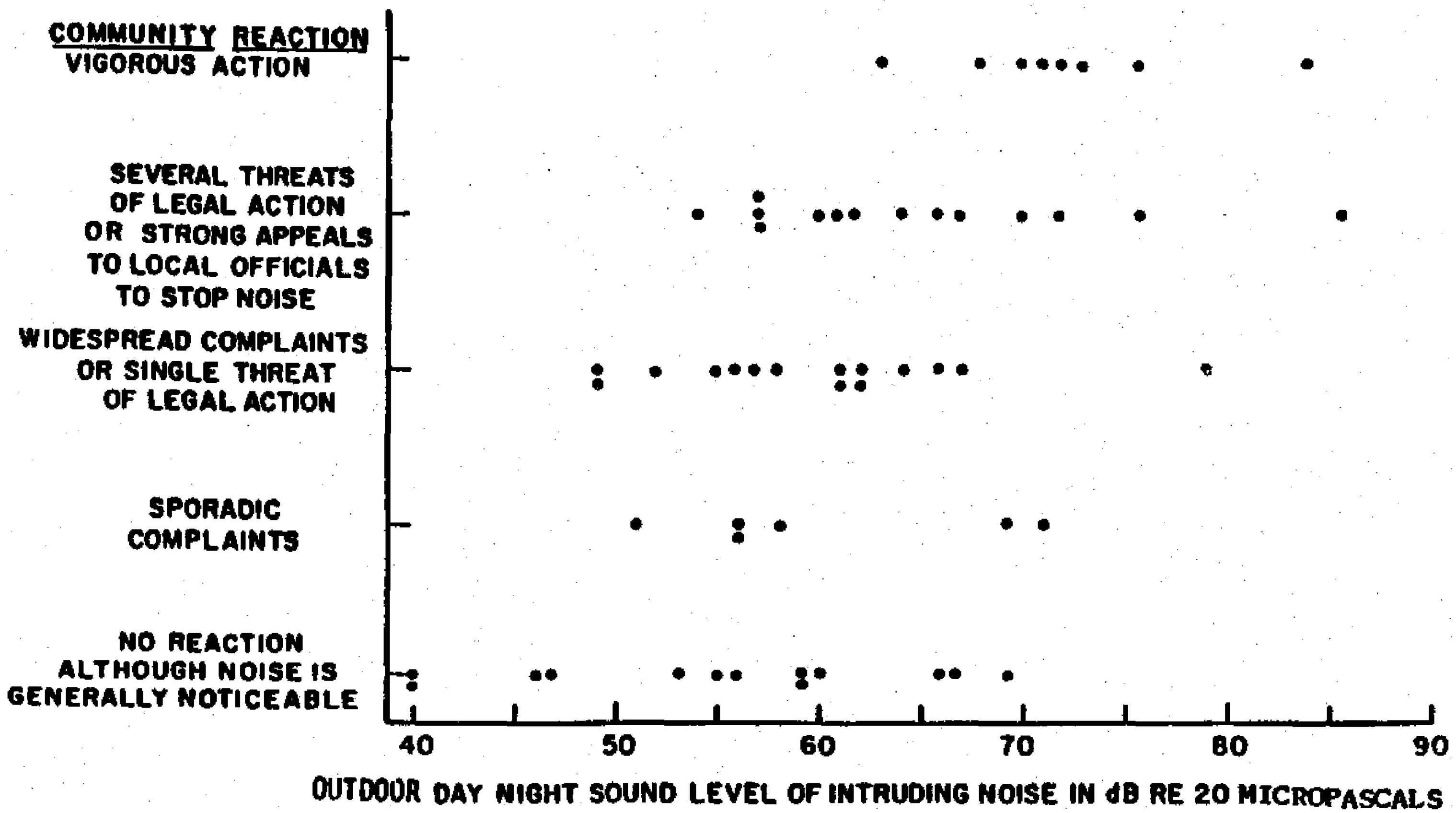

Figure 13: **Community Reaction to Noises of Many Types as a Function of Outdoor Day-night Sound Level of the Intruding Noise**

community reaction. The scatter of data points is as much as 32 dB, showing little correlation between Ldn and reaction. The data were reanalyzed to relate the normalized measured Ldn with the observed community reaction. The normalization procedure summarized in Table 6 follows the Stevens, Rosenblith and Bolt method with a few minor modifications. The results are summarized in Figure 14. Approximately 90 percent of the cases are enveloped by ±5 dB, and the standard deviation of these data is 3.3 dB about their means. This value of 3.3 dB compares with the standard deviation of 7.9 dB for the basic data in Figure 13.

The no-reaction response in Figure 14 corresponds to a normalized outdoor Ldn ranging between 50 and 61 dB, with a mean of 55 dB. This mean value is 5 dB below the value that characterizes a residential urban community which is the baseline category for the data in the figure. From these results, it appears that no community reaction to an intruding noise is expected on the average, when the normalized Ldn of an identifiable intruding noise is approximately 5 dB less than the Ldn in the absence of the identifiable intruding noise. This conclusion is not surprising; it simply suggests that people tend to judge the magnitude of an intrusion with reference to the noise environment in the absence of the intruding noise source.

The data in Figure 14 indicate that widespread complaints may be expected when the normalized value of the outdoor Ldn of the intruding noise exceeds that existing without the intruding noise by approximately 5 dB, and vigorous community reaction may be expected when the excess approaches 20 dB.

Clearly, the community reaction is better correlated with the normalized value of the Ldn produced by the intruding noise than with its absolute value. The most significant corrections involved in the normalization is the background noise (the Ldn that exists without the intruding noise). When the background noise is not included in the normalization of the data, the standard deviation increases from 3.3 to 6.4 dB, clearly accounting for a large fraction of the standard deviation (7.9 dB) of the basic data.

In order to evaluate noise in areas where the background noise is different from the urban Ldn of 60 dB used for the normalization of the data in Table 6 and Figure 14, it may be useful to re-normalize these data relative to the background level of principal interest. This may be accomplished by changing the position of the zero in Table 6 and rescaling Figure 14 as appropriate. Alternatively, the same analysis result can be accomplished by using background Ldn values given in Table 7 together with the relative Ldn values given in Table 8. As shown in the example for a quiet residential neighborhood in Table 8, sporadic complaints might be expected where the Ldn of the intruding noise is 50 dB and widespread complaints at an Ldn of 55 dB.

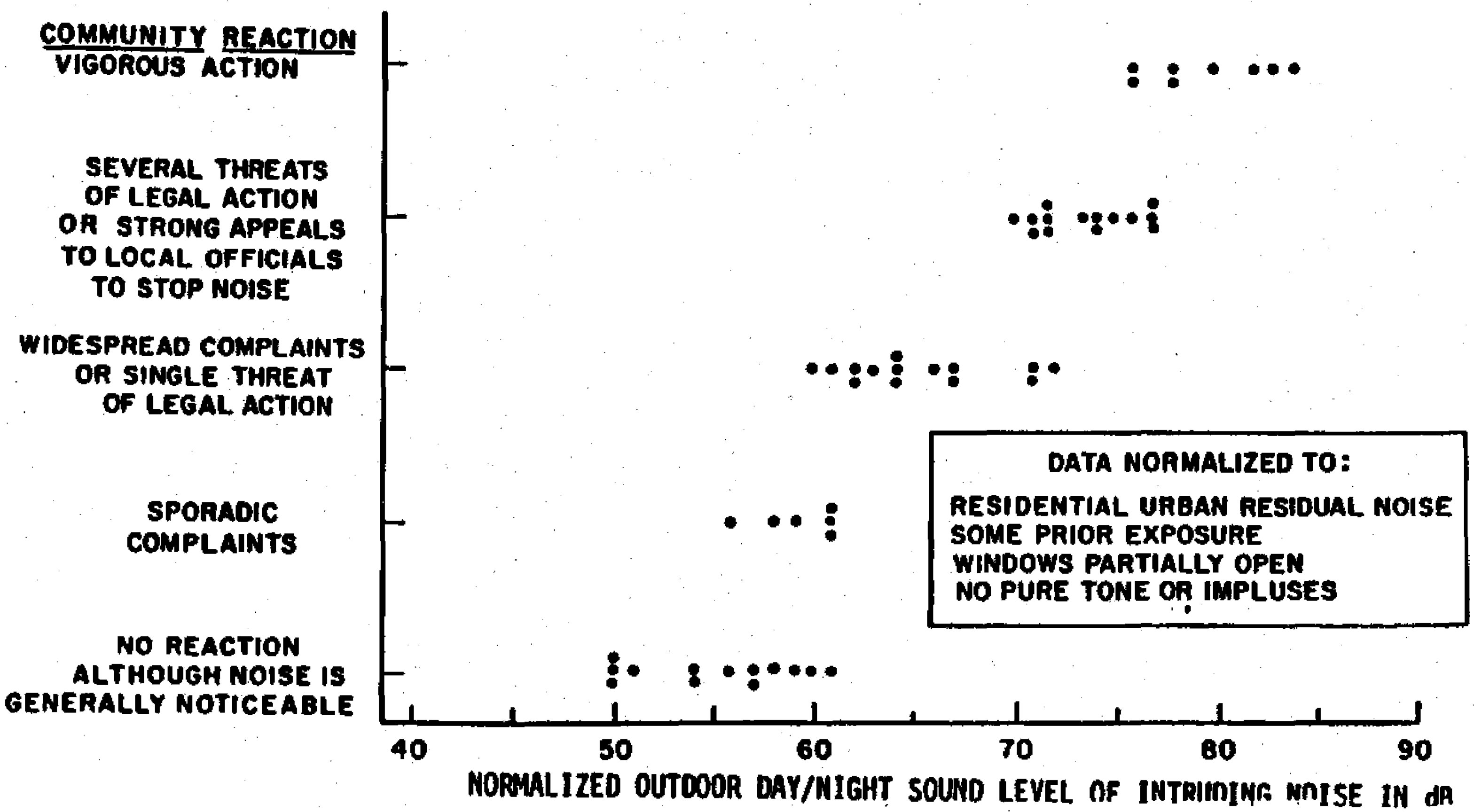

Figure 14: **Community Reaction to Noises of Many Types as a Function of the *Normalized* Outdoor Day-night Sound Level of the Intruding Noise**

TABLE 6

Corrections to be Added to the
Day-Night Sound Level (Ldn) to Obtain Normalized Ldn

Type of Correction	Description	Correction Added to Measured Ldn in dB
Seasonal Correction	Summer (or year-round operation)	0
	Winter only (or windows always closed)	- 5
Correction for Outdoor Residual Noise Level	Quiet suburban or rural community (away from large cities, industrial activity and trucking	+10
	Normal suburban community (away from industrial activity)	+ 5
	Urban residential community (not near heavily traveled roads or industrial areas)	0
	Noisy urban residential community (near relatively busy roads or industrial areas)	- 5
	Very noisy urban residential community	-10
Correction for Previous Exposure and Community Attitudes	No prior experience with intruding noise	+ 5
	Community has had some exposure to intruding noise; little effort is being made to control noise. This correction may also be applied to a community which has not been exposed previously to noise, but the people are aware that bona fide efforts are being made to control it.	0
	Community has had considerable exposure to intruding noise; noise maker's relations with community are good.	- 5
	Community aware that operation causing noise is necessary but will not continue indefinitely. This correction may be applied on a limited basis and under emergency conditions.	-10
Pure Tone or Impulse	No pure tone or impulsive character.	0
	Pure tone or impulsive character present.	+ 5

TABLE 7

Areas with Various Day-Night Noise Levels Together with Customary Qualitative Description of the Area

Qualitative Description*	Typical Range Ldn in dB	Average Ldn in dB	Average Census Tract Populations Density, Number of People per Square Mile
Quiet Suburban Residential	48-52	50	630
Normal Suburban Residential	53-57	55	2,000
Urban Residential	58-62	60	6,300
Noisy Urban Residential	63-67	65	20,000
Very Noisy Urban Residential	68-72	70	63,000

* Rural and undeveloped areas typically have Ldn levels in the range of 33-47 dB.

TABLE 8

Community Reaction in Residential Areas as a Function of Estimated Relative Normalized Outdoor Day-Night Sound Levels of Intruding and Background Noise Without the Presence of Intruding Noise

Community Average Reaction	Relative Ldn in dB (intruding minus background)	Example of Quiet Suburban Residential Area Intruding Noise Ldn in dB
None	- 5	45
Sporadic Complaints	0	50
Widespread Complaints	5	55
Threats of Legal Action	14	64
Vigorous Action (includes litigation and concerted efforts to obtain government regulation)	21	71

* Example is quiet suburban residential area with a background = 50 dB

TABLE 9

Examples of the Outdoor Sound Exposure Level for Typical Windows Open and Closed for Selected Probabilities of Sleep Disturbance and Awakening from Noise

Probability of Sleep		Outside Sound Exposure Level (dB)	
Awakening	Disturbance	Windows Open	Windows Closed
10 %	25 %	70	80
30 %	50 %	89	99
50 %	75 %	107	117

The partial day-night sound levels resulting from a single nighttime occurrence of one of the events in Table 9 is approximately 39 dB less than the SEL. Thus, for windows closed, the partial Ldnp resulting from a single nighttime occurrence of 117 dB is 78 dB and for an occurrence of 99 dB is 60 dB. Consequently, for most actual situations, annoyance criteria stated in terms of cumulative sound exposure give adequate protection for sleep disturbance.

Since a sound level of 40 dB is considered a conservative estimate of the level disturbing the sleep of patients in hospitals, a level of 34 to 47 dB is recommended for interior hospital noise levels. For other sleeping environments maximum acceptable levels of 55 dB are frequently assumed.

3.0 Summary

3.1 Background Guidance[1,2,9,21,22,23,24]

The levels of environmental noise which are expected to interfere with human activity depend upon the activity and the person's contextual frame of reference. The cumulative effect of activity interference by noise has been found to be the best measure in terms of annoyance. Although other factors, such as attitude towards the noise source, may influence an individual's reaction to activity interferences, the percentage of people annoyed, or highly annoyed, in a given environmental situation provides a useful index of the severity of the situation. Additionally, annoyance may be a useful indicator of potential *noise induced stresses*, which are thought by some to contribute to stress-related diseases.

There have been two basic approaches to developing criteria, or regulatory limits, for environmental noise. One approach is to determine the maximum levels which are compatible with various human activities (such as speech communication, sleep, mental activity, listening to music, etc.), or considered to be the maximum levels consistent with protection of hearing. The second approach is to assess the relative intrusive quality of noise and the reaction it causes, accounting for attitudinal and other factors.

In its Levels Document, the Environmental Protection Agency (EPA) utilized the first approach. To describe environmental noise, EPA defined the day-night average sound level (Ldn) which represents the average noise level in a 24-hour day, with a penalty of 10 dB for noise which occurs during the nighttime hours of 10 pm to 7 am. For residential areas it identified a Ldn of 55 dB as the "level...requisite to protect the public health and welfare with adequate margin of safety," the words in quotations representing its congressional mandate. This level was derived by selecting 45 dB within a home as compatible with 100 percent speech intelligibility, adding 15 dB to account for the average noise reduction of an exterior wall with a partially open window, and subtracting 5 dB as a margin of safety to account for other effects. It should be noted that this identified day-night sound level of 55 dB is not a regulation, but rather the long-term ideal goal. In 1974, over 50 percent of the U.S. population was living in outside noise environments exceeding this level.

Later, in its strategy document, EPA first recommended immediate efforts to reduce noise exposure to a Ldn value of no more than 75 dB. This value is essentially consistent with the level previously identified as maximum with respect to *protection of hearing*. Second, EPA recommended reduction of environmental noise levels to an Ldn of 65 dB or lower through vigorous regulatory and planning actions. Third, EPA recommended adoption of an Ldn of 55 dB as a goal to be considered "to the extent possible" in the planning of future programs.

In 1980, five Federal cabinet departments, agencies and administrations developed a set of guidelines for considering noise in land use planning and control.[22] These guidelines were intended to be used in coordinating policies and regulations of various organizations within the Federal government. Prediction programs and abatement efforts follow the same guidance. Further, they were to be advisory to state and local governments which have authority for most land use regulations. Similar recommendations are contained in the ANSI Standard, "Compatible Land Use with Respect to Noise"[23] and in the Federal Aviation Administration Airport Noise Campatibility Planning Part 150 Regulation.

3.2 Evaluation of Existing and Future Environments

To evaluate the severity of noise environments with respect to their effect on public health, the main factors to be considered are:

- Annoyance {required metric: Ldn}
- Sleep interference {required metric: SEL and Lmax}
- Noise-induced hearing loss {required metric: Leq(8hr)}
- Speech communication {required metric: Leq}

The combination of these four evaluations is sufficient for most situations. These same factors can provide guidance and relative assessment procedures to minimize direct and indirect stress effects responsible for most claims pertaining to health. There is no evidence that these stresses either cause or aggravate clinical diseases, as long as noise exposure levels are below those causing permanent hearing impairment.

The overall community response including and integrating all potential activity interference and health effects discussed, is best evaluated and forecasted based on the land-use guidelines summarized in 4.1 and condensed in Table 10.

The table gives the approximate percentage of residents who would be expected to be highly annoyed based on this synthesis of sociological surveys, see Figure 10. Also shown in the table are approximate community reactions for the Ldn normalized to urban residential background noise, year round, some prior exposure and without impulses or pure-tone characters.

The detailed criteria reviewed in Section 3 are to be used for evaluating specific health effects (e.g. noise-induced hearing loss or sleep interference) or specific activity interferences (e.g. school activity or leisure activity) at specific locations, for which the statistical response, on which Table 10 is based is not applicable.

TABLE 10

Summary Table Relating Residential Land Use Criteria to Effects[22]

Ldn in dB	Federal Interagency Guideline (Note 1)	Approximate % Highly Annoyed (Note 2)	Approximate Community Reaction for Urban Residential Area, Year round, Some Prior Exposure and Without Impulse and Pure-tone Characteristics (Note 3)
Not exceeding 55 (Note 4)	Compatible	Less than 4 %	No reaction
55-65	Generally compatible (Note 5)	4 - 15 %	Sporadic complaints (no reaction to widespread complaint)
65-75	Marginally compatible with 25-30 dB NLR (Note 6)	15 - 37 %	Widespread complaints to strong appeals and threats of legal action
above 75	Incompatible	Greater than 37 %	Vigorous Action

TABLE 10 FOOTNOTES:

1) The levels can be used by individual communities to incorporate public health and welfare goals into the planning process. These levels do not in themselves, however, form the sole basis for appropriate land use action because they do not consider cost, feasibility, the noise levels from any particular source, or the development needs of the community and do include an adequate margin of safety. They should be considered by all communities in their planning, including those who now enjoy quiet and wish to preserve it, as well as those which are relatively noisy and wish to mitigate the problem.

2) From Figure 10.

3) From Figure 12.

4) Environmental Protection Agency has identified Ldn of 55 dB as protective of public health and welfare with an adequate margin of safety.

5) The designation of these uses as "compatible" in this zone reflects individual Federal agencies' consideration of general cost and feasibility factors as well as past community experiences and program objectives. Localities, when evaluating the application of these guidelines to specific situations, may have different concerns or goals to consider.

6 a) Although local conditions may require residential use, it is discouraged in Ldn 65-70 dB and strongly discouraged in Ldn 70-75 dB. The absence of viable alternative development options should be determined and an evaluation indicating that a demonstrated community need for residential use would not be met if development were prohibited in these zones should be conducted prior to approvals.

b) Where the community determines that residential uses must be allowed, measures to achieve outdoor to indoor Noise Level Reduction (NLR) of at least 25 dB in Ldn 65-70 dB and 30 dB in Ldn 70-75 dB should be incorporated into building codes and be considered in individual approvals. Normal 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. Additional consideration should be given to modifying NLR levels based on peak noise levels.

c) NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, design and use of berms and barriers can help mitigate outdoor noise exposure particularly from ground level sources. Measures that reduce noise at a site should be used wherever practical in preference to measures which only protect interior spaces.

REFERENCES

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STANDARD INSTRUMENT DEPARTURES

This appendix contains copies of eight pages containing the Federal Aviation Administration's Standard Instrument Departures (civil) for San Francisco International Airport as of January 1990. The departures are named as follows:

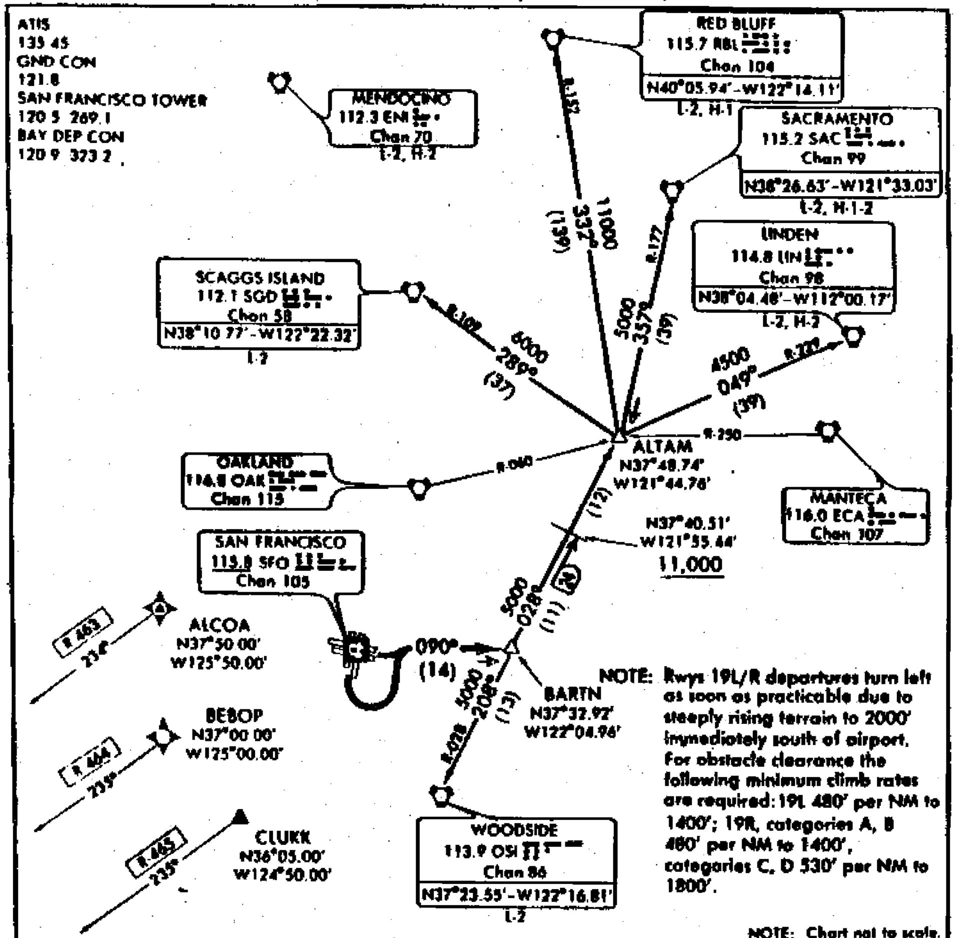
- DUMBARTON THREE
- EUGEN FOUR
- GAP NINE
- OFFSHORE ONE
- PORTE SEVEN
- QUIET ONE
- REBAS ONE
- SAN FRANCISCO THREE
- SHORELINE EIGHT
- STINS FOUR

SOURCE: U.S. Government Flight Information Publication "Standard Instrument Departures (civil) Western United States, Effective 11 January 1990 to 8 March 1990," NOAA.

(DUMB3.BARTN) 89152

DUMBARTON THREE DEPARTURE (PILOT NAV)

SAN FRANCISCO INTL
SAN FRANCISCO, CALIFORNIA



▼ DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAYS 10L/R and 19L/R: Turn left and climb via SFO R-090 to BARTN INT, thence via (transition) or (assigned route/fix).

LINDEN TRANSITION (DUMB3.LIN): From over BARTN INT via OSI R-028 and LIN R-229 to LIN VORTAC.

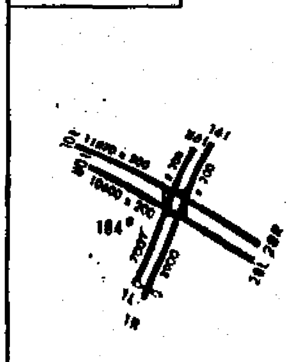
RED BLUFF TRANSITION (DUMB3.RBL): From over BARTN INT via OSI R-028 and RBL R-152 to RBL VORTAC.

SACRAMENTO TRANSITION (DUMB3.SAC): From over BARTN INT via OSI R-028 and SAC R-177 to SAC VORTAC.

SCAGGS ISLAND TRANSITION (DUMB3.SGD): From over BARTN INT via OSI R-028 and SGD R-109 to SGD VORTAC.

WOODSIDE TRANSITION (DUMB3.OSI): From over BARTN INT via OSI R-028 to OSI VORTAC.

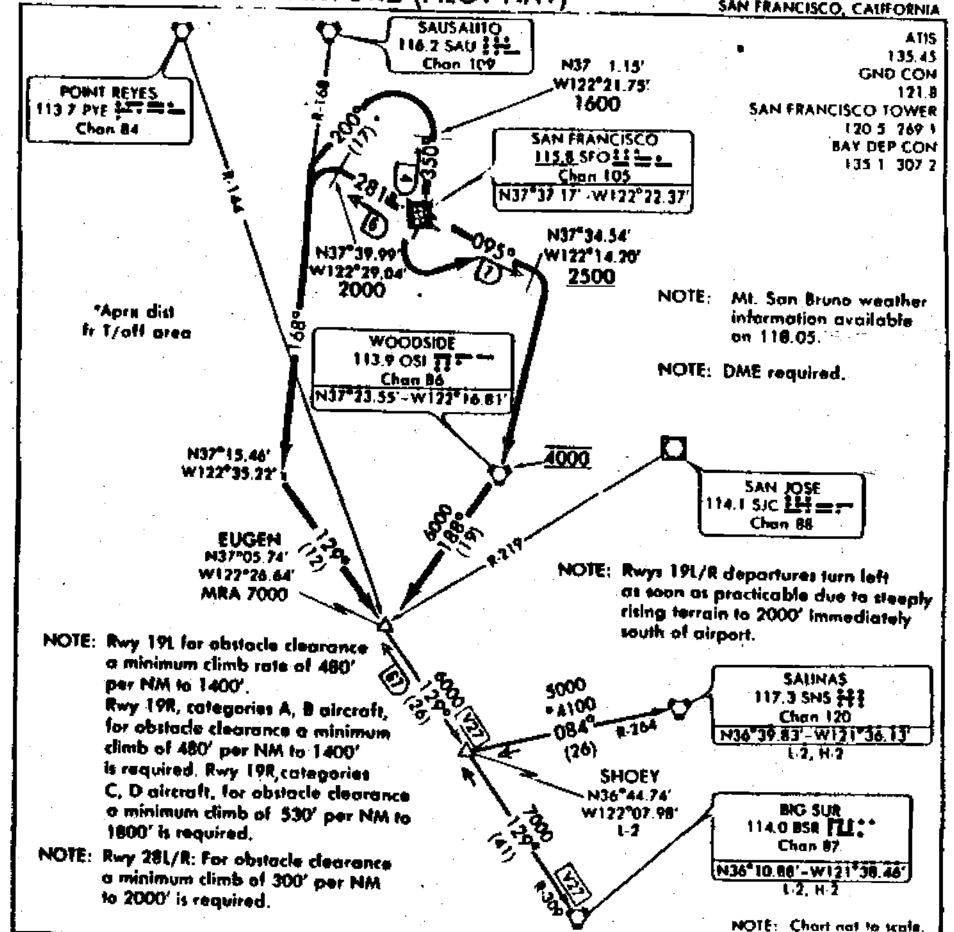
ELEV 11



(EUGEN4.EUGEN) 89208

EUGEN FOUR DEPARTURE (PILOT NAV)

SAN FRANCISCO INTL
SAN FRANCISCO, CALIFORNIA



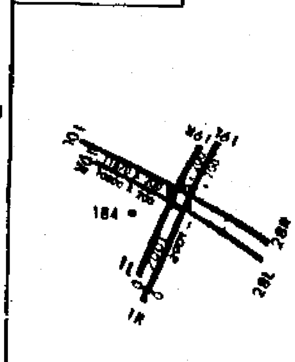
▼ DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAYS 1L/R: Climb via SFO R-350 until passing the 4 DME fix and after reaching 1600', then turn left heading 200° to intercept and proceed via SAU R-168 and BSR R-309 to EUGEN INT. Thence via (transition) or (assigned route).

TAKE-OFF RUNWAYS 10L/R: Climb via SFO R-095 to cross the 7 DME fix at or above 2500', then turn right and proceed direct OSI VORTAC. Cross OSI VORTAC at 4000, then via OSI R-188 to EUGEN INT. Thence via (transition) or (assigned route).

(Continued on next page)

ELEV 11



DEPARTURE ROUTE DESCRIPTION
(Continued)

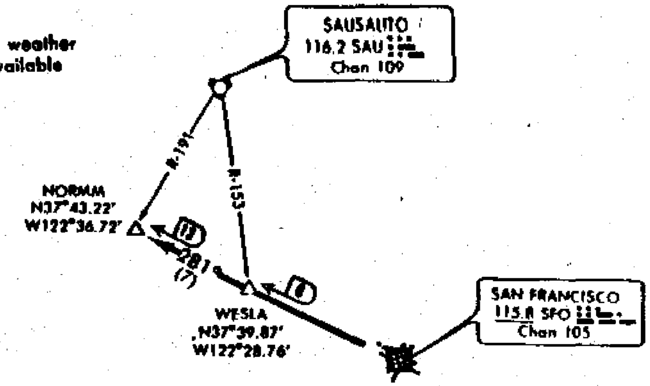
TAKE-OFF RUNWAYS 19L/R: Turn left to intercept and proceed via SFO R-095 to cross the 7 DME fix at or above 2500', then turn right and proceed direct OSI VORTAC. Cross OSI VORTAC at 4000, then via OSI R-188 to EUGEN INT. Thence via (transition) or (assigned route).

TAKE-OFF RUNWAYS 28L/R: Climb via SFO R-281 after passing 6 DME fix and reaching 2000', turn left to intercept and proceed via SAU R-168 and BSR R-309 to EUGEN INT. Thence via (transition) or (assigned route).

BIG SUR TRANSITION (EUGEN4.BSR)
SALINAS TRANSITION (EUGEN4.SNS)
SHOEY TRANSITION (EUGEN4.SHOEY)

ATIS
135.45
GND CON
121.8
SAN FRANCISCO TOWER
120.5 269.1
BAY DEP CON
135.1 307.2

NOTE: Mt. San Bruno weather information available on 118.05.



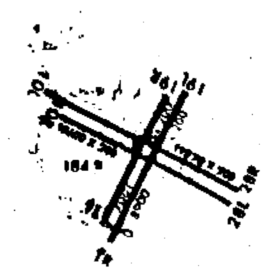
NOTE: Rwys 28L/R;
For obstacle clearance a minimum climb of 300' per NM to 2000' is required.

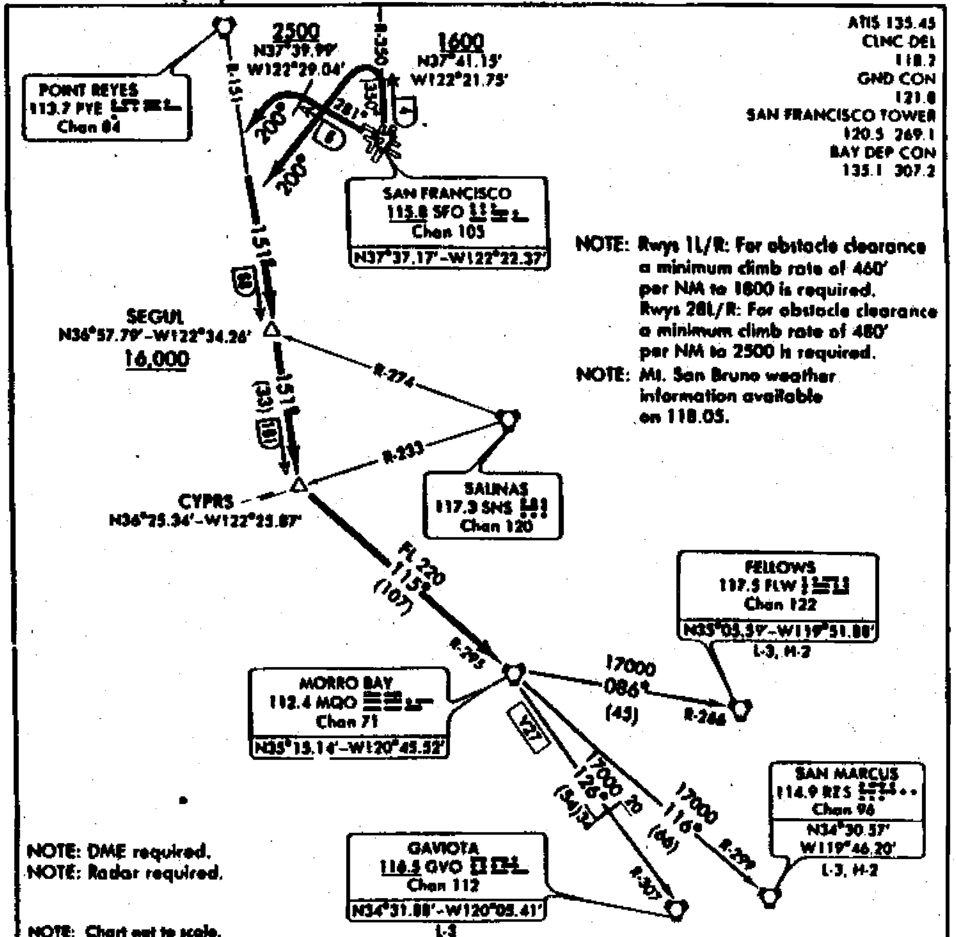
NOTE: Chart not to scale

DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAYS 28L/R: Via SFO VOR/DME R-281 to NORMM INT; Thence via (assigned route).

ELEV 11





DEPARTURE ROUTE DESCRIPTION

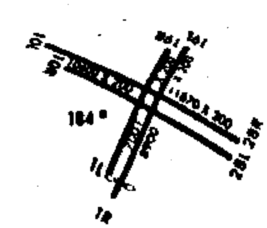
TAKE-OFF RUNWAYS 1L/R: Intercept and proceed via SFO R-350. Cross SFO R-350 4 DME at or above 1600'. Thence . . . .

TAKE-OFF RUNWAY 28L/R: Intercept and proceed via SFO R-281. Cross SFO R-281 6 DME at or above 2500'. Thence . . . .

. . . . Turn left heading 200° to intercept and proceed via PYE R-151 to SEGUL INT. Cross SEGUL INT at or above 16,000', then proceed via PYE R-151 to CYPRS INT. Then via MQO R-295 to MQO VORTAC. Thence via (transition) or (assigned route).

(Continued on next page)

ELEV 11



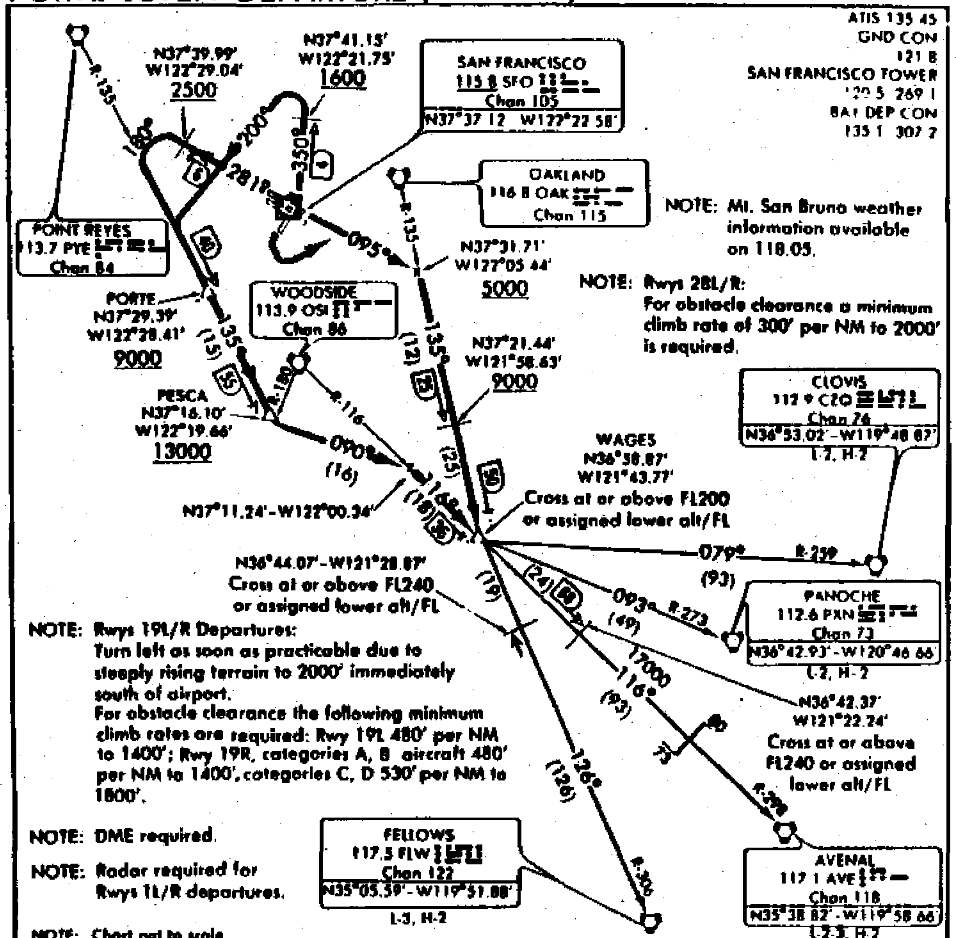
DEPARTURE ROUTE DESCRIPTION
(Continued)

When SFO VOR/DME is inoperative, Runway 28 departures expect radar vector to the PYE R-151 then resume SID.

FELLOWS TRANSITION (OFFSH1.FLW)

GAVIOTA TRANSITION (OFFSH1.GVO)

SAN MARCUS TRANSITION (OFFSH1.RZS)



DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAYS 1L/R: Intercept and proceed via SFO R-350. Cross SFO R-350 4 DME fix at or above 1600'. Turn left heading 200° to intercept and proceed via the PYE R-135. Cross PORTE DME fix at or above 9000' and PESCA DME fix at or above 13,000'. Then turn left heading 090° to intercept and proceed via the OSI R-116 to cross WAGES INT at or above FL200 or at assigned lower altitude/flight level. Thence via (transition) or (assigned route).

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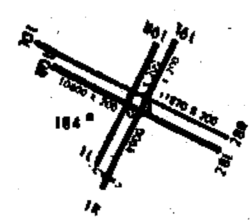
ELEV 11



DEPARTURE ROUTE DESCRIPTION
(Continued)

TAKE-OFF RUNWAYS 10L/R AND 19L/R: Intercept and proceed via SFO R-095 to intercept the OAK R-135 at or above 5000'. Proceed via OAK R-135 to cross the OAK R-135 25 DME fix at or above 9000'. Cross WAGES INT at or above FL200 or at assigned lower altitude/flight level. Thence via (transition) or (assigned route).

TAKE-OFF RUNWAYS 28L/R: Intercept and proceed via SFO R-281, cross SFO R-281 6 DME fix at or above 2500', then turn left heading 180° to intercept and proceed via the PYE R-135 to cross PORTE DME fix at or above 9000' and PESCA DME fix at or above 13,000'. Then turn left heading 090° to intercept and proceed via the OSI R-116 to cross WAGES INT at or above FL200 or at assigned lower altitude/flight level. Thence via (transition) or (assigned route). When SFO VOR/DME is inoperative, Rwy 28 departures expect radar vector to PYE R-135 then resume SID.

AVENAL TRANSITION (PORTE7.AVE): From over WAGES INT via OSI R-116 and AVE R-298 to AVE VORTAC. Cross the OSI R-116 60 DME fix at or above FL 240 or at assigned lower altitude/flight level.

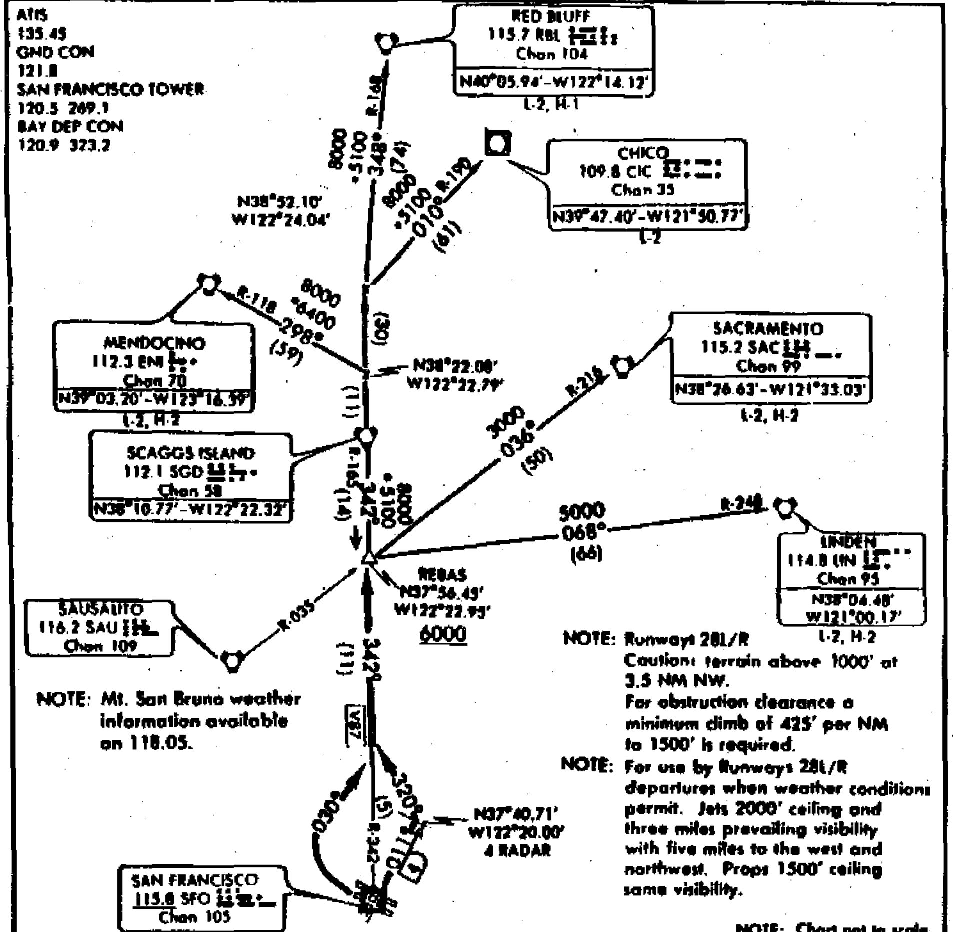
CLOVIS TRANSITION (PORTE7.CZQ): From over WAGES INT via CZQ R-259 to CZQ VORTAC.

FELLOWS TRANSITION (PORTE7.FLW): From over WAGES INT via FLW R-306 to FLW VORTAC. Cross the FLW R-306 126 DME fix at or above FL240 or at assigned lower altitude/flight level.

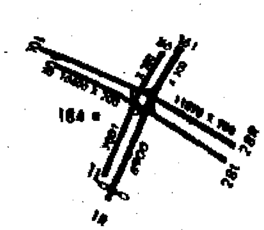
PANOCHE TRANSITION (PORTE7.PXN): From over WAGES INT via PXN R-273 to PXN VORTAC.

QUIET ONE DEPARTURE (PILOT NAV)

SAN FRANCISCO INTL
SAN FRANCISCO, CALIFORNIA



ELEV 11



DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAYS 1L/R: Climb via SFO R-011 to the 4 DME/Radar, then turn left heading 320° to intercept and proceed via SFO R-342 to cross REBAS INT at or above 6000'. Thence via (transition) or (assigned route).

TAKE-OFF RUNWAYS 28L/R: Turn right as soon as feasible heading 030° to intercept and proceed via the SFO R-342 to REBAS INT. Cross REBAS INT at or above 6000'. Then via (transition) or (assigned route). Maintain VFR conditions until intercepting SFO R-342.

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QUIET ONE DEPARTURE (PILOT NAV)
SAN FRANCISCO INTL
SAN FRANCISCO, CALIFORNIA

DEPARTURE ROUTE DESCRIPTION
(Continued)

CHICO TRANSITION (CUIT1.CIC): From over REBAS INT via SFO R-342 and CIC R-190 to CIC VOR/DME.

LINDEN TRANSITION (CUIT1.LIN): From over REBAS INT via LIN R-248 to LIN VORTAC.

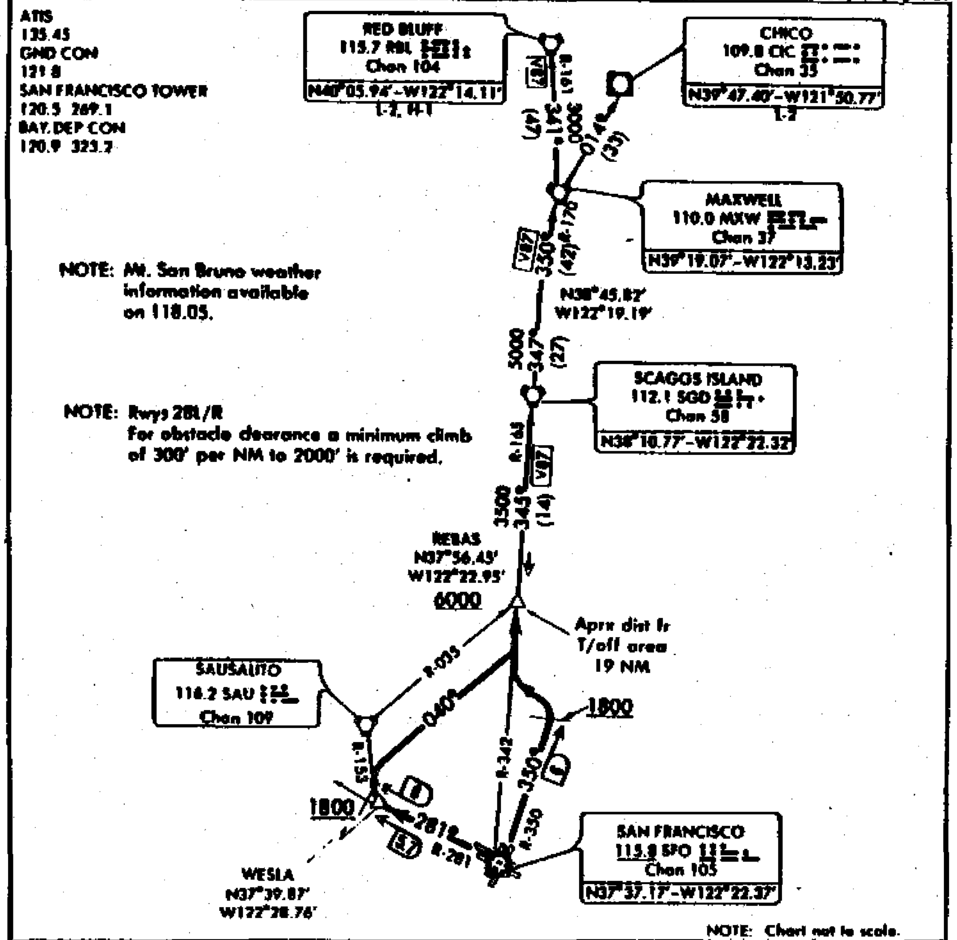
MENDOCINO TRANSITION (CUIT1.ENI): From over REBAS INT via SFO R-342 and ENI R-118 to ENI VORTAC.

RED BLUFF TRANSITION (CUIT1.RBL): From over REBAS INT via SFO R-342 and RBL R-168 to RBL VORTAC.

SACRAMENTO TRANSITION (CUIT1.SAC): From over REBAS INT via SAC R-216 to SAC VORTAC.

REBAS ONE DEPARTURE (PILOT NAV)

SAN FRANCISCO INTL
SAN FRANCISCO, CALIFORNIA



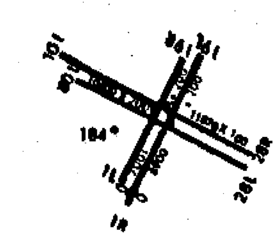
REV 11

DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAYS 1L/R: Climb via the SFO R-350 to cross the 6 DME fix at or above 1800', then turn left to intercept and proceed via the SFO R-342, to cross REBAS INT at or above 6000'. Then via (transition) or (assigned route).

TAKE-OFF RUNWAYS 28L/R: Climb via the SFO R-281 to cross the 6 DME fix or WESLA INT at or above 1800', then turn right heading 040° to intercept and proceed via SGD R-165 to cross REBAS INT at or above 6000'. Then via (transition) or (assigned route).

(Continued on next page)



DEPARTURE ROUTE DESCRIPTION
(Continued)

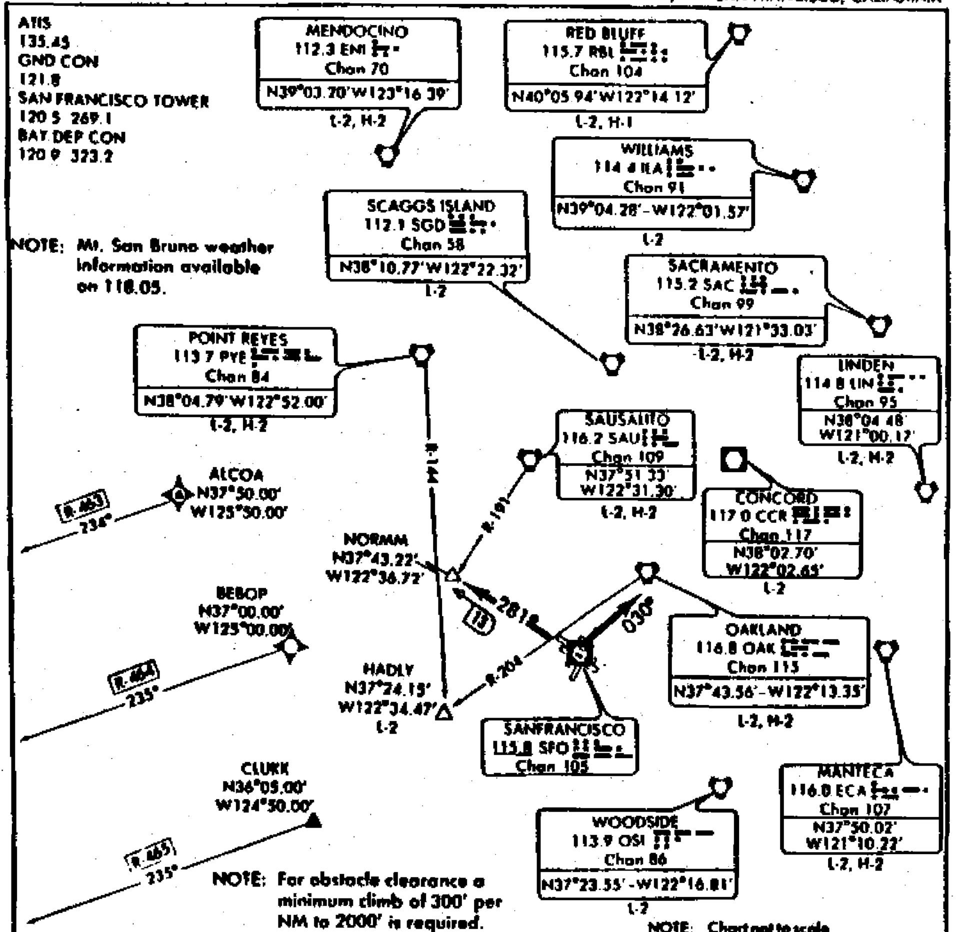
CHICO TRANSITION (REBAS1.CIC): From over REBAS INT via SGD R-165 to SGD VORTAC then SGD R-347 and MXW R-170 to MXW VORTAC. Thence via MXW R-014 to CIC VOR/DME.

RED BLUFF TRANSITION (REBAS1.RBL): From over REBAS INT via SGD R-165 to SGD VORTAC thence via SGD R-347, MXW R-170 to MXW VORTAC. Thence via MXW R-341 and RBL R-161 to RBL VORTAC.

(SFO3.SFO) 89132

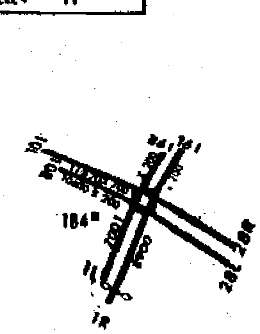
SAN FRANCISCO THREE DEPARTURE (VECTOR)

SAN FRANCISCO INTL
SAN FRANCISCO, CALIFORNIA



DEPARTURE ROUTE DESCRIPTION

ELEV 11



TAKE-OFF RUNWAYS 1L/R: Climb via heading 030° or as assigned for vector to assigned route/fix.
TAKE-OFF RUNWAYS 28L/R: Climb via SFO R-281 to NORMM INT; expect vector to assigned route/fix after NORMM INT.

LOST COMMUNICATIONS:

Take-off runways 1L/R, 28L/R: If not in contact with departure control after reaching 3000', continue to climb to assigned altitude and proceed direct to assigned route/fix.

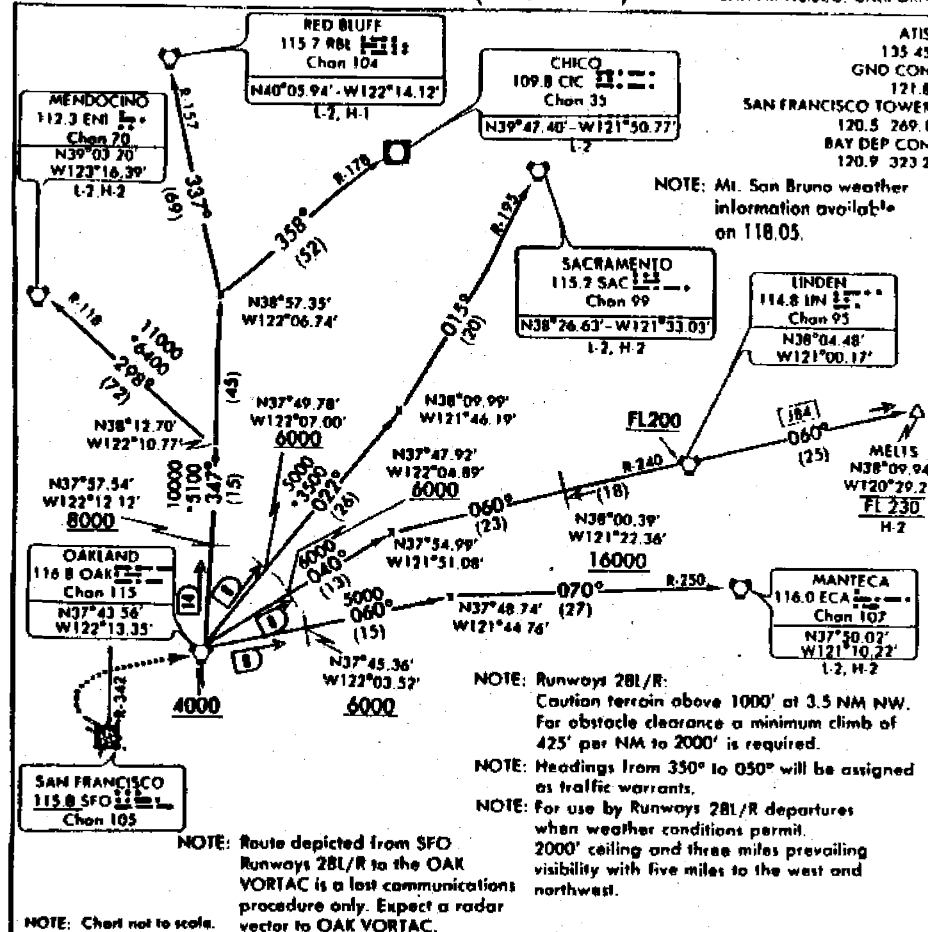
SAN FRANCISCO THREE DEPARTURE (VECTOR)
(SFO3.SFO)

SAN FRANCISCO, CALIFORNIA
SAN FRANCISCO INTL

(SHOR8. OAK) 89132

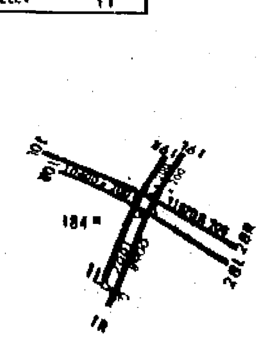
SHORELINE EIGHT DEPARTURE (PILOT NAV)

SAN FRANCISCO INTL
SAN FRANCISCO, CALIFORNIA



DEPARTURE ROUTE DESCRIPTION

ELEV 11



TAKE-OFF RUNWAYS 28L/R: Turn right as soon as feasible heading as assigned, for vector to OAK VORTAC. Then via (transition) or (assigned route). Maintain VFR conditions until crossing SFO R-342.

(Continued on next page)

SHORELINE EIGHT DEPARTURE (PILOT NAV)
(SHOR8.OAK)

SAN FRANCISCO, CALIFORNIA
SAN FRANCISCO INTL

DEPARTURE ROUTE DESCRIPTION
(Continued)

CHICO TRANSITION (SHOR8.CIC): Climb via OAK R-347 and CIC R-178 to CIC VOR/DME. Cross OAK R-347 14 DME fix at or above 8000'. Maintain (assigned altitude) or (flight level). Thence via (assigned route).

MANTECA TRANSITION (SHOR8.ECA): Climb via OAK R-060 and ECA R-250 to ECA VORTAC. Cross OAK R-060 8 DME fix at or above 6000'. Maintain (assigned altitude) or (flight level). Thence via (assigned route).

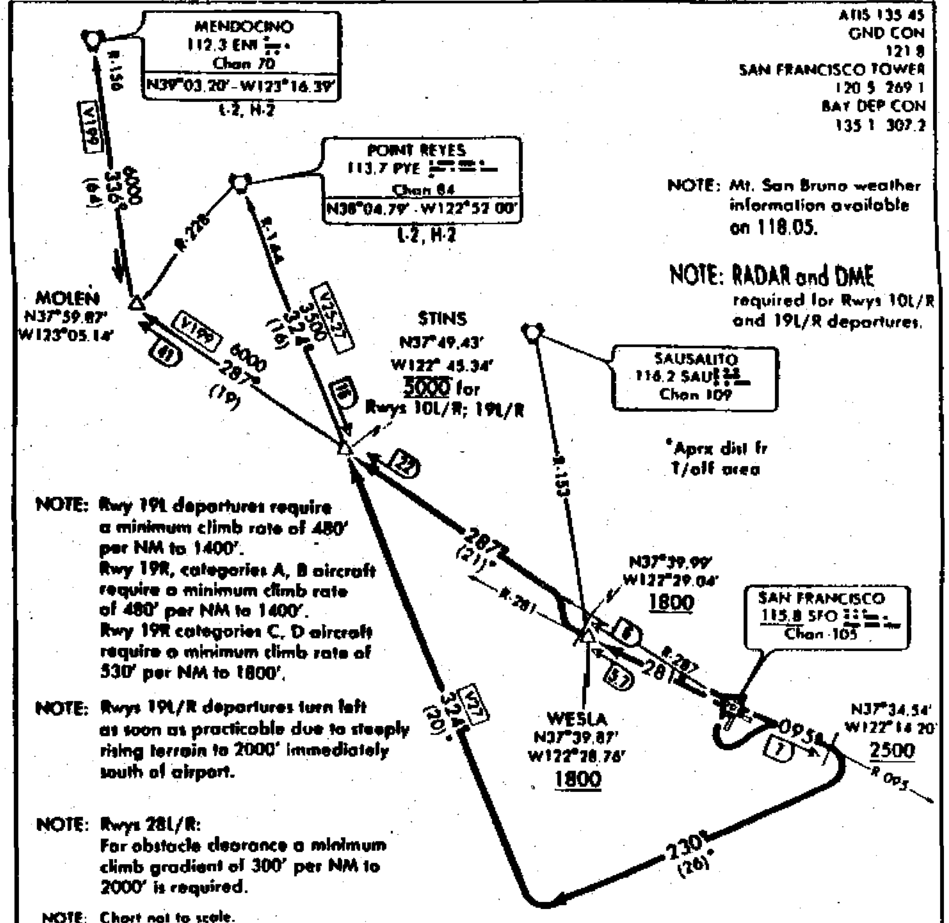
MELTS TRANSITION (SHOR8.MELTS): Climb via OAK R-040 and LIN R-240 and LIN R-060 to MELTS DME fix. Cross the OAK R-040 8 DME fix at or above 6000'. Cross the LIN R-240 18 DME fix at or above 16,000'. Cross LIN VORTAC at or above FL 200. Cross MELTS DME fix at FL 230. Thence via (assigned route).

MENDOCINO TRANSITION (SHOR8.ENI): Climb via OAK R-347 and ENI R-118 to ENI VORTAC. Cross the OAK R-347 14 DME fix at or above 8000'. Maintain (assigned altitude) or (flight level). Thence via (assigned route).

RED BLUFF TRANSITION (SHOR8.RBL): Climb via OAK R-347 and RBL R-157 to RBL VORTAC. Cross the OAK R-347 14 DME fix at or above 8000'. Maintain (assigned altitude) or (flight level). Thence via (assigned route).

SACRAMENTO TRANSITION (SHOR8.SAC): Climb via OAK R-022 and SAC R-195 to SAC VORTAC. Cross the OAK R-022 8 DME fix at or above 6000'. Maintain (assigned altitude) or (FL). Thence via (assigned route).

LOST COMMUNICATIONS:
Take-off runways 28L/R: If not in contact with departure control one minute after crossing the SFO R-342, proceed direct to OAK VORTAC. Cross OAK VORTAC at or above 4000'.



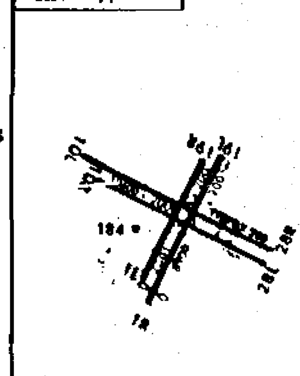
DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAYS 10L/R AND 19L/R: Intercept and proceed via SFO R-095. Cross the SFO R-095 7 DME fix at or above 2500', then turn right heading 230° to intercept and proceed via PYE R-144 to STINS INT. Cross STINS INT at 5000'. Thence via (transition) or (assigned route).

TAKE-OFF RUNWAYS 28L/R: Intercept and proceed via SFO R-281. Cross the SFO R-281 6 DME fix (or WESLA INT) at or above 1800', then turn right to intercept and proceed via SFO R-287 to STINS INT. Thence via (transition) or (assigned route).

(Continued on next page)

ELEV 11



Report 64-91

Addendum to Noise Analysis for San Francisco International Airport Master Plan Environmental Impact Report

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February 1991

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Table of Contents

List of Tables

List of Figures

1. INTRODUCTION

This addendum contains an analysis of the sensitivity of the noise impacts to the differences amongst alternative fleet forecasts. The initial analysis of noise impacts were made for the future years of 1996 and 2006, based on forecasts from the Draft Master Plan (MP), Ref. 1. It also noted that the number of operations estimated in the FAA Terminal Area Forecast (TAF), Ref. 2, were intermediate between the constrained and unconstrained Master Plan estimates.

In this analysis we add three additional forecasts that were contained in the California Aviation Systems Plan (CASP). These forecasts consist of an unconstrained "likely result" for the two study years, Ref. 3, and a recommended scenario for 2005, Ref. 4, extrapolated to 2006.

This report develops detailed fleet mixes from the CASP forecasts and then compares these fleets and their estimated noise to those obtained from the other forecasts.

2. AIRPLANE FLEET MIX DEVELOPED FOR CASP FORECASTS

The CASP Forecast, Ref. 3, was published in July of 1989. Its basic assumptions for San Francisco International Airport are contained in its summary statement, as follows:

"San Francisco

The opening of new terminal facilities and use of larger capacity airplanes will allow air service at San Francisco International Airport to grow normally during the first half or so of the forecast period. As traffic and service reach design capacity limits, air service growth for the Bay Area will increasingly be re-directed, principally to Oakland. San Francisco's share of the Bay Area market should drop from the high 70 percent to the low 60 percent (or lower) during the forecast period. While some international services will be operated at Oakland and San Jose, San Francisco will continue as the dominant international gateway airport for the Bay Area."

The CASP fleet operations forecasts for air carrier operations (excluding commuters) were based on forecasts of the enplaned passengers at the Airport. In turn, these forecasts were based on population forecasts for the counties served by the Airport and the historic per capita use of air transportation in this service area. The forecast passenger enplanements were then allocated to three size categories of turbojet airplanes, based on historical load factors and usage by equipment type and the evolving equipment mix based on "recent scheduling practices and fleet modernization programs".

Table 1A presents the CASP forecasts of air carrier operations in turbojet powered airplanes at San Francisco International Airport. It divides the operations by passenger and cargo uses and into three size categories:

Large Jet - 300 seat average
Medium Jet - 165 seat average
Small Jet - 100 seat average

Table 1B combines the annual passenger and cargo departure estimates, multiplies the result by two to obtain total operations (arrivals plus departures) and divides by 365 to obtain the annual average daily operations in each size category. It also contains the estimates for the study year of 1996 obtained by linear interpolation and for 2006 obtained by extrapolation of the 2000-2005 forecast periods.

Table 1B contains the 2005 recommended scenario, Ref. 4. It was based on the following stated assumptions:

"San Francisco Bay Metropolitan Area

The preliminary CASP update recommendations for the San Francisco Bay Metropolitan Area are described below:

1990 Scenario Conditions

- No air carrier operations are redistributed to other airports.
- No new air carrier airports or runways are proposed.
- No general aviation operations are relocated from air carrier to general aviation airports in the Region.

1995 Scenario Conditions

- Some air carrier operations are redistributed from San Francisco International to Metropolitan Oakland and San Jose International Airports.
- No new air carrier airports or runways are proposed.
- Runway extension at San Jose International Airport to provide parallel air carrier runways.
- No general aviation operations are relocated from air carrier to general aviation airports in the Region.

2000 Scenario Conditions

- Some air carrier operations are redistributed from San Francisco International to Metropolitan Oakland, San Jose International and a new air carrier airport.
- Air carrier service is added at Travis Air Force Base. Several studies have been conducted to identify potential new air carrier airport locations in the San Francisco Bay Area at both existing airports and new sites. There is already an existing joint-use agreement with the military that would permit air carrier operations at Travis Air Force Base. It was therefore assumed for this study that this would be the first new air carrier airport that could be added to the system in the San Francisco Bay Area.

- General aviation operations are relocated from air carrier to general aviation airports. The relocation involves only some of the single-engine airplanes local operations.

2005 Scenario Conditions

- Air carrier operations are redistributed from San Francisco International to San Jose International, an expanded Metropolitan Oakland and a new air carrier airport.
- A second air carrier runway is added at Metropolitan Oakland International Airport. The Port of Oakland is currently evaluating the feasibility of adding a new air carrier runway at Metropolitan Oakland International Airport. At this time the preferred location for a new runway has not been determined and the necessary environmental and other processing that would be required has not been initiated.
- General aviation operations are relocated from air carrier to general aviation airports. The relocation involves relocation of 90 percent of the local general aviation operations and 50 percent of the single-engine propeller airplane itinerant operations.
- The redistribution of air carrier operations results in a requirement for increased passenger terminal capacity over that currently estimated at airports in the San Francisco Bay Area by 2005.

  The latest information indicates MAP capacities of 12.0 MAP at Metropolitan Oakland international, 51.3 MAP at San Francisco International, 18.0 MAP at San Jose International and 5.0 MAP for joint use of Travis Air Force Base.

  To the extent it is not possible to provide these levels of passenger terminal capacity, then additional air carrier airports will need to be developed or expanded. Alternatively, the redistribution of more smaller and fewer large capacity air carrier airplanes and/or the relocation of additional high-performance general aviation turbojet operations need to be relocated from San Francisco International in order to permit additional air carrier operations and utilize the estimated excess passenger terminal capacity by 2005.

- At the Buchanan Field Airport in Concord, air carrier operations are assumed to continue to be limited to small jets and medium and small propeller airplanes. The Airport is expected to remain primarily a general aviation airport.
- Because of its remote location from most of the Bay Area, the Sonoma County Airport in Santa Rosa is expected to attract a relatively small amount of any air carrier operations that might be redistributed from the three major Bay Area air carrier airports.
- The general aviation activity associated with the preliminary recommended Scenario requires the relocation of a forecast total of 270,000 general aviation airplane operations and about 600 based airplanes from the three air carrier airports to other airports in the San Francisco Bay Area by 2005."

These three forecasts were distributed amongst the detailed equipment types using a methodology similar to that previously applied to the Master Plan (MP) estimates. To obtain this distribution, the airplanes contained in the FAA 1989 Report to Congress, Ref. 5, were subdivided into large, medium and small. The category assignments were similar to those used in the CASP, except that the DC870 series was retained as a large airplane as in the MP, and all B727 airplanes were considered to be medium size, as in the MP.

The FAA national fleet forecast, Ref. 5, contains the B7J7 airplane and does not contain the newly announced B777 airplane. The B7J7 airplane was a study airplane in the 150 seat category which was cancelled. For noise analysis it is assumed to be replaced by an MD80 series airplane which is of similar size. The new B777 airplane is not included in this study since its launch announcement came long after all of the MP analysis was completed. Additionally, there are no reliable national forecasts of its probable numbers in the future fleet.

The percentages of FAR Part 36 Stage 2 airplanes in the year 2006 are 5.1 and 4.2 for the CASP unconstrained and recommended scenarios, respectively. These numbers are consistent with the existing San Francisco Noise Abatement Regulation. However, it is currently proposed to be amended to require only Stage 3 airplane operations beginning in

2000. Further, the new law passed by Congress on a National Noise Policy, Ref. 6, would require phaseout of all Stage 2 airplanes by the beginning of 2004 and at least 85 percent of each air carrier fleet by the beginning of 2000. The effect of this new legislation would be to reduce all of the 2006 cumulative noise estimates (CNEL) by about one decibel.

The methodology to obtain the forecast fleet distributions was to:

a) Determine the proportionate change in the number of airplanes in the national fleet in each equipment type from the 1989 base year to the forecast year based on the FAA forecast.

b) Determine the proportionate reduction in future daily operations of airplanes operating at SFIA in 1989 because of forecast retirement.

c) For each forecast year and each size category determine the proportionate number of operations required of new airplanes (new airplane operations required equals forecast operations less 1989 operations plus retirements).

d) Allocate new airplane operations by equipment type in each size category in proportion to their existence in the forecast national fleet.

The resulting fleet mixes were then allocated to departure stage lengths (route distances) and time of operation as in the MP analysis, based on the 1989 operations for long, medium and short range. The detailed results for the three study periods are contained in Tables 2, 3 and 4. It is noted that these forecasts have a small number of "nighttime" Stage 2 airplanes which represent those estimated to operate between 10:00 and 11:00 P.M. when the Noise Abatement Regulation nighttime rule begins.

The corresponding CNEL contours calculated by the FAA Integrated Noise Model (INM)* are presented in Figures 1, 2 and 3. Comparison

*Note the INM algorithm for noise at the beginning of takeoff roll for locations behind the runway has been revised for these analyses to better represent the noise (back blast) actually experienced in this area.

of these three figures indicates both 2006 contours are substantially smaller than the 1996 contours in the region over the bay (Runway 01 L and R departures) but have only small changes over San Bruno and South San Francisco (Runway 28 L and R departures). The major decrease over the bay results from the change from Stage 2 to Stage 3 for the majority of airplanes. However, the Runway 28 departures are mostly long range B747 type airplanes whose average noise is almost at the Stage 3 levels for both study years.

3. COMPARISON OF THE VARIOUS FORECASTS

The various forecasts of average daily operations for air carriers (excluding commuter) at San Francisco International Airport are summarized in Table 5. All show an increase from actual 1989 operations. The increase for 1996 ranges between 12 and 48 percent and that for 2006 between 6 and 78 percent. In both years the MP constrained has the smallest forecast number of operations and the CASP unconstrained the largest number. Also, in both cases the FAA TAF forecast is bounded by the MP constrained and unconstrained forecast. The Recommended Scenario for 2006 is slightly greater than the MP constrained forecast but less than the FAA TAF forecast.

Table 6 compares the 1996 MP constrained and unconstrained daily operations forecasts with the CASP unconstrained forecasts. The CASP forecast is only 4 percent larger than the MP unconstrained forecast for the large airplanes including the 747. However, it is 29 and 21 percent greater for the medium and small size categories, respectively.

Table 7 compares the 2006 forecasts for the MP constrained and unconstrained and the CASP unconstrained and recommended scenario. The CASP recommended scenario is about the same as the MP constrained forecast in all size categories. However, the CASP unconstrained forecast is larger than the MP unconstrained forecast by 17, 12 and 73 percent for large, medium and small size categories, respectively. The significant difference in the forecasts with respect to the small airplanes does not have a major effect on noise impact because these airplanes are among the quietest airplanes. The magnitude of the difference is partly due to the base periods selected; for example, much of American's operations in small and medium airplanes had moved to San Jose in 1989. Also, the FAA national fleet forecast contained few airplanes of the 100 seat category, so that the forecast new airplanes were drawn from airplanes at the high seat capacity end of the small size range. Consequently, the number of airplanes assigned to the small size category contain more seats than the CASP forecast assumed.

Table 8 gives the INM calculated CNEL values at the remote monitoring stations (RMS), see Figure 4, for all of these forecasts. Table 9 gives similar data for the selected locations in other areas. Note that the levels actually experienced in the more remote areas are highly dependent upon their locations with respect to the model's flight tracks. These flight tracks were chosen to be representative within the 65 dB CNEL contours; many more tracks would be required to attempt to accurately model the cumulative noise at remote locations. For this purpose the maximum expected single event sound exposure levels at each of these locations is far more meaningful.

Tables 10 and 11 summarize the differences between the forecast cases and the 1989 Base Case. Note that the track density requirements for remote selected sites discussed above with respect to absolute values of cumulative noise do not apply to these differences. In 1996 the average difference at these sites from 1989 was -2.8 dB for the MP constrained, -2.6 dB for the MP unconstrained, and -2.0 dB for the CASP unconstrained. The FAA forecast results would be expected to be between -2.8 and -2.6 dB.

In 2006 there was greater variability amongst the forecasts. The resulting differences at the RMS in Table 10 range from -5.2 dB and -5.0 dB for the MP constrained and CASP recommended scenarios to -4.4 and -3.7 dB for the MP and the CASP unconstrained cases. Similar results are found for the selected remote locations in Table 11. The FAA TAF differences would be intermediate between these higher and lower pairs of results, with decreases on the order of -4.7 dB.

It should be noted that these average decreases in 2006 did not occur at all the measurement microphones. In fact, for the two unconstrained forecasts in 2006, small increases ranging from 0 to 0.9 dB were calculated at RMS 1, 4 and 12 which are located in San Bruno, South San Francisco and Foster City, respectively. These increases result primarily from the assumed increase in B747 traffic. Future projections of this traffic based on a better understanding of the 2006 heavy long-range airplane fleet including the B777 and other still to be announced airplanes should result in a decrease of noise from that estimated here.

References

1. "San Francisco International Airport, Final Draft Master Plan", November 1989.
2. FAA Terminal Area Forecasts, April 1987.
3. "California Aviation Systems Plan", Element II, Forecasts Volume 1 and 2, California Department of Transportation, Division of Aeronautics, July 1969.
4. "California Aviation Systems Plan", Element IV, Systems Requirements, California Department of Transportation, Division of Aeronautics, July 1989.
5. Federal Aviation Administration, "Report to Congress, Status of the U.S. Stage 2 Commercial Aircraft Fleet", August 1989.
6. Public Law...., 1990.

TABLE 1. SAN FRANCISCO INTERNATIONAL AIRPORT

A) CALIFORNIA AVIATION SYSTEM PLAN FORECAST PASSENGER AND CARGO JET POWERED AIR CARRIER AIRPLANE ANNUAL DEPARTURES

	LARGE JET 300 SEATS		MED JET 165 SEATS		SMALL JET 100 SEATS	
YEAR	PASS	CARGO	PASS	CARGO	PASS	CARGO
1980	21682	1378	54716	2762	42194	0
1985	25828	1838	61688	627	45228	846
1990	36204	1850	67605	701	58709	935
1995	44291	1903	78409	722	69933	962
2000	53386	1968	87110	746	86239	995
2005	62963	2046	97307	776	99167	1034

B) CALIFORNIA AVIATION SYSTEM PLAN FORECAST PASSENGER AND CARGO JET POWERED AIR CARRIER AIRPLANE AVERAGE DAILY OPERATIONS *

	AVERAGE AIRPLANE SIZE				AVERAGE
YEAR	LARGE	MEDIUM	SMALL	TOTAL	NO. SEATS
UNCONSTRINED FORECAST					
1980	126.36	314.95	231.20	672.50	167
1985	151.59	341.45	252.46	745.51	169
1990	208.52	374.28	326.82	909.61	172
1995	253.12	433.59	388.47	1075.18	172
** 1996	293.27	471.84	460.09	1225.20	172
2000	303.31	481.40	477.99	1262.71	172
2005	356.21	537.44	549.05	1442.70	173
** 2006	366.79	548.65	563.26	1478.70	173
RECOMMENDED SCENARIO					
2005	240.82	338.47	320.37	899.66	178
** 2006	247.97	345.53	328.66	922.16	178

* Average daily operations equals annual departures times two divided by 365 days.

** Obtained by linear interpolation

ABLE 2

AN FRANCISCO INTERNATIONAL AIRPORT 2006 CASP UNCONSTRAINED FORCAST DAILY OPERATIONS

	ARRIVALS				DEPARTURES		TOTALS		STAGE 1			STAGE 2			STAGE 3			STAGE 4			STAGE 5			STAGE 6			STAGE 7		
irplane Type	TOTAL	D	E	N	TOTAL	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N
IRBUS A330/340	10.19	5.44	3.26	1.49	10.19	7.64	0.83	1.72	0.21	0.00	0.19	0.65	0.00	0.23	0.83	0.00	0.04	3.39	0.79	0.72	1.56	0.04	0.39	1.01	0.00	0.15	0.00	0.00	0.00
OEING 747 -100, SP, 200	18.19	9.72	5.81	2.66	18.19	13.63	1.48	3.08	0.37	0.00	0.34	1.15	0.00	0.41	1.48	0.00	0.08	6.04	1.41	1.29	2.78	0.08	0.70	1.80	0.00	0.26	0.00	0.00	0.00
OEING 747 -200, 300, 400	22.27	11.89	7.12	3.26	22.27	16.69	1.82	3.77	0.45	0.00	0.41	1.41	0.00	0.50	1.81	0.00	0.09	7.40	1.72	1.58	3.40	0.09	0.86	0.00	0.00	0.00	2.21	0.00	0.32
OEING 767 (JT9)	25.07	13.39	8.01	3.67	25.07	18.79	2.04	4.24	0.51	0.00	0.46	1.59	0.00	0.57	2.04	0.00	0.11	8.33	1.94	1.78	3.83	0.11	0.96	0.00	0.00	0.00	2.49	0.00	0.36
OEING 767 (CF6)	50.14	26.78	16.02	7.34	50.14	37.57	4.09	8.48	1.02	0.00	0.93	3.18	0.00	1.13	4.08	0.00	0.21	16.66	3.88	3.57	7.66	0.21	1.93	0.00	0.00	0.00	4.97	0.00	0.72
cD DOUGLAS MD-11	12.35	6.60	3.95	1.81	12.35	9.25	1.01	2.09	0.25	0.00	0.23	0.78	0.00	0.28	1.01	0.00	0.05	4.10	0.96	0.88	1.89	0.05	0.47	0.00	0.00	0.00	1.22	0.00	0.18
cD DOUGLAS DC-10+L1011	35.67	19.05	11.40	5.22	35.67	26.73	2.91	6.03	0.72	0.00	0.66	2.26	0.00	0.81	2.91	0.00	0.15	11.85	2.76	2.54	5.45	0.15	1.37	3.54	0.00	0.51	0.00	0.00	0.00
cD DOUGLAS DC-8-71	1.90	1.01	0.61	0.28	1.90	1.42	0.15	0.32	0.04	0.00	0.04	0.12	0.00	0.04	0.15	0.00	0.01	0.63	0.15	0.14	0.29	0.01	0.07	0.00	0.00	0.00	0.19	0.00	0.03
IRBUS A300/310	7.63	5.22	1.74	0.67	7.63	5.31	1.35	0.97	2.40	0.74	0.46	1.73	0.54	0.03	0.15	0.00	0.04	1.03	0.07	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRBUS A320	34.58	23.66	7.89	3.03	34.58	24.08	6.11	4.40	10.86	3.33	2.08	7.85	2.47	0.12	0.67	0.00	0.18	4.69	0.31	2.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 727	12.52	8.74	2.86	0.93	12.52	10.00	2.21	0.31	4.37	1.21	0.31	2.89	0.89	0.00	0.31	0.00	0.00	2.43	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 737 (DC9+BAC111) (ON)	3.53	2.55	0.81	0.17	3.53	2.65	0.62	0.25	1.07	0.34	0.25	0.81	0.25	0.00	0.09	0.00	0.00	0.68	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 737 (DC9+BAC111) (D17)	3.52	2.55	0.80	0.17	3.52	2.64	0.62	0.25	1.06	0.34	0.25	0.81	0.25	0.00	0.09	0.00	0.00	0.68	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 737-300	221.13	151.00	50.49	19.64	221.13	153.57	39.06	28.50	69.54	21.30	13.24	50.18	15.79	0.82	4.25	0.00	1.20	29.21	1.96	13.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 757	47.97	32.65	10.95	4.37	47.97	32.12	8.47	7.38	14.63	4.62	3.33	10.85	3.43	0.22	0.90	0.00	0.28	6.14	0.43	3.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 737	53.00	36.26	12.10	4.64	53.00	36.90	9.36	6.74	16.65	5.11	3.19	12.03	3.79	0.19	1.03	0.00	0.27	7.19	0.47	3.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
McD DOUGLAS MD-80/90	126.52	86.56	28.89	11.08	126.52	88.09	22.35	16.09	39.74	12.19	7.62	28.72	9.04	0.45	2.47	0.00	0.65	17.15	1.12	7.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BRITISH AEROSPACE 146	44.18	34.75	6.63	2.81	44.18	35.92	5.99	2.27	32.33	5.99	2.27	3.59	0.00	0.00	0.00	0.00	0.00	-0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FOLKER F100	9.27	7.29	1.39	0.59	9.27	7.54	1.26	0.48	6.78	1.26	0.48	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS	739.63	485.11	180.71	73.81	739.63	530.54	111.73	97.36	203.01	56.42	36.75	131.37	36.46	5.80	24.28	0.00	3.35	127.61	18.12	42.18	26.85	0.74	6.76	6.35	0.00	0.91	11.08	0.00	1.60

ABLE 3

AN FRANCISCO INTERNATIONAL AIRPORT 1996 CASP UNCONSTRAINED FORECAST DAILY OPERATIONS

	ARRIVALS				DEPARTURES		TOTALS			STAGE 1			STAGE 2			STAGE 3			STAGE 4			STAGE 5			STAGE 6			STAGE 7	
irplane Type	TOTAL	D	E	N	TOTAL	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N	D	E	N
IRBUS A330/340	3.13	1.67	1.00	0.46	3.13	2.35	0.26	0.53	0.06	0.00	0.06	0.20	0.00	0.07	0.25	0.00	0.01	1.04	0.24	0.22	0.48	0.01	0.12	0.31	0.00	0.04	0.00	0.00	0.00
OEING 747 -100, SP, 200	18.19	9.72	5.81	2.66	18.19	13.63	1.48	3.08	0.37	0.00	0.34	1.15	0.00	0.41	1.48	0.00	0.08	6.04	1.41	1.29	2.78	0.08	0.70	1.80	0.00	0.26	0.00	0.00	0.00
OEING 747 -200, 300, 400	17.13	9.15	5.47	2.51	17.13	12.84	1.40	2.90	0.35	0.00	0.32	1.09	0.00	0.39	1.40	0.00	0.07	5.69	1.32	1.22	2.62	0.07	0.66	0.00	0.00	0.00	1.70	0.00	0.24
OEING 767 (JT9)	15.04	8.03	4.81	2.20	15.04	11.27	1.23	2.54	0.31	0.00	0.28	0.95	0.00	0.34	1.22	0.00	0.06	5.00	1.16	1.07	2.30	0.06	0.58	0.00	0.00	0.00	1.49	0.00	0.21
OEING 767 (CF6)	30.07	16.06	9.61	4.40	30.07	22.53	2.45	5.08	0.61	0.00	0.56	1.91	0.00	0.68	2.45	0.00	0.13	9.99	2.33	2.14	4.59	0.13	1.16	0.00	0.00	0.00	2.98	0.00	0.43
cD DOUGLAS MD-11	5.54	2.96	1.77	0.81	5.54	4.15	0.45	0.94	0.11	0.00	0.10	0.35	0.00	0.13	0.45	0.00	0.02	1.84	0.43	0.39	0.85	0.02	0.21	0.00	0.00	0.00	0.55	0.00	0.08
cD DOUGLAS DC-10+L1011	42.23	22.56	13.49	6.18	42.23	31.65	3.44	7.14	0.86	0.00	0.78	2.68	0.00	0.95	3.44	0.00	0.18	14.03	3.27	3.00	6.45	0.18	1.62	4.19	0.00	0.60	0.00	0.00	0.00
cD DOUGLAS DC-8-71	6.81	3.64	2.18	1.00	6.81	5.10	0.56	1.15	0.14	0.00	0.13	0.43	0.00	0.15	0.55	0.00	0.03	2.26	0.53	0.48	1.04	0.03	0.26	0.00	0.00	0.00	0.68	0.00	0.10
IRBUS A300/310	8.53	5.84	1.95	0.75	8.53	5.94	1.51	1.08	2.68	0.82	0.51	1.94	0.61	0.03	0.17	0.00	0.04	1.16	0.08	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRBUS A320	28.97	19.82	6.61	2.54	28.97	20.17	5.12	3.68	9.10	2.79	1.75	6.58	2.07	0.10	0.57	0.00	0.15	3.93	0.26	1.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 727	57.84	40.35	13.21	4.28	57.84	46.18	10.22	1.45	20.21	5.57	1.45	13.34	4.13	0.00	1.43	0.00	0.00	11.21	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 737 (DC9+BAC111) (ON)	17.96	13.00	4.10	0.86	17.96	13.49	3.17	1.29	5.43	1.73	1.29	4.14	1.28	0.00	0.44	0.00	0.00	3.48	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 737 (DC9+BAC111) (D17)	17.96	13.00	4.10	0.86	17.96	13.49	3.17	1.29	5.43	1.73	1.29	4.14	1.28	0.00	0.44	0.00	0.00	3.48	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 737-300	144.19	97.22	32.92	14.05	144.19	98.41	25.47	20.31	45.71	13.89	8.27	32.60	10.30	0.65	2.48	0.00	1.07	15.78	1.28	12.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 757	61.21	41.09	13.97	6.14	61.21	36.71	10.81	13.69	17.19	5.90	5.73	13.69	4.37	0.43	1.05	0.00	0.46	6.62	0.54	5.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OEING 7J7	3.46	2.37	0.79	0.30	3.46	2.41	0.61	0.44	1.09	0.33	0.21	0.79	0.25	0.01	0.07	0.00	0.02	0.47	0.03	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
cD DOUGLAS MD-80/90	84.44	57.77	19.28	7.39	84.44	58.79	14.92	10.74	26.52	8.14	5.09	19.17	6.03	0.30	1.65	0.00	0.43	11.45	0.75	4.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RITISH AEROSPACE 146	43.94	34.56	6.59	2.79	43.94	35.73	5.95	2.26	32.16	5.95	2.26	3.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OLKER F100	6.00	4.72	0.90	0.38	6.00	4.88	0.81	0.31	4.39	0.81	0.31	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
OTALS	612.64	403.51	148.56	60.57	612.64	439.72	93.02	79.90	172.71	47.67	30.70	109.21	30.33	4.65	19.54	0.00	2.76	103.46	14.45	34.51	21.10	0.58	5.31	6.30	0.00	0.91	7.40	0.00	1.07

TABLE 4

SAN FRANCISCO INTERNATIONAL AIRPORT 2006 CASP RECOMMENDED SCENARIO FORECAST DAILY OPERATIONS

Airplane Type	ARRIVALS TOTAL	D	E	N	DEPARTURES TOTAL	D	E	N
AIRBUS A330/340	3.38	1.81	1.08	0.49	3.38	2.53	0.28	0.57
BOEING 747 -100, SP, 200	18.19	9.72	5.81	2.66	18.19	13.63	1.48	3.08
BOEING 747 -200, 300, 400	13.21	7.06	4.22	1.93	13.21	9.90	1.08	2.23
BOEING 767 (JT9)	13.82	7.38	4.42	2.02	13.82	10.36	1.13	2.34
BOEING 767 (CF6)	27.65	14.77	8.83	4.05	27.65	20.72	2.25	4.68
McD DOUGLAS MD-11	4.10	2.19	1.31	0.60	4.10	3.07	0.33	0.69
McD DOUGLAS DC-10+L1011	35.67	19.05	11.40	5.22	35.67	26.73	2.91	6.03
McD DOUGLAS DC-8-71	1.90	1.01	0.61	0.28	1.90	1.42	0.15	0.32
AIRBUS A300/310	6.08	4.16	1.39	0.53	6.08	4.23	1.07	0.77
AIRBUS A320	17.63	12.06	4.03	1.54	17.63	12.27	3.11	2.24
BOEING 727	12.26	8.55	2.80	0.91	12.26	9.79	2.17	0.31
BOEING 737 (DC9+BAC111) (ON)	3.53	2.55	0.81	0.17	3.53	2.65	0.62	0.25
BOEING 737 (DC9+BAC111) (017)	3.53	2.55	0.81	0.17	3.53	2.65	0.62	0.25
BOEING 737-300	111.50	76.00	25.46	10.04	111.50	77.24	19.69	14.56
BOEING 757	30.88	20.96	7.05	2.87	30.88	20.25	5.45	5.18
BOEING 7J7	27.02	18.49	6.17	2.37	27.02	18.81	4.77	3.44
McD DOUGLAS MD-80/90	84.99	58.14	19.40	7.44	84.99	59.17	15.01	10.81
BRITISH AEROSPACE 146	43.25	34.02	6.49	2.75	43.25	35.17	5.86	2.22
FOLKER F100	2.53	1.99	0.38	0.16	2.53	2.06	0.34	0.13
TOTALS	461.12	302.46	112.45	46.21	461.12	332.66	68.35	60.10

Airplane Type	STAGE 1 D	E	N	STAGE 2 D	E	N	STAGE 3 D	E	N	STAGE 4 D	E	N	STAGE 5 D	E	N	STAGE 6 D	E	N	STAGE 7 D	E	N
AIRBUS A330/340	0.07	0.00	0.06	0.21	0.00	0.08	0.28	0.00	0.01	1.12	0.26	0.24	0.52	0.01	0.13	0.34	0.00	0.05	0.00	0.00	0.00
BOEING 747 -100, SP, 200	0.37	0.00	0.34	1.15	0.00	0.41	1.48	0.00	0.08	6.04	1.41	1.29	2.78	0.08	0.70	1.80	0.00	0.26	0.00	0.00	0.00
BOEING 747 -200, 300, 400	0.27	0.00	0.24	0.84	0.00	0.30	1.08	0.00	0.06	4.39	1.02	0.94	2.02	0.06	0.51	0.00	0.00	0.00	1.31	0.00	0.19
BOEING 767 (JT9)	0.28	0.00	0.26	0.88	0.00	0.31	1.13	0.00	0.06	4.59	1.07	0.98	2.11	0.06	0.53	0.00	0.00	0.00	1.37	0.00	0.20
BOEING 767 (CF6)	0.56	0.00	0.51	1.75	0.00	0.62	2.25	0.00	0.12	9.19	2.14	1.97	4.22	0.12	1.06	0.00	0.00	0.00	2.74	0.00	0.39
McD DOUGLAS MD-11	0.08	0.00	0.08	0.26	0.00	0.09	0.33	0.00	0.02	1.36	0.32	0.29	0.63	0.02	0.16	0.00	0.00	0.00	0.41	0.00	0.06
McD DOUGLAS DC-10+L1011	0.72	0.00	0.66	2.26	0.00	0.81	2.91	0.00	0.15	11.85	2.76	2.54	5.45	0.15	1.37	3.54	0.00	0.51	0.00	0.00	0.00
McD DOUGLAS DC-8-71	0.04	0.00	0.04	0.12	0.00	0.04	0.15	0.00	0.01	0.63	0.15	0.14	0.29	0.01	0.07	0.00	0.00	0.00	0.19	0.00	0.03
AIRBUS A300/310	1.91	0.59	0.37	1.38	0.43	0.02	0.12	0.00	0.03	0.82	0.05	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIRBUS A320	5.54	1.70	1.06	4.00	1.26	0.06	0.34	0.00	0.09	2.39	0.16	1.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOEING 727	4.28	1.18	0.31	2.83	0.88	0.00	0.30	0.00	0.00	2.38	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOEING 737 (DC9+BAC111) (ON)	1.07	0.34	0.25	0.81	0.25	0.00	0.09	0.00	0.00	0.68	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOEING 737 (DC9+BAC111) (017)	1.07	0.34	0.25	0.81	0.25	0.00	0.09	0.00	0.00	0.68	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOEING 737-300	35.11	10.74	6.64	25.29	7.96	0.43	2.11	0.00	0.64	14.35	0.99	7.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOEING 757	9.27	2.98	2.29	6.97	2.21	0.16	0.57	0.00	0.19	3.83	0.27	2.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BOEING 7J7	8.49	2.60	1.63	6.13	1.93	0.10	0.53	0.00	0.14	3.66	0.24	1.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
McD DOUGLAS MD-80/90	26.70	8.19	5.12	19.29	6.07	0.31	1.66	0.00	0.44	11.52	0.75	4.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BRITISH AEROSPACE 146	31.65	5.86	2.22	3.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FOLKER F100	1.85	0.34	0.13	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTALS	129.32	34.86	22.45	78.73	21.24	3.73	15.41	0.00	2.02	79.51	11.76	25.68	18.01	0.50	4.53	5.68	0.00	0.82	6.02	0.00	0.87

TABLE 5

SUMMARY OF TOTAL DAILY AIR CARRIER OPERATIONS FORECASTS FOR SAN FRANCISCO INTERNATIONAL AIRPORT

SOURCE	1989	1996	2006
1989 ACTUAL	829		
MASTER PLAN CONSTRAINED		927	881
CASP RECOMMENDED SCENARIO			922
FAA TERMINAL AREA FORECAST		945	1041
MASTER PLAN UNCONSTRAINED		1028	1128
CASP UNCONSTRAINED		1225	1479

TABLE 6

1996 FORECASTS FOR AVERAGE DAILY OPERATIONS IN COMPARISON WITH 1989 ACTUAL OPERATIONS

AIRPLANE TYPE	NUMBER SEATS	ACTUAL 1989 OPS	MASTER PLAN CONST	FORECAST UNCONST	CASP FORECAST
Large airplanes (300 seats)					
B747	450	53.80	61.73	68.13	70.63
MD11	360	0.00	5.22	9.42	11.07
A330/340	330	0.00	2.93	5.30	6.23
DC10/L1011	320	85.60	84.46	84.46	84.46
A300/310	250	10.60	14.60	16.44	17.06
B767	230	49.40	68.64	84.14	90.21
DC870	200	15.00	13.62	13.62	13.62
Sub total		214.40	251.20	281.51	293.27
Medium airplanes (165 seats)					
B757	200	26.20	63.89	81.24	122.41
A320	180	0.00	22.70	33.15	57.95
B7J7	150	0.00	2.71	3.96	6.92
MD80/90	150	83.60	117.01	132.39	168.88
B727	140	165.00	115.68	115.68	115.68
Sub total		274.80	321.99	366.42	471.84
Small airplanes (100 seats)					
B737300	140	140.60	191.57	215.03	288.38
B737/DC9/BA111	120	113.20	71.83	71.83	71.83
BAE146	100	85.80	86.51	86.84	87.87
F100	100	0.00	4.14	6.05	12.00
Sub total		339.60	354.05	379.75	460.09
TOTAL		828.80	927.24	1027.68	1225.20
Stage 2 operations		314.78	224.094	229.4864	224.10
Stage 2 percent		38.0%	24.2%	22.3%	18.3%

TABLE 7

2006 FORECASTS FOR AVERAGE DAILY OPERATIONS IN COMPARISON WITH 1989 ACTUAL OPERATIONS

AIRPLANE TYPE	NUMBER SEATS	ACTUAL 1989 OPS	M. PLAN CONST	CASP REC. SCENARIO	M. PLAN UNCONST	CASP FORECAST
Large airplanes (200 seats)						
B747	450	53.80	61.72	62.80	72.73	80.91
MD11	360	0.00	7.21	8.20	17.24	24.69
A330/340	330	0.00	5.95	6.76	14.23	20.38
DC10/L1011	320	85.60	71.33	71.33	71.33	71.33
A300/310	250	10.60	13.33	12.15	15.14	15.26
B767	230	49.40	78.91	82.94	119.94	150.42
DC870	200	15.00	3.79	3.79	3.79	3.79
Sub total		214.40	242.24	247.97	314.40	366.79
Medium airplanes (165 seats)						
B757	200	26.20	62.06	61.75	85.70	95.94
A320	180	0.00	35.55	35.25	58.99	69.15
B7J7	150	0.00	54.50	54.03	90.42	106.00
MD80/90	150	83.60	170.71	169.97	228.14	253.03
B727	140	165.00	24.52	24.52	24.52	24.52
Sub total		274.80	347.34	345.53	487.77	548.65
Small airplanes (100 seats)						
B737300	140	140.60	188.41	223.00	219.93	442.26
B737/DC9/BA111	120	113.20	14.11	14.11	14.11	14.11
BAE146	100	85.80	86.21	86.50	86.47	88.36
F100	100	0.00	2.94	5.06	4.87	18.53
Sub total		339.60	291.67	328.66	325.38	563.26
TOTAL		828.80	881.25	922.16	1127.55	1478.70
Stage 2 operations		314.78	38.63	38.63	38.63	38.63
Stage 2 percent		38.0%	4.4%	4.2%	3.4%	2.6%

TABLE 8

SAN FRANCISCO INTERNATIONAL AIRPORT CNEL VALUES CALCULATED AT REMOTE MONITOR STATIONS

RMS	CITY LOCATION	1989 BASE	1996 MP(C)	1996 MP(U)	1996 CP(U)	2006 MP(C)	2006 CP(R)	2006 MP(U)	2006 CP(U)
1	San Bruno	71.7	71.1	71.5	70.7	70.9	70.7	71.7	72.0
2	San Bruno	55.5	53.4	53.7	53.8	52.1	52.1	52.9	53.4
3	South San Francisco	56.2	53.6	53.8	54.1	51.3	51.5	52.1	52.7
4	South San Francisco	68.8	68.0	68.5	67.8	68.1	68.0	68.9	69.2
5	San Bruno	63.7	62.2	62.6	62.2	61.5	61.4	62.3	62.7
6	South San Francisco	65.8	63.5	64.0	63.6	63.4	63.2	64.3	64.4
7	Brisbane	55.3	51.9	52.0	52.9	48.5	48.9	49.4	50.3
8	Millbrae	71.2	67.8	67.9	68.8	64.2	64.7	65.1	66.0
9	Millbrae	63.6	60.1	60.3	61.1	56.2	56.8	57.1	58.0
10	Burlingame	59.8	56.2	56.3	57.2	52.3	52.8	53.0	54.0
11	Burlingame	63.9	60.4	60.5	61.4	56.5	57.1	57.3	58.3
12	Foster City	62.5	62.7	63.1	62.6	62.5	61.5	63.4	63.2
13	Hillsborough	50.3	46.7	46.8	47.7	42.8	43.4	43.6	44.5
14	South San Fancisco	54.2	52.0	52.3	52.5	50.8	50.8	51.6	52.1
15	South San Fancisco	62.2	59.0	59.1	59.7	54.8	55.2	55.4	56.1
16	South San Fancisco	57.4	55.3	55.6	55.6	54.4	54.2	55.3	55.5
17	South San Fancisco	60.3	58.4	58.8	58.6	58.1	57.5	58.9	58.9
18	Daly City	63.1	60.7	61.6	60.9	60.5	59.6	61.3	61.0
19	Pacifica	58.7	56.8	57.1	57.2	55.9	55.7	56.8	57.0
20	Daly City	55.7	52.6	52.8	53.6	50.1	50.5	51.0	51.9
21	San Francisco	53.7	50.7	50.9	51.7	48.3	48.7	49.3	50.2
22	San Francisco	63.9	60.4	60.6	61.4	57.7	58.1	58.5	59.4
23	San Francisco	60.9	57.7	57.8	58.6	54.9	55.3	55.8	56.7
24	San Francisco	59.5	56.2	56.3	57.0	53.4	53.8	54.2	55.1
25	San Francisco	54.9	51.7	51.9	52.6	49.1	49.5	50.0	50.9
26	San Francisco	52.9	49.7	49.9	50.6	47.1	47.4	48.0	48.8
27	San Francisco	40.5	37.7	37.9	38.8	35.4	35.8	36.4	37.4

TABLE 9

SAN FRANCISCO INTERNATIONAL AIRPORT CNEL VALUES CALCULATED AT SELECTED LOCATIONS

I.D.	CITY LOCATION	1989 BASE	1996 MP(C)	1996 MP(U)	1996 CP(U)	2006 MP(C)	2006 CP(R)	2006 MP(U)	2006 CP(U)
A	SF-Visitacion Valley	59.1	56.0	56.2	57.0	53.4	53.8	54.3	55.3
B	SF-San Miguel Hills	52.8	49.8	50.0	50.7	47.3	47.7	48.3	49.1
C	SF-Ingleside	53.7	50.7	50.9	51.6	48.2	48.6	49.1	50.0
D	Albany	49.6	46.1	46.2	47.0	43.0	43.4	43.8	44.7
E	Kensington	46.9	43.6	43.8	44.6	40.7	41.1	41.5	42.5
F	Berkeley	48.7	45.4	45.5	46.3	42.4	42.9	43.3	44.2
G	Berkeley	41.7	38.9	39.1	39.9	36.4	36.8	37.4	38.3
H	Berkeley	46.0	43.0	43.2	44.0	40.5	40.9	41.5	42.4
I	Berkeley	42.4	39.7	39.9	40.6	37.3	37.6	38.3	39.2
J	Orinda Village	40.2	39.5	39.8	39.7	38.8	38.3	34.8	39.9
K	Claremont ?	41.5	40.5	40.8	40.9	39.6	39.2	40.6	40.8
L	Piedmont ?	40.5	38.7	39.0	39.4	37.3	37.2	38.3	38.8
M	Orinda	39.4	36.7	37.0	37.7	34.4	34.8	35.5	36.3
N	Walnut Creek	47.2	43.9	44.0	44.8	49.8	41.3	41.6	42.6
O	Richmond	40.5	37.4	37.6	38.4	34.6	35.1	35.5	36.5
P	Moraga	52.8	49.3	49.4	50.2	46.1	46.6	46.9	47.8
Q	Danville	41.1	38.2	38.3	39.1	35.4	35.8	36.3	37.3
R	Pacifica	49.8	46.6	46.8	47.6	43.8	44.2	44.7	45.6
S	Pacifica	49.4	46.2	46.3	47.1	43.3	43.7	44.2	45.1
T	Pacifica	49.8	46.5	46.7	47.5	43.7	44.1	44.6	45.5

TABLE 10

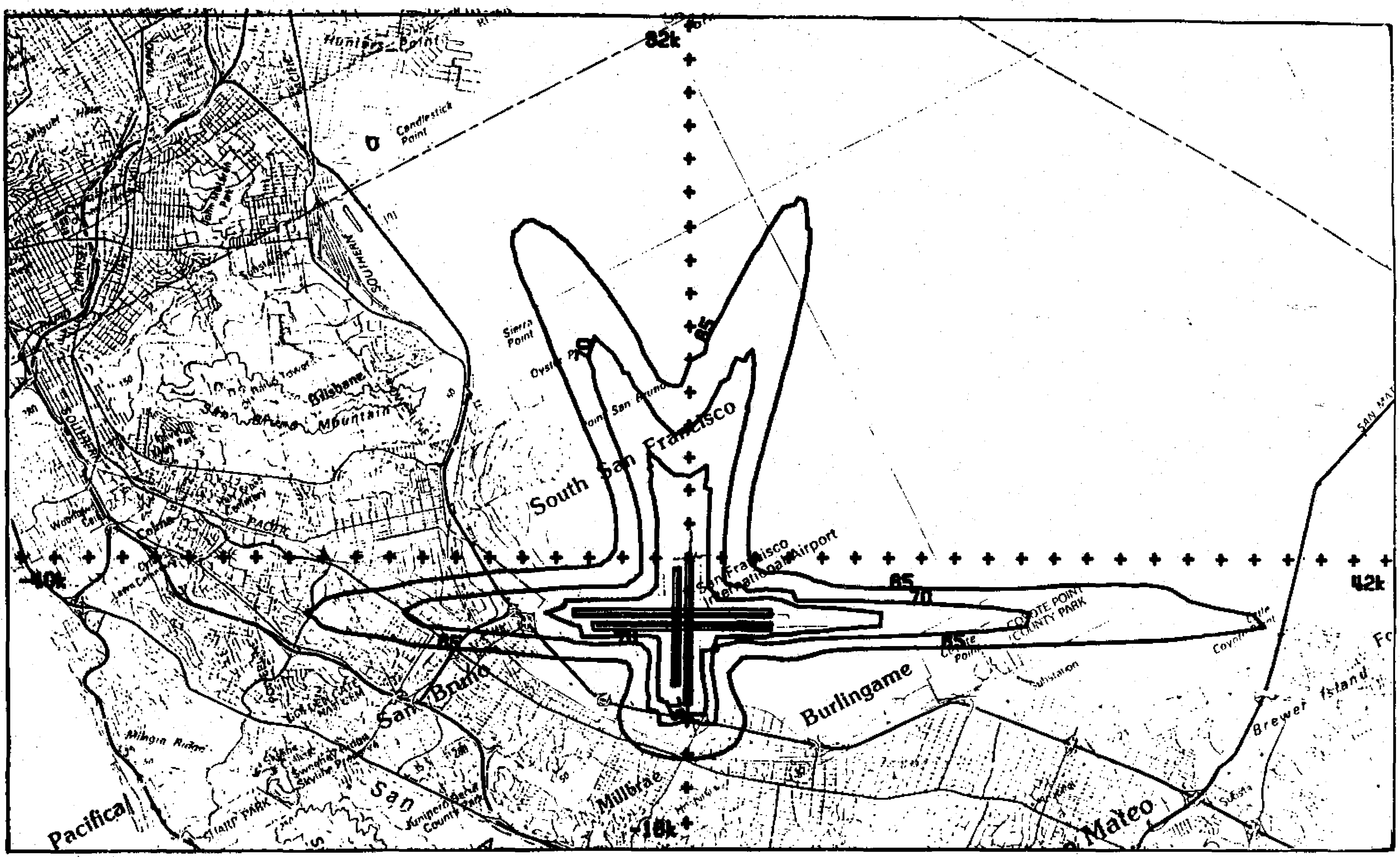
SAN FRANCISCO INTERNATIONAL AIRPORT CHANGES IN CNEL VALUES CALCULATED AT REMOTE MONITOR STATIONS

RMS	CITY LOCATION	1989 BASE	1996 MP(C)	1996 MP(U)	1996 CP(U)	2006 MP(C)	2006 CP(R)	2006 MP(U)	2006 CP(U)
1	San Bruno	71.7	-0.6	-0.2	-1.0	-0.8	-1.0	0.0	0.3
2	San Bruno	55.5	-2.1	-1.8	-1.7	-3.4	-3.4	-2.6	-2.1
3	South San Francisco	56.2	-2.6	-2.4	-2.1	-4.9	-4.7	-4.1	-3.5
4	South San Francisco	68.8	-0.8	-0.3	-1.0	-0.7	-0.8	0.1	0.4
5	San Bruno	63.7	-1.5	-1.1	-1.5	-2.2	-2.3	-1.4	-1.0
6	South San Francisco	65.8	-2.3	-1.8	-2.2	-2.4	-2.6	-1.5	-1.4
7	Brisbane	55.3	-3.4	-3.3	-2.4	-6.8	-6.4	-5.9	-5.0
8	Millbrae	71.2	-3.4	-3.3	-2.4	-7.0	-6.5	-6.1	-5.2
9	Millbrae	63.6	-3.5	-3.3	-2.5	-7.4	-6.8	-6.5	-5.6
10	Burlingame	59.8	-3.6	-3.5	-2.6	-7.5	-7.0	-6.8	-5.8
11	Burlingame	63.9	-3.5	-3.4	-2.5	-7.4	-6.8	-6.6	-5.6
12	Foster City	62.5	0.2	0.6	0.1	0.0	-1.0	0.9	0.7
13	Hillsborough	50.3	-3.6	-3.5	-2.6	-7.5	-6.9	-6.7	-5.8
14	South San Fancisco	54.2	-2.2	-1.9	-1.7	-3.4	-3.4	-2.6	-2.1
15	South San Fancisco	62.2	-3.2	-3.1	-2.5	-7.4	-7.0	-6.8	-6.1
16	South San Fancisco	57.4	-2.1	-1.8	-1.8	-3.0	-3.2	-2.1	-1.9
17	South San Fancisco	60.3	-1.9	-1.5	-1.7	-2.2	-2.8	-1.4	-1.4
18	Daly City	63.1	-2.4	-1.5	-2.2	-2.6	-3.5	-1.8	-2.1
19	Pacifica	58.7	-1.9	-1.6	-1.5	-2.8	-3.0	-1.9	-1.7
20	Daly City	55.7	-3.1	-2.9	-2.1	-5.6	-5.2	-4.7	-3.8
21	San Francisco	53.7	-3.0	-2.8	-2.0	-5.4	-5.0	-4.4	-3.5
22	San Francisco	63.9	-3.5	-3.3	-2.5	-6.2	-5.8	-5.4	-4.5
23	San Francisco	60.9	-3.2	-3.1	-2.3	-6.0	-5.6	-5.1	-4.2
24	San Francisco	59.5	-3.3	-3.2	-2.5	-6.1	-5.7	-5.3	-4.4
25	San Francisco	54.9	-3.2	-3.0	-2.3	-5.8	-5.4	-4.9	-4.0
26	San Francisco	52.9	-3.2	-3.0	-2.3	-5.8	-5.5	-4.9	-4.1
27	San Francisco	40.5	-2.8	-2.6	-1.7	-5.1	-4.7	-4.1	-3.1
	Average		-2.8	-2.6	-2.1	-5.2	-5.0	-4.4	-3.7
	Standard Deviation		0.9	1.0	0.6	2.1	1.7	2.1	1.8

TABLE 11

SAN FRANCISCO INTERNATIONAL AIRPORT CHANGES IN CNEL VALUES CALCULATED AT SELECTED LOCATIONS

I.D.	CITY LOCATION	1989 BASE	1996 MP(C)	1996 MP(U)	1996 CP(U)	2006 MP(C)	2006 CP(R)	2006 MP(U)	2006 CP(U)
A	SF-Visitacion Valley	59.1	-3.1	-2.9	-2.1	-5.7	-5.3	-4.8	-3.8
B	SF-San Miguel Hills	52.8	-3.0	-2.8	-2.1	-5.5	-5.1	-4.5	-3.7
C	SF-Ingleside	53.7	-3.0	-2.8	-2.1	-5.5	-5.1	-4.6	-3.7
D	Albany	49.6	-3.5	-3.4	-2.6	-6.6	-6.2	-5.8	-4.9
E	Kensington	46.9	-3.3	-3.1	-2.3	-6.2	-5.8	-5.4	-4.4
F	Berkeley	48.7	-3.3	-3.2	-2.4	-6.3	-5.8	-5.4	-4.5
G	Berkeley	41.7	-2.8	-2.6	-1.8	-5.3	-4.9	-4.3	-3.4
H	Berkeley	46.0	-3.0	-2.8	-2.0	-5.5	-5.1	-4.5	-3.6
I	Berkeley	42.4	-2.7	-2.5	-1.8	-5.1	-4.8	-4.1	-3.2
J	Orinda Village	40.2	-0.7	-0.4	-0.5	-1.4	-1.9	-3.4	-0.3
K	Claremont	41.5	-1.0	-0.7	-0.6	-1.9	-2.3	-0.9	-0.7
L	Piedmont	40.5	-1.8	-1.5	-1.1	-3.2	-3.3	-2.2	-1.7
M	Orinda	39.4	-2.7	-2.4	-1.7	-5.0	-4.6	-3.9	-3.1
N	Walnut Creek	47.2	-3.3	-3.2	-2.4	2.6	-5.9	-5.6	-4.6
O	Richmond	40.5	-3.1	-2.9	-2.1	-5.9	-5.4	-5.0	-4.0
P	Moraga	52.8	-3.5	-3.4	-2.6	-6.7	-6.2	-5.9	-5.0
Q	Danville	41.1	-2.9	-2.8	-2.0	-5.7	-5.3	-4.8	-3.8
R	Pacifica	49.8	-3.2	-3.0	-2.2	-6.0	-5.6	-5.1	-4.2
S	Pacifica	49.4	-3.2	-3.1	-2.3	-6.1	-5.7	-5.2	-4.3
T	Pacifica	49.8	-3.3	-3.1	-2.3	-6.1	-5.7	-5.2	-4.3
	Average		-2.8	-2.6	-2.0	-4.9	-5.0	-4.5	-3.6
	Standard Deviation		0.8	0.8	0.6	2.2	1.2	1.2	1.2



FAA INTEGRATED NOISE MODEL VERSION 3

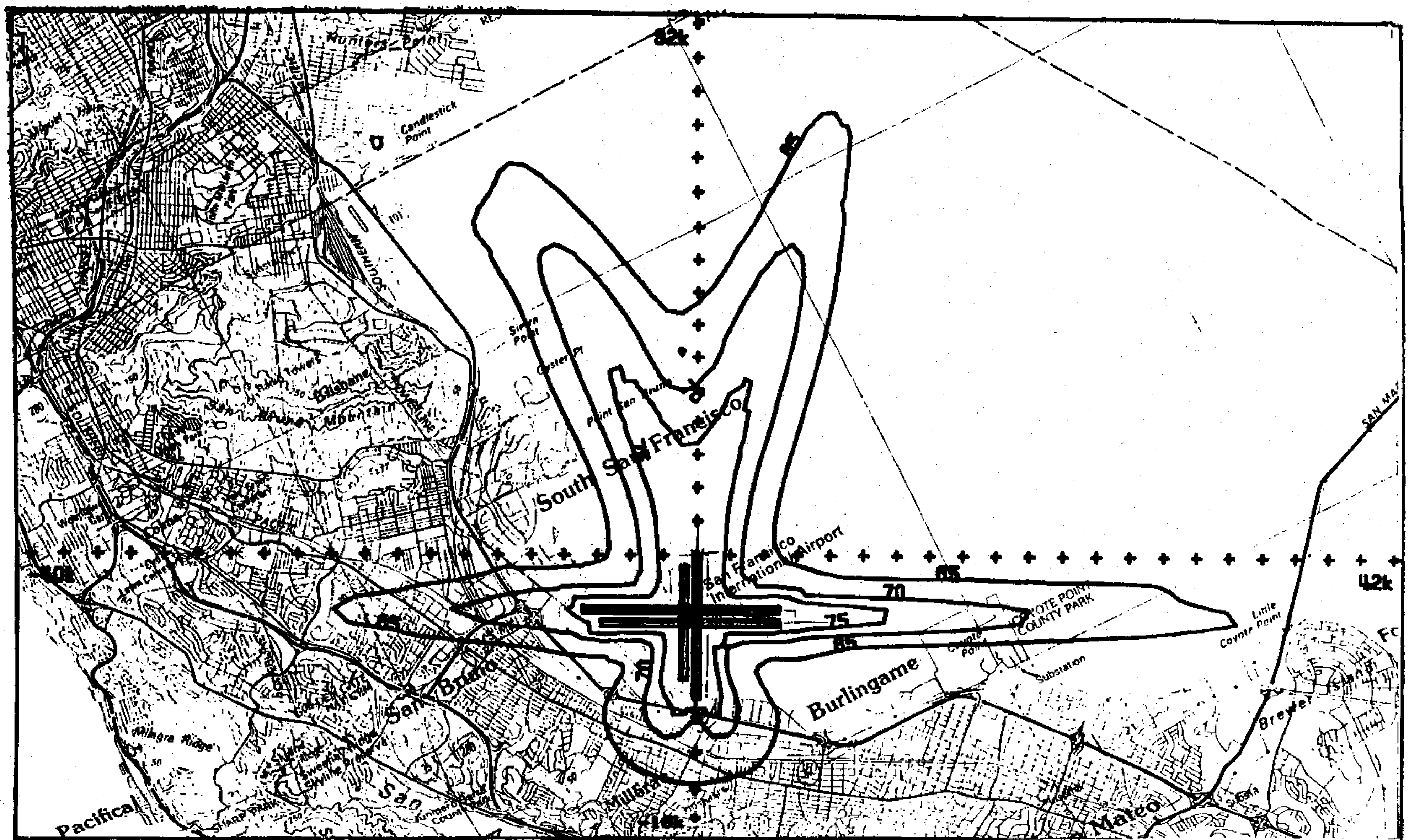
YEAR 2006 WITH CASP UNCONSTRAINED FORECAST

SAN FRANCISCO INTERNATIONAL AIRPORT

METRIC=CNEL

FT

FIGURE 1. 2006 UNCONSTRAINED



FAA INTEGRATED NOISE MODEL VERSION 3

YEAR 1996 WITH CASP UNCONSTRAINED FORECAST

SAN FRANCISCO INTERNATIONAL AIRPORT

METRIC=CNEL

FT

FIGURE 2. 1996 UNCONSTRAINED

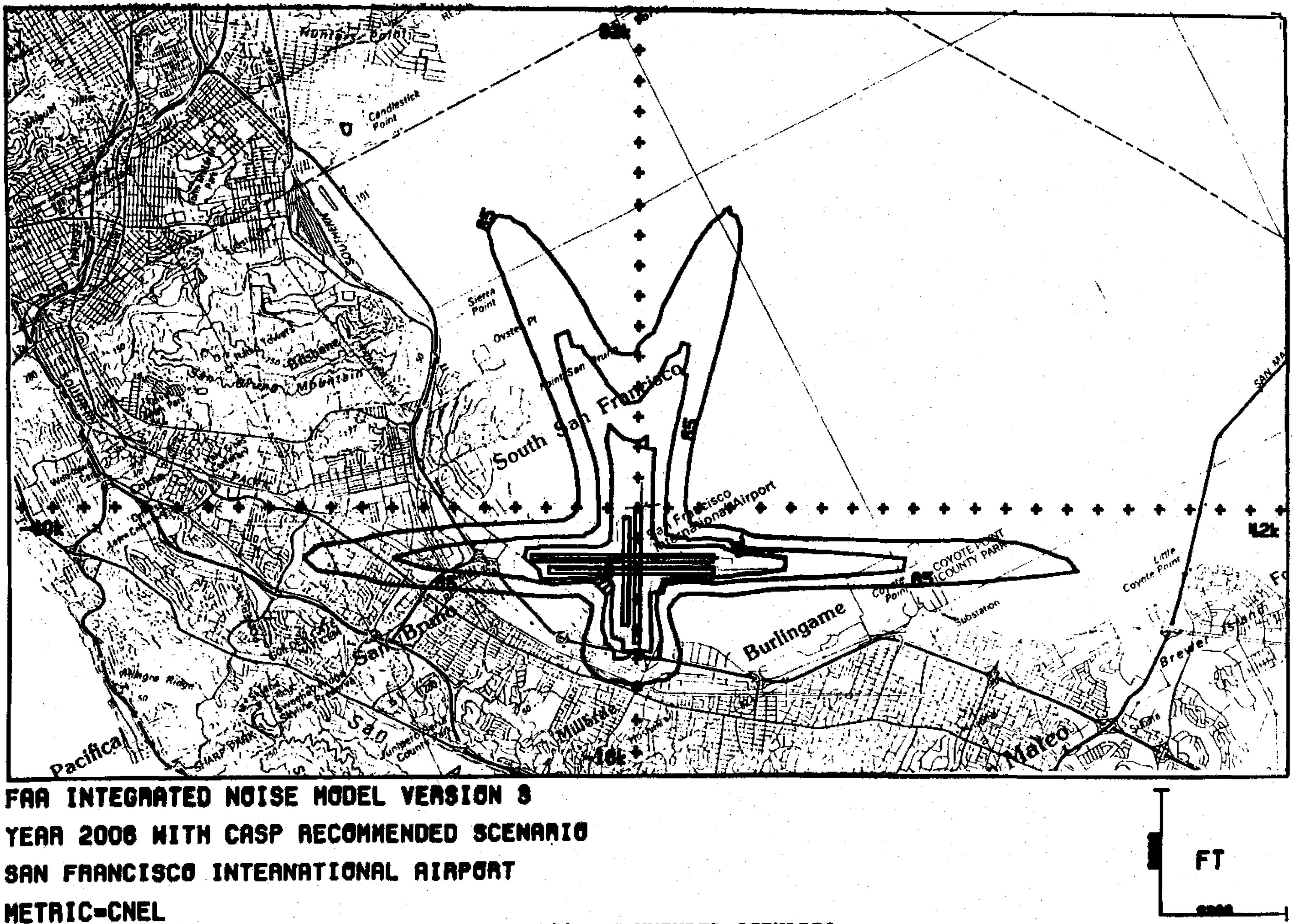


FIGURE 3. 2006 RECOMMENDED SCENARIO

APPENDIX D: AIR QUALITY

TABLE D-1: SAN FRANCISCO AIR POLLUTANT SUMMARY, 1987-1989

Pollutant	Standard	Monitoring Data by Year /a/ 1987	1988	1989
Ozone (O_3)				
Highest 1-hr average, ppm/b/	0.09/c/	0.09	0.09	0.08
Number of standard excesses		0	0	0
Carbon Monoxide (CO)				
Highest 1-hr average, ppm	20.0/c/	17.0	15.0	14.0
Number of standard excesses		0	0	0
Highest 8-hr average, ppm	9.0/c/	10.0	12.8	9.0
Number of standard excesses		1	1	0
Nitrogen Dioxide (NO_2)				
Highest 1-hr average, ppm	0.25/c/	0.15	0.12	0.14/e/
Number of standard excesses		0	0	0
Sulfur Dioxide (SO_2)				
Highest 24-hr average, ppm	0.05/d,f/	0.01	0.01	0.02
Number of standard excesses		0	0	0
Particulate Matter-10 Micron (PM_{10})				
Highest 24-hr average, ug/m^3 /b/	50/c/	65	117	101
Number of standard excesses /g/		4	5	13
Annual Geometric Mean, ug/m^3	30/c/	21.7	23.1	31.6
Lead				
Highest 30-day average, ug/m^3	1.5/d/	0.10	0.11	0.09
Number of standard excesses		0	0	0

NOTES: NR = Not Recorded; NA = Not Applicable
Underlined values indicate violations of standards.

/a/ CO data were collected at the BAAQMD monitoring station at 939 Ellis Street; all other data were collected at the Arkansas Street station.
/b/ ppm - parts per million; ug/m^3 - micrograms per cubic meter.
/c/ State standard, not to be exceeded.
/d/ State standard, not to be equaled or exceeded.
/e/ Data presented are valid, but incomplete in that an insufficient number of valid data points were collected to meet EPA and/or ARB criteria for representativeness.
/f/ State standard applies at locations where state 1-hour ozone or particulate standards are violated. Federal standard of 365 ug/m^3 applies elsewhere.
/g/ Measured every six days.

SOURCE: California Air Resources Board, *Air Quality Data Summaries*, 1987-1989.

● TABLE D-2: AIR QUALITY SENSITIVE RECEPTORS

<u>Within 1/4 mile of Airport Property Line</u>

Sheltering Pines Convalescent Hospital
Millbrae Serra Convalescent Hospital
Millbrae Nursery School
Residential areas (West of US 101)
Belle Air School (San Bruno)
Lomita Park School (Millbrae)

<u>Within 1/2 mile of Airport Property Line</u>

Residential areas (West of US 101)
Churches
Capuchino High School (San Bruno)
Happy Hall School (Childcare Center - San Bruno)
Saint Dunstan School (Millbrae)

<u>Within 1 mile of Airport Property Line</u>

Churches
Decima M. Allen School (San Bruno)
Edgemont School (San Bruno)
El Crystal School (San Bruno)
City Park (San Bruno)
Glen Oaks School (Millbrae)
Green Hills Country Club
Green Hills School (Millbrae)
Highlands School (Millbrae)
Taylor Jr. High School (Millbrae)
Former Chadbourne School (now vacant, will become senior citizens center/home) (Millbrae)
Mills High School (Millbrae)
Spring Valley School (Millbrae)
Peninsula Hospital
Lincoln School (Burlingame)
Parkside Jr. High School (San Bruno)
City of San Bruno Public Library
Ray Park (Burlingame)
Residential Areas (W. of El Camino Real)

SOURCE: Environmental Science Associates, Inc.

AIRPORTS COMMISSION
SAN FRANCISCO INTERNATIONAL AIRPORT

THE EARTHQUAKE OF 1989

A REPORT ON
SAN FRANCISCO INTERNATIONAL AIRPORT

BY: R.V. WILSON
DIRECTOR
COMMUNITY AFFAIRS

THE EARTHQUAKE OF 1989
A REPORT ON
SAN FRANCISCO INTERNATIONAL AIRPORT

At 5:04 p.m. on Tuesday, October 17, 1989, just about the time the third game of the World Series was scheduled to begin at Candlestick Park, a 7.1 earthquake struck the San Francisco Bay Area. It was a 15 second nightmare everyone knew was inevitable, a monster we would one day have to confront. Even though the quake's epicenter was centered south of San Francisco by some 70 miles, it had devastating effects on our City and our Airport. We had a lucky break, however, as it was still daylight.

The personal experiences of Airport employees during the earthquake are as numerous as the number of employees who experienced the trembler. The terminal buildings twisted and swayed, concrete walls bent and offices and terminal concessions were upset with desk drawers flying open, items on shelves tossed to the ground, bookshelves turned over, pictures hanging askew on the walls and pieces of plaster and ceiling tile and rubble covered the floors. Overhead water lines burst from the stress flooding terminal waiting areas and public lobbies. Amazingly there was little or no panic among the more than 15,000 passengers and employees that were immediately evacuated from the three terminal buildings. Aftershocks were on everyone's mind. Electrical power went off immediately in the terminals and except for emergency lighting everything inside was dark. A quiet sort of eerie sensation came over many of us as Airport police and employees orderly and quietly escorted passengers through a debris strewn terminal to outside center traffic islands, many of them not uttering a sound.

Damage to the South Terminal was minimal with some elongated metal ceiling panels falling. The International Terminal suffered more damage, particularly in the main lobby and the Air Traffic Control Tower. The ticket counter area lost approximately 15% of the ceiling tile and several broken sprinkler lines spewed water onto the marble and terrazzo floor. The water soaked composition ceiling tile and smooth surface of the floor was cause for several people slipping; however, no injuries were reported.

The Air Traffic Control Tower was a different story, however. Being 9 stories up, the highest point on the Airport, the tower suffered severe damage. Almost the entire ceiling including lighting fixtures, insulation and ceiling supports came crashing down onto the controllers and their consoles. A large 1/2" tempered plate glass tower window broke out of its frame and portions of the glass came hurtling inside the tower cab injuring three controllers with cuts severe enough to need medical attention. Some of the control tower's electrical gear fell out of the gaping hole where the window glass once was breaking into pieces on the catwalks below the exterior of the tower cab. Emergency generator power for the tower took over within 10 seconds of the main power failure again restoring power to the tower. The Airport was ordered closed and controllers immediately began diverting inbound aircraft on approach to SFO as well as holding all outbound aircraft from departing. Aircraft were held at their point of origin in various cities throughout the United States or if in route were diverted to other West Coast airports. Even though the tower was electronically functional, it lacked enough controllers to safely operate.

Approximately 500 to 1,000 passengers remained at the Airport overnight awaiting flights with no place to go. When safe to do so, passengers were allowed back into the South Terminal. Many of them slept on the floor in the South Terminal lobby along ticket counters and in the baggage claim areas on cots that were provided by the local American Red Cross. Hotels in the area immediately filled with other passengers. Hotel courtesy vans transported people from the Airport to various hotels. The Amfac and Hyatt Hotels in Burlingame were damaged by the earthquake and guests from those hotels quickly filled the remaining rooms of competitive hotels leaving little room for our remaining passengers. The Airport Hilton opened their vacant rooms as well as the Villa Hotel in San Mateo and the LaQuinta provided accommodations in their ballroom.

While many passengers remained at the Airport overnight, they were given blankets and pillows supplied by some of the airlines and food from the Airport's food concessionaire Marriott Host.

Airport Director Lou Turpen maintained periodic meetings with airline managers and Airport staff throughout the evening and early morning to map strategies and assess damage of various airline, Airport and tenant areas.

The Airport terminals were determined to be structurally sound by Airport engineers and there was no obvious damage to any of the runways. Additional inspection during daylight the next day confirmed there was no runway damage. Damage to the runways was expected because of the liquefaction effects that resulted in structural failure to so many other areas including the Marina District and Oakland Airport runways. It did not occur at SFO.. Underground fuel hydrant systems were reported okay and there were no fuel leaks or spills.

Initially no landings or takeoffs were permitted and the Airport roadways were secured by Airport Police who were only allowing emergency vehicles, necessary Airport employees for cleanup, and the media through. Other terminal traffic was turned away so as not to interject additional problems to an already emergency situation.

The North Terminal took the brunt of damage which was mainly focused in the United Airlines area. Boarding Area "F" suffered major damage with loss of approximately 80% of the ceiling tile, broken fire sprinkler lines spewing thousands of gallons of water onto the furniture and carpets as well as TV flight monitors in several locations toppled from their mountings above public seating areas miraculously hitting no one. Fifteen of United's twenty-two gates were out of service for three and one half days. Four to six inches of water covered most of Boarding Area "F" from gates 76 to 90 making it difficult to traverse and search the area. Carpets became soggy mixed with saturated ceiling tile and moving walkways were flooded. One serious injury occurred at Gate 78 when an airline employee was found under a check-in counter and could not move. The original diagnosis was a broken back or neck and the Airport's Fire Department, Police Department and medical clinic doctor were summoned to her aid. She was transported by Medivac ambulance to Peninsula Hospital.

The evacuation of all three terminals went very smoothly with many passengers and employees directed to the outside center islands and courtyards to await further notice concerning their flights, Airport closure, overnight status and food. Portable emergency lighting was set up by the Fire Department in the courtyards for passenger safety. Medical personnel made frequent trips to the courtyard areas to ascertain if anyone required medical attention.

The Airport's Fire Department responded to many reports of fires, medical requests, natural gas leaks and chemical spills at United Airlines' Maintenance Base. Several firefighters responded off duty to assist Marina District residents, many who were trapped in homes and apartments that had collapsed.

The Airport's sewage treatment facility was surveyed with no apparent damage and the water supply was investigated for contamination.

The Airport's rescue boat was readied for launching in order to provide bay water for firefighting if the domestic water supply should be cut off.

Electrical power was restored by the Airport electricians within 3 hours after the initial shock of the earthquake which definitely aided in the Airport's attempts to begin a major cleanup effort.

Even though the Airport was officially closed, United Airlines received permission and decided to transport 500 of their passengers to Seattle, Washington on two wide body aircraft. Passengers were bused from a remote location and ground loaded onto the aircraft. These passengers were awaiting departure to various parts of the country and would be disbursed through United's Seattle station. United Express had dispatched 40 employees from their Fresno terminal to SFO to aid in the cleanup. British Airways departed their flight to London since most of the passengers were in the process of boarding when the earthquake struck. There was very little air traffic activity in the Bay Area because of damage to SFO, San Jose and Oakland Airports and their respective towers and damage to smaller general aviation airports, such as San Carlos.

Many employees on their way home hearing of the problems at the Airport returned back to help. In fact, some retired employees called in and offered to return to help in any way they could at no cost. Now that's dedication.

The Airport did not receive a lot of media attention as you might expect. The media was focused on the Marina District, the Bay Bridge collapse and Interstate 880's devastation and only a smattering of radio, TV and print media paid any attention to the Airport.

Cleanup activities began as soon as power was restored. Airline and Airport people alike had no lines of demarcation and literally thousands of employees pitched in to help each other restore SFO to operational status in only 13 hours after the initial shock of the earthquake. In fact, the San Mateo Times said it precisely in an article the day following the earthquake in which the reporter wrote "SFO operated magnificently throughout the crisis, and how the building maintenance people got all that ceiling tile swept and hauled away in such short order remains a mystery." Well, it was no mystery but just hard work by a large group of tireless and dedicated employees. The Airport even received letters from passengers who couldn't believe the Airport was restored to operation so quickly.

Exactly 13 hours later at 6:00 a.m. on October 18, 1989, flights officially began again. Initially flights operated at about 50% of schedule since the tower was operating without a window and the noise was extreme. Tower controllers wanted to make sure they could convey and understand all radio transmissions between pilots and controllers. Activity improved the following day when a temporary plexiglass panel was put in to replace the window glass and by Thursday, October 19, 1989, the tower was fully operational. In fact, within 10 days after the earthquake the Airport had a record day with 1,443 operations. Logistically it was a nightmare for the airlines. It took several days to properly schedule flights since aircraft and flight crews had been diverted all over the country and were not where they were supposed to be, in San Francisco.

The terminal areas underwent extensive structural checks by Airport and independent engineers. Emergency contracts were put into force almost immediately to remove remaining ceiling, carpet and begin the task of replacement. The terminals will have the visible cosmetic scars of the quake for months to come but restoration of the damaged areas will have little effect on passengers and airline operations.

Aside from the terminal complex, major damage took place at Cargo Building No. 8 which housed Continental and Mexicana air cargo as well as other smaller offices. Because of the time of the quake, 5:04 p.m., very few people were in the building. Concrete columns supporting the three story structure broke away exposing reinforcing steel allowing the steel to "balloon" from the weight of the upper story. This building was constructed 'prior to' the stringent earthquake standards incorporated today and had limited seismic resistance. This particular building was constructed with techniques very similar to the Cypress Viaduct in the East Bay which so dramatically collapsed. Cargo Building No. 8 has been torn down and will be replaced with a modern structure.

A random survey was taken from the various airlines concerning the passenger loads immediately after the earthquake. Various airlines reported between normal passenger loads and a drop off of 40%. Cargo loads were down between 12 to 14%.

The rapid response to the disaster was not accidental. It pays to be prepared and the Airport was. The Airport's Disaster Preparedness Program worked.

Airports Commission President Morris Bernstein and Airport Director Lou Turpen had high praise for those people involved in the earthquake cleanup as well as safety response and will honor all those employees who so unselfishly gave of their time and energy to restore operations at SFO so quickly. At a gathering on Tuesday, December 12, 1989, a small token of appreciation will be presented to the employees, Airport, airline and tenant alike, who participated in the cleanup effort.

APPENDIX F: HAZARDOUS MATERIALS REGULATORY SETTING

HAZARDOUS MATERIALS REGULATORY SETTING

Laws and regulations govern the management of hazardous materials and wastes at the federal, state and local levels. The Environmental Protection Agency (EPA) is responsible for enforcing laws pertaining to hazardous materials and wastes at the federal level. The primary federal hazardous material and waste laws are contained in the Resource Conservation and Recovery Act of 1976 (RCRA), and the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA and Amendments 1986). These laws require that responsible parties report any known hazardous waste contamination of soil or groundwater to the EPA. (In the San Mateo area, reporting must be to either the California Department of Health Services, the San Francisco Bay Area Regional Water Quality Control Board (RWQCB) or the San Mateo County Department of Health Services, depending on the specific circumstance. Even though the Airport is owned and operated by the City of San Francisco, it is within San Mateo County borders and, therefore, reports to San Mateo Department of Health Services.)

Public Disclosure of Hazardous Materials

CERCLA was amended in 1986 by the Superfund Amendments and Reauthorization Act (SARA), which includes a section requiring public disclosure of information relating to the types and quantities of hazardous materials used at various types of facilities. The section, also called SARA Title III, or the Emergency Planning and Community Right-to-Know Act of 1986 ("right-to-know" law), addresses toxic air contaminant emissions inventories, community emergency planning, emergency release notification and hazardous chemical inventory reporting. SARA Title III includes requirements for making hazardous material safety data sheets (MSDSs) readily available in the workplace; it also mandates community information programs for industries with substantial hazardous material use.

The *Hazardous Materials Release Response Plans and Inventory Law of 1985* (Business Plan Act) requires that any business that handles hazardous materials prepare a business plan, which must include the following:

- details, including floor plans, of the facility and business conducted at the site;
- an inventory of hazardous materials that are handled or stored on the site;
- an emergency response plan; and
- a training program in safety procedures and emergency response for new employees, and an annual refresher course for all employees.

The Business Plan Act also allows an administering agency to require designated businesses to submit a risk management and prevention program (RMPP). An RMPP must include the following:

- a description of each accident involving acutely hazardous material that had occurred on the premises within the previous three years;
- a report detailing the condition of equipment used to handle acutely hazardous elements;
- maintenance and monitoring procedures and controls to minimize the risk of accident;
- a schedule for implementing future response procedures;
- audits, inspections, and record keeping procedures for the RMPP; and
- an identification of personnel at the business who are responsible for carrying out specified RMPP tasks.

The San Mateo County Department of Environmental Health and the Airports Commission at SFIA share responsibilities as the designated local administering agencies for the Business Plan Act. Any business or facility which handles a hazardous material or mixture containing hazardous material which has a quantity equal to or greater than 500 pounds, or total volume of 55 gallons or 200 cubic feet at standard temperature and pressure for a compressed gas, and is not contained solely in a consumer product and pre-packaged for direct distribution to, and used by the general public, is required to complete a Business Plan. Separate from the submission of the Business Plans, the County requires certain businesses handling certain quantities of extremely hazardous materials to prepare a risk management prevention program. The County is responsible for reviewing and approving all Business Plans. In addition, formal inspections are conducted of all facilities storing hazardous materials.

The California Office of Emergency Services assists the county with implementation of the Business Plan Act.

Hazardous Waste Handling Requirements

The federal *Resource Conservation and Recovery Act of 1976* (RCRA) created a federal hazardous waste "cradle to grave" regulatory program that is administered by the U.S. Environmental Protection Agency (EPA). RCRA gives EPA the authority to regulate the generation, transportation, treatment, storage, and disposal of hazardous waste.

RCRA was amended in 1984 by the *Hazardous and Solid Waste Act* (HSWA), which affirmed and extended the "cradle-to-grave" system of regulating hazardous substances. HSWA specifically prohibits the use of certain techniques for the disposal of some hazardous wastes.

RCRA also provides for individual states to implement a RCRA program directly as long as the state program is at least as stringent as federal RCRA requirements. EPA must approve state programs intended to implement federal regulations. In California, EPA has retained RCRA responsibility, but approval of the state program is pending.

The EPA has delegated much of its regulatory authority to the individual states whenever adequate state regulatory programs exist. The Toxic Substance Control Division, California Department of Health Services (DHS) is the agency empowered to enforce federal hazardous materials and waste regulations in California, in conjunction with the EPA.

The California hazardous materials and waste laws incorporate federal standards, but in many respects are stricter. For example, the California *Hazardous Waste Control Law* (HWCL), the state equivalent of RCRA, contains a much broader definition of hazardous materials and wastes. Some substances that are not considered hazardous under federal waste law are under state law. The HWCL allows DHS to adopt regulations governing the generation, transportation, and disposal of hazardous wastes. While the HWCL differs somewhat from RCRA, both laws impose "cradle to grave" regulatory systems for handling hazardous materials in a manner that protects human health and the environment. Regulations implementing the HWCL are generally more stringent than regulations implementing RCRA.

State hazardous materials and waste laws are contained in the California Code of Regulations (CCR), Title 26. Regulations implementing the HWCL list 791 hazardous chemicals and 20 to 30 more common materials that may be hazardous; establish criteria for identifying, packaging and labeling hazardous wastes; prescribe management of hazardous wastes; establish permits for hazardous waste storage, disposal and transportation; and identify hazardous wastes that cannot be disposed of in landfills.

Under both RCRA and the HWCL, hazardous waste manifests must be retained by the generator for a minimum of three years. Hazardous waste manifests list a description of the waste, its intended destination and regulatory information about the waste. A copy of each manifest must be filed with DHS. The generator must match copies of hazardous waste manifests with receipts from the treatment / disposal / recycling facility.

The County of San Mateo Department of Health Services, Office of Environmental Health, is directly involved in the management of hazardous materials and wastes within San Mateo county. Any business in the state that generates hazardous waste needs to be permitted. The County handles the permitting of all hazardous waste generators in the San Mateo County, including the Airport. Hazardous waste generators within the Airport also are required to obtain permits from the Airports Commission. In addition, the San Mateo County Fire Department issues permits for the storage of flammable liquids. The County is also responsible for issuing permits to businesses that store hazardous materials. To ensure compliance with regulatory requirements, the County conducts regular inspections.

Hazardous Material Emergency Response

The state *Hazardous Substance Account Act of 1984* (the state "superfund") was enacted to establish a response authority for releases of hazardous substances, to compensate persons injured by the release of hazardous substances, and to establish funding mechanisms to pay for the cleanup of hazardous waste releases.

The California Office of Emergency Services assists state and local agencies in emergency planning. In emergency situations, the Office of Emergency Services coordinates emergency response.

In the workplace, emergency equipment and supplies, such as fire extinguishers and eye washes, must be kept in accessible places and be checked periodically, according to State Fire Marshal's Office and Occupational Safety and Health Administration (OSHA) requirements. Spill centers must be inventoried and resupplied monthly (as required by OSHA). Fire extinguishers must be inspected and replenished, as necessary, on an annual basis. On a monthly basis, eye washes and safety showers must be checked.

Hazardous Material Worker Safety Requirements

The California Occupational Safety and Health Administration (Cal/OSHA) and the Federal Occupational Safety and Health Administration (OSHA) are the agencies responsible to assure worker safety in the handling and use of chemicals. In California, Cal/OSHA assumes primary responsibility for the enforcement of regulations governing the handling and use of chemicals in the workplace. Cal/OSHA standards are generally more stringent than the Federal "General Duty Codes."

The Federal OSHA has adopted numerous regulations pertaining to labor and worker safety (contained in the *Code of Federal Regulations Title 29 - Labor* [CFR 29]). These regulations specify, under the authority of the Occupational Safety and Health Act of 1970, inspections, citations, penalties, occupational injury reports, and labor agreements and agency standards. The OSHA regulations contain standards relating to hazardous materials handling, including workplace conditions, employee protection requirements, first aid, fire protection, and material handling and storage. Because California has a federally approved OSHA program it must have adopted regulations that are at least as stringent as those found in CFR 29.

Cal/OSHA regulations concerning the use of hazardous materials in the workplace (which are detailed in Title 8 of the California Code of Regulations [CCR]) include requirements for employee safety training, availability of safety equipment, accident and illness prevention programs, hazardous substance exposure warnings, and emergency action and fire prevention plan preparation. Cal/OSHA enforces the hazard communication program regulations, which contain training and information requirements including procedures for labeling, identifying, and communicating hazard information relating to hazardous substances and their handling as well as mandatory availability of Material Safety Data Sheets (MSDSs), and communication plan preparation requirements. These regulations also require preparation of emergency action plans (escape and evacuation procedures, rescue and medical duties, alarm systems, and training in emergency evacuation).

Both federal and state laws require businesses using hazardous materials to provide training to employees working with hazardous materials in chemical work practices and hazardous materials safety. The training must include methods of safe handling of hazardous materials, an explanation of Material Safety Data Sheets (MSDSs), use of emergency response equipment and supplies, and an explanation of the building emergency response plan and procedures.

Chemical safety information must be available. Specific, more detailed training and monitoring is required for the use of carcinogens, lead, asbestos, and other chemicals listed in CFR 29. Conformance with these regulations reduces the risk of accidents, worker health effects, and emissions.

State Fire Code regulations require emergency pre-fire plans to include training programs in the use of first aid fire equipment and methods of evacuation.

The federal *Toxic Substances Control Act* (TSCA) authorized EPA to regulate the production, use, distribution and disposal of chemicals that may present unreasonable risks to public health or the environment. TSCA provides EPA with the authority to ban (or phase out) the use of chemicals, to require record-keeping and reporting of certain information and to conduct premanufacture reviews of potential risks associated with the production of certain chemicals. Two hazardous materials that EPA must regulate under TSCA are a class of chemical substances known as polychlorinated biphenyls (PCBs) and asbestos.

The *Safe Drinking Water and Toxics Enforcement Act (Proposition 65)* requires that a business with 10 or more employees warn its employees and other individuals of any exposures to "significant levels" of state-listed substances that cause cancer, birth defects, and other reproductive harm. In addition, businesses are prohibited from knowingly discharging "significant amounts" of listed substances into water or land where the substance could get into any sources of drinking water.

Water Quality Protection

SFIA lies within the jurisdiction of the San Francisco Bay Regional Water Quality Control Board (RWQCB). The RWQCB is authorized by the State Water Resources Control Board (SWRCB) to enforce the provisions of the state Porter-Cologne Water Quality Control Act of 1969, which incorporates the federal Clean Water Act (1977) and the Federal Water Pollution Control Act (1972). The RWQCB has the authority to require groundwater investigations when the quality of the groundwaters or surface waters of the state have been or could be threatened, and to remediate the site if necessary.

Industrial wastewaters are regulated under many the provisions of the Clean Water Act to ensure that the state water quality standards are achieved. Regulations that affect airports are the National Pollutant Discharge Elimination System (NPDES) program (Section 402), Effluent Limitations (Section 301), National Standards of Performance (Section 306), and Toxic and Pretreatment Effluent Standards (Section 307).

Site Remediation

Remediation of a contaminated site is subject to many of the regulations described above, including CERCLA, RCRA, HWCL, and the state superfund act. These regulations are enforced by the California Department of Health Services and the SWRCB. Site remediation may be subject to regulation by other state or local agencies including the San Mateo County Department of Health Services. For example, if soils containing hazardous materials are excavated, the Bay Area Air Quality Management District may impose specific requirements on such activities to protect ambient air quality from dust or airborne contaminants. If extraction of contaminated groundwater or construction dewatering of a hazardous waste site is required, subsequent discharge of such waters to the storm / sewer collection system or to the publicly owned treatment works is regulated by the RWQCB and the Airports Commission.

Land Disposal Restrictions

The HSWA increased environmental requirements for hazardous waste facilities and restricted the disposal of RCRA-regulated hazardous waste in or on land, including landfills, land treatment areas, waste piles and surface impoundments. Hazardous wastes must meet certain treatment standards that are promulgated by the EPA. Treated or exempted wastes may be land disposed in facilities that meet the design requirements of Subtitle C of RCRA.

California land disposal restrictions are found in Title 22, Section 66900 of the California Code of Regulations. State land disposal treatment standards originate from the Hazardous Waste Management Act (1986) which parallels RCRA in that it also set a May 8, 1990 date for which all land disposal of untreated hazardous waste is banned. In addition, the act addresses the need for criteria for the disposal of solid hazardous waste and prohibits land disposal of liquid hazardous waste and hazardous wastes containing free liquids.

The state Toxic Pits Cleanup Act (1984) banned the discharge of liquid hazardous wastes containing cyanide or PCB's on January 1, 1985. Restricted wastes (wastes containing certain metals, halogenated organics, and especially toxic materials), or liquid hazardous wastes with a pH greater than twelve or less than two were prohibited from land disposal on January 1, 1986. The Act also affected land disposal of liquid hazardous wastes. All surface impoundments were required to be fitted with double linings, leachate collection and groundwater monitoring consistent with the State Water Resources Control Board regulations (Title 23 of the California Code of Regulations) by June 30, 1988 or stop accepting waste by that time. This law has resulted in closure of old ponds and alternative treatment and disposal of liquid hazardous wastes.

Underground Storage Tanks

Federal law and regulations relating to underground storage tanks (USTs) used to store hazardous materials (including petroleum products) require that UST owners and operators register USTs. New federal regulations also require extensive remodeling and upgrading of USTs, including installation of leak detection systems. Tank removal and testing procedures are also specified.

State laws relating to USTs include permit, monitoring, closure, and cleanup requirements. Regulations set forth UST construction and monitoring standards, existing UST monitoring standards, release reporting requirements, and closure requirements.

San Mateo County is designated by the SWRCB to enforce the state Underground Storage Tank (UST) Program. Permitting of underground storage tanks installation and removal is overseen by the San Mateo County Office of Environmental Health and the Airports Commission.

Above-Ground Storage Tanks

Currently, above-ground storage tanks are regulated by local agencies, most commonly the fire department. SFIA operates its own Fire Department that is responsible for the regulation of above-ground storage tanks containing flammable substances at the Airport. The SFIA Fire Department enforces National Fire Protection Association (NFPA) standards and San Francisco Fire Code regulations regarding the storage of flammables in above-ground storage tanks, and includes above-ground storage tanks in its hazardous material storage inspection program.

The Above-ground Petroleum Storage Act (SB 1050) was passed in 1989. This bill requires owners of above-ground petroleum storage tanks to prepare spill prevention control and countermeasure plans, prepare monitoring programs and pay storage fees. The fees will be deposited into the Environmental Protection Trust Fund to be used for specified purposes relating to spills. While the Act focuses on the storage of petroleum, it also requires the State Water Resources Control Board to conduct a study concerning improving the oversight of above-ground storage facilities. This study, due by January 1, 1992, will determine the extent to which above-ground tanks will be subject to a state inspection program.

OSHA also addresses the above-ground storage of hazardous materials. These regulations, found in Title 8, Section 5595 of the California Code of Regulations, establish requirements for drainage, dikes and walls to prevent accidental discharge from endangering employees or facilities.

Polychlorinated Biphenyls (PCBs)

PCBs are organic oils that were formerly used in many pieces of electrical equipment, including transformers and capacitors, primarily as electrical insulators. Years after their widespread and commonplace installation, it was discovered that PCBs cause various human health effects including cancer. PCBs are highly persistent in the environment.

In the early 1980s, EPA banned the use of PCBs in future electrical equipment and began a program to phase out PCB-containing portions of existing equipment. As part of the phase-out program, Pacific Gas & Electric Company (PG&E) has an active program to remove all PCB-containing transformers and replace them with equipment containing nonhazardous materials. Where PCB-containing transformers remain, they must be labeled.

The TSCA, which authorized EPA to regulate the production, use, distribution and disposal of certain chemicals, specifically mandated EPA to regulate PCBs. Title 40, Section 761.00 of the Code of Federal Regulations contains these regulations. The TSCA set dates for the removal of PCB-containing articles. As of October 1, 1985, the use and storage for reuse of PCB transformers (defined as containing 500 ppm PCB or more) that pose an exposure risk to food or feed is prohibited. In addition, the installation of PCB transformers in or near commercial buildings was prohibited. The EPA also required that all PCB transformers must be registered with fire personnel as of December 1, 1985 whether in use or in storage, and be inspected every three months. If a leak is found, the area must be contained to prevent exposure, and the leak must be eliminated.

As of October 1, 1990, the use of network PCB transformers is prohibited and all existing network PCB transformers must be removed. All PCB radical transformers must be equipped with electrical protection to avoid transformer failure due to high or low currents.

Asbestos

Asbestos, a naturally occurring fibrous material, was used as a fireproofing and insulating agent in building construction before such uses were banned by EPA in the 1970s. Asbestos use was eliminated because it was discovered to cause lung diseases in persons exposed to its airborne fibers. It was widely used prior to the discovery of its health effects; therefore, asbestos may be found in walls, ceiling, floors (tile), and building coating materials. The legal definition of asbestos-containing materials includes all construction materials that contain more than 0.1% asbestos by weight.

Inhalation of airborne particulates is the primary mode of asbestos entry into the body, making friable (easily crumbled) materials the greatest health threat. For this reason, it is regulated both as a hazardous air pollutant under the Clean Air Act and as a potential worker safety hazard, under the authority of OSHA. These regulations prohibit emissions of asbestos-related manufacturing, prohibit demolition or construction activities that could disturb asbestos, specify precautions and safe work practices that must be followed to minimize the potential for release of asbestos fibers, and require notice to federal and local governmental agencies prior to beginning renovation or demolition that could disturb asbestos. In the San Francisco Bay Area the agencies with primary responsibility for asbestos safety are the Bay Area Air Quality Management District, Cal/OSHA, Fed/OSHA and the EPA.

- Because the EPA has delegated the enforcement responsibility of all National Environmental Standard Hazardous Air Pollutants (NESHAP) requirements, including asbestos, to the BAAQMD, the BAAQMD is responsible for regulating the removal of friable asbestos of one percent or more. Although it was necessary at one time to notify the EPA of any intentions to demolish buildings, this is no longer required. Instead, BAAQMD must be notified ten days prior to a demolition, regardless of whether or not the buildings are known to contain asbestos. This requirement also applies to the removal of asbestos from areas of at least 100 square or linear feet./1/

- The Asbestos Hazards Emergency Response Act (AHERA) has also given EPA the authority to regulate abatement methods and establish standards for exposure levels during and following abatement activities, but AHERA only applies to public and non-profit private schools (K-12). AHERA spells out accreditation standards for the training of personnel involved in asbestos abatement at these schools, and in November 1992, the EPA is expected to implement regulations recently mandated by Congress that extend the training provisions of AHERA to those working on other public and commercial projects./2/

Some state regulations on asbestos are more stringent than federal regulations. For example, California requires licensing of contractors who conduct abatement activities.

In conformance with the Federal Clean Air Act, the Bay Area Air Quality Management District may require permits for monitoring and containment of asbestos during construction and demolition activities.

Air Toxics

The *Air Toxics "Hot Spots" Information and Assessment Act of 1987* (AB 2588) requires specified facilities to submit to the local air quality control agency a plan to inventory air toxics emissions for a specified list of substances. After the inventory plan is approved, the facility must implement the plan and submit the resulting facility air toxics emission inventory to the agency. In the San Francisco Bay Area, the Bay Area Air Quality Management District (BAAQMD) implements AB 2588. After BAAQMD receives completed emission inventories, it will be required to identify priority facilities for which health risk assessments must be performed.

● NOTES - Hazardous Materials Regulatory Setting

● /1/ Bernardo, Naomi, Air Quality Technician, Bay Area Air Quality Management District, telephone conversation, February 10, 1992.

● /2/ Lanier, Don, Compliance Monitor, Environmental Protection Agency, telephone conversation, February 10, 1992.

TABLE F-1

SAN FRANCISCO INTERNATIONAL AIRPORT

UNDERGROUND TANKS
AIRPORT-OWNED (20) AS OF JANUARY 10, 1991

LOCATION	CAPACITY GALLONS	S.F.I.A. I.D.#	CONTENTS	R.W.Q.C.B. I.D.#	Material	Year Installed
1. Central Pump Station	4,000	1UD	Diesel	38000024230000004	Steel	1969
2. Lomita/Millbrae Pump Station	4,000	2UD	Diesel	38000024230000005	Steel	1969
3. Shuttle Bus Maintenance Base	10,000	3UD	Diesel	38000024230000026	DWFG	1985
4. Shuttle Bus Maintenance Base	550	4UW	Waste Oil	38000024230000027	DWFG	1985
5. Maintenance Base	850	6UW	Waste Oil	38000024230000012	SWFG	1974
6. Maintenance Base	4,000	9UG	Diesel	38000024230000015	SWFG	1974
7. Maintenance Base	10,000	7UG	Unleaded	38000024230000013	SWFG	1974
8. Maintenance Base	6,000	8UG	Leaded	38000024230000014	SWFG	1974
9. Central Plant Fuel Storage Area	40,000	10UF	Diesel	38000024230000016	Steel	1978
10. Central Plant Fuel Storage Area	40,000	11UF	Diesel	38000024230000017	Steel	1978
11. Central Plant Fuel Storage Area	20,000	12UF	Diesel	38000024230000018	SWFG	1976
12. Central Plant Fuel Storage Area	20,000	13UF	Diesel	38000024230000019	SWFG	1976
13. Central Plant Fuel Storage Area	20,000	14UF	Diesel	38000024230000020	SWFG	1976
14. Central Plant Fuel Storage Area	20,000	15UF	Diesel	38000024230000021	SWFG	1976
15. North Terminal	1,000	18UF	Diesel	38000024230000009	*Steel	1990
16. Field Lighting Bldg. Firehouse #2	6,000	20UF	Diesel	38000024230000011	Steel	1954
17. H & I Connector	1,000	19UF	Diesel	38000024230000010	*SFDW	1990
18 Parking Garage	1,000	17UD	Diesel	38000024230000008	*DWFG	1986
19. International Terminal	4,000	16UP	Diesel	38000024230000023	*Steel	1990
20. South Terminal E/End	2,000	21UD	Diesel	—	Steel	1988

Note: SWFG – Single Wall Fiberglass

DWFG – Double Wall Fiberglass

* – Vaulted

SFDW – Steel Fiberglass Double Wall

TABLE F-2

San Francisco International Airport

Airport-owned
Above Ground Storage Tanks

	Location	Capaicty (gallons)	Contents	Age
1.	Treatment Plant	1,200	Diesel	1989 - 1 year
2.	Int'l Terminal	1,000	Diesel	1987 - 3 years
3.	Feild Lighting Building No. 2	4,000	Diesel	1984 - 6 years
4.	Central Plant Garage	1,000	Diesel	1976 - 14 years
5.	Plot 50 B-1 JAL Cargo Facilities	260	Diesel	1980 - 10 years

SAN FRANCISCO INTERNATIONAL AIRPORT
UNDERGROUND TANKS
TENANT OWNED (36)
Revised (12/12/90)

TABLE F-3

TENANT		CAPACITY GALLON	USE	I.D.	MATERIAL	YEAR INSTALLED
1. AMERICAN	1 Superbay Hangar	8,600	Unleaded	AAL-ULG-2	Steel	Unknown
2. AVIS	2 Rent-A-Car Facility	10,000	Unleaded	AVS-4 UG	DWFG	1986
	Rent-A-Car Facility	10,000	Unleaded	AVS-5 UG	DWFG	1986
3. BUDGET	4 Rent-A-Car Facility	12,000	Unleaded	BUD-1 UG	DWFG	1990
	Rent-A-Car Facility	12,000	Unleaded	BUD-2 UG	DWFG	1990
	Rent-A-Car Facility	1,000	Oil Product	BUD-3 UO	DWFG	1990
	Rent-A-Car Facility	6,000	Diesel	BUD-4 UD	DWFG	1990
4. CHEVRON (Gas Station)	4 Gas Station	1,000	Oil Waste	CHV-ULG 4	DWFG	1986
	Gas Station	10,000	Unleaded	UL #6670	DWFG	1986
	Gas Station	10,000	Unleaded	UL #6668	DWFG	1986
	Gas Station	10,000	Leaded	UL #6667	DWFG	1986
5. DOLLAR	1 Rent-A-Car Facility	10,000	Unleaded	DOL-1-UG	DWFG	1990
6. FAA	5 ALS Runway 28R	2,000	Diesel	FAA-1 UD	Steel	Unknown
	Air Traffic Control Tower	2,000	Diesel	FAA-2 UD	Steel	1990
	Glide Slope Runway 28	550	Unleaded	FAA-3 UD	Steel	Unknown
	GWQ Localizer	1,000	Diesel	FAA-4 UD	Steel	Unknown
	Remote Transmitter Receiver	550	Unleaded	FAA-5 UD	Steel	Unknown
7. HERTZ	4 Rental Car Facility	12,000	Unleaded	HRT-ULG 1	DWFG	1986
	Rental Car Facility	12,000	Unleaded	HRT-ULG 2	DWFG	1986
	Rental Car Facility	10,000	Unleaded	HRT-ULG 3	DWFG	1985
	Rental Car Facility	10,000	Diesel	HRT-UD 4	DWFG	1985
8. NATIONAL	5 Rental Car Facility	10,000	Unleaded	NAT-ULG-1	SWFG	1976
	Rental Car Facility	10,000	Unleaded	NAT-ULG-2	SWFG	1976
	Rental Car Facility	10,000	Unleaded	NAT-ULG-3	SWFG	1976
	Rental Car Facility	10,000	Unleaded	NAT-ULG-4	SWFG	1975
	Rental Car Facility	350	Oil Product	NAT-UO-5	Unknown	1976
9. SHELL OIL CO.	1 Shell Satellite II	6,000	Oil Waste	SHL-5 UW	DWFG	1986
10. TWA	1 TWA Maintenance Facility	10,000	Unleaded	TWA-1-UG	DWFG	1984
11. UNITED	6 Bldg. 15 West (Aux. Fuel Tank for Generators)	8,000	Jet Fuel	UAL-MOC-1W	VCS	1982
	Bldg. 51	4,000	Fuel Oil	UAL-MOC-5US	VCS	1969
	Bldg. 56	1,500	Solvent	UAL-MOC-6US	VCS	1971
	Bldg. 84 (Dirty Solvent Tank)	1,000	Solvent	UAL-MOC-7US	VCS	1968
	UAL-MOC (Calibration Fluid Tank-West)	1,200	Calibration Fluid	UAL-MOC-12UO	Carbon Steel	1971
	UAL-MOC (Calibration Fluid Tank-East)	1,200	Calibration Fluid	UAL-MOC-13UO	Carbon Steel	1971
12. PAN AM	2 Pan Am Maintenance Facility	6,800	Waste Oil	PAA-1-UW	Carbon Steel	1963
	Pan Am Maintenance Facility	10,000	Diesel	PAA-2-UF	Unknown	1963

NOTES: DWFG - Double Wall Fiberglas
SWFG - Single Wall Fiberglas
VCS - Vaulted Carbon Steel

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APPENDIX G: TRANSPORTATION

TABLE G-1: VEHICULAR LEVELS OF SERVICE AT SIGNALIZED INTERSECTIONS

Level of Service	Description	Volume/Capacity (v/c) Ratio/a/
A	Level of Service A describes a condition where the approach to an intersection appears quite open and turning movements are made easily. Little or no delay is experienced. No vehicles wait longer than one red traffic signal indication. The traffic operation can generally be described as excellent.	less than 0.60
B	Level of Service B describes a condition where the approach to an intersection is occasionally fully utilized and some delays may be encountered. Many drivers begin to feel somewhat restricted within groups of vehicles. The traffic operation can generally be described as very good.	0.61-0.70
C	Level of Service C describes a condition where the approach to an intersection is often fully utilized and back-ups may occur behind turning vehicles. Most drivers feel somewhat restricted, but not objectionably so. The driver occasionally may have to wait more than one red traffic signal indication. The traffic operation can generally be described as good.	0.71-0.80
D	Level of Service D describes a condition of increasing restriction causing substantial delays and queues of vehicles on approaches to the intersection during short times within the peak period. However, there are enough signal cycles with lower demand such that queues are periodically cleared, thus preventing excessive back-ups. The traffic operation can generally be described as fair.	0.81-0.90
E	Capacity occurs at Level of Service E. It represents the most vehicles that any particular intersection can accommodate. At capacity there may be long queues of vehicles waiting upstream of the intersection and vehicles may be delayed up to several signal cycles. The traffic operation can generally be described as poor.	0.91-1.00
F	Level of Service F represents a jammed condition. Back-ups from locations downstream or on the cross street may restrict or prevent movement of vehicles out of the approach under consideration. Hence, volumes of vehicles passing through the intersection vary from signal cycle to signal cycle. Because of the jammed condition, this volume would be less than capacity.	1.01+

/a/ Capacity is defined as Level of Service E.

SOURCE: Environmental Science Associates, Inc. from *Transportation Research Circular No. 212*, Transportation Research Board, 1980.

TABLE G-2: TRAFFIC LEVELS OF SERVICE FOR FREEWAYS

Level of Service	Description	Volume/Capacity (v/c) Ratio/a/
A	Level of Service A describes a condition of free flow, with low volumes and high speeds. Traffic density is low, with speeds controlled by driver desires, speed limits, and physical roadway conditions. There is little or no restriction in maneuverability due to the presence of other vehicles, and drivers can maintain their desired speeds with little or no delay.	0.00-0.60
B	Level of Service B is in the higher speed range of stable flow, with operating speeds beginning to be restricted somewhat by traffic conditions. Drivers still have reasonable freedom to select their speed and lane of operation. Reductions in speed are not unreasonable, with a low probability of traffic flow being restricted.	0.61-0.70
C	Level of Service C is still in the zone of stable flow, but speeds and maneuverability are more closely controlled by the higher volumes. Most of the drivers are restricted in their freedom to select their own speed, change lanes, or pass. A relatively satisfactory operating speed is still obtained.	0.71-0.80
D	Level of Service D approaches unstable flow, with tolerable operating speeds being maintained though considerably affected by changes in operating conditions. Fluctuations in volume and temporary restrictions to flow may cause substantial drops in operating speeds. Drivers have little freedom to maneuver, and comfort and convenience are low, but conditions can be tolerated for short periods of time.	0.81-0.90
E	Level of Service E cannot be described by speed alone, but represents operations at even lower operating speeds (typically about 30 to 35 mph) than in Level D, with volumes at or near the capacity of the highway. Flow is unstable, and there may be stoppages of momentary duration.	0.91-1.00
F	Level of Service F describes forced flow operation at low speeds (less than 30 mph), in which the freeway acts as storage for queues of vehicles backing up from a restriction downstream. Speeds are reduced substantially and stoppages may occur for short or long periods of time because of downstream congestion. In the extreme, both speed and volume can drop to zero.	1.01+

/a/ Capacity is defined as Level of Service E.

SOURCE: Environmental Science Associates, Inc. from information in the *Highway Capacity Manual*, Special Report 87, Highway Research Board, 1965.

TABLE G-3: VEHICULAR LEVELS OF SERVICE AT UNSIGNALIZED INTERSECTIONS

Level of Service	Description
A	Level of Service A describes a condition where the approach to an intersection appears quite open and turning movements are made easily. Little or no delay is experienced. The traffic operation can generally be described as excellent.
B	Level of Service B describes a condition where the approach to an intersection is occasionally fully used and some delays may be encountered. Many drivers begin to feel somewhat restricted within groups of vehicles. The traffic operation can generally be described as very good.
C	Level of Service C describes a condition where the approach to an intersection is often fully used and back-ups may occur behind turning vehicles. Most drivers feel somewhat restricted, but not objectionably so. The traffic operation can generally be described as good.
D	Level of Service D describes a condition of increasing restriction causing substantial delays and queues of vehicles on approaches to the intersection during short times within the peak period. The traffic operation can generally be described as fair.
E	Capacity occurs at Level of Service E. It represents the most vehicles that any particular intersection can accommodate. At capacity there may be long queues of vehicles waiting up-stream of the intersection and vehicles may experience very long delays. The traffic operation can generally be described as poor.
F	Level of Service F represents a jammed condition. Insufficient gaps of suitable size exist to permit movement of vehicles out of the approach under consideration. Extremely long delays occur, and drivers may select smaller than usual gaps. In such cases, safety may be a problem. This condition usually warrants improvement to the intersection.

SOURCE: Environmental Science Associates, Inc. from *Highway Capacity Manual*, Special Report 209, Transportation Research Board, 1985.

TABLE G-4: CUMULATIVE DEVELOPMENT VEHICLE TRIP GENERATION, A.M. and P.M. PEAK HOURS

			A.M. Peak Hour					P.M. Peak Hour				
Cumulative Development*		Units	Rate In	Rate Out	Trips In	Trips Out	Total Trips	Rate In	Rate Out	Trips In	Trips Out	Total Trips
Burlingame:/a/												
Hotel Rooms	1,325.00	Room	0.35	0.18	464	238	702	0.27	0.22	358	291	649
Restaurants	535.00	KSF	10.70	8.41	5,725	4,499	10,224	10.57	9.37	5,655	5,013	10,668
Office Space	714.00	KSF	1.32	0.20	942	143	1,085	0.23	1.18	164	843	1,007
Hyatt Regency Hotel	791.00	Room	0.35	0.18	277	142	419	0.27	0.22	214	174	388
Millbrae:/b/												
Millbrae Waterfront Park	2.80	Acre	0.30	0.16	1	0	1	0.19	0.36	1	1	2
San Bruno:/c,d,e,f/												
Bayhill 8 Office Space	250.00	KSF	1.55	0.23	387	57	444	0.27	1.43	67	357	424
Bayhill 8 Senior Housing	150.00	DU	0.20	0.55	30	82	112	0.63	0.37	94	55	149
Bayhill 8 Hotel Suites	300.00	Suite	0.28	0.23	84	69	153	0.27	0.31	81	93	174
Tanforan Park	128.30	KSF	0.81	0.81	104	104	208	2.87	2.87	368	368	736
Town Center	109.00	KSF	0.86	0.86	94	94	188	2.21	2.21	241	241	482
94-Unit Motel Suites	94.00	Suite	0.21	0.17	20	16	36	0.14	0.19	13	18	31
US Navy Office Space	107.20	KSF	1.72	0.26	184	28	212	0.31	1.64	33	176	209
US Navy Housing Units	110.00	DU	0.20	0.55	22	60	82	0.63	0.37	69	41	110
South San Francisco:/g,h/												
Marriott Courtyard	152.00	room	0.35	0.18	53	27	80	0.27	0.22	41	33	74
Hampton Inn/i/	140.00	room	0.35	0.18	49	25	74	0.27	0.22	38	31	69

/a/ Monroe, Margaret, City Planner, City of Burlingame, telephone conversation April 27, 1990 and letter to DKS Associates, May 2, 1990. Included in letter: Burlingame Hotel Development as of 10/86 and updated to 7/89; Burlingame Bayfront Specific Area Plan Exhibit M; Northern Bayfront Area Development list of completed projects revised 12/1/89.

/b/ Department of Community Development, City of Millbrae, telephone conversation, April 27, 1990.

/c/ Foscardo, George, Director of Planning and Building, City of San Bruno, telephone conversation, April 27, 1990.

/d/ City of San Bruno, North San Bruno Areawide Traffic Study Final Report, prepared by DKS Associates, December 1986.

/e/ City of San Bruno, Tanforan Park - Proposed Median Break on El Camino Real, prepared by DKS Associates, August 30, 1988.

/f/ City of San Bruno, Bayhill VIII Traffic Study, prepared by DKS Associates, May 17, 1989.

/g/ Cordes, Ken, City of South San Francisco Planning Department, telephone conversation, April 27, 1990.

/h/ City of South San Francisco, "Major Projects in South San Francisco," May 1990.

/i/ The analysis would remain essentially the same with deletion of one project and the addition of another. Carlson, Steve, Senior Planner, City of South San Francisco Planning Department, telephone conversation, March 27 and June 17, 1991. The "Precise Plan" approved for Hampton Inn expired in 1990. A new Genentech project, a 225,000-sq.-ft. research and development building, has subsequently been approved.

* Cumulative development was assumed to be built out by 1996 in Millbrae, San Bruno, and South San Francisco. In Burlingame the Hyatt Regency Hotel and 38 percent of other development was assumed to be built out in 1996.

Note: DU = dwelling units; KSF = thousands of gross square feet of floor area.

SOURCES: ITE and DKS Associates

TABLE G-5: PROJECT TRIP GENERATION 1996 A.M. AND P.M. PEAK HOURS

Name		Units	A.M. Peak Hour Rate In	A.M. Peak Hour Rate Out	A.M. Peak Hour Trips In	A.M. Peak Hour Trips Out	A.M. Peak Hour Total Trips	P.M. Peak Hour Rate In	P.M. Peak Hour Rate Out	P.M. Peak Hour Trips In	P.M. Peak Hour Trips Out	P.M. Peak Hour Total Trips
APM Interim Maint. Facility	60.00	KSF	0.85	0.12	51	7	58	0.13	0.91	8	55	63
Pan Am Maintenance Hangar	100.67	KSF	0.85	0.12	86	12	98	0.13	0.91	13	92	105
Service Station Relocate	0.10	KSF	0.85	0.12	0	0	0	0.13	0.91	0	0	0
New Bldg/Const/Engine Office	5.80	KSF	0.46	0.07	3	0	3	0.08	0.42	0	2	3
Unconstrained Growth A.M.	824.00	Enp	1.10	0.88	904	728	1,632					
Unconstrained Growth P.M.	895.00	Enp						0.950	1.030	856	922	1,772
UAL Catering Facility	46.20	KSF	0.85	0.12	39	6	45	0.13	0.91	6	42	48
UAL Cargo Facility Expand	36.28	KSF	0.85	0.12	31	4	35	0.13	0.91	5	33	38
W. Field Cargo/Maint.	268.70	KSF	0.85	0.12	228	32	260	0.13	0.91	35	245	280
American GSE	7.50	KSF	0.85	0.12	6	1	7	0.13	0.91	1	7	8
E. Field Cargo/Maint.	226.44	KSF	0.85	0.12	192	27	219	0.13	0.91	29	206	235
FBO Facility	1.89	KSF	0.85	0.12	2	0	2	0.13	0.91	0	2	2
N. Field Cargo/Maint.	237.00	KSF	0.85	0.12	201	28	229	0.13	0.91	31	216	247
Multipurpose Facility	5.00	KSF	0.85	0.12	4	1	5	0.13	0.91	1	5	6

SOURCES: ITE, DKS Associates

TABLE G-6: PROJECT TRIP GENERATION 2006 A.M. AND P.M. PEAK HOURS

			A.M. Peak Hour					P.M. Peak Hour				
Name		Units	Rate In	Rate Out	Trips In	Trips Out	Total Trips	Rate In	Rate Out	Trips In	Trips Out	Total Trips
Pan Am Maintenance Hangar	100.67	KSF	0.85	0.12	86	12	98	0.13	0.91	13	92	105
Service Station Relocate	0.10	KSF	0.85	0.12	0	0	0	0.13	0.91	0	0	0
100K Office Building	86.94	KSF	0.46	0.07	40	6	46	0.08	0.42	7	37	43
New Bldg/Const/Engine Office	5.80	KSF	0.46	0.07	3	0	3	0.08	0.42	0	2	3
Unconstrained Growth A.M.	1,428.00	Enp	1.10	0.88	1,567	1,261	2,827					
Unconstrained Growth P.M.Enp	1,552.00	Enp						0.950	1.030	1,474	1,599	3,073
UAL Catering Facility	46.20	KSF	0.85	0.12	39	6	45	0.13	0.91	6	42	48
UAL Cargo Facility Expand	36.28	KSF	0.85	0.12	31	4	35	0.13	0.91	5	33	38
W. Field Cargo/Maint.	268.70	KSF	0.85	0.12	228	32	260	0.13	0.91	35	245	280
American GSE	7.50	KSF	0.85	0.12	6	1	7	0.13	0.91	1	7	8
W. Field Cargo/Maint.	102.00	KSF	0.85	0.12	87	12	99	0.13	0.91	13	93	106
US Post Office	132.00	KSF	0.85	0.12	112	16	128	0.13	0.91	17	120	137
APM Maintenance Facility	60.00	KSF	0.84	0.12	50	7	58	0.12	0.91	7	55	62
E. Field Cargo/Maint.	226.44	KSF	0.85	0.12	192	27	219	0.13	0.91	29	206	235
FBO Facility	1.89	KSF	0.85	0.12	2	0	2	0.13	0.91	0	2	2
N. Field Cargo/Maint.	237.00	KSF	0.85	0.12	201	28	229	0.13	0.91	31	216	247
Multipurpose Facility	5.00	KSF	0.85	0.12	4	1	5	0.13	0.91	1	5	6

SOURCES: ITE, and DKS Associates

OFF-SITE AIR TERMINALS

Technical Aspects

The term "off-airport terminal" encompasses a variety of possible arrangements to get air passengers to (and from) an airport from remote locations. Depending upon the layout of the airport, characteristics of travellers, origins and destinations of travellers, and space available at remote locations, some or all of the following services could be provided:

- Scheduled coach or van express service from a remote location;
- Competitively priced (or free) parking;
- Comfortable waiting area;
- Ticket sales;
- Seat selection; and
- Baggage check-in.

The first three of these are the minimum characteristics of an "off-airport terminal". There is really little difference between this level of service and typical airport express transit service. On the basis of this definition, SFIA already has some level of off-airport terminal capability. The Marin Airporter has the most extensive service. It runs coaches from several locations. The Larkspur Landing location had, until 1991, provided space for airline ticket agents from United and American Airlines to sell tickets, check in bags, and have customers select seats. The basic coach service and one airline ticket agent still remain. Other airporter services to SFIA are described in Section III (Environmental Setting) of the EIR, on pp. 130 - 134.

Issues Affecting Feasibility

The potential effectiveness of diverting auto traffic to the off-Airport operation would depend on a number of factors, including:

- Frequency and reliability of bus or limo service;
- Accessibility of the remote location;
- Adequacy and price of parking, versus Airport parking characteristics;
- Efficiency of check-in services (if any) versus that of the airline terminal service; and
- Density of the market near the off-Airport terminal.

The recent experience of the Marin Airporter at the Larkspur Landing terminal, where ticketing and baggage check services were added to an established airport express transit service, highlights several issues relating to off-airport terminal operation. When ticketing and baggage check-in services were added, the following difficulties arose:

- Since coaches left every half-hour, passengers tended to arrive with about ten minutes to spare. This put a severe burden on the check-in agents who were not adequately equipped to handle such peaking of traffic.

- The ticket service was used mostly as a local ticket office rather than a convenience for same-day airline passengers. There was also a conflict between handling of ticket purchasers who were not flying that day and baggage check-in operations.

- The service did not really attract additional patronage to the Marin Airporter.

Eventually, baggage check-in operations were curtailed, and one of the airlines closed its ticket office.

In the Los Angeles area, the Van Nuys FlyAway Service is operated by the Los Angeles Department of Airports. This is an express bus service from the San Fernando Valley to Los Angeles International Airport which has seven air carriers providing ticketing at the terminal; baggage cannot be checked. This service recently reduced fares from nine dollars to four dollars. Apparently, this reduction did not have an immediate effect on the number of airline passengers using the service; however, airport employees found it to be a convenient service. Recent reports indicate that air passenger service is up.

Potential Effectiveness in Mitigating Airport Traffic Congestion

Additional off-Airport terminal capacity for SFIA would need to accomplish some, or all, of the following:

- Provide additional frequency at existing off-Airport locations;

- Seek out current gaps in off-Airport terminal operation, and encourage new service in this market. This would include opening new terminals and starting new coach services.

- Determine the level of bonus services such as baggage check-in and ticketing that could reasonably be provided, and the potential to attract new riders as a result of this additional service; and

- Identify the level to which users of additional off-Airport terminal services would be diverted from private automobiles, or other transit services.

Caltrans is currently funding a research project at the Institute for Transportation Studies at the University of California at Berkeley, titled: Feasibility Study for a California Off-Airport Terminal Demonstration Program. In part of this research project, air passenger survey data taken by the Metropolitan Transportation Commission (MTC) will be evaluated to determine current gaps in express transportation services to Bay Area airports. Should the results of this research indicate that a potential market for additional off-Airport terminals exists, SFIA would then be in a position to participate in efforts to increase the level of off-Airport terminal activity.

If off-Airport terminal services were initiated successfully, it would have the potential to reduce vehicle congestion at Airport approaches and regional routes to and from the airport. It is impossible to quantify the effects of such actions without a specific service under consideration.

Institutional Feasibility

The San Francisco Airports Commission charter (Section 3.691) prohibits the Airport from offering a transit service to an off-Airport terminal. SFIA cannot operate a transit system in competition with existing ground transportation services. As a result of this prohibition, SFIA has not been able to take advantage of a Caltrans demonstration project relating to off-Airport terminals. Therefore, for SFIA to engage directly in any activity related to implementing an off-Airport terminal would involve an amendment to the Airport's charter.

Alternatively, it might be possible for Caltrans to work with a private operator or an existing transit agency (e.g., SamTrans, AC Transit) to improve transit/off-Airport terminal services to SFIA.

On the basis of available information, it appears that adding off-Airport terminal capacity could reduce automobile travel to the Airport. As noted above, however, the Airport is prohibited by charter from offering, or being involved in such services. If additional services are to be offered, it would have to be the work of private- or public-transit operators. These operators would make decisions on whether to provide additional service, based on the potential profitability of the service.

Off-Airport terminals are part of the transit system to the Airport. Several mitigation measures related to increasing transit mode share are already suggested in the EIR. Any efforts to increase transit mode share would increase the attractiveness to private businesses to expand on or implement new off-Airport terminal services.

APPENDIX H: UTILITIES AND SERVICES

Table H-1: Proposed SFIA Master Plan Improvements to Existing Facility

Table H-2: Existing SFIA Utilities and Miscellaneous Structures, 1989

Table H-3: SFIA Fire Department Apparatus Inventory

TABLE H-1: PROPOSED SFIA MASTER PLAN IMPROVEMENTS TO EXISTING UTILITIES

Proposed Improvements	Which Utility Affected	What Will Happen
North Access Road Improvements	• Water • Sanitary Sewer	Relocation of existing water and sewer mains from adjoining future development parcels.
New Building Construction	• Water	Relocation of existing water mains.
General Aviation Facilities Relocation	• Sanitary Sewer	Additional Sewer Main to Access proposed site Addition of a new lift.
Construction of Boarding Area G	• Sanitary Sewer	Relocation of 18-inch force main to the perimeter of the apron
Construction of Ground Transportation Center	• Sanitary Sewer System	Rerouting of sewer lines to exterior.
	• Industrial Waste Sewer	Rerouting of IWSS lines.
1. Building construction increases runoff	• Drainage	Resizing and relocation of the existing drainage facilities serving the present car rental parking lots.
Construction of East Field Maintenance Hangar	• Industrial Waste • Sewer System	Local system for this area requires the replacement of the current 4-inch diameter main to an 8-inch diameter main and that the local lift station capacity be increased.

(Continued)

TABLE H-1: PROPOSED SFIA MASTER PLAN IMPROVEMENTS TO EXISTING UTILITIES (Continued)

Proposed Improvements	Which Utility Affected	What Will Happen
1. Building construction increases runoff	• Drainage	Resizing of current 42-inch storm drain to 48-inch and relocation into new roadway.
Expansion of Parking Lots D and DD (area currently underserved; expansion will increase drainage)	• Drainage	Addition of 48-inch drain to current 48-inch to increase capacity for current flooding and increased runoff
North and West Field Cargo/Maintenance Facilities	• Drainage	Drainage lines in each of these areas will be relocated to new roadway system

SOURCE: *SFIA Final Draft Master Plan*, 1989

TABLE H-2: EXISTING SFIA UTILITIES AND MISCELLANEOUS STRUCTURES, 1989

61	United Boilerhouse
89	United Water Storage Tank
91	Cold Storage
	<u>Utilities:</u>
14	Electrical Substation
22	Electrical Substation
29	Electrical Substation
37	Electrical Substation
75	Electrical Substation
77	Electrical Substation
78	Main Substation
27	Water Quality Control Plant
87	Water Quality Control Plant
30	Wastewater Pumping Plant
36	Wastewater Pumping Plant
	Industrial Waste Treatment
66	Pump House
85	Pump Station
92	Pump Station
73	Drainage Pumping Plant
74	Drainage Pumping Plant
76	Drainage Pumping Plant
79	Drainage Pumping Plant
	<u>Fueling Bulk Storage:</u>
24	Standard Oil Fuel Farm
25	Pacific SW Trading Fuel Farm
26	Pacific SW Trading Fuel Farm
	<u>Day Storage:</u>
69	Shell Storage Tanks
86	Shell Garage/Warehouse
70	Union Storage Tanks
71	PST Tanks
72	PST Tanks
	<u>Miscellaneous</u>
	Multi-Purpose Harbor Dock
	U.S. Coast Guard
	Ramps
	Pumps
	Fuel Hydrants
	Tank Farm

SOURCES: Table 6.3, *SFIA Final Draft Master Plan*, 1989; Airports Commission, 1990; Environmental Science Associates, 1990.

TABLE H-3

SAN FRANCISCO INTERNATIONAL AIRPORT FIRE DEPARTMENT

- A P P A R A T U S   I N V E N T O R Y -

OPERATIONAL EQUIPMENT

MOBILE #	MANUFACTURER YEAR	WATER GALLONS	FOAM GALLONS	CHEMICAL POUNDS	PUMP GPM	TURRET GPM	HOSE REELS	HOSE	MANNING	COMPANY	STATION
#31	Ford '87	EMT vehicle with all standard first-aid equipment, rescue equipment & tools							0-2	3	1
#36	Ford '73	Tractor towing boat trailer (#54) and 34' Rescue/Fire Boat (#55).									
#37	Oshkosh '80	4000	515	—	1900	1800/900	2-150' 1½"	—	0-2	1	1
#38	Oshkosh '81	4000	515	—	1900	1800/900	2-150' 1½"	—	0-2	2	2
#40	Oshkosh '85	3000	410	500 Halon	1000	1500/750	1-150' 1"	—	0-2	1	1
#41A	Oshkosh '80	3000	410	500 Halon	1000	1500/750	1-150' 1"	—	1-2	2	2
#42A	Ford '85	Fire Commanders Vehicle							1-0		
#43	GMC '77	Vehicle towing 21' 6" Boston Whaler Rescue Boat									
#45	Grumman '81	5000	50	—	1500	—	1-200' 1"	600' 3" 500' 5"	0-1	3	1
#47A	LTI '88 (Quint)	400	30	—	1500	—	1-250' 1"		1-2	3	1
#54	Boat Trailer	Fifth wheel trailer to tow 34' Rescue/Fire Boat.									
#55	Fire Boat '80	34' Rescue/Fire Boat equipped with two (2) full sets of scuba gear, miscellaneous rescue equipment and twenty 20-person rescue platforms.							0-1	1	1

AUXILIARY EQUIPMENT

MOBILE #	MANUFACTURER YEAR	WATER GALLONS	FOAM GALLONS	CHEMICAL POUNDS	PUMP GPM	TURRET GPM	HOSE REELS	HOSE	MANNING	COMPANY	STATION
#32	LaFrance '65	500	50	—	1000	—	2-200' 1"	600' 3" 500' 5"	—	-	-
#39	Oshkosh '81	1500	205	500	1000	750 foam	1-150' 1"	—	—	-	-
#44	Mack '71	75' elevating platform (Aerialscope) with standard ladder complement & special entry/overhaul tools.							—	-	-
#41	Yankee '60	1400	300	—	750	500	1-200' 1"	—	—	-	-

RESCUE EQUIPMENT

Light Units (2)	Each has five (5) fixtures (90,000 lumens each fixture), auxiliary generator, diesel power. Elevates to 10'. Also, two (2) single fixtures on 12' stands.
Foam Trailer	Presently being outfitted - 4000-gallon AFFF.
Hose Trailer	Carries 2500' of 5" hose - portable hydrants & fittings.

DIVISION VEHICLES

# 6	Chevrolet	Operations Officer's vehicle	#33	Ford	Scuba Van
# 7	Plymouth	Fire Chief's vehicle	#46	Pick-up	Safety Officer's vehicle
#30A	Plymouth	Fire Marshal's vehicle			

CONSTANT STAFFING LEVEL - 3-Officers / 14-Firefighters

APPENDIX I: FAA AND *CASP* ALTERNATIVES

SFBAA TASK FORCE RECOMMENDATIONS

Recommendations and assumptions for San Francisco Bay Area air carrier airports from *San Francisco Bay Area Airports Task Force Capacity Study of SFO, SJC and OAK International Airports* (prepared jointly by FAA, Bay Area International Airports Staffs, Air Transport Association, and the Airlines serving the San Francisco Bay Area), 1987:

"The San Francisco Bay Area Airports Capacity Task Force evaluated the operation of each airport and the potential benefits of the proposed improvements in terms of airfield capacity, demand, and delays. When appropriate, it used the airfield simulation model to determine peak period aircraft delays for current and future operations.

The task force annualized the peak period delays to determine the potential economic benefits of the proposed improvements, including different runway use strategies. The annualized delays indicate the efficiency of the existing system and provide a method for comparing the benefits of the proposed changes.

A dollar value was attached to each minute of average annual aircraft delay for both present and proposed operations. This made it possible to make several comparisons to establish the relative benefits, costs, and priorities of each item. These include: annual delay cost associated with each current operation (baseline case); reduction in delay costs from proposed improvements; cost benefit of the delay reduction versus the annualized implementation cost; and a method of prioritizing the proposed improvements based on a ranking of the resultant delay reductions.

The delay reduction proposals for San Francisco, Oakland and San Jose international airports are classified by category: airfield improvements; facilities and equipment (navigational aids); air traffic control procedures; and user improvements. The delay reduction recommendation for each airport listed by category, are shown in Tables I-1, I-2 and I-3. (SFBAA Task Force Study, p. 6)

TABLE I-1: RECOMMENDED ACTION PLAN FOR SAN FRANCISCO INTERNATIONAL AIRPORT

IMPROVEMENTS	Annual Savings/a/ ($ Millions/ Hours, Ths.)	Type of Action/b/	Time Frame/c/	Responsible Group
• Airfield				
1. Create holding areas near R/W 10 L/R, 1R and 28R	---/---/d/	Achievable	Near Term	Airport
2. Improve noise barrier for R/W 1R	$2.6/1.4	Achievable	Near Term	Airport
3. Extend R/W 19L/R	$57.1/31.5	Master Plan	Far Term	Airport
4. Extend R/W 28L/R	$151.7/83.7	Master Plan	Far Term	Airport
5. Construct independent, parallel R/W 28	$67.0/36.9	Master Plan	Far Term	Airport
6. Extend taxiway C to threshold R/W 10L	---/---/d/	Achievable	Near Term	Airport
7. Create high speed exit from R/W 10L between taxiway L and P	---/---/d/	Achievable	Near Term	Airport
8. Extend taxiway T to taxiway B or A	---/---/d/	Achievable	Near Term	Airport
• Air Traffic Control Improvements				
9. Expand visual approach procedure	$7.6/4.2	Achievable	Near Term	FAA
10. Offset instrument approach to R/W 28R	$17.1/9.2	Achievable	Near Term	FAA
11. Use staggered, 1-mile divergent IFR departures on R/W 10L/R	$12.5/6.8	Achievable	Near Term	FAA
• Facilities and Equipment				
12. Install Microwave Landing System (MLS) on R/W 28 and 19	$12.5/6.8	Achievable	Near Term	FAA
• User Improvements				
13. Taxi aircraft across active runways instead of towing	---/---/d/	Achievable	Near Term	Carriers
14. Distribute airline traffic more evenly among three airports	$93.0/53.0	Major Policy	Near Term	Carriers
15. Distribute traffic uniformly within the hour	$11.5/6.2	Major Policy	Near Term	Carriers
16. Divert 50% general aviation aircraft to reliever airports	$17.6/9.5	Major Policy	Near Term	Airport

- Improvements Considered But Not Recommended

1. Construct angled high speed exit for R/W 1: Cost couldn't be justified.
2. Convert taxiways to STOL runways: Not operationally advantageous.
3. Reduce IFR spacing: Not operationally feasible.

TABLE I-2: RECOMMENDED ACTION PLAN FOR SAN JOSE INTERNATIONAL AIRPORT

IMPROVEMENTS	Annual Savings/a/ ($ Millions/ Hours, Ths.)	Type of Action/b/	Time Frame/c/	Responsible Group
• Airfield				
1. Create staging area at R/W 30L/R	---/---/d/	Achievable	Near Term	Airport
2. Extend and upgrade R/W 30R/29	$1.0/1.5	Achievable	Near Term	Airport
3. Create angled exits for R/W 12R	---/---/d/	Achievable	Near Term	Airport
• Facilities and Equipment				
4. Promote use of reliever ILS training facilities	---/---/d/	Achievable	Far Term	FAA
5. Install MLS on R/W 30L	---/---/d/	Achievable		FAA
• Air Traffic Control Improvements				
6. Implement simultaneous departures with Moffett	---/---/d/	Achievable	Near Term	FAA USN

TABLE I-3: RECOMMENDED ACTION PLAN FOR METROPOLITAN OAKLAND INTERNATIONAL AIRPORT

IMPROVEMENTS	Annual Savings/a/ ($ Millions/ Hours, Ths.)	Type of Action/b/	Time Frame/c/	Responsible Group
• Airfield				
1. Construct taxiway from S.E. corner of terminal to R/W 29 approach threshold	---/---/d/	Achievable	Intermediate	Airport
2. Build taxiway parallel to R/W 27L	---/---/d/	Achievable	Intermediate	Airport
3. Add taxiway between north and south complexes	---/---/d/	Achievable	Intermediate	Airport
4. Convert taxiway 1 to air carrier R/W 29 and add parallel taxiway	---/---/d/	Achievable	Intermediate	Airport
5. Enlarge staging pads at entrances to R/W 11/29	---/---/d/	Achievable	Intermediate	Airport
6. Construct additional angled exit off R/W 11	---/---/d/	Achievable	Intermediate	Airport
7. Build penalty box on south side of approach end of R/W 29	---/---/d/	Achievable	Intermediate	Airport
• Facilities and Equipment				
8. Install MLS on R/W 29 and 27	---/---/d/	Achievable	Intermediate	FAA
9. Install a non-directional beacon approach to R/W 29	---/---/d/	Achievable	Intermediate	FAA

NOTE: The task force considers Oakland capacity adequate for forecast levels through 1995. However, it believes the improvements listed above would increase efficiency of aircraft movements on the ground.

NOTES - SFBAA Task Force Capacity Study Tables I-1, I-2 and I-3

/a/ Fiscal year implemented (in 1986 dollars).

/b/ Types of action: Achievable - changes or improvements for which benefits have been clearly identified; on which action may already be underway; and which do not require a major policy change by any of the participating Task Force organizations. Major Policy Change - a change in procedure or operational regulation which requires a major policy revision by one of the Task Force

NOTES - (continued)

organizations. Master Plan Study - a physical change for which the benefits in delay reduction must be evaluated in terms of its environmental and economic consequences by groups outside the task force.

/c/ Time Frame: Near Term - 1991; Intermediate Term - 1996; Far Term - Beyond 1996.

/d/ Savings: Figures not available because improvements were not simulated.

SOURCE (for Tables 1-1, 1-2 & 1-3): San Francisco Area Airports Task Force Capacity Study.

CASP RECOMMENDATIONS

Recommendations and assumptions for San Francisco Bay Area air carrier airports from the *California Aviation System Plan, Draft Report on Action Plan* (July 1989), California Department of Transportation, Division of Aeronautics:

"1990 Conditions

- No air carrier or general aviation operations are redistributed to other airports.

1995 Conditions

- Some air carrier operations are redistributed from San Francisco International to Metropolitan Oakland International and San Jose International Airports.
- Runway extension at San Jose International Airport to provide parallel air carrier runways.

2000 Conditions

- Air carrier operations are redistributed from San Francisco International to Metropolitan Oakland International, San Jose International and a new air carrier airport.
- Air carrier service is added at Travis Air Force Base. There is already an existing joint-use agreement with the military that would permit air carrier operations at Travis Air Force Base.
- Some general aviation operations are relocated from air carrier to general aviation airports.

2005 Conditions

- Air carrier operations are redistributed from San Francisco International to San Jose International, an expanded Metropolitan Oakland International and a new air carrier airport.
- A second air carrier runway is added at Metropolitan Oakland International Airport.

- General aviation operations are relocated from air carrier to general aviation airports. The general aviation activity associated with the recommended plan requires the relocation of a forecast total of 270,000 general aviation aircraft operations and about 600 based aircraft from the three air carrier airports to other airports in the San Francisco Bay Area by 2005.

- The redistribution of air carrier operations results in a requirement for increased passenger terminal capacity over that currently estimated at some airports in the San Francisco Bay Area by 2005.

  The latest information indicates MAP capacities of 12.0 MAP at Metropolitan Oakland International, 51.3 MAP at San Francisco International, 18.0 MAP at San Jose International and 5.0 MAP for joint use of Travis Air Force Base.

  To the extent it is not possible to provide these levels of passenger terminal capacity, then additional air carrier airports will need to be developed or expanded. Alternatively, the redistribution of more smaller and fewer large capacity air carrier aircraft and / or...additional high-performance general aviation turbojet operations need to be relocated from San Francisco International in order to permit additional air carrier operations and utilize the additional passenger terminal capacity by 2005.

- At the Buchanan Field Airport in Concord, air carrier operations are assumed to continue to be limited to small jets and medium and small propeller aircraft. The airport is expected to remain primarily a general aviation airport.

- Because of its remote location from most of the Bay Area, the Sonoma County Airport in Santa Rosa is expected to attract only a relatively small amount of air carrier operations that might be redistributed from the three major Bay Area air carrier airports."

APPENDIX J: SFIA CAPACITY

TABLE J-1: SFIA AVERAGE DAY PEAK MONTH FLIGHTS FORECAST FOR THE PROJECT SHOWING BOTH PROPORTIONAL INCREASES AND CAPACITY CONSTRAINTS (61 PERCENT OF THE TIME)/a/

		1996		2006	
Hour	1990	Proportional Increase/b/	Capacity Constraints/c/	Proportional Increase/b/	Capacity Constraints/c/
0000	19	22	22	24	24
0100	12	14	14	15	15
0200	6	7	7	8	8
0300	3	4	4	4	4
0400	2	2	2	3	3
0500	4	5	5	5	5
0600	28	33	33	36	36
0700	59	69	69	75	75
0800	75	88	88	96	96
0900	80	94	94	102	102
1000	74	87	87	95	95
1100	90	106	103	115	103
1200	94	110	103	120	103
1300	86	101	103	110	103
1400	77	91	99	98	103
1500	77	91	91	98	103
1600	81	95	95	104	103
1700	73	86	86	93	103
1800	69	81	81	88	103
1900	77	91	91	98	100
2000	69	81	81	88	88
2100	71	83	83	91	91
2200	53	60	60	65	65
2300	30	35	35	38	38
TOTAL	1,309	1,536	1,536	1,669	1,669

NOTES

/a/ Under visual flight rules, the airfield capacity at SFIA is 103 total flights (landings plus takeoffs) per hour (61 percent of the time) for a total daily (24-hour period) capacity of 2,472 flights.

/b/ Proportional increase assumes that all flights could take off and land per hour in the same proportions that occured in 1990.

/c/ Capacity constraints assumes that flights would first be scheduled to take off and land in the same proportions per hour as occurred in 1990. This would necessitate delays in some flights to the next hour. In 1996 these delays would be accommodated within the daytime hours. In 2006, these delays would result in an increase of two flights in the evening period and no increase in the nighttime period. Future flights could be spread in such a way as to have the maximum number of flights possible both scheduled to, and in actuality to take off and land during the daytime (7:00 a.m. to 7:00 p.m.) resulting in no increase during the evening hours.

SOURCES: 1990 SFO Tower Daily Traffic Counts; Environmental Science Associates, Inc.

TABLE J-2: SFIA AVERAGE DAY PEAK MONTH FLIGHTS FORECAST FOR THE PROJECT SHOWING BOTH PROPORTIONAL INCREASES AND CAPACITY CONSTRAINTS (25 PERCENT OF THE TIME)/a/

		1996		2006	
Hour	1990	Proportional Increase/b/	Capacity Constraints/c/	Proportional Increase/b/	Capacity Constraints/c/
0000	19	22	22	24	24
0100	12	14	14	15	15
0200	6	7	7	8	8
0300	3	4	4	4	4
0400	2	2	2	3	3
0500	4	5	5	5	5
0600	28	33	33	36	36
0700	59	69	69	75	75
0800	75	88	88	96	96
0900	80	94	94	102	102
1000	74	87	87	95	95
1100	90	106	103	115	103
1200	94	110	90	120	90
1300	86	101	90	110	90
1400	77	91	90	98	90
1500	77	91	90	98	90
1600	81	95	90	104	90
1700	73	86	90	93	90
1800	69	81	90	88	90
1900	77	91	103	98	103
2000	69	81	94	88	103
2100	71	83	83	91	103
2200	53	60	60	65	103
2300	30	35	35	38	61
TOTAL	1,309	1,536	1,536	1,669	1,669

NOTES:

/a/ Under visual flight rules there are occasions (about 25 percent of the time) when the most optimum weather conditions do not occur requiring that alternate runways (28L, 28R instead of 1L, 1R) are used for departures. The airfield capacity at SFIA drops from 103 to 90 total flights (landings plus takeoffs) per hour. During the peak month the times when such weather conditions generally occur are during the peak flight hours (noon to 7:00 p.m.). The table above generally reflects flight delays that would occur assuming these constraints.

/b/ Proportional increase assumes that all flights could take off and land per hour in the same proportions that occurred in 1990.

/c/ Capacity constraints assumes that flights would first be scheduled to take off and land in the same proportion per hour as occurred in 1990. This would necessitate delays in some flights to the next hour. In 1996 these delays would result in an increase of about ten percent more flights in the evening period and no increase in the nighttime period. In 2006, these delays would result in an increase of about 12 percent more flights in the evening period and about 31 percent more flights in the nighttime period.

SOURCES: 1990 SFO Tower Daily Traffic Counts; Environmental Science Associates, Inc.

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