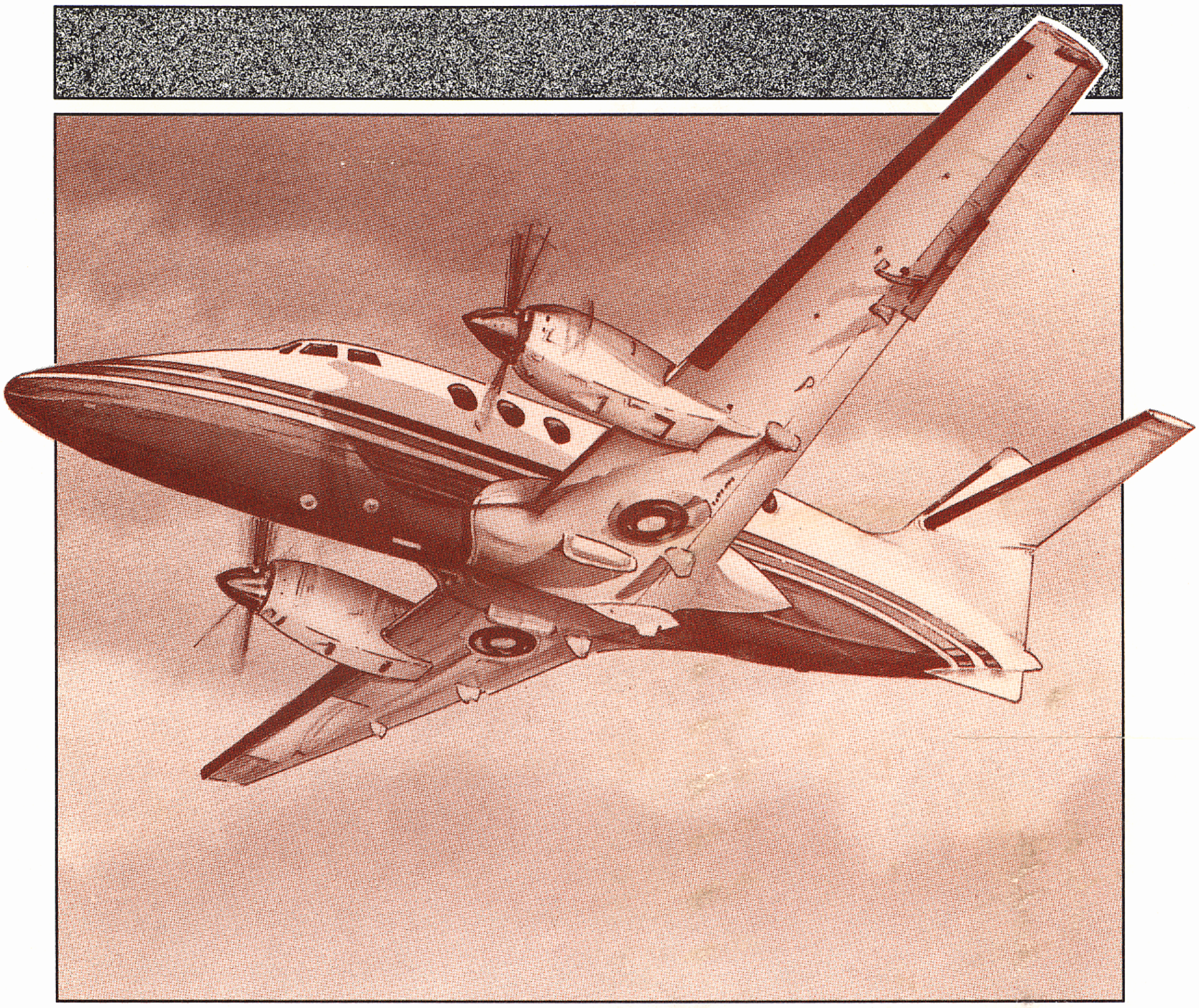
Comprehensive Land Use Plan



Desert Center Airport

Riverside County, California

Prepared for
Riverside County Airport Land Use Commission

DESERT CENTER AIRPORT
Riverside County, California

COMPREHENSIVE LAND USE PLAN

Prepared for

RIVERSIDE COUNTY AIRPORT LAND USE COMMISSION

by

COFFMAN ASSOCIATES

August 1992

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DESERT CENTER AIRPORT
Riverside County, California

Comprehensive Land Use Plan

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Chapter One
INTRODUCTION

Chapter One
INTRODUCTION

Desert Center Airport

1.1 PURPOSE AND SCOPE

The Comprehensive Land Use Plan for Desert Center Airport is intended to protect and promote the safety and welfare of residents of the airport vicinity and users of the airport while ensuring the continued operation of the airport. Specifically, the plan seeks to protect the public from the adverse effects of aircraft noise, to ensure that people and facilities are not concentrated in areas susceptible to aircraft accidents, and to ensure that no structures or activities encroach upon or adversely affect the use of navigable airspace.

Implementation of this plan will promote compatible urban development in the airport vicinity and restrict incompatible development, thus allowing for the continued operation of the airport.

1.2 LEGAL AUTHORITY

The Public Utilities Code of the State of California, Sections 21670 et seq., requires that the County Board of Supervisors establish an Airport Land Use Commission in each county with an airport operated for the benefit of the general public. The Code also sets forth the range of responsibilities, duties, and powers of the Commission.

Section 21675 requires the Airport Land Use Commission to formulate a comprehensive land use plan for the area surrounding each public use airport. The Commission may also formulate a plan for the area surrounding any federal military airport located in the County.

Section 21675 specifies that the comprehensive land use plans shall:

> (a)... provide for the orderly growth of each public airport and the area surrounding the airport within the jurisdiction of the Commission, and will safeguard the general welfare of the inhabitants within the vicinity of the airport and the public in general. The Commission plan shall include a long-range master plan or an airport layout plan ... that reflects the anticipated growth of the airport during at least the next 20 years. In formulating a land use plan, the Commission may develop height restrictions on buildings, specify use of land, and determine building standards, including soundproofing adjacent to airports, within the planning area. The comprehensive land use plan shall be reviewed as often as necessary in order to accomplish its purposes, but shall not be amended more than once in any calendar year.
>
> (b) The Commission may include, within its plan formulated pursuant to subdivision (a), the area within the jurisdiction of the Commission surrounding any federal military airport for all the purposes specified in subdivision (a)...

The Riverside County Airport Land Use Commission was established on December 14, 1970 when the Board of Supervisors acting in conjunction with the mayors of the cities in the county designated the existing five-member aviation commission to assume the planning responsibilities of an Airport Land Use Commission. On August 29, 1972, the Board, in response to the mayors of the cities in the county, added two more members to be appointed from time to time by a selection committee of the mayors.

1.3 FORMAT OF THIS DOCUMENT

This document includes eight chapters and several appendices. It is intended as a complete description of the policies of the Comprehensive Land Use Plan and the basis for the development of those policies.

Chapter Two presents an overview of the airport and its environs and is intended to provide important background information. It includes a description of airport facilities, airport operations and activity, local airspace, existing land use, and local land development regulations and policies.

Chapter Three presents the airport land use compatibility guidelines for Riverside County. Guidelines for noise compatibility, safety, and height are presented. These provide the basis for the airport-specific land use compatibility policies presented in Chapter Seven.

Chapter Four defines the existing and forecast aircraft noise environment at the airport. It describes the impacts of aircraft noise in the local area, describes potential issues of concern, and discusses land use planning and regulatory alternatives.

Chapter Five shows the safety zones at the airport based on the guidelines of Chapter Three. The relationship of the zones to existing land use is discussed. Important planning issues are identified and potential planning and regulatory alternatives are identified.

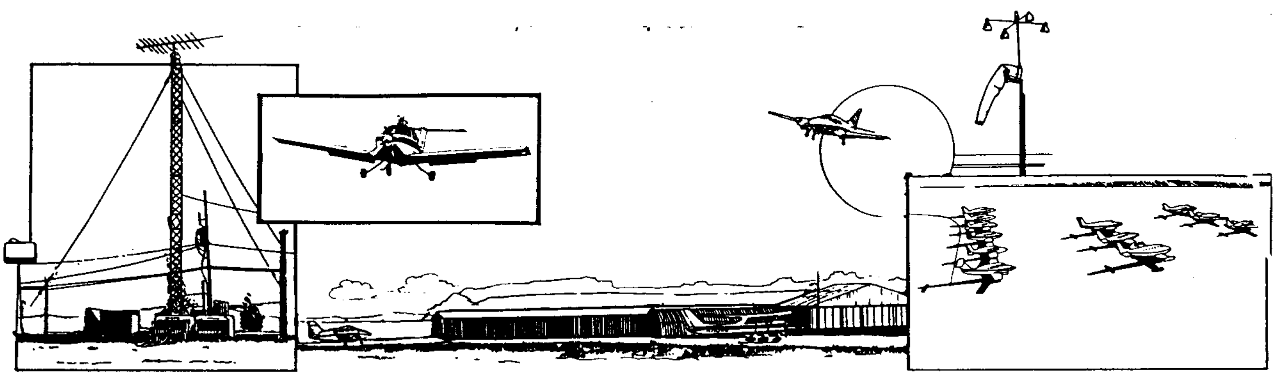
Chapter Six shows the height-influenced area at the airport. The potential impact of local planning and zoning regulations dealing with structure heights is reviewed. Potential land use management issues and alternatives are discussed.

Chapter Seven presents the official Comprehensive Land Use Plan for the airport. This is the core of the document and contains the actual policies which shall be applied in the airport influenced area.

Chapter Eight describes an implementation plan which has been prepared to give guidance to the Airport Land Use Commission and its staff in the administration of the plan. This chapter will also be helpful to local land use regulatory agencies desiring to bring local planning and regulatory documents into conformance with the Comprehensive Airport Land Use Plan.

The appendices present information of general interest related to the development of the Plan. Appendix A presents a forecast of future airport operations at Desert Center. Appendix B reviews scientific research and various state and Federal laws and guidelines related to aircraft noise and land use compatibility. Appendix C reviews safety considerations in the vicinity of airports. Aircraft accident statistics are presented and discussed as are various local, state, and Federal safety compatibility laws and guidelines. Appendix D is a glossary of specialized aviation, acoustic, and land use regulatory terms.

Chapter Two
DESERT CENTER AIRPORT AND ENVIRONS



Chapter Two
DESERT CENTER AIRPORT AND ENVIRONS

Desert Center Airport primarily serves as a general aviation utility airport. Such airports accommodate virtually all general aviation aircraft with maximum gross takeoff weights of 12,500 pounds or less, and some larger aircraft weighing more than 12,500 pounds.

2.1 LOCATION

Desert Center Airport is located in Eastern Riverside County just east of State Highway 177 near the unincorporated communities of Desert Center and Lake Tamarisk. The airport is owned by Riverside County and is operated by the Riverside County Economic Development Agency, Aviation Division. The airport is approximately one mile east of State Highway 177 with access provided by a gravel road.

Desert Center Airport consists of 1,129 acres and has a single runway. One aircraft is currently based at the airport. Annual operations are estimated at 1,500. **Exhibit 2A** illustrates the location of Desert Center Airport in its regional setting.

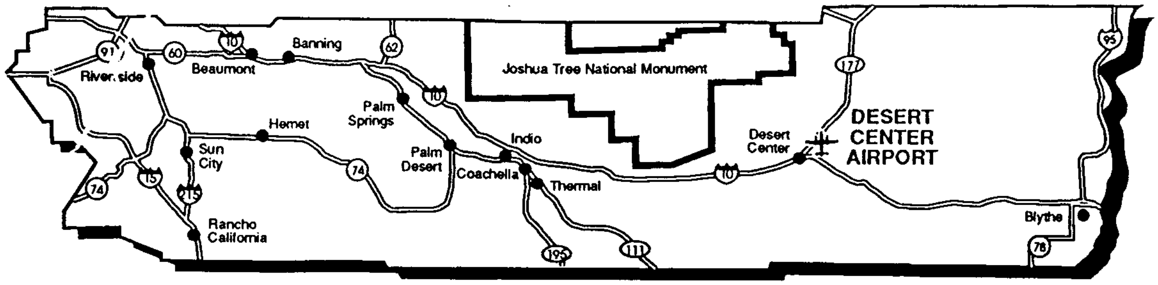


Exhibit 2A
LOCATION

2.2 *AIRPORT FACILITIES*

Airport facilities are classified as either airside or landside. Airside facilities are those that are directly associated with aircraft operations. Runways, taxiways, navigational aids, and airport lighting are examples. Landside facilities primarily consist of terminal buildings, hangars, aircraft parking apron, fuel storage, and auto parking. **Exhibit 2B** illustrates the layout of the existing airport facilities at Desert Center Airport.

2.2.1 RUNWAYS AND TAXIWAYS

Desert Center Airport currently has one runway. Runway 5-23, generally oriented southwest-northeast, is 4,200 feet in length and 50 feet in width. The runway has an asphaltic concrete surface with a rated pavement strength of 45,000 pounds single wheel load (SWL) and 80,000 dual wheel load (DWL). The effective runway gradient is .09 percent rising to the northeast. A a 30-foot wide connecting taxiway links the ramp with southwest end of the runway. **Table 2A** summarizes facility data for Runway 5-23.

TABLE 2A
Runway Facility Data
Desert Center Airport

	Runways	
	5	23
Length (ft.)	4,200	
Width (ft.)	50	
Surface Material	Asphalt	
Effective Runway Gradient	.09	
Load Bearing Capacity by Gear Type		
Single Wheel Load	45,000	
Dual Wheel Load	80,000	
Approach Aids	None	None
Lighting	None	None
Marking	Basic	Basic
Taxiway	Connecting Taxiway to Runway 5 only	

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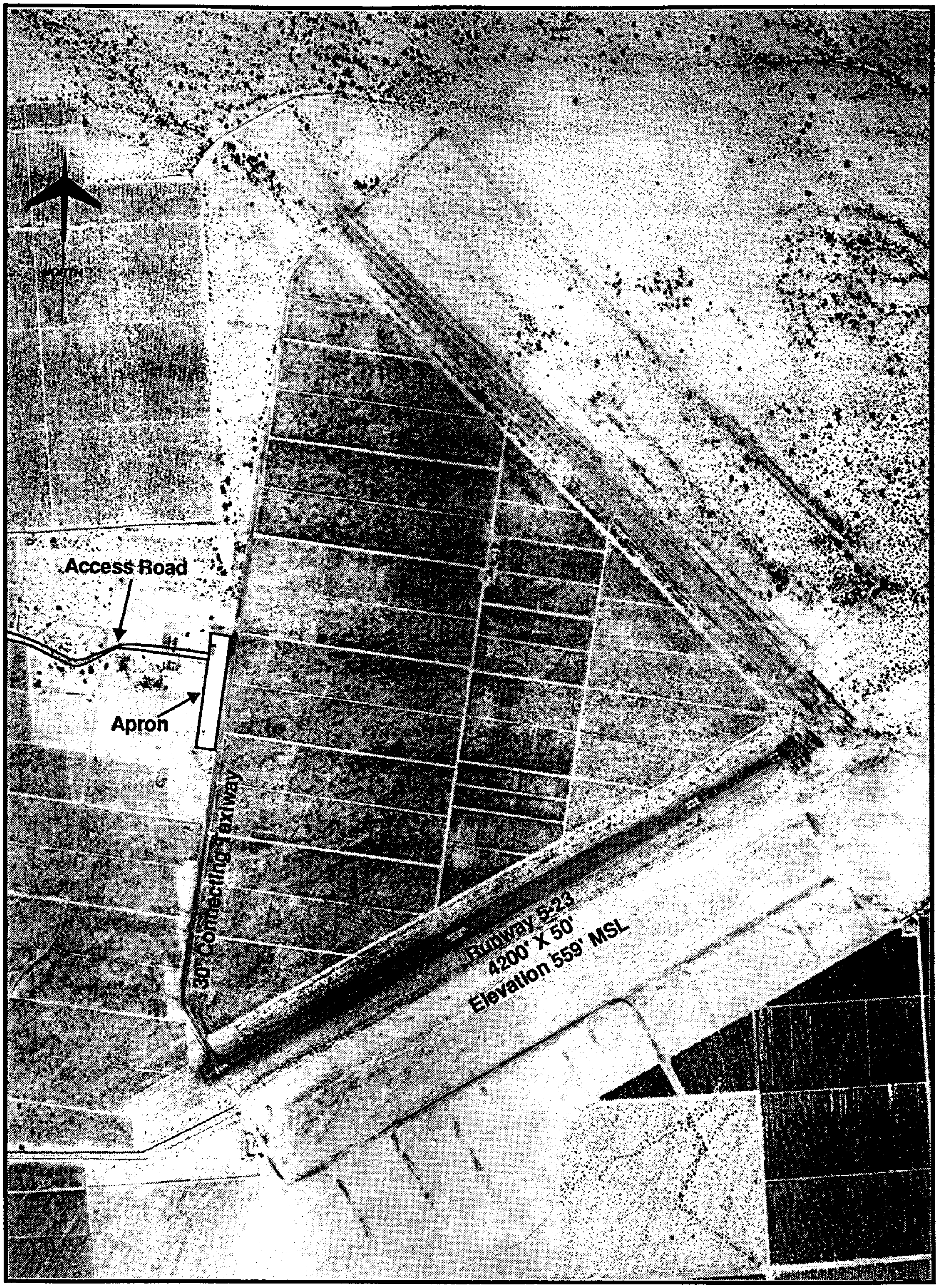


Exhibit 2B
AIRFIELD FACILITIES
DESERT CENTER AIRPORT

2.2.2 INSTRUMENT APPROACHES

Instrument-assisted approaches are defined using electronic and visual navigational aids to assist pilots in landing when visibility is reduced below specified minimums due to poor weather. While these are especially helpful in bad weather, they also promote safety and are often used when visibility is good. Instrument approaches are classified as precision and non-precision. Both provide course guidance. Some types of non-precision approaches also provide runway alignment, while precision approaches provide both runway alignment and glideslope information for the descent.

Currently, Desert Center Airport has no instrument approaches. Approaches to Runways 5 and 23 are visual and have no approach lighting, runway end lighting, or runway edge lighting systems. Therefore, approaches to Desert Center Airport are limited to daytime operations only.

2.2.3 AIRFIELD ACTIVITY AREAS

Exhibit 2B depicts the existing airfield activity areas located to the northwest of Runway 5-23. The aircraft parking apron consists of approximately 16,000 square yards of Portland Cement Concrete. Three aircraft tie-downs are available. There are no conventional hangars or T-hangars available at this time. Likewise, there are no fixed base operator services available at this time.

2.2.4 FUTURE AIRPORT IMPROVEMENTS

There are no significant airport improvements planned for the Desert Center Airport through the planning period.

2.3 AIRSPACE AND AIR TRAFFIC CONTROL

2.3.1 AIRSPACE STRUCTURE

An analysis of airspace is necessary to determine constraints on aircraft operations near the airport, if any, and to determine the influence of airspace on customary air traffic patterns. This could conceivably influence aircraft noise patterns and overflight areas, factors which need to be considered in developing airport land use compatibility policies. **Exhibit 2C** depicts the airspace structure in the Desert Center Airport area.

As shown in this exhibit, airspace for Desert Center Airport is restricted by the various military operations areas (MOAs) and restricted areas which surround the airport to the north and south. These areas are reserved for military use and serve as caution areas for civil aircraft or areas where flight restrictions may be imposed. The nearest of these areas is the Quail MOA 16 nautical miles east of Desert Center Airport.

Los Angeles Air Route Traffic Control Center provides radar services to participating VFR traffic within the Desert Center Airport area. These services include traffic separation, sequencing, and traffic advisories.

Numerous Federal Airways are defined throughout the region. These corridors, defined by radio navigational aids, are often referred to as "highways in the sky". While aircraft are not required to use Federal Airways, they are used by all commercial aircraft and by general aviation aircraft operating on a filed flight plan. Two sets of airways have been defined -- high altitude and low altitude. The high altitude system,

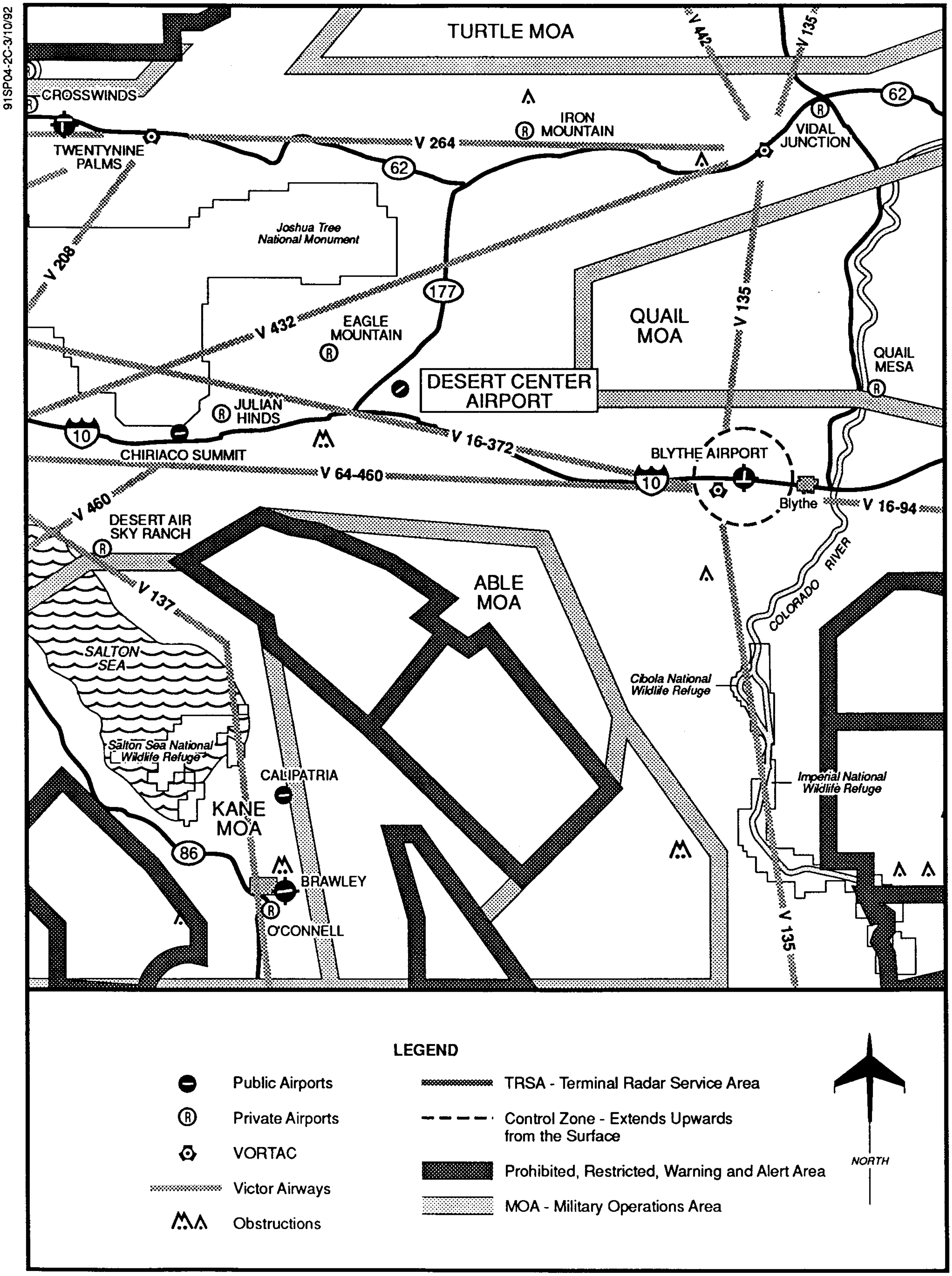


Exhibit 2C
AIRSPACE MAP
DESERT CENTER AIRPORT

known as the jet route system, begins at 18,000 feet above mean sea level (MSL) and is typically used by jet aircraft in enroute flight. The low altitude airways, known as Victor airways, begin at 1,200 feet above the ground (AGL) and extend upward to 18,000 feet MSL. They are four nautical miles wide. Victor airways are used by unpressurized aircraft for enroute travel. Air traffic control personnel often use Victor airways in vectoring aircraft in and out of airports. Victor Airways in the Desert Center area are shown in **Exhibit 2C**.

The Desert Center area also has various national wildlife refuges and national monuments. The takeoff and landing of aircraft within these areas is prohibited, and aircraft are requested to maintain altitudes of at least 2,000 AGL over these areas. The closest of these areas is the Joshua Tree National Monument west of the airport.

2.3.2 ENROUTE NAVIGATIONAL AIDS

Enroute navigational aids (navaids) are established to assist accurate enroute air navigation. These use ground based transmitting facilities and on-board receiving instruments.

There are several enroute navigational facilities in the Desert Center Airport area. Located approximately 30 nautical miles to the east is the Blythe VORTAC; approximately 26 nautical miles to the northwest is the Twenty-Nine Palms VORTAC; and approximately 42 nautical miles to the southwest is the Thermal VORTAC. These navigational aids can be used to guide the pilot to the Desert Center Airport. The VOR operates on a VHF frequency and the TACAN operates on a UHF frequency. The VOR provides course guidance to aircraft by means of a VHF radio frequency. The acronym "VOR" stands for Very High Frequency Omnidirectional Range. The TACAN (Tactical Navigation), primarily a military-oriented facility, provides both course guidance and line-of-sight distance measurement from a UHF transmitter.

2.3.3 NEIGHBORING AIRPORTS

Exhibit 2C shows major airports in the Desert Center area. Public use airports with paved runways within 40 nautical miles of Desert Center are described below.

Blythe Airport - Located 31 nautical miles east of Desert Center Airport, this Riverside County airport has two runways. The primary runway, 8-26, is 6,562 feet in length and 150 feet in width. The crosswind runway, 17-35, is 5,820 feet in length and 150 feet in width. A non-precision approach is available to Runway 26.

Calipatria Municipal Airport - Located 38 nautical miles southwest of Desert Center Airport is Calipatria Municipal Airport. This city airport has one runway, 8-26, generally oriented in an east-west direction. Runway 8-26 is 3,440 feet in length by 50 feet in width. It has no instrument approaches.

Chiriaco Summit Airport - Located 20 nautical miles southwest of Desert Center Airport, this Riverside County airport has one southwest-northeast runway (6-24) measuring 4,600 feet in length by 50 feet in width. It has no instrument approaches.

Twenty-Nine Palms Airport - Located 38 nautical miles to the northwest is Twenty-Nine Palms Airport with a two runway system. The primary runway, 8-26, is 5,531 feet in length by 47 feet in width. The crosswind runway, 17-35, is 3,800 feet in length by 50 feet in width. A non-precision approach is available to Runway 26.

2.3.4 CUSTOMARY FLIGHT PROCEDURES AT UNTOWERED AIRPORTS

The **Airmen's Information Manual (A.I.M.)** recommends a number of flight procedures for pilots to use when operating at an airport without an air traffic control tower, such as Desert Center Airport. Before taxiing for an outbound flight or when within 10 miles of an airport for an inbound flight, a pilot should communicate his/her intentions and obtain airport/traffic information in one of three ways: by communicating with a Flight Service Station, a UNICOM operator, or by making a self-announce broadcast on a common traffic advisory frequency (CTAF) as published in the **Airport/Facility Directory**.

A segmented circle visual indicator system, if installed, is designed to provide traffic pattern information for untowered airports. If there is no segmented circle, traffic pattern indicators may be installed on or near the end of the runway. Unless a traffic pattern indicator indicates otherwise, all turns must be made to the left following a normal left traffic pattern. While in the pattern, aircraft should maintain a pattern altitude of 1,000 feet above ground level (AGL), unless a different altitude has been established for the airport. At Desert Center, a standard left pattern is observed. The published pattern altitude is 1,000 feet AGL.

2.4 AIR TRAFFIC ACTIVITY

2.4.1 HISTORIC AND FORECAST BASED AIRCRAFT

Forecasts for based aircraft begin with an examination of available historical data and determination of past growth trends within the airport's service area. Historical data on based aircraft at Desert Center Airport is somewhat incomplete, however, information from past FAA 5010 Forms was compiled for the time period 1980 to 1991. Historically, based aircraft at Desert Center Airport have ranged from a high of 5 in 1980 to a low of 0 in 1988 through 1990. In 1991, one aircraft was based at the airport.

Appendix A explains in detail the methodologies used in forecasting based aircraft at Desert Center Airport. A market share analysis was used to project based aircraft through the year 2015. **Table 2B** depicts historic and forecast based aircraft for Desert Center Airport through the planning period. Also shown on this table are the based aircraft forecasts for Desert Center Airport as projected in the California Aviation System Plan and the Southern California Association of Governments General Aviation System Study. The forecast shows based aircraft at Desert Center increasing slightly during the planning period to three aircraft in 2015.

TABLE 2B
Historic and Forecast Based Aircraft
Desert Center Airport

Year	Based Aircraft	California Aviation System Plan Forecast[1]	SCAG General Aviation Systems Study[2]
1980	5	--	--
1981	NA	--	--
1982	NA	--	--
1983	3	--	--
1984	4	--	--
1985	3	--	--
1986	2	--	--
1987	NA	--	--
1988	0	--	--
1989	0	--	--
1990	0	2[1]	--
1991	1	--	--
Forecast			
1995	1	2	--
2000	2	2	--
2005	2	2	3
2010	3	--	--
2015	3	--	--

Notes: [1]California Aviation System Plan, Forecasts Element, prepared July 1989.
[2]Southern California Association of Governments, General Aviation Systems Study, Phase II, December 1987.

Source: Historical data from FAA 5010 Forms and California Public Use Airport Inventory Forms.

2.4.2 HISTORIC AND FORECAST OPERATIONS

Aircraft operations at Desert Center Airport have not been accurately counted because of the lack of an air traffic control tower. However, estimates of aircraft operations contained in the FAA 5010 Forms and the California Public Use Airport Inventory Forms were used to evaluate historical data for Desert Center Airport. These sources indicate average annual general aviation operations at Desert Center Airport ranging from a high of 3,000 in 1983 to 1986 to a low of 1,500 in 1988 to 1991. This information is depicted in **Table 2C**.

TABLE 2C
Historic and Forecast Operations
Desert Center Airport

Year	General Aviation Local	General Aviation Itinerant	Total
1980	1,000	500	1,500
1981	NA	NA	NA
1982	NA	NA	NA
1983	1,500	1,500	3,000
1984	1,500	1,500	3,000
1985	1,500	1,500	3,000
1986	1,500	1,500	3,000
1987	NA	NA	NA
1988	0	1,500	1,500
1989	0	1,500	1,500
1990	0	1,500	1,500
1991	0	1,500	1,500
Forecast			
1995	800	800	1,600
2000	900	850	1,750
2005	1,000	900	1,900
2010	1,100	1,100	2,100
2015	1,200	1,100	2,300

Source: Historical data from FAA 5010 Forms and California Public Use Inventory Forms.

As shown in this table, it appears that annual operations at Desert Center Airport decreased by 50 percent between 1986 and 1988. This drop may be misleading as there is no known reason why operations would decrease so drastically in this particular period at Desert Center Airport. Rather, the decrease in operations shown for 1988 may reflect a more gradual decrease in annual operations over a several years. It is possible that the cumulative effect of these changes was not recorded until 1988.

Historically, total general aviation operations at Desert Center Airport have been estimated as being evenly split between local and itinerant operations. Again, because there is no air traffic control tower, these figures are only rough estimates.

Ratios of aircraft operations to based aircraft were determined and used to project future general aviation operations. Based upon FAA forecasts for general aviation operations nationally, the ratio of aircraft operations to based aircraft can be expected to increase in the future. The current 50/50 split of local to itinerant operations was forecast to be maintained through the planning period. **Table 2C** depicts general aviation operations forecast for Desert Center Airport through the year 2015. Operations are expected to increase gradually from 1,500 in 1991 to 2,300 in 2015.

2.5 LAND USE IN AIRPORT VICINITY

2.5.1 EXISTING LAND USE

Exhibit 2D shows existing land use in the Desert Center Airport vicinity. The map was based on existing land use maps for the area, a field survey made by the consultant, aerial photographs, and miscellaneous maps of the local area.

The land use categories shown on the map were selected to conveniently fit the requirements of noise and land use compatibility planning. The "residential" category includes duplexes and conventionally built single-family homes. It also includes apartment and condominium complexes with three or more units per structure and manufactured homes and mobile homes in mobile home parks.

The "commercial, industrial, institutional" category includes all businesses, offices, industrial uses, utilities, transportation, and institutional uses that are not sensitive to noise. Examples of institutional uses that are tolerant of noise include sewage and water treatment plants, municipal and county offices, and street and highway department equipment yards.

The "undeveloped" category includes vacant lots, farmland, open spaces, desert areas, and woodlands not dedicated as park or preservation land.

There were no noise-sensitive institutions identified in the study area. These would include schools, churches, hospitals, and group quarters. There were also no "park and open space" areas such as public parks, golf courses, cemeteries, and nature preserves.

Most land in the study area is undeveloped. Several single-family houses, including several mobile homes, are scattered to the north and west of the airport study area. Some commercial uses occur along State Highway 177.

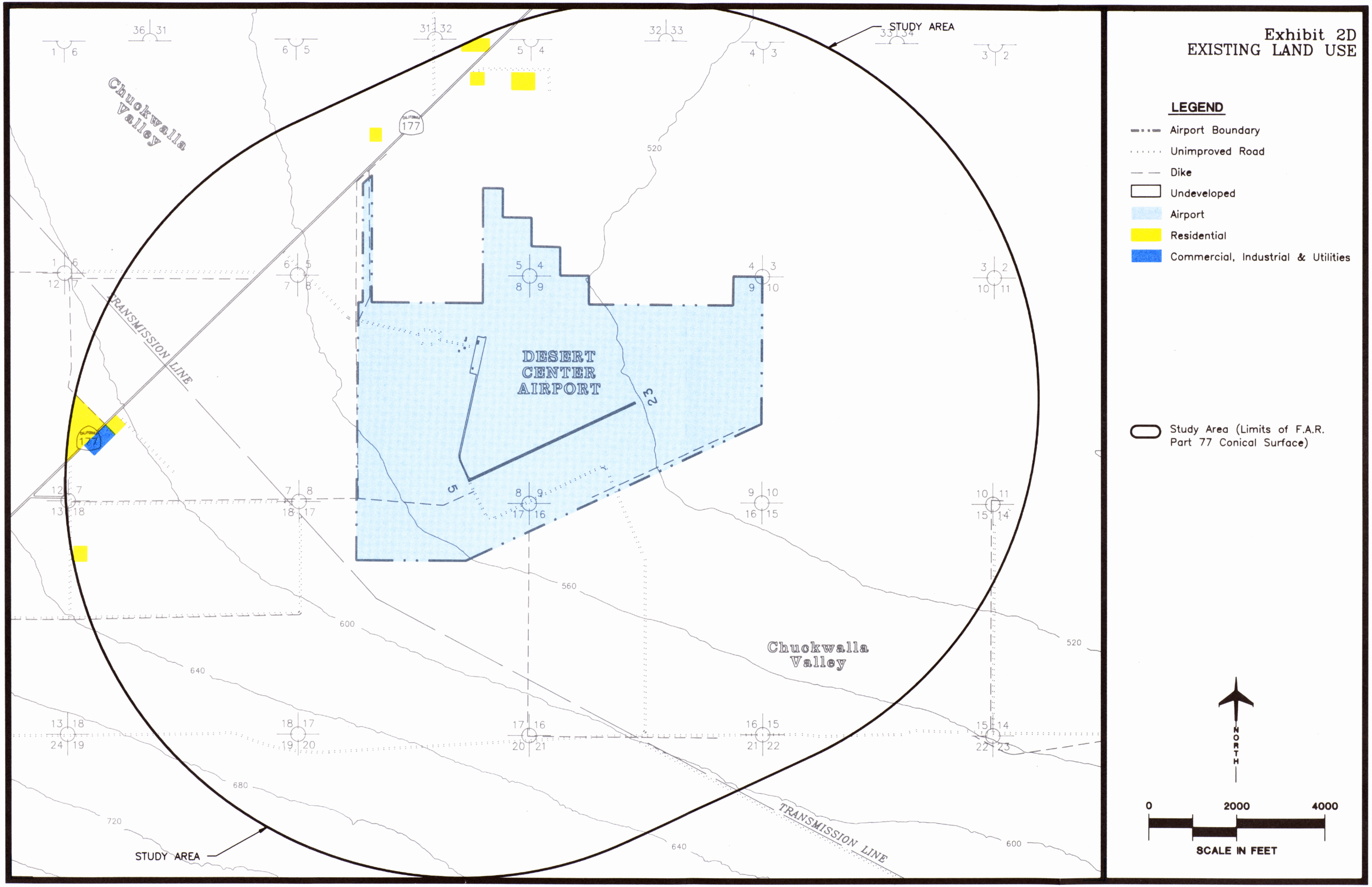
Two larger concentrations of development are just beyond the study area. To the southwest, north of Interstate Highway 10, is the unincorporated community of Desert Center. In 1990, it had an estimated population of 38. On the west side of State Highway 177 is the unincorporated community of Lake Tamarisk, with an estimated 1990 population of 547.

There are no known structures within the study area on the National Register of Historic Places.

2.5.2 LOCAL LAND USE POLICIES AND CONTROLS

In California, the chief local land use planning document is the city or county general plan. General plans set forth the major land use policies of the jurisdiction and

Exhibit 2D
EXISTING LAND USE



include maps of preferred future land uses and descriptions of general development and environmental protection standards.

On a day to day basis, local land use is regulated by the zoning, subdivision, and building codes. The zoning ordinance regulates the types of uses, building height, bulk, and density permitted in various areas. It must be based on the general plan. Subdivision regulations govern the platting of land, setting standards for site improvements. Building codes regulate the construction of buildings.

California law also provides for another type of land use regulation in the vicinity of public airports. The law requires counties with public airports to establish airport land use commissions (ALUCs). The role of the ALUCs is to adopt comprehensive land use plans for the areas around each airport to protect the safety and welfare of people near the airports and to promote the continued operation of the airports.

Each type of land use regulation is reviewed in this section.

2.5.2.a Airport Land Use Commission

The Riverside County Airport Land Use Commission was established in 1970. Under California law (Public Utilities Code Chapter 4, Article 3.5, Section 21670 et seq.), ALUCs are required to develop comprehensive land use plans for public use airports in the county. The ALUC is authorized to review proposed development actions to ensure consistency with the Comprehensive Land Use Plan.

Local general plans and specific plans should be consistent with the ALUC's Comprehensive Land Use Plans. Where the local agencies have amended their general and specific plans to be consistent with the Comprehensive Land Use Plan, then only general plan and specific plan amendments, new specific plan proposals, or zoning ordinance and building regulation proposals need to be referred to the ALUC for review.

Where the local general plans or specific plans are not consistent with the Airport Comprehensive Land Use Plan, State law enables the ALUC to require the local agencies to submit all development actions, regulations, and permits to the ALUC for review.

If the ALUC finds that local general plans or any development actions which it reviews do not comply with the Comprehensive Land Use Plan for the airport, it must notify the local agency. The local agency may overrule the ALUC after holding a public hearing and after making specific findings that the existing plans or proposals are compatible with the purposes of the aeronautics law. A two-thirds majority vote of the governing body is required.

In 1984, the Riverside County ALUC adopted an airport land use plan for the County. This was a framework document setting overall land use policies for all public use airports where final airport-influenced area boundaries had not yet been established. (At that time, final boundaries had been set only for Palm Springs Municipal Airport and Hemet-Ryan Airport.)

The 1984 plan established four kinds of regulatory areas, summarized in **Table 2D.** Areas I, II, and III are safety-related. Land uses are restricted in Areas I and II which are considered areas of significant safety concern. Area III is basically defined as the outer boundary of Areas I, II, and the 60 CNEL noise contours. In Area III, avigation easements are required for new development. Within the 60 CNEL noise contour, new residential development is to be discouraged. Where new housing is permitted, it is to be soundproofed to achieve an interior noise level of 45 CNEL.

TABLE 2D
Riverside County Airport Land Use Plan, 1984
Summary of Provisions

Regulatory Area	Basis For Boundary	Land Use Regulations
Area I	F.A.R. Part 77 approach surface.[1]	No high risk land uses.[2]
Area II	Areas of significant safety concern - subject to frequent turning, maneuvering, etc.	Minimum lot size for residential - 2 1/2 ac.
Area III	Airport influenced area based on type of airport, aircraft, flight patterns, noise levels, F.A.R. Part 77 surfaces.	Avigation easements required for all land uses.
CNEL Noise Contours	Define through noise analysis.	Discourage housing within 60 CNEL contour. Where housing is permitted, soundproof to achieve average interior sound level of 45 CNEL.

[1]F.A.R. Part 77 is a Federal aviation regulation which defines imaginary surfaces around airports for the purpose of height protection. Objects penetrating the surfaces may be considered obstructions to safe air navigation. The Part 77 "approach surface" is a fan-shaped area extending off the runway end.

[2]High risk land uses include those with high concentrations of people, those with flammable or explosive materials, or critical facilities. Examples include auditoriums, churches, schools, restaurants, hotels, large retail stores, residences, gas stations and fuel storage, hospitals, and communications facilities.

2.5.2.b General Plans

California state law requires that all cities and counties in the state shall prepare comprehensive, long-range general plans which direct the development of the community. The Desert Center Study Area is covered by the Riverside Comprehensive General Plan, adopted in March of 1984 and amended several times since then. The Desert Center area is in the Chuckwalla Land Use Planning Area. While the General Plan text has two land use policies related to future development in the Desert Center and Lake Tamarisk communities, they do not relate to the area in the immediate airport environs. (See **Comprehensive Plan**, 4th Edition, 1989, p. 98.)

All of the study area is designated as open space and conservation area in the General Plan. Two land use categories are shown in the area on the County's Open Space and Conservation Map. The airport and all abutting land is designated as "Agriculture". Other areas on the east and south side of the study area are designated as "Desert Areas". See **Exhibit 2E**.

The Comprehensive General Plan sets three broad objectives for all open space and conservation areas:

1. Open space which will protect County environmental resources and maximize public health and safety in areas where significant environmental hazards exist shall be preserved and maintained.

2. Open space considerations shall be incorporated into urban developments in order to enhance recreational opportunities and project aesthetics.

3. The utilization of natural resources including soil, water, vegetation, air,

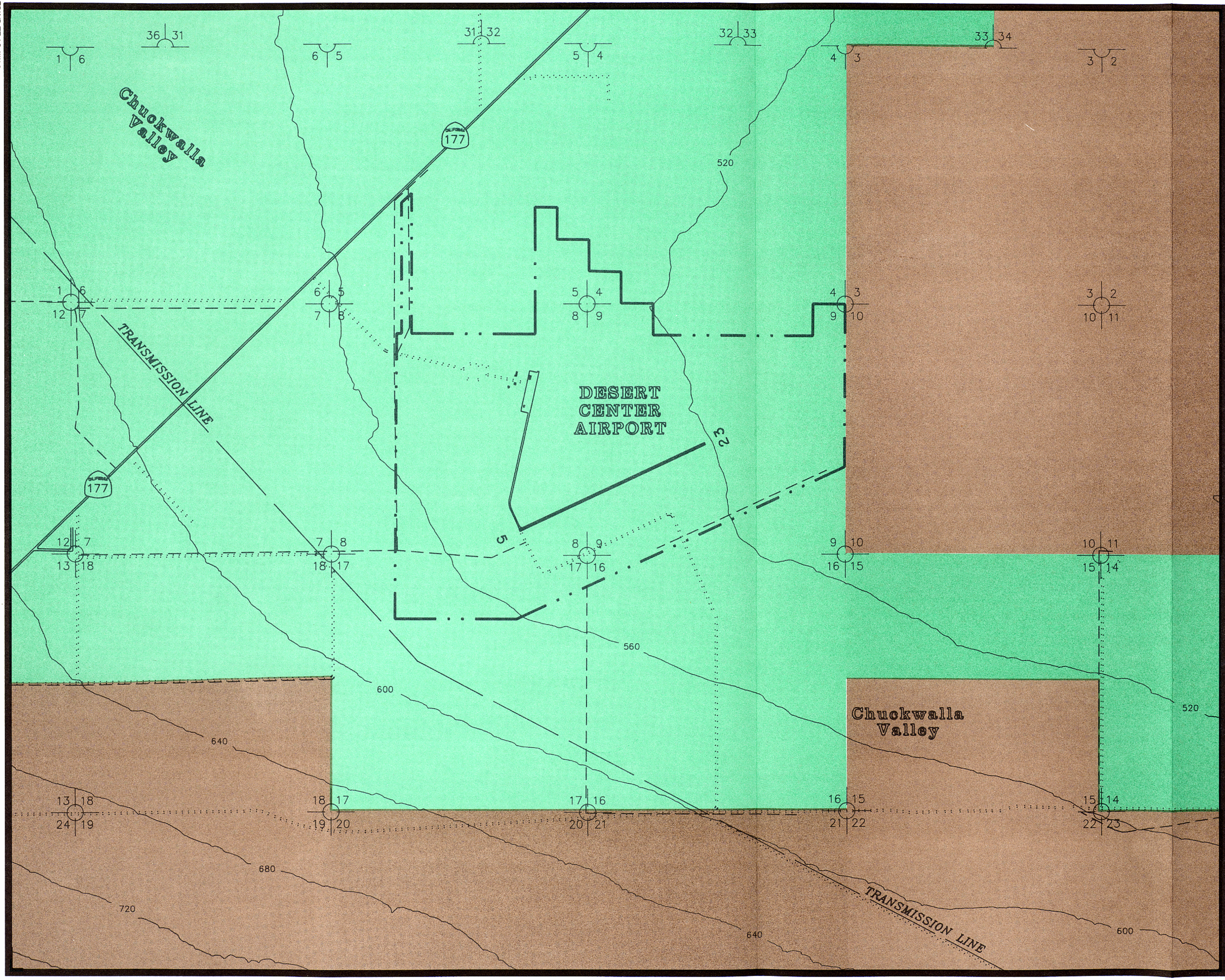


Exhibit 2E
RIVERSIDE COUNTY
GENERAL PLAN

LEGEND

- Airport Boundary
- Unimproved Road
- DIKE
- Agriculture
- Desert Areas

Source: Riverside County Comprehensive General Plan, 4th Edition, 1989, Open Space and Conservation Map.

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wildlife, and mineral resources shall be carefully controlled and managed. (See **Riverside County Comprehensive General Plan**, 4th Edition, 1989, p. 367.)

Policies for permitted land uses in each open space category are defined in the General Plan (pp. 369 - 375):

<u>Agriculture</u> - agriculture and associated uses (including limited commercial, industrial, and single-family residential); open space; farm labor housing; landfills; compatible resource development and associated uses; governmental uses. Minimum lot size: 10 acres.

<u>Desert Areas</u> - open space; limited recreational uses; limited single-family residential (1 dwelling per lot); landfills; compatible resource development and associated uses; governmental uses. Minimum lot size: Generally 10 acres.

2.5.2.c Zoning Ordinances and Specific Plans

Zoning ordinances are important in airport compatibility planning because they control the type and intensity of land uses in an area. The Desert Center Airport Study Area is under the zoning authority of Riverside County.

The Riverside County Land Use Ordinance is administered by the County Planning Director. The ordinance requires the issuance of zoning permits certifying zoning compliance before building permits can be issued. Some uses require approval of a plot plan before a building permit can be issued. This plot plan can be approved by the Planning Director if a public hearing is not required for the proposed use. If a public hearing is required, the plot plan must be approved by the Planning Commission or the East Area Planning Council. These planning bodies are also responsible for making zoning map or text changes, approving variances to the regulations, or approving a conditional use or public use permit. Decisions of these bodies may be appealed to the Riverside County Board of Supervisors.

The Riverside County Land Use Ordinance establishes 36 zoning districts: 14 residential districts, 5 commercial districts, 6 industrial districts, 4 agricultural districts, and 7 special districts. The district provisions of Riverside County Land Use Ordinance, as they apply to airport compatibility planning, are summarized in Table 2E. Permitted uses include those allowed in the district as a matter of right and without special review and approval. Conditional uses require review and approval from the Planning Commission or East Area Planning Council. Only noise-sensitive land uses are listed in the table.

The table shows the minimum required lot size per dwelling in each zoning district. However, for some of the county agricultural districts (A-1, A-2, and W-2), a larger minimum lot area may be specified for a particular use or area.

The County Land Use Ordinance also limits maximum building heights in each zoning district as shown in Table 2E. The height of structures near airports is an important consideration in land use planning since tall structures can create obstructions to safe air navigation.

While buildings are typically limited to heights of 50 feet in most County zoning districts, structures may be approved in many districts to heights of 105 feet or greater. Conditional use permits or plot plan approval are required for structures exceeding 105 feet. This process poses a risk of creating airport hazards within the Desert Center Airport Study Area if structures are approved which would penetrate any of the F.A.R. Part 77 surfaces.

The County Land Use Ordinance also provides for a Specific Plan District. This district is intended to be used for the development of large property holdings to allow flexibility and variability from the standard zoning district regulations.

TABLE 2E
Summary of Zoning Provisions
Riverside County Land Use Ordinance

Zoning District	Noise-Sensitive Uses: Permitted Use	Noise-Sensitive Uses: Conditional Use	Minimum Lot Size Per Dwelling	Maximum Building Height
RESIDENTIAL DISTRICTS				
RR, Rural Residential	Single-Family Dwellings Mobile Homes Guest Ranches/Motels Educational Institutions Libraries Museums	Mobile home parks	1/2 Acre	50 ft.[1]
R-R-O, Rural Residential Outdoor Advertising	Same as RR	Same as RR	1/2 Acre	50 ft.[1]
R-1, One-Family Dwellings	Single-family dwellings	Mobile home parks	7,200 s.f.	40 ft.
R-1A, One-Family Dwellings Mountain Resort	Same as R-1	Same as R-1	7,200 s.f.	40 ft.
RA, Residential Agricultural	Mobile Home Others per R-1	--	20,000 s.f.	50 ft.[2]
R-2, Multiple Family Dwellings	Two-family dwellings Multiple family dwellings Apartment houses Rooming/Boarding house Churches Schools Libraries Museums and art galleries Congregate care residential facilities Others per R-1	Mobile home parks Congregate care residential facilities	7,200 s.f	40 ft.
R-2A, Limited Multiple Family Dwellings	Two-family dwellings Multiple family dwellings Apartment houses Others per R-1	Mobile home parks	7,200 s.f.	30 ft.
R-3, General Residential	Fraternity/Sorority houses Hotels/motels Nursery schools/day care centers Institutions for the aged Others per R-2	Mobile home parks Evening nursery school Child care facilities Congregate care residential facilities	7,200 s.f.	50 ft.[3]
R-3A, Village Tourist Residential	One-family dwellings Churches Schools Libraries Museums	Apartments Hotels/motels Mobile home parks Nursery School/ day care centers	9,000 s.f.	50 ft.[3]
R-T, Mobile Home Subdivision Park	One-family mobile homes	Mobile home parks	3,600 - 7,200 s.f.	40 ft.
R-T-R, Mobile Home Subdivision - Rural	Same as R-T	--	40,000 s.f.	40 ft.

TABLE 2E (Continued)
Summary of Zoning Provisions
Riverside County Land Use Ordinance

Zoning District	Noise-Sensitive Uses: Permitted Use	Noise-Sensitive Uses: Conditional Use	Minimum Lot Size Per Dwelling	Maximum Building Height
RESIDENTIAL DISTRICTS				
R-4, Planned Residential	One-family dwellings Multiple family dwellings Churches	Mobile home parks	3,500 s.f.	50 ft.[3]
R-5, Open Area Combining Zone - Residential	--	--	--	50 ft.[3]
R-6, Residential Incentive	One-family dwellings Two-family dwellings Multiple family dwellings Apartment houses	Mobile home parks	5,000 s.f.	50 ft.
COMMERCIAL DISTRICTS				
C-1/CP, General Commercial	Hotels/motels Schools Mobile homes (caretaker) On-site operator's residence	Congregate care residential facilities	--	50 ft.[4]
C-T, Tourist Commercial	Hotels/motels Bed and breakfast	--	--	50 ft.[3]
C-P-S, Scenic Highway Commercial	Mobile homes (caretaker) On-site operator's residence Schools Day care centers Hotels/motels	--	--	50 ft.[4]
C-R, Rural Commercial	Churches Bed and breakfast Hotels/motels Libraries Museums On-site operator's Residence Mobile home (caretaker)	--	--	40 ft.
C-O, Commercial-Office	Library Museum	Clinics Day care centers Hotels/motels	--	50 ft.[3]
INDUSTRIAL DISTRICTS				
IP, Industrial Park	Day care centers One-family dwellings (caretaker)	--	--	50 ft.[2]
M-SC, Manufacturing Service Commercial	Mobile homes (caretaker) Others per IP	--	--	50 ft.[1]
MM, Manufacturing Medium	Same as M-SC	--	--	50 ft.[1]

TABLE 2E (Continued)
Summary of Zoning Provisions
Riverside County Land Use Ordinance

Zoning District	Noise-Sensitive Uses: Permitted Use	Noise-Sensitive Uses: Conditional Use	Minimum Lot Size Per Dwelling	Maximum Building Height
INDUSTRIAL DISTRICTS (continued)				
MH, Manufacturing Heavy	Same as M-SC	--	--	50 ft.[2]
MR, Mineral Resource	Residences/Mobile homes (caretaker)	--	--	50 ft.[2]
M-R-A, Mineral Resources and Related Manufacturing	Same as M-R	--	--	50 ft.[2]
AGRICULTURAL DISTRICTS				
A-1, Light Agriculture	Churches Schools Libraries Others per R-A	--	20,000 s.f.	50 ft.[2]
A-P, Light Agriculture with Poultry	One-family dwellings Mobile homes	--	5 Acres	50 ft.[2]
A-2, Heavy Agriculture	Same as A-1	--	20,000 s.f.	50 ft.[2]
A-D, Agriculture-Dairy	One-family dwellings Mobile homes	--	20 Acres	50 ft.[2]
SPECIAL DISTRICTS				
W-2, Controlled Development	Single-family dwellings Guest ranches Schools Libraries Museums Mobile homes	Mobile home parks	20,000 s.f.	50 ft.[1]
R-D, Regulated Development	Same as R-A and R-3	Mobile home parks	20,000 s.f.	50 ft.[2]
N-A, Natural Assets	One-family dwellings Guest dwellings Museums Mobile homes	Resort hotels Guest ranch	20 acres	20 ft.
W-2-M, Controlled with Mobile homes	Same as W-2	Same as W-2	20,000 s.f.	50 ft.[1]
W-1, Watercourse, Watershed and Conservation Areas	--	--	--	50 ft.[5]
W-E, Wind Energy Resource	One-family dwelling (caretakers)	--	--	20 ft.[6]
SP, Specific Plan	Single-family residential Multi-family residential Schools Libraries	--	Per approved plan	Per approved plan

TABLE 2E (Continued)
Summary of Zoning Provisions
Riverside County Land Use Ordinance

NOTES:

[1]Taller structures may be permitted subject to rezoning, conditional use, or plot plan approval. These include buildings up to 75 feet, structures other than buildings up to 105 feet, and broadcasting antennas over 105 feet.

[2]Taller structures may be permitted subject to rezoning, conditional use, or plot plan approval. These include buildings up to 75 feet and structures other than buildings up to 105 feet.

[3]Structures up to 75 feet in height may be permitted subject to rezoning, conditional use, or plot plan approval.

[4]Structures up to 75 feet, or taller for broadcasting antennas, may be permitted subject to rezoning, conditional use, or plot plan approval.

[5]Structures other than buildings up to 105 feet may be permitted subject to rezoning, conditional use, or plot plan approval. Commercial wind energy conversion systems up to 400 feet are permitted.

[6]Buildings up to 75 feet and structures other than buildings up to 400 feet may be permitted subject to rezoning, conditional use, or plot plan approval. Commercial wind energy conversion systems up to 500 feet are permitted.

In developing property under the Specific Plan, specific plans of land use unique to this particular property can be applied in accordance with definitive development standards and requirements relating to land use, density, lot size and shape, siting of buildings, setbacks, circulation, drainage, landscaping, water, sewer, public facilities, open space, parking, and other elements deemed necessary for the proper development of the property. There are no County specific plans in the Desert Center Airport Study area.

Exhibit 2F shows the existing zoning in the study area. The airport itself is zoned NA, Natural Assets as is most of the study area. Large parts of the study area are also zoned W-2, Controlled Development. The NA and W-2 districts are basically open space zones which permit only very limited development. As **Table 2E** shows, certain noise-sensitive uses are permitted in these zones, but at very low densities. The minimum lot size in the NA district is 20 acres. In the W-2 districts around the airport, the minimum lot size has been set at 10 acres.

2.5.2.d Subdivision Regulations

Subdivision regulations apply in cases where a parcel of land is proposed to be divided into lots or tracts. They are established to ensure the proper arrangement of streets, adequate and convenient open space, efficient movement of traffic, adequate and properly located utilities, access for fire-fighting apparatus, avoidance of congestion, and orderly and efficient layout and use of land. In some communities around the country, subdivision regulations are used to promote airport land use compatibility through special lot layout requirements, easement dedication requirements, or through the recording of plat notes regarding noise levels in the area.

Because the Desert Center Airport Study Area is within the unincorporated areas of the county, Riverside County has subdivision control. The regulations which are set forth in Ordinance 460, do not include any specific requirements pertaining to airport noise or safety.

2.5.2.e Building Codes

Building codes regulate the construction of buildings, ensuring that they are built to safe standards. Riverside County administers building codes in the unincorporated area, which includes the Desert Center Airport Study Area.

Riverside County administers the 1988 edition of the Uniform Building Code (UBC) promulgated by the International Conference of Building Officials. While this code establishes uniform thermal insulation standards for new construction, it has no special sound insulation standards to provide protection from external noise sources.

2.5.3 POTENTIAL FUTURE DEVELOPMENT

There is little potential for any significant future development within the Desert Center Airport Study Area. Some tourist commercial uses may potentially occur outside the study area at the intersection of State Highway 177 with U.S. Interstate 10. Limited residential development may occur in the Desert Center and Lake Tamarisk communities. Reclamation of the Eagle Mountain mining area north of Desert Center may possibly spur some local development.

2.5.4 REDEVELOPMENT PLAN

Riverside County has created a Redevelopment Agency in accordance with the California Community Redevelopment Law. The Redevelopment Agency is authorized to acquire, manage, and dispose of real property; provide relocation assistance to displaced occupants; demolish buildings; build and rehabilitate housing for low and moderate income persons; build and rehabilitate public utilities and facilities; and facilitate the redevelopment of land by private enterprise and public agencies. These activities must conform with an approved redevelopment plan. Among the financing tools available to the Redevelopment Agency is tax increment financing. Essentially, this provides that the portion of taxes generated by new development within a redevelopment project area is made available to the Redevelopment Agency for financing of improvements within that area.

Desert Center Airport has been designated as a County redevelopment area. The intent of this designation is to encourage expansion of airport facilities and commercial and industrial development at the airport. (See the **Redevelopment Plan for Redevelopment Project Airports**, County of Riverside Redevelopment Agency, 1988.) In addressing these concerns, the redevelopment plan promotes development in accordance with the Riverside County Comprehensive General Plan.

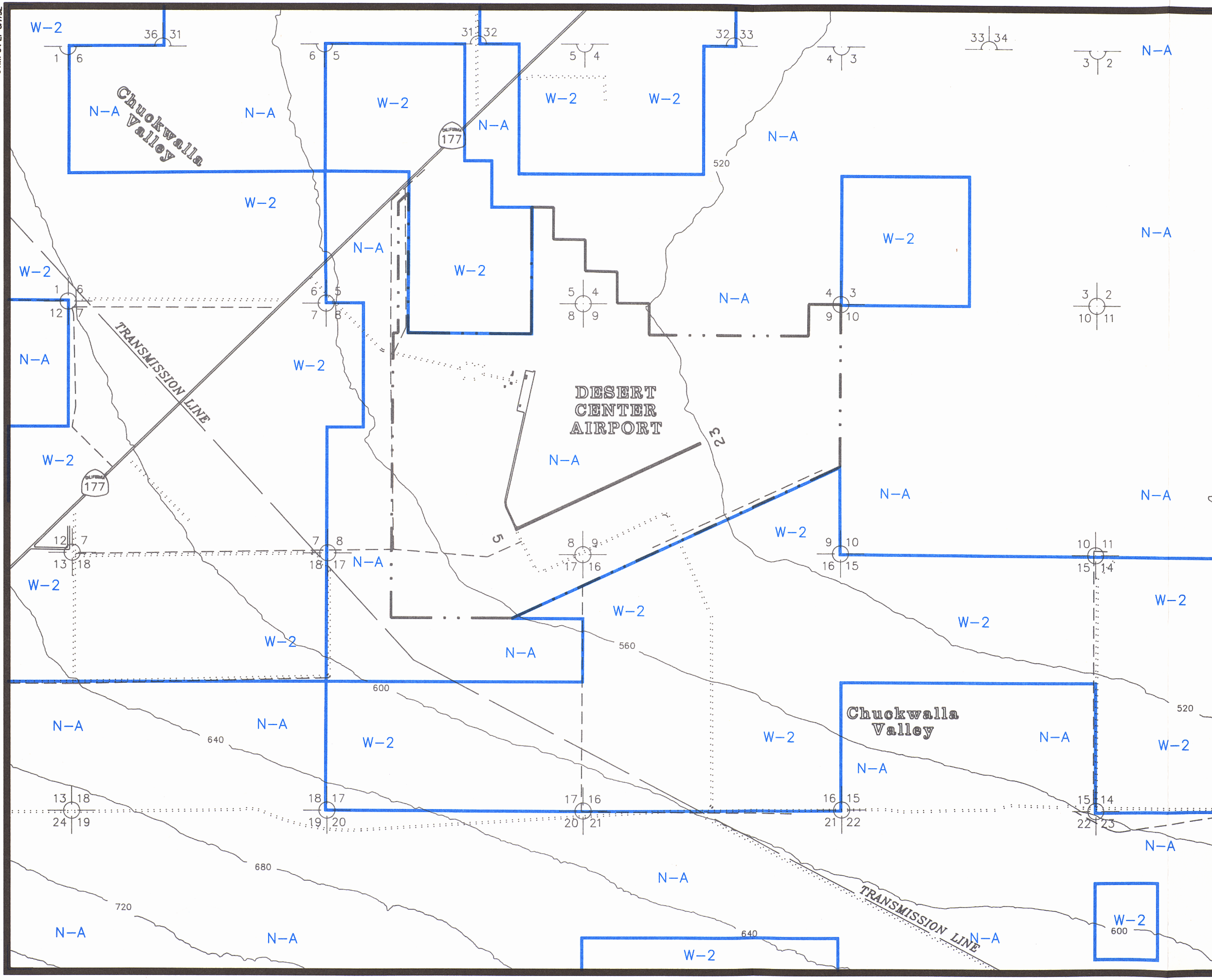

Exhibit 2F
GENERALIZED EXISTING ZONING

LEGEND

- Airport Boundary
- Unimproved Road
- Dike
- N-A Natural Assets
- W-2 Controlled Development

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Chapter Three
LAND USE COMPATIBILITY GUIDELINES

Chapter Three
RIVERSIDE COUNTY AIRPORT LAND USE COMPATIBILITY GUIDELINES

3.1 *INTRODUCTION*

This chapter presents land use compatibility guidelines which have been established by the Riverside County Airport Land Use Commission for use in comprehensive land use planning within airport influenced areas. These guidelines are intended to provide a common approach for identifying potential areas of incompatibility and for establishing land use criteria at each of the County's airports.

While providing a basis for a common analytical approach, the guidelines do provide for some flexibility in making specific determinations as to land use compatibility in any given situation. The many differences among the various airports in the County and in their environs makes it prudent to ensure that appropriate variations may be made to meet special circumstances in order to protect the public health, safety, and welfare. When variations are necessary, specific findings justifying the variations should be made and included in the Comprehensive Land Use Plan.

3.2 *CALIFORNIA AIRPORT LAND USE PLANNING GUIDELINES*

Aircraft noise is often the most disturbing environmental impact associated with the operation of an airport. As jet aircraft came into common use at civilian airports in the 1960's, public concern about aircraft noise became a serious issue. This concern was heightened as the environmental movement of the 1970's gathered steam. In response to these concerns, Congress and some state legislatures, in addition to numerous Federal and state agencies, began developing programs and guidelines to promote aircraft noise abatement and compatible development within noise-impacted areas.

At the same time, concern was growing in the aviation community about burgeoning urban development in the vicinity of airports. The development boom of the 1950's and 1960's, following the long slow-growth period of the 1930's and 1940's, corresponded with a sharp growth in aviation. Not only was noise a concern, but the safety of persons on the ground and in the air became an increasing concern with the construction of tall buildings and towers near airports and increasing development of all kinds within airport approaches.

In California, the state legislature responded to these public concerns by enacting the law mandating the creation of Airport Land Use Commissions and the preparation of comprehensive land use plans for all public airports in each county (Public Utilities Code, Ch. 4, Art. 3.5). In order to assist Airport Land Use Commissions in implementing the provisions of the law, the California Department of Transportation prepared a reference guide for local agencies. Published in 1983, the **Airport Land Use Planning Handbook** provides planning guidelines and suggestions based on a review of the research on noise and safety issues and a review of comprehensive land use plans in force at the time the document was prepared.

For purposes of preparing comprehensive land use plans for airports in Riverside County, the guidelines presented in the **Airport Land Use Planning Handbook** are used as described in this chapter. Because the state guidelines are not rigidly defined, but provide for local adjustments based on local conditions and concerns, some refinements in the state guidelines have been made for use in the County. Furthermore, the state guidelines are somewhat general. It is possible that additional detail will need to be developed to provide specific land use planning and regulation in certain airport areas. Such adjustments will be considered for each airport as needed.

3.3 NOISE COMPATIBILITY GUIDELINES

Table 3A shows the noise compatibility guidelines intended for use in the County. These are based on the guidelines suggested by the State of California in the 1983 **Airport Land Use Planning Handbook.** At general aviation airports, the guidelines call for discouraging new single-family dwellings and prohibiting mobile homes, within the 60 CNEL contour. Where homes are permitted within the 60 CNEL, the need for sound insulation should be studied and noise easements should be acquired.

Within the 65 CNEL, new residential construction should not be undertaken. New hotels or motels are permissible if the need for sound insulation is studied. Institutional uses should be discouraged within the 65-70 CNEL range. If no alternative location is available, the need for sound insulation should be studied before the institution is built. Commercial, industrial, and recreational uses are considered compatible with noise levels between 65 and 70 CNEL.

Appendix B presents a detailed discussion of the measurement of sound, the effects of noise exposure, and alternative noise compatibility guidelines.

TABLE 3A
Land Use Guidelines For Noise Compatibility

Type of Airport/ Land Use	60-65 CNEL	65-70 CNEL	70-75 CNEL	75-80 CNEL	80 + CNEL
Air Carrier and Military					
Residential/Lodgings	Potential for annoyance exists; identify high complaint areas Determine whether sound insulation requirements should be established for these areas. Require acoustical reports for all new construction. Noise easements should be required for new construction.	Discourage new single family dwellings. Prohibit mobile homes. New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. Noise easements should be required for new construction. Development policies for "infill".	New construction or development of residential uses should not be undertaken. New hotels and motels may be permitted after an analysis of noise reduction requirements is made and needed noise insulation is included in the design	New hotels and motels should be discouraged.	
General Aviation					
Residential/Lodgings	Discourage new single family dwellings Prohibit mobile homes. New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. Noise easements should be required. Develop policies for "infill".	New construction or development of residential uses should not be undertaken. New hotels and motels may be permitted after an analysis of noise reduction requirements is made and needed noise insulation is included in the design.	New hotels and motels should be discouraged.		
All Airports					
Public/Institutional	Satisfactory with little noise impact and requiring no special noise insulation requirements for new construction.	Discourage institutional uses. If no other alternative location is available, new construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation is included in the design.	No new institutional uses should be undertaken.		
Commercial		Satisfactory, with little noise impact and requiring no special noise insulation for new construction.	New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design. Noise reduction levels of 25-30 dB will be required.	Same as 70-75 CNEL	New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the construction.
Industrial			Satisfactory, with little noise impact and requiring no special noise insulation requirements for new construction.	New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design. Measures to achieve noise reduction of 25-35 dB must be incorporated in portions of building where the public is received and in office areas.	New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the construction.
Recreation/Open Space		Satisfactory, with little noise impact and requiring no special noise insulation requirements for new construction. Outdoor music shells and amphitheater should not be permitted.	Parks, spectator sports, golf courses and agricultural generally satisfactory with little noise impact. Nature areas for wildlife and zoos should not be permitted.	Land uses involving concentrations of people (spectator sports and some recreational facilities) or of animals (livestock farming and animal breeding) should not be permitted.	

Source: **Airport Use Planning Handbook: A Reference Guide for Local Agencies,** prepared for California Department of Transportation, Division of Aeronautics by Metropolitan Transportation Commission and Association of Bay Area Governments, 1983, p. 50.

3.4 *SAFETY COMPATIBILITY GUIDELINES*

The State has suggested the creation of five safety zones around airports. The zones are intended to promote land use planning and regulation which will promote the safety of persons on the ground while reducing the risks of serious harm to aircraft crews and passengers making forced landings in the immediate airport environs.

The State provides for several options in the definition of the safety zone boundaries and in the scope of land use regulations applying within the boundaries. The specific scope of the guidelines proposed for use in Riverside County are discussed here. They are described in **Table 3B.** All but the TPZ zone are shown in **Exhibit 3A.**

TABLE 3B
Land Use Compatibility Guidelines for Airport Safety Zones

Safety Zone	Dimensions (ft.) Length	Dimensions (ft.) Width[7]	Maximum Pop/DU Density[2]	Maximum Lot Coverage By Structures	Land Use
ISZ - Inner Safety Zone	1,320 to 2,500[3]	1,500	0	0	No petroleum or explosives. No above-grade powerlines.
OSZ - Outer Safety Zones	2,180 to 2,500[4]	1,500	Uses in structures:[9] 25 persons/ac. Uses not in structures: 50 persons/ac.	25% of net area	No residential No hotels, motels No restaurants, bars No schools, hospitals, government services No concert halls, auditoriums No stadiums, arenas No public utility stations, plants No public communication facilities No uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials
ETZ - Emergency Touchdown Zone	3,500 to 5,000[3]	500	0	0	No significant obstructions[5]
TPZ - Traffic Pattern Zone	F.A.R. Part 77 horizontal surface		----	50% of gross area or 65% of net area	Discourage schools, auditoriums, amphitheaters, stadiums Discourage uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials[8]
ERC - Extended Runway	5,000[7]	1,000	3 du/net ac. Uses in structures:[9] 100 persons/ac.	50% of gross area or 65% of net area	No uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials[8]

[1]Width of zones is centered on the extended runway centerline.
[2]Pop/DU - population or dwelling unit.
[3]Length is measured from the primary surface. The shorter length is for visual runways serving twin or single engine propeller aircraft, the longer for precision and non-precision instrument runways or runways serving jets.
[4]Length is measured from the ISZ. The shorter length is for visual runways serving twin and single engine propeller aircraft, the longer for precision and non-precision instrument runways or runways serving jets.
[5]Significant obstructions include but are not limited to large trees, heavy fences and walls, tall and steep berms and retaining walls, non-frangible street light and sign standards, billboards.
[6]Applies only to runways with precision or non-precision approaches or serving jet aircraft.
[7]Length is measured from the OSZ.
[8]This does not apply to service stations involving retail sale of motor vehicle fuel if fuel storage tanks are installed underground.
[9]A "structure" includes fully enclosed buildings and other facilities with fixed seating and enclosures limiting the mobility of people, such as sports stadiums, outdoor arenas, and amphitheaters.

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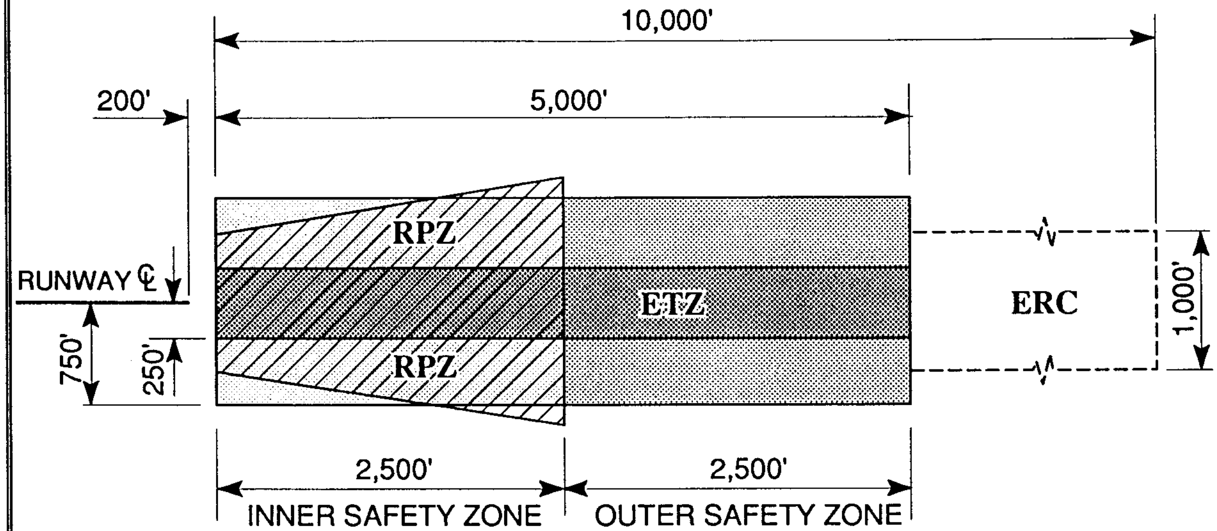
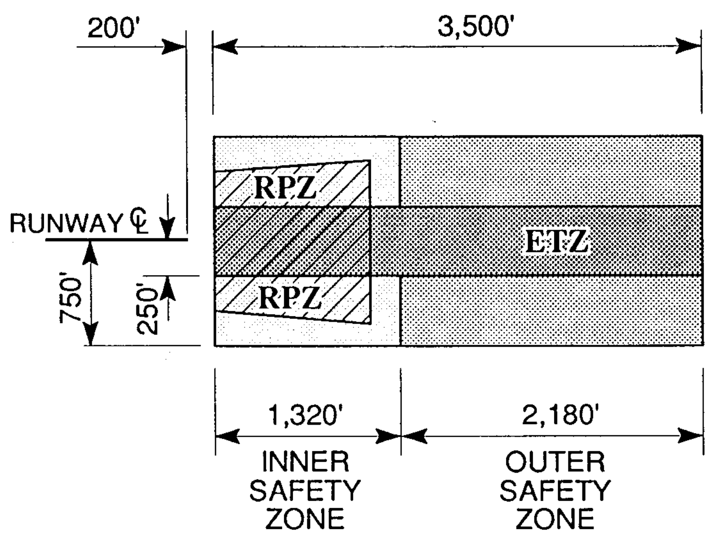
PRECISION AND NON-PRECISION INSTRUMENT RUNWAYS
- JET AIRCRAFT -



LEGEND

RPZ - Runway Protection Zone
ETZ - Emergency Touchdown Zone
ERC - Extended Runway Centerline

VISUAL APPROACH RUNWAYS
- TWIN ENGINE AIRCRAFT -



SOURCE: Airport Land Use Planning Handbook: A Reference and Guide for Local Agencies, prepared for California Department of Transportation, Division of Aeronautics by Metropolitan Transportation Commission and Association of Bay Area Governments, 1983, p. 97.

Exhibit 3A
SUGGESTED AIRPORT SAFETY
ZONES OFF RUNWAY ENDS

3.4.1 INNER SAFETY ZONE

The Inner Safety Zone (ISZ) is an area immediately off the runway end, 1,500 feet wide and from 1,320 to 2,500 feet long. The length of the zone varies depending on the type of runway approach and the type of aircraft using the runway. The shorter distance is for visual runways serving single and twin-engine propeller aircraft. The longer is for precision and non-precision instrument runways or runways serving jet aircraft. By their nature, instrument runways are used during bad weather and periods of poor visibility. Those are also periods of increased accident risk. Jet aircraft tend to be larger than propeller aircraft and operate at higher speeds, thus creating the risk of more severe damage on the ground in the event of an accident.

At most airports, the FAA-defined runway protection zone, a trapezoidal area, will lie within the ISZ. At airports with precision instrument runways, however, the outermost corners of the RPZ will extend just outside the ISZ. (See **Exhibit 3A.**) In such cases, the boundaries of the ISZ could be adjusted to include all of the RPZ.

The ISZ is an area of significant accident risk. Within the ISZ, no structures should be permitted. Storage of petroleum products and explosive materials should not be permitted, nor should petroleum or natural gas pipelines or above-grade powerlines.

3.4.2 OUTER SAFETY ZONE

The Outer Safety Zone (OSZ) is an area along the extended runway centerline immediately beyond the ISZ. It is 1,500 feet wide and ranges from 2,180 to 2,500 feet long. The length is based on the same factors as the Inner Safety Zone.

Within the OSZ, the density of the population in structures would be limited to 25 persons per acre. For uses not in structures, the density would be limited to 50 persons per acre. (A lower population density is recommended for uses in structures because of the reduced mobility which people would have. In addition, the consequences of an aircraft accident would be compounded by damage to the building.) Structures should not cover more than 25% of the lot.

Several land uses should be prohibited within the OSZ, as shown in **Table 3B.** These include dwellings, hotels, places of public assembly, public utility stations and plants which could be damaged in the event of an aircraft accident, and industries processing flammable materials.

3.4.3 EMERGENCY TOUCHDOWN ZONE

The Emergency Touchdown Zone (ETZ) is a 500-foot wide area extending from the primary surface to the end of the OSZ. It is intended as an emergency landing area. Of the five safety zones, the ETZ is the area with the greatest accident risk. Thus, no structures or significant obstructions should be permitted.

3.4.4 TRAFFIC PATTERN ZONE

The Traffic Pattern Zone (TPZ) is the area around the airport which is most frequently overflown by aircraft and within which the local traffic pattern is located. For the sake of clear and unambiguous definition of the area, the boundaries should be set at the outer edge of the horizontal surface based on F.A.R. Part 77. The horizontal surface extends 5,000 feet off the ends and sides of runways with only visual approaches and off utility runways with non-precision approaches. The surface extends 10,000 feet off the ends and sides of runways with precision approaches and off runways classified as "larger than utility" with non-precision approaches. These are reasonably close approximations of the limits of a pattern area for these different runways and approaches.

In the TPZ, structures should occupy no more than 50% of the gross development area or 65% of the net lot area, whichever is greater. The intent is to ensure that approximately 50% of the area remains clear of structures. This would help to ensure that emergency landing areas are available within this area of frequent low-level overflights.

While it may be impractical in all areas to encourage strict land use controls within the TPZ, certain uses should be discouraged. These include schools, auditoriums, amphitheaters, stadiums and other similar places of public assembly. Industries processing flammable materials should also be discouraged in the TPZ. (This restriction is not intended to apply to conventional automobile service stations.)

3.4.5 EXTENDED RUNWAY CENTERLINE ZONE

The Extended Runway Centerline Zone (ERC) would apply only off the ends of precision or non-precision instrument runways or runways serving jet aircraft. It is 1,000 feet wide and extends 5,000 feet beyond the Outer Safety Zone (OSZ). These runways are used in bad weather and during periods of poor visibility. The California **Airport Land Use Compatibility Planning Handbook** (1983, p. 99) notes that poor visibility has been a contributing factor in accidents where aircraft undershot the approach course.

In the ERC, lot coverage by structures should be limited in the same way as in the TPZ: no more than 50% of the gross development area or 65% of the net lot area, whichever is greater. Residential development in the ERC should not exceed 3 dwelling units per acre. The number of people permitted for uses in structures should not exceed 100 persons per acre.

Within the ERC, land uses involving the manufacture, storage, or distribution of explosives or flammable materials should be prohibited. (This does not apply to conventional automobile service stations.)

3.4.6 SPECIAL CONSIDERATIONS IN ALL SAFETY ZONES

Particularly hazardous land uses should be prohibited in all designated safety zones. These include those which would cause smoke, water vapor, or light interference, thus impeding the pilot's ability to see the airfield. Other uses which cause electrical interference with aircraft navigational and communications equipment also should be prohibited in the airport vicinity. Other inappropriate uses include those which attract large numbers of birds. Examples include landfills and some types of food processing plants involving outdoor storage of grain and other raw materials or food by-products.

The State **Airport Land Use Planning Handbook** (page 101) offers the following descriptions of land uses which are considered hazardous and should be prohibited within all airport safety zones:

- Any use which would direct a steady light or flashing light of red, white, green, or amber colors associated with airport operations toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport, other than an FAA approved navigational signal light or visual approach slope indicator.

- Any use which would cause sunlight to be reflected toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport.

- Any use which would generate smoke or which would attract large concentrations of birds, or which may otherwise affect safe air navigation within this area.

- Any use which would generate electrical interference that may be detrimental to the operation of aircraft and/or aircraft instrumentation.

3.5 AIRPORT VICINITY HEIGHT GUIDELINES

Airport vicinity height limitations are required for two reasons. The first is to protect the public safety, health, and welfare by ensuring that aircraft can safely fly in the airspace around the airport. This protects both the interests of those in the aircraft and those on the ground who could be injured in the event of an accident. Secondly, height limitations are required to protect the operating capability of airports, thus preserving an important part of the State's transportation system.

The Federal government has developed standards for determining obstructions in the navigable airspace. Federal Aviation Regulations Part 77 defines a variety of imaginary surfaces around airports. Each surface is defined at a certain altitude around the airport. **Exhibit 3B** shows an example of a Part 77 map for an airport.

As the exhibit shows, the dimensions of the surfaces vary depending on the type of approach to the runways. Non-precision runways have larger surfaces and flatter approach slopes than visual runways. Precision instrument runways have still larger surfaces and flatter approaches.

FAA uses these Part 77 obstructions standards not as absolute height limits, but as elevations above which structures may constitute a safety problem. Any penetrations of the Part 77 surface are subject to review on a case by case basis. If a safety problem is found to exist, FAA will issue a determination of a hazard to air navigation. FAA does not have the authority to prevent the encroachment. It is up to the local zoning authorities to enforce the FAA recommendation.

The California **Airport Land Use Planning Handbook** (1983, p. 105) states the following with respect to height limitation standards:

> While it is important to understand that these [F.A.R. Part 77] are in fact review standards, it is equally important to recognize that these standards provide a reasonable and defensible balance between the needs of the airspace users and the rights of property owners beneath the flight patterns. In this regard, the use of Part 77 obstruction standards as recommended height limits is appropriate.

The practice of using of F.A.R. Part 77 standards as height limits has been widely followed by Airport Land Use Commissions in California. FAA has encouraged this by producing a model zoning ordinance to limit the height of objects around airports (FAA Advisory Circular 150/5190-4A, December 14, 1987). The model ordinance proposes the use of the Part 77 surfaces as regulatory height limits.

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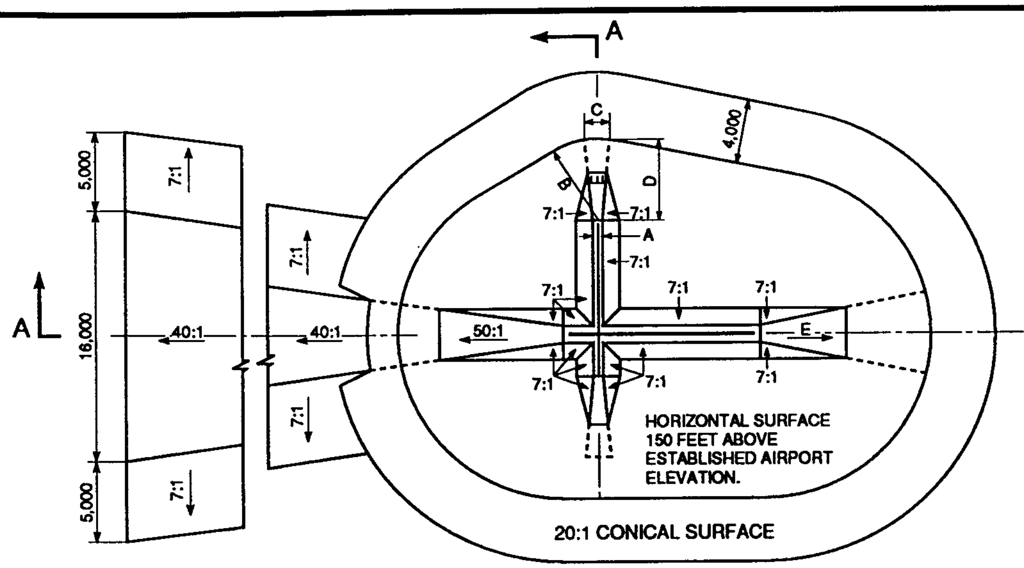
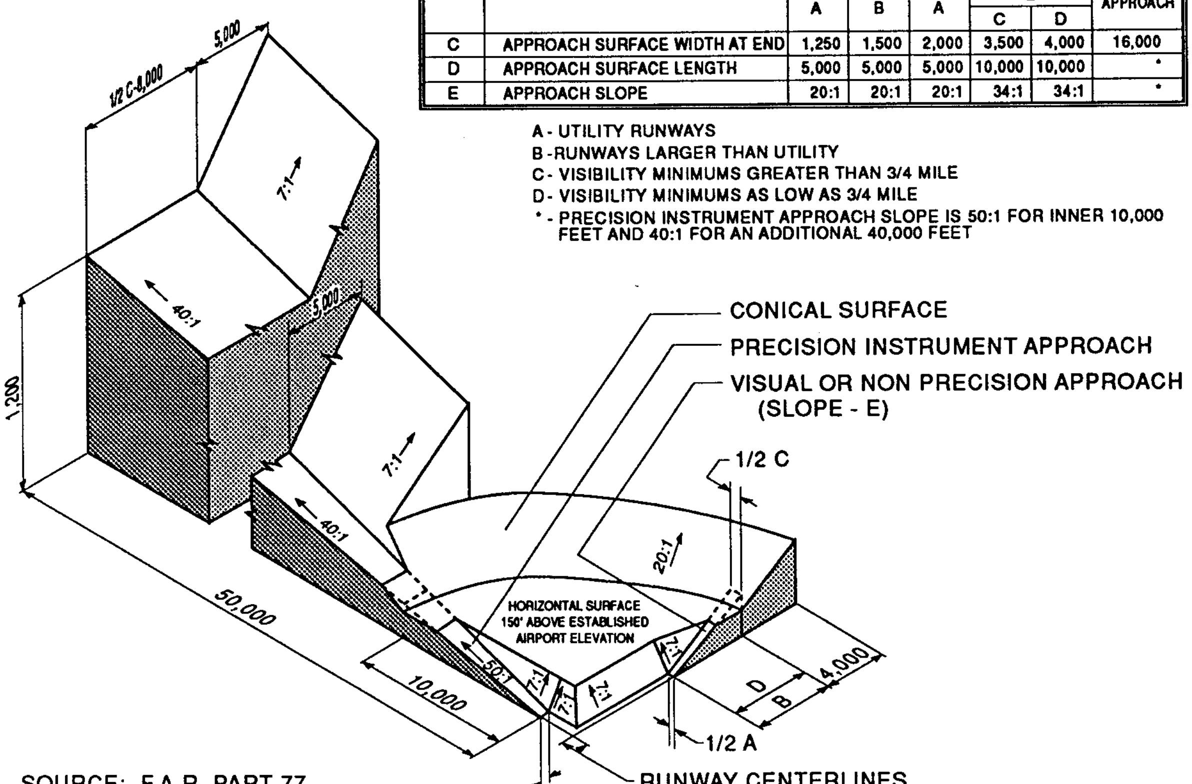


DIM	ITEM	DIMENSIONAL STANDARDS (FEET)					
		VISUAL RUNWAY		NON-PRECISION INSTRUMENT RUNWAY			PRECISION INSTRUMENT RUNWAY
		A	B	A	B C	B D	
A	WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END	250	500	500	500	1,000	1,000
B	RADIUS OF HORIZONTAL SURFACE	5,000	5,000	5,000	10,000	10,000	10,000
		VISUAL APPROACH		NON-PRECISION INSTRUMENT APPROACH			PRECISION INSTRUMENT APPROACH
		A	B	A	B C	B D	
C	APPROACH SURFACE WIDTH AT END	1,250	1,500	2,000	3,500	4,000	16,000
D	APPROACH SURFACE LENGTH	5,000	5,000	5,000	10,000	10,000	*
E	APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	*

A - UTILITY RUNWAYS
B - RUNWAYS LARGER THAN UTILITY
C - VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
D - VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
* - PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET



SOURCE: F.A.R. PART 77.

ISOMETRIC VIEW OF SECTION A-A

Exhibit 3B
FEDERAL AVIATION REGULATIONS PART 77:
CIVIL AIRPORT IMAGINARY SURFACES

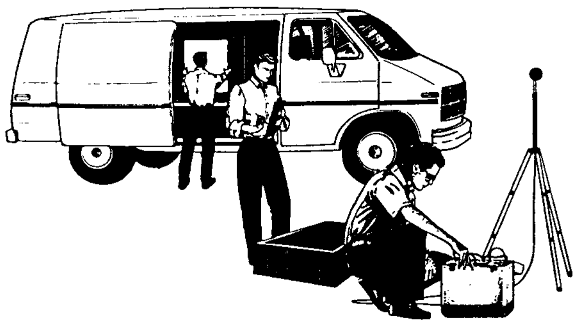
In view of the widespread acceptance of the F.A.R. Part 77 criteria, they will be used as the basis for height limitations in this Comprehensive Land Use Plan.

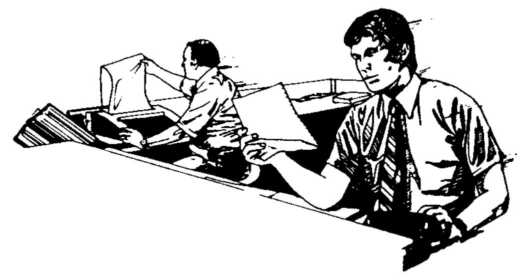
3.6 SUMMARY - AIRPORT INFLUENCED AREA

This chapter has presented the overall planning guidelines and criteria to be used in developing the Comprehensive Land Use Plan for Desert Center Airport. The noise and safety guidelines are based on the recommendations of the State of California as presented in the **Airport Land Use Planning Handbook**, 1983. The height guidelines are based on F.A.R. Part 77, as recommended by the State in the **Airport Land Use Planning Handbook.**

For purposes of defining the "airport-influenced area" around the airport, the composite of the noise and height-influenced areas will be used. The outer boundaries of the noise-influenced area correspond to the 60 CNEL contours for existing and forecast conditions. The outer boundary of the height-influenced area is the edge of the conical surface and, for airports with precision instrument approaches, the outer approach and transitional surfaces. (The outer boundary of the safety-influenced area is the horizontal surface which lies within the conical surface.)

Chapter Four
NOISE INFLUENCED AREA: ISSUES AND ALTERNATIVES





Chapter Four
NOISE INFLUENCED AREA: ISSUES AND ALTERNATIVES

4.1 INTRODUCTION

Analysis of noise exposure patterns leads to the determination of noise impacts. This section of this chapter discusses the development of noise exposure patterns, also called noise contours, for Desert Center Airport. Exhibits show two sets of noise contours for the airport: existing conditions (1991) and forecast conditions (2015).

4.2 NOISE METHODOLOGY

The basic methodology for definition of aircraft noise levels involves the extensive use of a mathematical model for aircraft noise prediction. The Federal Aviation Administration (FAA) has approved two models for this purpose. This study uses the FAA's Integrated Noise Model (INM), Version 3.9. A computerized overflight noise prediction model is necessary in noise studies because the development of noise contours directly from field studies would require months of measurement at numerous noise measurement sites -- a very impractical, extremely expensive, and less accurate method of evaluation.

The model contains a data base which relates slant range distance and engine thrust to noise levels for each aircraft. On an irregular grid around the airport, the model computes the associated noise exposure level for the specific aircraft and engine thrust used at that point along the flight track. The model sums individual noise exposure levels for each grid location. The model then generates a series of contour lines which connect the grid locations of equal noise level.

This report uses the Community Noise Equivalent Level (CNEL) to assess the existing and future noise exposure. The State of California requires the CNEL metric. The FAA accepts CNEL as a measure of cumulative noise exposure. CNEL represents the average daytime noise level during a 24-hour day, adjusted to an equivalent level to account for the lower tolerance of people to noise during the evening and nighttime periods, relative to the daytime period.

In the calculation of the CNEL metric, events which occur between 7:00 p.m. and 10:00 p.m. receive an approximately 5 decibel (dB) addition and events which occur between 10:00 p.m. and 7:00 a.m. receive a 10 dB addition. CNEL expresses the 24-hour average of the summed, energy adjusted events.

Summation metrics allow objective analysis. They can describe noise exposure comprehensively over a large area. The FAA requires the use of summation metrics in noise studies.

4.3 INM INPUT DATA

The Integrated Noise Model requires a variety of user-supplied data: a definition of the airport, operations by aircraft type, flight tracks, and runway use percentages, for example.

4.3.1 ACTIVITY DATA

Chapter Two of this study discussed historic and forecast aircraft activity for the airport. Presently, the airport serves as a base for one aircraft. The forecast anticipates that three aircraft will be based at the airport by 2015. **Table 4A** summarizes the current and forecast operations data. For noise modeling purposes, all operations are assumed to be by single-engine piston aircraft.

TABLE 4A
Summary of Operations
Desert Center Airport

	Annual Operations	
	1991	2015
General Aviation		
Local	750	1,200
Itinerant	750	1,100
Total Annual Operations	1,500	2,300

4.3.2 FLEET MIX

The INM data base provided the operational characteristics and noise data for the aircraft modeled.

The FAA has published a Pre-Approved List of Aircraft Substitutions. The list indicates that the general aviation single engine fixed pitch propeller model, the GASEPF, represents a broad range of single engine general aviation aircraft. Thus, the GASEPF was used to model the aircraft operating at Desert Center.

4.3.3 TIME OF DAY

The time of day that operations occur becomes particularly important as input to the INM due to the weighting of evening and nighttime events. Desert Center Airport does not have an Air Traffic Control Tower to keep operations statistics. Interviews at the airport indicated a lack of specific information concerning time of day of operations. Desert Center lacks a lighted runway, so operations are assumed not to occur after dark. For purposes of modeling, this study makes the assumption that general aviation operations occur in the ratio of 75% day, 20% evening, and 5% night (daylight hours before 7:00 a.m.).

4.3.4 RUNWAY USE

For modeling purposes, wind rose analysis usually determines runway use percentages. This analysis provides only the directional availability of a runway and does not consider pilot selection, primary runway operations, or local operating conventions. Local interviews indicated wind dependency for operations except that aircraft normally use Runway 5 for landing and takeoff during periods of calm winds. **Table 4B** summarizes the runway use percentages.

TABLE 4B
Runway Use Percentages
Desert Center Airport

	Runway	
	5	23
General Aviation		
Arrival	60	40
Departure	60	40

4.3.5 FLIGHT PROFILES

Optional input data to the INM includes modifications to approach and departure profiles. This analysis uses the profiles from the INM data base without modification. The model for Desert Center Airport uses Stage 1 (0 to 500 nautical miles) as the stage length for all aircraft operations. **Exhibit 4A** presents the departure profile from the INM data base for the aircraft used in this model.

4.3.6 FLIGHT TRACKS

Normally, radar tracking supplemented with field observation provides flight track information. Local interviews indicated no specific information concerning itinerant flight tracks. This study assumes that at airports such as Desert Center, with no control tower, operations will occur in accordance with the Airman's Information Manual. For touch-go operations, FAA Advisory Circular 7400.2C provides information for the track descriptions. The circular suggests a .75 nautical mile (about 4,500 feet) separation between the downwind leg and the runway. However, local pilots often fly the downwind leg of the touch-go operation much closer to the runway than indicated in the Advisory Circular. The model for this airport uses the close-in tracks described in local interviews. Local operating convention calls for left hand operation. Overall, the model contains 6 departure tracks, two arrival tracks, and two touch-go tracks. **Exhibit 4B** depicts the flight tracks used in the model for Desert Center.

4.4 INM OUTPUT

The Integrated Noise Model generated output files for the 1991 conditions and the forecast year 2015 conditions. Contours were produced for 55, 60, 65, 70, and 75 CNEL, but only the 55 CNEL was mapped.

4.4.1 EXISTING NOISE

The CNEL 55 contour and all higher contours remain within 75 feet of the runway centerline. The CNEL 55 contour circles the runway but all higher contours separate into two portions, one on each end of the runway. **Exhibit 4C** shows the noise contour set.

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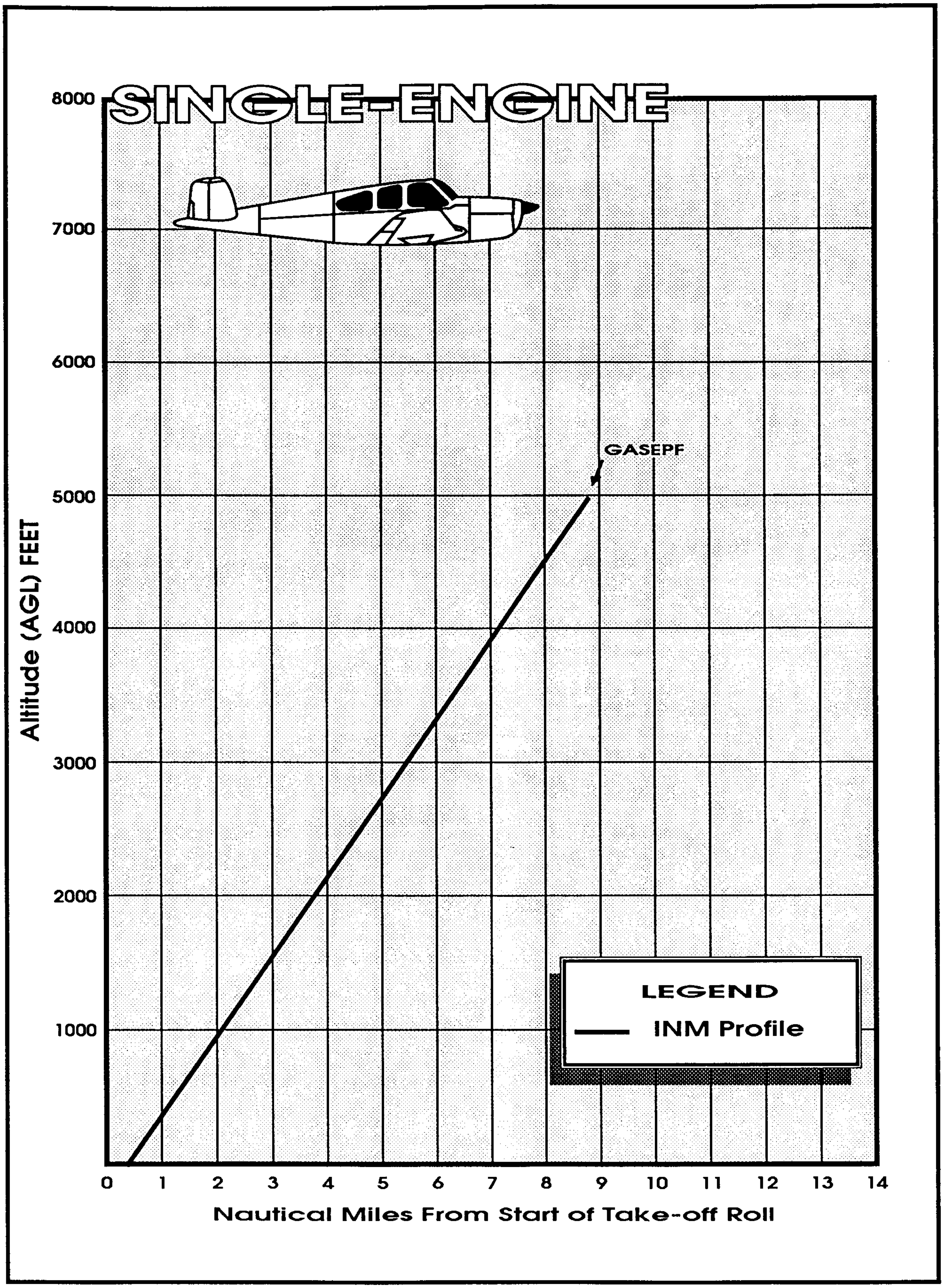
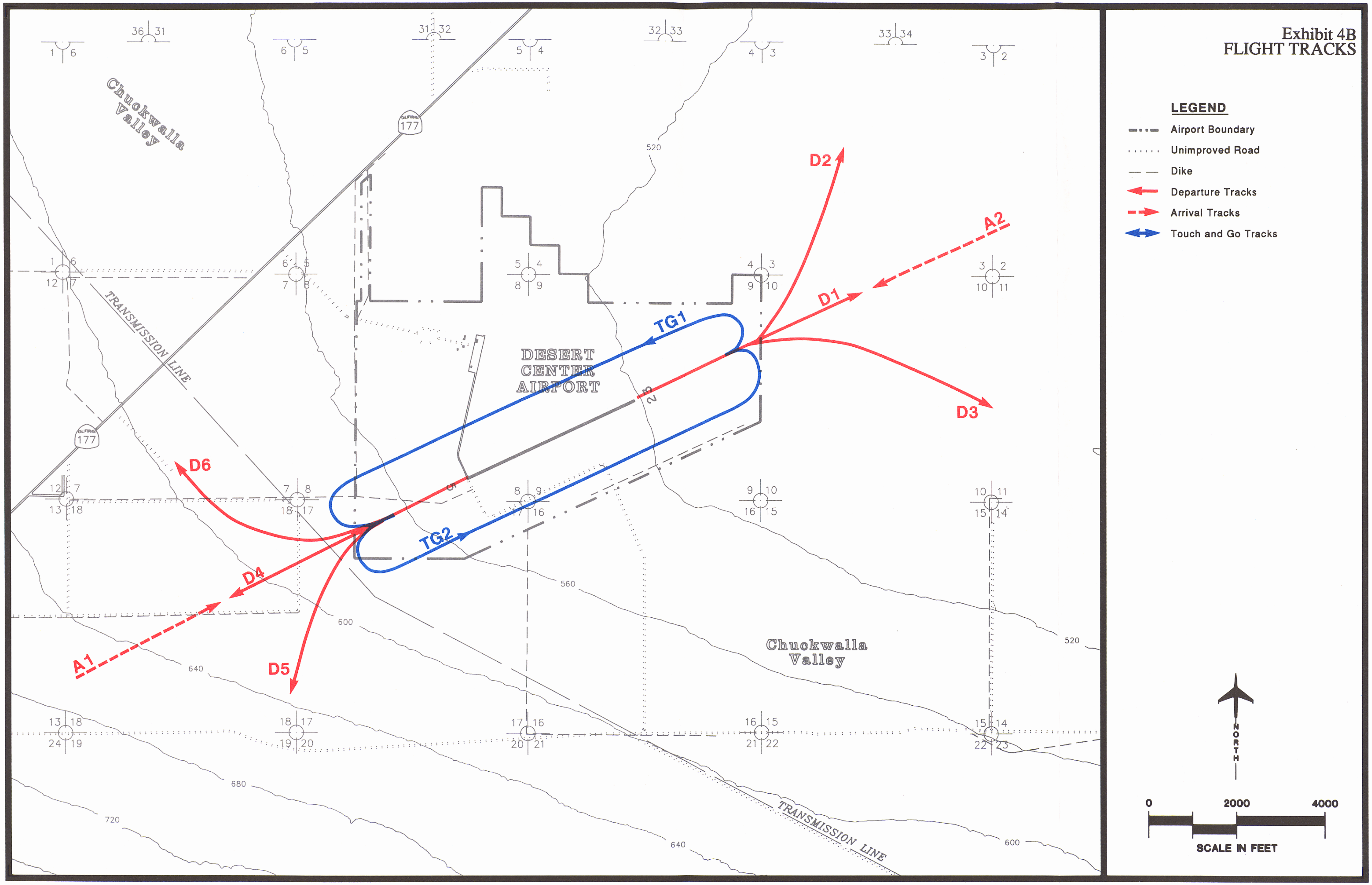


Exhibit 4A
DEPARTURE PROFILES
DESERT CENTER AIRPORT

Exhibit 4B
FLIGHT TRACKS



4.4.2 FORECAST NOISE

The anticipated increase in operations causes a slight increase in the contour size. The CNEL 55 contour connects the two runway end portions. The contour set at its widest point reaches 100 feet from the runway centerline. **Exhibit 4D** presents the noise contours.

Table 4C shows the surface area within the contours.

TABLE 4C
Area Within Noise Contours
Desert Center Airport

	1991		2015	
CNEL	Sq. Miles	Acres	Sq. Miles	Acres
55	.017348	11	.020138	13
60	.010668	7	.013000	8
65	.004664	3	.006818	4
70	.000483	.3	.001452	.9
75	--	--	--	--

4.5 NOISE IMPACTS AND ISSUES

As shown in **Exhibits 4C** and **4D**, aircraft noise above 55 CNEL is completely confined to the airport property. Thus, cumulative aircraft noise exposure cannot be considered a major impact on the Desert Center Airport environs.

Despite the low cumulative aircraft noise levels, it is possible that noise from single events could be considered a nuisance by airport area residents. Development of residences and noise-sensitive institutions should be avoided off the runway ends near the airport. Because this concern overlaps with safety concerns addressed in Chapter Five, no special noise-related land use policies are considered necessary.

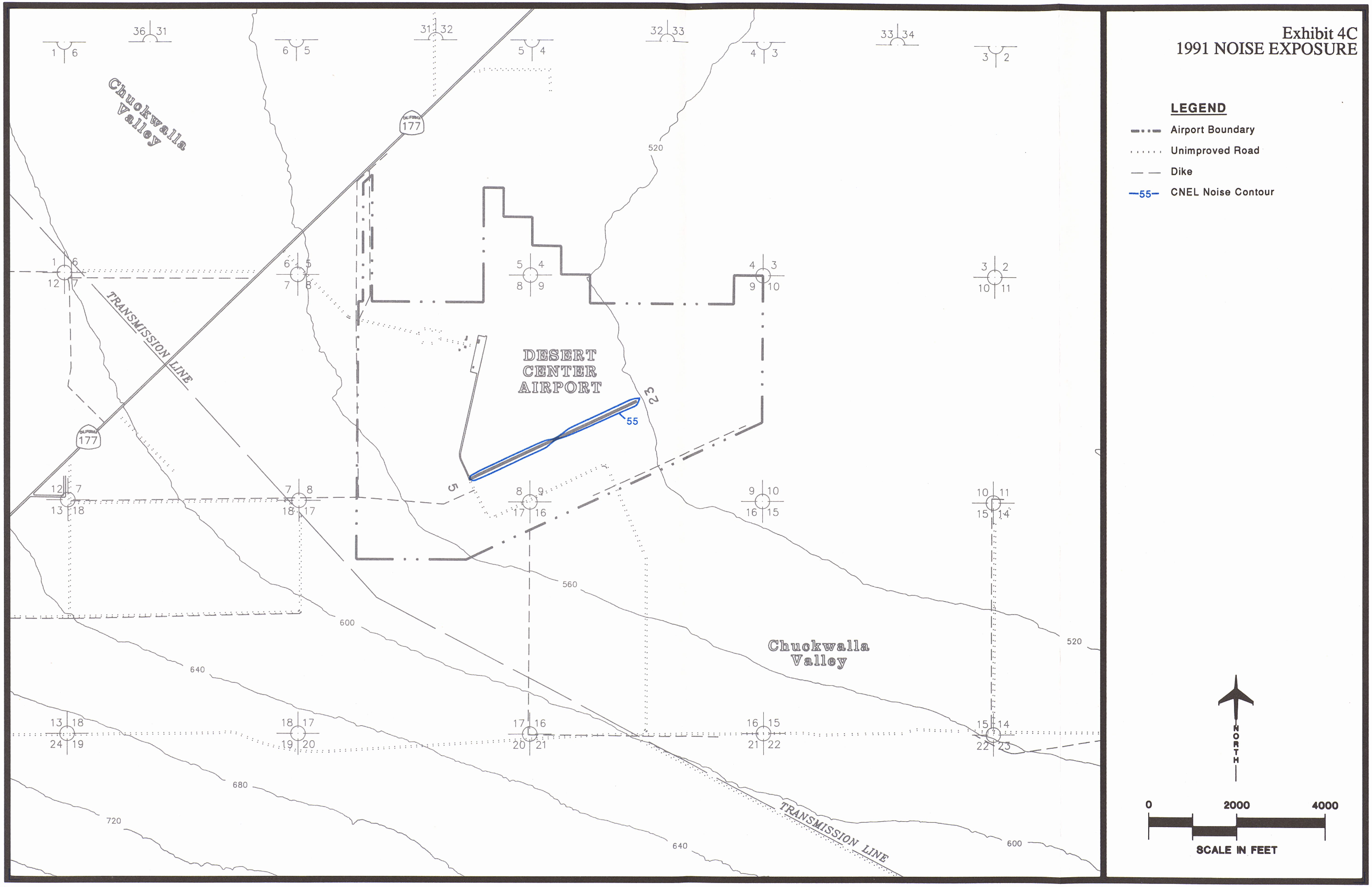
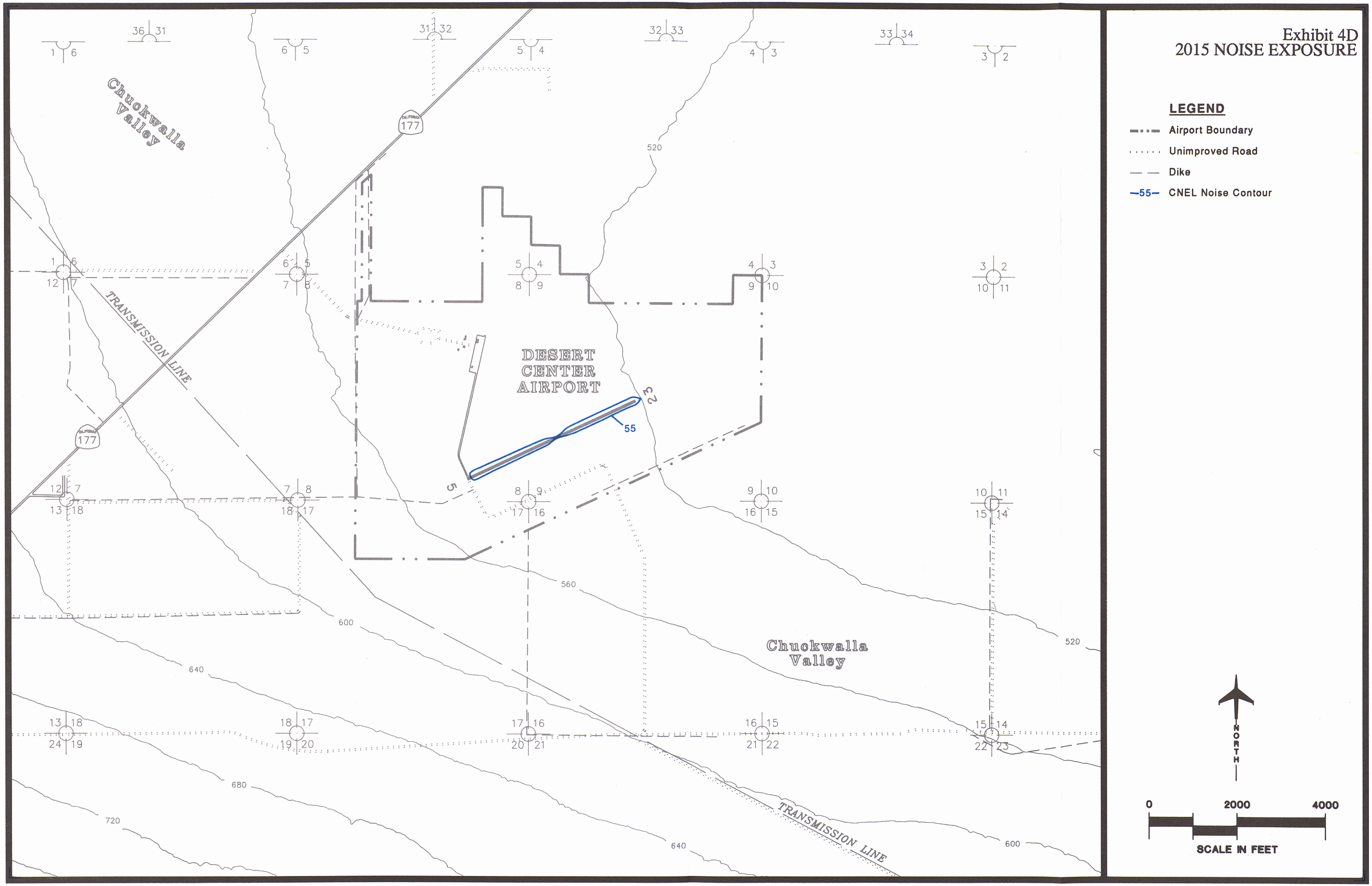
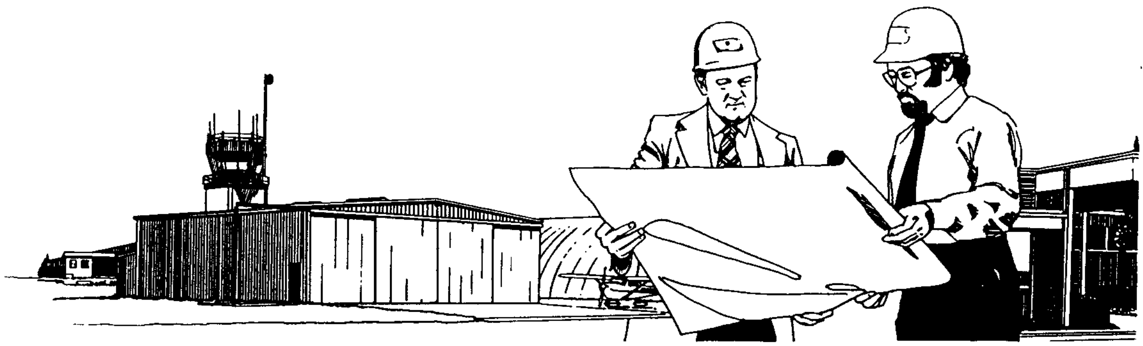


Exhibit 4C
1991 NOISE EXPOSURE
LEGEND
Airport Boundary
Unimproved Road
Dike
55 CNEL Noise Contour
DESERT CENTER AIRPORT
Chuckwalla Valley
Chuckwalla Valley
TRANSMISSION LINE
TRANSMISSION LINE
177
177
5
23
55
520
560
600
640
680
720
640
600
520
NORTH
0
2000
4000
SCALE IN FEET

Exhibit 4D
2015 NOISE EXPOSURE



Chapter Five
SAFETY-INFLUENCED AREAS: ISSUES AND ALTERNATIVES



Chapter Five SAFETY-INFLUENCED AREA: ISSUES AND ALTERNATIVES

Desert Center Airport

5.1 INTRODUCTION

Safety of people on the ground and in the air and the protection of property from airport-related hazards are among the responsibilities of the Airport Land Use Commission. This chapter provides an analysis of safety issues at Desert Center Airport, defining the airport safety areas and discussing safety compatibility planning issues and alternatives.

5.2 AREAS OF SAFETY CONCERN

In Chapter Three, the planning criteria for defining airport safety areas were discussed. **Exhibit 5A** shows the safety areas around Desert Center Airport based on these criteria.

The safety zones for Runway 5-23 are based on the criteria for a visual runway handling single and twin-engine aircraft. Classified as a utility runway, it lacks adequate width and length to handle most business jets on a regular basis, although business jets have been known to use the airport on occasion.

The exhibit shows existing land use in the airport area. The ISZ zones (inner safety zone) for both runway ends are completely contained on existing airport property.

Most of the ETZ (emergency touchdown zone) for each runway is on the airport property. The Runway 5 ETZ extends about 1,000 feet beyond the property line, while the Runway 23 ETZ extends about 500 feet off the property.

The OSZ's for each runway also are nearly contained on the property. They extend beyond the property line by 700 to 1,200 feet off the approach end of Runway 5 and 100 to 800 feet off the approach end of Runway 23.

With the exception of a power transmission line crossing through the TPZ and the outer edge of the ETZ and OSZ for Runway 5, and the few buildings on the airport in the TPZ, no development is within any of the safety zones.

5.3 *SAFETY ISSUES*

In determining the scope of any safety compatibility planning issues in the Desert Center area, it is necessary to compare the safety zone boundaries with the existing zoning map. (See **Exhibit 2F** in Chapter Two.) Then the potential for the development of incompatible land uses can be evaluated. Land uses permitted by the County Land Use Ordinance are compared with the land use compatibility guidelines for safety zones presented in **Table 3B** in Chapter Three (page 3-4). As the area is unincorporated, zoning jurisdiction rests with Riverside County. This discussion covers only those safety zones extending off the airport property.

5.3.1 ETZ - EMERGENCY TOUCHDOWN ZONE

According to the land use compatibility guidelines in **Table 3B**, no structures or significant obstructions should be permitted within the ETZ. Those parts of the ETZ which are off airport property east and west of the airport are currently zoned N-A, Natural Assets. Uses permitted in the N-A district which could constitute safety hazards include residences, public utility substations, and museums. Other potentially hazardous uses permitted subject to conditional use approval include recreational vehicle parks, mobile home parks, resort hotels, camps, and guest ranches. Of course, in the ETZ any structure should be considered a potential hazard.

Riverside County lacks the regulatory structure needed to ensure that the ETZ would be kept free of significant obstructions. Review of development proposals by the Airport Land Use Commission is the only current safeguard.

5.3.2 OSZ - OUTER SAFETY ZONE

Based on the land use compatibility guidelines in **Table 3B**, several kinds of land uses should be prohibited in the OSZ zone, including residences, hotels, restaurants and bars, various public assembly uses, and industries with flammable materials. Limits on the number of persons per acre and per building are also advised.

Those portions of the OSZ safety zone extending off airport property are zoned N-A, Natural Assets. As described above, several categories of land use which are incompatible in the OSZ are permitted by this zoning district.

5.3.3 TPZ - TRAFFIC PATTERN ZONE

According to **Table 3B** in Chapter Three, places of public assembly are to be discouraged in the TPZ as are industries with flammable products. Land in the TPZ is zoned W-2, Controlled Development, or N-A, Natural Assets.

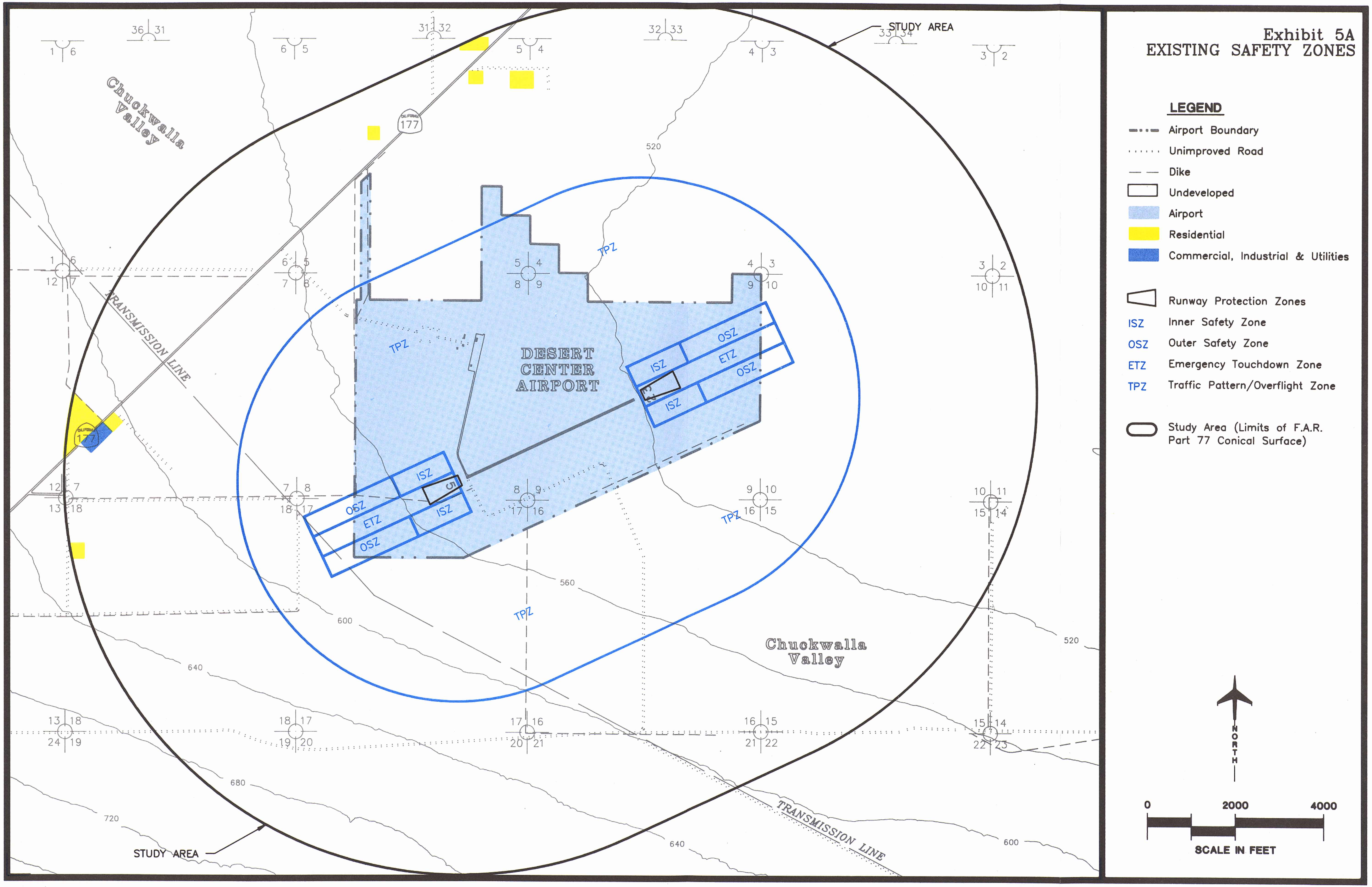


Exhibit 5A
EXISTING SAFETY ZONES
LEGEND
Airport Boundary
Unimproved Road
Dike
Undeveloped
Airport
Residential
Commercial, Industrial & Utilities
Runway Protection Zones
ISZ Inner Safety Zone
OSZ Outer Safety Zone
ETZ Emergency Touchdown Zone
TPZ Traffic Pattern/Overflight Zone
Study Area (Limits of F.A.R. Part 77 Conical Surface)
NORTH
0 2000 4000
SCALE IN FEET
DESERT CENTER AIRPORT
Chuckwalla Valley
Chuckwalla Valley
STUDY AREA
STUDY AREA
TRANSMISSION LINE
TRANSMISSION LINE
177
177
TPZ
ISZ
OSZ
ETZ
520
560
600
640
680
720

Some of the land uses permitted in these zoning districts, particularly in the W-2 district, could be considered incompatible in the TPZ safety zone. These include schools, libraries, museums, fairgrounds, drive-in theaters, mobile home parks, recreational vehicle parks, and rodeo arenas. Some of these uses are also permitted by right or conditionally in the N-A district.

In the Desert Center Airport area, the minimum residential lot size in the W-2 district is 10 acres. In the N-A zone, the minimum lot size is 20 acres. This ensures very low residential development density which is attractive from an airport safety compatibility perspective.

5.3.4 SUMMARY OF ISSUES IN SAFETY ZONES

Within the ETZ, OSZ, and TPZ safety zones, certain incompatible land uses are permitted by current zoning. The zoning regulations are not structured to set clear guidelines and policies to property owners, administrators, or policy makers as to the airport compatibility concerns that should be addressed in their land use planning and decision-making. While these people may attempt to make good faith efforts to consider these issues, the ordinance is not designed to make this easy. Under current policy, the Airport Land Use Commission, through its review of development proposals, is the only entity directly taking these airport issues into consideration.

Clearly, changes in local regulations should be made to ensure that airport compatibility considerations are addressed at the outset of the planning and development process. This requires changes in the County land use regulations.

5.4 POTENTIAL LAND USE MEASURES

Given the specialized safety compatibility concerns in different areas around the airport, the only reasonable regulatory instrument would appear to be airport environs overlay zoning. An ordinance amending the current County Land Use Ordinance could be adopted establishing overlay districts corresponding to the airport safety zones. The land use guidelines in **Table 3B** and on pages 3-4 through 3-7 could serve as the regulations applying within each overlay zone. The overlay regulations would supplement the requirements of the underlying districts.

Problems potentially may be encountered with the ETZ zones because of the severity of the proposed land use restrictions. Fortunately, these are relatively small and narrow areas. Given the large parcel sizes in the study area, property owners are likely to have only part of their property within any one of these zones.

Local planning policies and regulations provide ways of addressing potential property owner concerns about strict land use regulations in the ETZ. The use of planned development or specific plan authority is particularly appropriate. Owners of land through which the ETZ passes could prepare a special development plan, setting aside those areas as open space, clustering development elsewhere on their property.

5.5 SUMMARY

Except for a transmission line crossing the Runway 5 ETZ, all airport safety zones are free of potentially hazardous encroachments. A review of existing zoning, however, indicates that zoning districts around the airport permit potentially hazardous land uses within the safety zones.

While review of development proposals by the Airport Land Use Commission provides some assurance against the development of incompatible land uses in the safety areas, efforts should be made to encourage Riverside County to adopt some form of airport environs overlay zoning to implement the safety compatibility guidelines of this Plan.

Chapter Six
HEIGHT-INFLUENCED AREAS: ISSUES AND ALTERNATIVES

DESERT CENTER

Chapter Six
HEIGHT-INFLUENCED AREA: ISSUES AND ALTERNATIVES

6.1 INTRODUCTION

In order for an airport to be used safely and efficiently, it is essential that aircraft have access that is unimpeded by obstructions. Tall structures and trees long have been recognized as potential safety hazards in the environs of airports, especially along runway approaches.

This chapter reviews the Riverside County height protection guidelines, described in Chapter Three, as they apply in the Desert Center Airport area. Potential issues of concern are discussed, and potential measures to address the concerns are offered.

6.2 HEIGHT PROTECTION AREAS

The Federal Aviation Administration (FAA) has defined criteria to guide the review of proposed tall structures in the vicinity of airports. F.A.R. Part 77 defines imaginary surfaces around airports through which any proposed penetrations should be evaluated by FAA technical personnel for a hazard determination.

An FAA finding that a penetration is hazardous does not necessarily stop a project. The FAA ruling is merely advisory. F.A.R. Part 77 does not authorize the FAA to regulate land use in the airport vicinity. That remains a local function. FAA does recommend, however, that local governments adopt height controls in the vicinity of airports based on the Part 77 criteria. (See **A Model Zoning Ordinance to Limit Height of Objects Around Airports,** FAA Advisory Circular 150/5190-4A, December 14, 1987.)

Exhibit 3B in Chapter Three shows the Part 77 surfaces around a typical airport. They define a bowl or stadium-shaped area with ramps sloping up from each runway end. The dimensions of each surface vary depending on the runway classification and approach.

A Part 77 map for Desert Center Airport is shown in **Exhibit 6A**. The map is color-coded for ease of interpretation. In some areas, the various approach surfaces intersect and pass through each other. In those cases, the color-coding on the map gives precedence to the lowest area. Each Part 77 surface is discussed below.

6.2.1 PRIMARY SURFACE

The primary surface is in the immediate runway area. Its surface is the ground elevation. It extends 200 feet off each runway end and varies in width depending on the type of runway. At Desert Center, the primary surface for Runway 5-23 is 250 feet wide.

6.2.2 APPROACH SURFACE

The approach surface is a trapezoidal area extending outward and sloping upwards from the end of the primary surface. The approach slope, width, and length vary depending on the type of runway approach. At Desert Center, visual approaches are on both ends of Runway 5-23. They have approach slopes of 20:1, extending 5,000 feet outward from the end of the primary surface. Note that at distances of 3,000 feet (Runway 5) and 3,700 feet (Runway 23), the approach slopes rise above the horizontal surface, so the outer portions of the approach surfaces are not colored red.

6.2.3 TRANSITIONAL SURFACE

Transitional surfaces with a slope of 7:1 are defined between the primary and approach surfaces and the horizontal surface.

6.2.4 HORIZONTAL SURFACE

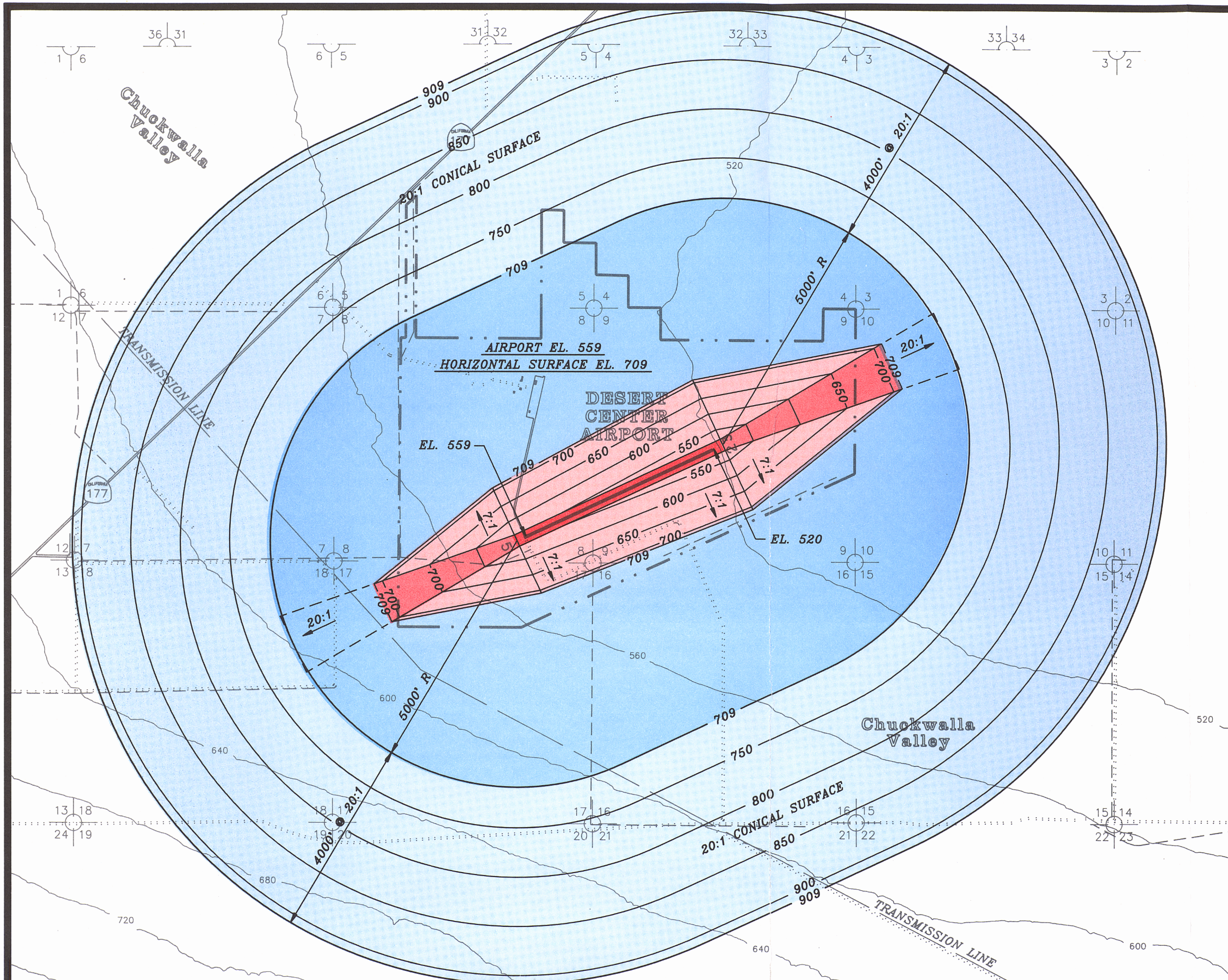
The horizontal surface is a flat plane 150 feet above the airport field elevation. Its outer boundary is 10,000 feet from precision and non-precision runways larger than utility, and 5,000 feet from visual and utility runways. The horizontal surface is a reasonable representation of the outer limits of a typical airport traffic pattern area.

At Desert Center, Runway 5-23 is defined as a utility runway with visual approaches. The boundaries of the horizontal surface are set at a radius of 5,000 feet from the runway. The elevation of the horizontal surface is 709 feet. (The airport field elevation is 559 feet.)

6.2.5 CONICAL SURFACE

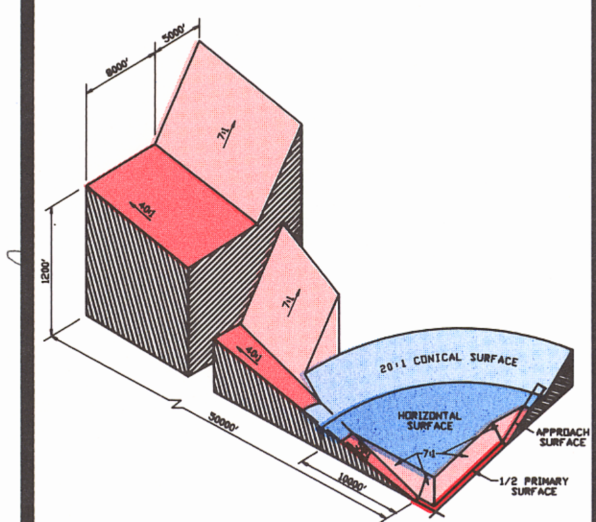
The conical surface slopes upwards from the horizontal surface at a rate of 20:1, extending 4,000 feet outward. This standard applies at all airports. At Desert Center, the elevation at the outer edge of the conical surface is 909 feet.

Exhibit 6A
F.A.R. PART 77 SURFACES



LEGEND

- Airport Boundary
- Unimproved Road
- Dike
- Primary Surface
- 7:1 Transitional Surfaces
- Approach Surfaces
- Horizontal Surface
- Conical Surface



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6.3 *HEIGHT PROTECTION ISSUES*

6.3.1 TOPOGRAPHY

The airport elevation is 559 feet above mean sea level (MSL). Topographic maps prepared by the U.S. Geological Survey (USGS) indicate that the land in the area slopes gently downward from southwest to northeast from a high of 700 feet at the southwest edge of the conical surface to about 490 feet at the east edge. The terrain does not pose any obstruction problems.

6.3.2 CURRENT HEIGHT LIMITS IN ZONING ORDINANCES

The height of structures permitted by the County zoning ordinance is an important consideration in height protection planning. The undeveloped land in the study area is zoned N-A Natural Assets or W-2 Controlled Development. (See **Exhibit 2F** in Chapter Two.)

The maximum building height is 20 feet in the N-A zone. In the W-2 zone it is 50 feet, although taller structures may be permitted through the conditional use or plot plan approval process. This includes buildings up to 75 feet, structures other than buildings up to 105 feet, and broadcasting antennas taller than 105 feet.

These height limitations should not pose frequent problems in the Desert Center area. The approach surfaces are particularly well protected by the current zoning. Those areas are zoned N-A. The 20-foot height limitation in that zoning district would not pose obstruction problems with the runway approaches.

The potential for approval of tall towers in the W-2 zoning district could result in penetrations of any of the horizontal and conical surfaces. Fortunately, approval of these developments is subject to special conditional use review and approval by the County. The Airport Land Use Commission would have ample opportunity to comment on such proposals and ensure FAA review of the proposal.

6.3.3 SUMMARY OF HEIGHT CONTROL ISSUES

In the W-2 district, the Riverside County zoning ordinance allows structure heights, subject to conditional use approval, which could penetrate the horizontal and conical surfaces around the airport.

In order to comply with the height limitation guidelines presented in Chapter Three, the Part 77 surfaces should be considered maximum height limits. New regulatory authority for the County should be considered in order to achieve this objective.

6.4 *POTENTIAL LAND USE MANAGEMENT MEASURES*

Height protection is best achieved through overlay zoning. The FAA's model height protection overlay zoning would be an appropriate model for the County to consider. If overlay zoning for safety compatibility is also considered, it would be desirable to design a comprehensive airport environs overlay zoning ordinance.

Zoning district boundaries are typically expressed in only two dimensions. Thus, they are quite simple to map. With the addition of the third dimension, height control regulations are more complicated to understand and administer.

Administration of height control regulations deserves careful consideration. It would be appropriate to adopt, by reference, the Part 77 map for the airport as the height control zoning map. The basic zoning maps of the County should somehow be marked to trigger a check of the Part 77 map for developments proposed in the area. For tall structures proposed under the Part 77 surfaces, applicants should be required to provide detailed information on the elevation of the structure with respect to the Part 77 surfaces to enable a determination of compliance to be made.

If the County wishes to have a procedure for the consideration of variances, approval should be conditioned upon a finding by FAA that no hazard would be created by the penetration. FAA's "no hazard" finding should be circulated to appropriate County agencies for comment prior to final decisions by local land use planning agencies. In addition, compliance with the conventional County standards relating to variances should be ensured.

The County's geographic information system (GIS), managed by the County Transportation Department, could be a valuable aid in the administration of height control zoning. The system includes topography for the County. If three-dimensional Part 77 maps for the airports in the County were also added to the system, it would enable preparation of a quick obstruction analysis for any proposed structure. The quality of the analysis, of course, will only be as accurate as the topographic data in the system. Currently, this is somewhat variable. More accurate topographic information can always be added to the GIS when it is available. Nevertheless, such a capability could be very valuable to the Airport Land Use Commission, County planners, and applicants.

6.5 SUMMARY

Based on a review of the current Part 77 map for the airport (**Exhibit 6A**) and USGS topographic maps, local terrain does not penetrate any Part 77 surfaces. A review of current height limits in the Riverside County zoning ordinance reveals that structures which could penetrate the Part 77 surfaces are permitted in the W-2 district. For the most part, this risk is confined to towers and antennas, which must receive conditional use or plot plan approval.

While review of development proposals by the Airport Land Use Commission provides some assurance against the development of tall structures penetrating the Part 77 surfaces, additional regulations would be helpful. The Commission should encourage Riverside County to adopt height protection overlay zoning to implement the height protection guidelines of this Plan. Use of the County's geographic information system should be seriously considered as an aid to administration of the zoning.

Chapter Seven
COMPREHENSIVE AIRPORT LAND USE PLAN

Chapter Seven COMPREHENSIVE AIRPORT LAND USE PLAN

Desert Center Airport

7.1 INTRODUCTION

This chapter presents the Comprehensive Land Use Plan for Desert Center Airport. It includes a description of the airport influenced area, land use compatibility standards, and related land use policies for use by the Riverside County Airport Land Use Commission.

7.2 AIRPORT INFLUENCED AREA

The "airport influenced area" is that area within which the Riverside County Airport Land Use Commission shall exercise its responsibilities under the California Public Utilities Code, Chapter 4, Article 3.5, Section 21670 et seq. As discussed in Section 3.6 of Chapter Three, the airport influenced area shall be the outer boundaries defined by overlaying the F.A.R. Part 77 surfaces and the 60 CNEL contour.

Exhibit 7A shows the airport influenced area at Desert Center Airport. It shows the airport noise contours for the year 2015, the airport safety areas, and the outer edge of the F.A.R. Part 77 conical surface.

7.3 LAND USE COMPATIBILITY STANDARDS

Land use compatibility standards within the airport influenced area at Desert Center Airport are based on three separate considerations: airport noise, safety, and height. These criteria are based on the policy guidelines discussed in Chapter Three. They have been refined for specific application at Desert Center Airport.

These land use standards are intended to be applied comprehensively. Where any parcels of land are subject to more than one set of land use compatibility standards, the most restrictive standard shall apply.

7.3.1 NOISE COMPATIBILITY STANDARDS

Exhibit 7B shows the land use standards for noise compatibility at Desert Center Airport. These are based on the guidelines shown in Table 3A in Chapter Three. They are presented in a format similar to FAA's land use compatibility guidelines to make them simpler to understand and implement.

Based on the forecasts for the year 2015, the 60 CNEL contour remains on the runway and cannot be clearly mapped at the scale of the study area base map. **Exhibit 7A** shows the 55 CNEL contour, which is also very small. Thus, these policies will have no practical effect unless activity at Desert Center increases more greatly than anticipated and the noise contours are updated.

Wherever uses are described as "not compatible", the Airport Land Use Commission shall disapprove development applications which would introduce those uses into areas impacted by noise above the designated level.

With the exception of transient lodgings (e.g. hotels and motels) and caretaker residences, all residential uses are considered incompatible with noise above 60 CNEL. Residences for caretakers or security personnel may be permitted as accessory uses to commercial or industrial uses in areas subject to noise up to 75 CNEL if appropriate soundproofing measures are taken. Transient lodgings are compatible within the 60 to 65 CNEL range. Between 65 and 70 CNEL, they may be permitted provided that measures are taken to ensure sound insulation to achieve a 25 dB outdoor to indoor noise level reduction. Transient lodgings are not compatible with noise above 70 CNEL.

Schools, hospitals, nursing homes, churches, auditoriums, and concert halls shall be considered noise-sensitive institutions. While they are compatible with noise levels between 60 and 65 CNEL, they are not compatible with noise levels above 65 CNEL.

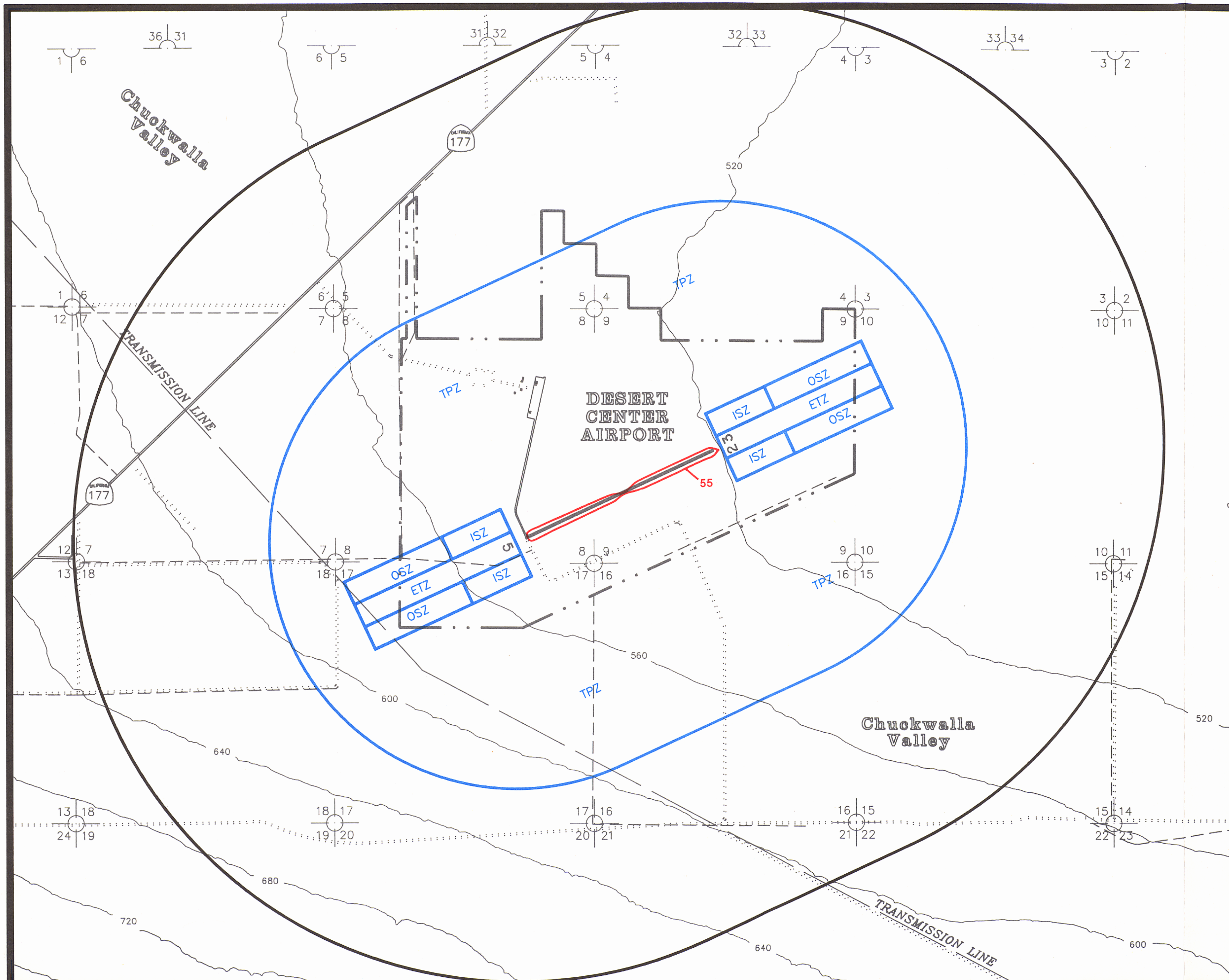
Other public and institutional uses, as well as commercial uses, are compatible with noise as high as 80 CNEL, although steps to ensure noise level reductions shall be taken when these uses are subject to aircraft noise above 70 CNEL.

Manufacturing is considered compatible with noise levels up to 80 CNEL. Noise level reduction measures, however, shall be taken when manufacturing uses are proposed for areas impacted by noise above 75 CNEL.

Mining, fishing, and other resource extraction uses, as well as crop raising, are compatible with all aircraft noise levels.

Most recreation and open space uses are compatible with noise levels up to 75

Exhibit 7A
AIRPORT INFLUENCED AREA



LEGEND

- Airport Boundary
- Unimproved Road
- Dike
- –55– CNEL Noise Contour - 2015
- ISZ Inner Safety Zone
- OSZ Outer Safety Zone
- ETZ Emergency Touchdown Zone
- TPZ Traffic Pattern Zone
- Outer Edge of F.A.R. Part 77 Conical Surface

NORTH

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SCALE IN FEET

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LAND USE	Community Noise Equivalent Level (CNEL) in decibels				
RESIDENTIAL	60-65	65-70	70-75	75-80	80+
Residential, other than mobile homes and transient lodgings	N[4]	N[4]	N[4]	N	N
Mobile home parks	N	N	N	N	N
Transient lodgings	Y	Y[1]	N	N	N
PUBLIC/INSTITUTIONAL					
Schools	Y	N	N	N	N
Hospitals and nursing homes	Y	N	N	N	N
Churches, auditoriums, and concert halls	Y	N	N	N	N
Governmental services	Y	Y	Y[2]	Y[3]	N
Transportation	Y	Y	Y[2]	Y[3]	N
Parking	Y	Y	Y[2]	Y[3]	N
COMMERCIAL USE					
Offices, business and professional	Y	Y	Y[2]	Y[3]	N
Wholesale and retail-building materials, hardware and farm equipment	Y	Y	Y[2]	Y[3]	N
Retail trade-general	Y	Y	Y[2]	Y[3]	N
Utilities	Y	Y	Y[2]	Y[3]	N
Communication	Y	Y	Y[2]	Y[3]	N
INDUSTRIAL					
Manufacturing	Y	Y	Y	Y[3]	N
Mining, fishing, resource extraction	Y	Y	Y	Y	Y
RECREATION/OPEN SPACE/ AGRICULTURE					
Outdoor sports arenas	Y	Y	Y	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N
Wildlife exhibits and zoos	Y	Y	N	N	N
Parks, resorts, and camps	Y	Y	Y	N	N
Golf courses, riding stables, and water recreation	Y	Y	Y	N	N
Livestock, farming and breeding	Y	Y	Y	N	N
Crop raising	Y	Y	Y	Y	Y

See other side for key to table

Exhibit 7B
RIVERSIDE COUNTY LAND USE STANDARDS
FOR NOISE COMPATIBILITY

KEY TO TABLE

Y (Yes)	Land use and related structures compatible and permitted (subject to other local land use controls).
N (No)	Land use and related structures not compatible and not permitted within designated CNEL range.
Y^1	Land use and related structures generally compatibile provided that measures to achieve an outdoor to indoor noise level reduction (NLR) of 25 dB are incorporated into design and construction of sleeping rooms.
Y^2	Land use and related structures generally compatible provided that measures to achieve an outdoor to indoor noise level reduction (NLR) of 30 dB are incorporated into design and construction of office areas and public reception and gathering areas within buildings.
Y^3	Land use and related structures generally compatible provided that measures to achieve an outdoor to indoor noise level reduction (NLR) of 35 dB are incorporated into design and construction of office areas and public reception and gathering areas within buildings.
N^4	Residences for caretakers or security personnel may be permitted as accessory uses to commericial or industrial uses. Measures to achieve the required outdoor to indoor noise level reduction (NLR) shall be incorporated into the design of the residences as follows: in the 60 -70 CNEL range - 25 dB NLR in the 70 -75 CNEL range - 30 dB NLR

CNEL. These include outdoor sports arenas, parks, resorts, and camps, in addition to livestock feeding and breeding. Outdoor music shells and amphitheaters are not compatible with noise above 65 CNEL, and wildlife exhibits and zoos are not compatible with noise above CNEL 70.

7.3.2 SAFETY COMPATIBILITY STANDARDS

Table 7A describes the safety compatibility standards at Desert Center Airport. These are based on the guidelines shown in Table 3B in Chapter Three, as refined based on subsequent consultations with local officials. The airport safety zones at Desert Center are shown in **Exhibit 7A**. A detailed drawing showing the dimensions of the areas is provided in **Exhibit 7C**. The boundaries of the safety zones shall be defined based on the ultimate airfield layout as shown in the official airport layout plan.

The safety zones are discrete and separate zones, rather than cumulative zones. The regulations applying in each zone shall be as described for that zone in **Table 7A**.

7.3.2.a ETZ Zone

Within the ETZ, Emergency Touchdown Zone, no structures and no land uses involving concentrations of people shall be permitted. Neither shall significant obstructions be permitted in this area. This area is 500 feet wide, centered on the extended runway centerline, and extends 3,500 feet off the end of the primary surface at each runway end.

7.3.2.b ISZ Zone

The ISZ, Inner Safety Zone, extends from 1,320 feet off the end of the primary surface and is 1,500 feet wide, centered on the extended runway centerline. Within this zone, no structures are permitted nor are uses involving concentrations of people. No petroleum or explosives or above-grade powerlines shall be permitted.

7.3.2.c OSZ Zone

The OSZ, Outer Safety Zone, extends outward from the ISZ for 2,180 feet. Within this zone, a variety of land uses shall be prohibited. These include residential, hotels, and motels, various uses involving large concentrations of people, public utility stations and communications facilities, and industries processing flammable materials.

Lot coverage by structures shall not exceed 25% of the net lot area. The intent of limiting structural coverage is to reduce the risk of an aircraft colliding with a building and endangering occupants while also improving the chance that a pilot could find open area in case of a controlled, forced landing.

The maximum population density for uses within the OSZ zone shall not exceed 25 persons per acre for uses in structures. The maximum population density for uses not in structures shall be 50 persons per acre.

The following methodology shall be used in determining whether a proposed structure complies with the population density requirements of the OSZ Zone. (This is based on Appendix G of the **Airport Land**

TABLE 7A
Land Use Compatibility Standards for Airport Safety Zones
Desert Center Airport

Safety Zone	Maximum Population or Dwelling Unit (du) Density	Maximum Coverage By Structures	Land Use
ETZ - Emergency Touchdown Zone	0[1]	0[1]	No significant obstructions[2]
ISZ - Inner Safety Zone	0[1]	0[1]	No petroleum or explosives No above-grade powerlines
OSZ - Outer Safety Zone	Uses in structures[3]: 25 persons/ac. (see text for explanation) Uses not in structures: 50 persons/ac.	25% of net area	No residential No hotels, motels No restaurants, bars No schools, hospitals, government services No concert halls, auditoriums No stadiums, arenas No public utility stations, plants No public communications facilities No uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials.
TPZ - Traffic Pattern Zone	Not Applicable	50% of gross area or 65% of net area whichever is greater	Discourage schools, auditoriums, amphitheaters, stadiums[5] Discourage uses involving, as the primary activity, manufacture, storage, or distribution of explosives or flammable materials.[4, 5]

NOTES:

A. The following uses shall be prohibited in all airport safety zones:

(1) Any use which would direct a steady light or flashing light of red, white, green, or amber colors associated with airport operations toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport, other than an FAA approved navigational signal light or visual approach slope indicator.

(2) Any use which would cause sunlight to be reflected toward an aircraft engaged in an initial straight climb following takeoff or toward an aircraft engaged in a straight final approach toward a landing at an airport.

(3) Any use which would generate smoke or water vapor or which would attract large concentrations of birds, or which may otherwise affect safe air navigation within the area.

(4) Any use which would generate electrical interference that may be detrimental to the operation of aircraft and/or aircraft instrumentation.

B. Avigation easements shall be secured through dedication for all land uses permitted in any safety zones.

---

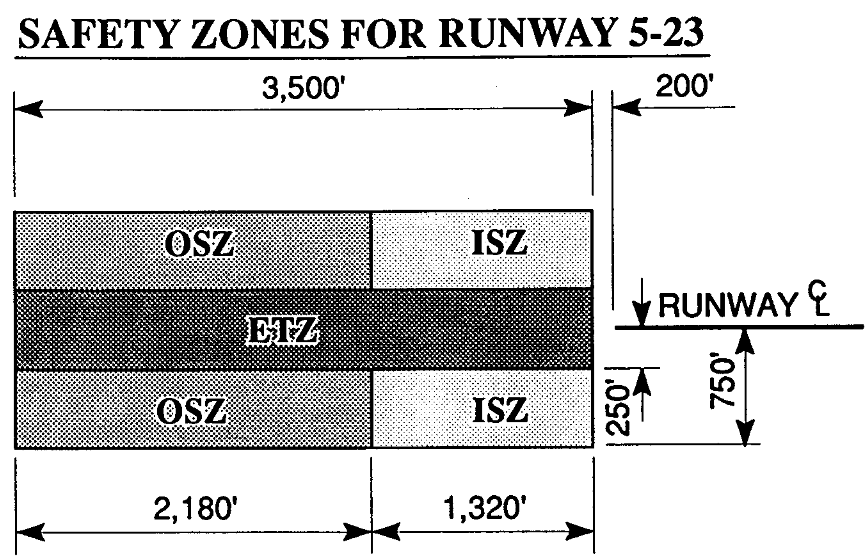
[1]No structures permitted in ETZ or ISZ.

[2]Significant obstructions include, but are not limited to, large trees, heavy fences and walls, tall and steep berms and retaining walls, non-frangible street light and sign standards, billboards.

[3]A "structure" includes fully enclosed buildings and other facilities involving fixed seating and enclosures limiting the mobility of people, such as sports stadiums, outdoor arenas, and amphitheaters.

[4]This does not apply to service stations involving retail sale of motor vehicle fuel if fuel storage tanks are installed underground.

[5]See Subsection 7.4.2 in text.



ZONE	DIMENSIONS (feet) LENGTH	WIDTH
ETZ - Emergency Touchdown Zone	1,320	1,500
ISZ - Inner Safety Zone	2,180	1,500
OSZ - Outer Safety Zone	3,500	500
TPZ - Traffic Pattern Zone	Outer edge of F.A.R. Part 77 Horizontal Surface	

Exhibit 7C
RUNWAY SAFETY ZONE DIMENSIONS
DESERT CENTER AIRPORT

Use Planning Handbook, California Department of Transportation, July 1983.)

1. Determine the net area, in acres, of that portion of the lot proposed for development that lies within the OSZ.

2. Divide the square footage of that portion of the proposed structure that lies within the OSZ by the square footage per occupant required by the building code. This defines maximum building occupancy.

3. Multiply the maximum occupancy (from Step 2) by 50% to estimate the maximum number of persons actually expected to be present at any one time.

4. Divide the "number of persons expected" (from Step 3) by the net lot area in acres (from Step 1). If this is less than 25 persons per acre, the use is consistent and permissible. If it exceeds 25 persons per acre, the use is inconsistent and shall be revised.

7.3.2.d TPZ Zone

The TPZ, Traffic Pattern Zone, covers an area of frequent aircraft overflight and low altitude turning movements. It is defined by the outer edge of the F.A.R. Part 77 horizontal surface. This is an area of lesser hazard compared with the other areas. No population or dwelling unit density limits apply within the TPZ. Maximum lot coverage shall be limited to 50% of the gross development area or 65% of the net lot area, whichever is greater.

Public and semi-public land uses involving very large concentrations of people, namely schools, auditoriums, amphitheaters, and stadiums, shall be discouraged from being developed in this area. Uses involving the manufacture, storage, or distribution of explosives or flammable materials also shall be discouraged in the TPZ. (This shall not be applied to service stations involving retail sale of motor vehicle fuel where the fuel tanks are underground.) It is recognized that within the large area of the TPZ, it may not always be possible to prevent these uses given the practical constraints that often exist with facility siting.

7.3.2.e Other Requirements

As noted in Table 7A, several other uses posing risks to aircraft in flight also shall be prohibited within all safety zones. These involve uses which would cause confusing or blinding lights and reflections to be directed to aircraft in flight, uses causing smoke, water vapor, or gatherings of birds, or those causing electrical interference. Rather than straight-forward land use restrictions, these may be considered performance standards. Only a few kinds of land uses have inherent attributes that would make them necessarily violate these standards. (Landfills and power generating plants are examples.) Many uses which might cause conflicts can be designed to avoid these problems. For example, businesses could design their lighting systems to avoid confusion with airfield lighting.

In addition to these land use restrictions, avigation easements shall be secured for all uses receiving development approval within any safety zone.

7.3.3 HEIGHT STANDARDS

The criteria defined in F.A.R. Part 77 shall constitute the airport vicinity height standards at Desert Center Airport. The F.A.R. Part 77 map for the airport is shown in Exhibit 6A in Chapter Six. The imaginary surfaces defined by this exhibit shall constitute height limits which shall not be exceeded by structures proposed for development beneath them.

7.4 RELATED LAND USE POLICIES

7.4.1 FINDINGS AS TO SIMILAR USES

Cases may arise where the Airport Land Use Commission (ALUC) must review a proposal for development of a land use which is not explicitly provided for by the land use standards of **Exhibit** 7A (noise compatibility) or **Table** 7A (safety compatibility). In such cases, the ALUC shall apply conventional rules of reason in determining whether or not the subject land use is substantially similar to any land use which is subject to regulation. In making these determinations, the ALUC shall review the background analysis presented in this Comprehensive Land Use Plan document, including the technical appendices.

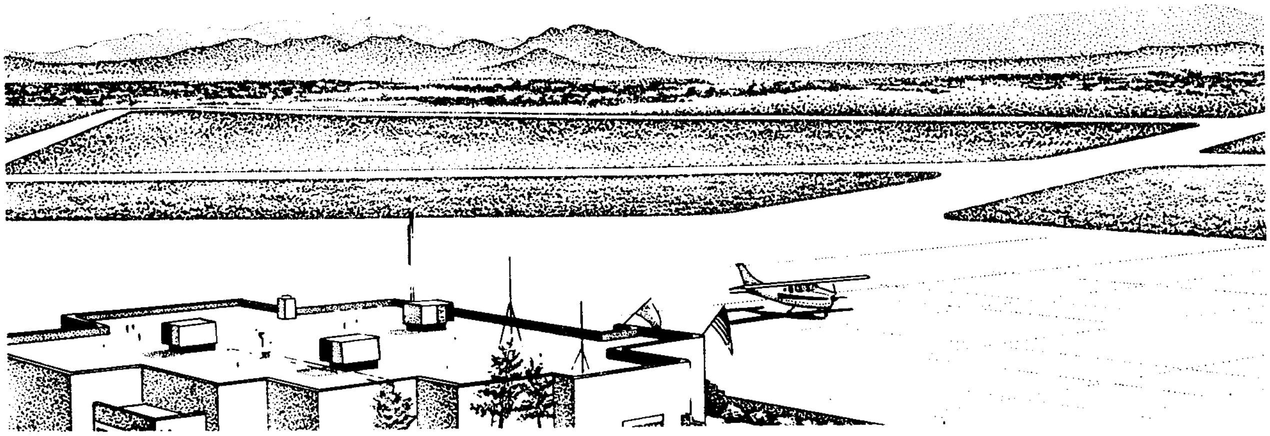
With respect to noise compatibility, the ALUC shall refer to the "Suggested Land Use Compatibility Guidelines" of the Federal Interagency Committee on Urban Noise, presented in Table B6 of Appendix B, for assistance in making findings as to similar uses.

7.4.2 FINDINGS FOR LAND USES WHICH ARE TO BE DISCOURAGED

Within the TPZ safety zone, a variety of land uses are to be discouraged from being developed. When development of these uses is proposed, the Airport Land Use Commission shall require the applicant to show that alternative locations have been considered and are not feasible. The applicant shall then be directed to consider a development plan that will minimize the exposure to hazard as much as possible. This might involve reducing structure heights, reducing lot coverage, or reducing the overall scale of the project, considering satellite locations for some of the proposed functions of the facility.

Land uses described as "uses to be discouraged" which were lawfully established prior to the adoption of this Comprehensive Land Use Plan shall be permitted to be modified or enlarged, provided that avigation easements are granted to Riverside County.

Chapter Eight
IMPLEMENTATION PLAN



Chapter Eight
IMPLEMENTATION PLAN

Desert Center Airport

8.1 ADOPTION OF PLAN

The Riverside County Airport Land Use Commission adopted the Comprehensive Land Use Plan (CLUP) for Desert Center Airport on July 15, 1992. A public hearing was held prior to adoption of the Plan on July 8, 1992. Additional public involvement in the development of the Plan was provided through an ad hoc airport advisory committee (AAC) created by the Airport Land Use Commission. AAC members included representatives of the Riverside County Planning Department, Riverside County Economic Development Agency, local property owners, airport users, the Airport Land Use Commission, and the State Division of Aeronautics. The AAC reviewed the working papers of the consultant and offered comments and suggestions throughout the planning process.

The approved Comprehensive Land Use Plan is the ALUC's official land use policy document within the airport influenced area for Desert Center Airport. ALUC decisions and recommendations on development actions proposed within the airport influenced area shall be based on the policies of the CLUP.

8.2 UPDATE AND AMENDMENT OF PLAN

The Riverside County Airport Land Use Commission and its staff should take care to keep the CLUP up-to-date. It should review the plan as often as necessary, although according to state law it may not be amended more than once per year.

It will be especially important to review the plan whenever the airport layout plan is amended or an airport master plan is developed. Changes in runway alignments or runway lengths in particular could require amendments to the CLUP. At the same time, it is important for the ALUC to ensure that the CLUP is considered during any future master plan studies.

The ALUC also should review the CLUP when new guidance documents are prepared by the California Department of Transportation. The Department of Transportation is now updating its "Airport Land Use Planning Handbook". It is important for the CLUP to consider the latest relevant information and research on noise, safety, and height compatibility issues, particularly when that information has been evaluated and weighed through an authoritative consultation process.

The CLUP also should be reviewed by the ALUC and staff whenever experience indicates that unanticipated difficulties are being encountered that might be solved through appropriate amendments to the plan.

8.3 *ADMINISTRATION OF PLAN*

8.3.1 SCOPE OF ALUC DEVELOPMENT REVIEW RESPONSIBILITIES

The State Aeronautics Law (Public Utilities Code Chapter 4, Article 3.5) encourages local general plans and specific plans to be consistent with the adopted Comprehensive Land Use Plans of County Airport Land Use Commissions. It also authorizes the Airport Land Use Commission (ALUC) to review local development actions to ensure consistency with the Comprehensive Land Use Plan.

Where the local general plans or specific plans are not consistent with the Airport Comprehensive Land Use Plan, the local agency shall be notified by the ALUC. The local agency may overrule the ALUC after holding a public hearing and after making specific findings that the existing plans are compatible with the purposes of the aeronautics law. A two-thirds majority vote of the governing body is required. (See Section 21676(a).)

If the ALUC finds that the local agencies have not revised their general or specific plans, or overruled the ALUC with the required two-thirds vote, State law enables the ALUC to require that the local agencies submit all development actions, regulations, and permits to the ALUC for review. If the ALUC finds that the proposed action is not consistent with the Comprehensive Airport Land Use Plan, the local agency shall be so notified and shall hold a public hearing to reconsider its plan. The local agency may overrule the ALUC with a two-thirds vote of its governing body if it makes specific findings that the proposed action is consistent with the purposes of Section 21670 of the Aeronautics Law. (See Section 21676.5(b).)

Where the local agencies have amended their general and specific plans to be consistent with the Comprehensive Land Use Plan, or where they have overruled the ALUC's finding of inconsistency, then only general plan and specific plan amendments, new specific plan proposals, or zoning ordinance and building regulation proposals need to be referred to the ALUC for review. If the ALUC determines that the proposed action is not consistent with the

Comprehensive Airport Land Use Plan, it shall inform the referring agency. The local agency may overrule the ALUC after a public hearing, with a two-thirds vote of the governing body, if it makes specific findings that the proposed action is consistent with the purposes of Section 21670 of the Aeronautics Law. (See Section 21676(b).)

8.3.2 COORDINATION WITH LOCAL GOVERNMENTS

The ALUC should ensure that proper coordination is established between its staff and local governments to ensure the efficient administration of the development review process. The Riverside County Planning Department must understand the boundaries of the airport influenced area and have clear maps available to them. In the Desert Center Airport study area, the county is the first point of contact with a developer. It is important that County planning staff be able to relay information as to whether a project is subject to review by the Airport Land Use Commission.

It is also important that the local government agencies be kept informed as to the appropriate staff contact at the County Aviation Unit when information about the ALUC's development review process is desired.

It may be appropriate for the ALUC and its staff to consider preparing a simple handout or brochure which explains the ALUC's development review process. It might include information about the process of reviewing a development proposal, scheduling a proposal for a hearing before the ALUC, and the consequences of action by the ALUC.

8.3.3 COUNTY GEOGRAPHIC INFORMATION SYSTEM

Riverside County has established a geographic information system (GIS) for the entire county. The system is managed by the County Transportation Department, Information Systems/GIS Division. The GIS is essentially an intelligent computerized mapping system. Geographic data can be analyzed and mapped in many different ways.

Among the data in the system are existing land use, topography, and zoning. The GIS can be a helpful planning tool as it can quickly provide planners with information and maps of various areas in the county.

Administration of the CLUP would be enhanced if the boundaries of the regulatory areas were added to the GIS. The system could be used in various helpful ways. For example, if the boundaries of a development project were encoded into the system, the GIS could be queried to determine whether the parcel was inside a CLUP regulatory area. If it was, a map could be produced and an estimate of the affected land area could be produced.

The GIS could be especially helpful in the administration of height standards. If the F.A.R. Part 77 map were entered into the system in a three-dimensional format, it would be possible to produce a high quality structural penetration analysis quickly and easily. As long as the structure location, height, and surface topography were known, the system could easily determine whether a penetration of a Part 77 surface would occur. It could also produce three-dimensional maps of the area.

For the GIS system to be effective, it would be necessary to encode the airport layout plans into the system as well as the various regulatory areas. This would ensure the proper definition of runway coordinates, bearings, and elevations, the foundations for defining the regulatory area boundaries.

8.3.4 CRITERIA FOR ALUC REVIEW OF GENERAL PLAN AMENDMENTS

Riverside County may consider amendments in its general plan from time to time. The major consideration of the ALUC as it reviews future general plan amendments is to ensure that the standards of the CLUP are complied with.

For specific guidance in the review of general plan amendments, the ALUC should consult Chapters Four, Five, and Six of the CLUP where noise, safety, and height issues and alternatives are discussed.

In some noise and safety zones, the policies of this Plan prohibit or limit the density of residential development. From the standpoint of airport compatibility, any future amendments to the Riverside County Comprehensive General Plan, or specific plan applications, involving density transfers generally would be acceptable. ("Density transfer" means allowing credit for unused residential development potential within the particular noise/safety zone to be transferred to a part of the property outside the noise/safety zone.) This shall not be interpreted as acceptance of any waivers from the land use compatibility policies of this plan. Density transfers shall be acceptable only if all land use policies within the airport influenced area are complied with.

8.4 RECOMMENDED ACTION BY LOCAL GOVERNMENTS

8.4.1 GENERAL PLAN AMENDMENTS

The Airport Land Use Commission should encourage Riverside County to amend its general plans to ensure compatibility with the CLUP. While the future land use designations of the County general plan do not conflict with the policies of the CLUP, text amendments are suggested to describe the land use compatibility policies in the Desert Center Airport environs as set forth in this CLUP.

8.4.2 LAND USE REGULATION AMENDMENTS

While the Airport Land Use Commission has considerable land use regulatory authority, administration would be simpler and more efficient if the county would adopt land use regulations enforcing the provisions of the CLUP.

Only one kind of land use regulation amendment is suggested for the Desert Center Airport area -- airport compatibility overlay zoning. The ALUC should encourage Riverside County to make this amendment.

As discussed in Chapters Five and Six, the current zoning provisions in the airport area involve potential conflicts with the land use policies of this CLUP. As the analysis in those chapters indicated, the clearest and simplest way to address these potential conflicts would be through airport compatibility overlay zoning. This would involve the adoption of an amendment to the county land use ordinance establishing a system of airport overlay zones. The overlay zones would impose standards supplementing those of the underlying zoning districts.

The boundaries of the overlay zones would correspond to the airport safety zones, and the F.A.R. Part 77 surfaces. Within each overlay zoning district, the land use, development density, and height standards of the CLUP would apply. (Noise overlay zoning districts are not appropriate in the Desert Center area at this time given the very small noise contours. The 60 CNEL contour barely clears the runway and cannot be clearly mapped at the scale of the study base maps. It is possible that increased activity in the future could lead to bigger noise contours, so it is important for the text of the regulations to refer to noise overlay zones, even if the districts do not currently apply in the Desert Center area.)

While overlay zoning is a simple concept, it can become somewhat complicated in practice. In order to facilitate coordination and understanding, it would be desirable to establish a uniform model ordinance for use by all affected jurisdictions in the county, around all public airports in the county. A lead agency for such an effort should be designated. The County Planning Department would be an appropriate agency as would the Aviation Division of the Economic Development Agency.

Appendix A
AVIATION DEMAND FORECASTS

DESERT CENTER

Appendix A
AVIATION DEMAND FORECASTS

The development of a Comprehensive Land Use Plan for Desert Center Airport includes the review of available aviation forecasts as presented in the California Aviation System Plan (July 1989) and the development of updated aviation activity forecasts to the year 2015. These forecasts will be used to analyze the types and quantity of aircraft that will use the airport through the planning period. Ultimately, this information will assist in developing a plan for compatible land uses around the airport and promoting appropriate land use measures that will minimize the public's exposure to safety hazards and excessive noise.

Forecasting any type of future activity is as much an art as it is a science. Regardless of the methodology used, assumptions must be made about how activities might change in the future. The objective of the forecast process is to develop estimates of the degree of these changes so that their impacts may be determined. Plans and preparations may then be made to accommodate them smoothly and effectively. The primary point to remember about forecasts is that they serve only as a guideline for future planning of the airport and determining its impacts upon the surrounding environs.

Aviation activity is affected by many external influences, as well as by the aircraft and facilities available at the airport. The spectrum of change since the first powered flight is almost beyond comprehension, as aviation has become the most dynamic form of transportation in the world. Because it is dynamic, changes and major technological breakthroughs have resulted in erratic growth patterns. More recently regulatory and economic actions have created very significant impacts upon activity patterns at most airports.

The following sections will discuss the historic trends in aviation both locally and on a national level. These trends will be examined along with outside influences that may affect future trends to develop the rationale for the selection of planning forecasts.

FORECASTING APPROACH

The development of aviation demand forecasts proceeds through both analytical and judgmental processes. Past trends in activity are normally examined in order to give an indication of what may be expected in the future. However, the judgement of the forecast analyst, based upon professional experience, knowledge of the aviation industry, and the local situation is important in the final subjective determination of the preferred forecast.

Quantitative forecasting techniques include trend line projection, correlation/regression analysis, and market share analysis.

Trend line projection is probably the simplest and most familiar of forecasting techniques. By fitting classical growth curves to historical demand data, then extending them into the future, a basic trend line projection is produced. A basic assumption of this technique is that outside factors will continue to affect aviation demand in much the same manner as in the past. As broad as this assumption may be, the trend line projection does serve as a reliable benchmark for comparing other projections.

Correlation analysis provides a measure of the direct relationship between two separate sets of historic data. Should there be a reasonable correlation between the data sets, further evaluation using regression analysis may be employed.

In regression analysis, values for the aviation demand element in question, **the dependent variable**, are projected on the basis of one or more other indicators, **the independent variables.** Historical values for all variables are analyzed to determine the relationship between the independent and dependent variables. These relationships may then be used, with projected values of the independent variable(s), to project corresponding values of the dependent variable.

Market share analysis involves a historical review of the activity at an airport or airport system as a percentage share of a larger statewide or national aviation market. Trend analysis of this historical share of the market is followed by projection of the share into the future. These shares are then multiplied by forecasts of the activity within the larger geographical area to produce a market share projection. This method has the same limitations as trend line projections, but similarly can provide a useful check on the validity of other forecasting techniques.

Like the trend line projection, market share analysis assumes that the factors will continue to affect future aviation demand in much the same manner as they have in the past. Again, as broad as this assumption is, such a method serves as a reliable benchmark against which other projections may be compared.

After completing the quantitative analysis, the second phase of demand forecasting requires experienced professional judgement. At this stage a number of intangible factors must be considered, including potential changes in the business climate, pertinent state of the art advances in aviation, the impact of new facilities to induce growth, and the planning policies and objectives of the airport owner.

Despite the analysis and professional judgment that goes into forecasting, one should not assume a high level of confidence in forecasts that extend beyond five years. Technological advances in aviation can substantially alter the growth rates in aviation demand and, thereby, alter the projected impact of the airport on its surrounding environs. The most obvious example is the impact of jet aircraft on the aviation industry, which resulted in a growth rate that far exceeded expectations. Such changes are difficult, if not impossible to predict, and there is simply no mathematical way to estimate their impacts.

AIRPORT SERVICE AREA

The initial step in determining aviation demand for an airport is to define its generalized service area for the various segments of aviation the airport can accommodate. The airport service area is determined primarily by evaluating the location of competing airports, their capabilities and services, and their relative attraction or convenience. With this information, a determination can be made as to how much aviation demand would likely be accommodated by a specific airport. It should be recognized that aviation demand does not necessarily conform to political and geographical boundaries.

In determining the aviation demand for Desert Center Airport, it is necessary to identify the role of the airport as well as the specific areas of aviation demand the airport is intended to serve. The airport's primary role has been and will continue to be to serve general aviation demand in the local area.

The airport service area is basically an area where there is a potential market for airport services. As in any business enterprise, the more attractive the facility is in services and capabilities, the more competitive it will be in the market. If the level of attractiveness expands in relation to nearby airports, so will the service area.

The next closest general aviation airport is Chiriaco Summit Airport, a public airport, located approximately 19 miles to the west adjacent to Interstate Highway 10. Blythe Airport, also a public airport, is located approximately 43 miles to the east adjacent to Interstate Highway 10.

The majority of the land within this area of eastern Riverside County is owned by State and Federal agencies and is retained as open space. There are, however, three unincorporated communities within the vicinity: Desert Center, Lake Tamarisk, and Eagle Mountain. Due to their isolated location, Desert Center and Lake Tamarisk serve primarily as retirement communities. Eagle Mountain was developed originally as a mining town, however, the closing of the town's major mining operations in 1983 created a decline in the population of this area as well as a significant economic impact. There is a proposal for a Trash-By-Rail program which could improve the economic vitality of this mountain community.

Therefore, the population which may be serviced by this airport is small, and includes primarily the communities of Desert Center, Eagle Mountain, and Lake Tamarisk. The general aviation service area for Desert Center Airport, then, includes these three communities and the area surrounding them, and is depicted on **Exhibit A1**.

GENERAL AVIATION ACTIVITY

General aviation activity comprises all of the aircraft operations at Desert Center Airport. General aviation is defined as that

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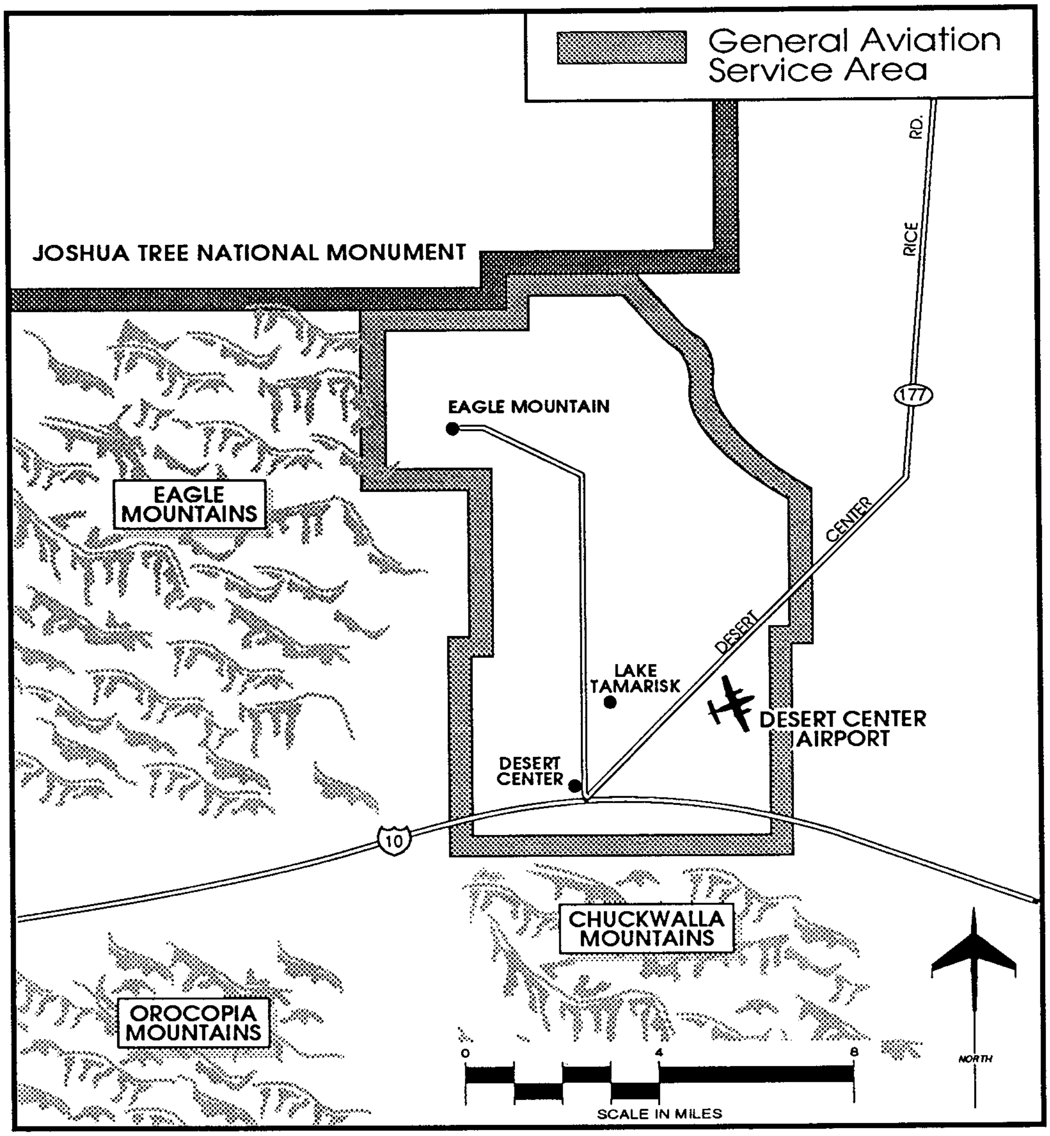

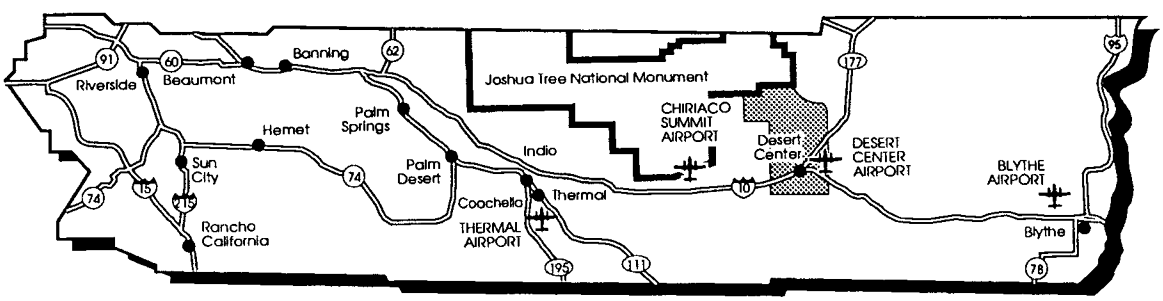

Exhibit A1

DESERT CENTER AIRPORT SERVICE AREA

portion of civil aviation which encompasses all facets of aviation except commercial airline operations. To determine the potential impact that Desert Center Airport will have on the surrounding environs, certain elements of this activity must be forecast. These indicators of general aviation demand include:

- Based Aircraft
- Aircraft Fleet Mix
- Annual Aircraft Operations

The single most important factor in the development of aviation activity forecasts is the number of based aircraft. By first developing a forecast of based aircraft, the growth of the other indicators can be projected based upon this growth and other factors characteristic to Desert Center Airport and the area it serves.

BASED AIRCRAFT

The number of general aviation aircraft based at an airport is primarily dependent upon the nature and magnitude of aircraft ownership in the area and on ownership trends nationally. Therefore, preparation of the based aircraft forecast for the airport was initiated with a review of historical data on general aviation aircraft ownership and the projection of those ownership trends nationally and within the airport's service area.

On an industry-wide basis, general aviation aircraft shipments declined through most of the 1980's. In 1980, there were over 12,000 new general aviation aircraft shipped compared to only 1,143 in 1988. However, the industry showed signs of some recovery in 1989 when 1,535 aircraft were shipped.

The FAA annually updates forecasts of active general aviation aircraft in the United States. The most recent forecasts were published in **FAA Aviation Forecasts-Fiscal Years 1991-2002**. These projections depict the U.S. active general aviation aircraft growing slowly until the end of the planning period. FAA forecasts an increase in U.S. general aviation aircraft from 219,700 in 1990 to 231,500 in the year 2002. The number of U.S. active general aviation aircraft in the Western Pacific Region has fluctuated over the past six years, ultimately increasing from 36,900 in 1986 to 37,700 in 1990. FAA aviation forecasts project active aircraft in the Western Pacific Region to increase to 39,100 in 1995, and to 39,600 by the year 2000.

Forecasts for based aircraft begin with an examination of available historical data and determination of past growth trends within the service area. The historical data on based aircraft at Desert Center Airport is somewhat incomplete, however information from past FAA 5010 Forms was compiled for the time period 1980 to 1991. The 5010 form is a master record used in an effort to keep up-to-date information about an airport. At most airports, this form is the best means available of obtaining a reasonable picture of the airport's past growth trends. In 1990, there were no based aircraft at Desert Center Airport. Historically, based aircraft at Desert Center Airport have ranged from a high of 5 in 1980 to a low of 0 in 1990. Historical information on based aircraft at Desert Center Airport is depicted in **Table A1**.

TABLE A1
Historical Based Aircraft
Desert Center Airport

Year	Number of Based Aircraft*
1980	5
1981	N/A
1982	N/A
1983	3
1984	4
1985	3
1986	2
1987	N/A
1988	0
1989	0
1990	0
1991	1

**All based aircraft have been single-engine piston aircraft.*

Source: FAA 5010 Forms and California Public Use Inventory Forms.

This historical data was then compared to various factors in an attempt to correlate growth to past trends. Variables considered in performing regression analysis included the number of aircraft registered in both Riverside County and the Desert Center area, and socioeconomic variables such as population, employment, and per capita income for both Riverside County and the Desert Center environs. **Table A2** summarizes the socioeconomic variables used in the multiple regression analysis.

Socioeconomic information specifically for the Desert Center Airport service area was not available, therefore, information for census tract number 458 was used and is referred to as Desert Center/Chiriaco Summit Environs. This area is depicted in **Exhibit A2**. It should be noted that much of the information for this census tract was also not available (such as 1985 information and forecasts for the years 2000 and 2010). In these instances, the information was estimated by Coffman Associates in order to perform multiple regression analysis for projecting based aircraft at Desert Center Airport. In performing regression analysis, a significant correlation exists when the square of the coefficient of correlation, or r^2, is greater than 0.95. Regression analysis was performed using the aforementioned variables. All attempts to establish a correlation for forecasting based aircraft at Desert Center Airport were determined to be insignificant or failed to provide any reasonable projection. Trend line analysis was also performed and provided no significant correlation.

TABLE A2
Socioeconomic Variables

	Actual 1980	1985	1990	Forecast 2000	2010
Population					
State of California	23,771,300	25,858,070	29,760,021	38,980,000[1]	NA
LA and Desert Region	12,603,400	13,612,600	14,640,837	17,481,221	19,597,122
Riverside County	668,600	794,800	1,170,410	1,890,246	2,390,784
Desert Center/ Chiriaco Summit Environs	4,440	4,467[3]	4,494	4,546[3]	4,600[3]
Employment					
State of California	10,793,650	12,009,000	13,846,000	NA	NA
LA and Desert Region	5,403,900	5,919,300	7,172,565	8,460,919	9,663,139
Riverside County	230,400	316,600	361,400	632,931	832,856
Desert Center/ Chiriaco Summit Environs	2,575	2,591[3]	2,606[3]	2,645[3]	2,680[3]
Per Capita Income					
State of California	11,603	16,033	19,840[2]	NA	NA
LA and Desert Region	10,970	14,696	18,288[2]	NA	NA
Riverside County	10,615	14,264	17,028[2]	NA	NA
Desert Center/ Chiriaco Summit Environs	6,500	NA	NA	NA	NA

[1] Forecast for year 2005
[2] 1989 Information
[3] Estimated by Coffman Associates

Notes: LA (Los Angeles) and Desert Region includes the counties of Ventura, Los Angeles, San Bernardino, Orange, Riverside, and Imperial. Socioeconomic information for the Desert Center/Chiriaco Summit environs is synonymous with information for Census Tract No. 458, 1980 and 1990 Census. (Refer to Exhibit A2).

Sources: State of California, Department of Finance, Financial and Economic Research; State of California, Department Employment, Labor Market Information Division; Riverside County Planning Department.

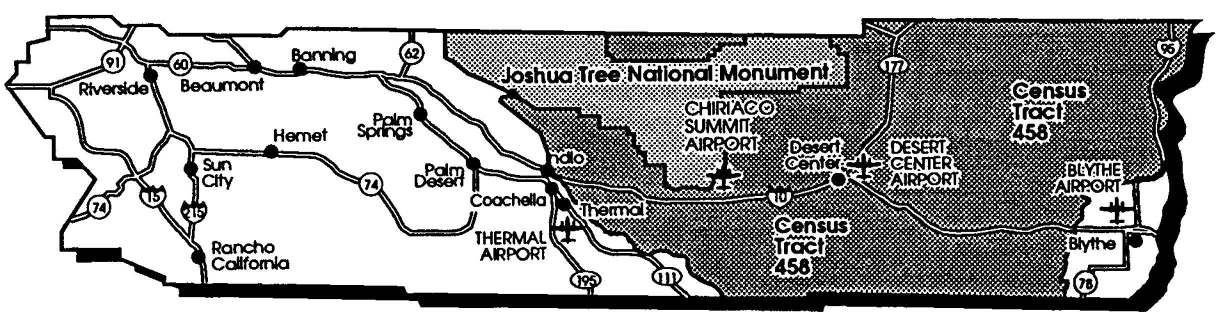

Exhibit A2
DESERT CENTER/CHIRIACO SUMMIT ENVIRONS

Market share analysis provided another projection for forecasting based aircraft for Desert Center Airport. Historical information on registered aircraft for Riverside County was analyzed focusing on those registered aircraft with an address within the Desert Center Airport service area (the communities of Desert Center, Eagle Mountain, or Lake Tamarisk). This information was compared to the U.S. registered general aviation aircraft, the Western Pacific Region active general aviation aircraft, and Riverside County registered aircraft. This provided a means for forecasting registered aircraft in Riverside County and the Desert Center Airport service area (see **Table A3**). As shown in this table, registered aircraft for the Desert Center Airport service area were forecast to increase to .17 percent of Riverside County registered aircraft. This increases registered aircraft in the airport service area through the planning period to the average level of the five-year period between the years 1987 to 1991.

TABLE A3
Projection of Registered Aircraft
Desert Center Airport Service Area

			Riverside County		Desert Center Airport Service Area	
Year	U.S. Active Aircraft	Western Pacific Region Active Aircraft	Registered Aircraft	% of Region	Registered Aircraft	% of County
1984	213,300	--	1,247	--	7	.56
1985	220,900	--	1,298	--	7	.53
1986	210,700	36,900	1,385	3.75	6	.43
1987	220,000	38,800	1,425	3.67	5	.35
1988	217,100	38,000	1,453	3.82	3	.35
1989	210,300	36,800	1,512	4.10	1	.06
1990	219,700	37,700	1,538	4.07	0	.00
1991	223,900[F]	38,300[F]	1,577	4.11	1	.06
Forecast						
1995	227,300	39,100	1,625	4.15	1	.06
2000	230,300	39,600	1,665	4.20	2	.12
2005	234,800[2]	40,100[2]	1,705	4.25	2	.12
2010	237,200[2]	40,600[2]	1,745	4.30	3	.17
2015	239,600[2]	41,100[2]	1,785	4.35	3	.17

NOTES:

[1]Includes the unincorporated communities of Desert Center, Lake Tamarisk, and Eagle Mountain.
[2]Forecasts for U.S. Active Aircraft and Western Pacific Region Active Aircraft for the years 2005, 2010, and 2015 were estimated by Coffman Associates.

Registered aircraft in the Desert Center Airport service area were considered as the potential based aircraft for Desert Center Airport. The total registered aircraft for the airport service area ranged from a high of 7 aircraft in 1984 to a low of 0 in 1990. Based aircraft projections for Desert Center Airport were established on the assumption that any Riverside County registered aircraft with an address within the airport service area would potentially base their aircraft at Desert Center Airport. Therefore, forecasts of registered aircraft within the Desert Center Airport service area and forecasts of based aircraft for Desert Center Airport are synonymous. In 1991, there was one registered aircraft with an airport service area address, accounting for one potential based aircraft at Desert Center Airport for the base year. **Table A4** depicts the based aircraft forecast for Desert Center Airport. Also depicted on this table are the based aircraft forecasts for Desert Center Airport as projected in the California Aviation System Plan and the Southern California Association of Governments General Aviation System Study.

TABLE A4
Based Aircraft Projections
Desert Center Airport

Year	Desert Center Airport Service Area Registered Aircraft	Desert Center Airport Based Aircraft	California Aviation System Plan Forecast[1]	SCAG General Aviation Systems Study[2]
Base Year				
1991	1	1	--	--
Forecast				
1995	1	1	2	--
2000	2	2	2	--
2005	2	2	2	3
2010	3	3	--	--
2015	3	3	--	--

[1]California Aviation System Plan, Forecasts Element, prepared in July 1989.
[2]Southern California Association of Government, General Aviation Systems Study, Phase II, December 1987.

NOTE: All projected based aircraft at Desert Center Airport are expected to be single-engine piston aircraft through the planning period.

As shown in this table, based aircraft projections are forecasted to remain low through the planning period. This is due in large part to the fact that the existing airport facilities are limited and the airport itself is in a remote location. Currently there is no sheltered hangar space at Desert Center Airport and the existing aircraft parking apron is in poor condition. There is a fixed base operator at the airport, however, no aircraft fuel service or other related pilot services are available at this time. Additionally, Desert Center Airport has no runway or taxiway lighting nor airport identifier lighting available and is therefore limited to day time operations only. There is no master plan for Desert Center Airport at this time and the county is planning no significant airport improvements in the near-term future. Thus, based aircraft projections were developed on the premise that no major improvements are planned for the airport through the planning period.

BASED AIRCRAFT FLEET MIX

Historical information on the fleet mix of based aircraft at Desert Center Airport was obtained from FAA 5010 forms. Also considered were the existing and forecast fleet trends for general aviation aircraft nationally. The overall trend is towards a higher percentage of larger, more sophisticated aircraft. The U.S. trend in aircraft mix, as presented in **FAA's Aviation Forecasts - Fiscal Years 1991-2002**, forecast single-engine piston aircraft to remain almost constant over the 12-year forecast period, increasing from 170,370 in 1990 to 170,500 in 2002. The number of multi-engine piston aircraft is forecast to increase slightly from 23,400 in 1990 to 24,000 in 2002, an average annual increase of 0.2 percent. Turbine powered aircraft are expected to increase from 10,726 in 1990 to 15,200 in 2002, an annual growth rate of 2.9 percent. The forecast for rotorcraft shows an increase from 7,400 rotorcraft in 1990 to 11,200 aircraft in the year 2002, an annual increase of 6.1%.

However, while FAA forecasts for the national active aircraft fleet mix project a trend towards a higher percentage of larger, more sophisticated aircraft, this trend was not projected to influence the based aircraft fleet mix at Desert Center Airport due to the limited airport services and facilities. Rather, all based aircraft at Desert Center Airport are expected to be single-engine piston aircraft through the planning period.

AIRCRAFT OPERATIONS

An airport operation is defined as any takeoff or landing performed by an aircraft. There are two types of operations - local and itinerant. A local operation is a takeoff or landing performed by an aircraft that will operate in the local traffic pattern within sight of the airport, or which will execute simulated approaches or touch-and-go operations at the airport. Itinerant operations include all arrivals and departures other than local. Generally, local operations are characterized as training operations, while itinerant operations are those with a specific destination away from the airport. Typically, itinerant operations increase with business and industry use since business aircraft are used primarily to carry people from one location to another.

Aircraft operations have not been accurately counted at Desert Center Airport because of the lack of an air traffic control tower. However, estimates contained in the FAA 5010 Forms and the California Public Use Airport Inventory forms were used to evaluate historical information on aircraft operations at Desert Center Airport. These sources indicate average annual general aviation operations at Desert Center Airport ranging from a high of 3,000 to a low of 1,500. **Table A5** presents historical information on aircraft operations at Desert Center Airport.

As shown in this table, it appears that annual operations at Desert Center Airport decreased by 50 percent between 1986 and 1988. This drop may be misleading as there is no known factor why operations would drop so drastically in this particular period at Desert Center Airport. Rather, the decrease in operations shown for 1988 may reflect a decrease in annual operations over a previous number of years. It is possible that the cumulative effect of these changes was not recorded until 1988. Of the total general aviation operations at Desert Center Airport, local and itinerant operations have historically been estimated as equally split (50/50). Again, because there is no air traffic control tower, these figures are only rough estimates of actual aircraft activity at the airport.

In discussions with the local fixed base operator for the Desert Center Airport, it was discovered that the majority of operations at the airport were transient traffic which use the airport for pilot training (touch-and-go's) which would count as local traffic. Itinerant operations include the use of the airport for business travel to the Eagle Mountain community. Transient aircraft which regularly use the airport are significantly different in type than those aircraft which could potentially base at Desert Center Airport. While based aircraft will typically be single-engine piston aircraft, transient aircraft have included the Gates Learjet, a business jet aircraft, and the King Air, a twin-turboprop business aircraft.

Historical information on both local and itinerant general aviation operations was obtained from the FAA 5010 forms and was used to project future aircraft operation levels.

FAA forecasts for general aviation operations nationally indicate a 1.8 percent annual increase over the next twelve years, while general aviation hours flown are forecast to increase by 1.4 percent per year over the next twelve years. General aviation operations at the 403 airports with FAA air traffic control services are forecast to increase 23.5 percent over the next twelve years.

Therefore, aircraft operations can be expected to increase slightly through the planning period. Table A5 presents the general aviation operations forecasts for Desert Center Airport based upon the national annual rate of increase (1.8 percent). The table also depicts the local and itinerant split in operations. This was forecast to maintain the current 50/50 split of local to itinerant operations (obtained from historical data on FAA 5010 forms). Also depicted on this table are the forecasts for general aviation operations for Desert Center Airport was projected in the California Aviation System Plan.

MILITARY ACTIVITY

Military training operations also comprise an infrequent portion of the operations at Desert Center Airport and its environs, although these operations have never been estimated as part of the airport's annual operations. Frequently, Norton Air Force Base practices airdrop training exercises in nearby airspace and on an infrequent occasion, may shoot a practice approach at Desert Center Airport. However, military practice operations at the airport are quite rare. Historically, the FAA 5010 form does not record any military operations for Desert Center Airport. Norton Air Force Base is scheduled to be decommissioned by April 1994, therefore, this military training activity probably will decrease substantially or drop off altogether in the future.

TABLE A5
General Aviation Operations Forecast
Desert Center Airport

Year	Based Aircraft	Local Operations	Itinerant Operations	Annual Operations	California Aviation System Plan
1980	5	1,000	500	1,500	--
1981	NA	NA	NA	NA	--
1982	NA	NA	NA	NA	--
1983	3	1,500	1,500	3,000	--
1984	4	1,500	1,500	3,000	--
1985	3	1,500	1,500	3,000	--
1986	2	1,500	1,500	3,000	--
1987	NA	NA	NA	NA	--
1988	0	0	1,500	1,500	--
1989	0	0	1,500	1,500	--
1990	0	0	1,500	1,500	2,881*
1991	1	0	1,500	1,500	--
Forecast					
1995	1	800	800	1,600	2,772
2000	2	900	850	1,750	2,728
2005	2	1,000	900	1,900	2,672
2010	3	1,100	1,000	2,100	--
2015	3	1,200	1,100	2,300	--

Sources: Historical data from FAA 5010 Forms and California Public Use Airport Inventory Forms.

*Forecast for 1990 prepared by California Aviation System Plan in July of 1989.

FORECAST SUMMARY

This chapter has determined the various aviation demand levels to be anticipated through the planning period. This information will be used to quantify the resultant aircraft safety and noise conditions for Desert Center Airport. **Table A6** provides a summary of the aviation forecasts for Desert Center Airport.

TABLE A6
Aviation Forecast Summary
Desert Center Airport

	Base Year	Forecast				
	1991	1995	2000	2005	2010	2015
Based Aircraft*	1	1	2	2	3	3
Annual Operations						
General Aviation						
Local	0	800	900	1,000	1,100	1,200
Itinerant	1,500	800	850	900	1,000	1,100
Total General Aviation	1,500	1,600	1,750	1,900	2,100	2,300
Total Aircraft Operations	1,500	1,600	1,750	1,900	2,100	2,300

*All based aircraft are expected to be single-engine piston aircraft through the planning period.

Appendix B
NOISE EXPOSURE AND LAND USE COMPATIBILITY

Appendix B
NOISE EXPOSURE AND LAND USE COMPATIBILITY

Aircraft noise is often the most noticeable environmental effect an airport will produce on the surrounding community. If the sound is sufficiently loud or frequent in occurrence, it may interfere with various activities or be considered objectionable. Before discussing the potential effects of noise exposure, it is appropriate to review some important principles of noise measurement.

MEASURES OF SOUND

A person's ability to perceive a specific sound depends on its magnitude and character, as differentiated from the magnitude and character of all other sounds in the environment. Several qualitative descriptions may be used to describe the attributes of a sound, such as:

- Magnitude -- loud or faint;
- Broadband frequency content -- high pitched hiss or rumble;
- Discrete frequency content -- tonal or broadband;
- Intermixing of pure tones -- harsh or melodic;
- Time variation -- intermittent, fluctuating, steady, impulsive;
- Duration -- long or short.

Conventional measures of sound attempt to determine its magnitude with respect to human perception, especially trying to account for the frequency response characteristics of the ear, and secondarily to the time integration characteristics of the ear. They do not account for most of the other subjective attributes. These are difficult to measure individually, and it is even more difficult to combine them in a single measure. However, one or more of these attributes may be important to enabling a human to perceive a specific sound. For example, an intermittent, impulsive "rat-tat-tat" is more easily distinguishable than a steady sound. To account for these attributes which are not easily measured, some noise rating scales have defined penalties that are applied to the measured magnitude of the sound to increase or decrease its value.

MAGNITUDE

The unit used to measure the magnitude of sound is the decibel. Decibels are used to measure loudness in the same way that "inches" and "degrees" are used to measure length and temperature. However, unlike the scales of length and temperature, which are linear, the sound level scale is logarithmic. By definition, the level of a sound which has ten times the mean square sound pressure of the reference sound is 10 decibels (dB) greater that the reference sound. A sound which has 100 times (10 x 10 or 10^2) the mean square sound pressure of the reference sound is 20 dB greater (10 x 2).

The logarithmic scale 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 range of 100 trillion to one. This huge number (a 1 followed by 14 zeros or 10^{14}) is much more conveniently represented on the logarithmic scale as 140 dB (10 x 14).

The use of the logarithmic decibel scale requires somewhat different arithmetic that we are accustomed to using with linear scales. For example, if two equally loud but independent noise sources operate simultaneously, the measured mean square sound pressure from both sources will be twice as great as either source operating alone. When expressed on the decibel scale, however, the sound pressure level from the combined sources is only 3 dB higher than the level produced by either source alone. (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.

Another interesting attribute of sound is the human perception of loudness. Scientists researching human hearing have determined that most people perceive a 10 dB increase in sound energy over a given frequency range as roughly a doubling of the loudness. Recalling the logarithmic nature of the decibel scale, this means that most people perceive a ten-fold increase in sound energy as a two-fold increase in loudness (Kryter 1984, p. 118). Furthermore, when comparing sounds over the same frequency range, most people cannot distinguish between sounds varying by less than two or three decibels.

Exhibit B1 presents examples of various noise sources at different noise levels, comparing the decibel scale with the relative sound energy and the human perception of loudness.

FREQUENCY WEIGHTING

Two sounds which have the same sound pressure level may "sound" quite different

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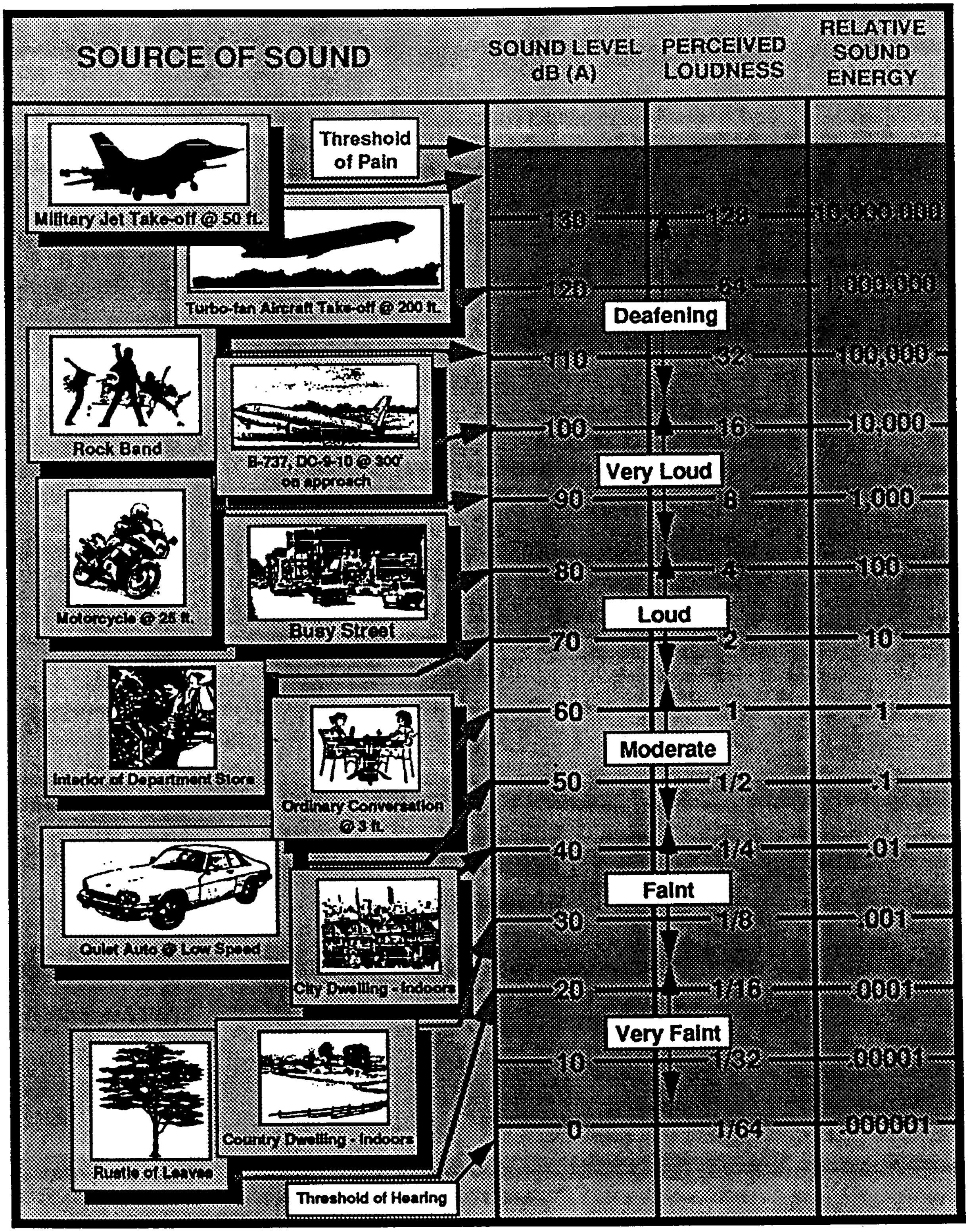

Source: Coffman Associates, Inc.

Exhibit B1
TYPICAL SOUND LEVELS

(e.g. a rumble versus a hiss) because of differing distributions of sound energy in the audible frequency range. The distribution of sound energy as a function of frequency is termed the "frequency spectrum". The spectrum is important to the measurement of the magnitude of sounds because the human ear is more sensitive to sounds at some frequencies than others. Specifically, the human ear hears best in the frequency range of 1,000 to 5,000 cycles per second (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.

Scientists who work in acoustics have attempted for many years to find the ideal method to weight the frequency spectrum just as does the human ear. These attempts have produced many different scales of sound measurement, including the A-weighted sound level (and also the B, C, D, and E-weighted scales). A-weighting, 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.

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 the U.S. Environmental Protection Agency and other government agencies for the description of sound in the environment. A newer weighting, such as the D or E weightings which are based on the decade of research leading to the perceived noise level scale, might eventually supplant A-weighting as the universal method. Until one of these newer scales is in common use and its superiority over A-weighting for measuring environmental sounds is demonstrated, A-weighting is expected to dominate.

The zero value on the A-weighted scale is the reference pressure of 20 micro-newtons per square meter (or micro-pascals). 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 distance of 1 meter is 40 dB; the sound level of a normal voice at 1 meter is 57 dB; a shout at 1 meter is 85 dB.

TIME VARIATION OF SOUND LEVEL

Generally, the magnitude of sound in the environment varies in a random fashion with time. Of course, there are many exceptions. For example, the sound of a waterfall is steady with time, as is the sound of a room air conditioner or the sound inside a car or airplane cruising at a constant speed. But in most places, the outdoor sound is ever-changing in magnitude because it is influenced by sounds from many sources.

In one sense, the temporal variation of the magnitude of sound is analogous to the variation in shade (light to dark) in a picture or one's surroundings. Similarly, the changing characteristics of the subjective attributes and frequency spectrum to the ear might be analogous to change in color to the eye. It may be that the temporal changes in magnitude and character of sound in the environment add richness to the human environmental experience, as do visual changes in intensity or color. Certainly the varying sounds of bird song and rustling leaves in the forest are more rewarding than the utter silence that precedes a storm or the steady hum of a noisy ballast transformer in a fluorescent light. Changing patterns of normal sound make humans continually aware of life going on around them and assure them that all is well. However, if the fluctuation in magnitude of sound exceeds the range which is acceptable in a specific context, if the average sound level is high enough to interfere with speech or some other activity, or if a sound of unusual character or undesirable connotation is perceived, the subconscious feeling of well-being may be replaced with annoyance or alarm.

It is generally easy to measure the continuously changing magnitude of the sound level. It may be displayed on a graphic level recorder in which a pen traces a line on a sheet of moving paper, and the displacement of the pen is proportional to the sound level. Over time, the printout will reveal an approximate background noise level and the magnitude and duration of sound events which were louder than the background. The data in these continuous recordings of sound are very instructive in understanding the nature of the outdoor sound environment at any location. However, to quantify an outdoor sound environment at one location so that it can be compared with others, it is necessary to simplify its description by eliminating much of the temporal detail.

There are three ways to accomplish this simplification.

(1) Values for background or residual sound and specific single event sounds can be sampled at various times during the day using a sound level meter or a continuous graphic level recording of the sound level.

(2) Statistical properties of the sound level can be determined. A statistical analyzer can be attached to the output of the sound level meter. This allows one to determine the amount of time that the sound level exceeds a given base sound level, or, conversely, the sound level which is exceeded to a stated percentage of the time.

(3) The value of a steady-state sound with the same average value of A-weighted sound energy as the time-varying sound can be calculated. This value is termed the Equivalent Sound Level (Leq).

Each of these descriptors has its own usefulness. Residual and maximum sound levels are easily measured by a hand-held sound level meter or a sophisticated computer-based monitoring system. However, such measurements give no indication of the duration of the various single events nor a notion of the average state of the environment.

The statistical method can be crudely accomplished by a hand-held sound level meter, but it is a time-consuming and tedious process and often not very accurate. It is best accomplished with a sophisticated instrument or monitoring system designed for the purpose. It can give the complete detailed statistical distribution curve of sound level versus time for any desired duration. For example, each hour of the day, daytime or nighttime, or 24-hour day. Such a curve is often a most useful reduction of the detail contained in a graphic level recording, although it eliminates all information about specific events. However, if a single value is required for convenience, it is necessary to make an arbitrary choice of a point (level and duration) on the curve, eliminating most of the statistical information.

The Equivalent Sound Level (Leq) is best measured with an instrument or monitoring system designed specifically for this purpose -- an Integrating Sound Level Meter. It can provide directly a single value for any desired durations, a value which includes all of the time-varying sound in the measurement period. As such, it is a more complete description than a statistical description. For example, if the "level which is exceeded 10% of the total time" is used as the descriptor of the time-varying sound, its value remains constant regardless of the magnitude of the sound levels which occur during that 10% time period. In contrast, all sounds, regardless of magnitude, are fully accounted for in the Equivalent Sound Level descriptor.

The major virtue of the Leq descriptor 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 noise and risk of hearing loss. It also is the basis for measures of the total outdoor noise environment, the Day/Night Sound Level (Ldn) and the Community Noise Equivalent Level (CNEL), which correlate well with community reaction to noise and to the results of social surveys of annoyance to aircraft noise.

KEY DESCRIPTORS OF SOUND

For purposes of quantifying environmental sound, four descriptors or metrics listed in Table B1 are useful. All are based on the logarithmic decibel (dB) scale and incorporate A-weighting to account for the frequency response of the ear.

TABLE B1
Principal Descriptors of Environmental Sound

Descriptor	Symbol Abbreviation	Definition	Uses
Sound Level	L	Mean square value of A-weighted sound pressure level at any time relative to a reference pressure.	Describes magnitude of a sound at a specific position and time.
Sound Exposure Level (SEL)	Le	Time integral of the mean square A-weighted sound pressure relative to mean square reference pressure and 1 second duration.	Describes magnitude of all of the sound at a specific position accumulated during a specific event, or for a stated time interval.
Equivalent Sound Level	Leq	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 sound (energy) state of environment. Usually employed for duration of: 1 hr. [Leq(1)], 8 hr. [Leq(8)], or 24 hr. [Leq(24)].
Day/Night Sound Level	Ldn	Equivalent sound level for a 24 hr. period with a +10 dB weighting applied to all sounds occurring between 10 p.m. and 7 a.m.	Describes average environment in residential situations accounting for effect of nighttime noises often is averaged over a 365-day year (YDNL).
Community Noise Sound Level	CNEL	Equivalent sound level for a 24 hr. period with a +10 dB weighting applied to all sounds occurring between 10 p.m. and 7 a.m. and a +4.8 dB weighting applied between 7:00 p.m. and 10:00 p.m.	Same uses as Ldn. Accounts for effect of evening as well as nighttime noise.

The sound level (L) in decibels is the quantity read on an ordinary sound level meter. It fluctuates with time following the fluctuations in magnitude of the sound. Its maximum value (Lmax) is one of the descriptors often used to characterize the sound of an airplane flyby. However, Lmax only gives the maximum magnitude of a sound -- it does not convey any information about the duration of the sound. Clearly, if two sounds have the same maximum sound level, the sound which lasts longer will generally cause more interference with human activity.

Both of these factors are included in the sound exposure level (SEL), which adds up all sound occurring in a stated time period or during a specific event. The SEL is read from integrating sound level meters and is the quantity that best describes the totality of the noise from an aircraft flyby.

The equivalent sound level (Leq) is simply the logarithm of the average value of the sound exposure during a stated time period. It is often used to describe sounds with respect to their potential for interfering with human activity, e.g. speech interference.

A special form of Leq is the day-night sound level (Ldn). Ldn is calculated by adding up all the sound exposure during daytime (0700 - 2200 hours) plus 10 times the sound exposure occurring during nighttime (2200 - 0700 hours) and averaging this sum by the number of seconds during a 24-hour day. The multiplication factor of 10 applied to nighttime sound is often referred to as a 10 dB penalty. It is intended to account for the increased annoyance attributable to noise during the night when ambient levels are lower and people are trying to sleep.

Another descriptor intended to enable an understanding of the potential annoyance of sound is the community noise equivalent level (CNEL). In wide use only in California, where its use is required, it is very similar to Ldn, except that it also includes a 4.8 dB penalty (often rounded to 5 dB) for noise occurring in the evening (1900-2200 hours).

Exhibit B2 graphically shows how the noise occurring during a 24-hour period is weighted and averaged by the CNEL descriptor (or metric). In that example, the noise occurring during the period, including aircraft noise and background noise, yields a CNEL value of 66. As a practical matter, this is a reasonably close estimate of the aircraft noise alone because, in this example, the background noise is low enough to contribute only a little to the overall CNEL value during the period of observation (Kryter 1984, p. 582).

AIRCRAFT NOISE ANALYSIS METHODOLOGY

The standard methodology for analyzing the prevailing noise conditions at airports involves the use of a computer simulation model. The Federal Aviation Administration (FAA) has approved two models for use in F.A.R. Part 150 Noise Compatibility Studies -- NOISEMAP and the Integrated Noise Model (INM). NOISEMAP is used most often at military airports, while the INM is most commonly used at civilian airports.

The Integrated Noise Model (INM) was developed by the Transportation Systems Center of the U.S. Department of Transportation at Cambridge, Massachusetts. It is undergoing continuous refinement. Version 3.9 is the most current version of the model at this time.

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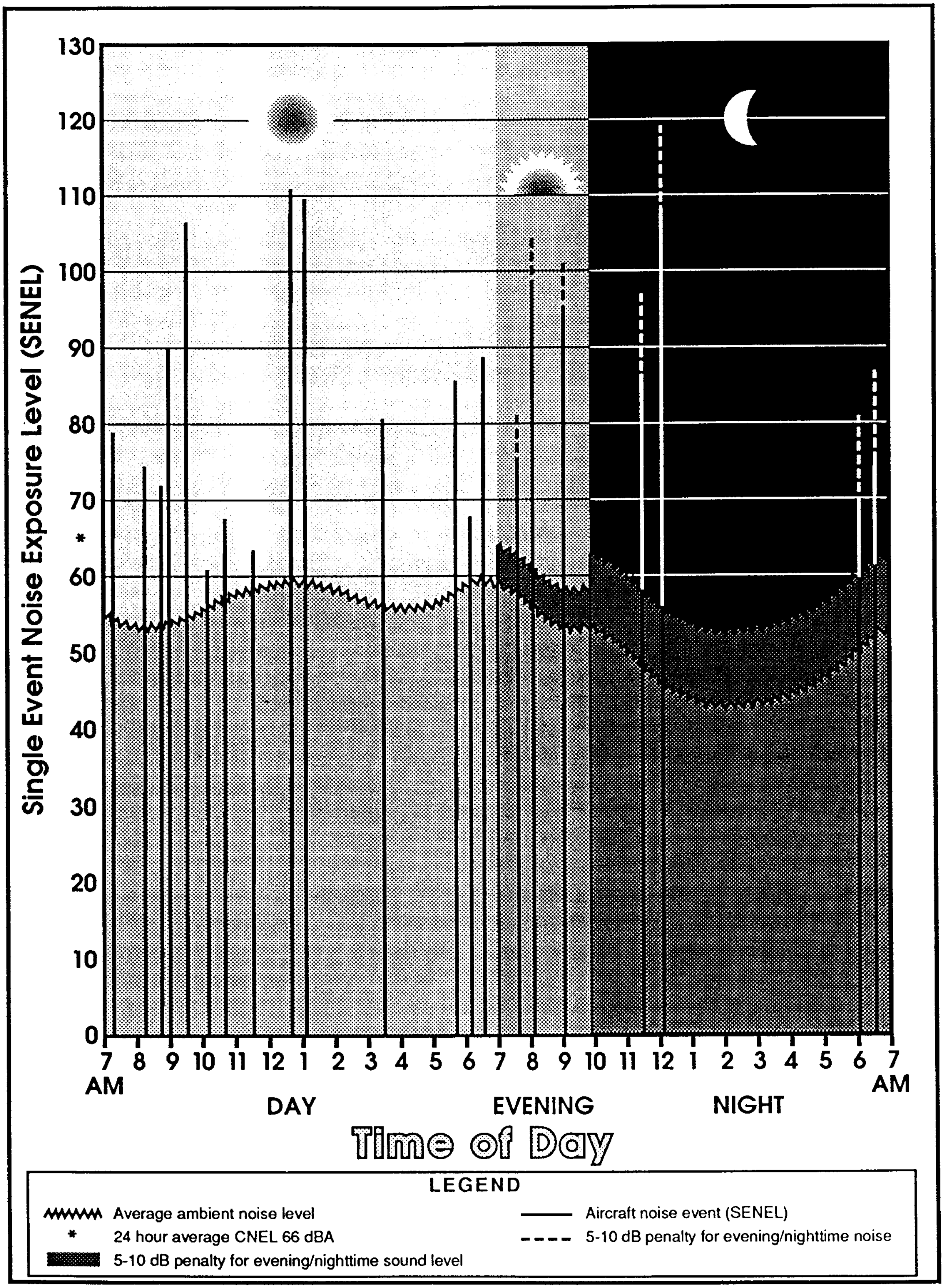

Exhibit B2
TYPICAL NOISE PATTERN AND CNEL SUMMATION

The INM works by defining a network of grid points at ground level around the airport. It then selects the shortest distance from each grid point to each flight track and computes the noise exposure for each aircraft operation, by aircraft type and engine thrust level, along each flight track. Corrections are applied for air-to-ground acoustical attenuation, acoustical shielding of the aircraft engines by the aircraft itself, and aircraft speed variations. The noise exposure levels for each aircraft are then summed at each grid location. The cumulative noise exposure levels at all grid points are then used to develop noise exposure contours for selected values (e.g. 65, 70, and 75 CNEL). Noise contours can be plotted using the Leq, Ldn, or CNEL descriptors. When the Ldn or CNEL descriptors are specified, the model applies the appropriate weighting factors to evening and nighttime aircraft operations. **Exhibit B3** graphically shows this calculation process.

In addition to the mathematical procedures defined in the model, the INM contains another very important element. This is a data base containing tables correlating noise, thrust settings, and flight profiles for most of the civilian aircraft, and many common military aircraft, operating in the United States. This data base, often referred to as the noise curve data, has been developed under FAA guidance based on rigorous noise monitoring in controlled settings.

A variety of user-supplied input data is required to use the Integrated Noise Model. This includes the airport elevation, a mathematical definition of the airport runways, the mathematical description of ground tracks above which aircraft fly, and the assignment of specific aircraft with specific engine types at specific takeoff weights to individual flight tracks. This is summarized in **Exhibit B3**. In addition, aircraft not included in the model's data base may be defined for modeling.

EFFECTS OF NOISE EXPOSURE

Aircraft noise can affect people both physically and psychologically. It is difficult, however, to make sweeping generalizations about the impacts of noise on people because of the wide variations in individual reactions. While much has been learned in recent years, some physical and psychological responses to noise are not yet fully understood and continue to be debated by researchers.

EFFECTS ON HEARING

Hearing loss is the major health danger posed by noise. A study published by the U.S. Environmental Protection Agency (EPA) found that exposure to noise of 70 Leq or higher on a continuous basis, over a very long time, at the human ear's most damage-sensitive frequency may result in a very small but permanent loss of hearing (U.S.E.P.A. 1974).

In a recent literature review, three studies are cited which examined hearing loss among people living near airports (Newman and Beattie 1985, pp. 33-42). The studies found that, under normal circumstances, people in the community near an airport are at no risk of suffering hearing damage from aircraft noise.

The Occupational Health and Safety Administration (OSHA) has established standards for permissible noise exposure in the work place. The standards are intended to guard against the risk of

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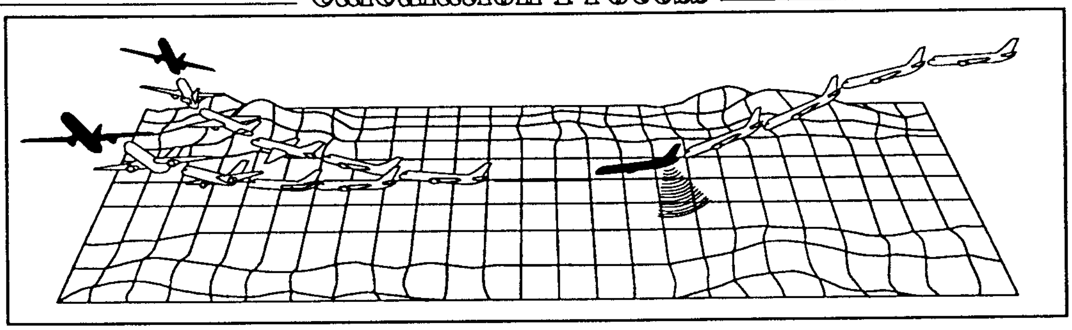
INM PROCESS

Input

- Airport Description
- Flight Tracks
- Departure Tracks
- Approach Profiles
- Noise Curves

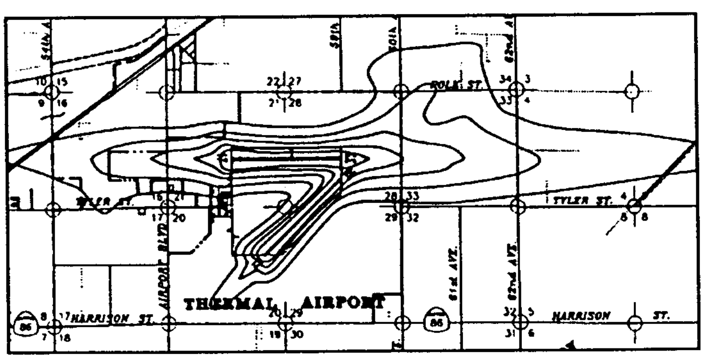
- Runway Use
- Fleet Mix
- Engine Types
- Runway Utilization
- Directional Traffic

Calculation Process



- Computer Accesses Stored Noise Curve Data for Aircraft Types Specified in Input.
- Model Determines Noise Contribution at Nodes from each Aircraft operation along each Flight Track.
- Model Sums All Contributions at Node.

Output



Contours and Plots

Simple and Detailed Grid Analysis

Exhibit B3
INTEGRATED NOISE
MODEL PROCESS

hearing loss. Protection against the effects of noise exposure is required when noise levels exceed the legal limits. The standards, shown in Table B2, establish a sliding scale of permissible noise levels by duration of exposure. The standards permit noise levels of up to 90 dBA for 8 hours per day without requiring hearing protection. The regulations also require employers to establish hearing conservation programs, however, where noise levels exceed 85 Leq during the 8-hour workday. This involves the monitoring of work place noise, the testing of employees' hearing, the provision of hearing protectors to employees at risk of hearing loss, and the establishment of a training program to inform employees about the effects of work place noise on hearing and the effectiveness of hearing protection devices.

TABLE B2
Permissible Noise Exposures, OSHA Standards

Duration per day, hours	Sound Level dBA slow response
8	90
6	92
4	95
3	97
2	100
1 1/2	102
1	105
1/2	110
1/4 or less	115

Source: 29 CFR Ch. XVII, Section 1910.

Based on noise monitoring data gathered by the consultant in numerous airport noise compatibility studies, noise levels of this magnitude and duration are rarely, if ever, found in airport environs. Rather, they tend to be confined to the ramp and runway areas of the airport. Aircraft noise levels in the environs of a general aviation airport, or even a military or commercial airport, are far too low to be considered as potentially damaging to hearing.

In a recent summary of the research on the health effects of noise, Taylor and Wilkins (1987, p. 4/10) conclude: "Those most at risk [of hearing loss] are personnel in the transportation industry, especially airport ground staff. Beyond this group, it is unlikely that the general public will be exposed to sustained high levels of transportation noise sufficient to result in hearing loss. Transportation noise control in the community can therefore not be justified on the grounds of hearing protection."

NON-AUDITORY HEALTH EFFECTS

It is sometimes claimed that aviation noise can harm the general physical and mental health of airport neighbors. Effects on the cardiovascular system, mortality rates, birth weights, achievement scores, and psychiatric admissions have been examined in the research literature. These questions remain unsettled because of conflicting findings based on differing methodologies and uneven study quality. It is quite possible that the contribution of noise to pathological effects is so low that it has not been isolated. While research is continuing, there is insufficient scientific evidence to support these concerns (Newman and Beattie 1985, pp 59-62).

Taylor and Wilkins (1987, p. 4/10) offer the following conclusions in their review of the research.

> The evidence of non-auditory effects of transportation noise is more ambiguous, leading to differences of opinion regarding the burden of prudence for noise control. There is no strong evidence that noise has a direct causal effect on such health outcomes as cardiovascular disease, reproductive abnormality, or psychiatric disorder. At the same time, the evidence is not strong enough to reject the hypothesis that noise is in some way involved in the multi-causal process leading to these disorders.... But even with necessary improvements in study design, the inherent difficulty of isolating the effect of a low dose agent such as transportation noise within a complex etiological system will remain. It seems unlikely, therefore, that research in the near future will yield findings which are definitive in either a positive or negative direction. Consequently, arguments for transportation noise control will probably continue to be based primarily on welfare criteria such as annoyance and activity disturbance.

SLEEP DISTURBANCE

There is a large body of research documenting the effect of noise on sleep disturbance, but the long-range effects of sleep disturbance caused by nighttime airport operations are not well understood. It is clear that sleep is essential for good physical and emotional health, and noise can interfere with sleep, even when the sleeper is not consciously awakened. While the long-term effect of sleep deprivation on mental and physical function is not clear, it is known to be harmful. It is also known that sleepers do not fully adjust to noise disruption over time. Although they may awaken less often and have fewer conscious memories of disturbance, noise-induced shifts in sleep levels continue to occur.

Newman and Beattie (1985, pp. 51-58) review the literature on sleep disturbance and note that the level of noise which can interfere with falling asleep or waking from sleep ranges from 35 to 70 dB, depending on sleep stage and variability among individuals. They note that studies show only slight habituation to noise.

Karl D. Kryter (1984, pp. 422-431) also reviews the literature on sleep disturbance. He reports the threshold level for awakening from sleep as ranging from 35 dB to 80 dB, depending on sleep stage and individual variability. Older people tend to be much more sensitive to noise-induced awakenings than younger people. Research has shown that, when measured through awakenings, people tend to become somewhat accustomed to noise. On the other hand, electro-encephalograms, which reveal information about sleep stages, show little habituation to noise. Kryter describes these responses to noise as "alerting responses." He adds that, because they occur unconsciously, they are apparently reflexive, reflecting normal physiological functions which may not be a cause of stress to the organism.

Most studies of sleep disturbance have been conducted under controlled laboratory conditions. The laboratory studies do not allow generalizations to be made about the potential for sleep disturbance in an actual airport setting, and more importantly, the impact of these disturbances on the residents. Only a few studies have examined the effect of nighttime noise on sleep disturbance in actual community settings. A recent report summarizes the results of eight such studies, most of which were done in Europe (Fields 1986). Four of the studies examined aircraft noise and the others examined highway noise. In all of them, sleep disturbance was correlated with cumulative noise exposure metrics such as Leq and L10. All studies showed a distinct tendency for increased sleep disturbance to be reported as cumulative noise exposure increased. The reviewer notes however, that sleep disturbance was very common, regardless of noise levels, and that many factors contributed to it. He points out that, "the prevalence of sleep disturbance in the absence of noise means that considerable caution must be exercised in interpreting any reports of sleep disturbance in noisy areas."

The findings of many of these sleep disturbance studies, while helping to answer basic research questions, are of little usefulness to policy makers and airport residents. For them, the important question is, "When does sleep disturbance caused by environmental noise become severe enough to constitute a problem in the community?"

Kryter (1984) reviews in detail one very important study that sheds light on this question. The Directorate of Operational Research and Analysis (DORA) of the British Civil Aviation Authority conducted an in-depth survey of 4,400 residents near London's Heathrow and Gatwick Airports over a four-month period in 1979. The study was intended to answer two policy-related questions: "What is the level of aircraft noise which will disturb a sleeping person?" and "What level of aircraft noise prevents people from getting to sleep?"

Analysis of the survey results indicated that the best correlations were found using cumulative energy dosage metrics, namely Leq. Kryter notes that support for the use of the Leq metric is provided by the finding that some respondents could not accurately recall the time association of a specific flight with an arousal from sleep. This suggests that the noise from successive overflights increased the general state of arousability from sleep.

With regard to difficulty in getting to sleep, the study found 25% of the respondents reporting this problem at noise levels of 60 Leq, 33% at 65 Leq, and 42% at 70 Leq. The percentage of people who reported being awakened at least once per week by aircraft noise was 19% at 50 Leq, 24% at 55 Leq, and 28% at 60 Leq. The percentage of people bothered "very much" or "quite a lot" by aircraft noise at night when in bed was 22% at 55 Leq and 30% at 60 Leq. Extrapolation of the trend line would put the percentage reporting annoyance at 65 Leq well above 40%. (See DORA 1980; cited in Kryter 1984, p. 434.)

DORA concluded with the following answers to the policy-related questions: (1) A significant increase in reports of sleep arousal will occur at noise levels at or above 65 Leq; (2) A significant increase in the number of people reporting difficulty in getting to sleep will occur at noise levels at or above 70 Leq. Kryter disagrees with these conclusions. He believes that the data indicate that noise levels approximately 10 decibels lower would represent the appropriate thresholds.

At any airport, the 65 CNEL contour developed from total daily aircraft activity will be larger than the 55 Leq developed from nighttime activity only. (At an airport with only nighttime use, the 65 CNEL contour would be identical with the 55 Leq contour because of the effect of the 10 dB penalty in the CNEL metric.) Thus, the 65 CNEL contour defines a noise impact envelope which encompasses all of the area within which significant sleep disturbance may be expected based on Kryter's interpretation of the DORA findings discussed above.

STRUCTURAL DAMAGE

Structural vibration from aircraft noise in the low frequency ranges is sometimes a concern of airport neighbors. While vibration contributes to annoyance reported by residents near airports, especially when it is accompanied by high audible sound levels, it rarely carries enough energy to damage safely constructed structures. High-impulse sounds such as blasting, sonic booms, and artillery fire are more likely to cause damage than continuous sounds such as aircraft noise.

A document published by the National Academy of Sciences suggested that one may conservatively consider noise levels above 130 dB lasting more than one second as potentially damaging to structures (CHABA 1977). Aircraft noise of this magnitude occurs on the ramp and runway and seldom, if ever, occurs beyond the boundaries of a commercial or general aviation airport.

The risk of structural damage from aircraft noise was studied as part of the environmental assessment of the Concorde supersonic jet transport. The probability of damage from Concorde overflights was found to be extremely slight. Actual overflight noise levels from the Concorde at Sully Plantation near Dulles International Airport in Fairfax County, Virginia were recorded at 115 dBA. No damage to the historic structures was found, despite their age (Hershey et al. 1975). Since the Concorde causes significantly more vibration than conventional commercial jet aircraft, the risk of structural damage caused by aircraft noise near airports is considered to be negligible. (See Wiggins 1975.)

OTHER ANNOYANCES

The psychological impact of aircraft noise is a more serious concern than direct physical impact. Studies conducted in the late 1960's and early 1970's found that the interruption of communication, rest, relaxation, and sleep are among the most important causes for complaints about aircraft noise. Interference with telephone conversations, radio listening, and television viewing are often mentioned as particular sources of annoyance.

The sound of approaching aircraft may cause fear in some people about the possibility of a crash. This fear is a factor motivating some complaints of annoyance in neighborhoods near airports around the country. (See, for examples, Richards and Ollerhead 1973; Federal Aviation Administration 1977; and Kryter 1984, p. 533.) This effect tends to be most pronounced in areas directly beneath frequently used flight tracks.

The EPA has also found that continuous exposure to high noise levels can affect work performance, especially in high-stress occupations. Based on the various land use compatibility guidelines discussed below, these adverse affects are most likely to occur in an airport area within the 75 Ldn, or 75 CNEL, contour.

Individual human response to noise is highly variable and is influenced by many factors. These include emotional variables, feelings about the necessity or preventability of the noise, judgments about the value of the activity creating the noise, an individual's activity at the time the noise is heard, general sensitivity to noise, beliefs about the impact of noise on health, and feelings of fear associated with the noise. Physical factors influencing an individual's reaction to noise include the background noise in the community, the time of day, the season of the year, the predictability of the noise, and the individual's control over the noise source.

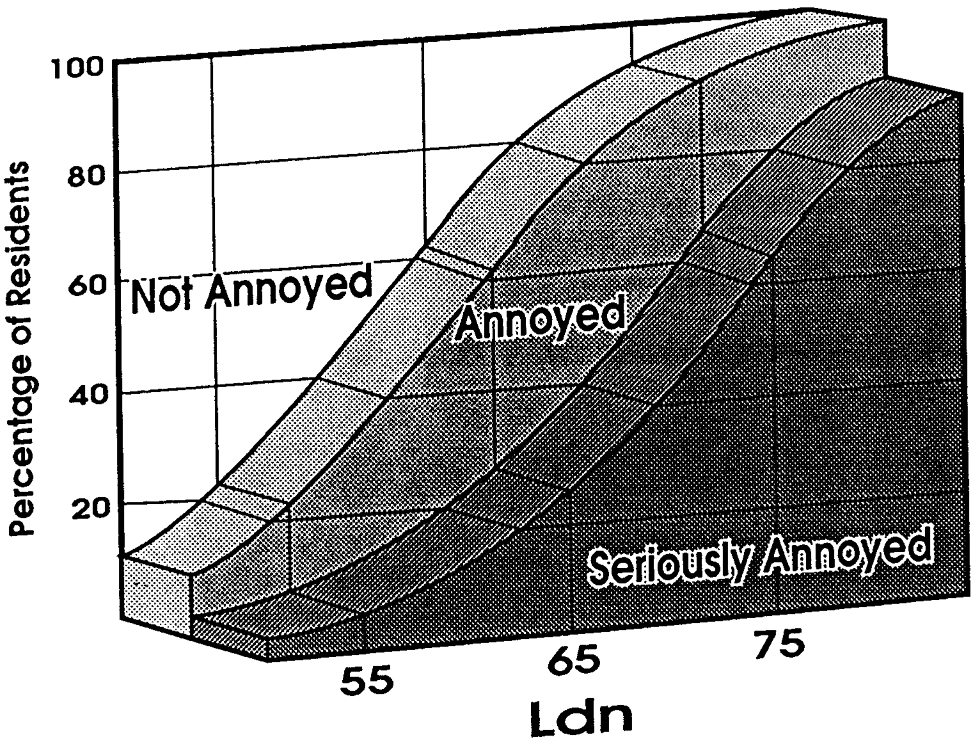
AVERAGE COMMUNITY RESPONSE TO NOISE

Although individual responses to noise can vary greatly, the average response among a group of people is much less variable. This enables us to make reasonable evaluations of the average impacts of aircraft noise on a community despite the wide variations in individual response.

Several studies have examined average community response to noise, focusing on the relationship between annoyance and noise exposure. (See, for examples, Richards and Ollerhead 1973; U.S.E.P.A. 1974; DORA 1980; Kryter 1970; and Great Britain Committee on the Problem of Noise 1963.) Particularly good reviews of this research are presented in Newman and Beattie 1985, p. 19, and Kryter 1984, p. 525. These studies have produced similar results, finding that annoyance is most directly related to cumulative noise exposure, rather than single-event exposure. Annoyance has been found to increase along either an exponential or an S-shaped curve as cumulative noise exposure increases. While these studies have shown curves that vary somewhat in their slope, they tend to be similar to the annoyance curve shown in **Exhibit B4.**

For research purposes, annoyance is usually measured through blind social surveys using random sampling techniques where people are asked to describe their feelings about the noise. Consistently, the best correlations have been found using cumulative noise exposure, or noise dosage, metrics. Indeed, cumulative noise metrics have been found consistently to provide the best explanatory power for all manner of noise effects, excluding the drastic effects of high-impulse sounds. The reason is that human response to broadband sound such as aircraft noise is related to two different dimensions of the sound -- energy level and frequency of occurrence. To put it in common sense terms, a person will tolerate a rare and very loud noise event, but as the number of events increases, the person's tolerance decreases. Across the country, one often hears this kind of comment from airport area residents: "I know jets have flown in and out of the airport for years, but they never really bothered me until the airport started expanding." Cumulative noise exposure metrics have been developed to quantify the combined effects of sound energy level and the frequency of occurrence.

A variety of cumulative noise exposure metrics have been used in research studies over the years. In the United States, the Ldn metric has been widely used, while in California, the CNEL metric is used. They are very similar. Ldn accumulates the total noise occurring during a 24-hour period, with a 10 decibel penalty applied to noise occurring between 10:00 p.m. and 7:00 a.m. The CNEL metric is the same except that it adds a 4.8 dB penalty for noise occurring between 7:00 p.m. and 10:00 p.m. There is little practical difference between the two metrics in practice. Calculations of CNEL and Ldn from the same data generally yield values with less than a .7 dB difference (CalTrans 1983, p. 37). Both metrics correlate well with average community response to noise.



Source: Richards and Ollerhead 1973.

Exhibit B4
ANNOYANCE CAUSED BY AIRCRAFT NOISE IN RESIDENTIAL AREAS

EFFECT OF BACKGROUND NOISE

It has been speculated that the overall ambient noise level in an environment determines to what degree people will be annoyed by aircraft noise of a given level. That is, in a louder environment, it takes a louder level of aircraft noise level to generate complaints than it does in a quieter environment. Both common sense and the consultant's experience in the field would indicate there is validity in this assumption.

Kryter (1984, p. 582) reviews some of the research on this question. He notes that the effects of laboratory tests and attitude surveys on this question are somewhat inconclusive. A laboratory test he reviews found that recordings of aircraft noise were judged to be less intrusive as the background road traffic noise was increased. On the other hand, an attitude survey in the Toronto Airport area found that the effects of background noise were not significant.

The studies reviewed by Kryter were intended to see if background noise provided some degree of masking of aircraft noise. They did not, however, take into consideration the subjects' rating of the overall quality of the noise environment.

The U.S. Environmental Protection Agency has provided guidelines to address the question of background noise and its relationship to aircraft noise. EPA has determined that complaints can be expected when the intruding CNEL exceeds the background CNEL by more than 5 dB (U.S. EPA 1974). The California Department of Transportation (CalTrans 1983, p. 52) notes that some Airport Land Use Commissions in California consider the effects of background noise in determining the aircraft noise contour of significance. Specifically, adjustments have been made in areas with quiet background noise levels of 50 to 55 CNEL. In those cases, aircraft CNEL contours are prepared down to the 55 or 60 CNEL level, and land use compatibility criteria are adjusted to apply to those areas.

LAND USE COMPATIBILITY GUIDELINES

The degree of annoyance which people suffer from aircraft noise varies depending on their activities at any given time. People rarely are as disturbed by aircraft noise when they are shopping, working, or driving as when they are at home. Transient hotel and motel residents seldom express as much concern with aircraft noise as do permanent residents of an area.

The concept of "land use compatibility" has arisen from this systematic variation in human tolerance to aircraft noise. Studies by governmental agencies and private researchers have defined the compatibility of different land uses with varying noise levels. Since the 1960's, many different sets of land use compatibility guidelines have been proposed and used. This section reviews some of the more well known guidelines.

FAA-DOD Guidelines

In 1964, the Federal Aviation Administration (FAA) and the U.S. Department of Defense (DOD) published similar documents setting forth guidelines to assist land use planning in areas subjected to aircraft noise from nearby airports. These guidelines are presented in **Table B3**. The guidelines establish three zones, describing the expected responses to aircraft noise from residents of each zone. In Zone 1, corresponding to areas exposed to noise below 65 Ldn, essentially no complaints would be expected, although noise could be an occasional nuisance. In Zone 2, corresponding to 65 to 80 Ldn, individuals may complain, perhaps vigorously. In Zone 3, corresponding to 80 Ldn and above, vigorous complaints would be likely and concerted group action could be expected.

TABLE B3
Chart for Estimating Response of Communities Exposed to Aircraft Noise

Noise Rating	Zone	Description of Expected Response
Less than 65 Ldn 100 CNR	1	Essentially no complaints would be expected. The noise may, however, interfere occasionally with certain activities of the residents.
65 to 80 Ldn 100 to 115 CNR	2	Individuals may complain, perhaps vigorously. Concerted group action is possible.
Greater than 80 Ldn 115 CNR	3	Individual reactions would likely include repeated, vigorous complaints. Concerted group action might be expected.

Note: CNR stands for "community noise rating", a cumulative noise descriptor similar to Ldn which is no longer in general use.

Sources: U.S. DOD 1964. Cited in Kryter 1984, p. 616.

HUD Guidelines

In 1971, the U.S.Department of Housing and Urban Development published noise assessment guidelines for use in evaluating the acceptability of sites for housing assistance. The guidelines, shown in Table B4, establish four classes of noise impact. The first two categories refer to areas outside the 65 Ldn contour, the first at a distance exceeding the distance between the 65 and 75 Ldn contours, the second at a lesser distance. Housing is considered clearly acceptable in the first category and "normally acceptable" in the second. Housing is considered "normally unacceptable" in the 65 to 75 Ldn range and clearly unacceptable inside the 75 Ldn contour.

TABLE B4
Site Exposure to Aircraft Noise

Distance from site to the center of the area covered by the principal runways	Acceptability category
Outside the Ldn = 65(NEF=30, CNR-100) contour at a distance greater than or equal to the distance between the contours Ldn = 65 and Ldn = 75	Clearly acceptable
Outside the Ldn = 65 contour, at a distance less than the distance between the Ldn =65 and Ldn =75	Normally acceptable
Between the Ldn =65 and Ldn =75 contours	Normally acceptable
Within the Ldn =75 contour	Clearly unacceptable

Note: CNR and NEF stand for "community noise rating", and "noise exposure forecast", cumulative noise descriptors which are no longer in general use.

Source: Schultz and McMahon 1971. Cited in Kryter 1984, p. 617.

EPA Guidelines

The U.S. Environmental Protection Agency published a document in 1974 suggesting maximum noise exposure levels to protect public health with an adequate margin of safety. These are shown in Table B5. They note that the risk of hearing loss may become a concern with exposure to noise above 74 Ldn. Interference with outdoor activities may become a problem with noise levels above 55 Ldn. Interference with indoor residential activities may become a problem with interior noise levels above 45 Ldn. If we assume that standard construction attenuates noise by about 20 dB, with doors and windows closed, a standard estimate, this corresponds to an exterior noise level of 65 Ldn.

TABLE B5
Summary of Noise Levels Identified as Requisite To Protect Public Health and Welfare With An Adequate Margin of Safety

Effect	Level	Area
Hearing Loss	74 Ldn +	All areas
Outdoor activity interference and annoyance	55 Ldn +	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places in which quiet is a basis for use.
	59 Ldn +	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.
Indoor activity interference and annoyance	45 Ldn +	Indoor residential areas
	49 Ldn +	Other indoor areas with human activities such as schools, etc.

Note: All Leq values from EPA document converted by FAA to Ldn for ease of comparison (Ldn = Leq(24) + 4 dB).
Source: U.S. EPA 1974. Cited in FAA 1977, p. 26.

Federal Interagency Committee on Urban Noise

In 1979, the Federal Interagency Committee on Urban Noise, including representatives of the Environmental Protection Agency, the Department of Transportation, the Housing and Urban Development Department, the Department of Defense, and the Veterans Administration, was established to coordinate various Federal programs relating to the promotion of noise-compatible development (Federal Interagency Committee on Urban Noise 1980). In 1980, the Committee published a report, **Guidelines for Considering Noise in Land Use Planning and Control**, which contained detailed land use compatibility guidelines for varying Ldn noise levels. These guidelines are presented in **Table B6.** The work of the Interagency Committee was very important as it brought together for the first time all Federal agencies with a direct involvement in noise compatibility issues and forged a general consensus on land use compatibility for noise analysis on Federal projects.

The Interagency guidelines describe the 65 Ldn contour as the threshold of significant impact for residential land uses and a variety of noise-sensitive institutions (such as hospitals, nursing homes, schools, cultural activities, auditoriums, and outdoor music shells). Within the 55 to 65 Ldn contour range, the guidelines note that cost and feasibility factors were considered in defining residential development and several of the institutions as compatible. In other words, the guidelines are based not solely on the effects of noise. They also consider the cost and feasibility of noise control.

TABLE B6
Suggested Land Use Compatibility Guidelines

SLUCM No.	Land Use Name		Noise Zones/DNL Levels in Ldn					
		A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
10	**Residential**							
11	Household Units							
11.11	Single Units - detached	Y	Y*	25[1]	30[1]	N	N	N
11.12	Single Units - semi-detached	Y	Y*	25[1]	30[1]	N	N	N
11.13	Single Units - attached row	Y	Y*	25[1]	30[1]	N	N	N
11.21	Two Units - side by side	Y	Y*	25[1]	30[1]	N	N	N
11.22	Two Units - one above the other	Y	Y*	25[1]	30[1]	N	N	N
11.31	Apartments - walk up	Y	Y*	25[1]	30[1]	N	N	N
11.32	Apartments - elevator	Y	Y*	25[1]	30[1]	N	N	N
12	Group Quarters	Y	Y*	25[1]	30[1]	N	N	N
13	Residential Hotels	Y	Y*	25[1]	30[1]	N	N	N
14	Mobile Home Park or Courts	Y	Y*	N	N	N	N	N
15	Transient Lodgings	Y	Y*	25[1]	30[1]	35[1]	N	N
16	Other Residential	Y	Y*	25[1]	30[1]	N	N	N

TABLE B6 (Continued)
Suggested Land Use Compatibility Guidelines

SLUCM No.	Land Use Name	A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
		Noise Zones/DNL Levels in Ldn						
20	**Manufacturing**							
21	Food and kindred products - manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
22	Textile mill products - manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
23	Apparel and other finished products made from fabrics, leather, and similar materials - manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
24	Lumber and wood products (except furniture) - manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
25	Furniture and fixtures - manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
26	Paper and allied products - manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
27	Printing, publishing, and allied industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
28	Chemicals and allied products manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
29	Petroleum refining and related industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
30	**Manufacturing (Continued)**							
31	Rubber and misc. plastic products - manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
32	Stone, clay and glass products - manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
33	Primary metal industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
34	Fabricated metal products - manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks - manufacturing	Y	Y	Y	25	30	N	N

TABLE B6 (Continued)
Suggested Land Use Compatibility Guidelines

SLUCM No.	Land Use Name	A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
		Noise Zones/DNL Levels in Ldn						
39	Miscellaneous manufacturing	Y	Y	Y	Y^2	Y^3	Y^4	N
40	**Transportation, communication and utilities**							
41	Railroad, rapid rail transit transit and street railway transportation	Y	Y	Y	Y^2	Y^3	Y^4	Y
42	Motor vehicle transportation	Y	Y	Y	Y^2	Y^3	Y^4	Y
43	Aircraft transportation	Y	Y	Y	Y^2	Y^3	Y^4	Y
44	Marine craft transportation	Y	Y	Y	Y^2	Y^3	Y^4	Y
45	Highway and street right-of-way	Y	Y	Y	Y^2	Y^3	Y^4	Y
46	Automobile parking	Y	Y	Y	Y^2	Y^3	Y^4	N
47	Communication	Y	Y	Y	25^5	30^5	N	N
48	Utilities	Y	Y	Y	Y^2	Y^3	Y^4	Y
49	Other transportation, communication and utilities	Y	Y	Y	25^5	30^5	N	N
50	**Trade**							
51	Wholesale trade	Y	Y	Y	Y^2	Y^3	Y^4	N
52	Retail trade - building materials, hardware and farm equipment	Y	Y	Y	Y^2	Y^3	Y^4	N
53	Retail trade - general merchandise	Y	Y	Y	25	30	N	N
54	Retail trade - food	Y	Y	Y	25	30	N	N
55	Retail trade - automotive, marine craft, aircraft and accessories	Y	Y	Y	25	30	N	N
56	Retail trade - apparel and accessories	Y	Y	Y	25	30	N	N

TABLE B6 (Continued)
Suggested Land Use Compatibility Guidelines

SLUCM No.	Land Use Name	Noise Zones/DNL Levels in Ldn A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
57	Retail trade - furniture, home furnishings and equipment	Y	Y	Y	25	30	N	N
58	Retail trade - eating and drinking establishments	Y	Y	Y	25	30	N	N
59	Other retail trade	Y	Y	Y	25	30	N	N
60	**Services**							
61	Finance, insurance and real estate services	Y	Y	Y	25	30	N	N
62	Personal services	Y	Y	Y	25	30	N	N
62.4	Cemeteries	Y	Y	Y	Y[2]	Y[3]	Y[4,11]	Y[6,11]
63	Business services	Y	Y	Y	25	30	N	N
64	Repair services	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
65	Professional services	Y	Y	Y	25	30	N	N
65.1	Hospitals, nursing homes	Y	Y*	25*	30*	N	N	N
65.2	Other medical facilities	Y	Y	Y	25	30	N	N
66	Contract construction services	Y	Y	Y	25	30	N	N
67	Governmental services	Y	Y*	Y*	25*	30*	N	N
68	Educational services	Y	Y*	25*	30*	N	N	N
69	Miscellaneous	Y	Y	Y	25	30	N	N
70	**Cultural, entertainment and recreational**							
71	Cultural activities (including churches)	Y	Y*	25*	30*	N	N	N
71.2	Nature exhibits	Y	Y*	Y*	N	N	N	N
72	Public assembly	Y	Y	Y	N	N	N	N
72.1	Auditoriums, concert halls	Y	Y	25	30	N	N	N
72.11	Outdoor music shells, amphitheaters	Y	Y*	N	N	N	N	N

TABLE B6 (Continued)
Suggested Land Use Compatibility Guidelines

SLUCM No.	Land Use Name	Noise Zones/DNL Levels in Ldn A 0-55	B 55-65	C-1 65-70	C-2 70-75	D-1 75-80	D-2 80-85	D-3 85+
72.2	Outdoor sports arenas, spectator sports	Y	Y	Y[7]	Y[7]	N	N	N
73	Amusements	Y	Y	Y	Y	N	N	N
74	Recreational activities (including golf courses, riding stables, water recreation)	Y	Y*	Y*	25*	30*	N	N
75	Resorts and group camps	Y	Y*	Y*	Y*	N	N	N
76	Parks	Y	Y*	Y*	Y*	N	N	N
79	Other cultural, entertainment	Y	Y*	Y*	Y*	N	N	N
80	**Resource Production and extraction**							
81	Agriculture (except livestock)	Y	Y	Y[8]	Y[9]	Y[10]	Y[10,11]	Y[10,11]
81.5 to 81.7	Livestock farming and animal breeding	Y	Y	Y[8]	Y[9]	N	N	N
82	Agricultural related activities	Y	Y	Y[8]	Y[9]	Y[10]	Y[10,11]	Y[10,11]
83	Forestry activities and related services	Y	Y	Y[8]	Y[9]	Y[10]	Y[10,11]	Y[10,11]
84	Fishing activities and related services	Y	Y	Y	Y	Y	Y	Y
85	Mining activities and related services	Y	Y	Y	Y	Y	Y	Y
89	Other source production and extraction	Y	Y	Y	Y	Y	Y	Y

TABLE B6 (Continued)
Suggested Land Use Compatibility Guidelines

NOTES

[1]a) Although local conditions may require residential use, it is discouraged in C-1 and strongly discouraged in C-2. 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 (Zone C-1) and 30 dB (Zone C-2) 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, 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.*

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

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

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

[5] If noise sensitive use indicated NLR; if not use is compatible.

[6] No buildings.

[7] Land use compatible provided special sound reinforcement systems are installed.

TABLE B6 (Continued)
Suggested Land Use Compatibility Guidelines

[8] Residential buildings require a NLR of 25.

[9] Residential buildings require a NLR of 30.

[10] Residential buildings not permitted.

[11] Land use not recommended, but if community decides use is necessary, hearing protection devices should be worn by personnel.

KEY

SLUCM	**Standard Land Use Coding Manual,** (U.S. Urban Renewal Administration and Bureau of Public Roads, 1965).
Y(Yes)	Land Use and related structures compatible without restrictions.
N(No)	Land Use and related structures are not compatible and should be prohibited.
NLR (Noise Level Reduction)	Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.
Y^x(Yes with restrictions)	Land Use and related structures generally compatible; see notes 2 through 4.
25, 30, or 35	Land Use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 must be incorporated into design and construction of structure.
25*, 30*, or 35*	Land Use generally compatible with NLR; however, measures to achieve an overall noise reduction do not necessarily solve noise difficulties and additional evaluation is warranted.

TABLE B6 (Continued)
Suggested Land Use Compatibility Guidelines

Y*	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....

Source: **Guidelines For Considering Noise In Land Use Planning and Control**, Federal Interagency Committee on Urban Noise, June 1980, p.6.

ANSI Guidelines

In 1980, the American National Standards Institute (ANSI) published recommendations for land use compatibility with respect to noise (ANSI 1980). Kryter (1984, p. 621) notes that no supporting data for the recommended standard is provided.

The ANSI guidelines are shown in **Exhibit B5.** While generally similar to the Federal Interagency guidelines, there are some important differences. First, ANSI's land use classification system is less detailed. Second, the ANSI standard acknowledges the potential for noise effects below the 65 Ldn level, describing several uses as "marginally compatible" with noise below 65 Ldn. These include single-family residential (from 55 to 65 Ldn), multi-family residential, schools, hospitals, and auditoriums (60 to 65 Ldn), and music shells (50 to 65 Ldn). Other outdoor activities, such as parks, playgrounds, cemeteries, and sports arenas, are described as marginally compatible with noise levels as low as 55 or 60 Ldn.

F.A.R. Part 150 Guidelines

The FAA adopted a revised and simplified version of the Federal Interagency guidelines when it promulgated F.A.R. Part 150 in the early 1980's. (The Interim Rule was adopted on January 19, 1981. The final rule was adopted on December 13, 1984, published in the Federal Register on December 18, and became effective on January 18, 1985.) Among the changes made by FAA include the use of a coarser land use classification system and the deletion of any reference to any potential for noise impacts below the 65 Ldn level.

The determination of the compatibility of various land uses with various noise levels, however, is very similar to the Interagency determinations.

Exhibit B6 lists the F.A.R. Part 150 land use compatibility guidelines. These are only guidelines. Part 150 explicitly states that determinations of noise compatibility and regulation of land use are purely local responsibilities. Lacking any specific guidance provided by State law or regulation, local airport sponsors around the

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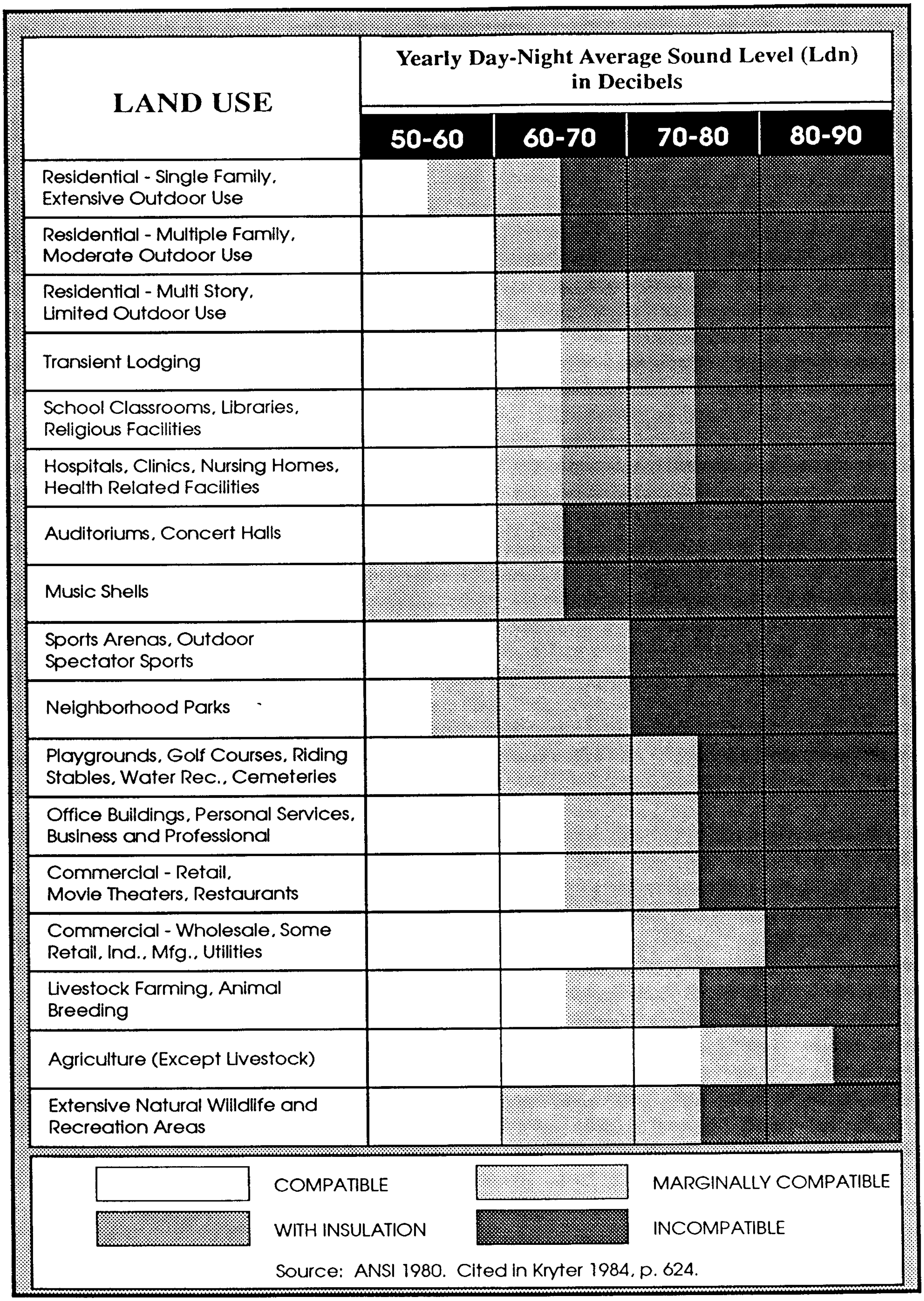

Exhibit B5

LAND USE COMPATIBILITY WITH YEARLY DAY-NIGHT AVERAGE SOUND LEVEL AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED

LAND USE	Yearly Day-Night Average Sound Level (DNL) in Decibels					
	Below 65	65-70	70-75	75-80	80-85	Over 85
RESIDENTIAL						
Residential, other than mobile homes and transient lodgings	Y	N[1]	N[1]	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N[1]	N[1]	N[1]	N	N
PUBLIC USE						
Schools	Y	N[1]	N[1]	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y[2]	Y[3]	Y[4]	Y[4]
Parking	Y	Y	Y[2]	Y[3]	Y[4]	N
COMMERCIAL USE						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale and retail-building materials, hardware and farm equipment	Y	Y	Y[2]	Y[3]	Y[4]	N
Retail trade-general	Y	Y	25	30	N	N
Utilities	Y	Y	Y[2]	Y[3]	Y[4]	N
Communication	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION						
Manufacturing, general	Y	Y	Y[2]	Y[3]	Y[4]	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y[6]	Y[7]	Y[8]	Y[8]	Y[8]
Livestock farming and breeding	Y	Y[6]	Y[7]	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL						
Outdoor sports arenas and spectator sports	Y	Y[5]	Y[5]	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts, and camps	Y	Y	Y	N	N	N
Golf courses, riding stables, and water recreation	Y	Y	25	30	N	N

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

See other side for notes and key to table.

Exhibit B6
FAA LAND USE
COMPATIBILITY GUIDELINES

KEY

Y (Yes) Land Use and related structures compatible without restrictions.

N (No) Land Use and related structures are not compatible and should be prohibited.

NLR Noise Level Reduction (outdoor to indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.

25, 30, 35 Land Use and related structures generally compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structure.

NOTES

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

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

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

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

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

6 Residential buildings require a NLR of 25.

7 Residential buildings require a NLR of 30.

8 Residential buildings not permitted.

Source: ***F.A.R. Part 150,*** *Appendix A, Table 1.*

Exhibit B6 (Continued)
FAA LAND USE
COMPATIBILITY GUIDELINES

country typically use the Part 150 Land Use guidelines as is when developing noise compatibility studies under F.A.R. Part 150.

California Guidelines

In the **Airport Land Use Planning Handbook** (CalTrans 1983, p. 50) land use compatibility guidelines are suggested for use in the preparation of comprehensive airport land use plans. These guidelines were developed after considering the guidelines of the State Office of Noise Control, HUD, and the FAA. They were also based on a review of all available comprehensive airport land use plans in California.

These standards, shown in **Table B7**, differ from the Federal guidelines in three important respects. First, they use a much less detailed land use classification system. Application of the guidelines through a zoning ordinance or similar local regulation, may necessitate refinement in the classification system. The Federal Interagency guidelines would be appropriate as a reference.

Second, they propose different standards for residential land use in the vicinity of air carrier and military airports than for general aviation airports. A third difference is that land use compatibility below the 65 CNEL level, down to 55 CNEL, is specifically addressed.

At air carrier and military airports, residential development within the 65 CNEL contour should be discouraged and mobile homes should be prohibited. It is strongly recommended that no residential development be permitted within the 70 CNEL contour.

At general aviation airports, these land use guidelines are recommended to apply to the next lower CNEL ranges -- the 60-65 and 65-70 CNEL, respectively. This is because at most general aviation airports, "the 65 CNEL noise contour ... does not sufficiently explain the annoyance area. The frequency of operations from some airports, visibility of aircraft at low altitudes and typically lower background noise levels around many general aviation airports are all believed to create a heightened awareness of general aviation activity and hence, potential for annoyance outside of the 65 CNEL contour." (See CalTrans 1983, p. 49.)

At general aviation airports, the potential for annoyance is noted within the 55 to 60 CNEL contours. The guidelines suggest that noise easements should be acquired for new construction and the potential need for sound insulation should be examined.

At all airports, institutional uses should be discouraged within the 65 CNEL contour. Commercial development is considered compatible with noise up to 70 CNEL and industrial land use with noise up to 75 CNEL.

CONCLUSION

This technical appendix has described the measurement of sound and the analysis of aircraft noise, reviewed the research on noise effects, and presented information on land use compatibility guidelines with respect to noise. It is intended to serve as a reference for the development of policy guidelines for the Riverside County Airport Land Use Commission as it develops comprehensive land use plans for the airports in the County.

TABLE B7
Land Use Guidelines For Noise Compatibility

Type of Airport/ Land Use	55-60 CNEL	60-65 CNEL	65-70 CNEL	70-75 CNEL	75-80 CNEL	80+ CNEL
Air Carrier and Military						
Residential/Lodgings		Potential for annoyance exists; identify high complaint areas Determine whether sound insulation requirements should be established for these areas. Require acoustical reports for all new construction. Noise easements should be required for new construction.	Discourage new single family dwellings. Prohibit mobile homes. New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. Noise easements should be required for new construction. Development policies for "infill".	New construction or development of residential uses should not be undertaken. New hotels and motels may be permitted after an analysis of noise reduction requirements is made and needed noise insulation is included in the design.	New hotels and motels should be discouraged.	
General Aviation						
Residential/Lodgings	Potential for annoyance exists; identify high complaint areas. Determine whether sound insulation requirements should be established for these areas. Noise easements should be required for new construction. Discourage residential use underneath the flight pattern.	Discourage new single family dwellings. Prohibit mobile homes. New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation is included in the design. Noise easements should be required. Development policies for "infill".	New construction or development of residential uses should not be undertaken. New hotels and motels may be permitted after an analysis of noise reduction requirements is made and needed noise insulation is included in the design.	New hotels and motels should be discouraged.		
All Airports						
Public/Institutional		Satisfactory with little noise impact and requiring no special noise insulation requirements for new construction.	Discourage institutional uses. If no other alternative location is available, new construction or development should be undertaken only after an analysis of noise reduction is made and needed noise insulation is included in the design.	No new institutional uses should be undertaken.		
Commercial			Satisfactory, with little noise impact and requiring no special noise insulation for new construction.	New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design. Noise reduction levels of 25-30 dB will be required.	Same as 70-75 CNEL	New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the construction.
Industrial				Satisfactory, with little noise impact and requiring no special noise insulation requirements for new construction.	New construction or development should be undertaken only after an analysis of noise reduction requirements is made and needed noise insulation features included in the design. Measures to achieve noise reduction of 25-35 dB must be incorporated in portions of building where the public is received and in office areas.	New construction or development should not be undertaken unless related to airport activities or services. Conventional construction will generally be inadequate and special noise insulation features should be included in the construction.
Recreation/Open Space			Satisfactory, with little noise impact and requiring no special noise insulation requirements for new construction. Outdoor music shells and amphitheater should not be permitted.	Parks, spectator sports, golf courses and agricultural generally satisfactory with little noise impact. Nature areas for wildlife and zoos should not be permitted.	Land uses involving concentrations of people (spectator sports and some recreational facilities) or of animals (livestock farming and animal breeding) should not be permitted.	

Source: Airport Use Planning Handbook: A Reference Guide for Local Agencies, prepared for California Department of Transportation, Division of Aeronautics by Metropolitan Transportation Commission and Association of Bay Area Governments, 1983, p. 50.

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Appendix C
SAFETY CONSIDERATIONS IN THE VICINITY OF AIRPORTS

Appendix C
SAFETY CONSIDERATIONS IN THE VICINITY OF AIRPORTS

INTRODUCTION

This technical appendix presents an overview of the important considerations regarding safety of persons on the ground and in the air in the vicinity of airports. It begins with a brief discussion of basic flight procedures. Aircraft accident data are then reviewed. Safety standards proposed in various advisory documents and regulations around the country are reviewed. The appendix concludes with a review of the safety standards proposed for use in California by the Department of Transportation, Division of Aviation.

FLIGHT PROCEDURES

In order to more fully understand the significance of aircraft accident data, it is important to have a basic understanding of basic flight procedures.

FLIGHT RULES

The Federal Aviation Administration has defined two sets of flight rules governing aircraft flight. Under Visual Flight Rules (VFR), pilots operate visually. It is their responsibility to maintain separation between aircraft. The FAA has defined a variety of flight procedures to facilitate coordination among VFR aircraft.

Instrument Flight Rules (IFR) govern aircraft operating under instrument control. IFR procedures are required when poor visibility limits the ability of a pilot to navigate visually. IFR procedures are also often used by qualified pilots in good weather conditions. Under IFR, pilots rely on cockpit instruments, navigational aids, and air traffic control services.

TRAFFIC PATTERN

An airport traffic pattern is a generalized route defined for aircraft to approach and depart the active runway. The pattern is typically defined in terms of altitude and a general path around the airport. The standard pattern altitude is 1,000 feet AGL, but variations are sometimes made. The typical pattern altitude for all public airports is published in the **Airport/Facility Directory** (NOAA 1992).

Exhibit C1 shows a typical lefthand traffic pattern. Although the lefthand pattern is the norm, in certain circumstances righthand patterns are observed at airports. In the case of parallel runways, for example, a lefthand pattern will be observed on the left runway and a righthand pattern on the right runway.

Aircraft approaching the airport enter the pattern on the downwind leg, turn left to the base leg perpendicular to the runway, then turn left to the final approach. Aircraft on departure leave the pattern via a straight-out track or a 45-degree left turn. The turn is not to be started until clearing the end of the runway and reaching pattern altitude. In practice there are many possible variations for entering and leaving the pattern, depending on pilot technique, the volume of traffic at the airport, and on air traffic control instructions (at airports with control towers). **Exhibit C1** shows some of the potential variations.

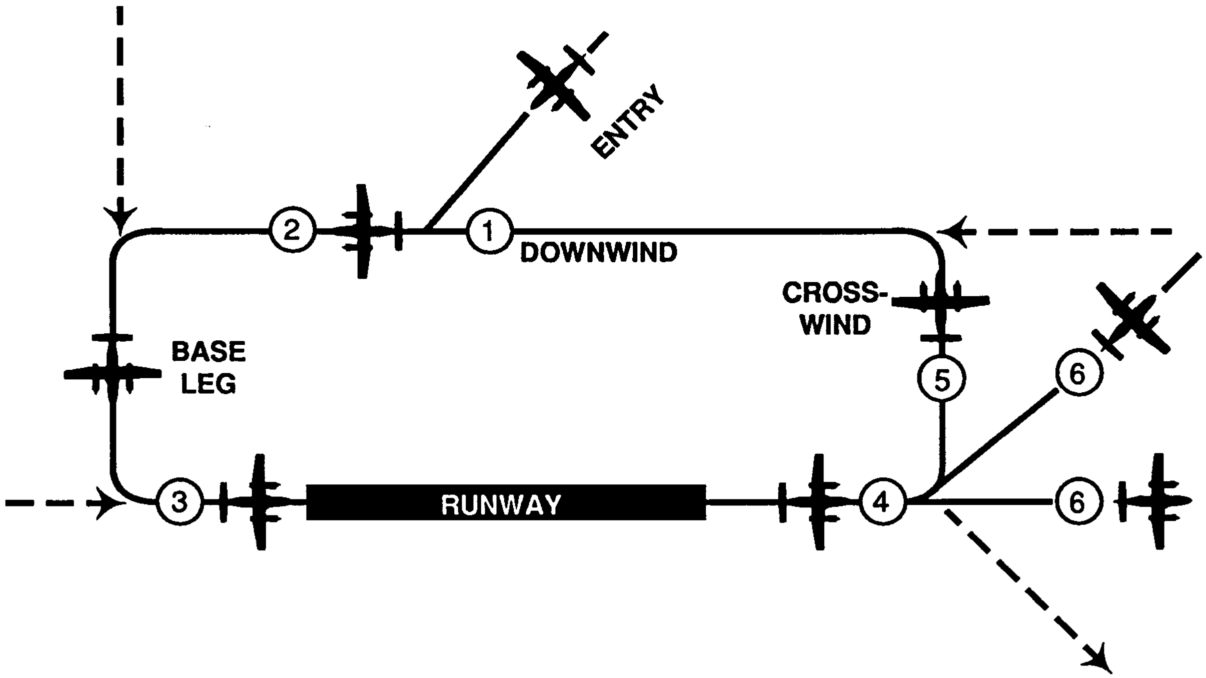
A common part of pilot training involves the touch-and-go procedure where the pilot makes repeated approaches or landings. In this case, the aircraft remains in the pattern throughout the procedure.

The size of the traffic pattern varies widely from airport to airport and even from time to time at any given airport. This is especially true at very busy airports and at those without air traffic control towers. The base leg may extend anywhere from one-quarter mile to one or even two miles depending on pilot technique and the volume of traffic in the pattern. The base leg may be displaced from the runway end from one to two miles for typical visual approaches. For runways with precision instrument approaches, the base leg may be extended even further, as aircraft seek to line up on the final approach beyond the outer marker (typically located about 5 miles off the runway end).

RUNWAY APPROACHES

There are two categories of runway approaches: visual and instrument. Visual approaches require the pilot to sight the runway and establish a final approach without aid of any special instrumentation. Certain lighting aids may be involved to make it easier to identify the runway and establish the proper rate of descent. These may include runway end identifier lights (REIL), and visual approach slope indicators (VASI), or precision approach path indicators (PAPI). Obviously, visual approaches can only be used when visibility is good.

Instrument approaches are defined using electronic navigational aids. They include non-precision and precision approaches. Non-precision approaches provide course guidance to align the aircraft with the runway. Precision approaches provide for course guidance directly aligned with the runway in addition to providing a glide slope to aid the descent. Instrument approaches can be used when the visibility is poor. Precision approaches permit operations with lower landing minimums than non-precision approaches. The



KEY:

(1) Enter pattern in level flight, abeam the midpoint of the runway, at pattern altitude. (1000' AGL is recommended pattern altitude unless established otherwise.)

(2) Maintain pattern altitude until abeam approach end of the landing runway, or downwind leg.

(3) Complete turn to final at least 1/4 mile from the runway.

(4) Continue straight ahead until beyond departure end of runway.

(5) If remaining in the traffic pattern, commence turn to crosswind leg beyond the departure end of the runway, within 300 feet of pattern altitude.

(6) If departing the traffic pattern, continue straight out, or exit with a 45° left turn beyond the departure end of the runway, after reaching pattern altitude.

NOTE: Dashed lines indicate variations that are sometimes observed.

SOURCE: Airman's Information Manual 1991, Aviation Supplies & Academics, Inc., Renton, WA., p.119.

Exhibit C1

RECOMMENDED STANDARD LEFT-HAND TRAFFIC PATTERN

Category I precision instrument approach, the most common, can be used with a runway visual range of approximately one-half mile and a ceiling as low as 200 feet. Typical non-precision approaches can be used with a runway visual range of no less than three-quarters of a mile and a ceiling of 400 feet.

AIRCRAFT ACCIDENTS

The most frequently cited cause of general aviation accidents is pilot error. Based on data compiled by the National Transportation Safety Board (NTSB) for 1979, almost 88% of all fatal general aviation accidents were caused, at least in part, by pilot error. Weather was a contributing factor in 40% of general aviation accidents, and terrain contributed to 21%. Other factors, including equipment failure, were far less prevalent as contributing causes.

Table C1 shows the frequency of aircraft accidents by phase of operation. Landing accidents are especially common, accounting for 41.5% of all general aviation accidents between 1974 and 1979. Almost 34% of accidents occurred in flight, and almost 20% during takeoff.

TABLE C1
General Aviation Accidents by Phase of Operation (1974-1979)

Phase of Operation	Percent of Total Accidents		Proportion Involving Serious/Fatal Injury
Static	0.8%		51%
Taxi	3.7%		4%
Takeoff	19.5%		23%
Run		4.8%	7%
Initial Climb		12.3%	31%
Other		2.4%	12%
In Flight	33.7%		45%
Landing	41.5%		14%
in traffic pattern		2.1%	46%
final approach - VFR		6.6%	28%
final approach - IFR		0.9%	68%
roll		12.6%	2%
go-around/missed approach		2.7%	30%
other		3.4%	31%
Unknown	0.8%		77%
TOTAL	100.0%[1]		27%

[1]Total Accidents - 25,963.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation*, Calendar Years 1974-1979. Cited in Hodges & Shutt 1990, p.47.

Table C2 presents more detail on the takeoff and landing accidents. Over twice as many occurred during landing as during takeoff (10,983 versus 5,053). Most of the difference is accounted for by the on-airport accidents.

When only the accidents occurring near the airport (generally within one mile) are considered, the numbers of takeoff and landing accidents are almost the same.

TABLE C2
Major General Aviation Accidents (1974-1979)

Landing or Takeoff	Location	Detailed Phase of Operation	Number of Accidents	%
Takeoff	On-Airport	Run	1,251	
		Aborted Takeoff	384	
	On-Airport Subtotal		1,635	
	Near Airport	Initial Climb	3,182	100%
	Other		236	
	Take off - Total		5,053	
Landing	On-Airport	Level Off-Touchdown	3,909	
		Roll	3,336	
	On-Airport Subtotal		7,245	
	Near Airport	Traffic Pattern-Circling	542	16.7%
		Final Approach-VFR	1,706	52.6%
		Initial Approach	61	1.9%
		Final Approach-IFR	228	7.0%
		Go Around-VFR	653	20.2%
		Missed Approach-IFR	51	1.6%
	Near Airport Subtotal		3,241	100.0%
	Other		497	
	Landing - Total		10,983	

Note: Major accidents are accidents in which the aircraft was destroyed or substantially damaged.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation,* annual reports from 1974 to 1979. Cited in CalTrans 1983, p. 74.

Of the takeoff accidents during the period, over three-fifths occurred near the airport. The near-airport takeoff accidents all occurred during the initial climb.

Approximately 30% of landing accidents occurred near the airport. Most of the rest occurred on the airport. Over half of the near-airport landing accidents occurred while making VFR final approaches.

Table C3 lists the ten most prevalent types of general aviation aircraft accidents. Engine failure or malfunction is the most common, accounting for almost 24% of all accidents and 12% of fatal accidents. Uncontrolled collisions with the ground or water accounted for almost 17% of fatal accidents, while controlled collisions with the ground accounted for nearly 14% of fatal accidents. Collisions with trees and poles accounted for 8% of all accidents and over 14% of fatal accidents.

TABLE C3
Ten Most Prevalent Types of General Aviation Accidents (1974-1978)
(Percentage of Total Accidents)

Type of Accident	All Accidents	Fatal Accidents
Engine Failure or Malfunction	23.8%	12.4%
Ground/Water Loop Swerve	12.2	--
Hard Landing	6.5	--
Stall Mush	4.4	--
Stall	--	6.5
Stall Spin	--	9.9
Collision with Ground/ Water Controlled	4.8	13.8
Collision with Ground/ Water Uncontrolled	3.9	16.9
Collided with Trees	4.1	8.5
Overshoot	4.4	--
Collided with Wires/Poles	3.8	5.6
Nose Over/Down	3.3	--
Airframe Failure in Flight	--	6.3
Midair Collisions	--	5.1
Missing Aircraft, Not Recovered	--	1.8

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation Calendar Year 1979*, NTSB-ARG-81-1, November 1981. Cited in CalTrans 1983, p. 75.

Table C4 shows data for all general aviation accidents involving collisions. During the period of observation (1974 through 1981), collisions accounted for 51% of all accidents. Collisions with the ground and water were the most common, accounting for nearly 21% of all accidents. The next most common were collisions with trees or crops (11.7%) followed by collisions with wires, poles, and fences (9.5%). The other categories of objects collided with were much less frequent in occurrence. It is interesting to note that collisions with houses and other buildings were quite rare, accounting for only .6% of the accidents, for an annual average of 26 accidents.

TABLE C4
General Aviation Accidents Involving Collisions (1974-1981)

Object Struck	Annual Average	Percentage of All Accidents
Ground (uncontrolled), Ground (controlled), Ditches, Dirt Banks, Water, Etc.	861	20.9%
Trees, Crops	483	11.7%
Wires, Poles, Fences	389	9.5%
Houses, Other Buildings	26	0.6%
Automobiles	25	0.6%
Airport Hazards (e.g., runway approach lights)	36	0.9%
Aircraft (one or both on ground)	36	0.9%
Aircraft (both in air)	66	1.6%
Other	167	4.0%
Total Collision Accidents	**2,097**	**51.0%**
Total General Aviation Accidents	**4,114**	**100.0%**

Notes: Data includes both primary accident types (i.e., accident began with the collision) and secondary accident types (i.e., something else happened which then resulted in a collision). A collision can be both a primary and a secondary accident type in the same accident -- a few of these instances are included in the data, but others (especially ones in which a mid-air collision was the primary accident type) appear not to be.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S, General Aviation,* Calendar Years 1974 to 1981. (Cited in Hodges & Shutt 1991, p. 5-11). Data is not published in this format for later years.

Table C5 presents additional detail on accidents involving collisions with buildings, presenting data for 1964 through 1982. Collisions with buildings are rare events. Even rarer are collisions resulting in harm to building occupants. During the 19-year period, 563 collisions occurred, including 240 with buildings off-airport. A total of 116 residences were involved. Thirty-five of the collisions resulted in injuries to persons in the buildings; 24 involved residences.

TABLE C5
General Aviation Accidents Involving Buildings

	General Aviation Accidents Involving Buildings			Accidents Involving Injuries to People in Buildings	
	Total	Off Airport	Residences	Total	Residences
1964	54	17	4	0	0
1965	37	16	3	2	1
1966	42	11	6	2	2
1967	37	12	5	0	0
1968	26	10	2	0	0
1969	25	9	4	0	0
1970	29	17	10	3	1
1971	21	8	6	1	1
1972	25	11	3	3	2
1973	32	16	3	3	0
1974	18	5	2	0	0
1975	30	10	6	1	1
1976	21	10	4	1	0
1977	34	18	12	4	4
1978	27	16	9	4	4
1979	27	15	8	3	3
1980	24	9	8	5	3
1981	23	10	4	1	0
1982	31	20	17	2	2
Total	563	240	116*	35	24
Annual Average	29.6	12.6	6.1	1.8	1.3

* Includes 13 on-airport residences.

Note: Published data not available for more recent years.

Source: AOPA - 1985, **Airports Good Neighbors to Have.** Cited in Hodges & Shutt 1991, p. 5-13.

Weather has been cited as a contributing factor in as many as 22% of all general aviation accidents, and 40% of fatal accidents. Poor visibility caused by fog and cloud cover reduce safety margins. Frequently, dense cloud cover is also accompanying by stormy conditions. Table C6 shows general aviation accidents for the 1974-1979 period classified by type of weather conditions. VFR conditions generally apply when visibility is at least three miles and the ceiling is at least 1,000 feet AGL. IFR conditions apply when visibility is reduced below these levels. "Below minimums" applies to conditions where visibility is so poor that IFR landings cannot be made.

TABLE C6
General Aviation Accidents by Type of Weather Conditions

Type of Weather Conditions	Percent of Total Accidents	Proportion Involving Serious/Fatal Injury
Visual Flight Rules	90.6%	23%
Instrument Flight Rules	7.4%	67%
Below Minimums	0.6%	70%
Unknown	1.4%	52%
Total	100.0%[1]	27%

[1]Total accidents - 25,963.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation,* Calendar Years 1974-1979. Cited in Hodges & Shutt 1990, p. 50.

By far most accidents occur during VFR conditions. Only 8% of accidents occurred during IFR or "below minimum" conditions. One reason clearly is because there is far less traffic during IFR weather. Many general aviation pilots are only rated for VFR flying. Accidents during IFR are much more likely to cause serious or fatal injuries, however. Two-thirds of all IFR accidents result in serious injuries or fatalities.

LOCATION OF ACCIDENTS

For purposes of airport safety compatibility planning, the location of accidents is the most important consideration. Unfortunately, only limited information is available. Before reviewing the empirical data on accident location, a discussion of aircraft operating characteristics during emergencies is offered.

Aircraft Operating Characteristics in Emergencies

Perhaps the most catastrophic event for a pilot to experience is the loss of engine power. That does not necessarily lead to the immediate loss of control, however. With careful technique, the pilot can maintain control of the aircraft as it descends. It has been calculated that an aircraft can glide as far as 1,000 feet for every 100 feet of altitude (Hodges & Shutt 1991, p. 5-4.) The key, of course, is to maintain control. Without power, this is no easy task, especially if turns are necessary. In the turn, the rate of descent increases.

An extremely important factor which cannot be measured is the skill, experience, and personality of the pilot confronting such a life-threatening circumstance. Needless to say, panic or incorrect decisions at the controls may increase the rate of descent or cause a loss of control.

Particularly critical phases of a flight are takeoff and landing. As the next section shows, most accidents occur during the landing phase and many during the takeoff. As a guide to planning, Hodges & Shutt (1991, p. 5-10) have calculated the "maximum takeoff trajectories" of aircraft assuming loss of an engine. For single-engine aircraft, the engine failure was assumed to occur at 400 feet above ground level (AGL), the minimum altitude at which a turn should be initiated. For the aircraft analyzed, the distance from start of takeoff roll to the end of motion after landing was 6,500 to 9,000 feet. The mean for the aircraft analyzed was 7,450 feet.

For twin-engine aircraft, the analysis assumed the failure of one engine just before the aircraft reaches V_{se}, the minimum airspeed needed to maintain a climb with only a single engine. That was assumed to occur at about 50 feet AGL. The maximum takeoff trajectory ranged from 3,750 to 5,150 feet. The mean was 4,350 feet.

Accidents Near Airports

The NTSB records general accident location information, including the distance from the airport. It does not, however, record accident coordinates, so it is not possible to plot the locations of accidents with respect to the runways.

Table C7 shows the percentage of general aviation accidents by distance from the airport. On-airport accidents were far more numerous but tended to be less serious, accounting for almost 45% of all accidents, but only 17% of serious and fatal accidents. Accidents near the airport (within one mile) accounted for about 15% of all accidents, but 22% of fatal accidents. Accidents within one to two miles were less frequent, accounting for just under 3% of all accidents and almost 5% of fatal accidents.

TABLE C7
Location of General Aviation Accidents (1974-1979)
(Percentage of Accidents)

	Accidents		Serious & Fatal Accidents		Collisions Between Aircraft	
Location	All Accidents	Near Airport Accidents	All Accidents	Near Airport Accidents	All Accidents	Near Airport Accidents
On Airport	44.8%	--	16.6%	--	54.5%	--
Near Airport						
In Traffic Pattern	4.2%	28.6%	5.8%	26.4%	7.8%	56.9%
Within 1/4 mile	4.9%	33.8%	7.2%	32.7%	1.9%	13.6%
Within 1/2 mile	2.7%	18.3%	4.4%	19.9%	2.2%	15.9%
Within 3/4 mile	.7%	4.5%	1.3%	6.1%	.9%	6.8%
Within 1 mile	2.1%	14.8%	3.3%	14.9%	.9%	6.8%
Subtotal	14.6%	100.0%	22.0%	100.0%	13.7%	100.0%
Within 2 miles	2.8%	--	4.9%	--	3.1%	--
Over 2 miles	32.2%	--	50.4%	--	26.2%	--
Unknown	5.6%	--	6.1%	--	2.5%	--
Total	100.0%	--	100.0%	--	100.0%	

Note: The NSTB defines an accident as occurrences incident to flight in which "as a result of the operation of an aircraft, any person (occupant or nonoccupant) receives fatal or serious injury or any aircraft receives substantial damage." Substantial damage means damage or structural failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component. Accident reports are filed for all accidents, both on and off airports. "On-airport" means on airport property. Distance from the airport is measured from airport boundary. Table excludes helicopter accidents and accidents due to sabotage.

Source: National Transportation Safety Board, *Annual Review of Aircraft Accident Data - U.S. General Aviation,* annual reports from 1974 to 1979. Cited in CalTrans 1983, p. 74.

The locations of near-airport accidents are broken down in the table. Accidents in the traffic pattern are noted, as are accidents for each quarter mile increment. Accidents are most common in the traffic pattern or within one-quarter mile of the airport. The most striking thing about this information relates to the location of collisions between aircraft. Nearly 57% of all near-airport aircraft collisions occur in the traffic pattern.

A study conducted for the California State Assembly Committee on Natural Resources and Conservation, prepared in 1973, reviewed the NTSB accident location data for 1970, noting the same general relationships discussed above (Hodges & Shutt 1990, p. 36). The report concluded:

[The one-mile distance]... is a reasonable measure of the region of influence between an airport and its surrounding community. It encloses the entire traffic pattern and most departing aircraft have made their initial power reduction and assumed normal climb attitude within that distance. On instrument approaches, the minimum descent altitude is usually reached within that area. In this region, the aircraft is at a critical transition between ground and flight with both the aircraft and pilot under significant stress. On takeoff, the aircraft is at maximum gross weight and fuel load with the engine(s) producing maximum power. This increases the likelihood of power failure while at the same time decreasing the chances of a successful emergency landing. On the landing approach, the pilot is under great stress, particularly under instrument conditions, thus increasing the probability of pilot error.

Accident Location Survey

Hodges & Shutt (1990, p. 40) present the results of an interesting study of aircraft accident locations based on data provided by fourteen airports. Although the sample is limited and care should be taken in the interpretation of the data, it is one relatively recent source of accident location data in a field of study which is sorely lacking for detailed and current information. Airports providing data are listed in **Table C8.** Exhibit C2 shows the location of these accidents with respect to the runway. Accidents are categorized by departure versus approach.

TABLE C8
Airports Surveyed for Accident Location Data

	Airport	*Associated City*
California	John Wayne Airport	Santa Ana
	Torrance Municipal Airport	Torrance
	Buchanan Field	Concord
	Fullerton Municipal Airport	Fullerton
	Reid Hillview Airport	San Jose
	Palo Alto Airport	Palo Alto
	South County Airport	Martinez
	Chino Airport	Chino
	Hayward Air Terminal	Hayward
Florida	Opa Locka Airport	Opa Locka
	North Perry Airport	Ft. Lauderdale
Kentucky	Bowman Field	Louisville
Louisiana	Lakefront	New Orleans
Missouri	Spirit of St. Louis Airport	St. Louis

Source: Hodges & Shutt 1990, p. 37.

Departure accidents tend to fan out fairly evenly as distance from the runway increases. Approach accidents tend to be clustered along the extended runway centerline, although there is considerable scatter. Some of the accidents off the centerline and off the sides of the runway may be accounted for by failed attempts at making short approaches or by accidents on missed approaches or go-arounds.

Exhibit C3 plots the location of accidents with respect to distance from the runway centerline and distance from the landing threshold. It shows that accidents tend to be clustered along the centerline and tend

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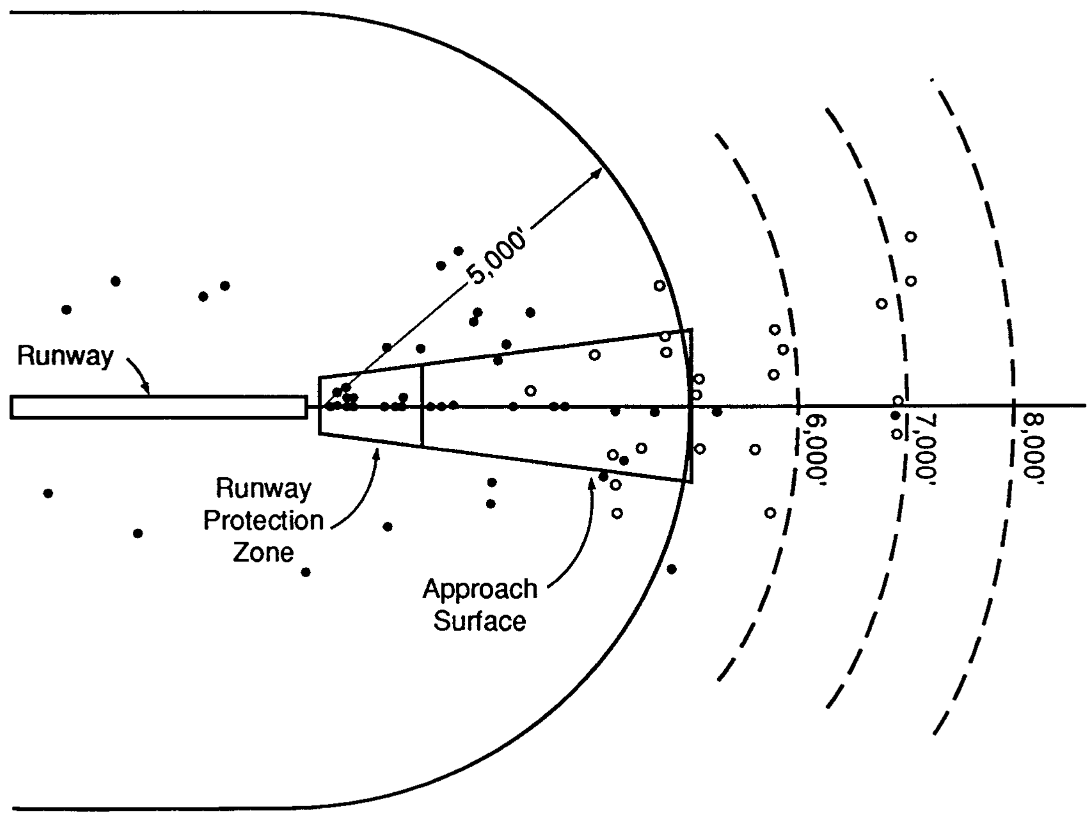
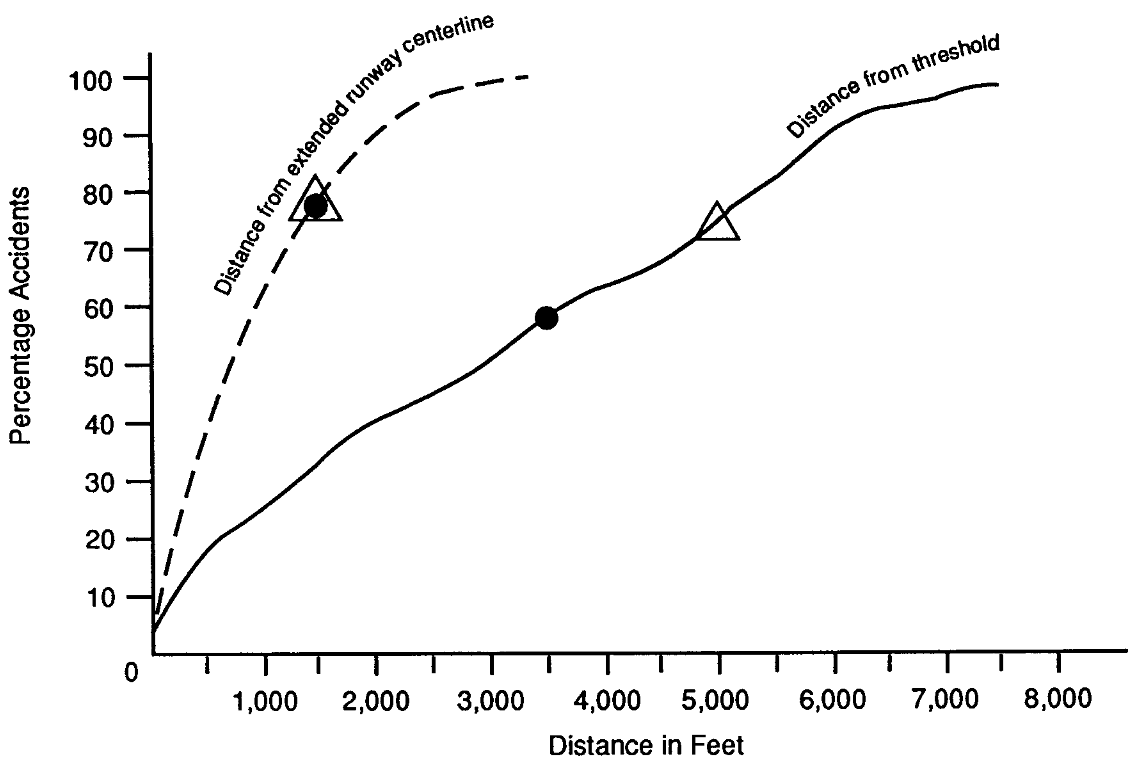


- o Accident Site - Departure
- • Accident Site - Approach

NOTE: Data compiled from 14 general aviation airports.
Runway protection zone and approach surface assumes a nonprecision approach to a utility runway.

SOURCE: Airport Land Use Compatibility Handbook, Version 1.1, Hodges & Shutt, August 1990, p. 40.

Exhibit C2
AIRCRAFT ACCIDENT SITES AT GENERAL AVIATION AIRPORTS



● State's suggested safety zone boundaries for twin-engine propeller aircraft.

△ State's suggested safety zone boundaries for jet aircraft and precision instrument approach runways.

NOTE: Data compiled for 14 general aviation airports with annual operations ranging from 150,000 to 300,000.
All airports had air traffic control towers.

SOURCE: Airport Land Use Compatibility Handbook, Version 1.1, Hodges & Shutt, August 1990, p.42.

Exhibit C3
DISTANCE OF ACCIDENTS FROM RUNWAY THRESHOLD AND CENTERLINE

to be spread out some distance from the threshold. Approximately 60% of the accidents occurred within 1,000 feet of the extended centerline, 75% within 1,500 feet, and 90% within 2,000 feet. With respect to the threshold, just under 60% occurred within 3,500 feet, 75% within 5,000 feet, and 90% within 6,000 feet.

SAFETY GUIDELINES AND STANDARDS - EXAMPLES

This section presents selected examples of safety compatibility guidelines and regulations from around the country. This is based on a spot check by the consultant rather than a comprehensive survey.

FEDERAL GOVERNMENT

The Federal Aviation Administration has defined areas in the immediate runway environment which must be kept free of obstructions. The largest is the Runway Protection Zone (RPZ), a trapezoidal area off the runway end. The size of the RPZ varies depending on the type of approach to the runway. It is smallest for visual approaches and largest for precision instrument approaches. **Exhibit C4** shows the basic configuration of the RPZ. FAA recommends that the area within the RPZ be kept free of structures and people and advises airport proprietors to secure title to the area.

Exhibit C4 also shows the runway approach area. Within this area, FAA is concerned only that objects not be allowed to penetrate an imaginary surface sloping upward from the runway end. FAA has no official policies regarding the use of the land beneath the approaches, although its policies permit the use of Airport Improvement Program funds for property acquisition up to 5,000 feet off the end of the runway (FAA 1989, Par. 602.b(2), p.70). This is a clear, although implicit, acknowledgement of the need for compatible use of this property to protect the interests of the airport and the general public. An old edition of the **Airport Improvement Program Handbook** went so far as to define property acquisition eligibility boundaries by type of runway approach and use (FAA 1979, Par. 602.c, p. 108). It established the following criteria:

> At airports serving ... turbojet aircraft, such areas of land may extend up to 1,250 feet laterally from the runway centerline, extending 5,000 feet beyond the end of the primary surface.
>
> On existing or planned nonprecision instrument runways, such areas of land may extend up to 750 feet laterally from the runway centerline, extending 3,400 feet a beyond each end of the primary surface.
>
> For an existing or planned visual runway, such areas of land may extend up to 500 feet laterally from the runway centerline, extending 2,000 feet beyond each end of the primary surface.

While this is no longer official FAA policy, it serves as a guideline in determining how to apply the more general policy which is now in force.

ARIZONA -- PIMA COUNTY

Pima County Arizona has adopted airport environs zoning establishing compatible use zones around each airport within its jurisdiction. (See Pima County Code, Chapter 18.57.) The ordinance establishes

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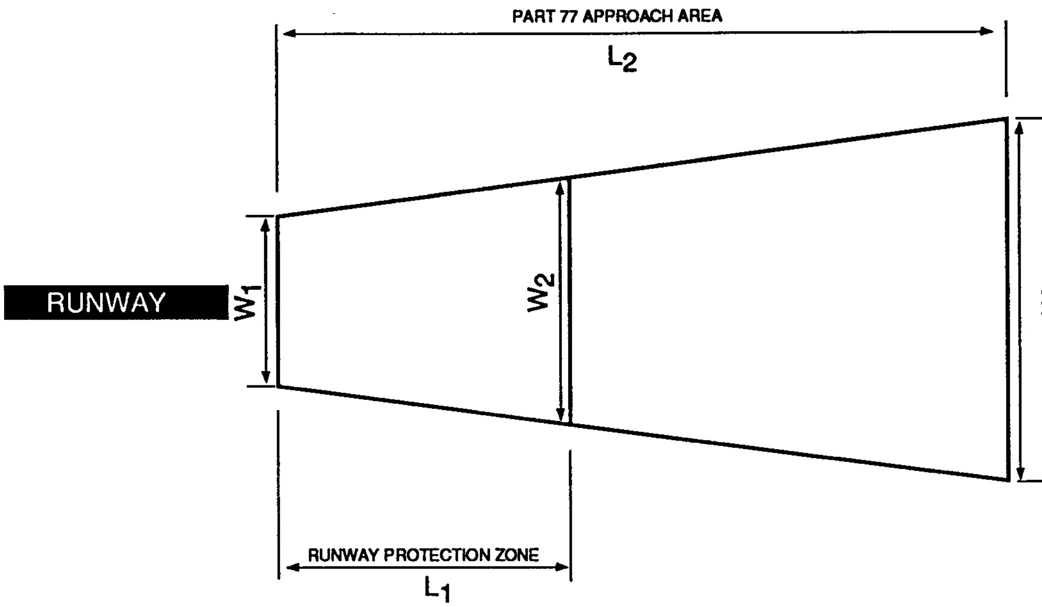

CATEGORY	W_1	W_2	W_3	L_1	L_2
1. Precision instrument	1,000	1,750	16,000	2,500	50,000
2. Nonprecision instrument for larger than utility with visibility minimums as low as 3/4 mi.	1,000	1,510	4,000	1,700	10,000
3. Nonprecision instrument for larger than utility with visibility minimums greater than 3/4 mi.	1,000	1,425	3,500	1,700	10,000
4. Visual approach for larger than utility	1,000	1,100	1,500	1,000	5,000
5. Nonprecision approach for utility	500	800	2,000	1,000	5,000
6. Visual approach utility	250	450	1,250	1,000	5,000

SOURCE: Federal Aviation Administration

Exhibit C4
RUNWAY PROTECTION ZONES AND APPROACH AREAS

three zones based on safety concerns: the RSZ runway safety zone, the CUZ-1 compatible use zone, and the CUZ-2 compatible use zone.

The RSZ zone is immediately off the runway ends. Development is strictly limited in this zone as the land must remain in open space. At general aviation airports, this area is typically 1,500 feet long and 1,500 feet wide.

The CUZ-1 zone is applied off the end of the RSZ zone at air carrier and military airports. Dimensions of the CUZ-1 zone at air carrier airports are 1,500 feet wide by 2,000 to 3,500 feet long, depending on the runway approach. At military airports, the zone is 3,000 feet wide by 5,000 feet long. Potentially hazardous land uses are prohibited as are uses attracting large numbers of people. Structures are not permitted to occupy over 35% of the lot area.

The CUZ-2 zone is applied off the end of the RSZ zone at smaller general aviation airports. It has similar use restrictions as the CUZ-1 zone, but permits structures to occupy up to 45% of the lot area. Off non-precision runways, it is 2,000 feet long and 1,500 feet wide. Off precision runways, it is 3,500 feet long and 1,500 feet wide.

LOUISIANA

The State of Louisiana has prepared a model airport hazard zoning ordinance for use at larger than utility airports in the state. the ordinance proposes height control standards generally based on F.A.R. Part 77. It also proposes standards for three land use safety zones.

Safety Zone A is defined as the area within the approach zone which extends outward from the primary surface a distance equal to two-thirds of the planned length of the runway. In this area only open space uses are permitted. Structures and above-ground obstructions are not permitted, nor are uses which would attract a group of persons.

Safety Zone B extends outward from the end of Zone A a distance equal to one-third of the planned length of the runway. Certain uses are specifically prohibited, including churches, hospitals, schools, theaters, stadiums, hotels and other places of public assembly. The building and population densities of other uses are restricted.

Safety Zone C is subject only to height limitations. It includes all that area within the horizontal zone. This corresponds to the F.A.R. Part 77 horizontal surface.

OREGON

The State of Oregon has suggested that local communities use the inner part of the approach area, extending from 2,500 to 5,000 feet off the end of the primary surface, as an area within which land use controls should be considered. The State adds that "local conditions may require additional areas of land use controls...", although it does not provide specific guidance (OrDOT 1981, p. 67).

WISCONSIN -- BROWN COUNTY

Brown County has established airport protection zoning in the vicinity of Austin Straubel Airport near Green Bay (Coons 1989, p. 30). The ordinance establishes three overlay zones. Zone A is referred to as the "noise cone/crash hazard zone". It extends off the end of each runway and includes the 65 Ldn contour area. Residential development is not permitted in the area. Neither are hospitals, churches, schools, theaters and other places of public assembly or uses attracting large populations of birds. Zone B is the overflight noise zone. Residential density limits are established and sound insulation is required. Zone C establishes only height limits.

CALIFORNIA SAFETY GUIDELINES

The California **Airport Land Use Planning Handbook** (CalTrans 1983) reviews the airport land use plans which were then in force in the State. The State developed guidelines for use in safety compatibility planning.

In its discussion of the need for appropriate land use restrictions in safety zones, it notes (CalTrans 1983, p. 93):

> The purpose for establishing land use restrictions in safety zones is to minimize the number of people exposed to aircraft crash hazards. The two principal methods for reducing the risk of injury and property damage on the ground are: 1) limit the number of persons in an areas and 2) limit the area covered by structures occupied by people so that there is a higher chance of aircraft landing (in a controlled situation) or crashing (in an uncontrolled situation) on vacant land... While the chance of an aircraft injuring someone on the ground is historically quite low, planners must remember that an aircraft crash is a high consequence event.

SAFETY AREA BOUNDARIES

The State has proposed the establishment of up to five safety zones around airports: inner safety zone/runway protection zone; outer safety zone; emergency touchdown area; traffic pattern/overflight zone; and extended runway centerline zone (CalTrans 1983, p. 96).

The boundaries of these areas, except for the traffic pattern/overflight zone, are shown in **Exhibit C5**. Two different sizes of zones are proposed, depending on the type of approach and aircraft using the runway. For visual runways and those serving only single and twin-engine aircraft, smaller areas are proposed. Larger areas are suggested for instrument runways or those serving jet aircraft.

Inner Safety Zone/ Runway Protection Zone

This area either corresponds to the actual runway protection zone or to a rectangular area roughly the same size as the runway protection zone. The rectangular area is 1,500 feet wide, and 1,320 long for visual runways and 2,500 feet long for instrument runways. While the nominal alignment of this area is along the extended runway centerline, it is suggested that if early turns are prescribed for noise abatement or air traffic control purposes, the safety area should be aligned with the commonly used departure path.

Within the inner safety zone, structures should be discouraged, especially within the runway protection zone. No activities involving assemblies of people should be permitted.

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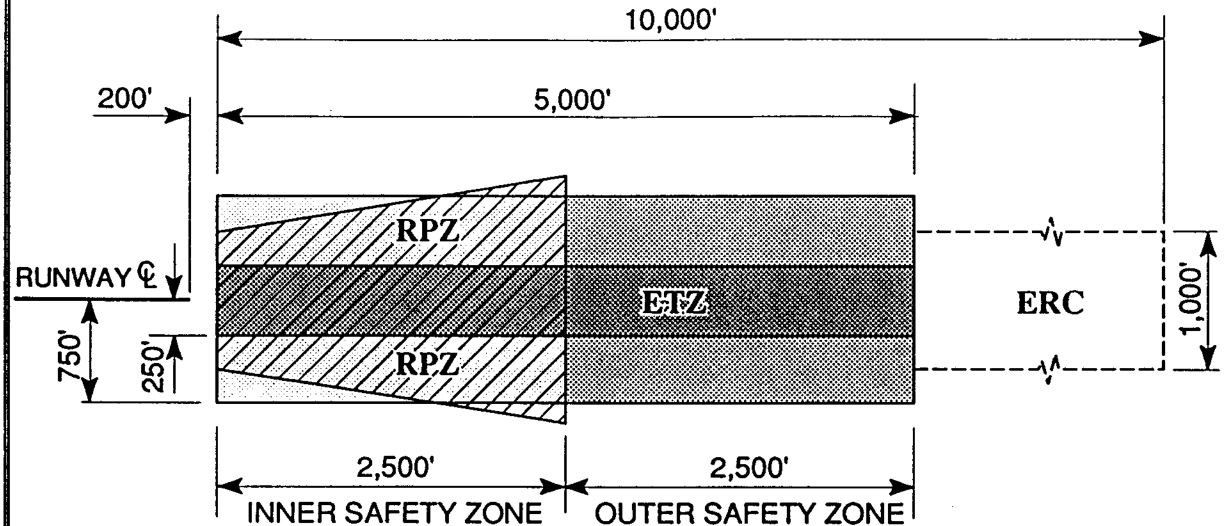
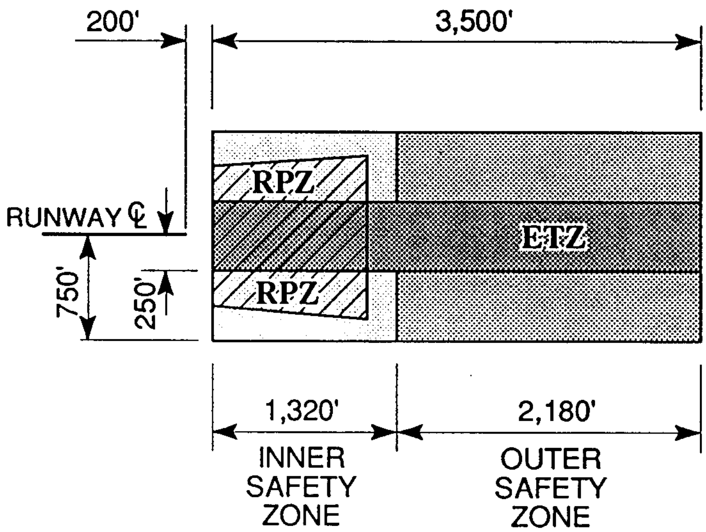
PRECISION AND NON-PRECISION INSTRUMENT RUNWAYS
- JET AIRCRAFT -



LEGEND

RPZ - Runway Protection Zone
ETZ - Emergency Touchdown Zone
ERC - Extended Runway Centerline

VISUAL APPROACH RUNWAYS
- TWIN ENGINE AIRCRAFT -



SOURCE: Airport Land Use Planning Handbook: A Reference and Guide for Local Agencies, prepared for California Department of Transportation, Division of Aeronautics by Metropolitan Transportation Commission and Association of Bay Area Governments, 1983, p. 97.

Exhibit C5
SUGGESTED AIRPORT SAFETY
ZONES OFF RUNWAY ENDS

Outer Safety Zone

The outer safety zone extends another 2,180 to 2,500 feet beyond the inner safety zone. The state also suggests that these zones should be shifted to conform with the primary flight tracks used for departures from the primary runway. If desired, the outer safety zone can be defined based on the F.A.R. Part 77 approach surface. (See **Exhibit C4**.)

The guidelines recommend that residential development should be strongly discouraged in this area. They also discourage other land uses including industries handling flammable materials, hotels and motels, and other commercial and institutional uses involving large concentrations of people. (One class of land use which should probably be added to this list is public utilities and facilities of vital interest. These include uses which would cause significant public inconvenience or harm if damaged or destroyed in an aircraft accident. Examples include power generating plants and substations, water and sewage treatment plants, and public communications facilities.)

The guidelines suggest density limits for uses in structures involving not more than 25 persons per acre at any one time or 150 people in any one building. For uses not in structures, density limits of 50 persons per acre are suggested.

Lot coverage requirements are also suggested to ensure that a disabled aircraft has sufficient opportunity to miss inhabited areas and structures. It is suggested that the density limits could be based on an assessment of the current densities within the area. It is suggested that it would not be unreasonable to require that 50% to 75% of the safety area be kept as open space, including streets and parking areas.

Emergency Touchdown Areas

The emergency touchdown zone is 500 feet wide, extending the length of the combined inner and outer safety zones. This is suggested as a emergency landing area for aircraft on takeoff or for aircraft on approach that fail to reach the runway. The accident location data discussed above and shown in **Exhibit C2** lend support to the advisability of such a zone.

In order to be effective, this area would have to be kept free of structures and significant obstructions.

Traffic Pattern Zone

This zone is intended to apply to the area beneath the traffic pattern and commonly used flight tracks in the airport vicinity. It is noted that the F.A.R. Part 77 horizontal surface is a reasonable approximation of the boundaries of this area.

The guidelines note that strict land use control in this area may be difficult or impractical given the large size of the area. The guidelines imply the need for careful evaluation of the existing land use situation in the area and the prospects for future development in order to set reasonable standards. It is suggested that large assemblages of people should be excluded from this area if it is possible to locate these uses elsewhere. Limits on the density of people in the area are discussed. Residential density limits of 3 units per acre are discussed as an example. Limits on lot coverage ranging from 20% to 50% are discussed.

Extended Runway Centerline

This is proposed only for precision and non-precision instrument runways, or runways serving jet aircraft. It is 1,000 feet wide, extending 10,000 feet from the primary surface. The guidelines suggest that land uses involving large concentrations of people in this area should be carefully reviewed. On page 99, the guidelines state, "Large concentrations of people directly on the runway centerline should be strongly discouraged."

LAND USE GUIDELINES WITHIN ALL SAFETY AREAS

Uses which would cause smoke, water vapor, or light interference should be prohibited from all safety areas. These could impair the pilot's ability to see the airfield. Visual hazards include lights that can be confused with airfield and runway lights. Particular confusion can be caused by steady or flashing lights of red, white, green or amber directed at aircraft making a final approach to a runway or making a straight climb after takeoff. Similarly, uses causing the reflection of sunlight onto aircraft engaged in the same maneuvers should be prohibited.

Other important safety hazards are those which attract large numbers of birds. Examples include landfills and perhaps some types of food processing plants involving outdoor storage of grain and other raw materials or food by-products.

Uses which cause electrical interference with aircraft navigational and communications equipment also should be prohibited in the airport vicinity.

SHIELDING OF POPULATION IN SAFETY AREAS

The State provides guidelines for shielding people on the ground to minimize the crash hazard. These actions are not encouraged. Rather they are characterized as last resort options which should be considered only if incompatible projects must be permitted in a safety area. Unfortunately, actions taken to shield people on the ground result in structures which greatly increase the risk of fatality to occupants of aircraft making emergency landings.

The State suggests general performance standards and design criteria to assist in the design of structures and barriers strong enough to withstand the impact of an aircraft crash. As it is apparently considered infeasible cost-effectively to shield structures from the largest aircraft, the guidelines offer guidance only for protection from relatively light aircraft under 12,500 pounds (CalTrans 1983, p. 101).

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Appendix D
GLOSSARY

APPENDIX D

GLOSSARY

A-WEIGHTED SOUND LEVEL - A sound pressure level, often noted as dBA, which has been frequency filtered or weighted to quantitatively reduce the effect of the low frequency noise. It was designed to approximate the response of the human ear to sound.

AMBIENT NOISE - The totality of noise in a given place and time -- usually a composite of sounds from varying sources at varying distances.

APPROACH LIGHT SYSTEM (ALS) - An airport lighting facility which provides visual guidance to landing aircraft by radiating light beams in a directional pattern by which the pilot aligns the aircraft with the extended centerline of the runway on the final approach for landing.

ATTENUATION - Acoustical phenomenon whereby a reduction in sound energy is experienced between the noise source and receiver. This energy loss can be attributed to atmospheric conditions, terrain, vegetation, and man-made and natural features.

AZIMUTH - Horizontal direction expressed as the angular distance between true north and the direction of a fixed point (as the observer's heading).

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

CROSSWIND LEG - A flight path at right angles to the landing runway off its upwind end.

DECIBEL (dB) - The physical unit commonly used to describe noise levels. The decibel represents a relative measure or ratio to a reference power. This reference value is a sound pressure of 20 micropascals which can be referred to as 1 decibel or the weakest sound that can be heard by a person with very good hearing in an extremely quiet room.

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

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

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

CNEL - Community Noise Equivalent Level. Equivalent sound level for a 24-hour period with a 10 dB weighting applied to noise between 10:00 p.m. and 7:00 a.m. and a 4.8 dB weighting applied to noise between 7:00 p.m. and 10:00 p.m. Required metric for airport noise studies in California. Also see "Leq".

EASEMENT - The legal right of one party to use a portion of the total rights in real estate owned by another party. This may include the right of passage over, on, or below the property; certain air rights above the property, including view rights; and the rights to any specified form of development or activity, as well as any other legal rights in the property that may be specified in the easement document.

EQUIVALENT SOUND LEVEL - See Leq.

FIXED BASE OPERATOR (FBO) - A provider of services to users of an airport. Such services include, but are not limited to, hangaring, fueling, flight training, repair and maintenance.

GLIDE SLOPE (GS) - Provides vertical guidance for aircraft during approach and landing. The glide slope consists of the following:

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

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

GROUND EFFECT - The excess attenuation attributed to absorption or reflection of noise by man-made or natural features on the ground surface.

HOURLY NOISE LEVEL (HNL) - A noise summation metric which considers primarily those single events which exceed a specified threshold or duration during one hour.

INSTRUMENT APPROACH - A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing, or to a point from which a landing may be made visually.

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

1. Localizer.
2. Glide Slope.
3. Outer Marker.
4. Middle Marker.
5. Approach Lights.

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

Ldn - The 24-hour average sound level, in decibels, for the period from midnight to midnight, obtained after the addition of ten decibels to sound levels for the periods between midnight and 7 a.m. and between 10 p.m. and midnight, local time, as averaged over a span of one year. It is the FAA standard metric for determining the cumulative exposure of individuals to noise.

Leq - Equivalent Sound Level. The steady A-weighted sound level over any specified period (not necessarily 24 hours) that has the same acoustic energy as the fluctuating noise during that period (with no consideration of a nighttime weighting.) It is a measure of cumulative acoustical energy. Because the time interval may vary, it should be specified by a subscript (such as Leq_8) for an 8-hour exposure to workplace noise) or be clearly understood.

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

MISSED APPROACH COURSE (MAC) - The flight route to be followed if, after an instrument approach, a landing is not effected, and occurring normally:

1. When the aircraft has descended to the decision height and has not established visual contact, or

2. When directed by air traffic control to pull up or to go around again.

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

NOISE CONTOUR - A continuous line on a map of the airport vicinity connecting all points of the same noise exposure level.

NONPRECISION APPROACH - A standard instrument approach procedure in which no electronic glide slope is provided.

PRECISION APPROACH - A standard instrument approach procedure in which an electronic glide slope is provided.

PRECISION APPROACH PATH INDICATOR (PAPI) - A lighting system providing visual approach slope guidance to aircraft during a landing approach. It is similar to a VASI but provides a sharper transition between the colored indicator lights.

PROFILE - The physical position of the aircraft during landings or takeoffs in terms of altitude in feet above the runway and distance from the runway end.

PROPAGATION - Sound propagation refers to the spreading or radiating of sound energy from the noise source. Propagation characteristics of sound normally involve a reduction in sound energy with an increased distance from source. Sound propagation is affected by atmospheric conditions, terrain, and man-made and natural objects.

RUNWAY END IDENTIFIER LIGHTS (REIL) - Two synchronized flashing lights, one on each side of the runway threshold, which provide rapid and positive identification of the approach end of a particular runway.

SEL - SEL expressed in dB, is a measure of the effect of duration and magnitude for a single-event measured in A-weighted sound level above a specified threshold which is at least 10 dB below the maximum value. In typical aircraft noise model calculations, SEL is used in computing aircraft acoustical contribution to the Equivalent Sound Level (Leq), the Day-Night Sound Level (Ldn), and the Community Noise Equivalent Level (CNEL).

SINGLE EVENT - An occurrence of audible noise usually above a specified minimum noise level caused by an intrusive source such as an aircraft overflight, passing train, or ship's horn.

SOUND EXPOSURE LEVEL - See SEL.

SLANT-RANGE DISTANCE - The straight line distance between the aircraft and the monitoring site.

TACTICAL AIR NAVIGATION (TACAN) -An ultra-high frequency electronic air navigation system which provides suitably-equipped aircraft a continuous indication of bearing and distance to the TACAN station.

TIME ABOVE (TA) - Expressed in minutes per 24-hour period. The 24-hour TA noise metric provided the duration in minutes for which aircraft-related noise exceeds specified A-weighted sound levels.

TOUCHDOWN ZONE LIGHTING (TDZ) - Two rows of transverse light bars located symmetrically about the runway centerline normally at 100 foot intervals. The basic system extends 3,000 feet along the runway.

UNICOM - A nongovernment communication facility which may provide airport information at certain airports. Locations and frequencies of UNICOM's are shown on aeronautical charts and publications.

VECTOR - A heading issued to an aircraft to provide navigational guidance by radar.

VERY HIGH FREQUENCY OMNIDIRECTIONAL RANGE STATION (VOR) - A ground-based electric navigation aid transmitting very high frequency navigation signals, 360 degrees in azimuth, oriented from magnetic north. Used as the basis for navigation in the national airspace system. The VOR periodically identifies itself by Morse Code and may have an additional voice identification feature.

VHF OMNIDIRECTIONAL RANGE/ TACTICAL AIR NAVIGATION (VORTAC) - A navigation aid providing VOR azimuth, TACAN azimuth, and TACAN distance-measuring equipment (DME) at one site.

VICTOR AIRWAY - A control area or portion thereof established in the form of a corridor, the centerline of which is defined by radio navigational aids.

VISUAL APPROACH - An approach wherein an aircraft on an IFR flight plan, operating in VFR conditions under the control of an air traffic control facility and having an air traffic control authorization, may proceed to the airport of destination in VFR conditions.

VISUAL APPROACH SLOPE INDICATOR (VASI) - An airport lighting facility providing vertical visual approach slope guidance to aircraft during approach to landing by radiating an directional pattern of high intensity red and white focused light beams which indicate to the pilot that he is **on path** if he sees red/white, **above path** if white/white, and **below path** if red/red. Some airports serving large aircraft have three-bar VASI's which provide two visual guide paths to the same runway.

VISUAL FLIGHT RULES (VFR) - Rules that govern the procedures for conducting flight under visual conditions. The term VFR is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate type of flight plan.

YEARLY DAY-NIGHT AVERAGE SOUND LEVEL - See Ldn.