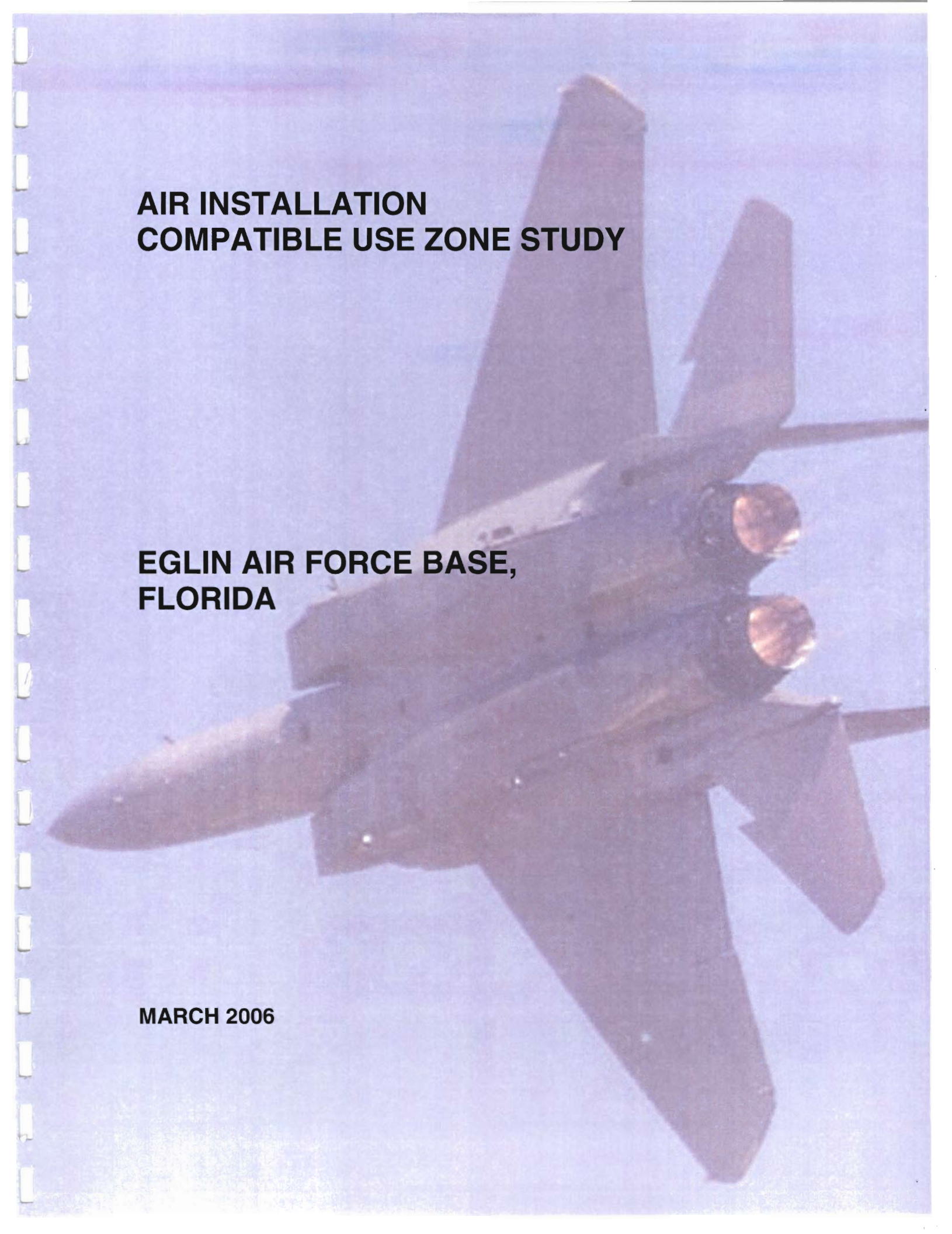

AIR INSTALLATION COMPATIBLE USE ZONE STUDY

EGLIN AIR FORCE BASE, FLORIDA

MARCH 2006

AIR INSTALLATION COMPATIBLE USE ZONE STUDY

EGLIN AIR FORCE BASE, FLORIDA

MARCH 2006

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ACRONYMS

AAC	Air Armament Center
AFB	Air Force Base
AFI	Air Force Instruction
AGL	above ground level
AICUZ	Air Installation Compatible Use Zone
AOD	Airport Overlay District
APZ	Accident Potential Zone
CZ	Clear Zone
dB	decibel
DNL	Day-Night Average A-Weighted Sound Level
DoD	Department of Defense
ETL	Engineering Technical Letter
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
INM	Integrated Noise Model
LZ	landing zone
NLR	Noise Level Reduction
SLUCM	Standard Land Use Coding Manual
SOS	Special Operations Squadron
the Base	Eglin Air Force Base
UFC	Unified Facilities Criteria
US	United States
USEPA	United States Environmental Protection Agency
VFR	visual flight rules

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SECTION 1
PURPOSE AND NEED

1.1 INTRODUCTION

This study is an update of the 1977 Eglin Air Force Base (AFB), Florida Air Installation Compatible Use Zone (AICUZ) Study. The update presents and documents changes to the AICUZ amendment for the period 1977-2006 and is based on the June 2005 aircraft operations condition. This AICUZ Study reaffirms Air Force policy of assisting local, regional, state, and federal officials in the areas surrounding Eglin AFB by promoting compatible development within the AICUZ area of influence; and protecting Air Force operational capability from the effects of land use that are incompatible with aircraft operations. Specifically, the report documents changes in aircraft operations since the last study and provides noise contours and compatible use guidelines for land areas surrounding the installation based on the June 2005 operations. This information is provided to assist local communities and to serve as a tool for future planning and zoning activities. Changes that occurred since the 1977 Eglin AFB AICUZ Study include:

- Changes in the models of fighter aircraft based at Eglin AFB;
- An increase in the number of operations by based aircraft;
- An increase in the number of transient and civil aircraft operations at Eglin AFB;
- Addition, elimination, and modification of aircraft flight tracks to correspond to flying operations changes; and
- Technical improvements to the NOISEMAP computer modeling program.

1.2 PURPOSE AND NEED

The purpose of the long-standing AICUZ program is to promote compatible land development in areas subject to aircraft noise and accident potential. As the nearby cities of Valparaiso and Niceville and Okaloosa County prepare and modify land use development plans, recommendations from this updated AICUZ Study should be included in the planning process to prevent incompatible land use that could compromise the ability of Eglin AFB to fulfill its mission. Accident potential and aircraft noise should be major considerations in the planning process.

Air Force AICUZ guidelines reflect land use recommendations for the Clear Zones (CZ), Accident Potential Zones (APZ) I and II, and four noise zones exposed to noise levels at or above 65 decibels (dB) Day-Night Average A-Weighted Sound Level (DNL). These guidelines were established on the basis of studies prepared and sponsored by several federal agencies, including the United States Department of Housing and Urban Development, United States Environmental Protection Agency (USEPA), United States Air Force, and state and local agencies. The guidelines recommend land uses that are compatible with airfield operations while allowing maximum beneficial use of adjacent properties. The Air Force has no desire to recommend land use regulations that render property economically useless. It

does, however, have an obligation to the inhabitants of the Eglin AFB area of influence and the citizens of the United States to point out ways to protect the public investment in the installation and the people living in areas adjacent to the installation. The AICUZ area of influence includes the area within the DNL 65 dB and greater noise exposure area and the area within the CZs and APZs.

The AICUZ program uses the latest technology to define noise levels in areas near Air Force installations with a flying mission. An analysis of Eglin AFB's flying operations was performed, including types of aircraft, flight patterns utilized, variations in altitude, power settings, number of operations, and hours of operations. This information was used to develop the noise contours contained in this study. The Department of Defense (DoD) NOISEMAP (Version 7.296) computer modeling program and the DNL metric were used to define the noise zones for Eglin AFB.

1.3 PROCESS, PROCEDURE, AND NOISE METRICS

Preparation and presentation of this update to Eglin AFB's AICUZ Study is part of the continuing Air Force participation in the local planning process. Guidance for the Air Force AICUZ program is contained in Air Force Instruction (AFI) 32-7063, *Air Installation Compatible Use Zone Program*, which implements DoD Instruction 4165.57, *Air Installations Compatible Use Zones*.

As local communities prepare land use plans and zoning ordinances, the Air Force recognizes it has the responsibility to provide input on its activities relating to the community. This study is presented in the spirit of mutual cooperation and assistance by Eglin AFB to aid in the land use planning process around the Base. Noise contours depicted on the AICUZ maps in this study are based on the June 2005 levels of flying activity.

Aircraft operational data used in this study were collected at Eglin AFB in May 2004. The Air Force reviewed and validated the data through a communicative process that was finalized in June 2005. Aircraft flight data were obtained to derive average daily operations by runway and type of aircraft. These data were supplemented by flight track information (where we fly), flight profile information (how we fly), and ground runup information. After verification for accuracy, the data were input into the NOISEMAP Version 7.296 computer program to produce DNL noise contours. The noise contours for Eglin AFB were plotted on an area map and overlaid with the CZ and APZ areas for the airfield.

A 2005 Base Realignment and Closure initiative would establish Eglin AFB as an Initial Joint Training Site for the Joint Strike Fighter (F-35). Entry-level aviators and maintenance technicians would be trained on how to safely operate and maintain the new aircraft. Delivery of the F-35 would not begin until 2008. The operations information needed for development of the noise contours was not available at the time this AICUZ Study was prepared. There will be a possible need to update the AICUZ Study when the F-35 operations at Eglin AFB are defined.

1.4 COMPUTERIZED NOISE EXPOSURE MODELS

The Air Force adopted the NOISEMAP computer program to describe noise impacts created by aircraft operations. NOISEMAP is one of two USEPA-approved computer programs; the other is the Integrated Noise Model (INM) used by the Federal Aviation Administration (FAA) for noise analysis at civil airports. The NOISEMAP and INM programs are similar; however, INM does not contain noise data for all military aircraft.

NOISEMAP is a suite of computer programs and components developed by the Air Force to predict noise exposure in the vicinity of an airfield due to aircraft flight, maintenance, and ground run-up operations. The components of NOISEMAP are:

- BASEOPS is the input module for NOISEMAP and is used to enter detailed aircraft flight track and profile and ground maintenance operational data.
- NOISEFILE is a comprehensive database of measured military and civil aircraft noise data. Aircraft operational information is matched with the noise measurements in the NOISEFILE after the detailed aircraft flight and ground maintenance operational data has been entered into BASEOPS.
- NMAP is the computational module in NOISEMAP. NMAP takes BASEOPS input and uses the NOISEFILE database to calculate the noise levels caused by aircraft events at specified grid points in the airbase vicinity. The output of NMAP is a series of georeferenced data points, specific grid point locations, and corresponding noise levels.
- NMPLOT is the program for viewing and editing the sets of georeferenced data points. NMPLOT plots the NMAP output in a noise contour grid that can be exported as files that can be used in mapping programs for analyzing the noise impacts.

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SECTION 2
INSTALLATION DESCRIPTION

2.1 DESCRIPTION OF EGLIN AIR FORCE BASE

Eglin AFB is located in Okaloosa County in northwestern Florida, approximately five miles from Fort Walton Beach and adjacent to the City of Valparaiso and the City of Niceville. The base is on approximately 724 square miles of land west of Valparaiso (see Figure 2.1). From the south, access is gained via Highway 397. Eglin AFB has two runways: Runway 01/19; and Runway 12/30.

2.2 MISSION

Eglin AFB is the headquarters for the Air Force Material Command's Air Armament Center (AAC), which is the focal point for all Air Force armament. The Center is responsible for the development, acquisition, testing, and deployment of all air-delivered weapons. The AAC accomplished its mission through five component units: 46th Test Wing; 96th Air Base Wing; Air-to-Air Missile Systems Wing; Air-to-Ground Munitions Systems Wing; and the Air Combat Support Group.

The Flying operations are accomplished by the 46th Test Wing and the 33d Fighter Wing, 53d Wing, and 5th Special Operations Squadron, which are associate units at Eglin AFB. The 46th Test Wing is the test and evaluation center for Air Force air-delivered weapons, navigation/guidance systems, and command and control systems. The 33d Fighter Wing is an Air Combat Command unit that operates F-15 aircraft. The 53d Wing has multi-faceted responsibilities including operational test and evaluation of armament and avionics, aircrew training devices, chemical defense, aerial reconnaissance improvements, and electronic warfare systems. The 5th Special Operations Squadron, an Air Force Reserve Command unit, operates MC-130P aircraft.

2.3 ECONOMIC IMPACT

The Economic Impact Region (EIR) for Eglin AFB is the geographic area subject to significant base-generated economic impacts, and is defined as the area within a 50-mile radius of the base. This area includes all of Okaloosa County, and a portion of Walton, and Santa Rosa Counties, and the Cities of Valparaiso and Niceville.

2.3.1 Local Economic Characteristics

As shown in Table 2.1, Okaloosa County had a population of over 170,000 in 2000. This was an increase of nearly 27,000 people (6 percent) from 1990. Okaloosa County is expected to grow in population during the next decade to over 200,000 by 2010. Table 2.1 also displays the population for the municipalities of Valparaiso and Niceville.

Table 2.1 Historic and Projected Population

Area	1990	2000	2010 projection
Valparaiso	4,672	6,408	--
Niceville	10,507	11,684	--
Okaloosa County	143,776	170,498	201,135

Source: US Census Bureau, 2000

In 2000, employment in Okaloosa County was estimated to be nearly 72,000 persons, with an estimated unemployment rate of 2.7 percent. Education, health and social services employ the largest percentage of workers, with over 11,000 employees (6 percent of total). Table 2.2 presents the Okaloosa County employment by industry group.

Table 2.2 Okaloosa County Employment Estimates by Industry Group, 2000

Industry	Employees
Agriculture, forestry, fishing and hunting, and mining	537
Construction	6,220
Manufacturing	3,685
Wholesale trade	1,098
Retail trade	10,167
Transportation and warehousing, and utilities	2,867
Information	1,647
Finance, insurance, real estate, and rental and leasing	5,169
Professional, scientific, management, administrative, and waste management services	7,696
Educational, health and social services	11,691
Arts, entertainment, recreation, accommodation and food services	9,523
Other services (except public administration)	3,867
Public administration	7,825
Total	**71,992**

Source: US Census Bureau, 2000

2.3.2 Base Impact

The geographic area subject to significant base-generated economic impacts is defined as the area within a 50-mile radius of Eglin AFB. As shown in Table 2.3, Eglin AFB directly employs over 34,000 personnel. The annual payroll of the installation is over $798 million (Table 2.4). As a result of payroll expenditures, annual expenses, and the estimated value of indirect jobs in the local area, Eglin AFB has an estimated total economic impact of nearly $1.4 billion. The majority of this economic impact was due to the payroll and contracts provided by the installation.

Table 2.3 Personnel by Classification

Classification	Total
Active Duty Military	9,033
Military Reserve	714
Trainees/Cadets	**376**
Total Military	**10,123**
Military Dependents	14,750
Appropriated Funds Civilian	4,189
Non-Appropriated Funds Civilian	5,841
Total Civilian Personnel	**24,780**
Grand Total	**34,903**

Source: Eglin AFB Fact Sheet, September 30, 2002

Table 2.4 Annual Payroll

Category	($)
Total Annual Payroll	798,346,685
Annual Expenses for Construction Services and Procurement	246,664,391
Estimated Value of Indirect Jobs	351,732,436
Total	**1,396,743,512**

Source: Eglin AFB Fact Sheet, September 30, 2002

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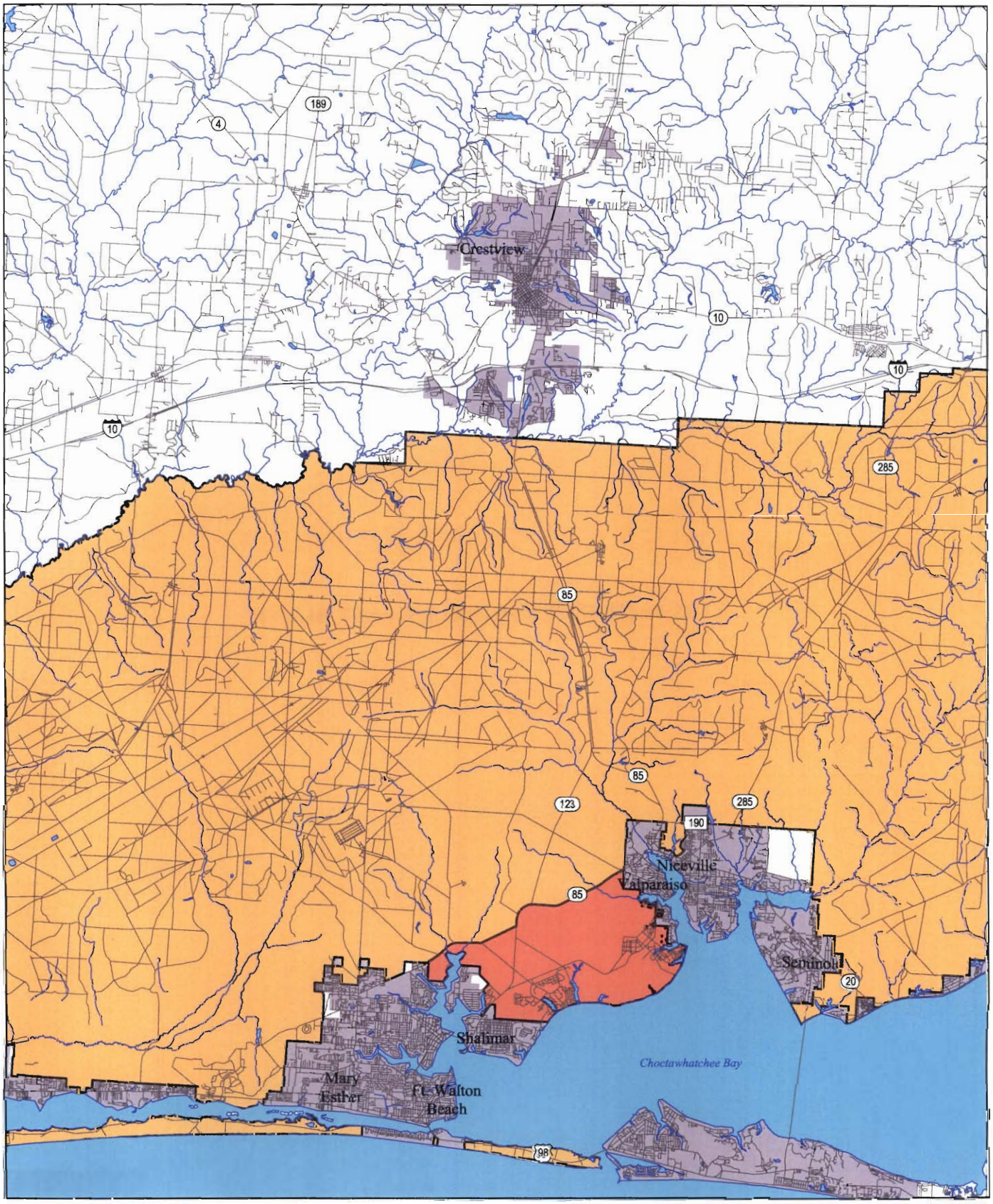

Eglin Air Force Base **2006 AICUZ Study**

LEGEND

- Eglin AFB Airfield
- Eglin AFB
- Urban Area

FLORIDA

N

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Miles

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Eglin AFB Location Map

Figure 2.1

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SECTION 3
AIRCRAFT OPERATIONS

3.1 INTRODUCTION

To describe the relationship between aircraft operations and land use at and around the airfield, it is necessary to fully evaluate the exact nature of flying activities. The June 2005 inventory of Eglin AFB aircraft operations included where aircraft fly, how high they fly, how many times they fly over a given area, and the time of day they operate.

Section 3.2 discusses aircraft operations at Eglin AFB. Section 3.3 discusses runway and flight track utilization for all operations by aircraft type. Section 3.4 describes aircraft maintenance activity, Section 3.5 discusses aircraft flight profiles, and Section 3.6 presents climatological data.

3.2 AIRCRAFT OPERATIONS

It is estimated that about 66,000 annual aircraft operations occur at Eglin AFB based on aircraft operations data validated in June 2005. An aircraft operation is defined as one takeoff/departure, one approach/landing, or half a closed pattern. A closed pattern consists of two portions, a takeoff/departure and an approach/landing, *i.e.,* two operations. A sortie is a single military aircraft flight from the initial takeoff through the termination landing. The minimum number of aircraft operations for one sortie is two operations, one takeoff (departure) and one landing (approach).

Table 3.1 summarizes the projected average busy-day aircraft operations for Eglin AFB based on information provided by Base staff, flying organization, and air traffic control personnel. Aircraft types operating at the Base consist primarily of military aircraft. In addition to the Eglin AFB aircraft, numerous types of transient military and civil air carrier aircraft conduct operations at the Base. Operations for the transient military and civilian aircraft types were combined with the selected aircraft based on similar characteristics (*e.g.*, number and type of engines, size of aircraft, airspeed, *etc.*). The table reflects a total of about 376 average busy-day aircraft operations based on collected operations data. About 4 percent of the total daily operations occur at night (10:00 p.m.-7:00 a.m.).

Although the number of military and civil aircraft operations at an installation usually varies from day to day, NOISEMAP requires input of the specific numbers of daily flight and aircraft maintenance engine runup operations. The Air Force does not follow the FAA's use of the "average annual day" in which annual operations are averaged over an entire 365-day year. Neither does the Air Force use the "worst-case day" since it typically does not represent the typical noise exposure. Instead, the Air Force uses the "average busy day" concept in which annual operations for an aircraft type are averaged over the number of flying days per year by that aircraft type. Non-flying days (*e.g.*, weekends or holidays) are not used in computing the "average busy day" operations. Flying activity at Eglin AFB for based aircraft ranges from 208 days per year for A-10s to 260 days per year for C-130, F-15, and F-16

aircraft. Transient aircraft operations are based on 210 days per year and civil aircraft operations occur 365 days per year.

Table 3.1 Average Busy Day Aircraft Operations for 2005

Category/ Aircraft Type	Daily Arrival/ Departure Operations	Daily Closed Pattern Operations	Total Daily Operations
Eglin AFB Aircraft			
A-10	8.00	4.00	12.00
C-130	4.76	4.05	8.81
F-15	109.33	3.46	112.79
F-16	24.94	16.84	41.78
C-32	1.32	8.72	10.04
Aero Club	16.24	48.72	64.96
Subtotal	164.59	85.79	250.38
Transient Military Aircraft			
A-10	0.97	0.00	0.97
AH-64	0.59	0.00	0.59
AV-8B	0.24	0.00	0.24
B-737	0.35	0.00	0.35
Beech Baron	0.20	0.00	0.20
Bell 212	0.72	0.00	0.72
C-12	0.87	0.00	0.87
C-130	1.46	31.10	32.56
C-21	0.85	0.00	0.85
Cessna 500	0.59	0.00	0.59
E-3	0.40	2.64	3.04
E-8	0.76	0.00	0.76
F-15	1.13	7.50	8.63
F-16	1.68	0.00	1.68
F-18	2.72	0.00	2.72
Single Engine	0.28	0.00	0.28
T-6	0.34	0.00	0.34
KC-10	0.12	1.32	1.44
KC-135	0.76	2.64	3.40
T-34	0.71	3.94	4.65
T-37	0.67	0.00	0.67
T-38	1.79	7.90	9.69
Subtotal	18.20	57.04	75.24
Civil Aircraft			
ATR-72	9.97	0.00	9.97
Regional Jet	20.80	0.00	20.80
DC-9	5.99	0.00	5.99
Beech 1900	5.98	0.00	5.98
MD-82	7.98	0.00	7.98
Subtotal	50.72	0.00	50.72
Total	**233.51**	**142.83**	**376.34**

Note: An operation is one takeoff/departure or one arrival/landing. A closed pattern consists of two operations, one takeoff and one landing.

3.3 RUNWAY AND FLIGHT TRACK UTILIZATION

Runway 01/19 is oriented 194°–014° and Runway 12/30 is oriented 122°–302°. Runway 01/19 is 10,012 feet long and 300 feet wide. Runway 12/30 is 12,005 feet long and 300 feet wide. The overrun at the north end of Runway 01/19 is 550 feet long and 300 feet wide and the overrun at the south end is 750 feet long and 300 feet wide. The overruns at each end of Runway 12/30 are 1,000 feet long and 300 feet wide. The airfield elevation is 85 feet above mean sea level (MSL).

Other airports and military airfields within the area surrounding the base influence Eglin AFB aircraft arrival and departure flight tracks. The Destin Airport is 6 miles southeast; Hurlburt Field is 10 miles southwest; and Duke Field (Eglin AFB Auxiliary Field Number 3) is 11 miles north. In addition to these military and public use airports, there are numerous runways in the Eglin AFB complex, which includes restricted airspaces to the east and west of the Base.

Aircraft operating at Eglin AFB use the following flight patterns:

- Straight-in arrivals;
- Straight-in arrivals to overhead patterns flown at approximately 1,500 feet above ground level (AGL);
- Straight-out departures;
- radar closed patterns to the west of the airfield; and
- overhead and rectangular closed patterns flown at 1,500 feet AGL and 1,000 feet AGL, respectively.

Flight patterns specific to Eglin AFB result from several considerations, including:

- Takeoff patterns routed to avoid noise-sensitive areas as much as possible;
- Arrivals and departures routed to avoid restricted airspace;
- Criteria governing the speed, rate of climb, and turning radius for each type of aircraft;
- Efforts to control and schedule missions to keep noise levels low, especially at night; and
- Coordination with the FAA to minimize conflict with civil aircraft operations.

Planning for the areas surrounding an airfield considers three primary aircraft operational/land-use determinants: (1) aircraft accident potential to land users; (2) aircraft noise; and (3) hazards to operations from land uses (*e.g.*, height of structures). Each of these concerns is addressed in conjunction with mission requirements and safe aircraft operations to determine the optimum flight track for each aircraft type. The flight tracks depicted in Figures 3.1 through 3.3 are the result of such planning and depict the representative flight

tracks used for noise modeling. Runway use is: Runway 01—10 percent: Runway 19—49 percent; Runway 12—28 percent; and Runway 30—12 percent.

3.4 AIRCRAFT MAINTENANCE RUNUP OPERATIONS

To the maximum extent possible, aircraft maintenance engine runup locations have been established in areas to minimize noise for people on Base, as well as for those in the surrounding communities. Aircraft maintenance engine runup operations are accomplished by based flying units and their associated maintenance functions.

Average busy-day aircraft maintenance runup operations were calculated similarly to flight operations described in Section 3.1. Weekly, monthly, or annual estimates of runups provided by Eglin AFB aircraft maintenance personnel were divided by the typical number of days runups were performed over the respective period. Approximately 17 percent of aircraft maintenance runup operations at Eglin AFB occur during nighttime (10:00 p.m. to 7:00 a.m.).

3.5 AIRCRAFT FLIGHT PROFILES

For purposes of this AICUZ Study, aircraft "flight profiles" denote the aircraft power settings, altitudes above runway level, and airspeeds along each flight track. Aircraft flight profiles for A-10, C-130, F-15, F-16, C-32, and Aero Club aircraft were obtained from Eglin AFB personnel. Generic flight profiles from the BASEOPS database were used to model operations for the other military and civil aircraft types. Noise data from the NOISEFILE database were used to model operations for all aircraft types.

3.6 CLIMATOLOGICAL DATA

Weather conditions, measured by temperature and relative humidity, are an important factor in the propagation of noise. Temperature and relative humidity affect sound absorption. The average temperature and humidity for each month of the year are input into BASEOPS, which then calculates the sound absorption coefficient for each month. Ranking the twelve monthly sound absorption coefficients from smallest to largest, BASEOPS chooses the sixth smallest sound absorption coefficient to represent the typical weather conditions at the installation. The month with the sixth smallest sound absorption coefficient for Eglin AFB is the month with the average monthly temperature of 67 degrees Fahrenheit and 70 percent relative humidity.

Eglin Air Force Base **2006 AICUZ Study**

LEGEND

- Flight Track
- Runway
- Roadway
- Eglin AFB Airfield
- Eglin AFB
- Urban Area

N

0 10,000

Feet

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Arrival Flight Tracks

Figure 3.1

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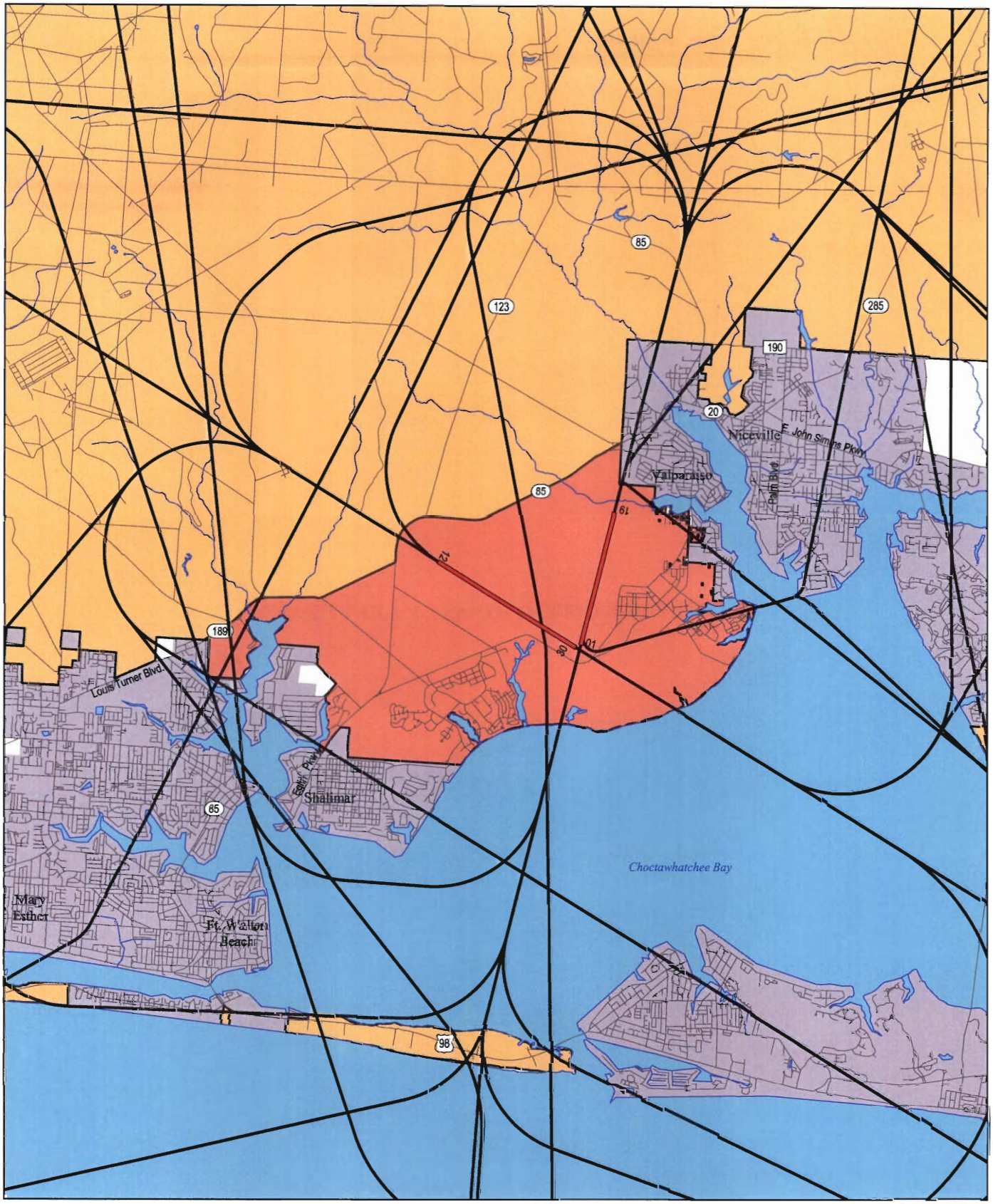

Eglin Air Force Base **2006 AICUZ Study**

LEGEND

- Flight Track
- Runway
- Roadway
- Eglin AFB Airfield
- Eglin AFB
- Urban Area

N

0 10,000

Feet

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Departure Flight Tracks

Figure 3.2

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Eglin Air Force Base **2006 AICUZ Study**

LEGEND

- Flight Track
- Runway
- Roadway
- Eglin AFB Airfield
- Eglin AFB
- Urban Area

N

0 10,000 Feet

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Closed Pattern Flight Tracks

Figure 3.3

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SECTION 4
EFFECTS OF AIRCRAFT OPERATIONS

4.1 INTRODUCTION

This section has two purposes. The first is to describe the imaginary surfaces associated with obstructions to air navigation, noise exposure, CZs, and APZs. The second purpose is to present applicable land-use compatibility guidelines and the Air Force's participation in the land-use planning process.

4.2 RUNWAY AIRSPACE IMAGINARY SURFACES

Obstructions to air navigation are considered to be:

- Natural objects or man-made structures that protrude above the planes or imaginary surfaces, and/or;
- Man-made objects that extend more than 500 feet AGL at the site of the structure.

4.2.1 Explanation of Terms

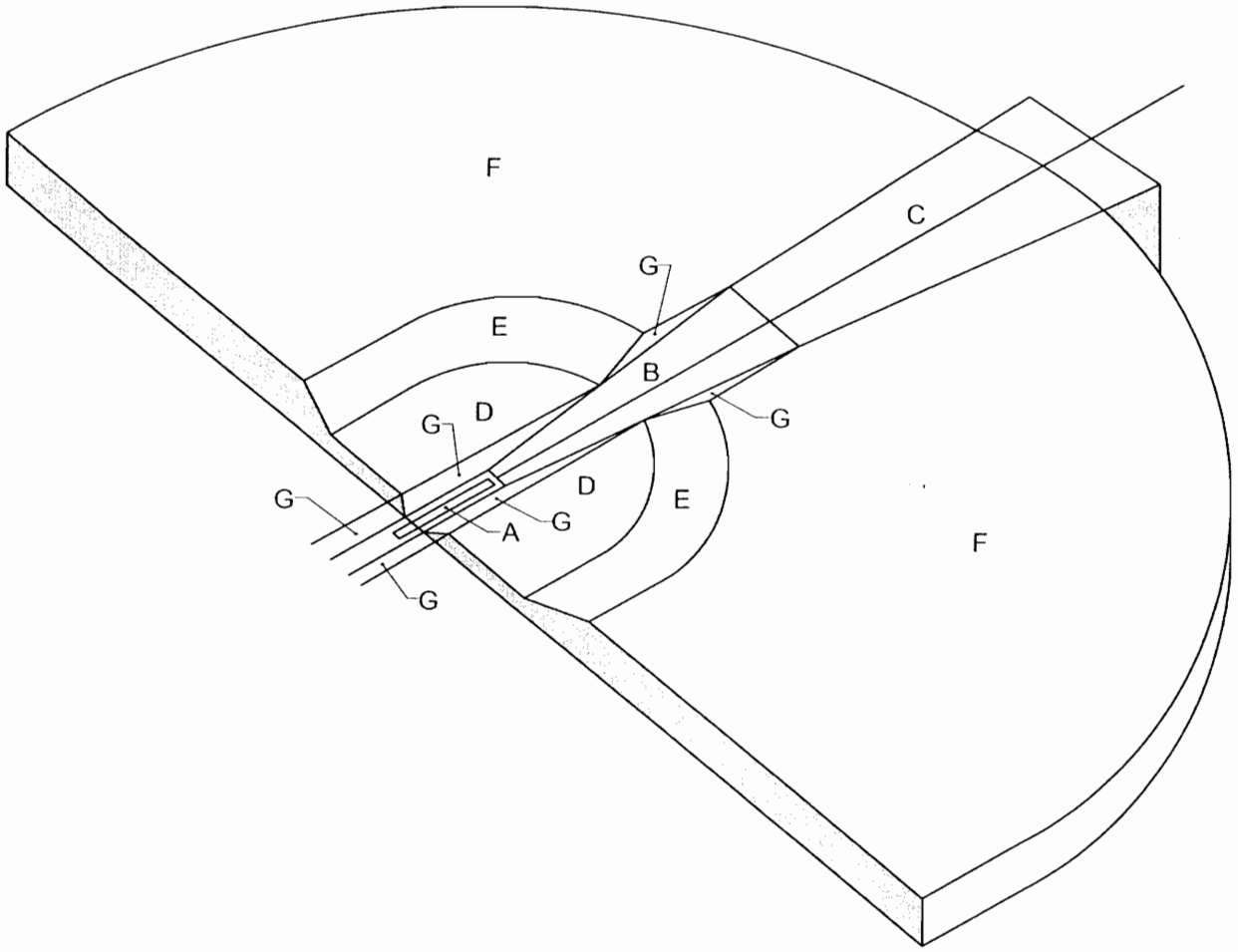
The following elevation, runway length, and dimensional criteria apply:

- Controlling Elevation—whenever surfaces or planes within the obstruction criteria overlap, the controlling (or governing) elevation becomes that of the lowest surface or plane.
- Runway Length—Eglin AFB has two runways. Runway 01/19 is 10,012 feet long and Runway 12/30 is 12,005 feet long. Both runways are Class B runways that are designed and built for sustained aircraft landings and take-offs:
- Established Airfield Elevation—The established elevation for the Eglin AFB airfield is 85 feet above mean sea level.
- Dimensions—All dimensions are measured horizontally unless otherwise noted.

4.2.2 Runway Airspace Imaginary Surfaces

Runway airspace imaginary surfaces, in graphical form, are the result of the application of obstruction height criteria to Eglin AFB. Imaginary surfaces are surfaces in space around airfields in relation to runways. The surfaces are designed to define the obstacle-free airspace at and around the airfield. Refer to Unified Facilities Criteria (UFC) 3-260-01, *Airfield and Heliport Planning and Design,* for a more complete description of runway airspace imaginary surfaces for Class B runways. Figure 4.1 depicts the runway airspace imaginary surfaces for the Eglin AFB Class B runways. Air Force obstruction criteria in UFC 3-260-01 are based on those contained in Federal Aviation Regulation (FAR) Part 77, *Objects Affecting Navigable Airspace*, Subpart C. The following paragraphs contain definitions of the runway airspace imaginary surfaces for Air Force class B runways:

- Primary Surface—An imaginary surface symmetrically centered on the runway, extending 200 feet beyond each runway end that defines the limits of the obstruction clearance requirements in the vicinity of the landing area. The width of the primary surface is 2,000 feet, or 1,000 feet on each side of the runway centerline.
- Clear Zone Surface—An obstruction-free surface (except for features essential for aircraft operations) on the ground symmetrically centered on the extended runway centerline beginning at the end of the runway and extending outward 3,000 feet. The CZ width is 3,000 feet (1,500 feet to either side of runway centerline).
- Accident Potential Zone Surfaces—APZ I begins at the outer end of the CZ and is 5,000 feet long and 3,000 feet wide. APZ II begins at the outer end of APZ I and is 7,000 feet long and 3,000 feet wide.
- Approach-Departure Clearance Surface—This imaginary surface is symmetrically centered on the extended runway centerline, beginning as an inclined plane (glide angle) 200 feet beyond each end of the primary surface, and extending for 50,000 feet. The slope of the approach-departure clearance surface is 50:1 until it reaches an elevation of 500 feet above the established airfield elevation. It then continues horizontally at this elevation to a point 50,000 feet from the starting point. The width of this surface at the runway end is 2,000 feet, flaring uniformly to a width of 16,000 feet at the end point.
- Inner Horizontal Surface—This imaginary surface is an oval plane at a height of 150 feet above the established airfield elevation. The inner boundary intersects with the approach-departure clearance surface and the transitional surface. The outer boundary is formed by scribing arcs with a radius 7,500 feet from the centerline of each runway end and interconnecting these arcs with tangents.
- Conical Surface—This is an inclined imaginary surface extending outward and upward from the outer periphery of the inner horizontal surface for a horizontal distance of 7,000 feet to a height of 500 feet above the established airfield elevation. The slope of the conical surface is 20:1. The conical surface connects the inner and outer horizontal surfaces.
- Outer Horizontal Surface—This imaginary surface is located 500 feet above the established airfield elevation and extends outward from the outer periphery of the conical surface for a horizontal distance of 30,000 feet.
- Transitional Surface—This imaginary surface extends outward and upward at right angles to the runway centerline and extended runway centerline at a slope of 7:1. The transitional surface connects the primary and the approach-departure clearance surfaces to the inner horizontal, the conical, and the outer horizontal surfaces.



Note:
The outer edge of the outer horizontal surfaces (F) extends to 44,500 feet from the runway centerline.

LEGEND

- A Primary Surface
- B Approach-Departure Clearance Surface (50:1 Slope Ratio)
- C Approach-Departure Clearance Surface (Horizontal)
- D Inner Horizontal Surface (45.72m [150'] Elevation)
- E Conical Surface (20:1 Slope Ratio)
- F Outer Horizontal Surface (152.40m [500'] Elevation)
- G Transitional Surface (7:1 Slope Ratio)

Class B Air Force Runway Airspace Imaginary Surfaces

Figure 4.1

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4.3 RESTRICTED AND/OR PROHIBITED LAND USES

The land areas outlined by these criteria should be regulated to prevent uses that might otherwise be hazardous to aircraft operations. The following uses should be restricted and/or prohibited:

- Releases into the air of any substance that would impair visibility or otherwise interfere with the operation of aircraft (e.g., steam, dust, or smoke);
- Light emissions, either direct or indirect (reflective), that would interfere with pilot vision;
- Electrical emissions that would interfere with aircraft communications systems or navigational equipment;
- Uses that would attract birds or waterfowl, including but not limited to, operation of sanitary landfills, waste transfer facilities, maintenance of feeding stations, sand and gravel dredging operations, storm water retention ponds, created wetland areas, or the growing of certain vegetation; and
- Structures within 10 feet of aircraft approach-departure and/or transitional surfaces.

4.4 NOISE EXPOSURE

NOISEMAP Version 7.296 was used to calculate and plot the DNL noise contours based on the average busy day aircraft operations data collected in 2005 and described in Sections 3.1 through 3.6. Figure 4.2 shows the DNL noise contours plotted in 5 dB increments, ranging from DNL 65 dB to DNL at or above 80 dB

Different sounds have different frequency content. When describing sound and its effect on a human population, A-weighted (dB) sound levels are typically used to account for the response of the human ear. The term "A-weighted" refers to a filtering of the sound signal to emphasize frequencies in the middle of the audible spectrum and to de-emphasize low and high frequencies in a manner corresponding to the way the human ear perceives sound. This filtering network has been established by the American National Standards Institute. The A-weighted noise level has been found to correlate well with people's judgments of the noisiness of different sounds and has been in use for many years as a measure of community noise.

Table 4.1 shows the off-installation noise exposure within the DNL 65 dB and greater noise exposure area for aircraft operations at Eglin AFB in terms of acreage and estimated affected population. DNL is the measure of the total noise environment. DNL averages the sum of all aircraft noise producing events over a 24-hour period, with a 10 dBA upward adjustment added to the nighttime events (between 10:00 p.m. and 7:00 a.m.). The population data used in preparing this estimate was obtained from the United States Census Bureau 2000 census. To estimate affected population, it was assumed that population was equally distributed within a census tract area. Using this assumption, the total acreage and population in each census tract surrounding Eglin AFB was collected and assessed. Using the noise

contour information, the number of acres of land in each noise zone (*i.e.*, DNL 65-69 dB, 70-74 dB, 75-79 dB, and 80 dB and greater) was divided by the number of acres of land in each census tract to determine what portion of the census tract was contained within each noise zone. To determine population, the population total in each block-group was then multiplied by this ratio to estimate affected population.

Table 4.1 Area and Population Within DNL 65 dB and Greater Noise Exposure Area (Off-Installation)

DNL Noise Zone	Acres	Population
65–69	558	1,382
70–74	235	834
75–79	64	156
80+	1	0
Total	**858**	**2,372**

From Table 4.1, a total of 858 acres and 2,372 persons are expected to be in the off-installation area within the DNL 65 dB and greater noise exposure area. The largest affected population is anticipated to be within the DNL 65–69 dB noise zone. This area is estimated to contain 558 acres in off-installation land area (65 percent of the total) and an estimated population of 1,382 persons (58 percent of the total) based on the calculated population densities for the area.

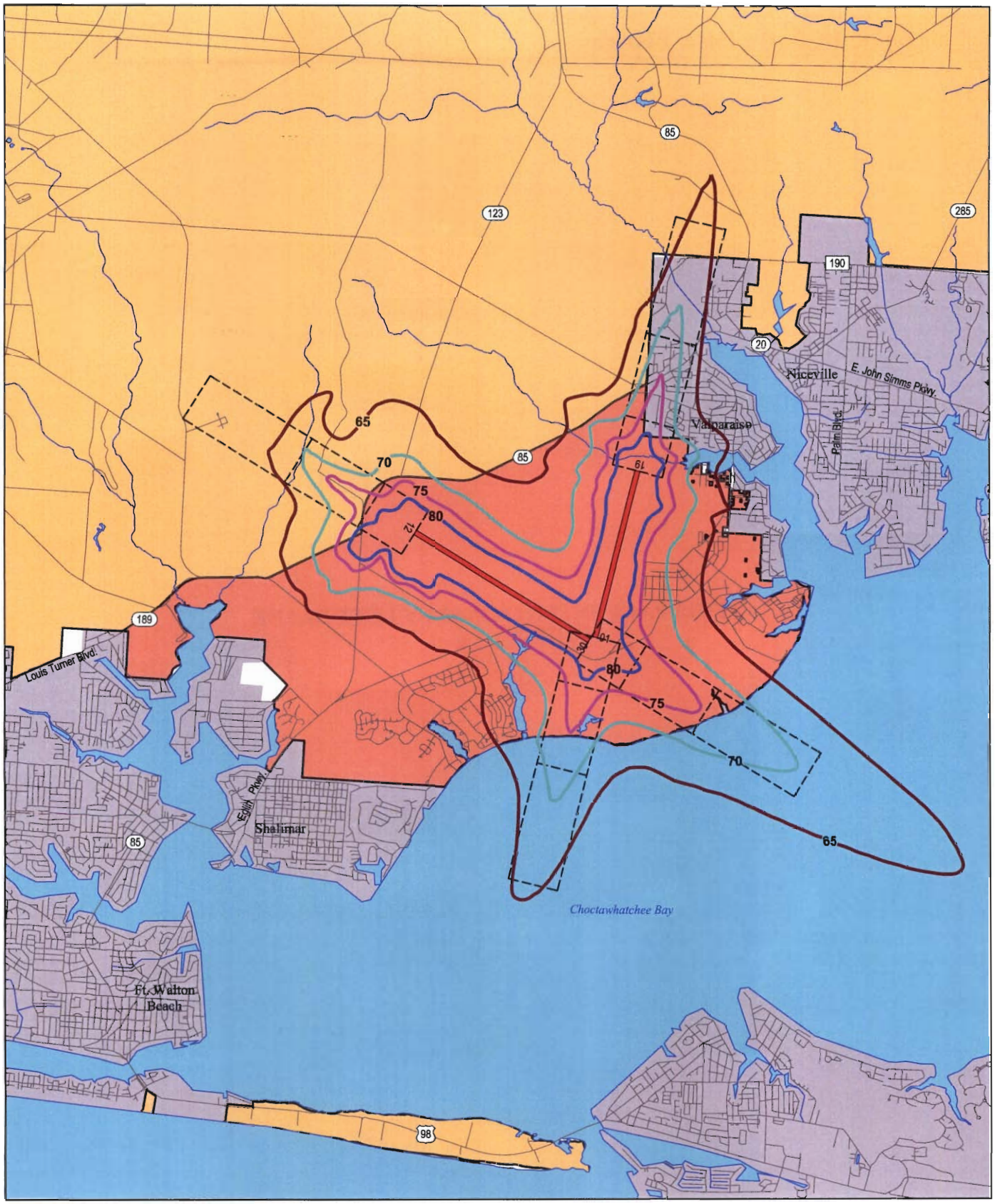
4.5 COMPARISON WITH 1977 AICUZ STUDY

Noise contours presented in this study differ in both shape and extent from the noise contours in the 1977 AICUZ Study. Figure 4.3 depicts the 1977 AICUZ Study contours and Figure 4.4 compares the 2006 and 1977 contours.

The overall exposure for this AICUZ Study is about 1,280 acres less than the 1977 AICUZ Study. Table 4.2 lists the total noise exposure for the four noise zones in each study. The decrease in noise exposure since the 1977 AICUZ Study is attributed to the elimination of noisier aircraft at the base and flight track and profile modifications to minimize aircraft noise.

Table 4.2 Total Acres Within the 2006 and 1977 AICUZ Study Noise Zones

	Acres	
DNL Noise Zone	2006 Study	1977 Study
65–69	6,765	7,368
70–74	3,089	3,462
75–79	1,454	1,631
80+	1,793	1,911
Total	**13,092**	**14,372**



Eglin Air Force Base **2006 AICUZ Study**

LEGEND

- DNL 65 dBA Contour
- DNL 70 dBA Contour
- DNL 75 dBA Contour
- DNL 80 dBA Contour
- Runway
- Roadway
- Eglin AFB Airfield
- Eglin AFB
- Urban Area

N

0 8,000

Feet

744299 EGLIN-ABDNC.DWG

Average Busy Day Noise Contours for 2006

Figure 4.2

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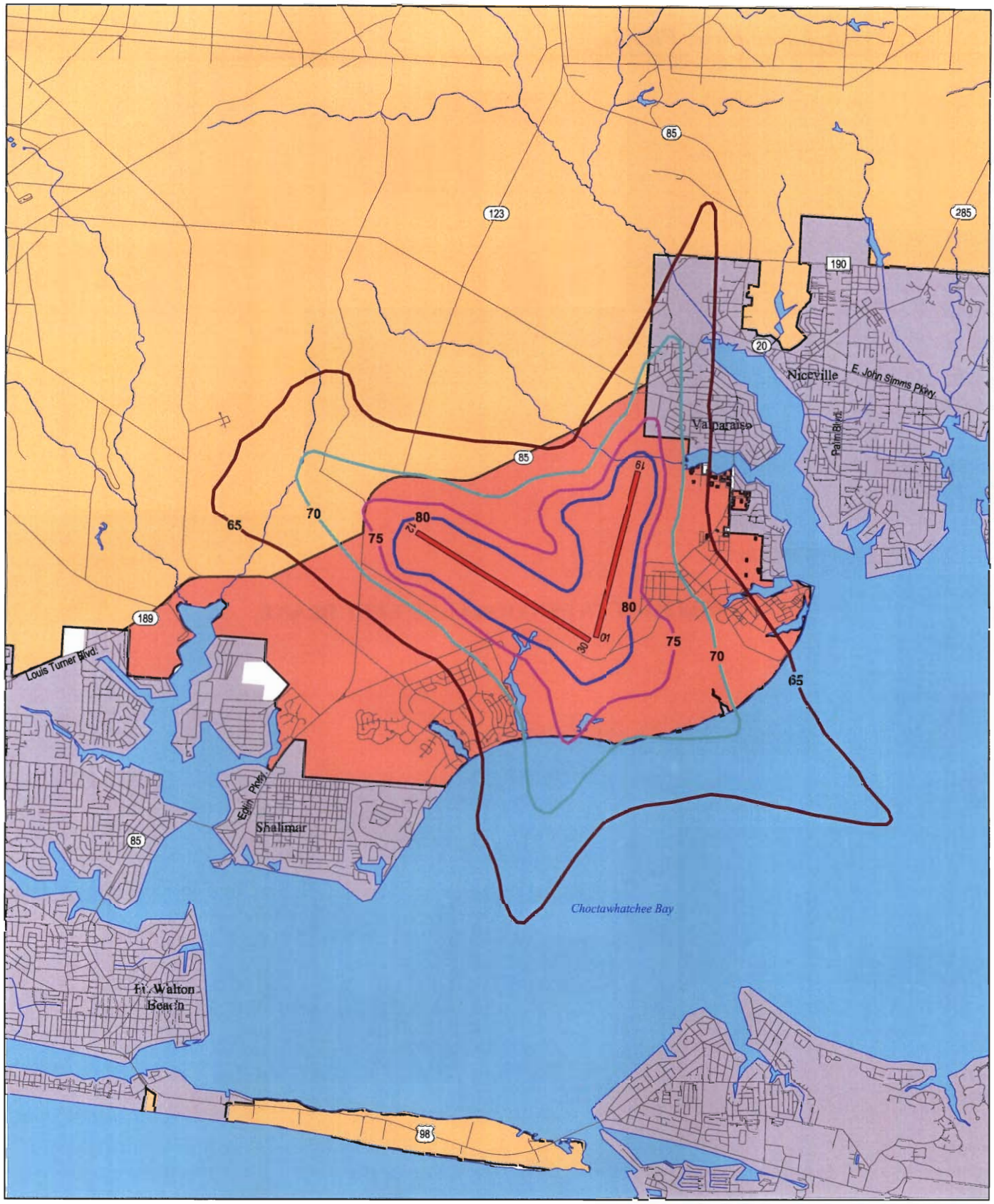

Eglin Air Force Base **2006 AICUZ Study**

LEGEND

- DNL 65 dBA Contour
- DNL 70 dBA Contour
- DNL 75 dBA Contour
- DNL 80 dBA Contour
- Runway
- Roadway
- Eglin AFB Airfield
- Eglin AFB
- Urban Area

N

0 8,000

Feet

744299 EGLIN-77NC.DWG

1977 AICUZ Study
Noise Contours

Figure 4.3

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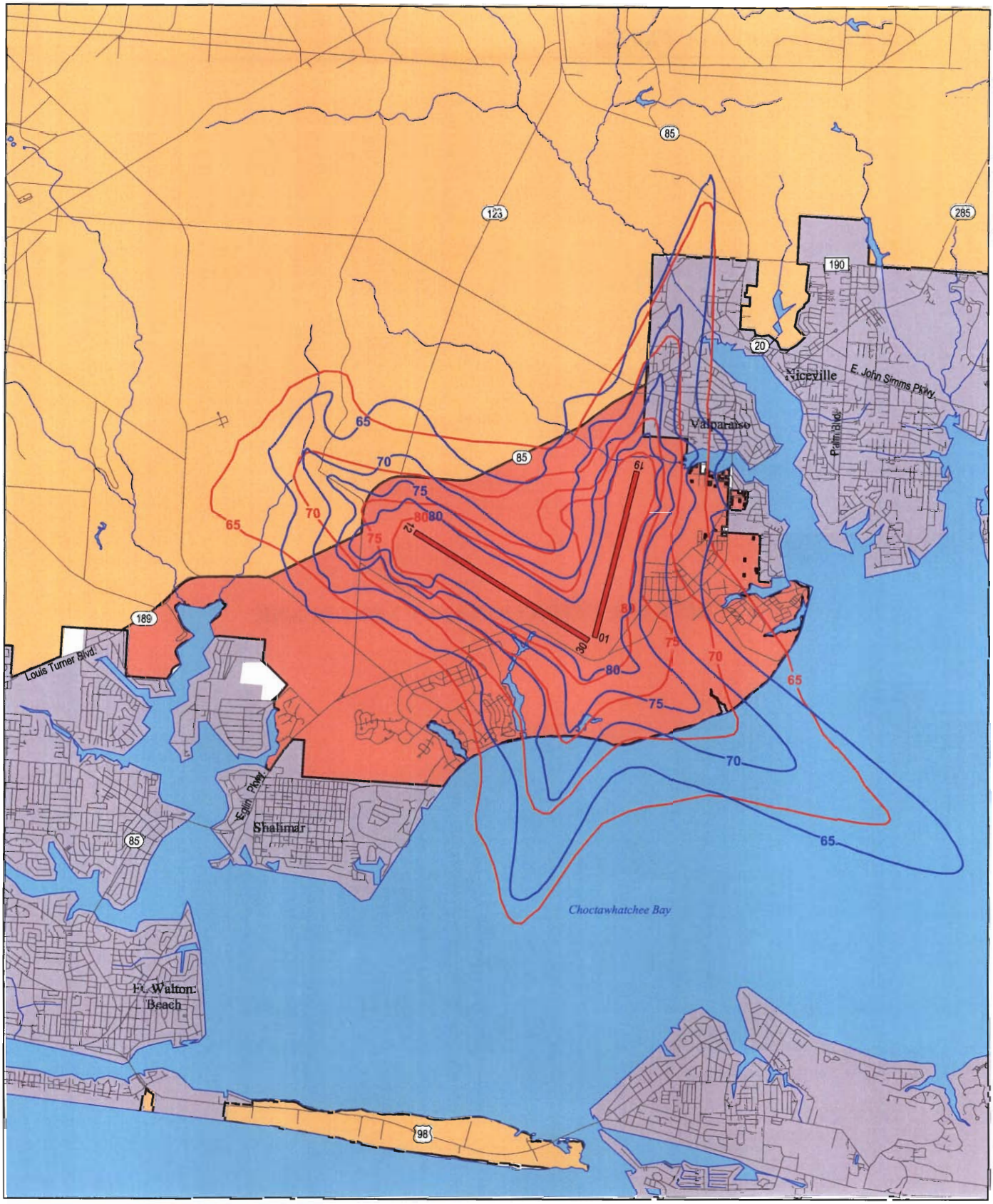

Eglin Air Force Base — **2006 AICUZ Study**

LEGEND

- 1977 Noise Contour
- 2005 Noise Contour
- Runway
- Roadway
- Eglin AFB Airfield
- Eglin AFB
- Urban Area

N

0 — 8,000 Feet

744299 EGLIN—COMP.DWG

Comparison of 2006 and 1977 AICUZ Study Noise Contours

Figure 4.4

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4.6 CLEAR ZONES AND ACCIDENT POTENTIAL ZONES FOR RUNWAYS

The purpose of this section is to describe the basis for CZs and APZs and apply the zones to the Eglin AFB runways.

4.6.1 Basis for Clear Zones and Accident Potential Zones

Areas around airports are exposed to the possibility of aircraft accidents even with well-maintained aircraft and highly trained aircrews. Despite stringent maintenance requirements and countless hours of training, past history makes it clear that accidents may occur.

The risk of people on the ground being killed or injured by aircraft accidents is miniscule. However, an aircraft accident is a high-consequence event and, when a crash does occur, the result is often catastrophic. Because of this, the Air Force does not attempt to base its safety standards on accident probabilities. Instead it approaches this safety issue from a land-use-planning perspective. Designation of safety zones around the airfield and restriction of incompatible land uses can reduce the public's exposure to safety hazards.

The AICUZ program includes three safety zones: the CZ, APZ I, and APZ II. These zones were developed from analysis of over 800 major Air Force accidents that occurred within 10 miles of an Air Force installation between 1968 and 1995. Figure B-3 in Appendix B summarizes the location of these accidents.

The CZ has the highest accident potential of the three zones, as 27 percent of accidents studied occurred in this area. Due to the relatively high accident potential, the Air Force adopted a policy of acquiring real estate interests in the CZ through purchase or easement when feasible.

APZ I is an area that possesses somewhat less accident potential than the CZ, with 10 percent of the accidents studied occurring in this zone. APZ II has less accident potential than APZ I, with 6 percent of the accidents studied occurring in this zone. While the potential for aircraft accidents in APZs I and II does not warrant land acquisition by the Air Force, land-use planning and controls are strongly encouraged in these areas for the protection of the public.

4.6.2 Clear Zones and Accident Potential Zones for Runways 01/19 and 12/30

Figure 4.5 depicts the CZs and APZs for Runways 01/19 and 12/30 at Eglin AFB. Each end of Runways 01/19 and 12/30 at Eglin AFB has a 3,000 foot by 3,000 foot CZ and two APZs. Accident potential on or adjacent to the runway or within the CZ is so high that the necessary land use restrictions would prohibit reasonable economic use of land. As stated previously, it is Air Force policy to request that Congress authorize and appropriate funds to purchase the real property interests in this area to prevent incompatible land uses.

Accident potential zone I is less critical than the CZ, but still possesses a significant risk factor. This 3,000 foot by 5,000 foot area has land use compatibility guidelines that are sufficiently flexible to allow reasonable economic use of the land, such as industrial/manufacturing, transportation, communication/utilities, wholesale trade, open space, recreation, and agriculture. However, uses that concentrate people in small areas are not acceptable.

Accident potential zone II is less critical than APZ I, but still possesses potential for accidents. Accident potential zone II, also 3,000 feet wide, is 7,000 feet long extending to 15,000 feet from the runway threshold. Acceptable uses include those of APZ I, as well as low density single family residential and those personal and business services and commercial/retail trade uses of low intensity or scale of operation. High density functions such as multi-story buildings, places of assembly (*e.g.*, theaters, churches, schools, restaurants, *etc.*), and high density office uses are not considered appropriate.

High people densities should be limited to the maximum extent possible in APZ II. The optimum density recommended for residential usage (where it does not conflict with noise criteria) in APZ II is one dwelling per acre. For most nonresidential usage, buildings should be limited to one story and the lot coverage should not exceed 20 percent.

4.6.3 Land Use Compatibility Guidelines for Runways

Section 4.6.3.1 introduces the AICUZ concept and Section 4.6.3.2 presents the land-use compatibility guidelines applicable to Eglin AFB.

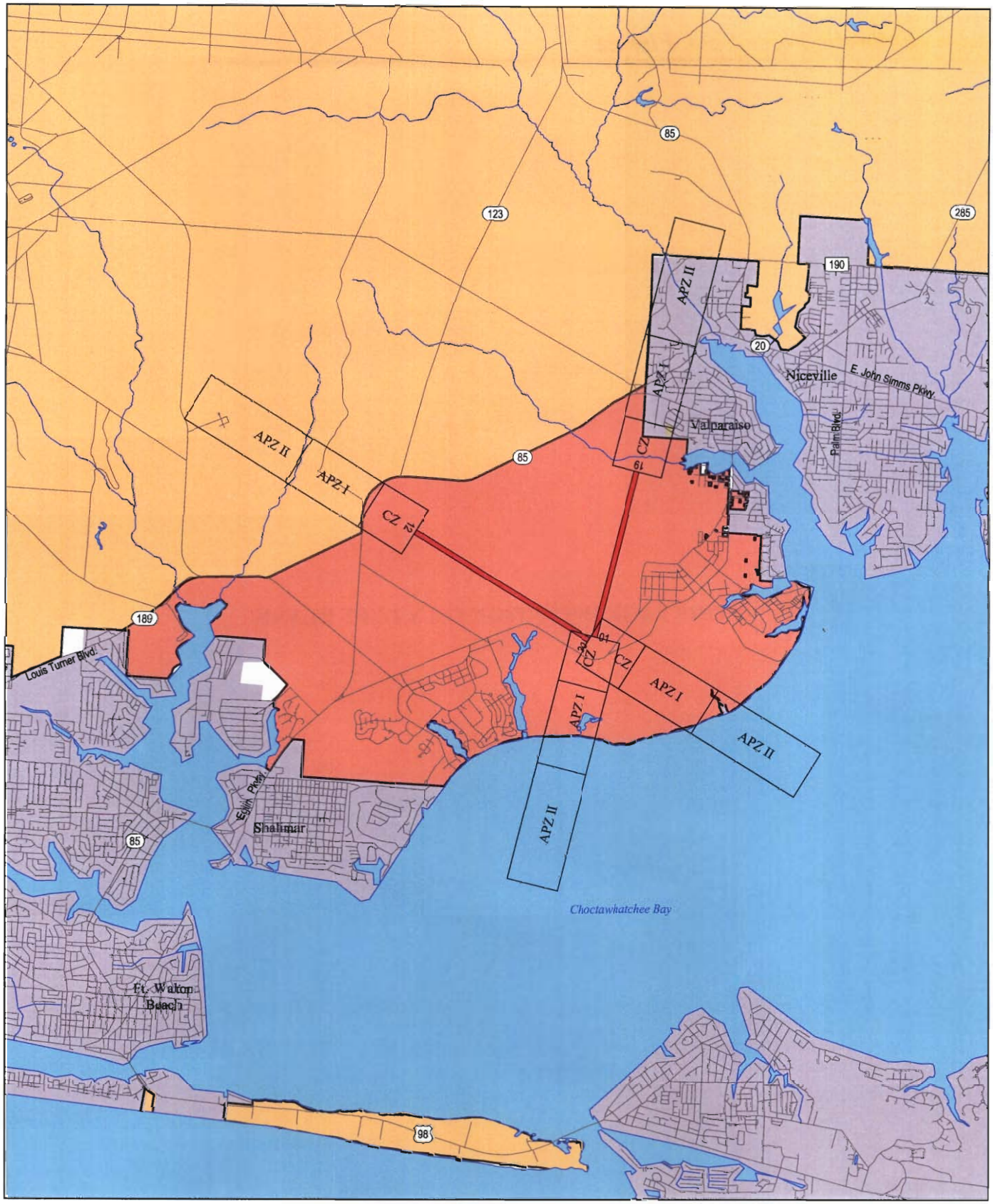
4.6.3.1 Introduction

The DoD developed the AICUZ program for military airfields. Using this program at its installations, the DoD works to protect aircraft operational capabilities and to assist local government officials in protecting and promoting the public's health, safety, and quality of life. The goal is to promote compatible land-use development around military airfields by providing information on aircraft noise exposure and accident potential.

AICUZ reports describe three basic types of constraints that affect, or result from, flight operations. The first constraint involves areas that the FAA and the DoD identified for height limitations (see Section 4.2).

The second constraint involves noise zones based on the DNL metric and the DoD NOISEMAP methodology. Using the NOISEMAP program, which is similar to FAA's INM, the Air Force produces noise contours showing the noise levels generated by aircraft operations. The AICUZ report contains noise contours plotted in 5 dB increments, ranging from DNL 65 dB to 80+ dB.

The third constraint involves CZs and APZs based on statistical analysis of past DoD aircraft accidents. DoD analysis has determined that areas immediately beyond the ends of runways and along the approach and departure flight paths have greater potential for aircraft accidents (see Figure 4.5).



Eglin Air Force Base **2006 AICUZ Study**

LEGEND

CZ	Clear Zone	Runway	Eglin AFB Airfield
APZ	Accident Potential Zone	Roadway	Eglin AFB
			Urban Area

N

0 8,000

Feet

744299 EGLIN-CZ.DWG

Clear Zones and Accident Potential Zones

Figure 4.5

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4.6.3.2 Land-Use Compatibility Guidelines for Runways

Each AICUZ Study contains land-use guidelines. Table 4.3 identifies land uses and possible noise exposure and accident potential combinations for Eglin AFB. These noise guidelines are essentially the same as those published by the Federal Interagency Committee on Urban Noise in the June 1980 publication, *Guidelines for Considering Noise in Land-Use Planning and Control.* The U.S. Department of Transportation publication, *Standard Land Use Coding Manual (SLUCM),* has been used to identify and code land-use activities. The designations are a combination of criteria listed in the Legend and Notes at the end of the table. For example, Y^{1} means land use and related structures are compatible without restriction at a suggested maximum density of 1-2 dwelling units per acre, possibly increased under a Planned Unit Development where lot coverage is less than 20 percent.

Table 4.3 Land Use Compatibility Guidelines

Land Use		Accident Potential Zones			Noise Zones in DNL dB			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65-69	70-74	75-79	80+
10	**Residential**							
11	Household units							
11.11	Single units; detached	N	N	Y^{1}	A^{11}	B^{11}	N	N
11.12	Single units; semidetached	N	N	N	A^{11}	B^{11}	N	N
11.13	Single units; attached row	N	N	N	A^{11}	B^{11}	N	N
11.21	Two units; side-by-side	N	N	N	A^{11}	B^{11}	N	N
11.22	Two units; one above the other	N	N	N	A^{11}	B^{11}	N	N
11.31	Apartments; walk up	N	N	N	A^{11}	B^{11}	N	N
11.32	Apartments; elevator	N	N	N	A^{11}	B^{11}	N	N
12	Group quarters	N	N	N	A^{11}	B^{11}	N	N
13	Residential hotels	N	N	N	A^{11}	B^{11}	N	N
14	Mobile home parks or courts	N	N	N	N	N	N	N
15	Transient lodgings	N	N	N	A^{11}	B^{11}	C^{11}	N
16	Other residential	N	N	N^{1}	A^{11}	B^{11}	N	N
20	**Manufacturing**							
21	Food & kindred products; manufacturing	N	N^{2}	Y	Y	Y^{12}	Y^{13}	Y^{14}

Table 4.3 Land Use Compatibility Guidelines *(...continued)*

Land Use		Accident Potential Zones			Noise Zones			
SLUCM No.	Name	Clear Zone	APZ I	APZ II	65-69	70-74	75-79	80+
22	Textile mill products; manufacturing	N	N[2]	Y	Y	Y[12]	Y[13]	Y[14]
23	Apparel and other finished products made from fabrics, leather, and similar materials; manufacturing	N	N	N[2]	Y	Y[12]	Y[13]	Y[14]
24	Lumber and wood products (except furniture); manufacturing	N	Y[2]	Y	Y	Y[12]	Y[13]	Y[14]
25	Furniture and fixtures; manufacturing	N	Y[2]	Y	Y	Y[12]	Y[13]	Y[14]
26	Paper & allied products; manufacturing	N	Y[2]	Y	Y	Y[12]	Y[13]	Y[14]
27	Printing, publishing, and allied industries	N	Y[2]	Y	Y	Y[12]	Y[13]	Y[14]
28	Chemicals and allied products; manufacturing	N	N	N[2]	Y	Y[12]	Y[13]	Y[14]
29	Petroleum refining and related industries	N	N	Y	Y	Y[12]	Y[13]	Y[14]
30	**Manufacturing**							
31	Rubber and misc. plastic products, manufacturing	N	N[2]	N[2]	Y	Y[12]	Y[13]	Y[14]
32	Stone, clay and glass products manufacturing	N	N[2]	Y	Y	Y[12]	Y[13]	Y[14]
33	Primary metal industries	N	N[2]	Y	Y	Y[12]	Y[13]	Y[14]
34	Fabricated metal products; manufacturing	N	N[2]	Y	Y	Y[12]	Y[13]	Y[14]
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks manufacturing	N	N	N[2]	Y	A	B	N
39	Miscellaneous manufacturing	N	Y[2]	Y[2]	Y	Y[12]	Y[13]	Y[14]
40	**Transportation, Communications and Utilities**							
41	Railroad, rapid rail transit and street railroad transportation	N[3]	Y[4]	Y	Y	Y[12]	Y[13]	Y[14]
42	Motor vehicle transportation	N[3]	Y	Y	Y	Y[12]	Y[13]	Y[14]

Table 4.3 Land Use Compatibility Guidelines *(...continued)*

Land Use		Accident Potential Zones			Noise Zones			
SLUCM No.	**Name**	**Clear Zone**	**APZ I**	**APZ II**	**65-69**	**70-74**	**75-79**	**80+**
43	Aircraft transportation	N[3]	Y[4]	Y	Y	Y[12]	Y[13]	Y[14]
44	Marine craft transportation	N[3]	Y[4]	Y	Y	Y[12]	Y[13]	Y[14]
45	Highway & street right-of-way	N[3]	Y	Y	Y	Y[12]	Y[13]	Y[14]
46	Automobile parking	N[3]	Y[4]	Y	Y	Y[12]	Y[13]	Y[14]
47	Communications	N[3]	Y[4]	Y	Y	A[15]	B[15]	N
48	Utilities	N[3]	Y[4]	Y	Y	Y	Y[12]	Y[13]
49	Other transportation communications and utilities	N[3]	Y[4]	Y	Y	A[15]	B[15]	N
50	**Trade**							
51	Wholesale trade	N	Y[2]	Y	Y	Y[12]	Y[13]	Y[14]
52	Retail trade-building materials, hardware and farm equipment	N	Y[2]	Y	Y	Y[12]	Y[13]	Y[14]
53	Retail trade-general merchandise	N	N[2]	Y[2]	Y	A	B	N
54	Retail trade-food	N	N[2]	Y[2]	Y	A	B	N
55	Retail trade-automotive, marine craft, aircraft and accessories	N	Y[2]	Y[2]	Y	A	B	N
56	Retail trade-apparel and accessories	N	N[2]	Y[2]	Y	A	B	N
57	Retail trade-furniture, home furnishings and equipment	N	N[2]	Y[2]	Y	A	B	N
58	Retail trade-eating and drinking establishments	N	N	N[2]	Y	A	B	N
59	Other retail trade	N	N[2]	Y[2]	Y	A	B	N
60	**Services**							
61	Finance, insurance and real estate services	N	N	Y[6]	Y	A	B	N
62	Personal services	N	N	Y[6]	Y	A	B	N
62.4	Cemeteries	N	Y[7]	Y[7]	Y	Y[12]	Y[13]	Y[14,21]
63	Business services	N	Y[8]	Y[8]	Y	A	B	N
64	Repair services	N	Y[2]	Y	Y	Y[12]	Y[13]	Y[14]
65	Professional services	N	N	Y[6]	Y	A	B	N
65.1	Hospitals, nursing homes	N	N	N	A*	B*	N	N
65.1	Other medical facilities	N	N	N	Y	A	B	N
66	Contract construction services	N	Y[6]	Y	Y	A	B	N
67	Governmental services	N	N	Y[6]	Y*	A*	B*	N

Table 4.3 Land Use Compatibility Guidelines *(...continued)*

Land Use		Accident Potential Zones			Noise Zones			
SLUCM No.	**Name**	**Clear Zone**	**APZ I**	**APZ II**	**65-69**	**70-74**	**75-79**	**80+**
68	Educational services	N	N	N	A*	B*	N	N
69	Miscellaneous services	N	N[2]	Y[2]	Y	A	B	N
70	**Cultural, Entertainment and Recreational**							
71	Cultural activities (including churches)	N	N	N[2]	A*	B*	N	N
71.2	Nature exhibits	N	Y[2]	Y	Y*	N	N	N
72	Public assembly	N	N	N	Y	N	N	N
72.1	Auditoriums, concert halls	N	N	N	A	B	N	N
72.11	Outdoor music shell, amphitheaters	N	N	N	N	N	N	N
72.2	Outdoor sports arenas, spectator sports	N	N	N	Y[17]	Y[17]	N	N
73	Amusements	N	N	Y[8]	Y	Y	N	N
74	Recreational activities (including golf courses, riding stables, water recreation)	N	Y[8,9,10]	Y	Y*	A*	B*	N
75	Resorts and group camps	N	N	N	Y*	Y*	N	N
76	Parks	N	Y[8]	Y[8]	Y*	Y*	N	N
79	Other cultural, entertainment and recreation	N	Y[9]	Y[9]	Y*	Y*	N	N
80	**Resources Production and Extraction**							
81	Agriculture (except livestock)	Y[16]	Y	Y	Y[18]	Y[19]	Y[20]	Y[20,21]
81.5 to 81.7	Livestock farming and animal breeding	N	Y	Y	Y[18]	Y[19]	Y[20]	Y[20,21]
82	Agricultural related activities	N	Y[5]	Y	Y[18]	Y[19]	N	N
83	Forestry activities and related services	N[5]	Y	Y	Y[18]	Y[19]	Y[20]	Y[20,21]
84	Fishing activities and related services	N[5]	Y[5]	Y	Y	Y	Y	Y
85	Mining activities and related services	N	Y[5]	Y	Y	Y	Y	Y
89	Other resources production and extraction	N	Y[5]	Y	Y	Y	Y	Y

LEGEND

SLUCM - Standard Land Use Coding Manual, U.S. Department of Transportation.

Y - (Yes) - Land use and related structures are compatible without restriction.

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

Y[x] - (yes with restrictions) - Land use and related structures generally compatible; see notes 1-21.

N* - (no with exceptions) - See notes 1-21.

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

A, B, or C - Land use and related structures generally compatible; measures to achieve NLR of A (DNL 25 dB), B (DNL 30 dB), or C (DNL 35 dB) need to be incorporated into the design and construction of structures.

A*, B*, and C* - Land use generally compatible with NLR. However, measures to achieve an overall noise level reduction do not necessarily solve noise difficulties and additional evaluation is warranted. See appropriate footnotes.

* - The designation of these uses as "compatible" in this zone reflects individual federal agency and program 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.

NOTES

1. Suggested maximum density of 1-2 dwelling units per acre possibly increased under a Planned Unit Development where maximum lot coverage is less than 20 percent.
2. Within each land use category, uses exist where further definition may be needed due to the variation of densities in people and structures. Shopping malls and shopping centers are considered incompatible in any accident potential zone (CZ, APZ I, or APZ II).
3. The placing of structures, buildings, or aboveground utility lines in the clear zone is subject to severe restrictions. In a majority of the clear zones, these items are prohibited. See AFI 32-7063 and UFC 3-260-01 for specific guidance.
4. No passenger terminals and no major aboveground transmission lines in APZ I.
5. Factors to be considered: labor intensity, structural coverage, explosive characteristics, and air pollution.
6. Low-intensity office uses only. Meeting places, auditoriums, etc., are not recommended.
7. Excludes chapels.
8. Facilities must be low intensity.
9. Clubhouse not recommended.
10. Areas for gatherings of people are not recommended.

11A. Although local conditions may require residential use, it is discouraged in DNL 65-69 dB and strongly discouraged in DNL 70-74 dB. An evaluation should be conducted prior to approvals, indicating a demonstrated community need for residential use would not be met if development were prohibited in these zones, and there are no viable alternative locations.

11B. Where the community determines the residential uses must be allowed, measures to achieve outdoor to indoor NLR for DNL 65-69 dB and DNL 70-74 dB should be incorporated into building codes and considered in individual approvals.

11C. NLR criteria will not eliminate outdoor noise problems. However, building location and site planning, and design and use of berms and barriers can help mitigate outdoor exposure, particularly from near ground level sources. Measures that reduce outdoor noise should be used whenever practical in preference to measures which only protect interior spaces.

12. Measures to achieve the same NLR as required for facilities in the DNL 65-69 dB range 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.
13. Measures to achieve the same NLR as required for facilities in the DNL 70-74 dB range 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.
14. Measures to achieve the same NLR as required for facilities in the DNL 75-79 dB range 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.
15. If noise sensitive, use indicated NLR; if not, the use is compatible.
16. No buildings.
17. Land use is compatible provided special sound reinforcement systems are installed.
18. Residential buildings require the same NLR required for facilities in the DNL 65-69 dB range.
19. Residential buildings require the same NLR required for facilities in the DNL 70-74 dB range.
20. Residential buildings are not permitted.
21. Land use is not recommended. If the community decides the use is necessary, personnel should wear hearing protection devices.

4.7 PARTICIPATION IN THE PLANNING PROCESS

The Air Force provides the AICUZ Study to local communities to assist them in preparing their local land use plans. This section discusses how the base participates in the community planning process. Section 6.3 addresses the role played by the local community in enhancing compatible land use.

Airspace obstructions, construction in the APZs, residential development, and the construction of other noise-sensitive uses near the base are of great concern to Eglin AFB. The Air Force is very interested in minimizing increases in incompatible usage and in encouraging voluntary conversion of non-compatible usage to compatible usage. Applying the categories for compatible land use described in Table 4.3, the Base evaluates the impact aircraft operations have on surrounding properties and the effect new development or changes in land use might have on Eglin AFB operational capabilities.

In addition to working with local governing entities and planning professionals, the Eglin AFB Base Public Affairs Office works to address complaints and concerns expressed by off-airfield neighbors.

Eglin AFB conducts active outreach to the community by meeting with various community groups and speaking with individuals as needed. The Eglin AFB Civil Engineer and Public Affairs Offices work together providing public meetings and informational workshops to disseminate information about base operations, forecasts, plans, and mitigation strategies.

The Eglin Encroachment Committee is the focus of community efforts to use portions of Eglin AFB land for various reasons such as parks, public roads, cellular antennas, cemeteries, and large tracts where wastewater can be disposed of. Portions of Eglin AFB also are used for hunting, fishing and other outdoor sports.

The Encroachment Committee oversees and approves the non-military use of Eglin' AFB's 724 square miles in Okaloosa, Walton, and Santa Rosa counties. The committee only takes requests for land use from elected officials and then examines them in detail to make sure that: they don't impair the Air Force's mission; they don't harm Eglin AFB's environment; and there is no private land available for the purpose. The Encroachment Committee also is the base's primary point of contact in the local planning process in that the committee reviews and comments on proposed land use or zoning requests from the community.

SECTION 5
LAND USE ANALYSIS

5.1 INTRODUCTION

Land use planning and control is a dynamic, rather than a static process. The specific characteristics of land use determinants will always reflect, to some degree, the changing conditions of the economic, social, and physical environment of a community, as well as changing public concern. The planning process accommodates this fluidity in which decisions are normally not based on boundary lines, but rather on more generalized area designations.

Eglin AFB was originally established in a relatively undeveloped area in Okaloosa County, Florida. In recent years, however, development has increased northeast of the base, particularly in Valparaiso and Niceville.

Improvements in computer technology have enabled the Air Force to more precisely display its flight tracks and noise contours for land use planning purposes. These technical improvements reveal the extent of the Eglin AFB region of influence into the counties and surrounding nearby cities and towns.

For the purpose of this Study, existing and future land uses on the figures in this section are generalized into one of the following six categories:

Residential: This category includes all types of residential activity, such as single and multi-family residences and mobile homes, at a density greater than one dwelling unit per acre.

Commercial: This category includes offices, retail, restaurants and other types of commercial establishments.

Industrial: This category includes manufacturing, warehousing, and other similar uses.

Public/Quasi-Public: This category includes publicly owned lands and/or land to which the public has access, including military reservations and training grounds, public buildings, schools, churches, cemeteries, and hospitals.

Recreational: This category includes land areas designated for recreational activity including parks, wilderness areas and reservations, conservation areas, and areas designated for trails, hikes, camping, etc.

Open/Agricultural/Low Density: This category includes undeveloped land areas, agricultural areas, grazing lands and areas with residential activity at densities less than or equal to one dwelling unit per acre.

5.2 EXISTING LAND USE

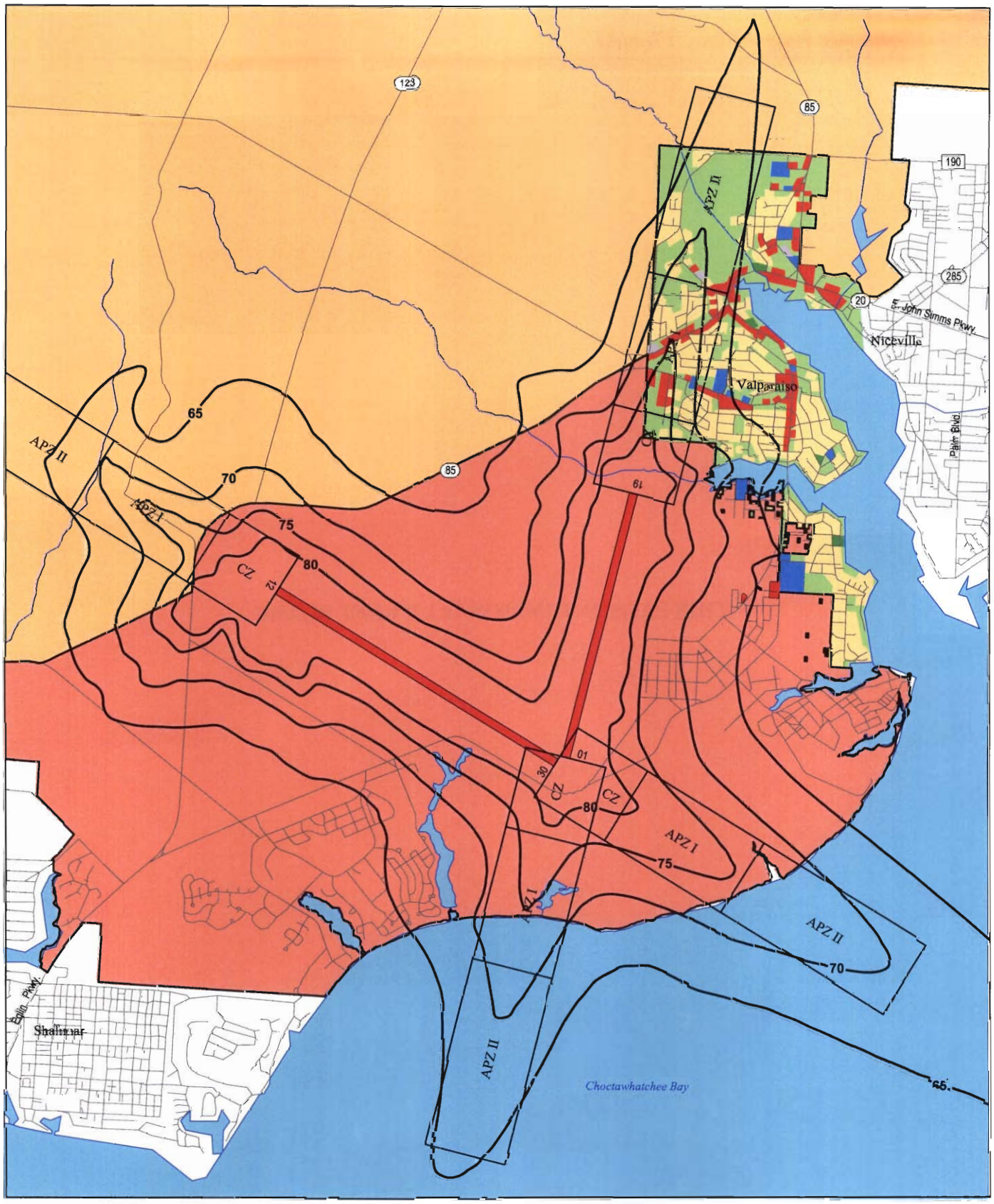
Existing land uses in the vicinity of Eglin AFB are shown in Figure 5.1. Land within the base environs falls within the cities of Valparaiso and Niceville, and unincorporated areas of Okaloosa County. Eglin AFB airfield activities primarily affect non-military land to the east; these areas include cities of Valparaiso and Niceville. The majority of the land surrounding the base can be characterized as moderate-density urban developed, with areas of undeveloped land north of the installation. Per Air Force Compatibility Guidance, residential development of less than one unit per acre is classified as open/agricultural/low density on Figure 5.1.

The majority of off-base development is located to the northeast of Eglin AFB. Directly east of the base lies the City of Valparaiso, comprised of a diverse mix of moderate density land uses. Single Family residential uses exist in small pockets throughout Valparaiso and in the extreme northwest corner of Niceville. Strip commercial uses are prevalent along John Simms Parkway (Highway 20), Valparaiso Parkway (Highway 190), and along Government Avenue (Highway 85) Mixed uses consisting of medium and high density residential, public, and commercial uses exist on either side of South John Simms Parkway and State Road 85 north of West John Simms Parkway to West College Blvd. Land uses in the triangle formed by Government Ave., Valparaiso Parkway, and North John Simms Parkway are also mixed use, with significant intermixed areas of Public uses including schools and churches.

Figure 5.1 presents the existing land uses for the area that surrounds Eglin AFB and within the DNL 65 dB and greater noise exposure area. Table 5.1 summarizes the acreage by land use category exposed to noise levels of DNL 65 dB and greater. Note that these acreages represent only the area outside the Eglin AFB boundaries.

Table 5.1 Generalized Existing Land Use Within DNL 65 dB and Greater Noise Exposure Area (Off Installation)

Category	Acreage
Residential	287
Commercial	68
Industrial	4
Public/Quasi-public	17
Recreational	0
Open/Agricultural/Low Density	455
Total	**831**



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Eglin Air Force Base **2006 AICUZ Study**

LEGEND

- Residential
- Commercial
- Industrial
- Recreational
- Open/Agriculture/Low Density
- Public/Quasi-Public
- Eglin AFB Airfield
- Eglin AFB
- DNL Contours
- Runway
- Roadway

N

0 5,000 Feet

General Existing Land Use

Figure 5.1

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The analysis also includes land use within the Eglin AFB CZs and APZs. Inclusion of the CZs and APZs in the evaluation shows 191 acres of residential land within the Eglin AFB CZs and APZs. Table 5.2 reflects the land use (outside the Eglin AFB boundaries) within the Eglin AFB CZs and APZs.

Table 5.2 Generalized Existing Land Use Within the Eglin AFB Clear Zones and Accident Potential Zones (Off-Installation)

Category	Acreage
Residential	191
Commercial	49
Industrial	4
Public/Quasi-public	2
Recreational/Open/Agricultural/Low Density	395
Total	**641**

5.3 CURRENT ZONING

Figure 5.2 overlays the 2006 noise contours and APZs on a map displaying the current generalized zoning in the vicinity of Eglin AFB. As described in the preceding existing land use section, the area of influence includes cities of Valparaiso and Niceville. All of the off-installation land adjacent to Eglin AFB is zoned. The zoning classifications identified on Figure 5.2 have been generalized for AICUZ planning purposes.

Local governments and planning agencies have developed a strong working relationship with Eglin AFB concerning development planning. Okaloosa County and the cities of Valparaiso and Niceville have taken steps to incorporate the mission of Eglin AFB by adopting land use plans and zoning controls that limit encroachment into the flight paths and affect operations of the airfield.

Zoning within the AICUZ area of influence generally reflects existing land use patterns. The vast majority of land in the Eglin AFB environs is zoned for various densities of residential uses. Commercially zoned land exists along the major corridors of Government Ave. and John Simms Parkway in Valparaiso and State Road 85 in Niceville. Land along Boggy Bayou, shoreline east of John Simms Parkway, is zoned as a Conservation District. Zoning has also been incorporated to protect the CZ and APZ, with industrial and commercial being the primary zoning classification.

Local jurisdictions recognize the importance of maintaining the capability of Eglin AFB by protecting it from urban encroachment. Continued maintenance of the land use restrictions currently in place will ensure the viability of Eglin AFB while helping to inform the owners of affected properties of the land use restrictions.

Analysis of the current zoning maps for these jurisdictions was performed to determine the acreage of each zoning designation within the DNL 65 dB and greater noise area. For this analysis, zoning designations were generalized into residential, commercial, industrial, public/quasi-public, and recreational/open/agricultural/low density categories. Figure 5.2 shows the results of the compilation, and Table 5.3 provides a breakdown of the generalized zoning (areas outside Eglin AFB only and outside CZs and APZs) within the DNL 65 dB and greater noise area.

Table 5.3 Generalized Zoning Within DNL 65 dB and Greater Noise Exposure Area (Off-Installation outside CZs and APZs)

Category	Acreage
Residential	123
Commercial	27
Industrial	0
Public/Quasi-public	20
Recreational/Open/Agricultural/Low Density	26
Total	**196**

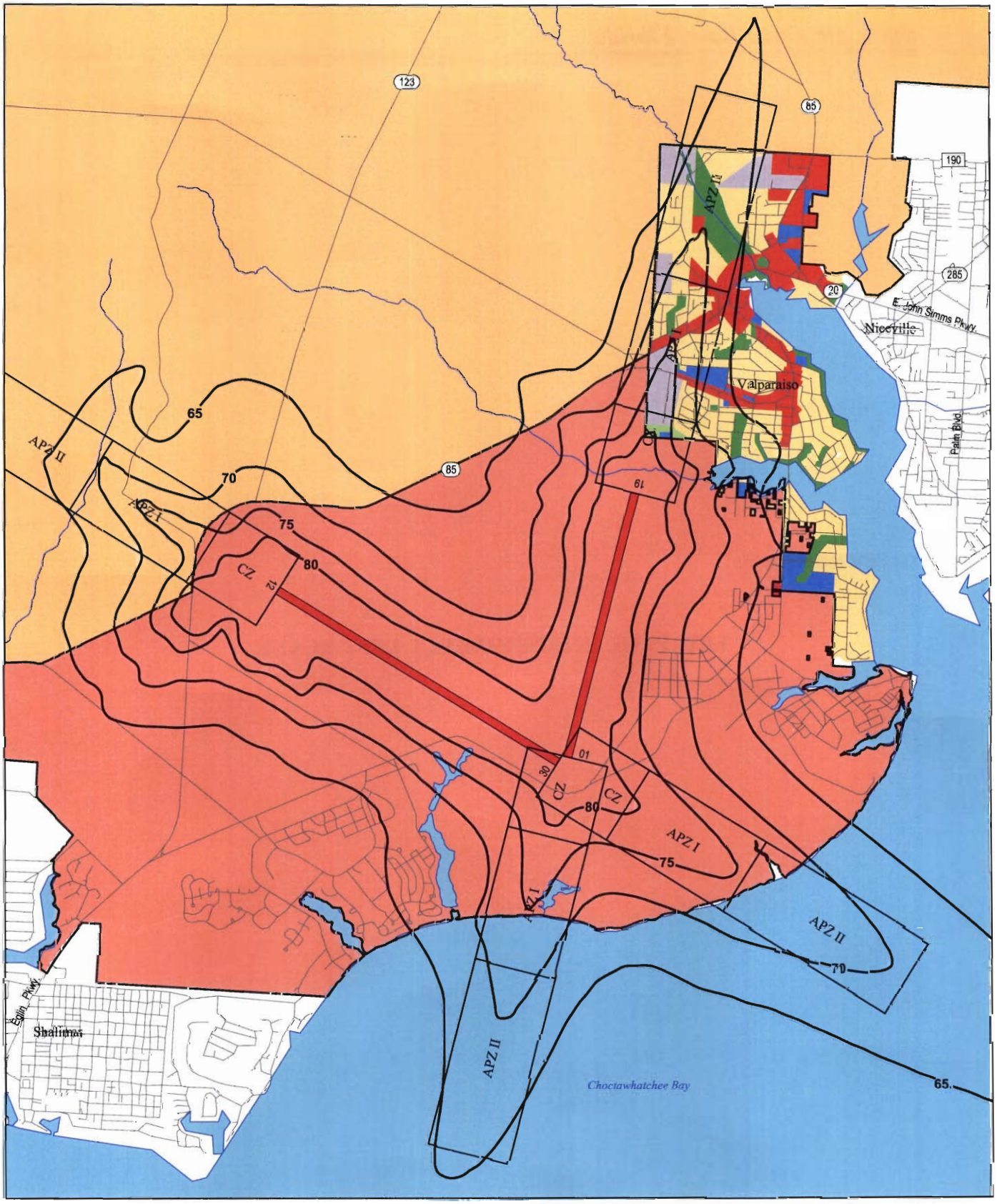
Source: City of Valparaiso Zoning Map
City of Niceville Zoning Map

A similar analysis was performed to determine the acreage of each generalized zoning category within the Eglin AFB CZs and APZs and is shown on Table 5.4.

Table 5.4 Generalized Zoning Within the Eglin AFB Clear Zones and Accident Potential Zones (Off-Installation)

Category	Acreage
Residential	326
Commercial	72
Industrial	136
Public/Quasi-public	12
Recreational/Open/Agricultural/Low Density	90
Total	**636**

Source: City of Valparaiso Zoning Map
City of Niceville Zoning Map



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Eglin Air Force Base — **2006 AICUZ Study**

LEGEND

- Residential
- Commercial
- Industrial
- Recreational
- Open/Agriculture/Low Density
- Public/Quasi-Public
- Eglin AFB Airfield
- Eglin AFB
- Municipal Boundary
- DNL Contours
- Runway
- Roadway

N

0 5,000 Feet

Generalized Zoning

Figure 5.2

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5.4 FUTURE LAND USE

Figure 5.3 shows generalized future land use predicted for the Eglin AFB area which mirror local zoning maps, comprehensive plans, and local development proposals. The following paragraphs discuss the anticipated future land use patterns.

The developed areas within the City of Valparaiso will maintain their mixture of residential, commercial, and public uses. Any development in these areas is expected to consist of infill and redevelopment. Consequently, future land use patterns east of the installation will reflect existing land use patterns. Continued commercial development is anticipated to occur along the major corridors of Government Ave. and John Simms Parkway in Valparaiso and State Road 85 in Niceville. Zoning has also been incorporated to protect the CZ and APZ, with industrial and commercial being the primary zoning classification. Planned industrial uses are targeted for the north and south side of Government Ave. near the southern boundary of Runway 19 APZ I.

The land use planning and zoning enacted by Okaloosa County and the cities of Valparaiso and Niceville ensure that significant land use incompatibilities in the Eglin AFB area of influence will be avoided in the future. The positive relationship among Eglin AFB, Valparaiso, Niceville, and Okaloosa County will continue to minimize the expansion of undeveloped areas surrounding the installation.

5.5 INCOMPATIBLE LAND USES

Table 4.3 shows land use compatibility as it is applied to existing land use within the Eglin AFB area of influence. For a land use area to be considered compatible, it must meet criteria for its category for both noise and accident potential as shown in Table 4.3. The compatibility guidelines shown in Table 4.3 were combined with the existing land use data presented on Figure 5.1 to determine land use compatibility associated with aircraft noise and the accident potential zones at Eglin AFB. Results of this analysis are shown numerically in Table 5.5 and graphically on Figure 5.4. There are land uses to the northeast of Eglin AFB that are considered to be incompatible with base operations.

Table 5.5 Incompatible Land Use for Runways 01/19 and 12/30 at Eglin AFB

Category	Acreage Within CZs and APZs			Acreage Within Noise Zones, Not Included in CZs and APZs				Total
	CLEAR ZONE	APZ I	APZ II	65-69	70-74	75-79	80+	
Residential	6	128	•	•	•	•	•	**134**
Commercial	•	43	•	•	•	•	•	**43**
Industrial	•	•	•	•	•	•	•	**0**
Public/Quasi-public	•	2	•	•	•	•	•	**2**

Table 5.5 Incompatible Land Use for Runways 01/19 and 12/30 at Eglin AFB
(...continued)

Category	Acreage Within CZs and APZs			Acreage Within Noise Zones, Not Included in CZs and APZs				Total
	CLEAR ZONE	APZ I	APZ II	65-69	70-74	75-79	80+	
Recreation/Open/ Agricultural/Low Density	•	•	•	•	•	•	•	0
Total	**6**	**173**	**0**	**0**	**0**	**0**	**0**	**179**

• Represents compatible land use

5.5.1 Runways 01 and 19 Clear Zones and Accident Potential Zones

5.5.1.1 Runway 01 Clear Zone (South of the Airfield)

All of the land within the CZ occurs within Eglin AFB. There are no incompatible land uses associated with the Runway 01 CZ.

5.5.1.2 Runway 01 Accident Potential Zone I (South of the Airfield)

All of the land within APZ I occurs within Eglin AFB property or Choctawhatchee Bay. There are no incompatible land uses associated with the Runway 01 APZ I.

5.5.1.3 Runway 01 Accident Potential Zone II (South of the Airfield)

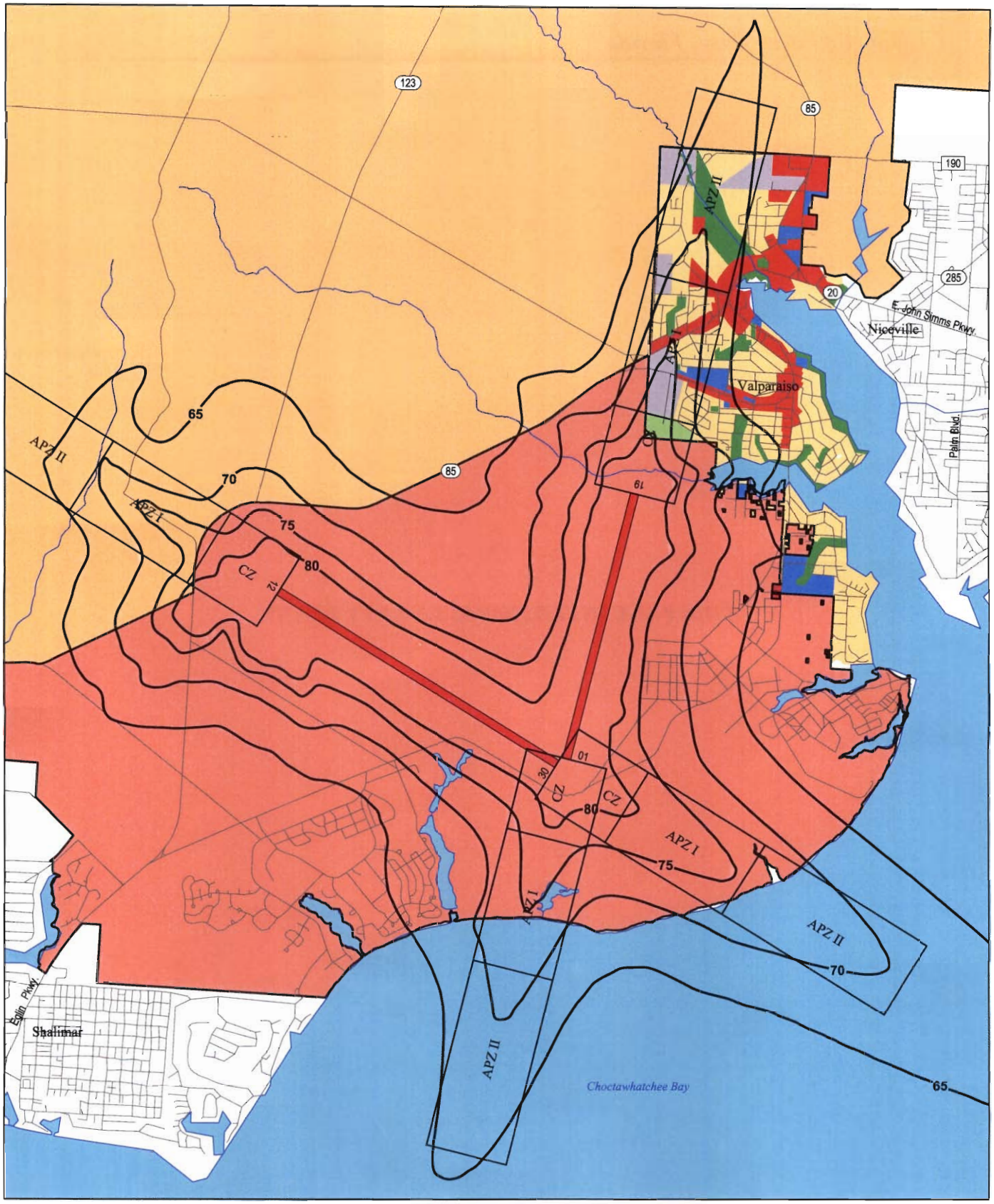
All of the land within APZ II occurs within Choctawhatchee Bay. There are no incompatible land uses associated with the Runway 01 APZ II.

5.5.1.4 Runway 19 Clear Zone (North of the Airfield)

Eglin AFB owns approximately 178 acres of the Runway 19 CZ. This discussion applies to that portion of the CZ outside the installation's boundaries. Any land uses other than vacant or agricultural are incompatible with the safety criteria established for a CZ. Two small areas of residential land use occur in the CZ. One area is in the north central portion of the CZ and the other is a small wedge of residential land at the northeastern corner of the CZ. All remaining land within the CZ is open space and is compatible with Air Force planning criteria.

5.5.1.5 Runway 19 Accident Potential Zone I (North of the Airfield)

In general, industrial, recreational, vacant, and agricultural/open land uses are compatible with the safety criteria established for APZ I. Compatibility of commercial uses within APZ I is dependent on densities and intensity of uses. A large area of medium-density residential development exists in APZ I east Wolverine Ave. and south of Government Ave. Two churches are also incompatibly located within APZ I along Valparaiso Parkway.



Eglin Air Force Base **2006 AICUZ Study**

LEGEND

- Residential
- Commercial
- Industrial
- Recreational
- Open/Agriculture/Low Density
- Public/Quasi-Public
- Eglin AFB Airfield
- Eglin AFB
- Municipal Boundary
- DNL Contours
- Runway
- Roadway

N

0 5,000 Feet

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General Future Land Use

Figure 5.3

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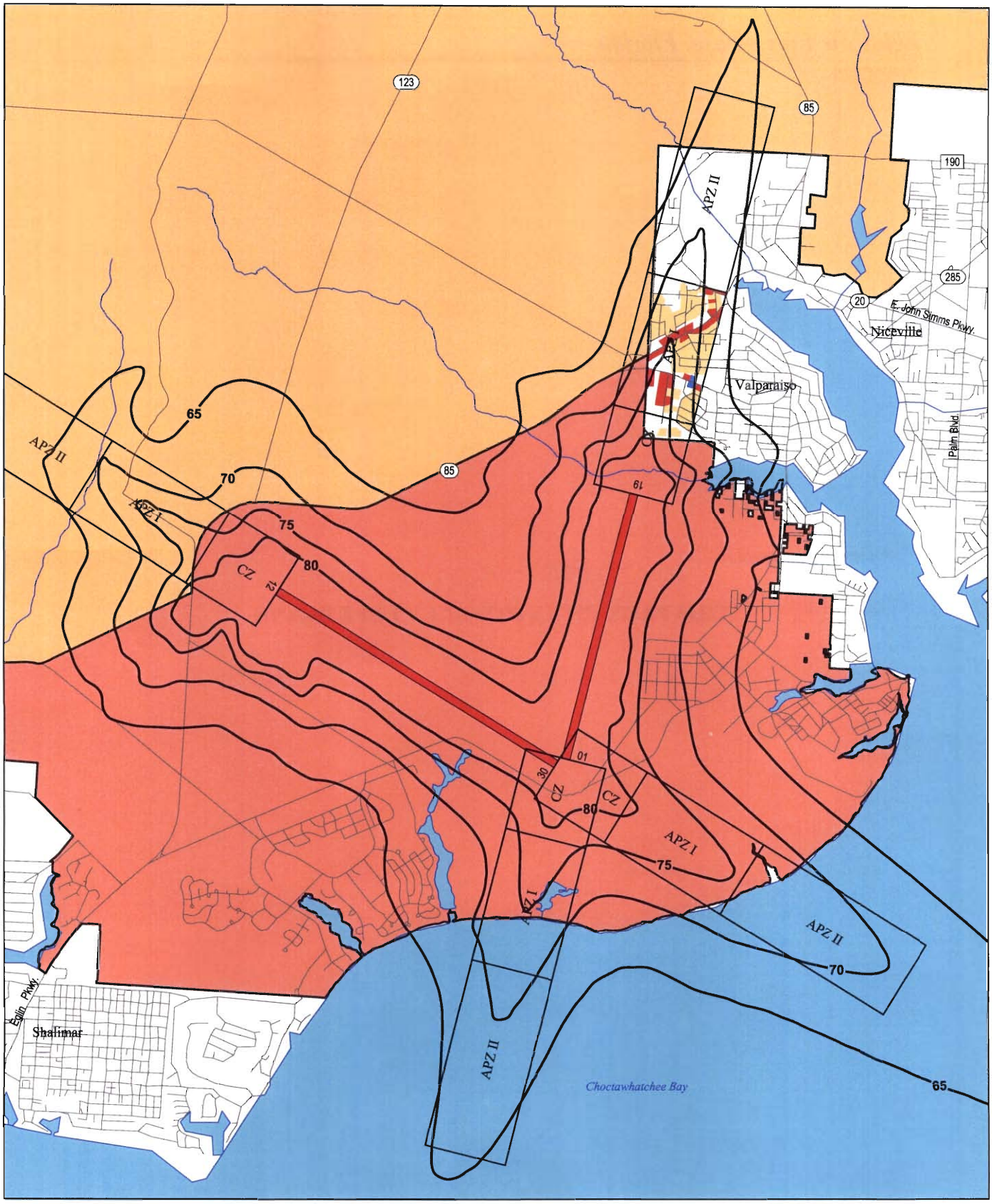

Eglin Air Force Base **2006 AICUZ Study**

LEGEND

- Residential
- Commercial
- Public/Quasi-Public
- Eglin AFB Airfield
- Eglin AFB
- DNL Contours
- Runway
- Roadway

N

0 5,000 Feet

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Incompatible Land Use

Figure 5.4

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5.5.1.6 Runway 19 Accident Potential Zone II (North of the Airfield)

Most categories of land use are compatible with the safety criteria established for APZ II with the exception of public/quasi-public and some densities of residential. If residential densities are greater than one dwelling unit per acre, these land uses would be incompatible. The low-density residential uses located within APZ II are developed at a density of one dwelling unit per acre and is consequently classified as compatible with AICUZ planning criteria. There are no incompatible land uses associated with the Runway 19 APZ II.

5.5.2 Runways 12 and 30 Clear Zones and Accident Potential Zones

5.5.2.1 Runway 12 Clear Zone (Northwest of the Airfield)

All of the land within the CZ occurs within Eglin AFB. There are no incompatible land uses associated with the Runway 12 CZ.

5.5.2.2 Runway 12 Accident Potential Zone I (Northwest of the Airfield)

All of the land within APZ I occurs within Eglin AFB property. There are no incompatible land uses associated with the Runway 12 APZ I.

5.5.2.3 Runway 12 Accident Potential Zone II (Northwest of the Airfield)

All of the land within APZ II occurs within Eglin AFB property. There are no incompatible land uses associated with the Runway 12 APZ II.

5.5.2.4 Runway 30 Clear Zone (Southeast of the Airfield)

All of the land within the CZ occurs within Eglin AFB. There are no incompatible land uses associated with the Runway 30 CZ.

5.5.2.5 Runway 30 Accident Potential Zone I (Southeast of the Airfield)

All of the land within APZ I occurs within Eglin AFB property or Choctawhatchee Bay. There are no incompatible land uses associated with the Runway 30 APZ I.

5.5.2.6 Runway 30 Accident Potential Zone II (Southeast of the Airfield)

All of the land within APZ II occurs within Choctawhatchee Bay. There are no incompatible land uses associated with the Runway 30 APZ II.

5.6 NOISE ZONES

At noise levels between DNL 65-69 dB, the only incompatible land use type is residential without NLR materials. Residential uses without NLR materials do not exist within the DNL 65-69 dB noise contours near Eglin AFB. Homes that have the recommended NLR measures incorporated into their construction are considered compatible.

5.7 AIR INSTALLATION COMPATIBLE USE ZONE STUDY UPDATES

AICUZ noise contours describe the noise characteristics of a specific operational environment, and as such, will change if a significant operational change is made. An AICUZ Study should be evaluated for an update if the noise exposure map changes by DNL 2 dB or more in noise sensitive areas from the noise contour map in the last publicly released AICUZ Study. With this in mind, this AICUZ Study updates the 1977 AICUZ Study and provides flight track, accident potential zone and noise zone information in this report which reflects the most accurate picture of the installation's aircraft activities as of June 2005.

SECTION 6
IMPLEMENTATION

6.1 INTRODUCTION

Implementation of the AICUZ Study must be a joint effort between the Air Force and adjacent communities. The role of the Air Force is to minimize impact on the local communities by Eglin AFB aircraft operations. The role of the communities is to ensure that development in the surrounding area is compatible with accepted planning and development principles and practices.

6.2 AIR FORCE RESPONSIBILITIES

In general, the Air Force perceives its AICUZ responsibilities as encompassing the areas of flying safety, noise abatement, and participation in the land use planning process.

Well-maintained aircraft and well-trained aircrews do a great deal to assure that aircraft accidents are avoided. Despite the best aircrew training and aircraft maintenance intentions, however, history clearly shows that accidents do occur. It is imperative flights be routed over sparsely populated areas as regularly as possible to reduce the exposure of lives and property to a potential accident.

Commanders are required by Air Force policy to periodically review existing traffic patterns, instrument approaches, weather minima, and operating practices, and evaluate these factors in relationship to populated areas and other local situations. This requirement is a direct result and expression of Air Force policy that all AICUZ plans must include an analysis of flying and flying-related activities designed to reduce and control the effects of such operations on surrounding land areas. Noise is generated from aircraft both in the air and on the ground. In an effort to reduce the noise effects of Eglin AFB operations on surrounding communities, the installation routes flight tracks to avoid populated areas.

Preparation and presentation of this Eglin AFB AICUZ Study is one phase of continuing Air Force participation in the local planning process. It is recognized that as the local community updates its land use plans, the Air Force must be ready to provide additional input when needed.

It is also recognized that the AICUZ program is an ongoing activity even after compatible development plans are adopted and implemented. Eglin AFB personnel are prepared to participate in the continuing discussion of zoning and other land use matters as they may affect, or may be affected by the Base. Base personnel also are available to provide information, criteria, and guidelines to state, regional, and local planning bodies, civic associations, and similar groups.

Participation in land-use planning can take many forms. The simplest of these forms is straightforward, consistent two-way discussion and information sharing with both professionals and neighbors. Copies of the AICUZ Study, including maps, will be provided

to regional planning departments and zoning administrators. Through this communication process, the Base reviews applications for development or changed use of properties within the noise impact and safety areas, as well as other nearby parcels. The Base coordinates closely with surrounding communities and counties on zoning and land-use issues.

6.3 LOCAL COMMUNITY RESPONSIBILITIES

Residents in the area neighboring Eglin AFB and Base personnel have a long history of working together for mutual benefit of the area around the airfield. Local jurisdictions have taken a proactive approach in incorporating land use regulations into local plans and ordinances which consider the Eglin AFB flying operations when considering development proposals. Adoption of the following recommendations will strengthen this relationship, increase the health and safety of the public, and help protect the integrity of the installation's flying mission:

- Continue to incorporate AICUZ policies and guidelines into the comprehensive plans of Okaloosa County and the cities of Valparaiso and Niceville. Use overlay maps of the AICUZ noise contours and Air Force Land Use Compatibility Guidelines to evaluate existing and future land use proposals.
- Modify existing zoning ordinances and subdivision regulations to support the compatible land uses outlined in this study.
- Modify building codes to ensure new construction within the AICUZ area has the recommended noise level reductions incorporated into its design and construction.
- Implement height and obstruction ordinances which reflect current Air Force and FAR Part 77 requirements.
- Keep the DoD Office of Economic Adjustment apprised of any development near Eglin AFB that may impact the program for Joint Land Use Studies.
- Continue to inform Eglin AFB of planning and zoning actions that have the potential of affecting base operations. Develop a working group representing city, county, and base planners to meet periodically to discuss AICUZ concerns and major development proposals that could affect airfield operations.

Appendix A

THE AICUZ CONCEPT, PROGRAM, METHODOLOGY, AND POLICIES

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THE AICUZ CONCEPT, PROGRAM, METHODOLOGY, AND POLICIES

A.1 Concept

Federal legislation, national sentiment, and other external forces, which directly affect the Air Force mission, serve greatly to increase the role of the Air Force in environmental and planning issues. Problems of airfield encroachment from incompatible land uses surrounding installations, as well as air and water pollution and socioeconomic impact, require continued and intensified Air Force involvement. The nature of these problems dictates direct Air Force participation in comprehensive community and land use planning. Effective, coordinated planning that bridges the gap between the federal government and the community requires establishment of good working relationships with local citizens, local planning officials, and state and federal officials. This depends on creating an atmosphere of mutual trust and helpfulness. The AICUZ concept has been developed in an effort to:

- protect local citizens from noise exposure and accident potential associated with flying activities; and
- prevent degradation of the capability of the Air Force to achieve its mission by promoting compatible land use planning.

The land use guidelines developed herein are a composite of a number of other land use compatibility studies that have been refined to fit the Eglin AFB aviation environment.

A.2 Program

Installation commanders establish and maintain active programs to promote the maximum feasible land use compatibility between air installations and neighboring communities. The program requires that all appropriate government bodies and citizens be fully informed whenever AICUZ or other planning matters affecting the installation are under consideration. This includes positive and continuous programs designed to:

- provide information, criteria, and guidelines to federal, state, regional, and local planning bodies, civic associations, and similar groups;
- inform such groups of the requirements of the flying activity, noise exposure, aircraft accident potential, and AICUZ plans;
- describe the noise reduction measures that are being used; and
- ensure that all reasonable, economical, and practical measures are taken to reduce or control the impact of noise-producing activities. These measures include such considerations as proper location of engine test facilities, provision of sound suppressors where necessary, and adjustment of flight patterns and/or techniques to minimize the noise impact on populated areas. This must be done without jeopardizing safety or operational effectiveness.

A.3 Methodology

The AICUZ consists of land areas upon which certain land uses may obstruct the airspace or otherwise be hazardous to aircraft operations, and land areas that are exposed to the health, safety, or welfare hazards of aircraft operations. The AICUZ includes:

- Accident Potential Zones (APZ) and Clear Zones (CZ) based on past Air Force aircraft accidents and installation operational data (see Appendix B);
- Noise zones (NZ) produced by the computerized DNL modeling of the noise created by aircraft flight and maintenance operations (see Appendix C); and
- The area designated by the FAA and the Air Force for purposes of height limitations in the approach and departure zones of the base (see Section 4 of the Study).

The APZ, CZ, and NZ are the basic building blocks for land use planning with AICUZ data. Compatible land uses are specified for these zones, and recommendations on building materials and standards to reduce interior noise levels inside structures are provided in Section 7.

As part of the AICUZ Program, the only real property acquisition for which the Air Force has requested and received Congressional authorization, and for which the installation and major commands request appropriation, are the areas designated as the CZ. Eglin AFB does not own all property in the CZs. Compatible land use controls for the remaining airfield area of influence should be accomplished through the community land use planning processes.

A.4 AICUZ Land Use Development Policies

The basis for any effective land use control system is the development of, and subsequent adherence to, policies which serve as the standard by which all land use planning and control actions are evaluated. Eglin AFB recommends the following policies be considered for incorporation into the comprehensive plans of agencies in the vicinity of the Base's area of influence:

A.4.1 Policy 1

To promote the public health, safety, peace, comfort, convenience, and general welfare of the inhabitants in the airfield area of influence, it is necessary to:

- guide, control, and regulate future growth and development;
- promote orderly and appropriate use of land;
- protect the character and stability of existing land uses;
- prevent destruction or impairment of the airfield and the public investment therein;
- enhance the quality of living in the areas affected; and
- protect the general economic welfare by restricting incompatible land use.

A.4.2 Policy 2

In furtherance of Policy 1, it is appropriate to:

- establish guidelines of land use compatibility;
- restrict or prohibit incompatible land use;
- prevent establishment of any land use which would unreasonably endanger aircraft operations and the continued use of the airfield;
- incorporate the AICUZ concept into community land use plans, modifying them when necessary; and
- adopt appropriate ordinances to implement airfield area of influence land use plans.

A.4.3 Policy 3

Within the boundaries of the CZ, certain land uses are inherently incompatible. The following land uses are not in the public interest and must be restricted or prohibited:

- uses that release into the air any substance, such as steam, dust, or smoke which would impair visibility or otherwise interfere with the operation of aircraft;
- uses that produce light emissions, either direct or indirect (reflective), which would interfere with pilot vision;
- uses that produce electrical emissions which would interfere with aircraft communication systems or navigation equipment;
- uses that attract birds or waterfowl, such as operation of sanitary landfills, maintenance or feeding stations, or growth of certain vegetation; and
- uses that provide for structures within 10 feet of aircraft approach-departure and/or transitional surfaces.

A.4.4 Policy 4

Certain noise levels of varying duration and frequency create hazards to both physical and mental health. A limited, though definite, danger to life exists in certain areas adjacent to airfields. Where these conditions are sufficiently severe, it is not consistent with public health, safety, and welfare to allow the following land uses:

- residential;
- retail business;
- office buildings;
- public buildings (schools, churches, etc.); and
- recreation buildings and structures.

A.4.5 Policy 5

Land areas below takeoff and final approach flight paths are exposed to significant danger of aircraft accidents. The density of development and intensity of use must be limited in such areas.

A.4.6 Policy 6

Different land uses have different sensitivities to noise. Standards of land use acceptability should be adopted, based on these noise sensitivities. In addition, a system of Noise Level Reduction guidelines (Appendix 4) for new construction should be implemented to permit certain uses where they would otherwise be prohibited.

A.4.7 Policy 7

Land use planning and zoning in the airfield area of influence cannot be based solely on aircraft-generated effects. Allocation of land used within the AICUZ should be further refined by consideration of:

- physiographic factors;
- climate and hydrology;
- vegetation;
- surface geology;
- soil characteristics;
- intrinsic land use capabilities and constraints;
- existing land use;
- land ownership patterns and values;
- economic and social demands;
- cost and availability of public utilities, transportation, and community facilities; and
- other noise sources.

A.5 Basic Land Use Compatibility

Research on aircraft accident potential, noise, and land use compatibility is ongoing at a number of federal and other agencies. These and all other compatibility guidelines must not be considered inflexible standards. They are the framework within which land use compatibility questions can be addressed and resolved. In each case, full consideration must be given to local conditions such as:

- previous community experience with aircraft accidents and noise;
- local building construction and development practices;

- existing noise environment due to other urban or transportation noise sources;
- time periods of aircraft operations and land use activities;
- specific site analysis; and
- noise buffers, including topography.

These basic guidelines cannot resolve all land use compatibility questions, but they do offer a reasonable framework within which to work.

A.6 Accident Potential

Each end of Runways 01/19 and 12/30 at Eglin AFB has a 3,000 foot by 3,000 foot CZ and two APZs (Section 5). Accident potential on or adjacent to the runway or within a CZ is so high that the necessary land use restrictions would prohibit reasonable economic use of land. As stated previously, it is Air Force policy to request Congress to authorize and appropriate funds for the necessary real property interests in this area to prevent incompatible land uses.

Accident Potential Zone I is less critical than the CZ, but still possesses a significant risk factor. This 3,000 foot by 5,000 foot area has land use compatibility guidelines which are sufficiently flexible to allow reasonable economic use of the land, such as industrial/manufacturing, transportation, communication/utilities, wholesale trade, open space, recreation, and agriculture. However, uses that concentrate people are not acceptable.

Accident Potential Zone II is less critical than APZ I, but still possesses potential for accidents. Accident potential zone II, also 3,000 feet wide, is 7,000 feet long extending to 15,000 feet from the runway threshold. Acceptable uses include those of APZ I, as well as low density single family residential and those personal and business services and commercial/retail trade uses of low intensity or scale of operation. High density functions such as multistory buildings, places of assembly (theaters, churches, schools, restaurants, *etc.*), and high density office uses are not considered appropriate.

High density populations should be limited to the maximum extent possible. The optimum density recommended for residential usage (where it does not conflict with noise criteria) in APZ II is one dwelling per acre. For most nonresidential usage, buildings should be limited to one story, and the lot coverage should not exceed 20 percent.

Land use guidelines for the two APZs are based on a hazard index system that compares the relationship of accident occurrence for five areas:

- on or adjacent to the runway;
- within the CZ;
- in APZ I;
- in APZ II; and

- in all other areas within a 10 nautical mile radius of the runway.

Accident potential on or adjacent to the runway or within the CZ is so high that few uses are acceptable. The risk outside APZ I and APZ II, but within the 10 nautical mile radius area, is significant, but is acceptable if sound engineering and planning practices are followed.

Land use guidelines for APZs I and II have been developed. The main objective has been to restrict all people-intensive uses because there is greater risk in these areas. The basic guidelines aim at prevention of uses that:

- have high residential density characteristics;
- have high labor intensity;
- involve above-ground explosives, fire, toxic, corrosive, or other hazardous characteristics;
- promote population concentrations;
- involve utilities and services required for area-wide population, where disruption would have an adverse impact (telephone, gas, etc.);
- concentrate people who are unable to respond to emergency situations, such as children, elderly, handicapped, etc.; and
- pose hazards to aircraft operations.

There is no question that these guidelines are relative. Ideally, there should be no people-intensive uses in either of these APZs. The free market and private property systems prevent this where there is a demand for land development. To go beyond these guidelines, however, substantially increases risk by placing more people in areas where there may ultimately be an aircraft accident.

A.7 Noise

Nearly all studies analyzing aircraft noise and residential compatibility recommend no residential uses in noise zones above DNL 75 dB. Usually, no restrictions are recommended below noise zone DNL 65 dB. There is currently no consensus between DNL 65-74 dB. These areas may not qualify for federal mortgage insurance in residential categories according to United States Department of Housing and Urban Development (HUD) Regulation 24 CFR 51B. In many cases, HUD approval requires noise attenuation measures, the Regional Administrator's concurrence, and an Environmental Impact Statement. The United States Department of Veterans Affairs also has airfield noise and accident restrictions which apply to its home loan guarantee program. Whenever possible, residential land use should be located below DNL 65 dB according to Air Force land use recommendations. Residential buildings within the DNL 65-70 dB noise contours should contain noise level reduction in accordance with the Air Force land use compatibility guidelines in the AICUZ Study, Table 4.3.

Most industrial/manufacturing uses are compatible in the airfield area of influence. Exceptions are uses such as research or scientific activities that require lower noise levels.

Noise attenuation measures are recommended for portions of buildings devoted to office use, receiving the public, or where the normal background noise level is low.

The transportation, communications, and utilities categories have a high noise level compatibility because they generally are not people-intensive. When people use land for these purposes, the use is generally very short in duration. Where buildings are required for these uses, additional evaluation is warranted.

The commercial/retail trade and personal and business services categories are compatible without restriction up to DNL 70 dB; however, they are generally incompatible above DNL 80 dB. Between DNLs 70-79 dB, noise level reduction measures should be included in the design and construction of buildings.

The nature of most uses in the public and quasi-public services category requires a quieter environment, and attempts should be made to locate these uses below DNL 65 dB (an Air Force land use recommendation), or else provide adequate noise level reduction.

Although recreational use has often been recommended as compatible with high noise levels, recent research has resulted in a more conservative view. Above DNL 75 dB, noise becomes a factor that limits the ability to enjoy such uses. Where the requirement to hear is a function of the use (*e.g.*, music shell, *etc.*), compatibility is limited. Buildings associated with golf courses and similar uses should be noise attenuated.

With the exception of forestry activities and livestock farming, uses in the resources production, extraction, and open space category are compatible almost without restrictions.

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Appendix B

CLEAR ZONES AND ACCIDENT POTENTIAL ZONES

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CLEAR ZONES AND ACCIDENT POTENTIAL ZONES

B.1 Guidelines For Accident Potential

Areas around airports are exposed to the possibility of aircraft accidents even with well-maintained aircraft and highly trained aircrews. Despite stringent maintenance requirements and countless hours of training, history makes it clear that accidents do happen.

When the AICUZ Program began, there were no current comprehensive studies on accident potential. To support the program, the Air Force completed a study of Air Force aircraft accidents that occurred between 1968 and 1972 within 10 nautical miles of airfields. The study of 369 accidents revealed that 75 percent of aircraft accidents occurred on or adjacent to the runway (1,000 feet to each side of the runway centerline) and in a corridor 3,000 feet (1,500 feet either side of the runway centerline) wide, extending from the runway threshold along the extended runway centerline for a distance of 15,000 feet. The Air Force updated these studies and this information is presented later in this section.

The CZ, APZ I, and APZ II were established based on crash patterns. The CZ starts at the end of the runway and extends outward 3,000 feet. It has the highest accident potential of the three zones. The Air Force adopted a policy of acquiring property rights to areas designated as CZs because of the high accident potential. APZ I extends from the CZ an additional 5,000 feet. It includes an area of reduced accident potential. APZ II extends from APZ I an additional 7,000 feet in an area of further reduced accident potential.

Research in accident potential conducted by the Air Force was the first significant effort in this subject area since 1952 when the President's Airport Commission published "The Airport and Its Neighbors," better known as the "Doolittle Report." The recommendations of this earlier report were influential in the formulation of the APZ concept.

The risk to people on the ground being killed or injured by aircraft accidents is small. However, an aircraft accident is a high consequence event, and when a crash does occur, the result is often catastrophic. Because of this, the Air Force does not attempt to base its safety standards on accident probabilities. Instead, the Air Force approaches this safety issue from a land use planning perspective.

B.2 Guidelines For Accident Potential

Military aircraft accidents differ from commercial air carrier and general aviation accidents because of the variety of aircraft used, the type of missions, and the number of training flights. In 1973, the Air Force performed a service-wide aircraft accident hazard study to identify land near airfields with significant accident potential. Accidents studied occurred within 10 nautical miles of airfields.

The study reviewed 369 major Air Force accidents during 1968-1972, and found that 61 percent of those accidents were related to landing operations, and 39 percent were takeoff

related. It also found that 70 percent occurred in daylight, and that fighter and training aircraft accounted for 80 percent of the accidents.

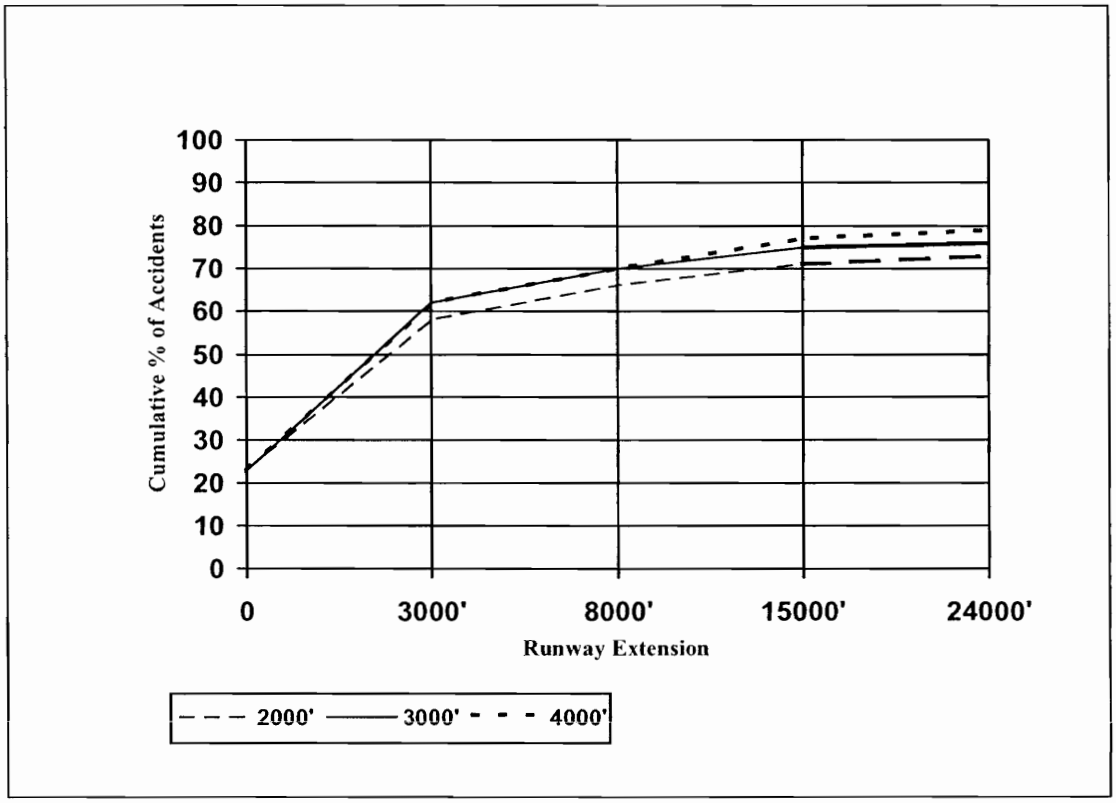
Because the purpose of the study was to identify accident hazards, the study plotted each of the 369 accidents in relation to the airfield. This plotting found that the accidents clustered along the runway and its extended centerline. To further refine this clustering, a tabulation was prepared that described the cumulative frequency of accidents as a function of distance from the runway centerline along the extended centerline. This analysis was done for widths of 2,000, 3,000, and 4,000 total feet. Table B.1 reflects the location analysis.

Table B.1 Location Analysis

	Width of Runway Extension (feet)		
Length From Both Ends of Runway (feet)	**2000**	**3000**	**4000**
Percent of Accidents			
On or Adjacent to Runway (1,000 feet to each side of runway centerline)	23	23	23
0 to 3,000	35	39	39
3,000 to 8,000	8	8	8
8,000 to 15,000	5	5	7
Cumulative Percent of Accidents			
On or Adjacent to Runway (1,000 feet to each side of runway centerline)	23	23	23
0 to 3,000	58	62	62
3,000 to 8,000	66	70	70
8,000 to 15,000	71	75	77

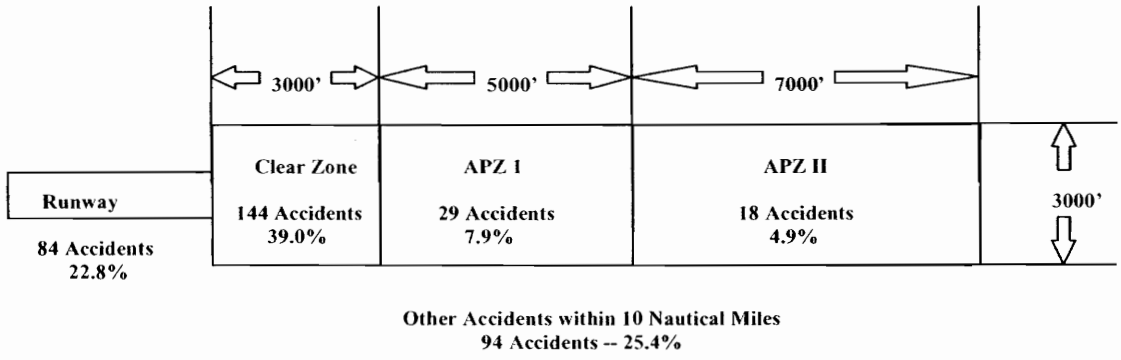
Figure B.1 indicates that the cumulative number of accidents rises rapidly from the end of the runway to 3,000 feet, rises more gradually to 8,000 feet, then continues at about the same rate of increase to 15,000 feet, where it levels off rapidly. The location analysis also indicates 3,000 feet as the optimum runway extension width and the width which includes the maximum percentage of accidents in the smallest area.

Figure B.1 Distribution of Air Force Aircraft Accidents (369 Accidents - 1968 - 1972)



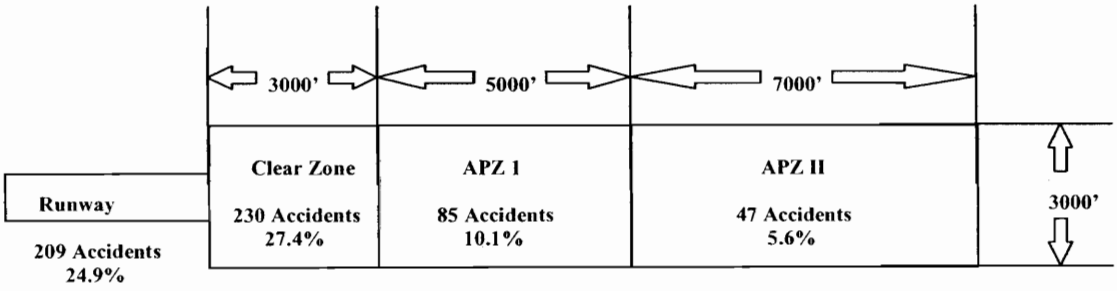
Using the optimum runway extension width, 3,000 feet, and the cumulative distribution of accidents from the end of the runway, zones were established that minimized the land area included and maximized the percentage of accidents included. The zone dimensions and accident statistics for the 1968-1972 study are shown in Figure B.2.

Figure B.2 Air Force Aircraft Accident Data (369 Accidents - 1968 - 1972)



The original study was updated to include accidents through September 1995. This updated study includes 838 accidents during the 1968-1995 period. Using the optimum runway extension width of 3,000 feet, the accident statistics of the updated study are shown in Figure B.3.

Figure B.3 Air Force Aircraft Accident Data (838 Accidents - 1968 - 1995)



Using the designated zones and accident data, it is possible to calculate a ratio of percentage of accidents to percentage of area size. These ratios indicate the CZ, with the smallest area size and the highest number of accidents, has the highest ratio, followed by the runway and adjacent area, APZ I, and then APZ II. Table B.2 reflects this data.

Table B.2 Accident to Area Ratio

Ratio of Percentage of Accidents to Percentage of Area

(Air Force Accident Data 1968 - 1995)

	Area[1] (Acres)	Number[2] Accident	Accident Per Acre	Percent of Total Area	Percent of Total Accidents	Ratio:[3] % Accidents to % Area
Runway Area	487	209	1 Per 2.3 acres	0.183	24.9	136
Clear Zone	413	230	1 Per 1.8 acres	0.155	27.4	177
APZ I	689	85	1 Per 8.1 acres	0.258	10.1	39
APZ II	964	47	1 Per 20.5 acres	0.362	5.6	16
Other Area	264,053	267	1 Per 989 acres	99.042	31.9	0.3

1 Area includes land within 10 nautical miles of runway.

2 Total number of accidents is 838 (through 1995).

3 Percent total accidents divided by percent total area.

Additional accident data for 1986 through July 1995 has been analyzed. Specific location data for some of the 1986-1995 accidents was not available and these were not included in the analysis. Table B.3 compares the 1968-1985 data with the data through July 1995:

Table B.3 Additional Accident Data				
	1968-1985		1968-1995	
ZONE	Accidents	% of Total	Accidents	% of Total
On-Runway	197	27.1	209	24.9
Clear Zone	210	28.8	230	27.4
APZ I	57	7.8	85	10.1
APZ II	36	5.0	47	5.7
Other (Within 10 nautical miles)	228	31.3	267	31.9
Total	728	100.0	838	100.0

Analysis has shown that the cumulative changes evident in accident location through July 1995 reconfirm the dimensions of the CZs and APZs.

B.3 Definable Debris Impact Areas

The Air Force also determined which accidents had definable debris impact areas, and in what phase of flight the accident occurred. Overall, 75 percent of the accidents had definable debris impact areas, although they varied in size by type of accident. The Air Force used weighted averages of impact areas, for accidents occurring only in the approach and departure phase, to determine the following average impact areas:

Average Impact Areas for Approach and Departure Accidents

Overall Average Impact Area	5.06 acres
Fighter, Trainer, and Misc. Aircraft	2.73 acres
Heavy Bomber and Tanker Aircraft	8.73 acres

B.4 Findings

Designation of safety zones around the airfield and restriction of incompatible land uses can reduce the public's exposure to safety hazards.

Air Force accident studies have found that aircraft accidents near Air Force installations occurred in the following patterns:

- 61% were related to landing operations.
- 39% were related to takeoff operations.
- 70% occurred in daylight.
- 80% were related to fighter and training aircraft operations.
- 25% occurred on the runway or within an area extending 1,000 feet out from each side of the runway.

- 27% occurred in an area extending from the end of the runway to 3,000 feet along the extended centerline and 3,000 feet wide, centered on the extended centerline.
- 15% occurred in an area between 3,000 and 15,000 feet along the extended runway centerline and 3,000 feet wide, centered on the extended centerline.

Air Force aircraft accident statistics found 75% of aircraft accidents resulted in definable impact areas. The size of the impact areas were:

- 5.06 acres overall average.
- 2.73 acres for fighters and trainers.
- 8.73 acres for heavy bombers and tankers.

Appendix C

NOISE AND NOISE LEVEL REDUCTION GUIDELINES

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NOISE AND NOISE LEVEL REDUCTION GUIDELINES

C.1 General

Noise, often defined as unwanted sound, is one of the most common environmental issues associated with aircraft operations. Of course, aircraft are not the only sources of noise in an urban or suburban surrounding, where noise from interstate and local roadway traffic, rail, industrial, and neighborhood sources also intrude on the everyday quality of life. Nevertheless, aircraft are readily identifiable to those affected by their noise and are typically singled out for special attention and criticism. Consequently, aircraft noise problems often dominate analyses of environmental impacts.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium such as air, and are sensed by the human ear. Whether that sound is interpreted as pleasant (*e.g.*, music) or unpleasant (*e.g.*, aircraft noise) depends largely on the listener's current activity, past experience, and attitude toward the source of that sound. It is often true that one person's music is another person's noise.

The measurement and human perception of sound involves two basic physical characteristics - intensity and frequency. Intensity is a measure of the acoustic energy of the sound vibrations and is expressed in terms of sound pressure. The higher the sound pressure, the more energy carried by the sound and the louder the perception of that sound. The second important physical characteristic is sound frequency, that is, the number of times per second the air vibrates or oscillates. Low-frequency sounds are characterized as rumbles or roars, while high-frequency sounds are typified by sirens or screeches.

The loudest sounds, which can be detected comfortably by the human ear, have intensities that are a trillion times larger than those of sounds that can be detected at the lower end of the spectrum. Because of this vast range, any attempt to represent the intensity of sound using a linear scale becomes very unwieldy. As a result, a logarithmic unit known as the decibel (dB) is used to represent the intensity of a sound. Such a representation is called a sound level.

A sound level of 0 dB is approximately the threshold of human hearing and is barely audible under extremely quiet listening conditions. Normal speech has a sound level of approximately 60 dB. Sound levels above 120 dB begin to be felt inside the human ear as discomfort and eventually pain at still higher levels.

Because of the logarithmic nature of the decibel unit, sound levels cannot be added or subtracted directly and are somewhat cumbersome to handle mathematically. However, some simple rules are useful in dealing with sound levels. First, if a sound's intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. Thus, for example:

$$60 \text{ dB} + 60 \text{ dB} = 63 \text{ dB}, \text{ and}$$

$$80 \text{ dB} + 80 \text{ dB} = 83 \text{ dB}.$$

The total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

Because the addition of sound levels behaves differently than that of ordinary numbers, such an addition is often referred to as "decibel addition" or "energy addition." The latter term arises from the fact that what is really happening when decibel values are added is each decibel value is first converted to its corresponding acoustic energy, then the energies are added using the normal rules of addition, and finally the total energy is converted to its decibel equivalent.

An important facet of decibel addition arises later when the concept of time-average sound levels is introduced to explain Day-Night Average A-Weighted Sound Level (DNL). Because of the logarithmic units, the louder levels that occur during the averaging period dominate the time-average sound levels. As a simple example, consider a sound level that is 100 dB and lasts for 30 seconds, followed by a sound level of 50 dB which also lasts for 30 seconds. The time-average sound level over the total 60-second period is 97 dB, not 75 dB.

Sound frequency is measured in terms of cycles per second (cps), or hertz (Hz), which is the preferred scientific unit for cps. The normal human ear can detect sounds that range in frequency from about 20 Hz to about 15,000 Hz. All sounds in this wide range of frequencies, however, are not heard equally well by the human ear, which is most sensitive to frequencies in the 1000 to 4000 Hz range. In measuring community noise, this frequency dependence is taken into account by adjusting the sound levels of the very high and low frequencies to approximate the human ear's lower sensitivity to those frequencies. This is called "A-weighting" and is commonly used in measurements of community environmental noise.

Sound levels measured using A-weighting are most properly called A-weighted sound levels while sound levels measured without any frequency weighting are most properly called sound levels. However, since most environmental impact analysis documents deal only with A-weighted sound levels, the adjective "A-weighted" is often omitted, and A-weighted sound levels are referred to simply as sound levels. In some instances it will be indicated that the sound levels have been A-weighted by using the abbreviation dBA or dB(A), rather than the abbreviation dB, for decibel. As long as the use of A-weighting is understood to be used, there is no difference implied by the terms "sound level" and "A-weighted sound level" or by the units dB, dBA, and dB(A).

In this document and most AICUZ documents, all sound levels are A-weighted sound levels and the adjective "A-weighted" has been omitted and dB is used for the decibel units.

Sound levels do not represent instantaneous measurements but rather averages over short periods of time. Two measurement time periods are most commonly used - one second and one-eighth of a second. Most environmental noise studies use slow response measurements,

and the adjective "slow response" is usually omitted. It is easy to understand why the proper descriptor "slow response A-weighted sound level" is usually shortened to "sound level" in environmental impact analysis documents.

C.2 Noise Metrics

A "metric" is defined as something "of, involving, or used in measurement." In environmental noise analyses, a metric refers to the unit or quantity that quantitatively measures the effect of noise on the environment. Noise studies have typically involved a confusing proliferation of noise metrics as individual researchers have attempted to understand and represent the effects of noise. As a result, past literature describing environmental noise abatement has included many different metrics.

Various federal agencies involved in environmental noise mitigation agree on common metrics for environmental impact analysis documents, and both the Department of Defense (DoD) and the FAA specified those which should be used for federal aviation noise assessments. These metrics are as follows.

C.2.1 Maximum Sound Level

The highest A-weighted sound level measured during a single event in which the sound level changes value as time goes on (*e.g.*, an aircraft overflight) is called the maximum A-weighted sound level or maximum sound level, for short. It is usually abbreviated by ALM, L_{max}, or L_{Amax}.

C.2.2 Sound Exposure Level

Individual time-varying noise events have two main characteristics - a sound level which changes throughout the event and a period of time during which the event is heard. Although the maximum sound level, described above, provides some measure of the intrusiveness of the event, it alone does not completely describe the total event. The period of time during which the sound is heard is also significant. The Sound Exposure Level (abbreviated SEL or L_{AE}) combines both of these characteristics into a single metric.

Sound Exposure Level is a logarithmic measure of the total acoustic energy transmitted to the listener during the event. Mathematically, it represents the sound level of the constant sound that would, in one second, generate the same acoustic energy as did the actual time-varying noise event. Since aircraft overflights usually last longer than 1 second, the SEL of an overflight is usually greater than the ALM of the overflight.

Note that sound exposure level is a composite metric that represents both the intensity of a sound level of the constant sound and its duration. It does not directly represent the sound level heard at any given time, but rather provides a measure of the net impact of the entire acoustic event. It has been well established in the scientific community that SEL measures this impact much more reliably than just the ALM.

Because the SEL and the ALM are both A-weighted sound levels expressed in decibels, there is sometimes confusion between the two, so the specific metric used should be clearly stated.

C.2.3 Day-Night Average Sound Level

Time-average sound levels are measurements of sound levels that are averaged over a specified length of time. These levels provide a measure of the average sound energy during the measurement period.

For the evaluation of community noise effects, and particularly aircraft noise effects, the DNL (mathematically represented as L_{dn}) is used. DNL averages aircraft sound levels at a location over a complete 24-hour period, with a 10-dB adjustment added to those noise events that take place between 10:00 p.m. and 7:00 a.m. (local time). This 10-dB "penalty" represents the added intrusiveness of sounds that occur during normal sleeping hours, both because of the increased sensitivity to noise during those hours and because ambient sound levels during nighttime are typically about 10 dB lower than during daytime hours.

As noted earlier for SEL, DNL does not represent the sound level heard at any particular time. DNL provides a single measure of overall noise impact, but does not provide specific information on the number of noise events or the individual sound levels which occur during the day. For example, a DNL of 65 dB could result from a very few noisy events, or a large number of quieter events.

Scientific studies and social surveys which have been conducted to evaluate community annoyance to all types of environmental noise have found the DNL to be the best measure to predict annoyance. Its use is endorsed by the scientific community (See References C.1 through C-5 at the end of this section).

There is, in fact, a remarkable consistency in the results of attitudinal surveys about aircraft noise conducted in different countries to find the percentages of groups of people who express various degrees of annoyance when exposed to different levels of DNL.

Reference C.6 was published in 1978. A more recent study has reaffirmed this relationship (Reference C.7). In general, correlation coefficients of 0.85 to 0.95 are found between the percentages of groups of people highly annoyed and the level of average noise exposure. The correlation coefficients for the annoyance of individuals are relatively low, however, on the order of 0.5 or less. This is not surprising, considering the varying personal factors that influence the manner in which individuals react to noise. Nevertheless, findings substantiate that community annoyance to aircraft noise can be predicted quite reliably using DNL.

This relation between community annoyance and DNL has been confirmed, even for infrequent aircraft noise events. Reference C.8 reported the reactions of individuals in a community to daily helicopter overflights correlated quite well with the daily time-average sound levels over this range of numbers of daily noise events.

The use of DNL has been criticized as not accurately representing community annoyance and land-use compatibility with aircraft noise. Much of that criticism stems from a lack of understanding of the basis for the measurement or calculation of L_{dn}. One frequent criticism is based on the principle that people inherently react more to single noise events and not as much to "meaningless" time-average sound levels.

In fact, a time-average noise metric, such as DNL, takes into account both the noise levels of all individual events which occur during a 24-hour period and the number of times those events occur. As described briefly above, the logarithmic nature of the decibel unit causes the noise levels of the loudest events to control the 24-hour average.

As a simple example of this characteristic, consider a case in which only one aircraft overflight occurs in daytime during a 24-hour period, creating a sound level of 100 dB for 30 seconds. During the remaining 23 hours, 59 minutes, and 30 seconds of the day, the ambient sound level is 50 dB. The DNL for this 24-hour period is 65.5 dB. Assume, as a second example, that ten such 30-second overflights occur in daytime hours during the next 24-hour period, with the same ambient sound level of 50 dB during the remaining 23 hours and 55 minutes of the day. The DNL for this 24-hour period is 75.4 dB. Clearly, the averaging of noise over a 24-hour period does not ignore the louder single events and tends to emphasize both the sound levels and number of those events. This is the basic concept of a time-average sound metric, and specifically the DNL.

C.3 Noise Effects

C.3.1 Hearing Loss

Noise-induced hearing loss is probably the best-defined of the potential effects of human exposure to excessive noise. Federal workplace standards for protection from hearing loss allow a time-average level of 90 dB over an 8-hour work period, or 85 dB averaged over a 16-hour period. An outdoor DNL of 75 dBA is considered the threshold above which the risk of hearing loss should be evaluated. Following guidelines recommended by the Committee on Hearing, Bioacoustics, and Biomechanics of the National Research Council, the average change in the threshold of hearing for people exposed to DNL equal to or greater than 75 dBA was evaluated. Results indicated that an average of 1 dBA hearing loss could be expected for people exposed to DNL equal to or greater than 75 dBA. For the most sensitive 10 percent of the exposed population, the maximum anticipated hearing loss would be 4 dBA. These hearing loss projections must be considered conservative as the calculations are based on an average daily outdoor exposure of 16 hours (7:00 a.m. to 10:00 p.m.) over a 40-year period. Since it is unlikely that airport neighbors will remain outside their homes 16 hours per day for extended periods of time, there is little possibility of hearing loss below a DNL of 75 dB, and this level is extremely conservative.

C.3.2 Nonauditory Health Effects

Nonauditory health effects of long-term noise exposure, where noise may act as a risk factor, have never been found to occur at levels below those protective against noise-induced

hearing loss, described above. Most studies attempting to clarify such health effects have found that noise exposure levels established for hearing protection will also protect against any potential nonauditory health effects, at least in workplace conditions. The best scientific summary of these findings is contained in the lead paper at the National Institute of Health Conference on Noise and Hearing Loss, held on 22-24 January 1990 in Washington, D.C.

> "The nonauditory effects of chronic noise exposure, when noise is suspected to act as one of the risk factors in the development of hypertension, cardiovascular disease, and other nervous disorders, have never been proven to occur as chronic manifestations at levels below these criteria (an average of 75 dBA for complete protection against hearing loss for an eight-hour day). At the recent (1988) International Congress on Noise as a Public Health Problem, most studies attempting to clarify such health effects did not find them at levels below the criteria protective of noise-induced hearing loss, and even above these criteria, results regarding such health effects were ambiguous. Consequently, one comes to the conclusion that establishing and enforcing exposure levels protecting against noise-induced hearing loss would not only solve the noise-induced hearing loss problem but also any potential nonauditory health effects in the work place." (Reference C.9; parenthetical wording added for clarification.)

Although these findings were directed specifically at noise effects in the work place, they are equally applicable to aircraft noise effects in the community environment. Research studies regarding the nonauditory health effects of aircraft noise are ambiguous, at best, and often contradictory. Yet, even those studies which purport to find such health effects use time-average noise levels of 75 dB and higher for their research.

For example, in an often-quoted paper, two University of California at Los Angeles (UCLA) researchers apparently found a relationship between aircraft noise levels under the approach path to Los Angeles International Airport and increased mortality rates among the exposed residents by using an average noise exposure level greater than 75 dB for the "noise-exposed" population (Reference C.10). Nevertheless, three other UCLA professors analyzed those same data and found no relationship between noise exposure and mortality rates (Reference C.11).

In summary, there is no scientific basis for a claim that potential health effects exist for aircraft DNL below 75 dB.

C.3.3 Annoyance

The primary effect of aircraft noise on exposed communities is one of annoyance. Noise annoyance is defined by the U.S. Environmental Protection Agency as any negative subjective reaction on the part of an individual or group (Reference C.3). As noted in the discussion of DNL above, community annoyance is best predicted by that metric.

It is often suggested that a lower DNL, such as 60 or 55 dB, be adopted as the threshold of community noise annoyance for airport environmental analysis documents. While there is no technical reason why a lower level cannot be measured or calculated for comparison purposes, a DNL of 65 dB:

- provides a valid basis for comparing and assessing community noise effects;
- represents a noise exposure level which is normally dominated by aircraft noise and not other community or nearby highway noise sources; and
- reflects the FAA's threshold for grant-in-aid funding of airport noise mitigation projects.
- United States Department of Housing and Urban Development also establishes a DNL standard of 65 dB for eligibility for federally guaranteed home loans.

C.3.4 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance to individuals on the ground. The disruption of routine activities such as radio or television listening, telephone use, or family conversation gives rise to frustration and irritation. The quality of speech communication is also important in classrooms, offices, and industrial settings and can cause fatigue and vocal strain in those who attempt to communicate over the noise. Research has shown that "whenever intrusive noise exceeds approximately 60 dB indoors, there will be interference with speech communication" (Reference C.5). A steady A-weighted background sound level of 60 dB will produce 93 percent intelligibility; that of 70 dB will produce 66 percent intelligibility; and that of 75 dB will produce 2 percent intelligibility (Figure D-1 in Reference C.3).

C.3.5 Sleep Interference

Sleep interference may be measured in either of two ways. "Arousal" represents actual awakening from sleep, while a change in "sleep stage" represents a shift from one of four sleep stages to another stage of lighter sleep without actual awakening. In general, arousal requires a somewhat louder noise level than does a change in sleep stage.

A recent analysis sponsored by the Air Force summarized 21 published studies concerning the effects of noise on sleep (Reference C.14). The analysis concluded that a lack of reliable studies in homes, combined with large differences among the results from the various laboratory studies and the limited in-home studies, did not permit development of an acceptable accurate assessment procedure. The noise events used in the laboratory studies and in contrived in-home studies were presented at much higher rates of occurrence than would normally be experienced in the home. None of the laboratory studies was of sufficiently long duration to determine any effects of habituation, such as those which would occur under normal community conditions.

Nevertheless, some guidance is available in judging sleep interference. The U.S. Environmental Protection Agency (USEPA) identified an indoor DNL of 45 dB as necessary

to protect against sleep interference (Reference C.3). Assuming a very conservative structural noise insulation of 20 dB for typical dwelling units, this corresponds to an outdoor DNL of 65 dB as minimizing sleep interference.

The Federal Interagency Committee on Noise (Reference C.5) reviewed the sleep disturbance issue and presented an Air Force-developed sleep disturbance dose-response prediction curve, which is based on data from Reference C.14, as an interim tool for analysis of potential sleep disturbance. This interim curve shows that for an indoor SEL of 65 dB, approximately 15 percent or less of those exposed should be awakened.

C.3.6 Noise Effects on Domestic Animals and Wildlife

Animal species differ greatly in their responses to noise. Each species has adapted, physically and behaviorally, to fill its ecological role in nature, and its hearing ability usually reflects that role. Animals rely on their hearing to avoid predators, obtain food, and communicate with and attract other members of their species. Aircraft noise may mask or interfere with these functions. Secondary effects may include nonauditory effects similar to those exhibited by humans - stress, hypertension, and other nervous disorders. Tertiary effects may include interference with mating and resultant population declines.

Many scientific studies are available regarding the effects of noise on wildlife and some anecdotal reports of wildlife "flight due to noise." Few of these studies or reports include any reliable measures of the actual noise levels involved.

In the absence of definitive data on the effect of noise on animals, the Committee on Hearing, Bioacoustics, and Biomechanics proposed that protective noise criteria for animals be taken to be the same as for humans (Reference C.16).

C.3.7 Effects of Noise-Induced Vibration on Structures and Humans

The sound from an aircraft overflight travels from the exterior to the interior of the house in one of two ways: through the solid structural elements and directly through the air. The sound transmission starts with noise impinging on the wall exterior. Some of this sound energy will be reflected away and some will make the wall vibrate. The vibrating wall radiates sound into the airspace, which in turn sets the interior finish surface vibrating, with some of the energy lost in the airspace. This surface then radiates sound into the dwelling interior. Vibrational energy also bypasses the air cavity by traveling through the studs and edge connections.

Normally, the most sensitive components of a structure to airborne noise are the windows and, infrequently, the plastered walls and ceilings. An evaluation of the peak sound pressure impinging on the structure is normally sufficient to determine the possibility of damage. In general, at sound levels above 130 dB, there is the possibility of structural damage. While certain frequencies (such as 30 Hz for window breakage) may be of more concern than other frequencies, conservatively, only sounds lasting more than 1 second above a sound level of 130 dB are potentially damaging to structural components (Reference C.17).

In terms of average acceleration of wall or ceiling vibration, the thresholds for structural damage (C.18) are:

- 0.5 meters/sec/sec—threshold of risk of damage to sensitive structures (e.g., ancient monuments); and
- meters/sec/sec—threshold of risk of damage to normal dwellings (e.g., houses with plaster ceilings and walls).

Noise-induced structural vibration may also cause annoyance to dwelling occupants because of induced secondary vibrations, or "rattle," of objects within the dwelling - hanging pictures, dishes, plaques, and bric-a-brac. Loose window panes may also vibrate noticeably when exposed to high levels of aircraft noise, causing homeowners to fear breakage. In general, such noise-induced vibrations occur at sound levels above those considered normally compatible with residential land use. Thus, assessments of noise exposure levels for compatible land use should also be protective of noise-induced secondary vibrations.

In the assessment of vibrations on humans, the following factors determine if a person will perceive and possibly react to building vibrations:

- Type of excitation: steady state, intermittent, or impulsive vibration;
- Frequency of the excitation. ISO 2631-2 (Reference C.18) recommends a frequency range of 1 to 80 Hz for the assessment of vibration on humans;
- Orientation of the body with respect to the vibration;
- The use of the occupied space; and
- Time of day.

C.3.8 Noise Effects on Terrain

It has been suggested that noise levels associated with low-flying aircraft may affect the terrain under the flight path by disturbing fragile soil or snow structures, especially in mountainous areas, causing landslides or avalanches. There are no known instances of such effects, and it is considered improbable that such effects will result from routine, subsonic aircraft operations.

C.3.9 Noise Effects on Historical and Archaeological Sites

Because of the potential for increased fragility of structural components of historical buildings and other historical sites, aircraft noise may affect such sites more severely than newer, modern structures. Again, there are few scientific studies of such effects to provide guidance for their assessment.

One study involved the measurements of sound levels and structural vibration levels in a superbly restored plantation house, originally built in 1795, and now situated approximately 1,500 feet from the centerline at the departure end of Runway 19L at Washington Dulles International Airport. These measurements were made in connection with the proposed

scheduled operation of the supersonic Concorde airplane at Dulles (Reference C.19). There was a special concern for the building's windows, since roughly half of the 324 panes were original. No instances of structural damage were found. Interestingly, despite the high levels of noise during Concorde takeoffs, the induced structural vibration levels were actually less than those induced by touring groups and vacuum cleaning.

As noted above for the noise effects of noise-induced vibrations of normal structures, assessments of noise exposure levels for normally compatible land uses should also be protective of historic and archaeological sites.

C.4 Noise Level Reduction Guidelines

A study that provides in-depth, state-of-the-art noise level reduction guidelines was prepared for the Naval Facilities Engineering Command (NAVFAC) in April 2005. The title of the document is *Guidelines for the Sound Insulation of Residences Exposed to Aircraft Operations* (C.20). A copy of this document can be obtained from NAVFAC Southern Division, Charleston, SC.

C.5 References

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C.17. Von Gierke, H.E., and Ward, W.D., "Criteria for Noise and Vibration Exposure," Handbook of Acoustical Measurements and Noise Control, Third Edition, 1991.

C.18. "Evaluation of Human Exposure to Whole-Body Vibration - Part 2: Continuous and Shock-Induced Vibration in Buildings (1 to 80 Hz)", International Organization for Standardization, Standards 2631-2, February 1989.

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C.20. *Guidelines for the Sound Insulation of Residences Exposed to Aircraft Operations*, Department of the Navy, Naval Facilities Engineering Command, Washington Navy Yard, 1322 Patterson Avenue, S.W., Suite 1000, Washington, DC 20374-5065.

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