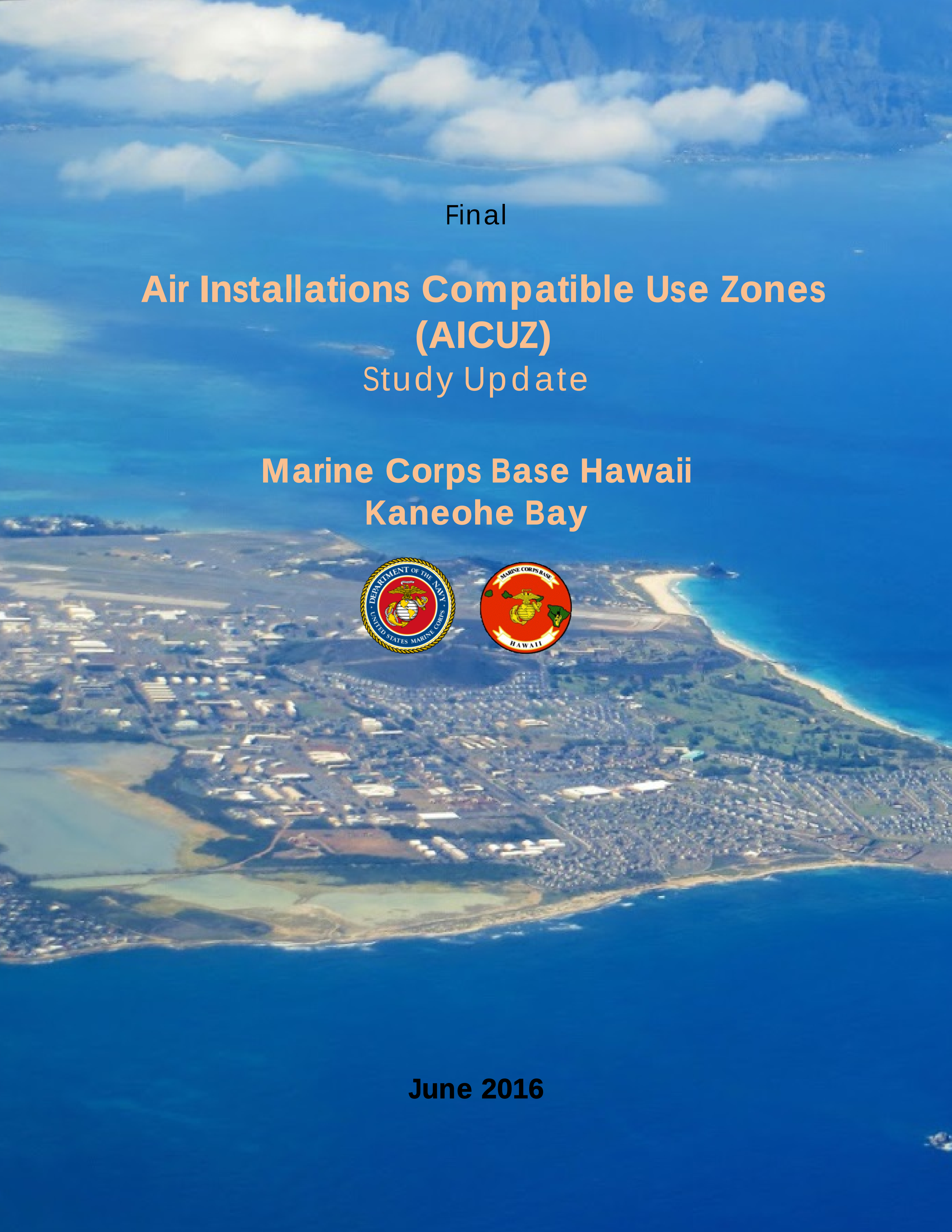

Final

Air Installations Compatible Use Zones (AICUZ)

Study Update

Marine Corps Base Hawaii
Kaneohe Bay

June 2016

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Marine Corps Base Hawaii
Kaneohe Bay

Prepared for:
Naval Facilities Engineering Command, Southwest
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Prepared by:
AECOM

June 2016

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Acronyms and Abbreviations

AAD	Average Annual Day Aircraft Operations
AFB	Air Force Base
AICUZ	Air Installations Compatible Use Zones
APZ	Accident Potential Zone
BASH	Bird/Wildlife Aircraft Strike Hazard
BRAC	Base Realignment and Closure
CNEL	Community Noise Equivalent Level
CPLO	Community Plans and Liaison Officer
CPRW	Commander, Patrol Reconnaissance Wing
CY	calendar year
CZ	Clear Zone; 3,000 ft beyond runway
dB	decibel
dBA	A-weighted decibel
DNL	Day-Night Average Sound Level; *average sound level over a 24-hour period*
DOD	U.S. Department of Defense
DOT	Department of Transportation
DZ	Drop Zone
EIS	Environmental Impact Statement
FAA	U.S. Federal Aviation Administration
FEIS	Final Environmental Impact Statement
FL	Flight line
FY	Fiscal Year
GCA	Ground Controlled Approach
GIS	Geographic Information System
HERO	Hazards of Electromagnetic Radiation to Ordnance
HMH	Heavy Helicopter Squadron
HMLA	Marine Light / Attack Helicopter Squadron
LAMPS	Light Airborne Multipurpose Systems
LHA	Landing ship helicopter assault
L_{max}	Maximum Sound Level
LZ	Landing Zone
MAG	Marine Aircraft Group
MALS	Marine Air Logistics Squadron
MARFORPAC	Marine Forces Pacific
MCAF	Marine Corps Air Facility
MCAS	Marine Corps Air Station
MCB	Marine Corps Base

MEF	Marine Expeditionary Force
NAS	Naval Air Station
NASMOD	Naval Aviation Simulation Model
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NDSA	Naval Defensive Sea Area
NGF	*Federal Aviation Administration Airport Designation Code for Kaneohe Marine Corps Air Facilities*
NLR	Noise Level Reduction
NOISEMAP	*Standard Computer DOD Model that projects Noise Impacts and calculates DNL sound contours*
OPNAVINST	Chief of Naval Operations Instructions
PAO	Public Affairs Office
PBY	Patrol Bomber
SEL	Sound Exposure Level
SLUCM	Standard Land Use Coding Manual
TACAN	Tactical Air Navigation
TERPS	Terminal Instrument Procedure for Airport and Air Operations
UAV	Unmanned Aerial Vehicle
UFC	Unified Facilities Criteria
U.S.	United States
USMC	United States Marine Corps
VFR	Visual Flight Rules
VMM	Marine Medium Tilt-Rotor Squadron
VMU	Marine Unmanned Aerial Vehicle Squadron
VR	Fleet Logistics Support Squadron
VP	Patrol Squadron

Executive Summary

ES1. Background

This Air Installations Compatible Use Zones (AICUZ) Study Update is for Marine Corps Base (MCB) Hawaii, Kaneohe Bay located on the Mōkapu Peninsula on the Island of Oahu, Hawaii. The study examines various planning parameters related to aircraft operations, noise, and safety, and provides recommendations that can be used to promote compatible land use in the airfield environs.

An AICUZ study was originally prepared and approved for Marine Corps Air Station (MCAS) Kaneohe Bay in 1976, and updated in 1983, 1990 and 2003. The 2003 AICUZ Study was approved by Headquarters Marine Corps on 26 March 2003. The current update reflects proposed transitions of aircraft at Marine Corps Base (MCB) Hawaii Kaneohe Bay that the Marine Corps and Department of the Navy (Navy) plan in the future and includes updated operational data for the airport.

MCB Hawaii Kaneohe Bay uses the AICUZ as a planning tool and is proactive in implementing planning actions that are compatible with it.

ES2. Noise

As part of this AICUZ Study Update, a noise study was conducted. The noise study provides an analysis of noise impacts based on an existing baseline condition for calendar year 2013 (CY13), and a prospective scenario condition circa calendar year 2018 (CY18).

MCB Hawaii Kaneohe Bay is located on Mokapu Peninsula on the windward (east) side of Oahu, near the communities of Kaneohe and Kailua. The base is approximately 12 miles northeast of Honolulu. MCB Hawaii Kaneohe Bay is one of several United States Marine Corps (USMC) properties managed by MCB Hawaii Kaneohe Bay on Oahu. The installation is home to the Third Marine Regiment, Marine Aircraft Group 24, and the Third Radio Battalion. MCB Hawaii Kaneohe Bay serves as the host for the Commander, Patrol and Reconnaissance Wing Two (CPRW-2) that provides expeditionary patrol and reconnaissance forces in support of the Third, Fifth, and Seventh fleet operations. MCB Hawaii Kaneohe Bay hosts three fleet squadrons of P-3C aircraft (VP-4, VP-9, and VP-47), one Special Projects Patrol P-3C unit (VPU-2), one reserve logistics squadron (VR-51), one squadron of H-60 helicopters (HSM-37), one squadron of CH-53 helicopters (HMH-463), one squadron of AH-1 and UH-1 helicopters (HMLA-367), and one squadron of unmanned aircraft (VMU-3).

Pursuant to the MV-22 EIS Record of Decision (ROD) (Navy 2012), two squadrons of MV-22 aircraft (VMM-268 and VMM-363) will be home based at MCB Hawaii Kaneohe Bay beginning in the first quarter of fiscal year (FY) 2017. One squadron of unmanned aircraft (VMU-3) has already relocated to MCB Hawaii Kaneohe Bay. The Navy has issued a ROD that announced the decision to disestablish the VPU-2 squadron at MCB Hawaii Kaneohe Bay (Navy June 2014). This disestablishment is not likely to occur until 2019; therefore, VPU-2 personnel and air operations were considered as part of the baseline and end-state in the analysis supporting the 2008 Final Environmental Impact Statement (FEIS). At this time, it was anticipated that existing P-3C squadrons at MCB Hawaii Kaneohe Bay would begin transitioning to P-8A aircraft in the 2016 timeframe.

A comparison of the prospective condition and 2003 AICUZ noise contours shows a relative increase in noise, largely over open water areas. Off-base, while most of the surrounding community with the exception of Coconut Island and portion of Kealohi Point are outside of the higher noise contours, the public may experience noise associated with routine aircraft operations. Recognizing the open air living style in Hawaii, the 60 decibel (dB) Day-Night Average Sound Level (DNL) contour is also shown outside of the AICUZ footprint, defined as the 65 DNL contour, for informational purposes. The updated prospective AICUZ footprint is shown on Figure ES-1.

ES3. Safety

Accident Potential Zones (APZs) are based on historical accident and operations data compiled throughout the military services and the application of margins of safety within these areas if an accident were to occur. They do not reflect the probability of an accident occurring at a particular location. Consequently, historical data indicates those accidents involving aircraft are more likely to occur in areas on or approaching the runway and clear zones than elsewhere. This study examined the APZs associated with operations at MCB Hawaii Kaneohe Bay. The Clear Zone (CZ) and APZs are depicted in Figure ES-1 for fixed wing aircraft operations and Figure ES-2 for rotary wing aircraft operations, respectively.

ES4. Land Use

Most land within the AICUZ footprint is owned by the Department of Defense (DOD). The main non-DOD land within the updated AICUZ footprint is Coconut Island, a 28-acre island in Kaneohe Bay off the island of Oahu owned by the State of Hawaii. The University of Hawaii’s Institute of Marine Biology is the major occupant of Coconut Island. This facility focuses on ocean research, education, biotechnology, and biodiversity studies. While there are some increases of AICUZ noise levels as compared to that under the 2003 AICUZ, the overall noise and APZ considerations for Coconut Island remain fundamentally the same. Similarly, there are also slight expansions of AICUZ noise levels on the tip of Kealohi Point reflected in this update. These areas are appropriately classified for the Institute of Marine Biology and/or preservation lands.

The proposed new development is based on the most recent geographic information system (GIS) files provided by MCB Hawaii and incorporates AICUZ considerations as an inherent part of the Marine Corps on-base planning process.

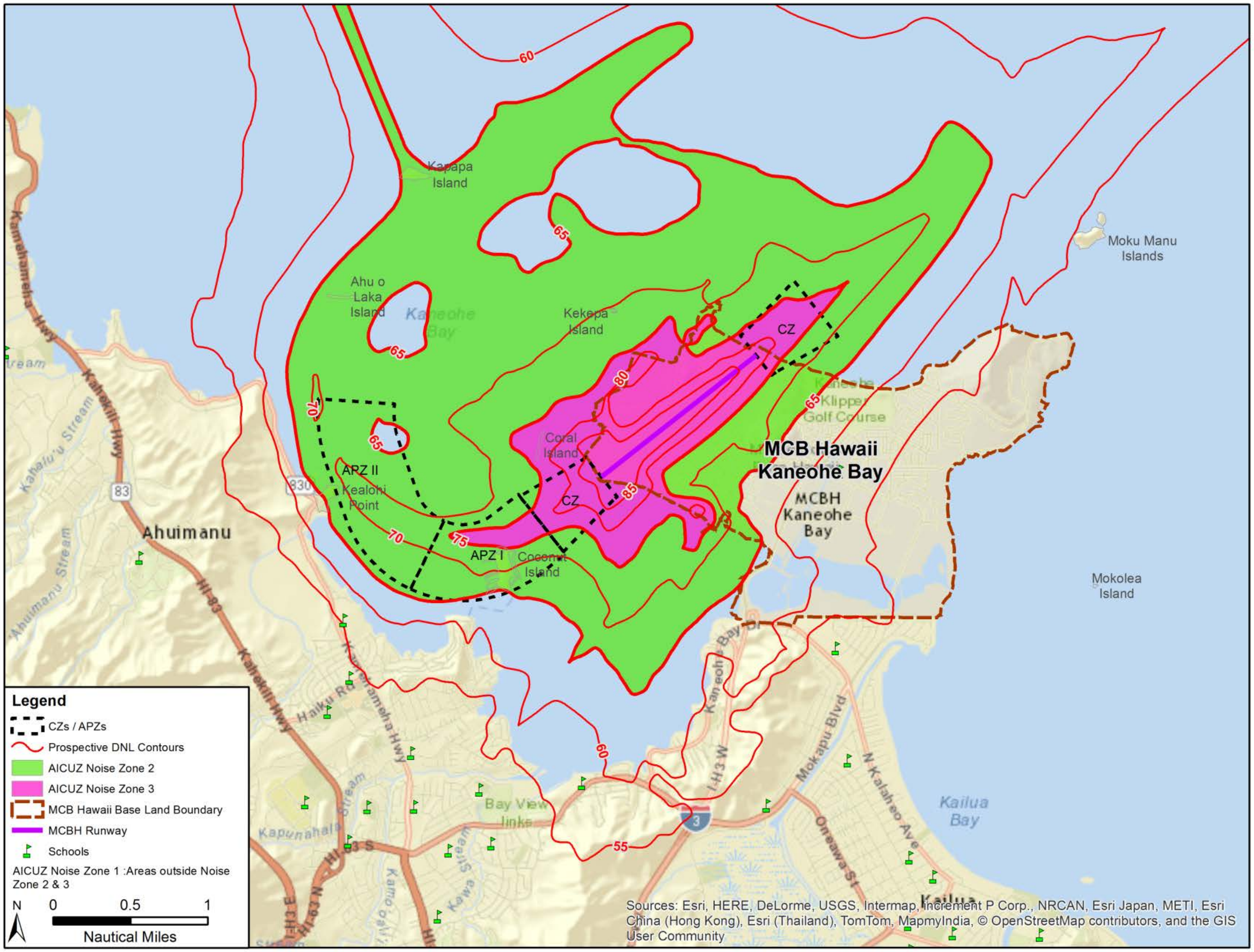

Figure ES-1 Prospective 2018 AICUZ Footprint MCB Hawaii Kaneohe Bay

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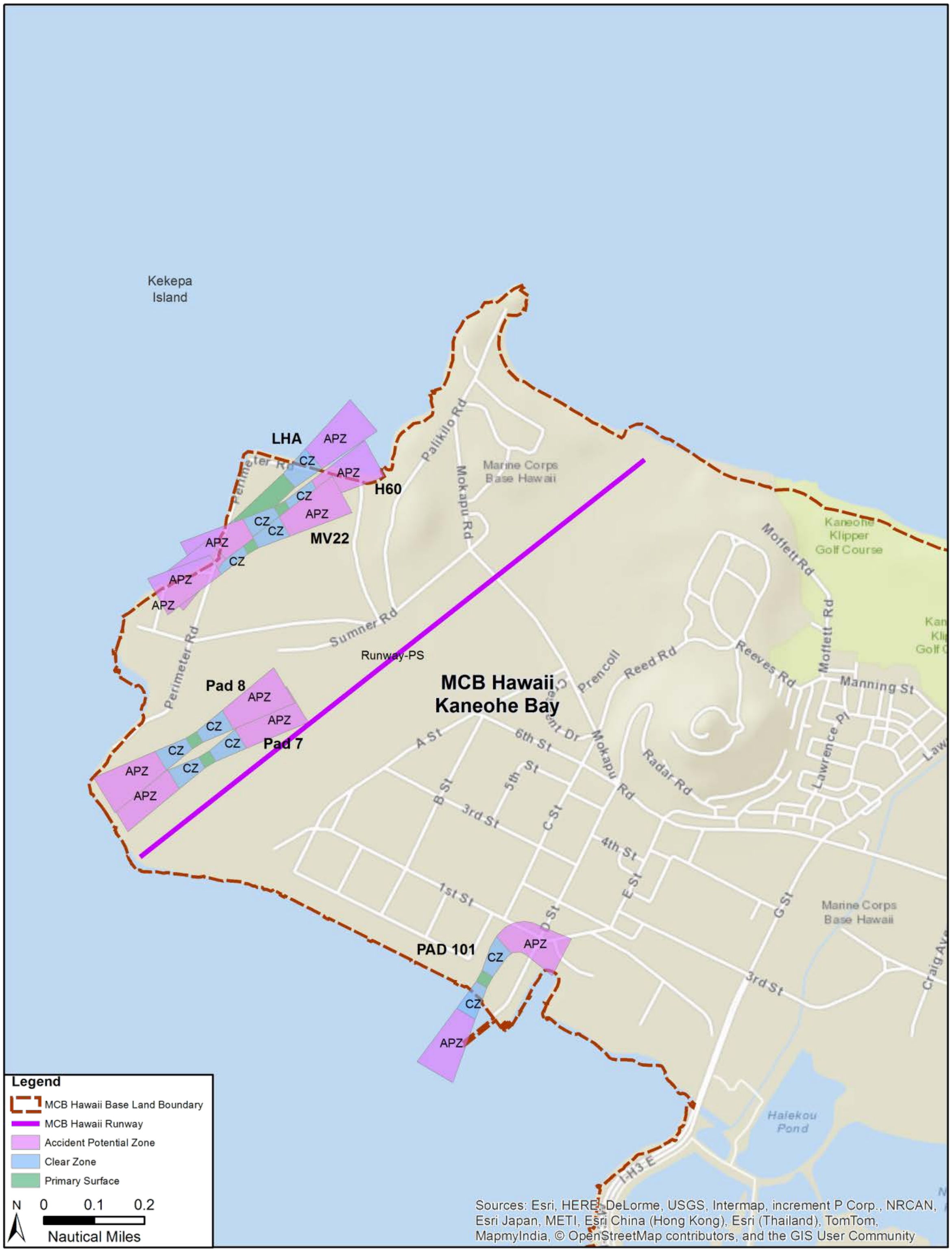

Figure ES-2 MCB Hawaii Rotary Wing Clear Zones and APZs

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ES5. Implementation

Tools used at the federal, Navy and Marine Corps, state, local government, private citizen, real estate professional, and builder/developer levels are available to aid in implementation of an AICUZ Program recommendations.

Land use in the MCB Hawaii Kaneohe Bay environs is controlled by the State Land Use Commission and City and County of Honolulu with existing land use regulations and zoning and that encourages new development compatible with military operations. While the AICUZ footprint area is largely over open water, a continuing dialog with local officials and citizen groups is an important on-going initiative of MCB Hawaii.

ES5.1 Marine Corps Potential Actions

- A continued community outreach program is a specific implementation strategy that can provide citizens with factual information regarding the noise and safety impacts of airfield operations, including information on periods of temporary increases in air activity. One of the priorities of MCB Hawaii Kaneohe Bay is to continually work to enhance community support (*MCB Hawaii Strategic Plan* 2013). The Public Affairs Office (PAO) is responsible for community outreach and engagement at MCB Hawaii Kaneohe Bay and the Community Plans and Liaison Officer (CPLO) is the contact individual.

- Capital improvement projects in proximity to the airfield should be evaluated and reviewed for potential direct and indirect impacts from operations by the CPLO and installation master planner at MCB Hawaii Kaneohe Bay so that such improvements foster compatible development with the AICUZ Study.

- Potential construction and siting of noise abatement structures should be evaluated and reviewed for potential direct and indirect impacts from operations by the CPLO and installation master planner at MCB Hawaii Kaneohe Bay.

ES5.2 Local Government Potential Actions

- Community decision makers should continue to actively inform and seek input from MCB Hawaii Kaneohe Bay as a major stakeholder and economic contributor in the community via the CPLO regarding land use decisions that may affect the operational integrity of the airfields.

- When making land use and development decisions affecting property in proximity to the airfields, the local community should recognize that noise contours and APZs are dynamic. There is a potential for operational and/or mission changes over time that would cause changes in the AICUZ footprint. In order to ensure the military value and flexibility currently available at MCB Hawaii Kaneohe Bay, proposed changes to the current locally adopted Ko'olaupoko Sustainable Communities Plan, policies, and resulting development regulations, including building code, disclosure requirements, etc., should be coordinated with MCB Hawaii Kaneohe Bay through the CPLO.

- It should be recognized that there are overland flight tracks outside the AICUZ footprint and that aircraft noise can be heard outside the AICUZ footprint.

- The University of Hawaii should coordinate proposed changes and implementation of the Coconut Island Long Range Development Plan with MCB Hawaii Kaneohe Bay to ensure AICUZ considerations continue to be taken into account in land use planning.

ES5.3 Recommendations

The following recommendation for MCB Hawaii Kaneohe Bay promotes continued compatible development and prevents incompatible development and potential encroachment that could result from changes in land use controls/zoning regulations.

1. Continue public awareness and intergovernmental coordination and cooperation in AICUZ implementation with local and State government agencies, including the University of Hawaii.

2. Seek coordination with the City and County of Honolulu's proposed update to the Koʻolaupoko Sustainable Communities Plan and updates of current local planning and zoning ordinances to reflect compatible land use recommendations as outlined in this study.

3. Post the approved AICUZ Study update on MCB Hawaii website, and provide copies of the AICUZ informational brochure to local government agencies and the Hawaii Association of Realtors.

4. Review of other management tools (e.g., Encroachment Control Plan, Military Mission Footprint, Real Estate Acquisition Strategy, Base Master Plan) that may be affected by the updated AICUZ.

5. Continue to conduct community outreach through open house presentation and attendance at neighborhood board meetings.

1 Introduction

The primary goal of the United States (U.S.) Department of Defense's (DOD) Air Installations Compatible Use Zones (AICUZ) Program is to protect the health, safety, and welfare of those living on and near a military airfield while preserving the operational capability of the airfield. The AICUZ Program works to meet this goal by recommending compatible land uses to local communities with planning and zoning authority off-base and application on-base through the military master planning process. AICUZ studies document past, existing and proposed conditions set forth in other documents and there are no proposed changes in operations as a result of this AICUZ update.

MCB Hawaii Kaneohe Bay airfield

This AICUZ Study Update is for Marine Corps Base (MCB) Hawaii Kaneohe Bay located on the Mōkapu Peninsula on the Island of Oahu. The regional location is shown on Figure 1-1. The study provides an analysis of noise and safety impacts based on an existing condition for fiscal year (FY) 2013 and for a prospective future condition, 2018. The analysis uses operations numbers, flight tracks, and flight procedures information provided by MCB Hawaii Kaneohe Bay air operations staff, and aviation tenant organizations. The analysis also uses information obtained from sources such as the City and County of Honolulu, the State of Hawaii, and the U.S. Census Bureau.

This AICUZ update is organized as follows:

- This chapter (Chapter 1) of the study provides background on the AICUZ Program.
- Chapter 2 describes the air installation and local airspace.
- Chapter 3 discusses aircraft types and aircraft operations at the air installation.
- Chapter 4 presents aircraft noise zones, how noise zones are determined, and what prospective future changes are anticipated.
- Chapter 5 discusses aircraft safety issues, including height and obstruction clearance requirements, and accident potential zones (APZs).
- Chapter 6 evaluates the compatibility of surrounding land uses with aircraft operations at MCB Hawaii Kaneohe Bay and presents AICUZ footprint maps and guidelines for compatible land use. It also provides recommendations that can continue to promote land use compatibility consistent with the recommendations of the AICUZ Program.

- Appendices A through D provide supplemental information.

1.1 AICUZ Background

In the early 1970s, the DOD established the AICUZ Program to balance the need for aircraft operations and community concerns over aircraft noise and accident potential. The key to the program's success is found in intergovernmental coordination, which occurs once the reports are approved, published and released to the public. An active local command effort to work with surrounding communities to prevent incompatible development in the vicinity of military airfields is the foundation of the program's success.

The purpose of the AICUZ Program is to achieve compatibility between operations at air installations and neighboring communities by:

a) Protecting the health, safety, and welfare of civilians and military personnel by encouraging land use which is compatible with aircraft operations;

b) Protecting Navy and Marine Corps installation investment by safeguarding the installation's operational capabilities;

c) Reducing noise impacts caused by aircraft operations while meeting operational, training, and flight safety requirements, both on and in the vicinity of air installations; and

d) Informing the public about the AICUZ Program and seeking cooperative efforts to minimize noise and aircraft accident potential impact by promoting compatible development in the vicinity of military air installations.

Under the AICUZ Program, the Department of the Navy[1] (Navy) identifies noise zones as a land use planning tool for local planning agencies. The Navy describes noise exposure using the Day-Night Average Sound Level (DNL). The DNL metric averages noise events that occur over a 24-hour period. Aircraft operations conducted at night (2200 to 0700 hours) are weighted because people are more sensitive to noise during sleeping hours, when ambient noise levels are lower. The DNL contours are displayed on a map and grouped to form noise zones that show the level of noise exposure in the surrounding areas.

The Navy also identifies APZs as a planning tool for local planning agencies. APZs are areas where an aircraft mishap is most likely to occur —and they do not reflect the probability of an accident. APZs follow departure, arrival, and flight pattern tracks and are based on analysis of historic data. The AICUZ includes three APZs—the Clear Zone (CZ), APZ I, and APZ II. For fixed-wing aircraft runways the Clear Zone extends 3,000 feet beyond the runway end and has the highest potential for accidents. APZ I generally extends 5,000 feet beyond the Clear Zone, and APZ II extends 7,000 feet beyond APZ I. APZs may also bend along flight paths to reflect operations more effectively. An accident is more likely to occur in the Clear Zone than in either APZ I or APZ II.

[1] The Department of the Navy is comprised of two uniformed services, the United States Navy and the United States Marine Corps.

Figure 1-1 Regional Location of MCB Hawaii

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The dimension of Clear Zones for rotary-wing runways and helipads for visual and standard instrument flight rules operations is 400 feet long (the width varies). The length of APZs for rotary-wing runways and helipads is 800 feet long (DOD Instruction 4165.57 2011).

Land use development should be compatible with noise zones and APZs around a military airfield. The Federal Aviation Administration (FAA) and the DOD both encourage local communities to ensure that new development or land uses that are proposed, are compatible with military operations and restrict uses or activities that could endanger aircraft and public safety in the vicinity of the airfield, including the following:

- Lighting (direct or reflected) that would impair pilot vision;
- Lighting (direct or reflected) that would attract birds;
- Towers, tall structures, and vegetation that penetrate navigable airspace or are to be constructed near the airfield;
- Uses that would generate smoke, steam, or dust;
- Uses that would generate turbulence, such as wind farms;
- Uses that would attract birds, especially waterfowl; and
- Electromagnetic interference with aircraft communications, navigation, or other electrical systems.

1.2 Purpose, Scope and Authority

The Marine Corps implemented the AICUZ Program at MCB Hawaii Kaneohe Bay to encourage, through local cooperation, compatible development in and around the airfield. The program was initiated locally with the Marine Corps' adoption of a 1976 AICUZ Study for MCAS Kaneohe Bay.

This study was updated in 1983 and again in 1990 to address changes in aircraft mix and operations. The most recent AICUZ study for MCB Hawaii Kaneohe Bay was approved by Commandant of the Marine Corps on 26 March 2003. Subsequent to the 2003 study, the noise analysis was updated as part of the 2012 *Final Environmental Impact Statement for Basing of MV-22 and H-1 Aircraft in Support of III Marine Expeditionary Force (MEF) Elements in Hawaii* (Navy 2012).

The authority for the establishment and implementation of the AICUZ Program is derived from:

- DOD, *Instruction 4165.57, Air Installations Compatible Use Zones*, 02 May 2011, Incorporating Change 1, Effective March 12, 2015;
- Chief of Naval Operations Instruction (OPNAVINST) *11010.36C* and Marine Corps Order (MCO) *11010.16, Air Installations Compatible Use Zones (AICUZ) Program*, 09 October 2008;
- DOD, *Unified Facilities Criteria (UFC) 3-260-01 Airfield and Heliport Planning and Design*, 17 November 2008; and
- Department of Transportation (DOT), FAA Regulations, *Code of Federal Regulations (CFR), Title 14, Part 77, Objects Affecting Navigable Airspace*, 2011.

1.3 Need for MCB Hawaii Kaneohe Bay

The Navy (comprised of the United States Navy and the Marine Corps) needs to ensure the continued ability of MCB Hawaii Kaneohe Bay to support current and evolving mission requirements while promoting the compatible growth and development of the surrounding community. The Navy refers to this condition as "sustainable readiness" and requires the continued use of MCB Hawaii Kaneohe Bay for the following reasons (*MCB Hawaii Strategic Plan 2013-2017*):

- The Navy must maintain the highest state of readiness capabilities in the Pacific and ensure that Marine forces are sufficiently manned, trained, and equipped to meet any crisis or conflict.
- Readiness is maintained with continual development and acquisition of superior weapons systems, and readily available high-quality test and training opportunities; and
- Forces require the weapons, support systems, and operational areas to "train as they fight."

Training requires adequate and unencumbered maneuver space and live fire ranges to support weapons and tactics, techniques and procedures of today and tomorrow to support overseas contingency operations. The addition of new aircraft, such as the MV-22 Osprey tiltrotor aircraft and H-1 Cobra and Huey attack and utility helicopters in Hawaii, is part of the Marine Corps' plan to restructure and rebase its forces in the Pacific over the next ten years, and to better integrate its aviation assets with ground and command elements in the Marine Forces Pacific (MARFORPAC) region of operation. This will eliminate existing rotary-wing deficiencies of the Marine Air-Ground Task Force in Hawaii and the need for work-arounds through gap deployments from elsewhere (Navy 2012).

The need for a fully operational airfield is integral to the base mission. The III Marine Expeditionary Force (MEF) (Hawaii) is one of the primary Marine Air-Ground Task Forces that provides a broad spectrum of response options when our nation's interests are threatened. Coordinating a balanced team of ground, air and logistics assets under a central command, III MEF (Hawaii) is capable of conducting a full range of operations from humanitarian assistance and disaster relief to high intensity combat.

MCB Hawaii manages the installations and natural resources located on approximately 4,500 acres throughout the island of Oahu, including Camp Smith, Kaneohe Bay, Marine Corps Training Area Bellows, Manana Family Housing Area, Pearl City Warehouse Annex, and Puuloa Range Complex. This AICUZ update's focus is on air operations at MCB Hawaii Kaneohe Bay.

1.4 Responsibility for Compatible Land Use

Air installations and local government agencies with planning and zoning authority share the responsibility for preserving land use compatibility near an air installation. Cooperative action by both parties is essential to prevent land use incompatibility. If local governments choose not to implement land development controls within the airfield environment, or are incapable of doing so, the Navy may acquire property rights to protect its operational integrity. However, this alternative is seldom exercised in areas that are already developed.

MCB Hawaii Kaneohe Bay has a twofold responsibility within the AICUZ Program. First, it seeks to reduce aircraft noise impacts, to the extent practicable without compromising flight safety or operational capability, through operational guidance and procedures. Second, the air installation command works with state and local planning officials to implement the objectives of the AICUZ Program and strives to

educate and inform the local civilian community of the mutual benefits of an effective AICUZ Program. The Public Affairs Office (PAO) is responsible for community outreach and engagement at MCB Hawaii Kaneohe Bay and the Community Plans and Liaison Officer (CPLO) is the contact individual.
The local governments have the responsibility to protect the health, safety, and welfare of their respective residents. The primary area of local land use responsibility is the City and County of Honolulu, and the state of Hawaii.

1.5 Previous AICUZ Efforts and Studies

Previous AICUZ efforts and related studies at MCB Hawaii Kaneohe Bay include the following:

a) 1976 AICUZ Study for MCAS Kaneohe Bay

b) 1983 AICUZ Study Update for MCAS Kaneohe Bay:
Reference: (VTN Pacific, Inc. 1983)
- Addressed changes in aircraft mix and operations.

c) 1990 AICUZ Study Update:
Reference: (Belt Collins & Associates 1990)
- Update to 1983 AICUZ noise contours. Reflected the introduction of the F/A-18 aircraft.

d) 1995 Noise Study:
Reference: (Wyle Laboratories 1995)
- Update to the 1990 Noise study reflecting relocation of F/A-18 squadrons, movement of P-3; CH-53D; SH-60; C-130 and HH-65 A aircraft to MCB Hawaii.
- This study along with an update to proposed maintenance run-ups provided by Wyle Laboratories on 2 February 1996, served as the basis for the noise portion of the 2003 AICUZ Study Update.

e) The 2003 AICUZ Study:
Reference: (MCB Hawaii 2003)
- This is the previously approved AICUZ for MCB Hawaii Kaneohe Bay. The *MCBH Kaneohe Bay Air Installations Compatible Use Zones Study* (MCB Hawaii 2003) is being updated with this AICUZ Study.

f) Marine Corps Base Hawaii *Master Plan Final*, December 2006:
- This document describes existing facilities, facilities planning analysis, physical conditions, constraints and land use on base.

g) *Aircraft Noise Study for the Introduction of the P-8A Multi-Mission Maritime Aircraft into the Fleet (WR-07-22),* January 2008:
- This study provided input to the *Final Environmental Impact Statement (EIS) for the Introduction of the P-8A Multi-Mission Maritime Aircraft into the U.S. Navy Fleet*, 2009. A Supplemental EIS was issued in April 2014 (Navy April 2014)

h) Marine Corps Base Hawaii (MCAF Kaneohe) *NASMOD Airfield and Airspace Baseline Update and Introduction of New Aircraft Study (Draft),* 20 March 2008. This document was used for the following noise study:
- *Aircraft Noise Study for MCBH Kaneohe Bay, Hawaii (WR-08-13)* (Wyle Laboratories 2008).

i) Final Environmental Impact Statement for Basing of MV-22 and HV-1 Aircraft in Support of III MEF Elements in Hawaii (Navy 2012)

j) *Final Supplemental Environmental Impact Statement for the Introduction of P-8A Multi-Mission Maritime Aircraft into the U.S. Navy Fleet* (Navy April 2014)

k) *Final Environmental Assessment Relocate Marine Unmanned Aerial Vehicle Squadron Three to Hawaii* (NAVFAC Pacific Division and USMC 2014)

l) 2014 AICUZ Update (new modeling results for this study).

1.6 Changes that Require an AICUZ Study Update

Operational and training requirements, aircraft mix, tempo of aviation activity, maintenance procedures, and community development seldom remain static. Therefore, to reflect current conditions, AICUZ studies are updated periodically. Since the development of the 2003 AICUZ Study for MCB Hawaii Kaneohe Bay, some variables have changed. Two scenarios were used for noise and accident potential impacts in this AICUZ Update, a baseline (existing) scenario reflecting operations in 2013, and a prospective future scenario reflecting changes anticipated after the next 5 years in 2018. The changes in aircraft that occurred between the last AICUZ update in 2003 and 2018 prospective condition are listed in Table 1-1.

Table 1-1 Changes from 2003 (Last AICUZ Update) to 2018 Prospective Scenarios

Changes from 2003 to 2013 Baseline
Transition from CH 53D Sea Stallions to CH 53E Super Stallions
Addition of a new AH-1/UH-1 HMLA Squadron
Addition of C-17 Globemaster
Introduction of MH-60R/S Seahawk
Changes from 2013 to 2018 Prospective
Transition from the current P-3C Orion aircraft to the P-8A Poseidon MMA
Introduction of two squadrons of MV-22 Osprey tilt-rotor aircraft
Continued arrival of based AH-1 Cobra/UH-1 Huey helicopters associated with HMLA squadron
Potential F-35B Joint Strike Fighter transient operations

The potential future impact noise and accident potential analysis was based on the future prospective scenario changes outlined above; the continued operations of other based aircraft, as well as normal transient aircraft operations included in the baseline (existing) scenario. Based aircraft are aircraft based and typically maintained at MCB Hawaii for the majority of the calendar year, while transient aircraft refers to visiting aircraft that support MCB Hawaii units or train at MCB Hawaii for a short period of time during each training event. A more detailed comparison of numbers of based aircraft in each time period can be found in Chapter 2. A discussion of detailed aircraft operations that were used in noise modeling is provided in Chapter 3 of this AICUZ Study.

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2 Installation

This section describes the location, mission, and aircraft base loading of MCB Hawaii Kaneohe Bay. The economic impact of the installation is also described.

2.1 Location and Historical Background

MCB Hawaii Kaneohe Bay is located on the Mōkapu Peninsula on the eastern side of the island of Oahu in the state of Hawaii. Figure 1-1 shows the regional setting of the airfield.

Marine Corps Air Station (MCAS) Kaneohe is the airfield portion of MCB Hawaii. However, for consistency with current nomenclature, references in this AICUZ update will be to MCB Hawaii Kaneohe Bay. The airfield is east of the City of Honolulu and adjacent to the communities of Kaneohe and Kailua on the installation's southern boundary. MCB Hawaii Kaneohe Bay is bounded by Kaneohe Bay on the southeast and the Pacific Ocean on the north and west. Ground access to the installation is primarily along the H-3 freeway from Honolulu, with a second entrance from the Kailua community.

MCAS Kaneohe Bay Gate in the 1950s

President Woodrow Wilson first designated land on the Mōkapu Peninsula for military use in 1918 and set aside 322 acres on the east side of the peninsula for the Army. The Navy began acquiring land on the west side of the peninsula in 1939, and by 1941 had acquired 498 acres. Construction of Kaneohe Naval Air Station (NAS) began on 5 September 1939, as part of the strengthening of the U.S. military presence in the Pacific. It was originally planned as a seaplane base to include five squadrons of seaplanes plus the facilities to support them. In 1941, Navy control of the air and water around the base was expanded by President Franklin D. Roosevelt's orders establishing the Kaneohe Bay Naval Defense Sea Area and the Kaneohe Bay NAS Reservation.

On 7 December 1941, Kaneohe NAS was one of the first military installations to be attacked during the Japanese bombing and suffered severe damage. In reaction to the attack and the advent of war in the Pacific, the military installations on the Mōkapu Peninsula greatly expanded in size and capabilities.

After the American victory at Midway in June 1942, the forward areas moved west to other Pacific Islands, and the role of military bases in Hawaii became focused on supply, repair, and training, as well as planning war strategy. Kaneohe NAS provided those services for aviation-related units. The Army installation, Camp Ulupau, was renamed Fort Hase in 1942.

In 1949, Kaneohe NAS was decommissioned, and the Navy made the land available for lease. All equipment and furniture on the base was moved to Barber's Point NAS on the west side of Oahu, and staffing at Kaneohe NAS was significantly reduced.

On 15 January 1952 the base came to life again, this time under the Marine Corps. It was commissioned MCAS Kaneohe, and included not only the former naval air station, but also the eastern portion of the peninsula formerly known as Fort Hase.

MCAS Kaneohe Bay is an ideal training site for a combined air/ground team. Station Operations and Headquarters Squadron supported flight operations until June 30, 1972, when Station Operations and Maintenance Squadron were commissioned in its place. Station Operations and Maintenance Squadron served until it was disbanded on July 30, 1994 and replaced by Marine Corps Air Facility Kaneohe Bay which continues to serve the operational needs of the aviation community.

In 1993, the Navy moved its P-3 and SH-60B helicopter squadrons to MCAS Kaneohe Bay from Barbers Point. In April 1994 the Marine Corps consolidated installations and facilities (MCAS Kaneohe Bay, Camp H. M. Smith, Molokai Training Support Facility, Manana Family Housing Area, Puuloa Range, and the Pearl City Warehouse Annex) in Hawaii under one command – MCB Hawaii headquartered at MCB Hawaii Kaneohe Bay. Marine Corps Air Facility Kaneohe Bay acquired four Navy P-3 Orion patrol squadrons and one SH-60 Seahawk Anti-Submarine squadron in 1999.

Both natural and manmade constraints to development are present on the installation. Environmentally sensitive areas include conservation areas along the Pacific Ocean. Areas beyond the installation boundary are also constrained. Urban development exists in the communities of Kailua adjacent to the base and Kaneohe across Kaneohe Bay. There is a 500-yard Naval Defensive Sea Area (NDSA), commonly referred to as the offshore security buffer zone around the Mōkapu Peninsula. The NDSA extends from the front gate of MCB Hawaii to Fort Hase beach on the eastern Mokapu Peninsula surrounding all of MCB Hawaii. This area is off-limits to non-DOD civilians. The majority of the installation boundary is surrounded by waters of Kaneohe Bay and Kailua Bay.

2.2 Mission

2.2.1 MCB Hawaii

MCB Hawaii maintains key operations, training, and support facilities, and provides services that are essential for the readiness and global projection of ground combat forces and aviation units, and the well-being, morale, and safety of military personnel, their families and the civilian workforce. MCB Hawaii manages the installations and natural resources located on a total of 4,500 acres throughout the island of Oahu, including Camp Smith, Kaneohe Bay, Marine Corps Training Area Bellows, Manana Family Housing Area, Pearl City Warehouse Annex, Puuloa Range Complex, and Molokai Training Support Facility.

MCB Hawaii Kaneohe Bay airfield, looking southeast.

Navy and Marine Corps units headquartered at MCB Hawaii Kaneohe Bay, include air, ground and combat service support elements; non-operational tenants include a branch health care clinic, a judicial court, a commissary facility, veterinary services and various Marine Corps schools and academies.

Aviation commands and units that are assigned to or supported by MCB Hawaii Kaneohe Bay include:

Marine Aircraft Group 24 (MAG-24): The mission of MAG-24 is to provide combat-ready, expeditionary aviation forces capable of short-notice, worldwide employment to a Marine Air Ground Task Force Operations. It is part of the

1st Marine Aircraft Wing. MAG-24 is presently experiencing an period of growth and transition. Since Marine Heavy Helicopter Squadron (HMH) 463's last deployment for Operation Enduring Freedom in Afghanistan that ended in 2011, all aircraft have been transitioned to the CH-53E (MCB Hawaii 2014). Upon HMH-363's return from combat operations in 2012, they were redesignated Marine Medium Tilt-Rotor Squadron 363 (VMM-363) and moved to MAG-16 in Miramar, California. VMM-363 now flies the MV-22 Osprey and are scheduled to return to MAG-24 beginning in the first quarter of FY17 through the first quarter of FY18. As of 2012, the entire USMC inventory of active duty CH-53D Sea Stallions have been retired.

Today MAG-24 consists of one CH-53E squadron (HMH-463), a Marine Aviation Logistics Squadron (MALS-24), and a Marine Wing Support Detachment (MWSD-24). Beginning in 2012 Marine Light / Attack Helicopter Squadron (HMLA)-367 relocated from MAG-39 in Camp Pendleton to MAG-24 (MCB Hawaii 2014). Upon completion of this period of transition, which is forecasted to stretch into FY17, MAG-24 will consist of one HMH (CH-53E), one HMLA (AH-1/UH-1), one unmanned aerial vehicle squadron (VMU), two VMMs (MV-22), a Marine Wing Support Detachment, and the Marine Aviation Logistics Squadron.

Fleet Logistics Support Squadron Five One (VR-51): Fleet Logistics Support Squadron (VR)-51 is a Naval Reserve Force squadron that maintains and flies the C-20G Gulf-Stream aircraft (also known as the Grey Ghost). It has two C-20 jets whose main mission is to transport senior enlisted and officers to their appointed place of duty. It is capable of flying worldwide.

Commander, Patrol Reconnaissance Wing Two (CPRW-2): CPRW-2 promotes regional security and enhancement of theater security cooperation through close interoperation with allied forces, friendly nations, and other U.S. military services. Provides support to Commander, Patrol and Reconnaissance Forces, Pacific who controls the long range P-3C Orion patrol aircraft. The P-3C aircraft capabilities include anti-submarine warfare, air reconnaissance, aerial mine warfare, air-to-surface missile attack, and maritime shipping surveillance and patrols. Missions also include search and rescue and drug interdiction. CPRW-2 consists of three Patrol/Reconnaissance squadrons (VP-4, VP-9 and VP-47), and one special purpose squadron (VPU-2). CPRW-2 will receive new P-8 Poseidons in the near future to replace their aging platform of P-3C Orion aircrafts.

Helicopter Maritime Strike Squadron Thirty-Seven (HSM-37): HSM-37 was established on 3 July 1975 at Naval Air Station, Barbers Point, Hawaii, and remains the Navy's oldest operational Light Airborne Multi-Purpose System (LAMPS) squadron. They provide highly trained, combat ready detachment for deployment on board U.S. Pacific Fleet air-capable ships and extend shipboard weapons delivery and sensor capabilities through the employment of the versatile MH-60R/S Seahawk helicopter currently.

Unmanned Aerial Vehicle Squadron VMU-3: VMU-3 was relocated from Marine Corps Air Ground Combat Center Twentynine Palms, California to Hawaii to conduct unmanned-aircraft training activities within existing training ranges in the region (NAVFAC Pacific and USMC 2014). This relocation addressed an existing Aviation Combat Element deficiency in Hawaii by adding Unmanned Aircraft Vehicles (UAVs) thereby achieving a balance in the USMC's capabilities in the Pacific and ensuring that Marine forces are sufficiently manned, trained, and equipped to meet any crisis or conflict (NAVFAC Pacific and USMC 2014). Three RQ-7B UAVs, at four aircraft per system, and nine RQ-21A UAVs, at five aircraft per system were relocated for a total of 57 unmanned aircraft (12 RQ-7B and 45 RQ-21A). The relocation was completed in June 2015 included UAV flight training activities in Hawaii, primarily within Special Use Area restricted airspace including at MCB Hawaii Kaneohe Bay and other training ranges on Hawaii. The delivery of the RQ-21A systems is scheduled for 2016 (NAVFAC Pacific and USMC 2014).

Other Users: MCB Hawaii Kaneohe Bay also supports visitors coming enroute to/from overseas as a rest stop or to support local ground based training. Other users of MCAS Kaneohe Bay facilities include transient Marine Corps and Navy squadrons, Air Force (C-17 training[2], fighter jet, cargo aircraft), Army helicopters (CH-47, OH-58, UH-60), foreign nations (P-3s, fighter jets), troop transport, contracted cargo jets, and participants in large scale DOD exercises including the biennial Rim of the Pacific exercise that has been conducted since 1968. Support varies over time and includes transpacific transits, local training and logistics support, as well as support during occasional exercises.

2.3 Description of Air Installation

This section describes airfield facilities and provides information related to operations at MCB Hawaii Kaneohe Bay (MCAS Kaneohe Bay, FAA designation NGF) as found in *Air Operations Manual MCASO Marine Corps Air Station Order P3710.1H* of 9 January 2014. Details of the airfield are illustrated in Figure 2-1.

2.3.1 Airfield Overview and Features

Location. The airfield is located at latitude 21° 27' 30" N and longitude 157° 46' 30" W on the Mōkapu Peninsula on the east side of the island of Oahu approximately 12 miles northeast of Honolulu. Magnetic variation is 10 degrees 8 minutes East, with a 0 minute West annual rate of change. The field elevation is 24 feet above mean sea level, measured at the approach end of Runway 22.

Hours of Operation. The airfield normally operates 0700 to 2400 hours local time Monday- Thursday; Friday 0700 to 2200, Saturday 0800 to 1700 hours local time. The airfield is normally closed on Sundays and federal holidays. Exceptions and adjustments to hours of operation by the Commanding Officer can made as required to meet operational requirements.

Navigational Aids. A class H Tactical Air Navigation (TACAN), NGF, channel 93X is located at the northeast end of Runway 4/22.

Runway. The airfield has a single runway 04/22[3], which slants up. The 7,771 feet long and 200 feet wide runway is constructed of asphalt and concrete and is approved for fixed-wing and helicopter operations. Runway 22 has a 0.3% downhill gradient for the first 3,000 feet. Visual slope indicators are installed on the left side of the runway approximately 1,000 feet from each approach end.

Arresting Gear. E-28 arresting gear is installed (but not always rigged) on the approach ends of Runway 04/22. Due to crew limitations, during an actual emergency requiring the use of the E-28 arresting gear, the recovery crew requires a 10-30 minute response time to rig the gear, depending on the time of day.

Taxiways. All taxiways, with the exception of Taxiway F, are 75 feet wide. Between Taxiway A and Runway 04/22, Taxiway F is 122 feet wide at its narrowest point.

[2] The C-17s based at Hickam Air Force Base do not have their own runway to meet their training requirements and must use the one at MCAS Kaneohe Bay for training purposes.

[3] A runway can normally be used in both directions, and is named for each direction. The two numbers of a runway always differ by 18, representing 180°

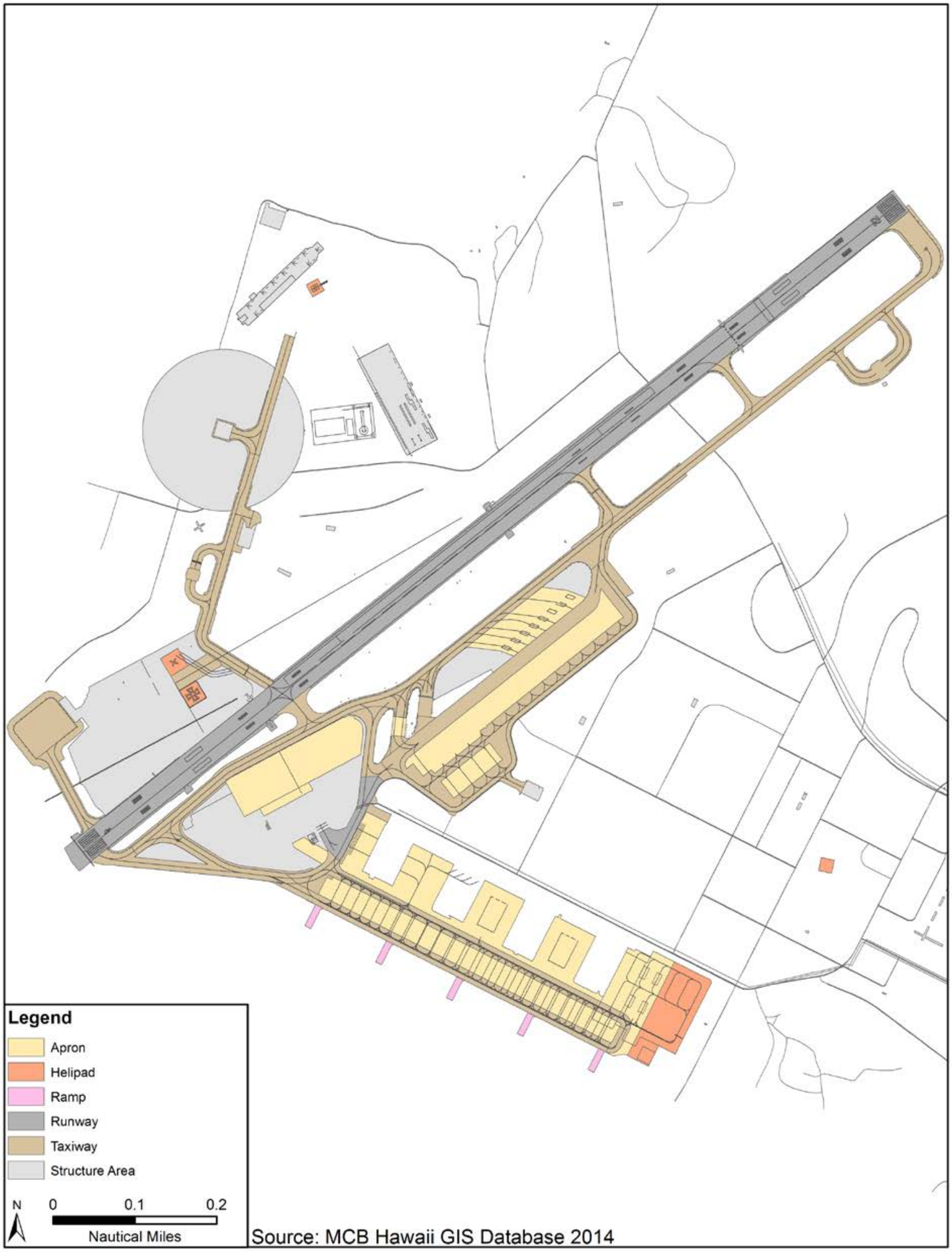

Figure 2-1 Airfield Diagram MCAS Kaneohe Bay

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Helicopter Landing Areas. Authorized helicopter landing areas on airfield include the following:

- Westfield, a helicopter and Landing Craft Air-Cushioned operating area linked to and northwest of Runway 04/22.
- Landing ship helicopter assault (LHA) Pad is painted on the north end of Westfield for helicopter Field Carrier Landing Practice (FCLP).
- Shipboard Landing Pad is a helicopter maritime strike squadron (HSM) pad with an optical shipboard glide slope indicator, lighted for night operations.
- Hangar 101 Helo Pad is located in the southeast corner of the flight line adjacent to and east of Hangar 101 and limited to only tenant command use for arrivals and departures.
- Pad 7 is marked by a painted "H" located southwest of Taxiway F and northwest of Runway 04. It is authorized for single helicopter arrivals, departures and testing.
- Pad 8 is located on the closed Runway 05/23 to the north of Pad 7. It is authorized for single helicopter arrivals, departures and testing.
- ALPHA Taxiway. When specifically authorized by the tower, helicopters may depart from or conduct full stop operations to ALPHA taxiway, except at the Mōkapu road crossing or adjacent to the fuel pit area.
- Landing Zones (LZ) and Drop Zones (DZ). There are also four LZs and two DZs authorized for specific uses.

2.3.2 Service Facilities

Hangar and Parking Areas. There are five aircraft hangars and one intermediate maintenance facility hangar. Transient parking is limited and is by prior permission only.

High power engine run-ups. High power run-ups are conducted in specific designated areas only. These run-ups are normally restricted to the hours of 0600-2200 Monday through Friday and 0800-1800 on Saturday and Sunday. Operational necessity can require that the run-up be conducted outside these designated times. All time deviations must be approved in advance.

Wash Rack and Rinse Facilities. An aircraft wash rack is located at Building 1631. A helicopter rinse facility is located adjacent to the intersection of Taxiway F and Summer Road in the Westfield area. A fixed wing rinse facility is located on the east side of Taxiway A, adjacent to the approach end of Runway 22.

Maintenance. Limited organizational maintenance depot and intermediate maintenance depot facilities are available through MAG-24 and MALS-24.
Fuels. Fuel service is provided by MCB Hawaii Fuels division. Fuel truck and hot pit re-fueling is available.

Meteorological and Oceanographic Weather Facility. Complete weather service facilities are available during airfield operating hours.

2.4 Airspace

MCB Hawaii is surrounded by Class D airspace[4] as shown in Figure 2-2. Class D airspace exists for control of visual flight rules (VFR) traffic within 4.3 statute miles of the center of the airfield up to and including 2,500 feet above ground level and is only operational when the airfield is open. Terminal approach control airspace extends out 35 nautical miles north of the airfield up to 9,000 feet. Kaneohe Approach/Departure Control is responsible for separation and sequencing of all aircraft operating outside the Kaneohe Class D airspace at altitudes above 1,200 feet. Assigned aircraft conduct extensive training operations within the airspace when they are not deployed.

2.5 Base Loading

2.5.1 MCB Hawaii Kaneohe Bay Personnel

In 2012, MCB Hawaii directly employed over 14,000 military and civilian personnel and resident contractors (Marstel-Day 2014). MCB Hawaii Kaneohe Bay is the largest civilian employer in the windward Oahu region.

2.5.2 MCB Hawaii Kaneohe Bay Assigned Aircraft

Home based flight activity is generated by the aircraft assigned to MCB Hawaii. This activity includes its primary mission, such as training or testing, and other missions including various types of support operations. The number and type of historical and projected aircraft assigned to MCB Hawaii Kaneohe Bay are shown on Table 2-1. Some of the home based aircraft are routinely deployed.

[4] Class D airspace is generally airspace from the surface to 2,500 feet above the airport elevation surrounding those airports that have an operational control tower. The configuration of each Class D airspace area is individually tailored and when instrument procedures are published, the airspace will normally be designed to contain the procedures.

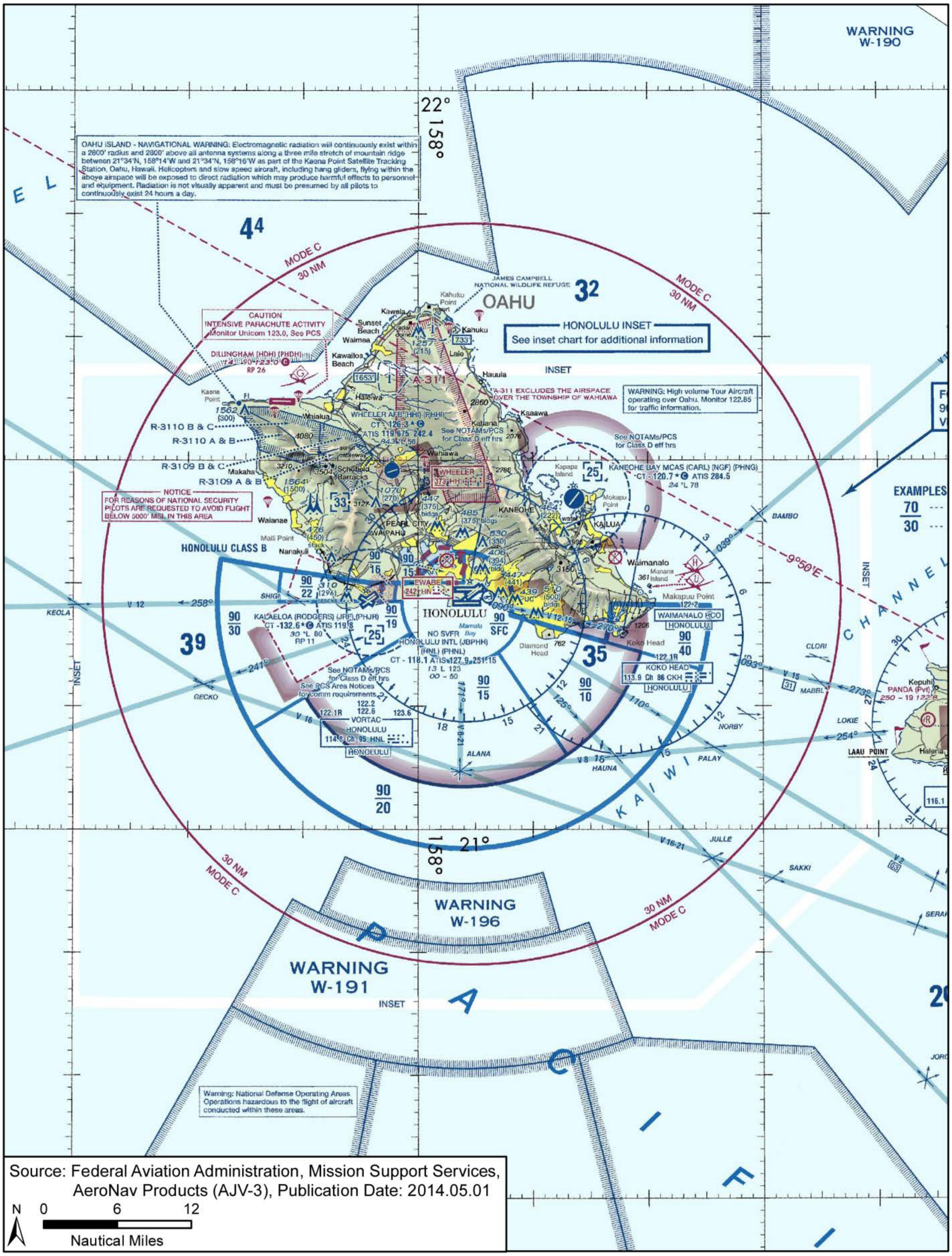

Figure 2-2 MCB Hawaii Airspace Diagram

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Table 2-1 Historical and Projected Aircraft Base Loading

Type Aircraft	Number of Based Aircraft		
	AICUZ Study 2003 (a)	2013 (b)	2018 Future (c)
CH-53D	38	0	0
CH-53E	0	14	14
SH-60R	10	15	21
C-20G	3	5	4
P-3C*	30	16	5
P-8A	0	0	2
Hawker Hunter**	0	2	3
MV-22	0	0	24
AH-1	0	14	18
UH-1	0	7	9
UAV	0	0	12
Totals	81	71	120

Notes: No transient aircraft are included.
UAVs are not modeled due to the low noise emissions as compared to other aircraft.
* Includes aircraft from VP-4, VP-47, VP-9 (one normally deployed); VPU-2, and *ETD (disestablished 2007*)
** See Section 3.2.1.

Sources: (a) MCB Hawaii Kaneohe Bay Air Installations Compatible Use Zones Study (MCB Hawaii Kaneohe Bay 2003)
(b) See Table 3-2 for details
(c) See Table 3-3 for details.

In addition to home based aircraft, transient aircraft also utilize MCB Hawaii Kaneohe Bay. Transient aircraft activity is generated by aircraft assigned to DOD services and other government agencies that use the same airspace. Transient activity may be single transit or reoccurring transits through the airspace, but transient aircraft are not under the operational control of MCB Hawaii Kaneohe Bay. Examples of transient aircraft are provided in Section 3.1.3 and include Air Force cargo aircraft (C-17) based at Hickam Air Force Base (AFB) and the F/A-18C/D combat jet. Around 2017, the F-35 B Joint Strike Fighter may begin to use MCB Hawaii. These aircraft train at MCB Hawaii Kaneohe Bay to support the movement of naval aircraft detachments abroad in preparation for deployment to carriers or for training on the sea range and airspace in the Pacific Ocean.

2.6 Economic Impact

MCB Hawaii is the largest civilian employer in the windward Oahu region. The base and its personnel represent the main client base of most local businesses. MCB Hawaii directly employs 14,335 military and civilians totaling $664.7 million in direct payroll (Marstel-Day 2014). The indirect/induced effect of that employment generates an additional 4,287 jobs. Nearly 93% of the total employment impact (17,243 jobs) occurs in the communities surrounding the installations.

Base spending generates $180 million in economic output, 1,189 jobs, and $7.6 million in state and local taxes. Civilian personnel generate $34.7 million in taxes in neighboring communities. In addition, Marine Corps retirees and their families contribute $5.2 million to the local economic output. The total economic impact of MCB Hawaii on the state is $1.5 billion annually (Marstel-Day 2014).

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3 Aircraft Operations

The main sources of sound at Marine Corps airfields are aircraft operations, including flight operations and engine maintenance operations, or run-ups. The level of sound exposure is related to a number of variables; however, the types of aircraft, number of aircraft operations, and flight tracks are the most significant factors. This section describes home-based aircraft and transient aircraft that frequently visit the Marine Corps airfield at MCB Hawaii Kaneohe Bay, including type and number of operations conducted by these aircraft, and the runways and flight tracks used to conduct the operations. Detailed operational data are presented for existing conditions and for a prospective future condition.

3.1 Aircraft Types

3.1.1 Past, Present, and Future Aircraft Types and Training

Since the 1940s, a wide variety of aircraft have been stationed at Kaneohe Bay. The earliest squadrons of aircraft were patrol bomber (PBY) Catalina flying boats, which came aboard in 1941. During World War II, the air station was a major training base with F-4F Wildcat and P-40 Warhawks and continued to support the PBY long-range reconnaissance aircraft and major training units. Flight instruction for naval aviators before they were sent into a forward combat area was also conducted at Kaneohe Bay. After the war, flying activity became limited and in 1949 NAS Kaneohe Bay was decommissioned. MCAS Kaneohe Bay was commissioned on January 15, 1952.

In 1953, MCAS Kaneohe Bay became the home of the 1st Provisional Marine Air Ground Task Force, Marine Expeditionary Brigade, which would remain in place for almost 40 years. In the late 1960s and 1970s, the evolution of aircraft types at MCAS Kaneohe Bay included the F-4 Phantom and F-8 Crusader, CH-46 and CH-53 rotary-wing aircraft, as well as various types of transient aircraft using the facilities on an interim basis. By the 1980s, the F/A-18 was replacing the F-4 Phantom, and F-8 Crusader and improved and upgraded rotary-wing CH-46 and CH-53 platforms were using the airfield.

Following the 1993 Base Realignment and Closure (BRAC) decisions, in 1994 the F/A-18 and CH-46 aircraft based at MCAS Kaneohe Bay were relocated to mainland installations and replaced by the CH-53D. Also in the late 1990s, four Navy P-3 squadrons and one SH-60 squadron were transferred to MCAS Kaneohe Bay from NAS Barbers Point.

In April 1994, the Marines consolidated its installations and facilities in Hawaii under a single command, MCB Hawaii. In October 1994 the 1st Marine Expeditionary Brigade was deactivated and replaced by the III Marine Expeditionary Force (MEF) (Hawaii). The III MEF (Hawaii) is under the administrative and operational control of its parent organization III MEF headquartered in Okinawa.

At the time of the 2003 AICUZ Update, MCB Hawaii Kaneohe Bay fixed-wing and rotary-wing aircraft based at MCB Hawaii included the CH-53D, SH-60B, P-3C, and C-20G. Today, the CH-53E, SH-60R, AH-1 and P-3C platforms are the predominant aircraft using MCB Hawaii Kaneohe Bay.

In the future, the P-8A Poseidon will replace almost all P-3C aircraft and the MV-22 will be based at MCB Hawaii. The addition of a HMLA (AH-1/UH-1) squadron, and a UAV squadron is also planned. Transient aircraft including the F/A-18, C-17, C-5 as well as a wide variety of other aircraft will continue to use the airport in support of training and military operations within the Pacific theater.

3.1.2 Based Aircraft Details

This section provides details on the P-3C, SH-60R, CH-53E, MV-22, P-8A, C-20G, AH-1, UH-1, and MK-58 which are based at MCB Hawaii.

3.1.2.1 P-3C Orion

Role: The P-3C was originally designed as a land-based, long-range, anti-submarine patrol aircraft. The P-3C first deployed to the Navy in 1969. It has advanced submarine detection sensors such as directional frequency and ranging sonobuoys, and magnetic anomaly detection equipment. The P-3C's mission in the late 1990s evolved to include surveillance of battlespace, either at sea or over land. Its long-range and loiter time provided invaluable assets during Operation Iraqi Freedom as it can view the battlespace and instantaneously provide that information to ground troops. The P-3C is scheduled to be replaced by the P-8A aircraft in the future.

The P-3C is a highly versatile patrol and reconnaissance aircraft.

- Engines: Four Allison T-56-A-14 turboprop engines
- Length, Height, and Wingspan: 117 feet, 33 feet, and 100 feet
- Armament: Up to around 20,000 pounds (9 metric tons) internal and external loads

3.1.2.2 MH-60R/S Seahawk

Role: The MH-60R/S Seahawk is a twin-engined medium lift utility helicopter configured for Anti-Submarine Warfare, Anti-Surface Warfare, Anti-Ship Surveillance and Targeting, vertical replenishment, communications relay, and special operations forces support. The MH-60R/S operates as an integral fighting unit aboard specifically configured ships as the Light airborne multi-purpose system helicopter to keep sea lanes open, and to protect high value military and commercial ships.

MH-60R in Flight

- Engines: Two General Electric T700-GE-401C turboshaft engines
- Length, Height, and Rotor Diameter: 65 feet; 13 to 17 feet; 54 feet
- Armament: Three external store stations; three MK 50 torpedoes or eight AGM-114M Hellfire anti-ship missiles; one machinegun

3.1.2.3 CH-53E Super Stallion

Role: The CH-53E Super Stallion is designed to transport heavy equipment and supplies during ship to shore movement on an amphibious assault and subsequent shore operations.

CH-53E Super Stallion in flight

- Engines: Three General Electric T-64-GE-416 turboshaft engines

- Length, Height, and Rotor Diameter: 100 feet, 28.4 feet, and 79 feet
- Armament: Two XM-218 .50 caliber machineguns

3.1.2.4 MV-22 Osprey

Role: The MV-22 is intended to provide the speed, endurance, radius of action, payload, and survivability needed to support the Marine Corps' operational concepts. It is a vertical/short take off and landing medium lift air vehicle that allows MV-22 squadrons to rapidly embark aboard and operate from air capable ships in support of training, contingency support, combat, and non-combat operations. An EIS for the basing and operation of up to two VMM squadrons (24 aircraft) and one Marine Light Attack Helicopter (HMLA) squadron (27 aircraft) at MCB Hawaii was completed in 2012 (Navy 2012).

The MV-22 Osprey tilt-rotor aircraft

- Engines: Two pivoting Rolls-Royce/Allison engines
- Length, Height, and Wingspan: 57 feet, 22 feet, and 85 feet
- Armament: .50 caliber ramp machinegun

3.1.2.5 P-8A Poseidon Multi-mission Maritime Aircraft

Role: The P-8A multi-mission marine aircraft is a modified Boeing 737-800ERX bringing together a highly reliable airframe with a state of the art mission system. It provides persistent anti-submarine warfare; anti-surface warfare; and intelligence, surveillance and reconnaissance sensors capable of broad-area, maritime and littoral operations (Navy April 2014).

P-8A multi-mission maritime aircraft

- Engines: Two high-bypass CFM56 turbofan engines
- Length, Height, and Wingspan: 130 feet, 42 feet, 117 feet
- Armament: Torpedoes, cruise missiles, bombs and mines

3.1.2.6 C-20G Gulfstream IV

Role: The C-20G aircraft is capable of all-weather, long-range, high speed non-stop flights between nominally suited airports. The C-20G normally operates with a crew of four and can carry up to 26 passengers, 6,000 pounds of cargo or a combination of passengers and cargo. The C-20G is operated by Fleet Logistics Support Wing Detachment at MCB Hawaii Kaneohe Bay.

C-20 G Gulfstream IV

- Engines: Two Rolls-Royce Spey Mark 511-8 turbofan engines
- Length, Height, and Wingspan: 83 feet, 24 feet, 78 feet
- Armament: N/A

3.1.2.7 AH-1Z Super Cobra/Viper

Role: The AH-1Z Super Cobra/Viper is a day/night Marine Corps attack helicopter that provides enroute escort for assault helicopters and their embarked forces. The primary mission as an armed tactical helicopter capable of helo close air support, low altitude and high speed flight, is tactical search and acquisition, reconnaissance by fire, multiple weapons fire support and point target attack of armor.

AH-1Z Super Cobra

- Engines: Two General Electric T700-GE-401C turboshaft engines
- Length, Height, and Rotor diameter: 58 feet, 14 feet, and 48 feet
- Armament: One M197 three barrel 20 mm machinegun; AGM-114 Hellfire and AIM-9 Sidewinder missiles; and 2.75 inch (70 mm) Hydra 70 or APKWS II rockets

3.1.2.8 UH-1Y

Role: The UH-1Y is a twin-piloted helicopter used in command and control, resupply, casualty evacuation, liaison and troop transport. It provides utility combat support to the landing force commander during ship-to-shore movement and subsequent operations ashore.

UH- 1Y

- Engines: Two General Electric T700GE-401C
- Length, Height, and Rotor diameter: 58 feet, 15 feet, and 49 feet
- Armament: Crew served M-240D 7.62 mm machinegun, or .5 BMGGAU-16/A caliber machinegun, or GAU-17/A 7.62 mm machinegun. The helicopter can also carry two 70 mm rockets

3.1.2.9 MK-58 Hawker Hunter

Role: The MK-58 is a transonic single seat fighter / ground attack monoplane used in tracking and targeting training for the Pacific Fleet and ground unit close air support training. This jet aircraft is painted in a light and dark gray camouflage pattern.

MK-58 Hawker Hunter

- Engine: Rolls-Royce Avon MK 207 turbine engine
- Length, Height, and Wingspan: 46 feet, 13 feet, 34 feet
- Armament: N/A

3.1.3 Transient Aircraft

Transient aircraft include the C-17 III, fighter attack jets (F/A-18C/D), large jets (B-767, B-747, C-5, An-124), medium jets (C-40, B-737, P-8, B-757), small jets (C-20, C-21/26), propeller planes (C-130, C-26, P-3), rotary wing aircraft (H-3/60/65, B-407/412) and the 4th Force Reconnaissance. The F-35B Joint Strike Fighter may begin visiting the airfield beginning in 2017. Details of the C-17 III, F/A-18C/D, B-737-700, and F-35B are provided below as examples of transient aircraft.

3.1.3.1 C-17 Globemaster III

Role: The C-17 III is a long-range military transport that can operate through small, austere airfields. It can take off on runways as short as 3,000 feet. Cargo is loaded onto the aircraft through a large aft door that accommodates military vehicles and virtually all of the Army's and Marine Corps' air-transportable equipment. The C-17 is capable of rapid strategic delivery of troops and all types of cargo to main operating bases or directly to forward bases in the deployment area. The aircraft is also able to perform tactical airlift and airdrop missions when required. Pacific Air Forces operates aircraft at Joint Base Pearl Harbor-Hickam, Hawaii. The C-17 III is a transient aircraft based at Hickam AFB. It sometimes uses MCB Hawaii for practice and transport of Marine forces.

C-17 Globemaster

- Engines: Four Pratt & Whitney F117-PQ -100 turbofan engines
- Length, Height, and Wingspan: 174 feet; 55 feet; 170 feet
- Armament: N/A

3.1.3.2 F/A-18C/D Hornet

Role: The Marine Corps F/A-18 C (single seat) and D (two seats) will continue to fly until replaced by the F-35B Joint Strike Fighter in the next decade.

- Engines: Two F404-GE-402 turbofan engines
- Length, Height, and Wingspan: 56 feet, 15 feet, 40 feet
- Armament: Up to 13,700 pound of external ordnance, including air-to-air and air-to-ground ordnance as well as a M61A1 20mm canon

FA-18 Hornet

3.1.3.3 B-737-700

Role: The Boeing 737 is a heavy commercial passenger aircraft. The US Navy version of B-737-700C is a convertible version where the seats can be removed to carry cargo instead. There is a large door on the left side of the aircraft.

B-737-700

- Engine: Two CFM56 engines
- Length, Height, and Wingspan: 110 feet, 47 feet, 112 feet
- Armament: N/A

3.1.3.4 F-35B

Role: The future F-35B Joint Strike Fighter is a technologically advanced fifth-generation strike fighter designed to operate from conventional runways and nuclear-powered aircraft carriers. The F-35 is a single-engine aircraft, equipped with state-of-the art technology that makes it more difficult to detect on radar, and capable of greater communication with other airborne and ground-based units. The F-35B is the short take-off/vertical landing variant of this aircraft.

Future F-35B Joint Strike Fighter

- Engine: Pratt Whitney F135 engine
- Length, Height, and Wingspan: 51 feet, 14 feet, 35 feet
- Armament: N/A

3.2 Aircraft Flight Operations

Table 3-1 provides a historical perspective of aircraft flight operations at the airfield from 1983 through 2013. Over this period, military peak operations totaling 108,393 occurred in 1986 and a low of 24,270 military operations occurred in 1995. Over the past five years military operations have averaged 40,675 operations annually representing about 87 percent of the total operations at this airfield. Civilian flight operations represent all non-military aircraft flights at the airfield such as military personnel transporting and cargo flights using civilian aircraft.

Table 3-1 Historical Annual Flight Operations at MCB Hawaii

Year	MCB Hawaii Kaneohe Bay Annual Flight Operations				
	Military Aircraft		Civilian Aircraft		Totals
	Navy/Marine Corps	Other	Air Carrier	General Aviation[1]	
1983	75,205	6,124	189	2,877	84,395
1984	79,585	8,707	164	4,064	92,520
1985	64,364	5,839	3,881	38	74,122
1986	100,500	7,893	3,968	543	112,904
1987	99,742	7,116	4,058	839	111,755
1988	78,471	5,798	Not available		
1989	82,781	3,241	Not available		
1990	75,864	4,113	512	5,108	85,597
1991	55,478	1,814	484	3,986	61,762
1992	59,357	2,642	799	3,401	66,199
1993	56,168	1,221	783	3,503	61,675
1994	36,915	2,987	112	3,227	43,241
1995	22,123	2,147	200	2,148	26,618
1996	26,861	1,991	65	1,561	30,476
1997	37,093	1,969	21	3,696	42,779
1998	39,257	2,038	22	3,242	44,559
1999	58,537	3,248	452	7,320	69,557
2000	58,693	3,639	11	24	62,367
2001	63,725	3,426	2	55	67,208
2002	66,012	5,526	15	292	71,845
2003	69,775	5,540	58	71	75,444
2004	52,406	3,449	8	303	56,166
2005	47,028	2,767	19	263	50,077
2006	37,212	5,446	15	754	43,427
2007	40,857	6,984	48	328	48,208
2008	42,451	7,884	25	716	51,076
2009	41,424	5,711	47	414	47,596
2010	38,062	7,015	118	1,377	46,572
2011	40,583	556	88	1,319	42,546
2012	42,276	6,335	147	773	49,531
2013	41,031	4,113	91	546	45, 781

Notes: [1] Includes civil flights, private or commercial not operating on regularly scheduled routes

Sources**:** MCB Hawaii, *Air Traffic Activity Reports (2000-2013)*; Wyle Laboratories WR-95-16; WR-07-22, WR-08-13.

3.2.1 Detailed Aircraft Flight Operations

Two flight operations scenarios were used for noise modeling: a Baseline scenario and a Prospective Future scenario. The flight operations used for the Baseline or existing condition are derived based on average operations between 2009 and 2013 and are shown in Table 3-2, totaling a little over 46,000 annual operations. Flight operations for the Prospective condition are shown in Table 3-3. The prospective future conditions scenario based on slightly more than 61,000 annual operations reflects the DOD plans for the potential future aircraft changes at MCB Hawaii Kaneohe Bay outlined below:

- Transition from the current P-3C Orion aircraft to the P-8A Poseidon MMA;
- Introduction of two squadrons of MV-22 Osprey tilt-rotor aircraft;
- Increase number of based AH-1 Cobra/UH-1 Huey helicopters associated with HMLA squadron; and
- Addition of one UAV squadron.

Other based operations as well as transient operations will continue. The overall inputs were confirmed in interviews and discussions with MCB Hawaii personnel in December 2013 before being consolidated in the noise study used in this AICUZ update.

It should be noted that this AICUZ update made a couple of conservative assumptions in predicting noise from based Hawker Hunter operations and potential future transient operations from F-35B Joint Strike Fighter:

- Transient FA-18C/D Hornet operations are generally the primary contributor to the noise footprint at most locations around the airfield. Transient Hornet aircraft engage in air-to-air combat training in offshore airspace. One aircraft associated with Hornet training operations is the based Hawker Hunter which serves as an aggressor aircraft for the Hornets. In order to account for the potential variation in the number of annual transient Hornet operations and for purposes of the AICUZ update and DNL computations, the Hawker Hunter operations were conservatively modeled as Hornet aircraft (as indicated in Tables 3-2 and 3-3), even though the Hawker Hunter produces less noise than a Hornet on a single-event basis. This approach results in a slightly larger, more conservative noise footprint as presented in the AICUZ update.

- In the 2017 time frame, MCB Hawaii would have potential to involve Joint Strike Fighter F-35B transient operations as compared to F/A-18C/D operations considered in this AICUZ update for the Prospective scenario. Since F/A-18C/D in-flight noise reference levels are generally comparable to F-35B as summarized *in Final Environmental Impact Statement for Navy F-35C West Coast Homebasing* (May 2014), the AICUZ noise footprint developed in this update reflects the Prospective scenario.

3.2.2 Runway and Flight Track Utilization

At MCB Hawaii Kaneohe Bay, Runway 04 is used for most take offs and landings because of the prevailing winds. Runway 22 is also used for take offs and landings. Rotary-wing aircraft also operate from Pads 7, 8, 101, and Westfield Pad for certain operations.

The modeled existing and prospective Average Annual Day (AAD) Aircraft Operations by flight track were used to develop noise contours and APZs based on annual flight operations listed in Tables 3-2 (baseline) and 3-3 (prospective). NOISEMAP, the DOD suite of programs used to generate noise contours, uses AAD events per flight track to compute the noise exposure around airfields. An event is defined as a take off operation, a landing operation, or a combination of both when the aircraft remains in the vicinity of the airfield in a closed circuit.

Flight tracks depicted in Figures 3-1 through 3-8 represent "typical" operations. An airfield operation is any take off or landing at an airfield. The take off and landing may be part of a training maneuver (or "pattern") in the vicinity of the runways or may simply be a departure or arrival of an aircraft. Several basic flight operations conducted at MCB Hawaii Kaneohe Bay are described below:

- Departure – an aircraft taking off from a runway.
- Non-break Arrival – an aircraft straight in landing on a runway.
- Overhead Arrival – a special type of approach in that instead of a straight-in, the aircraft splits off to the left or right making a spiral-like descent to the ground, using visual flight rules.
- TACAN (tactical air navigational) system arrival – TACAN is a navigation system used by military aircraft during approach. It provides the pilot with bearing and distance to a runway information from a ground unit.
- Touch and Go – An aircraft lands and takes off on a runway without coming to a full stop. After touching down, the pilot immediately goes to full power and takes off again.
- Ground Controlled Approach (GCA) Box – Ground Controlled Approach through establishing a GCA pattern, called the "Box" pattern, which is designed to accommodate repeated practice radar approaches.
- Hover Pattern Touch and Go – Helicopter performs touch and go in hover mode.
- Autorotation Touch and Go – Helicopter autorotation is used to perform power off during landing and then take off.

The departures tracks are shown on Figure 3-1 for fixed-wing aircraft and rotary-wing aircraft. The arrivals tracks are divided into non-break, overhead arrival, and TACAN arrival as shown on Figures 3-2 to 3-4, respectively. Touch and go, GCA box, hover touch and go, and autorotation touch and go flight operations are shown on Figures 3-5 to 3-8, respectively.

The flight tracks depicted represent predominant flight paths of aircraft. Noise modeling is based on the use of predominant flight paths because these paths dominate the noise environment around an airfield. Flight paths are represented as single lines on maps, but actual flight paths may vary because of aircraft performance, pilot technique, and weather conditions. Therefore, an actual flight path (track) is better thought of as a band rather than a single line.

3.3 Pre-flight and Maintenance Run-up Operations

Table 3-4 lists the modeled maintenance run-up activities for the baseline condition. The table includes the aircraft type, the engine type, location, magnetic heading, the number of annual operations by acoustical day and night, the power setting, and duration in minutes at each power setting. An aerial view of the run-up locations listed in the table is provided in Figure 3-9. The P-3C was modeled at three different locations including the Outdoor Test Stand, located some 600 feet to the north of the runway mid-field, the Flight Line (FL) to the south of the runway, and two High Power Turn areas about 300 feet south of Runway 04. Because of their proximity, the two high power areas were modeled as one site (HP). The CH-53E was modeled at the Outdoor Test Stand and the Westfield Hover Pad. The SH-60 aircraft was modeled at the Westfield Hover Pad.

Run-up operations from the Baseline scenario were scaled according to the changes in flight operations by applicable aircraft types. P-8A run-ups were taken directly from the MMA study (Navy April 2014) and are shown in Table 3-5 along with the modeled run-up operations for other aircraft for the Prospective scenario. The MMA study modeled two types of maintenance run-up operations for the P-8A: leak checks and pressure checks. These operations were modeled at the FL. The location and profiles of maintenance run-up operations for aircraft present in the baseline case would be the same in the prospective case.

Tables 3-4 and 3-5 present the maintenance run-up operations for the baseline (existing) and prospective (future) conditions used for modeling noise. Maintenance run-up locations are shown in Figure 3-9.

Table 3-2 Baseline (CY13) Annual Flight Operations at MCB Hawaii Kaneohe Bay

Category	Aircraft Type or Group	Modeled Aircraft Type	Departure			Non-Break Visual Arrival			Instrument Arrival (TACAN)			Overhead Break Arrival			Touch and Go (1)			GCA Box (1)			TOTAL		
			Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total
Based	P-8A MMA	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	P-3C	P-3C	3,000	538	3,538	1,500	163	1,663	1,500	375	1,875	-	-	-	12,273	526	12,799	928	21	949	19,201	1,623	20,824
	MH-60R	SH-60B	243	12	255	243	12	255	-	-	-	-	-	-	3,415	66	3,481	34	8	42	3,935	98	4,033
	CH-53E	CH-53E	599	149	748	426	284	710	36	2	38	-	-	-	1,662	468	2,130	111	1	112	2,834	904	3,738
	AH-1 / UH-1	AH-1W	726	182	908	518	345	863	43	2	45	-	-	-	1,984	603	2,587	135	1	136	3,406	1,133	4,539
	MV-22	n/a	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	ATAC Hawker Hunter	FA-18C/D	233	-	233	19	-	19	209	-	209	5	-	5	466	-	466	700	-	700	1,632	-	1,632
	C-20 (USMC)	C-20	213	15	228	188	15	203	25	-	25	-	-	-	193	25	218	45	15	60	664	70	734
	C-20 (USN VR-51)	C-20	115	15	130	52	21	73	31	26	57	-	-	-	60	30	90	40	20	60	298	112	410

Table 3-2 Baseline (CY13) Annual Flight Operations at MCB Hawaii Kaneohe Bay (cont'd)

Category	Aircraft Type or Group	Modeled Aircraft Type	Departure			Non-Break Visual Arrival			Instrument Arrival (TACAN)			Overhead Break Arrival			Touch and Go [1]			GCA Box [1]			TOTAL		
			Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total
Transient	Fighter/ Attack	FA-18C/D	367	3	370	109	-	109	239	6	245	16	-	16	13	-	13	-	-	-	744	9	753
	C-17	C-17	425	12	437	383	11	394	42	1	43	-	-	-	4,800	-	4,800	400	-	400	6,050	24	6,074
	Large Jet (B-767, B-747, C-5, An-124,…)	C-5A	74	16	90	68	15	83	5	2	7		-	-	-	-	-	-	-	-	147	33	180
	Medium Jet (C-40, B-737, P-8, B-757)	737-700	148	16	164	148	16	164	-	-	-	-	-	-	-	-	-	-	-	-	296	32	328
	Small Jet (C-20, C-21/26)	C-20	231	25	256	231	25	256	-	-	-	-	-	-	333	-	333	484	20	504	1,279	70	1,349
	Propeller (C-130, C-26, P-3)	P-3C	330	40	370	327	40	367	3	-	3	-	-	-	46	2	48	46	2	48	752	84	836
	Rotary-wing (H-3/60/65, B-407/412)	CH-53E	112	-	112	108	-	108	4	-	4	-	-	-	711	-	711	27	-	27	962	-	962
	4th Force Reconnaissance	Not Modeled	6	-	6	6	-	6	-	-	-	-	-	-	-	-	-	-	-	-	12	-	12
Based			**5,129**	**911**	**6,040**	**2,946**	**840**	**3,786**	**1,844**	**405**	**2,249**	**5**	**-**	**5**	**20,053**	**1,718**	**21,771**	**1,993**	**66**	**2,059**	**31,970**	**3,940**	**35,910**
Transient			**1,693**	**112**	**1,805**	**1,380**	**107**	**1,487**	**293**	**9**	**302**	**16**	**-**	**16**	**5,903**	**2**	**5,905**	**957**	**22**	**979**	**10,242**	**252**	**10,494**
Total			**6,822**	**1,023**	**7,845**	**4,326**	**947**	**5,273**	**2,137**	**414**	**2,551**	**21**	**-**	**21**	**25,956**	**1,720**	**27,676**	**2,950**	**88**	**3,038**	**42,212**	**4,192**	**46,404**

Note:

1) Each circuit counted as two operations

Source: Wyle Laboratories, March 27, 2014.

Table 3-3 Prospective (CY18) Annual Flight Operations at MCB Hawaii Kaneohe Bay

Category	Aircraft Type or Group	Modeled Aircraft Type	Departure			Non-Break Visual Arrival			Instrument Arrival (TACAN)			Overhead Break Arrival			Touch and Go [1]			GCA Box [1]			TOTAL		
			Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total
Based	P-8A MMA	B-737-700	101	3	104	100	3	103	1	-	1	-	-	-	-	-	-	-	-	-	202	6	208
	P-3C	P-3C	600	100	700	300	35	335	300	65	365	-	-	-	4,000	-	4,000	400	-	400	5,600	200	5,800
	MH-60R	SH-60B	660	32	692	659	33	692	-	-	-	-	-	-	9,263	178	9,441	91	23	114	10,674	265	10,939
	CH-53E	CH-53E	1,278	319	1,597	910	607	1,517	76	4	80	-	-	-	3,551	1,000	4,551	237	2	239	6,052	1,932	7,984
	AH-1 / UH-1	AH-1W	2,278	569	2,847	1,623	1,082	2,705	135	7	142	-	-	-	6,223	1,892	8,115	423	4	427	10,682	3,554	14,236
	MV-22	MV-22B	2,418	127	2,54	1,185	62	1,247	1,233	65	1,298	-	-	-	1,766	93	1,859	973	52	1,025	7,575	399	7,974
	ATAC Hawker Hunter	FA-18C/D	351	-	351	29	-	29	314	-	314	8	-	8	699	-	699	1,050	-	1,050	2,451	-	2,451
	C-20 (USMC)	C-20	213	15	228	188	15	203	25	-	25	-	-	-	193	25	218	45	15	60	664	70	734
	C-20 (USN VR-51)	C-20	115	15	130	52	21	73	31	26	57	-	-	-	60	30	90	40	20	60	298	112	410

Table 3-3 Prospective (CY18) Annual Flight Operations at MCB Hawaii Kaneohe Bay (cont'd)

Category	Aircraft Type or Group	Modeled Aircraft Type	Departure			Non-Break Visual Arrival			Instrument Arrival (TACAN)			Overhead Break Arrival			Touch and Go [1]			GCA Box [1]			TOTAL		
			Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total	Day (0700-2200)	Night (2200-0700)	Total
Transient	Fighter/Attack	FA-18C/D	596	-	596	334	42	376	51	3	54	166	-	166	50	-	50	-	-	-	1,197	45	1,242
	C-17	C-17	425	12	437	383	11	394	42	1	43	-	-	-	4,800	-	4,800	400	-	400	6,050	24	6,074
	Large Jet (B-767, B-747, C-5, An-124,…)	C-5A	66	16	82	60	16	76	4	2	6	-	-	-	-	-	-	-	-	-	130	34	164
	Medium Jet (C-40, B-737, P-8, B-757)	737-700	68	5	73	68	5	73	-	-	-	-	-	-	-	-	-	-	-	-	136	10	146
	Small Jet (C-20, C-21/26)	C-20	231	25	256	231	25	256	-	-	-	-	-	-	333	-	333	484	20	504	1,279	70	1,349
	Propeller (C-130, C-26, P-3)	P-3C	135	12	147	134	12	146	1	-	1	-	-	-	18	1	19	18	1	19	306	26	332
	Rotary-wing (H-3/60/65, B-407/412)	CH-53E	112	-	112	108	-	108	4	-	4	-	-	-	711	-	711	27	-	27	962	-	962
	4th Force Reconnaissance	Not Modeled	6	-	6	6	-	6	-	-	-	-	-	-	-	-	-	-	-	-	12	-	12
Based			**8,014**	**1,180**	**9,194**	**5,046**	**1,858**	**6,904**	**2,115**	**167**	**2,282**	**8**	**-**	**8**	**25,755**	**3,218**	**28,973**	**3,259**	**116**	**3,375**	**44,197**	**6,539**	**50,736**
Transient			**1,639**	**70**	**1,709**	**1,324**	**111**	**1,435**	**102**	**6**	**108**	**166**	**-**	**166**	**5,912**	**1**	**5,913**	**929**	**21**	**950**	**10,072**	**209**	**10,281**
Total			**9,653**	**1,250**	**10,903**	**6,370**	**1,969**	**8,339**	**2,217**	**173**	**2,390**	**174**	**-**	**174**	**31,667**	**3,219**	**34,886**	**4,188**	**137**	**4,325**	**54,269**	**6,748**	**61,017**

Note:

1) Each circuit counted as two operations

Source: Wyle Laboratories, March 27, 2014

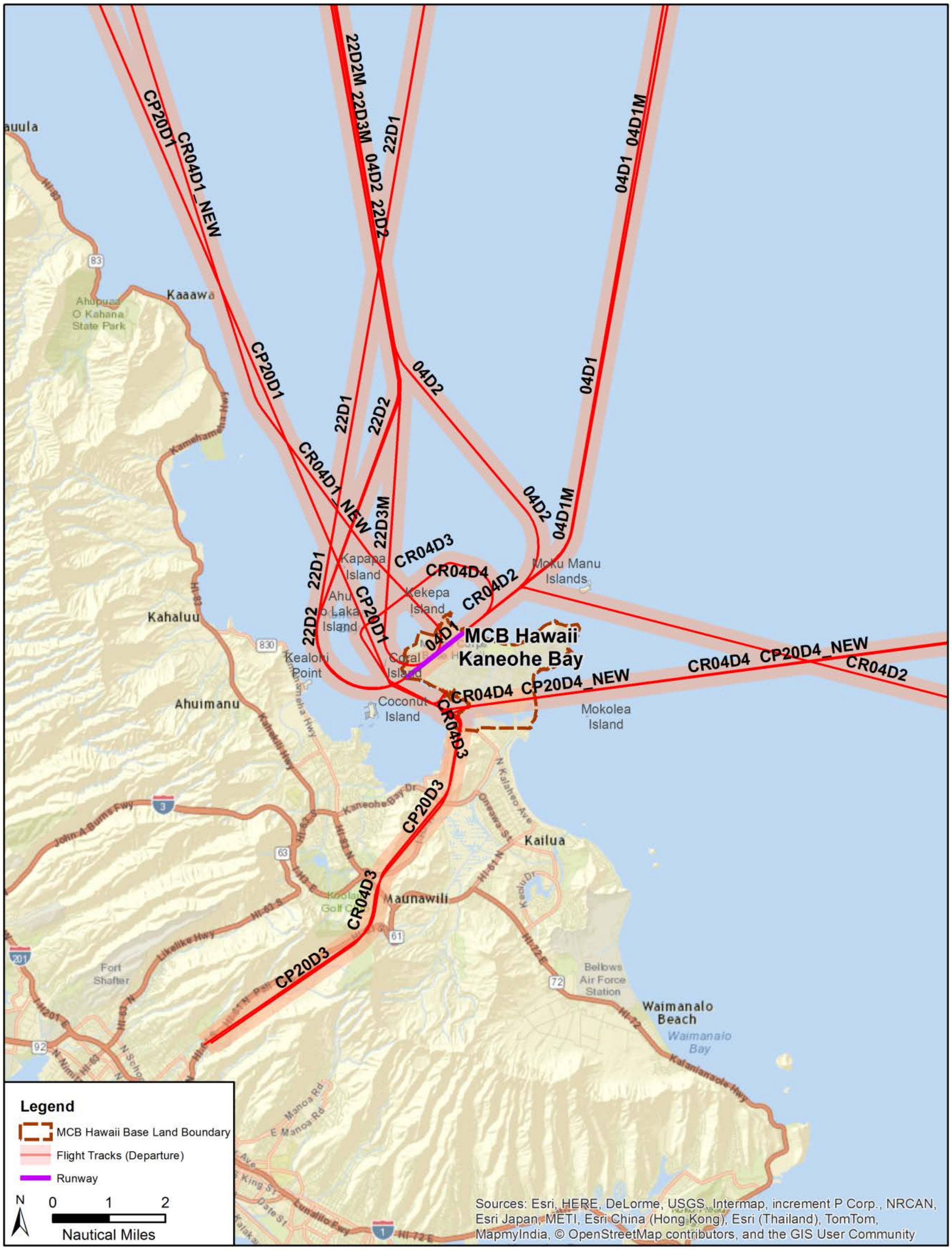

Figure 3-1 Departure Flight Tracks

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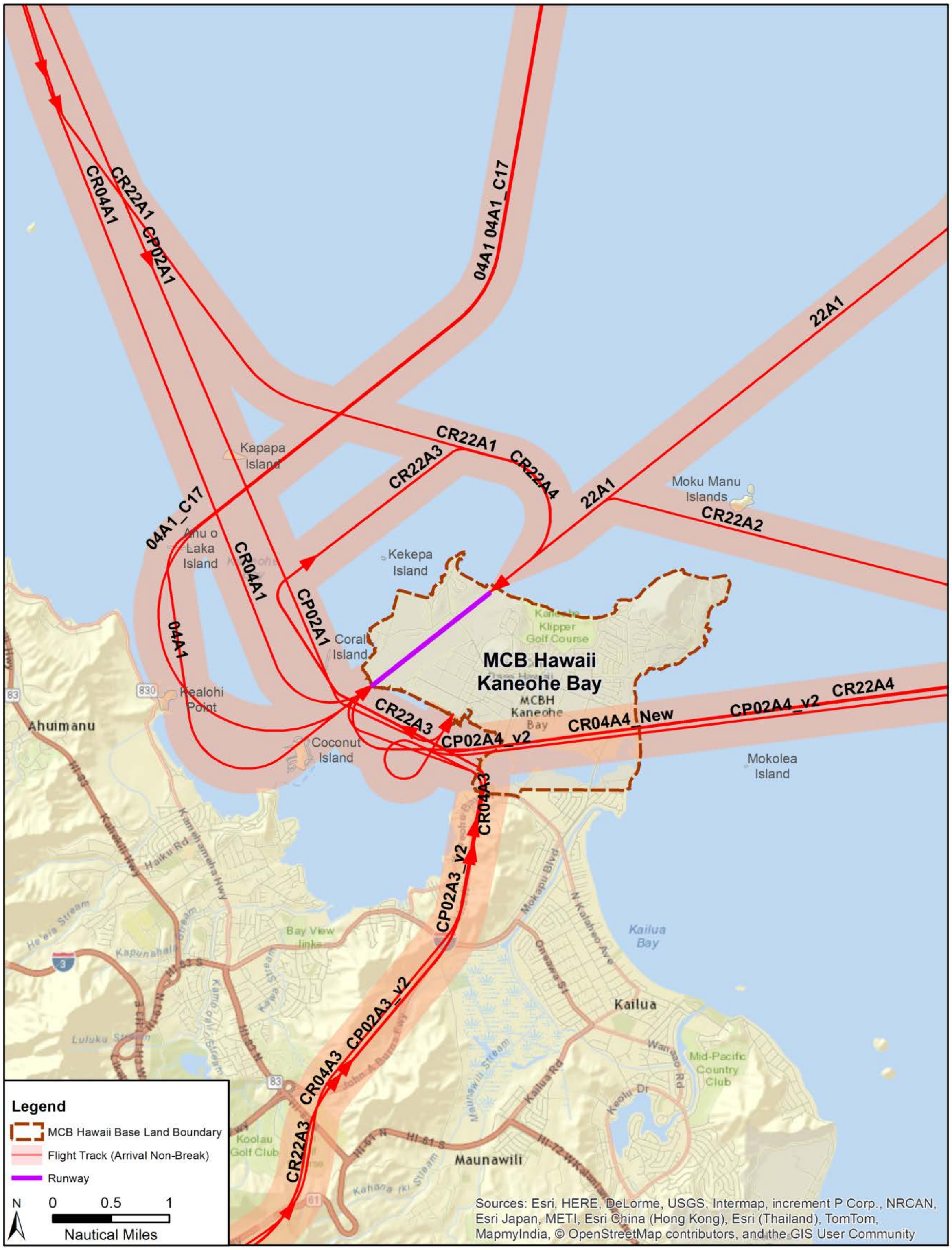

Figure 3-2 Arrival Non-Break Flight Tracks

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Figure 3-3 Arrival Overhead Break Flight Tracks

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Figure 3-4 Arrival TACAN Flight Tracks

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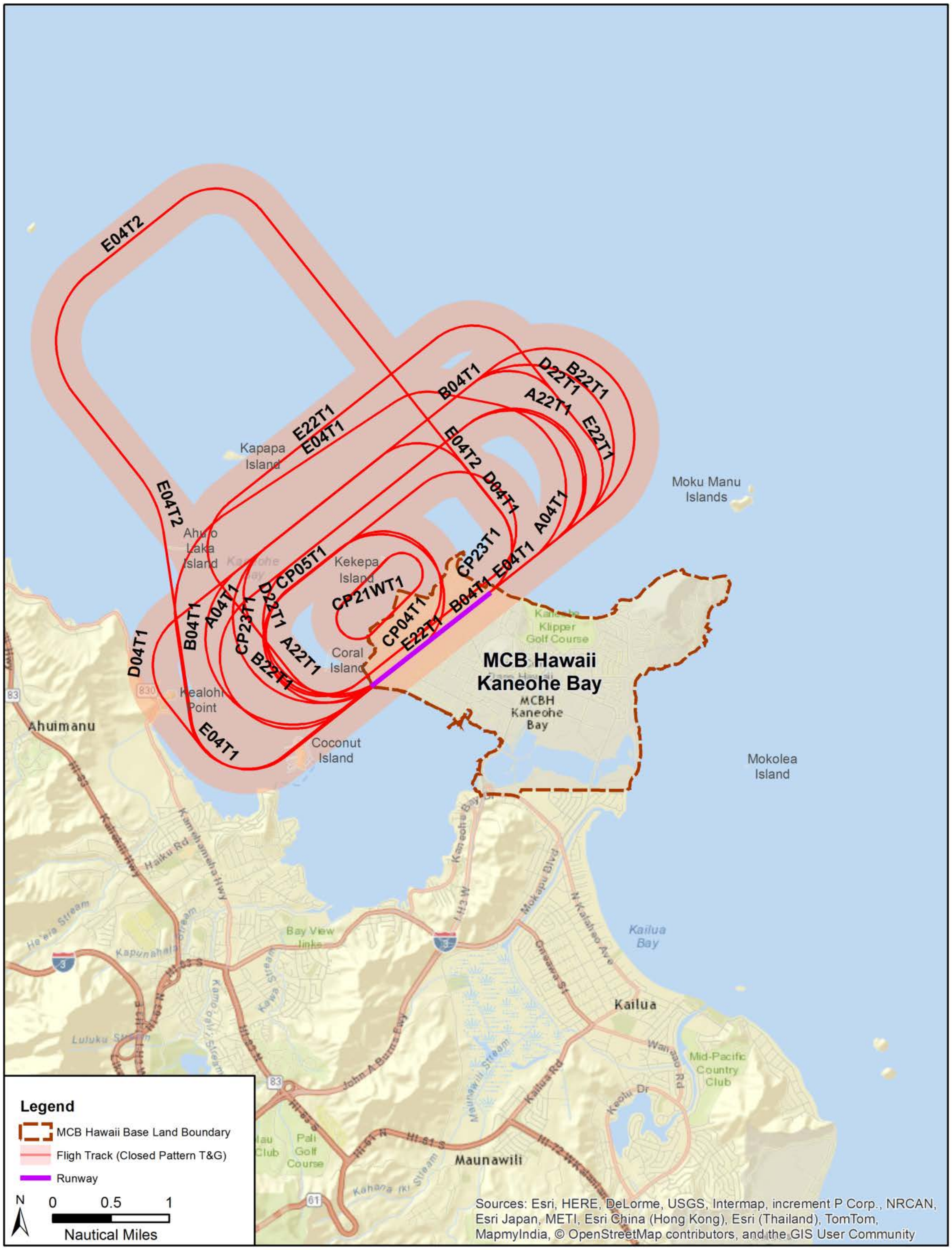

Figure 3-5 Touch and Go Pattern Flight Tracks

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Figure 3-6 GCA Box Flight Tracks

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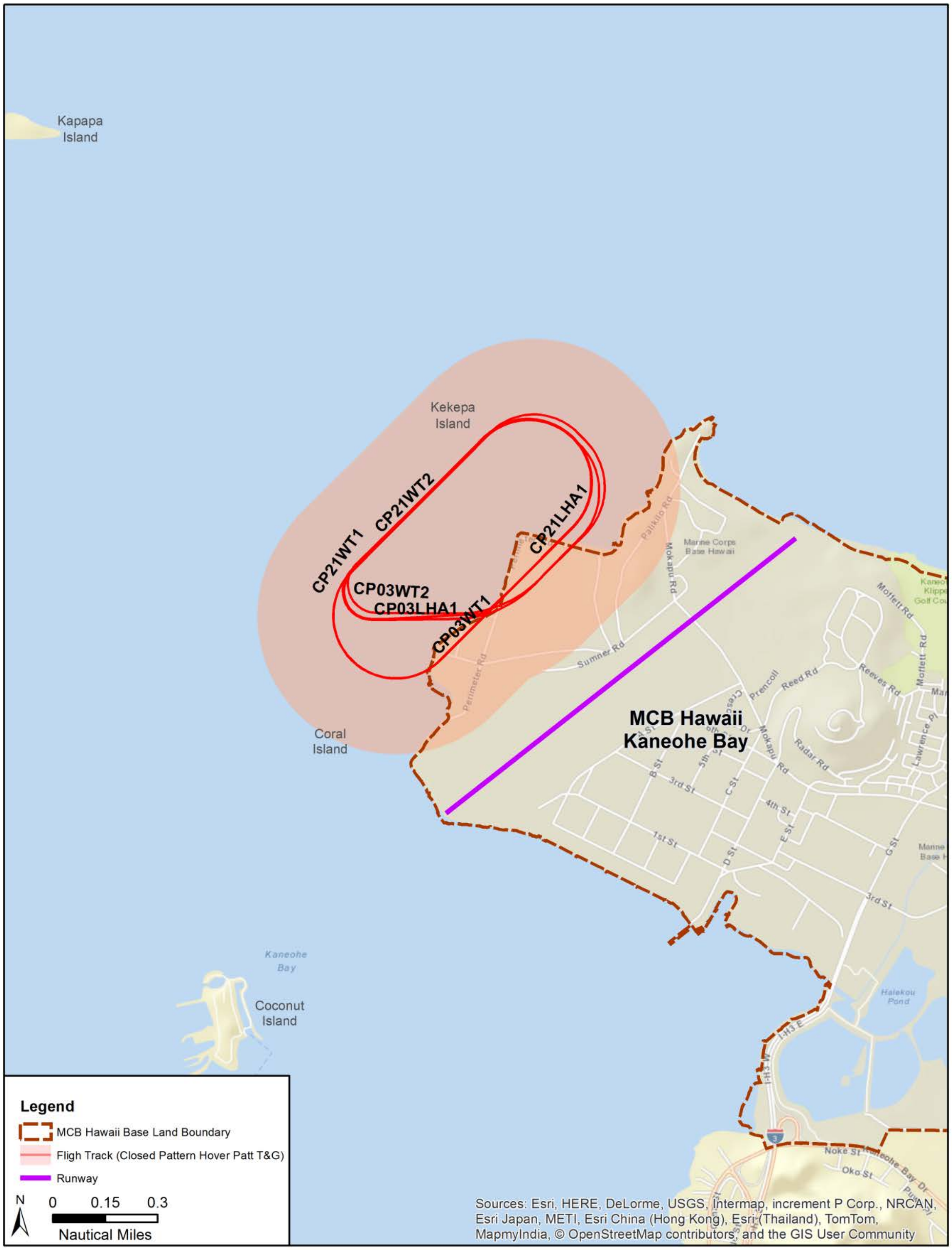

Figure 3-7 Hover Touch and Go Flight Tracks

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Figure 3-8 Autorotation Touch and Go

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Figure 3-9 MCB Hawaii Maintenance Run-up Locations

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Table 3-4 MCB Hawaii Baseline Annual Engine Maintenance Run-up Events

Aircraft Type	Engine Type	Run-up Type	Run-up Location / ID	Magnetic Heading (degrees)	Each Run-up Event			Period of Occurrence		AICUZ Annual Run-up Events	
					Reported Power Setting	Duration (Seconds)	Number of Engines Running	Day % (0700-2200)	Night % (2200-0700)	Baseline (CY 2013)	Prospective (CY 2018)
P-8A	56-7B-24	Leak Check	Flight Line	040	5400 lbs	300	2	75%	25%	**0**	**1**
		Pressure Check	Flight Line	040	5400 lbs	720	2	75%	25%	**0**	**1**
P-3	T56-A-14	High Power	HP = 33.3% CALA = 66.6%	40	4600 Shaft Horsepower	1800	4	95%	5%	**900**	**200**
MH-60	T700	Hover Check	Westfield Hover Pad	30 = 98% 230 = 2%	Idle	1800	2	95%	5%	**70**	**89**
H-53	T64-GE-416A	T-64 (H-53) GTETS Out of Frame	Outdoor Test Stand	135	21 Ground Max	3690	1	100%	0%	**30**	**30**
					7 Ground Idle	3690	1				
		APU (H-53) GTETS	Outdoor Test Stand	135	7 Ground Idle	3600	1	100%	0%	**4**	**4**
		Hover Check	Westfield Hover Pad	30 = 98% 230 = 2%	Idle	1800	2	95%	5%	**84**	**84**
AH-1	T53-L-13	Engine Wash	Bravo line	~020	Flight idle	300	2	30%	70%	**400**	**400**
UH-1	T53-L-13	Engine Wash	Bravo line	~020	Flight idle	300	2	30%	70%	**400**	**400**

Table 3-4 MCB Hawaii Baseline Annual Engine Maintenance Run-up Events (cont'd)

Aircraft Type	Engine Type	Run-up Type	Run-up Location / ID	Magnetic Heading (degrees)	Each Run-up Event			Period of Occurrence		AICUZ Annual Run-up Events	
					Reported Power Setting	Duration (Seconds)	Number of Engines Running	Day % (0700-2200)	Night % (2200-0700)	Baseline (CY 2013)	Prospective (CY 2018)
MV-22	T64-GE-416A (Modeled as CH-53E)	Low Work	Westfield Hover Pad	30 = 98% 230 = 2%	Ige Lite	420	1	95%	5%	**0**	**18**
		In-frame Engine Tests	Outdoor Test Stand	135	Idle	600	1	100%	0%	**0**	**52**
					MIL	1800					
		In-frame Engine Tests	Outdoor Test Stand	135	Idle	1200	1	100%	0%	**0**	**19**
					Max	2400					
		In-frame Engine Tests	Outdoor Test Stand	135	MIL	1800	1	100%	0%	**0**	**2**
F-18C/D	F404-GE-400/402	High Power	High power area	40	72% RPM	1500	2	100%	0%	**2**	**2**
					94% RPM	600	2				
					Max AB	600	2				
Hawker Hunter	Avon Turbojet	High power	High power area	40	80% RPM	900	1	100%	0%	**6**	**9**
C-20 (USMC)	Tay611	Low Power	Flight Line	040	Idle	1800	2	80%	20%	**24**	**24**
		High Power Turns	High power area	040	EPR	900	2	95%	5%	**6**	**6**
C-20 (VR-51)	Tay611	Low Power	Flight Line	040	Idle	1800	2	50%	50%	**12**	**15**
		High Power Turns	High power area	040	EPR	900	2	50%	50%	**2**	**5**

Source: Wyle Laboratories, March 27, 2014

Table 3-5 Modeled Maintenance Run-up Operations at MCB Hawaii Prospective (Future) Scenario[1]

Aircraft Type	Engine Type	Run-up Type	Run-up Location / ID	Magnetic Heading (degrees)	Events (annual)	Period of Occurrence		Each Run-up Event	Modeled Power Setting (if different)	Duration (Minutes)
						0700-2200 (%)	2200-0700 (%)	Reported Power Setting		
H-53	T-64	T-64 (H-53) GTETS Out of Frame	Outdoor Test Stand	135	18	100%	0%	Max SHP	-	62
								Min SHP	Idle	62
		APU (H-53) GTETS	Outdoor Test Stand	135	3	100%	0%	Min SHP	Idle	60
C-20	Tay611	Low power	Flight Line	040	24	80%	20%	Idle	-	30
		High Power Turns	High power area	040	6	95%	5%	EPR	11400 Lbs	15
P-8A	56-7B-24	Leak Check	Flight Line	040	48	75%	25%	Max SHP	-	5
		Pressure Check		040	24	75%	25%	Max SHP	-	12

Notes: [1]The events listed in this table would be in addition to the baseline events listed in Table 3-4.
Source: Wyle Laboratories, March 27, 2014

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4 Noise

This chapter provides background discussion on sound; noise environmental sound descriptors; noise metrics; noise analysis; and the noise associated with aircraft operations, including that generated by in-flight operations and maintenance run-up operations at MCB Hawaii Kaneohe Bay.

4.1 Aircraft Sound Sources

The main sources of sound at air installations are generally related to in-flight operations, pre-flight and maintenance run-up operations. Computer models are used to develop noise contours for land use planning purposes based on information about these operations, based upon the following factors:

- Type of operation (e.g. arrival, departure, pattern)
- Number of operations per day
- Time of operation
- Flight track
- Aircraft power settings, speeds, and altitudes
- Number and duration of maintenance run-ups
- Environmental data (temperature and humidity)
- Topographical features of the area
- Ground surface characteristics

4.2 What is Noise?

Noise is unwanted sound. Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, and are sensed by the ear. Whether that sound is interpreted as pleasant (e.g., music) or unpleasant (e.g., jackhammers) depends largely on the listener's current activity, past experience, and attitude toward the source of that sound. Sound is all around us; sound becomes noise when it interferes with normal activities such as sleep and conversation.

Aircraft noise is of concern to many in communities surrounding airports. The impact of aircraft noise is also a factor in the planning of future land use near air facilities. Because the noise from these operations impacts surrounding land use, the Navy has defined certain noise zones and provided associated recommendations regarding compatible land use in the AICUZ Program.

4.3 Characteristics of Sound

The measurement and human perception of sound involves three basic physical characteristics—intensity, frequency, and duration. 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. Frequency is the number of times per second the air vibrates or oscillates. Low-frequency sounds are characterized as rumbles or roars, while sirens or screeches typify high-frequency sounds. Duration is the length of time the sound can be detected.

A logarithmic unit known as decibel (dB) is used to represent the intensity of sound. Such a representation is called a sound level. The decibel is an event measurement as opposed to the DNL which is a day and night average level. A sound level of 10 dB is approximately the threshold of human hearing and is barely audible under extremely quiet 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 above 140 dB as pain. Sounds levels of typical noise sources and environments are shown in Figure 4-1.

Because of the logarithmic nature of the decibel unit, sound levels cannot be arithmetically added or subtracted. Therefore, the total sound level produced by two sounds of different levels is usually slightly higher than the higher of the two. If two sounds of equal intensity are added, the sound level increases by 3 dB. For example:

60.0 dB + 70.0 dB = 70.4 dB;
60 dB + 60 dB = 63 dB.

For a noise event, a change of 3 dB of event noise is the smallest change detected by the average human ear. An increase of about 10 dB is usually perceived as a doubling of loudness. This applies to sounds of all volumes. A small change in dB generally will not be noticeable. As the change in dB increases, the individual perception is greater, as shown in Table 4-1 below.

Table 4-1 Subjective Responses to Changes in A-weighted Decibels (dBA)

Change	Change in Perceived Loudness
1 dB	Requires close attention to notice
3 dB	Barely perceptible
5 dB	Quite noticeable
10 dB	Dramatic, twice or half as loud
20 dB	Striking, fourfold change

Source: *Wyle Laboratories* 2004.

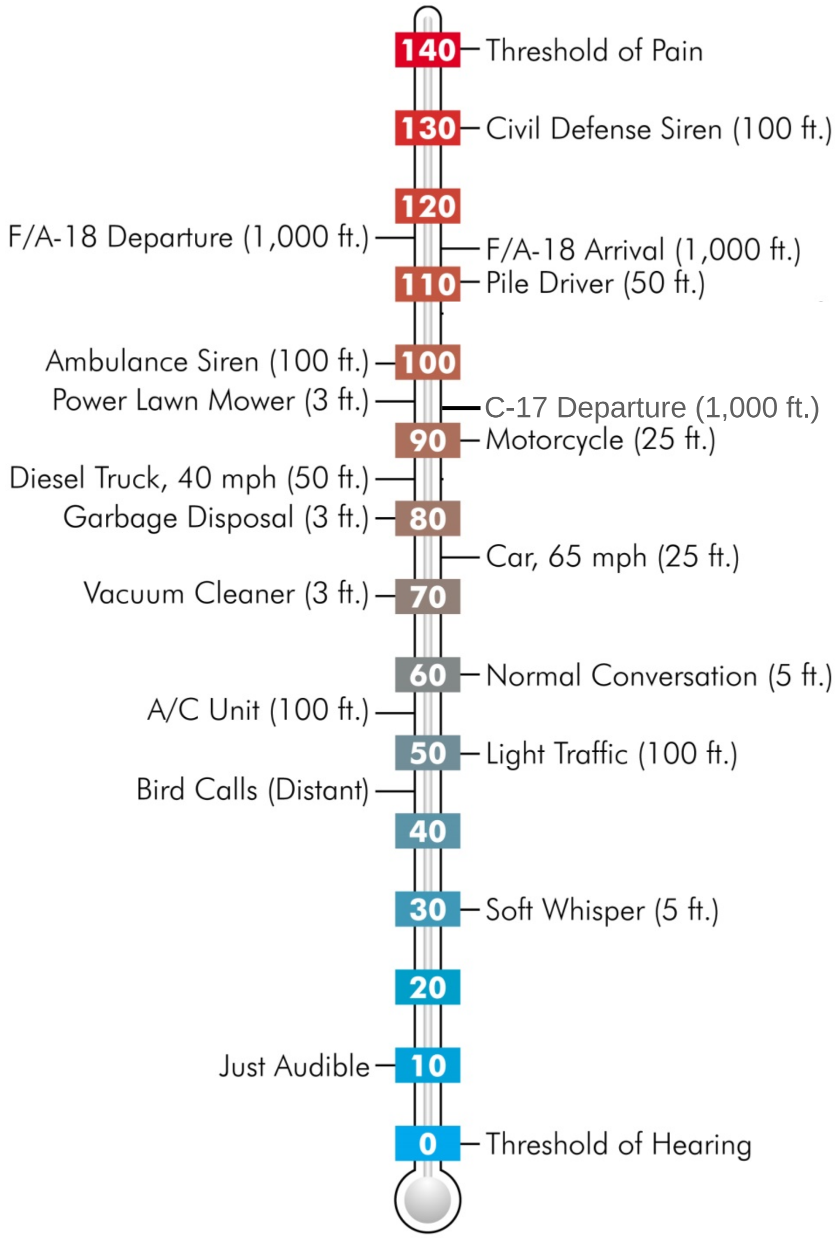

Figure 4-1 Sound Levels of Typical Sources and Environments

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4.3.1 Environmental Sound Descriptor

The sound environment around an air installation is typically described using a measure of cumulative exposure that results from all aircraft operations. The metric used to account for this is day-night average sound level (DNL) and is the standard noise metric used by the US Department of Housing and Urban Development, FAA, U.S. Environmental Protection Agency, and DOD. Studies of community response to numerous types of environmental noise show that DNL correlates well with the level of annoyance. A more detailed description of DNL follows:

- In general, DNL can be thought of as an accumulation of all of the sound produced by individual events that occur throughout a 24-hour period. The sound of each event is accounted for by an integration of the changing sound level over time. These integrated sound levels for individual events are called sound exposure levels (SELs). The logarithmic accumulation of the SELs from all operations during a 24-hour period determines the DNL for the day at that location.

- DNL also takes into account the time of day the events occur. The measure recognizes that events during nighttime hours may be more intrusive, and therefore more annoying, than the same events during daytime hours, when background sound levels are higher. To account for this additional annoyance, a penalty of 10 dB is added to each event that takes place during “acoustic” nighttime hours, defined as 2200 to 0700 hours the next day.

- DNL values around an air installation are presented not just for a single specific 24-hour period, but rather for an annual average day.

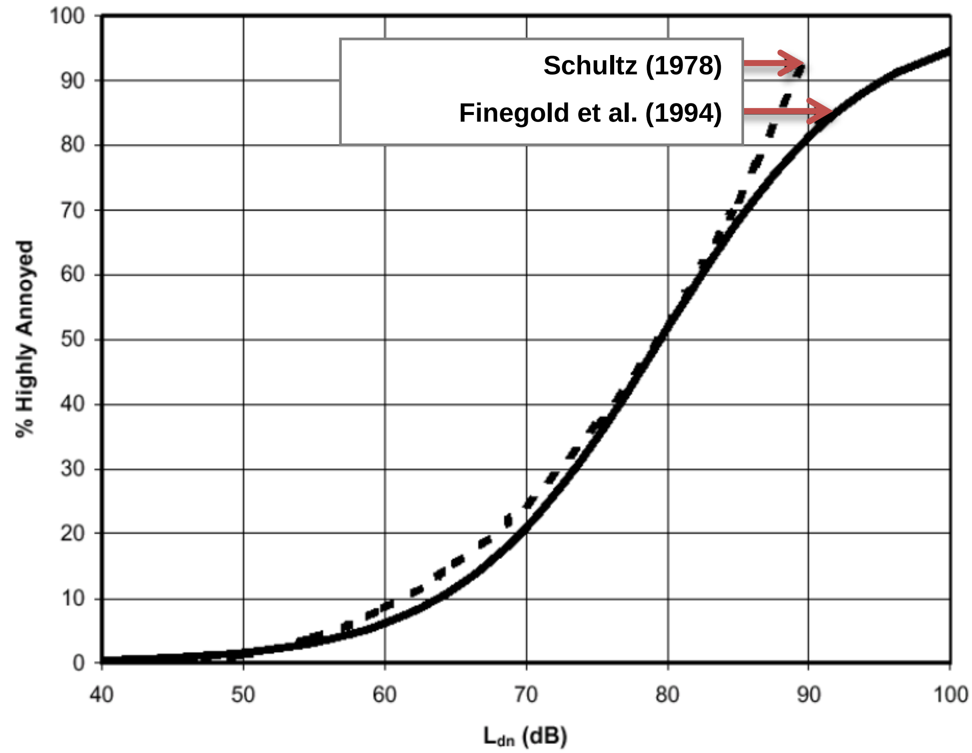
DNL averaging is done to obtain a stable representation of the noise environment free of variations in day-to-day operations or between weekdays and weekends as well as from fluctuations in wind directions, runway use, temperature, aircraft performance, and total airfield operations (any one of which can significantly influence noise exposure levels from one day to the next).

4.3.2 Individual Response to Sound Levels

Individual response to sound levels is influenced by many factors, including the following:

- Activity the individual is engaged in at the time of the event
- General sensitivity to sound
- Time of day
- Length of time an individual is exposed to a sound
- Predictability of sound
- Average temperature/inversions/other weather phenomena

Various scientific studies and social surveys have found a high correlation between the percentages of groups of people in communities highly annoyed and increases in the level of average sound exposure measured in DNL. This correlation is shown in Figure 4-2 from two studies. Such aircraft noise annoyance correlation was originally developed in the 1970s (dashed line in Figure 4-2) and was reaffirmed by the more recent study curve (solid line in Figure 4-2). The curve remains the best available method to estimate the community reaction to aircraft sound levels. Most people are exposed to sound levels of 50-55 DNL or higher on a daily basis. Research has indicated that about 87 percent of the population is not highly annoyed by outdoor sound levels below 65 dB DNL (Federal Interagency Committee on Urban Noise 1980).



Source: Shultz 1978 and Finegold, et al 1994; as taken from Wyle Laboratories, *Draft Wyle Report 08-13 Aircraft Noise Study for MCBH 2008.*

Figure 4-2 Influences of Sound Levels on Annoyance

Appendix B provides additional information on sound and noise.

4.4 Noise Concerns and Noise Abatement Procedures

4.4.1 Noise Concerns

MCB Hawaii engages in a variety of training exercises and real-world military operations which sometimes generate aircraft and weapon noise. This includes aircraft training at MCAS Kaneohe Bay and surrounding airspace and range operations at Puuloa Training Facility and Marine Corps Training Area Bellows. Residents near MCB Hawaii properties (e.g., Kaneohe, Kailua, Waimanalo, Kahaluu, and Ewa) identify military noise as a community concern.

MCB Hawaii's leadership regularly meets with community leadership, including state legislators and local city officials, to discuss relevant issues. Because the base acknowledges its operations affect surrounding communities, it evaluated Standard Operating Procedures to ensure there is a proper balance between training Marines and sailors, as required by the Department of Defense, and considering impact to residential areas. For instance, engine testing maintenance hours and aircraft flight paths were adjusted in order to reduce noise.

While it is normal and legal under federal law for aircraft to fly over land, MCB Hawaii established more specific course rules in order to outline a safe and expeditious pathway for tenant and transient aircraft to depart and arrive at the airfield. MCB Hawaii course rules are designed to keep aircraft over water and away from populated areas. However, pilots will occasionally fly over land or deviate from the local course rules to maintain safe flight operations. MCB Hawaii pilots are among the most professional and best-trained in the world, and they always operate in a safe and efficient manner while striving for noise abatement.

Residents should be aware noise will vary due to real-world missions, overseas deployments, training requirements, federal funding, maintenance, and weather. Since 2001, marine, sailor and equipment levels at MCB Hawaii have fluctuated due to operations in Afghanistan and Iraq. Currently, MCB Hawaii personnel are participating in the Unit Deployment Program and units rotate to Japan every six months.

MCB Hawaii distributes the Aloha Newsletter via email and the base website in order to provide information about upcoming training exercises, community events and other base operations. Residents may call MCB Hawaii's dedicated noise information line at 808- 257-8832 to sign up for the newsletter. This number is manned during working hours and has voicemail after hours. To file a noise concern, callers should provide their name, the address or general location of where the noise occurred, the time of the incident, and (if applicable) the type of aircraft.

The base has also recently launched an online form that allows users to submit their concerns electronically. A link to the form is located on the homepage at www.mcbhawaii.marines.mil.

Each call and message is logged for review by commanders and involved units.

4.4.2 Noise Abatement

Noise abatement procedures followed by MCB Hawaii are based on *Marine Corps Air Flight Operations P3710.1H*. These procedures include:

- High power engine run-ups are normally restricted to the hours of 0600 to 2200 Monday through Friday, and 0800 to 1800 hours on Saturdays and Sundays.
- All station based aircrews are directed to comply with local course rules and deviate only as necessary in the interest of safety or during emergencies.
- Aircraft departing Runway 22 shall avoid Coconut Island and populated areas by turning right to a heading of 340 degrees once past Taxiway F.
- Fixed-wing Touch and Gos from 2200 to 0600 are discouraged and must be preauthorized case by case by Airfield Operations.
- Fort Hase arrivals/departures are only authorized between 0600 and 2200 hours and do not overfly private housing areas.
- Helicopters are to avoid beaches by one mile when below 1,500 feet.
- Aircraft shall avoid overflying the Nu‘upia Ponds to the south and base residential areas to the north of LZ Boondocker

4.5 Noise Metrics

As used in environmental noise analyses, a metric refers to the unit or quantity that measures the effect of noise on the environment. The metric for the noise environment on and in the vicinity of airbases is normally described in terms of the time-average sound level generated by the aircraft operating at the facility. The federal noise metric used for this purpose is the DNL defined in units of dB. DNL has been determined to be a reliable measure of community sensitivity to noise and has become the standard metric used in the United States to quantify noise in aircraft noise studies and associated compatible land use and zoning analysis.

Aircraft noise is expressed in terms of A-weighted sound levels. A-weighting is a method of adjusting the frequency content of a sound event to closely resemble the way the average human ear responds to aircraft sound. The A-weighted scale is therefore considered to provide a good indication of the impact of noise produced by aircraft operations.

The average of sound over a 24-hour period considers the louder single events. When sound levels of two or more sources are added, the source with the lower sound level is dominated by the source with the higher sound level. The combined sound level is usually only slightly higher than the sound level produced by the louder source. For example, if a single daytime aircraft over-flight measuring 100 dBA for 30 seconds occurs within a 24-hour period in a 50-dBA noise environment, the DNL will be 65.5. If 10 such 30-second aircraft overflights occur in daytime hours in the 24-hour period, the DNL will be 75.4. Therefore, a few maximum sound events occurring during a 24-hour period will have a strong influence on the 24-hour DNL even though lower sound levels from other aircraft between these flights could account for the majority of the flight activity. It is important to note however, that individuals do not "hear" DNL. The DNL contours are intended for land use planning, not to describe what someone hears when a single event occurs.

The accumulation of noise computed in this manner provides a quantitative tool for comparing overall noise environments and is useful in developing compatible land use plans and zoning regulations in the airfields' environs. The DNLs are represented as contours connecting points of equal value, usually in 5-dB increments. The AICUZ footprint, as depicted in Figures 4-3 and 4-4, is defined as contours from 65 dB up to 85dB. The 65dB contour is used to define the AICUZ study area in accordance with the Title 14, Code of Federal Regulations, Section 150.21 – Airport Noise Compatibility Planning, EPA Order 5050.4B., and OPNAVINST 11010.36C/MCO 11010.16.

AICUZ Noise Zone 2 (DNL 65-74 dB) is an area of moderate impact where some land use controls are recommended and Noise Zone 3 (DNL 75 dB and above) is the most severely impacted area and the greatest degree of land use controls for noise exposure are recommended. Noise Zone 1 (less than 65 dB DNL), (unshaded area) is an area of low or no impact (although some people in these areas may be annoyed by aircraft overflights) and is included in the AICUZ boundary for informational purposes. These noise zones are shown on Figures 4-3 and 4-4 for the baseline and prospective scenarios, respectively.

In Hawaii, the State Department of Transportation uses the 60dB contour for determining compatible land use around commercial airports. This program is parallel to, but does not apply to military airfields which use the AICUZ study and the Federal DNL standard of 65 dB. Therefore, for local planning purposes, this AICUZ study has also depicted DNL contours from 55 dB up to 65 dB that are located outside of the military AICUZ footprint.

While the DNL noise descriptor is the most commonly used tool for analyzing noise generated at an air installation and is used as the metric for AICUZ study purposes, the DOD has been developing additional metrics (and analysis techniques) particularly in assessing noise exposure from a noise flight event. These supplemental metrics and analysis tools provide additional noise exposure information such as Sound Exposure Level (SEL) and Maximum Sound Level (L_{max}) and they can provide a direct comparison of the relative intrusiveness among single noise events of different intensities and durations of aircraft overflights.

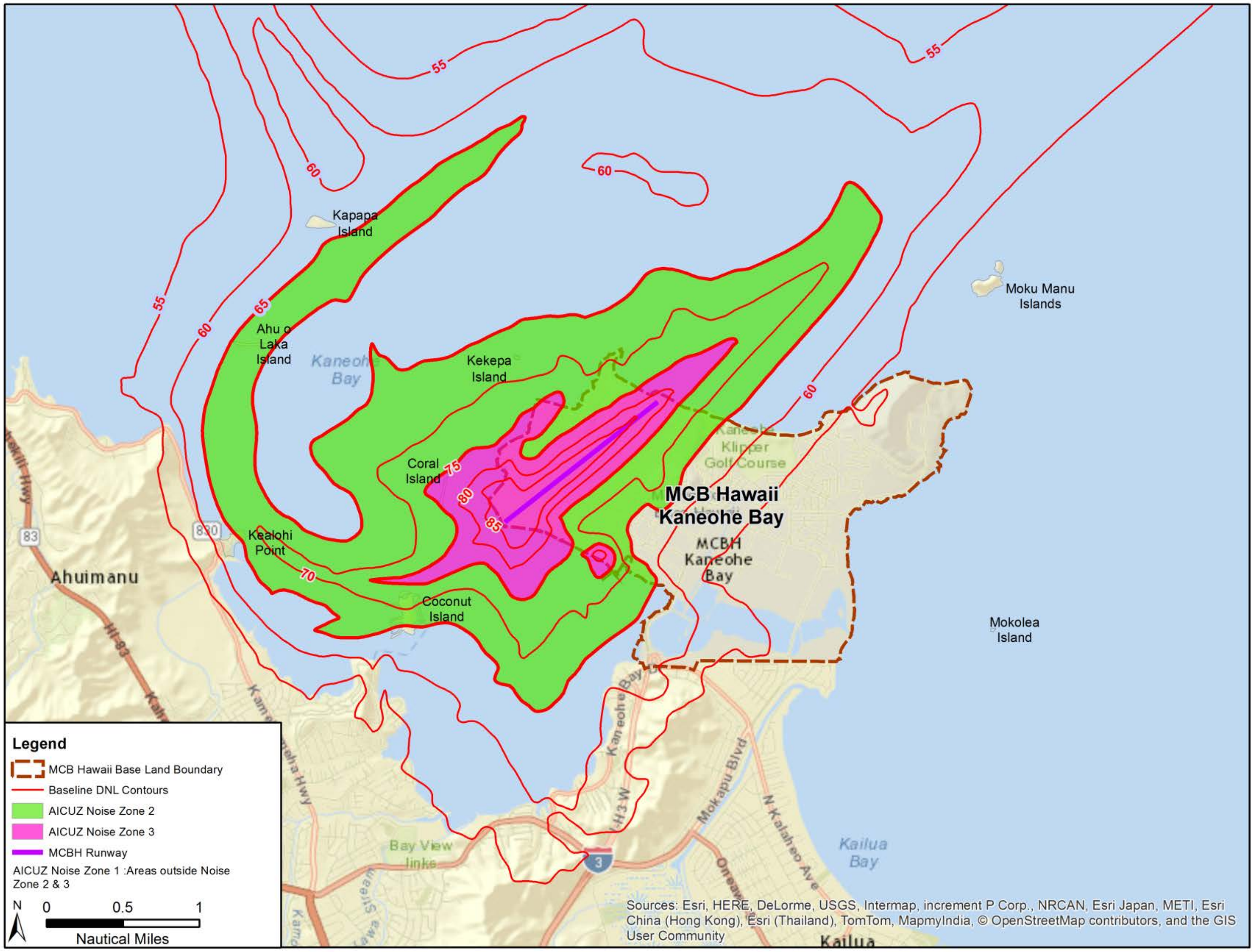


Figure 4-3 Baseline DNL Contours (dB)

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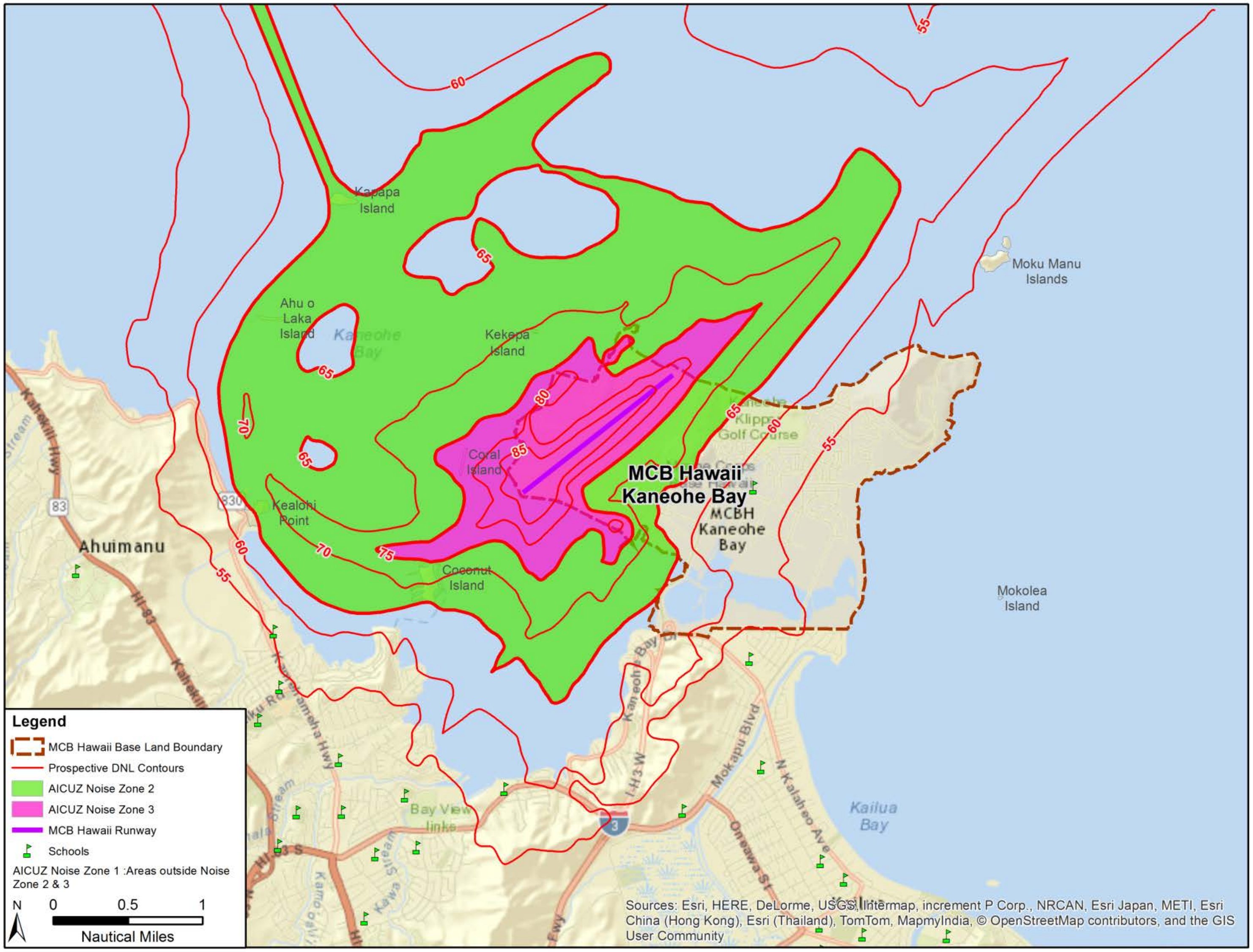

Figure 4-4 Prospective Scenario (2018) DNL Contours (dB)

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The SEL metric is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of total sound energy of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL captures the total sound energy from the beginning of the acoustic event to the point when the receiver no longer hears the sound. It then condenses that energy into a 1-second period of time and the metric represents the total sound exposure received. The SEL has proven to be a good metric to compare the relative exposure of transient sounds, such as aircraft overflights.

The highest A-weighted sound level measured during a single event where the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level or L_{max}. During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. L_{max} defines the maximum sound level occurring for a fraction of a second. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally 1/8 second (American National Standards Institute 1988). For sound from aircraft overflights, the SEL is usually greater than the L_{max} because an individual overflight takes seconds and the L_{max} occurs instantaneously. L_{max} can be used to compare aircraft noise levels with respect to speech interference.

4.6 Noise Contours

At a minimum, DOD requires that contours be plotted for DNL values of 65, 70, 75, and 80 dB in AICUZ studies. Three general noise exposure zones are defined in the AICUZ Program: areas with a DNL of less than 65 dB; areas with a DNL between 65 dB and 75 dB; and areas with a DNL of 75 dB or greater. These three areas are defined as AICUZ Noise Zones 1, 2, and 3, respectively.

4.6.1 Methodology

The Navy periodically conducts noise studies to assess the noise impacts of aircraft operations. As with updates to AICUZ studies, the need to conduct a noise study is generally prompted by a change in aircraft operations — either by the number of operations conducted at the airfield, the number and type of aircraft using the airfield, or the flight paths used for airfield departure/arrival changes. A noise study is also normally conducted as a part of an update to an AICUZ study.

The DOD NOISEMAP suite with the Rotorcraft Noise Model (RNM Version 7.357) is the current DOD standard computer model that projects noise levels from both fixed and rotary wing aircraft operations around military airfields and generates noise contour data. NOISEMAP calculates DNL contours resulting from aircraft operations using such variables as power settings, aircraft model and type, maximum sound levels, and duration and flight profiles for a given airfield. Analyses of aircraft noise exposure and compatible land use around an air installation.

The flight tracks, as well as pre-flight and maintenance run-up operations, establish the shape of the noise contours. In general, approaches and departures cause the narrow tapering of portions of the contours aligned with the flight tracks, while touch and go operations can determine the general contour size. Noise from pre-flight and maintenance run-up operation locations, if not overshadowed by flight operations, causes generally circular arcs. The noise modeling for this update includes atmospheric sound propagation effects over varying terrain, such as hills and mountainous regions, as well as regions of varying acoustical impedance including water around the airfield.

4.6.2 MCB Hawaii Kaneohe Bay DNL Contours and Event Noise

The AICUZ noise contours associated with the baseline (existing) operations are shown in Figure 4-3. The AICUZ noise contours for the prospective future conditions are shown in Figure 4-4. Historical AICUZ noise contours developed in 1990 and 2003 are presented in Figures 4-5 and 4-6, respectively, for informational and comparative purposes.

Comparisons of the noise contours contained in the 1990 AICUZ *or February 2003 AICUZ Study Update for MCBH Kaneohe Bay* and the prospective future condition are shown in Figures 4-7 and 4-8, respectively. While the vast majority of the changes are over open water areas, a small expansion of the 65 dB DNL contour over land on Coconut Island and in the area of Kealohi Point is seen for the prospective 2018 condition. While these are the only off-installation land areas with higher noise contours, both Coconut Island and Kealohi Point are projected to have noise levels similar to the prior 1990 AICUZ condition as shown in Figure 4-5. Therefore, during this 23 year planning period, the noise levels have fluctuated but have not significantly increase over land areas.

A comparison of the baseline and prospective future contours for MCB Hawaii Kaneohe Bay reflected in this AICUZ update, are also provided on Figure 4-9. The prospective future contours (AICUZ Noise Zones 2 and 3) are comparable but slightly expanded as compared to the baseline condition.

Typical aircraft overflight (i.e., areas that aircraft fly over) event noise in terms of SEL and L_{max} around Kealohi Point are summarized in Table 4-2. The loudest event noise would occur during the FA-18 A/C GCA pattern flight along Track 22G1 (see Figure 3-6) and C-5A arrival along Track 04A1 (see Figure 3-2).

Table 4-2 Comparison of Aircraft Overflight SEL and L_{max} around Kealohi Point

Aircraft	SEL (dB)	Lmax (dB)	Operation Type	Track ID
F-18A/C	110	104	GCA Pattern	22G1A
C-5A	109	105	Arrival	04A1
CH-53E	97	88	GCA Pattern	C22G1A
C-17	96	90	GCA Pattern	22G1A
C-20	92	85	Arrival	04A1
AH-1W	92	80	GCA Pattern	C22G1A
MV-22B	90	79	GCA Pattern	22G1A
P-8 *	88	85	Arrival	04A1
P-3C	86	83	Arrival	04A1
SH-60R	85	73	GCA Pattern	C22G1A

Notes: Based on atmospheric conditions of 76.2° F, 74.5% RH, & 30.05 in Hg

* P-8 Lmax estimated based on SEL-Lmax delta for P-3 conducting identical operation

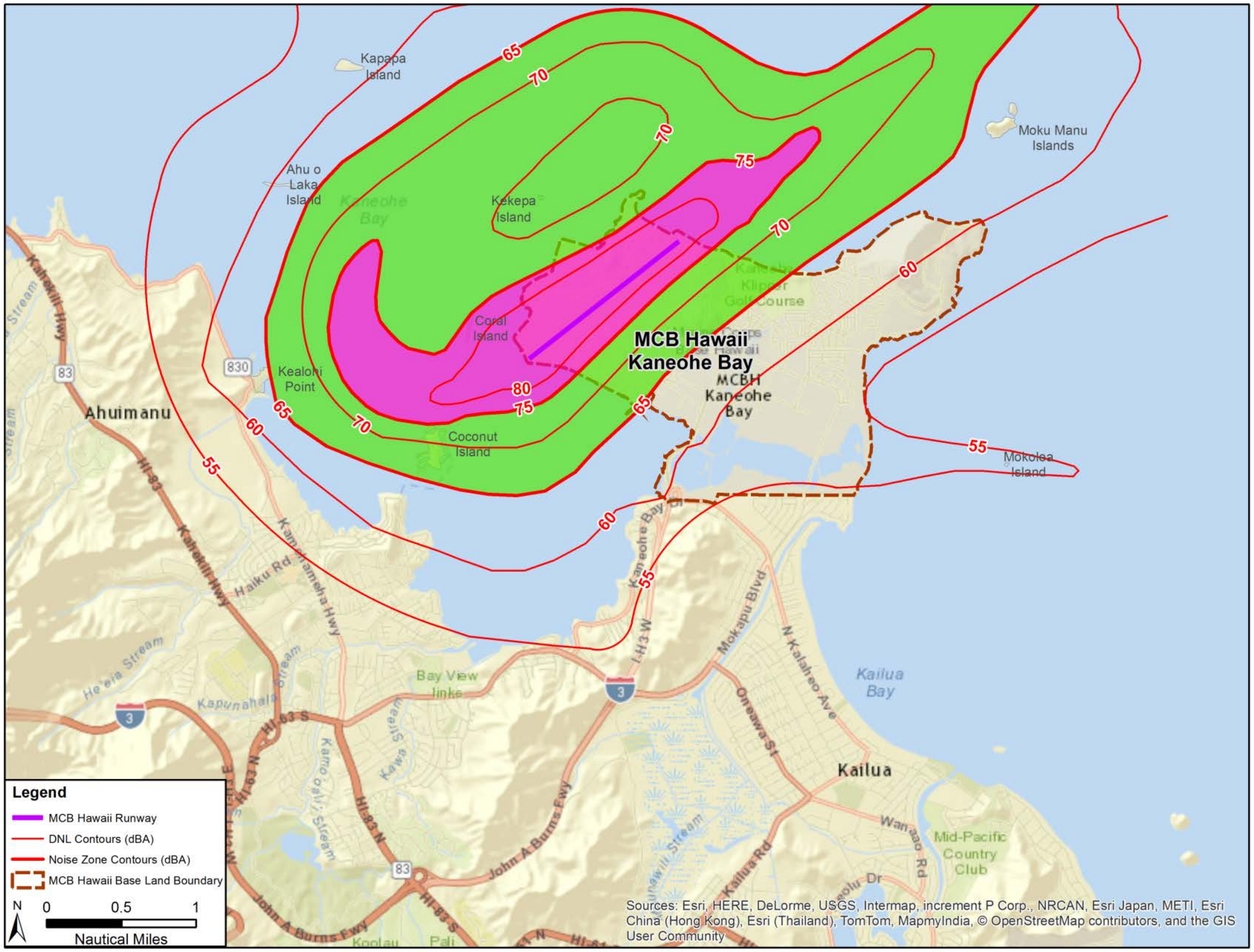

Figure 4-5 1990 AICUZ DNL Contours (dB)

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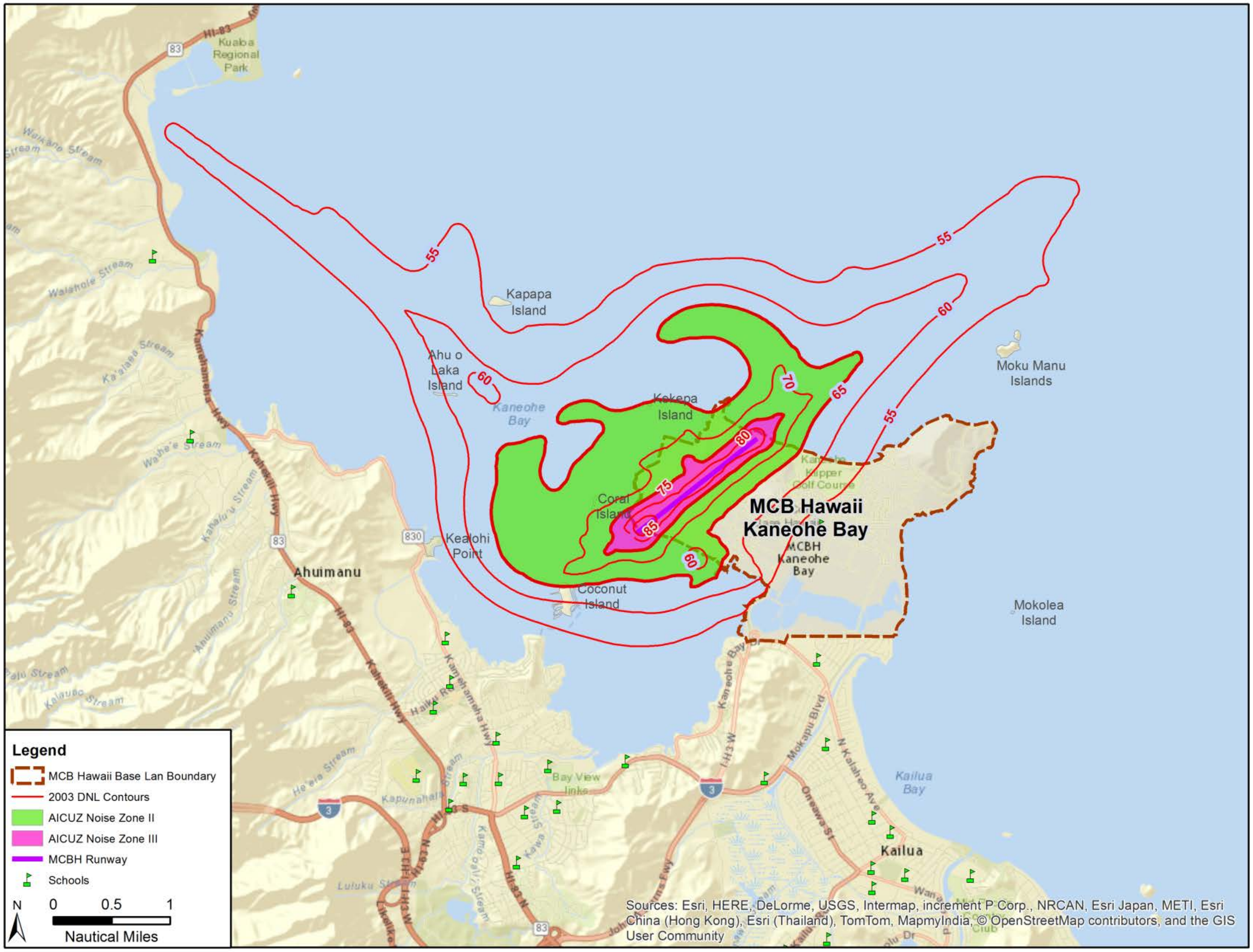

Figure 4-6 2003 AICUZ DNL Contours (dB)

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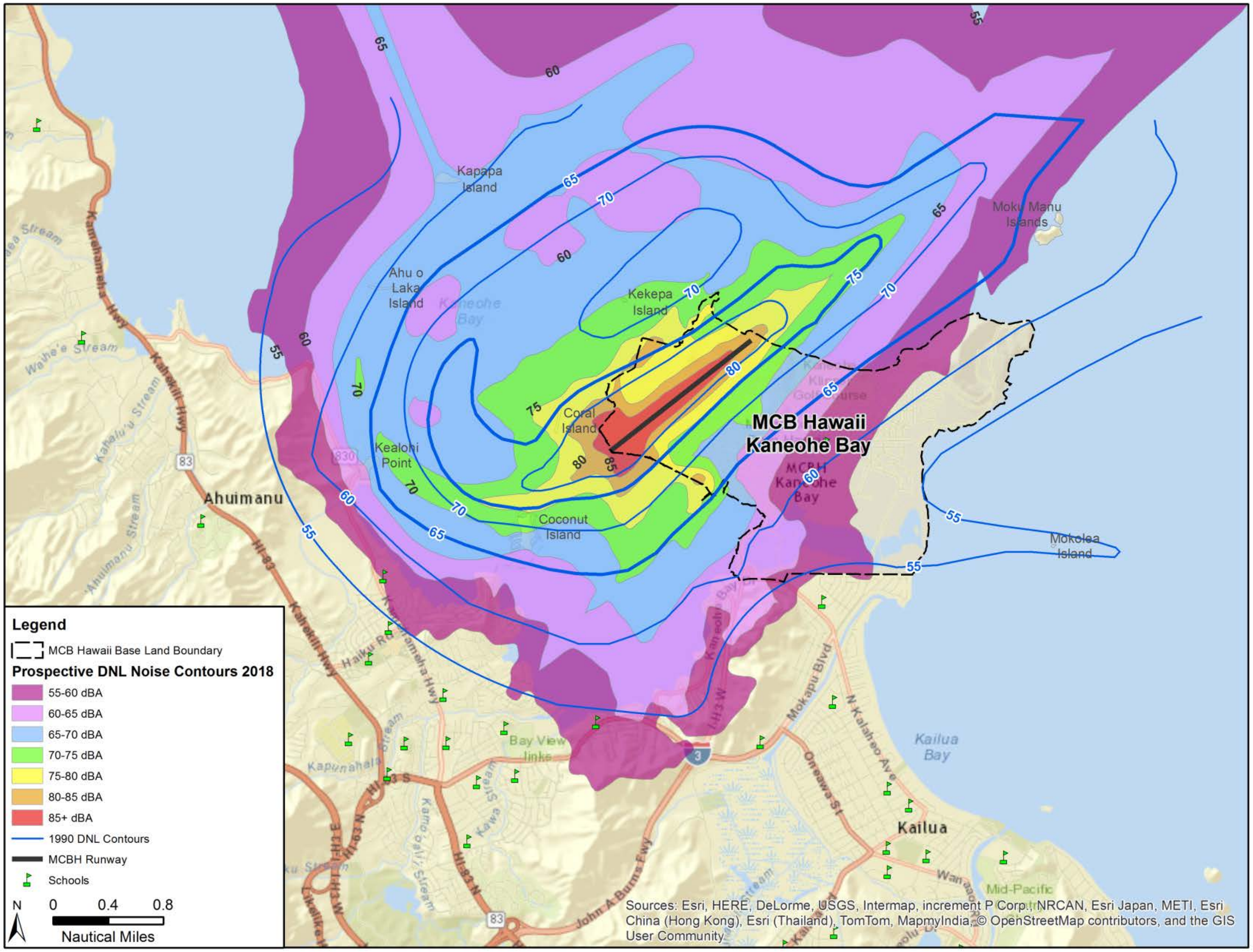

Figure 4-7 Comparison of 1990 and Prospective (2018) DNL Contours

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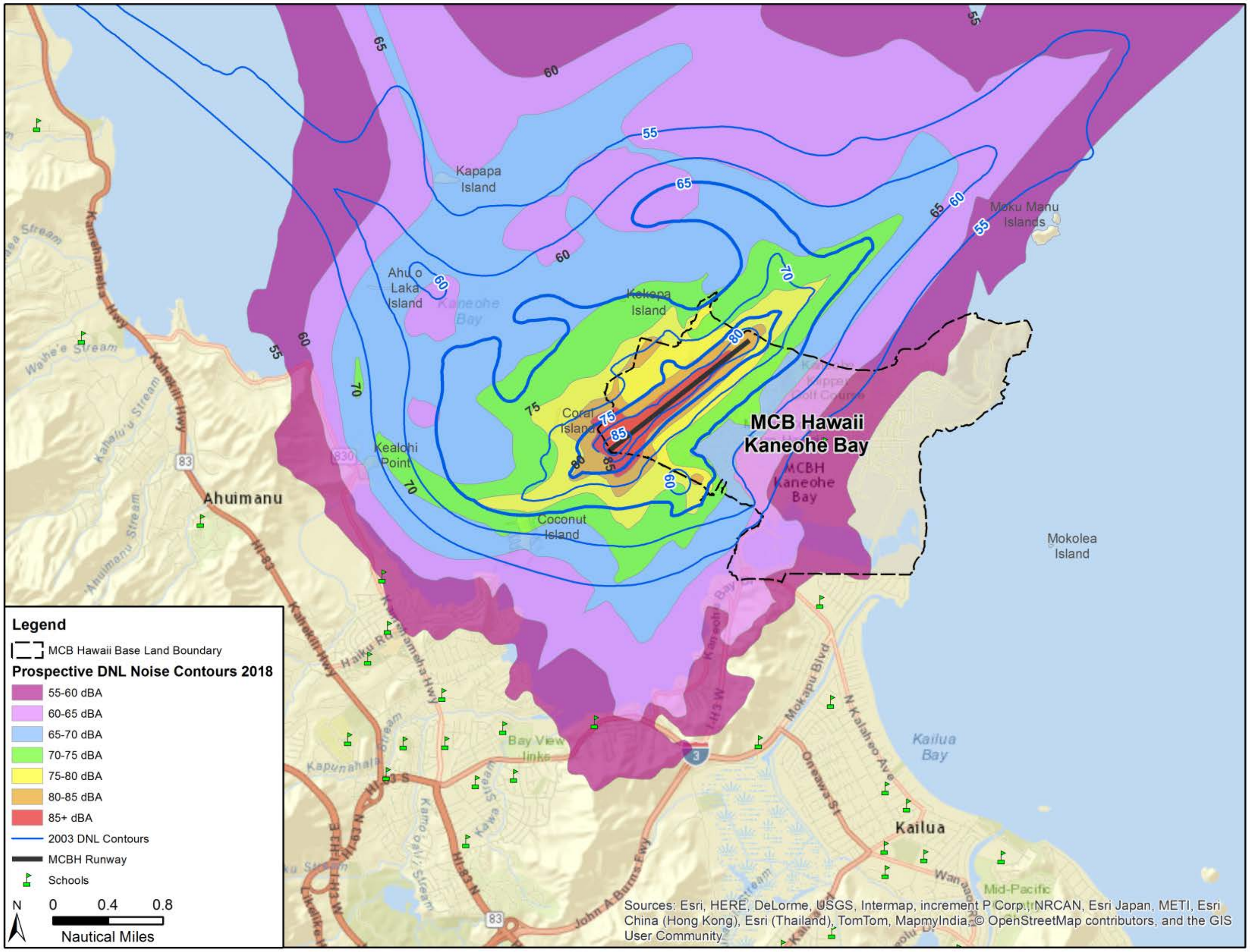

Figure 4-8 Comparison of 2003 and Prospective (2018) DNL Contours

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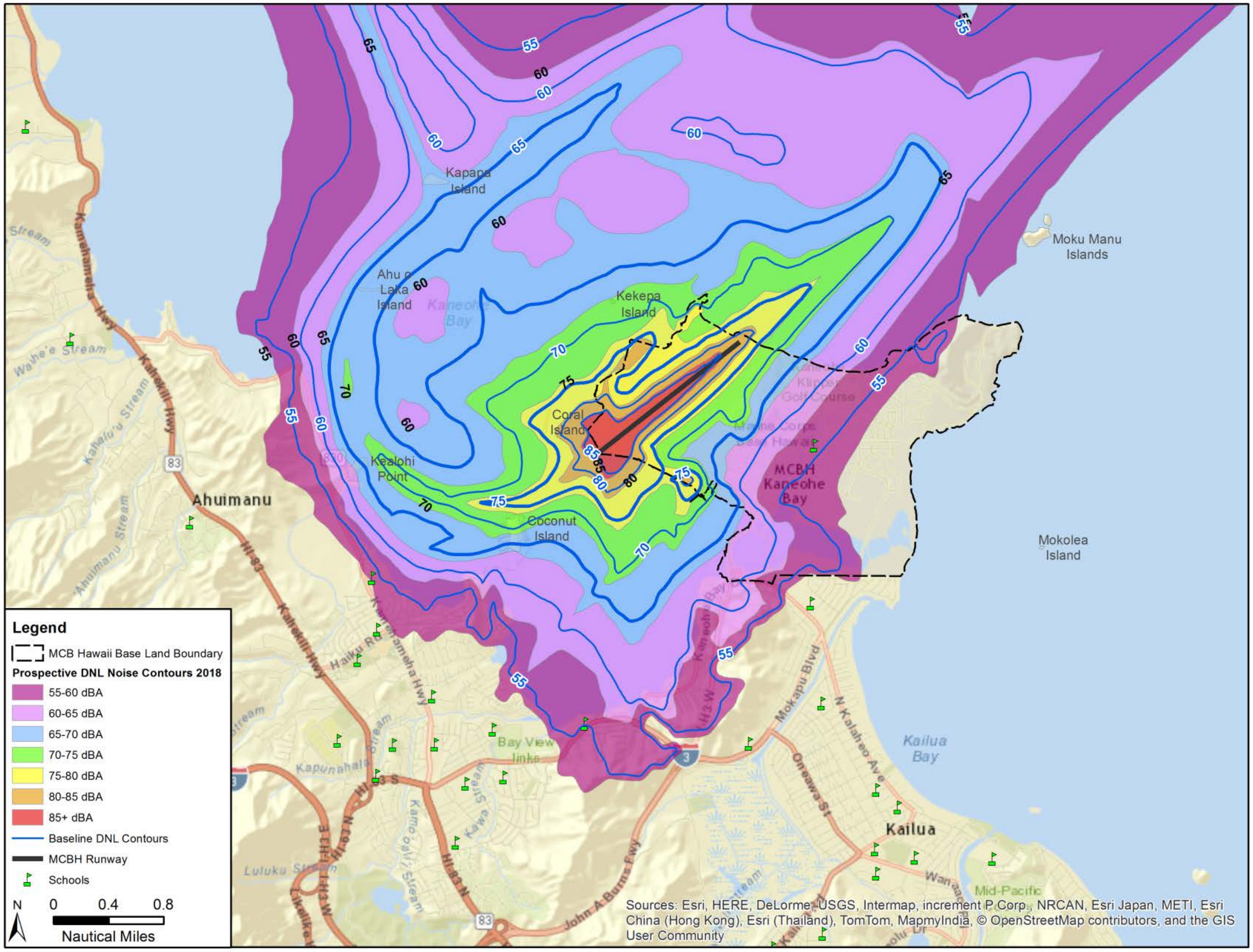

Figure 4-9 Comparison of Baseline (2013) and Prospective (2018) DNL Contours

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5 Safety

The Navy has created airfield planning tools to assist its facility planners and the local community in creating a safe environment on and around naval air installations. These tools include imaginary surfaces used to define volumes of airspace that are invisible to the human eye and APZs. The tools help identify and aid in the prevention of objects that potentially obstruct or interfere with aircraft arrivals, departure, and flight patterns and also help identify incompatible land uses and promote compatible land uses surrounding air installations.

AP-3C on approach to MCB Hawaii.

This section discusses Baseline and Prospective Future APZs, as well as prevention of other obstructions that can cause aircraft mishaps or impact operations. For the safety of the aviators and to protect persons on the ground, the height of objects and vegetation should be restricted. Imaginary surfaces that extend off runways can help to identify areas where potential airspace obstructions could occur and help with their prevention before they occur.

APZs rely on the fact that aircraft mishaps are more likely to occur on or near the runways than other areas. The Navy has identified APZ criteria around its runways and under flight tracks based on historical data showing where mishaps have occurred. Although the likelihood of an accident is remote, the Navy recommends that certain land uses that concentrate large numbers of people, such as dense residential developments, shopping centers or schools be not located in the APZs.

Other hazards to flight safety that are not recommended in the vicinity of the airfield include the following:

- Uses that attract birds, especially waterfowl;
- Lighting (direct or reflected) that impairs pilot vision;
- Lighting (direct or reflected) that attracts birds;
- Turbulence from nearby wind farms;
- Uses that would generate smoke, steam, or dust; and
- Uses that generate electromagnetic or thermal interference with aircraft communication, navigation, and electric systems

5.1 Objects Affecting Navigable Airspace

Aircraft operations can be constrained by the surrounding natural terrain and manmade features such as buildings, towers, poles, and other potential vertical obstructions to navigation. FAA, *CFR Title 14, Part 77, Objects Affecting Navigable Airspace* (Federal Aviation Rules [FAR] Part 77) outlines a notification procedure for proposed construction or alteration of objects near airports that could affect navigable airspace. UFC-3-260-01 (as well as FAR Part 77) also identifies a complex series of imaginary surfaces or planes used for siting facilities on and near military airfields and determining obstructions or hazards to air navigation for these airfields.

The U.S. standard for terminal instrument procedures for airports is a joint Army, Navy, Air Force, Coast Guard, and FAA publication (FAA 8260.3B also released as OPNAVINST 3722.16C) that provides procedures to be used in analyzing the potential impact a proposed construction or alteration project may have on terminal instrument procedures for an airfield and if the proposal would create an obstruction to air navigation if constructed. The early analysis of construction or alteration proposals in areas near airfields could identify and help preclude an air navigation obstruction before it occurs.

Hawaii Administrative Rules Title 19 Department of Transportation Subtitle 2 Airports Division Chapter 12 Airport Zoning regulates height limitations and imaginary surfaces in the environs of public, quasi-public, and military airports in Hawaii.

5.1.1 Notice of Construction or Alteration

Under the provisions of FAR Part 77, each sponsor who proposes any of the following construction/alteration must notify the Administrator of the FAA prior to beginning so that its potential impact on airspace can be assessed. As part of this assessment, both obstruction standards and terminal instrument procedure impacts are evaluated to determine if the project will result in an adverse impact on the airport flight procedures or create an obstruction or hazard to air navigation. Notification to FAA is required in the following areas:

1. Any construction or alteration of more than 200 feet in height above ground level at its site.

2. Any construction or alteration of greater height than an imaginary surface extending outward and upward at a 100 to 1 for a horizontal distance of 20,000 feet from the nearest point of the nearest runway.

3. Any highway, railroad, or other traverse way for mobile objects, of a height which, if adjusted upward (specific distances are specified in the FAR Part 77), and for a water way or any other traverse way not previously mentioned, an amount equal to the height of the highest mobile object that would normally traverse it, would exceed the heights outlined in subparagraphs 1 and 2 above.

4. Any construction or alteration that would be in an instrument approach area (defined in FAA standards) and available information indicates it might exceed a (imaginary surface) standard for obstructions. Paragraph 5.1.2 below outlines these standards for MCB Hawaii Kaneohe Bay.

5. Any construction or alterations on an airport.

FAR Part 77 also outlines formats and timing of notification.

5.1.2 Obstruction Standards

Subpart C of FAR Part 77, NAVFAC P-80.3, and UFC 3-260-1 establish standards for determining obstructions to air navigation commonly referred to as imaginary surfaces. Before the imaginary surfaces can be determined, the classes of runways are determined. DOD fixed-wing runways are separated into two classes for the purpose of defining imaginary surfaces and APZs: Class A and Class B runways. Class A runways are used primarily by light aircraft and do not have the potential for intensive use by heavy or high-performance aircraft. Class B runways are used by all other fixed-wing aircraft. The runway at MCB Hawaii Kaneohe Bay is a single fixed-wing Class B runway (Section 2.3.1).

The Navy criteria for Class B runways are provided for the implementation of the following:

- The *Primary Surface* is a surface on the ground or water centered lengthwise on the runway and extending 200 feet beyond each end of the runway. The width is 1,500 feet per Class B runway. The Primary Surface is normally highly protected and free of all obstructions.

- The *Clear Zone* is immediately adjacent to the end of the runway and extends 3,000 feet outward along the runway centerline.

- *Approach/Departure Clearance Surfaces* extend from the primary surfaces at a 50:1 inclined plane for a Class B runway. When the surface reaches an elevation of 500 feet, the surface becomes a horizontal plane.

- *Horizontal Clearance Surfaces* include one at 150 feet above airfield elevation extending to 7,500 feet from the runway, and another at 500 feet above airfield elevation extending from 14,500 feet to 44,500 feet from the runway end.

- *Conical and other Transitional Surfaces* connect the Horizontal Clearance Surfaces to the Approach/Departure Clearance Surfaces and the Primary Surfaces.

Figure 5-1 outlines the geometry used to create the imaginary surfaces for Class B runways.

In general, no aboveground structures are permitted in the Primary Surface and Clear Zone areas. The height of structures should be controlled to prevent penetration of the transitional surfaces and approach departure surfaces. These restrictions limit the height of structures as the distance from the runway surface decreases. Approaching the runway surface and its corresponding flight path, more stringent height limitations are imposed. Figure 5-2 provides the application of these criteria to MCB Hawaii Kaneohe Bay.

5.2 Accident Potential Zones

5.2.1 Navy Clear Zone and APZs

APZs are based on historical accident and operations data compiled throughout the military and the application of margins of safety within those areas (which have been determined to be potential impact areas) if an accident were to occur. Criteria on APZs are found in OPNAVINST 11010.36C/MCO 11010.16. Figure 5-3 details the geometry that is used to create APZs for Class B runways.

The Navy recognizes three types of APZs for Class B runways: the Clear Zone, APZ I, and APZ II, defined as follows:

- *Clear Zone* — The trapezoidal area lying immediately beyond the end of the runway and outward along the extended runway centerline for a distance of 3,000 feet. For Navy and Marine Corps installations, the dimensions are 1,500 feet wide at the runway threshold and 2,284 feet wide at the outer edge. The Clear Zone is required for all active runway ends.

- *APZ I* — The rectangular area beyond the Clear Zone, which has a measurable potential for aircraft accidents relative to the Clear Zone. APZ I is provided under flight tracks that experience 5,000 or more annual operations (departures or approaches). APZ I is typically 3,000 feet wide by 5,000 feet long and may be rectangular or curved to conform to the shape of the predominant flight track.

- *APZ II*—The rectangular area beyond APZ I (or the Clear Zone if APZ I is not used), which has a measurable potential for aircraft accidents relative to APZ I or the Clear Zone. APZ II is always provided where APZ I is required. The dimensions of APZ II are typically 3,000 feet wide by 7,000 feet long, and like APZ I, may be curved to correspond with the predominant flight track.

Past policy was not to depict APZs over water areas where no land is involved. However, with Coconut Island located under the APZ, the Clear Zone, and APZ I and APZ II are depicted for the MCB Hawaii AICUZ.

The dimension of Clear Zones for rotary-wing runways and helipads for visual and standard instrument flight rules operations is 400 feet long (the width varies). A rotary-wing runway or helipad has only one APZ with the length of 800 feet long (DOD Instruction 4165.57).

5.2.2 APZs at MCB Hawaii Kaneohe Bay for Baseline and Prospective Future Operations

Figure 5-4 depicts the fixed-wing APZs for MCB Hawaii Kaneohe Bay as generated by the baseline and the prospective future operational scenarios described in Chapter 3. There are no differences in the APZs over land for the two scenarios. As seen in the figures, all runways have Clear Zones. APZs I and II are also shown on the primary arrival patterns to Runway 04 over Coconut Island. The APZ I over Coconut Island is fundamentally the same as has been depicted in previous AICUZ documents as well as in the Coconut Island Long Range Development Plan of 2004. A portion of the shoreline at Kealohi Point (Heeia State Park) touches the edge of APZ II as shown in Figure 5-4, but no occupied structures or populated areas are affected.

APZ guidelines for helicopters are much smaller than those for fixed-wing aircraft and are outlined in OPNAVINST 11010.36C/MCO 11010.16 and UFC 3-260-1. Helicopter Clear Zone/APZ for MCB Hawaii are illustrated in Figure 5-5. Facility planners consider helicopter APZs as well when siting facilities near the airfield’s many landing pads.

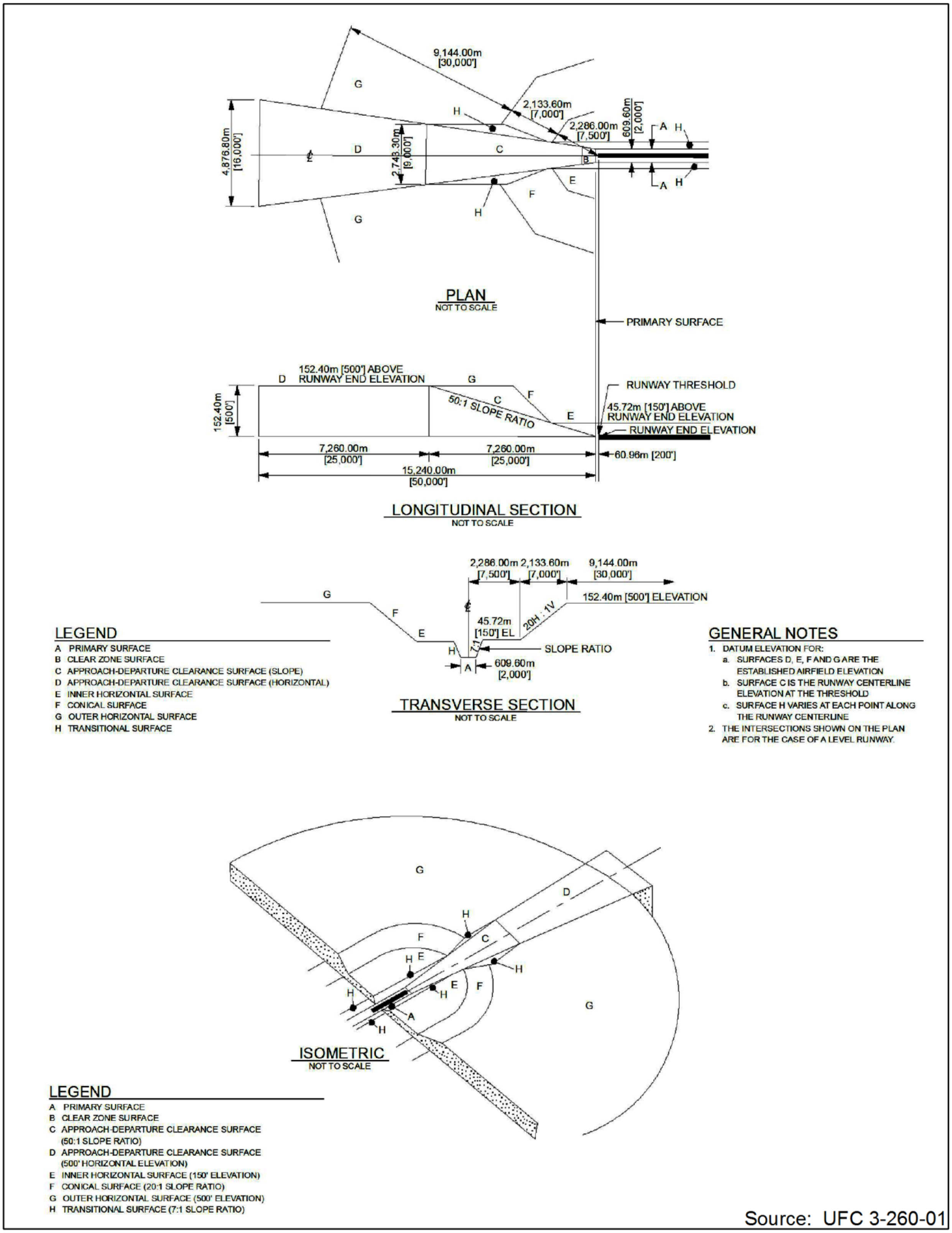

Figure 5-1 Imaginary Surfaces for Class B Runways

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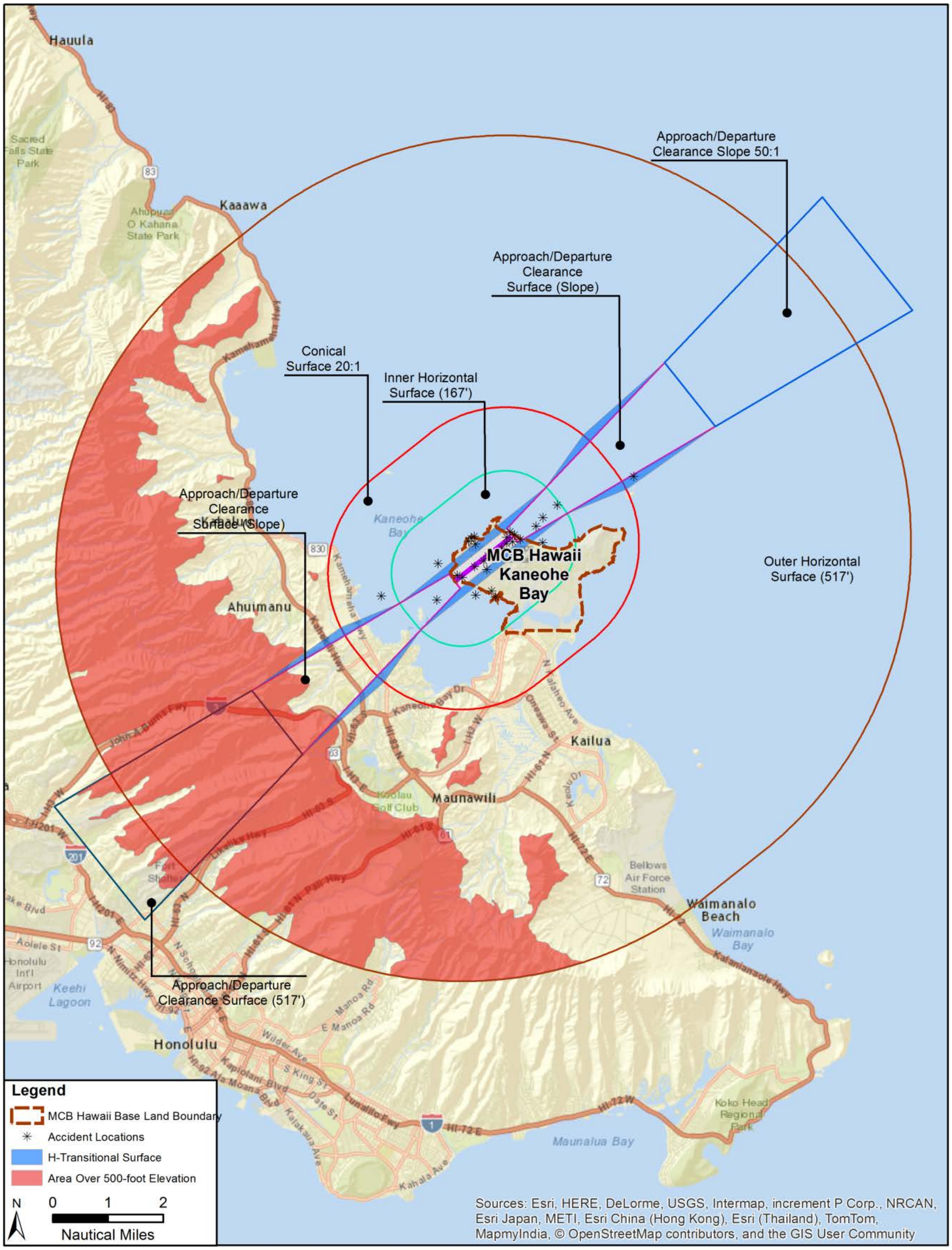

Figure 5-2 Imaginary Surfaces – MCB Hawaii

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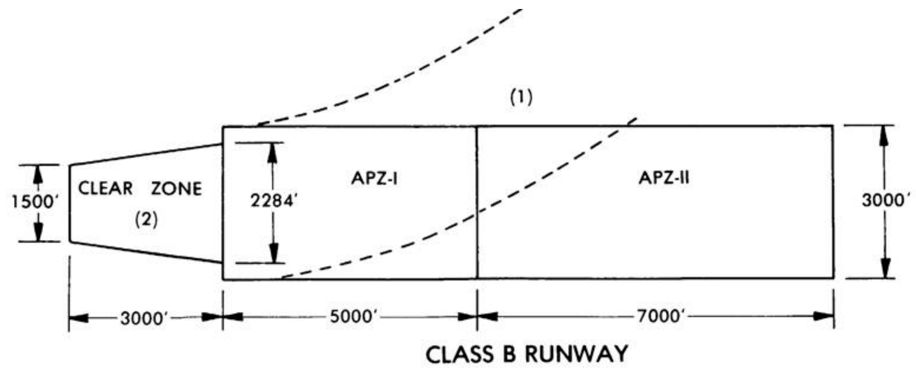

Notes:
(1) APZ I and II may be altered to conform to flight shadow.
(2) The 2284’ dimension is based on criteria of using a 7°-58’-11” flare angle for the approach departure surface where the outer width of that surface was established at 15,500’. This dimension would be 2,312’ where the outer width of the surface was established at 16,000’. Flare starts at 200’ from end of runways and 3,000’ Clear Zone length starts at runway end. See NAVFAC P-80.3 for more details.

Source:
OPNAVINST 11010.36C/MCO 11010.16.

Figure 5-3 Fixed-Wing APZs for Class B Runways

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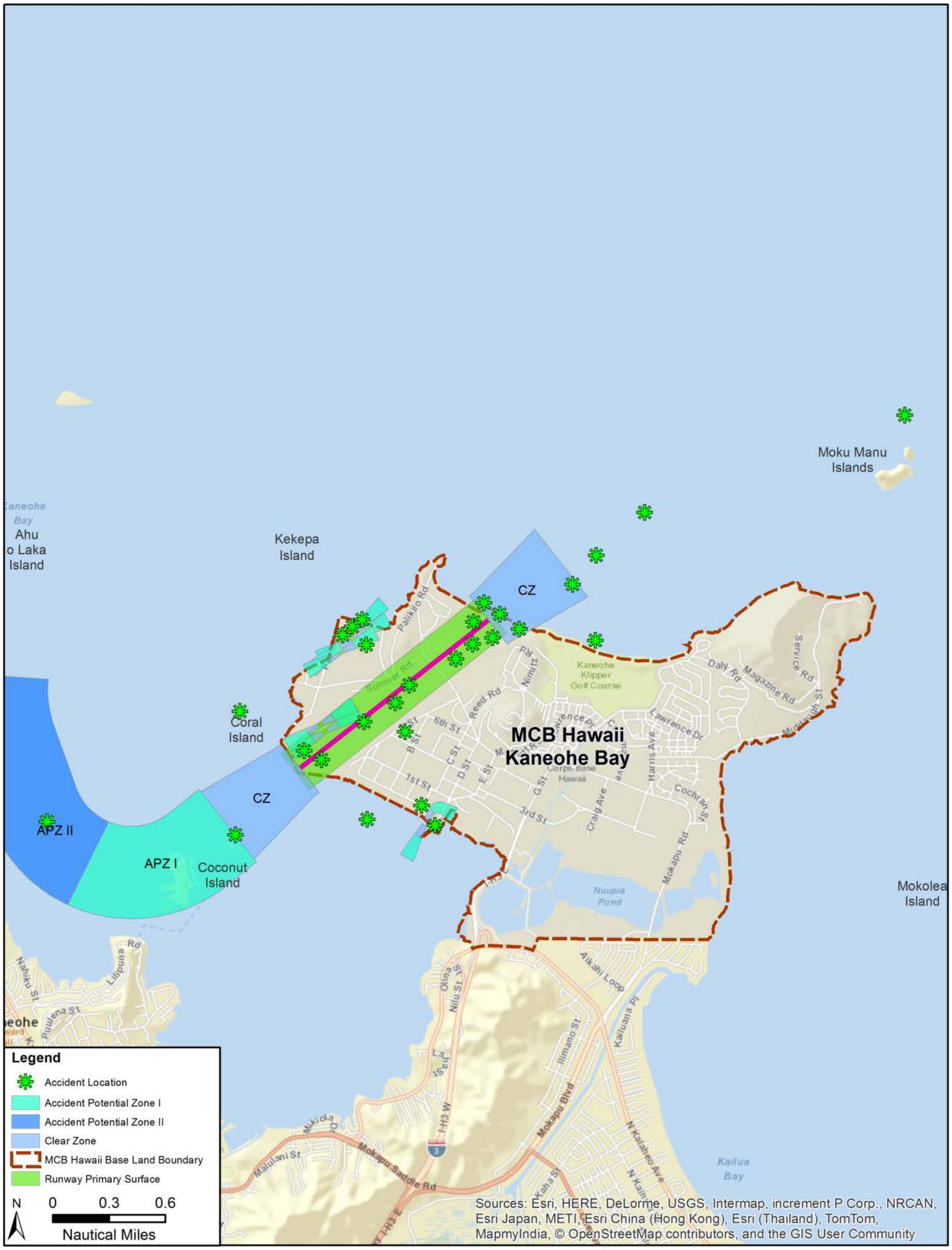

Figure 5-4 MCB Hawaii Fixed-Wing Clear Zones and APZs

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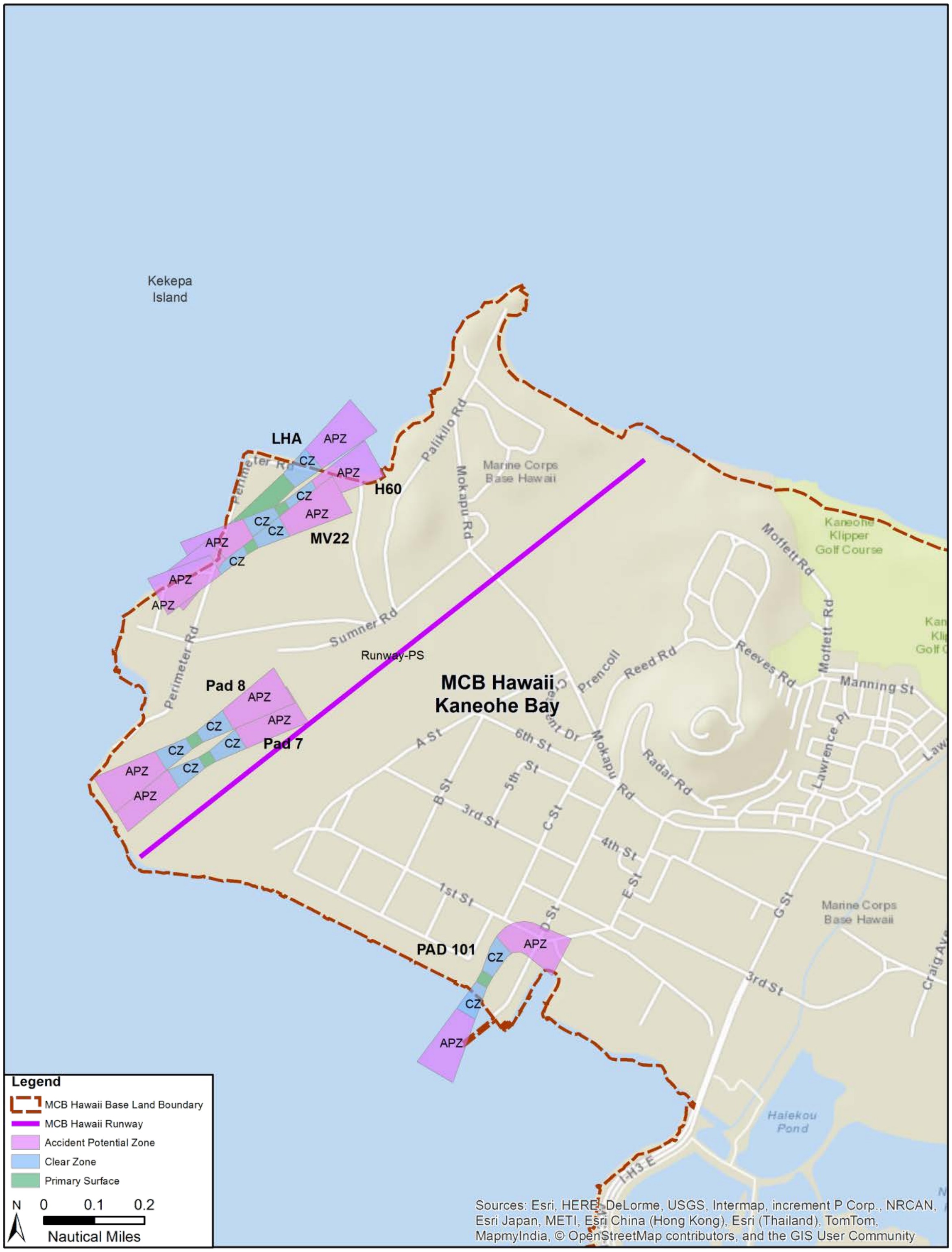

Figure 5-5 MCB Hawaii Rotary Wing Clear Zones and APZs

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5.2.3 Accident History

A summary of MCB Hawaii Kaneohe Bay aircraft accidents that occurred during flight operations from 1963 to 2013 is presented in Table 5-1 . Locations of accidents are shown on Figure 5-6.

Table 5-1 Summary of Aircraft Accidents at MCB Hawaii 1963 - 2013

Aircraft Type	On-Base	Off-Base	Total
Single-Engine Jet TA-4F	0	1	1
Twin Engine Jet/unknown F-4	11	5	16
Four Engine Jet P-3	1	0	1
Helicopter CH/HH-53	3	2	5
CH/HH-46	2	2	4
UH-1	0	1	1
Total	17	11	28

Notes:
All Off-Base accidents occurred over open water in Kaneohe Bay or in the Pacific Ocean
The latest aircraft accident in this table occurred in 2012.
Source: *Navy Safety Center.*

5.3 Airfield Safety Violations/Waivers

Airfield safety violations, in the form of flight obstructions, occur when any object (natural, manmade, stationary, or mobile) penetrates the imaginary surfaces, as outlined in NAVFAC P-80.3 and FAR Part 77 (see Section 5.1). These airfield safety violations require waivers, which are agreements that certain airfield safety violations will not be enforced due to the overriding operational needs of the station. MCB Hawaii Kaneohe Bay has obtained waivers for the following items.

- KNB-1 APN/FBN 63
- KNB-2 Structure 138 in relation to taxiway
- KNB-3 Trees along taxiway to the end of Runway 4
- KNB-4 Str 153 near taxiway
- KNB-5 Trees end of Runway 4
- KNB-6 Str 138 near taxiway
- KNB-7 Str 153 near taxiway
- KNB-8 Str 1596 near taxiway
- KNB-9 Str 141, Runway 4
- KNB-10 E-28 Arresting gear
- KNB-11 OLS primary source

- KNB-12 Pumphouse 155
- KNB-13 Electrical substation
- KNB-14 Security fencing
- KNB-15 Randomes
- KNB-16 Hard stand parking
- KNB-17 Combat loading area
- KNB-18 Mokapu Road
- KNB-19 Hangars 104 and 105
- KNB-20 TACAN antenna
- KNB-21 Helo parking hangars 104 and 105
- KNB-22 3-foot fence corrosion control
- KNB-23 Utility vault
- KNB-24 Remote Automated Weather Systems (RAWS) system Runway 22
- KNB-25 Placement of AN/TPN 22 metcals
- KNB-27 Minimum of 500 feet required between taxiway and centerline does not exist along a portion of the taxiway
- K-29 Hangar 105 is 641 feet from runway C/L along with associated transient line parking apron.

5.4 Electromagnetic Interference

New generations of military aircraft are highly dependent on complex electronic systems to perform critical flight and mission-related functions. This dependence on digital electronics, combined with higher clock rates, power-conserving signal levels, increased use of composite materials, onboard radar, communications transmitters, and lasers, increases the susceptibility of aircraft communication, navigation, and other electrical systems to electromagnetic interference (EMI). EMI is defined by the American National Standards Institute as any electromagnetic disturbance that interrupts, obstructs, or otherwise degrades or limits the effective performance of electronics/electrical equipment. It can be induced intentionally, as in forms of electronic warfare, or unintentionally, as a result of spurious emissions and responses, such as high-tension line leakage. EMI may also be caused by atmospheric phenomena, such as lightning and precipitation static, and non-telecommunications equipment, such as vehicles and industrial machinery.

EMI may also affect aircraft weapons systems, which often include a myriad of digital electronics. Hazards of Electromagnetic Radiation to Ordnance (HERO) are also of concern. The *Marine Corps Air Facility Operations P3710.1H* Air Operations Manual provides guidelines related to HERO during aircraft weapons loading and unloading.

No on- or off-installation land uses create EMI/HERO for flight operations, communications among aviators and ground control personnel, or weapons loading and unloading.

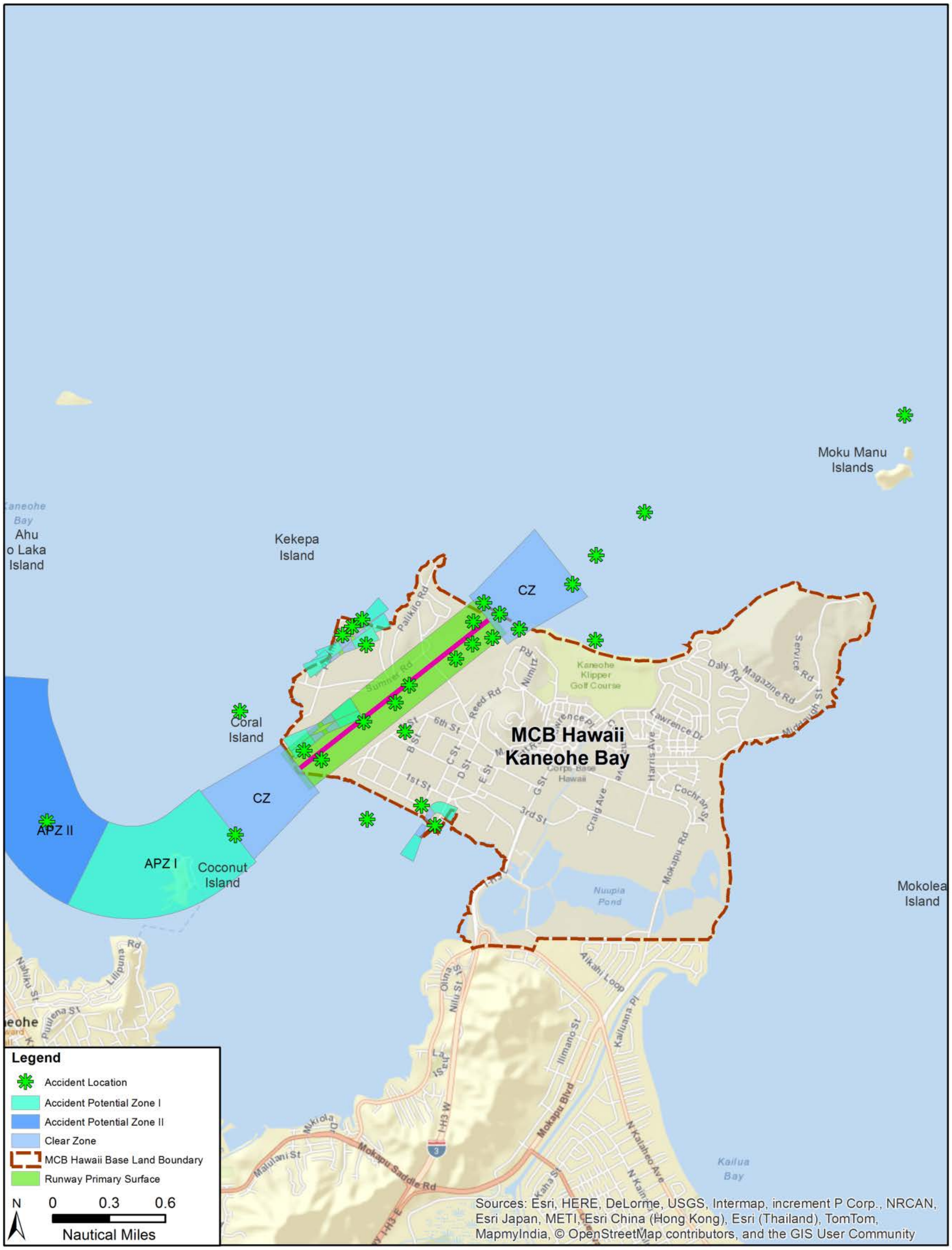

Figure 5-6 Aircraft Accidents at MCB Hawaii 1963-2013

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5.5 Lighting and Glare

Bright lights, either directed or reflected, in the vicinity of an airfield can impair a pilot's vision, especially at night. A sudden flash from a bright light causes a spot or "halo" to remain at the center of the visual field for a few seconds or more, rendering a person virtually blind to all other visual input. This is particularly dangerous at night when the flash can destroy the eye's adaptation to darkness, typically requiring 40 to 45 minutes for partial recovery. In addition, solar and other renewable energy projects may cause reflective glare hazards for pilots.

Past DOD pilot encounters with laser flashes from outdoor light at concerts, fairs, theme parks, and casinos have increased the awareness of these hazards. Spotlights and reflected light from glass-exterior buildings can also impair pilot vision. According to personnel at MCB Hawaii Kaneohe Bay, there are no existing or expected major issues related to off-installation lighting or renewable energy projects in the vicinity of the airfield.

5.6 Smoke, Dust, and Steam

Unchecked land uses around airfields may emit smoke, fly ash, dust, steam, vapor, gases, or other forms of air emissions that can impair visibility in the vicinity of the airfield, interfere with the safe operation of aircraft, and endanger the landing, take off, or maneuvering of aircraft at the airfield. According to personnel at MCB Hawaii Kaneohe Bay, there are also no major issues related to these types of air emissions at or in the vicinity of the airfield.

5.7 Bird/Animal Aircraft Strike Hazards (BASH)

The Air Force and Navy report at least 3,000 bird/wildlife strikes each year (DOD Partners in Flight 2014). One of DOD's aviation safety programs is the Bird/Wildlife Aircraft Strike Hazard (BASH) prevention program. Because the same airspace is used by planes and birds, the prevention of bird strikes is of serious concern to the military. Air operations, aviation safety, and natural resources personnel work together to reduce the risk of bird and wildlife strikes through the Operational Risk Management process (DOD Partners in Flight 2014).

Tools used to detect bird movements that may present a bird strike hazard include radars used at different scales (DOD Partners in Flight 2014). The Doppler radar WSR-88D can show the direction and speed of migrating bird flocks up to 60 nautical miles from an airfield 24 hours a day. Closer to the local airfield mobile marine radars can track real time movements of individual birds or flocks adjacent to and in a 6 to 8 mile radius of runways. The BASH Plan is an integral part of the Integrated Natural Resources Management Plan, which are developed by military installations to manage wildlife and habitats. Habitats immediately adjacent to the runways are managed in a way to be less attractive to wildlife (e.g., maintained grass).

MCB Hawaii Kaneohe Bay maintains a BASH plan and implements BASH guidelines (MCAF 2006) to manage the hazard of resident and migratory bird species in the airfield area. Flight Operations and the Air Station are responsible for clearing birds from the runways and taxi approaches. The BASH Plan, tailored to specific conditions and operations at Kaneohe Bay, provides guidance to minimize bird strike hazards to military aircraft. As part of the BASH Plan, a Bird Hazard Working Group was established with procedures to identify high hazard situations and to aid aircrews in determining if altering/discontinuing flying operations are required. The plan outlines aircrew operating procedures to avoid high-hazard situations and procedures to decrease the attractiveness of the airfield to birds by eliminating, controlling, or reducing environmental factors attractive to birds, such as keeping the runway areas clear of most vegetation except grasses. The plan includes detailed distribution of information to all assigned and transient aircrews on bird hazards and provided guidelines for dispersing birds on the airfield.

Birds are regularly hazed from the flightline area by U.S. Department of Agriculture Wildlife Services staff, under permits from the U.S. Fish and Wildlife Service. The MCB Hawaii Environmental Compliance and Protection Department Natural Resources Section secures the Depredation Permit from the U.S. Fish and Wildlife Service for operations and ensure compliance by U.S. Department of Agriculture Wildlife Services staff.

The Naval Safety Center has recorded mishap information regarding wildlife strike events with naval aircraft since 1979 (Naval Safety Center 2009). Table 5-2 lists the number of BASH incidents on record at Naval Safety Center for MCB Hawaii Kaneohe Bay from 2000 through 2013. Most incidents occurred during the low phases of flight—take offs and landings. The records show that a wide variety of bird species were involved in the incidents, including swallows, pigeons, sparrows, egrets, ducks, seagulls, and plovers. One incident was attributed to insects.

Table 5-2 MCB Hawaii Kaneohe Bay BASH Incidents

Year	Number BASH Incidents
2000	1
2001	0
2002	5
2003	2
2004	11
2005	4
2006	0
2007	1
2008	1
2009	4
2010	0
2011	5
2012	8
2013	9

Source: Naval Safety Center 2008, 2013.

6 AICUZ, Land Use Compatibility Guidelines, and Implementation

The AICUZ boundary is generally defined as the areas contained within the noise zones and APZs of an air installation. The AICUZ footprint is the minimum area where land use controls are recommended to protect the health, safety, and welfare of those living on or near a military airfield. Recognizing the open air living style in Hawaii the 65 DNL contour defines the boundary of the MCB Hawaii Kaneohe Bay AICUZ.

Although control over land use and development in the vicinity of military facilities is the responsibility of local governments, the Navy encourages localities to adopt programs, policies, and regulations that promote compatible development within the AICUZ footprint. This chapter presents the AICUZ footprint for MCB Hawaii Kaneohe Bay and the recommended land use compatibility guidelines that local planning and zoning officials can use in their review of land use control and zoning regulation updates.

6.1 AICUZ Footprints for MCB Hawaii Kaneohe Bay

The AICUZ footprint encompasses noise contours of 65 dB DNL and higher (i.e., Noise Zones 2 and 3) as well as the primary surface, clear zones, and APZs I and II surrounding an airfield's runways. The AICUZ footprint is further defined as the minimum area within which land use controls are considered necessary to promote compatible land use development and to protect the health, safety, and welfare of those living on or near a military airfield. Figure 6-1 presents the AICUZ footprints for MCB Hawaii Kaneohe Bay for the Prospective Future operations scenario addressed in this update.

The superimposed noise exposure levels and APZ boundaries conceptually create potential subzones within an AICUZ footprint that can contain various combinations of noise and accident potential exposure. The land use recommendations for both noise and APZs would apply in such areas.

Noise zones are depicted in Figure 6-1. Noise Zone 1 (less than 65 dB DNL) (unshaded area) is an area of low or no impact (although some people in these areas may be annoyed by aircraft overflights) and is included in the AICUZ boundary for informational purposes (See Section 4.5).

Noise Zone 2 (DNL 65-74 dB) is an area of moderate impact where some land use controls are recommended and Noise Zone 3 (DNL 75 dB and above) is the most severely impacted area and the greatest degree of land use controls for noise exposure are recommended.

6.2 Land Use Compatibility within AICUZ Footprint

Noise-sensitive uses including, but not limited to, housing, schools, hospitals, and churches are recommended to be placed outside of areas experiencing 65 dB DNL or higher. People-intensive uses including, but not limited to, shopping malls, theaters, and activities that would draw concentrations of people to an area should be placed outside APZs.

Certain land uses are considered compatible under certain conditions. For example, recreational uses, such as parks, are considered compatible under APZ I provided that the recreational use does not include a high density of people (e.g., spectator sports). In the Clear Zone recreational activities, including water recreation, are not suggested. Agricultural uses are compatible above 75 DNL, but residential buildings are not considered compatible. Compatibility is a relative term and should be considered along with specific local land use development criteria by local governments in their decision making processes.

Federal guidelines for suggested land uses are contained in *The Federal Highway Administration's Standard Land Use Coding Manual* (SLUCM) (U.S. Department of Transportation 1965). The SLUCM standards, including their codes and sub-codes, provide planners with detailed information describing specific land use categories and are nationwide in scope. Since many air installations are in urban areas, these guidelines assume an urban environment with higher levels of ambient "background" noise than might exist in rural and suburban areas. These compatibility guidelines are, therefore, sometimes modified at the local government level to address a specific local noise environment. SLUCM codes and land use compatibility guidelines for Clear Zones and APZs are provided in Appendix A.

6.3 Land Use Compatibility Analysis

This section presents information pertaining to land use planning authorities, existing land use, zoning, and future land use in the MCB Hawaii Kaneohe Bay environs. In addition, this section examines AICUZ recommendations as they apply to current and future land use in the areas on the base and surrounding the airfield. Land use compatibility implementation decisions are made by local government authorities responsible for land use planning and zoning through their local planning and zoning regulations.

6.3.1 MCB Hawaii Kaneohe Bay

The MCB Hawaii Kaneohe Bay facilities are located on 2,951 acres on the Mōkapu peninsula on the windward side of the island of Oahu. Windward Oahu is separated from Honolulu and the leeward side of the island by the Koʻolau Mountain Range that runs east-west across the island of Oahu. The Mōkapu peninsula is bounded by the Pacific Ocean on the north, Kailua Bay on the east, Kaneohe Bay on the west and residential housing to the south.

Aerial View of the Ko'olau Mountain Range and Kaneohe Bay

Kailua to the southeast and Kaneohe to the southwest are the two closest communities with housing and other amenities. MCB Hawaii Kaneohe Bay is accessed from Honolulu by the Likelike Highway through Kaneohe or on the Pali Highway through Kailua. The newest and quickest route is the H-3 Freeway that directly links MCB Hawaii Kaneohe Bay with Joint Base Pearl Harbor Hickam.

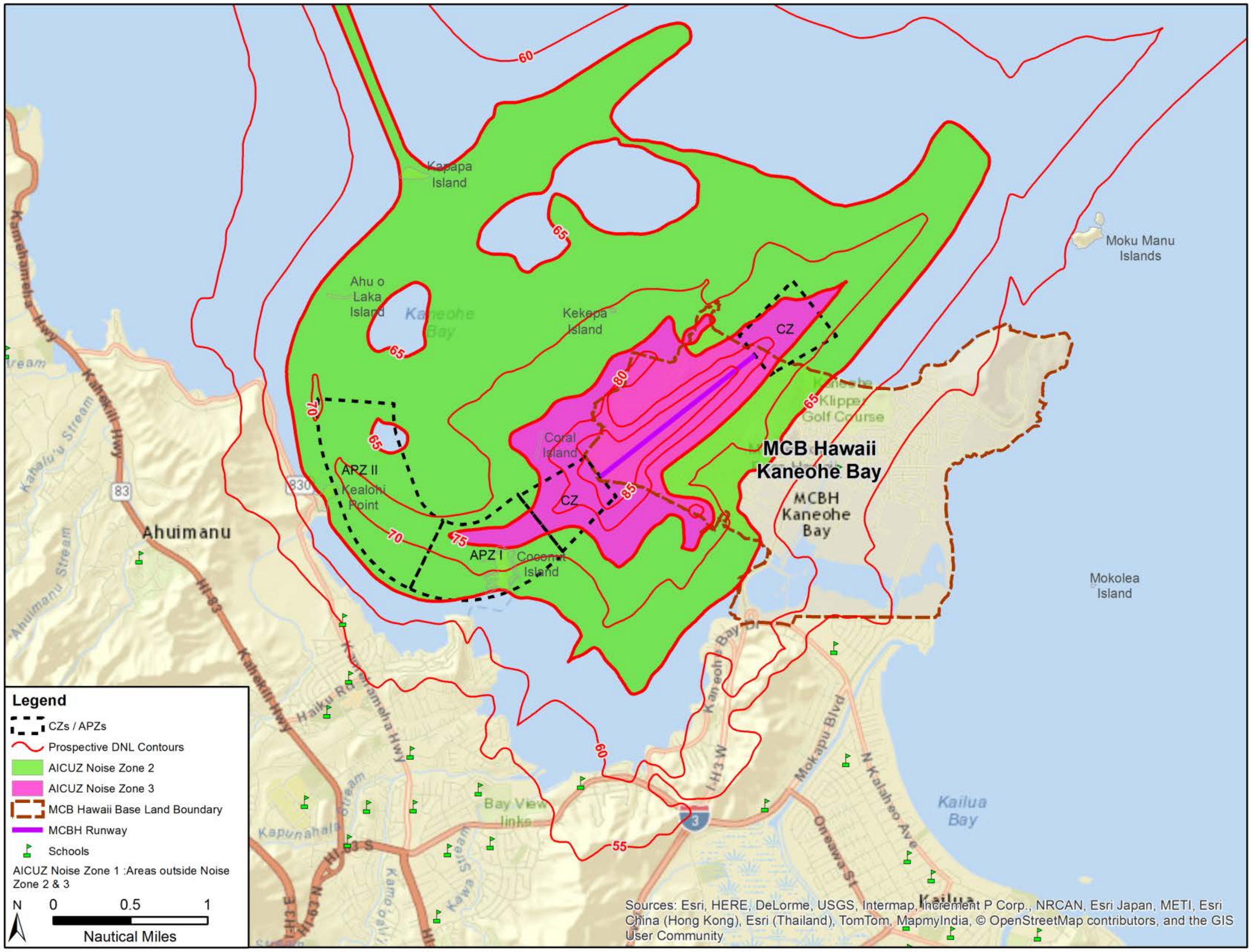

Figure 6-1 Prospective AICUZ Footprint MCB Hawaii Kaneohe Bay

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A major land use is the runway complex and related aircraft operational and maintenance facilities located in the western and southwestern portions of the base. The eastern portion of the base is dominated by ground operations. Bachelor quarters are located near both these primary work areas. The central portion of the base is used for administrative, medical and community support areas. Family housing occupies the north central and northwestern portions that are farthest away from the operational areas. Other factors affecting land use are areas with excessive slopes, wetlands, wildlife management areas, and cultural resources (Wil Chee - Planning, Inc. 2006).

6.3.1.1 Demographics

The major population centers near the Marine Corps airfield are Kaneohe, Kailua, MCB Hawaii Kaneohe Bay, and Kahaluu with 2010 populations of 34,597, 38,635, 9,517, and 4,738 (U.S. Census 2010). Based on the 2010 U.S. Census, the communities of Kaneohe, Kailua, MCB Hawaii Kaneohe Bay, and Kahaluu constitute about 4% of the state's total population of 1,360,301 down from approximately 7% of Hawaii's population in 2000. According to the city and county of Honolulu population projections, this area is expected to experience only minimal growth through 2020.

6.3.2 Existing Land Uses in AICUZ Areas

6.3.2.1 Existing On-Station Land Use

Land use on base is governed by the MCB Hawaii Master Plan. The MCB Hawaii Master Plan (MCB Hawaii 2006) divided on-station uses into 12 distinct classifications. These land use activities are:

- Operational spaces
- Training
- Supply/Storage
- Health Services
- Administration space
- Family Housing
- Bachelor Enlisted Quarters
- Community Facilities
- Recreational Space
- Open Space
- Utilities/Landfill areas
- Areas of Constraint

Aerial View of MCB Hawaii; civilian homes border this installation to the southeast.

Furthermore, the MCB Hawaii Master Plan divided the base into six distinct land use planning zones (MCB Hawaii 2006), as shown in Figure 6-2 and described below.

- **Zone 1** (West Field) is the primary land use on base and is home to the operational and aircraft maintenance area. The activities in this area include: the runway complex; air operations facilities; air-control tower; aircraft hangars; fuel-farm station; supply/storage areas; and support infrastructure for the aircraft stationed on base.

- **Zone 2** houses the command, administrative facilities, and ground operations. Facilities in this zone include: an educational and professional development center; command administrative offices; bachelor enlisted quarters; the Regimental/Group Headquarters; and the Main Gate.

- **Zone 3** is the location of on-base family housing complexes, enlisted troop quarters, and recreational areas.

- **Zone 4** is the location of the Community Facilities. It houses the Exchange, the Commissary, the Post Office, retail stores, and restaurants.

- **Zone 5** has the training facilities, small arms armory, maintenance facilities, ground unit supply and storage buildings, warehouses, and the Mokapu-Gate. This area is also bordered by wetlands, wildlife management areas, cultural resources, and areas with steep slopes.

- **Zone 6** is largely open space with the ground operations, training area, and the Ulupau Firing Range Complex.

Figure 6-3 shows the noise contours from this AICUZ update overlaid on the six land use planning zones. The areas of constraint include: the air operations region (approach and take off pathways and the hover areas); the shoreline and beach areas; open spaces; and the wetland/marsh areas to the south of the base (MCB Hawaii 2006). The base resources have been carefully planned out so that activities at the airfield have the least impact to noise sensitive areas.

The Base Master Plan calls for better use of land to meet future requirements placed on the Marine Corps and to make the use of existing space more efficient. With the expected arrival of new aircraft, equipment, and new ground unit assets, the base is embarking on a restructuring plan with an expected completion date of December 2015. Plans call for the expansion of the runway to accommodate the new aircraft; expansion of aircraft hangar/repair areas; and new structures to house expanded ground forces and personnel needs. The goals set forth in the Base Master Plan to guide future requirements and expansion efforts are:

- Organize an integrated ground training venue by using the open spaces between Ulupau Crater ranges and the III MEF area;
- Consolidate the ground unit facilities to the east-end of the base; and
- Consolidate air operations to the west-end of the base.

6.3.2.2 Existing Off-Station Land Use

MCB Hawaii Kaneohe Bay is surrounded by the Pacific Ocean on three sides and is connected to Oahu’s roadway system via the H-3 state highway system and Mōkapu Boulevard. The base is bordered to the north by the Pacific Ocean and civilian residential housing lies to the south. These homes are located primarily along the shores of Kaneohe and Kailua Bay. The population density within this area varies and is largely dependent on topography and existing infrastructure. The flight paths are closer to Kaneohe and air operations are more visible to its residents. Kailua and its suburban homes and businesses to the west are less impacted by air operations than is Kaneohe.

Land uses along the shore and near the base are primarily single-family residences, schools, and commercial enterprises. Commerce along the shore or nearby the base includes a privately run marina, businesses in the Aikahi Shopping Center, and the Bayview Golf Course. Additional enterprises are located inland in the form of small businesses, restaurants, office complexes, automobile dealerships, and other shopping centers. In Kaneohe these businesses are located along Kamehameha Highway, between the Likelike Highway and Haiku Road.

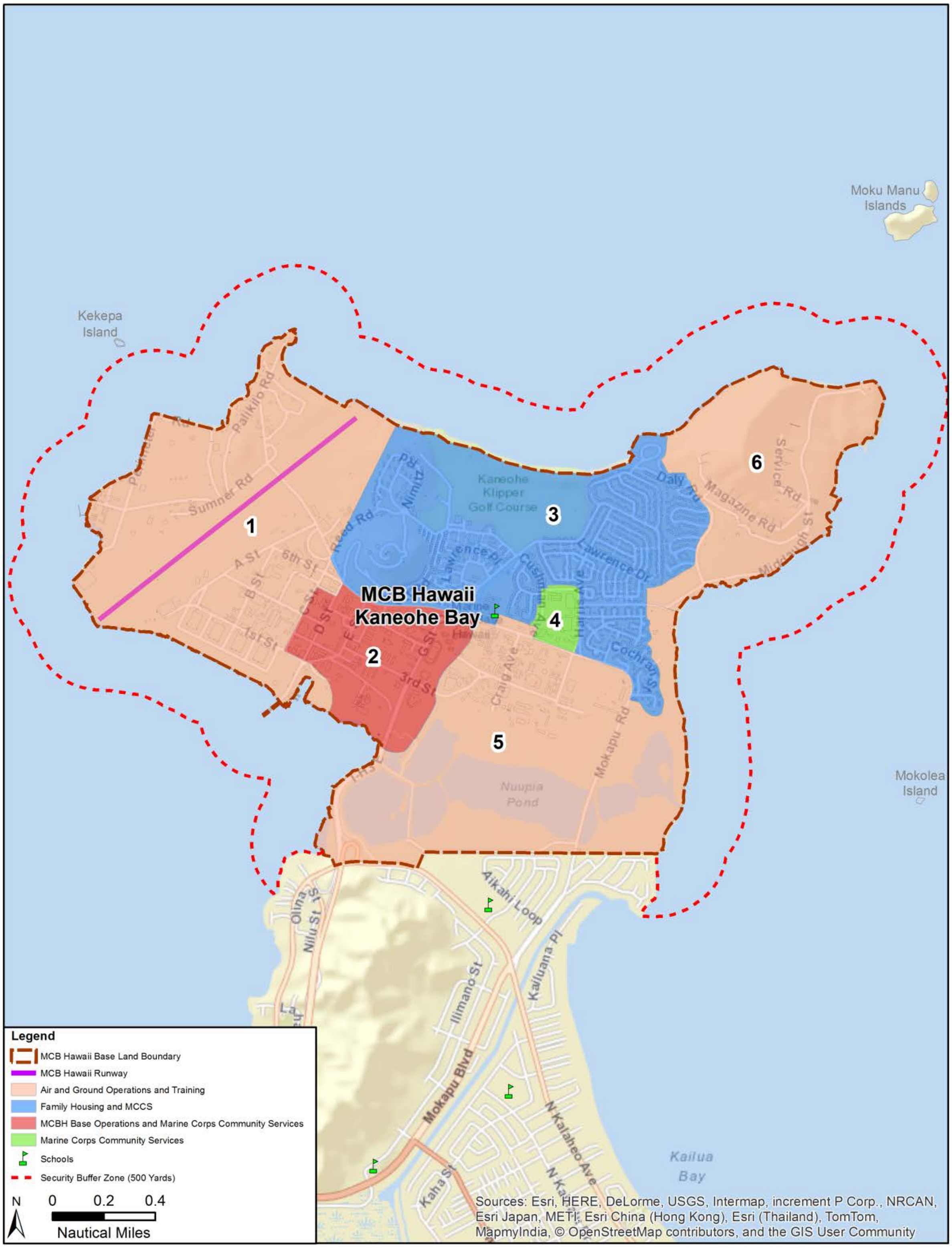

Figure 6-2 MCB Hawaii Kaneohe Bay On-Station Land Use

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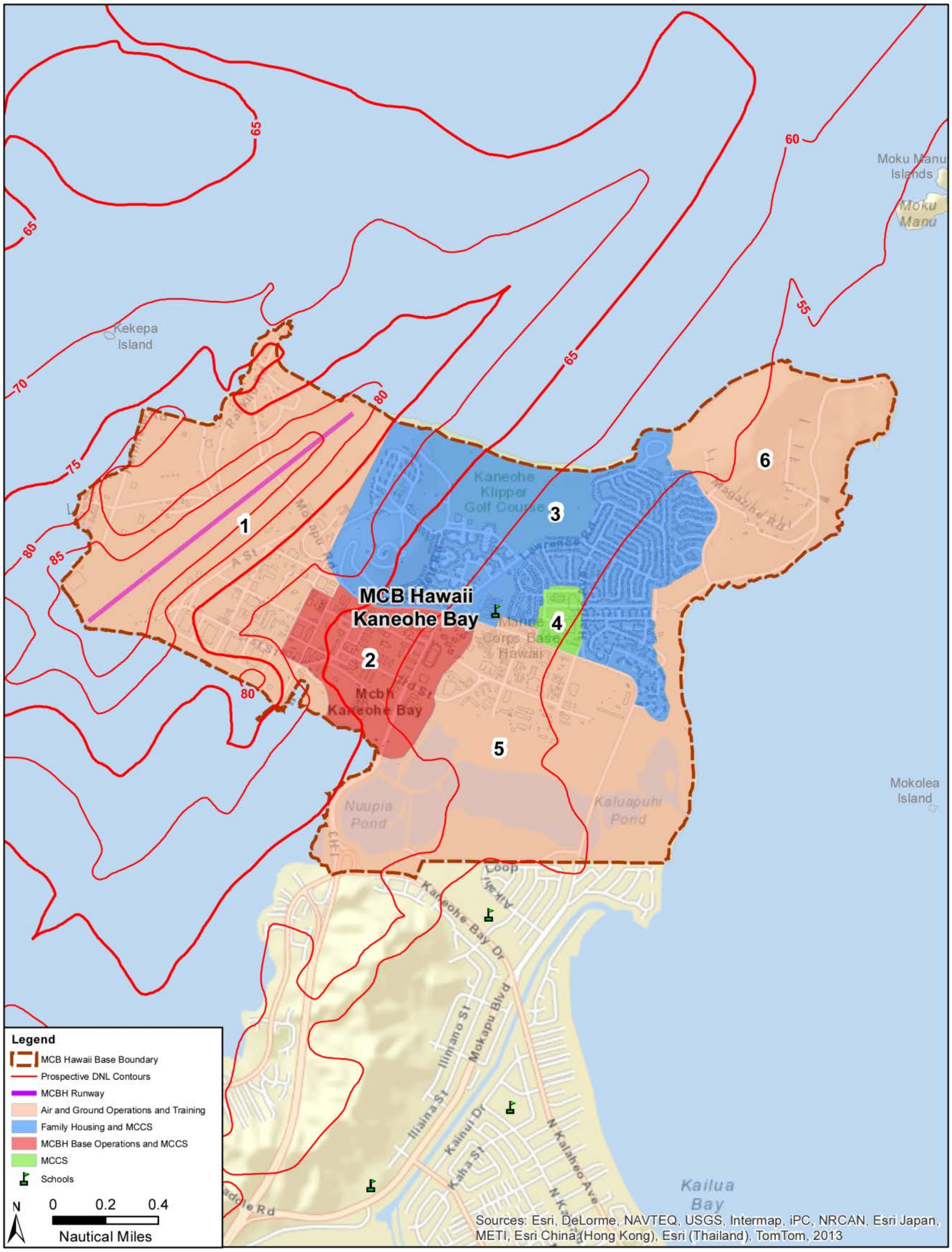

Figure 6-3 Prospective Noise Contours in Relation to MCB Hawaii Land Use

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Kailua also has similar commerce, these are located away from MCB Hawaii Kaneohe Bay, clustered around the intersection of Oneawa Street and Kailua road (radiating outward). No heavy industry exists in either community; however, Kaneohe does have some light industrial areas along Kahuhipa Street, and in Kailua along Kapaa Quarry Road. There is also a rock quarry three miles south of MCB Hawaii Kaneohe Bay near the H-3 Freeway.

Institutional uses in the general area include several public elementary schools; James B. Castle High School; Kalaheo High School; King Intermediate School; Windward Community College; and the privately run Hawaii Pacific University.

Healthcare organization in Kaneohe and Kailua also include medical facilities and elder care homes. Kaneohe has numerous medical practitioners operating in the community. These clinics dot the town in various locations and medical buildings. Kailua has similar medical office resources. The Castle Medical Center in Kailua serves as the major health center in the Windward Oahu area.

There are also conservation areas including bird and wildlife sanctuaries managed by the State of Hawaii.

Existing State land use designations with the Prospective AICUZ footprint from this AICUZ update superimposed for ease of reference are shown in Figure 6-4.

While the noise contours of 65 DNL and above off-base remain almost exclusively over water as shown in Figure 6-4, citizens in the Kailua and Kaneohe areas will continue to hear some noise related to air operations associated with the Marine Corps Air Station Kaneohe Bay.

There are several small islands that dot the windward side of Oahu. Many of these islands are within this study area, however only one – Coconut Island – is inhabited. Coconut Island, (also known as Moku O Lo‘e) comprises approximately 29 acres of land and houses a research facility run by the University of Hawaii Institute of Marine Biology. Coconut Island lies near approach pathways of aircraft using the Marine Corps Air Station Kaneohe Bay and has experienced noise impacts for many years as noted in previous AICUZ studies. The AICUZ impact is recognized in the Coconut Island Long Range Development Plan and accompanying Final Environmental Impact Statement of March 2004. The dB level of the Prospective 2018 AICUZ footprint in the Coconut Island area is essentially unchanged from the 1990 AICUZ noise levels and has increased approximately 5 dB as compared to the 2003 AICUZ.

6.3.3 Zoning and Land Use Controls

6.3.3.1 On-Station Land Use Controls

The MCB Hawaii Master Plan contains numerous objectives for managing land use activities. The key components of these guidelines are: 1) areas in higher noise levels should be used for operational, maintenance, warehousing, and industrial uses; 2) the safety of personnel and property should be enhanced by planning facilities with current ordnance, fire protection, and air facilities in mind; 3) activities planned for the area should be close to their primary users and support activities; and 4) quality of life issues should be convenient to users in future planning by providing better housing and community facility resources.

6.3.3.2 Off-Station Land Use Controls

The land surrounding Mōkapu Peninsula is governed by the State of Hawaii regulations, and City and County of Honolulu planning and land use ordinances. All authorized land use activities in this area must meet federal, state, and county standards. The State of Hawaii Land Use Commission determines appropriate land use activities by dividing areas into districts. Land use law divides districts into four classifications:

- Urban: typically land reserved for residential, commercial and industrial uses.
- Rural: lands are defined as areas that include activities or uses characterized by low density residential lots of not more than one dwelling per one-half acre or where "city-like" concentrations of people, structures, and streets are absent.
- Agricultural: lands are areas intended for intensive cultivation of crops.
- Conservation districts: environmentally sensitive regions that require additional safeguards. In Hawaii these lands are typically tropical forests, nature preserves, wildlife sanctuaries, and wetlands.

State Department of Lands and Natural Resources manages the Conservation district, while the city and county have land use authority to regulate lands outside of the Conservation districts. Rural and agricultural lands are covered by mutual jurisdiction: state laws define permitted uses and counties are given administrative oversight, implementation, and enforcement responsibilities (Hawaii Revised Statutes; Volume 4, Chapter §205-05, 2007). The City and County of Honolulu, Department of Planning and Permitting regulates permissible uses in this area of Oahu through the General Plan, Koʻolaupoko Sustainable Communities Plan, and land use ordinance.

Figure 6-5 shows the AICUZ footprint superimposed on the City and County of Honolulu's zoning designations as defined in the land use ordinance (refer to Appendix C for a detailed discussion and definition of state land use districts, zoning designations, and permitted uses).

For Oahu, the City and County of Honolulu has established a three level system of land use policies and guidelines. These regulate urban growth and permitted activities. The primary policy directive is the General Plan. This provides broad-based goals, objectives, and policy statements. The Sustainable Community Plans make up an additional and vital planning tool for the city and county of Honolulu. Oahu is segmented into eight geographical planning districts. These policy statements are more detailed and area-specific than the General Plan. Land Use ordinances, zoning, permitting, and Capital Improvement Programs make up the final level of city and county's land use policies and guidelines.

The Mōkapu Peninsula and its surrounding communities are classified as Urban and fall under the Koʻolaupoko Sustainable Community planning region. This district covers the entire central and southern windward coast from the agricultural region of Kahaluʻu (northern Kaneohe Bay) to the southeast tip of Oahu, Makapuʻu point. The rural areas of Waiāhole, Waikāne, and Waimanalo also fall within this planning region.

Coconut Island is classified as a conservation area and is zoned as restricted preservation (Figure 6-5) that is within AICUZ Noise Zone 2. The tip of Kealohi Point within AICUZ Noise Zone 2 is also classified as a conservation area and is a mix of restricted and general preservation (Figure 6-5).

The Sustainable Community Plan is intended to build upon the goals set forth by the General Plan. They provide an additional vision and future from the diverse communities they represent. The Koʻolaupoko plan objectives are to protect and preserve the natural, scenic, cultural and historic resources and improve and replace the area's aging infrastructure.

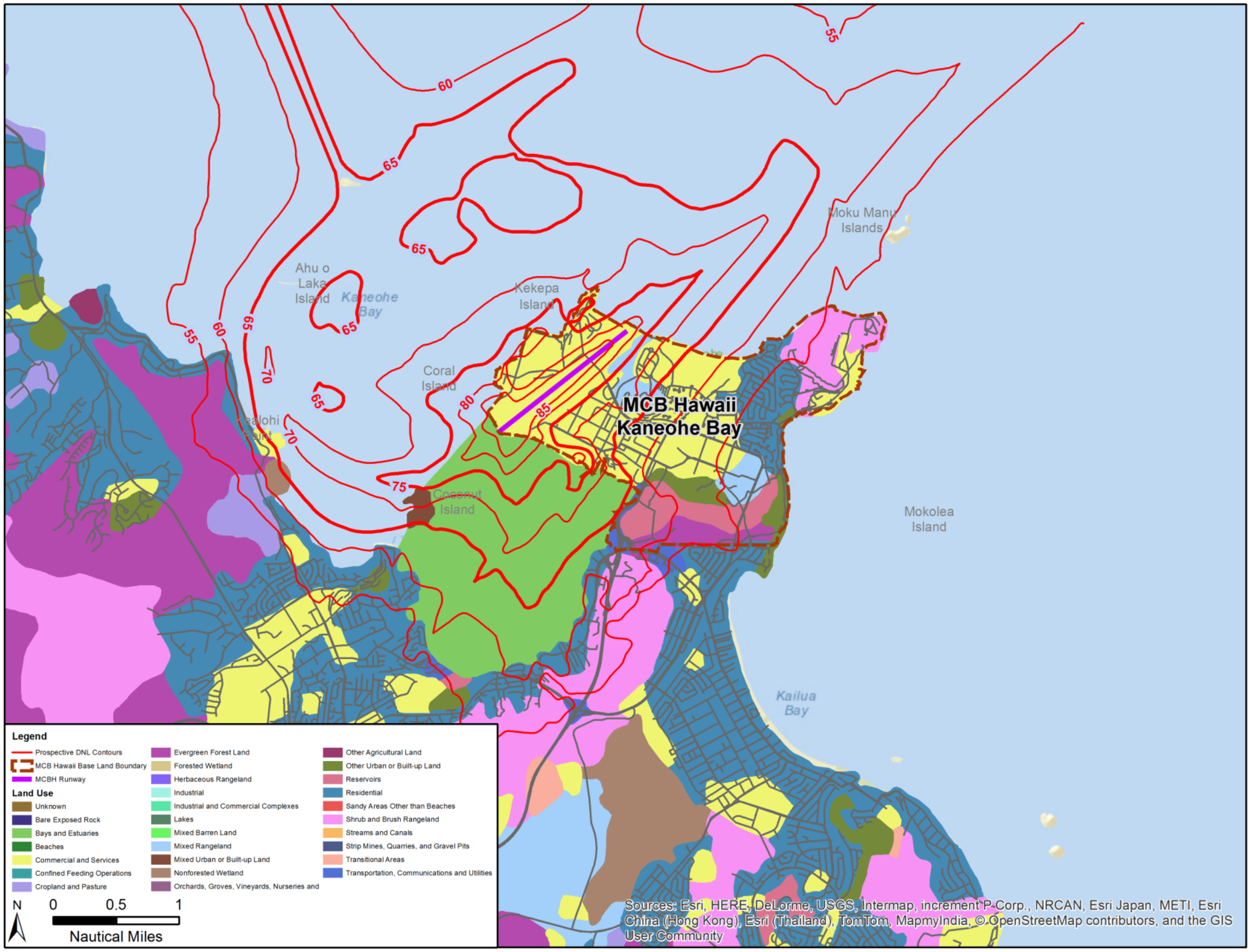

Figure 6-4 Existing Land Use and Prospective Future Footprint

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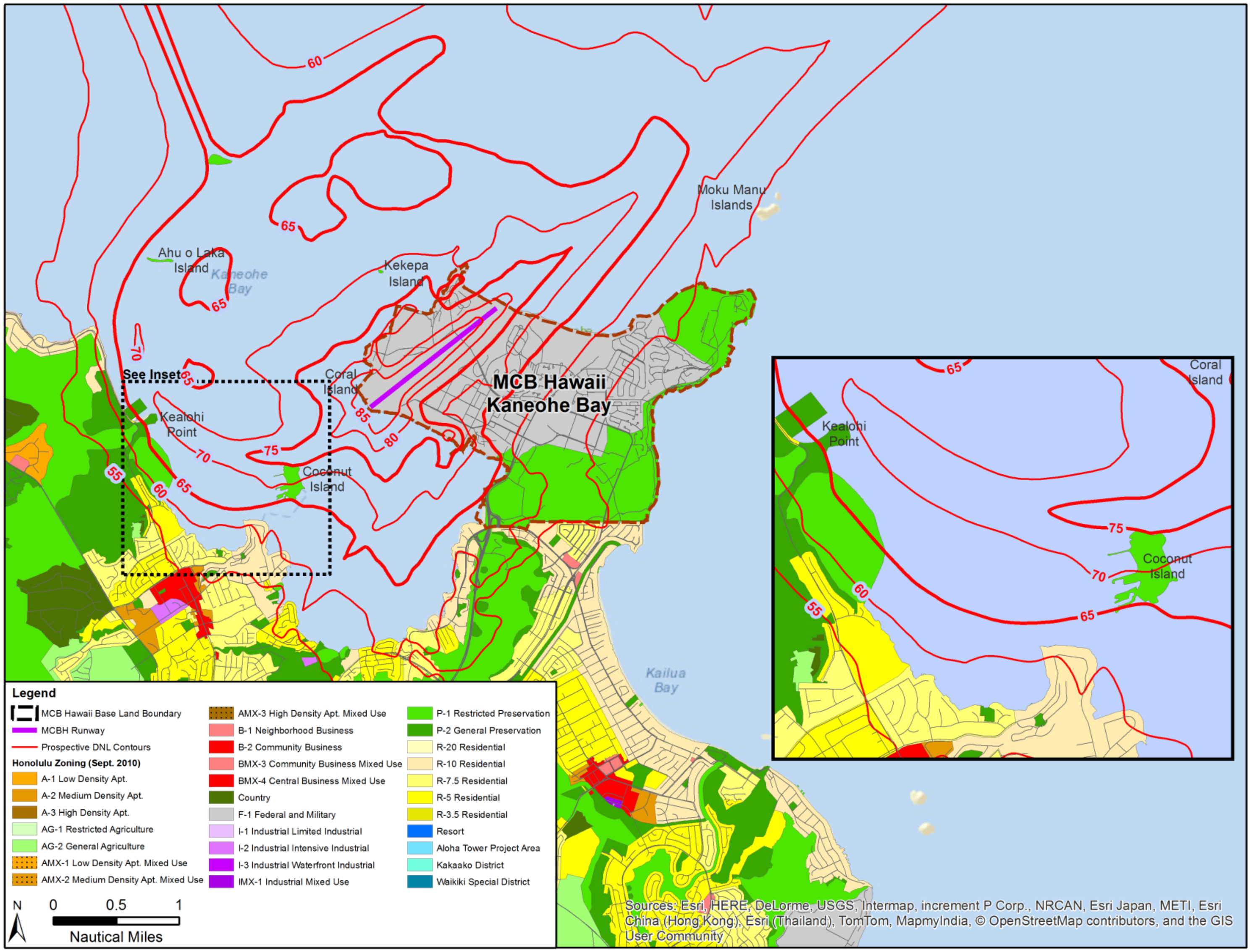

Figure 6-5 Prospective DNL Contours Compared to Land Use Zoning

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The General Plan Population Guideline for this region intends that the main two communities, Kailua and Kaneohe, remain suburban low-density population centers, with limited growth and urbanization. The Koʻolaupoko Sustainable Community Plan reinforces this by setting urban, rural, agricultural, and preservation delineations. Whenever possible, it stresses the maintenance of open space and agricultural regions.

Aerial View of Kailua Bay

6.3.3.3 Local Noise and Safety Regulations

The State of Hawaii Airport Zoning is authorized under Chapter 262 of the Hawaii Revised Statutes and is administered by the state DOT. The Hawaiian DOT Administrative Rules, Title 19, Chapter 12 includes the authority to control airport hazards contrary to the public interest and provides procedures for adopting airport zoning regulations, including controls of lighting and heights in lands surrounding civilian and military airports (See Appendix D).

The FAA Regulations on Airport Noise Compatibility Planning Programs, Part 150 are the civilian equivalent of the DOD's AICUZ Program. While this program is similar to the AICUZ program, it does not apply to military airfields. For civilian airports, the State DOT Airports Division has an implementation program that carries out the FAA's Part 150 Regulations. The Hawaiian DOT program is similar to the FAA Part 150 Regulations; however the Hawaii program recommends a noise level of 60 DNL for residential uses, while federal programs, including the AICUZ, land use recommendations begin at level of 65 DNL.

The Hawaiian DOT policy of a recommended noise level of 60 DNL for residential uses has been written into the Part 150 Noise Compatibility Program for Honolulu International Airport, but it is not in the Hawaii Revised Statutes as law. Therefore, the 55 and 60 dB DNL contours have been included on figures for informational and planning purposes only.

According to the *CFR Part 150 Noise Compatibility Program for Honolulu International Airport* (Part 150), the FAA allows local authorities to establish aircraft noise land use compatibility guidelines that consider local conditions. Based on these local conditions "…Department of Transportation – Airports Division (DOT-AIR) decreased the acceptable exterior DNL level for residential housing from 65 to 60 DNL because houses in Hawaii have an Outside-to-Inside Noise Level Reduction (NLR) factor approximately five to fifteen decibels less than a mainland type house. Therefore, DOT-AIR recommended that housing and noise sensitive buildings be built in areas with noise impacts below 60 DNL" (EKNA Services Inc. 2004).

Disclosure of location within an AICUZ boundary is required under the Hawaii Seller's Disclosure Law, Chapter 508D Mandatory Seller Disclosures in Real Estate Transactions. Section 508D-15 (3) states that any property "Within the boundaries of the Air Installation Compatibility Use Zone of any Air Force, Army, Navy, or Marne Corps airport as officially designated by military authorities" must be disclosed by the seller to the buyer. This requirement is included in the Hawaii Association of Realtors Seller's Real Property Disclosure Statement standard form (Revised 4/07). Item 60 on this standard checklist asks the question, "Is this Property located within the boundaries of the Air Installation Compatibility Use Zone of any Air Force, Army Navy, or Marine Corps airport as officially designated by military authorities?" (See Appendix D). However, neither the law nor the disclosure statement specifies a specific noise level as the threshold for compatible noise level. Therefore, in accordance with the Title 14, Code of Federal

Regulations, Section 150.21 – Airport Noise Compatibility Planning, EPA Order 5050.4B, and OPNAVINST 11010.36C/MCO 11010.16, the 65dB contour and higher is used to define the MCB Hawaii Kaneohe Bay AICUZ boundaries.

6.3.4 Future Land Use

6.3.4.1 Planned On-Station Land Use

The MCB Hawaii Master Plan (2006) is divided into two volumes that involve long-range planning concepts and capital improvement planning for infrastructure and facilities needs. The Master Plan is currently being updated with an expected completion date of April 2016. The overall planning objective of the MCB Hawaii Master Plan was to provide an orderly development scheme while accommodating the numerous tenants' distinct land use needs, as well as federal government public trust, natural resources, and conservation/environmental compliance responsibilities. The Base Plan puts forward a land use pattern for future long range development of MCB Hawaii. The master plan document is intended to serve in the following ways:

- Be a comprehensive and fundamental document for outlining installation land use strategy.
- Cover all MCB Hawaii geographical areas.
- Be a key instrument for guiding development decisions, shaping installation policies, and maintaining continuity in future facilities planning and development.

Specific planning objectives of this master plan are as follows:

- Designate open space and undeveloped land for training;
- Address troop training needs which are not reflected in traditional Basic Facilities Requirements;
- Consolidate facilities to improve unit integrity and functional relationships;
- Continue to enhance the quality of life for MCB Hawaii personnel and dependents; and
- Continue to comply with all environmental laws.

Development plans presented within the Capital Improvement Plan, Volume 2, identify sites for all significant facilities required to support the mission of MCB Hawaii, while being consistent with related planning documents (MCB Hawaii Master Plan, Navy, 2006).

6.3.4.2 Planned Off-Station Land Use

MCB Hawaii Kaneohe Bay and the land areas surrounding it, including the communities of Kailua and Kaneohe, are governed under the policy as described in the General Plan (City and County of Honolulu 2002) and Koʻolaupoko Sustainable Community Plan (City and County of Honolulu 2000, 2010). These plans establish land use policies, planning guidelines, principles, and implementation practices. The general goals for the Koʻolaupoko region are geared toward creating a more vibrant and clean environment. Some key developmental priorities for Kaneohe and Kailua are:

- Enhancing the natural environment;
- Preserving and promoting open space throughout the region;
- Reducing visual impacts;
- Projects should conform to delineated boundaries (e.g., urban versus rural);
- Applications for zoning and other regulatory approval should be consistent with the Sustainable Communities Plan's vision, guidelines and boundaries; and
- Not to adversely impact the existing character of residential areas or the enhancement thereof.

Overall, the development priorities for Ko‘olaupoko are controlled growth, improvements to infrastructure and enhancement of residential standards. The only development that is encouraged is low-density residential improvements, and commercial gentrification. Except for improvements and construction projects at MCB Hawaii Kaneohe Bay, the Windward Oahu communities expect to see limited population growth and land development for the foreseeable future. Figure 6-5 shows the current state land use designations in the surrounding off-post communities.

The land surrounding MCB Hawaii Kaneohe Bay has been highly developed in the past five decades, leaving little unused land which may be subject to development in the future. Most of the land is zoned residential or preservation. It is unlikely that residential land use will be changed in the future.

6.3.5 AICUZ Impacts

6.3.5.1 AICUZ Impacts On-Base

This AICUZ study area includes land within the 65 DNL noise contour, with land use recommendations provided for APZs and noise levels above 65 DNL. While the majority of the family and housing and bachelor enlisted quarters, as well as the community support facilities, lie outside of the 65 DNL, there is a cluster of family homes to the east of the runway that are in the 65 DNL contour range. According to the MCB Hawaii Master Plan, additional land uses that fall in the 65 DNL range include: all of the industrial facilities near West Field, maintenance facilities, bachelor enlisted quarters, the golf course, the Pyramid Rock beach area, operational and maintenance regions, and the runway complex itself. All of these land uses are compatible with 65 DNL noise thresholds with the exception of bachelor housing. New residential communities and enlisted quarters require additional evaluation as to location and/or noise level reduction measures to be incorporated into new construction.

The planning regions that this AICUZ study focuses on are Zone 1 and portions of Zones 2 and 3 (see Figure 6-2). Construction projects, all of which are within the 65 DNL noise contours, are listed below. Most of the projects in Zones 1 and 2 are industrial or support facilities in nature and conform to the 65 DNL noise thresholds. A few planned facilities may require additional noise control measures incorporated into their designs (P-736, and UP-X16). Furthermore, a small section of existing on-base housing—along Moffett Road—may be affected by this updated AICUZ footprint.

Zone 1:

- Aircraft Parking Apron; P822 FY12
- Aircraft Fire and Rescue Station; P-822 FY12
- Aircraft Operations Bldg.; P-822 FY12
- Operational Trainer Facility; P884 FY14
- MV-22 Hangar P-904 FY13
- MV-22 Apron P-905 FY13
- MV-22 Hangar P-907 FY14
- MV-22 Apron P-908 FY14
- Aircraft Maintenance Expansion P-864 FY14
- Aviation Simulator Modernization/Addition P-884 FY14
- Aircraft Maintenance Hangar Upgrades P-863 FY14
- VMU, MWSD and CH53E Upgrades P-861 FY15
- Airfield Lighting Repairs and Improvements P-902 FY16
- LHD Pad Conversion and MV-22 Landing Zones P-887 FY17/FY18+
- MAG-24 Armory Expansion P-913 FY17/FY18+
- MCCS Self Storage P-915 FY17/FY18+

- Van Pad Modernization P-936 FY17/FY18+
- Hangar 102 Fire Protection and Electrical Upgrades P-891 FY18+Airfield Security Fence P881 FY17/FY18+
- MAG-24 HQ; P-836
- Pyramid Rock Recreation Pavilion; N-X12 **Please check with MCCS**
- Marina Cove improvements; N-X14**May be complete, please check with MCCS**
- Construct Vehicle Tunnel under runway;
- P-883 FY20+
- Runway Clear Zone Building Demo and Airfield Improvements FY20+

Zone 2:

- Barracks P-910 FY16
- Barracks P-911 FY17/FY18+
- Barracks P-912 FY18+
- Fire Station P-930 FY17/FY18+
- Water Reclamation Facility Upgrades P-875 FY17/FY18+
- Renovate Building 208 for CISD and MITSC P881 FY17/FY18+
- Dewey Square Troop Training Ctr., P-736; FY20+New Kaneohe Entry Control Points, P-877 FY17/FY18+

Zone 3:

- Bachelor's Officers Quarters.; Air Conditioning.; P-910 FY16

Zone 4:

- None

Zone 5:

- Bachelor Enlisted Quarters P858 FY11
- Armory Addition and Renovation P778 FY14
- 3D Radio Battalion Complex P852 FY14
- AAV Maintenance Facility P373 FY17/FY18+
- Rappel Tower P838 FY17/FY18+
- Multi Purpose Training Complex P843 FY17/FY18+
- Artillery Battery Complex P847 FY17/FY18+
- Regimental Consolidated Comm/Elec Facility P923 FY17/FY18+
- Enlisted Dining Facility P837 FY20+
- Regimental HQ P880 FY20+

Zone 6:

- Ordnance Storage Magazine Modifications P879 FY17+

6.3.5.2 AICUZ Impacts Off-Base

Coconut Island and the tip of Kealohi Point is a civilian land area within the AICUZ Noise Zones 2 and 3. About 28.2 acres (11.4 hectares) of Coconut Island and 1.3 acres (0.5 hectare) along shoreline of Kealohi Point are within the APZ-1 and APZ-II associated with the approach to Runway 04. The 1990 AICUZ footprint impacts on Coconut Island and the tip of Kealohi Point were also utilized in the 2004 Long Range Development Plan and environmental impact documentation for the Coconut Island (State of Hawaii, Hawaii Institute of Marine Biology 2004).

The University of Hawaii's Institute of Marine Biology is the major occupant of Coconut Island. Most of the buildings and structures on the island use open windows. This facility is generally used for ocean research, education, biotechnology, and biodiversity studies.
Coconut Island and the tip of Kealohi Point are classified as State Conservation District areas and zoned by the City and County of Honolulu as Preservation. Any construction and capital improvements within the State Conservation District would require a State Conservation District Use Permit and a Special Management Area Permit from the City and County of Honolulu as discussed in the 2004 Long Range Development Plan for the island (State of Hawaii, Hawaii Institute of Marine Biology 2004).

Individuals in areas outside the 65 dB DNL contour will on occasion hear aircraft operations in areas fronting the base, along Kaneohe Bay Drive and near Kealohi Point and the He‘eia Kea Boat Harbor.

6.3.6 Land Use Compatibility Summary

Due to MCB Hawaii Kaneohe Bay's location surrounded on three sides by the Pacific Ocean, most of the AICUZ noise contours from aircraft traffic fall over open ocean. The Navy land use recommendations are associated primarily with noise contours of 65 DNL and above. The vast majority of these areas are over water and most off-base land uses are compatible with the Navy land use recommendations. However, in view of the open air living style in Hawaii, and the Hawaiian DOT recommendations for residential land use outside the 60 DNL for civilian airports, the AICUZ footprint in this AICUZ includes lands within the 65 DNL contour and also depicts the 60 and 55 DNL contour for informational purposes. Fair disclosure of residential property located within the boundaries of an AICUZ or FAA Part 150 Civilian Study is required under the Hawaii Seller's Disclosures Law Chapter 508D. This disclosure provision has been incorporated into the Hawaii Association of Realtors Standard Seller' Real Property Disclosure Statement release 11/07 (See Appendix D).

The amount of land affected by aircraft from MCB Hawaii Kaneohe Bay under the current conditions is listed below in Table 6-1. Of the total AICUZ footprint, 960 on- land acres are on-base, and 32 acres are on land located off-base (3.3% of Off-Base on-land acres). The off-base land areas are zoned as preservation lands.

Table 6-1 Comparison of Prospective 2018, 2013, 2003 and 1990 On-land AICUZ Footprint

Year	On-Base *(acres/hectares)*	Off-Base *(acres/hectares)*
Prospective (2018)	1,023 / 414	51 / 21
2013	960 / 389	32 / 13
2003	269/109	3/1.2
1990	1,132/458	36/15

The area increases under the prospective (2018) scenario to 1,023 acres on-base, and 51 acres on land located off-base (5.0% of Off-Base on-land acres). The impacts under the prospective scenario are similar to impacts reflected in the 1990 AICUZ with approximate a net increase of 15 acres of Off-Base AICUZ footprint.

While changes in an AICUZ footprint and the associated on- and off-base noise and APZ designation can change over time depending on operational levels and aircraft assigned, the prospective AICUZ footprint contained in this update reflects the best available information from the Navy at this time.

6.4 Implementation and Recommendations

The goals of the AICUZ Program can most effectively be accomplished by active participation of all interested parties, including the Marine Corps, local government, private citizens, real estate professionals, and builders/developers. Program implementation includes developing a current noise and safety analysis for the airfields; establishing cooperation among local, state, and federal agencies; maintaining a concern response program; and developing strategies to protect the long-term viability of the airfield. This section presents recommendations for the continued implementation of a successful AICUZ Program at MCB Hawaii Kaneohe Bay.

The Navy's AICUZ Program is focused on promoting land use compatibility between air installations and surrounding community. The program recognizes the local government's responsibility to protect the public health, safety, and welfare through land use control tools such as zoning ordinances, building codes, subdivision regulations, building permits, and disclosure statements. Successful implementation of such land use controls depends on a close working relationship between the Marine Corps and community leaders. The activity (in this case, MCB Hawaii Kaneohe Bay) should continue to work with the local government (the City and County of Honolulu), state government, other federal agencies, citizens' groups, and the general public on the AICUZ Program.

Although the emphasis of AICUZ Program implementation is focused on areas within the AICUZ footprint (noise and safety impact area), MCB Hawaii can take a position and comment on land use issues outside the footprint that might lead to incompatible development. Therefore, the Commanding Officer and staff should monitor proposed development beyond the AICUZ footprint, and, if needed, present those concerns in appropriate forums. MCB Hawaii maintains records of important discussions, negotiations, and testimony with and before local officials and boards.

6.4.1 Implementation

Land use in the MCB Hawaii Kaneohe Bay environs is controlled with existing local government land use regulations that encourage compatible development. While the AICUZ impact areas are over open water, a continuing dialog with local officials and citizen groups is an important on-going initiative of MCB Hawaii Office of Public Affairs, with support from the Air Operations Department and Public Works planning officials.

6.4.1.1 MCB Hawaii Potential Actions

- A continued community outreach program is a specific implementation strategy that can provide citizens with factual information regarding the noise and safety impacts of airfield operations, including information on periods of temporary increases in air activity. The PAO is responsible for community outreach and engagement at MCB Hawaii Kaneohe Bay and the CPLO is the contact individual.

- Capital improvement projects in proximity to the airfield should be evaluated and reviewed for potential direct and indirect impacts from operations by the CPLO and installation master planner at MCB Hawaii Kaneohe Bay so that such improvements foster compatible development with the AICUZ Study.

- Potential construction of noise abatement structures should be evaluated and reviewed for potential direct and indirect impacts from operations by the CPLO and installation master planner at MCB Hawaii Kaneohe Bay.

6.4.1.2 Local Government Potential Actions

- Community decision makers should continue to actively inform and seek input from MCB Hawaii Kaneohe Bay as a major stakeholder, and economic contributor in the community via the CLPO regarding land use decisions that may affect the operational integrity of the airfields.

- When making land use and development decisions affecting property in proximity to the airfields, the local community should recognize that noise contours and APZs are dynamic. There is a potential for operational and/or mission changes over time that would cause changes in the AICUZ footprint. In order to ensure the military value and flexibility currently available at MCB Hawaii Kaneohe Bay, proposed changes to the current Koʻolaupoko Sustainability Community Plan and resulting development regulations, building code, disclosure requirements, etc., should be coordinated with MCB Hawaii Kaneohe Bay through the CPLO.

- It should be recognized that there are overland flight tracks outside the AICUZ footprint and that aircraft noise can be heard outside the AICUZ footprint. Rotary and fixed wing aircraft will have to follow the established flight track as part of training and other missions.

- The University of Hawaii should coordinate proposed changes and implementation of the Coconut Island Long Range Development Plan with MCB Hawaii Kaneohe Bay to ensure AICUZ considerations continue to be taken into account in land use planning.

6.4.2 Recommendations

The following recommendations for MCB Hawaii Kaneohe Bay promote continued compatible development and prevent incompatible development resulting from changes in land use controls/zoning regulations.

1. Continue public awareness and intergovernmental coordination and cooperation in AICUZ implementation with the City and County of Honolulu and State government agencies, including the University of Hawaii.

2. Seek coordination with the City and County of Honolulu's ongoing update to the Koʻolaupoko Sustainable Communities Plan to reflect compatible land use recommendations as outlined in this AICUZ update.

3. Posting approved AICUZ Study update on MCB Hawaii Web site, and provide copies of AICUZ Brochure to local government agencies and the Hawaii Association of Realtors.

4. Review of other management tools (e.g., Encroachment Control Plan, Military Mission Footprint, Real Estate Acquisition Strategy, Base Master Plan) that may be affected by the updated AICUZ.

5. Continue to conduct community outreach through open house presentation and attendance at neighborhood board meetings.

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Appendix A:

Land Use Compatibility in Noise and Accident Potential Zones

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Table A-1. DOD-Recommended Land Use Compatibility in Noise Zones

Land Use		Suggested Land Use Compatibility						
		Noise Zone 1 (DNL or CNEL)		Noise Zone 2 (DNL or CNEL)		Noise Zone 3 (DNL or CNEL)		
SLUCM NO	**LAND USE NAME**	**< 55**	**55–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85+**
	Residential							
11	Household units	Y	Y[1]	N[1]	N[1]	N	N	N
11.11	Single units: detached	Y	Y[1]	N[1]	N[1]	N	N	N
11.12	Single units: semidetached	Y	Y[1]	N[1]	N[1]	N	N	N
11.13	Single units: attached row	Y	Y[1]	N[1]	N[1]	N	N	N
11.21	Two units: side-by-side	Y	Y[1]	N[1]	N[1]	N	N	N
11.22	Two units: one above the other	Y	Y[1]	N[1]	N[1]	N	N	N
11.31	Apartments: walk-up	Y	Y[1]	N[1]	N[1]	N	N	N
11.32	Apartments: elevator	Y	Y[1]	N[1]	N[1]	N	N	N
12	Group quarters	Y	Y[1]	N[1]	N[1]	N	N	N
13	Residential hotels	Y	Y[1]	N[1]	N[1]	N	N	N
14	Mobile home parks or courts	Y	Y[1]	N	N	N	N	N
15	Transient lodgings	Y	Y[1]	N[1]	N[1]	N[1]	N	N
16	Other residential	Y	Y[1]	N[1]	N[1]	N	N	N
20	***Manufacturing***							
21	Food and kindred products; manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
22	Textile mill products; manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
23	Apparel and other finished products; products made from fabrics, leather, and similar materials; manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
24	Lumber and wood products (except furniture); manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
25	Furniture and fixtures; manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
26	Paper and allied products; manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
27	Printing, publishing, and allied industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
28	Chemicals and allied products; manufacturing	Y	Y	Y	Y[2]	Y[3]	Y[4]	N
29	Petroleum refining and related industries	Y	Y	Y	Y[2]	Y[3]	Y[4]	N

(Continued on next page)

Table A-1 DOD-Recommended Land Use Compatibility in Noise Zones (Continued)

Land Use		Suggested Land Use Compatibility						
		Noise Zone 1 (DNL or CNEL)		Noise Zone 2 (DNL or CNEL)		Noise Zone 3 (DNL or CNEL)		
SLUCM NO	LAND USE NAME	< 55	55–64	65–69	70–74	75–79	80–84	85+
30	***Manufacturing (continued)***							
31	Rubber and misc. plastic products; manufacturing	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
32	Stone, clay, and glass products; manufacturing	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
33	Primary metal products; manufacturing	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
34	Fabricated metal products; manufacturing	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
35	Professional, scientific, and controlling instruments; photographic and optical goods; watches and clocks	Y	Y	Y	25	30	N	N
39	Miscellaneous manufacturing	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
40	***Transportation, communication, and utilities***							
41	Railroad, rapid rail transit, and street railway transportation	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
42	Motor vehicle transportation	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
43	Aircraft transportation	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
44	Marine craft transportation	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
45	Highway and street right-of-way	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
46	Automobile parking	Y	***Y***	***Y***	Y [2]	Y [3]	Y [4]	N
47	Communication	Y	Y	Y	25 [5]	30 [5]	N	N
48	Utilities	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
49	Other transportation, communication, and utilities	Y	Y	Y	25 [5]	30 [5]	N	N
50	***Trade***							
51	Wholesale trade	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
52	Retail trade—building materials, hardware and farm equipment	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
53	Retail trade—shopping centers	Y	Y	Y	25	30	N	N
54	Retail trade—food	Y	Y	Y	25	30	N	N

(Continued on next page)

Table A-1 DOD-Recommended Land Use Compatibility in Noise Zones (Continued)

Land Use		Suggested Land Use Compatibility						
		Noise Zone 1 (DNL or CNEL)		Noise Zone 2 (DNL or CNEL)		Noise Zone 3 (DNL or CNEL)		
SLUCM NO	**LAND USE NAME**	**< 55**	**55–64**	**65–69**	**70–74**	**75–79**	**80–84**	**85+**
50	***Trade (Continued)***							
55	Retail trade—automotive, marine craft, aircraft and accessories	Y	Y	Y	25	30	N	N
56	Retail trade—apparel and accessories	Y	Y	Y	25	30	N	N
57	Retail trade—furniture, home furnishings and equipment	Y	Y	Y	25	30	N	N
58	Retail trade—eating and drinking establishments	Y	Y	Y	25	30	N	N
59	Other retail trade	Y	Y	Y	25	30	N	N
60	***Services***							
61	Finance, insurance, and real estate services	Y	Y	Y	25	30	N	N
62	Personal services	Y	Y	Y	25	30	N	N
62.4	Cemeteries	Y	Y	Y	Y [2]	Y [3]	Y [4,11]	Y [6,11]
63	Business services	Y	Y	Y	25	30	N	N
63.7	Warehousing and storage	Y	Y	Y	Y [2]	Y [3]	Y [4]	N
64	Repair services	Y	*Y*	*Y*	Y [2]	Y [3]	Y [4]	N
65	Professional services	Y	Y	Y	25	30	N	N
65.1	Hospitals, other medical facilities	Y	Y [1]	25	30	N	N	N
65.16	Nursing homes	Y	Y	N [1]	N [1]	N	N	N
66	Contract construction services	Y	Y	Y	25	30	N	N
67	Government services	Y	Y [1]	Y [1]	25	30	N	N
68	Educational services	Y	Y [1]	25	30	N	N	N
69	Miscellaneous	Y	Y	Y	25	30	N	N
70	***Cultural, entertainment, and recreational***							
71	Cultural activities (churches)	Y	Y[1]	25	30	N	N	N
71.2	Nature exhibits	Y	Y[1]	Y[1]	N	N	N	N
72	Public assembly	Y	Y[1]	Y	N	N	N	N
72.1	Auditoriums, concert halls	Y	Y	25	30	N	N	N
72.11	Outdoor music shells, amphitheaters	Y	Y [1]	N	N	N	N	N
72.2	Outdoor sports arenas, spectator sports	Y	Y	Y [7]	Y [7]	N	N	N
73	Amusements	Y	Y	Y	Y	N	N	N
74	Recreational activities (golf courses, riding stables, water recreation)	Y	Y[1]	Y[1]	25	30	N	N
75	Resorts and group camps	Y	Y [1]	Y [1]	Y [1]	N	N	N
76	Parks	Y	Y [1]	Y [1]	Y [1]	N	N	N
79	Other cultural, entertainment, and recreation facilities	Y	Y [1]	Y [1]	Y [1]	N	N	N

(Continued on next page)

Table A-1 DOD-Recommended Land Use Compatibility in Noise Zones (Concluded)

Land Use		Suggested Land Use Compatibility						
		Noise Zone 1 (DNL or CNEL)		Noise Zone 2 (DNL or CNEL)		Noise Zone 3 (DNL or CNEL)		
SLUCM NO	LAND USE NAME	< 55	55–64	65–69	70–74	75–79	80–84	85+
80	***Resource production and extraction***							
81	Agriculture (except livestock)	Y	Y	Y [8]	Y [9]	Y [10]	Y [10,11]	Y [10,11]
81.5	Livestock farming	Y	Y	Y [8]	Y [9]	N	N	N
81.7	Animal breeding	Y	Y	Y [8]	Y [9]	N	N	N
82	Agriculture-related activities	Y	Y	Y [8]	Y [9]	Y [10]	Y [10,11]	Y [10,11]
83	Forestry activities	Y	Y	Y [8]	Y [9]	Y [10]	Y [10,11]	Y [10,11]
84	Fishing activities	Y	Y	Y	Y	Y	Y	Y
85	Mining activities	Y	Y	Y	Y	Y	Y	Y
89	Other resource production or extraction	Y	Y	Y	Y	Y	Y	Y

Key:

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

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

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

Y* (Yes with Restrictions): Land use and related structures are generally compatible. However, see note(s) indicated by the superscript.

N* (No with Exceptions): Land use and related structures are generally incompatible. However, see notes indicated by the superscript.

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

25, 30, or 35: The numbers refer to NLR levels. Land use and related structures generally are compatible; however, measures to achieve NLR of 25, 30, or 35 must be incorporated into design and construction of structures. Measures to achieve an overall noise reduction do not necessarily solve noise difficulties outside the structure, and additional evaluation is warranted. Also, see notes indicated by superscripts where they appear with one of these numbers.

DNL: Day Night Average Sound Level.

CNEL: Community Noise Equivalent Level (Normally within a very small decibel difference of DNL).

Ldn: Mathematical symbol for DNL.

Notes:

1. a) Although local conditions regarding the need for housing may require residential use in these zones, residential use is discouraged in DNL 65–69 and strongly discouraged in DNL 70–74. The absence of viable alternative development options should be determined and an evaluation should be conducted locally prior to local approvals, indicating that a demonstrated community need for the residential use would not be met if development were prohibited in these zones.

   b) Where the community determines that these uses must be allowed, measures to achieve an outdoor to indoor NLR of at least 25 dB in DNL 65–69 and NLR of 30 dB in DNL 70–74 should be incorporated into building codes and be in individual approvals; for transient housing, an NLR of at least 35 dB should be incorporated in DNL 75–79.

   c) Normal permanent construction can be expected to provide an NLR of 20 dB; thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation, upgraded Sound Transmission Class (STC) ratings in windows and doors, and closed windows year-round. Additional consideration should be given to modifying NLR levels based on peak noise levels or vibrations.

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

Notes (Continued):

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

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

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

5. If project or proposed development is noise sensitive, use indicated NLR; if not, land use is compatible without NLR.

6. No buildings.

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

8. Residential buildings require NLR of 25.

9. Residential buildings require NLR of 30.

10. Residential buildings not permitted.

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

Source:
OPNAVINST 11010.36C, 2008.

Table A-2. Suggested Land Use Compatibility in Accident Potential Zones

SLUCM NO.	LAND USE NAME	CLEAR ZONE Recommendation	APZ-I Recommendation	APZ-II Recommendation	Density Recommendation
10	***Residential***				
11	Household units				
11.11	Single units: detached	N	N	Y[2]	Maximum density of 1-2 Du/Ac
11.12	Single units: semidetached	N	N	N	
11.13	Single units: attached row	N	N	N	
11.21	Two units: side-by-side	N	N	N	
11.22	Two units: one above the other	N	N	N	
11.31	Apartments: walk-up	N	N	N	
11.32	Apartments: elevator	N	N	N	
12	Group quarters	N	N	N	
13	Residential hotels	N	N	N	
14	Mobile home parks or courts	N	N	N	
15	Transient lodgings	N	N	N	
16	Other residential	N	N	N	
20	***Manufacturing*** [3]				
21	Food and kindred products; manufacturing	N	N	Y	Maximum FAR 0.56
22	Textile mill products; manufacturing	N	N	Y	Same as above
23	Apparel and other finished products; products made from fabrics, leather, and similar materials; manufacturing	N	N	N	
24	Lumber and wood products (except furniture); manufacturing	N	Y	Y	Maximum FAR of 0.28 in APZ I & 0.56 in APZ II
25	Furniture and fixtures; manufacturing	N	Y	Y	Same as above
26	Paper and allied products; manufacturing	N	Y	Y	Same as above
27	Printing, publishing, and allied industries	N	Y	Y	Same as above
28	Chemicals and allied products; manufacturing	N	N	N	
29	Petroleum refining and related industries	N	N	N	

(Continued on next page)

Table A-2. Suggested Land Use Compatibility in Accident Potential Zones (Continued)

SLUCM NO.	LAND USE NAME	CLEAR ZONE Recommendation	APZ-I Recommendation	APZ-II Recommendation	Density Recommendation
30	***Manufacturing*** [3] ***(continued)***				
31	Rubber and misc. plastic products; manufacturing	N	N	N	
32	Stone, clay, and glass products; manufacturing	N	N	Y	Maximum FAR 0.56
33	Primary metal products; manufacturing	N	N	Y	Same as above
34	Fabricated metal products; manufacturing	N	N	Y	Same as above
35	Professional scientific, and controlling instruments; photographic and optical goods; watches and clocks	N	N	N	
39	Miscellaneous manufacturing	N	Y	Y	Maximum FAR of 0.28 in APZ I & 0.56 in APZ II
40	***Transportation, communication, and utilities*** [4]**.**				See Note 3 below.
41	Railroad, rapid rail transit, and street railway transportation	N	Y[5]	Y	Same as above.
42	Motor vehicle transportation	N	Y[5]	Y	Same as above
43	Aircraft transportation	N	Y[5]	Y	Same as above
44	Marine craft transportation	N	Y[5]	Y	Same as above
45	Highway and street right-of-way	N	Y[5]	Y	Same as above
46	Auto parking	N	Y[5]	Y	Same as above
47	Communication	N	Y[5]	Y	Same as above
48	Utilities	N	Y[5]	Y	Same as above
485	Solid waste disposal (landfills, incineration, etc.)	N	N	N	
49	Other transport, communication, and utilities	N	Y[5]	Y	See Note 3 below
50	***Trade***				
51	Wholesale trade	N	Y	Y	Maximum FAR of 0.28 in APZ I. & .56 in APZ II.
52	Retail trade—building materials, hardware and farm equipment	N	Y	Y	Maximum FAR of 0.14 in APZ I & 0.28 in APZ II
53	Retail trade—shopping centers	N	N	Y	Maximum FAR of 0.22.
54	Retail trade—food	N	N	Y	Maximum FAR of 0.24
55	Retail trade—automotive, marine craft, aircraft and accessories	N	Y	Y	Maximum FAR of 0.14 in APZ I & 0.28 in APZ II
56	Retail trade—apparel and accessories	N	N	Y	Maximum FAR 0.28
57	Retail trade—furniture, home furnishings and equipment	N	N	Y	Same as above
58	Retail trade—eating and drinking establishments	N	N	N	
59	Other retail trade	N	N	Y	Maximum FAR of 0.22

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Table A-2. Suggested Land Use Compatibility in Accident Potential Zones (Continued)

SLUCM NO.	LAND USE NAME	CLEAR ZONE Recommendation	APZ-I Recommendation	APZ-II Recommendation	Density Recommendation
60	***Services*** [6]				
61	Finance, insurance, and real estate services	N	N	Y	Maximum FAR of 0.22 for "General Office/Office park"
62	Personal services	N	N	Y	Office uses only. Maximum FAR of 0.22.
62.4	Cemeteries	N	Y[7]	Y[7]	
63	Business services (credit reporting; mail, stenographic, reproduction; advertising)	N	N	Y	Max. FAR of 0.22 in APZ II
63.7	Warehousing and storage services	N	Y	Y	Max. FAR 1.0 APZ I; 2.0 in APZ II
64	Repair services	N	Y	Y	Max. FAR of 0.11 APZ I; 0.22 in APZ II
65	Professional services	N	N	Y	Max. FAR of 0.22
65.1	Hospitals, nursing homes	N	N	N	
65.1	Other medical facilities	N	N	N	
66	Contract construction services	N	Y	Y	Max. FAR of 0.11 APZ I; 0.22 in APZ II
67	Government services	N	N	Y	Max FAR of 0.24
68	Educational services	N	N	N	
69	Miscellaneous	N	N	Y	Max. FAR of 0.22
70	***Cultural, entertainment, and recreational***				
71	Cultural activities	N	N	N	
71.2	Nature exhibits	N	Y[8]	Y[8]	
72	Public assembly	N	N	N	
72.1	Auditoriums, concert halls	N	N	N	
72.11	Outdoor music shells, amphitheaters	N	N	N	
72.2	Outdoor sports arenas, spectator sports	N	N	N	
73	Amusements—fairgrounds, mini-golf, driving ranges; amusement parks	N	N	Y	
74	Recreational activities (including golf courses, riding stables, water recreation)	N	Y[8]	Y[8]	Max. FAR of 0.11 APZ I; 0.22 in APZ II
75	Resorts and group camps	N	N	N	
76	Parks	N	Y[8]	Y[8]	Same as 74
79	Other cultural, entertainment, and recreation facilities	N	Y[8]	Y[8]	Same as 74
80	***Resource production and extraction***				
81	Agriculture (except livestock)	Y[4]	Y[9]	Y[9]	
81.5, 81.7	Livestock farming and breeding	N	Y[9,10]	Y[9,10]	
82	Agriculture-related activities	N	Y[9]	Y[9]	Max FAR of 0.28 APZ I; 0.56 APZ II no activity which produces smoke, glare, or involves explosives
83	Forestry activities [11]	N	Y	Y	Same as Above
84	Fishing activities [12]	N[12]	Y	Y	Same as Above

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Table A-2. Suggested Land Use Compatibility in Accident Potential Zones (Concluded)

SLUCM NO.	LAND USE NAME	CLEAR ZONE Recommendation	APZ-I Recommendation	APZ-II Recommendation	Density Recommendation
85	Mining activities	N	Y	Y	Same as Above
89	Other resource production or extraction	N	Y	Y	Same as Above
90	***Other***				
91	Undeveloped land	Y	Y	Y	
93	Water areas	N[13]	N[13]	N[13]	

Key:
SLUCM: Standard Land Use Coding Manual, U.S. Department of Transportation.
Y (Yes): Land use and related structures are normally compatible without restriction.
N (No): Land use and related structures are not normally compatible and should be prohibited.
Y^x: (Yes with restrictions)Land use and related structures are generally compatible. However, see notes indicated by the superscript.
N^x: (No with exceptions) Land use and related structures are generally incompatible. However, see notes indicated by the superscript.
FAR: Floor area ratio. A floor area ratio is the ratio between the square feet of floor area of the building and the site area. It is customarily used to measure nonresidential intensities.
Du/Ac: Dwelling units per acre. This metric is customarily used to measure residential densities.

Notes:

1. A "Yes" or a "No" designation for compatible land use is to be used only for general comparison. Within each, uses exist where further evaluation may be needed in each category as to whether it is clearly compatible, normally compatible, or not compatible due to the variation of densities of people and structures. In order to assist installations and local governments, general suggestions as to floor/area ratios are provided as a guide to density in some categories. In general, land use restrictions that limit commercial, services, or industrial buildings or structure occupants to 25 per acre in APZ I and 50 per acre in APZ II are the range of occupancy levels considered to be low density. Outside events should normally be limited to assemblies of not more than 25 people per acre in APZ I and not more than 50 people per acre in APZ II.

2. The suggested maximum density for detached single-family housing is one to two Du/Ac. In a planned unit development (PUD) of single-family detached units where clustered housing development results in large open areas, this density could possibly be increased provided the amount of surface area covered by structures does not exceed 20 percent of the PUD total area. PUD encourages clustered development that leaves large open areas.

3. Other factors to be considered: labor intensity, structural coverage, explosive characteristics, air pollution, electronic interference with aircraft, height of structures, and potential glare to pilots.

4. No structures (except airfield lighting), buildings, or aboveground utility/ communications lines should normally be located in Clear Zone areas on or off the installation. The Clear Zone is subject to severe restrictions. See NAVFAC P-80.3 or Tri-Service Manual AFM 32-1123(I); TM 5-803-7, NAVFAC P-971, *Airfield and Heliport Planning & Design*, May 1, 1999, for specific design details.

5. No passenger terminals and no major aboveground transmission lines in APZ I.

6. Low-intensity office uses only. Accessory uses such as meeting places and auditoriums are not recommended.

7. No chapels are allowed within APZ I or APZ II.

8. Facilities must be low intensity, and provide no tot lots, etc. Facilities such as clubhouses, meeting places, auditoriums, and large classrooms are not recommended.

9. Includes livestock grazing but excludes feedlots and intensive animal husbandry. Activities that attract concentrations of birds, creating a hazard to aircraft operations, should be excluded.

10. Includes feedlots and intensive animal husbandry.

11. Lumber and timber products removed due to establishment, expansion, or maintenance of Clear Zones will be disposed of in accordance with appropriate DOD Natural Resources Instructions.

12. Controlled hunting and fishing may be permitted for the purpose of wildlife management.

13. Naturally occurring water features (e.g., rivers, lakes, streams, wetlands) are compatible.

Source:
OPNAVINST 11010.36C, 2008.

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Appendix B:

Discussion of Noise and Its Effect on the Environment

The accompanying discussion was prepared by Wyle Laboratories as Appendix A to the *MCBH 2008 Noise Study WR-08-13*. It is provided here as Appendix B of the AICUZ Study for general background information on Noise. The original numbering is retained.

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APPENDIX B

Discussion of Noise and Its Effect on the Environment

{The accompaning discussion was prepared by Wyle Laboratories as an Appendix A to the MCBH 2008 Noise Study WR-08-13. It is provided here as Appendix B of the AICUZ Study for general background information on Noise. The original numbering is retained.}

APPENDIX A
Discussion of Noise and Its Effect on the Environment

A.1 Basics of Sound

Noise is unwanted sound. Sound is all around us; sound becomes noise when it interferes with normal activities, such as sleep or conversation.

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., jackhammers) depends largely on the listener's current activity, past experience, and attitude toward the source of that sound.

The measurement and human perception of sound involves three basic physical characteristics: intensity, frequency, and duration. First, intensity is a measure of the acoustic energy of the sound vibrations and is expressed in terms of sound pressure. The greater the sound pressure, the more energy carried by the sound and the louder the perception of that sound. The second important physical characteristic of sound is frequency, which 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 third important characteristic of sound is duration or the length of time the sound can be detected.

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. Because of this vast range, using a linear scale to represent the intensity of sound becomes very unwieldy. As a result, a logarithmic unit known as the decibel (abbreviated 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. Sound levels between 130 to 140 dB are felt as pain (Berglund and Lindvall 1995).

Because of the logarithmic nature of the decibel unit, sound levels cannot be arithmetically added or subtracted 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. For example:

60 dB + 60 dB = 63 dB, and

80 dB + 80 dB = 83 dB.

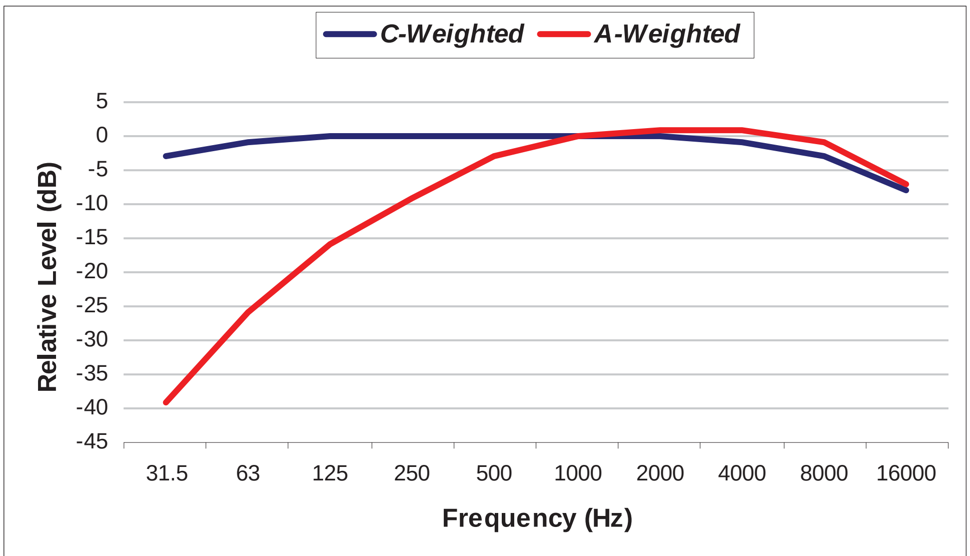
Second, the total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

60.0 dB + 70.0 dB = 70.4 dB.

Because the addition of sound levels is different than that of ordinary numbers, such addition is often referred to as "decibel addition" or "energy addition." The latter term arises from the fact that what we are really doing when we add decibel values is first converting each decibel value to its corresponding acoustic energy, then adding the energies using the normal rules of addition, and finally converting the total energy back to its decibel equivalent.

The minimum change in the sound level of individual events that an average human ear can detect is about 3 dB. On average, a person perceives a change in sound level of about 10 dB as a doubling (or halving) of the sound's loudness, and this relation holds true for loud and quiet sounds. A decrease in sound level of 10 dB actually represents a 90% decrease in sound intensity but only a 50% decrease in perceived loudness because of the nonlinear response of the human ear (similar to most human senses).

Sound frequency is measured in terms of cycles per second (cps), or hertz (Hz), which is the standard 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 by the human ear, which is most sensitive to frequencies in the 1,000 to 4,000 Hz range. Weighting curves have been developed to correspond to the sensitivity and perception of different types of sound. A-weighting and C-weighting are the two most common weightings. A-weighting accounts for frequency dependence by adjusting the very high and very low frequencies (below approximately 500 Hz and above approximately 10,000 Hz) to approximate the human ear's lower sensitivities to those frequencies. C-weighting is nearly flat throughout the range of audible frequencies, hardly de-emphasizing the low frequency sound while approximating the human ear's sensitivity to higher intensity sounds. The two curves shown in Figure A-1 are also the most adequate to quantify environmental noises.



Source: ANSI S1.4 -1983 "Specification of Sound Level Meters"

Figure A-1. Frequency Response Characteristics of A and C Weighting Networks

A.1.2 A-weighted Sound Level

Sound levels that are measured using A-weighting, called A-weighted sound levels, are often denoted by the unit dBA or dB(A) rather than dB. When the use of A-weighting is understood, the adjective "A-weighted" is often omitted and the measurements are expressed as dB. In this report (as in most environmental impact documents), dB units refer to A-weighted sound levels.

Noise potentially becomes an issue when its intensity exceeds the ambient or background sound pressures. Ambient background noise in metropolitan, urbanized areas typically varies from 60 to 70 dB and can be as high as 80 dB or greater; quiet suburban neighborhoods experience ambient noise levels of approximately 45-50 dB (U.S. Environmental Protection Agency 1978).

Figure A-2 is a chart of A-weighted sound levels from typical sounds. Some noise sources (air conditioner, vacuum cleaner) are continuous sounds which levels are constant for some time. Some (automobile, heavy truck) are the maximum sound during a vehicle pass-by. Some (urban daytime, urban nighttime) are averages over extended periods. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.

Aircraft noise consists of two major types of sound events: aircraft takeoffs and landings, and engine maintenance operations. The former can be described as intermittent sounds and the latter as continuous. Noise levels from flight operations exceeding background noise typically occur beneath main approach and departure corridors, in local air traffic patterns around the airfield, and in areas immediately adjacent to parking ramps and aircraft staging areas. As aircraft in flight gain altitude, their noise contribution drops to lower levels, often becoming indistinguishable from the background.

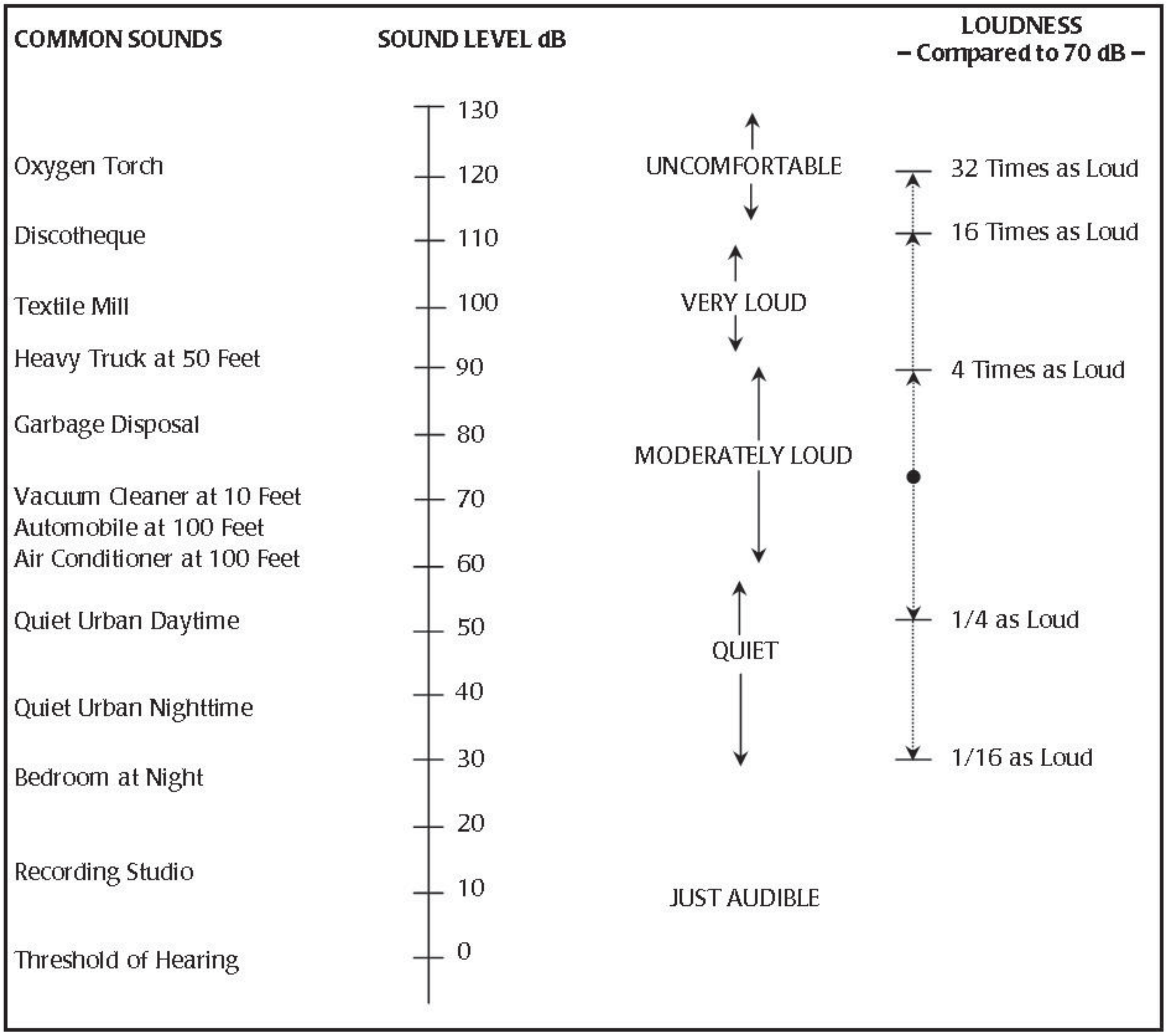
C-weighted Sound Level

Sound levels measured using a C-weighting are most appropriately called C-weighted sound levels (and denoted dBC). C-weighting is nearly flat throughout the audible frequency range, hardly de-emphasizing the low frequency. This weighting scale is generally used to describe impulsive sounds. Sounds that are characterized as impulsive generally contain low frequencies. Impulsive sounds may induce secondary effects, such as shaking of a structure, rattling of windows, inducing vibrations. These secondary effects can cause additional annoyance and complaints.

The following definitions in the American National Standard Institute (ANSI) Report S12.9, Part 4 provide general concepts helpful in understanding impulsive sounds (American National Standards Institute 1996).

<u>Impulsive Sound</u>: Sound characterized by brief excursions of sound pressure (acoustic impulses) that significantly exceeds the ambient environmental sound pressure. The duration of a single impulsive sound is usually less than one second (American National Standards Institute 1996).

<u>Highly Impulsive Sound</u>: Sound from one of the following enumerated categories of sound sources: small-arms gunfire, metal hammering, wood hammering, drop hammering, pile driving, drop forging, pneumatic hammering, pavement breaking, metal impacts during rail-yard shunting operation, and riveting.



Source: *Handbook of Noise Control*, C.M. Harris, Editor, McGraw-Hill Book Co., 1979, and FICAN 1992.

Figure A-2. Typical A-weighted Sound Levels of Common Sounds

High-energy Impulsive Sound: Sound from one of the following enumerated categories of sound sources: quarry and mining explosions, sonic booms, demolition and industrial processes that use high explosives, military ordnance (e.g., armor, artillery and mortar fire, and bombs), explosive ignition of rockets and missiles, explosive industrial circuit breakers, and any other explosive source where the equivalent mass of dynamite exceeds 25 grams.

A.2 Noise Metrics

As used in environmental noise analyses, a metric refers to the unit or quantity that quantitatively measures the effect of noise on the environment. To quantify these effects, the Department of Defense and the Federal Aviation Administration use three noise-measuring techniques, or metrics: first, a measure of the highest sound level occurring during an individual aircraft overflight (single event); second, a combination of the maximum level of that single event with its duration; and third, a description of the noise environment based on the cumulative flight and engine maintenance activity. Single noise events can be described with Sound Exposure Level or Maximum Sound Level. Another measure of instantaneous level is the Peak Sound Pressure Level. The cumulative energy noise metric used is the Day/Night Average Sound Level. Metrics related to DNL include the Onset-Rate Adjusted Day/Night Average Sound Level, and the Equivalent Sound Level. In the state of California, it is mandated that average noise be described in terms of Community Noise Equivalent Level (State of California 1990). CNEL represents the Day/Evening/Night average noise exposure, calculated over a 24-hour period. Metrics and their uses are described below.

A.2.1 Maximum Sound Level (L_{max})

The highest A-weighted integrated sound level measured during a single event in which the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level or maximum sound level.

During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. The maximum sound level indicates the maximum sound level occurring for a fraction of a second. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally 1/8 second, and is denoted as "fast" response (American National Standards Institute 1988). Slowly varying or steady sounds are generally measured over a period of one second, denoted "slow" response. The maximum sound level is important in judging the interference caused by a noise event with conversation, TV or radio listening, sleep, or other common activities. Although it provides some measure of the intrusiveness of the event, it does not completely describe the total event, because it does not include the period of time that the sound is heard.

A.2.2 Peak Sound Pressure Level (L_{pk})

The peak sound pressure level, is the highest instantaneous level obtained by a sound level measurement device. The peak sound pressure level is typically measured using a 20 microseconds or faster sampling rate, and is typically based on unweighted or linear response of the meter.

A.2.3 Sound Exposure Level (SEL)

Sound exposure level is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of the net impact of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL would include both the maximum noise level and the lower noise levels produced during onset and recess periods of the overflight.

SEL is a logarithmic measure of the total acoustic energy transmitted to the listener during the event. Mathematically, it represents the sound level of a constant sound that would, in one second, generate the same acoustic energy as the actual time-varying noise event. For sound from aircraft overflights, which typically lasts more than one second, the SEL is usually greater than the L_{max} because an individual overflight takes seconds and the maximum sound level (L_{max}) occurs instantaneously. SEL represents the best metric to compare noise levels from overflights.

A.2.4 Day-Night Average Sound Level (DNL) and Community Noise Equivalent Level (CNEL)

Day-Night Average Sound Level and Community Noise Equivalent Level are composite metrics that account for SEL of all noise events in a 24-hour period. In order to account for increased human sensitivity to noise at night, a 10 dB penalty is applied to nighttime events (10:00 p.m. to 7:00 a.m. time period). A variant of the DNL, the CNEL level includes a 5-decibel penalty on noise during the 7:00 p.m. to 10:00 p.m. time period, and a 10-decibel penalty on noise during the 10:00 p.m. to 7:00 a.m. time period.

The above-described metrics are average quantities, mathematically representing the continuous A-weighted or C-weighted sound level that would be present if all of the variations in sound level that occur over a 24-hour period were smoothed out so as to contain the same total sound energy. These composite metrics account for the maximum noise levels, the duration of the events (sorties or operations), and the number of events that occur over a 24-hour period. Like SEL, neither DNL nor CNEL represent the sound level heard at any particular time, but quantifies the total sound energy received. While it is normalized as an average, it represents all of the sound energy, and is therefore a cumulative measure.

The penalties added to both the DNL and CNEL metrics account for 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.

The inclusion of daytime and nighttime periods in the computation of the DNL and CNEL reflects their basic 24-hour definition. It can, however, be applied over periods of multiple days. For application to civil airports, where operations are consistent from day to day, DNL and CNEL are usually applied as an annual average. For some military airbases, where operations are not necessarily consistent from day to day, a common practice is to compute a 24-hour DNL or CNEL based on an average busy day, so that the calculated noise is not diluted by periods of low activity.

Although DNL and CNEL provide a single measure of overall noise impact, they do not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. For example, a daily average sound level of 65 dB could result from a very few noisy events or a large number of quieter events.

Daily average sound levels are typically used for the evaluation of community noise effects (i.e., long-term annoyance), and particularly aircraft noise effects. In general, scientific studies and social surveys have found a high correlation between the percentages of groups of people highly annoyed and the level of average noise exposure measured in DNL (U.S. Environmental Protection Agency 1978 and Schultz 1978). The correlation from Schultz's original 1978 study is shown in Figure A-3. It represents the results of a large number of social surveys relating community responses to various types of noises, measured in day-night average sound level.

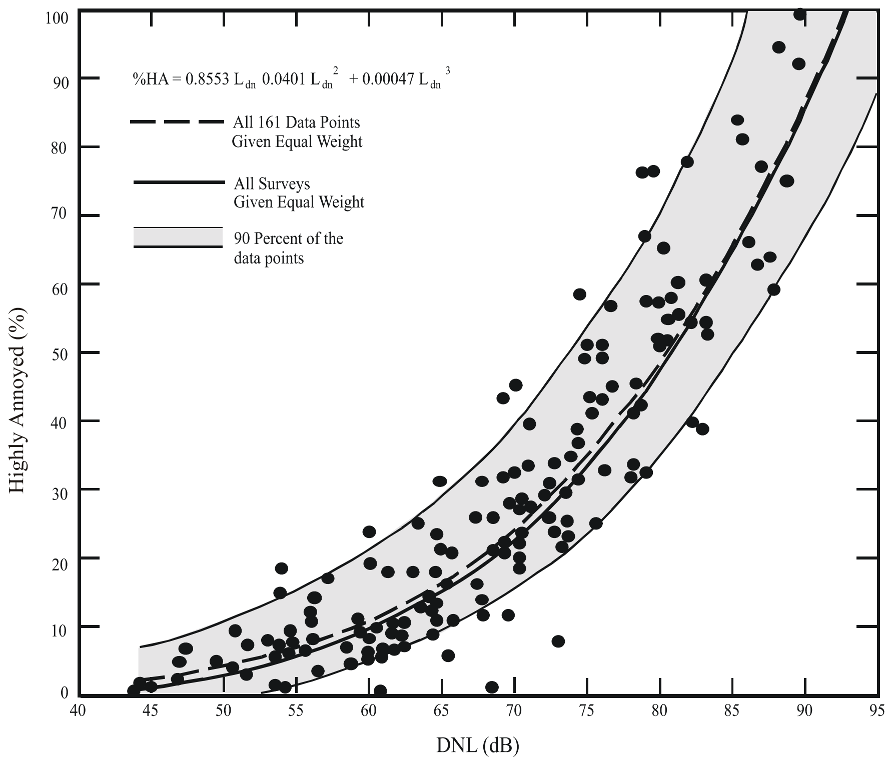


Figure A-3. Community Surveys of Noise Annoyance

A more recent study has reaffirmed this relationship (Fidell, et al. 1991). Figure A-4 (Federal Interagency Committee On Noise 1992) shows an updated form of the curve fit (Finegold, et al. 1994) in comparison with the original. The updated fit, which does not differ substantially from the original, is the current preferred form. 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. However, for the evaluation of community noise impacts, the scientific community has endorsed the use of DNL (American National Standards Institute 1980; American National Standards Institute 1988; U.S. Environmental Protection Agency 1974; Federal Interagency Committee On Urban Noise 1980 and Federal Interagency Committee On Noise 1992).

The use of DNL (CNEL in California) 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 DNL. One frequent criticism is based on the inherent feeling that people react more to single noise events and not as much to "meaningless" time-average sound levels.

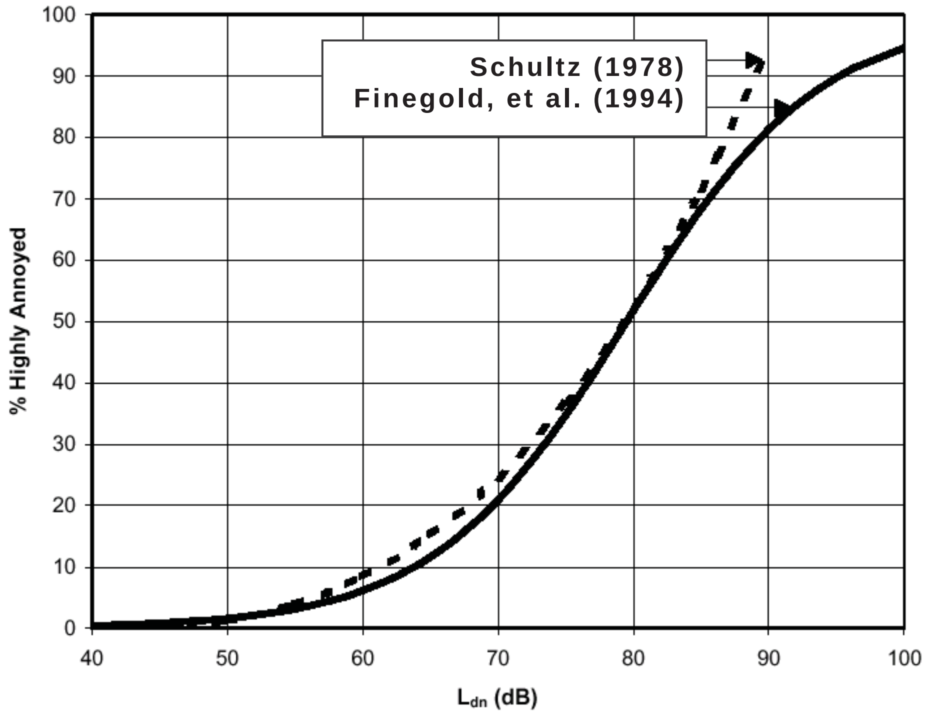


Figure A-4. Response of Communities to Noise; Comparison of Original (Schultz, 1978) and Current (Finegold, et al. 1994) Curve Fits

In fact, a time-average noise metric, such as DNL and CNEL, takes into account both the noise levels of all individual events that occur during a 24-hour period and the number of times those events occur. 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 during the daytime over 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 day-night average sound level for this 24-hour period is 65.9 dB. Assume, as a second example, that 10 such 30-second overflights occur during 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 day-night average sound level for this 24-hour period is 75.5 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.

A.2.5 Equivalent Sound Level (L_{eq})

Another cumulative noise metric that is useful in describing noise is the equivalent sound level. L_{eq} is calculated to determine the steady-state noise level over a specified time period. The L_{eq} metric can provide a more accurate quantification of noise exposure for a specific period, particularly for daytime periods when the nighttime penalty under the DNL metric is inappropriate.

Just as SEL has proven to be a good measure of the noise impact of a single event, L_{eq} has been established to be a good measure of the impact of a series of events during a given time period. Also, while L_{eq} is defined as an average, it is effectively a sum over that time period and is, thus, a measure of the cumulative impact of noise. For example, the sum of all noise-generating events during the period of 7 a.m. to 4 p.m. could provide the relative impact of noise generating events for a school day.

A.2.6 Rate Adjusted Day-Night Average Sound Level (L_{dnr})

Military aircraft flying on Military Training Routes (MTRs) and in Restricted Areas/Ranges generate a noise environment that is somewhat different from that associated with airfield operations. As opposed to patterned or continuous noise environments associated with airfields, overflights along MTRs are highly sporadic, ranging from 10 per hour to less than one per week. Individual military overflight events also differ from typical community noise events in that noise from a low-altitude, high-airspeed flyover can have a rather sudden onset, exhibiting a rate of increase in sound level (onset rate) of up to 150 dB per second.

To represent these differences, the conventional SEL metric is adjusted to account for the “surprise” effect of the sudden onset of aircraft noise events on humans with an adjustment ranging up to 11 dB above the normal Sound Exposure Level (Stusnick, et al. 1992). Onset rates between 15 to 150 dB per second require an adjustment of 0 to 11 dB, while onset rates below 15 dB per second require no adjustment. The adjusted SEL is designated as the onset-rate adjusted sound exposure level (SEL_r).

Because of the sporadic, often seasonal, occurrences of aircraft overflights along MTRs and in Restricted Areas/Ranges, the number of daily operations is determined from the number of flying days in the calendar month with the highest number of operations in the affected airspace or MTR. This avoids dilution of the exposure from periods of low activity, much the way that the average busy day is used around military airbases. The cumulative exposure to noise in these areas is computed by DNL over the busy month, but using SEL_r instead of SEL. This monthly average is denoted L_{dnmr}. If onset rate adjusted DNL is computed over a period other than a month, it would be designated L_{dnr} and the period must be specified. In the state of California, a variant of the L_{dnmr} includes a penalty for evening operations (7 p.m. to 10 p.m) and is denoted $CNEL_{mr}$.

A.3 Noise Effects

A.3.1 Annoyance

The primary effect of aircraft noise on exposed communities is one of long-term annoyance. Noise annoyance is defined by the EPA as any negative subjective reaction on the part of an individual or group (U.S. Environmental Protection Agency 1974). As noted in the discussion of DNL above, community annoyance is best measured by that metric.

The results of attitudinal surveys, conducted to find percentages of people who express various degrees of annoyance when exposed to different levels of DNL, are very consistent. The most useful metric for assessing people’s responses to noise impacts is the percentage of the exposed population expected to be “highly annoyed.” A wide variety of responses have been used to determine intrusiveness of noise and disturbances of speech, sleep, television or radio listening, and outdoor living. The concept of “percent highly annoyed” has provided the most consistent response of a community to a particular noise environment. The response is remarkably complex, and when considered on an individual basis, widely varies for any given noise level (Federal Interagency Committee On Noise 1992).

A number of nonacoustic factors have been identified that may influence the annoyance response of an individual. Newman and Beattie (1985) divided these factors into emotional and physical variables:

Emotional Variables

- Feelings about the necessity or preventability of the noise;
- Judgment of the importance and value of the activity that is producing the noise;
- Activity at the time an individual hears the noise;
- Attitude about the environment;
- General sensitivity to noise;
- Belief about the effect of noise on health; and
- Feeling of fear associated with the noise.

Physical Variables

- Type of neighborhood;
- Time of day;
- Season;
- Predictability of noise;
- Control over the noise source; and
- Length of time an individual is exposed to a noise.

A.3.2 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. Speech is an acoustic signal characterized by rapid fluctuations in sound level and frequency pattern. It is essential for optimum speech intelligibility to recognize these continually shifting sound patterns. Not only does noise diminish the ability to perceive the auditory signal, but it also reduces a listener's ability to follow the pattern of signal fluctuation. In general, interference with speech communication occurs when intrusive noise exceeds about 60 dB (Federal Interagency Committee On Noise 1992).

Indoor speech interference can be expressed as a percentage of sentence intelligibility among two people speaking in relaxed conversation approximately 3 feet apart in a typical living room or bedroom (U.S. Environmental Protection Agency 1974). The percentage of sentence intelligibility is a non-linear function of the (steady) indoor background A-weighted sound level. Such a curve-fit yields 100 percent sentence intelligibility for background levels below 57 dB and yields less than 10 percent intelligibility for background levels above 73 dB. The function is especially sensitive to changes in sound level between 65 dB and 75 dB. As an example of the sensitivity, a 1 dB increase in background sound level from 70 dB to 71 dB yields a 14 percent decrease in sentence intelligibility. The sensitivity of speech interference to noise at 65 dB and above is consistent with the criterion of DNL 65 dB generally taken from the Schultz curve. This is consistent with the observation that speech interference is the primary cause of annoyance.

A.3.3 Sleep Interference

Sleep interference is another source of annoyance and potential health concern associated with aircraft noise. Because of the intermittent nature and content of aircraft noise, it is more disturbing than continuous noise of equal energy. Given that quality sleep is requisite for good health, repeated occurrences of sleep interference could have an effect on overall health.

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 higher noise level than does a change in sleep stage.

Sleep is not a continuous, uniform condition but a complex series of states through which the brain progresses in a cyclical pattern. Arousal from sleep is a function of a number of factors that include age, sex, sleep stage, noise level, frequency of noise occurrences, noise quality, and pre-sleep activity. Because individuals differ in their physiology, behavior, habitation, and ability to adapt to noise, few studies have attempted to establish noise criterion levels for sleep disturbance.

Lukas (1978) concluded the following with regard to human sleep response to noise:

- Children 5 to 8 years of age are generally unaffected by noise during sleep.
- Older people are more sensitive to sleep disturbance than younger people.
- Women are more sensitive to noise than men, in general.
- There is a wide variation in the sensitivity of individuals to noise even within the same age group.
- Sleep arousal is directly proportional to the sound intensity of aircraft flyover. While there have been several studies conducted to assess the effect of aircraft noise on sleep, none have produced quantitative dose-response relationships in terms of noise exposure level, DNL, and sleep disturbance. Noise-sleep disturbance relationships have been developed based on single-event noise exposure.

An analysis sponsored by the U.S. Air Force summarized 21 published studies concerning the effects of noise on sleep (Pearsons, et al. 1989). The analysis concluded that a lack of reliable studies in homes, combined with large differences among the results from the various laboratory studies, did not permit development of an acceptably 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 were of sufficiently long duration to determine any effects of habituation, such as that which would occur under normal community conditions.

A study of the effects of nighttime noise exposure on the in-home sleep of residents near one military airbase, near one civil airport, and in several households with negligible nighttime aircraft noise exposure, revealed SEL as the best noise metric predicting noise-related awakenings. It also determined that out of 930 subject nights, the average spontaneous (not noise-related) awakenings per night was 2.07 compared to the average number of noise-related awakenings per night of 0.24 (Fidell, et al. 1994). Additionally, a 1995 analysis of sleep disturbance studies conducted both in the laboratory environment and in the field (in the sleeping quarters of homes) showed that when measuring awakening to noise, a 10 dB increase in SEL was associated with only an 8 percent increase in the probability of awakening in the laboratory studies, but only a 1 percent increase in the field (Pearsons, et al. 1995). Pearsons, et al. (1995), reported that even SEL values as high as 85 dB produced no awakenings or arousals in at least one study. This observation suggests a strong influence of habituation on susceptibility to noise-induced sleep disturbance. A 1984 study (Kryter 1984) indicates that an indoor SEL of 65 dB or lower should awaken less than 5 percent of exposed individuals.

Nevertheless, some guidance is available in judging sleep interference. The EPA identified an indoor DNL of 45 dB as necessary to protect against sleep interference (U.S. Environmental Protection Agency 1978). Assuming a very conservative structural noise insulation of 20 dB for typical dwelling units, this corresponds to an outdoor day-night average sound level of 65 dB to minimize sleep interference.

In 1997, the Federal Interagency Committee on Aviation Noise (FICAN) adopted an interim guideline for sleep awakening prediction. The new curve, based on studies in England (Ollerhead, et al. 1992) and at two U.S. airports (Los Angeles International and Denver International), concluded that the incidence of sleep awakening from aircraft noise was less than identified in a 1992 study (Federal Interagency Committee On Noise 1992). Using indoor single-event noise levels represented by SEL, potential sleep awakening can be predicted using the curve presented in Figure A-5. Typically, homes in the United States provide 15 dB of sound attenuation with windows open and 25 dB with windows closed and air conditioning operating. Hence, the outdoor SEL of 107 dB would be 92 dB indoors with windows open and 82 dB indoors with windows closed and air conditioning operating.

Using Figure A-5, the potential sleep awakening would be 15% with windows open and 10% with windows closed in the above example.

The new FICAN curve does not address habituation over time by sleeping subjects and is applicable only to adult populations. Nevertheless, this curve provides a reasonable guideline for assessing sleep awakening. It is conservative, representing the upper envelope of field study results.

The FICAN curve shown in Figure A-5 represents awakenings from single events. To date, no exact quantitative dose-response relationship exists for noise-related sleep interference from multiple events; yet, based on studies conducted to date and the USEPA guideline of a 45 DNL to protect sleep interference, useful ways to assess sleep interference have emerged. If homes are conservatively estimated to have a 20-dB noise insulation, an average of 65 DNL would produce an indoor level of 45 DNL and would form a reasonable guideline for evaluating sleep interference. This also corresponds well to the general guideline for assessing speech interference. Annoyance that may result from sleep disturbance is accounted for in the calculation of DNL, which includes a 10-dB penalty for each sortie occurring after 10 pm or before 7 am.

A.3.4 Hearing Loss

Considerable data on hearing loss have been collected and analyzed. It has been well established that continuous exposure to high noise levels will damage human hearing (U.S. Environmental Protection Agency 1978). People are normally capable of hearing up to 120 dB over a wide frequency range. Hearing loss is generally interpreted as the shifting of a higher sound level of the ear's sensitivity or acuity to perceive sound. This change can either be temporary, called a temporary threshold shift (TTS), or permanent, called a permanent threshold shift (PTS) (Berger, et al. 1995).

The EPA has established 75 dB for an 8-hour exposure and 70 dB for a 24-hour exposure as the average noise level standard requisite to protect 96% of the population from greater than a 5 dB PTS (U.S. Environmental Protection Agency 1978). Similarly, the National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics (CHABA) identified 75 dB as the minimum level at which hearing loss may occur (Committee on Hearing, Bioacoustics, and Biomechanics 1977).

However, it is important to note that continuous, long-term (40 years) exposure is assumed by both EPA and CHABA before hearing loss may occur.

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 over a 16-hour period. Even the most protective criterion (no measurable hearing loss for the most sensitive portion of the population at the ear's most sensitive frequency, 4,000 Hz, after a 40-year exposure) is a time-average sound level of 70 dB over a 24-hour period.

Studies on community hearing loss from exposure to aircraft flyovers near airports showed that there is no danger, under normal circumstances, of hearing loss due to aircraft noise (Newman and Beattie 1985).

A laboratory study measured changes in human hearing from noise representative of low-flying aircraft on MTRs. (Nixon, et al. 1993). In this study, participants were first subjected to four overflight noise exposures at A-weighted levels of 115 dB to 130 dB. One-half of the subjects showed no change in hearing levels, one-fourth had a temporary 5-dB increase in sensitivity (the people could hear a 5-dB wider range of sound than before exposure), and one-fourth had a temporary 5-dB decrease in sensitivity (the people could hear a 5-dB narrower range of sound than before exposure). In the next phase, participants were subjected to a single overflight at a maximum level of 130 dB for eight successive exposures, separated by 90 seconds or until a temporary shift in hearing was observed. The temporary hearing threshold shifts resulted in the participants hearing a wider range of sound, but within 10 dB of their original range.

In another study of 115 test subjects between 18 and 50 years old, temporary threshold shifts were measured after laboratory exposure to military low-altitude flight (MLAF) noise (Ising, et al. 1999). According to the authors, the results indicate that repeated exposure to MLAF noise with L_{max} greater than 114 dB, especially if the noise level increases rapidly, may have the potential to cause noise induced hearing loss in humans.

Because it is unlikely that airport neighbors will remain outside their homes 24 hours per day for extended periods of time, there is little possibility of hearing loss below a day-night average sound level of 75 dB, and this level is extremely conservative.

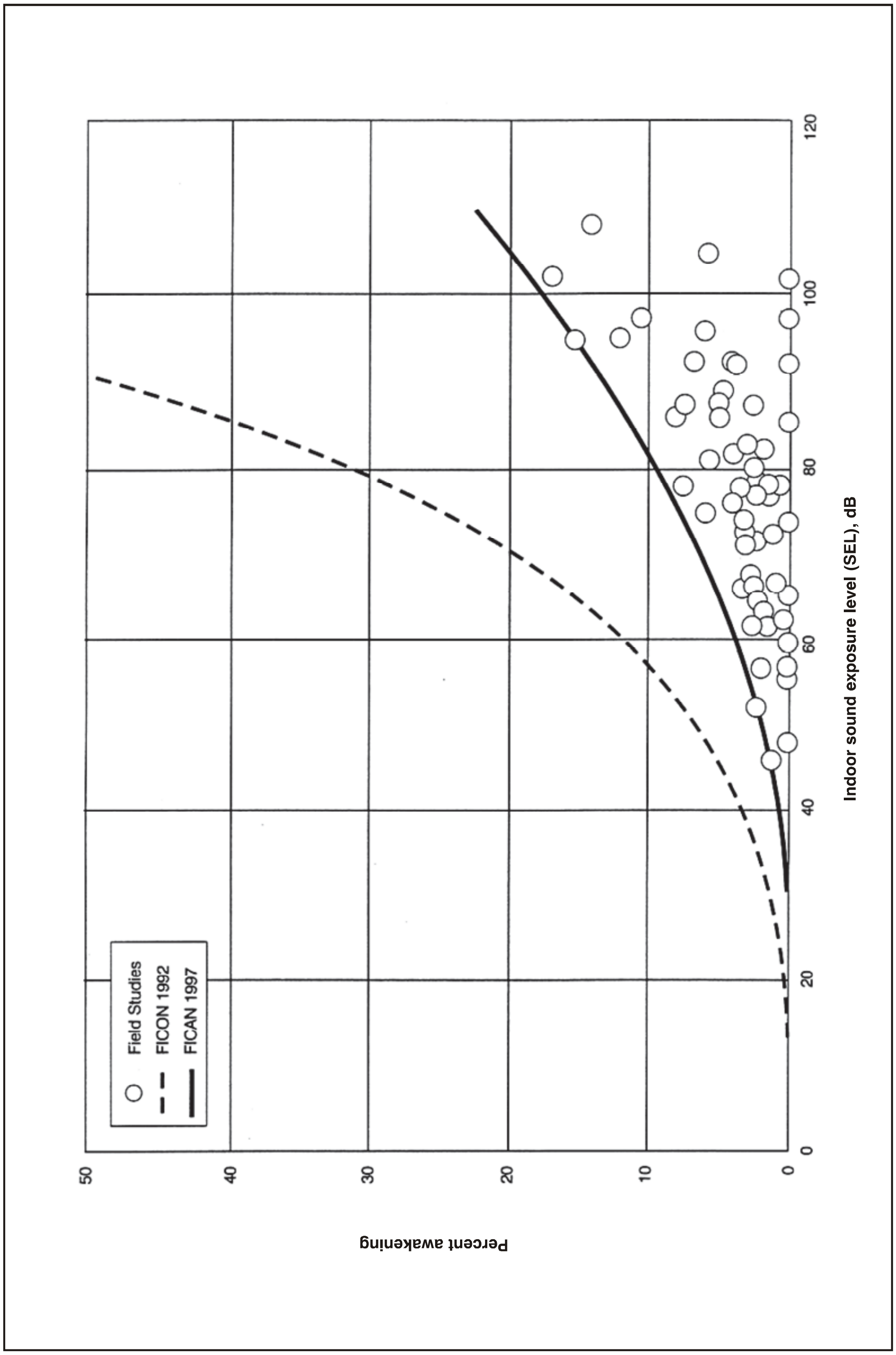


Figure A-5. Recommended Sleep Disturbance Dose-Response Relationship

A.3.5 Nonauditory Health Effects

Studies have been conducted to determine whether correlations exist between noise exposure and cardiovascular problems, birth weight, and mortality rates. The nonauditory effect of noise on humans is not as easily substantiated as the effect on hearing. The results of studies conducted in the United States, primarily concentrating on cardiovascular response to noise, have been contradictory (Cantrell 1974). Cantrell (1974) concluded that the results of human and animal experiments show that average or intrusive noise can act as a stress-provoking stimulus. Prolonged stress is known to be a contributor to a number of health disorders. Kryter and Poza (1980) state, "It is more likely that noise-related general ill-health effects are due to the psychological annoyance from the noise interfering with normal everyday behavior, than it is from the noise eliciting, because of its intensity, reflexive response in the autonomic or other physiological systems of the body." Psychological stresses may cause a physiological stress reaction that could result in impaired health.

The National Institute for Occupational Safety and Health and EPA commissioned CHABA in 1981 to study whether established noise standards are adequate to protect against health disorders other than hearing defects. CHABA's conclusion was that:

Evidence from available research reports is suggestive, but it does not provide definitive answers to the question of health effects, other than to the auditory system, of long-term exposure to noise. It seems prudent, therefore, in the absence of adequate knowledge as to whether or not noise can produce effects upon health other than damage to auditory system, either directly or mediated through stress, that insofar as feasible, an attempt should be made to obtain more critical evidence.

Since the CHABA report, there have been more recent studies that suggest that noise exposure may cause hypertension and other stress-related effects in adults. Near an airport in Stockholm, Sweden, the prevalence of hypertension was reportedly greater among nearby residents who were exposed to energy averaged noise levels exceeding 55 dB and maximum noise levels exceeding 72 dB, particularly older subjects and those not reporting impaired hearing ability (Rosenlund, et al. 2001). A study of elderly volunteers who were exposed to simulated military low-altitude flight noise reported that blood pressure was raised by L_{max} of 112 dB and high speed level increase (Michalak, et al. 1990). Yet another study of subjects exposed to varying levels of military aircraft or road noise found no significant relationship between noise level and blood pressure (Pulles, et al. 1990).

The U.S. Department of the Navy prepared a programmatic Environmental Assessment (EA) for the continued use of non-explosive ordnance on the Vieques Inner Range. Following the preparation of the EA, it was learned that research conducted by the University of Puerto Rico, Ponce School of Medicine, suggested that Vieques fishermen and their families were experiencing symptoms associated with vibroacoustic disease (VAD) (U.S. Department of the Navy 2002). The study alleged that exposure to noise and sound waves of large pressure amplitudes within lower frequency bands, associated with Navy training activities--specifically, air-to-ground bombing or naval fire support--was related to a larger prevalence of heart anomalies within the Vieques fishermen and their families. The Ponce School of Medicine study compared the Vieques group with a group from Ponce Playa. A 1999 study conducted on Portuguese aircraft-manufacturing workers from a single factory reported effects of jet aircraft noise exposure that involved a wide range of symptoms and disorders, including the cardiac issues on which the Ponce School of Medicine study focused. The 1999 study identified these effects as VAD.

Johns Hopkins University (JHU) conducted an independent review of the Ponce School of Medicine study, as well as the Portuguese aircraft workers study and other relevant scientific literature. Their findings concluded that VAD should not be accepted as a syndrome, given that exhaustive research across a number of populations has not yet been conducted. JHU also pointed out that the evidence supporting the existence of VAD comes largely from one group of investigators and that similar results would have to be replicated by other investigators. In short, JHU concluded that it had not been established that noise was the causal agent for the symptoms reported and no inference can be made as to the role of noise from naval gunfire in producing echocardiographic abnormalities (U.S. Department of the Navy 2002).

Most studies of nonauditory health effects of long-term noise exposure have found that noise exposure levels established for hearing protection will also protect against any potential nonauditory health effects, at least in workplace conditions. One of the best scientific summaries of these findings is contained in the lead paper at the National Institutes of Health Conference on Noise and Hearing Loss, held on 22 to 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 8-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" (von Gierke 1990).

Although these findings were specifically directed at noise effects in the workplace, 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 that purport to find such health effects use time-average noise levels of 75 dB and higher for their research.

For example, two UCLA researchers apparently found a relationship between aircraft noise levels under the approach path to Los Angeles International Airport (LAX) and increased mortality rates among the exposed residents by using an average noise exposure level greater than 75 dB for the "noise-exposed" population (Meacham and Shaw 1979). Nevertheless, three other UCLA professors analyzed those same data and found no relationship between noise exposure and mortality rates (Frerichs, et al. 1980).

As a second example, two other UCLA researchers used this same population near LAX to show a higher rate of birth defects for 1970 to 1972 when compared with a control group residing away from the airport (Jones and Tauscher 1978). Based on this report, a separate group at the Center for Disease Control performed a more thorough study of populations near Atlanta's Hartsfield International Airport (ATL) for 1970 to 1972 and found no relationship in their study of 17 identified categories of birth defects to aircraft noise levels above 65 dB (Edmonds, et al. 1979).

In summary, there is no scientific basis for a claim that potential health effects exist for aircraft time-average sound levels below 75 dB.

The potential for noise to affect physiological health, such as the cardiovascular system, has been speculated; however, no unequivocal evidence exists to support such claims (Harris 1997). Conclusions drawn from a review of health effect studies involving military low-altitude flight noise with its unusually high maximum levels and rapid rise in sound level have shown no increase in cardiovascular disease (Schwartze and Thompson 1993). Additional claims that are unsupported include flyover noise producing increased mortality rates and increases in cardiovascular death, aggravation of post-traumatic stress syndrome, increased stress, increase in admissions to mental hospitals, and adverse affects on pregnant women and the unborn fetus (Harris 1997).

A.3.6 Performance Effects

The effect of noise on the performance of activities or tasks has been the subject of many studies. Some of these studies have established links between continuous high noise levels and performance loss. Noise-induced performance losses are most frequently reported in studies employing noise levels in excess of 85 dB. Little change has been found in low-noise cases. It has been cited that moderate noise levels appear to act as a stressor for more sensitive individuals performing a difficult psychomotor task.

While the results of research on the general effect of periodic aircraft noise on performance have yet to yield definitive criteria, several general trends have been noted including:

- A periodic intermittent noise is more likely to disrupt performance than a steady-state continuous noise of the same level. Flyover noise, due to its intermittent nature, might be more likely to disrupt performance than a steady-state noise of equal level.
- Noise is more inclined to affect the quality than the quantity of work.
- Noise is more likely to impair the performance of tasks that place extreme demands on the worker.

A.3.7 Noise Effects on Children

In response to noise-specific and other environmental studies, Executive Order 13045, Protection of Children from Environmental Health Risks and Safety Risks (1997), requires federal agencies to ensure that policies, programs, and activities address environmental health and safety risks to identify any disproportionate risks to children.

A review of the scientific literature indicates that there has not been a tremendous amount of research in the area of aircraft noise effects on children. The research reviewed does suggest that environments with sustained high background noise can have variable effects, including noise effects on learning and cognitive abilities, and reports of various noise-related physiological changes.

A.3.7.1 Effects on Learning and Cognitive Abilities

In the recent release (2002) of the "Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools," the American National Standards Institute refers to studies that suggest that loud and frequent background noise can affect the learning patterns of young children. ANSI provides discussion on the relationships between noise and learning, and stipulates design requirements and acoustical performance criteria for outdoor-to-indoor noise isolation. School design is directed to be cognizant of, and responsive to, surrounding land uses and the shielding of outdoor noise from the indoor environment. ANSI has approved a new standard for acoustical performance criteria in schools. The new criteria include the requirement that the one-hour-average background noise level shall not exceed 35 dBA in core learning spaces smaller than 20,000 cubic-feet and 40 dBA in core learning spaces with enclosed volumes exceeding 20,000 cubic-feet. This would require schools be constructed such that, in quiet neighborhoods indoor noise levels are lowered by 15 to 20 dBA relative to outdoor levels. In schools near airports, indoor noise levels would have to be lowered by 35 to 45 dBA relative to outdoor levels (American National Standards Institute 2002).

The studies referenced by ANSI to support the new standard are not specific to jet aircraft noise and the potential effects on children. However, there are references to studies that have shown that children in noisier classrooms scored lower on a variety of tests. Excessive background noise or reverberation within schools causes interferences of communication and can therefore create an acoustical barrier to learning (American National Standards Institute 2002). Studies have been performed that contribute to the body of evidence emphasizing the importance of communication by way of the spoken language to the development of cognitive skills. The ability to read, write, comprehend, and maintain attentiveness, are, in part, based upon whether teacher communication is consistently intelligible (American National Standards Institute 2002).

Numerous studies have shown varying degrees of effects of noise on the reading comprehension, attentiveness, puzzle-solving, and memory/recall ability of children. It is generally accepted that young children are more susceptible than adults to the effects of background noise. Because of the developmental status of young children (linguistic, cognitive, and proficiency), barriers to hearing can cause interferences or disruptions in developmental evolution.

Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of schoolchildren. Although many factors could contribute to learning deficits in school-aged children (e.g., socioeconomic level, home environment, diet, sleep patterns), evidence exists that suggests that chronic exposure to high aircraft noise levels can impair learning.

Specifically, elementary school children attending schools near New York City's two airports demonstrated lower reading scores than children living farther away from the flight paths (Green, et al. 1982). Researchers have found that tasks involving central processing and language comprehension (such as reading, attention, problem solving, and memory) appear to be the most affected by noise (Evans and Lepore 1993; Hygge 1994; and Evans, et al. 1995). It has been demonstrated that chronic exposure of first- and second-grade children to aircraft noise can result in reading deficits and impaired speech perception (i.e., the ability to hear common, low-frequency [vowel] sounds but not high frequencies [consonants] in speech) (Evans and Maxwell 1997).

The Evans and Maxwell (1997) study found that chronic exposure to aircraft noise resulted in reading deficits and impaired speech perception for first- and second-grade children. Other studies found that children residing near the Los Angeles International Airport had more difficulty solving cognitive problems and did not perform as well as children from quieter schools in puzzle-solving and attentiveness (Bronzaft 1997; Cohen, et al. 1980). Children attending elementary schools in high aircraft noise areas near London's Heathrow Airport demonstrated poorer reading comprehension and selective cognitive impairments (Haines, et al. 2001a, b). Similarly, a study conducted by Hygge (1994) found that students exposed to aircraft noise (76 dBA) scored 20% lower on recall ability tests than students exposed to ambient noise (42-44 dBA). Similar studies involving the testing of attention, memory, and reading comprehension of schoolchildren located near airports showed that their tests exhibited reduced performance results compared to those of similar groups of children who were located in quieter environments (Evans, et al. 1995; Haines, et al. 1998). The Haines and Stansfeld study indicated that there may be some long-term effects associated with exposure, as one-year follow-up testing still demonstrated lowered scores for children in higher noise schools (Haines et al., 2001a and 2001b). In contrast, a study conducted by Hygge, et al. (2002) found that although children living near the old Munich airport scored lower in standardized reading and long-term memory tests than a control group, their performance on the same tests was equal to that of the control group once the airport was closed.

Finally, although it is recognized that there are many factors that could contribute to learning deficits in school-aged children, there is increasing awareness that chronic exposure to high aircraft noise levels may impair learning. This awareness has led the World Health Organization and a North Atlantic Treaty Organization working group to conclude that daycare centers and schools should not be located near major sources of noise, such as highways, airports, and industrial sites (World Health Organization 2000; North Atlantic Treaty Organization 2000).

A.3.7.2 Health Effects

Physiological effects in children exposed to aircraft noise and the potential for health effects have also been the focus of limited investigation. Studies in the literature include examination of blood pressure levels, hormonal secretions, and hearing loss.

As a measure of stress response to aircraft noise, authors have looked at blood pressure readings to monitor children's health. Children who were chronically exposed to aircraft noise from a new airport near Munich, Germany, had modest (although significant) increases in blood pressure, significant increases in stress hormones, and a decline in quality of life (Evans, et al. 1998). Children attending noisy schools had statistically significant average systolic and diastolic blood pressure ($p<0.03$). Systolic blood pressure means were 89.68 mm for children attending schools located in noisier environments compared to 86.77 mm for a control group. Similarly, diastolic blood pressure means for the noisier environment group were 47.84 mm and 45.16 for the control group (Cohen, et al. 1980).

Although the literature appears limited, relatively recent studies focused on the wide range of potential effects of aircraft noise on school children have also investigated hormonal levels between groups of children exposed to aircraft noise compared to those in a control group. Specifically, Haines, et al. (2001b and 2001c) analyzed cortisol and urinary catecholamine levels in school children as measurements of stress response to aircraft noise. In both instances, there were no differences between the aircraft-noise-exposed children and the control groups.

Other studies have reported hearing losses from exposure to aircraft noise. Noise-induced hearing loss was reportedly higher in children who attended a school located under a flight path near a Taiwan airport, as compared to children at another school far away (Chen, et al. 1997). Another study reported that hearing ability was reduced significantly in individuals who lived near an airport and were frequently exposed to aircraft noise (Chen and Chen 1993). In that study, noise exposure near the airport was reportedly uniform, with DNL greater than 75 dB and maximum noise levels of about 87 dB during overflights. Conversely, several other studies that were reviewed reported no difference in hearing ability between children exposed to high levels of airport noise and children located in quieter areas (Fisch 1977; Andrus, et al. 1975; Wu, et al. 1995).

A.3.8 Effects on Domestic Animals and Wildlife

Hearing is critical to an animal's ability to react, compete, reproduce, hunt, forage, and survive in its environment. While the existing literature does include studies on possible effects of jet aircraft noise and sonic booms on wildlife, there appears to have been little concerted effort in developing quantitative comparisons of aircraft noise effects on normal auditory characteristics. Behavioral effects have been relatively well described, but the larger ecological context issues, and the potential for drawing conclusions regarding effects on populations, has not been well developed.

The relationships between potential auditory/physiological effects and species interactions with their environments are not well understood. Manci, et al. (1988), assert that the consequences that physiological effects may have on behavioral patterns is vital to understanding the long-term effects of noise on wildlife. Questions regarding the effects (if any) on predator-prey interactions, reproductive success, and intra-inter specific behavior patterns remain.

The following discussion provides an overview of the existing literature on noise effects (particularly jet aircraft noise) on animal species. The literature reviewed here involves those studies that have focused on the observations of the behavioral effects that jet aircraft and sonic booms have on animals.

A great deal of research was conducted in the 1960's and 1970's on the effects of aircraft noise on the public and the potential for adverse ecological impacts. These studies were largely completed in response to the increase in air travel and as a result of the introduction of supersonic jet aircraft. According to Manci, et al. (1988), the foundation of information created from that focus does not necessarily correlate or provide information specific to the impacts to wildlife in areas overflown by aircraft at supersonic speed or at low altitudes.

The abilities to hear sounds and noise and to communicate assist wildlife in maintaining group cohesiveness and survivorship. Social species communicate by transmitting calls of warning, introduction, and other types that are subsequently related to an individual's or group's responsiveness.

Animal species differ greatly in their responses to noise. Noise effects on domestic animals and wildlife are classified as primary, secondary, and tertiary. Primary effects are direct, physiological changes to the auditory system, and most likely include the masking of auditory signals. Masking is defined as the inability of an individual to hear important environmental signals that may arise from mates, predators, or prey. There is some potential that noise could disrupt a species' ability to communicate or could interfere with behavioral patterns (Manci, et al. 1988). Although the effects are likely temporal, aircraft noise may cause masking of auditory signals within exposed faunal communities. Animals rely on 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. Other primary effects, such as ear drum rupture or temporary and permanent hearing threshold shifts, are not as likely given the subsonic noise levels produced by aircraft overflights. Secondary effects may include non-auditory effects such as stress and hypertension; behavioral modifications;

interference with mating or reproduction; and impaired ability to obtain adequate food, cover, or water. Tertiary effects are the direct result of primary and secondary effects, and include population decline and habitat loss. Most of the effects of noise are mild enough that they may never be detectable as variables of change in population size or population growth against the background of normal variation (Bowles 1995). Other environmental variables (e.g., predators, weather, changing prey base, ground-based disturbance) also influence secondary and tertiary effects, and confound the ability to identify the ultimate factor in limiting productivity of a certain nest, area, or region (Smith, et al. 1988). Overall, the literature suggests that species differ in their response to various types, durations, and sources of noise (Manci, et al. 1988).

Many scientific studies have investigated the effects of aircraft noise on wildlife, and some have focused on wildlife "flight" due to noise. Apparently, animal responses to aircraft are influenced by many variables, including size, speed, proximity (both height above the ground and lateral distance), engine noise, color, flight profile, and radiated noise. The type of aircraft (e.g., fixed wing versus rotor-wing [helicopter]) and type of flight mission may also produce different levels of disturbance, with varying animal responses (Smith, et al. 1988). Consequently, it is difficult to generalize animal responses to noise disturbances across species.

One result of the 1988 Manci, et al., literature review was the conclusion that, while behavioral observation studies were relatively limited, a general behavioral reaction in animals from exposure to aircraft noise is the startle response. The intensity and duration of the startle response appears to be dependent on which species is exposed, whether there is a group or an individual, and whether there have been some previous exposures. Responses range from flight, trampling, stampeding, jumping, or running, to movement of the head in the apparent direction of the noise source. Manci, et al. (1988), reported that the literature indicated that avian species may be more sensitive to aircraft noise than mammals.

A.3.8.1 Domestic Animals

Although some studies report that the effects of aircraft noise on domestic animals is inconclusive, a majority of the literature reviewed indicates that domestic animals exhibit some behavioral responses to military overflights but generally seem to habituate to the disturbances over a period of time. Mammals in particular appear to react to noise at sound levels higher than 90 dB, with responses including the startle response, freezing (i.e., becoming temporarily stationary), and fleeing from the sound source. Many studies on domestic animals suggest that some species appear to acclimate to some forms of sound disturbance (Manci, et al. 1988). Some studies have reported such primary and secondary effects as reduced milk production and rate of milk release, increased glucose concentrations, decreased levels of hemoglobin, increased heart rate, and a reduction in thyroid activity. These latter effects appear to represent a small percentage of the findings occurring in the existing literature.

Some reviewers have indicated that earlier studies, and claims by farmers linking adverse effects of aircraft noise on livestock, did not necessarily provide clear-cut evidence of cause and effect (Cottereau 1978). In contrast, many studies conclude that there is no evidence that aircraft overflights affect feed intake, growth, or production rates in domestic animals.

Cattle

In response to concerns about overflight effects on pregnant cattle, milk production, and cattle safety, the U.S. Air Force prepared a handbook for environmental protection that summarizes the literature on the impacts of low-altitude flights on livestock (and poultry) and includes specific case studies conducted in numerous airspaces across the country. Adverse effects have been found in a few studies but have not been reproduced in other similar studies. One such study, conducted in 1983, suggested that 2 of 10 cows in late pregnancy aborted after showing rising estrogen and falling progesterone levels. These increased hormonal levels were reported as being linked to 59 aircraft overflights. The remaining eight cows showed no changes in their blood concentrations and calved normally (U.S. Air Force 1994b). A similar study reported abortions occurred in three out of five pregnant cattle after exposing them to flyovers by six different aircraft (U.S.Air Force 1994b). Another study suggested that feedlot cattle could stampede and injure themselves when exposed to low-level overflights (U.S. Air Force 1994b).

A majority of the studies reviewed suggests that there is little or no effect of aircraft noise on cattle. Studies presenting adverse effects to domestic animals have been limited. A number of studies (Parker and Bayley 1960; Casady and Lehmann 1967; Kovalcik and Sottnik 1971) investigated the effects of jet aircraft noise and sonic booms on the milk production of dairy cows. Through the compilation and examination of milk production data from areas exposed to jet aircraft noise and sonic boom events, it was determined that milk yields were not affected. This was particularly evident in those cows that had been previously exposed to jet aircraft noise.

A study examined the causes of 1,763 abortions in Wisconsin dairy cattle over a one-year time period and none were associated with aircraft disturbances (U.S.Air Force 1993). In 1987, Anderson contacted seven livestock operators for production data, and no effects of low-altitude and supersonic flights were noted. Three out of 43 cattle previously exposed to low-altitude flights showed a startle response to an F/A-18 aircraft flying overhead at 500 feet above ground level and 400 knots by running less than 10 meters. They resumed normal activity within one minute (U.S.Air Force 1994b). Beyer (1983) found that helicopters caused more reaction than other low-aircraft overflights, and that the helicopters at 30 to 60 feet overhead did not affect milk production and pregnancies of 44 cows and heifers in a 1964 study (U.S. Air Force 1994b).

Additionally, Beyer reported that five pregnant dairy cows in a pasture did not exhibit fright-flight tendencies or disturb their pregnancies after being overflown by 79 low-altitude helicopter flights and 4 low-altitude, subsonic jet aircraft flights (U.S. Air Force 1994b). A 1956 study found that the reactions of dairy and beef cattle to noise from low-altitude, subsonic aircraft were similar to those caused by paper blowing about, strange persons, or other moving objects (U.S. Air Force 1994b).

In a report to Congress, the U. S. Forest Service concluded that "evidence both from field studies of wild ungulates and laboratory studies of domestic stock indicate that the risks of damage are small (from aircraft approaches of 50 to 100 meters), as animals take care not to damage themselves (U.S. Forest Service 1992). If animals are overflown by aircraft at altitudes of 50 to 100 meters, there is no evidence that mothers and young are separated, that animals collide with obstructions (unless confined) or that they traverse dangerous ground at too high a rate." These varied study results suggest that, although the confining of cattle could magnify animal response to aircraft overflight, there is no proven cause-and-effect link between startling cattle from aircraft overflights and abortion rates or lower milk production.

Horses

Horses have also been observed to react to overflights of jet aircraft. Several of the studies reviewed reported a varied response of horses to low-altitude aircraft overflights. Observations made in 1966 and 1968 noted that horses galloped in response to jet flyovers (U.S. Air Force 1993). Bowles (1995) cites Kruger and Erath as observing horses exhibiting intensive flight reactions, random movements, and biting/kicking behavior. However, no injuries or abortions occurred, and there was evidence that the mares adapted somewhat to the flyovers over the course of a month (U.S. Air Force 1994b). Although horses were observed noticing the overflights, it did not appear to affect either survivability or reproductive success. There was also some indication that habituation to these types of disturbances was occurring.

LeBlanc, et al. (1991), studied the effects of F-14 jet aircraft noise on pregnant mares. They specifically focused on any changes in pregnancy success, behavior, cardiac function, hormonal production, and rate of habituation. Their findings reported observations of "flight-fright" reactions, which caused increases in heart rates and serum cortisol concentrations. The mares, however, did habituate to the noise. Levels of anxiety and mass body movements were the highest after initial exposure, with intensities of responses decreasing thereafter. There were no differences in pregnancy success when compared to a control group.

Swine

Generally, the literature findings for swine appear to be similar to those reported for cows and horses. While there are some effects from aircraft noise reported in the literature, these effects are minor. Studies of continuous noise exposure (i.e., 6 hours, 72 hours of constant exposure) reported influences on short-term hormonal production and release. Additional constant exposure studies indicated the observation of stress reactions, hypertension, and electrolyte imbalances (Dufour 1980). A study by Bond, et al. (1963), demonstrated no adverse effects on the feeding efficiency, weight gain, ear physiology, or thyroid and adrenal gland condition of pigs subjected to observed aircraft noise. Observations of heart rate increase were recorded, noting that cessation of the noise resulted in the return to normal heart rates. Conception rates and offspring survivorship did not appear to be influenced by exposure to aircraft noise.

Similarly, simulated aircraft noise at levels of 100 dB to 135 dB had only minor effects on the rate of feed utilization, weight gain, food intake, or reproduction rates of boars and sows exposed, and there were no injuries or inner ear changes observed (Manci, et al. 1988; Gladwin, et al. 1988).

Domestic Fowl

According to a 1994 position paper by the U.S. Air Force on effects of low-altitude overflights (below 1,000 ft) on domestic fowl, overflight activity has negligible effects (U.S. Air Force 1994a). The paper did recognize that given certain circumstances, adverse effects can be serious. Some of the effects can be panic reactions, reduced productivity, and effects on marketability (e.g., bruising of the meat caused during "pile-up" situations).

The typical reaction of domestic fowl after exposure to sudden, intense noise is a short-term startle response. The reaction ceases as soon as the stimulus is ended, and within a few minutes all activity returns to normal. More severe responses are possible depending on the number of birds, the frequency of exposure, and environmental conditions. Large crowds of birds, and birds not previously exposed, are more likely to pile up in response to a noise stimulus (U.S. Air Force 1994a). According to studies and interviews with growers, it is typically the previously unexposed birds that incite panic crowding, and the tendency to do so is markedly reduced within five exposures to the stimulus (U.S. Air Force 1994a). This suggests that the birds habituate relatively quickly. Egg productivity was not adversely affected by infrequent noise bursts, even at exposure levels as high as 120 to 130 dBA.

Between 1956 and 1988, there were 100 recorded claims against the Navy for alleged damage to domestic fowl. The number of claims averaged three per year, with peak numbers of claims following publications of studies on the topic in the early 1960s (U.S. Air Force 1994a). Many of the claims were disproved or did not have sufficient supporting evidence. The claims were filed for the following alleged damages: 55% for panic reactions, 31% for decreased production, 6% for reduced hatchability, 6% for weight loss, and less than 1% for reduced fertility (U.S. Air Force 1994a).

Turkeys

The review of the existing literature suggests that there has not been a concerted or widespread effort to study the effects of aircraft noise on commercial turkeys. One study involving turkeys examined the differences between simulated versus actual overflight aircraft noise, turkey responses to the noise, weight gain, and evidence of habituation (Bowles, et al. 1990). Findings from the study suggested that turkeys habituated to jet aircraft noise quickly, that there were no growth rate differences between the experimental and control groups, and that there were some behavioral differences that increased the difficulty in handling individuals within the experimental group.

Low-altitude overflights were shown to cause turkey flocks that were kept inside turkey houses to occasionally pile up and experience high mortality rates due to the aircraft noise and a variety of disturbances unrelated to aircraft (U.S. Air Force 1994a).

A.3.8.2 Wildlife

Studies on the effects of overflights and sonic booms on wildlife have been focused mostly on avian species and ungulates such as caribou and bighorn sheep. Few studies have been conducted on marine mammals, small terrestrial mammals, reptiles, amphibians, and carnivorous mammals. Generally, species that live entirely below the surface of the water have also been ignored due to the fact they do not experience the same level of sound as terrestrial species (National Park Service 1994). Wild ungulates appear to be much more sensitive to noise disturbance than domestic livestock (Manci, et al. 1988). This may be due to previous exposure to disturbances. One common factor appears to be that low-altitude flyovers seem to be more disruptive in terrain where there is little cover (Manci, et al. 1988).

A.3.8.2.1 MAMMALS

Terrestrial Mammals

Studies of terrestrial mammals have shown that noise levels of 120 dBA can damage mammals' ears, and levels at 95 dBA can cause temporary loss of hearing acuity. Noise from aircraft has affected other large carnivores by causing changes in home ranges, foraging patterns, and breeding behavior. One study recommended that aircraft not be allowed to fly at altitudes below 2,000 feet above ground level over important grizzly and polar bear habitat (Dufour 1980). Wolves have been frightened by low-altitude flights that were 25 to 1,000 feet off the ground. However, wolves have been found to adapt to aircraft overflights and noise as long as they were not being hunted from aircraft (Dufour 1980).

Wild ungulates (American bison, caribou, bighorn sheep) appear to be much more sensitive to noise disturbance than domestic livestock (Weisenberger, et al. 1996). Behavioral reactions may be related to the past history of disturbances by such things as humans and aircraft. Common reactions of reindeer kept in an enclosure exposed to aircraft noise disturbance were a slight startle response, raising of the head, pricking ears, and scenting of the air. Panic reactions and extensive changes in behavior of individual animals were not observed. Observations of caribou in Alaska exposed to fixed-wing aircraft and helicopters showed running and panic reactions occurred when overflights were at an altitude of 200 feet or less. The reactions decreased with increased altitude of overflights, and, with more than 500 feet in altitude, the panic reactions stopped. Also, smaller groups reacted less strongly than larger groups. One negative effect of the running and avoidance behavior is increased expenditure of energy. For a 90-kg animal, the calculated expenditure due to aircraft harassment is 64 kilocalories per minute when running and 20 kilocalories per minute when walking. When conditions are favorable, this expenditure can be counteracted with increased feeding; however, during harsh winter conditions, this may not be possible. Incidental observations of wolves and bears exposed to fixed-wing aircraft and helicopters in the northern regions suggested that wolves are less disturbed than wild ungulates, while grizzly bears showed the greatest response of any animal species observed.

It has been proven that low-altitude overflights do induce stress in animals. Increased heart rates, an indicator of excitement or stress, have been found in pronghorn antelope, elk, and bighorn sheep. As such reactions occur naturally as a response to predation, infrequent overflights may not, in and of themselves, be detrimental. However, flights at high frequencies over a long period of time may cause harmful effects. The consequences of this disturbance, while cumulative, is not additive. It may be that aircraft disturbance may not cause obvious and serious health effects, but coupled with a harsh winter, it may have an adverse impact. Research has shown that stress induced by other types of disturbances produces long-term decreases in metabolism and hormone balances in wild ungulates.

Behavioral responses can range from mild to severe. Mild responses include head raising, body shifting, or turning to orient toward the aircraft. Moderate disturbance may be nervous behaviors, such as trotting a short distance. Escape is the typical severe response.

Marine Mammals

The physiological composition of the ear in aquatic and marine mammals exhibits adaptation to the aqueous environment. These differences (relative to terrestrial species) manifest themselves in the auricle and middle ear (Manci, et al. 1988). Some mammals use echolocation to perceive objects in their surroundings and to determine the directions and locations of sound sources (Simmons 1983 in Manci, et al. 1988).

In 1980, the Acoustical Society of America held a workshop to assess the potential hazard of manmade noise associated with proposed Alaska Arctic (North Slope-Outer Continental Shelf) petroleum operations on marine wildlife and to prepare a research plan to secure the knowledge necessary for proper assessment of noise impacts (Acoustical Society of America, 1980). Since 1980 it appears that research on responses of aquatic mammals to aircraft noise and sonic booms has been limited. Research conducted on northern fur seals, sea lions, and ringed seals indicated that there are some differences in how various animal groups receive frequencies of sound. It was observed that these species exhibited varying intensities of a startle response to airborne noise, which was habituated over time. The rates of habituation appeared to vary with species, populations, and demographics (age, sex). Time of day of exposure was also a factor (Muyberg 1978 in Manci, et al. 1988).

Studies accomplished near the Channel Islands were conducted near the area where the space shuttle launches occur. It was found that there were some response differences between species relative to the loudness of sonic booms. Those booms that were between 80 and 89 dBA caused a greater intensity of startle reactions than lower-intensity booms at 72 to 79 dBA. However, the duration of the startle responses to louder sonic booms was shorter (Jehl and Cooper 1980 in Manci, et al. 1988).

Jehl and Cooper (1980) indicated that low-flying helicopters, loud boat noises, and humans were the most disturbing to pinnipeds. According to the research, while the space launch and associated operational activity noises have not had a measurable effect on the pinniped population, it also suggests that there was a greater "disturbance level" exhibited during launch activities. There was a recommendation to continue observations for behavioral effects and to perform long-term population monitoring (Jehl and Cooper 1980).

The continued presence of single or multiple noise sources could cause marine mammals to leave a preferred habitat. However, it does not appear likely that overflights could cause migration from suitable habitats as aircraft noise over water is mobile and would not persist over any particular area. Aircraft noise, including supersonic noise, currently occurs in the overwater airspace of Eglin, Tyndall, and Langley AFBs from sorties predominantly involving jet aircraft. Survey results reported in Davis, et al. (2000), indicate that cetaceans (i.e., dolphins) occur under all of the Eglin and Tyndall marine airspace. The continuing presence of dolphins indicates that aircraft noise does not discourage use of the area and apparently does not harm the locally occurring population.

In a summary by the National Parks Service (1994) on the effects of noise on marine mammals, it was determined that gray whales and harbor porpoises showed no outward behavioral response to aircraft noise or overflights. Bottlenose dolphins showed no obvious reaction in a study involving helicopter overflights at 1,200 to 1,800 feet above the water. Neither did they show any reaction to survey aircraft unless the shadow of the aircraft passed over them, at which point there was some observed tendency to dive (Richardson, et al. 1995). Other anthropogenic noises in the marine environment from ships and pleasure craft may have more of an effect on marine mammals than aircraft noise (U.S. Air Force 2000). The noise effects on cetaceans appear to be somewhat attenuated by the air/water interface. The cetacean fauna along the coast of California have been subjected to sonic booms from military aircraft for many years without apparent adverse effects (Tetra Tech, Inc. 1997).

Manatees appear relatively unresponsive to human-generated noise to the point that they are often suspected of being deaf to oncoming boats [although their hearing is actually similar to that of pinnipeds (Bullock, et al. 1980)]. Little is known about the importance of acoustic communication to manatees, although they are known to produce at least ten different types of sounds and are thought to have sensitive hearing (Richardson, et al. 1995). Manatees continue to occupy canals near Miami International Airport, which suggests that they have become habituated to human disturbance and noise (Metro-Dade County 1995). Since manatees spend most of their time below the surface and do not startle readily, no effect of aircraft overflights on manatees would be expected (Bowles, et al. 1991).

A.3.8.2.2 BIRDS

Auditory research conducted on birds indicates that they fall between the reptiles and the mammals relative to hearing sensitivity. According to Dooling (1978), within the range of 1 to 5 kHz, birds show a level of hearing sensitivity similar to that of the more sensitive mammals. In contrast to mammals, bird sensitivity falls off at a greater rate to increasing and decreasing frequencies. Passive observations and studies examining aircraft bird strikes indicate that birds nest and forage near airports. Aircraft noise in the vicinity of commercial airports apparently does not inhibit bird presence and use.

High-noise events (like a low-altitude aircraft overflight) may cause birds to engage in escape or avoidance behaviors, such as flushing from perches or nests (Ellis, et al. 1991). These activities impose an energy cost on the birds that, over the long term, may affect survival or growth. In addition, the birds may spend less time engaged in necessary activities like feeding, preening, or caring for their young because they spend time in noise-avoidance activity. However, the long-term significance of noise-related impacts is less clear. Several studies on nesting raptors have indicated that birds become habituated to aircraft overflights and that long-term reproductive success is not affected (Grubb and King 1991; Ellis, et al. 1991). Threshold noise levels for significant responses range from 62 dB for Pacific black brant (Branta bernicla nigricans) (Ward and Stehn 1990) to 85 dB for crested tern (Sterna bergii) (Brown 1990).

Songbirds were observed to become silent prior to the onset of a sonic boom event (F-111 jets), followed by "raucous discordant cries." There was a return to normal singing within 10 seconds after the boom (Higgins 1974 in Manci, et al., 1988). Ravens responded by emitting protestation calls, flapping their wings, and soaring.

Manci, et al. (1988), reported a reduction in reproductive success in some small territorial passerines (i.e., perching birds or songbirds) after exposure to low-altitude overflights. However, it has been observed that passerines are not driven any great distance from a favored food source by a nonspecific disturbance, such as aircraft overflights (U.S. Forest Service 1992). Further study may be warranted.

A recent study, conducted cooperatively between the DoD and the USFWS, assessed the response of the red-cockaded woodpecker to a range of military training noise events, including artillery, small arms, helicopter, and maneuver noise (Pater, et al. 1999). The project findings show that the red-cockaded woodpecker successfully acclimates to military noise events. Depending on the noise level that ranged from innocuous to very loud, the birds responded by flushing from their nest cavities. When the noise source was closer and the noise level was higher, the number of flushes increased proportionately. In all cases, however, the birds returned to their nests within a relatively short period of time (usually within 12 minutes). Additionally, the noise exposure did not result in any mortality or statistically detectable changes in reproductive success (Pater, et al. 1999). Red-cockaded woodpeckers did not flush when artillery simulators were more than 122 meters away and SEL noise levels were 70 dBA.

Lynch and Speake (1978) studied the effects of both real and simulated sonic booms on the nesting and brooding eastern wild turkey (Meleagris gallopavo silvestris) in Alabama. Hens at four nest sites were subjected to between 8 and 11 combined real and simulated sonic booms. All tests elicited similar responses, including quick lifting of the head and apparent alertness for between 10 and 20 seconds. No apparent nest failure occurred as a result of the sonic booms.

Twenty-one brood groups were also subjected to simulated sonic booms. Reactions varied slightly between groups, but the largest percentage of groups reacted by standing motionless after the initial blast. Upon the sound of the boom, the hens and poults fled until reaching the edge of the woods (approximately 4 to 8 meters). Afterward, the poults resumed feeding activities while the hens remained alert for a short period of time (approximately 15 to 20 seconds). In no instances were poults abandoned, nor did they scatter and become lost. Every observation group returned to normal activities within a maximum of 30 seconds after a blast.

A3.8.2.2.1 RAPTORS

In a literature review of raptor responses to aircraft noise, Manci, et al. (1988), found that most raptors did not show a negative response to overflights. When negative responses were observed they were predominantly associated with rotor-winged aircraft or jet aircraft that were repeatedly passing within 0.5 mile of a nest.

Ellis, et al. (1991), performed a study to estimate the effects of low-level military jet aircraft and mid- to high-altitude sonic booms (both actual and simulated) on nesting peregrine falcons and seven other raptors (common black-hawk, Harris' hawk, zone-tailed hawk, red-tailed hawk, golden eagle, prairie falcon, bald eagle). They observed responses to test stimuli, determined nest success for the year of the testing, and evaluated site occupancy the following year. Both long- and short-term effects were noted in the study. The results reported the successful fledging of young in 34 of 38 nest sites (all eight species) subjected to low-level flight and/or simulated sonic booms. Twenty-two of the test sites were revisited in the following year, and observations of pairs or lone birds were made at all but one nest. Nesting attempts were underway at 19 of 20 sites that were observed long enough to be certain of breeding activity. Reoccupancy and productivity rates were within or above expected values for self-sustaining populations.

Short-term behavior responses were also noted. Overflights at a distance of 150 m or less produced few significant responses and no severe responses. Typical responses consisted of crouching or, very rarely, flushing from the perch site. Significant responses were most evident before egg laying and after young were "well grown." Incubating or brooding adults never burst from the nest, thus preventing egg breaking or knocking chicks out of the nest. Jet passes and sonic booms often caused noticeable alarm; however, significant negative responses were rare and did not appear to limit productivity or reoccupancy. Due to the locations of some of the nests, some birds may have been habituated to aircraft noise. There were some test sites located at distances far from zones of frequent military aircraft usage, and the test stimuli were often closer, louder, and more frequent than would be likely for a normal training situation.

Manci, et al. (1988), noted that a female northern harrier was observed hunting on a bombing range in Mississippi during bombing exercises. The harrier was apparently unfazed by the exercises, even when a bomb exploded within 200 feet. In a similar case of habituation/non-disturbance, a study on the Florida snail-kite stated the greatest reaction to overflights (approximately 98 dBA) was "watching the aircraft fly by." No detrimental impacts to distribution, breeding success, or behavior were noted.

Bald Eagle

A study by Grubb and King (1991) on the reactions of the bald eagle to human disturbances showed that terrestrial disturbances elicited the greatest response, followed by aquatic (i.e., boats) and aerial disturbances. The disturbance regime of the area where the study occurred was predominantly characterized by aircraft noise. The study found that pedestrians consistently caused responses that were greater in both frequency and duration. Helicopters elicited the highest level of aircraft-related responses. Aircraft disturbances, although the most common form of disturbance, resulted in the lowest levels of response. This low response level may have been due to habituation; however, flights less than 170 meters away caused reactions similar to other disturbance types. Ellis, et al. (1991), showed that eagles typically respond to the proximity of a disturbance, such as a pedestrian or aircraft within 100 meters, rather than the noise level. Fleischner and Weisberg (1986) stated that reactions of bald eagles to commercial jet flights, although minor (e.g., looking), were twice as likely to occur when the jets passed at a distance of 0.5 mile or less. They also noted that helicopters were four times more likely to cause a reaction than a commercial jet and 20 times more likely to cause a reaction than a propeller plane.

The USFWS advised Cannon AFB that flights at or below 2,000 feet AGL from October 1 through March 1 could result in adverse impacts to wintering bald eagles (U.S. Fish and Wildlife Serice 1998). However, Fraser, et al. (1985), suggested that raptors habituate to overflights rapidly, sometimes tolerating aircraft approaches of 65 feet or less.

Osprey

A study by Trimper, et al. (1998), in Goose Bay, Labrador, Canada, focused on the reactions of nesting osprey to military overflights by CF-18 Hornets. Reactions varied from increased alertness and focused observation of planes to adjustments in incubation posture. No overt reactions (e.g., startle response, rapid nest departure) were observed as a result of an overflight. Young nestlings crouched as a result of any disturbance until they grew to 1 to 2 weeks prior to fledging. Helicopters, human presence, float planes, and other ospreys elicited the strongest reactions from nesting ospreys. These responses included flushing, agitation, and aggressive displays. Adult osprey showed high nest occupancy rates during incubation regardless of external influences.

The osprey observed occasionally stared in the direction of the flight before it was audible to the observers. The birds may have been habituated to the noise of the flights; however, overflights were strictly controlled during the experimental period. Strong reactions to float planes and helicopter may have been due to the slower flight and therefore longer duration of visual stimuli rather than noise-related stimuli.

Red-tailed Hawk

Anderson, et al. (1989), conducted a study that investigated the effects of low-level helicopter overflights on 35 red-tailed hawk nests. Some of the nests had not been flown over prior to the study. The hawks that were naïve (i.e., not previously exposed) to helicopter flights exhibited stronger avoidance behavior (nine of 17 birds flushed from their nests) than those that had experienced prior overflights. The overflights did not appear to affect nesting success in either study group. These findings were consistent with the belief that red-tailed hawks habituate to low-level air traffic, even during the nesting period.

A.3.8.2.2.2 MIGRATORY WATERFOWL

A study of caged American black ducks was conducted by Fleming, et al., in 1996. It was determined that noise had negligible energetic and physiologic effects on adult waterfowl. Measurements included body weight, behavior, heart rate, and enzymatic activity. Experiments also showed that adult ducks exposed to high noise events acclimated rapidly and showed no effects.

The study also investigated the reproductive success of captive ducks, which indicated that duckling growth and survival rates at Piney Island, North Carolina, were lower than those at a background location. In contrast, observations of several other reproductive indices (i.e., pair formation, nesting, egg production, and hatching success) showed no difference between Piney Island and the background location. Potential effects on wild duck populations may vary, as wild ducks at Piney Island have presumably acclimated to aircraft overflights. It was not demonstrated that noise was the cause of adverse impacts. A variety of other factors, such as weather conditions, drinking water and food availability and variability, disease, and natural variability in reproduction, could explain the observed effects. Fleming noted that drinking water conditions (particularly at Piney Island) deteriorated during the study, which could have affected the growth of young ducks. Further research would be necessary to determine the cause of any reproductive effects.

Another study by Conomy, et al. (1998) exposed previously unexposed ducks to 71 noise events per day that equaled or exceeded 80 dBA. It was determined that the proportion of time black ducks reacted to aircraft activity and noise decreased from 38 percent to 6 percent in 17 days and remained stable at 5.8 percent thereafter. In the same study, the wood duck did not appear to habituate to aircraft disturbance. This supports the notion that animal response to aircraft noise is species-specific. Because a startle response to aircraft noise can result in flushing from nests, migrants and animals living in areas with high concentrations of predators would be the most vulnerable to experiencing effects of lowered birth rates and recruitment over time. Species that are subjected to infrequent overflights do not appear to habituate to overflight disturbance as readily.

Black brant studied in the Alaska Peninsula were exposed to jets and propeller aircraft, helicopters, gunshots, people, boats, and various raptors. Jets accounted for 65% of all the disturbances. Humans, eagles, and boats caused a greater percentage of brant to take flight. There was markedly greater reaction to Bell-206-B helicopter flights than fixed wing, single-engine aircraft (Ward, et al. 1986).

The presence of humans and low-flying helicopters in the Mackenzie Valley North Slope area did not appear to affect the population density of Lapland longspurs, but the experimental group was shown to have reduced hatching and fledging success and higher nest abandonment. Human presence appeared to have a greater impact on the incubating behavior of the black brant, common eider, and Arctic tern than fixed-wing aircraft (Gunn and Livingston 1974).

Gunn and Livingston (1974) found that waterfowl and seabirds in the Mackenzie Valley and North Slope of Alaska and Canada became acclimated to float plane disturbance over the course of three days. Additionally, it was observed that potential predators (bald eagle) caused a number of birds to leave their nests. Non-breeding birds were observed to be more reactive than breeding birds. Waterfowl were affected by helicopter flights, while snow geese were disturbed by Cessna 185 flights. The geese flushed when the planes were under 1,000 feet, compared to higher flight elevations. An overall reduction in flock sizes was observed. It was recommended that aircraft flights be reduced in the vicinity of premigratory staging areas.

Manci, et al. 1988 reported that waterfowl were particularly disturbed by aircraft noise. The most sensitive appeared to be snow geese. Canada geese and snow geese were thought to be more sensitive than other animals such as turkey vultures, coyotes, and raptors (Edwards, et al. 1979).

A.3.8.2.2.3 WADING AND SHORE BIRDS

Black, et al. (1984), studied the effects of low-altitude (less than 500 feet AGL) military training flights with sound levels from 55 to 100 dBA on wading bird colonies (i.e., great egret, snowy egret, tricolored heron, and little blue heron). The training flights involved three or four aircraft, which occurred once or twice per day. This study concluded that the reproductive activity--including nest success, nestling survival, and nestling chronology--was independent of F-16 overflights. Dependent variables were more strongly related to ecological factors, including location and physical characteristics of the colony and climatology. Another study on the effects of circling fixed-wing aircraft and helicopter overflights on wading bird colonies found that at altitudes of 195 to 390 feet, there was no reaction in nearly 75% of the 220 observations. Ninety percent displayed no reaction or merely looked toward the direction of the noise source. Another 6 percent stood up, 3 percent walked from the nest, and 2 percent flushed (but were without active nests) and returned within 5 minutes (Kushlan 1978). Apparently, non-nesting wading birds had a slightly higher incidence of reacting to overflights than nesting birds. Seagulls observed roosting near a colony of wading birds in another study remained at their roosts when subsonic aircraft flew overhead (Burger 1981). Colony distribution appeared to be most directly correlated to available wetland community types and was found to be distributed randomly with respect to military training routes. These results suggest that wading bird species presence was most closely linked to habitat availability and that they were not affected by low-level military overflights (U.S. Air Force 2000).

Burger (1986) studied the response of migrating shorebirds to human disturbance and found that shorebirds did not fly in response to aircraft overflights, but did flush in response to more localized intrusions (i.e., humans and dogs on the beach). Burger (1981) studied the effects of noise from JFK Airport in New York on herring gulls that nested less than 1 kilometer from the airport. Noise levels over the nesting colony were 85 to 100 dBA on approach and 94 to 105 dBA on takeoff. Generally, there did not appear to be any prominent adverse effects of subsonic aircraft on nesting, although some birds flushed when the concorde flew overhead and, when they returned, engaged in aggressive behavior. Groups of gulls tended to loaf in the area of the nesting colony, and these birds remained at the roost when the concorde flew overhead. Up to 208 of the loafing gulls flew when supersonic aircraft flew overhead. These birds would circle around and immediately land in the loafing flock (U.S. Air Force 2000).

In 1969, sonic booms were potentially linked to a mass hatch failure of Sooty Terns on the Dry Tortugas (Austin et al, 1969). The cause of the failure was not certain, but it was conjectured that sonic booms from military aircraft or an overgrowth of vegetation were factors. In the previous season, Sooties were observed to react to sonic booms by rising in a "panic flight," circling over the island, then usually settling down on their eggs again. Hatching that year was normal. Following the 1969 hatch failure, excess vegetation was cleared and measures were taken to reduce supersonic activity. The 1970 hatch appeared to proceed normally. A colony of Noddies on the same island hatched successfully in 1969, the year of the Sooty hatch failure.

Subsequent laboratory tests of exposure of eggs to sonic booms and other impulsive noises (Bowles et al 1991; Bowles et al 1994; Cottereau 1972; Cogger and Zegarra 1980) failed to show adverse effects on hatching of eggs. A structural analysis (Ting et al, 2002) showed that, even under extraordinary circumstances, sonic booms would not damage an avian egg.

Burger (1981) observed no effects of subsonic aircraft on herring gulls in the vicinity of JFK International Airport. The concorde aircraft did cause more nesting gulls to leave their nests (especially in areas of higher density of nests), causing the breakage of eggs and the scavenging of eggs by intruder prey. Clutch sizes were observed to be smaller in areas of higher-density nesting (presumably due to the greater tendency for panic flight) than in areas where there were fewer nests.

A.3.8.3 Fish, Reptiles, and Amphibians

The effects of overflight noise on fish, reptiles, and amphibians have been poorly studied, but conclusions regarding their expected responses have involved speculation based upon known physiologies and behavioral traits of these taxa (Gladwin, et al. 1988). Although fish do startle in response to low-flying aircraft noise, and probably to the shadows of aircraft, they have been found to habituate to the sound and overflights. Reptiles and amphibians that respond to low frequencies and those that respond to ground vibration, such as spadefoots (genus Scaphiopus), may be affected by noise. Limited information is available on the effects of short-duration noise events on reptiles. Dufour (1980) and Manci, et al. (1988), summarized a few studies of reptile responses to noise. Some reptile species tested under laboratory conditions experienced at least temporary threshold shifts or hearing loss after exposure to 95 dB for several minutes. Crocodilians in general have the most highly developed hearing of all reptiles. Crocodile ears have lids that can be closed when the animal goes under water. These lids can reduce the noise intensity by 10 to 12 dB (Wever and Vernon 1957). On Homestead Air Reserve Station, Florida, two crocodilians (the American Alligator and the Spectacled Caiman) reside in wetlands and canals along the base runway suggesting that they can coexist with existing noise levels of an active runway including DNLs of 85 dB.

A.3.8.4 Summary

Some physiological/behavioral responses such as increased hormonal production, increased heart rate, and reduction in milk production have been described in a small percentage of studies. A majority of the studies focusing on these types of effects have reported short-term or no effects.

The relationships between physiological effects and how species interact with their environments have not been thoroughly studied. Therefore, the larger ecological context issues regarding physiological effects of jet aircraft noise (if any) and resulting behavioral pattern changes are not well understood.

Animal species exhibit a wide variety of responses to noise. It is therefore difficult to generalize animal responses to noise disturbances or to draw inferences across species, as reactions to jet aircraft noise appear to be species-specific. Consequently, some animal species may be more sensitive than other species and/or may exhibit different forms or intensities of behavioral responses. For instance, wood ducks appear to be more sensitive and more resistant to acclimation to jet aircraft noise than Canada geese in one study. Similarly, wild ungulates seem to be more easily disturbed than domestic animals.

The literature does suggest that common responses include the “startle” or “fright” response and, ultimately, habituation. It has been reported that the intensities and durations of the startle response decrease with the numbers and frequencies of exposures, suggesting no long-term adverse effects. The majority of the literature suggests that domestic animal species (cows, horses, chickens) and wildlife species exhibit adaptation, acclimation, and habituation after repeated exposure to jet aircraft noise and sonic booms.

Animal responses to aircraft noise appear to be somewhat dependent on, or influenced by, the size, shape, speed, proximity (vertical and horizontal), engine noise, color, and flight profile of planes. Helicopters also appear to induce greater intensities and durations of disturbance behavior as compared to fixed-wing aircraft. Some studies showed that animals that had been previously exposed to jet aircraft noise exhibited greater degrees of alarm and disturbance to other objects creating noise, such as boats, people, and objects blowing across the landscape. Other factors influencing response to jet aircraft noise may include wind direction, speed, and local air turbulence; landscape structures (i.e., amount and type of vegetative cover); and, in the case of bird species, whether the animals are in the incubation/nesting phase.

A.3.9 Property Values

Property within a noise zone (or Accident Potential Zone) may be affected by the availability of federally guaranteed loans. According to U.S. Department of Housing and Urban Development (HUD), Federal Housing Administration (FHA), and Veterans Administration (VA) guidance, sites are acceptable for program assistance, subsidy, or insurance for housing in noise zones of less than 65 DNL, and sites are conditionally acceptable with special approvals and noise attenuation in the 65 to 75 DNL noise zone and the greater than 75 DNL noise zone. HUD's position is that noise is not the only determining factor for site acceptability, and properties should not be rejected only because of airport influences if there is evidence of acceptability within the market and if use of the dwelling is expected to continue. Similar to the Navy's and Air Force's Air Installation Compatible Use Zone Program, HUD, FHA, and VA recommend sound attenuation for housing in the higher noise zones and written disclosures to all prospective buyers or lessees of property within a noise zone (or Accident Potential Zone).

Newman and Beattie (1985) reviewed the literature to assess the effect of aircraft noise on property values. One paper by Nelson (1978), reviewed by Newman and Beattie, suggested a 1.8 to 2.3 percent decrease in property value per decibel at three separate airports, while at another period of time, they found only a 0.8 percent devaluation per decibel change in DNL. However, Nelson also noted a decline in noise depreciation over time which he theorized could be due to either noise sensitive people being replaced by less sensitive people or the increase in commerical value of the property near airports; both ideas were supported by Crowley (1978). Ultimately, Newman and Beattie summarized that while an effect of noise was observed, noise is only one of the many factors that is part of a decision to move close to, or away from, an airport, but which is sometimes considered an advantage due to increased opportunities for employment or ready access to the airport itself. With all the issues associated with determining property values, their reviews found that decreases in property values usually range from 0.5 to 2 percent per decibel increase of cumulative noise exposure.

More recently Fidell et al (1996) studied the influences of aircraft noise on actual sale prices of residential properties in the vicinity of two military facilities and found that equations developed for one area to predict residential sale prices in areas unaffected by aircraft noise worked equally well when applied to predicting sale prices of homes in areas with aircraft noise in excess of LDN 65dB. Thus, the model worked equally well in predicting sale prices in areas with and without aircraft noise exposure. This indicates that aircraft noise had no meaningful effect on residential property values. In some cases, the average sale prices of noise exposed properties were somewhat higher than those elsewhere in the same area. In the vicinity of Davis-Monthan AFB/Tucson, AZ, Fidell found the homes near the airbase were much older, smaller and in poorer condition than homes elsewhere. These factors caused the equations developed for predicting sale prices in areas further away from the base to be inapplicable with those nearer the base. However, again Fidell found that, similar to other researchers, differences in sale prices between homes with and without aircraft noise were frequently due to factors other than noise itself.

A.3.10 Noise Effects on Structures

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 pressures impinging on the structure is normally used to determine the possibility of damage. In general, with peak sound levels above 130 dB, there is the possibility of the excitation of structural component resonances. While certain frequencies (such as 30 hertz for window breakage) may be of more concern than other frequencies, conservatively, only sounds lasting more than one second above a sound level of 130 dB are potentially damaging to structural components (Committee on Hearing, Bioacoustics, and Biomechanics 1977).

Noise-induced structural vibration may also cause annoyance to dwelling occupants because of induced secondary vibrations, or rattling of objects within the dwelling such as hanging pictures, dishes, plaques, and bric-a-brac. Window panes may also vibrate noticeably when exposed to high levels of airborne noise. In general, such noise-induced vibrations occur at peak sound levels of 110 dB or greater. Thus, assessments of noise exposure levels for compatible land use should also be protective of noise-induced secondary vibrations.

A.3.11 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, especially in mountainous areas, causing landslides or avalanches. There are no known instances of such effects, and it is considered improbable that such effects would result from routine, subsonic aircraft operations.

A.3.12 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. Particularly in older structures, seemingly insignificant surface cracks initiated by vibrations from aircraft noise may lead to greater damage from natural forces (Hanson, et al. 1991). 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 (Wesler 1977). There was 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 conventional structures, assessments of noise exposure levels for normally compatible land uses should also be protective of historic and archaeological sites.

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Appendix C:

County Zoning Designations and State Land Use Classifications for MCBH Kaneohe Bay and Surrounding Area

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County Zoning Designations and State Land Use Classifications for MCBH Kaneohe Bay and Surrounding Area

State Land Use District	County Zoning	Permitted Uses
Conservation	P-1; Restricted Preservation	Area regulated by the State Department of Land and Natural Resources
	P-2; General Preservation	Aquaculture; cemeteries; composting; crop production; forestry; game preserves; golf courses; livestock grazing; public uses and structures; utility installations
Agriculture	AG-1; Restricted Agriculture	Agricultural machinery service and sales; agriculture processing and distribution; aquaculture; composting; crop production; farm dwellings; forestry; livestock grazing production; public uses and structures; sawmills; storage of agricultural production products; utility installations; veterinary services
	AG-2; General Agriculture	All uses permitted in the AG-1; (additional uses include): restricted agriculture district; game preserves; commercial kennels
Urban	Country	Aquaculture; crop production; kennels; livestock grazing; production products and veterinary services; one-family dwellings; public uses and structures; language schools; utility installations
	R-5, R-7.5, R-10 Residential	Consulates; detached one-family dwellings; language schools; public uses and structures; utility installations
	A-2; Apartments	Boarding facilities; consulates; duplex units; detached one-two, and multi-family dwellings; public uses and structures; language schools; utility installations
	B-1; Neighborhood Business	Art galleries; business services; car washes; commercial parking lots/garages; consulates; convenience stores; dance or music schools; day-care centers; drive-thru restaurants; financial institutions; indoor amusement and recreation facilities; medical clinics and laboratories; meeting facilities; office buildings; personal services; photographic processing and studios; public uses and structures; repair facilities; retail; schools; theaters; service stations; utility installations; veterinary services

State Land Use District	County Zoning	Permitted Uses
Urban	B-2; Community Business	All uses permitted in B-1; (additional uses include): automobile sales; bars; cabarets; catering establishments; home improvement centers; research laboratories; self-storage facilities; food manufacturing and processing; motion picture and television studios; publishing plants; wholesaling and distribution; business colleges; broadcasting stations
	BMX-3; Community Business Mixed Use District	All uses permitted in B-1/B-2; (additional uses include): off-site joint development; hotels; and special needs housing for the elderly
	I-2; Intensive Industrial	Agricultural and animal product processing; agricultural machinery sales and service; sawmills; agricultural product sales; agricultural product storage and distribution; automobile sales and rentals; automobile sales; commercial kennels; bars, clubs, nightclubs, taverns; broadcasting stations; business services; car washes; catering establishments; commercial kennels; commercial parking lots/garages; composting; data processing facilities; day-care facilities; drive-thru facilities; eating establishments; financial institutions; food manufacturing and processing; freight movers; heavy equipment sales and rentals; heliports; home improvement and furnishing services; indoor amusement and recreation facilities; indoor amusement and recreation facilities; linen suppliers; mail and package handling; manufacturing; marina accessories; maritime sales, meeting facilities; motion picture and television studios; public uses and structures; publishing plants; repair establishments; resource extraction; schools; service stations; storage yards; training, construction, maintenance; truck-terminals; utility installations; warehousing; wholesaling and distribution

Source: City and County of Honolulu, Department of Planning and Permitting; Land Use Ordinance, *Table 21-3 - Master Use Table*, 2007.

Appendix D:
Local Noise Regulations

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CHAPTER 262
AIRPORT ZONING ACT

Section

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§262-1 Definitions. As used in this chapter, unless the context otherwise requires:

"Airport" means any area of land or water designed and set aside for the landing and taking-off of all aircraft and utilized or to be utilized in the interest of the public for such purposes;

"Airport hazard" means any structure or tree which obstructs the air space required for the flight of aircraft in landing or taking-off at an airport, or any use of land which creates a dangerous condition, including the placement of strong lights which blind pilots during such operations;

"Airport hazard area" means any area of land or water upon which an airport hazard might be established if not prevented as provided in this chapter;

"Airport protection" means protection against an airport hazard;

"Department" means the department of transportation;

"Director" means the director of transportation or the director's authorized representative;

"Person" means any individual, partnership, corporation, unincorporated association, joint stock association, or any trustee, receiver, assignee, or other similar representative thereof; or the State or any of its political subdivisions, or agencies thereof;

"Structure" means any object constructed or installed by humans, including, but without limitation, buildings, towers, smokestacks, chimneys, and overhead transmission lines;

"Tree" means any object of natural growth. [L 1965, c 140, pt of §1; Supp, §17A-1; HRS §262-1; gen ch 1985, 1993]

Revision Note

Numeric designations deleted and definitions rearranged.

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§262-2 Airport hazards contrary to public interest. An airport hazard endangers the lives and property of users of an airport and of occupants of land in its vicinity, and in effect reduces the size of the area available for the landing, taking-off, and maneuvering of aircraft, thus tending to destroy or impair the utility of an airport and the public investment therein. Accordingly, it is declared:

(1) That the creation, maintenance, or establishment of an airport hazard is a public nuisance and an injury to the community served by the airport in question; therefore, it is necessary in the interest of the public health, public safety, and general welfare that the creation, maintenance, or establishment of airport hazards be prevented; and

(2) That the prevention of the creation, maintenance, or establishment of airport hazards should be accomplished, to the extent legally possible, by exercise of the police power, without compensation.

It is further declared that both the prevention of the creation, maintenance, or establishment of airport hazards and the elimination, removal, alteration, mitigation, or marking and lighting of existing airport hazards are public purposes. [L 1965, c 140, pt of §1; Supp, §17A-2; HRS §262-2]

Case Notes

Cited: 17 H. 523, 524.

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§262-3 Power to adopt airport zoning regulations. To prevent the creation or establishment of airport hazards, the director of transportation may adopt, amend, repeal, administer, and enforce, under the police power and in the manner and upon the conditions prescribed in this chapter, airport zoning regulations for an airport hazard area in the State, which regulations may divide each area into zones, and, within such zones, specify the land uses permitted and regulate and restrict the height to which structures may be erected and trees allowed to grow, subject to section 262-6. [L 1965, c 140, pt of §1; Supp, §17A-3; HRS §262-3]

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§262-4 Relation to comprehensive zoning regulations. In the event of conflict between any airport zoning regulations adopted under this chapter and any ordinances or other regulations applicable to the same area, whether the conflict be with respect to the height of structures or trees, the use of land, or any other matter, and whether other regulations were adopted by or under the authority of the State or by or under the authority of a county, the more stringent limitation or requirement shall govern and prevail. [L 1965, c 140, pt of §1; Supp, §17A-4; HRS §262-4]

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[§262-4.5] Outdoor lighting. To the extent that it is practical and not in conflict with any safety regulation or federal law, regulation, or mandate, if any airport rule or standard relating to outdoor lighting on any ramp or apron area, roadway, or parking lot conflicts with any county ordinance or other rule regarding outdoor lighting, the more stringent requirement or standard shall govern all new installations of outdoor lighting. [L 2007, c 121, §2]

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§262-5 Procedure for adoption of zoning regulations. (a) The director of transportation shall adopt airport zoning regulations in accordance with chapter 91.

(b) At least ninety days before the public hearing on the initial zoning of any airport hazard area, the director shall notify the appropriate state and county planning agencies and any boards or commissions of a similar nature which may be concerned, and thirty days before the public hearing such agencies, boards, and commissions may file with the director their recommendations as to the boundaries of the various zones to be established and the regulations to be adopted therefor. The director shall give due consideration to recommendations so filed. [L 1965, c 140, pt of §1; Supp, §17A-5; HRS §262-5]

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§262-6 Airport zoning regulations. (a) All airport zoning regulations adopted under this chapter shall have the force and effect of law. The regulations shall be reasonable and none shall impose any requirement or restriction which is not reasonably necessary to effectuate the purposes of this chapter. In determining what regulations the director may adopt, the director of transportation shall consider, among other things, the character of the flying operations expected to be conducted at the airport, the nature of the terrain within the airport hazard area, the character of the neighborhood, and the uses to which the property to be zoned is put and adaptable.

(b) Nonconforming uses. No airport zoning regulations adopted under this chapter shall require the removal, lowering, or other change or alteration of any structure or tree not conforming to the regulations when adopted or amended, or otherwise interfere with the continuance of any nonconforming use, except as provided in section 262-7. [L 1965, c 140, pt of §1; Supp, §17A-6; HRS §262-6; gen ch 1985]

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§262-7 Permits, hazard markings, and lighting. (a) Permits. Any airport zoning regulations adopted under this chapter may require that before any new structure, tree, or use may be constructed, planted, or established, and before any existing use, tree, or structure may be substantially changed, replanted, or substantially altered or repaired, a permit be obtained authorizing such construction, planting, establishment, change, replanting, alteration, or repair. In any event, all the regulations shall provide that before any nonconforming structure or tree may be replaced, substantially altered or repaired, rebuilt, or replanted, a permit must be secured from the department of transportation authorizing the replacement, alteration, repair, rebuilding, or replanting. No permit shall be granted that would allow the establishment, maintenance, or creation of an airport hazard. Except as provided herein, all applications for permits shall be granted.

(b) Hazard markings and lighting. In granting any permit under this section, the director may, if the director deems such action advisable to effectuate the purposes of this chapter and reasonable under the circumstances, so condition such permit as to require the owner of the structure or tree in question to permit the State, at its own expense, to install, operate, and maintain thereon such markers and lights as may be necessary to indicate to operators of aircraft the presence of an airport hazard. [L 1965, c 140, pt of §1; Supp, §17A-7; HRS §262-7; gen ch 1985]

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§262-8 Appeals. Any person aggrieved by any order, requirement, determination, or decision of the director of transportation made in the adoption, amendment, repeal, or administration of airport zoning regulations may appeal the person's grievance to the appropriate circuit court in accordance with chapter 91. [L 1965, c 140, pt of §1; Supp, §17A-8; HRS §262-8; gen ch 1985]

Rules of Court

Appeal to circuit court, see HRCP rule 72.

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§262-9 Application. If the airport zoning regulations adopted under this chapter, although generally reasonable, are finally held to interfere with the use or enjoyment of a particular structure or parcel of land to such an extent as to be in violation of the State Constitution or the Constitution of the United States, the holding shall not affect the application of the regulations to other structures and parcels of land. [L 1965, c 140, pt of §1; Supp, §17A-9; HRS §262-9]

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§262-10 Enforcement and remedies. Any person who wilfully violates section 262-7(a) or any regulations, orders, or rulings promulgated or made pursuant to this chapter, shall for each violation, be fined not more than $1,000 or imprisoned not more than ninety days, or both. In addition the director of transportation may institute, in any court of competent jurisdiction, an action in the name of the State to prevent, restrain, correct, or abate any violation of this chapter, or of airport zoning regulations adopted under this chapter, or of any order or ruling made in connection with their administration or enforcement, and the court shall adjudge to the State such relief, by way of injunction (which may be mandatory) or otherwise, as may be proper under all the facts and circumstances of the case, to effectuate the purposes of this chapter and of the regulations adopted and orders and ruling made pursuant thereto. [L 1965, c 140, pt of §1; Supp, §17A-10; HRS §262-10]

Cross References

Classification of offense and authorized punishment, see §§701-107, 706-640, 663.
Injunction of violation of laws, see §603-23.

Rules of Court

Injunction, see HRCP rule 65.

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§262-11 Acquisition of air rights. When (1) it is desired to remove, lower, or otherwise terminate a nonconforming structure or use; or (2) the approach protection necessary cannot, because of constitutional limitations, be provided by airport zoning regulations under this chapter; or (3) it appears advisable that the necessary approach protection be provided by acquisition of property rights rather than by airport zoning regulations, the director of transportation on behalf of the State may acquire, by purchase, grant, or condemnation in the manner provided by chapter 101, such air right, aviation easement, or other estate or interest in the property or nonconforming structure or use in question as may be necessary or proper to effectuate the purposes of this chapter, including acquisition of a fee simple estate. [L 1965, c 140, pt of §1; Supp, §17A-11; HRS §262-11]

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DEPARTMENT OF TRANSPORTATION

Amendment and Compilation of Chapter 19-12
Hawaii Administrative Rules
May 24, 2007

SUMMARY

1. §19-12-9 is amended.

2. Chapter 19-12 is compiled.

HAWAII ADMINISTRATIVE RULES

TITLE 19

DEPARTMENT OF TRANSPORTATION

SUBTITLE 2

AIRPORTS DIVISION

CHAPTER 12

AIRPORT ZONING

Historical note. This chapter is based substantially on the airport zoning regulations. [Eff 4/21/72; am 4/6/74; R 6/21/81]

§19-12-1 Purpose. These rules shall apply to all public, quasi-public, and military airports, including their airport hazard areas, in the State. These rules do not apply to private airports. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-3)

§19-12-2 Definitions. As used in this chapter, unless the context clearly indicates otherwise:

"Airport" means any area of land or water designed or set aside for the landing and taking-off of all aircraft and utilized or to be utilized in the interest of the public for such purposes.

"Airport hazard" means any structure or tree which obstructs the airspace required for the flight of aircraft in landing or taking-off at an airport, or any use of land which creates a dangerous condition, including the placement of strong lights which blind pilots during such operations.

"Airport hazard area" means any area of land or water upon which an airport hazard might be established if not prevented as provided in chapter 262, Hawaii Revised Statutes.

"Airport protection" means protection against an airport hazard.

"Director" means the director of transportation or his authorized representative.

"Department" means the department of transportation of the State of Hawaii.

"FAA" means the Federal Aviation Administration.

"Height" means distance above ground level, unless otherwise specified.

"Military airport" means an airport owned or operated by the United States Department of Defense or any branch or agency thereof.

"Nonconforming use" means any pre-existing structure or tree, or other use of land which is inconsistent with the provisions of these rules or of chapter 262, Hawaii Revised Statutes.

"Nonprecision instrument runway" means a runway having an existing instrument approach procedure utilizing air navigation facilities with only horizontal guidance, or area type navigation equipment, for which a straight-in nonprecision instrument approach procedure has been approved, or planned, and for which no precision approach facilities are planned, or indicated on a state, FAA, or military service planning document.

"Person" means any individual, partnership, corporation, unincorporated association, joint stock association, or any trustee, receiver, assignee, or other similar representative thereof; or the State or any of its political subdivisions or agencies thereof.

"Precision instrument runway" means a runway having an existing instrument approach procedure utilizing an instrument landing system (ILS), ground controlled approach (GCA), or a precision approach radar (PAR). It also means a runway for which a precision approach system is planned and is so indicated by an approved airport layout plan, a military service approved military airport layout plan, any other State or FAA planning document, or military service military airport planning document.

"Private airport" means an airport owned or operated by a person and not open to the public.

"Public airport" means an airport owned or operated by the State, municipality, county, or other political subdivision or public corporation of the State, and open for the use of the general public.

"Quasi-public airport" means an airport owned or operated by a person and open to the public in part or in whole as evidenced by its use by either aircraft operators or paying passengers carried in privately owned aircraft, operated for hire.

"Rules" means the rules governing airport zoning as set forth in this chapter.

"Runway" means the area of airport designated for the landing and taking-off of aircraft.

"State" means the State of Hawaii.

"Structure" means any object constructed or installed by man, including but not limited to buildings, towers, smokestacks, chimneys, and overhead transmission lines.

"Tree" means any object of natural growth.

"Utility runway" means a runway that is constructed for and intended to be used by propeller driven aircraft of twelve thousand five hundred maximum gross weight and less.

"Visual runway" means a runway intended solely for the operation of aircraft using visual approach procedures, with no straight-in instrument approach procedure and no instrument designation indicated on an approved airport layout plan, a military service approved military airport layout plan, or by a planning document submitted to the FAA by competent authority. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-3)

§19-12-3 Kinds of object affected. These rules shall apply to:

(1) Any object of natural growth, terrain, or permanent or temporary construction or alteration, including equipment or materials used therein, and apparatus of a permanent or temporary character; and

(2) Alteration of any permanent or temporary existing structure by a change in its height (including appurtenances), or lateral dimensions, including equipment or materials used therein. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-6)

§19-12-4 Zones. For the purpose of these rules, the airport hazard areas shall be divided into the following zones:

(1) Horizontal
(2) Conical
(3) Primary
(4) Approach
(5) Transitional
(6) Heliport primary
(7) Heliport approach
(8) Heliport transitional

Each zone shall be the ground area underlying the airport imaginary surface described in §§19-12-5 and 19-12-6, i.e., the horizontal zone shall be the ground area underlying the horizontal surface; the conical zone shall be the ground area underlying the conical surface; etc. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-6)

§19-12-5 Civil airport imaginary surfaces. The following civil airport imaginary surfaces shall be established with relation to the airport and to each runway. The size of each imaginary surface shall be based on the category of each runway according to the type of approach available or planned for that runway. The slope and dimensions of the approach surface applied to each end of a runway shall be determined by the most precise approach existing or planned for that runway end.

(1) Horizontal surface shall be a horizontal plane one hundred fifty feet above the established airport elevation, the perimeter of which shall be constructed by swinging arcs of specified radii from the center of each end of the primary surface of each runway of each airport and connecting the adjacent arcs by lines tangent to those arcs. The radius of each arc shall be:

(A) Five thousand feet for all runways designated as utility or visual;

(B) Ten thousand feet for all other runways. The radius of the arc specified for each end of a runway shall have the same arithmetical value. That value shall be the highest determined for either end of the runway. When a five thousand-foot arc is encompassed by tangents connecting two adjacent ten thousand-foot arcs, the five thousand-foot arc shall be disregarded on the construction of the perimeter of the horizontal surface.

(2) Conical surface shall be a surface extending outward and upward from the periphery of the horizontal surface at a slope of twenty to one for a horizontal distance of four thousand feet.

(3) Primary surface shall be a surface longitudinally centered on a runway. When the runway has a specially prepared hard surface, the primary surface shall extend two hundred feet beyond each end of that runway; but when the runway has no specially prepared hard surface or planned hard surface, the primary surface shall end at each end of that runway. The elevation of any point on the primary surface shall be the same as the elevation of the nearest point on the runway centerline.

The width of a primary surface shall be:

(A) Two hundred fifty feet for utility runways having only visual approaches.

(B) Five hundred feet for utility runways having nonprecision instrument approaches.

(C) For other than utility runways, the width shall be:

(i) Five hundred feet for visual runways having only visual approaches.

(ii) Five hundred feet for nonprecision instrument runways having visibility minimums greater than three-fourths statute mile.

(iii) One thousand feet for a nonprecision instrument runway having a nonprecision instrument approach with a visibility minimum as low as three-fourths of a statute mile, and for precision instrument runways.

The width of the primary surface of a runway shall be that width prescribed in this section for the most precise approach existing or planned for either end of that runway.

(4) Approach surface shall be surface longitudinally centered on the extended runway centerline and extending outward and upward from each end of the primary surface. An approach surface shall be applied to each end of each runway based upon the type of approach available or planned for that runway end.

(A) The inner edge of the approach surface shall be the same width as the primary surface and shall expand uniformly to a width of:

(i) One thousand two hundred fifty feet for that end of a utility runway with only visual approaches;

(ii) One thousand five hundred feet for that end of a runway other than a utility runway with only visual approaches;

(iii) Two thousand feet for that end of utility runway with a nonprecision instrument approach;

(iv) Three thousand five hundred feet for that end of a nonprecision instrument runway other than utility having visibility minimums greater than three-fourths of a statute mile;

(v) Four thousand feet for that end of a nonprecision instrument runway, other than utility, having a nonprecision instrument approach with visibility minimums as low as three-fourths statute mile; and

(vi) Sixteen thousand feet for precision instrument runways.

(B) The approach surface shall extend for a horizontal distance of:

(i) Five thousand feet at a slope of twenty to one for all utility and visual runways;

(ii) Ten thousand feet at a slope of thirty-four to one for all nonprecision instrument runways other than utility; and

(iii) Ten thousand feet at a slope of fifty to one with an additional forty thousand feet at a slope of forty to one for all precision instrument runways.

(C) The outer width of an approach surface to an end of a runway shall be that width prescribed in this paragraph (4) for the most precise approach existing or planned for that runway end.

(5) Transitional surfaces shall extend outward and upward at right angles to the runway centerline and the runway centerline extended at a slope of seven to one from the sides of the primary surface and from the sides of the approach surfaces. Transitional surfaces for those portions of the precise approach surface which project through and beyond the limits of the conical surface shall extend a distance of five thousand feet measured horizontally from the edge of the approach surface and at right

angles to the runway centerline. [Eff 6/12/81; am and comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-6)

§19-12-6 Airport imaginary surfaces for heliports. (a) Heliport primary surface. The area of the primary surface shall coincide in size and shape with the designated take-off and landing area of a heliport. This surface shall be a horizontal plane at the elevation of the established heliport elevation.

(b) Heliport approach surface. The approach surface shall begin at each end of the heliport primary surface, shall have the same width as the primary surface, and shall extend outward and upward at a slope of eight to one for a horizontal distance of four thousand feet where its width is five hundred feet.

(c) Heliport transitional surfaces. These surfaces shall extend outward and upward from the lateral boundaries of the heliport primary surface and from the approach surfaces at a slope of two to one for a distance of two hundred fifty feet measured horizontally from the centerline of the primary and approach surfaces. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-6)

§19-12-7 Height limitations. No structure shall be constructed, erected, altered, or maintained, and no tree shall be maintained in any zone created by these rules to a height which would penetrate the surface established in §§19-12-5 and 19-12-6. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-6)

§19-12-8 Overlapping surfaces. Where any surfaces overlap, the lower or lowest height limitation shall govern and prevail in the overlapped area. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-6)

§19-12-9 Excepted height limitations. Nothing in these rules shall be construed as prohibiting the construction, erection, maintenance, or alteration of any structure, the growth of any tree, or any use below the height limitations established in §19-12-7, provided that it does not violate §19-12-10. [Eff 6/12/81; comp 8/30/97; am and comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-6)

§19-12-10 Use restrictions. Notwithstanding any other provisions of these rules, no use may be made of land within any zone established by these rules or within the vicinity of the zone which would:

(1) Create electrical, electronic, or atmospheric interference with radio communication or landing aids between an airport and an aircraft;

(2) Make it difficult or confusing for operators of aircraft to distinguish between airport lights and non-airport lights;

(3) Result in glare to, or blinding of, the eyes of operators of aircraft approaching or taking-off from an airport; and

(4) Impair visibility in the vicinity of an airport or otherwise endanger the landing, taking-off, or maneuvering of aircraft. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-6)

§19-12-11 Nonconforming uses. (a) Rules not retroactive. These rules shall not be construed to (1) require the removal, lowering, or other change or alteration of any structure or tree or use not conforming to these rules as of the effective date of these rules or as of the effective date of the rules superseded by these rules, or (2) otherwise interfere with the continuance of any such nonconforming use. Nothing contained herein shall require any change of construction, alteration, or intended use of any structure, the construction or alteration of which was begun prior to the effective date of these rules, and which is diligently prosecuted.

(b) Markings and lighting. Notwithstanding the provisions of subsection (a) of this section, the owner of any nonconforming structure or tree or use shall permit the installation, operation, and maintenance thereon of such markers and lights as shall be deemed necessary by the director to indicate to the operators of aircraft in the vicinity of the presence of an airport hazard or of an incompatible land use. These markers and lights shall be installed, operated, and maintained at the expense of the State.

(c) Nonconforming uses abandoned or destroyed. Whenever the director determines that a nonconforming structure, tree, or use has been abandoned or more than fifty percent torn down, physically deteriorated or decayed, that nonconforming structure or tree or use shall not be reconstructed, rehabilitated, replanted, or resumed. [Eff 6/12/81; am and comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-6)

§19-12-12 Permits required. (a) Except as provided in §§19-12-9 and 19-12-13, no substantial change shall be made in the use of land, and no structure shall be erected or altered and no tree shall be planted or otherwise established in any zone described in §19-12-4 unless a permit therefor shall have been applied for and granted by the director. Each application for a permit shall indicate the purpose for which the permit is desired, with sufficient detail to permit a determination of whether the resulting structure or tree would conform to the height limitations established in §19-12-7, or whether the resulting use violates the use restrictions established in §19-12-10. The director shall grant all applications for a permit unless to do so would allow the establishment, maintenance, or creation of an airport hazard.

(b) No permit shall be granted which would allow the establishment, maintenance, or creation of an airport hazard or permit a nonconforming use, structure, or tree to be made or become higher, or become a greater hazard to air navigation, than it was on the effective date of these rules or the rules superseded by these rules.

(c) In granting any application for a permit, the director may, if he deems such action advisable and reasonable in the circumstances, so condition the permit as to require the owner of the structure or tree or the user in question to install, operate, and maintain thereon such markers and lights as may be necessary to indicate to operators or aircraft the presence of an airport hazard. [Eff 6/12/81; am and comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-7)

§19-12-13 <u>Exceptions</u>. (a) In the area lying within the limits of the horizontal zone and the conical zone, no permit shall be required for any tree or structure less than seventy-five feet in height above the ground, except when the tree or structure would extend above the height prescribed for such instrument or noninstrument approach zones in §19-12-7.

(b) In the areas lying within the limits of the transitional zones beyond the perimeter of the horizontal zone, no permit shall be required for any tree or structure less than seventy-five feet of height above the ground, except when the tree or structure, because of terrain, land contour, or topographic features, would extend above the height limit prescribed for such transitional zones in §19-12-7.

(c) Nothing contained in subsections (a) and (b) of this section shall be construed as permitting or intending to permit any construction, erection, maintenance, or alteration of any structure, or the growth of any tree in excess of the height limits established by §19-12-7. [Eff 6/12/81; am and comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-7)

§19-12-14 <u>Application; severability</u>. In any case in which these rules may be finally held to interfere with the use or enjoyment of land to such an extent as to be in violation of the state constitution or the Constitution of the United States, such holding shall not affect the application of these rules to other structures, trees, or parcels of land.

These rules are hereby declared to be severable and if any portion or the application thereof to any person, circumstance, or property is held to be invalid for any reason, the validity of that portion or its application to any other person, circumstance, or property, and the validity of the remainder of these rules, or the application of the remainder to any person, circumstance, or property shall not be affected. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §§262-6, 262-9)

§19-12-15 Enforcement. Enforcement of these rules shall be as set forth in §262-10, Hawaii Revised Statutes. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-10)

§19-12-16 Penalty. Penalties for violation of any of these rules shall be as set forth in §262-10, Hawaii Revised Statutes. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-10)

§19-12-17 Repeal. The airport zoning regulations effective April 21, 1972, and as amended effective April 6, 1974, and all rules relating to airport zoning in effect prior to the effective date of this chapter are repealed. [Eff 6/12/81; comp 8/30/97; comp JUN 18 2007] (Auth: HRS §262-3) (Imp: HRS §262-3)

DEPARTMENT OF TRANSPORTATION

Amendments to and compilation of Chapter 19-12, Hawaii Administrative Rules, on the Summary Page dated May 24, 2007, were adopted on May 24, 2007, following public hearings held on November 28 and 29, 2006, after public notice was given in the Honolulu Star-Bulletin, Maui News, Garden Island and West Hawaii Today on October 10, 2006, and the Hawaii Herald-Tribune on October 12, 2006.

These amendments to and compilation of Chapter 19-12, Hawaii Administrative Rules, shall take effect ten days after filing with the Office of the Lieutenant Governor.

BARRY FUKUNAGA
Director of Transportation

APPROVED:

LINDA LINGLE
Governor
State of Hawaii

Date: JUN - 6 2007

Filed

LIEUTENANT GOVERNOR'S

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2761

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CHAPTER 508D
MANDATORY SELLER DISCLOSURES IN REAL ESTATE TRANSACTIONS

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Sections:

§508D-1 Definitions.
As used in this chapter, unless the context requires otherwise:

"Disclosure statement" means a written statement prepared by the seller or at the seller's direction, that purports to fully and accurately disclose all material facts relating to the residential real property being offered for sale that:

Are within the knowledge or control of the seller;
Can be observed from visible, accessible areas; or
Are required to be disclosed under section 508D-15.

Except for the disclosures required under section 508D-15, no seller shall have any duty to examine any public records when preparing a disclosure statement.

"Material fact" means any fact, defect, or condition, past or present, that would be expected to measurably affect the value to a reasonable person of the residential real property being offered for sale. The disclosure statement shall not be construed as a substitute for any expert inspection, professional advice, or warranty that the buyer may wish to obtain.

"Real estate purchase contract" means a contract, as it may be amended, by which a seller agrees to sell and a buyer agrees to buy residential real property which shall include a deposit, receipt, offer, acceptance, or other similar agreement for the sale or lease with option to buy.

"Residential real property" means fee simple or leasehold real property on which currently is situated:

From one to four dwelling units; or
A residential condominium or cooperative apartment, the primary use of which is occupancy as a residence.

"Sale of residential real property" means the transfer or disposition of residential real property for consideration including, without limitation, a sale by exchange (provided that the transferor to an exchange accommodator but not the exchange accommodator who has acquired the residential real property for tax purposes prior to transfer to the buyer is deemed to be the seller for purposes of this chapter), auction, or lease with option to buy.

[L 1994, c 214, pt of §2; am L 1996, c 161, §1; am L 2001, c 224, §1]

§508D-2 Applicability.
Except as otherwise provided for in this chapter, this chapter applies to any sale of residential real property. The failure of the seller or the seller's agent to comply with this chapter shall not affect the validity of title to any residential real property sold.

[L 1994, c 214, pt of §2; am L 1996, c 161, §2]

§508D-3 Exemptions.
This chapter shall not apply to the following sales of residential real property:

1. Sale to a co-owner;
2. Sale to a spouse, parent, or child of the seller;
3. Sale by devise, descent, or court order;
4. Sale by operation of law, including, but not limited to, any transfer by foreclosure, bankruptcy, or partition, or any transfer to a seller's creditor incident to a deed (or assignment) in lieu of foreclosure, workout, or the settlement or partial settlement of any preexisting obligation of a seller owed a creditor and any later sale of residential real property by such creditor;
5. Sale by a lessor to a lessee resulting from conversion of leased land to fee simple;
6. Initial sale of new residential real property pursuant to chapter 484 under a current public offering statement or chapter 484 exemption;
7. Sales of condominium apartments accompanied by delivery of an unexpired public report; or
8. Sale of time share interests as defined under chapter 514E.

[L 1994, c 214, pt of §2; am L 1995, c 172, §1; am L 1996, c 161, §3; am L 2001, c 224, §2]

§508D-4 Prohibitions on sales of residential real property.
Except as provided in section 508D-3, no seller may sell residential real property unless:

1. Prior to the sale of such residential real property, a disclosure statement is:
    a. Signed and dated by the seller within six months before or ten calendar days after the acceptance of a real estate purchase contract by the buyer; and
    b. Delivered to the buyer as provided in section 508D-5;
    c. The buyer acknowledges receipt of the disclosure statement on the real estate purchase contract or in any addendum attached to the contract, or in a separate document; and
    d. The buyer is afforded the opportunity to examine the disclosure statement as provided in section 508D-5.

[L 1994, c 214, pt of §2; am L 1996, c 161, §4]

§508D-5 Delivery of disclosure statement to buyer; procedures.
No later than ten calendar days from acceptance of a real estate purchase contract, the seller, either directly or through the seller's agent, shall provide the disclosure statement to the buyer.

Upon receipt of the disclosure statement, the buyer shall have fifteen calendar days to:

1. Examine the disclosure statement; and
2. Decide whether to rescind the real estate purchase contract.

If the buyer decides to rescind the real estate purchase contract, the buyer shall deliver to the seller directly or through the seller's agent within the fifteen-day period written notification of the buyer's decision to rescind the real estate purchase contract. Failure to deliver the written notification to the seller within the fifteen-day period shall be deemed an acceptance of the disclosure statement. Any rescission made pursuant to this subsection shall be without loss of deposits to the buyer which deposits shall be immediately returned to the buyer.

The seller and buyer may agree in writing to reduce or extend the time period provided for the delivery or examination and rescission period. The form of the receipt for the disclosure statement required by section 508D-4(2) shall provide that the buyer shall have the right to examine the disclosure statement and to rescind the real estate purchase contract in accordance with this section.

[L 1994, c 214, pt of §2; am L 1996, c 161, §5]

§508D-6 Later discovered inaccurate information.
Prior to closing the real estate purchase contract, a buyer who receives a disclosure statement that fails to disclose a material fact or contains an inaccurate assertion that directly, substantially, and adversely affects the value of the residential real property, and who was not aware of the foregoing failure or inaccuracy, may elect in writing to rescind the real estate purchase contract within fifteen calendar days of the earlier to occur of:

1. The discovery of the failure or inaccuracy; or
2. The receipt of an amended disclosure statement correcting the failure or inaccuracy, in the manner provided by section 508D-5(b) or (c).

The buyer's right to rescind the real estate purchase contract under this section shall not apply if the sale of the residential real property has been recorded; provided that the buyer may pursue all additional remedies provided by law.

[L 1994, c 214, pt of §2; am L 1996, c 161, §6; am L 2001, c 224, §3]

§508D-7 Seller's agent's duties and responsibilities for disclosure.
Any person or entity acting in the capacity of an escrow agent for the sale of residential real property subject to this chapter, shall not be deemed the agent of the seller or buyer for purposes of the disclosure requirements of this chapter unless the seller or buyer and the escrow agent agree in writing to the establishment of the agency for such purpose.

When a seller's agent cannot obtain the disclosure statement and does not have written assurances from the buyer that the disclosure statement was received, the seller's agent shall notify the buyer in writing of the buyer's rights to the disclosure statement and rights of rescission provided by this chapter. However, the seller's agent shall not be required to prepare the disclosure statement. The seller's agent responsible for delivering the disclosure statement, or the aforesaid written notification of the buyer's rights if applicable, shall maintain a record of the action taken by that agent to effect compliance.

If the seller's agent is or becomes aware of any material facts inconsistent with or contradictory to the disclosure statement or the inspection report of a third party provided by the seller, the seller's agent shall disclose these facts to the seller, the buyer, and the buyer's agent. Nothing in this chapter precludes all other obligations of the seller's or the buyer's agent under Hawaii law.

[L 1994, c 214, pt of §2; am L 1996, c 161, §7; am L 2001, c 224, §4]

§508D-8 Excluded facts from the disclosure statement.
Except as otherwise provided by law, the fact that:

1. An occupant of the residential real property was afflicted with acquired immune deficiency syndrome (AIDS) or AIDS related complex, or had been tested for human immunodeficiency virus; or
2. The residential real property was the site of an act or occurrence that had no effect on the physical structure or the physical environment of the residential real property, or the improvements located on the residential real property;may be excluded from the disclosure statement. This information shall not be deemed a material fact for purposes of the disclosure statement.

[L 1994, c 214, pt of §2; am L 1996, c 161, §8]

§508D-9 Good faith and due care in preparing the disclosure statement.
A seller or the seller's agent shall prepare the disclosure statement in good faith and with due care. A buyer shall have no cause of action against a seller or seller's agent for, arising out of, or relating to the providing of a disclosure statement when the disclosure statement is prepared in good faith and with due care. For purposes of this section, "in good faith and with due care" includes honesty in fact in the investigation, research, and preparation of the disclosure statement and may include information on the following:

1. Facts based on only the seller's personal knowledge;
2. Facts provided to the seller by governmental agencies and departments;
3. Existing reports prepared for the seller by third-party consultants, including without limitation a:
    a. Licensed engineer;
    b. Land surveyor;
    c. Geologist;
    d. Wood-destroying insect control expert; or

e.Contractor, or other home inspection expert; dealing with matters within the scope of the professional's license or expertise for the purpose of the disclosure statement; and
f.Facts provided to the seller by a managing agent of a homeowner's association, including without limitation, a condominium, cooperative, or community association.

Notwithstanding this subsection, a seller or seller's agent shall be under no obligation to engage the services of any person in the investigation, research, or preparation of the disclosure statement. The failure to engage the services of any such person for this purpose shall not be deemed an absence of good faith or due care by the seller or the seller's agent in the investigation, research, or preparation of the disclosure statement.

The representations contained in the disclosure statement shall be construed to be made only to, and for the benefit of, the buyer and shall be deemed accurate only as to the time when made, except as otherwise provided in section 508D-13.

[L 1994, c 214, pt of §2; am L 1996, c 161, §9; am L 2001, c 224, §5]

§508D-11 Disclosure form.
In addition to the other information required by this chapter, the form for the disclosure statement shall include the following:

1.A notice to the buyer that the buyer may wish to obtain professional advice and inspections of the residential real property;
2.A notice to the buyer that the information contained in the disclosure statement is the representation of the seller and not the representation of the seller's agent (except as to those representations, if any, specifically identified as being made by the seller's agent and not by the seller); and
3.A notice of the buyer's rescission rights pursuant to this chapter.

[L 1994, c 214, pt of §2; am L 1996, c 161, §11; am L 2001, c 224, §6]

§508D-12 Indication of receipt of disclosure statement.
The buyer shall indicate receipt of the seller's disclosure statement on the real estate purchase contract, or in any addendum attached to the contract, or in a separate document.

Receipts taken for the disclosure statement shall be kept on file in possession of the seller or seller's agent for a period of three years from the date the receipt was taken.

[L 1994, c 214, pt of §2; am L 1996, c 161, §12]

§508D-13 Later material facts.
Information in a disclosure statement that has not been disclosed or becomes inaccurate regarding a material fact as a result of an act, agreement, or occurrence (or otherwise becomes known to seller) after the statement is provided to the buyer does not violate this chapter. However, if such information directly, substantially, and adversely affects the value of the residential real property, the seller shall provide an amended disclosure statement to the buyer disclosing the material fact within ten calendar days after the seller's discovery of such information if the seller discovers such information prior to the recorded sale of the residential real property, and in any event, no later than twelve noon of the last business day prior to the recorded sale of the real property. The buyer shall have fifteen calendar days to examine the amended disclosure statement and, if the buyer was not already aware of such information, to rescind the real estate purchase contract in accordance with section 508D-5(b) or (c). The buyer's right to rescind the real estate purchase contract under this section shall not apply if the sale of the residential real property has been recorded; provided that the buyer may pursue all additional remedies provided by law.

[L 1994, c 214, pt of §2; am L 1995, c 108, §2; am L 1996, c 161, §13; am L 2001, c 224, pt of §7]

§508D-14 Additional disclosure requirements.
The requirements of this chapter are in addition to all other disclosure obligations of the seller required by law relating to the sale of residential real property.

[L 1994, c 214, pt of §2; am L 1996, c 161, §14; am L 2001, c 224, pt of §7]

§508D-15 Notification required; ambiguity.
When residential real property lies:

1.Within the boundaries of a special flood hazard area as officially designated on Flood Insurance Administration maps promulgated by the United States Department of

Housing and Urban Development for the purposes of determining eligibility for emergency flood insurance programs;
2.Within the boundaries of the noise exposure area shown on maps prepared by the department of transportation in accordance with Federal Aviation Regulation Part 150-Airport Noise Compatibility Planning (14 Code of Federal Regulations Part 150) for any public airport;
3.Within the boundaries of the Air Installation Compatibility Use Zone of any Air Force, Army, Navy, or Marine Corps airport as officially designated by military authorities; or
4.Within the anticipated inundation areas designated on the department of defense's civil defense tsunami inundation maps; subject to the availability of maps that designate the four areas by tax map key (zone, section, parcel), the seller shall include such material fact information in the disclosure statement provided to the buyer subject to this chapter. Each county shall provide, where available, maps of its jurisdiction detailing the four designated areas specified in this subsection. The maps shall identify the properties situated within the four designated areas by tax map key number (zone, section, parcel) and shall be of a size sufficient to provide information necessary to serve the purposes of this section. Each county shall provide legible copies of the maps and may charge a reasonable copying fee.

When it is questionable whether residential real property lies within any of the designated areas referred to in subsection (a) due to the inherent ambiguity of boundary lines drawn on maps of large scale, the ambiguity shall be construed in favor of the seller; provided that a good faith effort has been made to determine the applicability of subsection (a) to the subject real property.

Except as required under subsections (a) and (b), the seller shall have no duty to examine any public record when preparing a disclosure statement.

[L 1994, c 214, pt of §2; am L 1996, c 161, §15; am L 2001, c 224, pt of §7]

§508D-16 Remedies; voidable contracts.
A buyer may elect to complete the purchase of residential real property even if the seller fails to comply with the requirements of this chapter. After recordation of the sale of residential real property, a buyer shall have no right under this chapter to rescind the real estate purchase contract despite the seller's failure to comply with the requirements of this chapter.

When the buyer is provided a disclosure statement prepared and delivered in accordance with this chapter and the buyer decides to rescind the real estate purchase contract, the buyer shall not be entitled to any damages but shall be entitled to the immediate return of all deposits.

In addition to the rights of rescission granted to the buyer under this chapter, when the seller negligently fails to provide the disclosure statement required by this chapter, the seller shall be liable to the buyer for the amount of the actual damages, if any, suffered as a result of the seller's negligence.

In addition to the remedies allowed under subsection (b) or (c), a court may also award the prevailing party attorney's fees, court costs, and administrative fees.

[L 1994, c 214, pt of §2; am L 1996, c 161, §16]

§508D-16.5 Rescission.
Notwithstanding anything to the contrary in this chapter, any action for rescission brought under this chapter shall commence prior to the recorded sale of the real property.

[L 1995, c 108, §1]

§508D-17 Limitation of actions.
Any action brought under this chapter shall commence within two years from the date the buyer received the disclosure statement; provided that if no disclosure statement was delivered to the buyer, then the action shall commence within two years of the recorded sale of the residential real property.

This chapter supersedes all other laws relating to the time for commencement of actions for failure to make the disclosures required by this chapter.

[L 1994, c 214, pt of §2; am L 1996, c 161, §17]

§508D-18 Alternative dispute resolution.
If the real estate purchase contract provides for alternative dispute resolution, then prior to filing an action in any court to enforce this chapter, a seller or buyer shall first submit the claim to alternative dispute resolution as required in the real estate purchase contract.

[L 1994, c 214, pt of §2; am L 1996, c 161, §18]

§508D-19 Severability.
If any provision of this chapter, or the application thereof to any person or circumstance is held invalid, the invalidity shall not affect other provisions or applications that can be given effect without the invalid provision or application, and to this end the provisions of this chapter are severable.

[L 1994, c 214, pt of §2]

SELLER'S REAL PROPERTY DISCLOSURE STATEMENT
Hawaii Association of Realtors® Standard Form
Revised 4/07 (NC) For Release 11/07

Hawai'i Association of REALTORS®

REALTOR®

Information Obtained from Public Records
(May Be Completed by Listing Broker)

Seller(s) Name(s) (All on Title): ____________________
Property Reference or address: ____________________
Tax Map Key: Div. ________ /Zone ________ /Sec. ________ /Plat ________ /Parcel ________ /CPR ________ (if applicable).
County Zoning: ________ State Land Use Designation: ________ [ ] Fee Simple [ ] Leasehold
Licensee: ____________________ Brokerage Firm: ____________________

Purpose of Disclosure Statement: Pursuant to Hawaii Revised Statutes, Chapter 508D (for residential real property), and under common law (for all other real estate transactions, including the sale of vacant land) a seller of residential real property is obligated to fully and accurately disclose in writing to a buyer all "material facts" concerning the property. "Material facts" are defined as "any fact, defect, or condition, past or present, that would be expected to measurably affect the value to a reasonable person of the residential real property being offered for sale." This Disclosure Statement is intended to assist Seller in organizing and presenting all material facts concerning the Property. It is very important that Seller exercise due care in preparing responses to questions posed in the Disclosure Statement, and that all responses are made in good faith, are truthful and complete to the best of Seller's knowledge. Seller's agent, Buyer and Buyer's agent may rely upon Seller's disclosures. SELLER MAY WISH TO OBTAIN PROFESSIONAL ADVICE AND/OR HAVE AN EXPERT INSPECT PROPERTY PRIOR TO PREPARING DISCLOSURE.

MUST BE COMPLETED BY SELLER ONLY

Seller's Statement: This is a statement concerning information relating to the condition of Property that: (i) is within the knowledge or control of Seller; (ii) can be observed from visible, accessible areas; or (iii) which is required by Section 508D-4.5 and 508D-15, Hawaii Revised Statutes. Seller may not be aware of problems affecting Property, and there may be material facts of which Seller is not aware that qualified experts may be able to discover or time may reveal. Unless Buyer has been otherwise specifically advised, Seller has not conducted any inspections of generally inaccessible areas of Property. BUYER SHOULD TAKE CARE TO PROTECT BUYER'S OWN INTEREST BY OBTAINING PROFESSIONAL ADVICE AND BY CONDUCTING THOROUGH INSPECTIONS AND OBTAINING EXPERT HELP IN EVALUATING PROPERTY AND BY OBTAINING BUYER'S OWN PUBLIC RECORDS. The statements made below are made by Seller and are not statements or representations of Seller's agent. The Disclosure Statement and the disclosures made by Seller are provided exclusively to Buyers involved in this transaction only, and do not apply to any subsequent sales not involving this Seller.

THIS DISCLOSURE STATEMENT IS NOT A WARRANTY OF ANY KIND BY SELLER OR BY ANY AGENT REPRESENTING SELLER AND IS NOT A SUBSTITUTE FOR ANY EXPERT INSPECTION, PROFESSIONAL ADVICE, OR WARRANTY THAT BUYER MAY WISH TO OBTAIN.

If not owner occupied, date of Seller's last visit ____________________.

Instructions to Seller: (1) Answer ALL questions. (2) Explain all material facts known to you. (3) If additional space is needed in Section I, attach new pages and sign at the bottom. (4) Each dwelling/structure shall have its own Disclosure. (5) NTMK means NOT TO MY KNOWLEDGE. (6) NA means NOT APPLICABLE and cannot be answered by "Yes," "No" or "NTMK."

A. ITEMS: Check items listed below if you are aware of any current or past defects/malfunctions or major repairs. If checked, use the same number and describe in Section I.

(1) [ ] Appliances	(12) [ ] Fire Sprinkler System	(23) [ ] Smoke Detectors
(2) [ ] Bathtubs/Showers/Basins/Toilets	(13) [ ] Fireplace/Chimney	(24) [ ] Solar/Water/Electric Systems
(3) [ ] Ceilings	(14) [ ] Floors/Floor Coverings	(25) [ ] Spa
(4) [ ] Ceiling Fans	(15) [ ] Foundations/Slabs	(26) [ ] Swimming Pool
(5) [ ] Central Vacuum Systems	(16) [ ] Gutters	(27) [ ] Walkways
(6) [ ] Counters/Cabinets	(17) [ ] Heating/Ventilating/Cooling	(28) [ ] Walls Exterior
(7) [ ] Decking/Railings/Lanai	(18) [ ] Lawn Sprinkler System	(29) [ ] Walls Interior
(8) [ ] Doors/Door Bells/Garage Door	(19) [ ] Plumbing	(30) [ ] Water Features
(9) [ ] Driveways	(20) [ ] Roofs	(31) [ ] Water Heater
(10) [ ] Electric Outlets/Switches/Lights	(21) [ ] Security Systems	(32) [ ] Windows/Jalousies/Skylights
(11) [ ] Fences/Perimeter Walls	(22) [ ] Sinks/Faucets	(33) [ ] Other ________

B. GENERAL: Do any of the following conditions exist? If "yes", use the same number and describe in Section I.

	YES	NO	NTMK	NA	
34)	[ ]	[ ]	[ ]	[ ]	Does any other party have an unrecorded interest in this Property and/or a say in its disposition?
35)	[ ]	[ ]	[ ]	[ ]	Are there any lawsuits or foreclosure actions affecting this Property?
36)	[ ]	[ ]	[ ]	[ ]	Are there any easements affecting this Property?
37)	[ ]	[ ]	[ ]	[ ]	Are there any roadways, driveways, walls, fences, and/or other improvements which are shared with adjoining land owners?
38)	[ ]	[ ]	[ ]	[ ]	Are there any known encroachments?
39)	[ ]	[ ]	[ ]	[ ]	Are there any written agreements concerning items 36, 37 or 38?
40)	[ ]	[ ]	[ ]	[ ]	Have there ever been substances, materials, or products which may be an environmental hazard such as, but not limited to, asbestos, formaldehyde, radon gas, lead-based paint, fuel or chemical storage tanks, contaminated soil or water?
41)	[ ]	[ ]	[ ]	[ ]	Is there filled land on this Property?
42)	[ ]	[ ]	[ ]	[ ]	Has there ever been any settling or slippage, sliding, subsidence, or other soil problem?
43)	[ ]	[ ]	[ ]	[ ]	Has there ever been any drainage, water infiltration, seepage, flooding, or grading problems?
44)	[ ]	[ ]	[ ]	[ ]	Are there any violations of government regulations/ordinances related to this Property?
44a)	[ ]	[ ]	[ ]	[ ]	(a) Are there any zoning or setback violations and/or citations?
44b)	[ ]	[ ]	[ ]	[ ]	(b) Are there any nonconforming uses or restrictions on rebuilding?
45)	[ ]	[ ]	[ ]	[ ]	Are there any violations of existing land leases?
46)	[ ]	[ ]	[ ]	[ ]	Is this Property subject to Covenants, Conditions and Restrictions (CC&Rs)?
46a)	[ ]	[ ]	[ ]	[ ]	(a) Are there any violations of the Covenants, Conditions and Restrictions covering this Property?
47)	[ ]	[ ]	[ ]	[ ]	Are there any rental, lease or license agreements affecting this Property?
47a)	[ ]	[ ]	[ ]	[ ]	(a) Are there any violations of the rental, lease or license agreements?
48)	[ ]	[ ]	[ ]	[ ]	Has there been any sign of, or are you aware of any pest problems (e.g., roaches, fleas, ticks, ants, rats, etc.)?
49)	[ ]	[ ]	[ ]	[ ]	Is there any damage caused by tree roots?
50)	[ ]	[ ]	[ ]	[ ]	Is the Property located in a Special Management Area?
51)	[ ]	[ ]	[ ]	[ ]	Is this Property located in a geothermal subzone or near a geothermal facility?
52)	[ ]	[ ]	[ ]	[ ]	Is the Property located in a tsunami (tidal wave) inundation area and/or flood zone?
53)	[ ]	[ ]	[ ]	[ ]	Is the Property located in volcanic hazard Zone 1 or 2? (Only applicable to Island of Hawaii)
54)	[ ]	[ ]	[ ]	[ ]	Is there any existing or past damage to this Property or any of the structures from earthquake, fire, flooding, landslides, falling rocks, tsunami, volcanic activity, or wind?
55)	[ ]	[ ]	[ ]	[ ]	Is this Property subject to excessive air pollution? (e.g., "VOG")
56)	[ ]	[ ]	[ ]	[ ]	Are you aware of any adverse conditions existing in this general neighborhood/area (e.g., pesticides, soil problems, irrigation, odors, etc.)?
57)	[ ]	[ ]	[ ]	[ ]	Is this Property located in an aircraft path and/or does it experience regular excessive aircraft noise?
58)	[ ]	[ ]	[ ]	[ ]	Is this Property exposed to other types of recurring excessive noise (e.g., night club, school, coqui frogs etc.)?
59)	[ ]	[ ]	[ ]	[ ]	Are there any additional material facts you should disclose regarding this Property or neighborhood (e.g., history of homicide, felony, or suicide, pending development in the area, road widening projects, zoning changes; etc.)?
60)	[ ]	[ ]	[ ]	[ ]	Is this Property located within the boundaries of the Air Installation Compatibility Use Zone of any Air Force, Army, Navy, or Marine Corps airport as officially designated by military authorities?
61)	[ ]	[ ]	[ ]	[ ]	Are you aware of the presence of or removal of unexploded military ordnance in this general area?
62)	[ ]	[ ]	[ ]	[ ]	Is access to this Property restricted?
	→				[ ] Public [ ] Private Road [ ] By easement

C. IMPROVEMENTS: Do any of the following conditions exist? If "yes", use the same number and describe in Section I.

	YES	NO	NTMK	NA	
63)	[ ]	[ ]	[ ]	[ ]	Has there ever been any sign of mold, mildew and/or fungus?
64)	[ ]	[ ]	[ ]	[ ]	Were the original improvements or any additions, structural modifications, or alterations built without building permits?
65)	[ ]	[ ]	[ ]	[ ]	Were any of the building permits not finalized (closed) by the permitting agency?
66)	[ ]	[ ]	[ ]	[ ]	Were any of the improvements to this Property built under an owner-builder permit?
66a)	→				(a) Date of Completion of the improvements covered under the owner-builder permit: ______________
67)	[ ]	[ ]	[ ]	[ ]	Is the Seller/Builder a licensed contractor who is providing warranties?
68)	[ ]	[ ]	[ ]	[ ]	Have you given any release or waiver of liability, or release from a warranty to any government agency, contractor, engineer, architect, land surveyor, or landscape architect, for any defect, mistake, or omission in the design or construction of this Property?
69)	[ ]	[ ]	[ ]	[ ]	Has the roof been repaired or replaced?
69a)	→				(a) When and by whom? ______________
69b)	→				(b) What is the age of the roof? ______________
69c)	[ ]	[ ]	[ ]	[ ]	(c) Are there any transferable warranties? List dates of expiration: ______________

______________ BUYER'S INITIALS

______________ SELLER'S INITIALS & DATE

	YES	NO	NTMK	NA	
70)	[ ]	[ ]	[ ]	[ ]	Is there any presence of wood destroying organisms (e.g., termites, powder post beetles, dry rot, carpenter ants, etc.) in the improvements?
70a)	[ ]	[ ]	[ ]	[ ]	(a) Is there any known damage to the improvements caused by wood destroying organisms?
70b)	[ ]	[ ]	[ ]	[ ]	(b) Has the problem been treated?
70c)	[ ]	[ ]	[ ]	[ ]	(c) Has the damage been repaired?
71)	[ ]	[ ]	[ ]	[ ]	Has there been any termite treatment? List type and date. ______
71a)	[ ]	[ ]	[ ]	[ ]	(a) Are there any warranties? List type and expiration dates. ______
72)	[ ]	[ ]	[ ]	[ ]	Is there any structural damage due to dry rot or other wood destroying organisms?

D. ASSOCIATIONS: Do any of the following conditions exist? If "yes", use the same number and describe in Section I.

	YES	NO	NTMK	NA	
73)	[ ]	[ ]	[ ]	[ ]	Is this Property part of a Condominium Property Regime (CPR)?
74)	[ ]	[ ]	[ ]	[ ]	Are there any "common area" facilities (such as pools, tennis courts, walkways, or other areas) co-owned in undivided interest with others?
75)	[ ]	[ ]	[ ]	[ ]	Is this Property subject to a Homeowners' and/or Community Association?
75a)	[ ]	[ ]	[ ]	[ ]	(a) If yes, what are the fees and payments? ______
75b)	[ ]	[ ]	[ ]	[ ]	(b) Has your Association notified you of future maintenance fee increases, special assessments, and/or association loans?
75c)	[ ]	[ ]	[ ]	[ ]	(c) Is membership mandatory?

E. UTILITIES:

76) What is your source of water supply?
a) [ ] Public [ ] Private
Is this Property separately metered? [ ] Yes [ ] No
Is this a submeter? [ ] Yes [ ] No
Is there a shared water supply? [ ] Yes [ ] No
b) [ ] Catchment: Tank type ______ Capacity ______ Age ______ Condition ______
c) [ ] Other ______
Describe existing problems in Section I.

77) What type of waste water/sewage system do you have?
[ ] Public Sewer [ ] Private Sewer [ ] Connected? If not, is connection currently required? [ ] Yes [ ] No
[ ] Cesspool [ ] Septic System [ ] Individual Sewage Treatment Plant Location ______
Last Pumped ______ How Often? ______
Does the cesspool serve more than one dwelling or living unit, including "ohana" homes? (A "dwelling" or "living unit" is defined as having its own kitchen/food preparation area, bathroom and sleeping/living area.) [ ] Yes [ ] No
Describe existing problems in Section I.

78) What is your source of electrical power?
[ ] Public [ ] Other: ______
a) Is the Property subject to Special Subdivision Project Provision (SSPP) connection fees? [ ] Yes [ ] No

79) Propane Gas: [ ] Piped [ ] Tank [ ] None
80) Telephone Service: [ ] Yes [ ] No [ ] Only party line
81) Television Cable Service: [ ] Yes [ ] No [ ] Not available
82) Broadband Internet [ ] DSL [ ] Cable [ ] None
Describe existing problems in Section I.

F. CONDO SPECIFIC: Do any of the following conditions exist? If "yes", use the same number and describe in Section I.

	YES	NO	NTMK	NA	
83)	[ ]	[ ]	[ ]	[ ]	Do you have knowledge of any parking problems for your apartment?
84)	[ ]	[ ]	[ ]	[ ]	Do you have assigned and/or deeded storage space outside of your apartment?
85)	[ ]	[ ]	[ ]	[ ]	Were additions, modifications, and/or alterations made to your Property without obtaining required association approval?
86)	[ ]	[ ]	[ ]	[ ]	Are there restrictions on pets?
87)	[ ]	[ ]	[ ]	[ ]	Is your dwelling sprinklered for fire protection?
88)	[ ]	[ ]	[ ]	[ ]	Do you have any leaks or water damage in or to your Property?
89)	[ ]	[ ]	[ ]	[ ]	Has there been any leakage or water penetration from apartments above or adjacent to your apartment or leakage or water penetration to apartments below your apartment?

______ BUYER'S INITIALS ______ SELLER'S INITIALS & DATE

G. PLANNED COMMUNITIES: Hawaii law requires that if the Property being offered for sale is in a Planned Community, "disclosure statement" includes the Planned Community declaration and association documents as those terms are defined in Section 421J-2, Hawaii Revised Statutes.

YES NO NA

90)[ ] [ ] [ ] Are the Planned Community declaration and association documents attached to this Disclosure Statement?

H. FURTHER CONDO NOTICES TO BUYER:

UNIT MODIFICATIONS & LANAI ENCLOSURES: If Buyer is contemplating enclosing a lanai or making other modifications to this Property, an attorney, architect or other professionals knowledgeable in such matters should be consulted first. Obtaining permission to make enclosures or other modifications may involve more than approval by the Association's Board of Directors. Approval may be complex and may require approval from the City & County Building Department.

RESERVE STUDY: State law requires certain common interest properties to perform a study and make projections of upcoming maintenance expenses for the common elements. The Association must set aside appropriate reserves for those needs. Currently, there is no standardized reserve study. Some studies are very short and simple, while others are long and complex. Some properties may have a summary of the reserve study. It is recommended that Buyer obtain a copy of the summary of the reserve study or if unavailable, the reserve study. Buyer should read the information and seek the guidance of an attorney, accountant and/or other competent professionals to analyze its contents.

I. Question Number and Explanation: ______________________________

Under Hawaii law, unless otherwise agreed in the Purchase Contract, Buyer shall have fifteen (15) calendar days from the date of receiving the Disclosure Statement to examine the Disclosure Statement and to rescind the Purchase Contract. Such rescission must be made in writing and provided to Seller directly or Seller's agent. If timely written notice is provided, then all deposits made by Buyer shall be immediately returned to Buyer.

Seller gives permission to any Broker to provide this statement to any Buyer whose identity has been made known to Seller, a lending institution, or the escrow company involved in the transaction between the parties.

SELLER DATE SELLER DATE

NOTE: THERE IS NO WARRANTY ON PLAIN LANGUAGE. An effort has been made to put this agreement into plain language. But there is no promise that it is in plain language. In legal terms, THERE IS NO WARRANTY, EXPRESSED OR IMPLIED, THAT THIS AGREEMENT COMPLIES WITH CHAPTER 487A OF THE HAWAII REVISED STATUTES, AS AMENDED. This means that the Hawaii Association of REALTORS® is not liable to any Buyer, Seller, or other person who uses this form for any damages or penalty because of any violation of Chapter 487A. People are cautioned to see their own attorneys about Chapter 487A (and other laws that may apply).

BUYER'S INITIALS

RECEIPT OF REAL PROPERTY DISCLOSURE STATEMENT

Hawaii Association of Realtors® Standard Form

Revised 4/07 (NC) For Release 11/07

Property Reference or Address: ____

Tax Map Key: Div. ________ /Zone _______ /Sec. _______ /Plat _______ /Parcel _______ /CPR _______ (if applicable).

Hawaii law, including Hawaii Revised Statutes ("HRS") Chapter 467 (Real Estate Brokers & Salespersons Licensing Laws), HRS Chapter 480 (Consumer Protection), HRS Chapter 508D (Seller's Disclosure Law, when applicable); and the National Association of REALTORS® Code of Ethics require the disclosure of information relating to the condition of the Property with respect to any past or present material facts, defects, and/or conditions.

By signing below, Buyer hereby acknowledges and agrees that Buyer has received a copy of Seller's Disclosure Statement for the above referenced property dated: ______________________________ and prepared by: ______________________________________ .

(The Disclosure Statement provided must be signed and dated by Seller within six (6) months before or ten (10) calendar days after the acceptance of the Purchase Contract.)

Buyer further understands that:

1. The Disclosure Statement was prepared in good faith and with due care by Seller. Buyer may wish to obtain professional advice and/or inspections on the Property within the time frames of the Purchase Contract as agreed to by Buyer and Seller. Unless Buyer has been otherwise advised, Seller has not conducted any inspection of generally inaccessible areas of the Property. There may be material facts of which Seller is not aware which qualified experts may be able to discover or latent or hidden defects which time may reveal. The disclosures made by Seller are provided exclusively to Buyer involved in this Purchase Contract and does not apply to any subsequent sales *not* involving this Seller.

2. Responses cannot be considered to be substitutes for a careful inspection of the Property by Buyer and/or any inspections which Buyer may choose to obtain.

3. If "NTMK" is marked in response to any questions, Buyer recognizes that this does not mean there may not be a defect which an expert could discover or the passage of time would reveal. Likewise, Buyer recognizes that a problem may be more serious than Seller/Inspector knows.

4. This Disclosure Statement is not a warranty of any kind by Seller or by any agent representing Seller.

5. Unless otherwise agreed in the Purchase Contract, as provided in HRS section 508D-5(b)(2), Buyer shall have fifteen (15) calendar days from the date of receiving the Disclosure Statement to rescind the Offer to purchase the Property. Such rescission must be made in writing and provided to Seller or Seller's Agent. If timely written notice is provided, then all deposits made by Buyer shall be immediately returned to Buyer.

6. Hawaii law requires that Buyer shall sign a receipt of the Seller's Disclosure Statement, which Buyer shall provide to Seller. Seller or Seller's agent shall retain said receipt for a period of three years.

Buyer	Date	Buyer	Date

NOTE: THERE IS NO WARRANTY ON PLAIN LANGUAGE. An effort has been made to put this agreement into plain language. But there is no promise that it is in plain language. In legal terms, THERE IS NO WARRANTY, EXPRESSED OR IMPLIED, THAT THIS AGREEMENT COMPLIES WITH CHAPTER 487A OF THE HAWAII REVISED STATUTES, AS AMENDED. This means that the Hawaii Association of REALTORS® is not liable to any Buyer, Seller, or other person who uses this form for any damages or penalty because of any violation of Chapter 487A. People are cautioned to see their own attorneys about Chapter 487A (and other laws that may apply).

Appendix E:
Endorsement Letters

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UNITED STATES MARINE CORPS
MARINE CORPS BASE HAWAII
BOX 63002 KANEOHE BAY HAWAII 96863-3002

IN REPLY REFER TO:
5080
SP&E
11 SEP 2015

From: Commanding Officer, Marine Corps Base Hawaii
To: Commander, Marine Corps Installations Command
Via: Commanding General, Marine Corps Installation Pacific

Subj: AIR INSTALLATION COMPATIBLE USE ZONE DOCUMENT FOR MARINE CORPS BASE HAWAII

Ref: (a) MCO 11010.16, Air Installations Compatible Use Zones (AICUZ) Program

Encl: (1) Pre-Final AICUZ Study Update dated Aug 2015

1. The Marine Corps Base (MCB) Hawaii AICUZ Study Update has been completed in accordance with the reference and is forwarded per the enclosure for Marine Corps Installations Command approval.

2. The point of contact for this issue at MCB Hawaii is Tiffany Patrick, (808) 257-8815 or e-mail at tiffany.patrick@usmc.mil.

S. C. KILLEEN

UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS COMMAND
3000 MARINE CORPS PENTAGON
WASHINGTON, DC 20350-3000

IN REPLY REFER TO:
11010
G-7

MAR 21 2016

From: Commander, Marine Corps Installations Command
To: Commanding Officer, Marine Corps Base Hawaii
Via: Commanding General, Marine Corps Installations Command - Pacific

Subj: AIR INSTALLATION COMPATIBLE USE ZONE DOCUMENT FOR MARINE CORPS BASE HAWAII

Ref: (a) AICUZ Study Update, MCB Hawaii Kaneohe Bay, November 2015

1. The Air Installation Compatible Use Zone (AICUZ) Study Update for Marine Corps Base (MCB) Hawaii, as presented by the reference, is approved for implementation.

2. This study is a result of extensive analysis of all known methods to ensure that development of surrounding lands will be compatible with the potential noise and safety hazards associated with aircraft operations at MCB Hawaii Kaneohe Bay.

3. Public distribution of this document is appropriate.

4. My point of contact for this matter is Mr. Tom Ruffini, AC/S G-7 at 571-256-7258, or thomas.ruffini@usmc.mil.

C. L. HUDSON

UNITED STATES MARINE CORPS
MARINE CORPS INSTALLATIONS PACIFIC
UNIT 35001
FPO AP 96373-5001

IN REPLY REFER TO:
5080
CGOF
15 Oct 15

FIRST ENDORSEMENT on CO, MCB Hawaii ltr of 14 Sep 15

From: Commanding General, Marine Corps Installations Pacific
To: Commander, Marine Corps Installations Command

Subj: AIR INSTALLATION COMPATIBLE USE ZONE DOCUMENT FOR MARINE CORPS BASE HAWAII

Ref: (a) MCO 11010.16, Air Installations Compatible Use Zones (AICUZ) Program

Encl: (1) Pre-Final AICUZ Study Update dated Aug 2015

1. Forwarded, recommending approval.

2. The point of contact for this issue at Marine Corps Installations Pacific is Lieutenant Colonel Scott E. Conway, 315-645-4220 or email at scott.conway@usmc.mil. The point of contact for Marine Corps Base Hawaii is Tiffany Patrick, (808) 257-8815 or email at tiffany.patrick@usmc.mil.

C. B. SNYDER
Acting

Copy to:
MCIPAC AC/S, G-7
CO, MCB Hawaii