Appendix C Noise Report

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AIRCRAFT NOISE STUDY FOR NAVAL AIR STATION WHIDBEY ISLAND AND OUTLYING LANDING FIELD COUPEVILLE, WASHINGTON

wyle

WR 10-22
October 2012

Prepared for:
Ecology and Environment, Inc.

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Aircraft Noise Study for Naval Air Station Whidbey Island and Outlying Landing Field Coupeville, Washington

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Acronyms & Abbreviations

ID	Definition
°F	degrees Fahrenheit
AAD	Annual Average Daily
AFE	Above Field Elevation
AFRL	Air Force Research Laboratory
AGL	Above Ground Level
AICUZ	Air Installations Compatible Use Zones
APZ	Accident Potential Zone
ASW	Anti-Submarine Warfare
ATAR	Air Traffic Activity Report
ATC	Air Traffic Control
CNO	Chief of Naval Operations
CY	Calendar Year
CZ	Clear Zone
dB	Decibel
dBA	A-Weighted Decibels
dBC	C-Weighted Decibels
DNL	Day-Night Average Sound Level
DoD	Department of Defense
DoN	Department of the Navy
E&E	Ecology & Environment, Inc.
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPR	Engine Pressure Ratio
ESHP	Effective Shaft Horsepower
FCLP	Field Carrier Landing Practice
FICON	Federal Interagency Committee On Noise
GCA	Ground Controlled Approach
GIS	Geographic Information Systems
Hz	Hertz
ID	Identification
IFR	Instrument Flight Rules
in Hg	inches of mercury
in-lbs	inch pounds (torque)
kts	Knots
L_{max}	Maximum Sound Level
MMA	Multi-mission Maritime Aircraft
MSL	Mean Sea Level
NAS	Naval Air Station
NASWI	Naval Air Station Whidbey Island
NAVFAC	Naval Facilities Engineering Command

ID	Definition
NC or %NC	Compressor RPM
NMAP	NOISEMAP
OLF	Outlying Landing Field
POI	Point of Interest
RH	Relative Humidity
RPM	Revolutions Per Minute
SEL	Sound Exposure Level
T&G	Touch-and-Go
TACAN	Tactical Area Navigation
U.S.	United States
VFR	Visual Flight Rules

Executive Summary

The primary purpose of this study is to present the results of the noise analysis for the proposed transitions of three expeditionary EA-6B Prowler squadrons to EA-18G Growler aircraft and addition of one reserve EA-18G squadron at Naval Air Station (NAS) Whidbey Island, Washington.

This report examines the aircraft noise for the Baseline conditions in Calendar Year 2011 (CY2011), the Proposed condition in 2016 (CY2016), and the Cumulative condition in 2018 (CY2018) on and in the vicinity of NAS Whidbey Island and Outlying Landing Field (OLF) Coupeville.

The study was conducted according to established Department of Defense (DoD) guidelines and best practices. It included extensive data collection, validation, and analysis and subject to a rigorous technical and quality assurance process. The noise analysis leveraged the DoD NOISEMAP suite of computer-based modeling tools to determine airfield noise exposure in terms of the Day-Night Average Sound Level (DNL).

The Baseline condition consists of approximately 70,500 annual flight operations at Ault Field of which approximately 45, 27, and 26 percent are conducted by the P-3C, EA-6B and EA-18G, respectively. Coupeville operations total 6,166 annually. The Proposed condition results in a net increase of approximately 2,200 operations at Ault Field by the reserve EA-18G. The EA-6B transition to EA-18G will have completed prior to the proposed condition. The addition of one reserve squadron of EA-18G would generally result in a decrease of up to 6 decibels (dB) in DNL exposure relative to the Baseline levels. Although the total operations increase slightly the decrease is due to the completion of the transition from the EA-6B to the relatively quieter EA-18G.

The Cumulative condition accounts for the Navy planned transition from the P-3 to the P-8. The noise analysis shows that the P-3 replacement by the P-8 would have minimal effect on the noise environment in the vicinity of NAS Whidbey Island because single-event noise levels of the P-3 and P-8 SELs are approximately 20 dB less than the EA-6B or EA-18G. The P-3/P-8 contribution to the overall DNL is minimal.

In addition, maximum sound levels and sound exposure levels are presented for four specific flight tracks in support of the Biological Assessment being conducted by Ecology and Environment, Inc.

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SECTION 1

Introduction

Throughout the United States (U.S.) and overseas, the Naval Facilities Engineering Command (NAVFAC) conducts aircraft noise surveys at various Naval and Marine Corps Air Stations and associated facilities. The noise exposure contours developed during these studies are integrated primarily into Air Installations Compatible Use Zones (AICUZ) studies or other environmental documents, such as Environmental Impact Statements (EIS). These environmental documents are employed by NAVFAC to promote the compatibility of Navy and Marine Corps activities with neighboring land uses. This report presents the noise survey's results for Naval Air Station (NAS) Whidbey Island (NASWI) and Naval Outlying Landing Field (OLF) Coupeville.

In support of an Environmental Assessment (EA) being conducted by Ecology & Environment, Inc., (E&E) the purpose of this report is to analyze and determine the aircraft noise environment at NASWI's Ault Field of three scenarios – Baseline, Proposed and Cumulative.

- The Baseline Scenario is an estimate of total operations during Calendar Year 2011 (CY2011) but with other modeling parameters based on the Preferred Alternative 5 from the Multi-Mission Maritime Aircraft (MMA) noise study (Amefia 2008) which, in turn, was primarily based on the 2004 noise study (Bremer et al).
- The Proposed Scenario transitions three expeditionary EA-6B squadrons to EA-18G aircraft and adds one reserve EA-18G squadron at NASWI.
- The Cumulative Scenario analyzes the same activities as the Proposed Scenario but also considers the transition of P-3C squadrons to P-8A aircraft.

This report is organized into seven primary sections, followed by two appendices. Section 2 presents an overview of the noise metrics and the technical tools used to conduct this analysis. Section 3 provides background on NASWI and a description of the operating environment. Sections 4, 5, and 6 describe the Baseline, Proposed and Cumulative Scenarios' operations data and noise exposure, respectively. Section 7 provides the single-event analysis. Appendix A presents the representative flight profiles for all modeled aircraft and Appendix B discusses the basics of noise and its effects on the environment.

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SECTION 2

Study Methodology and Data Collection

This section describes the data collection procedures and an overview of the noise analysis methodology, noise metrics and computerized noise models.

2.1 Data Collection

The primary purpose of this study is to estimate the noise exposure for the proposed and cumulative scenarios. In May of 2010, Wyle began the data collection phase which included a site visit to NASWI to gather and confirm the information needed to estimate noise exposure, including flight track utilization, flight profile data and operation counts (NAS Whidbey Island 2010). An additional follow-up site visit was conducted in May of 2011. Specific contact information is shown in Table 2-1. Following the 2011 site visit, data sources and operational assumptions were validated by U.S. Fleet Forces Command (Keys 2011).

Table 2-1 Points of Contact

Name	Title/Function	Organization	Phone	E-Mail
Dan Worra	NASWI OPSO	NASWI	(360) 257-2120	daniel.worra@navy.mil
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2.2 Noise Modeling

2.2.1 Noise Metrics

The Department of Defense (DoD) and the Federal Interagency Committee On Noise (FICON)[1] use three types of metrics to describe noise exposure:

1) A measure of the highest sound level occurring during an individual aircraft overflight (single event);

2) A combination of the maximum level of that single event with its duration; and

3) A description of the noise environment based on the cumulative flight and engine maintenance activity.

The DoD and the FICAN use Maximum Sound Level (L_{max}), Sound Exposure Level (SEL) and Day-Night Average Sound Level (DNL) for the aforementioned three types, respectively.

The metrics used to describe aircraft noise in this study are presented in terms of A-weighted decibels (dB), which de-emphasizes low-frequency noise, i.e., noise containing components less than 200 Hertz (Hz), to approximate the response and sensitivity of the human ear.

2.2.1.1 Maximum Sound Level (L_{max}) and Sound Exposure Level (SEL)

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. At any given time during the event, the measured sound level is actually an average taken over one-eighth of a second. The variation in sound level with time is shown by the solid line in Figure 2-1. The maximum sound level, L_{max}, is the instantaneous maximum sound level measured/heard during the event. The L_{max} 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.

The Sound Exposure Level, SEL, is a composite metric that represents all of the sound energy of the event and includes both the intensity of a sound and its duration. The SEL metric is the best metric to compare noise levels from overflights of different aircraft types. For sound from military aircraft overflights, the SEL is usually 5 to 10 dB greater than the L_{max}. For example, the L_{max} of the sample event in Figure 2-1 is 93.5 dB whereas the SEL is 102.7 dB.

[1] DoD is a member of FICON.

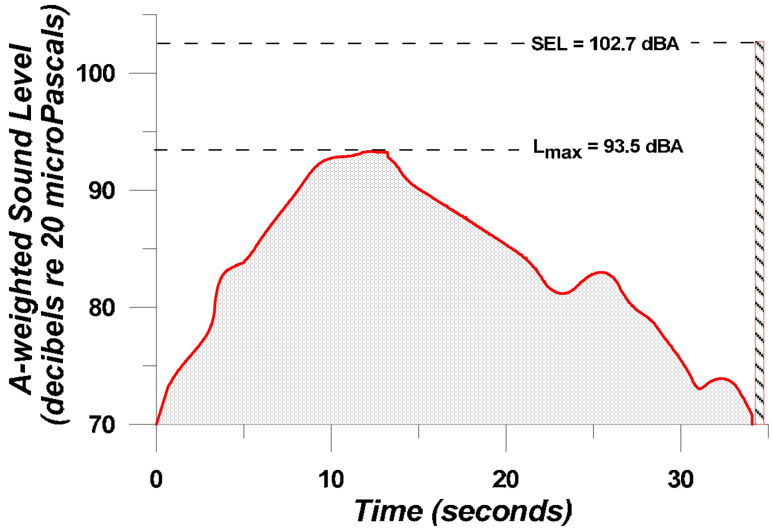

Figure 2-1 Example of Maximum Sound Level and Sound Exposure Level from an Individual Event

2.2.1.2 Day-Night Average Sound Level (DNL or L_{dn})

The Day-Night Average Sound Level, DNL, is a composite noise metric accounting for the sound energy 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). Noise-sensitive land uses, such as housing, schools, and medical facilities are considered as being compatible in areas where the DNL is less than 65 dB. Noise sensitive land uses are discouraged in areas where the DNL is between 65 and 69 dB, and strongly discouraged where the DNL is between 70 and 74 dB. At higher levels, i.e. greater than 75 dB, land use and related structures are not compatible and should be prohibited.

Because it is an energy-based quantity, DNL tends to be dominated by the noisier events. As a simple example, consider a case in which only one daytime aircraft overflight occurs 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 resultant DNL would be 66 dB. In comparison, consider a second example that 10 such 30-second overflights occur during daytime hours instead, with the same ambient sound level of 50 dB during the remaining 23 hours and 55 minutes. The resultant DNL would be 76 dB. The energy averaging of noise over a 24-hour period does not ignore the louder single events and tends to emphasize both the sound levels and the number of those events.

Figure 2-2 graphically describes DNL using hourly average noise levels ($L_{eq(h)}$)for each hour of the day as an example. Note the $L_{eq(h)}$ for the hours between 10 pm and 7 am have a 10 dB penalty assigned. The DNL for the example noise distribution shown in Figure 2-2 is 65 dB.

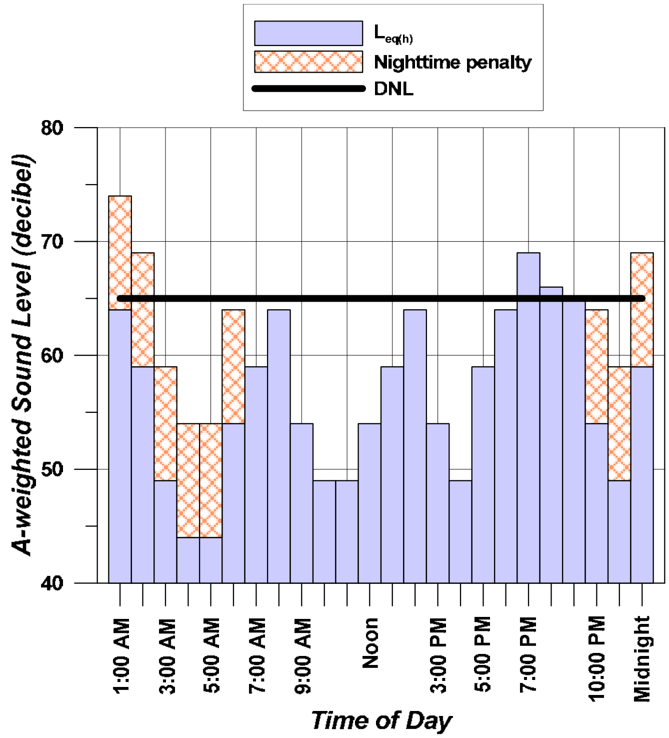

Figure 2-2 Example of Day-Night Average Sound Level Computed from Hourly Equivalent Sound Levels

2.2.2 Noise Models

This section describes the analysis tools used to calculate the noise levels contained in this report, namely, the NOISEMAP computer program. The program described below is most accurate and useful for comparing "before-and-after" noise levels that would result from alternative scenarios when calculations are made in a consistent manner. The program allows noise exposure prediction of such proposed actions without actual implementation and/or noise monitoring of those actions. The program also has the flexibility of calculating sound levels at specified points on the ground allowing the analysis of noise-sensitive receptors.

2.2.3.1 NOISEMAP

Analyses of aircraft noise exposure and compatible land uses around DoD airfield-like facilities are normally accomplished using a suite of computer-based programs, collectively called NOISEMAP (Czech and Plotkin 1998; Wasmer and Maunsell 2006a; Page et al 2008; Wasmer and Maunsell 2006b). NOISEMAP is the model for airbases and is most appropriate when the flight tracks are well defined, such as those near an airfield. NOISEMAP typically requires the entry of runway coordinates, airfield information, flight tracks, flight profiles along each flight track for each aircraft, numbers of daily flight operations, run-up coordinates, run-up profiles, and run-up operations. Flight and run-up profiles include the number of DNL daytime (0700-2200) and nighttime (2200-0700) events. The NOISEMAP process results in a "grid" file containing noise levels at different points of a user specified rectangular area. The spacing of the grid points for this study was 500 feet (ft). From the grid of points, lines of equal DNL (contours) of 60 dB through 85 dB (if applicable), in 5 dB increments, were plotted with the suite's NMPlot program

NOISEMAP can also compute DNL for specific points of interest, e.g., noise-sensitive receptors, and determine the primary contributors to the overall DNL at each point.

2.3 Impact and Geospatial Analysis

2.3.1 Topographical Data

The NOISEMAP suite of programs include the ability to account for atmospheric sound propagation effects over varying terrain, including hills and mountainous regions, as well as regions of varying acoustical impedance—for example, water around coastal regions. Even for flat terrain, the propagation algorithms are more robust than for excluding terrain. This feature is used in computing the noise levels presented in this analysis. By including terrain in the propagation calculations, the shielding effect of landforms can be included in the analysis. Acoustical impedance describes how sound is reflected or absorbed by the surface. Sound tends to travel farther over hard surfaces, such as pavement or water, than it does over soft surfaces, such as plowed earth or vegetation.

Elevation and impedance grid files were created from Geographic Information Systems (GIS) files of elevation contours for the land in the vicinity of NASWI and the OLF. The elevation and impedance grid files use point spacing of 300 feet. All areas on land were modeled with "soft" acoustical impedance (flow resistivity of 200 kPa-s/m^2) and all water surfaces were modeled with "hard" acoustical impedance (flow resistivity of 1 million kPa-s/m^2).

2.3.2 Exposure Calculation

Noise exposure is quantified by off-facility land acreage. Off-facility acreage, housing or population counts for this study were not part of the scope of work.

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SECTION 3

NAS Whidbey Island and OLF Coupeville

The following six sections discuss the regional and vicinity areas, the aviation users, climatic conditions, data collection efforts and historical flight operations.

3.1 Regional and Local Settings

Figure 3-1 shows the regional context of NASWI and OLF Coupeville as they are located approximately 50 miles north-northwest of Seattle, Washington. The boundaries of NASWI are depicted on the vicinity map in Figure 3-2. Ault Field borders the city of Oak Harbor to the south. OLF Coupeville, located 9.8 miles south-southeast of Ault Field and 3 miles southeast of the town of Coupeville, is used primarily for Field Carrier Landing Practice (FCLP).

The layout and vicinity of Ault Field are depicted in Figure 3-2. The elevation is 47 feet above Mean Sea Level (MSL). The magnetic declination, as of 2011, is 17.4 degrees east. Ault Field has two intersecting runways, Runway 07/25 and Runway 14/32:

- **Runway 07/25**
  - Length: 8,000 feet
  - Width: 200 feet
  - Magnetic Headings: 69°/249° (07/25)
  - Overruns: 1,000/700-foot overrun (07/25)
- **Runway 14/32**
  - Length: 8,000 feet
  - Width: 200 feet
  - Magnetic Headings: 137°/317° (14/32)
  - Overruns: 1,000/1,000-foot overrun (14/32)

The layout and vicinity of OLF Coupeville are depicted in Figure 3-2. The field elevation is 199 feet above MSL. The OLF has one concrete runway, Runway 14/32:

- **Runway 14/32**
  - Length: 5,400 feet
  - Width: 200 feet

Figure 3-1 Region of NAS Whidbey Island and OLF Coupeville

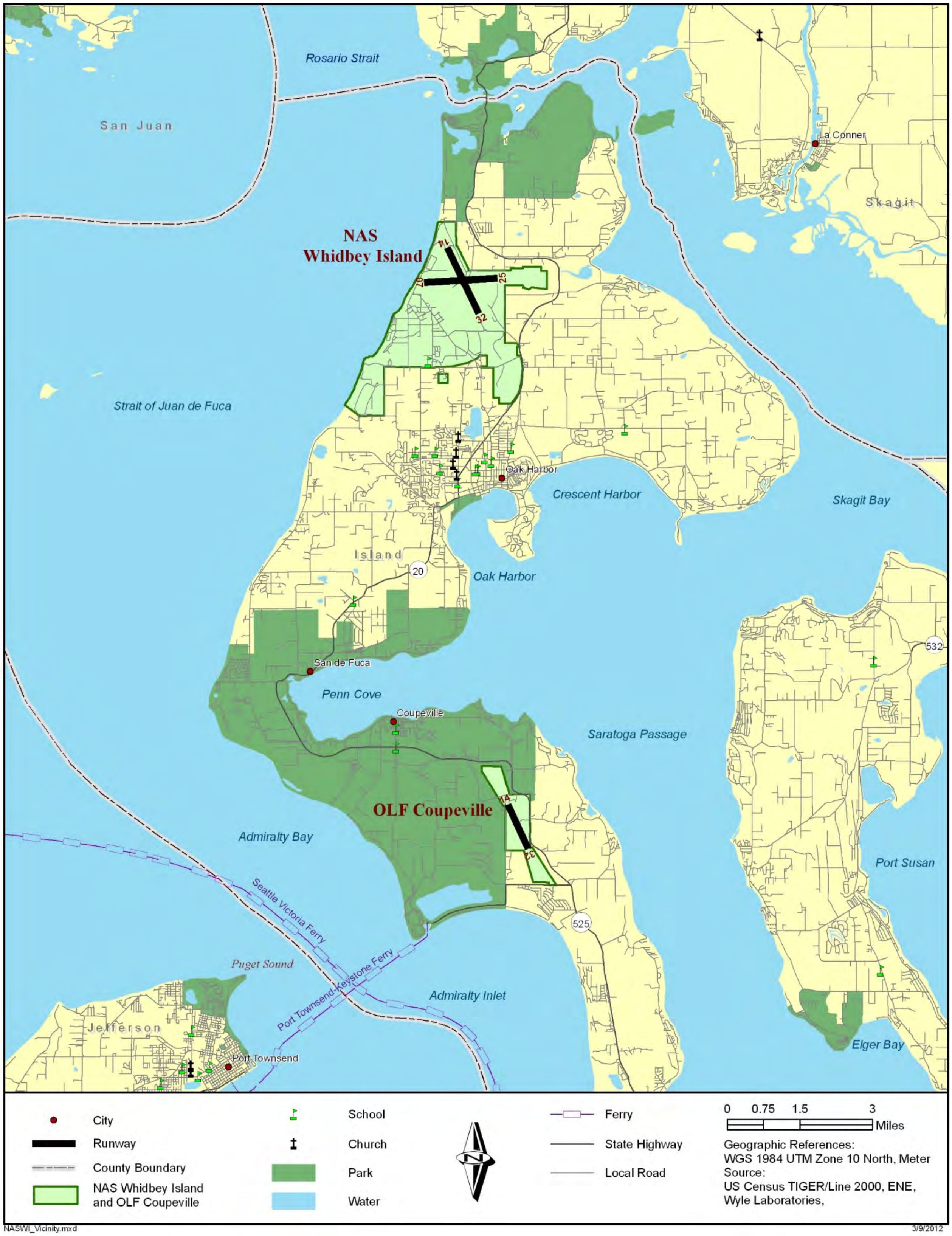

Figure 3-2 Vicinity of NAS Whidbey Island and OLF Coupeville

3.2 Aviation Users

The U.S. Navy is the primary user of Ault Field and the OLF facilities and runways. There are 19 active-duty squadrons, 2 reserve squadrons and several other tenants. The aircraft types currently operating at NASWI are:

- EA-18G Growler, electronic warfare jet,
- EA-6B Prowler, electronic warfare jet
- P-3C Orion, four engine turbo-prop for patrol and reconnaissance,
- C-9 Skytrain II, twin-engine jet based on a McDonnell Douglas DC-9 airliner, and
- Various transient aircraft types.

The EA-6B is in the process of being replaced by the EA-18G. Most P-3C aircraft will be replaced by the P-8A Poseidon which is a twin-engine jet based on a Boeing 737-800.

3.3 Climatic Data

Weather is an important factor in the propagation of noise and the computer model requires input of the average daily temperatures in degrees Fahrenheit (degrees F), percent relative humidity (percent RH) and station pressure in inches of mercury (in Hg) for each month of a year. Average monthly weather data was not available so the standard weather conditions of 59 degrees F, 70 percent relative humidity and atmospheric pressure of 29.92 in Hg were used for modeling.

SECTION 4

Baseline Scenario

Section 4.1 details the flight operations. Section 4.2 presents the runway/flight track utilization, flight profiles and derivation of annual average daily flight operations. Sections 4.3 and 4.4 contain the maintenance run-ups and resultant aircraft noise exposure.

4.1 Flight Operations

The first step in the noise analysis process is to determine the number of annual flight operations for the year studied. A flight operation is defined as a takeoff or landing of one aircraft with patterns counted as two operations per circuit. The counts in this report do not include transitions through the airspace above or near NASWI. The computer noise model requires input of flight operations by aircraft type, operation type, and temporal period (daytime hours of 0700-2200 and nighttime hours of 2200-0700).

The Baseline scenario for this study is defined as the operations during Calendar Year 2011 (Keys 2011) As 2011 was not yet completed when the analysis for this study was begun, the Baseline scenario (i.e., CY2011) was derived from a six-year average of the NASWI Air Traffic Activity Reports (ATAR) for CY2005 through CY2010. Baseline flight operations for Ault Field total 70,557 as presented in Table 4-1. The EA-6B is currently in the process of being replaced by the EA-18G. The Navy provided the numbers of NASWI-based Prowler and Growler aircraft for CY2011 as 40 and 39, respectively. This ratio was used to adjust the proportion of Prowler and Growler operations for the Baseline scenario.

Operation types include departures, straight-in arrivals, Tactical Air Navigation (TACAN) arrivals, overhead break arrivals, touch and go (T&G) patterns, FCLP patterns, Ground Control Approach (GCA) box patterns, depart and re-enter patterns, and Interfacility departures and arrivals between Ault Field and the OLF. The P-3C, EA-6B and EA-18G conduct the majority of the operations at Ault Field with 45, 27, and 26 percent, respectively. Approximately nine percent of Ault Field flight operations occur during the DNL nighttime (2200-0700).

The OLF only includes FCLPs and Interfacility departures/arrivals to/from Ault Field. The 5,396 annual OLF Coupeville FCLP operations were provided by NASWI. The interfacility operations between Ault Field and OLF Coupeville were determined using the average of 7 FCLP passes per sortie (Keys 2011). This results in 6,166 total flight operations at Coupeville for the Baseline scenario as shown in Table 4-2. The EA-6B and EA-18G are the only aircraft to use the OLF. The 9-hour DNL nighttime period (2200-0700) accounts for six percent of total flight operations at the OLF.

Table 4-1 Annual Baseline Flight Operations for NAS Whidbey Island (Ault Field)

Aircraft Type	VFR Departure			Interfacility Departure to Coupeville		
	Day (0700 - 2200)	Night (2200 - 0700)	Total	Day (0700 - 2200)	Night (2200 - 0700)	Total
EA-18G	1,796	117	1,913	179	11	190
EA-6B [(3)]	1,842	120	1,962	184	11	195
P-8A	-	-	-	-	-	-
P-3C	7,388	210	7,598	-	-	-
C-9	196	106	302	-	-	-
Transient [(2)]	152	82	234	-	-	-
Total	**11,374**	**635**	**12,009**	**363**	**22**	**385**

Aircraft Type	VFR Straight-in Arrival			IFR Straight-in Arrival			TACAN Arrival			Overhead Break Arrival			Interfacility Arrival from Coupeville		
	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
EA-18G	642	17	659	-	-	-	207	17	224	937	93	1,030	179	11	190
EA-6B [(3)]	658	18	676	-	-	-	212	18	230	961	95	1,056	184	11	195
P-8A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-3C	5,173	147	5,320	1,108	31	1,139	1,108	31	1,139	-	-	-	-	-	-
C-9	196	106	302	-	-	-	-	-	-	-	-	-	-	-	-
Transient [(2)]	152	82	234	-	-	-	-	-	-	-	-	-	-	-	-
Total	**6,821**	**370**	**7,191**	**1,108**	**31**	**1,139**	**1,527**	**66**	**1,593**	**1,898**	**188**	**2,086**	**363**	**22**	**385**

Aircraft Type	Touch and Go [(1)]			FCLP [(1)]			Depart and Re-enter Pattern [(1)]			GCA Pattern [(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
EA-18G	4,000	189	4,189	6,932	1,448	8,380	104	8	112	888	800	1,688	15,864	2,711	18,575
EA-6B [(3)]	4,103	194	4,297	7,109	1,486	8,595	106	8	114	910	820	1,730	16,269	2,781	19,050
P-8A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-3C	11,947	227	12,174	-	-	-	-	-	-	4,328	162	4,490	31,052	808	31,860
C-9	-	-	-	-	-	-	-	-	-	-	-	-	392	212	604
Transient [(2)]	-	-	-	-	-	-	-	-	-	-	-	-	304	164	468
Total	**20,050**	**610**	**20,660**	**14,041**	**2,934**	**16,975**	**210**	**16**	**226**	**6,126**	**1,782**	**7,908**	**63,881**	**6,676**	**70,557**

Table 4-2 Annual Baseline Flight Operations for OLF Coupeville

Aircraft Type	Interfacility Arrival			FCLP [(1)]			Interfacility Departure			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
EA-18G	179	11	190	2,510	154	2,664	179	11	190	2,868	176	3,044
EA-6B [(3)]	184	11	195	2,574	158	2,732	184	11	195	2,942	180	3,122
P-8A			-	-	-	-			-	-	-	-
P-3C			-	-	-	-			-	-	-	-
C-9			-	-	-	-			-	-	-	-
Transient [(2)]			-	-	-	-			-	-	-	-
Total	**363**	**22**	**385**	**5,084**	**312**	**5,396**	**363**	**22**	**385**	**5,810**	**356**	**6,166**

Notes:

(1) One circuit counted as two operations (1 takeoff and 1 landing)
(2) Modeled as P-3C
(3) EA-6B includes 3 Expeditionary Squadrons

4.2 Runway and Flight Track Utilization, Flight Profiles and Annual Average Daily Operations

The next step in the noise modeling process is assignment of flight operations to runways and flight tracks via utilization percentages for each aircraft type, operation type, and DNL time period. Tables A-1 through A-3 of Appendix A detail the modeled runway and flight track utilization percentages. Flight track and flight track utilization was initially based on the MMA study (Amefia 2008) and WR 04-26 and adjusted with guidance from NASWI personnel. Modeled flight tracks are depicted in Figures A-1 through A-17 in Appendix A.

Fixed-wing flight profiles consist of a combination of power settings, airspeeds and altitudes along each modeled flight track. This data defines the vertical profiles (altitude) and performance profile (power setting and airspeed) for each modeled aircraft. The representative profiles for each modeled aircraft type are contained in Appendix A. Fixed-wing departure profiles can be automatically modeled with a pre-flight run-up conducted at the runway threshold prior to brake release. The EA-6B includes a 1-second pre-flight run-up at military power. The EA-18G, modeled herein with a F/A-18E/F Super Hornet, includes a 1-second pre-flight run-up at either military or afterburner power depending on the departure profile type. No pre-flight run-ups were modeled for the P-3C or the P-8, the latter modeled as a Boeing 737-700. The C-9A departures include a 5-second pre-flight run-up at a power setting of 2 Engine Pressure Ratio (EPR).

The next step in the noise modeling process is the computation of the Annual Average Daily (AAD) day and night events for each profile. This is accomplished by dividing the track operations by 365 and further dividing closed-pattern operations (e.g., touch-and-go, depart and re-entry FCLP and GCA Box) by 2[2]. The resultant numbers of events are presented in Table B-4. There are approximately 130 AAD flight events modeled for the baseline scenario for the NAS and 10 AAD flight events for OLF.

4.3 Maintenance Run-Up Operations

Squadron and maintenance personnel conduct various types of tests on aircraft engines at one or more power settings for certain lengths of time. These tests are termed maintenance 'run-ups'. During these operations, engines remain in the airframe of the aircraft (i.e., "in-frame" run-up) or are removed from the airframe (i.e., "out-of-frame" run-up). Out-of-frame run-ups can only be conducted on apparatus designed for the engines (called "test stands").

Table 4-3 lists the modeled run-ups for the Baseline scenario. The EA-18G run-up operation counts were updated in this report to reflect new information provided by NASWI personnel (Dzubay 2010). Approximately 35 percent of the EA-18G run-ups would occur during the DNL nighttime period, however all run-ups conducted at night would be low power. The high power run-ups only occur during the DNL daytime period. The P-3C and the P-8 run-up operations are unchanged from MMA study (Amefia 2008).

[2] The closed-pattern operations are divided by two for noise modeling purposes only. ATC counts closed patterns as two distinct operations: one departure and one arrival. In NOISEMAP the departure and arrival are represented by one event because both operations are connected (i.e., on a single flight track).

Baseline EA-18G high power run-ups are conducted at the high power pad which is located just west of Runway 31 and aircraft are oriented parallel to Runway 31 as shown in Figure 4-1. EA-18G low power run-ups are conducted on the ramp in the southwest portion of the NASWI with aircraft oriented approximately perpendicular to Runway 31.

P-3C and P-8 low power run-ups would also be conducted on the southwest ramp while P-3C high power run-ups are conducted on the active runway near the threshold at Red Label Foxtrot and Red Label Delta with the aircraft oriented along the runway heading.

Table 4-3 Modeled Maintenance Run-up Operations at NAS Whidbey Island for Baseline Scenario

Aircraft Type	Engine Type	Run-up Type	Run-up ID	Magnetic Heading	Annual Events	Day (0700 - 2200)	Night (2200 - 0700)	Modeled Power Setting	Duration (Minutes)	No. of Engines Running
EA-6B	J52-P-408	Water Wash	Lo-Pwr (1)	045	445	65%	35%	65% RPM	25	1
								75% RPM	8	1
		Low power	Lo-Pwr (1)	045	1067	65%	35%	65% RPM	15	1
								80% RPM	15	1
		High Power	Hi-Pwr	315	4	100%	0%	65% RPM	16	1
								70% RPM	15	1
								95% RPM	10	1
EA-18G	F414-GE-400	Water Wash	Lo-Pwr (1)	045	86	45%	55%	65% NC	20	1
		Low power	Lo-Pwr (1)	045	2592	45%	55%	65% NC	15	1
								80% NC	15	1
		High Power	Hi-Pwr	315	10	100%	0%	65% NC	10	1
								80% NC	10	1
								90% NC	10	1
								96% NC	10	1
								A/B	3	1
P-3C	T56-A-14	Lo-Pwr	Lo-Pwr	126	1604	100%	0%	1000 ESHP	15	1
		Out-Of-Phase	Lo-Pwr	126	130			250 ESHP	30	4
								450 ESHP	10	4
								1000 ESHP	10	4
		Prop Dynamic Balance	Lo-Pwr	126	123			1500 ESHP	15	1
		High-PowerD	Red Label Delta	315	154			1500 ESHP	15	2
								2750 ESHP	15	2
								4300 ESHP	10	2
		High-PowerF	Red Label Foxtrot	-18	154			1500 ESHP	15	2
								2750 ESHP	15	2
								4300 ESHP	10	2
		Prop Dynamic Balancing	Hi-Pwr	315	123			1500 ESHP	15	1

Notes:

(1) Run-up events split equally between three Lo-Pwr run-up locations

Figure 4-1 Maintenance Run-up Locations at NAS Whidbey Island

4.4 Aircraft Noise Exposure

Using the data described in Sections 4.1 through 4.3, NOISEMAP was used to calculate and plot the 60 dB through 85 dB DNL contours for the Baseline AAD operations. Figure 4-2 shows the resulting DNL contours.

The 60 dB contour surrounding Ault Field extends approximately 7-9 miles from the runway endpoints. These lobes are primarily due to EA-6B and EA-18G on the approach portion of GCA patterns where aircraft are generally descending on a 3-degree glide slope through 3000 feet Above Ground Level (AGL) 10 miles from the runway. The 65 dB DNL contour extends nearly to the eastern shore of the mainland across Skagit Bay, the location where EA-18G flying GCA approaches descend down to 1000 feet AGL. The 65 dB DNL contour otherwise extends over land approximately 3 to 4 miles from the center of the airfield, the result of overlapping T&G and FCLP operations. The 80 dB and 85 dB DNL contours extend approximately 1.7 miles and 3,400 feet to the east outside the station boundary, respectively, due to the arrival portion of EA-6B and EA-18G T&G patterns on Runway 25.

The DNL contours at Coupeville are due to the OLF's FCLP operations. The 65 dB DNL extends northward to the southern shore of Penn Cove and approximately 2 miles south of the OLF's runway.

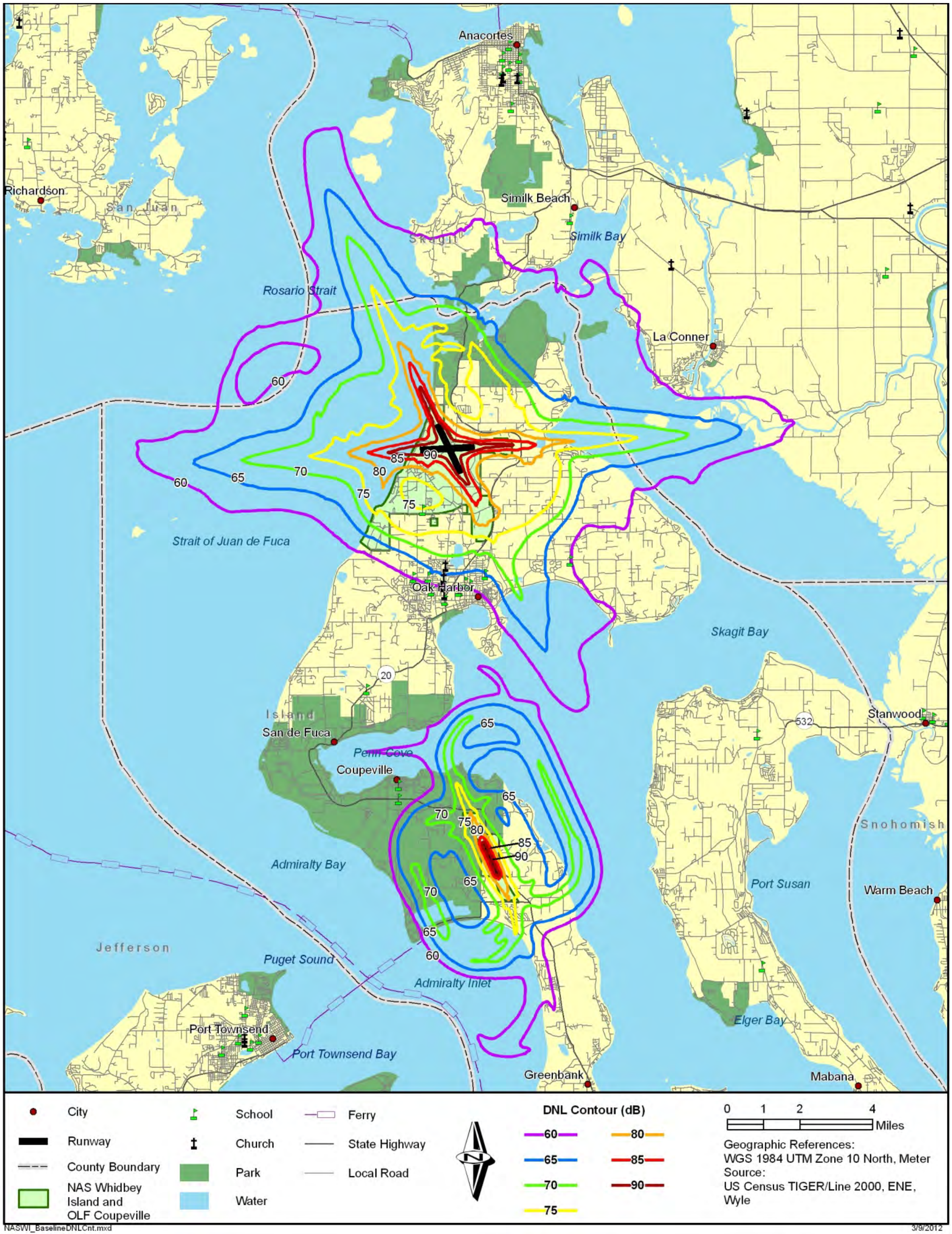

Figure 4-2 DNL Contours for Baseline AAD Aircraft Operations at NAS Whidbey Island

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SECTION 5

Proposed Scenario

Section 5.1 discusses flight operations by aircraft type. Section 5.2 discusses runway/helipad utilization, flight track utilization, flight profiles and daily operations by aircraft type. Section 5.3 describes maintenance run-up operations and Section 5.4 discusses the resultant average daily noise exposure.

5.1 Flight Operations

The Proposed scenario would be composed of the Baseline scenario plus the addition of VAQ-209, which is a reserve squadron of EA-18G aircraft, and the transition of 3 squadrons of EA-6B to EA-18G. This would result in the net addition of 2,178 annual flight operations (Keys 2011). The proposed EA-18G reserve squadron operations would occur at Ault Field with none occurring at OLF Coupeville. The Navy's ongoing transition from the EA-6B to the EA-18G is expected to complete prior to the Proposed Action.

Tables 5-1 and 5-2 show the resultant set of flight operations by category, aircraft type and period of day. Total annual flight operations for Ault Field would be 72,735. Total annual flight operations at the OLF would remain unchanged from Baseline with 6,166 operations. The EA-18G and P-3C would conduct the majority of the operations at Ault Field with 55 and 44 percent, respectively. Flight operations during the DNL nighttime period (10 p.m. to 7 a.m.) at Ault Field would increase 1 percent for a total of approximately 10 percent.

5.2 Runway and Flight Track Utilization, Flight Profiles and Annual Average Daily Operations

The expeditionary aircraft would use the same runway utilization, flight track utilization, and flight profiles within each operation type as the EA-18G aircraft in the Baseline scenario. The annual average daily flight events for the proposed expeditionary aircraft are shown in Table A-5 of Appendix A. The expeditionary aircraft would contribute approximately 4 AAD flight events to the total of 134 AAD flight events at Ault Field for the Proposed scenario.

5.3 Maintenance Run-Up Operations

The additional reserve EA-18G aircraft would conduct maintenance run-ups in the same manner and tempo as the currently based EA-18G and annual events have been estimated by scaling the baseline EA-18G run-ups operations by number of proposed aircraft. The resulting additional maintenance run-ups are shown in Table 5-3.

Table 5-1 Annual Flight Operations for Proposed Scenario at NAS Whidbey Island (Ault Field)

Aircraft Type	VFR Departure			Interfacility Departure to Coupeville		
	Day (0700 - 2200)	Night (2200 - 0700)	Total	Day (0700 - 2200)	Night (2200 - 0700)	Total
VAQ-209 EA-18G (3)	431	28	459			-
EA-18G	3,638	237	3,875	363	22	385
EA-6B			-			-
P-8A	-	-	-	-	-	-
P-3C	7,388	210	7,598	-	-	-
C-9	196	106	302	-	-	-
Transient (2)	152	82	234	-	-	-
Total	11,805	663	12,468	363	22	385

Aircraft Type	VFR Straight-in Arrival			IFR Straight-in Arrival			TACAN Arrival			Overhead Break Arrival			Interfacility Arrival from		
	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
VAQ-209 EA-18G (3)	187	13	200	-	-	-	44	3	47	198	15	213	-	-	-
EA-18G	1,300	35	1,335	-	-	-	419	35	454	1,898	188	2,086	363	22	385
EA-6B			-	-	-	-			-			-			-
P-8A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-3C	5,173	147	5,320	1,108	31	1,139	1,108	31	1,139	-	-	-	-	-	-
C-9	196	106	302	-	-	-	-	-	-	-	-	-	-	-	-
Transient (2)	152	82	234	-	-	-	-	-	-	-	-	-	-	-	-
Total	7,008	383	7,391	1,108	31	1,139	1,571	69	1,640	2,096	203	2,299	363	22	385

Aircraft Type	Touch and Go (1)			FCLP (1)			Depart and Re-enter Pattern (1)			GCA Pattern (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
VAQ-209 EA-18G (3)	873	41	914	-	-	-	23	2	25	145	175	320	1,901	277	2,178
EA-18G	8,103	383	8,486	14,041	2,934	16,975	210	16	226	1,798	1,620	3,418	32,133	5,492	37,625
EA-6B			-			-			-			-	-	-	-
P-8A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
P-3C	11,947	227	12,174	-	-	-	-	-	-	4,328	162	4,490	31,052	808	31,860
C-9	-	-	-	-	-	-	-	-	-	-	-	-	392	212	604
Transient (2)	-	-	-	-	-	-	-	-	-	-	-	-	304	164	468
Total	20,923	651	21,574	14,041	2,934	16,975	233	18	251	6,271	1,957	8,228	65,782	6,953	72,735

Table 5-2 Annual Flight Operations for Proposed Scenario at OLF Coupeville

Aircraft Type	Interfacility Arrival			FCLP (1)			Interfacility Departure			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
VAQ-209 EA-18G (3)	-	-	-	-	-	-	-	-	-	-	-	-
EA-18G	363	22	385	5,084	312	5,396	363	22	385	2,868	176	6,166
EA-6B			-			-			-			-
P-8A			-	-	-	-			-	-	-	-
P-3C			-	-	-	-			-	-	-	-
C-9			-	-	-	-			-	-	-	-
Transient (2)			-	-	-	-			-	-	-	-
Total	363	22	385	5,084	312	5,396	363	22	385	2,868	176	6,166

Notes:

(1) One circuit counted as two operations (1 takeoff and 1 landing)
(2) Transient aircraft modeled as P-3C
(3) Assumed same ops tempo as baseline EA-18G;

Table 5-3 Annual Maintenance Run-up Operations at NAS Whidbey Island for the Proposed Scenario

Aircraft Type	Engine Type	Run-up Type	Run-up ID	Magnetic Heading	Annual Events	Day (0700 - 2200)	Night (2200 - 0700)	Modeled Power Setting	Duration (Minutes)	No. of Engines Running
EA-18G	F414-GE-400	Water Wash	Lo-Pwr (1)	045	195	45%	55%	65% NC	20	1
		Low power	Lo-Pwr (1)	045	3440	45%	55%	65% NC	15	1
								80% NC	15	1
		High Power	Hi-Pwr	315	18	100%	0%	65% NC	10	1
								80% NC	10	1
								90% NC	10	1
								96% NC	10	1
								A/B	3	1
P-3C	T56-A-14	Lo-Pwr	Lo-Pwr	126	1604	100%	0%	1000 ESHP	15	1
		Out-Of-Phase	Lo-Pwr	126	130			250 ESHP	30	4
								450 ESHP	10	4
								1000 ESHP	10	4
		Prop Dynamic Balance	Lo-Pwr	126	123			1500 ESHP	15	1
		High-PowerD	Red Label Delta	315	154			1500 ESHP	15	2
								2750 ESHP	15	2
								4300 ESHP	10	2
		High-PowerF	Red Label Foxtrot	-18	154			1500 ESHP	15	2
								2750 ESHP	15	2
								4300 ESHP	10	2
		Prop Dynamic Balancing	Hi-Pwr	315	123			1500 ESHP	15	1

Notes:

(1) Run-up events split equally between three Lo-Pwr run-up locations

5.4 Aircraft Noise Exposure

Using the data described in Sections 5.1 through 5.3, NOISEMAP was used to calculate and plot the 60 dB through 85 dB DNL contours for the Proposed AAD operations at NASWI. Figure 5-1 shows the resulting DNL contours.

The 60 dB contour surrounding Ault Field would extend approximately 6-8 miles from the runway endpoints. These lobes would be primarily due to EA-18G on the approach portion of GCA patterns. The 65 dB DNL contour would extend nearly to the eastern shore of the mainland across Skagit Bay, the location where aircraft flying GCA approaches would pass through 1000 feet AGL. The 65 dB DNL contour otherwise would extend over land approximately 3 to 4 miles from the center of the airfield, the result of overlapping T&G and FCLP flight tracks and operations. The 80 dB and 85 dB DNL contours would extend between 1.5 miles and 3,300 feet to the east outside the station boundary, respectively, due to the arrival portion of EA-18G T&G patterns on Runway 25.

The extent of the proposed 65 dB and 75 dB DNL contour lobes would decrease as much as one mile in length relative to the Baseline scenario as shown in Figure 5-2. Even though the total operations would increase by 3 percent the noise exposure would decrease because on a single event basis the EA-18G SEL is 2 to 8 dB less than the EA-6B SEL for most types of operations.

Similar to Ault Field, the noise exposure at the OLF would decrease by approximately 1 dB DNL for the Proposed scenario.

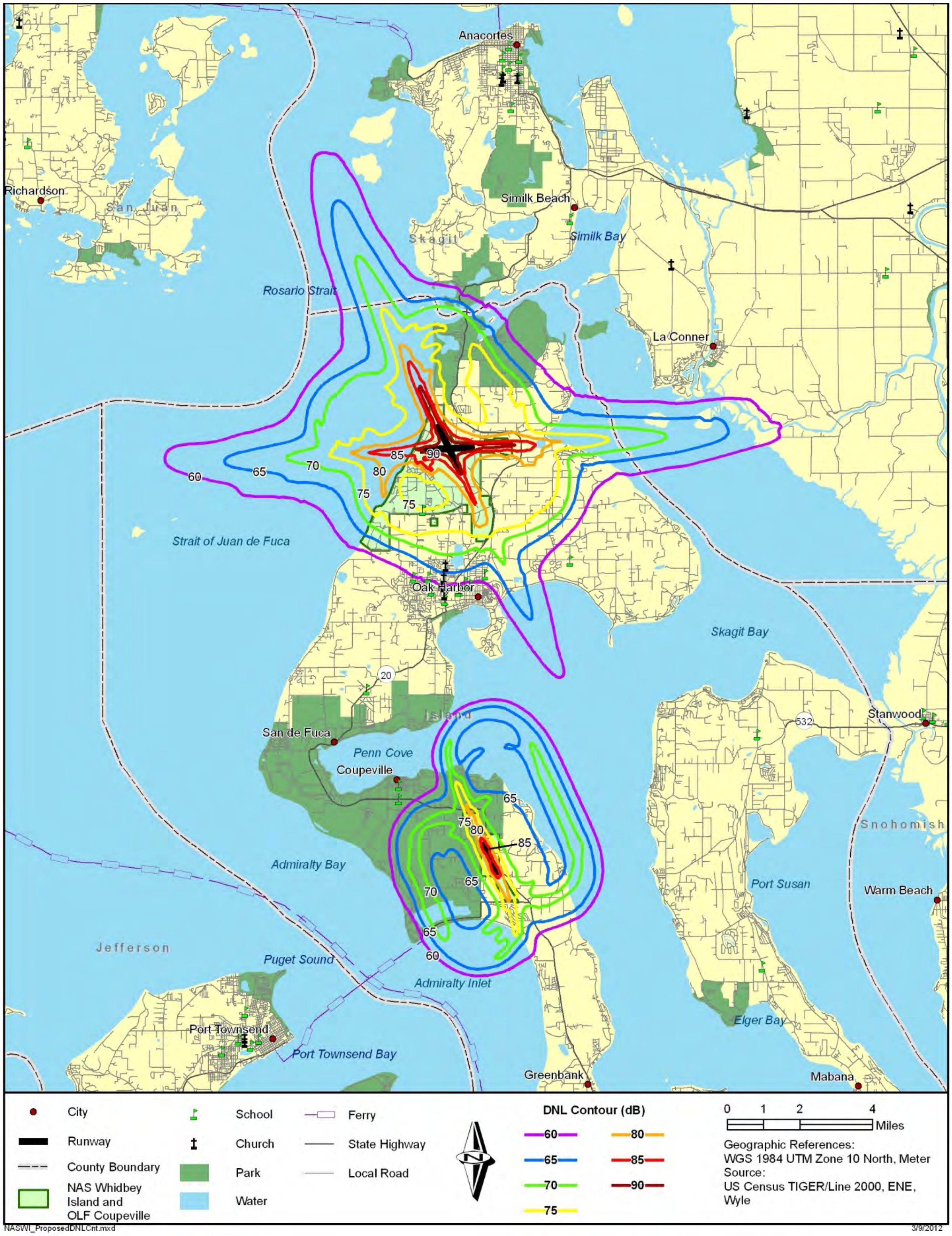

Figure 5-1 DNL Contours for Proposed Scenario AAD Aircraft Operations

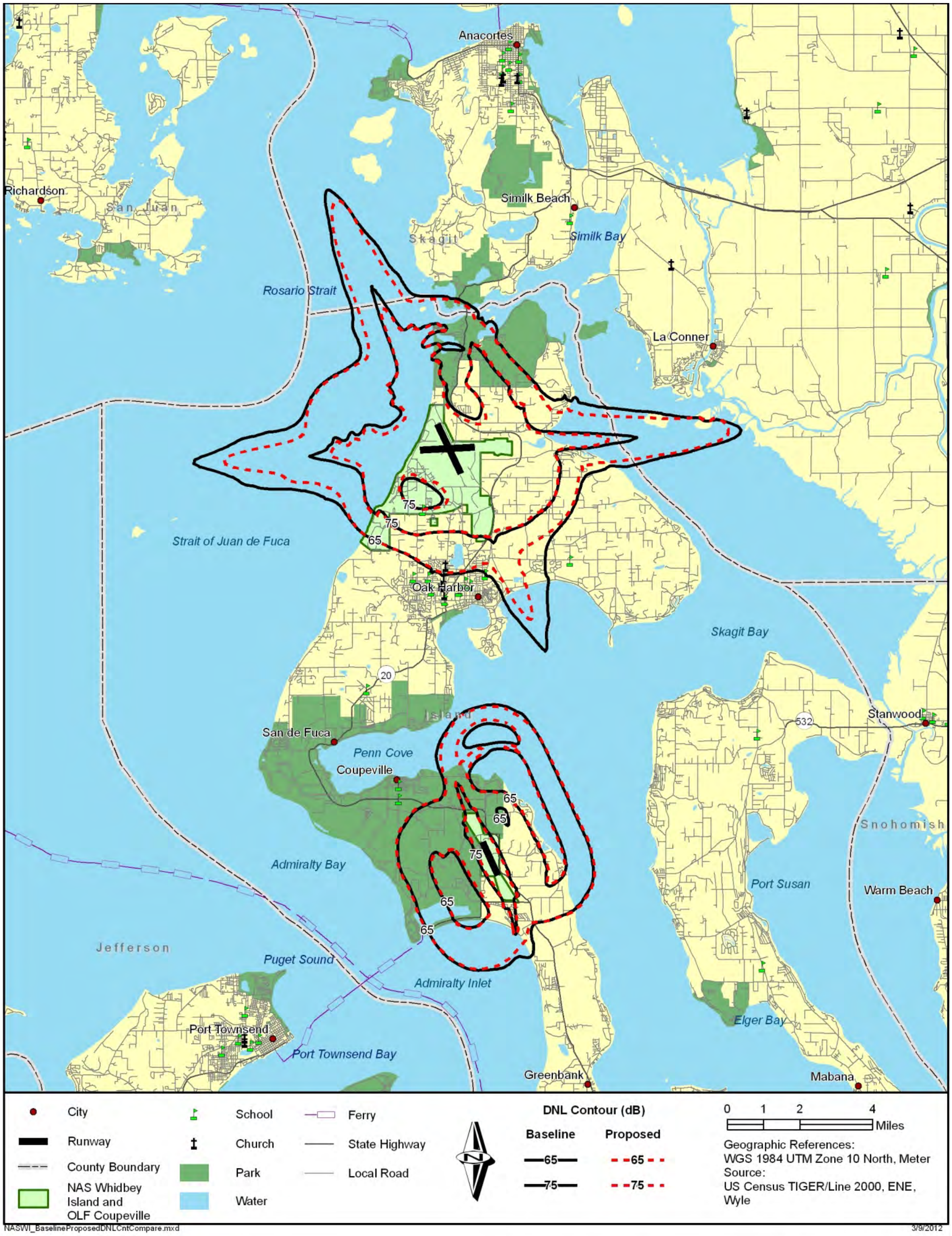

Figure 5-2 Comparison of Selected DNL Contours for Baseline and the Proposed Scenario

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SECTION 6 Cumulative Scenario

The Cumulative scenario considers the effect of the transition of P-3 to P-8 on the Proposed scenario. Section 6.1 discusses flight operations by aircraft type. Section 6.2 discusses runway/helipad utilization, flight track utilization, flight profiles and daily operations by aircraft type. Section 6.3 describes maintenance run-up operations and Section 6.4 discusses the resultant average daily noise exposure.

6.1 Flight Operations

The Cumulative scenario is composed of the Proposed scenario with the P-3 to P-8 transition. The P-8 basing at NASWI had been analyzed in the MMA study (Amefia 2008). To determine potential cumulative impacts for purpose of an EIS, this study analyzes the P-8 and remaining P-3 operations presented in the MMA Alternative 5 along with the Proposed scenario. This would result in a total of 77,830 annual operations at Ault Field as shown in Table 6-1, an increase of approximately 7,000 annual flight operations relative to the Baseline scenario. The EA-18G, and P-8A would conduct the majority of the operations at Ault Field with 51 and 34 percent respectively. The 9-hour nighttime period would account for approximately 8 percent of total flight operations at Ault Field, a decrease of 2 percent relative to the Proposed scenario.

Operations at OLF Coupeville would not change for the Cumulative scenario relative to the Proposed scenario.

6.2 Runway and Flight Track Utilization, Flight Profiles and Annual Average Daily Operations

The P-8 aircraft would use the same runway utilization and flight track utilization as the P-3C aircraft in the Baseline and Proposed scenarios. The 135 annual average daily flight events for the Cumulative scenario are shown in Table A-6 of Appendix A.

6.3 Maintenance Run-Up Operations

The P-8 would conduct maintenance run-up tests, including pressure and leak checks which would occur at either the primary high power location or on the ramp near the P-8 hanger. The resulting run-up events for the Cumulative scenario are shown in Table 6-3.

Table 6-1 Annual Flight Operation for Cumulative Scenario at NAS Whidbey Island (Ault Field)

Aircraft Type	VFR Departure			Interfacility Departure to Coupeville		
	Day (0700 - 2200)	Night (2200 - 0700)	Total	Day (0700 - 2200)	Night (2200 - 0700)	Total
VAQ-209 EA-18G (3)	431	28	459	-	-	-
EA-18G	3,638	237	3,875	363	22	385
EA-6B			-			-
P-8A	1,690	51	1,741	-	-	-
P-3C	621	19	640	-	-	-
C-9	196	106	302	-	-	-
Transient (2)	152	82	234	-	-	-
Total	**6,728**	**523**	**7,251**	**363**	**22**	**385**

Aircraft Type	VFR Straight-in Arrival			IFR Straight-in Arrival			TACAN Arrival			Overhead Break Arrival			Interfacility Arrival from Coupeville		
	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
VAQ-209 EA-18G (3)	187	13	200	-	-	-	44	3	47	198	15	213	-	-	-
EA-18G	1,300	35	1,335	-	-	-	419	35	454	1,898	188	2,086	363	22	385
EA-6B			-	-	-	-			-			-			-
P-8A	1,183	36	1,219	254	7	261	254	7	261	-	-	-	-	-	-
P-3C	432	13	445	95	3	98	94	3	97	-	-	-	-	-	-
C-9	196	106	302	-	-	-	-	-	-	-	-	-	-	-	-
Transient (2)	152	82	234	-	-	-	-	-	-	-	-	-	-	-	-
Total	**3,450**	**285**	**3,735**	**349**	**10**	**359**	**811**	**48**	**859**	**2,096**	**203**	**2,299**	**363**	**22**	**385**

Aircraft Type	Touch and Go (1)			FCLP (1)			Depart and Re-enter Pattern (1)			GCA Pattern (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
VAQ-209 EA-18G (3)	873	41	914	-	-	-	23	2	25	145	175	320	1,901	277	2,178
EA-18G	8,103	383	8,486	14,041	2,934	16,975	210	16	226	1,798	1,620	3,418	32,133	5,492	37,625
EA-6B			-			-			-			-	-	-	-
P-8A	19,292	-	19,292	-	-	-	-	-	-	3,858	-	3,858	26,531	101	26,632
P-3C	7,536	-	7,536	-	-	-	-	-	-	1,507	-	1,507	10,285	38	10,323
C-9	-	-	-	-	-	-	-	-	-	-	-	-	392	212	604
Transient (2)	-	-	-	-	-	-	-	-	-	-	-	-	304	164	468
Total	**35,804**	**424**	**36,228**	**14,041**	**2,934**	**16,975**	**233**	**18**	**251**	**7,308**	**1,795**	**9,103**	**71,546**	**6,284**	**77,830**

Table 6-2 Annual Flight Operations for Cumulative Scenario at OLF Coupeville

Aircraft Type	Interfacility Arrival			FCLP (1)			Interfacility Departure			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
EA-18G(3)	-	-	-	-	-	-	-	-	-	-	-	-
EA-18G	363	22	385	5,084	312	5,396	363	22	385	5,810	356	6,166
EA-6B			-			-			-	-	-	-
P-8A			-	-	-	-			-	-	-	-
P-3C			-	-	-	-			-	-	-	-
C-9			-	-	-	-			-	-	-	-
Transient (2)			-	-	-	-			-	-	-	-
Total	**363**	**22**	**385**	**5,084**	**312**	**5,396**	**363**	**22**	**385**	**5,810**	**356**	**6,166**

Notes:

(1) One circuit counted as two operations (1 takeoff and 1 landing)
(2) Transient aircraft modeled as P-3C
(3) Assumed same ops tempo and baseline EA-18G;

Table 6-3 Annual Maintenance Run-up Operations at NAS Whidbey Island for Expeditionary and Reserve EA-18G for Cumulative Scenario

Aircraft Type	Engine Type	Run-up Type	Run-up ID	Magnetic Heading	Annual Events	Day (0700 - 2200)	Night (2200 - 0700)	Modeled Power Setting	Duration (Minutes)	No. of Engines Running
EA-18G	F414-GE-400	Water Wash	Lo-Pwr (1)	045	195	45%	55%	65% NC	20	1
		Low power	Lo-Pwr (1)	045	3440	45%	55%	65% NC	15	1
								80% NC	15	1
		High Power	Hi-Pwr	315	18	100%	0%	65% NC	10	1
								80% NC	10	1
								90% NC	10	1
								96% NC	10	1
								A/B	3	1
P-3C	T56-A-14	Lo-Pwr	Lo-Pwr	126	1604	100%	0%	1000 ESHP	15	1
		Out-Of-Phase	Lo-Pwr	126	130			250 ESHP	30	4
								450 ESHP	10	4
								1000 ESHP	10	4
		Prop Dynamic Balance	Lo-Pwr	126	123			1500 ESHP	15	1
		High-PowerD	Red Label Delta	315	154			1500 ESHP	15	2
								2750 ESHP	15	2
								4300 ESHP	10	2
		High-PowerF	Red Label Foxtrot	-18	154			1500 ESHP	15	2
								2750 ESHP	15	2
								4300 ESHP	10	2
		Prop Dynamic Balancing	Hi-Pwr	315	123			1500 ESHP	15	1
P-8A	CFM56-7B-24	Leak Check	Lo-Pwr	126	24	75%	25%	5400 Lbs	5	2
		Pressure Check	Lo-Pwr	126	12			5400 Lbs	12	2
		Leak Check	Hi-Pwr	67	24			5400 Lbs	5	2
		Pressure Check	Hi-Pwr	67	12			5400 Lbs	12	2

Notes:

(1) Run-up events split equally between three Lo-Pwr run-up locations

6.4 Aircraft Noise Exposure

Using the data described in Sections 6.1 through 6.3, NOISEMAP was used to calculate and plot the 60 dB through 85 dB DNL contours for the Baseline AAD operations at NASWI. Figure 6-1 shows the resulting DNL contours.

The SELs of the P-8 and P-3 would be approximately 20 dB less than the SELs for the EA-6B and EA-18G and would not contribute significantly to the overall aircraft noise environment. Thus, contours for the Cumulative scenario would be nearly identical to the contours for the Proposed scenario. The 60 dB contour surrounding Ault Field would extend approximately 6-8 miles from the runway endpoints. These lobes would be primarily due to EA-18G on the approach portion of GCA patterns. The 65 dB DNL contour would extend nearly to the eastern shore of the mainland across Skagit Bay, the location where aircraft flying GCA approaches would pass through 1000 feet AGL. The 65 dB DNL contour otherwise would extend over land approximately 3 to 4 miles from the center of the airfield, the result of overlapping T&G and FCLP flight tracks and operations. The 80 dB and 85 dB DNL contours would extend between 1.5 miles and 3,300 feet to the east outside the station boundary, respectively, due to the arrival portion of EA-18G T&G patterns on Runway 25.

The extent of the proposed 65 dB and 75 dB DNL contour lobes would decrease as much as one mile in length relative to the Baseline scenario as shown in Figure 5-2. Even though the total operations would increase by 3 percent the noise exposure would decrease because on a single event basis the EA-18G SEL is 2 to 8 dB less than the EA-6B SEL for most types of operations.

Similar to Ault Field, the noise exposure at the OLF would decrease slightly be approximately 1 dB DNL for the Proposed scenario relative to Baseline.

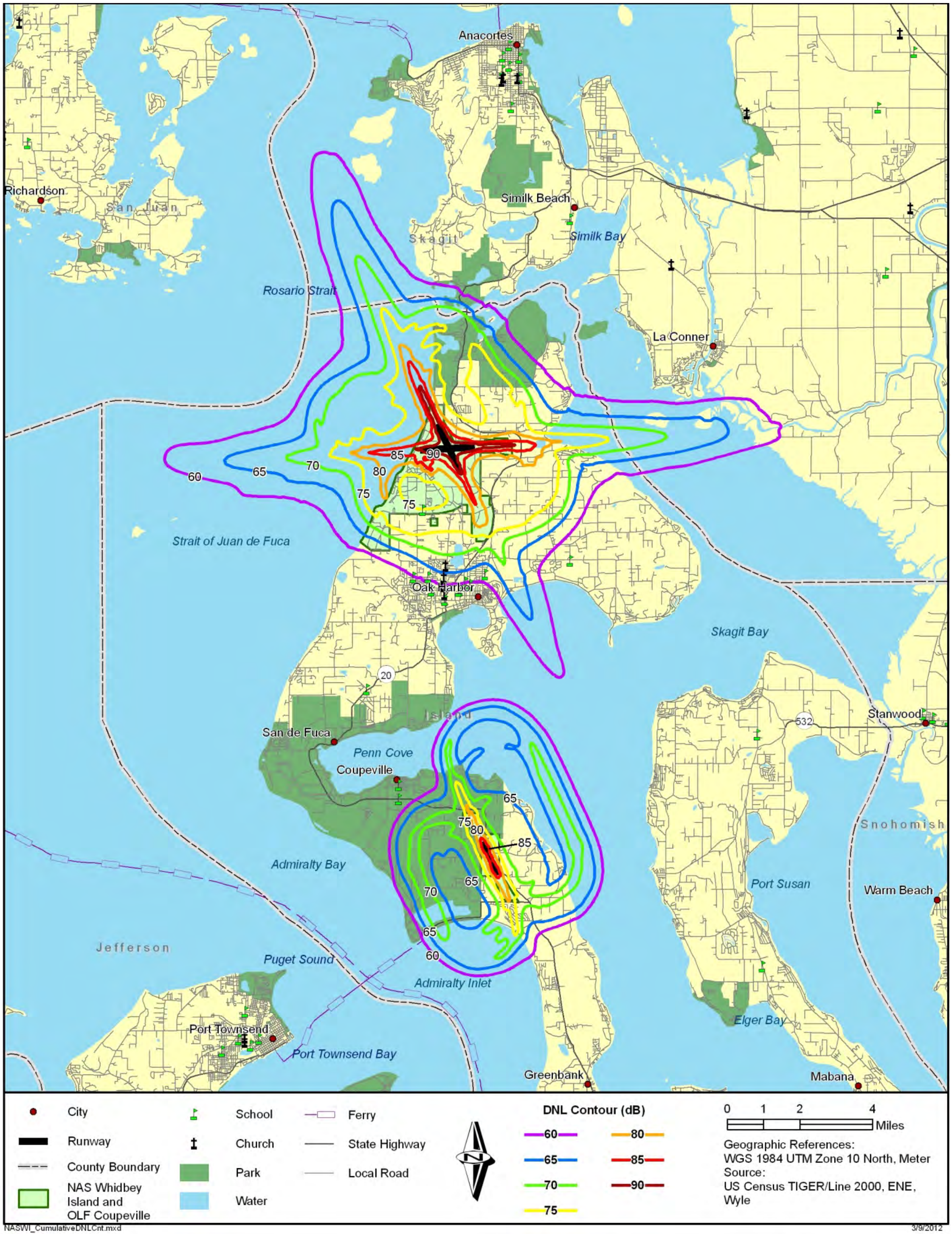


Figure 6-1 DNL Contours for the Cumulative Scenario AAD Aircraft Operations

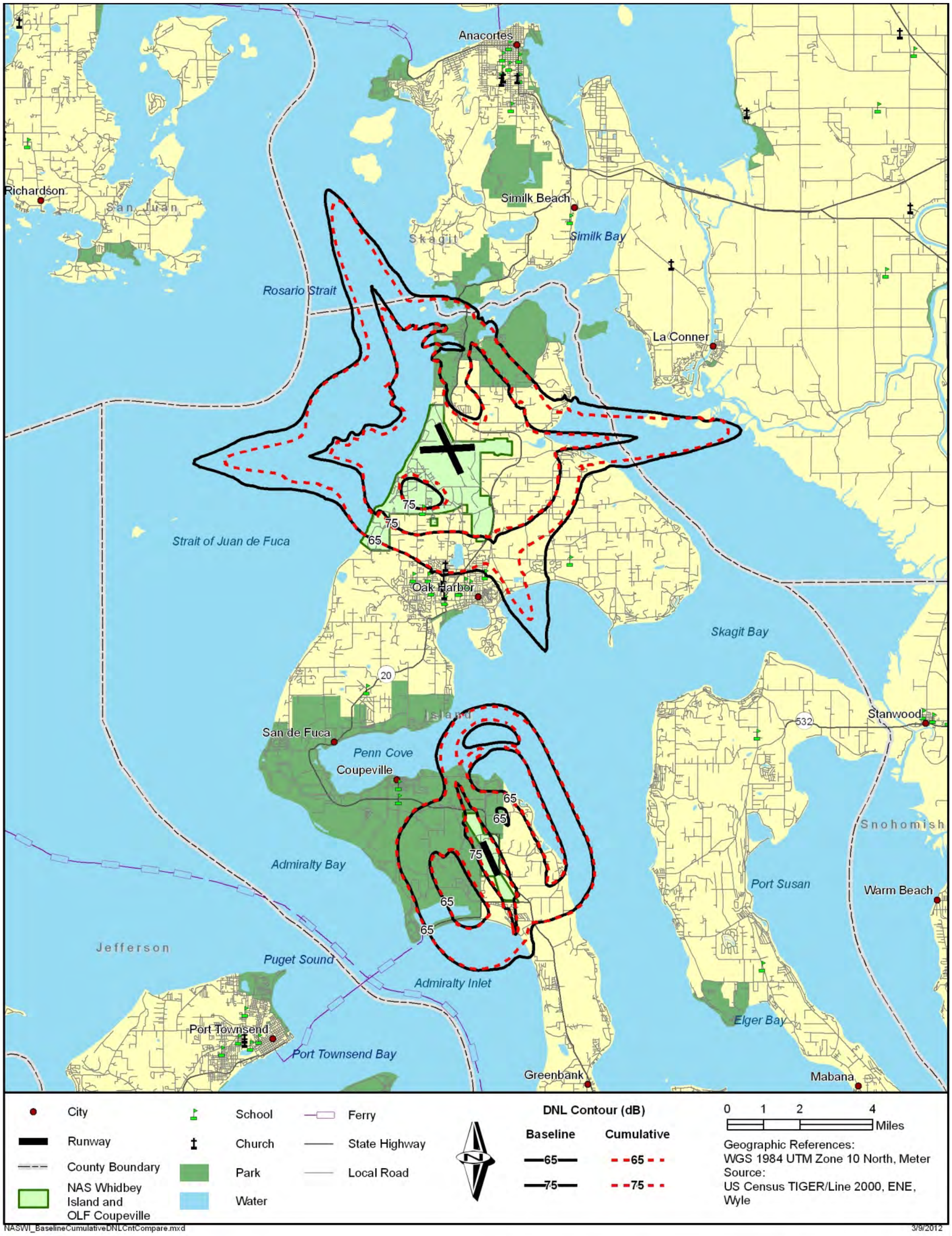


Figure 6-2 Comparison of Selected DNL Contours for Baseline and Cumulative Scenario

SECTION 7

Single Event Analysis

This section presents additional information in support of a biological assessment being performed by E&E (section 7.1) and additional information on the noise signature of the key aircraft (section 7.2).

7.1 Support for the Biological Assessment

The single events with the greatest SEL and L_{max} affecting the area approximately 500 feet offshore to the west of NASWI have been identified and are presented in Tables 7-1 and 7-2. EA-6B SELs range between 121 and 133 dB. EA-18G SELs range between 104 and 127 dB. For the arrival portions of closed patterns such as GCA Box and FCLP/T&G, the two aircraft are similar in SEL as their differences are 3 dB or less, with the EA-18G having the greater SEL for arrivals from patterns to Runway 13. However, for departures from Runway 25 or 31, the EA-6B has SELs 18 to 23 dB greater than the EA-18G primarily due to the lower altitude climb-out profile of the EA-6B.

Table 7-1 Greatest Single-Event Sound Levels Offshore of NASWI

Aircraft Type	Closest Runway End	Offshore Distance from Shoreline (feet)*	Approximate Aircraft Altitude (ft MSL)	Applicable Flight Track(s)	Representative Flight Profile ID	Description	Maximum SEL (dBA)	Maximum L_{max} (dBA)
EA-6B	25	500	750	25D1,2,3,4,5,6	107	Standard Departure	133	128
EA-6B	25	500	350	07G1	181	Arrival portion of GCA Pattern to Runway 07	128	124
EA-6B	31	500	900	31D1,2,3,4,5	120	Standard Departure	130	125
EA-6B	31	500	400	13TN2	179NB	Arrival portion of FCLP pattern to Runway 13	124	121
EA-18G	25	500	1600	25D1,2,3,4,5,6	207A	Standard Departure	115	105
EA-18G	25	500	350	07G1	281	Arrival portion of GCA Pattern to Runway 07	127	124
EA-18G	31	500	2150	31D1,2,3,4,5	220B	Standard Departure	110	104
EA-18G	31	500	400	13TN2	279NB	Arrival portion of FCLP pattern to Runway 13	127	123

* on extended runway centerline

Table 7-2 EA-18G Single-Event Sound Levels Relative to the EA-6B*

Closest Runway End	Flight Track(s)	Description	SEL (dBA)	L_{max} (dBA)
25	25D1,2,3,4,5,6	Standard Departure	-18	-23
25	07G1	Arrival portion of GCA Pattern to Runway 07	-1	0
31	31D1,2,3,4,5	Standard Departure	-20	-21
31	13TN2	Arrival portion of FCLP pattern to Runway 13	3	2

* negative values indicate EA-18G is less than the EA-6B

The numbers of average daily events for each of the four types of operations from Tables 7-1 and 7-2 are compiled in Table 7-3. All of the events listed in Table 7-3 would exceed 92 dB SEL offshore to the west of NASWI and represent the greatest single event types in terms of L_{max}. Additional operation types not tabulated may exceed 92 dB SEL in that location but did not have greater L_{max} and were not included. The Proposed scenario would increase the number of average daily departure events exceeding 92 dB SEL by 20 percent (1 event) to 6 average daily events. The Proposed scenario would not change the number of GCAs or FCLP/T&G events exceeding 92 dB SEL by more than 1 event.

Table 7-3 Representative Average Daily Events Exceeding 92 dB Sound Exposure Level Offshore to the West of NASWI

Operation Type	Flight Tracks	Baseline			Proposed
		EA-6B	EA-18G	Total	EA-18G (only)
Departures	25D1,2,3,4,5,6	2.3	2.3	4.6	5.2
	31D1,2,3,4,5	0.4	0.3	0.7	0.9
GCA Pattern - Arrival Portion	07G1,2,3	0.3	0.3	0.6	0.7
FCLP and T&G Pattern - Arrival Portion	13TN1,2,3 13TD1,2,3	6.3	6.2	12.5	13

* tracks/profiles with greatest Lmax

The 92 dB SEL contour has also been plotted for the representative flight profiles of Table 7-1 in Figures 7-1 and 7-2. The figures reflect the differences tabulated in Table 7-2. The EA-6B departure contours end at the end of the departure tracks' first turn while the EA-18G departure contours end near the beginning of the first turn. The contours for the patterns are similar in size and shape with the only noticeable difference is in the contours of the GCA Box operations with the EA-6B contours *outlining* the GCA Box area whereas the EA-18G's GCA Box contours *follow* the GCA track.

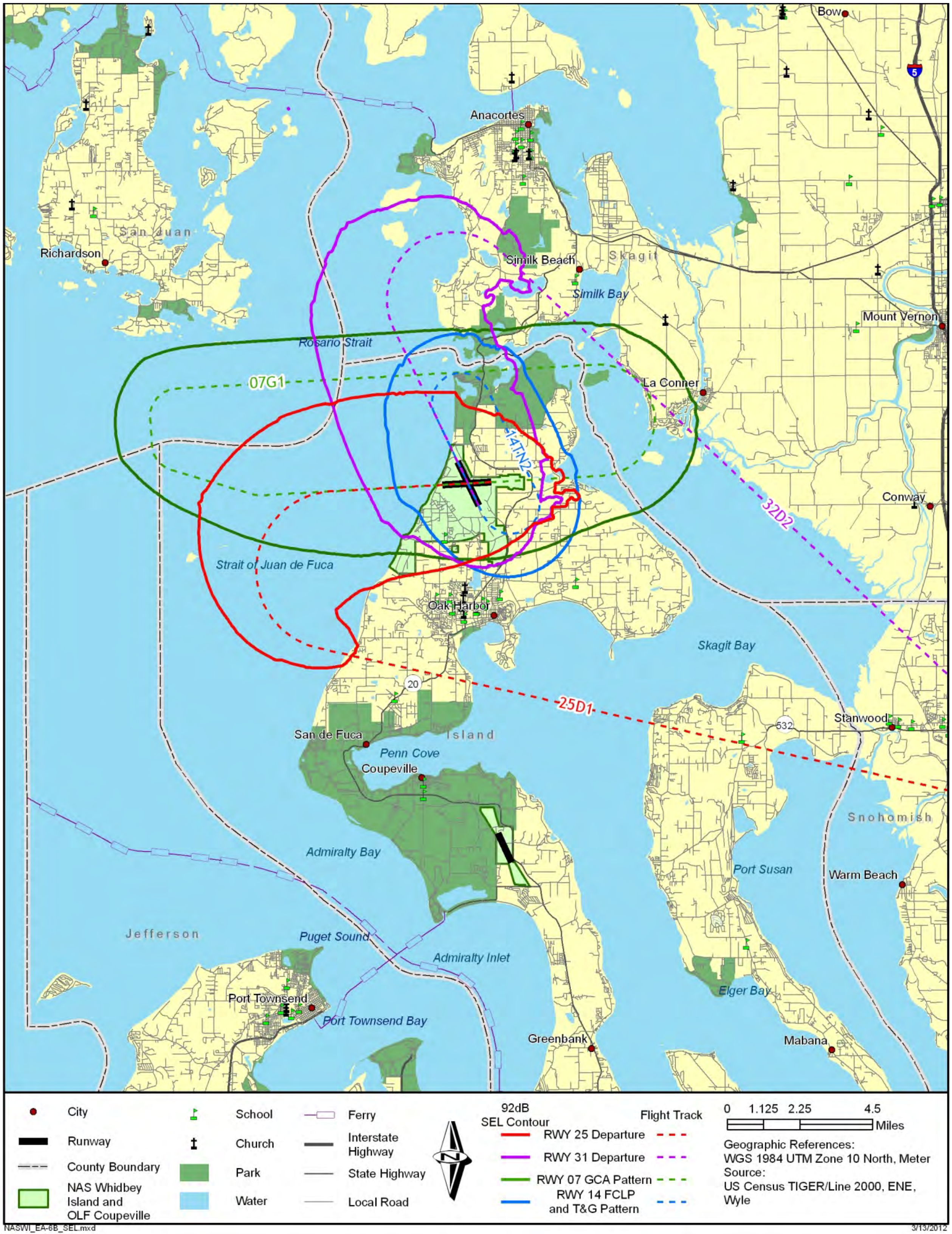


Figure 7-1 SEL Contours of 92 dB for Representative Flight Profiles of the EA-6B

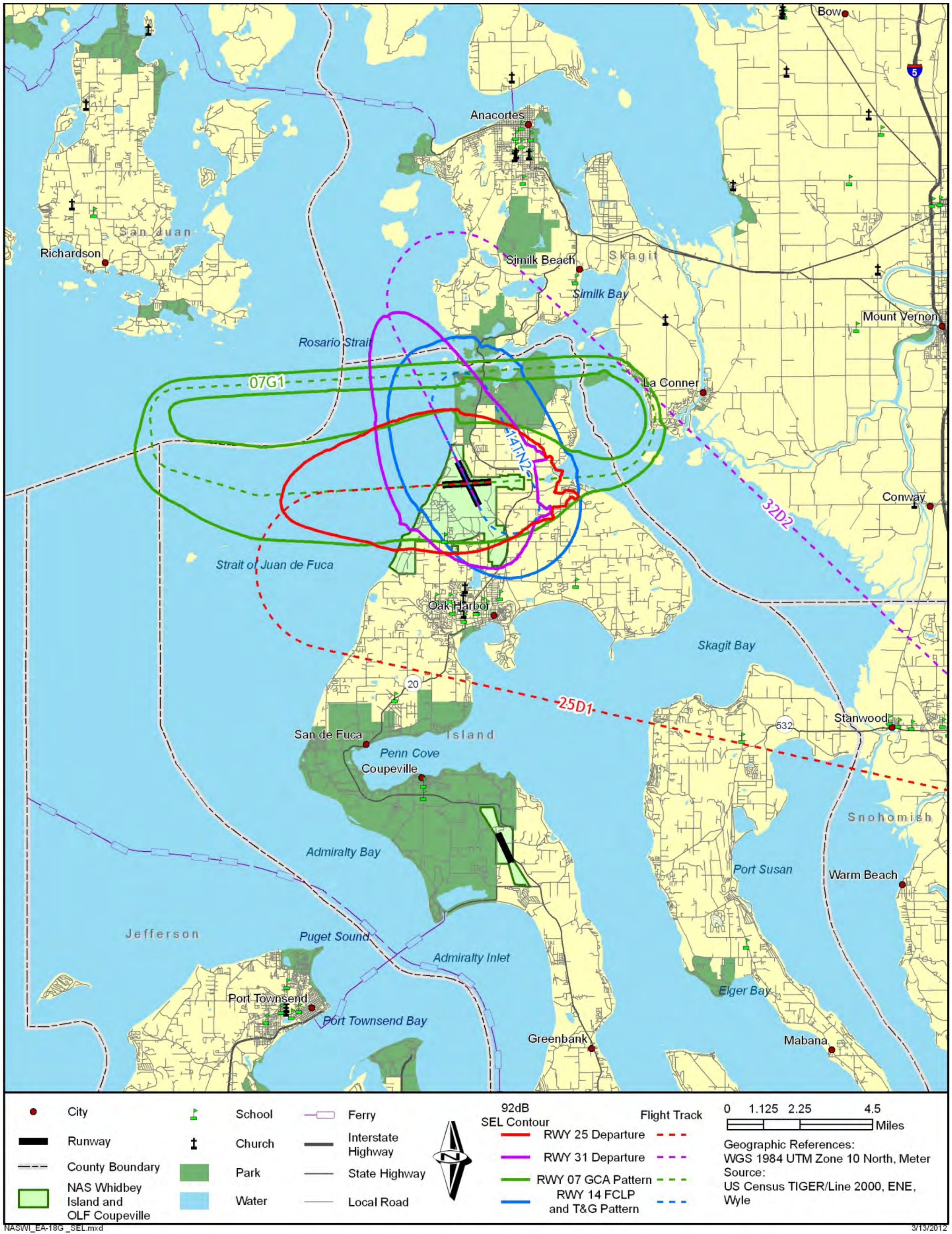
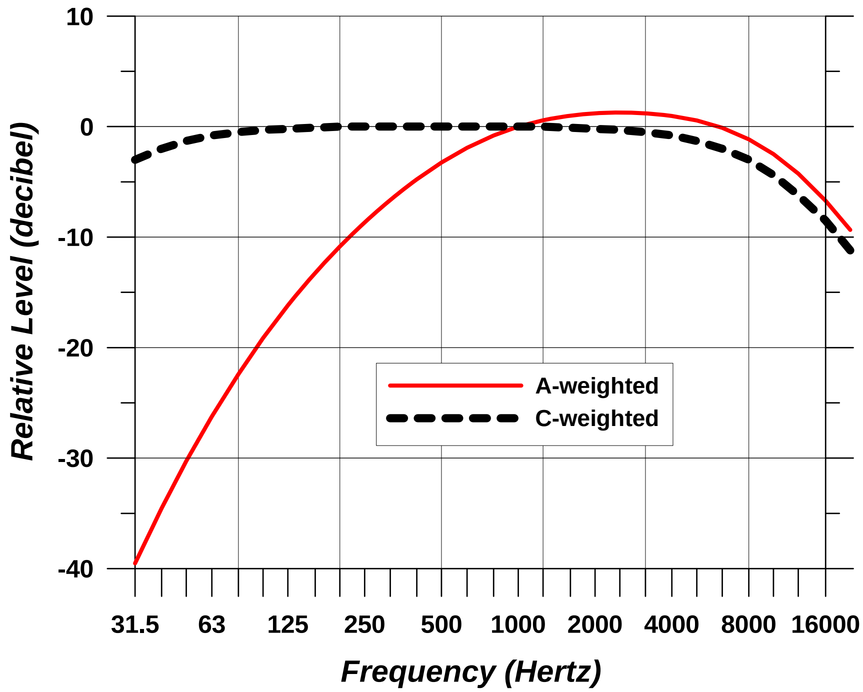


Figure 7-2 **SEL Contours of 92 dB for Representative Flight Profiles of the EA-18G**

7.2 Low-Frequency Noise

The sound levels in this report are in A-weighted decibels. Sound frequency is the number of times per second the air vibrates or oscillates per second and has units of Hertz (Hz). 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- and C-weightings are the two most common weightings and are shown in Figure 7-3. 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.



Source: ANSI S1.4A -1985 "Specification of Sound Level Meters"

Figure 7-3 Frequency Response Characteristics of A- and C-Weighting Networks

These two weightings are adequate to quantify most types of environmental noises. Aircraft noise is assessed for land use compatibility in terms of A-weighted decibels (of Day-Night Average Sound Level). To assess the potential for structural vibration, rattle or damage, C-weighting is utilized.

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 dBC, there is the possibility of the excitation of structural component resonances. While certain frequencies (such as 30 Hz 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 dBC are potentially damaging to structural components (Committee on Hearing, Bioacoustics, and Biomechanics 1977).

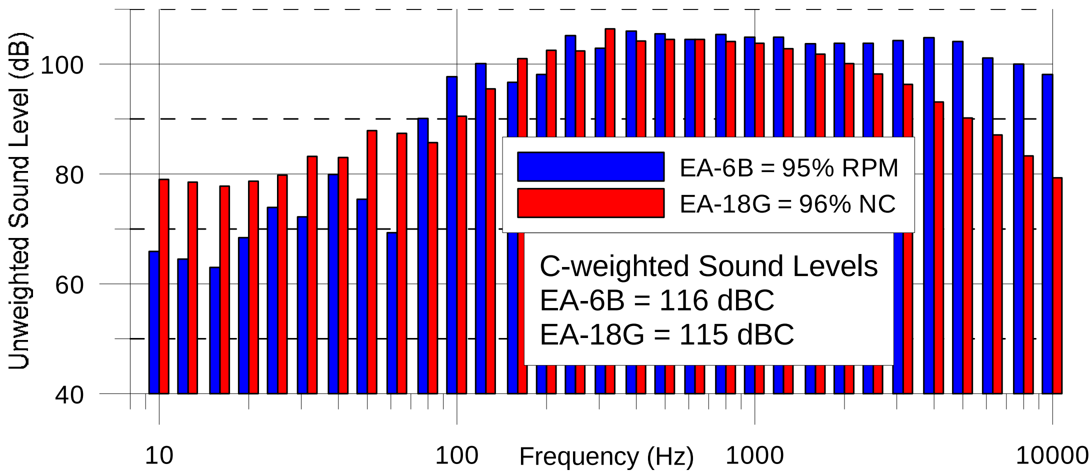
Noise-induced structural vibration may also cause annoyance to dwelling occupants because of induced secondary vibrations, or rattling of objects within the dwelling such as hanging pictures, dishes, plaques, and bric-a-brac. Window panes may also vibrate noticeably when exposed to high levels of airborne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

NASWI has received complaints of building rattle/vibration due to Growler events. Figure 7-4 shows the unweighted one-third octave band spectra from the acoustic reference database (Noisefile). It is important to note that the database's condition is for the aircraft at an altitude of 1000 ft AGL and the receiver located on the ground directly below the aircraft. The Growler's unweighted spectral levels are, on average, 11 dB greater than the Prowler during a Mil power takeoff passing through 1000 ft AGL for frequencies less than 50 Hz. For approaches and cruise power at 1000 ft AGL the frequency spectra of the two aircraft are similar for frequencies less than 50 Hz with average differences of 3 to 5 dB. With its increased low-frequency content, the Growler takeoff events have higher potential to cause noise-induced vibration.

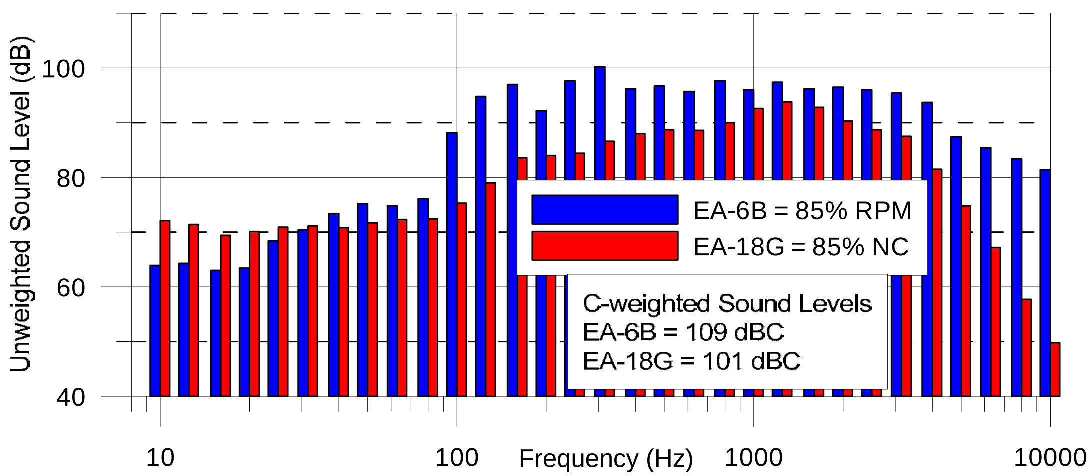
Using the acoustic reference data, the overall C-weighted sound levels for both aircraft for these three conditions are contained in Table 7-4. Due to the EA-6B's spectra sound levels, especially in frequencies minimally affected by the C-weighting, C-weighted sound levels for the EA-6B and EA-18G only differ by 1-2 dBC for the takeoff and approach conditions. In cruise flight, the C-weighted sound levels for the EA-6B are approximately 8 dBC greater than EA-18G. None of these conditions cause C-weighted sound levels to exceed 130 dBC and structural damage would not be expected, however, the takeoff condition has C-weighted sound levels greater than 110 dBC for both aircraft, creating an environment conducive to noise-induced vibration. Additional analysis is recommended to more accurately determine the potential for building rattle/vibration.

Table 7-4 C-weighted Sound Levels, 1000 ft AGL

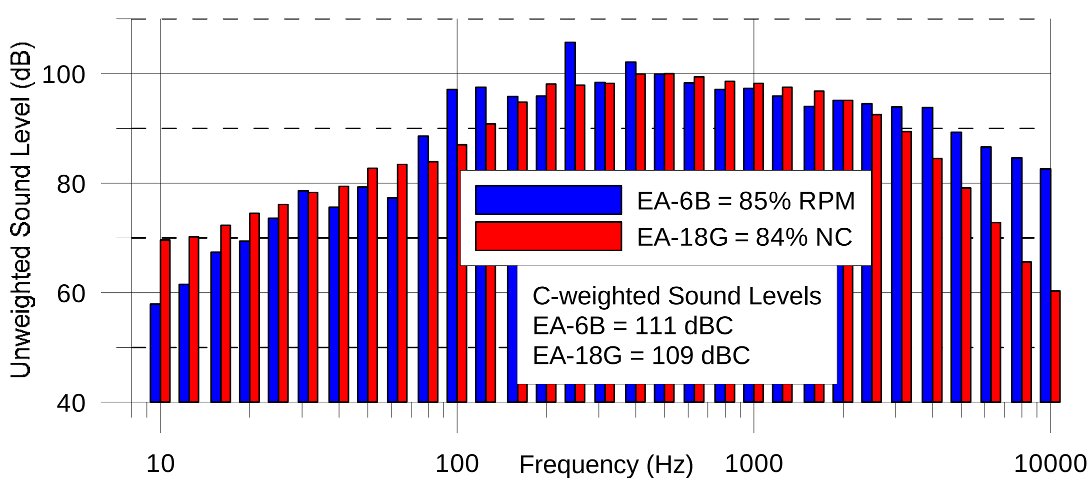
Condition	EA-6B	EA-18G	EA-18G Relative to EA-6B
Takeoff	116	115	-1
Approach (gear down)	111	109	-2
Cruise	109	101	-8



a) Takeoff



b) Cruise



c) Approach

Figure 7-4 Comparison of Sound Spectra for EA-6B and EA-18G (1000 ft AGL, 59°F, 70%RH)

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Appendix A

SUPPORTIVE TABULAR AND GRAPHIC DATA

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Table A-1 Runway and Flight Track Utilization at NASWI and Coupeville for EA-6B and EA-18G

Operation Type	Runway Utilization		Direction split		Flight Track Utilization (%)			
	ID	%			Track ID	Description	Day (0700-2200)	Night (2200-0700)
Departure AB (80%) MIL (20%)	07	13%	East	70%	07D1	Short	50%	50%
					07D2	Center	35%	35%
					07D3	Long	15%	15%
			South	30%	07D4	Short	50%	50%
					07D5	Center	35%	35%
					07D6	Long	15%	15%
	25	44%	East	70%	25D1	Short	50%	50%
					25D2	Center	35%	35%
					25D3	Long	15%	15%
			South	30%	25D4	Short	50%	50%
					25D5	Center	35%	35%
					25D6	Long	15%	15%
	14	36%	East	70%	13D1	Short	50%	50%
					13D2	Center	35%	35%
					13D3	Long	15%	15%
			South	30%	13D4	Short	50%	50%
					13D5	Center	35%	35%
					13D6	Long	15%	15%
	32	7%	East	70%	31D1	Short	50%	50%
					31D2	Center	35%	35%
					31D3	Long	15%	15%
			South	30%	31D4	Short	50%	50%
					31D5	Center	35%	35%
					31D6	Long	15%	15%
Straight-in Arrival	07	13%	East	70%	07A4A	Short	50%	50%
					07A4B	Center	35%	35%
					07A4C	Long	15%	15%
			South	30%	07A5A	Short	50%	50%
					07A5B	Center	35%	35%
					07A5C	Long	15%	15%
	25	44%	East	70%	25A4	Short/Ctr/Long	100%	100%
			South	30%	25A5A	Short	50%	50%
					25A5B	Center	35%	35%
					25A5C	Long	15%	15%
	14	36%	East	70%	13A5A	Short	50%	50%
					13A5B	Center	35%	35%
					13A5C	Long	15%	15%
			South	30%	13A6A	Short	50%	50%
					13A6B	Center	35%	35%
					13A6C	Long	15%	15%
	32	7%	East	70%	31A5A	Short	50%	50%
					31A5B	Center	35%	35%
					31A5C	Long	15%	15%
			South	30%	31A6A	Short	50%	50%
					31A6B	Center	35%	35%
					31A6C	Long	15%	15%
High TACAN Arrival	07	13%			07AHT		100%	100%
	25	44%			25AHT		100%	100%
	14	36%			13AHT		100%	100%
	32	7%			31AHT		100%	100%

Table A-1 Runway and Flight Track Utilization at NASWI and Coupeville for EA-6B and EA-18G (continued)

Operation Type	Runway Utilization ID	Runway Utilization %	Direction split		Flight Track Utilization (%) Track ID	Description	Day (0700-2200)	Night (2200-0700)
Overhead Break Arrival	07	13%	East	90%	07OD1A	Short	33%	
					07OD1B	Center	33%	
					07OD1C	Long	34%	
			West	10%	07OD2A	Short	33%	
					07OD2B	Center	33%	
					07OD2C	Long	34%	
			East	90%	07ON1A	Short		33%
					07ON1B	Center		33%
					07ON1C	Long		34%
			West	10%	07ON2A	Short		33%
					07ON2B	Center		33%
					07ON2C	Long		34%
	25	44%	East	90%	25OD1A	Short	33%	
					25OD1B	Center	33%	
					25OD1C	Long	34%	
			West	10%	25OD2A	Short	33%	
					25OD2B	Center	33%	
					25OD2C	Long	34%	
			East	90%	25ON1A	Short		33%
					25ON1B	Center		33%
					25ON1C	Long		34%
			West	10%	25ON2A	Short		33%
					25ON2B	Center		33%
					25ON2C	Long		34%
	14	36%	East	90%	13OD1A	Short	33%	
					13OD1B	Center	33%	
					13OD1C	Long	34%	
			West	10%	13OD2A	Short	33%	
					13OD2B	Center	33%	
					13OD2C	Long	34%	
			East	90%	13ON1A	Short		33%
					13ON1B	Center		33%
					13ON1C	Long		34%
			West	10%	13ON2A	Short		33%
					13ON2B	Center		33%
					13ON2C	Long		34%
	32	7%	East	90%	31OD1A	Short	33%	
					31OD1B	Center	33%	
					31OD1C	Long	34%	
			West	10%	31OD2A	Short	33%	
					31OD2B	Center	33%	
					31OD2C	Long	34%	
			East	90%	31ON1A	Short		33%
					31ON1B	Center		33%
					31ON1C	Long		34%
			West	10%	31ON2A	Short		33%
					31ON2B	Center		33%
					31ON2C	Long		34%

Table A-1 Runway and Flight Track Utilization at NASWI and Coupeville for EA-6B and EA-18G (continued)

Operation Type	Runway Utilization ID	Runway Utilization %	Direction split	Track ID	Description	Day (0700-2200)	Night (2200-0700)
Depart and Re-enter	07	13%		07DR		50%	50%
				07DL		50%	50%
	25	44%		25DR		50%	50%
				25DL		50%	50%
	14	36%		13DR		50%	50%
				13DL		50%	50%
	32	7%		31DR		50%	50%
				31DL		50%	50%
Touch and Go at Ault Field	07	13%	Daylight	07TD1	Short	13%	
				07TD2	Center	25%	
				07TD3	Long	13%	
			Darkness	07TN1	Short	12%	25%
				07TN2	Center	25%	50%
				07TN3	Long	12%	25%
	25	44%	Daylight	25TD1	Short	13%	
				25TD2	Center	25%	
				25TD3	Long	13%	
			Darkness	25TN1	Short	12%	25%
				25TN2	Center	25%	50%
				25TN3	Long	12%	25%
	14	36%	Daylight	13TD1	Short	13%	
				13TD2	Center	25%	
				13TD3	Long	13%	
			Darkness	13TN1	Short	12%	25%
				13TN2	Center	25%	50%
				13TN3	Long	12%	25%
	32	7%	Daylight	31TD1	Short	13%	
				31TD2	Center	25%	
				31TD3	Long	13%	
			Darkness	31TN1	Short	12%	25%
				31TN2	Center	25%	50%
				31TN3	Long	12%	25%
FCLP at Ault Field	07	13%	Daylight	07TD1	Short	13%	
				07TD2	Center	25%	
				07TD3	Long	13%	
			Darkness	07TN1	Short	12%	25%
				07TN2	Center	25%	50%
				07TN3	Long	12%	25%
	25	44%	Daylight	25TD1	Short	13%	
				25TD2	Center	25%	
				25TD3	Long	13%	
			Darkness	25TN1	Short	12%	25%
				25TN2	Center	25%	50%
				25TN3	Long	12%	25%
	14	36%	Daylight	13TD1	Short	13%	
				13TD2	Center	25%	
				13TD3	Long	13%	
			Darkness	13TN1	Short	12%	25%
				13TN2	Center	25%	50%
				13TN3	Long	12%	25%
	32	7%	Daylight	31TD1	Short	13%	
				31TD2	Center	25%	
				31TD3	Long	13%	
			Darkness	31TN1	Short	12%	25%
				31TN2	Center	25%	50%
				31TN3	Long	12%	25%

Table A-1 Runway and Flight Track Utilization at NASWI and Coupeville for EA-6B and EA-18G (concluded)

Operation Type	Runway Utilization ID	Runway Utilization %	Direction split	Flight Track Utilization (%) Track ID	Description	Day (0700-2200)	Night (2200-0700)
GCA Pattern at Ault Field	07	13%		07G1	3 nm	50%	50%
				07G2	4 nm	20%	20%
				07G3	5 nm	30%	30%
	25	44%		25G1	3 nm	50%	50%
				25G2	4 nm	20%	20%
				25G3	5 nm	30%	30%
	14	36%		13G1	3 nm	50%	50%
				13G2	4 nm	20%	20%
				13G3	5 nm	30%	30%
	32	7%		31G1	3 nm	50%	50%
				31G2	4 nm	20%	20%
				31G3	5 nm	30%	30%
Interfacility Ault Field to Coupeville	7	13%		07WC14D	Interfacility to 14	50%	
				07WC14N			50%
				07WC32D	Interfacility to 32	50%	
				07WC32N			50%
	25	44%		25WC13D	Interfacility to 14	50%	
				25WC13N			50%
				25WC32D	Interfacility to 32	50%	
				25WC32N			50%
	14	36%		13WC14D	Interfacility to 14	50%	
				13WC14N			50%
				13WC32D	Interfacility to 32	50%	
				13WC32N			50%
	32	7%		31WC14D	Interfacility to 14	50%	
				31WC14N			50%
				31WC32D	Interfacility to 32	50%	
				31WC32N			50%
FCLP at Coupeville	14	50%		14TD1		13%	
				14TD2		25%	
				14TD3		13%	
				14TN1		12%	25%
				14TN2		25%	50%
				14TN3		12%	25%
	32	50%		32TD1		13%	
				32TD2		25%	
				32TD3		13%	
				32TN1		12%	25%
				32TN2		25%	50%
				32TN3		12%	25%
Interfacility Coupeville to Ault Field	14	50%		14CW07D	Interfacility to 07	25%	
				14CW07N			25%
				14CW13D	Interfacility to 25	25%	
				14CW13N			25%
				14CW25D	Interfacility to 13	25%	
				14CW25N			25%
				14CW31D	Interfacility to 31	25%	
				14CW31N			25%
	32	50%		32CW07D	Interfacility to 07	25%	
				32CW07N			25%
				32CW13D	Interfacility to 13	25%	
				32CW13N			25%
				32CW25D	Interfacility to 25	25%	
				32CW25N			25%
				32CW31D	Interfacility to 31	25%	
				32CW31N			25%

Table A-2 Runway and Flight Track Utilization at NASWI and Coupeville for C-9

Operation Type	Runway ID	Runway %	Direction split		Track ID	Description	Day (0700-2200)	Night (2200-0700)
Departure	07	13%	East	40%	07D1	Short	0%	0%
					07D2	Center	50%	50%
					07D3	Long	50%	50%
			South	60%	07D4	Short	0%	0%
					07D5	Center	50%	50%
					07D6	Long	50%	50%
	25	44%	East	40%	25D1	Short	0%	0%
					25D2	Center	50%	50%
					25D3	Long	50%	50%
			South	60%	25D4	Short	0%	0%
					25D5	Center	50%	50%
					25D6	Long	50%	50%
	14	36%	East	40%	14D1	Short	0%	0%
					14D2	Center	50%	50%
					14D3	Long	50%	50%
			South	60%	14D4	Short	0%	0%
					14D5	Center	50%	50%
					14D6	Long	50%	50%
	32	7%	East	40%	32D1	Short	0%	0%
					32D2	Center	50%	50%
					32D3	Long	50%	50%
			South	60%	32D4	Short	0%	0%
					32D5	Center	50%	50%
					32D6	Long	50%	50%
Straight-in Arrival	07	13%	East	40%	07A1	arrival	100%	100%
			South	60%	07A2	arrival	50%	50%
					07A3	arrival	50%	50%
	25	44%	East	40%	25A1	arrival	100%	100%
			South	60%	25A2	arrival	50%	50%
					25A3	arrival	50%	50%
	14	36%	East	40%	14A1	arrival	50%	50%
					14A2	arrival	50%	50%
			South	60%	14A3	arrival	50%	50%
					14A4	arrival	50%	50%
	32	7%	East	40%	32A1	arrival	50%	50%
					32A2	arrival	50%	50%
			South	60%	32A3	arrival	50%	50%
					32A4	arrival	50%	50%

Table A-3 Runway and Flight Track Utilization at NASWI and Coupeville for P-3 and P-8

Operation Type	Runway Utilization ID	Runway Utilization %	Track ID	Description	Flight Track Utilization (%) Day (0700-2200)	Flight Track Utilization (%) Night (2200-0700)
Departure	07	13%	07D1	Short		
			07D2	Center	20%	20%
			07D3	Long	20%	20%
			07D4	Short		
			07D5	Center	30%	30%
			07D6	Long	30%	30%
	25	44%	25D1	Short		
			25D2	Center	20%	20%
			25D3	Long	20%	20%
			25D4	Short		
			25D5	Center	30%	30%
			25D6	Long	30%	30%
	13	36%	13D1	Short		
			13D2	Center	20%	20%
			13D3	Long	20%	20%
			13D4	Short		
			13D5	Center	30%	30%
			13D6	Long	30%	30%
	31	7%	31D1	Short		
			31D2	Center	20%	20%
			31D3	Long	20%	20%
			31D4	Short		
			31D5	Center	30%	30%
			31D6	Long	30%	30%
Low TACAN Departure	07	13%	07DLT		100%	100%
	25	44%	25DLT		100%	100%
	13	36%	13DLT		100%	100%
	31	7%	31DLT		100%	100%
Straight-in Arrival (VFR)	07	13%	07A1		40%	40%
		13%	07A2		30%	30%
		13%	07A3		30%	30%
	25	44%	25A1		40%	40%
		44%	25A2		30%	30%
		44%	25A3		30%	30%
	13	36%	13A1		20%	20%
		36%	13A2		20%	20%
		36%	13A3		30%	30%
		36%	13A4		30%	30%
	31	7%	31A1		20%	20%
		7%	31A2		20%	20%
		7%	31A3		30%	30%
		7%	31A4		30%	30%

Table A-3 Runway and Flight Track Utilization at NASWI and Coupeville for P-3 and P-8 (concluded)

Operation Type	Runway Utilization		Flight Track Utilization (%)			
	ID	%	Track ID	Description	Day (0700-2200)	Night (2200-0700)
Straight-in Arrival (IFR)	07	13%	07A4B	Center	20%	20%
		13%	07A4C	Long	20%	20%
		13%	07A5B	Center	30%	30%
		13%	07A5C	Long	30%	30%
	25	44%	25A4	Short/Ctr/Long	40%	40%
		44%	25A5B	Center	30%	30%
		44%	25A5C	Long	30%	30%
	13	36%	13A5B	Center	20%	20%
		36%	13A5C	Long	20%	20%
		36%	13A6B	Center	30%	30%
		36%	13A6C	Long	30%	30%
	31	7%	31A5B	Center	20%	20%
		7%	31A5C	Long	20%	20%
		7%	31A6B	Center	30%	30%
		7%	31A6C	Long	30%	30%
Low TACAN Arrival	07	13%	07ALT		100%	100%
	25	44%	25ALT		100%	100%
	13	36%	13ALT		100%	100%
	31	7%	31ALT		100%	100%
Touch and Go at Ault Field	07	13%	07TN1	Short	25%	25%
		13%	07TN2	Center	50%	50%
		13%	07TN3	Long	25%	25%
	25	44%	25TN1	Short	25%	25%
		44%	25TN2	Center	50%	50%
		44%	25TN3	Long	25%	25%
	13	36%	13TN1	Short	25%	25%
		36%	13TN2	Center	50%	50%
		36%	13TN3	Long	25%	25%
	31	7%	31TN1	Short	25%	25%
		7%	31TN2	Center	50%	50%
		7%	31TN3	Long	25%	25%
GCA Pattern	07	13%	07G2	4 nm	50%	50%
		13%	07G3	5 nm	50%	50%
	25	44%	25G2	4 nm	50%	50%
		44%	25G3	5 nm	50%	50%
	13	36%	13G2	4 nm	50%	50%
		36%	13G3	5 nm	50%	50%
	31	7%	31G2	4 nm	50%	50%
		7%	31G3	5 nm	50%	50%

Table A-4 Modeled Average Daily Flight Events at NASWI and Coupeville for Baseline

Operation Type	Rwy ID	Flight Track	EA-6B Day (0700-2200)	EA-6B Night (2200-0700)	EA-6B Total	EA-18G Day (0700-2200)	EA-18G Night (2200-0700)	EA-18G Total	C-9 Day (0700-2200)	C-9 Night (2200-0700)	C-9 Total	P-3 Day (0700-2200)	P-3 Night (2200-0700)	P-3 Total	Total Day (0700-2200)	Total Night (2200-0700)	Total
Departure MIL	07	07D1	0.23	0.015	0.2446	0.0448	0.0029	0.0477			-				0.2744	0.0179	0.2923
		07D2	0.161	0.0105	0.1712	0.0313	0.002	0.0333	0.014	0.0076	0.0216	0.2503	0.0097	0.2600	0.4563	0.0298	0.4861
		07D3	0.069	0.0045	0.0734	0.0134	0.0009	0.0143	0.014	0.0076	0.0216	0.2503	0.0097	0.2600	0.3466	0.0227	0.3693
		07D4	0.098	0.0064	0.1048	0.0192	0.0013	0.0205			-				0.1176	0.0077	0.1253
		07D5	0.069	0.0045	0.0734	0.0134	0.0009	0.0143	0.021	0.0113	0.0322	0.3755	0.0145	0.3900	0.4787	0.0312	0.5099
		07D6	0.03	0.0019	0.0314	0.0058	0.0004	0.0062	0.021	0.0113	0.0322	0.3755	0.0145	0.3900	0.4317	0.0281	0.4598
	25	25D1	0.777	0.0506	0.8278	0.1516	0.0099	0.1615			-				0.9288	0.0605	0.9893
		25D2	0.544	0.0354	0.5794	0.1061	0.0069	0.1130	0.047	0.0256	0.0729	0.8472	0.0328	0.8800	1.5446	0.1007	1.6453
		25D3	0.233	0.0152	0.2484	0.0455	0.003	0.0485	0.047	0.0256	0.0729	0.8472	0.0328	0.8800	1.1732	0.0766	1.2498
		25D4	0.333	0.0217	0.3548	0.065	0.0042	0.0692			-				0.3981	0.0259	0.4240
		25D5	0.233	0.0152	0.2484	0.0455	0.003	0.0485	0.071	0.0383	0.1092	1.2708	0.0492	1.3201	1.6204	0.1057	1.7262
		25D6	0.1	0.0065	0.1064	0.0195	0.0013	0.0208	0.071	0.0383	0.1092	1.2708	0.0492	1.3201	1.4611	0.0953	1.5565
	14	14D1	0.636	0.0414	0.6773	0.124	0.0081	0.1321			-				0.7599	0.0495	0.8094
		14D2	0.445	0.029	0.4741	0.0868	0.0057	0.0925	0.039	0.0209	0.0596	0.6932	0.0268	0.7200	1.2638	0.0824	1.3462
		14D3	0.191	0.0124	0.2032	0.0372	0.0024	0.0396	0.039	0.0209	0.0596	0.6932	0.0268	0.7200	0.9599	0.0625	1.0224
		14D4	0.273	0.0178	0.2903	0.0531	0.0035	0.0566			-				0.3256	0.0213	0.3469
		14D5	0.191	0.0124	0.2032	0.0372	0.0024	0.0396	0.058	0.0314	0.0894	1.0398	0.0403	1.0800	1.3258	0.0865	1.4122
		14D6	0.082	0.0053	0.0871	0.0159	0.001	0.0169	0.058	0.0314	0.0894	1.0398	0.0403	1.0800	1.1955	0.078	1.2734
	32	32D1	0.124	0.0081	0.1317	0.0241	0.0016	0.0257			-				0.1477	0.0097	0.1574
		32D2	0.087	0.0056	0.0921	0.0169	0.0011	0.0180	0.008	0.0041	0.0116	0.1348	0.0052	0.1400	0.2457	0.016	0.2617
		32D3	0.037	0.0024	0.0395	0.0072	0.0005	0.0077	0.008	0.0041	0.0116	0.1348	0.0052	0.1400	0.1866	0.0122	0.1988
		32D4	0.053	0.0035	0.0565	0.0103	0.0007	0.0110			-				0.0633	0.0042	0.0675
		32D5	0.037	0.0024	0.0395	0.0072	0.0005	0.0077	0.011	0.0061	0.0174	0.2022	0.0078	0.2100	0.2578	0.0168	0.2746
		32D6	0.016	0.001	0.0169	0.0031	0.0002	0.0033	0.011	0.0061	0.0174	0.2022	0.0078	0.2100	0.2325	0.0151	0.2476
Departure Afterburner	07	07D1			-	0.1791	0.0117	0.1908			-				0.1791	0.0117	0.1908
		07D2			-	0.1254	0.0082	0.1336			-				0.1254	0.0082	0.1336
		07D3			-	0.0537	0.0035	0.0572			-				0.0537	0.0035	0.0572
		07D4			-	0.0768	0.005	0.0818			-				0.0768	0.005	0.0818
		07D5			-	0.0537	0.0035	0.0572			-				0.0537	0.0035	0.0572
		07D6			-	0.023	0.0015	0.0245			-				0.023	0.0015	0.0245
	25	25D1			-	0.6062	0.0395	0.6457			-				0.6062	0.0395	0.6457
		25D2			-	0.4243	0.0276	0.4519			-				0.4243	0.0276	0.4519
		25D3			-	0.1819	0.0118	0.1937			-				0.1819	0.0118	0.1937
		25D4			-	0.2598	0.0169	0.2767			-				0.2598	0.0169	0.2767
		25D5			-	0.1819	0.0118	0.1937			-				0.1819	0.0118	0.1937
		25D6			-	0.0779	0.0051	0.0830			-				0.0779	0.0051	0.0830
	14	14D1			-	0.496	0.0323	0.5283			-				0.496	0.0323	0.5283
		14D2			-	0.3472	0.0226	0.3698			-				0.3472	0.0226	0.3698
		14D3			-	0.1488	0.0097	0.1585			-				0.1488	0.0097	0.1585
		14D4			-	0.2126	0.0138	0.2264			-				0.2126	0.0138	0.2264
		14D5			-	0.1488	0.0097	0.1585			-				0.1488	0.0097	0.1585
		14D6			-	0.0638	0.0042	0.0680			-				0.0638	0.0042	0.0680
	32	32D1			-	0.0964	0.0063	0.1027			-				0.0964	0.0063	0.1027
		32D2			-	0.0675	0.0044	0.0719			-				0.0675	0.0044	0.0719
		32D3			-	0.0289	0.0019	0.0308			-				0.0289	0.0019	0.0308
		32D4			-	0.0413	0.0027	0.0440			-				0.0413	0.0027	0.0440
		32D5			-	0.0289	0.0019	0.0308			-				0.0289	0.0019	0.0308
		32D6			-	0.0124	0.0008	0.0132			-				0.0124	0.0008	0.0132
Low TACAN Departure	07	07DHT										1.4339	0.0555	1.4894	1.4339	0.0555	1.4894
	25	25DHT										4.8532	0.1879	5.0411	4.8532	0.1879	5.0411
	14	14DHT										3.9708	0.1538	4.1246	3.9708	0.1538	4.1246
	32	32DHT										0.7721	0.0299	0.8020	0.7721	0.0299	0.8020

Table A-4 Modeled Average Daily Flight Events at NASWI and Coupeville for Baseline (continued)

Operation Type	Rwy ID	Flight Track	EA-6B			EA-18G			C-9			P-3			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
Straight-in Arrival (VFR)	07	07A1						-	0.0279	0.0151	0.0430	0.7586	0.0326	0.7913	0.7865	0.0477	0.8343
		07A2						-	0.0209	0.0113	0.0322	0.569	0.0245	0.5934	0.5899	0.0358	0.6256
		07A3						-	0.0209	0.0113	0.0322	0.569	0.0245	0.5934	0.5899	0.0358	0.6256
	25	25A1						-	0.0945	0.0511	0.1456	2.5677	0.1104	2.6781	2.6622	0.1615	2.8237
		25A2						-	0.0709	0.0383	0.1092	1.9258	0.0828	2.0086	1.9967	0.1211	2.1178
		25A3						-	0.0709	0.0383	0.1092	1.9258	0.0828	2.0086	1.9967	0.1211	2.1178
	14	14A1						-	0.0387	0.0209	0.0596	1.0504	0.0452	1.0956	1.0891	0.0661	1.1552
		14A2						-	0.0387	0.0209	0.0596	1.0504	0.0452	1.0956	1.0891	0.0661	1.1552
		14A3						-	0.058	0.0314	0.0894	1.5756	0.0678	1.6434	1.6336	0.0992	1.7328
		14A4						-	0.058	0.0314	0.0894	1.5756	0.0678	1.6434	1.6336	0.0992	1.7328
	32	32A1						-	0.0075	0.0041	0.0116	0.2042	0.0088	0.2130	0.2117	0.0129	0.2246
		32A2						-	0.0075	0.0041	0.0116	0.2042	0.0088	0.2130	0.2117	0.0129	0.2246
		32A3						-	0.0113	0.0061	0.0174	0.3064	0.0132	0.3195	0.3177	0.0193	0.3369
		32A4						-	0.0113	0.0061	0.0174	0.3064	0.0132	0.3195	0.3177	0.0193	0.3369
Straight-in Arrival (IFR)	07	07A4A	0.082	0.0022	0.0842	0.08	0.002	0.0821			-	0	0		0.162	0.0043	0.1663
		07A4B	0.0574	0.0016	0.0590	0.056	0.002	0.0575			-	0.0789	0.0022	0.0811	0.1923	0.0053	0.1976
		07A4C	0.0246	0.0007	0.0253	0.024	6E-04	0.0246			-	0.0789	0.0022	0.0811	0.1275	0.0035	0.1310
		07A5A	0.0352	0.001	0.0362	0.0343	9E-04	0.0352			-	0	0		0.0695	0.0019	0.0714
		07A5B	0.0246	0.0007	0.0253	0.024	6E-04	0.0246			-	0.1184	0.0033	0.1217	0.167	0.0046	0.1716
		07A5C	0.0105	0.0003	0.0108	0.0103	3E-04	0.0106			-	0.1184	0.0033	0.1217	0.1392	0.0039	0.1431
	25	25A4	0.5552	0.0152	0.5704	0.5417	0.014	0.5560			-	0.5343	0.0149	0.5492	1.6312	0.0444	1.6756
		25A5A	0.119	0.0033	0.1223	0.1161	0.003	0.1192			-	0	0		0.2351	0.0064	0.2415
		25A5B	0.0833	0.0023	0.0856	0.0813	0.002	0.0835			-	0.4007	0.0112	0.4119	0.5653	0.0157	0.5810
		25A5C	0.0357	0.001	0.0367	0.0348	9E-04	0.0357			-	0.4007	0.0112	0.4119	0.4712	0.0131	0.4843
	14	14A5A	0.2271	0.0062	0.2333	0.2216	0.006	0.2275			-	0	0		0.4487	0.0121	0.4608
		14A5B	0.159	0.0043	0.1633	0.1551	0.004	0.1592			-	0.2186	0.0061	0.2247	0.5327	0.0145	0.5472
		14A5C	0.0681	0.0019	0.0700	0.0665	0.002	0.0683			-	0.2186	0.0061	0.2247	0.3532	0.0098	0.3630
		14A6A	0.0973	0.0027	0.1000	0.095	0.003	0.0975			-	0	0		0.1923	0.0052	0.1975
		14A6B	0.0681	0.0019	0.0700	0.0665	0.002	0.0683			-	0.3278	0.0092	0.3370	0.4624	0.0129	0.4753
		14A6C	0.0292	0.0008	0.0300	0.0285	8E-04	0.0293			-	0.3278	0.0092	0.3370	0.3855	0.0108	0.3963
	32	32A5A	0.0442	0.0012	0.0454	0.0431	0.001	0.0442			-	0	0		0.0873	0.0023	0.0896
		32A5B	0.0309	0.0008	0.0317	0.0302	8E-04	0.0310			-	0.0425	0.0012	0.0437	0.1036	0.0028	0.1064
		32A5C	0.0133	0.0004	0.0137	0.0129	3E-04	0.0132			-	0.0425	0.0012	0.0437	0.0687	0.0019	0.0706
		32A6A	0.0189	0.0005	0.0194	0.0185	5E-04	0.0190			-	0	0		0.0374	0.001	0.0384
		32A6B	0.0133	0.0004	0.0137	0.0129	3E-04	0.0132			-	0.0637	0.0018	0.0655	0.0899	0.0025	0.0924
		32A6C	0.0057	0.0002	0.0059	0.0055	1E-04	0.0056			-	0.0637	0.0018	0.0655	0.0749	0.0021	0.0770
High TACAN Arrival	07	07AHT	0.0755	0.0064	0.0819	0.0737	0.006	0.0798			-	0	0		0.1492	0.0125	0.1617
	25	25AHT	0.2556	0.0217	0.2773	0.2495	0.021	0.2700			-	0	0		0.5051	0.0422	0.5473
	14	14AHT	0.2091	0.0178	0.2269	0.2042	0.017	0.2210			-	0	0		0.4133	0.0346	0.4479
	32	32AHT	0.0407	0.0035	0.0442	0.0397	0.003	0.0430			-	0	0		0.0804	0.0068	0.0872
Low TACAN Arrival	07	07ALT			-			-			-	0.3946	0.011	0.4057	0.3946	0.011	0.4057
	25	25ALT			-			-			-	1.3357	0.0374	1.3730	1.3357	0.0374	1.3730
	14	14ALT			-			-			-	1.0928	0.0306	1.1234	1.0928	0.0306	1.1234
	32	32ALT			-			-			-	0.2125	0.0059	0.2184	0.2125	0.0059	0.2184

Table A-4 Modeled Average Daily Flight Events at NASWI and Coupeville for Baseline (continued)

Operation Type	Rwy ID	Flight Track	EA-6B			EA-18G			C-9			P-3			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
Overhead Break Arrival	07	07OD1A	0.1017	0	0.1017	0.0991	0	0.0991			-	0	0		0.2008	0	0.2008
		07OD1B	0.1017	0	0.1017	0.0991	0	0.0991			-	0	0		0.2008	0	0.2008
		07OD1C	0.1047	0	0.1047	0.1021	0	0.1021			-	0	0		0.2068	0	0.2068
		07OD2A	0.0113	0	0.0113	0.011	0	0.0110			-	0	0		0.0223	0	0.0223
		07OD2B	0.0113	0	0.0113	0.011	0	0.0110			-	0	0		0.0223	0	0.0223
		07OD2C	0.0116	0	0.0116	0.0113	0	0.0113			-	0	0		0.0229	0	0.0229
		07ON1A	0	0.01	0.0100	0	0.0098	0.0098			-	0	0		0	0.0198	0.0198
		07ON1B	0	0.01	0.0100	0	0.0098	0.0098			-	0	0		0	0.0198	0.0198
		07ON1C	0	0.0104	0.0104	0	0.0101	0.0101			-	0	0		0	0.0205	0.0205
		07ON2A	0	0.0011	0.0011	0	0.0011	0.0011			-	0	0		0	0.0022	0.0022
		07ON2B	0	0.0011	0.0011	0	0.0011	0.0011			-	0	0		0	0.0022	0.0022
		07ON2C	0	0.0012	0.0012	0	0.0011	0.0011			-	0	0		0	0.0023	0.0023
	25	25OD1A	0.3441	0	0.3441	0.3355	0	0.3355			-	0	0		0.6796	0	0.6796
		25OD1B	0.3441	0	0.3441	0.3355	0	0.3355			-	0	0		0.6796	0	0.6796
		25OD1C	0.3545	0	0.3545	0.3456	0	0.3456			-	0	0		0.7001	0	0.7001
		25OD2A	0.0382	0	0.0382	0.0373	0	0.0373			-	0	0		0.0755	0	0.0755
		25OD2B	0.0382	0	0.0382	0.0373	0	0.0373			-	0	0		0.0755	0	0.0755
		25OD2C	0.0394	0	0.0394	0.0384	0	0.0384			-	0	0		0.0778	0	0.0778
		25ON1A	0	0.034	0.0340	0	0.0333	0.0333			-	0	0		0	0.0673	0.0673
		25ON1B	0	0.034	0.0340	0	0.0333	0.0333			-	0	0		0	0.0673	0.0673
		25ON1C	0	0.035	0.0350	0	0.0343	0.0343			-	0	0		0	0.0693	0.0693
		25ON2A	0	0.0038	0.0038	0	0.0037	0.0037			-	0	0		0	0.0075	0.0075
		25ON2B	0	0.0038	0.0038	0	0.0037	0.0037			-	0	0		0	0.0075	0.0075
		25ON2C	0	0.0039	0.0039	0	0.0038	0.0038			-	0	0		0	0.0077	0.0077
	14	14OD1A	0.2815	0	0.2815	0.2745	0	0.2745			-	0	0		0.556	0	0.5560
		14OD1B	0.2815	0	0.2815	0.2745	0	0.2745			-	0	0		0.556	0	0.5560
		14OD1C	0.29	0	0.2900	0.2828	0	0.2828			-	0	0		0.5728	0	0.5728
		14OD2A	0.0313	0	0.0313	0.0305	0	0.0305			-	0	0		0.0618	0	0.0618
		14OD2B	0.0313	0	0.0313	0.0305	0	0.0305			-	0	0		0.0618	0	0.0618
		14OD2C	0.0322	0	0.0322	0.0314	0	0.0314			-	0	0		0.0636	0	0.0636
		14ON1A	0	0.0278	0.0278	0	0.0272	0.0272			-	0	0		0	0.055	0.0550
		14ON1B	0	0.0278	0.0278	0	0.0272	0.0272			-	0	0		0	0.055	0.0550
		14ON1C	0	0.0287	0.0287	0	0.0281	0.0281			-	0	0		0	0.0568	0.0568
		14ON2A	0	0.0031	0.0031	0	0.003	0.0030			-	0	0		0	0.0061	0.0061
		14ON2B	0	0.0031	0.0031	0	0.003	0.0030			-	0	0		0	0.0061	0.0061
		14ON2C	0	0.0032	0.0032	0	0.0031	0.0031			-	0	0		0	0.0063	0.0063
	32	32OD1A	0.0547	0	0.0547	0.0534	0	0.0534			-	0	0		0.1081	0	0.1081
		32OD1B	0.0547	0	0.0547	0.0534	0	0.0534			-	0	0		0.1081	0	0.1081
		32OD1C	0.0564	0	0.0564	0.055	0	0.0550			-	0	0		0.1114	0	0.1114
		32OD2A	0.0061	0	0.0061	0.0059	0	0.0059			-	0	0		0.012	0	0.0120
		32OD2B	0.0061	0	0.0061	0.0059	0	0.0059			-	0	0		0.012	0	0.0120
		32OD2C	0.0063	0	0.0063	0.0061	0	0.0061			-	0	0		0.0124	0	0.0124
		32ON1A	0	0.0054	0.0054	0	0.0053	0.0053			-	0	0		0	0.0107	0.0107
		32ON1B	0	0.0054	0.0054	0	0.0053	0.0053			-	0	0		0	0.0107	0.0107
		32ON1C	0	0.0056	0.0056	0	0.0055	0.0055			-	0	0		0	0.0111	0.0111
		32ON2A	0	0.0006	0.0006	0	0.0006	0.0006			-	0	0		0	0.0012	0.0012
		32ON2B	0	0.0006	0.0006	0	0.0006	0.0006			-	0	0		0	0.0012	0.0012
		32ON2C	0	0.0006	0.0006	0	0.0006	0.0006			-	0	0		0	0.0012	0.0012
Depart and Re-enter	07	07DR	0.0094	0.0007	0.0101	0.0093	0.0007	0.0100			-	0	0		0.0187	0.0014	0.0201
		07DL	0.0094	0.0007	0.0101	0.0093	0.0007	0.0100			-	0	0		0.0187	0.0014	0.0201
	25	25DR	0.0319	0.0024	0.0343	0.0313	0.0024	0.0337			-	0	0		0.0632	0.0048	0.0680
		25DL	0.0319	0.0024	0.0343	0.0313	0.0024	0.0337			-	0	0		0.0632	0.0048	0.0680
	14	14DR	0.0261	0.002	0.0281	0.0256	0.002	0.0276			-	0	0		0.0517	0.004	0.0557
		14DL	0.0261	0.002	0.0281	0.0256	0.002	0.0276			-	0	0		0.0517	0.004	0.0557
	32	32DR	0.0051	0.0004	0.0055	0.005	0.0004	0.0054			-	0	0		0.0101	0.0008	0.0109
		32DL	0.0051	0.0004	0.0055	0.005	0.0004	0.0054			-	0	0		0.0101	0.0008	0.0109

Table A-4 Modeled Average Daily Flight Events at NASWI and Coupeville for Baseline (continued)

Operation Type	Rwy ID	Flight Track	EA-6B Day (0700-2200)	EA-6B Night (2200-0700)	EA-6B Total	EA-18G Day (0700-2200)	EA-18G Night (2200-0700)	EA-18G Total	C-9 Day (0700-2200)	C-9 Night (2200-0700)	C-9 Total	P-3 Day (0700-2200)	P-3 Night (2200-0700)	P-3 Total	Total Day (0700-2200)	Total Night (2200-0700)	Total Total
Touch and Go at Ault Field	07	07TD1	0.0925	0	0.0925	0.0901	0	0.0901			-	0	0		0.1826	0	0.1826
		07TD2	0.1849	0	0.1849	0.1803	0	0.1803			-	0	0		0.3652	0	0.3652
		07TD3	0.0925	0	0.0925	0.0901	0	0.0901			-	0	0		0.1826	0	0.1826
		07TN1	0.0902	0.0086	0.0988	0.0879	0.0084	0.0963			-	0.532	0.0101	0.5420	0.71	0.0271	0.7371
		07TN2	0.1804	0.0173	0.1977	0.1759	0.0168	0.1927			-	1.064	0.0202	1.0840	1.4201	0.0543	1.4744
		07TN3	0.0902	0.0086	0.0988	0.0879	0.0084	0.0963			-	0.532	0.0101	0.5420	0.71	0.0271	0.7371
	25	25TD1	0.3129	0	0.3129	0.3051	0	0.3051			-	0	0		0.618	0	0.6180
		25TD2	0.6259	0	0.6259	0.6102	0	0.6102			-	0	0		1.2361	0	1.2361
		25TD3	0.3129	0	0.3129	0.3051	0	0.3051			-	0	0		0.618	0	0.6180
		25TN1	0.3053	0.0292	0.3345	0.2977	0.0285	0.3262			-	1.8	0.0342	1.8344	2.4032	0.0919	2.4951
		25TN2	0.6106	0.0585	0.6691	0.5953	0.057	0.6523			-	3.601	0.0684	3.6689	4.8064	0.1839	4.9903
		25TN3	0.3053	0.0292	0.3345	0.2977	0.0285	0.3262			-	1.8	0.0342	1.8344	2.4032	0.0919	2.4951
	14	14TD1	0.256	0	0.2560	0.2496	0	0.2496			-	0	0		0.5056	0	0.5056
		14TD2	0.5121	0	0.5121	0.4992	0	0.4992			-	0	0		1.0113	0	1.0113
		14TD3	0.256	0	0.2560	0.2496	0	0.2496			-	0	0		0.5056	0	0.5056
		14TN1	0.2498	0.0239	0.2737	0.2435	0.0233	0.2668			-	1.473	0.028	1.5009	1.9662	0.0752	2.0414
		14TN2	0.4996	0.0478	0.5474	0.4871	0.0466	0.5337			-	2.946	0.056	3.0018	3.9325	0.1504	4.0829
		14TN3	0.2498	0.0239	0.2737	0.2435	0.0233	0.2668			-	1.473	0.028	1.5009	1.9662	0.0752	2.0414
	32	32TD1	0.0498	0	0.0498	0.0485	0	0.0485			-	0	0		0.0983	0	0.0983
		32TD2	0.0996	0	0.0996	0.0971	0	0.0971			-	0	0		0.1967	0	0.1967
		32TD3	0.0498	0	0.0498	0.0485	0	0.0485			-	0	0		0.0983	0	0.0983
		32TN1	0.0486	0.0047	0.0533	0.0474	0.0045	0.0519			-	0.286	0.0054	0.2918	0.3824	0.0146	0.3970
		32TN2	0.0971	0.0093	0.1064	0.0947	0.0091	0.1038			-	0.573	0.0109	0.5837	0.7646	0.0293	0.7939
		32TN3	0.0486	0.0047	0.0533	0.0474	0.0045	0.0519			-	0.286	0.0054	0.2918	0.3824	0.0146	0.3970
FCLP at Ault Field	07	07TD1	0.1602	0	0.1602	0.1562	0	0.1562			-	0	0		0.3164	0	0.3164
		07TD2	0.3204	0	0.3204	0.3124	0	0.3124			-	0	0		0.6328	0	0.6328
		07TD3	0.1602	0	0.1602	0.1562	0	0.1562			-	0	0		0.3164	0	0.3164
		07TN1	0.1563	0.0662	0.2225	0.1524	0.0645	0.2169			-	0	0		0.3087	0.1307	0.4394
		07TN2	0.3126	0.1323	0.4449	0.3048	0.1289	0.4337			-	0	0		0.6174	0.2612	0.8786
		07TN3	0.1563	0.0662	0.2225	0.1524	0.0645	0.2169			-	0	0		0.3087	0.1307	0.4394
	25	25TD1	0.5422	0	0.5422	0.5287	0	0.5287			-	0	0		1.0709	0	1.0709
		25TD2	1.0844	0	1.0844	1.0574	0	1.0574			-	0	0		2.1418	0	2.1418
		25TD3	0.5422	0	0.5422	0.5287	0	0.5287			-	0	0		1.0709	0	1.0709
		25TN1	0.529	0.2239	0.7529	0.5158	0.2182	0.7340			-	0	0		1.0448	0.4421	1.4869
		25TN2	1.058	0.4478	1.5058	1.0317	0.4364	1.4681			-	0	0		2.0897	0.8842	2.9739
		25TN3	0.529	0.2239	0.7529	0.5158	0.2182	0.7340			-	0	0		1.0448	0.4421	1.4869
	14	14TD1	0.4436	0	0.4436	0.4326	0	0.4326			-	0	0		0.8762	0	0.8762
		14TD2	0.8872	0	0.8872	0.8652	0	0.8652			-	0	0		1.7524	0	1.7524
		14TD3	0.4436	0	0.4436	0.4326	0	0.4326			-	0	0		0.8762	0	0.8762
		14TN1	0.4328	0.1832	0.6160	0.4221	0.1785	0.6006			-	0	0		0.8549	0.3617	1.2166
		14TN2	0.8657	0.3664	1.2321	0.8441	0.357	1.2011			-	0	0		1.7098	0.7234	2.4332
		14TN3	0.4328	0.1832	0.6160	0.4221	0.1785	0.6006			-	0	0		0.8549	0.3617	1.2166
	32	32TD1	0.0863	0	0.0863	0.0841	0	0.0841			-	0	0		0.1704	0	0.1704
		32TD2	0.1725	0	0.1725	0.1682	0	0.1682			-	0	0		0.3407	0	0.3407
		32TD3	0.0863	0	0.0863	0.0841	0	0.0841			-	0	0		0.1704	0	0.1704
		32TN1	0.0842	0.0356	0.1198	0.0821	0.0347	0.1168			-	0	0		0.1663	0.0703	0.2366
		32TN2	0.1683	0.0712	0.2395	0.1641	0.0694	0.2335			-	0	0		0.3324	0.1406	0.4730
		32TN3	0.0842	0.0356	0.1198	0.0821	0.0347	0.1168			-	0	0		0.1663	0.0703	0.2366
GCA Pattern at Ault Field	07	07G1	0.081	0.073	0.1540	0.0791	0.0712	0.1503			-	0	0		0.1601	0.1442	0.3043
		07G2	0.0324	0.0292	0.0616	0.0316	0.0285	0.0601			-	0.385	0.0144	0.3998	0.4494	0.0721	0.5215
		07G3	0.0486	0.0438	0.0924	0.0474	0.0427	0.0901			-	0.385	0.0144	0.3998	0.4814	0.1009	0.5823
	25	25G1	0.2742	0.2471	0.5213	0.2676	0.2411	0.5087			-	0	0		0.5418	0.4882	1.0300
		25G2	0.1097	0.0988	0.2085	0.107	0.0964	0.2034			-	1.304	0.0488	1.3532	1.521	0.244	1.7651
		25G3	0.1645	0.1483	0.3128	0.1606	0.1447	0.3053			-	1.304	0.0488	1.3532	1.6294	0.3418	1.9713
	14	14G1	0.2244	0.2022	0.4266	0.219	0.1973	0.4163			-	0	0		0.4434	0.3995	0.8429
		14G2	0.0898	0.0809	0.1707	0.0876	0.0789	0.1665			-	1.067	0.0399	1.1071	1.2446	0.1997	1.4443
		14G3	0.1346	0.1213	0.2559	0.1314	0.1184	0.2498			-	1.067	0.0399	1.1071	1.3332	0.2796	1.6128
	32	32G1	0.0436	0.0393	0.0829	0.0426	0.0384	0.0810			-	0	0		0.0862	0.0777	0.1639
		32G2	0.0175	0.0157	0.0332	0.017	0.0153	0.0323			-	0.208	0.0078	0.2153	0.242	0.0388	0.2808
		32G3	0.0262	0.0236	0.0498	0.0255	0.023	0.0485			-	0.208	0.0078	0.2153	0.2592	0.0544	0.3136

Table A-4 Modeled Average Daily Flight Events at NASWI and Coupeville for Baseline (concluded)

Operation Type	Rwy ID	Flight Track	EA-6B Day (0700-2200)	EA-6B Night (2200-0700)	EA-6B Total	EA-18G Day (0700-2200)	EA-18G Night (2200-0700)	EA-18G Total	C-9 Day (0700-2200)	C-9 Night (2200-0700)	C-9 Total	P-3 Day (0700-2200)	P-3 Night (2200-0700)	P-3 Total	Total Day (0700-2200)	Total Night (2200-0700)	Total Total
Interfacility Ault Field to Coupeville	7	07WC14D	0.0328	0	0.0328	0.0319	0	0.0319			-	0	0		0.0647	0	0.0647
		07WC14N	0	0.002	0.0020	0	0.002	0.0020			-	0	0		0	0.004	0.0040
		07WC32D	0.0328	0	0.0328	0.0319	0	0.0319			-	0	0		0.0647	0	0.0647
		07WC32N	0	0.002	0.0020	0	0.002	0.0020			-	0	0		0	0.004	0.0040
	25	25WC14D	0.1109	0	0.1109	0.1079	0	0.1079			-	0	0		0.2188	0	0.2188
		25WC14N	0	0.0066	0.0066	0	0.0066	0.0066			-	0	0		0	0.0132	0.0132
		25WC32D	0.1109	0	0.1109	0.1079	0	0.1079			-	0	0		0.2188	0	0.2188
		25WC32N	0	0.0066	0.0066	0	0.0066	0.0066			-	0	0		0	0.0132	0.0132
	14	14WC14D	0.0907	0	0.0907	0.0883	0	0.0883			-	0	0		0.179	0	0.1790
		14WC14N	0	0.0054	0.0054	0	0.0054	0.0054			-	0	0		0	0.0108	0.0108
		14WC32D	0.0907	0	0.0907	0.0883	0	0.0883			-	0	0		0.179	0	0.1790
		14WC32N	0	0.0054	0.0054	0	0.0054	0.0054			-	0	0		0	0.0108	0.0108
	32	32WC14D	0.0176	0	0.0176	0.0172	0	0.0172			-	0	0		0.0348	0	0.0348
		32WC14N	0	0.0011	0.0011	0	0.0011	0.0011			-	0	0		0	0.0022	0.0022
		32WC32D	0.0176	0	0.0176	0.0172	0	0.0172			-	0	0		0.0348	0	0.0348
		32WC32N	0	0.0011	0.0011	0	0.0011	0.0011			-	0	0		0	0.0022	0.0022
FCLP at Coupeville	14	14TD1	0.2231	0	0.2231	0.2175	0	0.2175			-	0	0		0.4406	0	0.4406
		14TD2	0.4462	0	0.4462	0.4351	0	0.4351			-	0	0		0.8813	0	0.8813
		14TD3	0.2231	0	0.2231	0.2175	0	0.2175			-	0	0		0.4406	0	0.4406
		14TN1	0.2177	0.0271	0.2448	0.2122	0.0264	0.2386			-	0	0		0.4299	0.0535	0.4834
		14TN2	0.4353	0.0541	0.4894	0.4245	0.0527	0.4772			-	0	0		0.8598	0.1068	0.9666
		14TN3	0.2177	0.0271	0.2448	0.2122	0.0264	0.2386			-	0	0		0.4299	0.0535	0.4834
	32	32TD1	0.2231	0	0.2231	0.2175	0	0.2175			-	0	0		0.4406	0	0.4406
		32TD2	0.4462	0	0.4462	0.4351	0	0.4351			-	0	0		0.8813	0	0.8813
		32TD3	0.2231	0	0.2231	0.2175	0	0.2175			-	0	0		0.4406	0	0.4406
		32TN1	0.2177	0.0271	0.2448	0.2122	0.0264	0.2386			-	0	0		0.4299	0.0535	0.4834
		32TN2	0.4353	0.0541	0.4894	0.4245	0.0527	0.4772			-	0	0		0.8598	0.1068	0.9666
		32TN3	0.2177	0.0271	0.2448	0.2122	0.0264	0.2386			-	0	0		0.4299	0.0535	0.4834
Interfacility Coupeville to Ault Field	14	14CW07D	0.063	0	0.0630	0.0613	0	0.0613			-	0	0		0.1243	0	0.1243
		14CW07N	0	0.0038	0.0038	0	0.0038	0.0038			-	0	0		0	0.0076	0.0076
		14CW14D	0.063	0	0.0630	0.0613	0	0.0613			-	0	0		0.1243	0	0.1243
		14CW14N	0	0.0038	0.0038	0	0.0038	0.0038			-	0	0		0	0.0076	0.0076
		14CW25D	0.063	0	0.0630	0.0613	0	0.0613			-	0	0		0.1243	0	0.1243
		14CW25N	0	0.0038	0.0038	0	0.0038	0.0038			-	0	0		0	0.0076	0.0076
		14CW32D	0.063	0	0.0630	0.0613	0	0.0613			-	0	0		0.1243	0	0.1243
		14CW32N	0	0.0038	0.0038	0	0.0038	0.0038			-	0	0		0	0.0076	0.0076
	32	32CW07D	0.063	0	0.0630	0.0613	0	0.0613			-	0	0		0.1243	0	0.1243
		32CW07N	0	0.0038	0.0038	0	0.0038	0.0038			-	0	0		0	0.0076	0.0076
		32CW14D	0.063	0	0.0630	0.0613	0	0.0613			-	0	0		0.1243	0	0.1243
		32CW14N	0	0.0038	0.0038	0	0.0038	0.0038			-	0	0		0	0.0076	0.0076
		32CW25D	0.063	0	0.0630	0.0613	0	0.0613			-	0	0		0.1243	0	0.1243
		32CW25N	0	0.0038	0.0038	0	0.0038	0.0038			-	0	0		0	0.0076	0.0076
		32CW32D	0.063	0	0.0630	0.0613	0	0.0613			-	0	0		0.1243	0	0.1243
		32CW32N	0	0.0038	0.0038	0	0.0038	0.0038			-	0	0		0	0.0076	0.0076
Departure			5.0467	0.3287	5.3754	4.9204	0.3208	5.2412	0.5372	0.2906	0.8278	20.658	0.7997	21.4575	31.162	1.7398	32.9019
Straight-in VFR			0	0	-	0	0	-	0.537	0.2904	0.8274	14.589	0.6276	15.2164	15.126	0.918	16.0438
Straight-in IFR			1.8026	0.0496	1.8522	1.7588	0.0465	1.8053	0	0	-	3.0355	0.0849	3.1205	6.5969	0.181	6.7780
TACAN Arrival			0.5809	0.0494	0.6303	0.5671	0.0467	0.6138	0	0	-	3.0356	0.0849	3.1205	4.1836	0.181	4.3646
Overhead Break Arrival			2.6329	0.2602	2.8931	2.5671	0.2546	2.8217	0	0	-	0	0	-	5.2	0.5148	5.7148
Touch and Go at Ault Field			5.6204	0.2657	5.8861	5.4794	0.2589	5.7383	0	0	-	16.366	0.3109	16.6767	27.466	0.8355	28.3011
FCLP at Ault Field			9.7383	2.0355	11.7738	9.4959	1.9835	11.4794	0	0	-	0	0	-	19.234	4.019	23.2532
Depart and Re-enter			0.145	0.011	0.1560	0.1424	0.011	0.1534	0	0	-	0	0	-	0.2874	0.022	0.3094
GCA Pattern at Ault Field			1.2465	1.1232	2.3697	1.2164	1.0959	2.3123	0	0	-	5.9288	0.2218	6.1507	8.3917	2.4409	10.8327
Interfacility from Ault Field to Coupeville			0.504	0.0302	0.5342	0.4906	0.0302	0.5208	0	0	-	0	0	-	0.9946	0.0604	1.0550
FCLP at Coupeville			3.5262	0.2166	3.7428	3.438	0.211	3.6490	0	0	-	0	0	-	6.9642	0.4276	7.3918
Interfacility from Coupeville to Ault Field			0.504	0.0304	0.5344	0.4904	0.0304	0.5208	0	0	-	0	0	-	0.9944	0.0608	1.0552
Total			31.348	4.4005	35.748	30.567	4.2895	34.856	1.0742	0.581	1.6552	63.612	2.1298	65.7425	126.6	11.401	138.002

Table A-5 Modeled Average Daily Flight Events at NASWI and Coupeville for Proposed

Operation Type	Rwy	Flight Track	EA-18G			C-9			P-3			Total		
	ID		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
Departure MIL	07	07D1	0.1015	0.0066	0.1081			-				0.1015	0.0066	0.1081
		07D2	0.0709	0.0045	0.0754	0.014	0.0076	0.0216	0.2503	0.0097	0.2600	0.3352	0.0218	0.3570
		07D3	0.0304	0.002	0.0324	0.014	0.0076	0.0216	0.2503	0.0097	0.2600	0.2947	0.0193	0.3140
		07D4	0.0435	0.0029	0.0464			-				0.0435	0.0029	0.0464
		07D5	0.0304	0.002	0.0324	0.0209	0.0113	0.0322	0.3755	0.0145	0.3900	0.4268	0.0278	0.4546
		07D6	0.0131	0.0009	0.0140	0.0209	0.0113	0.0322	0.3755	0.0145	0.3900	0.4095	0.0267	0.4362
	25	25D1	0.3434	0.0224	0.3658			-				0.3434	0.0224	0.3658
		25D2	0.2403	0.0156	0.2559	0.0473	0.0256	0.0729	0.8472	0.0328	0.8800	1.1348	0.074	1.2088
		25D3	0.1031	0.0068	0.1099	0.0473	0.0256	0.0729	0.8472	0.0328	0.8800	0.9976	0.0652	1.0628
		25D4	0.1472	0.0095	0.1567			-				0.1472	0.0095	0.1567
		25D5	0.1031	0.0068	0.1099	0.0709	0.0383	0.1092	1.2708	0.0492	1.3201	1.4448	0.0943	1.5392
		25D6	0.0442	0.0029	0.0471	0.0709	0.0383	0.1092	1.2708	0.0492	1.3201	1.3859	0.0904	1.4764
	14	14D1	0.2809	0.0183	0.2992			-				0.2809	0.0183	0.2992
		14D2	0.1966	0.0129	0.2095	0.0387	0.0209	0.0596	0.6932	0.0268	0.7200	0.9285	0.0606	0.9891
		14D3	0.0843	0.0054	0.0897	0.0387	0.0209	0.0596	0.6932	0.0268	0.7200	0.8162	0.0531	0.8693
		14D4	0.1203	0.0079	0.1282			-				0.1203	0.0079	0.1282
		14D5	0.0843	0.0054	0.0897	0.058	0.0314	0.0894	1.0398	0.0403	1.0800	1.1821	0.0771	1.2591
		14D6	0.036	0.0023	0.0383	0.058	0.0314	0.0894	1.0398	0.0403	1.0800	1.1338	0.074	1.2077
	32	32D1	0.0546	0.0036	0.0582			-				0.0546	0.0036	0.0582
		32D2	0.0383	0.0025	0.0408	0.0075	0.0041	0.0116	0.1348	0.0052	0.1400	0.1806	0.0118	0.1924
		32D3	0.0163	0.0011	0.0174	0.0075	0.0041	0.0116	0.1348	0.0052	0.1400	0.1586	0.0104	0.1690
		32D4	0.0233	0.0016	0.0249			-				0.0233	0.0016	0.0249
		32D5	0.0163	0.0011	0.0174	0.0113	0.0061	0.0174	0.2022	0.0078	0.2100	0.2298	0.015	0.2448
		32D6	0.007	0.0005	0.0075	0.0113	0.0061	0.0174	0.2022	0.0078	0.2100	0.2205	0.0144	0.2349
Departure Afterburner	07	07D1	0.4057	0.0265	0.4322			-				0.4057	0.0265	0.4322
		07D2	0.284	0.0186	0.3026			-				0.284	0.0186	0.3026
		07D3	0.1216	0.0079	0.1295			-				0.1216	0.0079	0.1295
		07D4	0.174	0.0113	0.1853			-				0.174	0.0113	0.1853
		07D5	0.1216	0.0079	0.1295			-				0.1216	0.0079	0.1295
		07D6	0.0521	0.0034	0.0555			-				0.0521	0.0034	0.0555
	25	25D1	1.373	0.0895	1.4625			-				1.373	0.0895	1.4625
		25D2	0.961	0.0625	1.0235			-				0.961	0.0625	1.0235
		25D3	0.412	0.0267	0.4387			-				0.412	0.0267	0.4387
		25D4	0.5884	0.0383	0.6267			-				0.5884	0.0383	0.6267
		25D5	0.412	0.0267	0.4387			-				0.412	0.0267	0.4387
		25D6	0.1764	0.0116	0.1880			-				0.1764	0.0116	0.1880
	14	14D1	1.1234	0.0732	1.1966			-				1.1234	0.0732	1.1966
		14D2	0.7864	0.0512	0.8376			-				0.7864	0.0512	0.8376
		14D3	0.337	0.022	0.3590			-				0.337	0.022	0.3590
		14D4	0.4815	0.0313	0.5128			-				0.4815	0.0313	0.5128
		14D5	0.337	0.022	0.3590			-				0.337	0.022	0.3590
		14D6	0.1445	0.0095	0.1540			-				0.1445	0.0095	0.1540
	32	32D1	0.2183	0.0143	0.2326			-				0.2183	0.0143	0.2326
		32D2	0.1529	0.01	0.1629			-				0.1529	0.01	0.1629
		32D3	0.0655	0.0043	0.0698			-				0.0655	0.0043	0.0698
		32D4	0.0935	0.0061	0.0996			-				0.0935	0.0061	0.0996
		32D5	0.0655	0.0043	0.0698			-				0.0655	0.0043	0.0698
		32D6	0.0281	0.0018	0.0299			-				0.0281	0.0018	0.0299
Low TACAN Departure	07	07DHT							1.4339	0.0555	1.4894	1.4339	0.0555	1.4894
	25	25DHT							3.9708	0.1538	5.0411	3.9708	0.1538	5.0411
	14	14DHT							4.8532	0.1879	4.1246	4.8532	0.1879	4.1246
	32	32DHT							0.7721	0.0299	0.8020	0.7721	0.0299	0.8020

Table A-5 Modeled Average Daily Flight Events at NASWI and Coupeville for Proposed (continued)

Operation Type	Rwy ID	Flight Track	EA-18G Day (0700-2200)	EA-18G Night (2200-0700)	EA-18G Total	C-9 Day (0700-2200)	C-9 Night (2200-0700)	C-9 Total	P-3 Day (0700-2200)	P-3 Night (2200-0700)	P-3 Total	Total Day (0700-2200)	Total Night (2200-0700)	Total Total
Straight-in Arrival (VFR)	07	07A1			-	0.0279	0.0151	0.0430	0.7586	0.0326	0.7913	0.7865	0.0477	0.8343
		07A2			-	0.0209	0.0113	0.0322	0.569	0.0245	0.5934	0.5899	0.0358	0.6256
		07A3			-	0.0209	0.0113	0.0322	0.569	0.0245	0.5934	0.5899	0.0358	0.6256
	25	25A1			-	0.0945	0.0511	0.1456	2.5677	0.1104	2.6781	2.6622	0.1615	2.8237
		25A2			-	0.0709	0.0383	0.1092	1.9258	0.0828	2.0086	1.9967	0.1211	2.1178
		25A3			-	0.0709	0.0383	0.1092	1.9258	0.0828	2.0086	1.9967	0.1211	2.1178
	14	14A1			-	0.0387	0.0209	0.0596	1.0504	0.0452	1.0956	1.0891	0.0661	1.1552
		14A2			-	0.0387	0.0209	0.0596	1.0504	0.0452	1.0956	1.0891	0.0661	1.1552
		14A3			-	0.058	0.0314	0.0894	1.5756	0.0678	1.6434	1.6336	0.0992	1.7328
		14A4			-	0.058	0.0314	0.0894	1.5756	0.0678	1.6434	1.6336	0.0992	1.7328
	32	32A1			-	0.0075	0.0041	0.0116	0.2042	0.0088	0.2130	0.2117	0.0129	0.2246
		32A2			-	0.0075	0.0041	0.0116	0.2042	0.0088	0.2130	0.2117	0.0129	0.2246
		32A3			-	0.0113	0.0061	0.0174	0.3064	0.0132	0.3195	0.3177	0.0193	0.3369
		32A4			-	0.0113	0.0061	0.0174	0.3064	0.0132	0.3195	0.3177	0.0193	0.3369
Straight-in Arrival (IFR)	07	07A4A	0.1811	0.0051	0.1862			-				0.1811	0.0051	0.1862
		07A4B	0.1267	0.0036	0.1303			-	0.0789	0.0022	0.0811	0.2056	0.0058	0.2114
		07A4C	0.0543	0.0014	0.0557			-	0.0789	0.0022	0.0811	0.1332	0.0036	0.1368
		07A5A	0.0776	0.0022	0.0798			-				0.0776	0.0022	0.0798
		07A5B	0.0543	0.0014	0.0557			-	0.1184	0.0033	0.1217	0.1727	0.0047	0.1774
		07A5C	0.0233	0.0007	0.0240			-	0.1184	0.0033	0.1217	0.1417	0.004	0.1457
	25	25A4	1.226	0.0345	1.2605			-	0.5343	0.0149	0.5492	1.7603	0.0494	1.8097
		25A5A	0.2628	0.0075	0.2703			-				0.2628	0.0075	0.2703
		25A5B	0.184	0.0053	0.1893			-	0.4007	0.0112	0.4119	0.5847	0.0165	0.6012
		25A5C	0.0788	0.0022	0.0810			-	0.4007	0.0112	0.4119	0.4795	0.0134	0.4929
	14	14A5A	0.5015	0.0142	0.5157			-				0.5015	0.0142	0.5157
		14A5B	0.351	0.0099	0.3609			-	0.2186	0.0061	0.2247	0.5696	0.016	0.5856
		14A5C	0.1505	0.0043	0.1548			-	0.2186	0.0061	0.2247	0.3691	0.0104	0.3795
		14A6A	0.215	0.006	0.2210			-				0.215	0.006	0.2210
		14A6B	0.1505	0.0043	0.1548			-	0.3278	0.0092	0.3370	0.4783	0.0135	0.4918
		14A6C	0.0645	0.0019	0.0664			-	0.3278	0.0092	0.3370	0.3923	0.0111	0.4034
	32	32A5A	0.0975	0.0027	0.1002			-				0.0975	0.0027	0.1002
		32A5B	0.0683	0.0019	0.0702			-	0.0425	0.0012	0.0437	0.1108	0.0031	0.1139
		32A5C	0.0292	0.0007	0.0299			-	0.0425	0.0012	0.0437	0.0717	0.0019	0.0736
		32A6A	0.0419	0.0012	0.0431			-				0.0419	0.0012	0.0431
		32A6B	0.0292	0.0007	0.0299			-	0.0637	0.0018	0.0655	0.0929	0.0025	0.0954
		32A6C	0.0124	0.0002	0.0126			-	0.0637	0.0018	0.0655	0.0761	0.002	0.0781
High TACAN Arrival	07	07AHT	0.1668	0.0147	0.1815			-				0.1668	0.0147	0.1815
	25	25AHT	0.5647	0.0495	0.6142			-				0.5647	0.0495	0.6142
	14	14AHT	0.4621	0.0406	0.5027			-				0.4621	0.0406	0.5027
	32	32AHT	0.0898	0.008	0.0978			-				0.0898	0.008	0.0978
Low TACAN Arrival	07	07ALT			-			-	0.3946	0.011	0.4057	0.3946	0.011	0.4057
	25	25ALT			-			-	1.3357	0.0374	1.3730	1.3357	0.0374	1.3730
	14	14ALT			-			-	1.0928	0.0306	1.1234	1.0928	0.0306	1.1234
	32	32ALT			-			-	0.2125	0.0059	0.2184	0.2125	0.0059	0.2184

Table A-5 Modeled Average Daily Flight Events at NASWI and Coupeville for Proposed (continued)

Operation Type	Rwy	Flight Track	EA-18G			C-9			P-3			Total		
	ID		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
Overhead Break Arrival	07	07OD1A	0.2243		0.2243			-				0.2243		0.2243
		07OD1B	0.2243		0.2243			-				0.2243		0.2243
		07OD1C	0.2311		0.2311			-				0.2311		0.2311
		07OD2A	0.0249		0.0249			-				0.0249		0.0249
		07OD2B	0.0249		0.0249			-				0.0249		0.0249
		07OD2C	0.0256		0.0256			-				0.0256		0.0256
		07ON1A		0.0237	0.0237			-					0.0237	0.0237
		07ON1B		0.0237	0.0237			-					0.0237	0.0237
		07ON1C		0.0244	0.0244			-					0.0244	0.0244
		07ON2A		0.0027	0.0027			-					0.0027	0.0027
		07ON2B		0.0027	0.0027			-					0.0027	0.0027
		07ON2C		0.0027	0.0027			-					0.0027	0.0027
	25	25OD1A	0.7593		0.7593			-				0.7593		0.7593
		25OD1B	0.7593		0.7593			-				0.7593		0.7593
		25OD1C	0.7822		0.7822			-				0.7822		0.7822
		25OD2A	0.0844		0.0844			-				0.0844		0.0844
		25OD2B	0.0844		0.0844			-				0.0844		0.0844
		25OD2C	0.0869		0.0869			-				0.0869		0.0869
		25ON1A		0.0804	0.0804			-					0.0804	0.0804
		25ON1B		0.0804	0.0804			-					0.0804	0.0804
		25ON1C		0.0828	0.0828			-					0.0828	0.0828
		25ON2A		0.0089	0.0089			-					0.0089	0.0089
		25ON2B		0.0089	0.0089			-					0.0089	0.0089
		25ON2C		0.0092	0.0092			-					0.0092	0.0092
	14	14OD1A	0.6212		0.6212			-				0.6212		0.6212
		14OD1B	0.6212		0.6212			-				0.6212		0.6212
		14OD1C	0.64		0.6400			-				0.64		0.6400
		14OD2A	0.069		0.0690			-				0.069		0.0690
		14OD2B	0.069		0.0690			-				0.069		0.0690
		14OD2C	0.0711		0.0711			-				0.0711		0.0711
		14ON1A		0.0657	0.0657			-					0.0657	0.0657
		14ON1B		0.0657	0.0657			-					0.0657	0.0657
		14ON1C		0.0678	0.0678			-					0.0678	0.0678
		14ON2A		0.0072	0.0072			-					0.0072	0.0072
		14ON2B		0.0072	0.0072			-					0.0072	0.0072
		14ON2C		0.0075	0.0075			-					0.0075	0.0075
	32	32OD1A	0.1209		0.1209			-				0.1209		0.1209
		32OD1B	0.1209		0.1209			-				0.1209		0.1209
		32OD1C	0.1245		0.1245			-				0.1245		0.1245
		32OD2A	0.0134		0.0134			-				0.0134		0.0134
		32OD2B	0.0134		0.0134			-				0.0134		0.0134
		32OD2C	0.0138		0.0138			-				0.0138		0.0138
		32ON1A		0.0128	0.0128			-					0.0128	0.0128
		32ON1B		0.0128	0.0128			-					0.0128	0.0128
		32ON1C		0.0133	0.0133			-					0.0133	0.0133
		32ON2A		0.0014	0.0014			-					0.0014	0.0014
		32ON2B		0.0014	0.0014			-					0.0014	0.0014
		32ON2C		0.0014	0.0014			-					0.0014	0.0014
Depart and Re-enter	07	07DR	0.0207	0.0016	0.0223			-				0.0207	0.0016	0.0223
		07DL	0.0207	0.0016	0.0223			-				0.0207	0.0016	0.0223
	25	25DR	0.0569	0.0045	0.0614			-				0.0569	0.0045	0.0614
		25DL	0.0569	0.0045	0.0614			-				0.0569	0.0045	0.0614
	14	14DR	0.0696	0.0054	0.0750			-				0.0696	0.0054	0.0750
		14DL	0.0696	0.0054	0.0750			-				0.0696	0.0054	0.0750
	32	32DR	0.0111	0.0009	0.0120			-				0.0111	0.0009	0.0120
		32DL	0.0111	0.0009	0.0120			-				0.0111	0.0009	0.0120

Table A-5 Modeled Average Daily Flight Events at NASWI and Coupeville for Proposed (continued)

Operation Type	Rwy ID	Flight Track	EA-18G Day (0700-2200)	EA-18G Night (2200-0700)	EA-18G Total	C-9 Day (0700-2200)	C-9 Night (2200-0700)	C-9 Total	P-3 Day (0700-2200)	P-3 Night (2200-0700)	P-3 Total	Total Day (0700-2200)	Total Night (2200-0700)	Total Total
Touch and Go at Ault Field	07	07TD1	0.2004		0.2004			-				0.2004		0.2004
		07TD2	0.401		0.4010			-				0.401		0.4010
		07TD3	0.2004		0.2004			-				0.2004		0.2004
		07TN1	0.1955	0.0189	0.2144			-	0.5319	0.0101	0.5420	0.7274	0.029	0.7564
		07TN2	0.3912	0.0377	0.4289			-	1.0638	0.0202	1.0840	1.455	0.0579	1.5129
		07TN3	0.1955	0.0189	0.2144			-	0.5319	0.0101	0.5420	0.7274	0.029	0.7564
	25	25TD1	0.6786		0.6786			-				0.6786		0.6786
		25TD2	1.3571		1.3571			-				1.3571		1.3571
		25TD3	0.6786		0.6786			-				0.6786		0.6786
		25TN1	0.6621	0.064	0.7261			-	1.8002	0.0342	1.8344	2.4623	0.0982	2.5605
		25TN2	1.324	0.128	1.4520			-	3.6005	0.0684	3.6689	4.9245	0.1964	5.1209
		25TN3	0.6621	0.064	0.7261			-	1.8002	0.0342	1.8344	2.4623	0.0982	2.5605
	14	14TD1	0.5551		0.5551			-				0.5551		0.5551
		14TD2	1.1103		1.1103			-				1.1103		1.1103
		14TD3	0.5551		0.5551			-				0.5551		0.5551
		14TN1	0.5416	0.0523	0.5939			-	1.4729	0.028	1.5009	2.0145	0.0803	2.0948
		14TN2	1.0834	0.1046	1.1880			-	2.9458	0.056	3.0018	4.0292	0.1606	4.1898
		14TN3	0.5416	0.0523	0.5939			-	1.4729	0.028	1.5009	2.0145	0.0803	2.0948
	32	32TD1	0.1079		0.1079			-				0.1079		0.1079
		32TD2	0.216		0.2160			-				0.216		0.2160
		32TD3	0.1079		0.1079			-				0.1079		0.1079
		32TN1	0.1054	0.0101	0.1155			-	0.2864	0.0054	0.2918	0.3918	0.0155	0.4073
		32TN2	0.2106	0.0204	0.2310			-	0.5728	0.0109	0.5837	0.7834	0.0313	0.8147
		32TN3	0.1054	0.0101	0.1155			-	0.2864	0.0054	0.2918	0.3918	0.0155	0.4073
FCLP at Ault Field	07	07TD1	0.3168		0.3168			-				0.3168		0.3168
		07TD2	0.6335		0.6335			-				0.6335		0.6335
		07TD3	0.3168		0.3168			-				0.3168		0.3168
		07TN1	0.3091	0.1307	0.4398			-				0.3091	0.1307	0.4398
		07TN2	0.6181	0.2612	0.8793			-				0.6181	0.2612	0.8793
		07TN3	0.3091	0.1307	0.4398			-				0.3091	0.1307	0.4398
	25	25TD1	1.0722		1.0722			-				1.0722		1.0722
		25TD2	2.1444		2.1444			-				2.1444		2.1444
		25TD3	1.0722		1.0722			-				1.0722		1.0722
		25TN1	1.046	0.4421	1.4881			-				1.046	0.4421	1.4881
		25TN2	2.0923	0.8841	2.9764			-				2.0923	0.8841	2.9764
		25TN3	1.046	0.4421	1.4881			-				1.046	0.4421	1.4881
	14	14TD1	0.8773		0.8773			-				0.8773		0.8773
		14TD2	1.7546		1.7546			-				1.7546		1.7546
		14TD3	0.8773		0.8773			-				0.8773		0.8773
		14TN1	0.856	0.3616	1.2176			-				0.856	0.3616	1.2176
		14TN2	1.7118	0.7233	2.4351			-				1.7118	0.7233	2.4351
		14TN3	0.856	0.3616	1.2176			-				0.856	0.3616	1.2176
	32	32TD1	0.1706		0.1706			-				0.1706		0.1706
		32TD2	0.3411		0.3411			-				0.3411		0.3411
		32TD3	0.1706		0.1706			-				0.1706		0.1706
		32TN1	0.1665	0.0703	0.2368			-				0.1665	0.0703	0.2368
		32TN2	0.3328	0.1406	0.4734			-				0.3328	0.1406	0.4734
		32TN3	0.1665	0.0703	0.2368			-				0.1665	0.0703	0.2368
GCA Pattern at Ault Field	07	07G1	0.1759	0.1599	0.3358			-				0.1759	0.1599	0.3358
		07G2	0.0703	0.064	0.1343			-	0.3854	0.0144	0.3998	0.4557	0.0784	0.5341
		07G3	0.1054	0.0959	0.2013			-	0.3854	0.0144	0.3998	0.4908	0.1103	0.6011
	25	25G1	0.5952	0.5414	1.1366			-				0.5952	0.5414	1.1366
		25G2	0.238	0.2165	0.4545			-	1.3043	0.0488	1.3532	1.5423	0.2653	1.8077
		25G3	0.3572	0.325	0.6822			-	1.3043	0.0488	1.3532	1.6615	0.3738	2.0354
	14	14G1	0.4871	0.4431	0.9302			-				0.4871	0.4431	0.9302
		14G2	0.1948	0.1772	0.3720			-	1.0672	0.0399	1.1071	1.262	0.2171	1.4791
		14G3	0.2922	0.2659	0.5581			-	1.0672	0.0399	1.1071	1.3594	0.3058	1.6652
	32	32G1	0.0947	0.0862	0.1809			-				0.0947	0.0862	0.1809
		32G2	0.0378	0.0344	0.0722			-	0.2075	0.0078	0.2153	0.2453	0.0422	0.2875
		32G3	0.0567	0.0517	0.1084			-	0.2075	0.0078	0.2153	0.2642	0.0595	0.3237

Table A-5 Modeled Average Daily Flight Events at NASWI and Coupeville for Proposed (concluded)

Operation Type	Rwy ID	Flight Track	EA-18G Day (0700-2200)	EA-18G Night (2200-0700)	EA-18G Total	C-9 Day (0700-2200)	C-9 Night (2200-0700)	C-9 Total	P-3 Day (0700-2200)	P-3 Night (2200-0700)	P-3 Total	Total Day (0700-2200)	Total Night (2200-0700)	Total Total
Interfacility Ault Field to Coupeville	7	07WC14D	0.0647		0.0647			-				0.0647		0.0647
		07WC14N		0.0041	0.0041			-					0.0041	0.0041
		07WC32D	0.0647		0.0647			-				0.0647		0.0647
		07WC32N		0.0041	0.0041			-					0.0041	0.0041
	25	25WC14D	0.2188		0.2188			-				0.2188		0.2188
		25WC14N		0.0134	0.0134			-					0.0134	0.0134
		25WC32D	0.2188		0.2188			-				0.2188		0.2188
		25WC32N		0.0134	0.0134			-					0.0134	0.0134
	14	14WC14D	0.1791		0.1791			-				0.1791		0.1791
		14WC14N		0.0109	0.0109			-					0.0109	0.0109
		14WC32D	0.1791		0.1791			-				0.1791		0.1791
		14WC32N		0.0109	0.0109			-					0.0109	0.0109
	32	32WC14D	0.0349		0.0349			-				0.0349		0.0349
		32WC14N		0.0022	0.0022			-					0.0022	0.0022
		32WC32D	0.0349		0.0349			-				0.0349		0.0349
		32WC32N		0.0022	0.0022			-					0.0022	0.0022
FCLP at Coupeville	14	14TD1	0.4411		0.4411			-				0.4411		0.4411
		14TD2	0.8824		0.8824			-				0.8824		0.8824
		14TD3	0.4411		0.4411			-				0.4411		0.4411
		14TN1	0.4303	0.0535	0.4838			-				0.4303	0.0535	0.4838
		14TN2	0.8609	0.1068	0.9677			-				0.8609	0.1068	0.9677
		14TN3	0.4303	0.0535	0.4838			-				0.4303	0.0535	0.4838
	32	32TD1	0.4411		0.4411			-				0.4411		0.4411
		32TD2	0.8824		0.8824			-				0.8824		0.8824
		32TD3	0.4411		0.4411			-				0.4411		0.4411
		32TN1	0.4303	0.0535	0.4838			-				0.4303	0.0535	0.4838
		32TN2	0.8609	0.1068	0.9677			-				0.8609	0.1068	0.9677
		32TN3	0.4303	0.0535	0.4838			-				0.4303	0.0535	0.4838
Interfacility Coupeville to Ault Field	14	14CW07D	0.1243		0.1243			-				0.1243		0.1243
		14CW07N		0.0077	0.0077			-					0.0077	0.0077
		14CW14D	0.1243		0.1243			-				0.1243		0.1243
		14CW14N		0.0077	0.0077			-					0.0077	0.0077
		14CW25D	0.1243		0.1243			-				0.1243		0.1243
		14CW25N		0.0077	0.0077			-					0.0077	0.0077
		14CW32D	0.1243		0.1243			-				0.1243		0.1243
		14CW32N		0.0077	0.0077			-					0.0077	0.0077
	32	32CW07D	0.1243		0.1243			-				0.1243		0.1243
		32CW07N		0.0077	0.0077			-					0.0077	0.0077
		32CW14D	0.1243		0.1243			-				0.1243		0.1243
		32CW14N		0.0077	0.0077			-					0.0077	0.0077
		32CW25D	0.1243		0.1243			-				0.1243		0.1243
		32CW25N		0.0077	0.0077			-					0.0077	0.0077
		32CW32D	0.1243		0.1243			-				0.1243		0.1243
		32CW32N		0.0077	0.0077			-					0.0077	0.0077
Departure			11.145	0.7264	11.8711	0.5372	0.2906	0.8278	20.658	0.7997	21.4575	32.34	1.8167	34.1564
Straight-in VFR					-	0.537	0.2904	0.8274	14.589	0.6276	15.2164	15.126	0.918	16.0438
Straight-in IFR			3.9804	0.1119	4.0923			-	3.0355	0.0849	3.1205	7.0159	0.1968	7.2128
TACAN Arrival			1.2834	0.1128	1.3962			-	3.0356	0.0849	3.1205	4.319	0.1977	4.5167
Overhead Break Arrival			5.81	0.6147	6.4247			-			-	5.81	0.6147	6.4247
Touch and Go at Ault Field			12.187	0.5813	12.7681			-	16.366	0.3109	16.6767	28.553	0.8922	29.4448
FCLP at Ault Field			19.258	4.0186	23.2762			-			-	19.258	4.0186	23.2762
Depart and Re-enter			0.3166	0.0248	0.3414			-			-	0.3166	0.0248	0.3414
GCA Pattern at Ault Field			2.7053	2.4612	5.1665			-	5.9288	0.2218	6.1507	8.6341	2.683	11.3172
Interfacility from Ault Field to Coupeville			0.995	0.0612	1.0562			-			-	0.995	0.0612	1.0562
FCLP at Coupeville			6.9722	0.4276	7.3998			-			-	6.9722	0.4276	7.3998
Interfacility from Coupeville to Ault Field			0.9944	0.0616	1.0560			-			-	0.9944	0.0616	1.0560
Total			65.646	9.2021	74.8485	1.0742	0.581	1.6552	63.612	2.1298	65.7425	130.33	11.913	142.246

Table A-6 Modeled Average Daily Flight Events at NASWI and Coupeville for Cumulative

Operation Type	Rwy ID	Flight Track	EA-18G Day (0700-2200)	EA-18G Night (2200-0700)	EA-18G Total	C-9 Day (0700-2200)	C-9 Night (2200-0700)	C-9 Total	P-3 Day (0700-2200)	P-3 Night (2200-0700)	P-3 Total	P-8 Day (0700-2200)	P-8 Night (2200-0700)	P-8 Total	Total Day (0700-2200)	Total Night (2200-0700)	Total
Departure MIL	07	07D1	0.1015	0.0066	0.1080			-			-			-	0.1015	0.0066	0.1080
		07D2	0.0709	0.0045	0.0754	0.0140	0.0076	0.0215	0.0257	0.0034	0.0291	0.0561	0.0017	0.0578	0.1667	0.0172	0.1838
		07D3	0.0304	0.0020	0.0324	0.0140	0.0076	0.0215	0.0257	0.0034	0.0291	0.0561	0.0017	0.0578	0.1261	0.0147	0.1408
		07D4	0.0435	0.0029	0.0464			-			-			-	0.0435	0.0029	0.0464
		07D5	0.0304	0.0020	0.0324	0.0209	0.0113	0.0323	0.0385	0.0050	0.0435	0.0842	0.0025	0.0867	0.1740	0.0209	0.1949
		07D6	0.0131	0.0009	0.0140	0.0209	0.0113	0.0323	0.0385	0.0050	0.0435	0.0842	0.0025	0.0867	0.1568	0.0197	0.1765
	25	25D1	0.3434	0.0224	0.3658			-			-			-	0.3434	0.0224	0.3658
		25D2	0.2403	0.0156	0.2559	0.0473	0.0256	0.0728	0.0869	0.0113	0.0982	0.1899	0.0057	0.1956	0.5644	0.0582	0.6226
		25D3	0.1031	0.0068	0.1099	0.0473	0.0256	0.0728	0.0869	0.0113	0.0982	0.1899	0.0057	0.1956	0.4271	0.0494	0.4765
		25D4	0.1472	0.0095	0.1567			-			-			-	0.1472	0.0095	0.1567
		25D5	0.1031	0.0068	0.1099	0.0709	0.0383	0.1092	0.1303	0.0170	0.1473	0.2848	0.0086	0.2934	0.5890	0.0707	0.6598
		25D6	0.0442	0.0029	0.0471	0.0709	0.0383	0.1092	0.1303	0.0170	0.1473	0.2848	0.0086	0.2934	0.5301	0.0669	0.5970
	14	14D1	0.2809	0.0183	0.2992			-			-			-	0.2809	0.0183	0.2992
		14D2	0.1966	0.0129	0.2095	0.0387	0.0209	0.0596	0.0711	0.0093	0.0804	0.1554	0.0047	0.1601	0.4618	0.0478	0.5096
		14D3	0.0843	0.0054	0.0897	0.0387	0.0209	0.0596	0.0711	0.0093	0.0804	0.1554	0.0047	0.1601	0.3494	0.0403	0.3898
		14D4	0.1203	0.0079	0.1282			-			-			-	0.1203	0.0079	0.1282
		14D5	0.0843	0.0054	0.0897	0.0580	0.0314	0.0894	0.1066	0.0139	0.1205	0.2331	0.0070	0.2401	0.4820	0.0577	0.5397
		14D6	0.0360	0.0023	0.0383	0.0580	0.0314	0.0894	0.1066	0.0139	0.1205	0.2331	0.0070	0.2401	0.4337	0.0545	0.4882
	32	32D1	0.0546	0.0036	0.0582			-			-			-	0.0546	0.0036	0.0582
		32D2	0.0383	0.0025	0.0408	0.0075	0.0041	0.0116	0.0138	0.0018	0.0156	0.0302	0.0009	0.0311	0.0898	0.0093	0.0991
		32D3	0.0163	0.0011	0.0174	0.0075	0.0041	0.0116	0.0138	0.0018	0.0156	0.0302	0.0009	0.0311	0.0678	0.0079	0.0757
		32D4	0.0233	0.0016	0.0249			-			-			-	0.0233	0.0016	0.0249
		32D5	0.0163	0.0011	0.0174	0.0113	0.0061	0.0174	0.0207	0.0027	0.0234	0.0453	0.0014	0.0467	0.0936	0.0113	0.1049
		32D6	0.0070	0.0005	0.0075	0.0113	0.0061	0.0174	0.0207	0.0027	0.0234	0.0453	0.0014	0.0467	0.0843	0.0107	0.0949
Departure Afterburner	07	07D1	0.4057	0.0265	0.4322			-			-			-	0.4057	0.0265	0.4322
		07D2	0.2840	0.0186	0.3026			-			-			-	0.2840	0.0186	0.3026
		07D3	0.1216	0.0079	0.1296			-			-			-	0.1216	0.0079	0.1296
		07D4	0.1740	0.0113	0.1853			-			-			-	0.1740	0.0113	0.1853
		07D5	0.1216	0.0079	0.1296			-			-			-	0.1216	0.0079	0.1296
		07D6	0.0521	0.0034	0.0555			-			-			-	0.0521	0.0034	0.0555
	25	25D1	1.3730	0.0895	1.4625			-			-			-	1.3730	0.0895	1.4625
		25D2	0.9610	0.0625	1.0236			-			-			-	0.9610	0.0625	1.0236
		25D3	0.4120	0.0267	0.4387			-			-			-	0.4120	0.0267	0.4387
		25D4	0.5884	0.0383	0.6267			-			-			-	0.5884	0.0383	0.6267
		25D5	0.4120	0.0267	0.4387			-			-			-	0.4120	0.0267	0.4387
		25D6	0.1764	0.0116	0.1880			-			-			-	0.1764	0.0116	0.1880
	14	14D1	1.1234	0.0732	1.1966			-			-			-	1.1234	0.0732	1.1966
		14D2	0.7864	0.0512	0.8376			-			-			-	0.7864	0.0512	0.8376
		14D3	0.3370	0.0220	0.3590			-			-			-	0.3370	0.0220	0.3590
		14D4	0.4815	0.0313	0.5128			-			-			-	0.4815	0.0313	0.5128
		14D5	0.3370	0.0220	0.3590			-			-			-	0.3370	0.0220	0.3590
		14D6	0.1445	0.0095	0.1540			-			-			-	0.1445	0.0095	0.1540
	32	32D1	0.2183	0.0143	0.2326			-			-			-	0.2183	0.0143	0.2326
		32D2	0.1529	0.0100	0.1629			-			-			-	0.1529	0.0100	0.1629
		32D3	0.0655	0.0043	0.0698			-			-			-	0.0655	0.0043	0.0698
		32D4	0.0935	0.0061	0.0997			-			-			-	0.0935	0.0061	0.0997
		32D5	0.0655	0.0043	0.0698			-			-			-	0.0655	0.0043	0.0698
		32D6	0.0281	0.0018	0.0299			-			-			-	0.0281	0.0018	0.0299
Low TACAN Departure	07	07DHT							0.1470	0.0192	0.1662	0.3214	0.0097	0.3311	0.4684	0.0289	0.4973
	25	25DHT							0.4975	0.0650	0.5625	1.0878	0.0328	1.1206	1.5853	0.0978	1.6831
	14	14DHT							0.4071	0.0532	0.4603	0.8900	0.0269	0.9169	1.2971	0.0801	1.3772
	32	32DHT							0.0792	0.0103	0.0895	0.1731	0.0052	0.1783	0.2523	0.0155	0.2678

Table A-6 Modeled Average Daily Flight Events at NASWI and Coupeville for Cumulative (continued)

Operation Type	Rwy ID	Flight Track	EA-18G Day (0700-2200)	EA-18G Night (2200-0700)	EA-18G Total	C-9 Day (0700-2200)	C-9 Night (2200-0700)	C-9 Total	P-3 Day (0700-2200)	P-3 Night (2200-0700)	P-3 Total	P-8 Day (0700-2200)	P-8 Night (2200-0700)	P-8 Total	Total Day (0700-2200)	Total Night (2200-0700)	Total
Straight-in Arrival (VFR)	07	07A1			-	0.0279	0.0151	0.0430	0.0778	0.0113	0.0891	0.1685	0.0051	0.1736	0.2742	0.0315	0.3057
		07A2			-	0.0209	0.0113	0.0323	0.0583	0.0085	0.0668	0.1264	0.0038	0.1302	0.2056	0.0236	0.2293
		07A3			-	0.0209	0.0113	0.0323	0.0583	0.0085	0.0668	0.1264	0.0038	0.1302	0.2056	0.0236	0.2293
	25	25A1			-	0.0945	0.0511	0.1456	0.2632	0.0382	0.3014	0.5704	0.0174	0.5878	0.9281	0.1067	1.0348
		25A2			-	0.0709	0.0383	0.1092	0.1974	0.0286	0.2260	0.4278	0.0130	0.4408	0.6961	0.0799	0.7760
		25A3			-	0.0709	0.0383	0.1092	0.1974	0.0286	0.2260	0.4278	0.0130	0.4408	0.6961	0.0799	0.7760
	14	14A1			-	0.0387	0.0209	0.0596	0.1077	0.0156	0.1233	0.2334	0.0071	0.2405	0.3798	0.0436	0.4234
		14A2			-	0.0387	0.0209	0.0596	0.1077	0.0156	0.1233	0.2334	0.0071	0.2405	0.3798	0.0436	0.4234
		14A3			-	0.0580	0.0314	0.0894	0.1615	0.0234	0.1849	0.3500	0.0107	0.3607	0.5695	0.0655	0.6350
		14A4			-	0.0580	0.0314	0.0894	0.1615	0.0234	0.1849	0.3500	0.0107	0.3607	0.5695	0.0655	0.6350
	32	32A1			-	0.0075	0.0041	0.0116	0.0209	0.0030	0.0239	0.0454	0.0014	0.0468	0.0738	0.0085	0.0823
		32A2			-	0.0075	0.0041	0.0116	0.0209	0.0030	0.0239	0.0454	0.0014	0.0468	0.0738	0.0085	0.0823
		32A3			-	0.0113	0.0061	0.0174	0.0314	0.0046	0.0360	0.0681	0.0021	0.0702	0.1108	0.0128	0.1236
		32A4			-	0.0113	0.0061	0.0174	0.0314	0.0046	0.0360	0.0681	0.0021	0.0702	0.1108	0.0128	0.1236
Straight-in Arrival (IFR)	07	07A4A	0.1811	0.0051	0.1861			-			-			-	0.1811	0.0051	0.1861
		07A4B	0.1267	0.0036	0.1304			-	0.0081	0.0008	0.0089	0.0181	0.0005	0.0186	0.1529	0.0049	0.1579
		07A4C	0.0543	0.0014	0.0558			-	0.0081	0.0008	0.0089	0.0181	0.0005	0.0186	0.0805	0.0027	0.0833
		07A5A	0.0776	0.0022	0.0798			-			-			-	0.0776	0.0022	0.0798
		07A5B	0.0543	0.0014	0.0558			-	0.0121	0.0011	0.0132	0.0271	0.0007	0.0278	0.0935	0.0032	0.0968
		07A5C	0.0233	0.0007	0.0240			-	0.0121	0.0011	0.0132	0.0271	0.0007	0.0278	0.0625	0.0025	0.0650
	25	25A4	1.2260	0.0345	1.2605			-	0.0548	0.0052	0.0600	0.1225	0.0034	0.1259	1.4033	0.0431	1.4464
		25A5A	0.2628	0.0075	0.2702			-			-			-	0.2628	0.0075	0.2702
		25A5B	0.1840	0.0053	0.1893			-	0.0411	0.0039	0.0450	0.0919	0.0025	0.0944	0.3170	0.0117	0.3287
		25A5C	0.0788	0.0022	0.0809			-	0.0411	0.0039	0.0450	0.0919	0.0025	0.0944	0.2118	0.0086	0.2203
	14	14A5A	0.5015	0.0142	0.5158			-			-			-	0.5015	0.0142	0.5158
		14A5B	0.3510	0.0099	0.3609			-	0.0224	0.0021	0.0245	0.0501	0.0014	0.0515	0.4235	0.0134	0.4369
		14A5C	0.1505	0.0043	0.1548			-	0.0224	0.0021	0.0245	0.0501	0.0014	0.0515	0.2230	0.0078	0.2308
		14A6A	0.2150	0.0060	0.2210			-			-			-	0.2150	0.0060	0.2210
		14A6B	0.1505	0.0043	0.1548			-	0.0336	0.0032	0.0368	0.0752	0.0021	0.0773	0.2593	0.0096	0.2689
		14A6C	0.0645	0.0019	0.0664			-	0.0336	0.0032	0.0368	0.0752	0.0021	0.0773	0.1733	0.0072	0.1805
	32	32A5A	0.0975	0.0027	0.1002			-			-			-	0.0975	0.0027	0.1002
		32A5B	0.0683	0.0019	0.0703			-	0.0044	0.0004	0.0048	0.0097	0.0003	0.0100	0.0824	0.0026	0.0851
		32A5C	0.0292	0.0007	0.0299			-	0.0044	0.0004	0.0048	0.0097	0.0003	0.0100	0.0433	0.0014	0.0447
		32A6A	0.0419	0.0012	0.0431			-			-			-	0.0419	0.0012	0.0431
		32A6B	0.0292	0.0007	0.0299			-	0.0065	0.0006	0.0071	0.0146	0.0004	0.0150	0.0503	0.0017	0.0520
		32A6C	0.0124	0.0002	0.0127			-	0.0065	0.0006	0.0071	0.0146	0.0004	0.0150	0.0335	0.0012	0.0348
High TACAN Arrival	07	07AHT	0.1668	0.0147	0.1815			-			-			-	0.1668	0.0147	0.1815
	25	25AHT	0.5647	0.0495	0.6142			-			-			-	0.5647	0.0495	0.6142
	14	14AHT	0.4621	0.0406	0.5027			-			-			-	0.4621	0.0406	0.5027
	32	32AHT	0.0898	0.0080	0.0978			-			-			-	0.0898	0.0080	0.0978
Low TACAN Arrival	07	07ALT			-			-	0.0405	0.0038	0.0443	0.0905	0.0025	0.0930	0.1310	0.0063	0.1373
	25	25ALT			-			-	0.1369	0.0129	0.1498	0.3062	0.0084	0.3146	0.4431	0.0213	0.4644
	14	14ALT			-			-	0.1120	0.0106	0.1226	0.2505	0.0069	0.2574	0.3625	0.0175	0.3800
	32	32ALT			-			-	0.0218	0.0021	0.0239	0.0487	0.0013	0.0500	0.0705	0.0034	0.0739

Table A-6 Modeled Average Daily Flight Events at NASWI and Coupeville for Cumulative (continued)

Operation Type	Rwy ID	Flight Track	EA-18G			C-9			P-3			P-8			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
Overhead Break Arrival	07	07OD1A	0.2243	-	0.2243			-			-			-	0.2243	-	0.2243
		07OD1B	0.2243	-	0.2243			-			-			-	0.2243	-	0.2243
		07OD1C	0.2311	-	0.2311			-			-			-	0.2311	-	0.2311
		07OD2A	0.0249	-	0.0249			-			-			-	0.0249	-	0.0249
		07OD2B	0.0249	-	0.0249			-			-			-	0.0249	-	0.0249
		07OD2C	0.0256	-	0.0256			-			-			-	0.0256	-	0.0256
		07ON1A	-	0.0237	0.0237			-			-			-	-	0.0237	0.0237
		07ON1B	-	0.0237	0.0237			-			-			-	-	0.0237	0.0237
		07ON1C	-	0.0244	0.0244			-			-			-	-	0.0244	0.0244
		07ON2A	-	0.0027	0.0027			-			-			-	-	0.0027	0.0027
		07ON2B	-	0.0027	0.0027			-			-			-	-	0.0027	0.0027
		07ON2C	-	0.0027	0.0027			-			-			-	-	0.0027	0.0027
	25	25OD1A	0.7593	-	0.7593			-			-			-	0.7593	-	0.7593
		25OD1B	0.7593	-	0.7593			-			-			-	0.7593	-	0.7593
		25OD1C	0.7822	-	0.7822			-			-			-	0.7822	-	0.7822
		25OD2A	0.0844	-	0.0844			-			-			-	0.0844	-	0.0844
		25OD2B	0.0844	-	0.0844			-			-			-	0.0844	-	0.0844
		25OD2C	0.0869	-	0.0869			-			-			-	0.0869	-	0.0869
		25ON1A	-	0.0804	0.0804			-			-			-	-	0.0804	0.0804
		25ON1B	-	0.0804	0.0804			-			-			-	-	0.0804	0.0804
		25ON1C	-	0.0828	0.0828			-			-			-	-	0.0828	0.0828
		25ON2A	-	0.0089	0.0089			-			-			-	-	0.0089	0.0089
		25ON2B	-	0.0089	0.0089			-			-			-	-	0.0089	0.0089
		25ON2C	-	0.0092	0.0092			-			-			-	-	0.0092	0.0092
	14	14OD1A	0.6212	-	0.6212			-			-			-	0.6212	-	0.6212
		14OD1B	0.6212	-	0.6212			-			-			-	0.6212	-	0.6212
		14OD1C	0.6400	-	0.6400			-			-			-	0.6400	-	0.6400
		14OD2A	0.0690	-	0.0690			-			-			-	0.0690	-	0.0690
		14OD2B	0.0690	-	0.0690			-			-			-	0.0690	-	0.0690
		14OD2C	0.0711	-	0.0711			-			-			-	0.0711	-	0.0711
		14ON1A	-	0.0657	0.0657			-			-			-	-	0.0657	0.0657
		14ON1B	-	0.0657	0.0657			-			-			-	-	0.0657	0.0657
		14ON1C	-	0.0678	0.0678			-			-			-	-	0.0678	0.0678
		14ON2A	-	0.0072	0.0072			-			-			-	-	0.0072	0.0072
		14ON2B	-	0.0072	0.0072			-			-			-	-	0.0072	0.0072
		14ON2C	-	0.0075	0.0075			-			-			-	-	0.0075	0.0075
	32	32OD1A	0.1209	-	0.1209			-			-			-	0.1209	-	0.1209
		32OD1B	0.1209	-	0.1209			-			-			-	0.1209	-	0.1209
		32OD1C	0.1245	-	0.1245			-			-			-	0.1245	-	0.1245
		32OD2A	0.0134	-	0.0134			-			-			-	0.0134	-	0.0134
		32OD2B	0.0134	-	0.0134			-			-			-	0.0134	-	0.0134
		32OD2C	0.0138	-	0.0138			-			-			-	0.0138	-	0.0138
		32ON1A	-	0.0128	0.0128			-			-			-	-	0.0128	0.0128
		32ON1B	-	0.0128	0.0128			-			-			-	-	0.0128	0.0128
		32ON1C	-	0.0133	0.0133			-			-			-	-	0.0133	0.0133
		32ON2A	-	0.0014	0.0014			-			-			-	-	0.0014	0.0014
		32ON2B	-	0.0014	0.0014			-			-			-	-	0.0014	0.0014
		32ON2C	-	0.0014	0.0014			-			-			-	-	0.0014	0.0014
Depart and Re-enter	07	07DR	0.0207	0.0016	0.0223			-			-			-	0.0207	0.0016	0.0223
		07DL	0.0207	0.0016	0.0223			-			-			-	0.0207	0.0016	0.0223
	25	25DR	0.0569	0.0045	0.0614			-			-			-	0.0569	0.0045	0.0614
		25DL	0.0569	0.0045	0.0614			-			-			-	0.0569	0.0045	0.0614
	14	14DR	0.0696	0.0054	0.0750			-			-			-	0.0696	0.0054	0.0750
		14DL	0.0696	0.0054	0.0750			-			-			-	0.0696	0.0054	0.0750
	32	32DR	0.0111	0.0009	0.0120			-			-			-	0.0111	0.0009	0.0120
		32DL	0.0111	0.0009	0.0120			-			-			-	0.0111	0.0009	0.0120

Table A-6 Modeled Average Daily Flight Events at NASWI and Coupeville for Cumulative (continued)

Operation Type	Rwy ID	Flight Track	EA-18G			C-9			P-3			P-8			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
Touch and Go at Ault Field	07	07TD1	0.2004	-	0.2004			-			-			-	0.2004	-	0.2004
		07TD2	0.4010	-	0.4010			-			-			-	0.4010	-	0.4010
		07TD3	0.2004	-	0.2004			-			-			-	0.2004	-	0.2004
		07TN1	0.1955	0.0189	0.2144			-	0.3355	-	0.3355	0.8589	-	0.8589	1.3899	0.0189	1.4088
		07TN2	0.3912	0.0377	0.4289			-	0.6710	-	0.6710	1.7178	-	1.7178	2.7800	0.0377	2.8177
		07TN3	0.1955	0.0189	0.2144			-	0.3355	-	0.3355	0.8589	-	0.8589	1.3899	0.0189	1.4088
	25	25TD1	0.6786	-	0.6786			-			-			-	0.6786	-	0.6786
		25TD2	1.3571	-	1.3571			-			-			-	1.3571	-	1.3571
		25TD3	0.6786	-	0.6786			-			-			-	0.6786	-	0.6786
		25TN1	0.6621	0.0640	0.7261			-	1.1356	-	1.1356	2.9070	-	2.9070	4.7047	0.0640	4.7687
		25TN2	1.3240	0.1280	1.4520			-	2.2711	-	2.2711	5.8140	-	5.8140	9.4091	0.1280	9.5371
		25TN3	0.6621	0.0640	0.7261			-	1.1356	-	1.1356	2.9070	-	2.9070	4.7047	0.0640	4.7687
	14	14TD1	0.5551	-	0.5551			-			-			-	0.5551	-	0.5551
		14TD2	1.1103	-	1.1103			-			-			-	1.1103	-	1.1103
		14TD3	0.5551	-	0.5551			-			-			-	0.5551	-	0.5551
		14TN1	0.5416	0.0523	0.5939			-	0.9291	-	0.9291	2.3785	-	2.3785	3.8492	0.0523	3.9015
		14TN2	1.0834	0.1046	1.1880			-	1.8582	-	1.8582	4.7569	-	4.7569	7.6985	0.1046	7.8031
		14TN3	0.5416	0.0523	0.5939			-	0.9291	-	0.9291	2.3785	-	2.3785	3.8492	0.0523	3.9015
	32	32TD1	0.1079	-	0.1079			-			-			-	0.1079	-	0.1079
		32TD2	0.2160	-	0.2160			-			-			-	0.2160	-	0.2160
		32TD3	0.1079	-	0.1079			-			-			-	0.1079	-	0.1079
		32TN1	0.1054	0.0101	0.1155			-	0.1807	-	0.1807	0.4625	-	0.4625	0.7486	0.0101	0.7587
		32TN2	0.2106	0.0204	0.2311			-	0.3613	-	0.3613	0.9250	-	0.9250	1.4969	0.0204	1.5174
		32TN3	0.1054	0.0101	0.1155			-	0.1807	-	0.1807	0.4625	-	0.4625	0.7486	0.0101	0.7587
FCLP at Ault Field	07	07TD1	0.3168	-	0.3168			-			-			-	0.3168	-	0.3168
		07TD2	0.6335	-	0.6335			-			-			-	0.6335	-	0.6335
		07TD3	0.3168	-	0.3168			-			-			-	0.3168	-	0.3168
		07TN1	0.3091	0.1307	0.4397			-			-			-	0.3091	0.1307	0.4397
		07TN2	0.6181	0.2612	0.8793			-			-			-	0.6181	0.2612	0.8793
		07TN3	0.3091	0.1307	0.4397			-			-			-	0.3091	0.1307	0.4397
	25	25TD1	1.0722	-	1.0722			-			-			-	1.0722	-	1.0722
		25TD2	2.1444	-	2.1444			-			-			-	2.1444	-	2.1444
		25TD3	1.0722	-	1.0722			-			-			-	1.0722	-	1.0722
		25TN1	1.0460	0.4421	1.4881			-			-			-	1.0460	0.4421	1.4881
		25TN2	2.0923	0.8841	2.9764			-			-			-	2.0923	0.8841	2.9764
		25TN3	1.0460	0.4421	1.4881			-			-			-	1.0460	0.4421	1.4881
	14	14TD1	0.8773	-	0.8773			-			-			-	0.8773	-	0.8773
		14TD2	1.7546	-	1.7546			-			-			-	1.7546	-	1.7546
		14TD3	0.8773	-	0.8773			-			-			-	0.8773	-	0.8773
		14TN1	0.8560	0.3616	1.2177			-			-			-	0.8560	0.3616	1.2177
		14TN2	1.7118	0.7233	2.4351			-			-			-	1.7118	0.7233	2.4351
		14TN3	0.8560	0.3616	1.2177			-			-			-	0.8560	0.3616	1.2177
	32	32TD1	0.1706	-	0.1706			-			-			-	0.1706	-	0.1706
		32TD2	0.3411	-	0.3411			-			-			-	0.3411	-	0.3411
		32TD3	0.1706	-	0.1706			-			-			-	0.1706	-	0.1706
		32TN1	0.1665	0.0703	0.2368			-			-			-	0.1665	0.0703	0.2368
		32TN2	0.3328	0.1406	0.4734			-			-			-	0.3328	0.1406	0.4734
		32TN3	0.1665	0.0703	0.2368			-			-			-	0.1665	0.0703	0.2368
GCA Pattern at Ault Field	07	07G1	0.1759	0.1599	0.3358			-			-			-	0.1759	0.1599	0.3358
		07G2	0.0703	0.0640	0.1343			-	0.1342	-	0.1342	0.3435	-	0.3435	0.5480	0.0640	0.6120
		07G3	0.1054	0.0959	0.2013			-	0.1342	-	0.1342	0.3435	-	0.3435	0.5831	0.0959	0.6790
	25	25G1	0.5952	0.5414	1.1366			-			-			-	0.5952	0.5414	1.1366
		25G2	0.2380	0.2165	0.4545			-	0.4542	-	0.4542	1.1627	-	1.1627	1.8549	0.2165	2.0714
		25G3	0.3572	0.3250	0.6821			-	0.4542	-	0.4542	1.1627	-	1.1627	1.9741	0.3250	2.2990
	14	14G1	0.4871	0.4431	0.9302			-			-			-	0.4871	0.4431	0.9302
		14G2	0.1948	0.1772	0.3720			-	0.3716	-	0.3716	0.9513	-	0.9513	1.5177	0.1772	1.6949
		14G3	0.2922	0.2659	0.5581			-	0.3716	-	0.3716	0.9513	-	0.9513	1.6151	0.2659	1.8810
	32	32G1	0.0947	0.0862	0.1810			-			-			-	0.0947	0.0862	0.1810
		32G2	0.0378	0.0344	0.0722			-	0.0723	-	0.0723	0.1850	-	0.1850	0.2951	0.0344	0.3295
		32G3	0.0567	0.0517	0.1084			-	0.0723	-	0.0723	0.1850	-	0.1850	0.3140	0.0517	0.3657

Table A-6 Modeled Average Daily Flight Events at NASWI and Coupeville for Cumulative (concluded)

Operation Type	Rwy ID	Flight Track	EA-18G			C-9			P-3			P-8			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
Interfacility Ault Field to Coupeville	7	07WC14D	0.0647	-	0.0647			-			-			-	0.0647	-	0.0647
		07WC14N	-	0.0041	0.0041			-			-			-	-	0.0041	0.0041
		07WC32D	0.0647		0.0647			-			-			-	0.0647	-	0.0647
		07WC32N		0.0041	0.0041			-			-			-	-	0.0041	0.0041
	25	25WC14D	0.2188	-	0.2188			-			-			-	0.2188	-	0.2188
		25WC14N	-	0.0134	0.0134			-			-			-	-	0.0134	0.0134
		25WC32D	0.2188	-	0.2188			-			-			-	0.2188	-	0.2188
		25WC32N	-	0.0134	0.0134			-			-			-	-	0.0134	0.0134
	14	14WC14D	0.1791	-	0.1791			-			-			-	0.1791	-	0.1791
		14WC14N	-	0.0109	0.0109			-			-			-	-	0.0109	0.0109
		14WC32D	0.1791	-	0.1791			-			-			-	0.1791	-	0.1791
		14WC32N	-	0.0109	0.0109			-			-			-	-	0.0109	0.0109
	32	32WC14D	0.0349	-	0.0349			-			-			-	0.0349	-	0.0349
		32WC14N	-	0.0022	0.0022			-			-			-	-	0.0022	0.0022
		32WC32D	0.0349	-	0.0349			-			-			-	0.0349	-	0.0349
		32WC32N	-	0.0022	0.0022			-			-			-	-	0.0022	0.0022
FCLP at Coupeville	14	14TD1	0.4411	-	0.4411			-			-			-	0.4411	-	0.4411
		14TD2	0.8824	-	0.8824			-			-			-	0.8824	-	0.8824
		14TD3	0.4411	-	0.4411			-			-			-	0.4411	-	0.4411
		14TN1	0.4303	0.0535	0.4838			-			-			-	0.4303	0.0535	0.4838
		14TN2	0.8609	0.1068	0.9677			-			-			-	0.8609	0.1068	0.9677
		14TN3	0.4303	0.0535	0.4838			-			-			-	0.4303	0.0535	0.4838
	32	32TD1	0.4411	-	0.4411			-			-			-	0.4411	-	0.4411
		32TD2	0.8824	-	0.8824			-			-			-	0.8824	-	0.8824
		32TD3	0.4411	-	0.4411			-			-			-	0.4411	-	0.4411
		32TN1	0.4303	0.0535	0.4838			-			-			-	0.4303	0.0535	0.4838
		32TN2	0.8609	0.1068	0.9677			-			-			-	0.8609	0.1068	0.9677
		32TN3	0.4303	0.0535	0.4838			-			-			-	0.4303	0.0535	0.4838
Interfacility Coupeville to Ault Field	14	14CW07D	0.1243	-	0.1243			-			-			-	0.1243	-	0.1243
		14CW07N	-	0.0077	0.0077			-			-			-	-	0.0077	0.0077
		14CW14D	0.1243	-	0.1243			-			-			-	0.1243	-	0.1243
		14CW14N	-	0.0077	0.0077			-			-			-	-	0.0077	0.0077
		14CW25D	0.1243	-	0.1243			-			-			-	0.1243	-	0.1243
		14CW25N	-	0.0077	0.0077			-			-			-	-	0.0077	0.0077
		14CW32D	0.1243	-	0.1243			-			-			-	0.1243	-	0.1243
		14CW32N	-	0.0077	0.0077			-			-			-	-	0.0077	0.0077
	32	32CW07D	0.1243	-	0.1243			-			-			-	0.1243	-	0.1243
		32CW07N	-	0.0077	0.0077			-			-			-	-	0.0077	0.0077
		32CW14D	0.1243	-	0.1243			-			-			-	0.1243	-	0.1243
		32CW14N	-	0.0077	0.0077			-			-			-	-	0.0077	0.0077
		32CW25D	0.1243	-	0.1243			-			-			-	0.1243	-	0.1243
		32CW25N	-	0.0077	0.0077			-			-			-	-	0.0077	0.0077
		32CW32D	0.1243	-	0.1243			-			-			-	0.1243	-	0.1243
		32CW32N	-	0.0077	0.0077			-			-			-	-	0.0077	0.0077
Departure			11.1447	0.7266	11.8713	0.5370	0.2904	0.8274	2.1180	0.2765	2.3945	4.6303	0.1396	4.7699	18.4300	1.4331	19.8631
Straight-in VFR			-	-	-	0.5370	0.2904	0.8274	1.4954	0.2169	1.7123	3.2411	0.0987	3.3398	5.2735	0.6060	5.8795
Straight-in IFR			3.9805	0.1122	4.0928	-	-	-	0.3112	0.0294	0.3406	0.6959	0.0192	0.7151	4.9876	0.1608	5.1485
TACAN Arrival			1.2835	0.1127	1.3962	-	-	-	0.3112	0.0294	0.3406	0.6959	0.0191	0.7150	2.2906	0.1612	2.4518
Overhead Break Arrival			5.8099	0.6146	6.4244	-	-	-	-	-	-	-	-	-	5.8099	0.6146	6.4244
Touch and Go at Ault Field			12.1867	0.5814	12.7681	-	-	-	10.3234	-	10.3234	26.4275	-	26.4275	48.9376	0.5814	49.5190
FCLP at Ault Field			19.2577	4.0186	23.2763	-	-	-	-	-	-	-	-	-	19.2577	4.0186	23.2763
Depart and Re-enter			0.3167	0.0247	0.3414	-	-	-	-	-	-	-	-	-	0.3167	0.0247	0.3414
GCA Pattern at Ault Field			2.7054	2.4611	5.1665	-	-	-	2.0646	-	2.0646	5.2850	-	5.2850	10.0550	2.4611	12.5161
Interfacility from Ault Field to Coupeville			0.9949	0.0612	1.0561	-	-	-	-	-	-	-	-	-	0.9949	0.0612	1.0561
FCLP at Coupeville			6.9723	0.4275	7.3998	-	-	-	-	-	-	-	-	-	6.9723	0.4275	7.3998
Interfacility from Coupeville to Ault Field			0.9945	0.0616	1.0561	-	-	-	-	-	-	-	-	-	0.9945	0.0616	1.0561
Total			65.6468	9.2021	74.8489	1.0740	0.5808	1.6548	16.6238	0.5522	17.1760	40.9757	0.2766	41.2523	124.3203	10.6118	134.9320

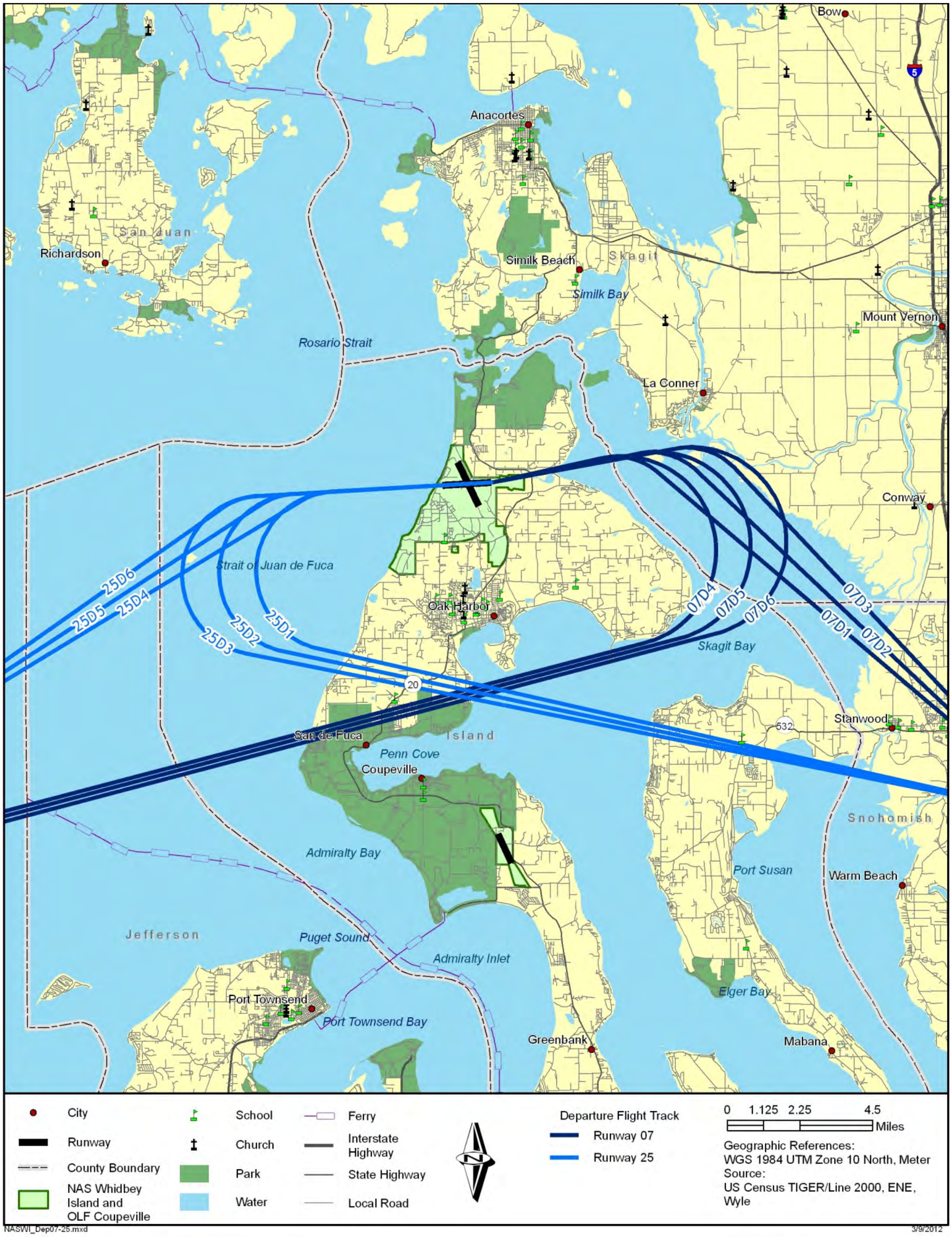


Figure A-1 Modeled Average Daily Departure Flight Tracks on Runway 07/25 at NAS Whidbey Island

Figure A-2 Modeled Average Daily Departure Flight Tracks on Runway 14/32 at NAS Whidbey Island

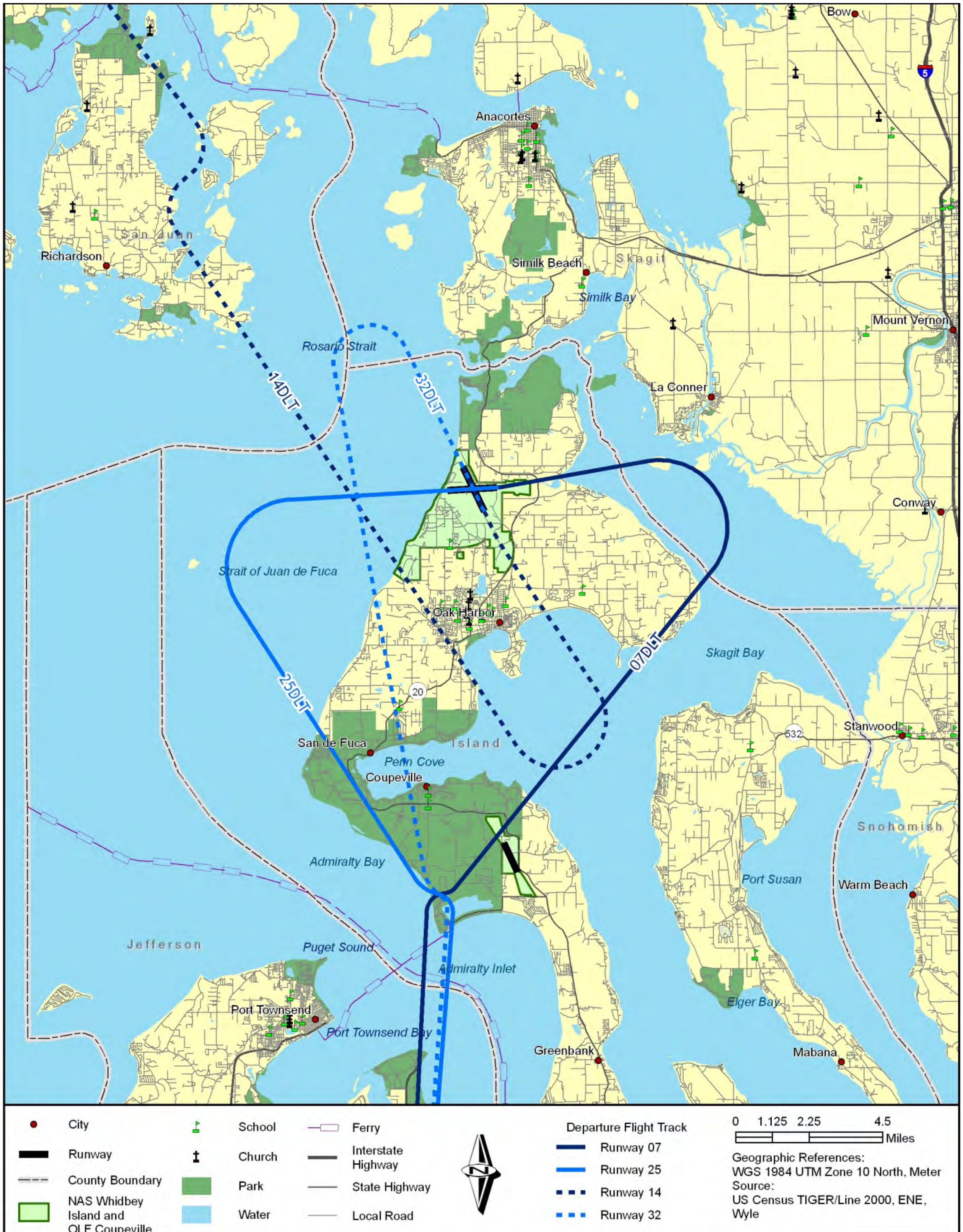


Figure A-3 Modeled Average Daily Low-TACAN Departure Flight Tracks at NAS Whidbey Island

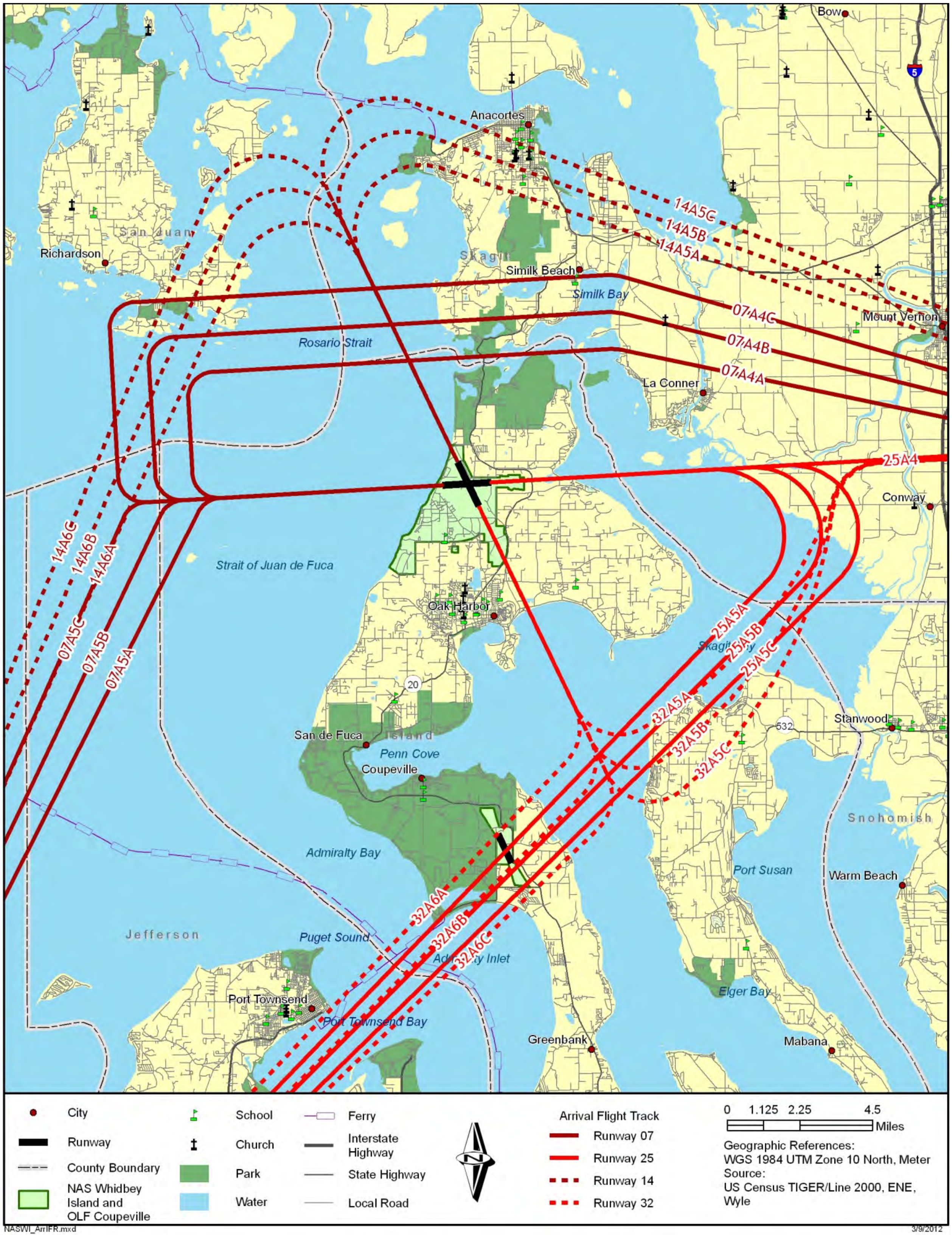


Figure A-4 Modeled Average Daily Straight-In IFR Arrival Flight Tracks at NAS Whidbey Island

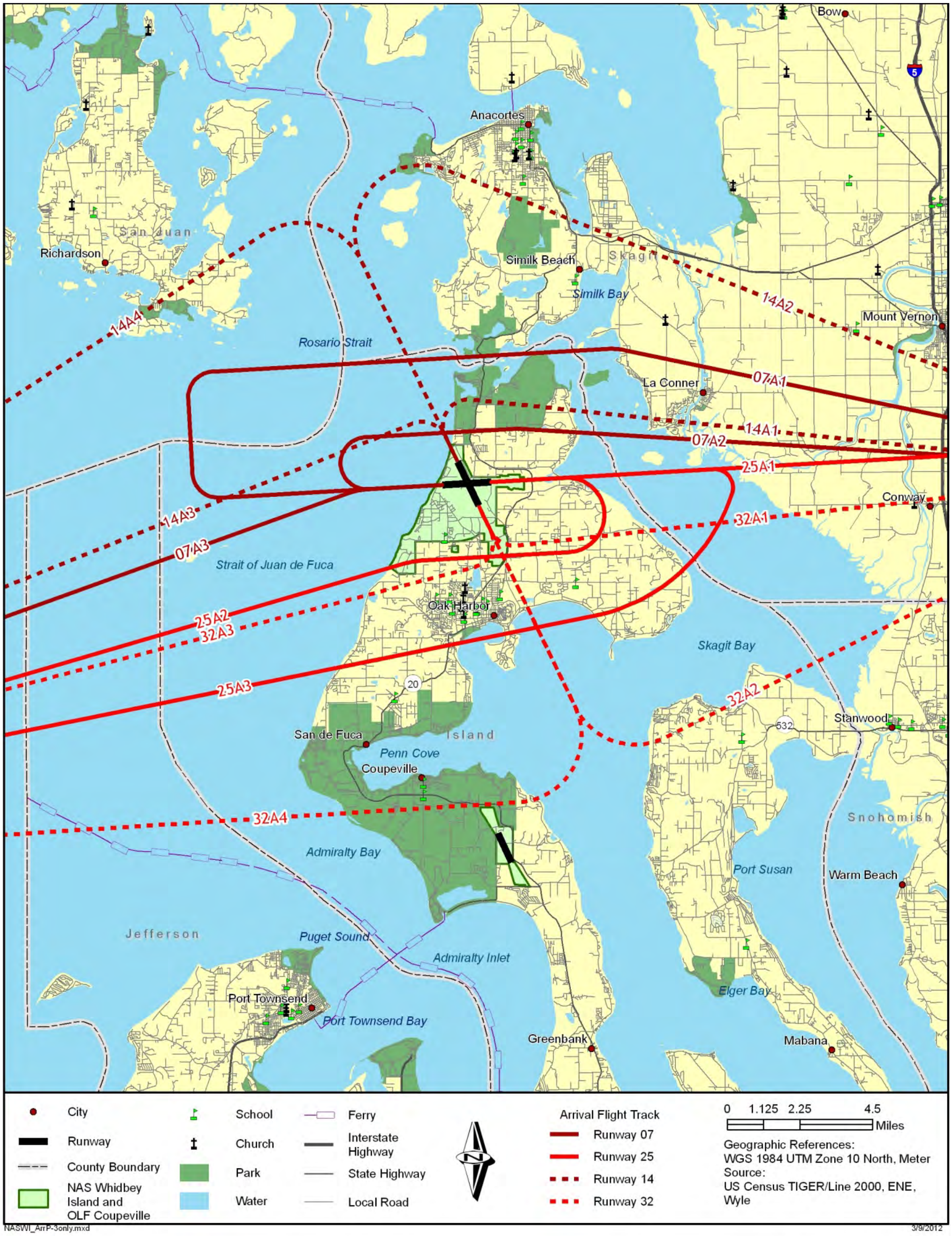


Figure A-5 Modeled Average Daily Straight-In VFR Arrival Flight Tracks at NAS Whidbey Island

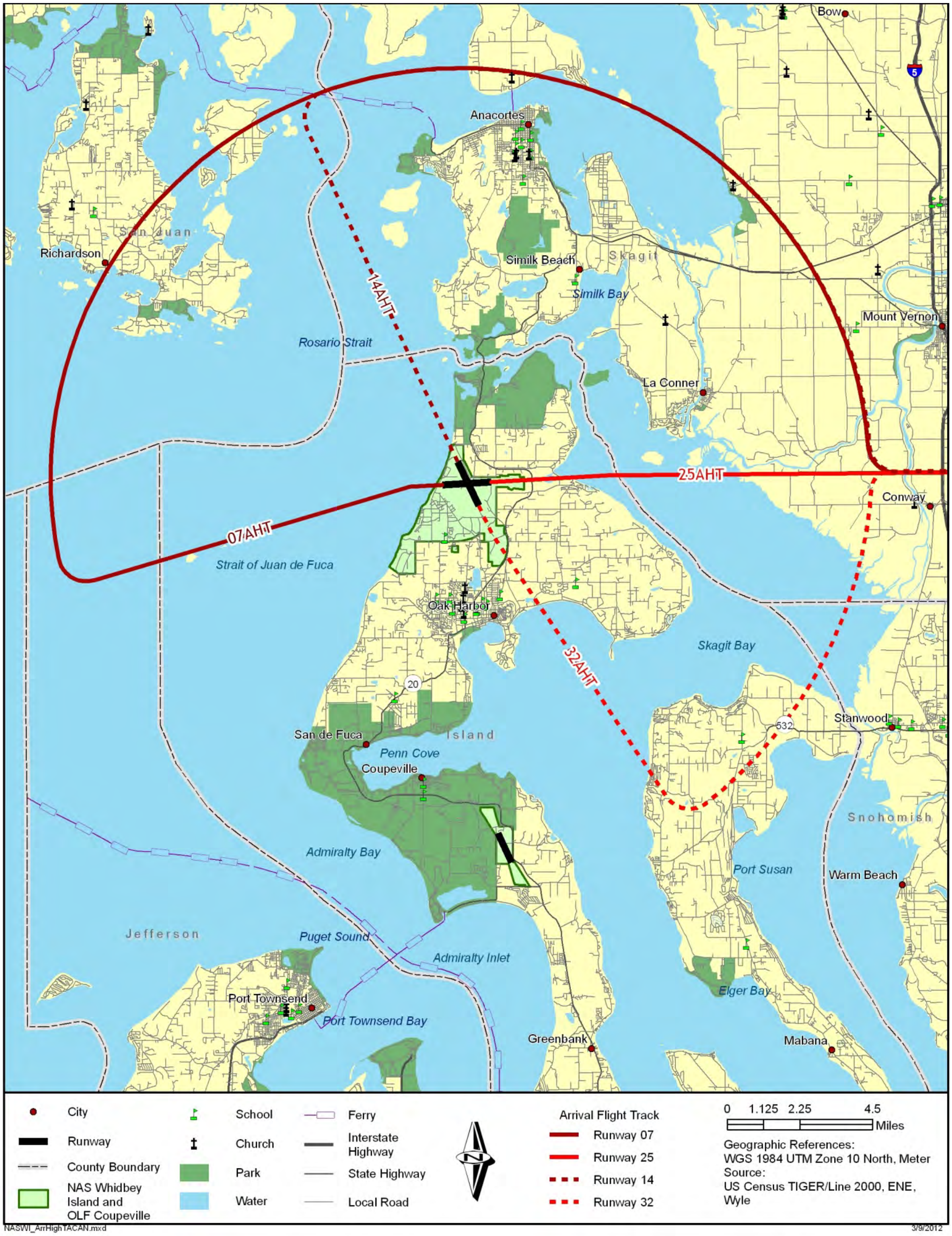


Figure A-6 Modeled Average Daily High-TACAN Arrival Flight Tracks at NAS Whidbey Island

Figure A-7 Modeled Average Daily Low-TACAN Arrival Flight Tracks at NAS Whidbey Island

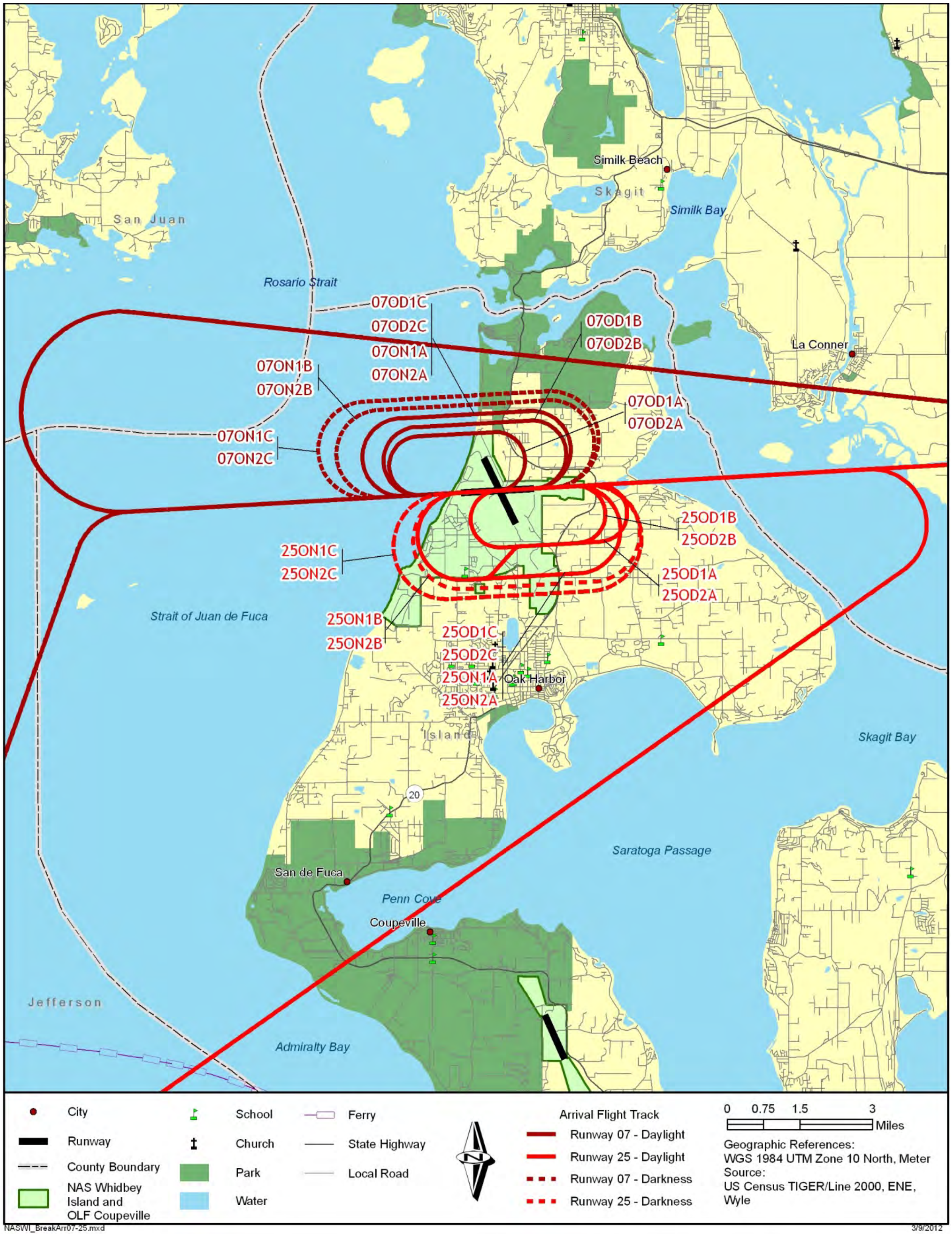


Figure A-8 Modeled Average Daily Overhead Break Arrival Flight Tracks on Runway 07/25 at NAS Whidbey Island

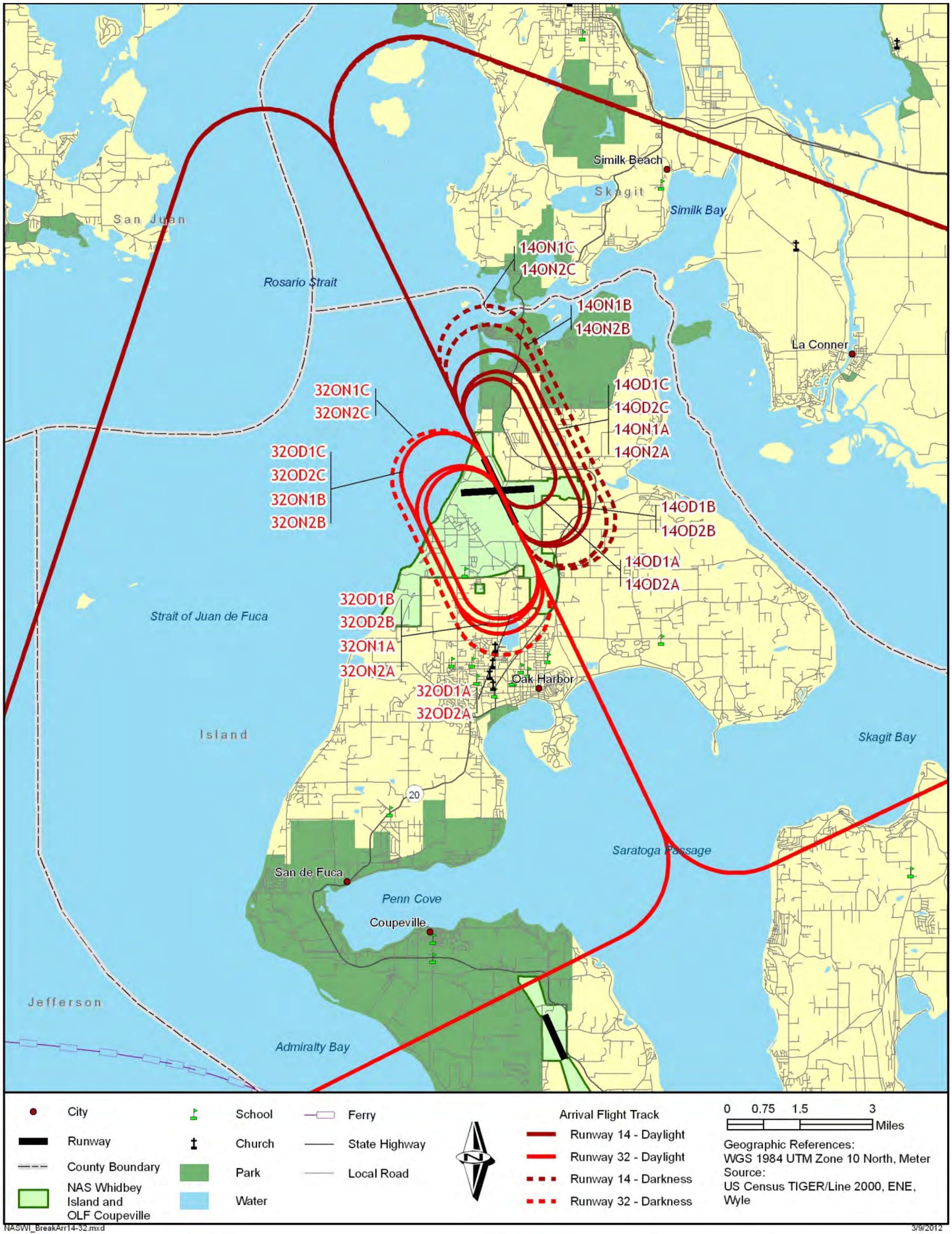


Figure A-9 Modeled Average Daily Overhead Break Arrival Flight Tracks on Runway 14/32 at NAS Whidbey Island

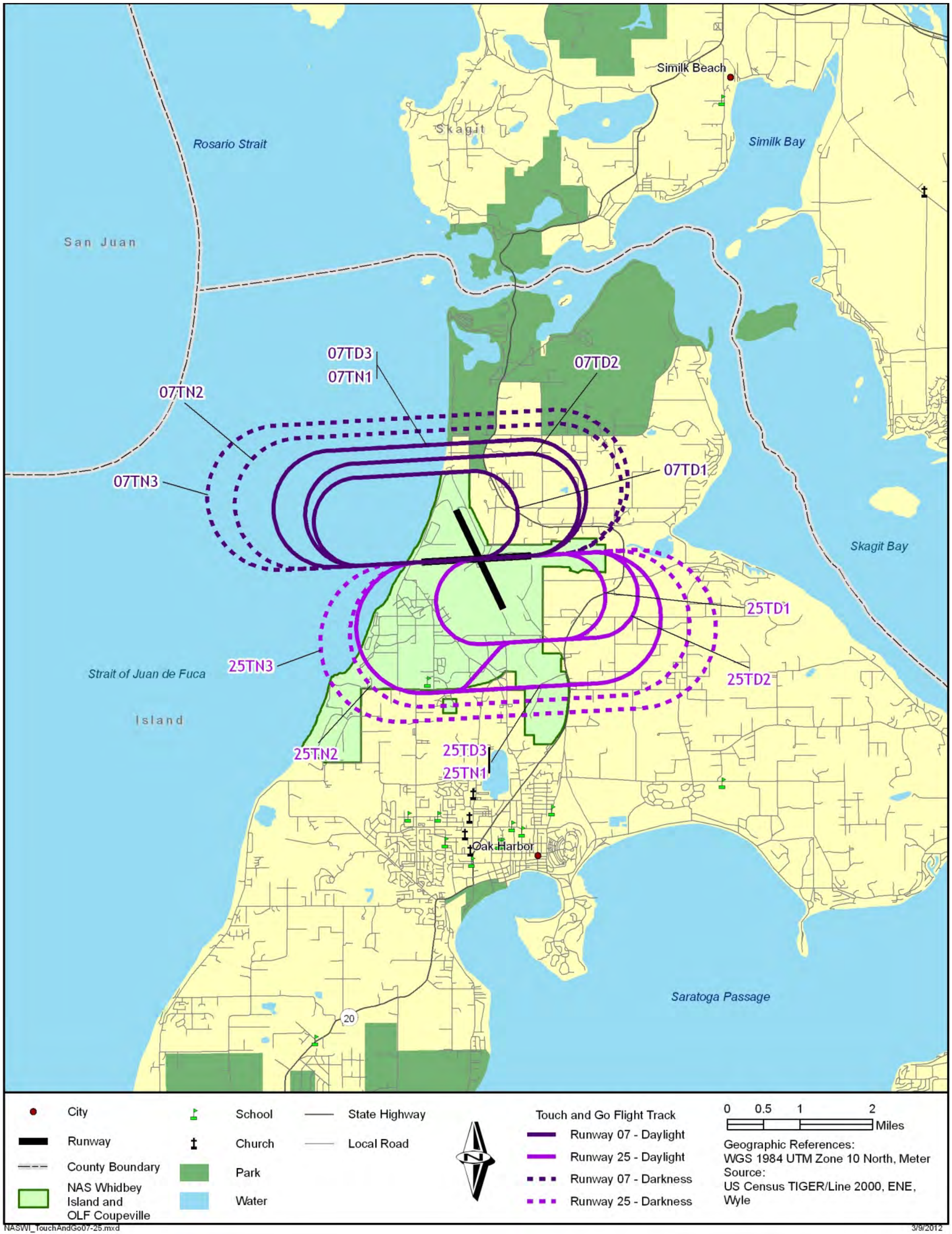


Figure A-10 Modeled Average Daily Tower Pattern Flight Tracks on Runway 07/25 at NAS Whidbey Island

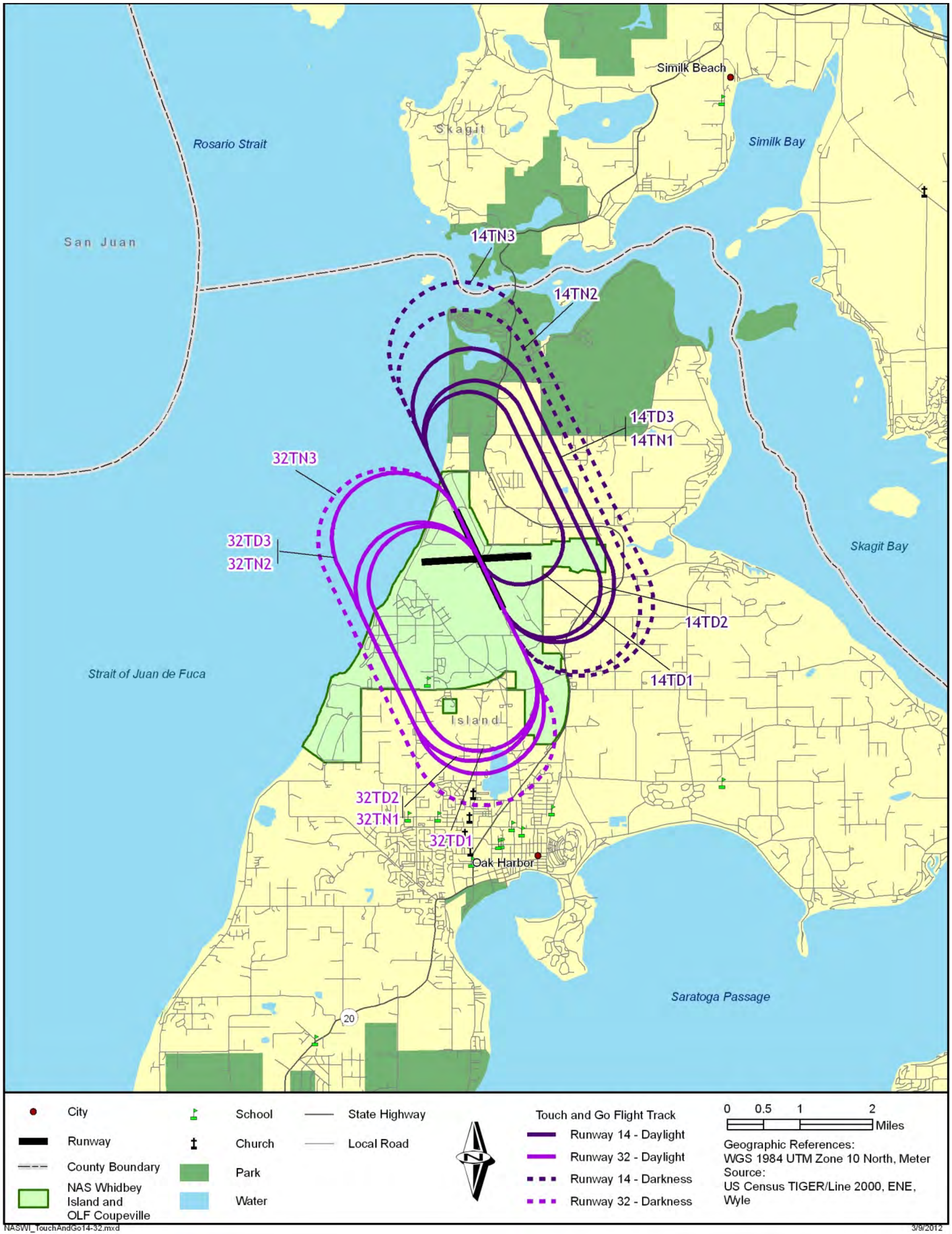


Figure A-11 Modeled Average Daily Tower Pattern Flight Tracks on Runway 14/32 at NAS Whidbey Island

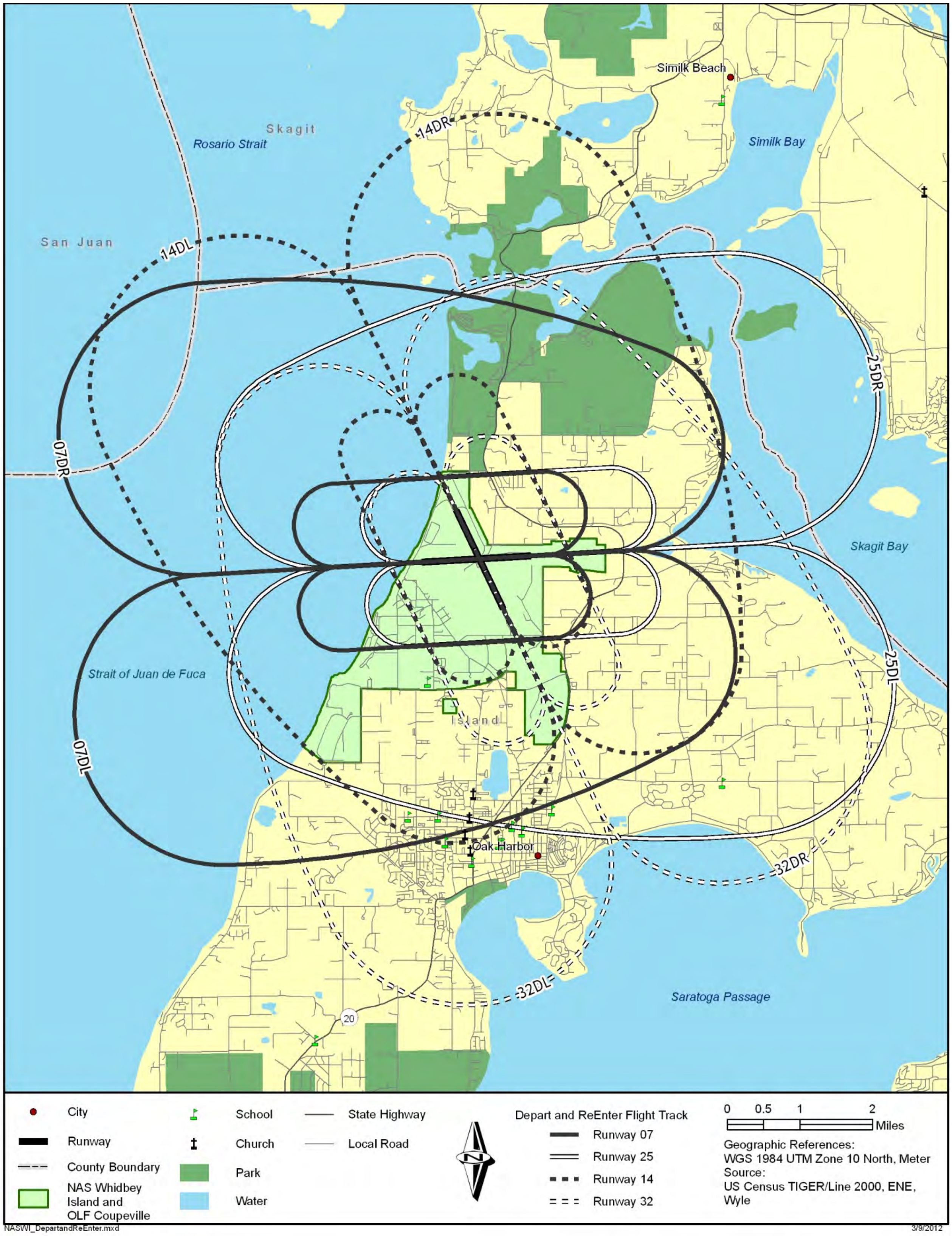


Figure A-12 Modeled Average Daily Depart and ReEnter Flight Tracks at NAS Whidbey Island

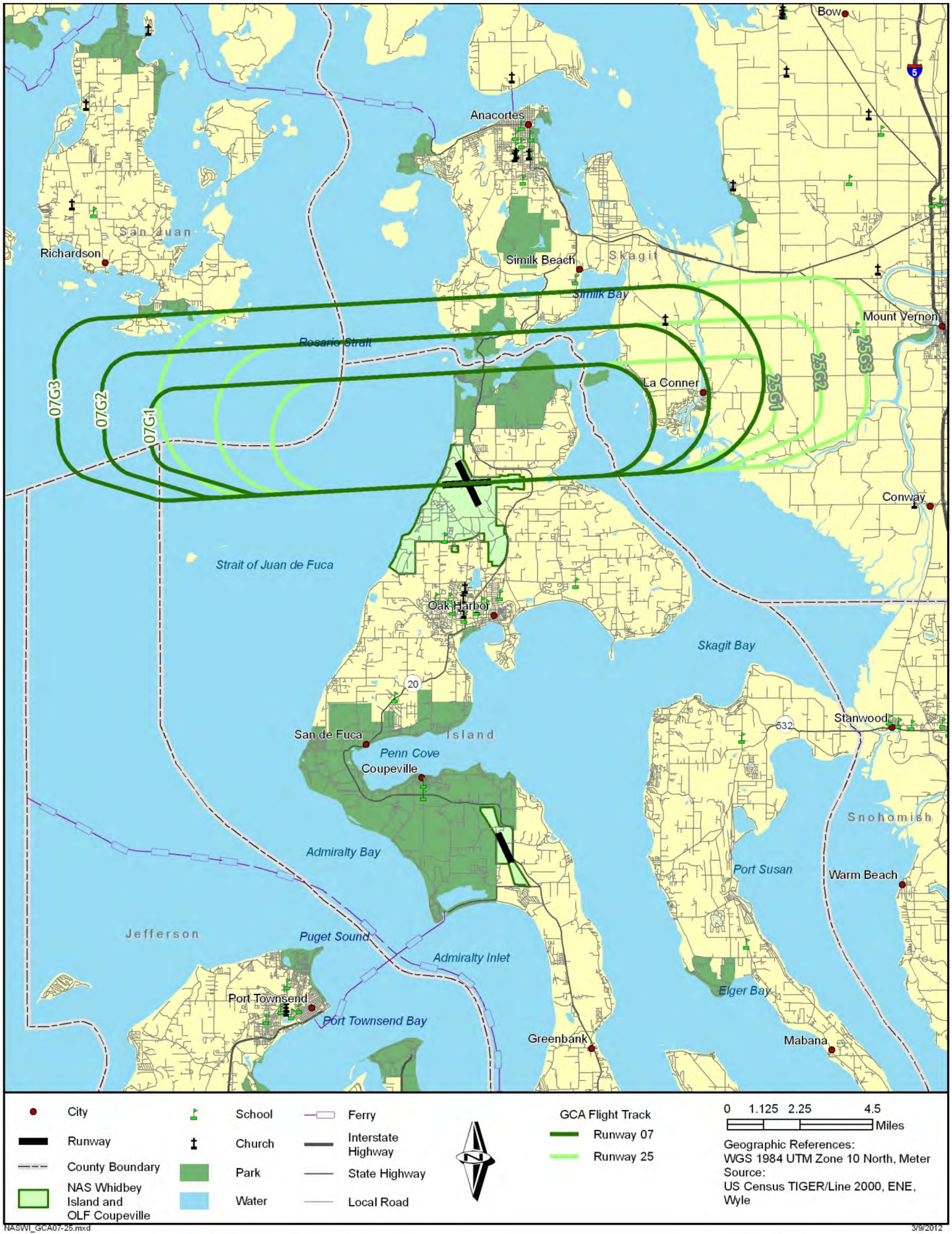


Figure A-13 Modeled Average Daily GCA Box Flight Tracks on Runway 07/25 at NAS Whidbey Island

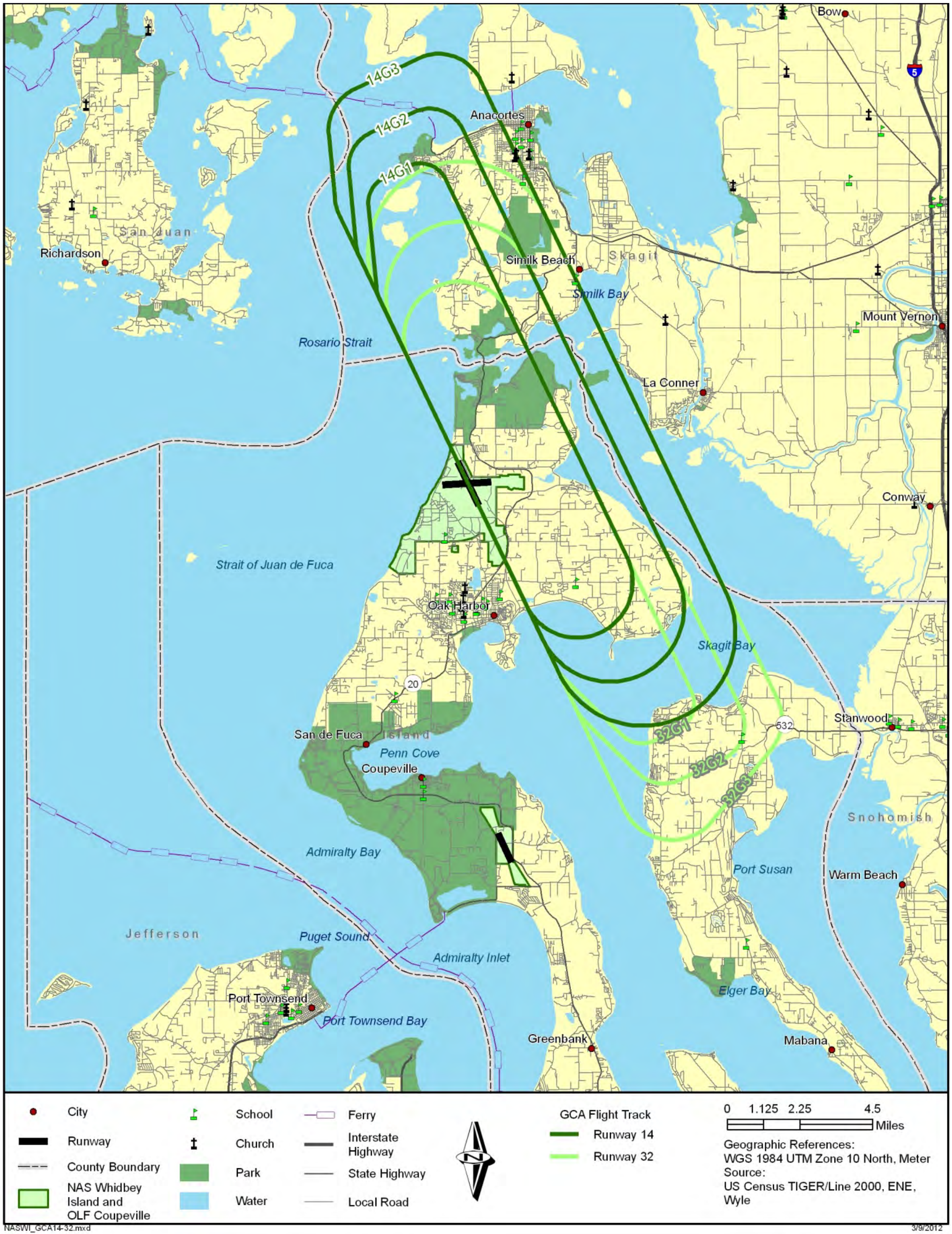


Figure A-14 Modeled Average Daily GCA Box Flight Tracks on Runway 14/32 at NAS Whidbey Island

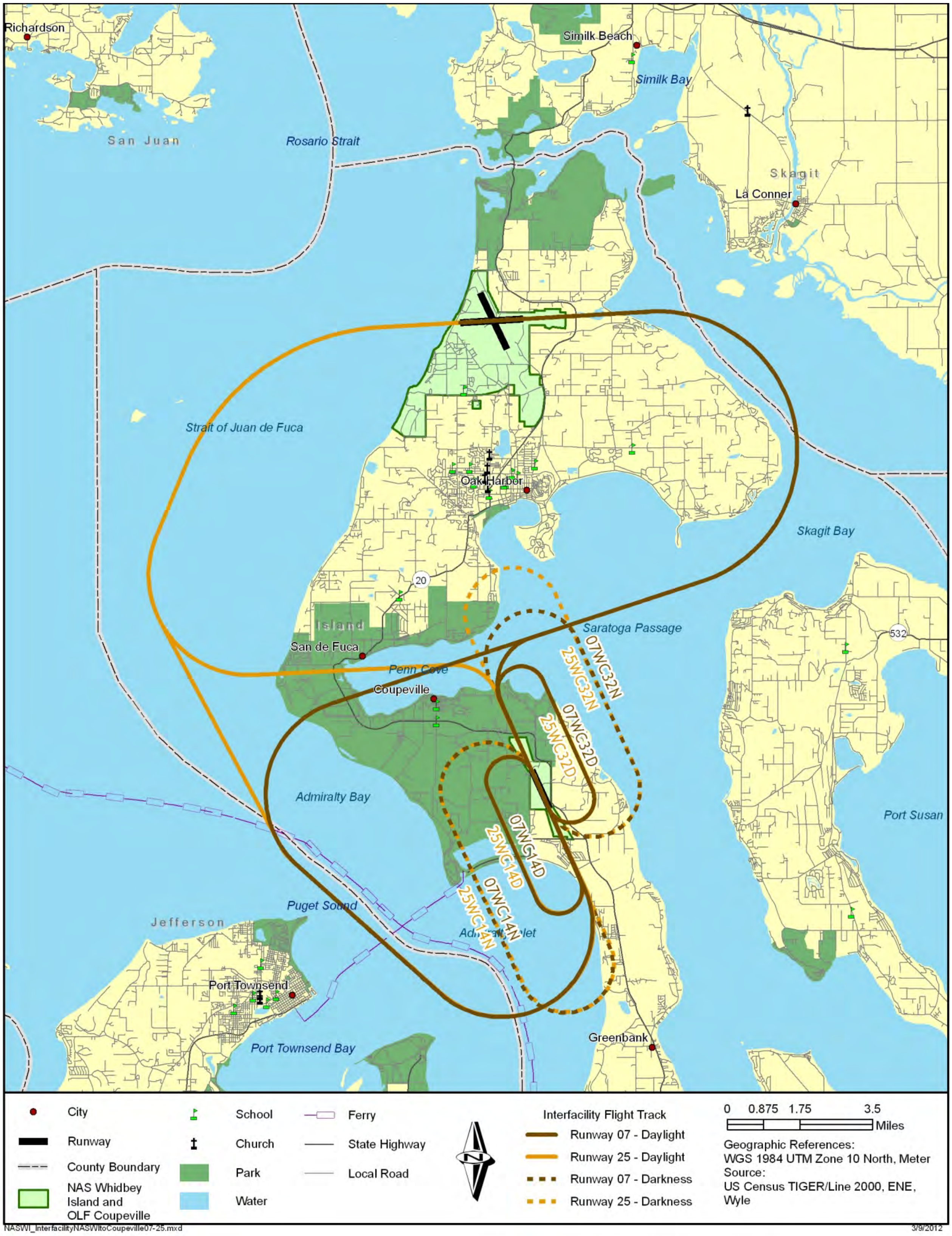


Figure A-15 Modeled Average Daily Interfacility Flight Tracks – NAS Whidbey Island Runway 07/25 to OLF Coupeville

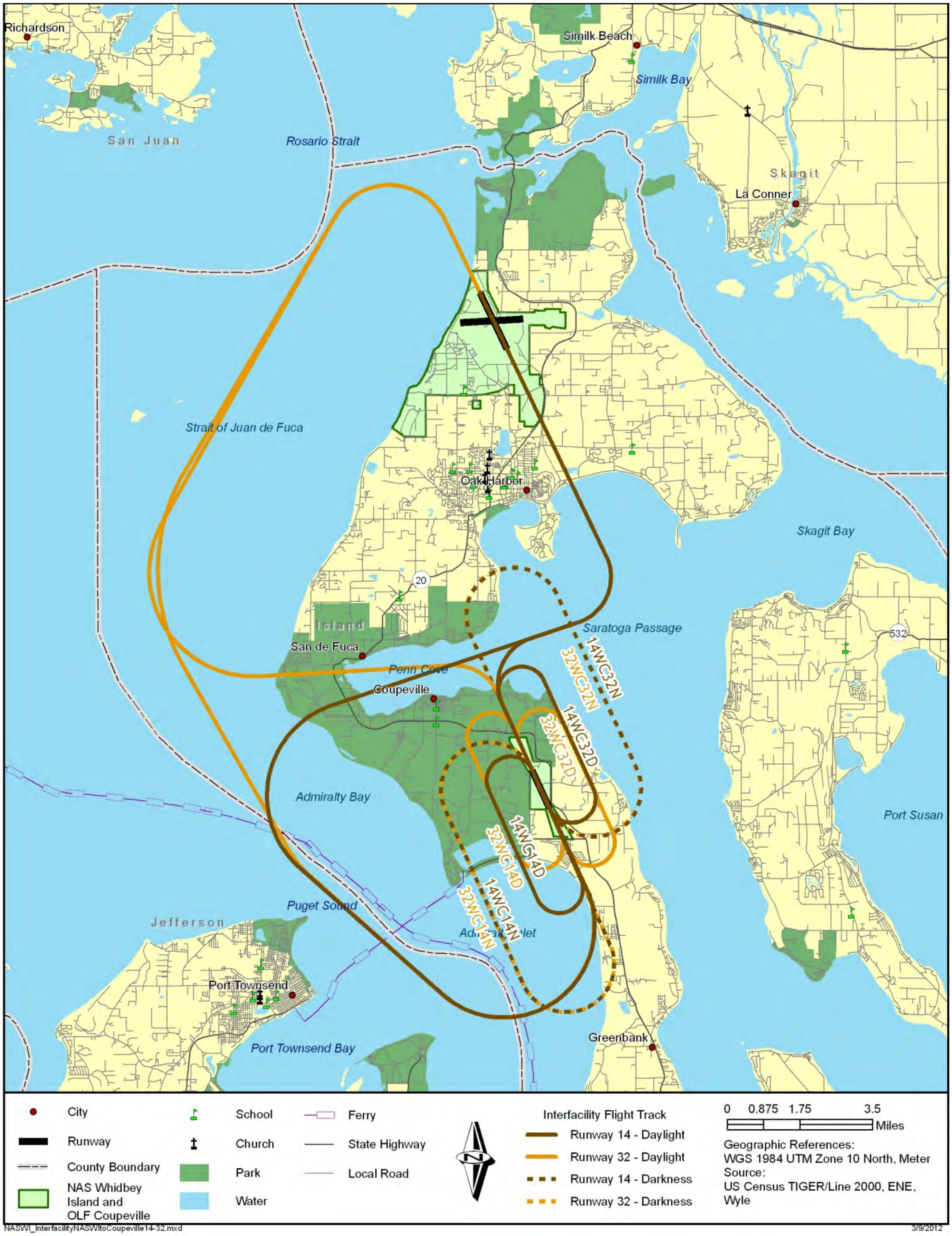


Figure A-16 Modeled Average Daily Interfacility Flight Tracks – NAS Whidbey Island Runway 14/32 to OLF Coupeville

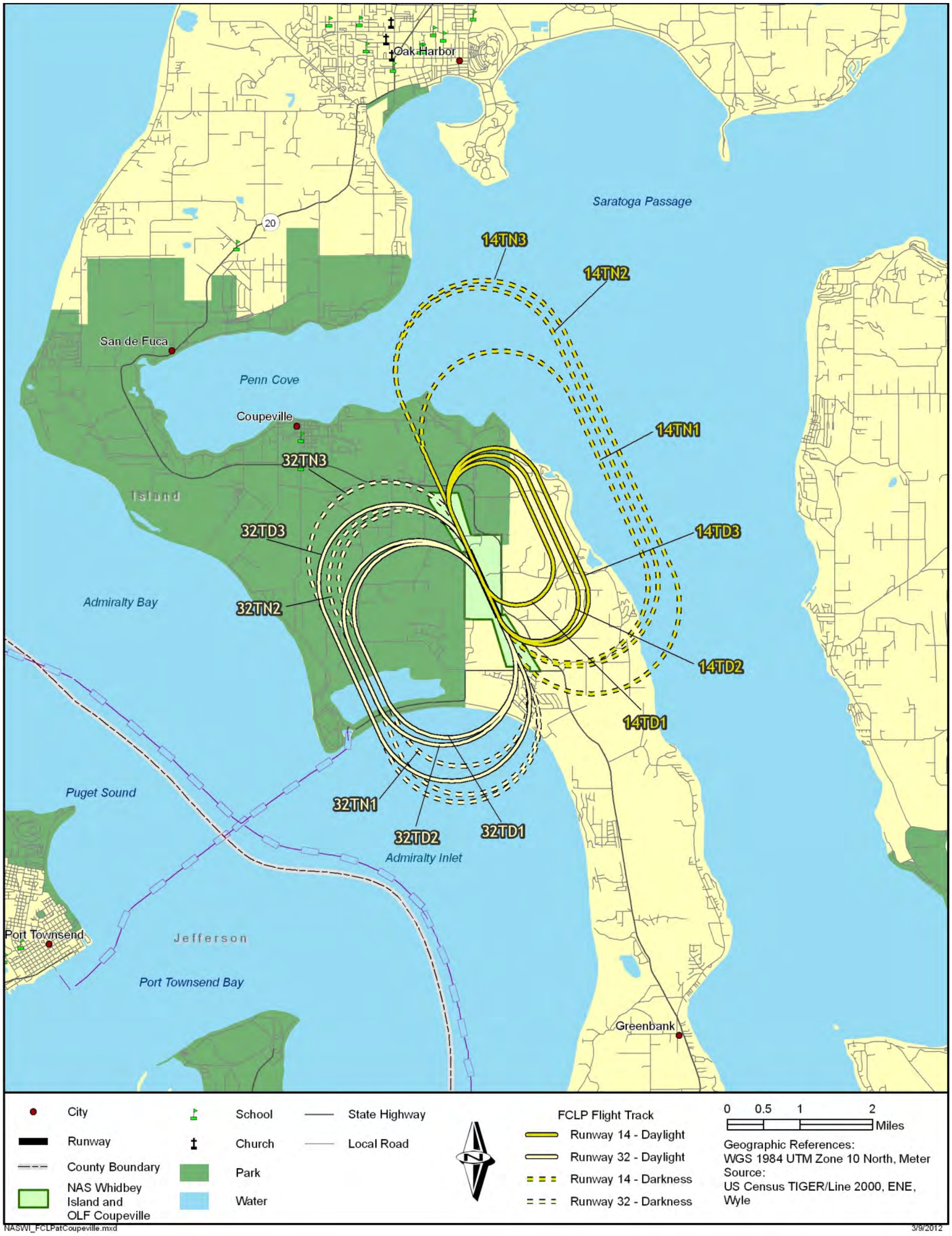


Figure A-17 Modeled Average Daily FCLP Flight Tracks at OLF Coupeville

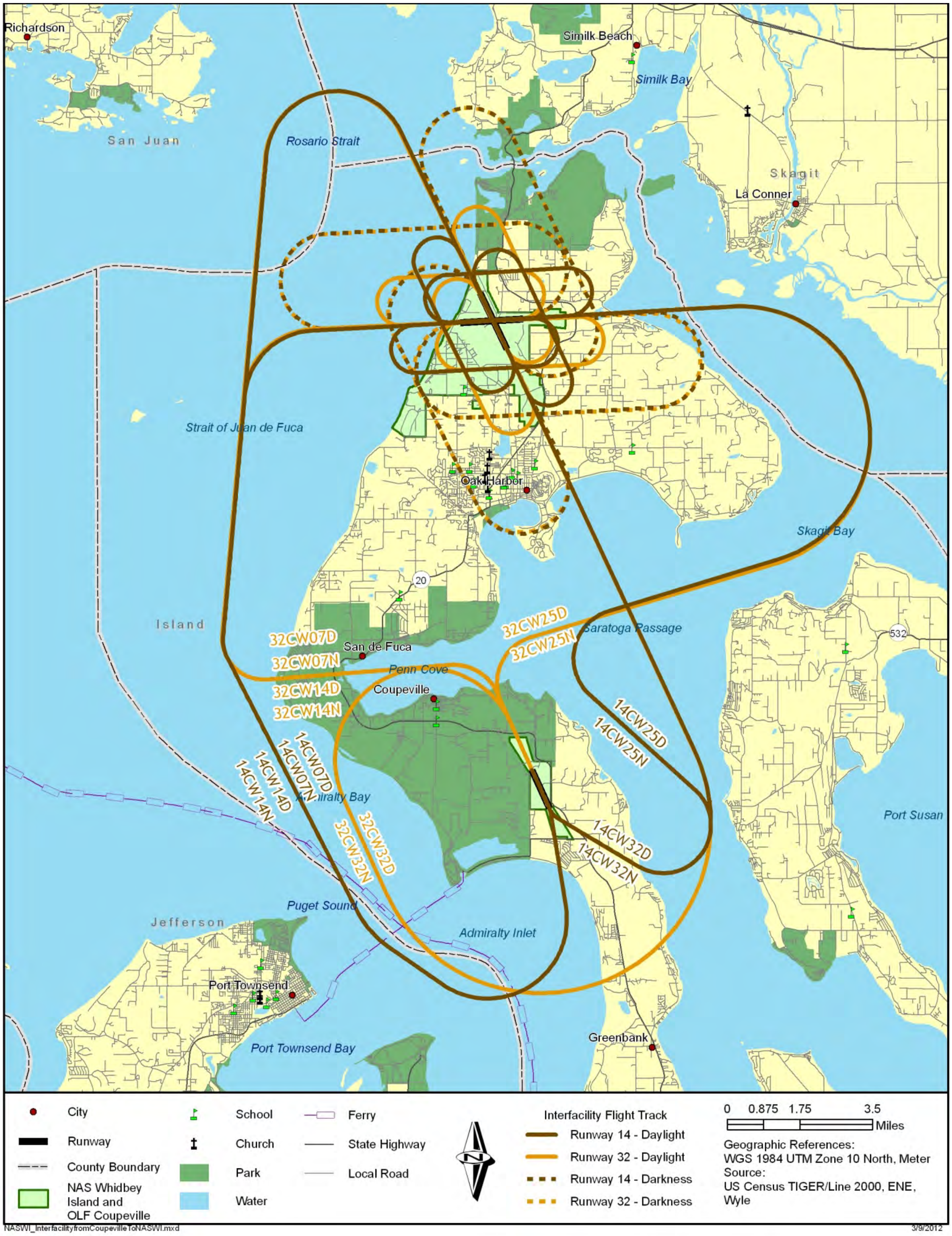


Figure A-18 Modeled Average Daily Interfacility Flight Tracks – OLF Coupeville to NAS Whidbey Island

This appendix provides scaled plots of individual flight profiles for each modeled aircraft type representative of each type of applicable flight operation. The following navigational aids are depicted on the maps:

- NUW – TACAN

The flight profiles are shown in the following order:

Profile Pages	Aircraft
A-44 - A-55	EA-6B
A-56 - A-69	EA-18G
A-70 - A-76	P-3C
A-77 - A-83	P-8A
A-84 - A-85	C-9A

Each figure includes a table describing the profile parameters of the associated flight track. The columns of the profile data tables are described below:

Column Heading	Description
Point	Sequence letter along flight track denoting change in flight parameters
Distance (feet)	Distance along flight track from runway threshold in feet
Height (feet)	Altitude of aircraft in feet Above Ground Level (AGL*) or relative to Mean Sea Level (MSL)
Power (Appropriate Unit)	Engine power setting and Drag Configuration/Interpolation Code (defines sets of interpolation code in NOISEMAP (F for FIXED, P for PARALLEL, V for VARIABLE))
Speed (kts)	Indicated airspeed of aircraft in knots

*AGL in this appendix corresponds to Above Field Elevation (AFE). Ault Field elevation is 47 ft MSL and all 'AGL' altitudes shown in this appendix would be converted to MSL by adding 47 feet.

Ault Field elevation = 47 ft MSL

OLF Coupeville elevation = 199 ft MSL

Flight Profile 127

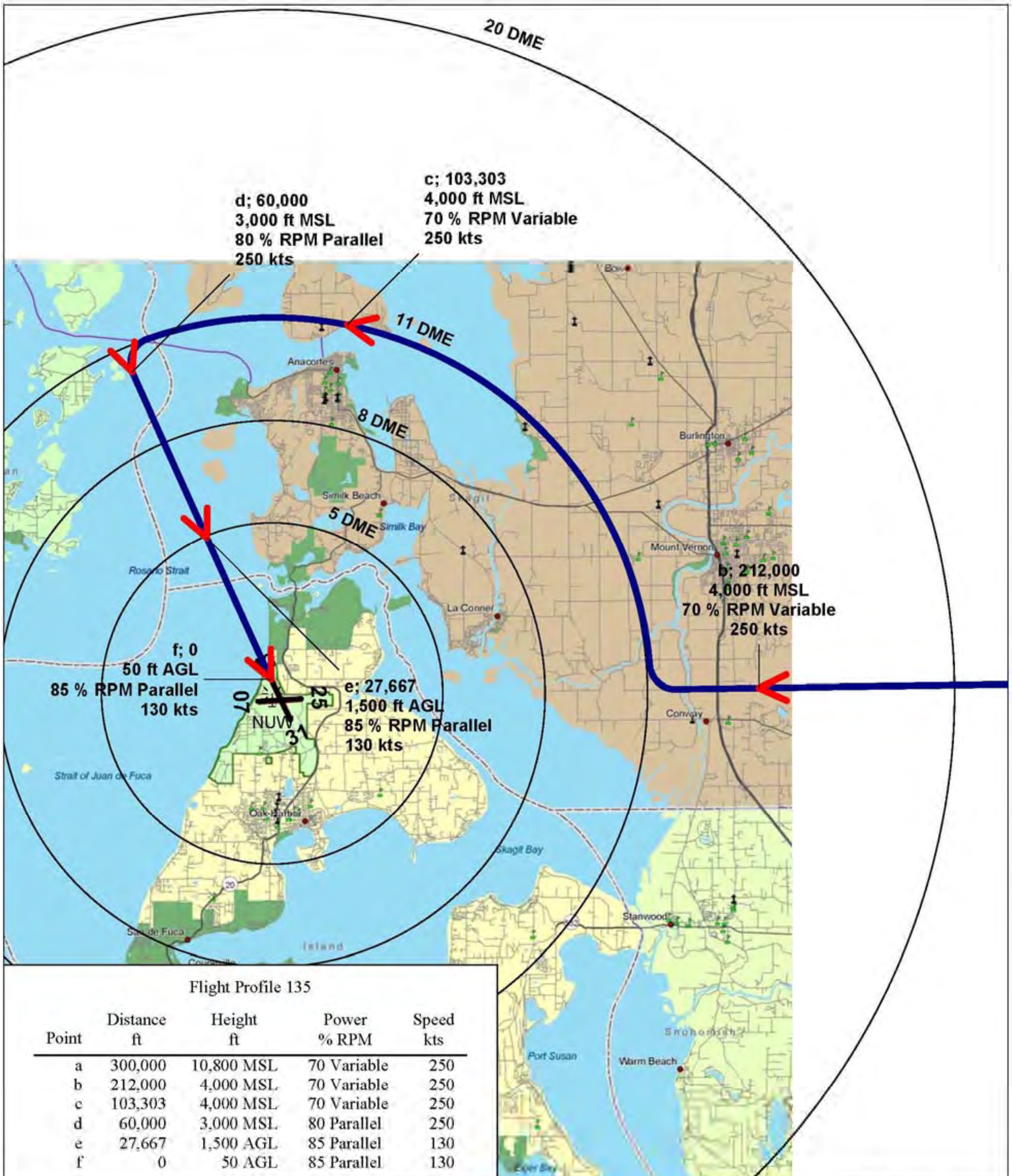
Point	Distance ft	Height ft	Power % RPM	Speed kts
a	240,000	25,000 MSL	84 Variable	300
b	120,000	10,000 MSL	75 Variable	300
c	60,000	3,000 MSL	80 Variable	300
d	24,629	1,500 AGL	80 Parallel	250
e	18,228	1,000 AGL	85 Parallel	130
f	0	50 AGL	85 Parallel	130

Flight Profile 127
Based EA-6B
on Runway 25, Flight Track 25A4 - IFR Arrival Short Center Long East

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000

Scale in Feet 1:220,000 (1 inch = 18,400 feet)

N



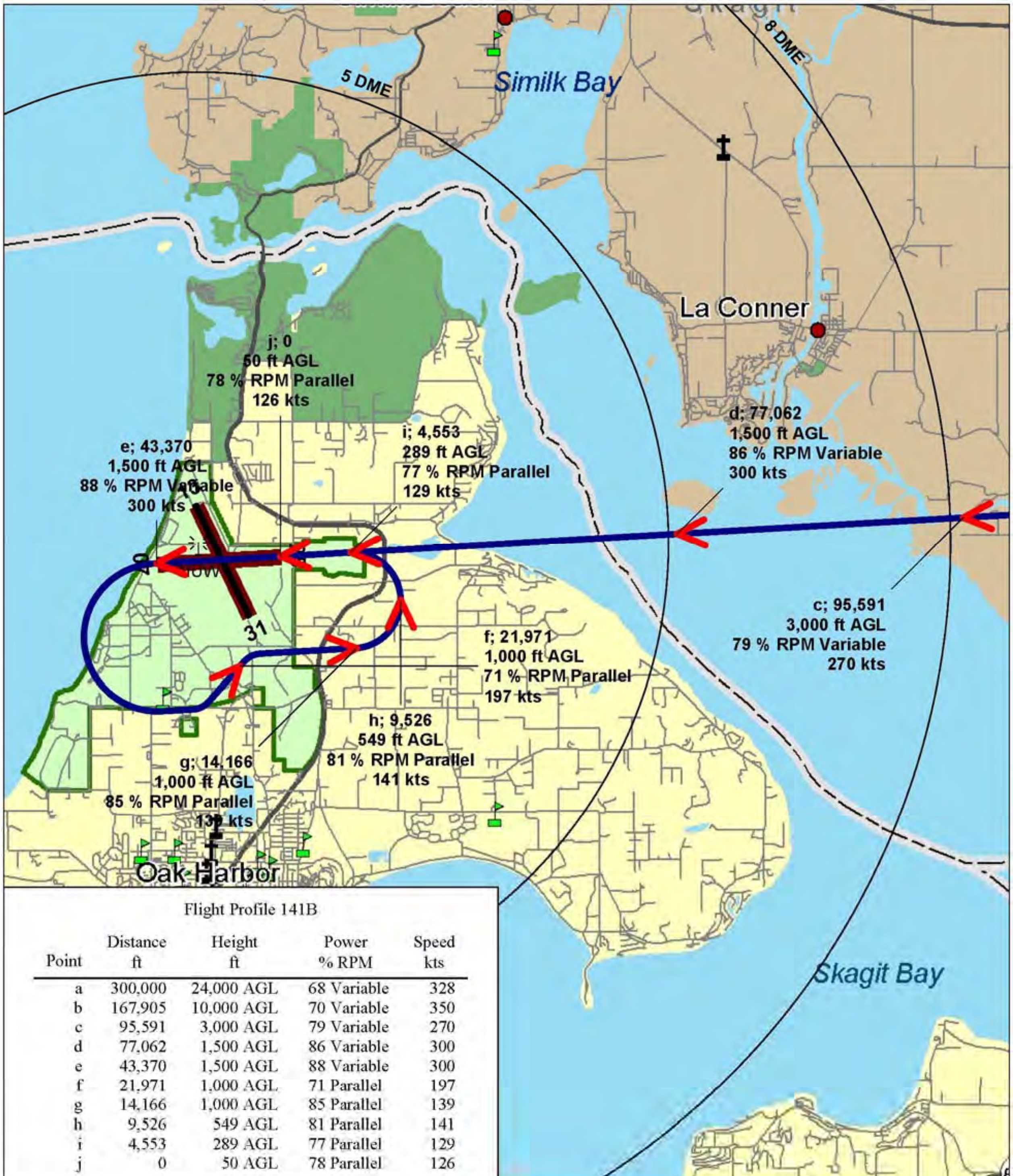
Flight Profile 135

Point	Distance ft	Height ft	Power % RPM	Speed kts
a	300,000	10,800 MSL	70 Variable	250
b	212,000	4,000 MSL	70 Variable	250
c	103,303	4,000 MSL	70 Variable	250
d	60,000	3,000 MSL	80 Parallel	250
e	27,667	1,500 AGL	85 Parallel	130
f	0	50 AGL	85 Parallel	130

Flight Profile 135
Based EA-6B
on Runway 13, Flight Track 13AHT - HI-TACAN Arrival

0 20,000 40,000 60,000 80,000 100,000

Scale in Feet 1:330,000 (1 inch = 27,500 feet)



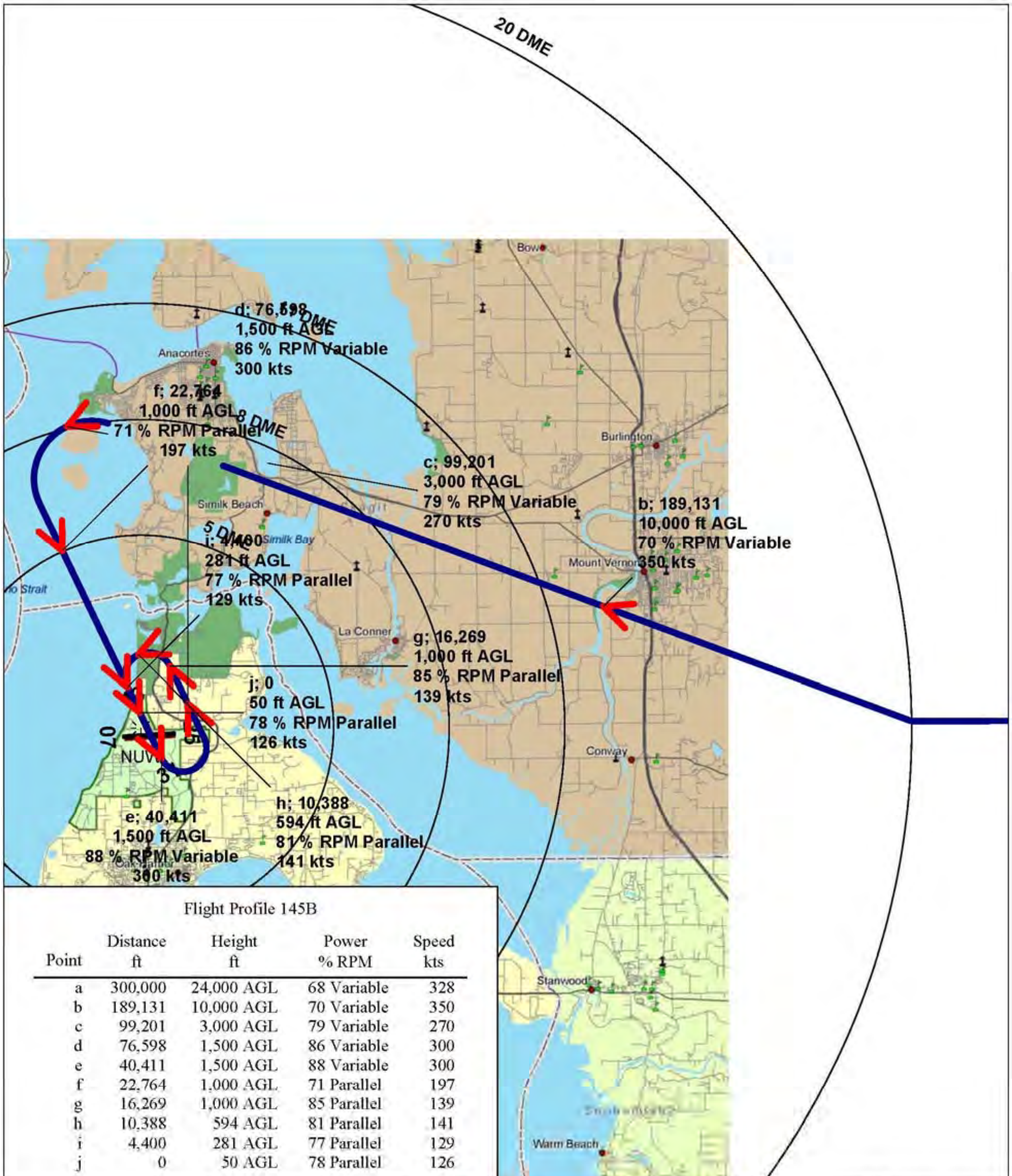
Flight Profile 141B

Point	Distance ft	Height ft	Power % RPM	Speed kts
a	300,000	24,000 AGL	68 Variable	328
b	167,905	10,000 AGL	70 Variable	350
c	95,591	3,000 AGL	79 Variable	270
d	77,062	1,500 AGL	86 Variable	300
e	43,370	1,500 AGL	88 Variable	300
f	21,971	1,000 AGL	71 Parallel	197
g	14,166	1,000 AGL	85 Parallel	139
h	9,526	549 AGL	81 Parallel	141
i	4,553	289 AGL	77 Parallel	129
j	0	50 AGL	78 Parallel	126

Flight Profile 141B
Based EA-6B
on Runway 25, Flight Track 25OD1B - OvHd Day Arrival from East Center

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:120,000 (1 inch = 10,000 feet)



Flight Profile 145B

Point	Distance ft	Height ft	Power % RPM	Speed kts
a	300,000	24,000 AGL	68 Variable	328
b	189,131	10,000 AGL	70 Variable	350
c	99,201	3,000 AGL	79 Variable	270
d	76,598	1,500 AGL	86 Variable	300
e	40,411	1,500 AGL	88 Variable	300
f	22,764	1,000 AGL	71 Parallel	197
g	16,269	1,000 AGL	85 Parallel	139
h	10,388	594 AGL	81 Parallel	141
i	4,400	281 AGL	77 Parallel	129
j	0	50 AGL	78 Parallel	126

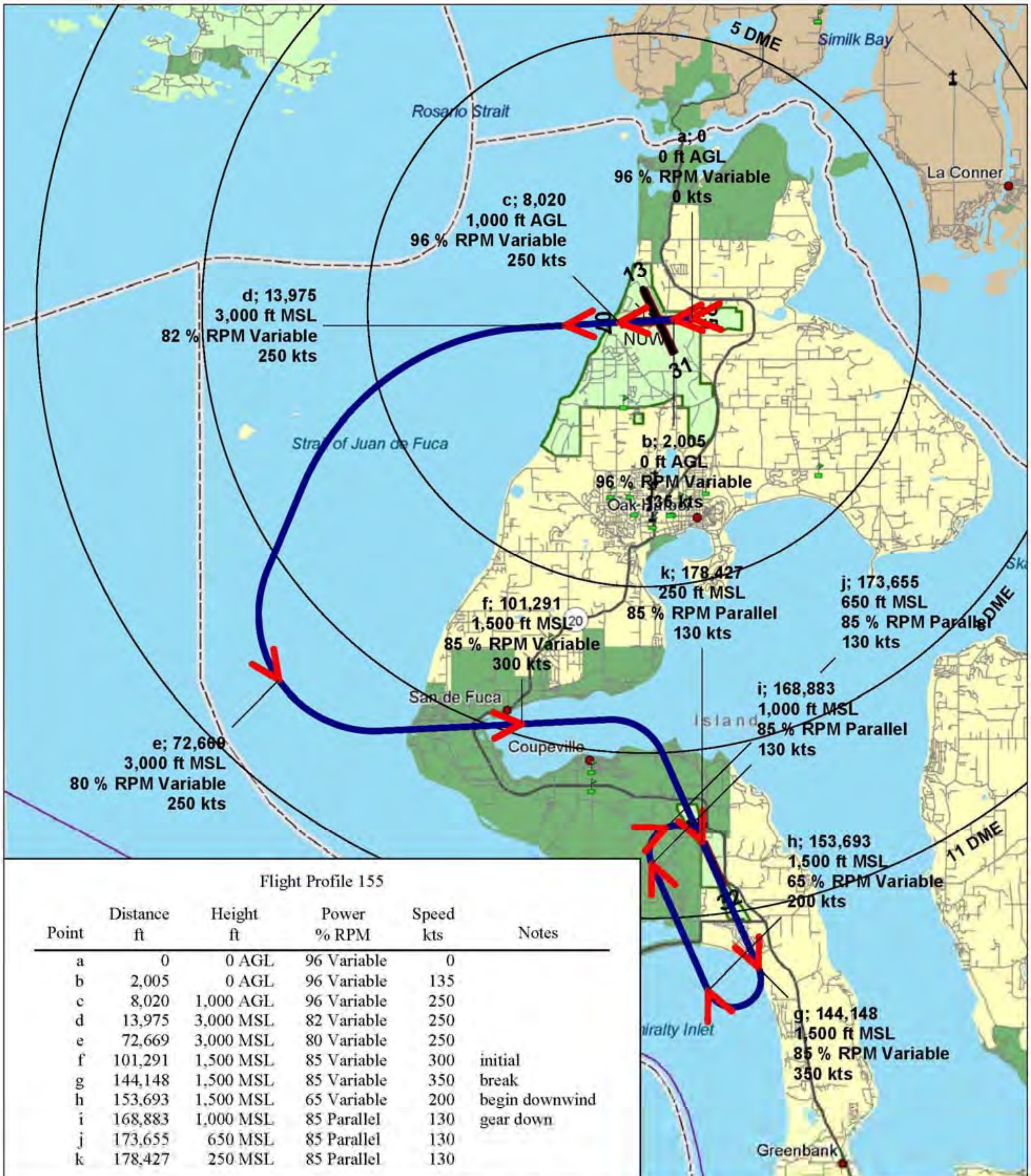
Flight Profile 145B

Based EA-6B

on Runway 13, Flight Track 13OD1B - EA-6B OvHd Day Arrival from East Center

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000 100,000

Scale in Feet 1:292,000 (1 inch = 24,400 feet)



Flight Profile 155

Point	Distance ft	Height ft	Power % RPM	Speed kts	Notes
a	0	0 AGL	96 Variable	0	
b	2,005	0 AGL	96 Variable	135	
c	8,020	1,000 AGL	96 Variable	250	
d	13,975	3,000 MSL	82 Variable	250	
e	72,669	3,000 MSL	80 Variable	250	
f	101,291	1,500 MSL	85 Variable	300	initial
g	144,148	1,500 MSL	85 Variable	350	break
h	153,693	1,500 MSL	65 Variable	200	begin downwind
i	168,883	1,000 MSL	85 Parallel	130	gear down
j	173,655	650 MSL	85 Parallel	130	
k	178,427	250 MSL	85 Parallel	130	

Flight Profile 155

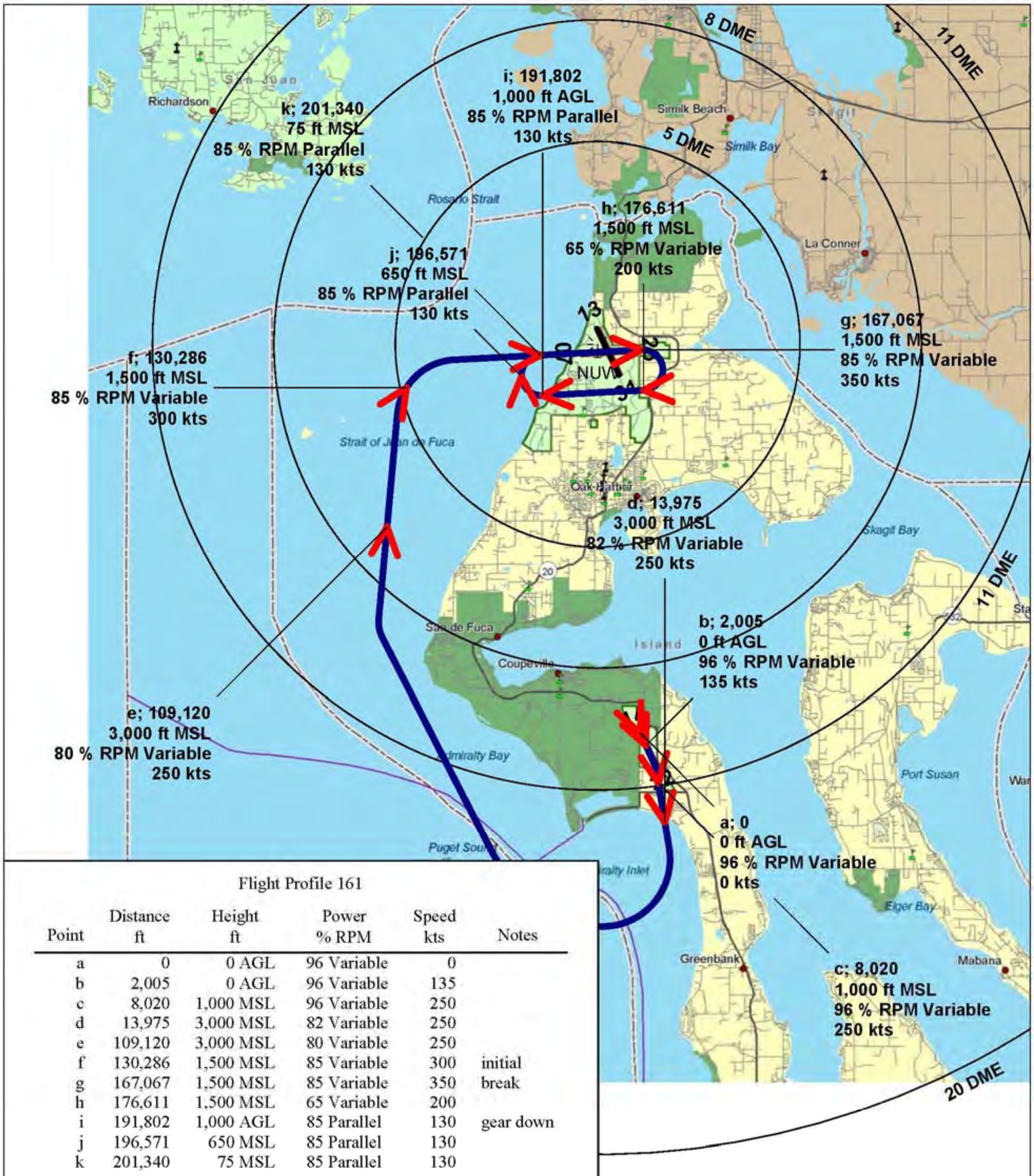
Based EA-6B

on Runway 25, Flight Track 25WC14D - Whidbey to Coupeville RWY14

Prior to brake release, aircraft sits at 96 % RPM Variable for 1 sec

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:208,000 (1 inch = 17,300 feet)



Flight Profile 161

Point	Distance ft	Height ft	Power % RPM	Speed kts	Notes
a	0	0 AGL	96 Variable	0	
b	2,005	0 AGL	96 Variable	135	
c	8,020	1,000 MSL	96 Variable	250	
d	13,975	3,000 MSL	82 Variable	250	
e	109,120	3,000 MSL	80 Variable	250	
f	130,286	1,500 MSL	85 Variable	300	initial
g	167,067	1,500 MSL	85 Variable	350	break
h	176,611	1,500 MSL	65 Variable	200	
i	191,802	1,000 AGL	85 Parallel	130	gear down
j	196,571	650 MSL	85 Parallel	130	
k	201,340	75 MSL	85 Parallel	130	

Flight Profile 161
Based EA-6B
on Runway 14, Flight Track 14CW07D - Coupeville to Whidbey RWY07
Prior to brake release, aircraft sits at 96 % RPM Variable for 1 sec

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:285,000 (1 inch = 23,700 feet)

N

Flight Profile 170L

Point	Distance ft	Height ft	Power % RPM	Speed kts	Notes
a	0	0 AGL	94 Parallel	127	
b	600	0 AGL	94 Parallel	135	
c	11,243	1,500 MSL	83 Parallel	150	
d	69,678	1,500 MSL	83 Parallel	127	
e	108,750	1,500 MSL	85 Variable	300	initial
f	127,405	1,500 MSL	85 Variable	350	break
g	136,949	1,500 MSL	65 Variable	200	begin downwind
h	152,139	1,000 MSL	85 Parallel	130	gear down
i	156,912	617 AGL	85 Parallel	130	
j	170,798	50 AGL	85 Parallel	130	

Flight Profile 170L
Based EA-6B
on Runway 25, Flight Track 25DL - Depart and ReEnter

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000

Scale in Feet 1:140,000 (1 inch = 11,700 feet)

N

Flight Profile 174DB

Point	Distance ft	Height ft	Power % RPM	Speed kts
a	0	0 AGL	94 Parallel	127
b	600	0 AGL	94 Parallel	135
c	7,500	1,000 AGL	83 Parallel	150
d	37,160	1,000 AGL	83 Parallel	127
e	43,244	427 AGL	80 Parallel	134
f	51,399	0 AGL	85 Parallel	127

Flight Profile 174DB
Based EA-6B
on Runway 25, Flight Track 25TD2 - Tower Pattern Day - Center

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:53,000 (1 inch = 4,410 feet)

Flight Profile 178DB

Point	Distance ft	Height ft	Power % RPM	Speed kts
a	0	0 AGL	94 Parallel	127
b	600	0 AGL	94 Parallel	135
c	7,500	1,000 AGL	83 Parallel	150
d	33,612	1,000 AGL	83 Parallel	127
e	43,244	427 AGL	80 Parallel	134
f	51,399	0 AGL	85 Parallel	127

Flight Profile 178DB
Based EA-6B
on Runway 25, Flight Track 25TD2 - Tower Pattern Day - Center

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000 18,000

Scale in Feet 1:53,000 (1 inch = 4,410 feet)

N

Flight Profile 184

Point	Distance ft	Height ft	Power % RPM	Speed kts	Notes
a	0	0 AGL	96 Variable	130	
b	600	0 AGL	96 Variable	130	
c	13,975	3,000 MSL	82 Variable	230	
d	135,306	3,000 MSL	82 Parallel	230	gear down
e	156,057	3,000 MSL	84 Parallel	130	
f	170,131	1,000 AGL	84 Parallel	130	
g	185,690	0 AGL	84 Parallel	130	

Flight Profile 184

Based EA-6B

on Runway 25, Flight Track 25G1 - 3NM Wide GCA Box

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:162,000 (1 inch = 13,500 feet)

N

Flight Profile 193DB

Point	Distance ft	Height ft	Power % RPM	Speed kts	Notes
a	0	200 MSL	94 Parallel	130	
b	600	200 MSL	94 Parallel	130	
c	7,495	1,000 MSL	83 Parallel	130	
d	23,061	1,000 MSL	83 Parallel	130	end downwind
e	27,903	600 MSL	80 Parallel	130	
f	35,473	200 MSL	85 Parallel	130	

Flight Profile 193DB

Based EA-6B

on Runway 14, Flight Track 14TD2 - EA-6B Coupeville Pattern Day - Center

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000

Scale in Feet 1:108,000 (1 inch = 9,020 feet)

Flight Profile 193NB

Point	Distance ft	Height ft	Power % RPM	Speed kts	Notes
a	0	200 MSL	94 Parallel	130	
b	600	200 MSL	94 Parallel	130	
c	7,500	1,000 MSL	83 Parallel	130	
d	41,267	1,000 MSL	83 Parallel	130	end downwind
e	60,934	600 MSL	80 Parallel	130	
f	71,883	200 MSL	85 Parallel	130	

Flight Profile 193NB
Based EA-6B
on Runway 14, Flight Track 14TN2 - EA-6B Coupeville Pattern Night - Center

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:117,000 (1 inch = 9,760 feet)

Flight Profile 207A

Point	Distance ft	Height ft	Power % NC	Speed kts
a	0	0 AGL	97 Min A/B	0
b	2,000	0 AGL	97 Afterburner	135
c	8,000	1,000 AGL	96 Variable	250
d	9,250	1,500 AGL	95 Variable	300
e	59,000	17,000 AGL	84 Variable	300
f	200,000	17,000 AGL	84 Variable	300

Flight Profile 207A

Based EA-18G

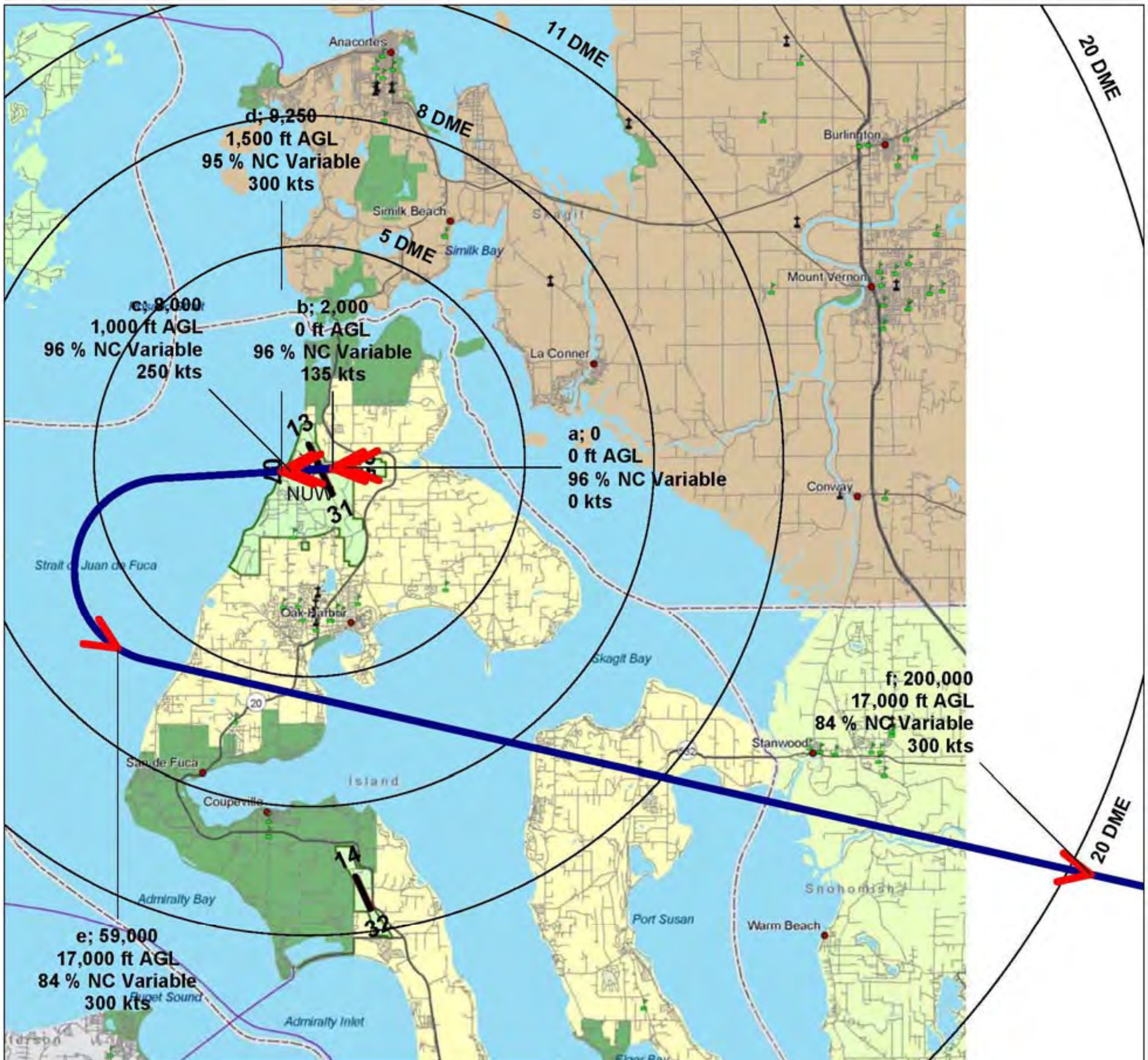
on Runway 25, Flight Track 25D1 - Departure to East

Prior to brake release, aircraft sits at 97 % NC Min A/B for 1 sec

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:283,000 (1 inch = 23,600 feet)

N



Flight Profile 207B

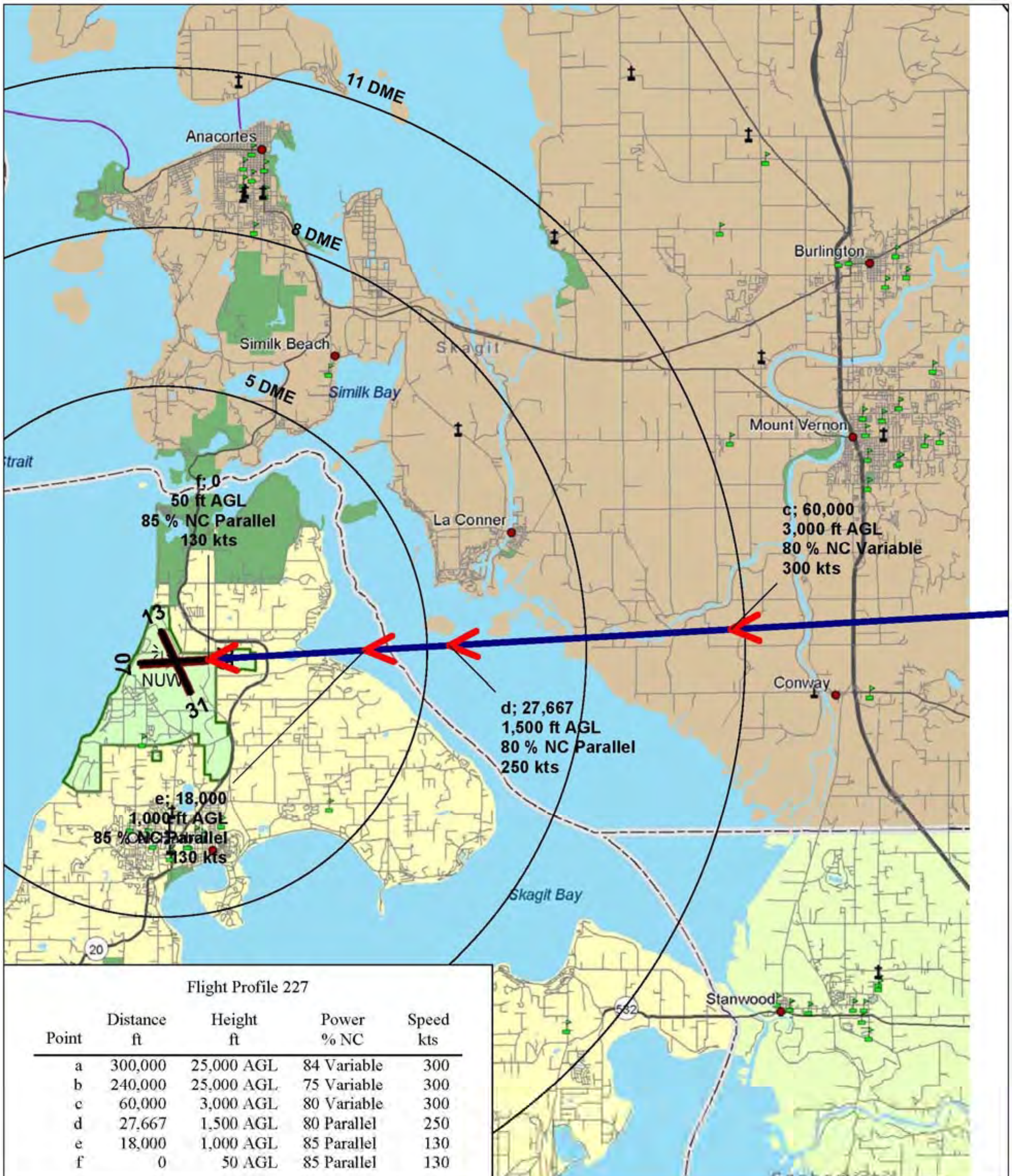
Point	Distance ft	Height ft	Power % NC	Speed kts
a	0	0 AGL	96 Variable	0
b	2,000	0 AGL	96 Variable	135
c	8,000	1,000 AGL	96 Variable	250
d	9,250	1,500 AGL	95 Variable	300
e	59,000	17,000 AGL	84 Variable	300
f	200,000	17,000 AGL	84 Variable	300

Flight Profile 207B
Based EA-18G
on Runway 25, Flight Track 25D1 - Departure to East
Prior to brake release, aircraft sits at 96 % NC Variable for 1 sec

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000 100,000

Scale in Feet 1:297,000 (1 inch = 24,700 feet)

N



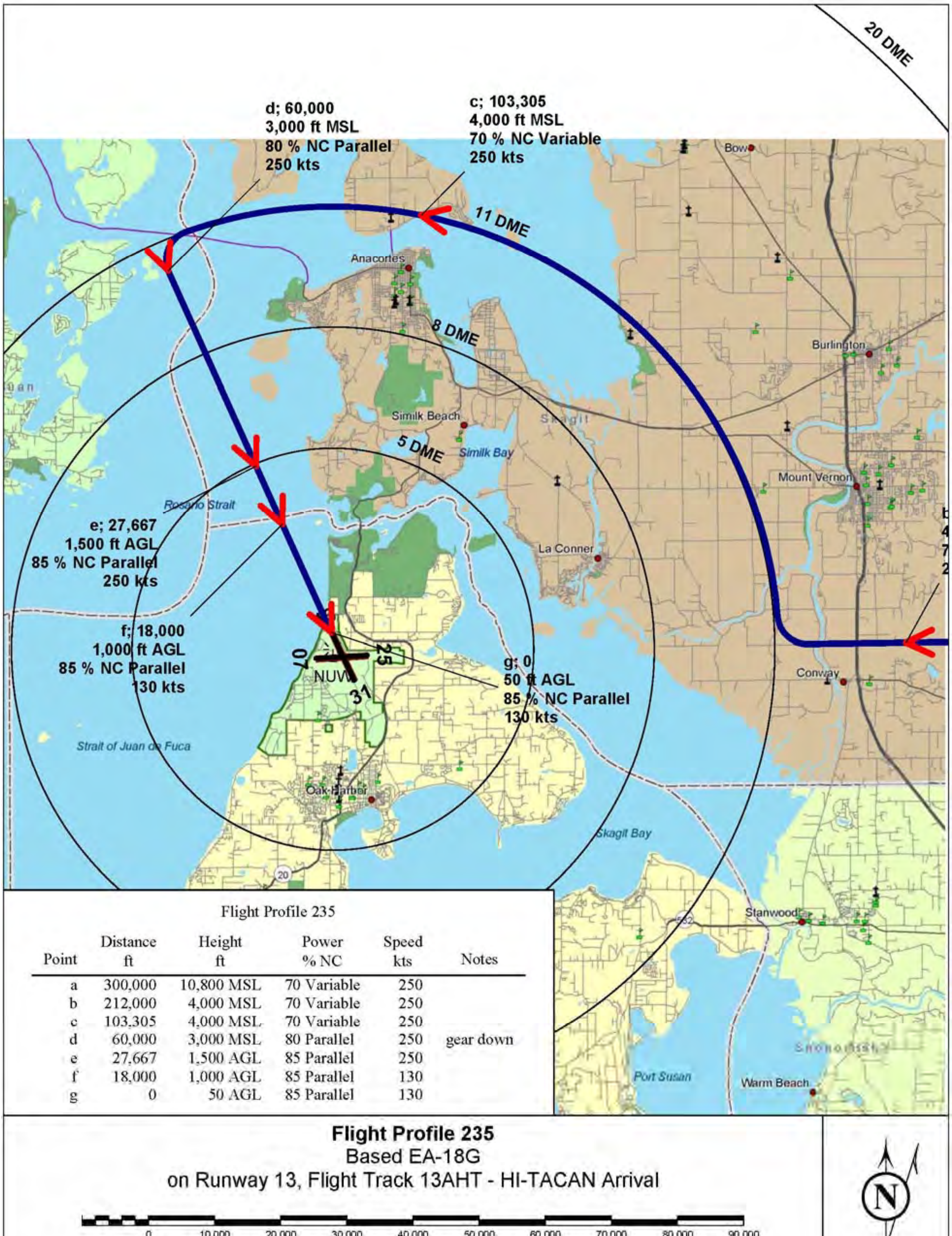
Flight Profile 227

Point	Distance ft	Height ft	Power % NC	Speed kts
a	300,000	25,000 AGL	84 Variable	300
b	240,000	25,000 AGL	75 Variable	300
c	60,000	3,000 AGL	80 Variable	300
d	27,667	1,500 AGL	80 Parallel	250
e	18,000	1,000 AGL	85 Parallel	130
f	0	50 AGL	85 Parallel	130

Flight Profile 227
Based EA-18G
on Runway 25, Flight Track 25A4 - IFR Arrival Short Center Long East

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000

Scale in Feet 1:213,000 (1 inch = 17,700 feet)



Flight Profile 235

Point	Distance ft	Height ft	Power % NC	Speed kts	Notes
a	300,000	10,800 MSL	70 Variable	250	
b	212,000	4,000 MSL	70 Variable	250	
c	103,305	4,000 MSL	70 Variable	250	
d	60,000	3,000 MSL	80 Parallel	250	gear down
e	27,667	1,500 AGL	85 Parallel	250	
f	18,000	1,000 AGL	85 Parallel	130	
g	0	50 AGL	85 Parallel	130	

Flight Profile 235
Based EA-18G
on Runway 13, Flight Track 13AHT - HI-TACAN Arrival

Scale in Feet 1:264,000 (1 inch = 22,000 feet)

Flight Profile 241B

Point	Distance ft	Height ft	Power % NC	Speed kts	Notes
a	300,000	10,000 MSL	84 Variable	300	
b	167,905	10,000 MSL	75 Variable	300	
c	98,722	3,000 MSL	80 Variable	300	
d	76,764	1,500 MSL	85 Variable	300	initial
e	43,348	1,500 MSL	85 Variable	350	break
f	28,558	1,500 MSL	65 Variable	200	begin downwind
g	16,948	1,000 MSL	84 Parallel	130	gear down
h	9,500	617 AGL	84 Parallel	130	
i	0	50 AGL	84 Parallel	130	

Flight Profile 241B

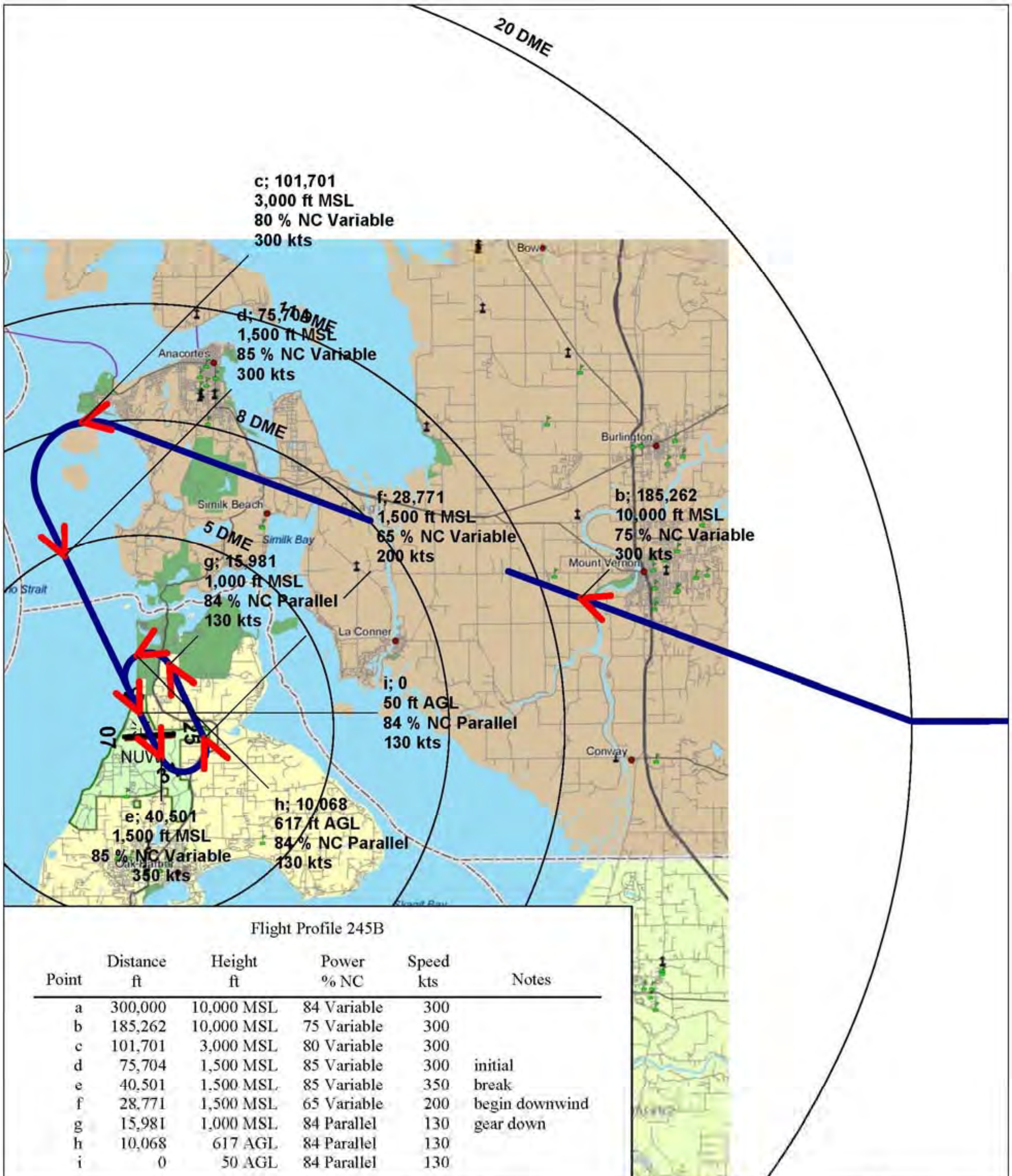
Based EA-18G

on Runway 25, Flight Track 25OD1B - OvHd Day Arrival from East Center

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:194,000 (1 inch = 16,100 feet)

N



Flight Profile 245B

Point	Distance ft	Height ft	Power % NC	Speed kts	Notes
a	300,000	10,000 MSL	84 Variable	300	
b	185,262	10,000 MSL	75 Variable	300	
c	101,701	3,000 MSL	80 Variable	300	
d	75,704	1,500 MSL	85 Variable	300	initial
e	40,501	1,500 MSL	85 Variable	350	break
f	28,771	1,500 MSL	65 Variable	200	begin downwind
g	15,981	1,000 MSL	84 Parallel	130	gear down
h	10,068	617 AGL	84 Parallel	130	
i	0	50 AGL	84 Parallel	130	

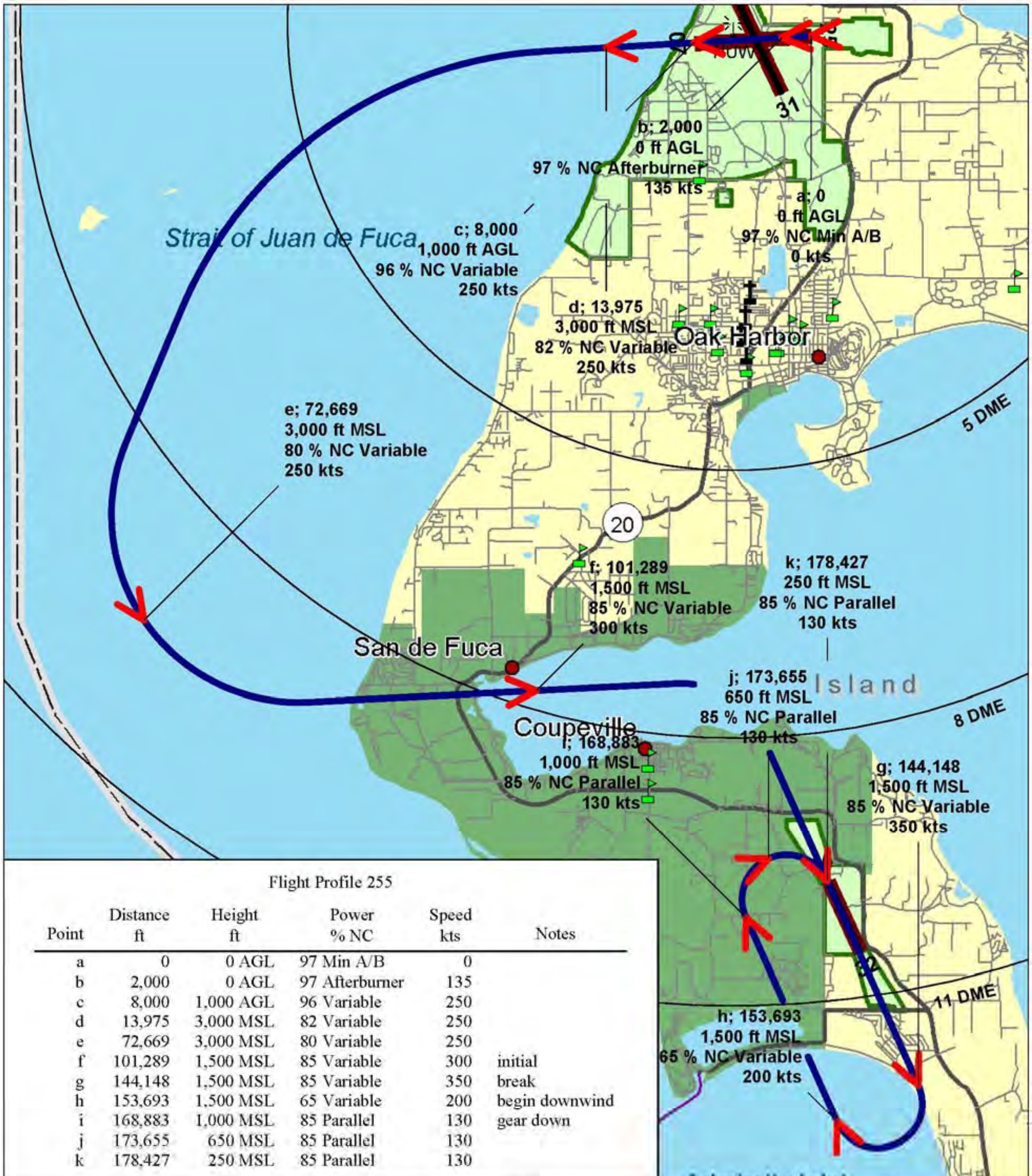
Flight Profile 245B

Based EA-18G

on Runway 13, Flight Track 13OD1B - EA-6B OvHd Day Arrival from East Center

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000 100,000

Scale in Feet 1:292,000 (1 inch = 24,400 feet)



Flight Profile 255

Point	Distance ft	Height ft	Power % NC	Speed kts	Notes
a	0	0 AGL	97 Min A/B	0	
b	2,000	0 AGL	97 Afterburner	135	
c	8,000	1,000 AGL	96 Variable	250	
d	13,975	3,000 MSL	82 Variable	250	
e	72,669	3,000 MSL	80 Variable	250	
f	101,289	1,500 MSL	85 Variable	300	initial
g	144,148	1,500 MSL	85 Variable	350	break
h	153,693	1,500 MSL	65 Variable	200	begin downwind
i	168,883	1,000 MSL	85 Parallel	130	gear down
j	173,655	650 MSL	85 Parallel	130	
k	178,427	250 MSL	85 Parallel	130	

Flight Profile 255

Based EA-18G

on Runway 25, Flight Track 25WC14D - Whidbey to Coupeville RWY14

Prior to brake release, aircraft sits at 97 % NC Min A/B for 1 sec

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000

Scale in Feet 1:129,000 (1 inch = 10,700 feet)

N

Flight Profile 261

Point	Distance ft	Height ft	Power % NC	Speed kts	Notes
a	0	0 AGL	96 Variable	0	
b	2,000	0 AGL	96 Variable	135	
c	8,000	1,000 MSL	96 Variable	250	
d	13,975	3,000 MSL	82 Variable	250	
e	61,387	3,000 MSL	80 Variable	250	
f	114,610	3,000 MSL	80 Variable	250	
g	132,904	1,500 MSL	85 Variable	300	initial
h	167,067	1,500 MSL	85 Variable	350	break
i	176,611	1,500 MSL	65 Variable	200	begin downwind
j	191,802	1,000 MSL	85 Parallel	130	gear down
k	196,571	650 MSL	85 Parallel	130	
l	201,340	75 MSL	85 Parallel	130	

Flight Profile 261

Based EA-18G

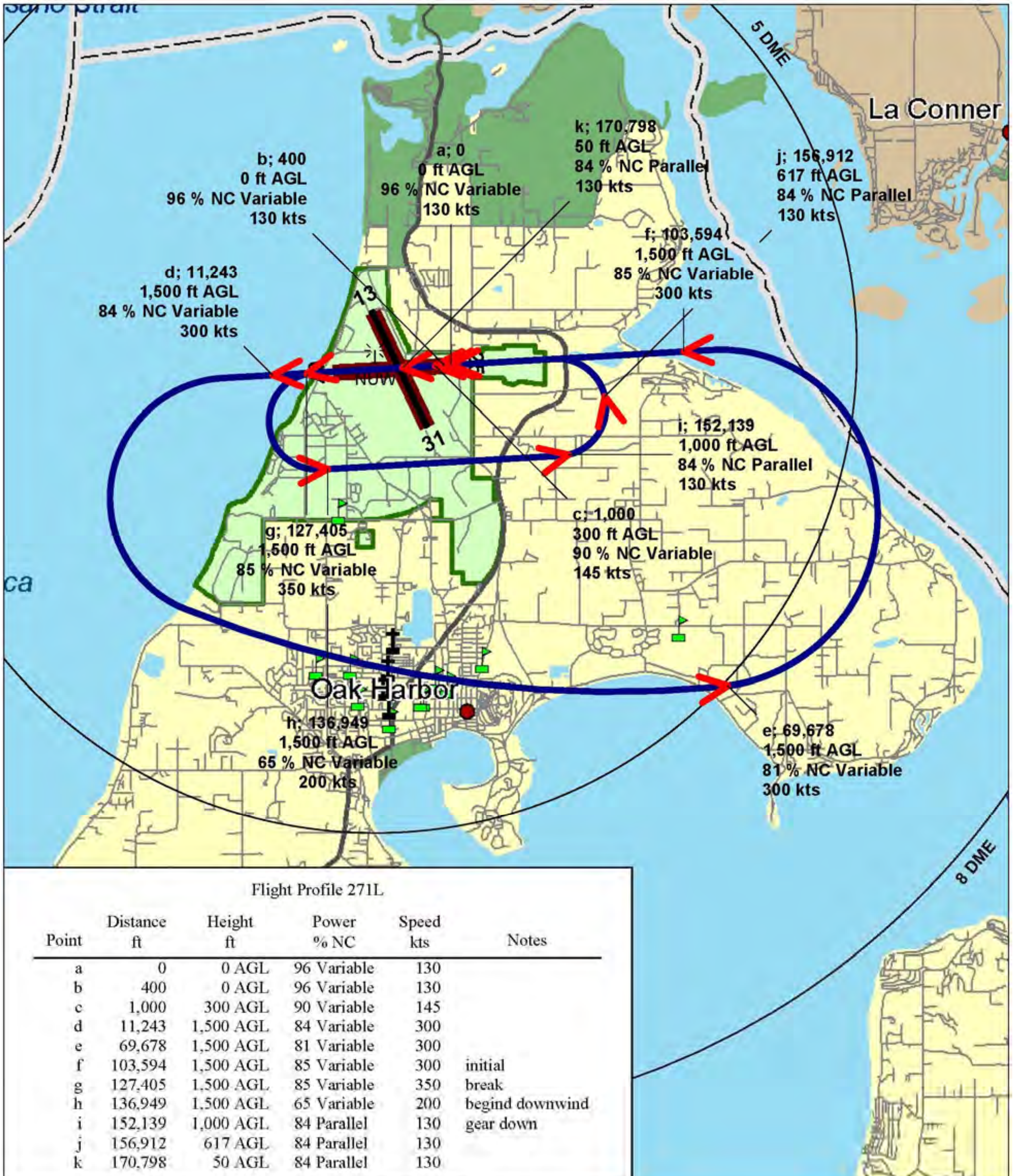
on Runway 14, Flight Track 14CW07D - Coupeville to Whidbey RWY07

Prior to brake release, aircraft sits at 96 % NC Variable for 1 sec

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000 44,000 48,000 52,000

Scale in Feet 1:147,000 (1 inch = 12,300 feet)

N



Flight Profile 271L

Point	Distance ft	Height ft	Power % NC	Speed kts	Notes
a	0	0 AGL	96 Variable	130	
b	400	0 AGL	96 Variable	130	
c	1,000	300 AGL	90 Variable	145	
d	11,243	1,500 AGL	84 Variable	300	
e	69,678	1,500 AGL	81 Variable	300	
f	103,594	1,500 AGL	85 Variable	300	initial
g	127,405	1,500 AGL	85 Variable	350	break
h	136,949	1,500 AGL	65 Variable	200	begind downwind
i	152,139	1,000 AGL	84 Parallel	130	gear down
j	156,912	617 AGL	84 Parallel	130	
k	170,798	50 AGL	84 Parallel	130	

Flight Profile 271L
Based EA-18G
on Runway 25, Flight Track 25DL - Depart and ReEnter

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000 32,000 36,000 40,000

Scale in Feet 1:117,000 (1 inch = 9,740 feet)

Flight Profile 274DB

Point	Distance ft	Height ft	Power % NC	Speed kts
a	0	0 AGL	96 Variable	130
b	400	0 AGL	96 Variable	130
c	1,000	300 AGL	90 Parallel	145
d	7,495	1,000 AGL	84 Parallel	130
e	34,175	1,000 AGL	81 Parallel	130
f	41,899	500 AGL	84 Parallel	130
g	51,399	0 AGL	84 Parallel	130

Flight Profile 274DB

Based EA-18G

on Runway 25, Flight Track 25TD2 - Tower Pattern Day - Center

0 2,000 4,000 6,000 8,000 10,000 12,000

Scale in Feet 1:40,300 (1 inch = 3,360 feet)

N

Flight Profile 278DB

Point	Distance ft	Height ft	Power % NC	Speed kts
a	0	0 AGL	96 Variable	130
b	400	0 AGL	96 Variable	130
c	1,000	300 AGL	90 Parallel	145
d	7,495	1,000 AGL	84 Parallel	130
e	33,984	1,000 AGL	81 Parallel	130
f	41,899	500 AGL	84 Parallel	130
g	51,399	0 AGL	84 Parallel	130

Flight Profile 278DB
Based EA-18G
on Runway 25, Flight Track 25TD2 - Tower Pattern Day - Center

0 2,000 4,000 6,000 8,000 10,000 12,000

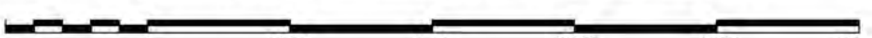
Scale in Feet 1:40,300 (1 inch = 3,360 feet)

N

Flight Profile 284

Point	Distance ft	Height ft	Power % NC	Speed kts	Notes
a	0	0 AGL	96 Variable	130	
b	400	0 AGL	96 Variable	130	
c	13,975	3,000 AGL	82 Variable	230	
d	135,306	3,000 AGL	82 Parallel	230	gear down
e	147,021	3,000 AGL	84 Parallel	130	
f	170,473	1,000 AGL	84 Parallel	130	
g	185,690	0 AGL	84 Parallel	130	

Flight Profile 284
Based EA-18G
on Runway 25, Flight Track 25G1 - 3NM Wide GCA Box



Scale in Feet 1:162,000 (1 inch = 13,500 feet)

Flight Profile 293DB

Point	Distance ft	Height ft	Power % NC	Speed kts	Notes
a	0	200 MSL	96 Variable	130	
b	400	200 MSL	96 Variable	130	
c	1,000	500 MSL	90 Parallel	145	
d	7,495	1,000 MSL	84 Parallel	130	
e	23,061	1,000 MSL	82 Parallel	130	end downwind
f	27,231	600 MSL	84 Parallel	130	catch 3 deg glide slope
g	35,473	200 MSL	84 Parallel	130	

Flight Profile 293DB

Based EA-18G

on Runway 14, Flight Track 14TD2 - EA-6B Coupeville Pattern Day - Center

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:93,500 (1 inch = 7,790 feet)

Flight Profile 293NB

Point	Distance ft	Height ft	Power % NC	Speed kts	Notes
a	0	200 MSL	96 Variable	130	
b	400	200 MSL	96 Variable	130	
c	1,000	500 MSL	90 Parallel	145	
d	7,495	1,000 MSL	84 Parallel	130	
e	41,267	1,000 MSL	82 Parallel	130	end downwind
f	61,200	600 MSL	84 Parallel	130	catch 3 deg glide slope
g	71,883	200 MSL	84 Parallel	130	

Flight Profile 293NB

Based EA-18G

on Runway 14, Flight Track 14TN2 - EA-6B Coupeville Pattern Night - Center

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:237,000 (1 inch = 19,700 feet)

Flight Profile 307

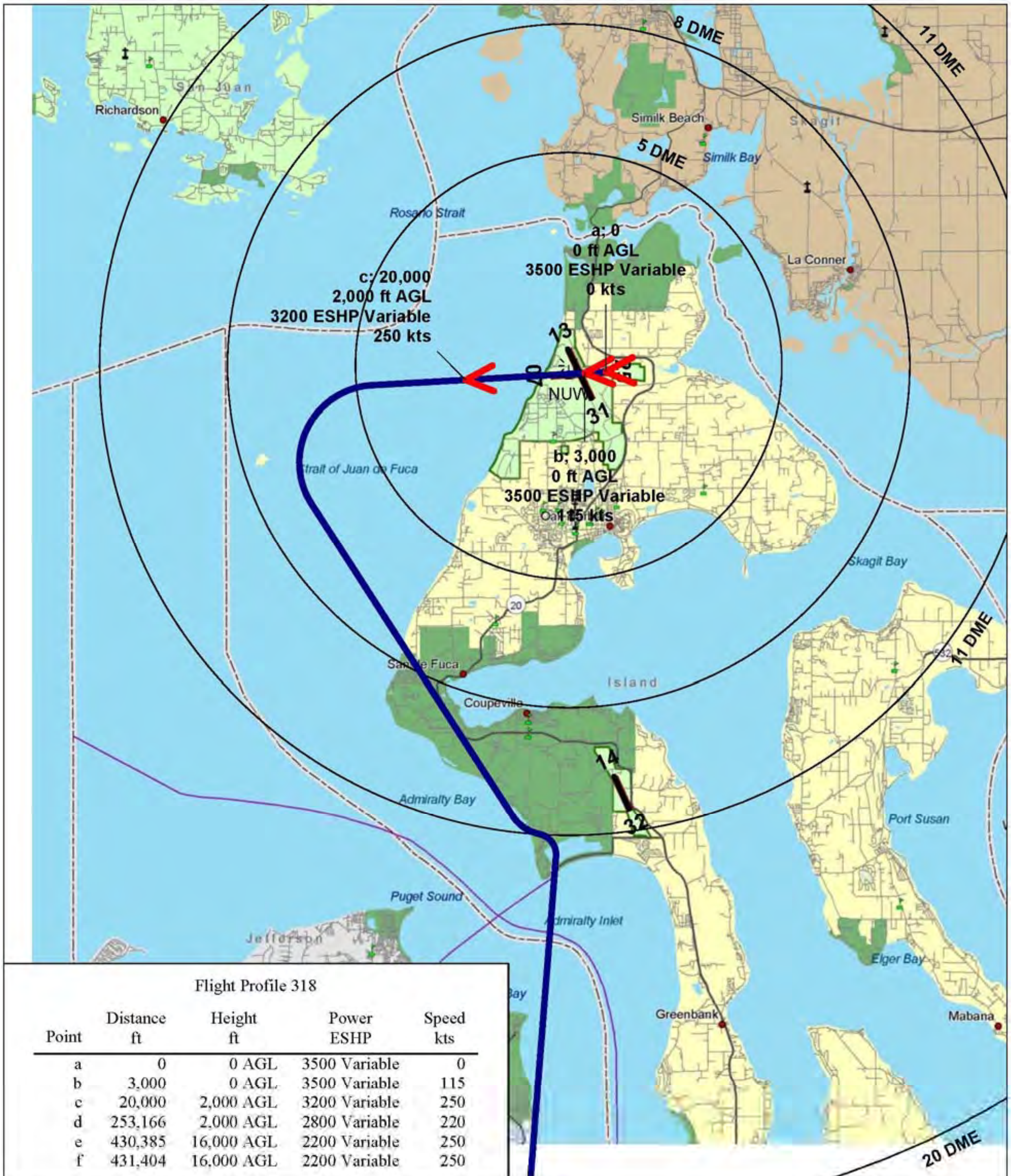
Point	Distance ft	Height ft	Power ESHP	Speed kts
a	0	0 AGL	3500 Variable	0
b	3,000	0 AGL	3500 Variable	115
c	27,005	2,000 AGL	3200 Variable	250
d	33,757	3,000 AGL	2800 Variable	220
e	209,292	16,000 AGL	2200 Variable	250
f	300,000	16,000 AGL	2200 Variable	250

Flight Profile 307
Based P-3
on Runway 25, Flight Track 25D5 - Departure to West

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000

Scale in Feet 1:224,000 (1 inch = 18,600 feet)

N



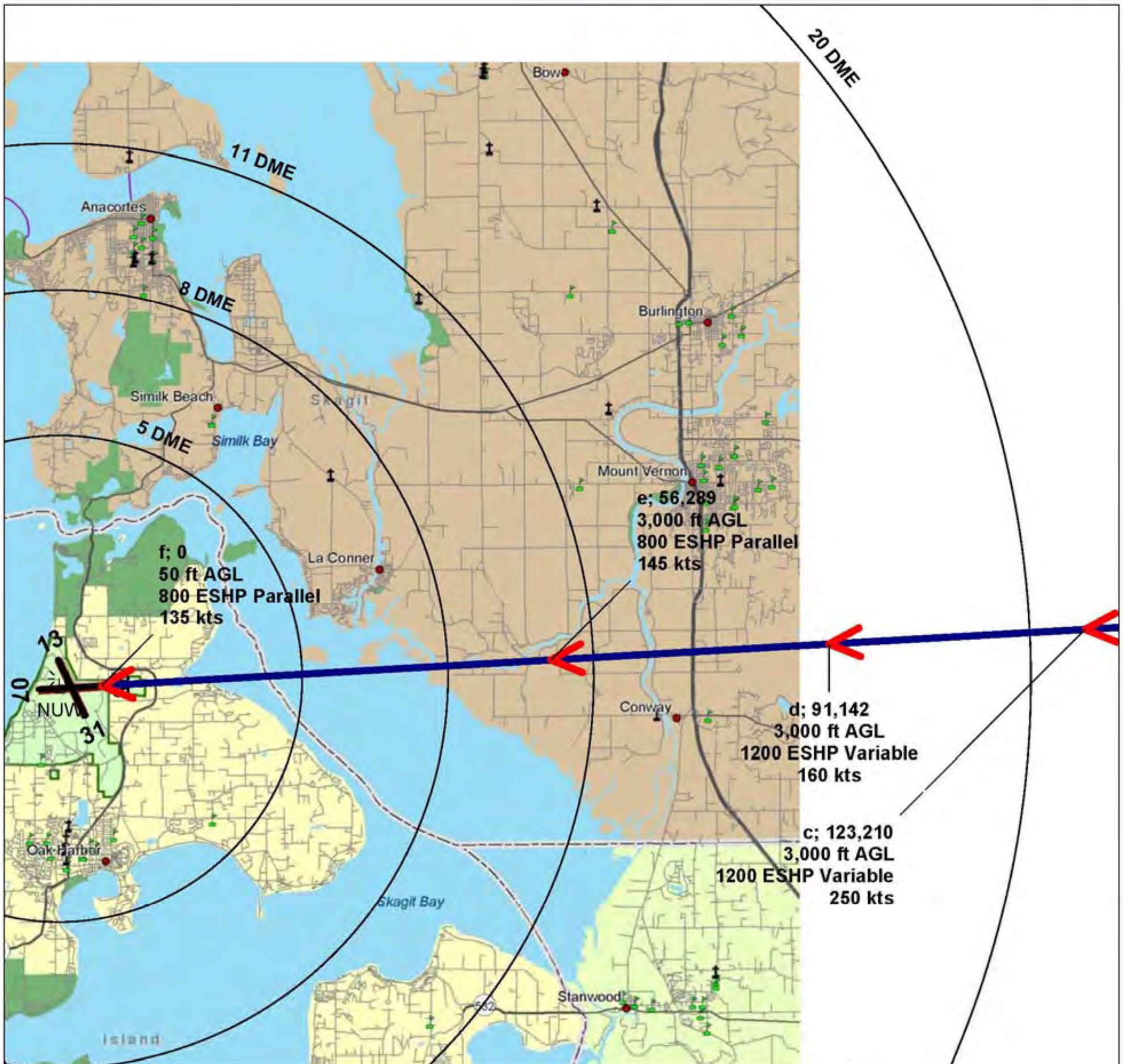
Flight Profile 318

Point	Distance ft	Height ft	Power ESHP	Speed kts
a	0	0 AGL	3500 Variable	0
b	3,000	0 AGL	3500 Variable	115
c	20,000	2,000 AGL	3200 Variable	250
d	253,166	2,000 AGL	2800 Variable	220
e	430,385	16,000 AGL	2200 Variable	250
f	431,404	16,000 AGL	2200 Variable	250

Flight Profile 318
Based P-3
on Runway 25, Flight Track 25DLT - LO-TACAN Departure

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:264,000 (1 inch = 22,000 feet)



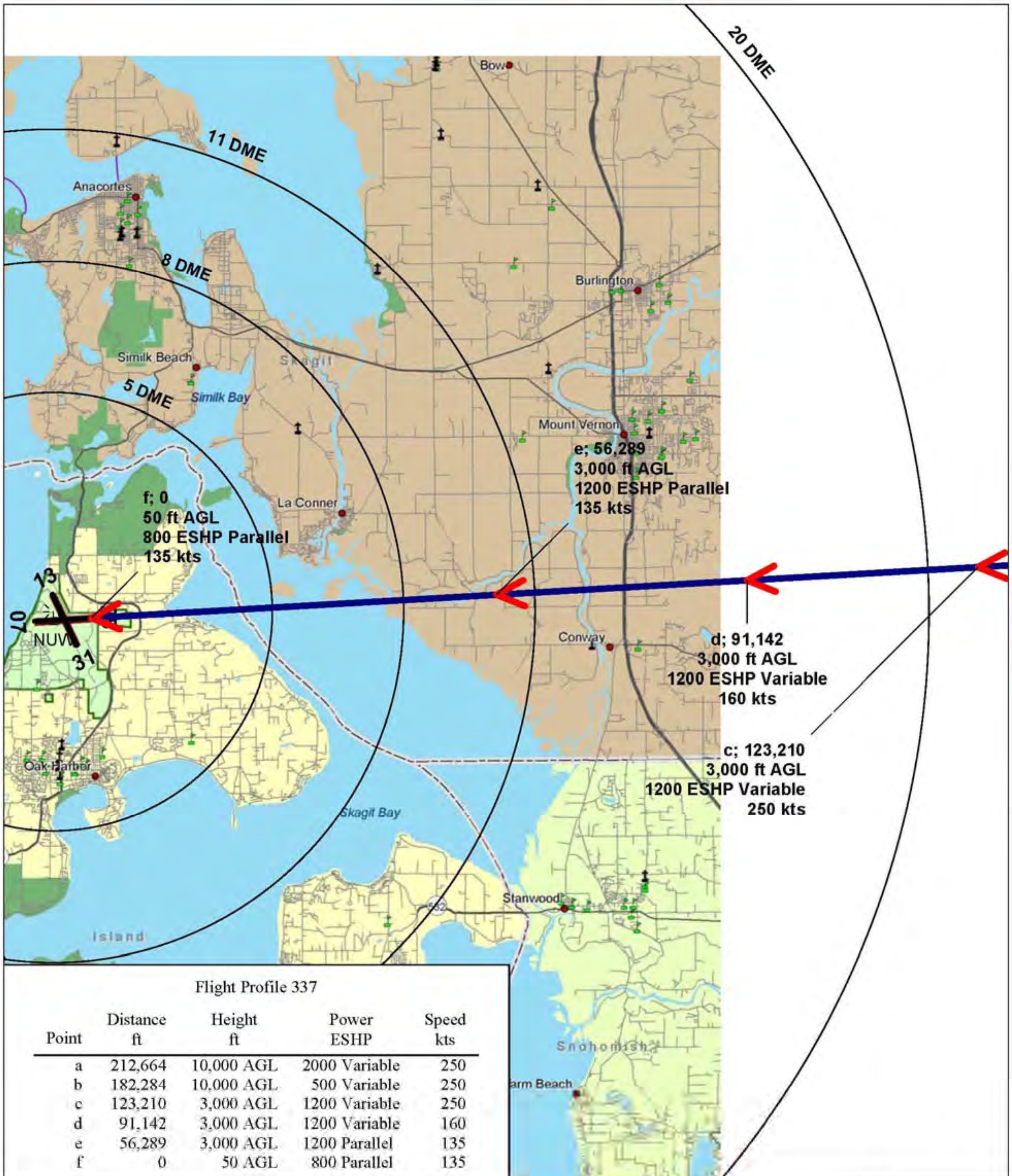
Flight Profile 324

Point	Distance ft	Height ft	Power ESHP	Speed kts	Notes
a	212,664	10,000 AGL	2000 Variable	250	
b	182,284	10,000 AGL	500 Variable	250	
c	123,210	3,000 AGL	1200 Variable	250	
d	91,142	3,000 AGL	1200 Variable	160	
e	56,289	3,000 AGL	800 Parallel	145	gear down; start 3 deg glide slope
f	0	50 AGL	800 Parallel	135	

Flight Profile 324
Based P-3
on Runway 25, Flight Track 25A1 - P-3 VFR Arrival from East

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:257,000 (1 inch = 21,400 feet)



Flight Profile 337

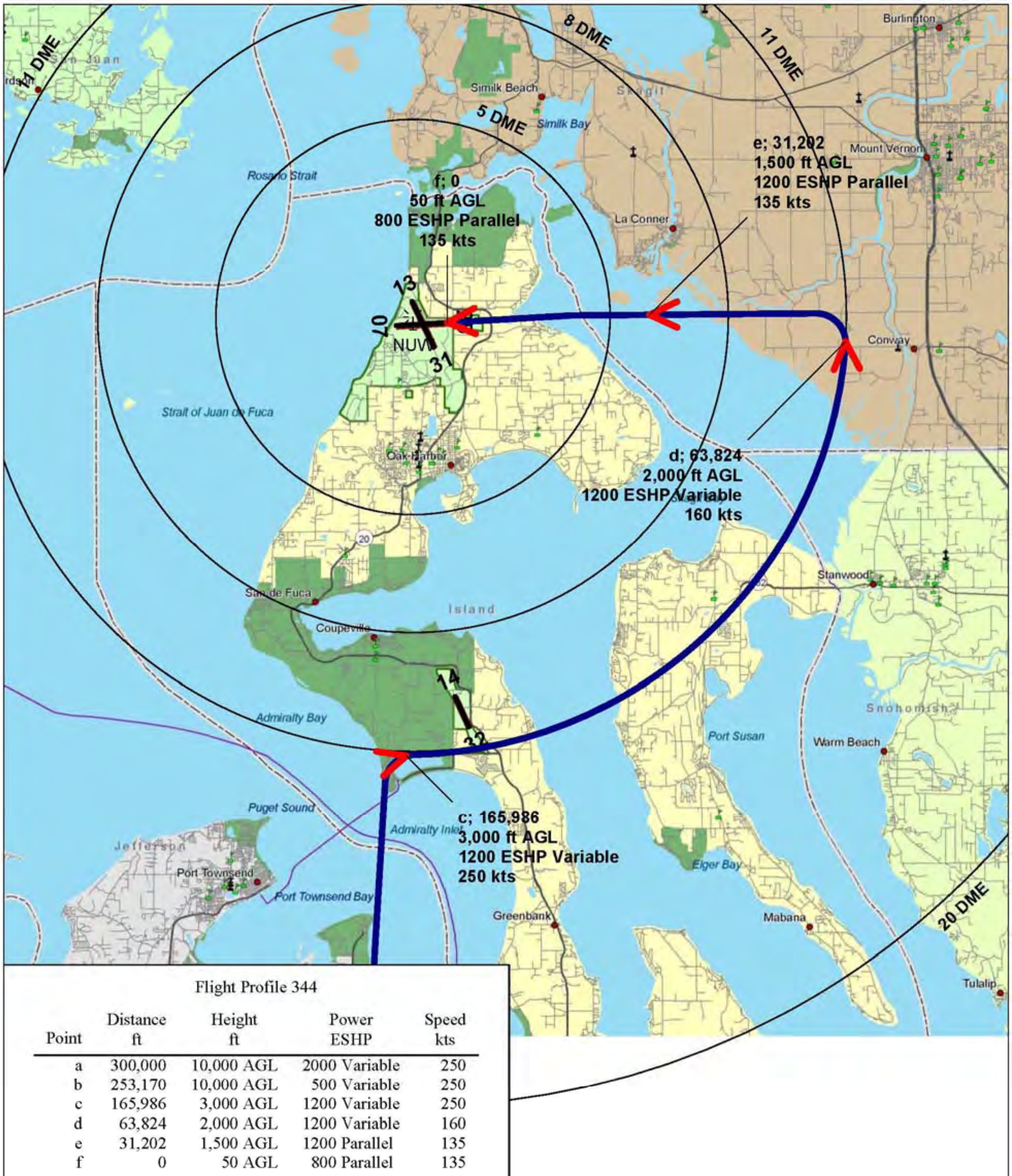
Point	Distance ft	Height ft	Power ESHP	Speed kts
a	212,664	10,000 AGL	2000 Variable	250
b	182,284	10,000 AGL	500 Variable	250
c	123,210	3,000 AGL	1200 Variable	250
d	91,142	3,000 AGL	1200 Variable	160
e	56,289	3,000 AGL	1200 Parallel	135
f	0	50 AGL	800 Parallel	135

Flight Profile 337
Based P-3
on Runway 25, Flight Track 25A4 - IFR Arrival Short Center Long East

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000

Scale in Feet 1:257,000 (1 inch = 21,400 feet)

N



Flight Profile 344

Point	Distance ft	Height ft	Power ESHP	Speed kts
a	300,000	10,000 AGL	2000 Variable	250
b	253,170	10,000 AGL	500 Variable	250
c	165,986	3,000 AGL	1200 Variable	250
d	63,824	2,000 AGL	1200 Variable	160
e	31,202	1,500 AGL	1200 Parallel	135
f	0	50 AGL	800 Parallel	135

Flight Profile 344
Based P-3
on Runway 25, Flight Track 25ALT - LO-TACAN Arrival

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000

Scale in Feet 1:286,000 (1 inch = 23,800 feet)

N

Flight Profile 348DB

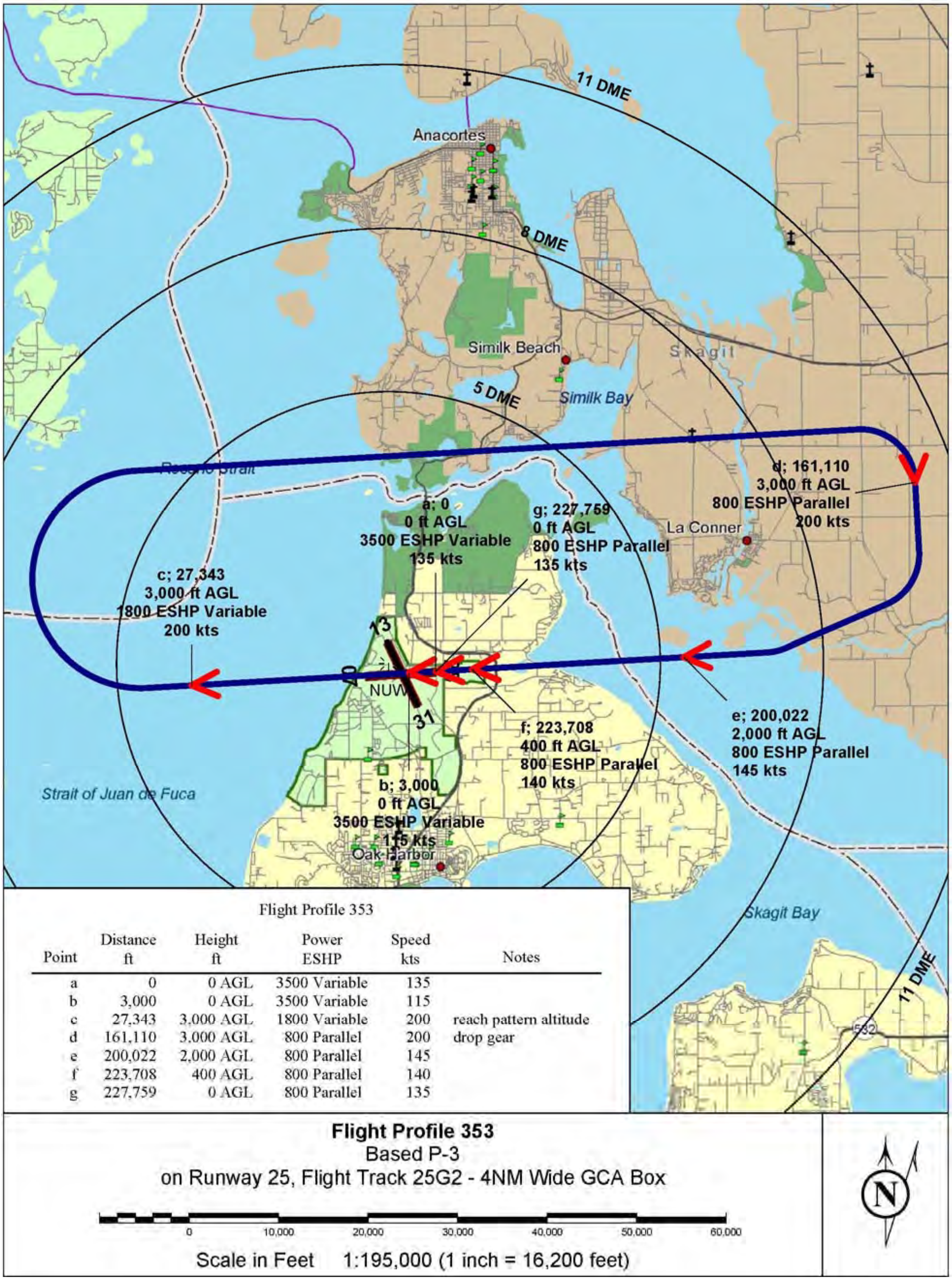
Point	Distance ft	Height ft	Power ESHP	Speed kts	Notes
a	0	0 AGL	3500 Variable	135	
b	3,000	0 AGL	3500 Variable	115	
c	11,257	500 AGL	2500 Variable	160	
d	18,822	1,000 AGL	1200 Variable	160	reach pattern altitude
e	33,302	1,000 AGL	1200 Parallel	160	gear down; abeam of landing point
f	39,343	1,000 AGL	800 Parallel	160	
g	55,393	317 AGL	800 Parallel	145	
h	61,450	0 AGL	800 Parallel	135	

Flight Profile 348DB
Based P-3
on Runway 25, Flight Track 25TN2 - Tower Pattern Night - Center

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000

Scale in Feet 1:48,600 (1 inch = 4,050 feet)

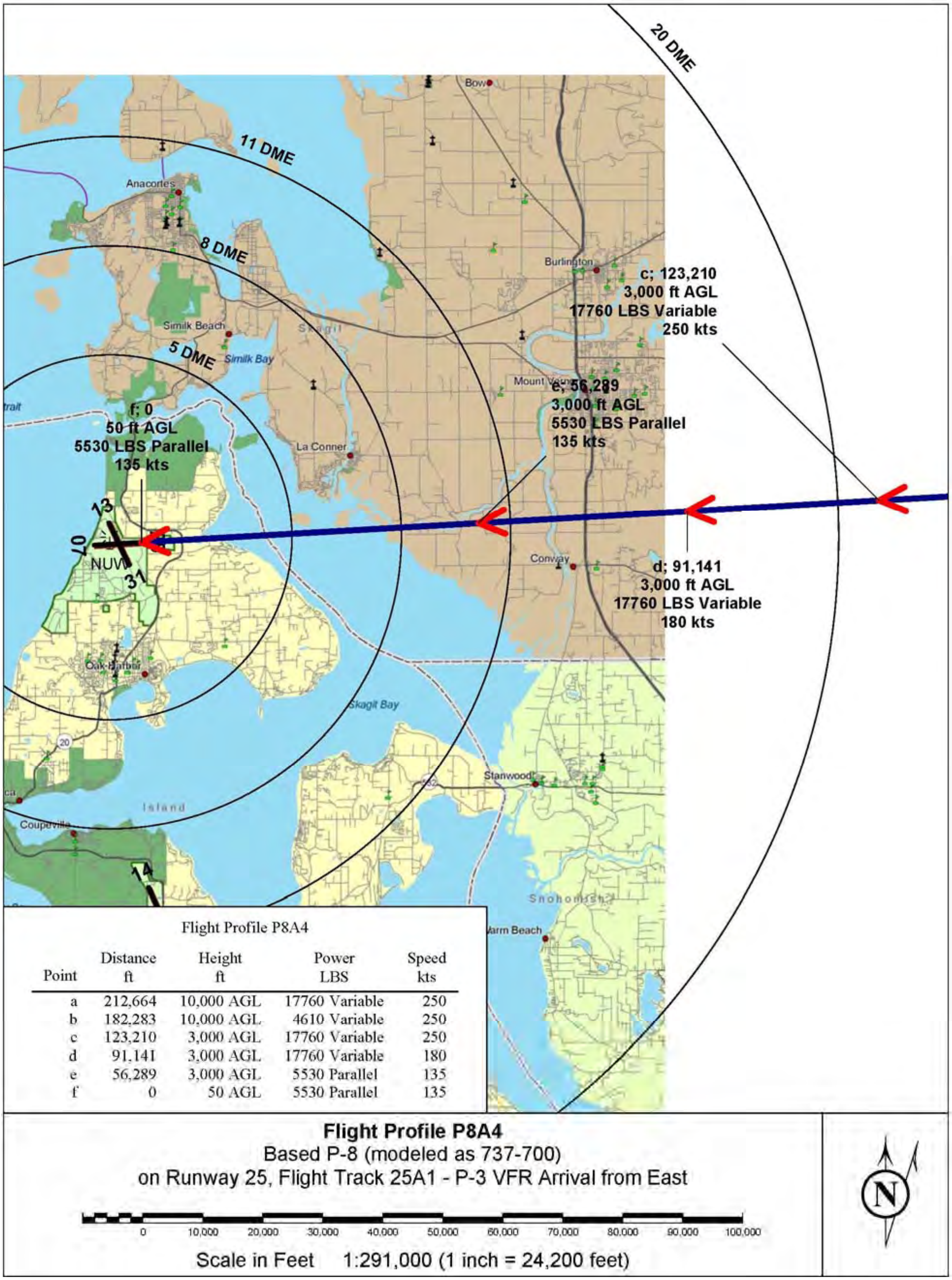
N



Flight Profile 353

Point	Distance ft	Height ft	Power ESHP	Speed kts	Notes
a	0	0 AGL	3500 Variable	135	
b	3,000	0 AGL	3500 Variable	115	
c	27,343	3,000 AGL	1800 Variable	200	reach pattern altitude
d	161,110	3,000 AGL	800 Parallel	200	drop gear
e	200,022	2,000 AGL	800 Parallel	145	
f	223,708	400 AGL	800 Parallel	140	
g	227,759	0 AGL	800 Parallel	135	

Flight Profile 353
Based P-3
on Runway 25, Flight Track 25G2 - 4NM Wide GCA Box

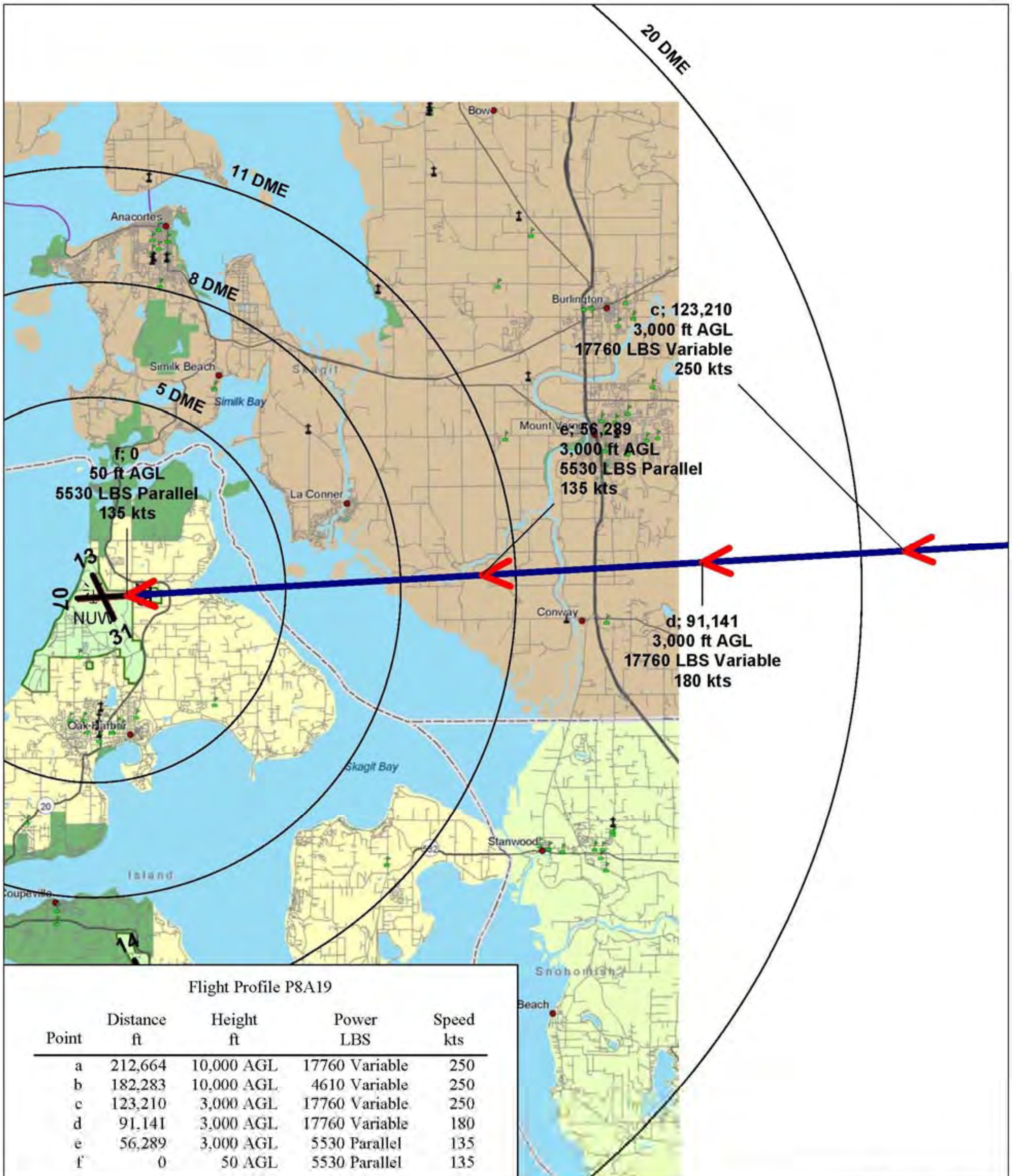


Flight Profile P8A4

Point	Distance ft	Height ft	Power LBS	Speed kts
a	212,664	10,000 AGL	17760 Variable	250
b	182,283	10,000 AGL	4610 Variable	250
c	123,210	3,000 AGL	17760 Variable	250
d	91,141	3,000 AGL	17760 Variable	180
e	56,289	3,000 AGL	5530 Parallel	135
f	0	50 AGL	5530 Parallel	135

Flight Profile P8A4
Based P-8 (modeled as 737-700)
on Runway 25, Flight Track 25A1 - P-3 VFR Arrival from East

Scale in Feet 1:291,000 (1 inch = 24,200 feet)



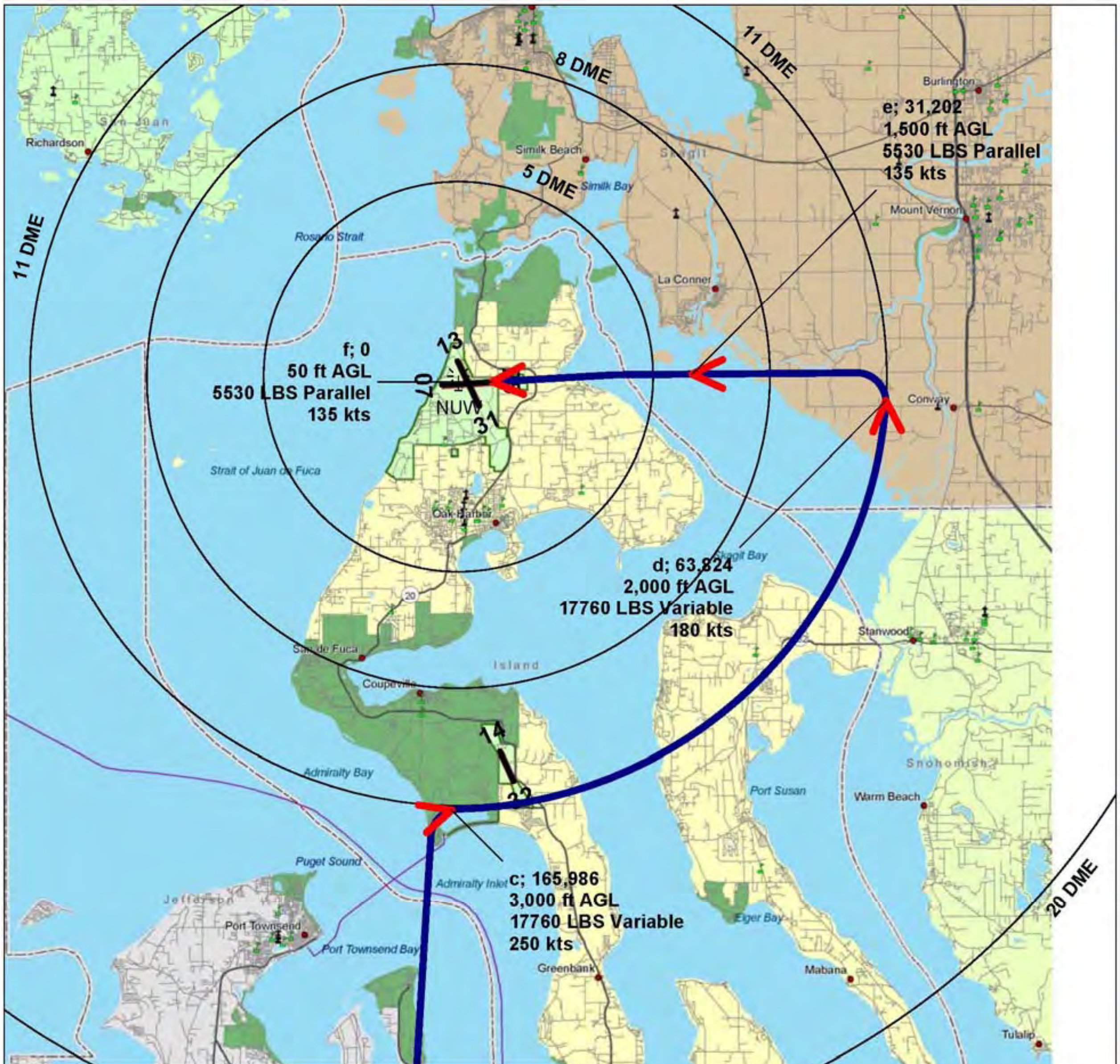
Flight Profile P8A19

Point	Distance ft	Height ft	Power LBS	Speed kts
a	212,664	10,000 AGL	17760 Variable	250
b	182,283	10,000 AGL	4610 Variable	250
c	123,210	3,000 AGL	17760 Variable	250
d	91,141	3,000 AGL	17760 Variable	180
e	56,289	3,000 AGL	5530 Parallel	135
f	0	50 AGL	5530 Parallel	135

Flight Profile P8A19
Based P-8 (modeled as 737-700)
on Runway 25, Flight Track 25A4 - IFR Arrival Short Center Long East

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000 80,000 90,000 100,000

Scale in Feet 1:293,000 (1 inch = 24,400 feet)



Flight Profile P8A31

Point	Distance ft	Height ft	Power LBS	Speed kts
a	300,000	10,000 AGL	17760 Variable	250
b	253,170	10,000 AGL	4610 Variable	250
c	165,986	3,000 AGL	17760 Variable	250
d	63,824	2,000 AGL	17760 Variable	180
e	31,202	1,500 AGL	5530 Parallel	135
f	0	50 AGL	5530 Parallel	135

Flight Profile P8A31
Based P-8 (modeled as 737-700)
on Runway 25, Flight Track 25ALT - LO-TACAN Arrival

0 20,000 40,000 60,000 80,000 100,000

Scale in Feet 1:320,000 (1 inch = 26,700 feet)

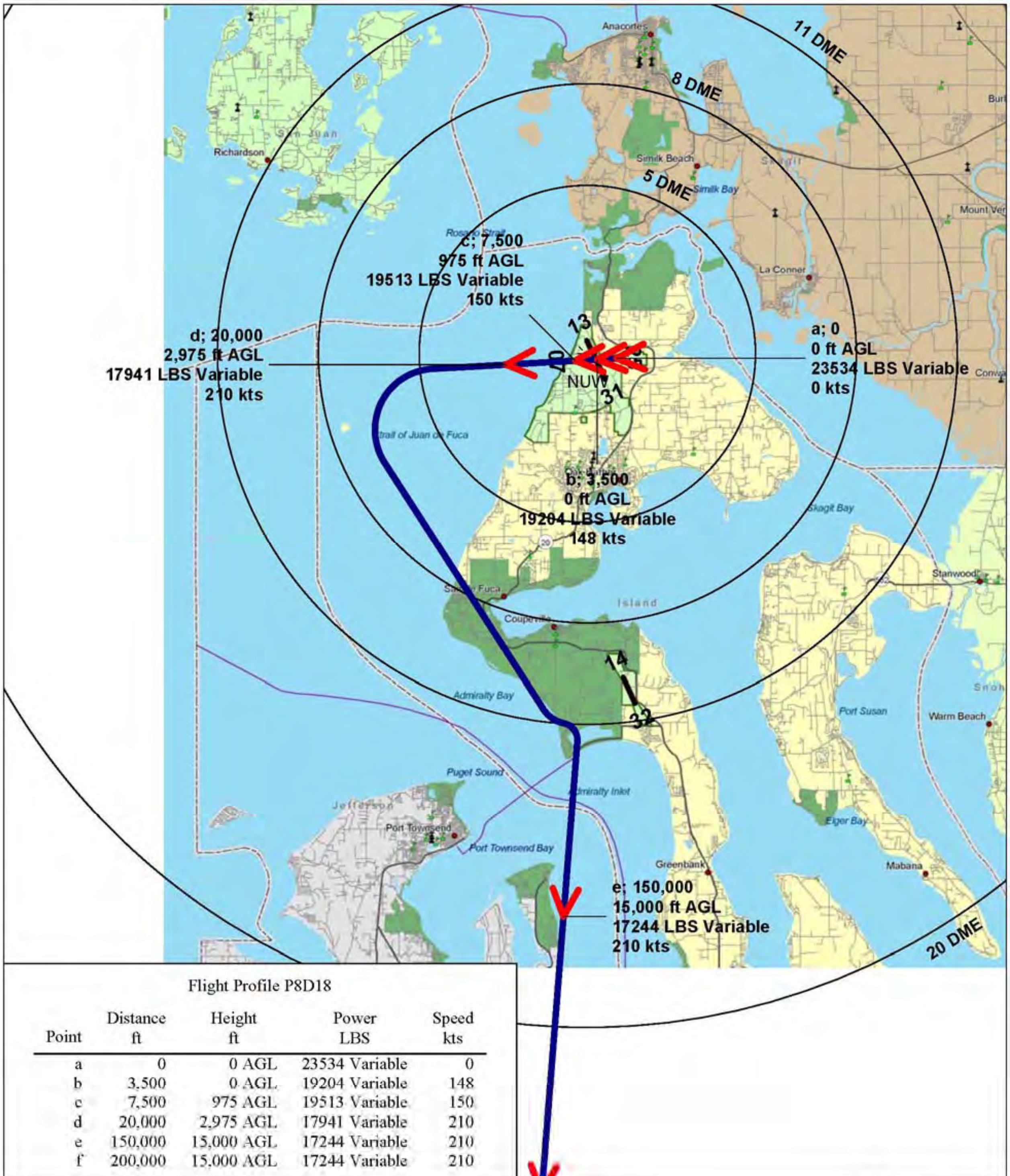
Flight Profile P8D7

Point	Distance ft	Height ft	Power LBS	Speed kts
a	0	0 AGL	23534 Variable	0
b	3,500	0 AGL	19204 Variable	148
c	7,500	975 AGL	19513 Variable	150
d	20,000	2,975 AGL	17941 Variable	210
e	150,000	15,000 AGL	17244 Variable	210
f	200,000	15,000 AGL	17244 Variable	210

Flight Profile P8D7
Based P-8 (modeled as 737-700)
on Runway 25, Flight Track 25D5 - Departure to West

0 10,000 20,000 30,000 40,000 50,000

Scale in Feet 1:180,000 (1 inch = 15,000 feet)



Flight Profile P8D18

Point	Distance ft	Height ft	Power LBS	Speed kts
a	0	0 AGL	23534 Variable	0
b	3,500	0 AGL	19204 Variable	148
c	7,500	975 AGL	19513 Variable	150
d	20,000	2,975 AGL	17941 Variable	210
e	150,000	15,000 AGL	17244 Variable	210
f	200,000	15,000 AGL	17244 Variable	210

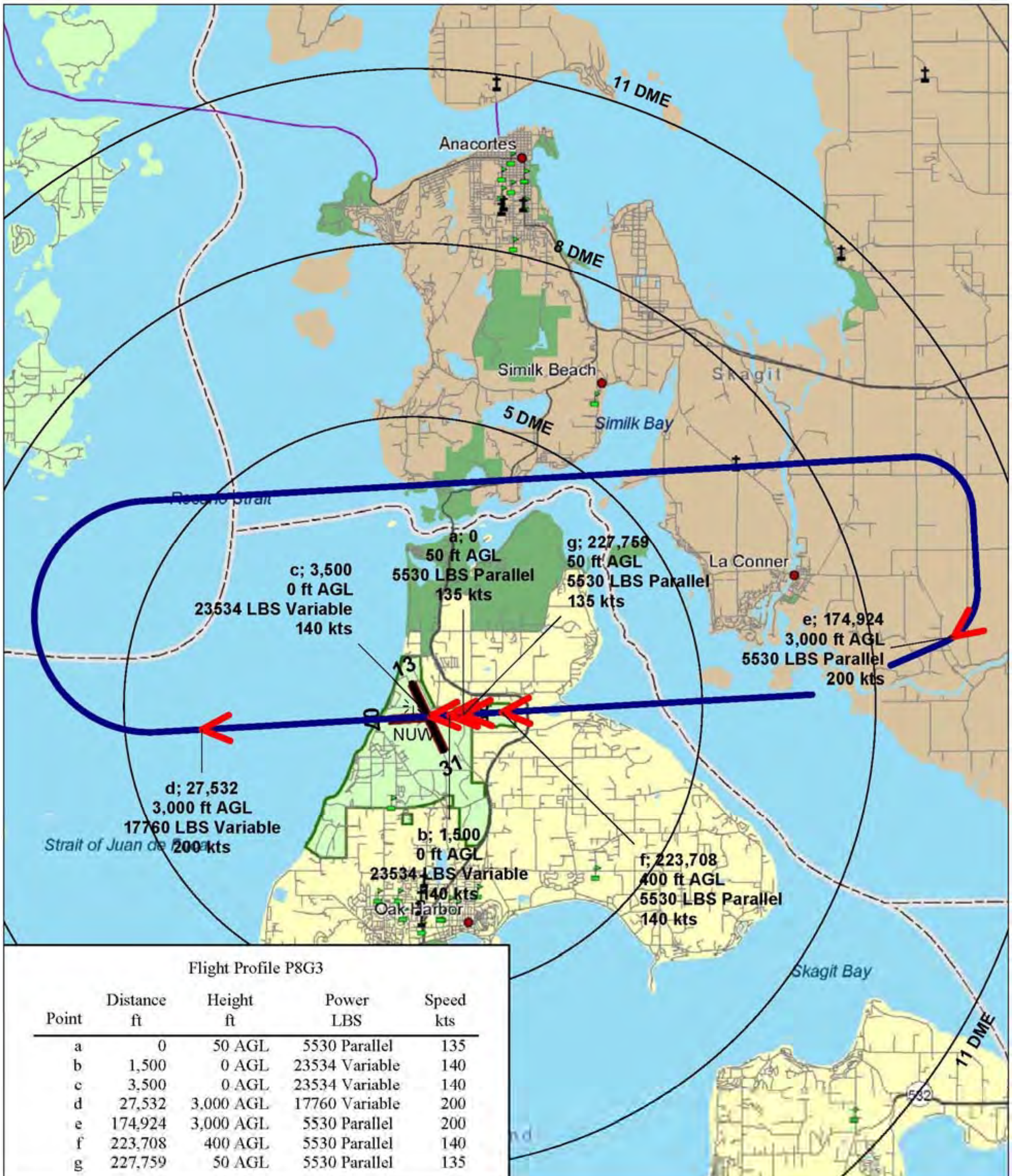
Flight Profile P8D18

Based P-8 (modeled as 737-700)

on Runway 25, Flight Track 25DLT - LO-TACAN Departure

0 20,000 40,000 60,000 80,000 100,000

Scale in Feet 1:334,000 (1 inch = 27,900 feet)



Flight Profile P8G3

Point	Distance ft	Height ft	Power LBS	Speed kts
a	0	50 AGL	5530 Parallel	135
b	1,500	0 AGL	23534 Variable	140
c	3,500	0 AGL	23534 Variable	140
d	27,532	3,000 AGL	17760 Variable	200
e	174,924	3,000 AGL	5530 Parallel	200
f	223,708	400 AGL	5530 Parallel	140
g	227,759	50 AGL	5530 Parallel	135

Flight Profile P8G3
Based P-8 (modeled as 737-700)
on Runway 25, Flight Track 25G2 - 4NM Wide GCA Box

0 10,000 20,000 30,000 40,000 50,000 60,000

Scale in Feet 1:195,000 (1 inch = 16,200 feet)

Flight Profile P8T8

Point	Distance ft	Height ft	Power LBS	Speed kts
a	0	50 AGL	5530 Parallel	135
b	1,500	0 AGL	23534 Variable	140
c	3,500	0 AGL	23534 Variable	140
d	26,500	1,000 AGL	17760 Variable	150
e	39,000	1,000 AGL	5530 Parallel	150
f	61,450	50 AGL	5530 Parallel	135

Flight Profile P8T8
Based P-8 (modeled as 737-700)
on Runway 25, Flight Track 25TN2 - Tower Pattern Night - Center

0 2,000 4,000 6,000 8,000 10,000 12,000 14,000 16,000

Scale in Feet 1:48,600 (1 inch = 4,050 feet)

N

Flight Profile 407

Point	Distance ft	Height ft	Power EPR	Speed kts
a	0	0 AGL	2 Variable	0
b	3,500	0 AGL	2 Variable	115
c	17,000	1,500 AGL	2 Variable	200
d	24,000	2,500 AGL	1.8 Variable	250
e	40,000	4,000 AGL	1.8 Variable	250
f	200,000	15,000 AGL	1.8 Variable	250

Flight Profile 407
Based C-9
on Runway 25, Flight Track 25D5 - Departure to West
Prior to brake release, aircraft sits at 2 EPR Variable for 5 sec

0 4,000 8,000 12,000 16,000 20,000 24,000 28,000

Scale in Feet 1:90,100 (1 inch = 7,510 feet)

Flight Profile 420

Point	Distance ft	Height ft	Power EPR	Speed kts
a	200,000	10,532 AGL	1.3 Variable	250
b	100,000	5,000 AGL	1.3 Variable	220
c	55,000	2,900 AGL	1.2 Variable	180
d	36,600	1,900 AGL	1.3 Variable	135
e	0	50 AGL	1.13 Variable	120

Flight Profile 420

Based C-9

on Runway 25, Flight Track 25A1 - P-3 VFR Arrival from East

0 10,000 20,000 30,000 40,000 50,000 60,000 70,000

Scale in Feet 1:212,000 (1 inch = 17,700 feet)

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Appendix B

DISCUSSION OF NOISE AND ITS EFFECTS ON THE ENVIRONMENT

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B.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.

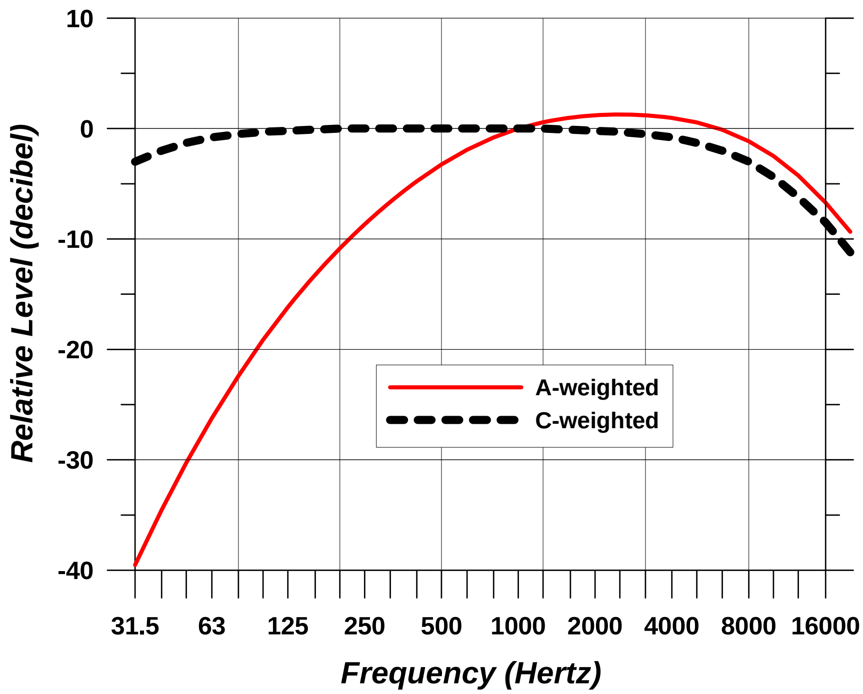
Second, the total sound level produced by two sounds of different levels is usually only slightly more than the higher of the two. For example:

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 percent decrease in sound intensity but only a 50 percent 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 B-1 are also the most adequate to quantify environmental noises.



Source: ANSI S1.4A -1985 "Specification of Sound Level Meters"

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

B.1.1 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 (EPA) 1978).

Figure B-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.

B.1.2 C-weighted Sound Level

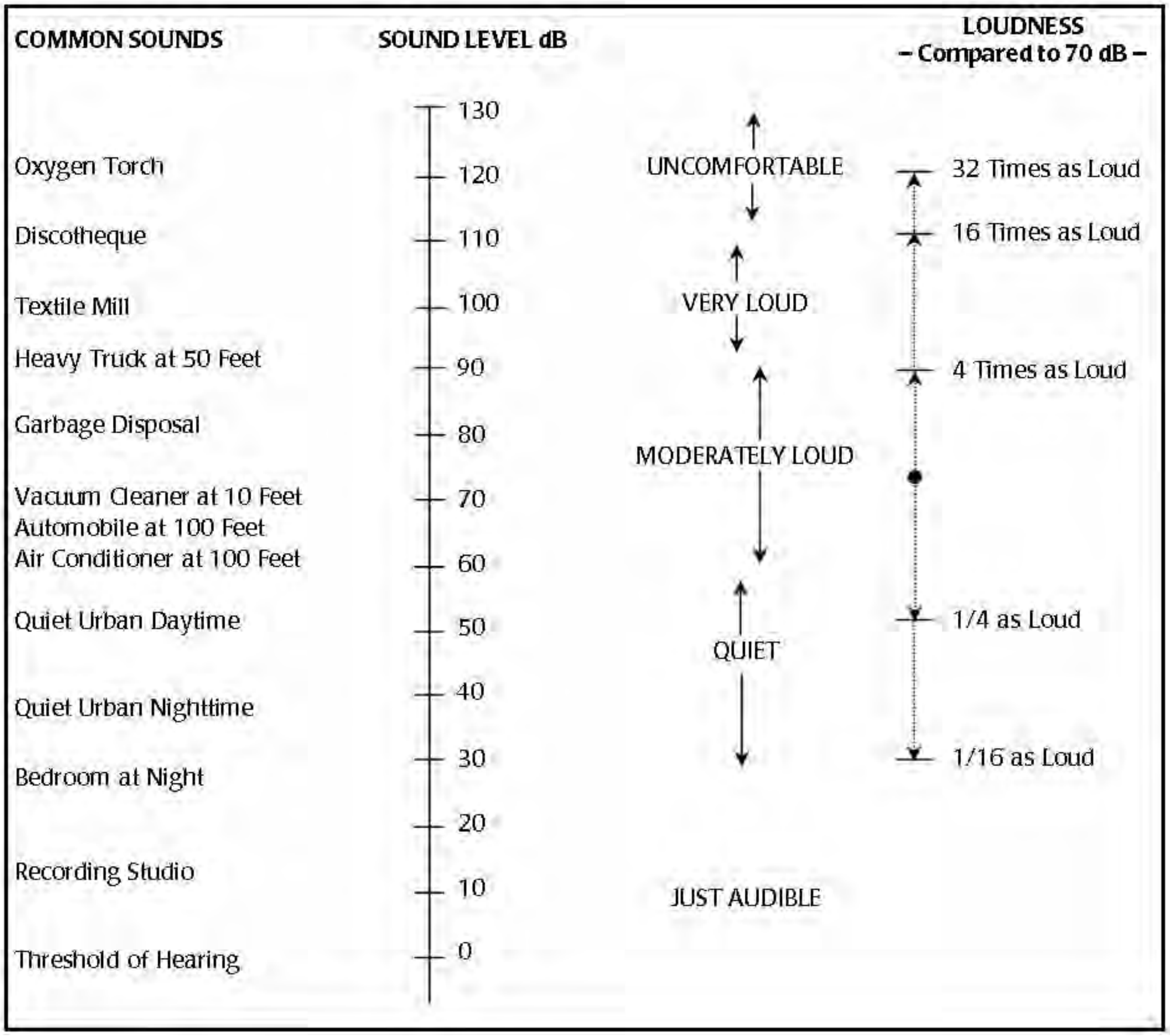
Sound levels measured using a C-weighting are most appropriately called C-weighted sound levels (and denoted dBC). C-weighting is nearly flat throughout the audible frequency range, hardly de-emphasizing the low frequency. This weighting scale is generally used to describe impulsive sounds. Sounds that 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 (ANSI 1996).

Impulsive Sound: 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 (ANSI 1996).

Highly Impulsive Sound: 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.

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.



SOURCE: Handbook of Noise Control, *C.M. Harris, Editor McGraw-Hill Book Co., 1979, and FICAN 1997*

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

B.2 Noise Metrics

In general, a metric is a statistic for measuring or quantifying. A noise metric quantifies the noise environment. There are three families of noise metrics described herein – one for single noise events such as an aircraft flyby, one for cumulative noise events such as a day's worth of aircraft activity and one which quantifies the events or time relative to single noise events.

Within the single noise event family, metrics described below include Peak Sound Pressure Level, Maximum Sound Level and Sound Exposure Level. Within the cumulative noise events family, metrics described below include Equivalent Sound Level, Day-Night Average Sound Level and several others. Within the events/time family, metrics described below include Number of Events Above a Threshold Level and Time Above a Specified Level.

B.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 L_{max} 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 one-eighth of a second, and is denoted as "fast" response (ANSI 1988). Slowly varying or steady sounds are generally measured over a period of one second, denoted "slow" response. The L_{max} 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.

B.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 L_{pk} is typically measured using a 20 microseconds or faster sampling rate, and is typically based on unweighted or linear response of the meter.

B.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 L_{max} 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 L_{max} occurs instantaneously. SEL represents the best metric to compare noise levels from overflights.

B.2.4 Equivalent Sound Level (L_{eq})

A cumulative noise metric useful in describing noise is the Equivalent Sound Level. L_{eq} is the continuous sound level that would be present if all of the variations in sound level occurring over a specified time period were smoothed out as to contain the same total sound energy.

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.

B.2.5 Day-Night Average Sound Level (DNL or L_{dn}) and Community Noise Equivalent Level (CNEL)

Day-Night Average Sound Level and Community Noise Equivalent Level are composite metrics that account for 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 includes a 5 dB penalty on noise during the 7:00 a.m. to 10:00 p.m. time period, and a 10 dB penalty on noise during the 10:00 p.m. to 7:00 a.m. time period. The notations DNL and L_{dn} are both used for Day-Night Average Sound Level and are equivalent.

Like L_{eq}, DNL and CNEL without their penalties 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 single-measure time-average metrics account for the SELs, L_{max}, the duration of the events (sorties or operations), and the number of events that occur over a 24-hour period but do not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. 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 nighttime penalties in both DNL and CNEL 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 evening penalty in CNEL accounts for the added intrusiveness of sounds during that period.

The inclusion of daytime, evening and nighttime periods in the computation of the DNL and CNEL reflects their basic 24-hour definition. They 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.

The logarithmic nature of the decibel unit causes the noise levels of the loudest events to control the 24-hour average. A DNL of 65 dB could result from a very few noisy events or a large number of quieter events.

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 DNL 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 DNL 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.

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 (EPA 1978 and Schultz 1978).

B.2.6 Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr}) and Onset-Rate Adjusted Monthly Community Noise Equivalent Level ($CNEL_{mr}$)

Military aircraft utilizing Special Use Airspace (SUA) such as Military Training Routes (MTRs), Military Operating Areas (MOAs) and 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, flight activity in SUAs is highly sporadic and often seasonal ranging from ten 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 SEL (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 characteristic of SUA activity and so as not to dilute the resultant noise exposure, the month with the most operations or sorties from a yearly tabulation for the given SUA is examined -- the so-called busiest month. 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 $CNEL_{mr}$.

B.2.7 Number-of-Events Above (NA) a Threshold Level (L)

The Number-of-events Above metric (NA) provides the total number of noise events that exceed the selected noise level threshold during a specified period of time. Combined with the selected threshold level (L), the NA metric is symbolized as NAL. The threshold L can be defined in terms of either the SEL or L_{max} metric, and it is important that this selection is reflected in the nomenclature. When labeling a contour line or point of interest (POI) on a map the NAL will be followed by the number of events in parentheses for that line or POI. For example, the noise environment at a location where 10 events exceed an SEL of 90 dB, over a given period of time, would be represented by the nomenclature NA90SEL(10). Similarly, for L_{max} it would be NA90L_{max}(10). The period of time can be an average 24-hour day, daytime, nighttime, school day, or any other time period appropriate to the nature and application of the analysis.

NA can be portrayed for single or multiple locations, or by means of noise contours on a map similar to the common DNL contours. A threshold level is selected that best meets the need for that situation. An L_{max} threshold is normally selected to analyze speech interference, whereas an SEL threshold is normally selected for analysis of sleep disturbance.

The NA metric is the only supplemental metric that has been developed that combines single-event noise levels with the number of aircraft operations. In essence, it answers the question of how many aircraft (or range of aircraft) fly over a given location or area at or above a selected threshold noise level.

B.2.8 Time Above (TA) a Specified Level (L)

The Time Above (TA) metric is a measure of the total time that the A-weighted aircraft noise level is at or above a defined sound level threshold. Combined with the selected threshold level (L), the TA metric is symbolized as TAL. TA is not a sound level, but rather a time expressed in minutes. TA values can be calculated over a full 24-hour annual average day, the 15-hour daytime and 9-hour nighttime periods, a school day, or any other time period of interest, provided there is operational data to define the time period of interest.

TA has application for describing the noise environment in schools, particularly when comparing the classroom or other noise sensitive environments for different operational scenarios. TA can be portrayed by means of noise contours on a map similar to the common DNL contours.

The TA metric is a useful descriptor of the noise impact of an individual event or for many events occurring over a certain time period. When computed for a full day, the TA can be compared alongside the DNL in order to determine the sound levels and total duration of events that contribute to the DNL. TA analysis is usually conducted along with NA analysis so the results show not only how many events occur above the selected threshold(s), but also the total duration of those events above those levels for the selected time period.

B.3 Noise Effects

This noise effects section includes discussions of annoyance, speech interference and sleep disturbance, and the effects of noise on hearing, health, performance, learning, animals, property values, terrain and archaeological sites.

B.3.1 Annoyance

The primary effect of aircraft noise on exposed communities is one of long-term annoyance, defined by the Environmental Protection Agency (EPA) as any negative subjective reaction on the part of an individual or group. The scientific community has adopted the use of long-term annoyance as a primary indicator of community response because it attempts to account for all negative aspects of effects from noise, e.g., increased annoyance due to being awakened the previous night by aircraft and interference with everyday conversation.

Numerous laboratory studies and field surveys have been conducted to measure annoyance and to account for a number of variables, many of which are dependent on a person's individual circumstances and preferences. Laboratory studies of individual response to noise have helped isolate a number of the factors contributing to annoyance, such as the intensity level and spectral characteristics of the noise, duration, the presence of impulses, pitch, information content, and the degree of interference with activity. Social surveys of community response to noise have allowed the development of general dose-response relationships that can be used to estimate the proportion of people who will be highly annoyed by a given noise level. The results of these studies have formed the basis for criteria established to define areas of compatible land use.

A wide variety of responses have been used to determine intrusiveness of noise and disturbances of speech, sleep, audio/video entertainment, and outdoor living; but the most useful metric for assessing peoples' responses to noise is the percentage of the population expected to be "highly annoyed." The concept of "percent highly annoyed" has provided the most consistent response of a community to a particular noise environment. In his synthesis of several different social surveys that employed different response scales, Schultz (1978) defined "highly annoyed" respondents as those respondents whose self-described annoyance fell within the upper 28 percent of the response scale where the scale was numerical or un-named. For surveys where the response scale was named, Schultz counted those who claimed to be highly annoyed, combining the responses of "very annoyed" and "extremely annoyed." Schultz's definition of "percent highly annoyed" (%HA) became the basis for the Federal policy on environmental noise. Daily average sound levels are typically used for the evaluation of community noise effects, such as long-term annoyance.

In general, scientific studies and social surveys have found a correlation between the percentages of groups of people highly annoyed and the level of average noise exposure. Thus, the results are expressed as the average %HA at various exposure levels measured in DNL. The classic analysis is Schultz's original 1978 study, whose results are shown in Figure B-3. This figure is commonly referred to as the Schultz curve. It represents the synthesis of a large number of social surveys (161 data points in all), that relates the long-term community response to various types of noise sources, measured using the DNL metric.

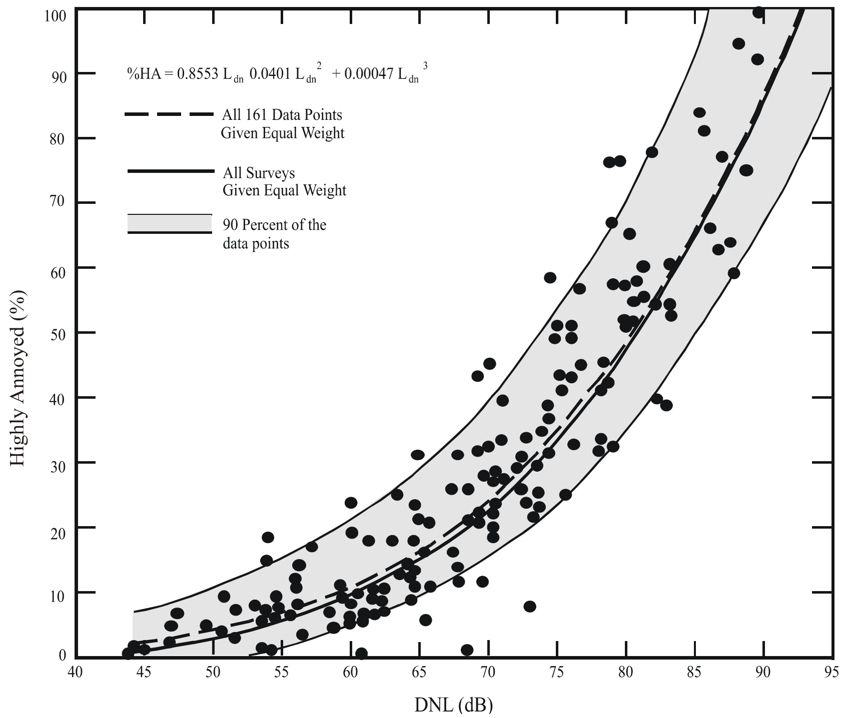
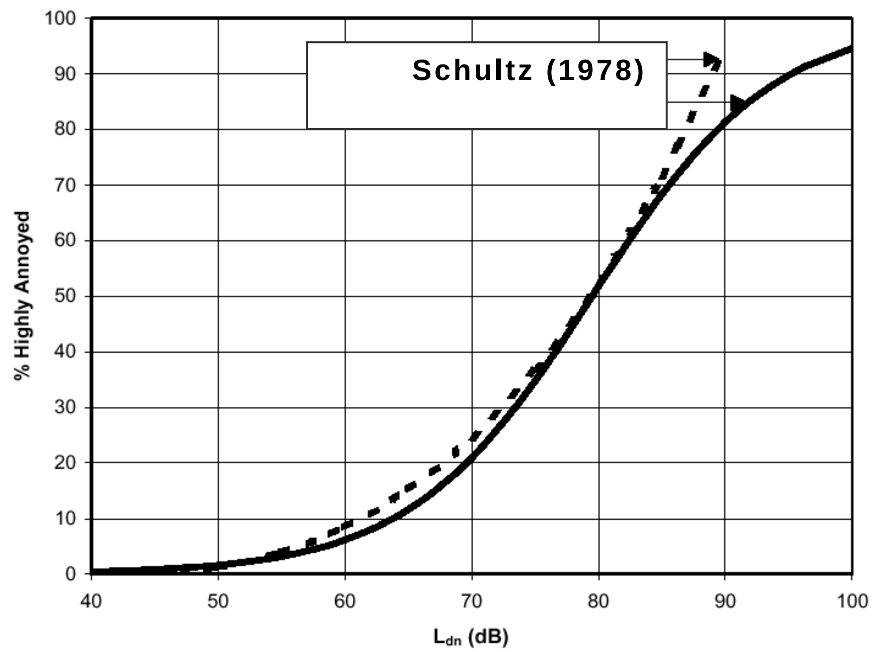


Figure B-3. Community Surveys of Noise Annoyance

An updated study of the original Schultz data based on the analysis of 400 data points collected through 1989 essentially reaffirmed this relationship. Figure B-4 shows an updated form of the curve fit in comparison with the original Schultz curve (Finegold 1994). The updated fit, which does not differ substantially from the original, is the preferred form in the U.S. The relationship between %HA and DNL is:

$$\%HA = 100/[1+ \exp(11.13 – 0.141L_{dn})]$$

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. However, the correlation coefficients for the annoyance of individuals are relatively low, 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.



SOURCE:(Schultz, 1978) and Current (Finegold, et al. 1994) Curve Fits

Figure B-4. Response of Communities to Noise; Comparison of Original

A number of non-acoustic 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.

The low correlation coefficients for individuals' reactions reflect the large amount of scatter among the data drawn from the various surveys and point to the substantial uncertainty associated with the equation representing the relationship between %HA and DNL. Based on the results of surveys it has been observed that noise exposure can explain less than 50 percent of the observed variance in annoyance, indicating that non-acoustical factors play a major role. As a result, it is not possible to accurately predict individual annoyance in any specific community based on the aircraft noise exposure. Nevertheless, changes in %HA can be useful in giving the decision maker more information about the relative effects that different alternatives may have on the community.

The original Schultz curve and the subsequent updates do not separate out the annoyance from aircraft noise and other transportation noise sources. This was an important element, in that it allowed Schultz to obtain some consensus among the various social surveys from the 1960s and 1970s that were synthesized in the analysis. In essence, the Schultz curve assumes that the effects of long-term annoyance on the general population are the same, regardless of whether the noise source is road, rail, or aircraft. In the years after the classical Schultz analysis, additional social surveys have been conducted to better understand the annoyance effects of various transportation sources.

Miedema & Vos (1998) present synthesis curves for the relationship between DNL and percentage "Annoyed" and percentage "Highly Annoyed" for three transportation noise sources. Separate, non-identical curves were found for aircraft, road traffic, and railway noise. Table B-1 illustrates that, for a DNL of 65 dB, the percent of the people forecasted to be Highly Annoyed is 28 percent for air traffic, 18 percent for road traffic, and 11 percent for railroad traffic. For an outdoor DNL of 55 dB, the percent highly annoyed would be close to 12 percent if the noise is generated by aircraft operations, but only 7 percent and 4 percent, respectively, if the noise is generated by road or rail traffic. Comparing the levels on the Miedema & Vos curve to those on the updated Schultz curve indicates that the percentage of people highly annoyed by aircraft noise may be higher than previously thought when the noise is solely generated by aircraft activity.

Table B-1. Percent Highly Annoyed for Different Transportation Noise Sources

DNL (dB)	Percent Hightly Annoyed (% HA)			
	Miedema and Vos			Schultz Combined
	Air	Road	Rail	
55	12	7	4	3
60	19	12	7	6
65	28	18	11	12
70	37	29	16	22
75	48	40	22	36

Source: Miedema & Vos 1998

As noted by the World Health Organization (WHO), even though aircraft noise seems to produce a stronger annoyance response than road traffic, caution should be exercised when interpreting synthesized data from different studies (WHO 2000). The WHO noted that five major parameters should be randomly distributed for the analyses to be valid: personal, demographic, and lifestyle factors, as well as the duration of noise exposure and the population experience with noise

The FICON found that the updated Schultz curve remains the best available source of empirical dosage effect information to predict community response to transportation noise without any segregation by transportation source (FICON 1992); a position held by the FICAN in 1997 (FICAN 1997). However, FICON also recommended further research to investigate the differences in perceptions of aircraft noise, ground transportation noise (highways and railroads), and general background noise.

B.3.2 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance for communities. 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 particularly important in classrooms and offices. In industrial settings it can cause fatigue and vocal strain in those who attempt to communicate over the noise.

The disruption of speech in the classroom is a primary concern, due to the potential for adverse effects on children's learning ability. There are two aspects to speech comprehension:

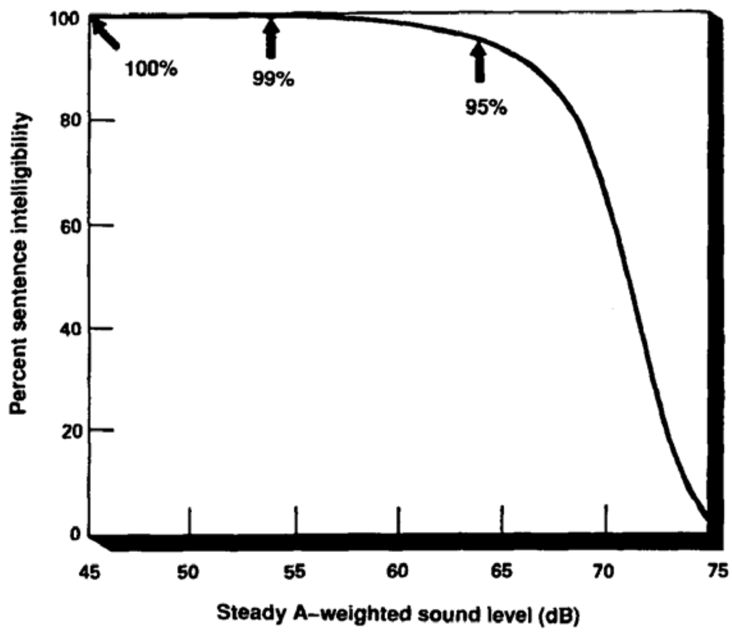
1. *Word Intelligibility* - the percent of words transmitted and received. This might be important for students in the lower grades who are learning the English language, and particularly for students who have English as a Second Language.
2. S*entence Intelligibility* – the percent of sentences transmitted and understood. This might be important for high-school students and adults who are familiar with the language, and who do not necessarily have to understand each word in order to understand sentences.

For teachers to be clearly understood by their students, it is important that regular voice communication is clear and uninterrupted. Not only does the background sound level have to be low enough for the teacher to be clearly heard, but intermittent outdoor noise events also need to be minimized. It is therefore important to evaluate the steady background level, the level of voice communication, and the single-event level due to aircraft overflights that might interfere with speech.

Several research studies have been conducted and guideline documents been developed resulting in a fairly consistent set of noise level criteria for speech interference. This section provides an overview of the results of these studies.

U.S. Federal Criteria for Interior Noise

In 1974, the EPA identified a goal of an indoor 24-hour average sound level $L_{eq(24)}$ of 45 dB to minimize speech interference based on the intelligibility of sentences in the presence of a steady background noise (EPA 1974). Intelligibility pertains to the percentage of speech units correctly understood out of those transmitted, and specifies the type of speech material used, i.e. sentences or words. The curve displayed in Figure B-5 shows the effect of steady indoor background sound levels on sentence intelligibility. For an average adult with normal hearing and fluency in the language, steady background sound levels indoors of less than 45 dB L_{eq} are expected to allow 100 percent intelligibility of sentences.



Source: EPA 1974

Figure B-5. Speech Intelligibility Curve

The curve shows 99 percent sentence intelligibility for background levels at a L_{eq} of 54 dB, and less than 10 percent intelligibility for background levels above a L_{eq} of 73 dB. Note that the curve is especially sensitive to changes in sound level between 65 dB and 75 dB - an increase of 1 dB in background sound level from 70 dB to 71 dB results in a 14 percent decrease in sentence intelligibility, whereas a 1 dB increase in background sound level from 60 dB to 61 dB results in less than 1 percent decrease in sentence intelligibility.

Classroom Criteria

For listeners with normal hearing and fluency in the language, complete sentence intelligibility can be achieved when the signal-to-noise ratio (i.e., the difference between the speech level and the level of the interfering noise) is in the range 15-18 dB (Lazarus 1990).

Both the ANSI and the American Speech-Language-Hearing Association (ASHLA) recommend at least a 15 dB signal-to-noise ratio in classrooms, to ensure that children with hearing impairments and language disabilities are able to enjoy high speech intelligibility (ANSI 2002; ASHLA 1995). As such, provided that the average adult male or female voice registers a minimum of 50 dB L_{max} in the rear of the classroom, the ANSI standard requires that the continuous background noise level indoors must not exceed a L_{eq} of 35 dB (assumed to apply for the duration of school hours).

The WHO reported for a speaker-to-listener distance of about 1 meter, empirical observations have shown that speech in relaxed conversations is 100 percent intelligible in background noise levels of about 35 dB, and speech can be fairly well understood in the presence of background levels of 45 dB. The WHO recommends a guideline value of 35 dB L_{eq} for continuous background levels in classrooms during school hours (WHO 2000).

Bradley suggests that in smaller rooms, where speech levels in the rear of the classroom are approximately 50 dB L_{max}, steady-state noise levels above 35 dB L_{eq} may interfere with the intelligibility of speech (Bradley 1993).

For the purposes of determining eligibility for noise insulation funding, the Federal Aviation Administration (FAA) guidelines state that the design objective for a classroom environment is 45 dB L_{eq} resulting from aircraft operations during normal school hours (FAA 1985).

However, most aircraft noise is not continuous and consists of individual events where the sound level exceeds the background level for a limited time period as the aircraft flies over. Since speech interference in the presence of aircraft noise is essentially determined by the magnitude and frequency of individual aircraft flyover events, a time-averaged metric alone, such as L_{eq}, is not necessarily appropriate when evaluating the overall effects. In addition to the background level criteria described above, single-event criteria, which account for those sporadic intermittent outdoor noisy events, are also essential to specifying speech interference criteria.

In 1984, a report to the Port Authority of New York and New Jersey recommended utilizing the Speech Interference Level (SIL) metric for classroom noise criteria (Sharp and Plotkin 1984). This metric is based on the maximum sound levels in the frequency range (approximately 500 Hz to 2,000 Hz) that directly affects speech communication. The study identified an SIL (the average of the sound levels in the 500, 1000, and 2000 Hz octave-bands) of 45 dB as the desirable goal, which was estimated to provide 90 percent word intelligibility for the short time periods during aircraft over-flights. Although early classroom level criteria were defined in terms of SIL, the use and measurement of L_{max} as the primary metric has since become more popular. Both metrics take into consideration the L_{max} associated with intermittent noise events and can be related to existing background levels when determining speech interference percentages. An SIL of 45 dB is approximately equivalent to an A-weighted L_{max} of 50 dB for aircraft noise (Wesler 1986).

In 1998, a report also concluded that if an aircraft noise event's indoor L_{max} reached the speech level of 50 dB, 90 percent of the words would be understood by students seated throughout the classroom (Lind, Pearsons, and Fidell 1998). Since intermittent aircraft noise does not appreciably disrupt classroom communication at lower levels and other times, the authors also adopted an indoor L_{max} of 50 dB as the maximum single-event level permissible in classrooms. Note that this limit was set based on students with normal hearing and no special needs; at-risk students may be adversely affected at lower sound levels.

Bradley recommends SEL as a better indicator of indoor estimated speech interference in the presence of aircraft overflights (Bradley 1985). For acceptable speech communication using normal vocal efforts, Bradley suggests that the indoor SEL be no greater than 64 dB. He assumes a 26 dB outdoor-to-indoor noise reduction that equates to 90 dB SEL outdoors. Aircraft events producing outdoor SEL values greater than 90 dB would result in disruption to indoor speech communication. Bradley's work indicates that, for speakers talking with a casual vocal effort, 95 percent intelligibility would be achieved when indoor SEL values did not exceed 60 dB, which translates approximately to an L_{max} of 50 dB.

In the presence of intermittent noise events, ANSI states that the criteria for allowable background noise level can be relaxed since speech is impaired only for the short time when the aircraft noise is close to its maximum value. Consequently, they recommend when the background noise level of the noisiest hour is dominated by aircraft noise, the indoor criteria (35 dB L_{eq} for continuous background noise) can be increased by 5 dB to an Leq of 40 dB, as long as the noise level does not exceed 40 dB for more than 10 percent of the noisiest hour. (ANSI 2002).

The WHO does not recommend a specific indoor L_{max} criterion for single-event noise, but does place a guideline value at L_{eq} of 35 dB for overall background noise in the classroom. However, WHO does report that "for communication distances beyond a few meters, speech interference starts at sound pressure levels below 50 dB for octave bands centered on the main speech frequencies at 500 Hz, 1kHz, and 2 kHz." (WHO 2000). One can infer this can be approximated by an L_{max} value of 50 dB.

The United Kingdom Department for Education and Skills (UKDFES) established in its classroom acoustics guide a 30-minute time-averaged metric [$L_{eq(30min)}$] for background levels and $L_{A1,30}$ min for intermittent noises, at thresholds of 30-35 dB and 55 dB, respectively. $L_{A1,30}$ min represents the A-weighted sound level that is exceeded one percent of the time (in this case, during a 30 minute teaching session) and is generally equivalent to the L_{max} metric (UKDFES 2003).

Summary

As the previous section demonstrates, research indicates that it is not only important to consider the continuous background levels using time-averaged metrics, but also the intermittent events, using single-event metrics such as L_{max}. Table B-2 provides a summary of the noise level criteria recommended in the scientific literature.

Table B-2. Indoor Noise Level Criteria Based on Speech Intelligibility

Source	Metric/Level (dB)	Effects and Notes
U.S. FAA (1985)	L_{eq}(during school hours) = 45 dB	Federal assistance criteria for school sound insulation; supplemental single-event criteria may be used
Lind et al. (1998), Sharp and Plotkin (1984), Wesler (1986)	L_{max} = 50 dB / SIL 45	Single event level permissible in the classroom
WHO (1999)	L_{eq} = 35 dB L_{max} = 50 dB	Assumes average speech level of 50 dB and recommends signal to noise ratio of 15 dB
U.S. ANSI (2002)	L_{eq} = 40 dB, Based on Room Volume	Acceptable background level for continuous noise/ relaxed criteria for intermittent noise in the classroom
U.K. DFES (2003)	$L_{eq(30min)}$ = 30-35 dB L_{max} = 55 dB	Minimum acceptable in classroom and most other learning environs

When considering intermittent noise caused by aircraft overflights, a review of the relevant scientific literature and international guidelines indicates that an appropriate criteria is a limit on indoor background noise levels of 35 to 40 dB L_{eq} and a limit on single events of 50 dB L_{max}.

B.3.3 Sleep Disturbance

The disturbance of sleep is a major concern for communities exposed to nighttime aircraft noise. There have been numerous research studies that have attempted to quantify the complex effects of noise on sleep. This section provides an overview of the major noise-induced sleep disturbance studies that have been conducted, with particular emphasis placed on those studies that have influenced U.S. federal noise policy. The studies have been separated into two groups:

1. Initial studies performed in the 1960s and 1970s, where the research was focused on laboratory sleep observations.
2. Later studies performed in the 1990s up to the present, where the research was focused on field observations, and correlations to laboratory research were sought.

Initial Studies

The relationship between noise levels and sleep disturbance is complex and not fully understood. The disturbance depends not only on the depth of sleep, but also on the previous exposure to aircraft noise, familiarity with the surroundings, the physiological and psychological condition of the recipient, and a host of other situational factors. The most readily measurable effect of noise on sleep is the number of arousals or awakenings, and so the body of scientific literature has focused on predicting the percentage of the population that will be awakened at various noise levels. Fundamentally, regardless of the tools used to measure the degree of sleep disturbance (awakenings, arousals, etc.), these studies have grouped the data points into bins to predict the percentage of the population likely to be disturbed at various sound level thresholds.

FICON produced a guidance document that provided an overview of the most pertinent sleep disturbance research that had been conducted throughout the 1970s (FICON 1992). Literature reviews and meta-analysis conducted between 1978 and 1989 made use of the existing datasets that indicated the effects of nighttime noise on various sleep-state changes and awakenings (Lukas 1978; Griefahn 1978; Peasons et. al. 1989). FICON noted that various indoor A-weighted sound levels – ranging from 25 to 50 dB were observed to be thresholds below which significant sleep effects were not expected. Due to the large variability in the data, FICON did not endorse the reliability of the results.

However, FICON did recommend the use of an interim dose-response curve—awaiting future research—which predicted the percent of the exposed population expected to be awakened as a function of the exposure to single event noise levels expressed in terms of SEL. This curve was based on the research conducted for the U.S. Air Force (Finegold 1994). The dataset included most of the research performed up to that point, and predicted that ten percent of the population would be awakened when exposed to an interior SEL of approximately 58 dB. The data utilized to derive this relationship were primarily the results of controlled laboratory studies.

Recent Sleep Disturbance Research – Field and Laboratory Studies

It was noted in the early sleep disturbance research that the controlled laboratory studies did not account for many factors that are important to sleep behavior, such as habituation to the environment and previous exposure to noise and awakenings from sources other than aircraft noise. In the early 1990s, field studies were conducted to validate the earlier laboratory work. The most significant finding from these studies was that an estimated 80 to 90 percent of sleep disturbances were not related to individual outdoor noise events, but were instead the result of indoor noise sources and other non-noise-related factors. The results showed that there was less of an effect of noise on sleep in real-life conditions than had been previously reported from laboratory studies.

FICAN

The interim FICON dose-response curve that was recommended for use in 1992 was based on the most pertinent sleep disturbance research that was conducted through the 1970s, primarily in laboratory settings. After that time, considerable field research was conducted to evaluate the sleep effects in peoples' normal, home environment. Laboratory sleep studies tend to show higher values of sleep disturbance than field studies because people who sleep in their own homes are habituated to their environment and, therefore, do not wake up as easily (FICAN 1997).

Based on the new information, FICAN updated its recommended dose-response curve in 1997, depicted as the lower curve in Figure B-6. This figure is based on the results of three field studies (Ollerhead 1992; Fidell et. al. 1994; Fidell et al. 1995a and 1995b), along with the datasets from six previous field studies.

The new relationship represents the higher end, or upper envelope, of the latest field data. It should be interpreted as predicting the "maximum percent of the exposed population expected to be behaviorally awakened" or the "maximum percent awakened" for a given residential population. According to this relationship, a maximum of 3 percent of people would be awakened at an indoor SEL of 58 dB, compared to 10 percent using the 1992 curve. An indoor SEL of 58 dB is equivalent to outdoor SEL's of 73 and 83 dB respectively assuming 15 and 25 dB noise level reduction from outdoor to indoor with windows open and closed, respectively.

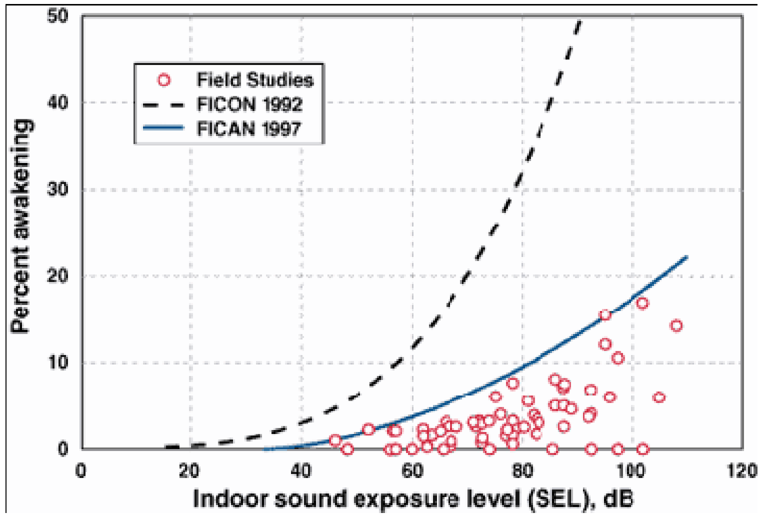


Figure B-6. FICAN's 1997 Recommended Sleep Disturbance Dose-Response Relationship

The FICAN 1997 curve is represented by the following equation:

$$\text{Percent Awakenings} = 0.0087 \times [\text{SEL} - 30]^{1.79}$$

Note the relatively low percentage of awakenings to fairly high noise levels. People think they are awakened by a noise event, but usually the reason for awakening is otherwise. For example, the 1992 UK CAA study found the average person was awakened about 18 times per night for reasons other than exposure to an aircraft noise – some of these awakenings are due to the biological rhythms of sleep and some to other reasons that were not correlated with specific aircraft events.

Number of Events and Awakenings

In recent years, there have been studies and one proposal that attempted to determine the effect of multiple aircraft events on the number of awakenings. The German Aerospace Center (DLR) conducted an extensive study focused on the effects of nighttime aircraft noise on sleep and other related human performance factors (Basner 2004). The DLR study was one of the largest studies to examine the link between aircraft noise and sleep disturbance and involved both laboratory and in-home field research phases. The DLR investigators developed a dose-effect curve that predicts the number of aircraft events at various values of L_{max} expected to produce one additional awakening over the course of a night. The dose-effect curve was based on the relationships found in the field studies.

In July 2008 ANSI and the Acoustical Society of America (ASA) published a method to estimate the percent of the exposed population that might be awakened by multiple aircraft noise events based on statistical assumptions about the probability of awakening (or not awakening) (ANSI 2008). This method relies on probability theory rather than direct field research/experimental data to account for multiple events.

Figure B-7 depicts the awakenings data that form the basis and equations of ANSI S12.9-2008. The curve labeled 'Eq. (B1)' is the relationship between noise and awakening endorsed by FICAN in 1997. The ANSI recommended curve labeled 'Eq. (1)' quantifies the probability of awakening for a population of sleepers who are exposed to an outdoor noise event as a function of the associated indoor SEL in the bedroom. This curve was derived from studies of behavioral awakenings associated with noise events in "steady state" situations where the population has been exposed to the noise long enough to be habituated. The data points in Figure B-7 come from these studies. Unlike the FICAN curve, the ANSI 2008 curve represents the average of the field research data points.

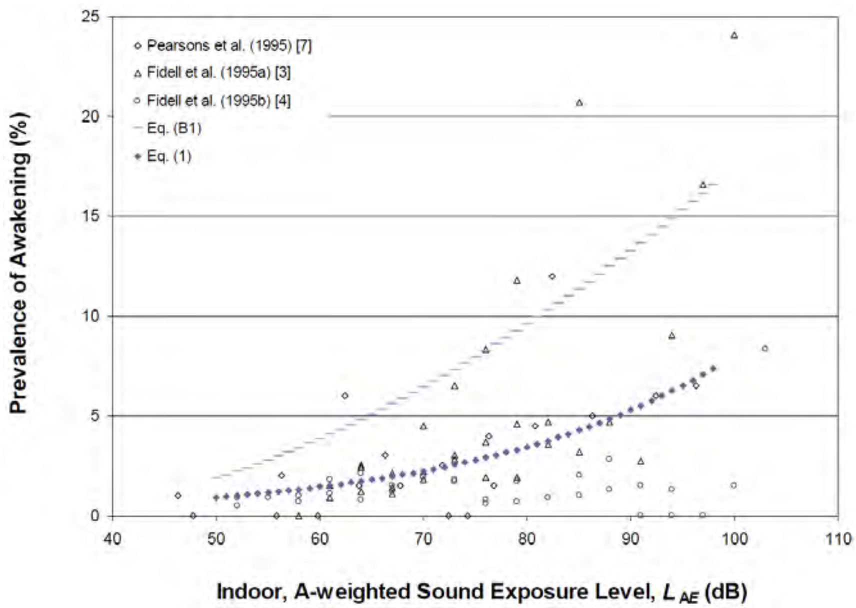


Figure B-7. Plot of Sleep Awakening Data versus Indoor SEL

In December 2008, FICAN recommended the use of this new estimation procedure for future analyses of behavioral awakenings from aircraft noise. In that statement, FICAN also recognized that additional sleep disturbance research is underway by various research organizations, and results of that work may result in additional changes to FICAN's position. Until that time, FICAN recommends the use of ANSI S12.9-2008.

B.3.4 Noise-Induced Hearing Impairment

Residents in surrounding communities express concerns regarding the effects of aircraft noise on hearing. This section provides a brief overview of hearing loss caused by noise exposure. The goal is to provide a sense of perspective as to how aircraft noise (as experienced on the ground) compares to other activities that are often linked with hearing loss.

Hearing Threshold Shifts

Hearing loss is generally interpreted as a decrease in the ear's sensitivity or acuity to perceive sound; i.e. a shift in the hearing threshold to a higher level. This change can either be a Temporary Threshold Shift (TTS), or a Permanent Threshold Shift (PTS) (Berger 1995).

TTS can result from exposure to loud noise over a given amount of time, yet the hearing loss is not necessarily permanent. An example of TTS might be a person attending a loud music concert. After the concert is over, the person may experience a threshold shift that may last several hours, depending upon the level and duration of exposure. While experiencing TTS, the person becomes less sensitive to low-level sounds, particularly at certain frequencies in the speech range (typically near 4,000 Hz). Normal hearing ability eventually returns, as long as the person has enough time to recover within a relatively quiet environment.

PTS usually results from repeated exposure to high noise levels, where the ears are not given adequate time to recover from the strain and fatigue of exposure. A common example of PTS is the result of working in a loud environment such as a factory. It is important to note that a temporary shift (TTS) can eventually become permanent (PTS) over time with continuous exposure to high noise levels. Thus, even if the ear is given time to recover from TTS, repeated occurrence of TTS may eventually lead to permanent hearing loss. The point at which a Temporary Threshold Shift results in a Permanent Threshold Shift is difficult to identify and varies with a person's sensitivity.

Criteria for Permanent Hearing Loss

Considerable data on hearing loss have been collected and analyzed by the scientific/medical community. It has been well established that continuous exposure to high noise levels will damage human hearing (EPA 1978). The Occupational Safety and Health Administration (OSHA) regulation of 1971 standardizes the limits on workplace noise exposure for protection from hearing loss as an average level of 90 dB over an 8-hour work period or 85 dB over a 16-hour period (the average level is based on a 5 dB decrease per doubling of exposure time) (US Department of Labor 1970). 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 an average sound level of 70 dB over a 24-hour period.

The US EPA 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 percent of the population from greater than a 5 dB PTS (EPA 1978). The National Academy of Sciences Committee on Hearing, Bioacoustics, and Biomechanics identified 75 dB as the minimum level at which hearing loss may occur (CHABA 1977). Finally, the WHO has concluded that environmental and leisure-time noise below an L_{eq24} value of 70 dB "will not cause hearing loss in the large majority of the population, even after a lifetime of exposure" (WHO 2000).

Hearing Loss and Aircraft Noise

The 1982 EPA Guidelines report specifically addresses the criteria and procedures for assessing the noise-induced hearing loss in terms of the Noise-Induced Permanent Threshold Shift (NIPTS), a quantity that defines the permanent change in hearing level, or threshold, caused by exposure to noise (EPA, 1982). Numerically, the NIPTS is the change in threshold averaged over the frequencies 0.5, 1, 2, and 4 kHz that can be expected from daily exposure to noise over a normal working lifetime of 40 years, with the exposure beginning at an age of 20 years. A grand average of the NIPTS over time (40 years) and hearing sensitivity (10 to 90 percentiles of the exposed population) is termed the Average NIPTS or Ave NIPTS for short. The Average Noise Induced Permanent Threshold Shift (Ave. NIPTS) that can be expected for noise exposure as measured by the DNL metric is given in Table B-3.

Table B-3. Ave. NIPTS and 10th Percentile NIPTS as a Function of DNL

DNL	Ave. NIPTS dB*	10th Percentile NIPTS dB*
75-76	1.0	4.0
76-77	1.0	4.5
77-78	1.6	5.0
78-79	2.0	5.5
79-80	2.5	6.0
80-81	3.0	7.0
81-82	3.5	8.0
82-83	4.0	9.0
83-84	4.5	10.0
84-85	5.5	11.0

* Rounded to the nearest 0.5 dB

For example, for a noise exposure of 80 dB DNL, the expected lifetime average value of NIPTS is 2.5 dB, or 6.0 dB for the 10th percentile. Characterizing the noise exposure in terms of DNL will usually overestimate the assessment of hearing loss risk as DNL includes a 10 dB weighting factor for aircraft operations occurring between 10 p.m. and 7 a.m. If, however, flight operations between the hours of 10 p.m. and 7 a.m. account for 5 percent or less of the total 24-hour operations, the overestimation is on the order of 1.5 dB.

From a civilian airport perspective, the scientific community has concluded that there is little likelihood that the resulting noise exposure from aircraft noise could result in either a temporary or permanent hearing loss. 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). The EPA criterion (L_{eq24} = 70 dBA) can be exceeded in some areas located near airports, but that is only the case outdoors. Inside a building, where people are more likely to spend most of their time, the average noise level will be much less than 70 dBA (Eldred and von Gierke 1993). Eldred and von Gierke also report that "several studies in the U.S., Japan, and the U.K. have confirmed the predictions that the possibility for permanent hearing loss in communities, even under the most intense commercial take-off and landing patterns, is remote."

With regard to military airbases, as individual aircraft noise levels are increasing with the introduction of new aircraft, a 2009 DoD policy directive requires that hearing loss risk be estimated for the at risk population, defined as the population exposed to DNL greater than or equal to 80 dB and higher (DoD 2009). Specifically, DoD components are directed to "*use the 80 Day-Night A-Weighted (DNL) noise contour to identify populations at the most risk of potential hearing loss*". This does not preclude populations outside the 80 DNL contour, i.e. at lower exposure levels, from being at some degree of risk of hearing loss. However, the analysis should be restricted to populations within this contour area, including residents of on-base housing. The exposure of workers inside the base boundary area should be considered occupational and evaluated using the appropriate DoD component regulations for occupational noise exposure.

With regard to military airspace activity, studies have shown conflicting results. A 1995 laboratory study measured changes in human hearing from noise representative of low-flying aircraft on MTRs (Nixon, et al. 1993). The potential effects of aircraft flying along MTRs is of particular concern because of maximum overflight noise levels can exceed 115 dB, with rapid increases in noise levels exceeding 30 dB per second. In this study, participants were first subjected to four overflight noise exposures at A-weighted levels of 115 dB to 130 dB. Fifty percent of the subjects showed no change in hearing levels, 25 percent had a temporary 5 dB *increase* in sensitivity (the people could hear a 5 dB wider range of sound than before exposure), and 25 percent 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 showed an *increase* in sensitivity of up to 10 dB.

In another study of 115 test subjects between 18 and 50 years old in 1999, temporary threshold shifts were measured after laboratory exposure to military low-altitude flight noise (Ising, et al. 1999). According to the authors, the results indicate that repeated exposure to military low-altitude flight 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.

Summary

Aviation and typical community noise levels near airports are not comparable to the occupational or recreational noise exposures associated with hearing loss. Studies of aircraft noise levels associated with civilian airport activity have not definitively correlated permanent hearing impairment with aircraft activity. It is unlikely that airport neighbors will remain outside their homes 24 hours per day, so there is little likelihood of hearing loss below an average sound level of 75 dB DNL. Near military airbases, average noise levels above 75 dB may occur, and while new DoD policy dictates that NIPTS be evaluated, no research results to date have definitively related permanent hearing impairment to aviation noise.

B.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 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 effects on pregnant women and the unborn fetus (Harris 1997).

B.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.

B.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.

B.3.7.1 Effects on Learning and Cognitive Abilities

In 2002 ANSI refers to studies that suggest that loud and frequent background noise can affect the learning patterns of young children (ANSI 2002). 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. The ANSI acoustical performance criteria for schools 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 (ANSI 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 (ANSI 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 (ANSI 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. 1998). 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, and 2001b). Similarly, a 1994 study found that students exposed to aircraft noise of approximately 76 dBA scored 20% lower on recall ability tests than students exposed to ambient noise of 42-44 dBA (Hygge 1994). Similar studies involving the testing of attention, memory, and reading comprehension of school children 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. 1998; 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 2002 study 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. (Hygge, et al. 2002).

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).

B.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, 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, two studies analyzed cortisol and urinary catecholamine levels in school children as measurements of stress response to aircraft noise (Haines, et al. 2001b and 2001c). 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).

B.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.

B.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. 1990a). 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).

B.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).

B.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. 1991b).

B.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 one to five 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.

B.3.8.2.2.1 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.

B.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).

B.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 percent 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 1970, sonic booms were potentially linked to a mass hatch failure of Sooty Terns on the Dry Tortugas (Austin, et al. 1970). 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. 1991a; 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.

B.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.

B.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.

B.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 dB DNL, and sites are conditionally acceptable with special approvals and noise attenuation in the 65 to 75 dB DNL noise zone and the greater than 75 dB 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 commercial 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 65 dB DNL. 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 in Tucson, AZ, Fidell found the homes near the AFB 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 AFB. 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.

B.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 Hz 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.

B.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.

B.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 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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