Appendix D
Noise Study

Final Report

Aircraft Noise Study to Support the Environmental Impact Statement for the Patuxent River Complex

June 2019

Prepared for
Peggy Farrell, PMP, QEP, CHMM
Leidos, Inc.
11955 Freedom Dr.
Reston, VA 20190

PO Subcontract No.
P010209490 Mod1

Report No.
BRRC 19-05

Prepared by
Ben Manning, MS
Micah Downing, PhD
Blue Ridge Research and Consulting, LLC
29 N. Market St., Suite C
Asheville, NC 28801
(p) 828-252-2209
(f) 831-603-8321
BlueRidgeResearch.com

(intentionally blank)

List of Acronyms

A/C	aircraft
AAM	Advanced Acoustic Model
AGL	above ground level
AGNM	Air Gunnery Noise Model
AICUZ	Air Installations Compatible Use Zones
Alt	Action Alternative
ANSI	American National Standards Institute
ATC	Air Traffic Control
AVG	average
BRRC	Blue Ridge Research and Consulting, LLC
CDNL	C-weighted day-night average sound level
dB	decibel
dBA	A-weighted decibels
dBC	C-weighted decibels
deg	degrees
DNL	day-night average sound level
DNWG	Defense Noise Working Group
DoD	Department of Defense
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ETR	engine thrust request
F	Fahrenheit
FAA	Federal Aviation Administration
FCLP	Field Carrier Landing Practice
FICON	Federal Interagency Committee on Noise
FICUN	Federal Interagency Committee on Urban Noise
FIST	Flight Information Scheduling and Tracking
ft	feet
GASEPF	General Aviation Single Engine Fixed Propeller
GCA	Ground Controlled Approach
Helos	helicopters
HP	Horsepower
Hz	hertz
ID	identification number
IFR	instrument flight rules
Kts	knots
L_{Aeq}	equivalent A-weighted sound level
L_{Amax} or L_{max}	maximum sound level (A-weighted decibels)
lbs/hr	pounds per hour
L_{dn}	A-weighted day-night average sound level
L_{dnmr}	A-weighted onset-rate adjusted monthly day-night average sound level
L_{eq}	Equivalent Sound Level
$L_{eq(8h)}$	equivalent sound level averaged over 8 hours
L_{max}	maximum sound level
L_{Pk}	peak pressure level

max	maximum
MDARNG	Maryland Army National Guard
min	Minutes
MOA	Military Operating Area
MR_NMAP	Military Operating Area and Route Noise Map Model
MSL	mean sea level
MTR	Military Training Route
N/A	not applicable
NA_L	number of events above a threshold sound level
NAS	Naval Air Station
NAVAIR	Naval Air System Command
NAWCAD	Naval Air Warfare Center Aircraft Division
NLR	noise level reduction
NM	nautical mile
NTWL	Naval Test Wing Atlantic
OAETC	Open-Air Engine Test Cell
OLF	Outlying Landing Field
PFO	Precautionary Flame Out
PPR	Prior Permission Required
PRC	Patuxent River Complex
RPM	revolutions per minute
SAR	Search and Rescue
SEL	sound exposure level
SELr	onset-rate adjusted sound exposure level
SFO	Simulated Flame Out
SHARP	Sierra Hotel Airport Reporting Program
TA	Time Above
TPS	Test Pilot School
TUAS	Tactical Unmanned Aircraft System
UAS	Unmanned Aircraft System
UASTD	Unmanned Aircraft Systems Test Directorate
USN	United States Navy
VFR	visual flight rules
VORTAC	Very High Frequency Omni-Directional Radio Range Tactical Air Navigation Aid
VTUAS	Vertical Take-off and Landing Unmanned Aircraft System

Table of Contents

1 Introduction 1

1.1 Purpose 1

1.2 Description of NAS Patuxent River and OLF Webster 1

1.3 Description of Alternatives 3

1.4 Historical Annual Flight Hours 3

2 Noise Metrics & Models 4

2.1 Noise Metrics 5

2.1.1 Maximum Sound Level (L_{Amax}) 6

2.1.2 Sound Exposure Level (SEL) 6

2.1.3 Peak Pressure Level (L_{Pk}) 7

2.1.4 Number-of-Events above a Threshold Level 7

2.1.5 Equivalent A-weighted Sound Level (L_{Aeq}) 7

2.1.6 Day/Night Average Sound Level, DNL or L_{dn} 8

2.1.7 Noise Analysis 8

2.2 Computerized Noise Exposure Models 10

2.2.1 NoiseMap and AAM 10

2.2.2 MOA and Route NoiseMap Model (MR_NMap) 11

2.2.3 PCBoom 11

2.2.4 Air Gunnery Noise Model 12

2.2.5 Airfield Analysis at NAS Patuxent River and OLF Webster for the No Action Alternative 12

2.3 NAS Patuxent River and OLF Webster No Action Alternative Aircraft Operations 13

2.3.1 No Action Alternative Squadron Specific Data Modeling 13

2.3.2 No Action NAS Patuxent River and OLF Webster Annual Flight Operations 16

2.3.3 NAS Patuxent River and OLF Webster Runway Utilization 19

2.3.4 Flight Operation Type Distributions 19

2.3.5 Acoustical Day/Night 21

2.3.6 Flight Tracks 21

2.3.7 Flight Profiles ... 33
2.3.8 Weather Data ... 33
2.3.9 NAS Patuxent River Static Pads and Profiles ... 34
2.4 NAS Patuxent River and OLF Webster No Action Alternative Acoustic Environment ... 37
2.4.1 No Action Alternative DNL Noise Contours ... 37
2.4.2 No Action Alternative DNL and SEL at Representative Locations ... 37
3 Airfield Analysis at NAS Patuxent River and OLF Webster for the Action Alternatives ... 41
3.1 NAS Patuxent River and OLF Webster Action Alternatives Aircraft Operations ... 41
3.1.1 Action Alternatives Squadron Specific Data Modeling ... 41
3.1.2 Action Alternatives NAS Patuxent River and OLF Webster Annual Flight Operations ... 42
3.2 NAS Patuxent River and OLF Webster Action Alternatives Acoustic Environment ... 42
3.2.1 Action Alternatives DNL Noise Contours ... 42
3.2.2 Noise Contour Description Points Analysis and Comparison with the No Action Alternative ... 49
3.2.3 Proposed Action Alternatives DNL and SEL at Representative Locations ... 57
4 Patuxent River Complex Airspace Noise Analysis ... 58
4.1 PRC Airspace Operational Parameters ... 58
4.1.1 Test Pilot School Airspace Parameters ... 58
4.1.2 VX-23 Airspace Parameters ... 60
4.1.3 Search and Rescue Airspace Parameters ... 60
4.1.4 VX-20 Airspace Parameters ... 60
4.1.5 HX-21 Airspace Parameters ... 61
4.1.6 VX-1 Airspace Parameters ... 61
4.1.7 VQ-4 Airspace Parameters ... 62
4.1.8 VXS-1 Airspace Parameters ... 62
4.1.9 UX-24 and MDARNG Airspace Parameters ... 62
4.1.10 Transient Aircraft Airspace Parameters ... 63
4.1.11 Military Training Routes ... 63
4.2 PRC Airspace Noise Analysis Results ... 63

5 PRC Supersonic Aircraft Noise and Aircraft Munitions Noise 65

5.1 Supersonic Aircraft Noise Analysis 65

5.2 Aircraft Munitions Noise Analysis 65

5.3 Sonic Boom and Aircraft Munitions Noise Results 66

6 Supplemental Metrics Results 71

6.1 Outdoor Annual Number of Events Exceeding 80, 90, and 100 dBA L_{Amax} 71

6.2 Outdoor Speech Interference 73

6.3 Indoor Speech Interference 74

6.4 Sleep Disturbance 76

6.5 Classroom Speech Interference 77

6.6 Single Event Noise Analysis 79

7 References 83

Appendix A: Data Validation Tables 85

Appendix B: Squadron and Aircraft Specific Flight Tracks 107

Appendix C: Squadron and Aircraft Specific Representative Flight Profiles..227

List of Figures

Figure 1-1. Patuxent River Complex and Associated Airspace and Ranges 2
Figure 2-1. NAS Patuxent River Fixed Wing Arrival Flight Tracks 23
Figure 2-2. NAS Patuxent River Helicopter Arrival Flight Tracks 24
Figure 2-3. NAS Patuxent River Fixed Wing Departure Flight Tracks 25
Figure 2-4. NAS Patuxent River Helicopter Departure Flight Tracks 26
Figure 2-5. NAS Patuxent River Fixed Wing IFR Closed Pattern Flight Tracks 27
Figure 2-6. NAS Patuxent River Fixed Wing VFR Closed Pattern Flight Tracks 28
Figure 2-7. OLF Webster Fixed Wing and Helicopter Arrival Flight Tracks 29
Figure 2-8. OLF Webster Fixed Wing and Helicopter Departure Flight Tracks 30
Figure 2-9. OLF Webster Fixed Wing and Helicopter Interfacility Flight Tracks 31
Figure 2-10. OLF Webster Fixed Wing and Helicopter Closed Pattern Flight Tracks 32
Figure 2-11. Ground Run-up Locations at NAS Patuxent River 34
Figure 2-12. NAS Patuxent River DNL Contours for No Action Alternative 38
Figure 2-13. OLF Webster DNL Contour for No Action Alternative 39
Figure 2-14. NAS Patuxent River Noise Study Representative Locations for DNL and Supplemental Metrics Analyses 40
Figure 3-1. NAS Patuxent River DNL Contours for Alternative 1 45
Figure 3-2. NAS Patuxent River DNL Contours for Alternative 2 46
Figure 3-3. OLF Webster DNL Contours for Alternative 1 47
Figure 3-4. OLF Webster DNL Contours for Alternative 2 48
Figure 3-5. Noise Contour Description Points and Comparison with the No Action Alternative 52
Figure 3-6. NAS Patuxent River DNL Noise Contour Description Points for 65 dBA DNL Contour Comparison of Alternative 2 and No Action to the 2009 AICUZ 53
Figure 3-7. OLF Webster DNL Noise Contour Description Points with Alternative 2 and No Action DNL Contours 55
Figure 4-1. PRC Airspace Areas Modeled in the Noise Analysis 59
Figure 5-1. No Action Sonic Boom and Aircraft Munitions CDNL Results 67
Figure 5-2. Alternative 1 Sonic Boom and Aircraft Munitions CDNL Results 68
Figure 5-3. Alternative 2 Sonic Boom and Aircraft Munitions CDNL Results 69
Figure 5-4. Aircraft Munitions Peak Noise Results 70
Figure 6-1. Comparative Noise Levels in dBA 71

List of Tables

Table 1-1. Total Historical Annual Squadron Flight Hours at NAS Patuxent River and OLF Webster 4
Table 2-1. Data Collection Sources and Dates 13
Table 2-2. No Action Alternative 10-year Average Annual Flight Hours and Operations at NAS Patuxent River and OLF Webster 17
Table 2-3. Modeled Annual No Action Alternative Operations by Aircraft and Squadron 18
Table 2-4. Runway Utilization for NAS Patuxent River 19
Table 2-5. Runway Utilization for OLF Webster 19
Table 2-6. VX-23 Operational Distributions by Aircraft and Operation Type 20
Table 2-7. Test Pilot School Operational Distributions by Aircraft and Operation Type 20
Table 2-8. Acoustical Day/Night Operations Distributions by Squadron, Aircraft, and Operation Type for NAS Patuxent River and OLF Webster 22
Table 2-9. Weather Data Inputs for NoiseMap 34
Table 2-10. Ground Run-up Operations and Profiles for NAS Patuxent River 35
Table 2-11. No Action Alternative DNL and Maximum SEL at Each Representative Location 37
Table 3-1. Action Alternatives 1 and 2 Flight Hours and Scale Factors Required to Reach these Flight Hours 43
Table 3-2. Total Annual Operations for the No Action and Action Alternatives 1 and 2 44
Table 3-3. Explanations of the Shapes, Increase, or Differences for the NAS Patuxent River No Action and Alternative 2 DNL Contours at Each Noise Contour Description Point 50
Table 3-4. Explanations of Difference between the NAS Patuxent River No Action/Alternatives and the 2009 AICUZ for the 65 dBA DNL Contours at Each Noise Contour Description Point 54
Table 3-5. Explanations of the Shapes, Increases, or Differences for the OLF Webster No Action and Alternative 2 DNL Contours at Each Noise Contour Description Point 56
Table 3-6. Alternative 1 DNL and Maximum SEL at Each Representative Location 57
Table 3-7. Alternative 2 DNL and Maximum SEL at Each Representative Location 57
Table 4-1. Test Pilot School Airspace Operational Parameters 58
Table 4-2. VX-23 Airspace Operational Parameters 60
Table 4-3. VX-20 Airspace Operational Parameters 61
Table 4-4. HX-21 Airspace Operational Parameters 61
Table 4-5. VX-1 Airspace Operational Parameters 62
Table 4-6. VXS-1 Airspace Operational Parameters 62
Table 4-7. UX-24 and MDARNG Airspace Operational Parameters 62
Table 4-8. PRC Airspace Analysis L_{DNMR} (dBA) Results for Each Airspace Area 64
Table 4-9. PRC Airspace Single Event Overflight SEL_R and L_{AMAX} Noise Results 64
Table 6-1. No Action Outdoor Number of Annual Events Exceeding 80, 90, and 100 dBA L_{AMAX} 72
Table 6-2. Alternative 1 Outdoor Number of Annual Events Exceeding 80, 90, and 100 dBA L_{AMAX} 72
Table 6-3. Alternative 2 Outdoor Number of Annual Events Exceeding 80, 90, and 100 dBA L_{AMAX} 73
Table 6-4. No Action Events per Hour Outdoor Speech Interference 73
Table 6-5. Alternative 1 Events per Hour Outdoor Speech Interference 74
Table 6-6. Alternative 2 Events per Hour Outdoor Speech Interference 74
Table 6-7. No Action Events per Hour Indoor Speech Interference 75
Table 6-8. Alternative 1 Events per Hour Indoor Speech Interference 75
Table 6-9. Alternative 2 Events per Hour Indoor Speech Interference 76
Table 6-10. No Action Potential of 2200-0700 Sleep Disturbance 76
Table 6-11. Alternative 1 Potential of 2200-0700 Sleep Disturbance 77

Table 6-12. Alternative 2 Potential of 2200-0700 Sleep Disturbance 77
Table 6-13. No Action Classroom Speech Interference for Schools 78
Table 6-14. Alternative 1 Classroom Speech Interference for Schools 78
Table 6-15. Alternative 2 Classroom Speech Interference for Schools 79
Table 6-16. SEL and L_{AMAX} Comparison of Aircraft Operations at NAS Patuxent River 80
Table 6-17. No Action Top Contributor to the Overall DNL at Each Representative Location 81
Table 6-18. Alternative 1 Top Contributor to the Overall DNL at Each Representative Location 81
Table 6-19. Alternative 2 Top Contributor to the Overall DNL at Each Representative Location 82

1 Introduction

This noise analysis report supports the US Navy's (USN) preparation of an Environmental Impact Statement (EIS) for testing and training operations at Naval Air Station (NAS) Patuxent River, Outlying Field (OLF) Webster, and the Atlantic Test Range. The Patuxent River Complex (PRC) includes supporting land areas (NAS Patuxent River, OLF Webster, and the Bloodsworth Island Range), water areas (e.g., Chesapeake Bay, lower Potomac, St. Mary's, and lower Patuxent River), airspace, and Atlantic Test Ranges' assets (e.g., fixed targets, aim points, recovery areas, and instrumentation sites) (Figure 1-1). This analysis presents a No Action Alternative along with two Action Alternatives. These Action Alternatives include an increase in overall operations compared to the No Action Alternative. This report is divided into sections that present the study's objectives and goals, the data used in the noise model, the noise model analysis, and results. The first section provides an overview of the No Action and Action Alternatives. Section 2 summarizes the noise metrics used to describe and quantify the noise environments, and provides a brief description of the computer noise analysis model used to calculate the noise exposures. Section 3 provides the results of the airfield analysis at NAS Patuxent River and OLF Webster for the No Action Alternative. Section 4 provides the airspace noise analysis results for the PRC for the No Action and the Alternatives. Section 5 discusses the results of sonic booms from supersonic aircraft operations, along with noise from aerial weaponry operations within the PRC. Section 6 presents supplemental metrics results at representative locations throughout the study area.

1.1 Purpose

The objectives of this aircraft noise study are to model the community noise levels from all current and projected aircraft operations within the PRC, which includes NAS Patuxent River and OLF Webster. This analysis includes airspace, supersonic, and aircraft munitions noise, in addition to airfield noise. The No Action Alternative represents a 10-year average of fiscal year (FY) 2008 through 2017 of aircraft operations. This long span of annual operations data was used to capture the varying nature of test aircraft operations. The data collected on the aircraft flight hours for each squadron under the No Action Alternative were used to determine flight hour estimates under each of the Action Alternatives. The methodology for this flight hour estimate, or scaling factor, is discussed in Section 3.1.

1.2 Description of NAS Patuxent River and OLF Webster

NAS Patuxent River is home to Naval Air System Command (NAVAIR) headquarters, the Naval Air Warfare Center Aircraft Division (NAWCAD), and the U.S. Naval Test Pilot School. The PRC serves as a center for test and evaluation and systems acquisition relating to naval aviation and is host to more than 50 tenants including three Services (Navy, Air Force, and Army), federal agencies, and private industry. NAVAIR at NAS Patuxent River is one of eight NAVAIR sites that provide the highest standards in warfare technology through supremacy in naval aviation technologies. The mission of NAWCAD at NAS Patuxent River is to support NAVAIR in providing the warfighter with absolute combat power through technologies that deliver dominant combat effects and matchless capabilities. The mission of NAS Patuxent River is to provide effective and affordable integrated warfare systems and life-cycle support by performing research, development, test and evaluation, engineering, and fleet support for manned and unmanned aircraft, engines, avionics, aircraft support systems, and ship/shore/air operations.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

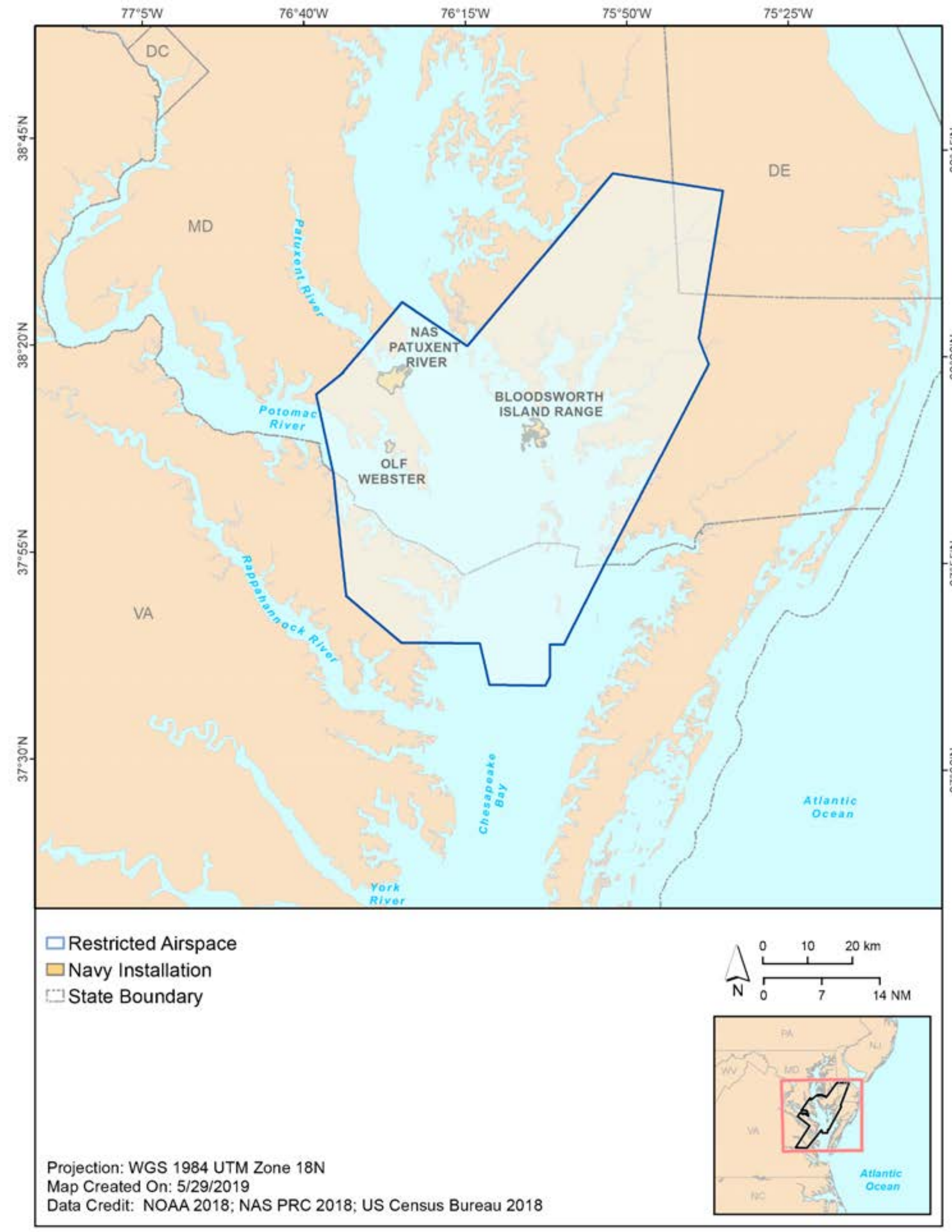

Figure 1-1. Patuxent River Complex and Associated Airspace and Ranges

2

NAS Patuxent River is located in Patuxent River, MD, adjacent to Lexington Park, and encompasses over 13,800 acres and houses 935 buildings (including 10 hangars, totaling more than 8.76 million square feet), with five active runways (longest is 11,800 feet), and possesses 5,000 square miles of controlled airspace of which 780 square miles are restricted.

Located 12 miles southwest of NAS Patuxent River, OLF Webster is home to the NAWCAD 4.11 and NAWCAD 5.1.11, Coast Guard Station St. Inigoes, and a component of the Maryland Army National Guard (MDARNG). NAWCAD 5.1.11 supports fixed and rotary wing autonomous/semi-autonomous remotely piloted aircraft, including the MQ-8B Fire Scout Vertical Take-off and Landing Unmanned Aircraft System (VTUAS) and the RQ-7B Shadow 200 Tactical Unmanned Aircraft System (TUAS). Additionally, UX-24, formerly known as the Unmanned Aircraft Systems Test Directorate (UASTD), operates and maintains two Aerostar Unmanned Aircraft Systems (UAS) that provide customers a safe and efficient method to test a variety of payloads. UX-24 also assists other platform flight tests with support to range clearance operations. The MDARNG operates the RQ-7B Shadow 200 TUAS at OLF Webster.

1.3 Description of Alternatives

The EIS No Action Alternative and two Action Alternatives were analyzed in this noise study. The No Action Alternative is the 10-year annual average of operational data across all squadrons operating at NAS Patuxent River and OLF Webster. It represents a total of 20,100 flight hours across all squadrons (including transients). The Action Alternatives are titled Alternatives 1 and 2 and involve the projected future flight hour estimates for each squadron. Alternative 1 represents a total of 23,400 flight hours at NAS Patuxent River and OLF Webster and Alternative 2 represents a total of 26,000 flight hours. The data collected on the aircraft flight hours for each squadron under the No Action Alternative was used to determine projected flight hour estimates under each of the Action Alternatives. The methodology for this flight hour estimate or scaling factor is discussed in Section 3.1.

The Action Alternatives take into consideration the aircraft platforms that will be retired in the future or are no longer part of a squadron at NAS Patuxent River. For instance, the P-3 and T-6 are no longer part of the VX-20 squadron, although they are modeled in the No Action Alternative. These aircraft have been removed from the Action Alternatives. The No Action represents an average of the past 10 years of aircraft operations, while the Action Alternatives reflect estimated future operations. The Action Alternatives also include future platforms such as the MQ-25. A full list of aircraft modeled in the No Action and Action Alternatives is presented in Section 3.

1.4 Historical Annual Flight Hours

NAS Patuxent River is primarily a test and evaluation facility; therefore, flight hours for each squadron are tracked and used as the basis of flight projections instead of operations or sorties. As a result, the historical data collected are flight hours. For most squadrons, flight hour data are collected from the Flight Information Scheduling and Tracking (FIST) database. For those squadrons who do not use FIST (i.e., VQ-4, VXS-1, VX-1, and MDARNG), flight hours are reported directly to the NAVAIR Ranges Sustainability Office. Flight hours for transient aircraft utilizing PRC airspace only are captured in an Air Traffic Control (ATC) Actuals database. Combining these data sets, Table 1-1 displays the historical flight hours of each squadron that utilizes NAS Patuxent River and OLF Webster. The annual flight hours for all aircraft at NAS Patuxent River and OLF Webster range from a low of 18,438 hours in 2015 to a high of 23,264 hours in 2012. The 10-year average of 20,054 flight hours, rounded up to 20,100 hours, was used for the No Action Alternative and is displayed in Table 3-2 in Section 3. Action Alternatives 1 and 2 were based on subject matter expert projections for future average and peak flight hours, respectively. To derive the operational totals for the No Action Alternative and projected Action Alternatives needed for noise modeling, the FIST system sorties and landings data were used. This process to convert flight hours to operations is further discussed in Sections 3 and 4.

Table 1-1. Total Historical Annual Squadron Flight Hours at NAS Patuxent River and OLF Webster

Squadron	FY 08	FY 09	FY 10	FY 11	FY 12	FY 13	FY 14	FY 15	FY 16	FY 17	10-YR Average	10-YR Peak (FY 12)
Transient (Non-FIST)	1,843	1,761	1,720	1,863	1,321	1,286	1,003	756	1,235	655	1,344	1,321
Transient (FIST)	68	95	95	535	220	225	221	294	352	305	241	220
HX-21	2,365	2,217	1,896	2,272	1,975	2,152	1,801	1,721	1,887	1,947	2,023	1,975
UX-24 / UASTD	356	233	101	227	616	352	434	365	393	487	356	616
Air Ops	1,338	1,568	1,642	1,462	1,447	1,277	1,044	1,045	775	820	1,242	1,447
TPS	6,460	5,196	5,788	6,583	7,194	6,706	6,021	5,822	5,962	6,098	6,183	7,194
VX-20	3,116	3,344	4,228	5,512	5,452	4,130	3,819	3,814	3,977	3,845	4,124	5,452
VX-23	3,068	2,821	2,910	3,586	4,309	4,185	3,828	3,748	3,609	3,230	3,529	4,309
VXS-1	282	355	443	302	157	240	344.7	257.6	168.9	266.9	282	157
VX-1	131.825	399	350	14	81	93	45.7	8	63.9	385	157	81
MDARNG	95	119	206	49	0	145.2	177.1	248.3	300.5	170.7	151	151
VQ-4	440.5	388.5	417	426	492	378	368	359.5	451	490	421	492
Total	**19,563**	**18,497**	**19,796**	**22,831**	**23,264**	**21,169**	**19,107**	**18,438**	**19,174**	**18,700**	**20,054**	**23,415**

Key: UASTD = Unmanned Aircraft Systems Test Directorate; FIST = Flight Information Scheduling and Tracking; FY = fiscal year; MDARNG = Maryland Army National Guard.
Notes: 10-year average of 20,054 was rounded up to 20,100 flight hours for the No Action Alternative.
10-year peak of 23,415 was rounded down to 23,400 flight hours for Action Alternative 1.

2 Noise Metrics & Models

Military aircraft testing and training operations generate noise that has the potential to affect residents and land uses. Although many other sources of noise are present in today's communities, aircraft noise is readily identifiable based on its uniqueness. An assessment of aircraft noise requires a general understanding of how sound affects people and the natural environment, as well as how it is measured.

Around a military or civilian airfield, the noise environment is normally described in terms of the time-average sound level generated by aircraft operating at that facility. In this study, operations consist of the flight activities conducted during an average annual day, including arrivals and departures at the airfield, flight patterns in the general vicinity of the airfield, and ground run-up and maintenance operations. These noise events are described as *transient noise*, which has a gradual onset and has a duration greater than a few seconds.

The noise environment close to military testing and training areas includes various types of noise sources that can either be classified as transient or impulsive noise. *Impulsive noise* refers to sudden noise events with rapid onsets and very brief durations such as sonic booms or aerial weapon firing. Additionally, noise for airspace training operations varies dramatically compared to airfield noise. As opposed to patterned or continuous noise environments associated with airfields, overflights within a range can be highly variable in occurrence and location. Individual military overflight events also differ from typical community noise events because noise from a low-altitude, high-airspeed flyover can have a sudden onset (i.e., exhibiting a rate of increase in sound level – onset rate – of up to 30 to 150 decibel (dB) per second).

2.1 Noise Metrics

A noise metric refers to a unit or quantity that measures an aspect of the received noise used in environmental noise analyses. A metric is used to relate the received noise to its various effects. To quantify these effects, the Department of Defense (DoD) and the Federal Aviation Administration (FAA) use a series of metrics to describe the noise environment from aircraft operations. These metrics range from simple to descriptive to complex measures of the noise environment.

Simple metrics quantify the sound levels occurring during an individual aircraft overflight (single event) and the total noise exposure from the event. Single noise events can be described with the maximum sound level (L_{Amax}) and sound exposure level (SEL) metrics. SEL is used to relate the modeled noise with the potential for sleep disturbance. Another simple measure of instantaneous noise level is the Peak Sound Pressure Level that is used primarily for impulsive noise associated with sonic booms and gun firings. For this noise study, the SEL and L_{Amax} metrics are used in the Supplemental Metrics (Section 6) at the representative locations to present the noise levels of single flyover events. Peak Sound Pressure Level is used to quantify single air munitions events in Section 5.2.

Descriptive metrics are used to quantify a listener's experience in a noise environment. Two of the common descriptive metrics are the frequency of occurrence of noise events (Number of Events Above a Threshold Sound Level, NA_L) and the cumulative duration of the events (Time Above, TA) above a given threshold level. These metrics provide an estimate of "how often" and "how long" noise events would occur in a given location. These metrics provide a good measure of the noise that may be experienced from proposed operations, and they can be related to speech interference for both the general population and classroom. For this analysis, NA_L is utilized for assessing speech interference at the representative locations described in Section 6. Currently, the calculation of TA is not reliable with NoiseMap 7.3 (NoiseMap is described in section 2.2) (Downing, 2016). Therefore, the TA metric is not used in this noise study.

Complex metrics quantify the cumulative noise exposure using a number of different methods of analyzing the noise based on the expected flight and aircraft engine run-up maintenance schedules. Some common metrics are the Equivalent Sound Level (L_{eq}) and the Day/Night Average Sound Level or A-weighted Day-Night Average Sound Level (DNL or L_{dn}). DNL is the fundamental metric used to describe the aircraft noise environment in and around an airfield and is directly related to the long-term community annoyance resulting from this noise. The other metrics (simple and descriptive) supplement this long-term characterization of the noise environment and help to clarify different aspects of the noise effects. DNL is the metric used in this study to analyze the cumulative noise exposure and to generate the noise contour map. Both DNL and L_{eq} are used for the supplemental metric results at the representative locations (Section 6).

Frequency Weighting. To assess the effects from these different types of noise events, noise metrics can use different weighting factors, which emphasize certain parts of the audio frequency spectrum. The normal human ear detects sounds in the range from 20 Hertz (Hz) to 20,000 Hz, and it is most sensitive to sounds in the 1,000 to 4,000 Hz range. Community noise is therefore assessed using a filter that approximates the frequency response of the human ear, adjusting low and high frequencies to match the sensitivity of the ear. This "A-weighting" filter is used to assess most community noise sources. However, for impulsive noise, a "C-weighting" filter is used. "C-weighting" denotes an adjustment to the frequency content of a noise event to represent human response to louder noise levels. Compared to A-weighting, C-weighting enhances the lower frequency content of a noise event. For this noise study, A-weighting is used for noise generated by aircraft arrival, departure, closed pattern, and airspace operations while C-weighting is used for supersonic and aircraft munitions noise.

2.1.1 Maximum Sound Level (L_{Amax})

The highest A-weighted integrated sound level measured during a single noise event in which the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level (L_{Amax}). During an aircraft overflight, the noise level starts at the ambient or background sound level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. L_{Amax} indicates the maximum sound level occurring for a fraction of a second during the event. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally 1/8th of a second. The maximum sound level is important in judging the interference caused by a noise event with conversation, TV 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 over which the sound is heard. In this noise study, L_{Amax} is used to quantify the maximum sound level of aircraft overflights at the representative locations described in Section 6 and within the airspace areas within the PRC for the airspace analysis presented in Section 4.2.

2.1.2 Sound Exposure Level (SEL)

SEL is a 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 exposure of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL would include both the maximum sound level and the lower sound 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 last more than one second, the SEL is usually greater than the L_{Amax} because an individual overflight takes seconds and the L_{Amax} occurs in a fraction of a second. SEL also provides the best measure to compare noise levels from different aircraft and/or operations. For aircraft noise, the SEL metric utilizes A-weighting. For airspace noise modeling, the onset-rate adjusted sound exposure level (SELr) is used, which has a penalty ranging from 0 to 11 decibels (dB) (higher penalties for higher aircraft airspeed operations) applied to the SEL to account for the added intrusiveness of high speed aircraft operations in the airspaces. This noise study uses SEL for the single event supplemental metrics presented in Section 6.6. SELr is used for the PRC airspace single event overflight noise results found in Section 4.2.

2.1.3 Peak Pressure Level (L_{Pk})

The peak pressure level (L_{Pk}) is the highest instantaneous, unweighted sound level over any given time period. It is used to quantify impulsive, short duration events such as a weapon firing or a sonic boom. L_{Pk} is used to assess potential of structural damage and the risk of complaints. High peak sound levels can generate complaints from people in the local community. L_{Pk} is used in this noise study to quantify the supersonic aircraft events and the use of aircraft munitions in the PRC.

2.1.4 Number-of-Events above a Threshold Level

The Number-of-Events Above a threshold level (NA_L) describes the number of noise events that exceed a threshold level during a defined time period. The threshold level is generally defined by either L_{Amax} or SEL and the value is denoted by the subscript. For example, NA_{65} denotes the number of events that exceed 65 A-weighted decibels (dBA) for a given time period. The time period can range from a particular hour of the day to any or all 24 hours of a day and depends on the descriptive nature of the NA_L analysis. For example, to determine the number of events occurring during a school day, the time period would include the hours the local school is occupied. It is important to note that the metrics used for the threshold and time period are not explicitly stated in the NA_L metric and must be defined in the text of the analysis. For this analysis, the SEL is used as the basis of the calculations of NA_L.

2.1.5 Equivalent A-weighted Sound Level (L_{Aeq})

A complex noise metric that is useful in describing noise is the Equivalent A-weighted Sound Level (L_{Aeq}). L_{Aeq} relates the time varying noise level to a steady-state noise level that has the same total energy over a specified time period. The L_{Aeq} metric can provide a more accurate quantification of noise exposure for a specific period, particularly for daytime periods when the nighttime adjustment under the DNL metric is inappropriate.

Just as SEL has proven to be a good measure of the noise impact of a single event, L_{Aeq} has been established to be a good measure of the impact of a series of events during a given time period. Also, while L_{Aeq} 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 0700 to 1600 could provide the relative impact of noise events for a typical school day and would be denoted by $L_{eq,8hr}$. In this noise study, $L_{eq,8hr}$ is used to assess the cumulative classroom speech interference during the 8-hour school day. Results are presented in Section 6.5.

2.1.6 Day/Night Average Sound Level, DNL or L_{dn}

Day-Night Average Sound Level (DNL or L_{dn}) is a complex metric that accounts for the SEL of all noise events in a 24-hour period. To account for increased human sensitivity to noise at night (2200 to 0700), a 10 dB adjustment is applied to nighttime events. The adjustment added to the DNL metric accounts 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.

DNL is an average quantity mathematically representing the continuous A-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. DNL accounts for the maximum noise levels, the duration of the events (operations), the number of events and the timing of their occurrence over a 24-hour period. Like SEL, DNL does not represent the sound level heard at any particular time, but it 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. Section 3.2 presents the DNL contour map for the No Action Alternative and Section 4.2 presents the Action Alternatives.

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

For airspace noise, the conventional DNL metric is adjusted to account for the potential "surprise" effect on humans from the sudden onset of aircraft noise events with an adjustment up to 11 dB above the normal SEL (Stusnick et al., 1992 & 1993). 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 DNL is designated as the A-weighted Onset-Rate Adjusted Monthly Day-Night Average Sound Level (L_{dnmr}).

For impulsive noise, a C-weighted DNL (CDNL) is used to represent the long-term noise exposure from these events. This metric is the same as DNL except C-weighting is used. CDNL is used in this analysis for supersonic and aircraft munitions noise.

2.1.7 Noise Analysis

2.1.7.1 Community Annoyance

In 1979, the Federal Interagency Committee on Urban Noise (FICUN) was established, and the committee published *Guidelines for Considering Noise in Land-Use Planning and Control* (FICUN, 1980). These guidelines complement federal agency criteria by providing for the consideration of noise in all land-use planning and interagency/intergovernmental processes. The FICUN established DNL, which is the most appropriate descriptor for all noise sources. In 1982, the Environmental Protection Agency (EPA) published *Guidelines for Noise Impact Analysis* to provide all types of decision-makers with analytic procedures to uniformly express and quantify noise impacts (EPA, 1982). The American National Standards Institute (ANSI) endorsed DNL in 1990 as the "acoustical measure to be used in assessing compatibility between various land uses and outdoor noise environment" (ANSI, 2003). In 1992, the

Federal Interagency Committee on Noise (FICON) reaffirmed the use of DNL as the principal aircraft noise descriptor in the document titled *Federal Agency Review of Selected Airport Noise Analysis Issues* (FICON, 1992). 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 (Schultz, 1974; Fidell, et al., 1991; Finegold, et al., 1994).

2.1.7.1.1 *Supplemental Analysis*

Additional effects can also be assessed to extend the description of the noise environment at some representative location around an airfield. These additional analyses utilized supplemental metrics to model specific effects such as speech interference, sleep disturbance, and classroom impacts. These supplemental analyses are described in the Defense Noise Working Group (DNWG) guidelines (DNWG, 2009a & 2009b). For this analysis, the following supplemental analyses are included: speech interference, sleep disturbance, and classroom speech interference.

2.1.7.1.2 *Speech Interference*

Indoor speech interference from flight operations can be annoying to the public. For this analysis, the recommended conservative indoor noise threshold of 50 dBA is used to indicate flight events, which have the potential to interfere with indoor speech. NA_L is utilized to estimate the number of events that exceed this threshold. Currently, NoiseMap7 only predicts single event levels with SELs. Thus, to calculate the interior noise level, 10 dBA was subtracted from the calculated SEL to estimate the interior L_{Amax} (L_{Amax} is on average approximately 10 dBA less than SEL) and then Noise Level Reductions (NLR) of 15 dB and 25 dB were applied to account for windows being either opened or closed, respectively (FICON, 1992). When windows are open, the noise reduction from the outside of the house to inside is 15 dB (this depends on house construction and is an average). When windows are closed, the noise reduction from the outside of the house to the inside is 25 dB (this depends on the windows type and is an average for newer construction homes). Thus, to calculate the number of events above 50 dBA indoors with windows open, a 65 dBA threshold is applied (50 dBA plus house reduction of 15 dBA). To calculate the number of events above 50 dBA indoors with windows closed, a 75 dBA threshold is applied (50 dBA plus house and windows reduction of 25 dBA). Additionally, for this analysis only the acoustic daytime events (0700 to 2200) are considered.

2.1.7.1.3 *Sleep Disturbance*

The potential for sleep disturbance from flight operations at NAS Patuxent River and OLF Webster exists for the surrounding communities. The probabilities of awakenings are calculated at representative locations for operations occurring between 2200 and 0700. The estimation procedure follows the recommended method outlined in the American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound – Part 6: Methods for Estimation of Awakenings Associated with Outdoor Noise Events Heard in Homes (ANSI, 2008). This method estimates the probability of a single awakening from nighttime operations based on the received outdoor SEL. The estimations included the probability of awakening within a home with windows open and windows closed. For open windows, an NLR of 15 dB is assumed to estimate the interior sound levels. For closed windows, a NLR of 25 dB is used (FICON, 1992).

2.1.7.1.4 *Classroom Interference*

To assess the potential impacts to the school and classroom environment, two metrics were calculated to estimate the noise levels generated during the school day: $L_{eq,8hr}$ and NA_L. The $L_{eq,8hr}$ metric provides the average sound level generated by aircraft operations during a school day, and NA_L estimates the number of potentially interfering flight events. DNWG guidelines for classroom interference (DNWG, 2013) recommend using an outdoor $L_{eq,8hr}$ of 60 dBA as a screening level to indicate schools requiring further assessment. For schools within the 60 dBA $L_{eq,8hr}$, NA_L should be calculated for an interior level of 50 dBA as utilized for indoor speech interference. For the estimation of these metrics, the flight operations are scaled by a factor of 8/15 to account for the difference in the 8-hour school day and the 15-hour acoustic daytime period used for the DNL calculation. For the NA_L calculation, the same procedures are utilized as for speech interference.

2.2 Computerized Noise Exposure Models

2.2.1 NoiseMap and AAM

To analyze aircraft noise exposure around airfield facilities, NoiseMap (Czech & Plotkin, NMAP 7.0 User's Manual, Wyle Research Report, WR 98-13, 1998) and the Advanced Acoustic Model (AAM) (Bradley, Hobbs, Wilmer, & Czech, 2016) are typically used. NoiseMap is a suite of computer programs that was developed by the US Air Force. AAM is a suite of computer programs developed by the National Aeronautics and Space Administration for both single event and cumulative helicopter flight noise analysis. AAM is the DoD-recommended noise model for helicopter flyover noise modeling. Previously, the Rotorcraft Noise Model was used for helicopter modeling, but it has been replaced by AAM. It should be noted that hover and static helicopter operations are currently modeled with NoiseMap.

The latest NoiseMap package of computer programs consists of BaseOps Version 7 (Wasmer & Maunsell, 2006a), OMEGA10, OMEGA11 (Mohlman, 1983), NoiseMap Version 7.3 (Czech, 2014; Downing, 2016), NMPlot Version 4.6 (Wasmer & Maunsell, 2006b), and the latest issue of NOISFILE (Downing, 2016). NOISEFILE is the DoD noise database originating from noise measurements of controlled flyovers at prescribed power, speed, and drag configurations for many models of aircraft. AAM is also incorporated into this suite of programs through the integration of the data input module BASEOPS. With BASEOPS, the user enters the runway coordinates, airfield information, flight tracks, flight profiles along each track by each aircraft, numbers of flight operations, run-up coordinates, run-up profiles, and run-up operations. After the operational parameters are defined, both NoiseMap and AAM calculate DNL values on a grid of ground locations on and around the facility. The NMPlot program draws contours of equal DNL for overlay onto land-use maps. For this noise study, NoiseMap Version 7.3 and AAM version 2 were used to generate DNL contours of 55, 60, 65, 70, 75, 80, and 85 dBA.

NoiseMap and AAM also have the flexibility of calculating sound levels (SEL, $L_{eq,24hr}$, and DNL) at specified points so that noise values at representative locations around an airfield can be described in more detail. Section 6 contains supplemental metrics calculated by NoiseMap and AAM at representative locations.

Together, NoiseMap and AAM compare “before and after” community noise effects. NoiseMap and AAM provide noise level estimations prior to implementation of a proposed action and field verification. The noise modeling results of these computer programs, along with noise analysis metrics and guidelines presented in Section 2.1 provide a relative measure of noise effects around air facilities.

2.2.2 MOA and Route NoiseMap Model (MR_NMap)

Analyses of aircraft noise exposures and compatible land uses around and underneath airspace testing and training ranges are normally accomplished using MR_NMap. The US Air Force developed this general purpose computer model for calculating noise exposures occurring away from airbases, including Military Operating Areas (MOAs) and ranges, as well as along Military Training Routes (MTRs). This model expands the calculation of noise exposures away from airbases by using algorithms from both NoiseMap (Moulton, 1992) and ROUTEMAP (Moulton, 1992; Bradley, 1996). MR_NMap uses two primary noise models to calculate the noise exposure: area and track operations. Area operations capture operations that do not have well defined tracks, but occur within a defined area, such as air-to-air combat within a MOA. Track operations are used for well-defined flight track, such as MTRs, aerial refueling, and strafing tracks. For this analysis, most of the operations within the PRC are area operations, but there are some track operations modeled for the Chesapeake test track.

The program uses the same user interface, BaseOps, as NoiseMap, for the development of the input data. For track operations, input requirements are the same as for ROUTEMAP, but more than just MTRs can be modeled. For area operations, the model allows flexibility. If little is known about the airspace utilization within a MOA, then the MOA boundaries can simply be used and the operations are uniformly distributed within the defined area. However, if more is known about how and where the aircraft fly within the MOA, subareas can be defined within the MOA to more accurately model the noise exposure.

Once the airspace is defined, the user must describe the mission types occurring within each airspace segment. Individual aircraft missions include the altitude distribution, average airspeed, and average engine power settings. These individual profiles are coupled with airspace components and annual operational rates. After the airspace and operational parameters are defined, MR_NMap calculates the resulting L_{dn} or L_{dnmr}. The model calculates these noise metrics either for a user-defined grid or at user-defined points. The grid calculation can be passed to NMPlot to plot the noise contours as provided in this analysis. The specific point calculation generates a table that provides the noise exposure, as well as the top contributors to the noise exposure. This table was used to generate the PRC airspace single event overflight noise results presented in Section 4.2.

2.2.3 PCBoom

PCBoom (Version 6) computes single-event sonic boom footprints and signatures from any supersonic vehicle executing any maneuver in a three-dimensional atmosphere, including winds and terrain effects (Plotkin, 1996 & 2010). This model has been verified with field measurements and accurately accounts for focusing of the sonic boom from aircraft maneuvers (Downing, 1998). The program has a menu interface that simplifies use and the presentation of results. The user specifies the aircraft, the maneuver, and atmospheric conditions. The primary output is the sonic boom footprint, which is defined in terms of contours of equal overpressure (or other amplitude metric) on the ground relative to the aircraft's position. PCBoom also generates sonic boom signatures, pressure-time-histories, and spectra of booms on the ground.

Although PCBoom is a single event sonic boom type model, the individual sonic boom footprints were accumulated into a calculated CDNL grid for the presentation of cumulative sonic boom CDNL contours. The current DoD cumulative sonic boom model, BooMap3, would not accurately model the type of supersonic events occurring at PRC. BooMap3 is for air combat supersonic events. Supersonic events at PRC are straight line segments that are either level or in diving flight. Additionally, BooMap assumes a fairly random heading for the supersonic segment, whereas the events at PRC have a range of set headings. For this analysis, the individual sonic boom footprints were combined to estimate the CDNL from the supersonic operations occurring within the PRC airspace.

2.2.4 Air Gunnery Noise Model

Air Gunnery Noise Model (AGNM) addresses the generation and propagation of noise from air-weaponry operations. The model handles the complexity of the distributed noise events while maintaining the accurate acoustical modeling required for environmental noise analysis. This noise analysis utilizes AGNM Version 2.0 and this version utilizes BaseOps for operational data entry.

One of the complexities related to AGNM is that aircraft rarely fly the exact attack profile prescribed and in some cases, the attack run is simply a generalized fan where the pilot can approach the target from a range of headings. To solve this problem of an unknown source location, a generalized statistical firing volume is used. This volume is defined by the parameters of the attack run with a three-dimensional Gaussian distribution of firing points. The noise footprint is then calculated to represent the noise from a single bullet fired from within the space. This statistical method is not representative of a single bullet fired, and instead, represents the average noise expected once a statistically large number of bullets have been fired. AGNM handles the noise from the muzzle blast, as well as the ballistic wave of the projectile. The results from AGNM include CDNL and L_{Pk} noise contours. The AGNM is utilized in this noise study to analyze aircraft munitions at the Hannibal and Hooper targets.

2.2.5 Airfield Analysis at NAS Patuxent River and OLF Webster for the No Action Alternative

The types of testing and training operations conducted at NAS Patuxent River and OLF Webster are numerous and variable. Assessment of aircraft noise requires a range of data to describe the types, frequency, and locations of noise-generating operations occurring within and between the two airfields. The primary sources of data are the FIST data; Air Traffic Activity Reports; interviews with aircrews, air traffic controllers, aircraft maintenance staff, planners, and schedulers; and annual reports pulled from the Query Tool. The data from these sources were compiled and integrated into a data validation package. This package includes the frequency of flight operations, time periods of operations, airfield layout, runway utilization, traffic flow utilization, flight tracks, flight profiles, and maintenance locations and operations. The majority of the operational data within this package was collected during a site visit from May 14-18, 2018. The operational data description was finalized and validated by all squadrons on 09 November 2018. This validated operational data was then used in the noise model. The following sections describe the modeled aircraft operations.

2.3 NAS Patuxent River and OLF Webster No Action Alternative Aircraft Operations

During the site visit to NAS Patuxent River and OLF Webster, several sources of data were provided by the NAVAIR Ranges Sustainability Office and were the starting point for the data collection. Table 2-1 displays the data collected, the sources of the data, and the date or date range of the data collected.

Table 2-1. Data Collection Sources and Dates

Data Type	Date
NAS Patuxent River AICUZ Study and Noise Study	2009
OLF Webster AICUZ data and EIS	2006 AICUZ and 1998 EIS
FIST Data ○ These data were used to derive average annual operations (arrival, departure, and closed pattern) and 2200-0700 operations at NAS Patuxent River and OLF Webster. ○ Sorties and landings were provided for all platforms and across all squadrons. The number of closed patterns per sortie was derived by taking landings and dividing by sorties. ○ For VXS-1, VX-1, and VQ-4 squadrons, FIST data was incomplete or not available, so used pilot estimates/flight logs for VXS-1 and VX-1, and used SHARP data (10-year average) for VQ-4 operations.	CY 2008–CY 2017
Supersonic Runs Data from the Query Tool from BayWatch and ATC	FY 2008–FY 2017 (10 years)
Ammunition Store Release Data from the Query Tool	FY 2008–FY 2017 (10 years)
OAETC Facility Noise Survey Data (from David Boyer – NAWCAD Propulsion Support Equipment Evaluation and Verification Branch)	FY 2013–FY 2017 (5 years)
Number of launches of each aircraft type for the TC-7 catapult (Jonathan Stevenson)	CY 2013–CY 2017 (5 years)
Total Annual Operations Runway Utilization (NAS Patuxent River Air Traffic Activity Reports)	CY 2013–CY 2017 (5 years)
F-35B and F-35C Flight Simulator Data (VX-23)	F-35B Flight Simulator Run was made May 2018; F-35C Flight Simulator Run was made June 2018.
PPR logs used to derive transient aircraft operations involving the airfield and 10-year ATC actuals data for transient airspace only operations	6 months PPR logs (January through June 2018) and ATC actuals data FY 2008–FY 2017 (10 years)

Key: AICUZ = Air Installations Compatible Use Zones; NAS = Naval Air Station; OLF = Outlying Landing Field; EIS = Environmental Impact Statement; FIST = Flight Information Scheduling and Tracking; FY = fiscal year; SHARP = Sierra Hotel Airport Reporting Program; ATC = Air Traffic Control; OAETC = Open-Air Engine Test Cell; NAWCAD = Naval Air Warfare Center Aircraft Division; PPR = Prior Permission Required.

2.3.1 No Action Alternative Squadron Specific Data Modeling

The following sections pertain to the data collection of each squadron during the site visit and the data validation process. This section also details the aircraft substitutions that were used in the modeling. Additionally, some aircraft are no longer part of a squadron, but they were included in the No Action

Alternative because of their impact in the 10-year average. These aircraft were not modeled in the Action Alternatives.

2.3.1.1 Test Pilot School Data Collection

For the Test Pilot School (TPS), since many different aircraft are part of the 10-year average operations data, the most utilized aircraft associated with TPS were modeled and acted as surrogates for all the other aircraft. Thus, all aircraft at the TPS were grouped into the following categories along with the aircraft(s) modeled for that category: Fighter (T-38 and F/A-18E/F), Helicopter (H-60 and H-72), Single Engine Propeller Aircraft (T-6), Twin Engine Turboprop (C-12), and Small Jet (C-21). If a less utilized aircraft fell into a category with multiple modeled aircraft (such as the T-38 and F/A-18E/F), then the modeled surrogate aircraft was the aircraft that is most similar in engine type and design as the substituted aircraft.

Closed pattern operations were determined from the FIST landing data, and the percent usage between NAS Patuxent River and OLF Webster was determined from the squadron interview. For the C-12, 28 percent are performed at NAS Patuxent River and 72 percent are performed at OLF Webster. For the T-6, 57 percent are performed at NAS Patuxent River and 43 percent are performed at OLF Webster. For the H-60 and H-72 helicopters, 90 percent are performed at NAS Patuxent River and 10 percent are performed at OLF Webster.

2.3.1.2 VX-23 Data Collection

The primary aircraft of VX-23 are the F/A-18C/D, F/A-18E/F, EA-18G, F-35B/C, and T-45. The FIST data lists only F/A-18 and F-35 without the variant listed, but the squadron provided the following breakdown for the No Action Alternative: 50 percent of F/A-18 operations are C/D model (Hornet), 40 percent are E/F model (Super Hornet), and 10 percent are EA-18G model (Growler). Since the E/A-18G Growler does not have noise source data, the E/F Super Hornet is the surrogate, so 50 percent of F/A-18 operations for the No Action are the E/F Super Hornet model. For the F-35, 60 percent are the B model and 40 percent are the C model for No Action Alternative. For the development of flight profile parameters, the squadron provided examples of simulator data for the F-35B/C. These examples were used to derive standard profiles for the F-35B/C, and the squadron reviewed and approved these flight profiles for use in the noise modeling.

MQ-25 is expected to begin service at NAS Patuxent River starting in FY 2022. Thus, MQ-25 is not modeled in the No Action Alternative, but it is included in the Action Alternatives. MQ-25 is expected to fly 20 weeks per year and 100 flying days per year. This expected operational tempo will generate 120 annual sorties for Alternative 1 and 133 sorties for Alternative 2. These MQ-25 sorties will include local patterns. For catapult sorties, three patterns on average are estimated. For carrier suitability testing sorties, five patterns are estimated. The MQ-25 surrogate is the C-21, as the C-21 engine closest resembles the MQ-25 engine in the noise model.

2.3.1.3 Search and Rescue and Maryland Army National Guard (MDARNG) Data Collection

For Search and Rescue (SAR), the No Action Alternative models both the MH-60 and the C-12. The C-12 is no longer part of SAR, but it was included in the No Action due to the large number of operations in the 10-year average of FIST data for SAR. For the Action Alternatives, the C-12 is removed from SAR operations and only the MH-60 is modeled. The MH-60 departs from and arrives at the Naval Air Warfare Center helipad. The MDARNG operates the RQ-7 at OLF Webster. The RQ-7 has no current source noise data. The General Aviation Single Engine Fixed Propeller (GASEPF) aircraft within NoiseFile was used as a surrogate because it is the smallest single engine aircraft in the noise model to represent the RQ-7.

2.3.1.4 VX-20 Data Collection

The primary aircraft in VX-20 are the MQ-4, C-38, P-8, E-2, C-12, C-130, and E-6B. The C-21 (Learjet 35) is the surrogate for the C-38, the T-2, and the MQ-4. The T-2s were replaced by the C-38 Courier. Since the C-21 is the closest aircraft in NoiseFile to the C-38, the C-21 is also used as the surrogate for the T-2. The MQ-4 engine is most similar to the C-21 engine of all the options of aircraft in the noise model. Additionally, since the MQ-4 is a new platform (hasn't been flying at Patuxent River for the past 10 years), 2017 data from FIST was used for the operations of the MQ-4 instead of the 10-year average. The E-2 is the surrogate for the C-2 since the C-2 is a derivative of the E-2 (same platform and engines). The P-3 is no longer in VX-20 (was removed from VX-20 in 2016), so the P-3 is modeled in the No Action (10-year average), but it is not modeled in the Action Alternatives. The T-6 is the surrogate aircraft for the T-34, but it is removed from the Action Alternatives since the T-34 is no longer part of VX-20. Boeing 737-700 is surrogate for P-8 (closest platform in NoiseFile to the P-8); however, for run-up operation modeling, C-22 is used as a surrogate for P-8 since 737-700 does not have any static run-up data in NoiseFile.

2.3.1.5 HX-21 Data Collection

The primary aircraft in HX-21 are H-1, V-22, H-60, CH-53, and Presidential VH-92 and H-3. All helicopter operations were modeled in AAM. H-1 and H-60 utilize the NAWC Pad; V-22 utilizes the 109 Pad 95 percent of time and the runways 5 percent of time; CH-53 utilizes the main runways and Runway 02/20; and Presidential VH-92 and H-3 utilize the Presidential helipad. No noise source data for the Presidential VH-92 and H-3 is included in NoiseFile, so the CH-53E was used as the surrogate helicopter. For the CH-53K no noise source data exists, so the CH-53E is the only variant of the CH-53 modeled.

2.3.1.6 VX-1 Data Collection

The primary aircraft in VX-1 are the E-2, P-8, and H-60R/S. The FIST data for VX-1 was incomplete, so pilot estimates of sorties and closed pattern operations were used. E-2 performs 3 sorties per week and operates 50 weeks per year with 1 closed pattern per sortie. P-8 performs 4 sorties per week and operates 50 weeks per year with 1 closed pattern per sortie. H-60 performs 150 flights over 5 months, or 350 flights per year with 0.6 closed patterns per sortie.

2.3.1.7 VQ-4 Data Collection

The E-6B (based on the Boeing 707) is the only aircraft used by VQ-4 squadron. Since VQ-4 uses the SHARP system instead of FIST, a 10-year average of SHARP data was used for number of sorties. For the closed pattern rate, the pilots estimated the number of closed patterns per sortie since this type of data is not included in the SHARP data system.

2.3.1.8 VXS-1 Data Collection

The primary aircraft in VXS-1 are the P-3 and the C-12. FIST data were not used due to incomplete data, so 10 years of logs were used since they contain both flight hours as well as number of flights for VXS-1.

The pilots estimated the operational split between P-3 and C-12 at 70 percent to 30 percent. The pilot estimates for the number of closed patterns per sortie were also used: two patterns per sortie for P-3 and three patterns per sortie for C-12. The pilot estimates of 10% of arrivals occur between 2200-0700 was used since the flight time was not included in the VXS-1 logs.

2.3.1.9 UX-24 Data Collection

The UX-24 squadron has group 3 and group 4 UASs including RQ-21, RQ-26A, and MQ-8. Group 1 and 2 UASs were not modeled, because they are so small there is nothing in the noise model to accurately model the low level of noise from these small UASs. UH-1 is the surrogate helicopter for the MQ-8, and GASEPF aircraft is the surrogate for the RQ-21 and RQ-26 since it is smallest (in size and engine power) aircraft available in the noise model. MQ-8 uses spot 1 75 percent of time and spot 2 25 percent of time. Spot 1 and spot 2 are the MQ-8 takeoff and landing pads. RQ-21/26 flies Route A 75 percent of time, Route B 12.5 percent of time, and Route C 12.5 percent of time (UAV training routes publication LUO-314.22).

2.3.1.10 Transient Aircraft Data Collection

Transient aircraft operations come from 2 sources: 10-year average of FIST data and 6 months of Prior Permission Required (PPR) logs multiplied by 2 to represent a full year. The total transient operations represent the addition of these two sources. Transient aircraft operations include an annual average of 89 fighter jet sorties, 120 helicopter/tilt-rotor sorties, and 128 cargo/surveillance/multi-mission aircraft sorties.

2.3.2 No Action NAS Patuxent River and OLF Webster Annual Flight Operations

No Action Alternative aircraft activity at NAS Patuxent River and OLF Webster was modeled based on a 10-year average of FIST data with some supplemental transient aircraft data to fill the identified gaps (6 months of PPR logs). This dataset included annual sorties, landings, and acoustic nighttime (2200-0700 hours) sorties and landings for each aircraft type within each squadron. The number of closed patterns per sortie was derived by taking the number of landings and dividing by sorties. One Closed Pattern Circuit (one time around the pattern) is counted as two operations: one arrival and one departure. A sortie typically consists of multiple airfield operations: a departure along with local closed pattern work before a final arrival to a full stop. For this reason, airfield operations are shown in these tables instead of sorties. Using these data, the annual acoustic day (0700-2200) and acoustic night (2200-0700) arrivals, departures, and closed pattern operations were derived for most squadrons. Table 2-2 presents the No Action Alternative (10-year average) Annual Flight Hours and Total Annual Operations (rounded to the nearest 10 operations) at NAS Patuxent River and OLF Webster for each squadron. A further breakout of arrival, departure, and closed pattern operations (unrounded) for each aircraft within each squadron for the No Action Alternative is displayed in Table 2-3. The aircraft and squadrons that utilize OLF Webster are the Test Pilot School C-12, T-6, H-60, and H-72; HX-21 Squadron's H-60, H-1, and CH-53E; and all aircraft in UX-24 and the RQ-7 of MDARNG. Appendix A provides detailed tables on the distribution of sorties and closed patterns per sortie for each aircraft within each squadron.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 2-2. No Action Alternative 10-year Average Annual Flight Hours and Operations at NAS Patuxent River and OLF Webster

Organization	Squadron	No Action Hours	No Action Operations
Naval Test Wing Atlantic (NTWL) Tenant	TPS	6,197	34,480
	VX-20	4,134	8,380
	VX-23	3,537	12,010
	HX-21	2,028	12,300
	UX-24	357	990
	AIR OPS (SAR)	1,245	5,280
	Total	*17,498*	*73,440*
NAS Patuxent River Tenant	VQ-4	422	1,080
	VXS-1	283	980
	VX-1	157	2,720
	MDARNG	151	270
	Total	*1,013*	*5,050*
Non-NAS Patuxent River	Transient (FIST)	242	480
	Transient (Non-FIST)	1,347	1,590
	Total	*1,589*	*2,070*
TOTAL		***20,100***	***80,560***

Key: FIST = Flight Information Scheduling and Tracking; MDARNG = Maryland Army National Guard; NTWL = Naval Test Wing Atlantic; NAS = Naval Air Station; OLF = Outlying Landing Field; OPS=operations; SAR=Search and Rescue; TPS=Test Pilot School.

.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 2-3. Modeled Annual No Action Alternative Operations by Aircraft and Squadron

Group	Squadron	Annual Departures	Annual Arrivals	Annual Closed Pattern Operations	Total Annual Operations
MV-22	HX-21	218	218	523	959
H-60	HX-21	597	597	2,746	3,940
H-1 (includes TH-57 ops - modeled as UH-1N)	HX-21	404	404	5,494	6,302
CH-53E/K (includes CH-46 ops)	HX-21	97	97	504	698
Presidential VH-92 (modeled as CH-53)	HX-21	23	23	138	184
Presidential H-3 (modeled as CH-53E)	HX-21	27	27	162	216
C-12/C-26	TPS	365	365	2,117	2,847
C-21 (LEAR jet)	TPS	218	218	392	828
F/A-18E/F	TPS	263	263	526	1,052
UH-72 (and H-58)	TPS	787	787	9,444	11,018
UH-60	TPS	662	662	4,634	5,958
T-6	TPS	883	883	5,651	7,417
T-38	TPS	1,219	1,219	2,926	5,364
MQ-4 (Modeled as C-21)	VX-20	60	60	0	120
C-21 (surrogate for C-38 and T-2)	VX-20	233	233	885	1,351
P-8	VX-20	148	148	296	592
E-2	VX-20	368	368	903	1,639
P-3	VX-20	182	182	619	983
C-12	VX-20	82	82	312	476
T-6	VX-20	220	220	1,496	1,936
707 (E-6B) Turbofans CFM-56	VX-20	44	44	106	194
C-130	VX-20	339	339	407	1,085
F/A-18C/D	VX-23	976	976	2,574	4,526
F/A-18E/F	VX-23	976	976	2,574	4,526
F-35B	VX-23	374	374	408	1,156
F-35C	VX-23	250	250	272	772
T-45	VX-23	172	172	690	1,034
H-60	SAR	472	472	1,699	2,643
C-12	SAR	471	471	1,696	2,638
E-2	VX-1	150	150	300	600
P-8	VX-1	250	250	500	1,000
H-60R/S	VX-1	350	350	420	1,120
NP-3 Orion	VXS-1	104	104	416	624
C-12	VXS-1	45	45	270	360
707 (E-6B) Turbofans CFM-56	VQ-4	448	448	179	1,075
UH-1 (surrogate for MQ-8)	UX-24	188	188	113	489
GASEPF (surrogate for RQ-21 and RQ-26A)	UX-24	105	105	294	504
GASEPF (surrogate for RQ-7)	MDARNG	56	56	157	269
C-12	Total Transients	46	46	120	212
C-130	Total Transients	52	52	62	166
C-21	Total Transients	26	26	31	83
F-18E/F	Total Transients	37	37	59	133
F-35C	Total Transients	25	25	25	75
GASEPF	Total Transients	62	62	161	285
H-60	Total Transients	96	96	422	614
MV-22	Total Transients	24	24	106	154
P-3	Total Transients	38	38	46	122
P-8	Total Transients	38	38	46	122
T-38	Total Transients	27	27	43	97
Total		**13,297**	**13,297**	**53,964**	**80,558**

Key: GASEPF = General Aviation Single Engine Fixed Propeller; MDARNG = Maryland Army National Guard; SAR=Search and Rescue; TPS=Test Pilot School.

18

2.3.3 NAS Patuxent River and OLF Webster Runway Utilization

Aircraft noise modeling is based on the distribution of operations among runways and flight tracks. The modeled distributions for NAS Patuxent River are based on detailed runway operations data that were obtained for calendar year (CY) 2013 through 2017. CY 2016 Runway data were excluded in the average since not all runways were active during 2016. The four-year average of the runway operations data is displayed in Table 2-4 and was used for all aircraft and across all squadrons except for MQ-4 at NAS Patuxent River. The MQ-4 used Runway 14/32 exclusively. For Runway 02/20 closed patterns, Runway 02 is utilized for 35 percent of pattern operations and Runway 20 is utilized for 65 percent of pattern operations. Runway 02/20 utilization is separate from the main runways since the squadrons that utilize runway 02/20 provided information on how often that runway is utilized. Therefore, the modeling only required how often the Runway 02 direction is utilized vs the Runway 20 direction. Although OLF Webster runway utilization is now tracked, at the time of data collection, insufficient data existed for an accurate modeling of runway utilization. Therefore, the NAS Patuxent River main runways utilization is used for OLF Webster, as shown in Table 2-5.

Table 2-4. Runway Utilization for NAS Patuxent River

Runway	% Utilization
06	27%
14	14%
24	26%
32	33%
02	35%
20	65%

Key: NAS = Naval Air Station

Table 2-5. Runway Utilization for OLF Webster

Runway	% Utilization
08	27%
15	14%
26	26%
33	33%

Key: OLF = Outlying Landing Field

2.3.4 Flight Operation Type Distributions

The next step in the noise modeling process is to develop the average frequency of each flight operation conducted throughout the year. Table 2-6 and Table 2-7 show the VX-23 and TPS squadrons, respectively, percent distributions of the total annual operations by aircraft and operation type at NAS Patuxent River.

Table 2-6. VX-23 Operational Distributions by Aircraft and Operation Type

Operation	Type	F/A-18C/D and E/F	F-35B	F-35C	T-45
Arrivals	Straight-in Arrival (VFR)	5%	5%	5%	5%
	Overhead Break Arrival	57%	34%	56%	38%
	PFO Arrival		1%	1%	38%
	Straight-in to Slow Landing		20%		
	Straight-in to Vertical Landing		15%		
	Instrument Approach	38%	25%	38%	20%
		good	*good*	*good*	*good*
Departures	Military		1%	1%	100%
	Afterburner Takeoff to Mil Climb	100%	74%	99%	
	Short Takeoff to Mil Climb		25%		
		good	*good*	*good*	*good*
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	60%	41%	50%	40%
	FCLP Pattern (600 ft AGL left hand pattern)	5%	15%	15%	
	PFO Pattern		1%	1%	40%
	IFR Pattern or GCA Box	35%	27%	34%	20%
	Touch and Go to Slow Landing		1%		
	Touch and Go to Vertical Landing		15%		
		good	*good*	*good*	*good*

Key: AGL = above ground level: FCLP = Field Carrier Landing Practice; IFR = instrument flight rules; GCA = Ground Controlled Approach; Mil=military; PFO = Precautionary Flame Out; VFR = visual flight rules.

Table 2-7. Test Pilot School Operational Distributions by Aircraft and Operation Type

Operation	Type	T-38/F-18	T-6	C-12/C-21	H-60/H-72
Arrivals	Straight-in Arrival	5%	5%	90%	100%
	Overhead Break Arrival	90%	90%	5%	
	Carrier Break Arrival				
	SFO Arrival				
	Straight-in to Slow Landing				
	Tactical - Overhead Break				
	IFR Straight-in	5%	5%	5%	
		good	*good*	*good*	*good*
Departures	Military		100%	100%	100%
	Afterburner Takeoff to Mil Climb	100%			
	Short Takeoff to Mil Climb				
		good	*good*	*good*	*good*
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	90%	90%	90%	90%
	SFO Pattern				
	IFR Pattern or GCA Box	10%	10%	10%	10%
	Touch and Go to Slow Landing				
		good	*good*	*good*	*good*

Key: GCA = Ground Controlled Approach; IFR = instrument flight rules; SFO = Simulated Flame Out; VFR = visual flight rules.

These two squadrons are displayed in this section because they are the top contributing squadrons to the overall noise footprint in the area surrounding NAS Patuxent River. The "good" cells shown in the table (as well as the tables in Appendix A) show that the percentages add up to 100. This quality control feature of the data validation package allows the user to input data that adds to the correct total. The operation type distributions displayed in these tables were collected through interviews with the squadron personnel during the site visit. The operation type distributions of all other squadrons are displayed in the data validation package in Appendix A.

2.3.5 Acoustical Day/Night

The percent utilizations of acoustical day (0700-2200) and acoustical night (2200-0700) aircraft activity for each airframe and operation type at NAS Patuxent River and OLF Webster were derived from the FIST data for the squadrons that utilize the FIST data system. For the squadrons that do not utilize FIST (VX-1, VXS-1, and VQ-4), pilot estimates were used for the percent utilization of operations occurring during acoustical day and acoustical night. The percent of acoustical night operations varies greatly from one aircraft type to the next and for the various squadrons at NAS Patuxent River since the mission types are unique across each squadron and platform. The acoustical day and acoustical night percent utilization of each aircraft across every squadron at NAS Patuxent River and OLF Webster is listed in Table 2-8. Note that since the MDARNG RQ-7, UX-24, RQ-21, and RQ-26 were modeled as GASEPF, those aircraft operations were combined in the UX-24 squadron and are listed under GASEPF.

2.3.6 Flight Tracks

The modeled flight tracks include instrument flight rules (IFR) and visual flight rules (VFR) arrivals, departures, and closed patterns. The flight tracks were developed based on the squadron interviews during the site visit, then later confirmed via the data validation process. The modeled fixed wing and helicopter tracks at NAS Patuxent River are displayed in Figure 2-1 through Figure 2-6. In Figure 2-6, only Runway 24 VFR Pattern flight tracks are shown for clarity. The closed pattern tracks on all other runways are identical, just orientated with the directions of the other runways. The modeled tracks at OLF Webster are displayed in Figure 2-7 through Figure 2-10. The interfacility tracks shown on the maps are tracks flown between NAS Patuxent River and OLF Webster. Appendix B provides the maps of the tracks that are flown for each individual aircraft across all squadrons at NAS Patuxent River and OLF Webster along with the traffic flow utilization of each track.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 2-8. Acoustical Day/Night Operations Distributions by Squadron, Aircraft, and Operation Type for NAS Patuxent River and OLF Webster

	VX-23				TPS				HX-21						SAR	
	MQ-25		**All Other A/C**		**C-12/C-26**		**All Others**		**H-60**		**UH-1**		**All Other A/C**		**H-60 and C-12**	
Operation	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**
Straight-in Arrival	95.0%	5.0%	98%	2%	96%	4%	100%	0%	92%	8%	94%	6%	97%	3%	95%	5%
Overhead Break Arrival			100%	0%	100%	0%	100%	0%							100%	0%
Departures	95.0%	5.0%	99.5%	0.5%	99.5%	0.5%	100%	0%	99%	1%	99%	1%	99%	1%	99.5%	0.5%
Closed Patterns	95.0%	5.0%	100%	0%	100%	0%	100%	0%	99%	1%	99%	1%	100%	0%	100%	0%

	VX-20															
	MQ-4		**C-38(C-21)**		**P-8**		**E-2**		**P-3**		**C-12**		**T-6**		**C-130**	
Operation	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**
Straight-in Arrival	84%	16%	95%	5%	96%	4%	95%	5%	90%	10%	93%	7%	99%	1%	97%	3%
Overhead Break Arrival			100%	0%			99%	1%					99%	1%		
Departures	99%	1%	100%	0%	99%	1%	98%	2%	96%	4%	99%	1%	100%	0%	99%	1%
VFR Touch and Go Pattern					100%	0%	98%	2%	100%	0%			100%	0%	100%	0%
IFR GCA Box Pattern			95%	5%	100%	0%	96%	4%	100%	0%	93%	7%	100%	0%	100%	0%

	VX-1				VXS-1				VQ-4		UX-24				Transients	
	E-2 and P-8		**Helos**		**P-3**		**C-12**		**E-6B**		**UH-1**		**GASEPF**		**All A/C**	
Operation	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**	**Acoustic Day 0700 to 2200**	**Acoustic Night 2200 to 0700**
Straight-in Arrival	95%	5%	100%	0%	90%	10%	90%	10%	83.0%	17.0%	99.5%	0.5%	99%	1%	95%	5%
Overhead Break Arrival																
Departures	100%	0%	100%	0%	90%	10%	90%	10%	93.0%	7.0%	99.5%	0.5%	99.5%	0.5%	97%	3%
Closed Patterns	100%	0%	100%	0%	100%	0%	100%	0%	93.0%	7.0%	100%	0%	100%	0%	100%	0%

Key: A/C = aircraft; GASEPF = General Aviation Single Engine Fixed Propeller; GCA = Ground Controlled Approach; Helos = helicopters; IFR = instrument flight rules; NAS = Naval Air Station; OLF = Outlying Landing Field; SAR = Search and Rescue; TPS = Test Pilot School; VFR = visual flight rules.

22

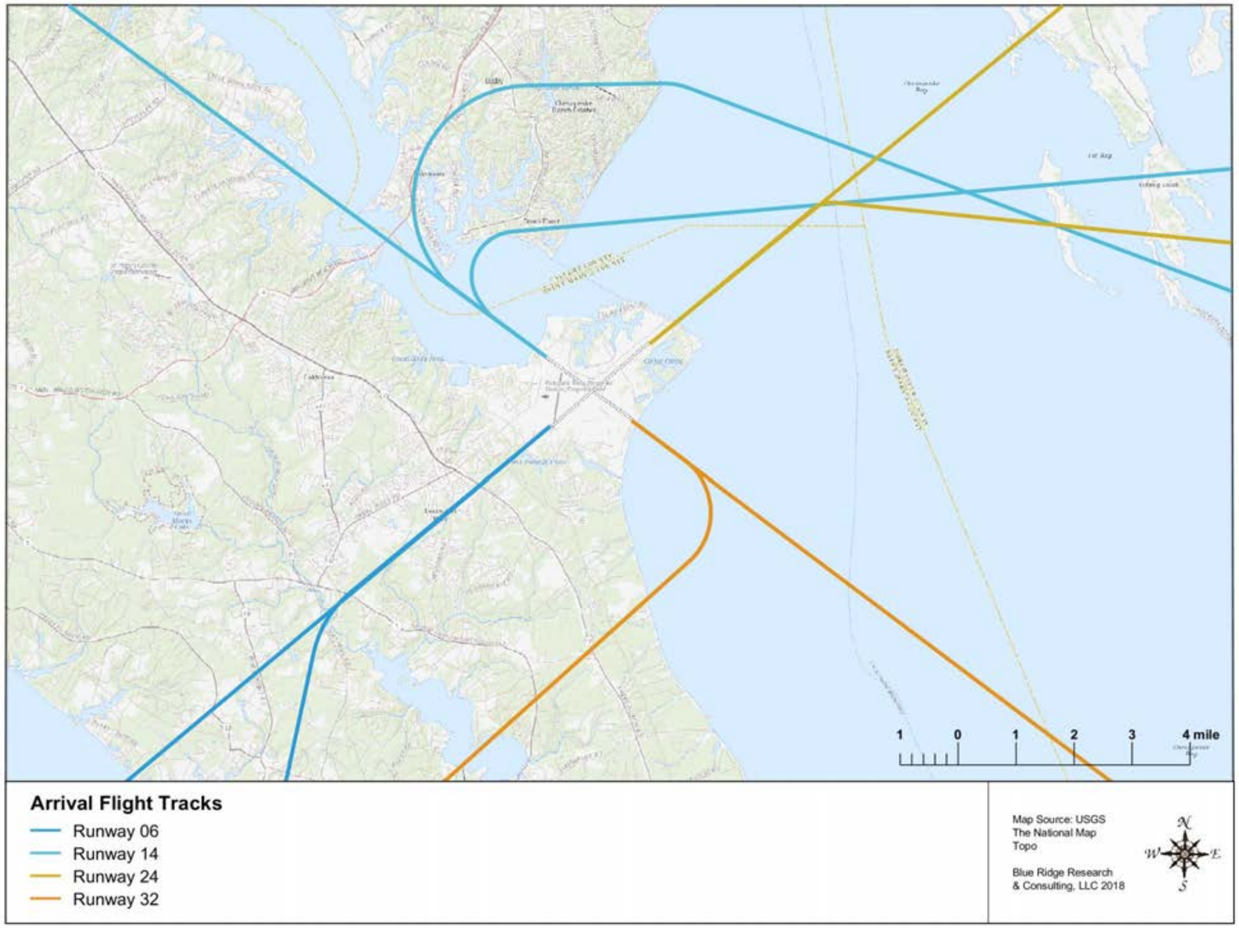

Figure 2-1. NAS Patuxent River Fixed Wing Arrival Flight Tracks

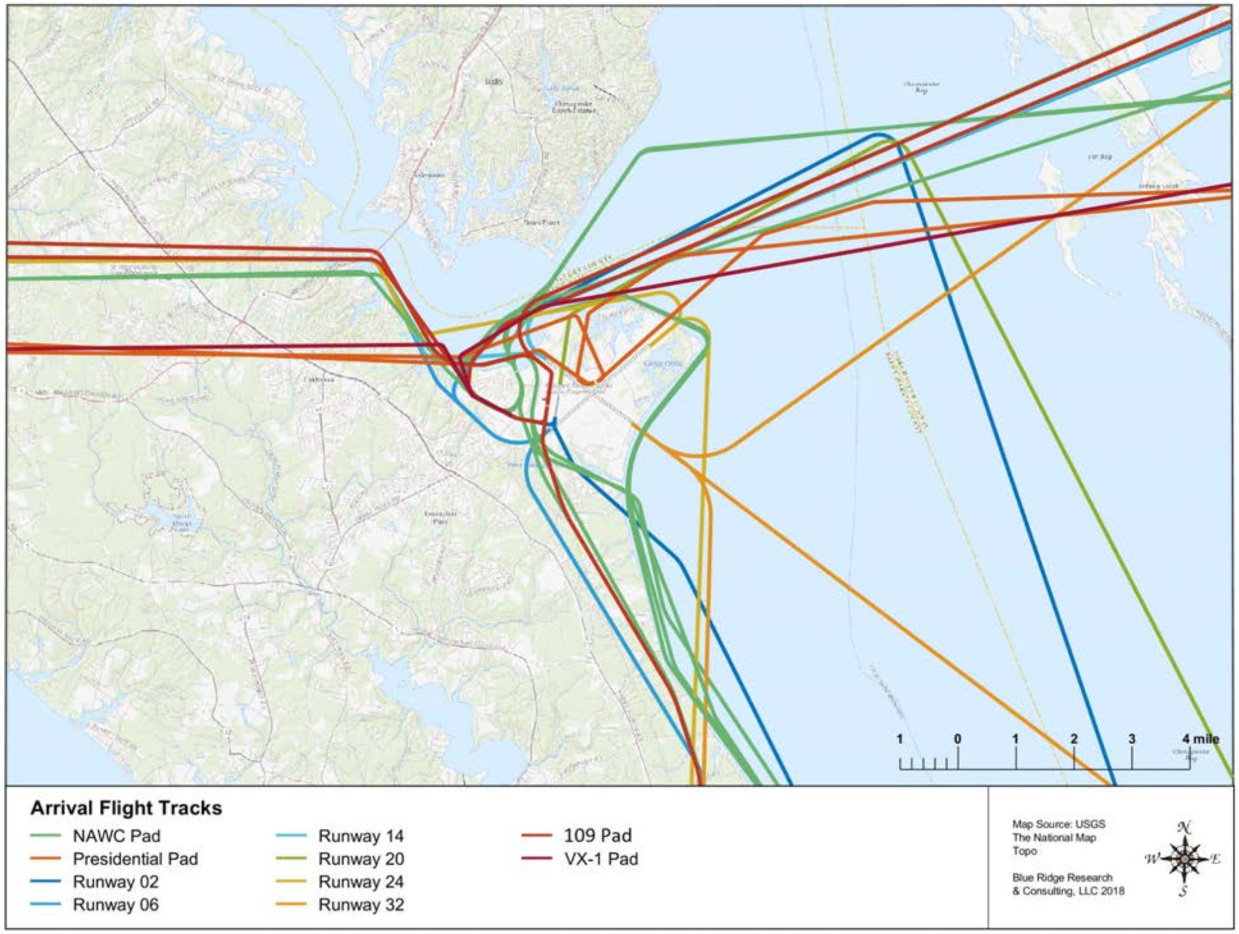

Figure 2-2. NAS Patuxent River Helicopter Arrival Flight Tracks

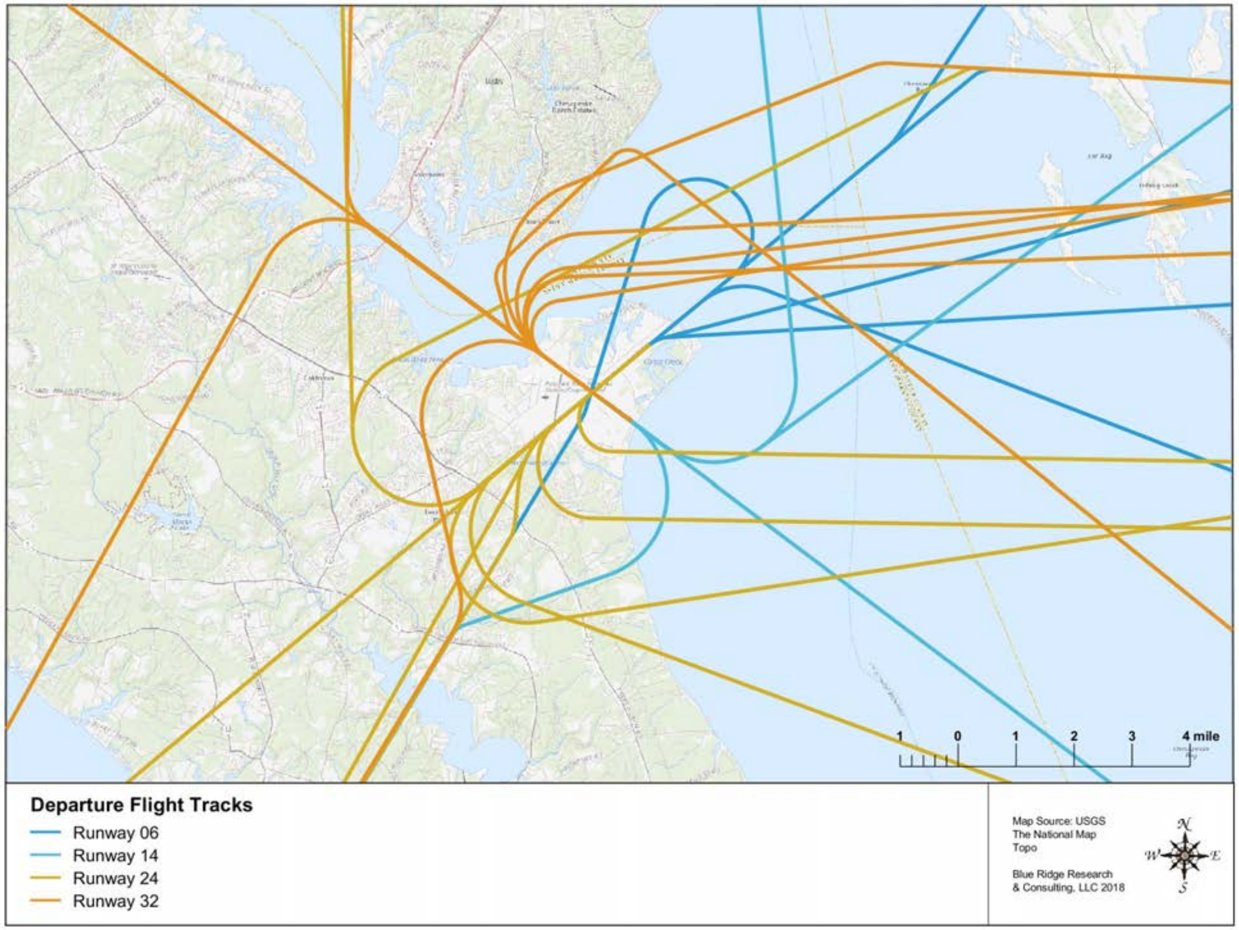

Figure 2-3. NAS Patuxent River Fixed Wing Departure Flight Tracks

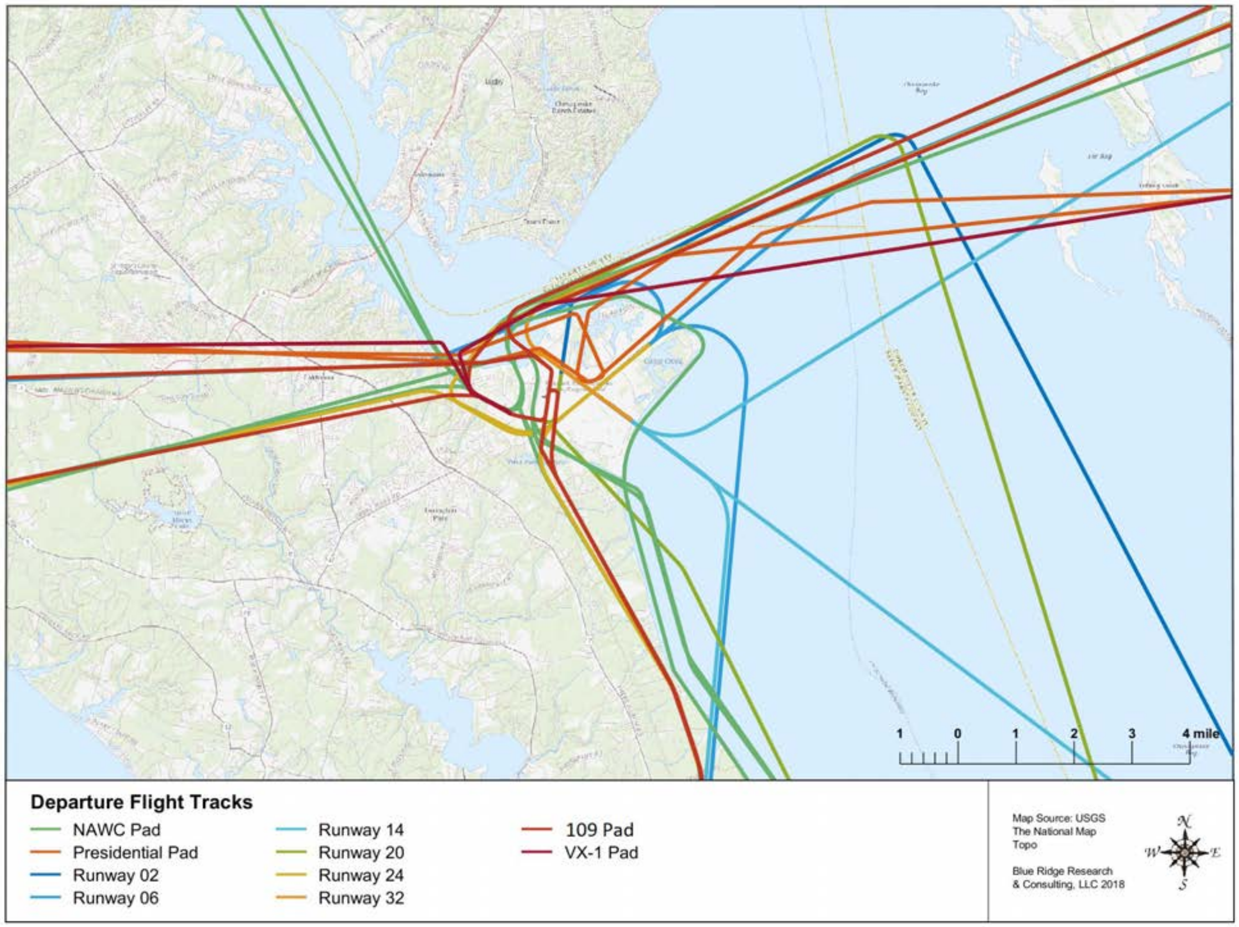

Figure 2-4. NAS Patuxent River Helicopter Departure Flight Tracks

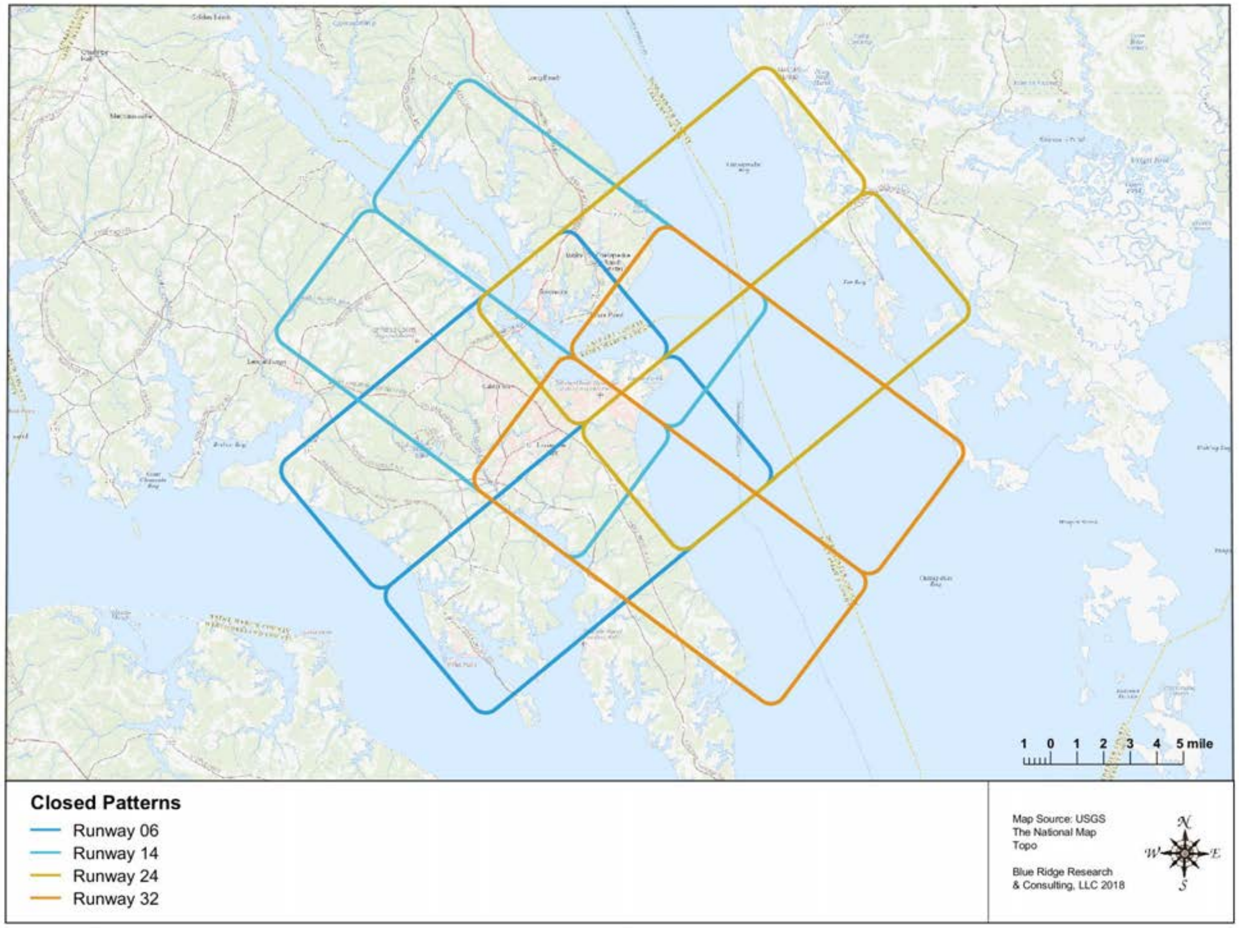

Figure 2-5. NAS Patuxent River Fixed Wing IFR Closed Pattern Flight Tracks

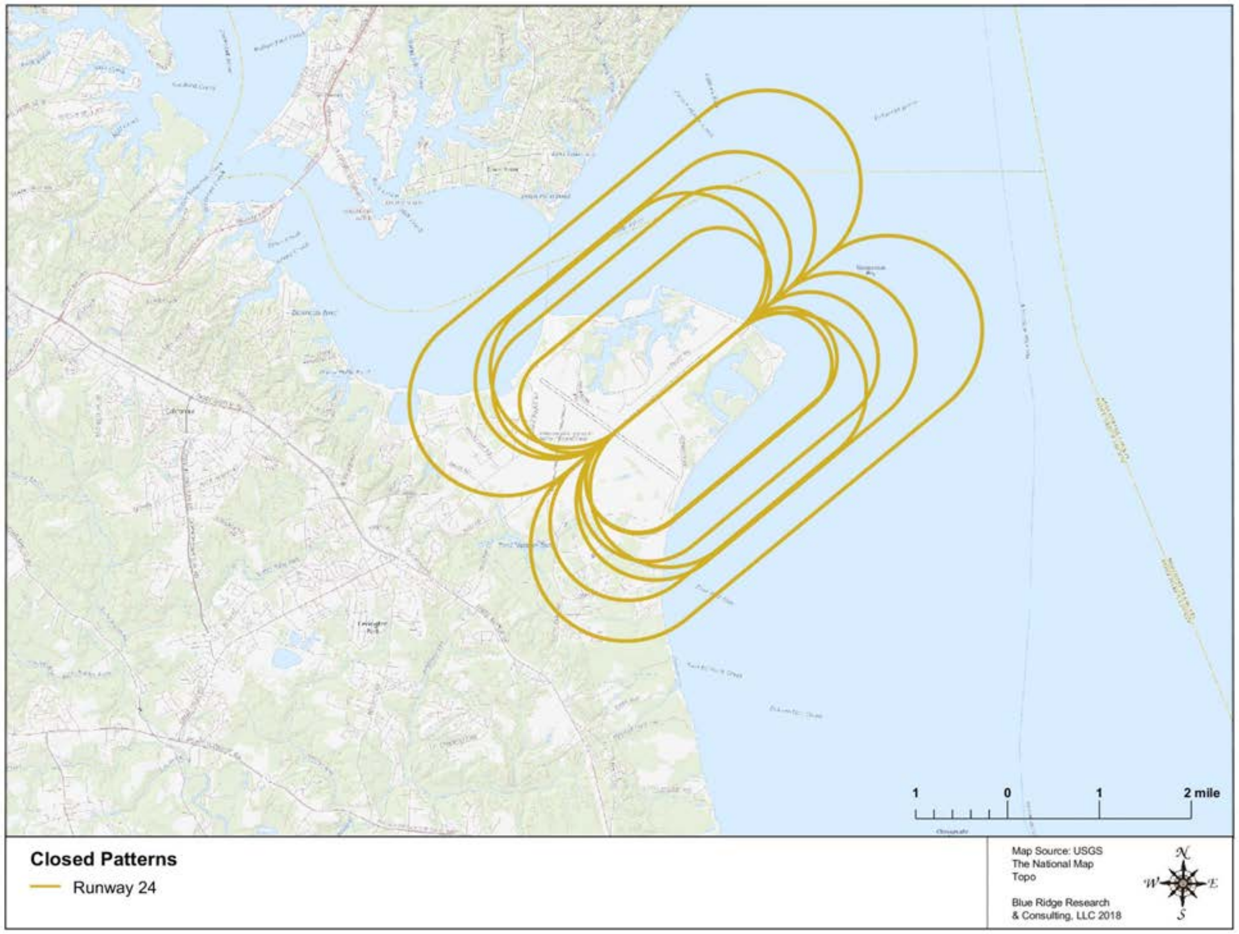

Figure 2-6. NAS Patuxent River Fixed Wing VFR Closed Pattern Flight Tracks

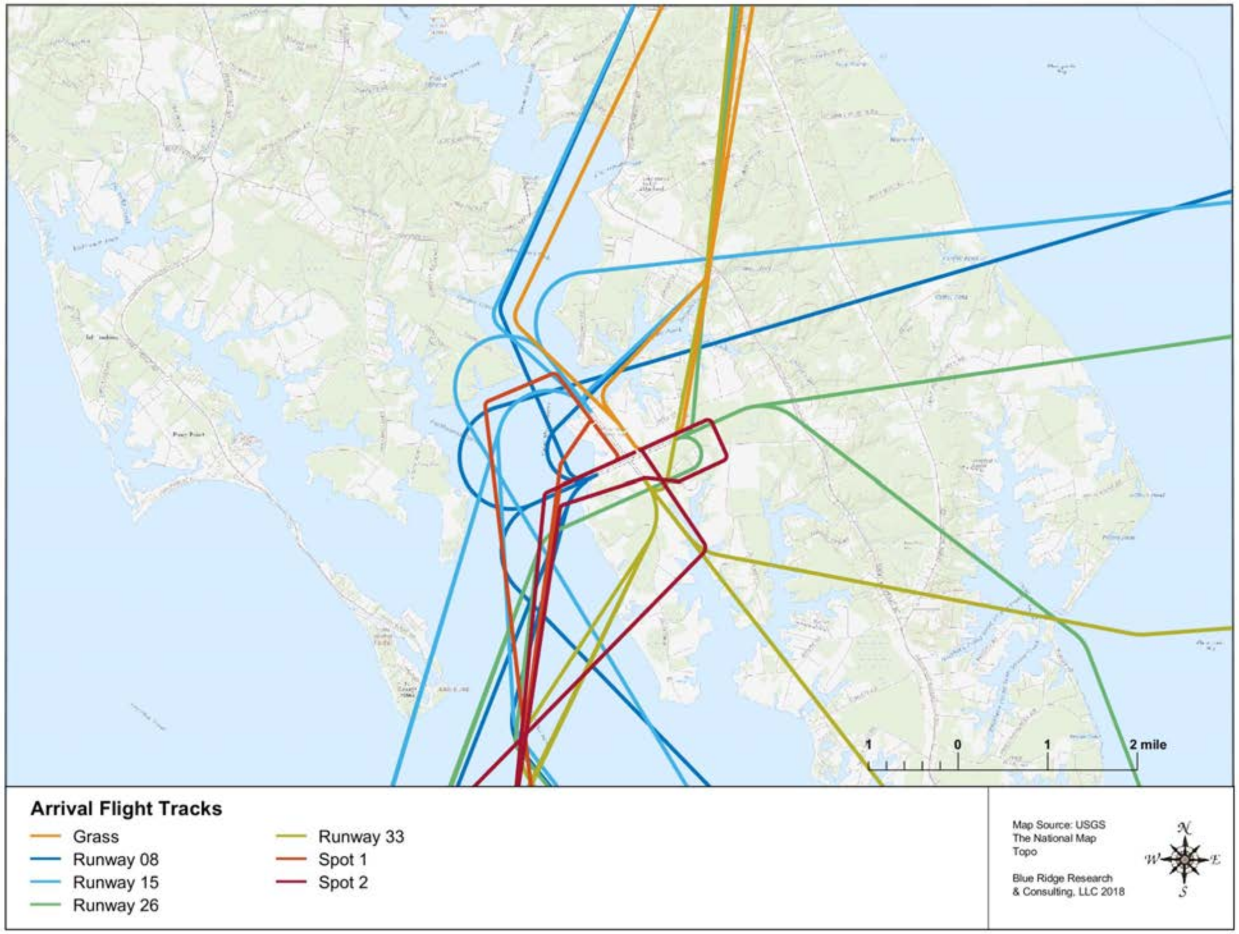

Figure 2-7. OLF Webster Fixed Wing and Helicopter Arrival Flight Tracks

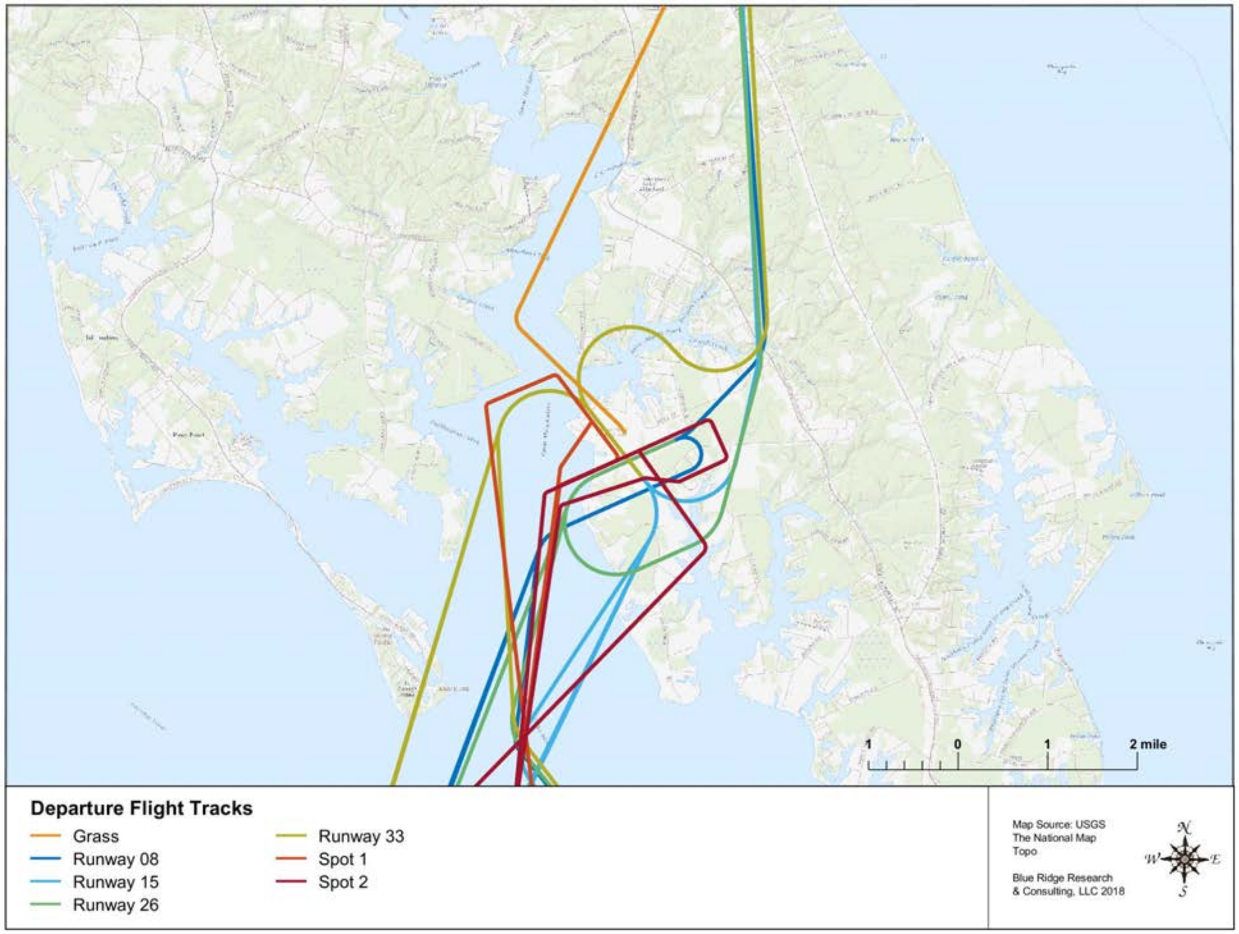

Figure 2-8. OLF Webster Fixed Wing and Helicopter Departure Flight Tracks

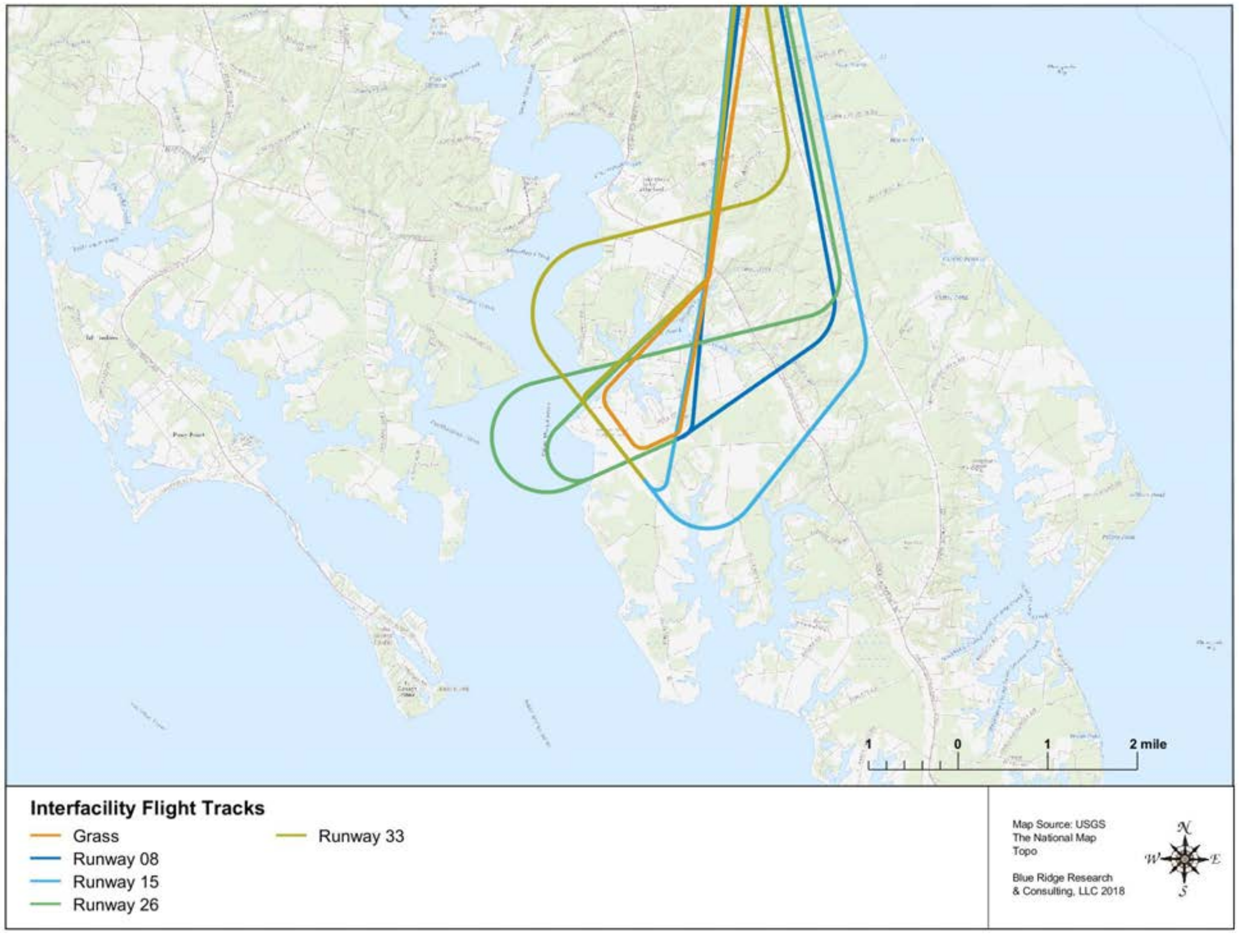

Figure 2-9. OLF Webster Fixed Wing and Helicopter Interfacility Flight Tracks

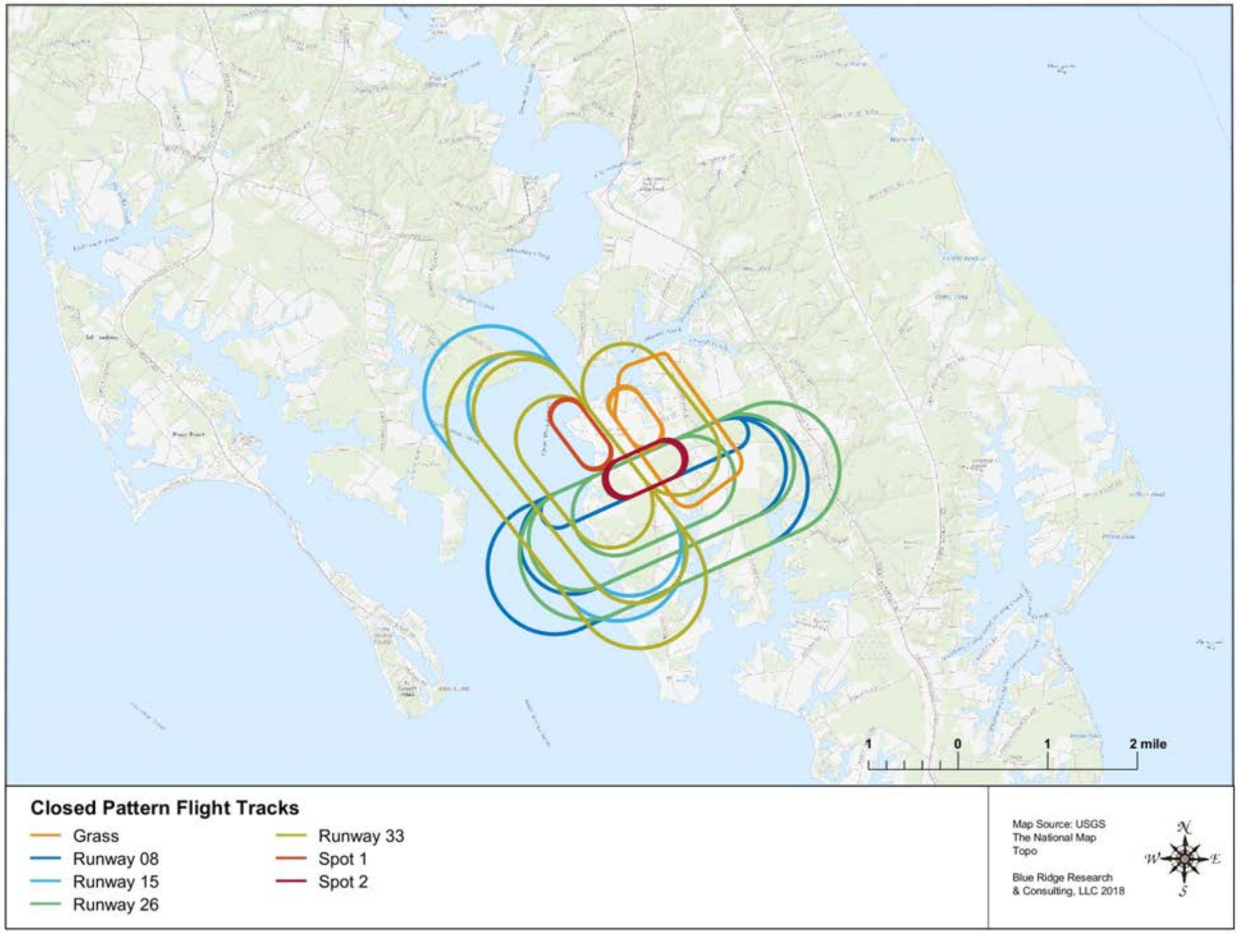

Figure 2-10. OLF Webster Fixed Wing and Helicopter Closed Pattern Flight Tracks

2.3.7 Flight Profiles

The modeled flight profiles were developed based on interviews with the aircrews operating at NAS Patuxent River and OLF Webster. These discussions required an iterative process as the aircrews and modelers worked together to translate the flying parameters into the parameters utilized by the noise model. This process ensures that the modeled flight profiles provide an accurate description of the aircrews' nominal flight procedures throughout the year. For the transient aircraft, if the transient aircraft type is the same aircraft type as a based aircraft, then the based aircraft profile is used for the transient aircraft profile. If there are no based aircraft profiles for a transient aircraft type, then the transient aircraft profile is used from the previous analysis. The NAS Oceana Super Hornet profiles were used as the basis for this study's Super Hornet profiles since the NAS Oceana profiles are more current than the NAS Patuxent River profiles derived in the previous Air Installations Compatible Use Zones (AICUZ). These NAS Oceana profiles were reviewed by the Super Hornet Pilot from the VX-23 squadron and were approved as accurate profiles for this noise study.

Representative flight profiles for all based aircraft within the NoiseMap and AAM models are provided in Appendix C. Each figure includes a table of flight parameters describing the flight trajectory along the flight track. The parameters are varied linearly between the points denoted by the corresponding letter. For departure and pattern profiles, the trajectories proceed as the aircraft flies. However, for arrivals, the trajectories are described in reverse. Please note that some of the following profiles depicted have trajectories that extend beyond the map range. Only one representative profile is shown for each squadron, aircraft, and operation type because all profiles for that operation type are either identical or very similar. If all modeled profiles of all modeled aircraft were displayed, then there would be nearly 1,000 displayed profiles, many of which are redundant.

It is important to note a few of the modeling parameters. First, the terms "Variable" and "Parallel" refer to noise interpolation codes that are used to distinguish between clean and dirty configurations, respectively, when the noise data is significantly different between the configurations for an individual aircraft. (The "dirty" configuration has flaps and landing gear extended.)

2.3.8 Weather Data

The weather data used within NoiseMap is displayed in Table 2-9. These data were sourced from weather.gov and are used to determine the effect of atmospheric absorption that occurs during noise propagation. NoiseMap utilizes the daily average temperatures, relative humidity, and atmospheric pressure for each month to determine the appropriate values to represent the nominal acoustic absorption for a given year. For these monthly averages, the values for March were determined by the model to best represent acoustical absorption for the year. It should be noted these values represent the nominal acoustic absorption condition of the atmosphere and not the average weather conditions for the area.

Table 2-9. Weather Data Inputs for NoiseMap

Weather Data for NoiseMap	Temperature (F)	Relative Humidity (%)
January	35	59%
February	45	72%
March	41	55%
April	55	54%
May	73	69%
June	77	68%
July	78	64%
August	81	69%
September	77	77%
October	64	67%
November	52	67%
December	38	60%

Key: F = Fahrenheit

2.3.9 NAS Patuxent River Static Pads and Profiles

The ground run-up locations at NAS Patuxent River are displayed in Figure 2-11. Ground run-up operations and profiles for the No Action Alternative based aircraft at the various NAS Patuxent River static pad locations are displayed in Table 2-10. No static operations occur at OLF Webster.

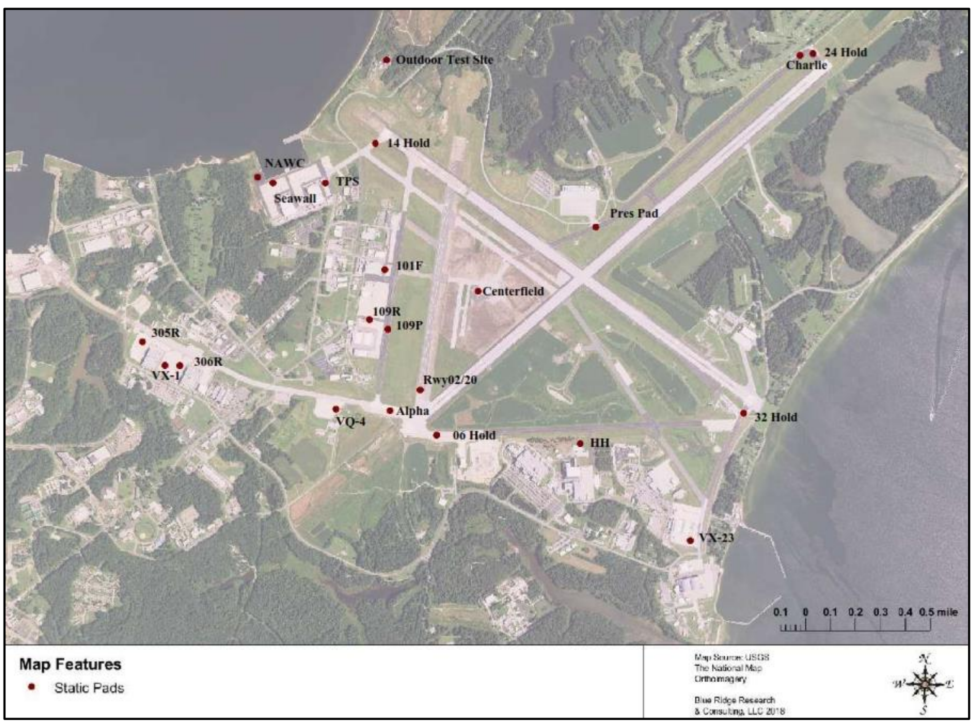

Figure 2-11. Ground Run-up Locations at NAS Patuxent River

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 2-10. Ground Run-up Operations and Profiles for NAS Patuxent River

Squadron	Test Name	Aircraft	Engine Type	Modeled Aircraft / Engine (if different)	Location	Magnetic Heading (deg)	Annual Events: Events	Annual Events: % Day (0700-2200)	Annual Events: % Night (2200-0700)	Power Setting	Duration at Power Setting (Minutes)	Number of Engines Running Simultaneously
HX-21	Pre and post flight turns	H-60			NAWC pad	175	597	90%	10%	idle	20	2
		H-1			NAWC pad	175	404	92%	8%	idle	20	1
		V-22			109 pad	200	218	95%	5%	idle	20	2
		CH-53			In front of Hanger 101	200	146	95%	5%	idle	20	3
		VH-92		H-60	Presidential pad	79	250	90%	10%	idle	20	2
		H-3		CH-53	Presidential pad	79	50	95%	5%	idle	20	2
	Dedicated Maintenance turns	H-60			Seawall (both lines)	170	50	95%	5%	idle	120	2
		H-1			Seawall (both lines)	170	50	95%	5%	idle	120	1
		V-22			Seawall (both lines)	170	50	95%	5%	idle	120	2
		CH-53			In front of Hanger 101	200	50	100%	0%	idle	120	3
		VH-92		H-60	Seawall (both lines)	170	50	95%	5%	idle	120	2
		H-3		CH-53	Seawall (both lines)	170	50	95%	5%	idle	120	2
SAR	Spin up before launch	H-60			NAWC pad	175	472	95%	5%	idle	60	2
VXS-1	High Power Turns	P-3			Off-duty runway or Taxiway Alpha	into wind	12	100%	0%	idle	19	2
								100%	0%	max	0.5	2
		C-12			Off-duty runway or Taxiway Alpha	into wind	6	100%	0%	idle	19	2
								100%	0%	max	0.5	2
	Low Power Turns	P-3			Hanger 109 Ramp	200	24	100%	0%	idle	60	4
		C-12			Inactive Runway or Alpha	into wind	24	100%	0%	idle	60	2
VQ-4	High Power Turns	E-6			VQ-4 Ramp	35	3	90%	10%	max	10	1
VX-20	Runway Hold Short Runs	C-38		C-21	Runway Hold Short	point towards runway	41	100%	0%	65%	3	1
		C-12			Runway Hold Short	point towards runway	41	100%	0%	65%	3	1
	High Power Turns	P-8			Approach End of Rwy 06	100	1	100%	0%	max	1	2
	Low Power Turns	P-8			Building 305 behind the hanger	115	12	100%	0%	40% N1	30	2
		E-2			Hanger 306	115	60	99%	1%	1800 ISHP	25	2
	High Power Turns	E-2			Taxiway Alpha or on Runway 02/20	into wind	60	99%	1%	4600 ISHP	7	1
								99%	1%	idle	15	2
VX-23	High Power Turns	F-18C/D			Center Field Stand	0	12	99%	1%	AB	2	2
								99%	1%	Mil	3	2
								99%	1%	50%	25	2
								99%	1%	Idle	30	2
					Hush House	20	12	99%	1%	AB	2	2
								99%	1%	Mil	3	2
								99%	1%	50%	25	2
								99%	1%	Idle	30	2
		F-18E/F			Center Field Stand	90	12	99%	1%	AB	2	2
								99%	1%	Mil	3	2
								99%	1%	50%	25	2
								99%	1%	Idle	30	2
					Hush House	180	12	99%	1%	AB	2	2
								99%	1%	Mil	3	2
								99%	1%	50%	25	2
								99%	1%	Idle	30	2
	Low Power Parking Turns	F-18C/D			VX-23 Parking Spots	20	300	99%	1%	80%	5	2
								99%	1%	Idle	55	2
		F-18E/F			VX-23 Parking Spots	20	300	99%	1%	80%	5	2
								99%	1%	Idle	59	2

35

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 2-10. Ground Run-up Operations and Profiles for NAS Patuxent River (continued)

Squadron	Test Name	Aircraft	Engine Type	Modeled Aircraft / Engine (if different)	Location	Magnetic Heading (deg)	Annual Events: Events	Annual Events: % Day (0700-2200)	Annual Events: % Night (2200-0700)	Power Setting	Duration at Power Setting (Minutes)	Number of Engines Running Simultaneously
VX-1	High Power turns	E-2			Taxiway Alpha	110	12	99%	1%	100% max	14	1
					Taxiway Charlie	50	12	99%	1%	100% max	14	1
		P-8			Runway 06 Threshold	300	3	99%	1%	90%	10	1
					Runway 02/20	15	3	99%	1%	90%	10	1
	Low Power turns	E-2			VX-1 parking	300	150	95%	5%	idle	45	2
		P-8			VX-1 parking	300	17	95%	5%	idle	5	2
Open-Air Engine Test Cell	Open-Air Engine Test Cell Runs	N/A	T700-401	AH-1/UH-1	Test Pad #2375	West	10	95%	5%	Idle	21.7	1
										Mil	21.7	1
			T-56-425/427	E-2	Test Pad #2353	SW	13	95%	5%	Idle	40.9	1
										Mil	40.9	1
			T-56-14	P-3	Test Pad #2353	SW	6	95%	5%	Idle	37.8	1
										Mil	37.8	1
			T-56-16	C-130	Test Pad #2353	SW	5	95%	5%	Idle	40.7	1
										Mil	27.1	1
			T64-419	CH-53	Test Pad #2375	West	1	95%	5%	Idle	27.7	1
										Mil	14.3	1
			F404-400	F-18A/C	Test Pad #1689	SW	11	95%	5%	Idle	17	1
										Mil	39.1	1
										AB	0.6	1
			F414	F-18E/F	Test Pad #1689	SW	16	95%	5%	Idle	16.6	1
										Mil	16.6	1
										AB	1.4	1
			T700-401	H-60	Test Pad #2375	West	7	95%	5%	Idle	34.7	1
										Mil	23.1	1
			J52	EA-6B	Test Pad #1689	SW	1	95%	5%	Idle	22.2	1
										Mil	54	1
Test Pilot School	Low Power Runs	F/A-18E/F			TPS Flight Line	West	90	100%	0%	up to 80	30	2
		T-38C			TPS Flight Line	South	204	100%	0%	up to 80	20	1
		T-6B			TPS Flight Line	North	264	100%	0%	30% torque	15	1
		NU-1B		T-6	TPS Flight Line	West	36	100%	0%	up to 80	30	1
		U-6A		T-6	TPS Flight Line	West	24	100%	0%	up to 80	30	1
		C-12C			TPS Flight Line	West	144	100%	0%	up to 71	10	1
		C-26A		C-21	TPS Flight Line	West	144	100%	0%	up to 71	10	1
		OH-58C		AH-1/UH-1	TPS Flight Line	varies with wind	84	100%	0%	100	60	1
		UH-60A/L			TPS Flight Line	varies with wind	84	100%	0%	100	60	1
		UH-72A		H-60	TPS Flight Line	North or south	4	100%	0%	70	10	1
	High Power Turns	F/A-18E/F			Center field	South West	9	100%	0%	idle	30	2
										50%	25	2
										100% Mil	5	2
		T-38C			Center field	South West	48	100%	0%	idle	30	1
										50%	50	1
										100% Mil	10	1
		T-6B			TPS Flight Line	West	12	100%	0%	Max	15	1
		NU-1B		T-6	TPS Flight Line	West	12	100%	0%	Max	60	1
		U-6A		T-6	TPS Flight Line	West	24	100%	0%	Max	60	1
		C-12C			TPS Flight Line	West	24	100%	0%	Max	10	1
		C-26A		C-21	TPS Flight Line	West	24	100%	0%	Max	10	1

Key: deg = degrees; max = maximum; NAS = Naval Air Station; NAWC = Naval Air Warfare Center; Rwy = Runway; SAR = Search and Rescue; SW = southwest; TPS = Test Pilot School.

2.4 NAS Patuxent River and OLF Webster No Action Alternative Acoustic Environment

2.4.1 No Action Alternative DNL Noise Contours

The approved data validation package was used as the modeling input for the noise analysis, and NoiseMap version 7.3 was used to calculate and plot the DNL 55 dB through 85 dB contours for the No Action Alternative, shown in Figure 2-12 for NAS Patuxent River and Figure 2-13 for OLF Webster. At OLF Webster, resultant DNL values are below 65 dBA, so only the 55 and 60 dBA DNL contours are shown. At NAS Patuxent River, the DNL contour lobes extend farthest along the runway centerlines, as these lobes are generated by VFR and IFR arrivals and the arrival portion of Ground Controlled Approach (GCA) patterns. Along the coastline south of the airfield, the contours propagate farther over the water than over the land. This portion of the noise is controlled by low power run-up from VX-23, which is near the water. The noise from these run-ups is propagating farther over the water than over the land due to lower sound absorption of the water compared to land. Also, several curved lobes in the 65 dBA DNL contours are observed. These lobes are caused by F/A-18E/F Super Hornet VFR Closed Pattern flight profiles switching from lower power setting to higher power setting during a turn. Further explanations of the various lobes and islands in the DNL contours and differences between the No Action DNL contours and the Alternatives DNL contours are described in Section 3.2.2.

2.4.2 No Action Alternative DNL and SEL at Representative Locations

Representative locations were selected by the NAVAIR Ranges Sustainability Office for DNL analysis as well as for additional supplemental analyses. These locations are shown in Figure 2-14. The No Action Alternative overall DNL and maximum SEL of a single modeled aircraft event at each of the representative locations are listed in Table 2-11. The location with the highest DNL is Cedar Cove Apartments (PO8). Cedar Cove Apartments and Drum Point Club (PO3) have the highest maximum SEL from a single modeled aircraft event. At each location, the noise model outputs the top 20 contributors to the overall DNL. The maximum SEL comes from the aircraft event with the highest SEL out of these top 20 contributors, and it is not necessarily the event that is the top contributor to the overall DNL. Supplemental metrics at these locations are presented in Section 6.

Table 2-11. No Action Alternative DNL and Maximum SEL at Each Representative Location

Representative Locations		DNL	Max SEL
ID	Description	(dBA)	(dBA)
P01	Asbury Solomons	47	103
P02	Our Lady Star of the Sea School	58	110
P03	Drum Point Club	64	113
P04	Captain Walter Francis Duke Elementary School	48	95
P05	Green Holly Elementary School	48	93
P06	Chancellors Run Activity Center	45	90
P07	Lexington Park Elementary School	59	107
P08	Cedar Cove Apartments	66	113
P09	Spring Ridge Middle School	46	96
P10	Elms Beach Park	52	102
P11	Historic St. Mary's City	40	94
P12	Harry Lundeberg School of Seamanship	42	86
P13	St. Ignatius Roman Catholic Church	47	95
P14	Point Lookout State Park	23	73
P15	Northumberland Elementary School	24	73

Key: dBA = A=weighted decibels; DNL = day-night average sound level; ID = identification number; SEL = sound exposure level.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

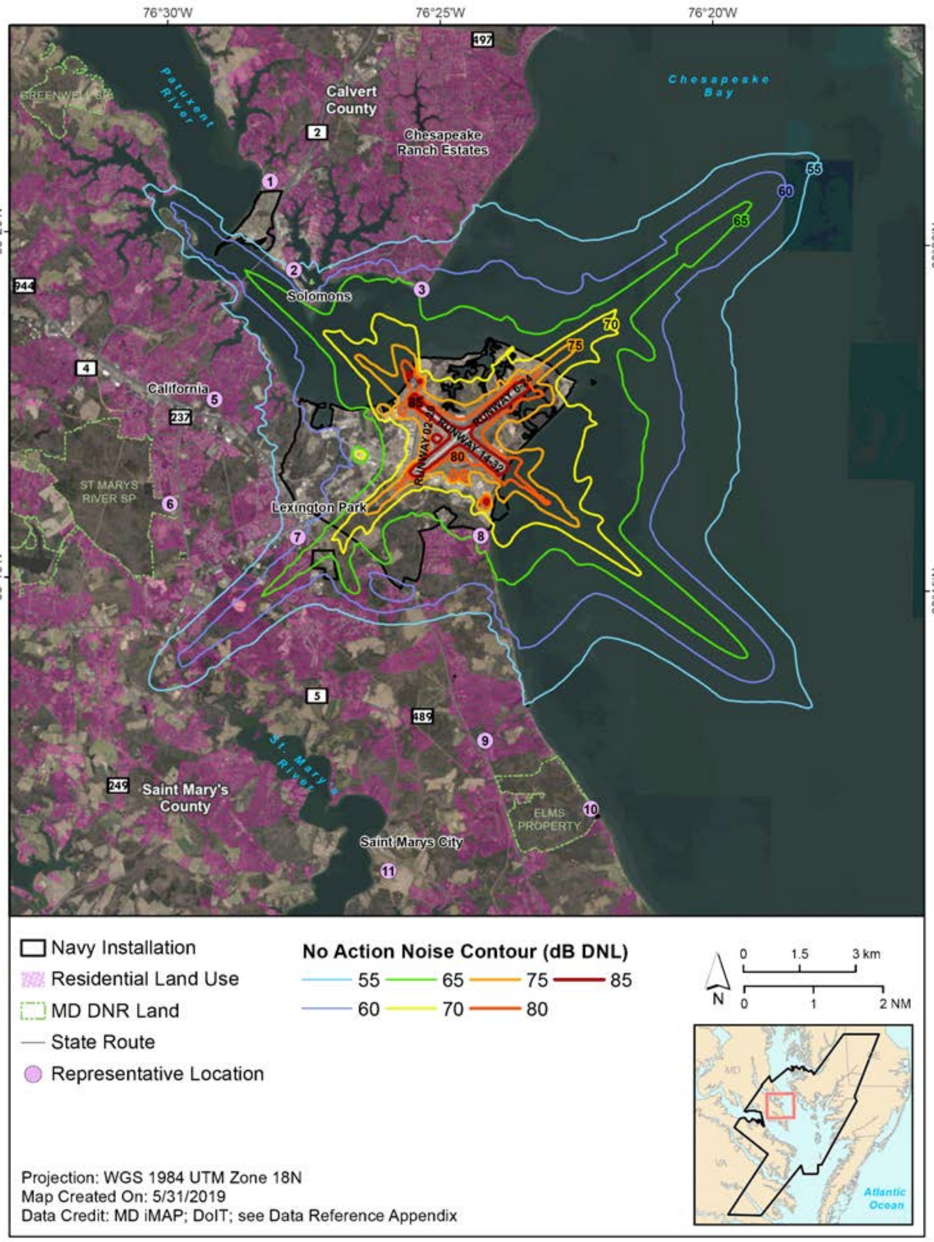

Figure 2-12. NAS Patuxent River DNL Contours for No Action Alternative

38

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

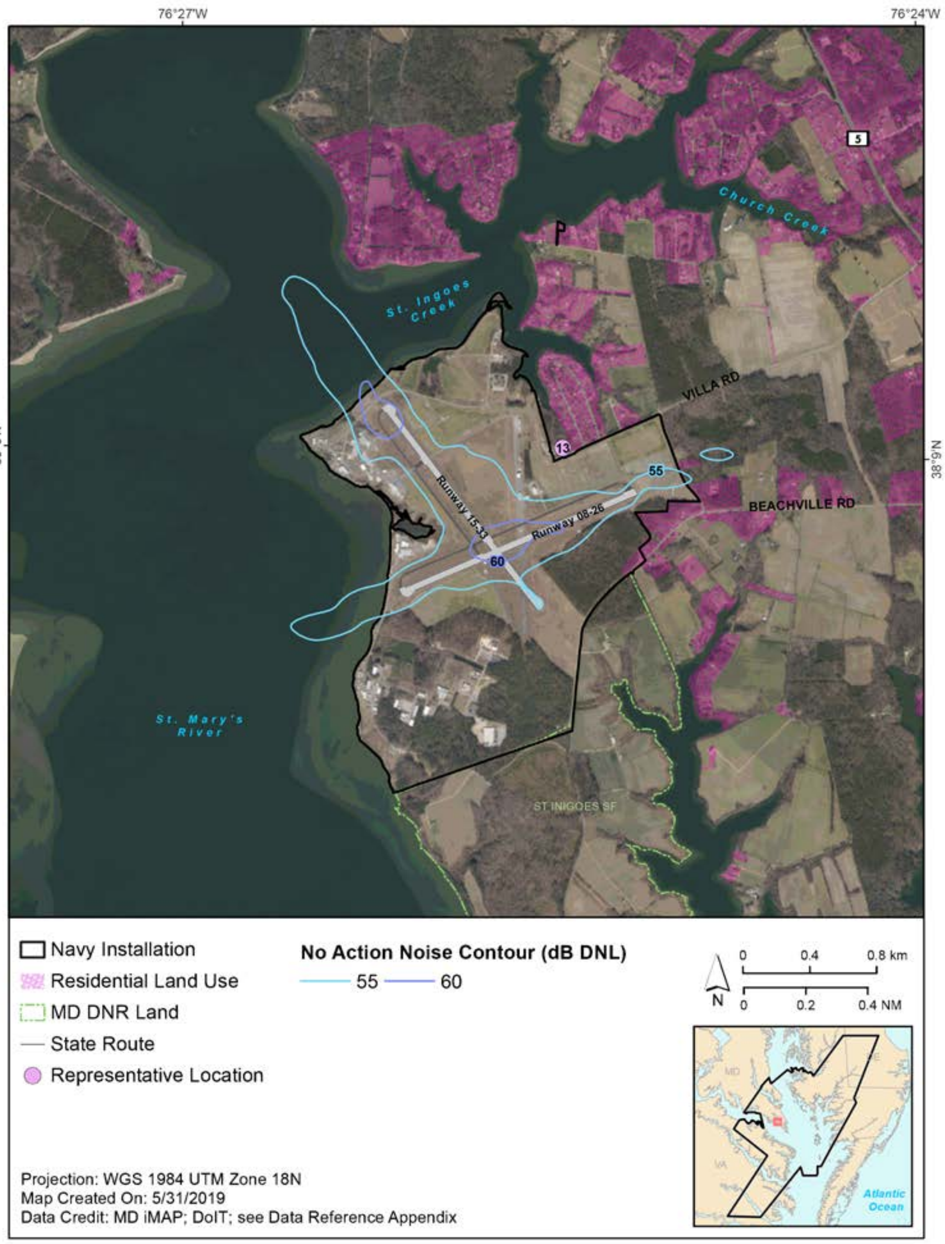

Figure 2-13. OLF Webster DNL Contour for No Action Alternative

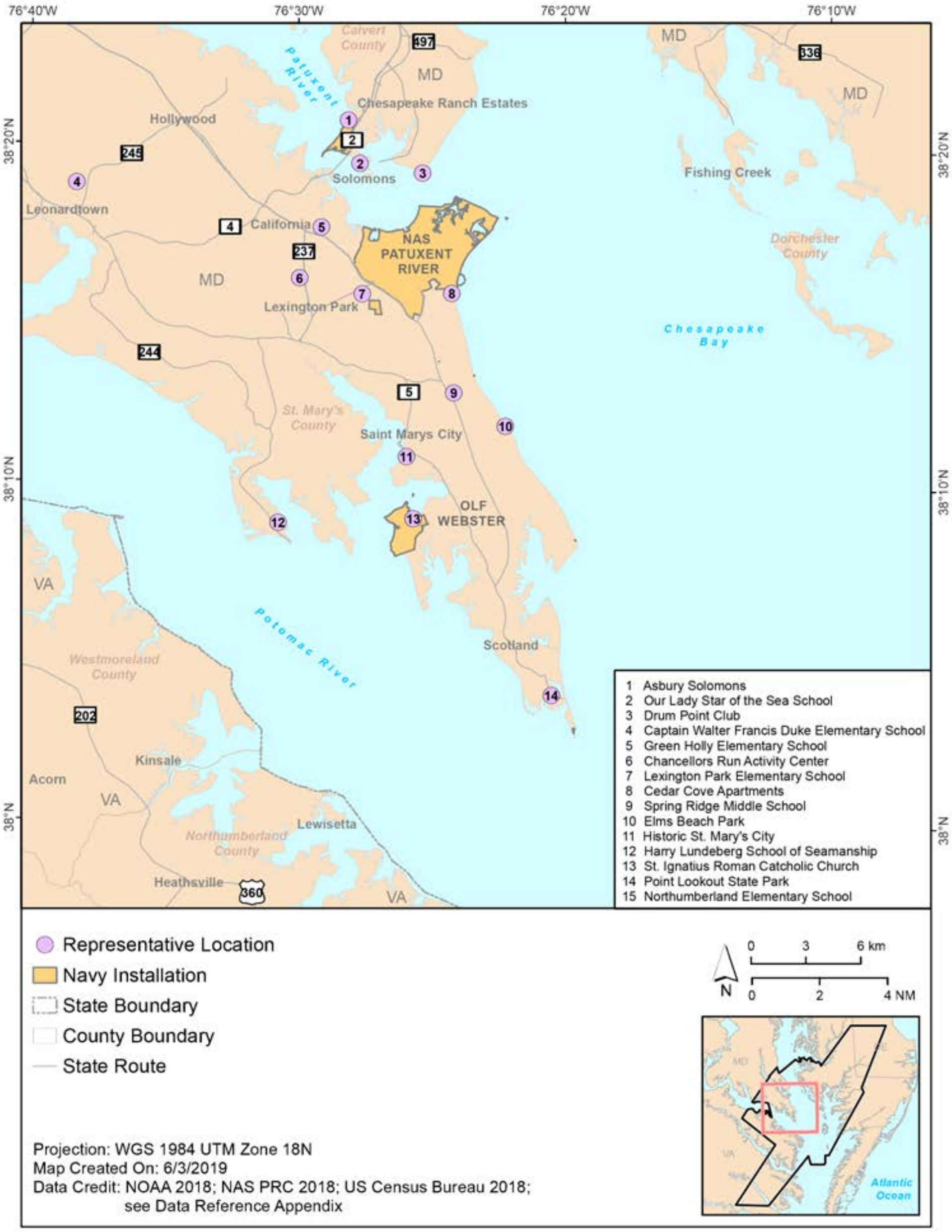

Figure 2-14. NAS Patuxent River Noise Study Representative Locations for DNL and Supplemental Metrics Analyses

3 Airfield Analysis at NAS Patuxent River and OLF Webster for the Action Alternatives

The Proposed Action consists of Alternative 1 and Alternative 2, and these alternatives represent two different flight hour increases over the No Action 10-year average level of flight hours at NAS Patuxent River and OLF Webster. While the No Action represents 20,100 total annual flight hours for all squadrons and transient aircraft at NAS Patuxent River and OLF Webster, Alternative 1 increases the operations to 23,400 annual flight hours, and Alternative 2 further increases the operations to 26,000 annual flight hours. Additionally, the aircraft type distributions within most squadrons are changed for the Alternatives relative to the No Action. These changes account for the expected future distribution of aircraft types flying at NAS Patuxent River and OLF Webster.

3.1 NAS Patuxent River and OLF Webster Action Alternatives Aircraft Operations

Several squadrons provided projected future flight hours by aircraft platform based on information or data on their individual future fleet-mix. The aircraft platforms in the TPS, VXS-1, and VX-1 squadrons were scaled equally (all aircraft within the squadron had the same scale factor that was applied for the entire squadron) from the No Action Alternative to the estimated Alternative 1 and Alternative 2 hours since no change is expected or known in their future aircraft composition.

3.1.1 Action Alternatives Squadron Specific Data Modeling

This section provides the operational data items that are different from the No Action Alternative. Operational parameters that do not vary between the No Action and the Action Alternatives are the following:

- Runways
- Runway Utilization
- Flight Tracks and their Utilizations
- Operational Type Distributions
- Acoustical Day Night Distributions
- Flight Profiles
- Static Operation Locations and Profiles
- Weather Data

For SAR, the H-60 is the only aircraft modeled in the Alternatives since the C-12 is no longer part of SAR at NAS Patuxent River. In VX-20, P-3 and T-6 (used as the modeling surrogate for T-34) are removed from the Alternatives as those aircraft are no longer part of VX-20. Additionally, the C-2 is replaced with the V-22 from HX-21, so those sorties are moved from VX-20 to HX-21 in the Alternatives. In VX-23, the F-35B/C is expected to decrease future utilization while the F/A-18E/F and EA-18G are expected to increase future utilization at NAS Patuxent River. Additionally, the variant utilization of both the F-35 and the F/A-18 is expected to change. In the Alternatives, 25 percent of F/A-18 operations is the C/D Hornet model (instead of 50 percent from the No Action), 50 percent is the E/F Super Hornet model (instead of 40 percent) and 25 percent is the E/A-18G Growler model (instead of 10 percent). For HX-21 future Alternatives, CH-53K is utilized in place of CH-53E. However, since there is no noise source data for the CH-53K, the CH-53E is the only variant of the CH-53 that is modeled.

3.1.2 Action Alternatives NAS Patuxent River and OLF Webster Annual Flight Operations

To develop the modeled operations for each aircraft within each squadron, the first step calculates individual aircraft/squadron combination scaling factors to increase their flight hours from the No Action Alternative to the Action Alternatives. Table 3-1 lists these calculated scale factors for Alternatives 1 and 2. The scale factors are the numbers that the No Action hours have to be multiplied by to equal the Alternative 1 and Alternative 2 hours.

The second step applies these calculated flight hour scale factors to the No Action Alternative operations of the corresponding platforms and squadrons shown in Table 3-3 of Section 3.1. This step assumes that the hours per sortie and the closed pattern rate (average patterns per sortie) are the same in the Action Alternatives as the No Action. Table 3-2 lists the Total Annual Operations modeled under the No Action in the first column, the same scale factors that were calculated from Table 3-1 in the columns with the green highlighted headings, and the Total Annual Operations derived for Alternatives 1 and 2 (multiplying the No Action Operations by the scale factor for each Alternative). The numbers of static operations are also scaled on these same scaling factors, which are specific to each squadron and aircraft within each squadron from Table 3-1 and Table 3-2.

3.2 NAS Patuxent River and OLF Webster Action Alternatives Acoustic Environment

3.2.1 Action Alternatives DNL Noise Contours

The DNL 55 dB through 85 dB contours for the Action Alternatives 1 and 2 are shown in Figure 3-1 and Figure 3-2, respectively, for NAS Patuxent River and Figure 3-3 and Figure 3-4, respectively, for OLF Webster. These figures display the Alternative contours as solid lines and the No Action results as shaded areas. At OLF Webster, from the No Action to the Alternatives, the DNL values are still very low, and the 65 dBA contour is the very small green island centered at the more heavily utilized of the two helipads for the MQ-8 Fire Scout UAS. At NAS Patuxent River, the DNL contours are very similar to the No Action contours. As expected, some of the lobes in the 65 and 70 dBA contours extend out a bit farther than in the No Action, and each contour set is a bit larger/wider than the No Action due to the increase of overall operations between the No Action and the Alternatives. Further explanations of the various lobes and islands in the DNL contours and differences between the No Action DNL contours and the Alternatives DNL contours are described in Section 4.2.

Table 3-1. Action Alternatives 1 and 2 Flight Hours and Scale Factors Required to Reach these Flight Hours

Organization	Squadron	Platform	No Action	Alternative 1	Scale Factor for Alt 1	Alternative 2	Scale Factor for Alt 2
Naval Test Wing Atlantic (NTWL) Tenant	TPS	Various	6,197	7,079	1.142	7,865	1.269
	VX-20	P-3	648	0	0.000	0	0.000
		T-6/T-34	345	0	0.000	0	0.000
		C-12 Tac	194	455	2.342	505	2.602
		C-130	790	710	0.899	789	0.999
		C-38	352	474	1.344	526	1.493
		E-2	984	580	0.589	644	0.655
		E-6B	157	178	1.130	197	1.256
		MQ-4 Triton	93	163	1.744	181	1.937
		P-8	570	1,302	2.284	1,447	2.538
	VX-23	F/A-18E/F and EA-18G	1,634	2,663	1.630	2,960	1.812
		F/A-18C/D	1,089	888	0.815	986	0.905
		F-35B	374	142	0.380	158	0.422
		F-35C	249	142	0.570	158	0.634
		T-45	191	207	1.084	230	1.205
		MQ-25A	0	296	1.000	329	1.111
	HX-21	CH-53	132	355	2.690	395	2.989
		H-1	557	355	0.638	395	0.708
		MH-60R/S	1,025	1,421	1.386	1,578	1.540
		Presidential (VH-92, H-3, VH-71)	81	533	6.576	592	7.307
		V-22	233	320	1.373	355	1.524
	UX-24	UAS Group 1-2	93	438	4.714	487	5.238
		UAS Group 3	79	250	3.143	278	3.492
		UAS Group 4	185	379	2.052	421	2.280
	AIR OPS (SAR)	C-12 and MH-60S SAR	1,245	704	1.131	783	1.258
	Total		*17,498*	*20,032*		*22,258*	
NAS Patuxent River Tenant	VQ-4	E-6B	422	498	1.181	554	1.313
	VXS-1	P-3, C-12	283	334	1.180	371	1.311
	VX-1	E-2, P-3, P-8, H-60	157	186	1.184	207	1.318
	MDARNG	RQ-7 Shadow	151	474	3.136	526	3.483
	Total		*1,013*	*1,492*		*1,658*	
Non-NAS Patuxent River	Transient (FIST)	Various	242	285	1.178	316	1.306
	Transient (ATC Actuals)	Various	1,347	1,591	1.181	1,768	1.313
	Total		*1,589*	*1,876*		*2,084*	
TOTAL			***20,100***	***23,400***		***26,000***	

Key: ATC = Air Traffic Control; FIST = Flight Information Scheduling and Tracking; MDARNG = Maryland Army National Guard; NAS = Naval Air Station; NTWL = Naval Test Wing Atlantic; OPS = operations; SAR = Search and Rescue; TPS = Test Pilot School; UAS = Unmanned Aircraft System.

Table 3-2. Total Annual Operations for the No Action and Action Alternatives 1 and 2

Organization	Squadron	Platform	No Action	Scale Factor for Alt 1	Alternative 1	Scale Factor for Alt 2	Alternative 2
Naval Test Wing Atlantic (NTWL) Tenant	TPS	Various	34,480	1.142	39,387	1.269	43,761
	VX-20	P-3	985	0.000	0	0.000	0
		T-6/T-34	1,937	0.000	0	0.000	0
		C-12 Tac	476	2.342	1,115	2.602	1,238
		C-130	1,085	0.899	976	0.999	1,084
		C-38	1,351	1.344	1,816	1.493	2,018
		E-2	1,640	0.589	967	0.655	1,073
		E-6B	194	1.130	219	1.256	244
		MQ-4 Triton	120	1.744	209	1.937	232
		P-8	592	2.284	1,352	2.538	1,503
	VX-23	F/A-18E/F and EA-18G	5,430	1.630	8,850	1.812	9,836
		F/A-18C/D	3,620	0.815	2,952	0.905	3,278
		F-35B	1,155	0.380	439	0.422	488
		F-35C	771	0.570	439	0.634	489
		T-45	1,034	1.084	1,121	1.205	1,246
		MQ-25A	0	1.000	396	1.111	440
	HX-21	CH-53	698	2.690	1,878	2.989	2,087
		H-1	6,302	0.638	4,018	0.708	4,464
		MH-60R/S	3,940	1.386	5,460	1.540	6,067
		Presidential (VH-92, H-3, VH-71)	400	6.576	2,631	7.307	2,923
		V-22	960	1.373	1,318	1.524	1,463
	UX-24	UAS Group 1-2	90	4.714	424	5.238	471
		UAS Group 3	446	3.143	1,402	3.492	1,558
		UAS Group 4	454	2.052	932	2.280	1,035
	AIR OPS (SAR)	C-12 and MH-60S SAR	5,280	1.131	2,987	1.258	3,321
	Total		*73,440*		*81,288*		*90,319*
NAS Patuxent River Tenant	VQ-4	E-6B	1,080	1.181	1,275	1.313	1,418
	VXS-1	P-3, C-12	980	1.180	1,156	1.311	1,285
	VX-1	E-2, P-3, P-8, H-60	2,720	1.184	3,220	1.318	3,586
	MDARNG	RQ-7 Shadow	270	3.136	847	3.483	941
	Total		*5,050*		*6,498*		*7,230*
Non-NAS Patuxent River	Transient (FIST)	Various	480	1.178	565	1.306	627
	Transient (ATC Actuals)	Various	1,590	1.181	1,878	1.313	2,087
	Total		*2,070*		*2,443*		*2,714*
TOTAL			***80,560***		***90,229***		***100,263***

Key: ATC = Air Traffic Control; FIST = Flight Information Scheduling and Tracking; MDARNG = Maryland Army National Guard; NAS = Naval Air Station; NTWL = Naval Test Wing Atlantic; OPS = operations; SAR = Search and Rescue; TPS = Test Pilot School; UAS = Unmanned Aircraft System.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

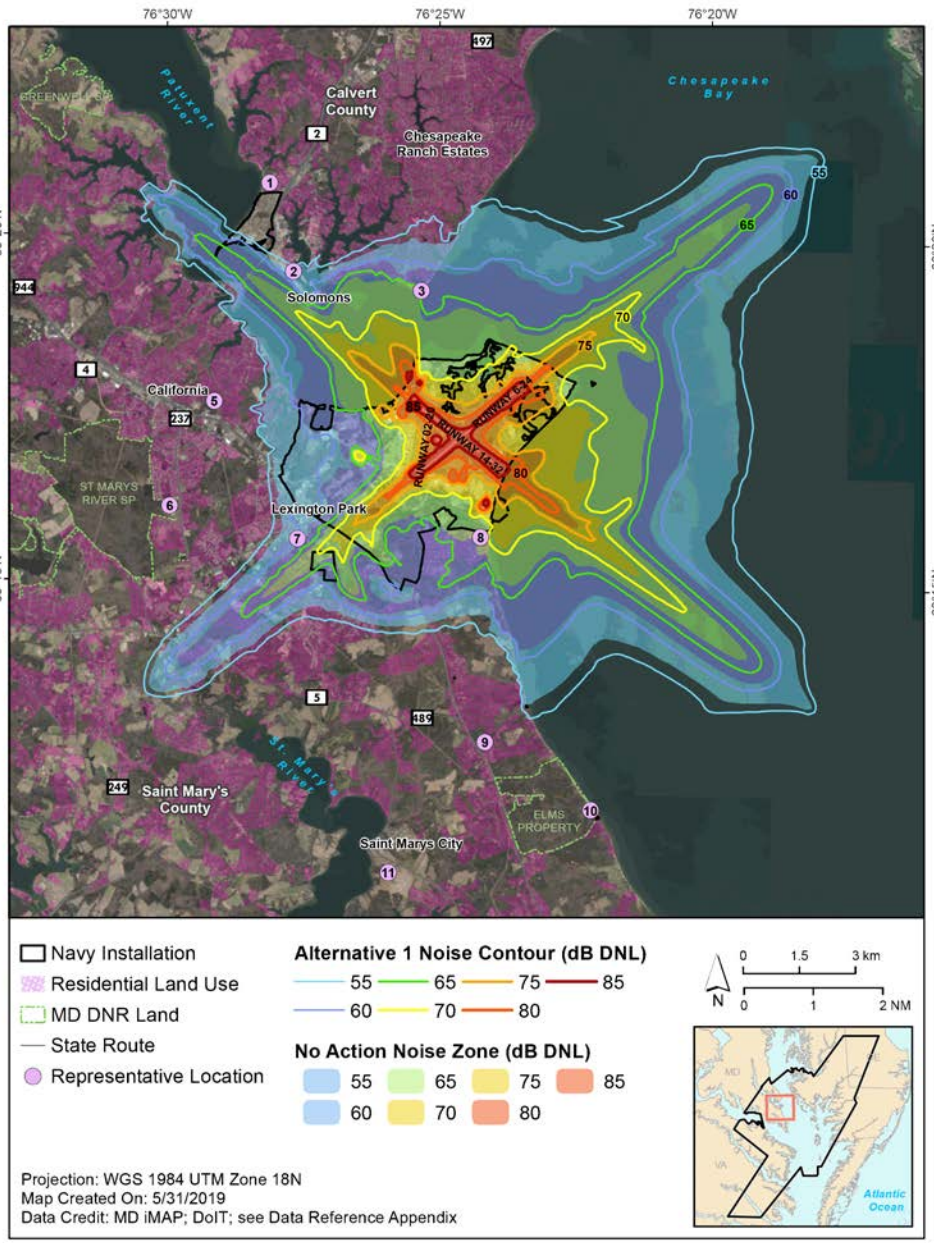

Figure 3-1. NAS Patuxent River DNL Contours for Alternative 1

45

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

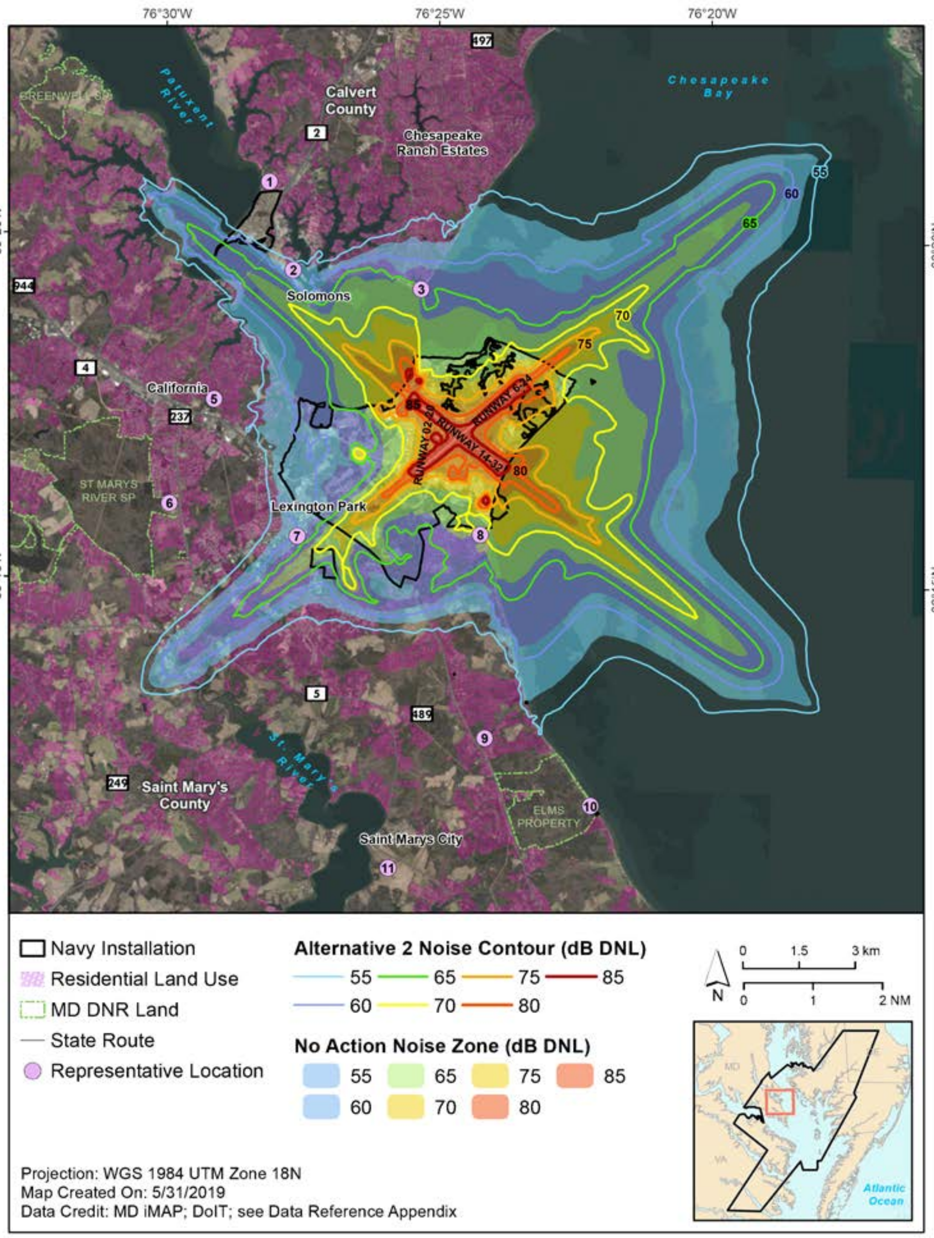

Figure 3-2. NAS Patuxent River DNL Contours for Alternative 2

46

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

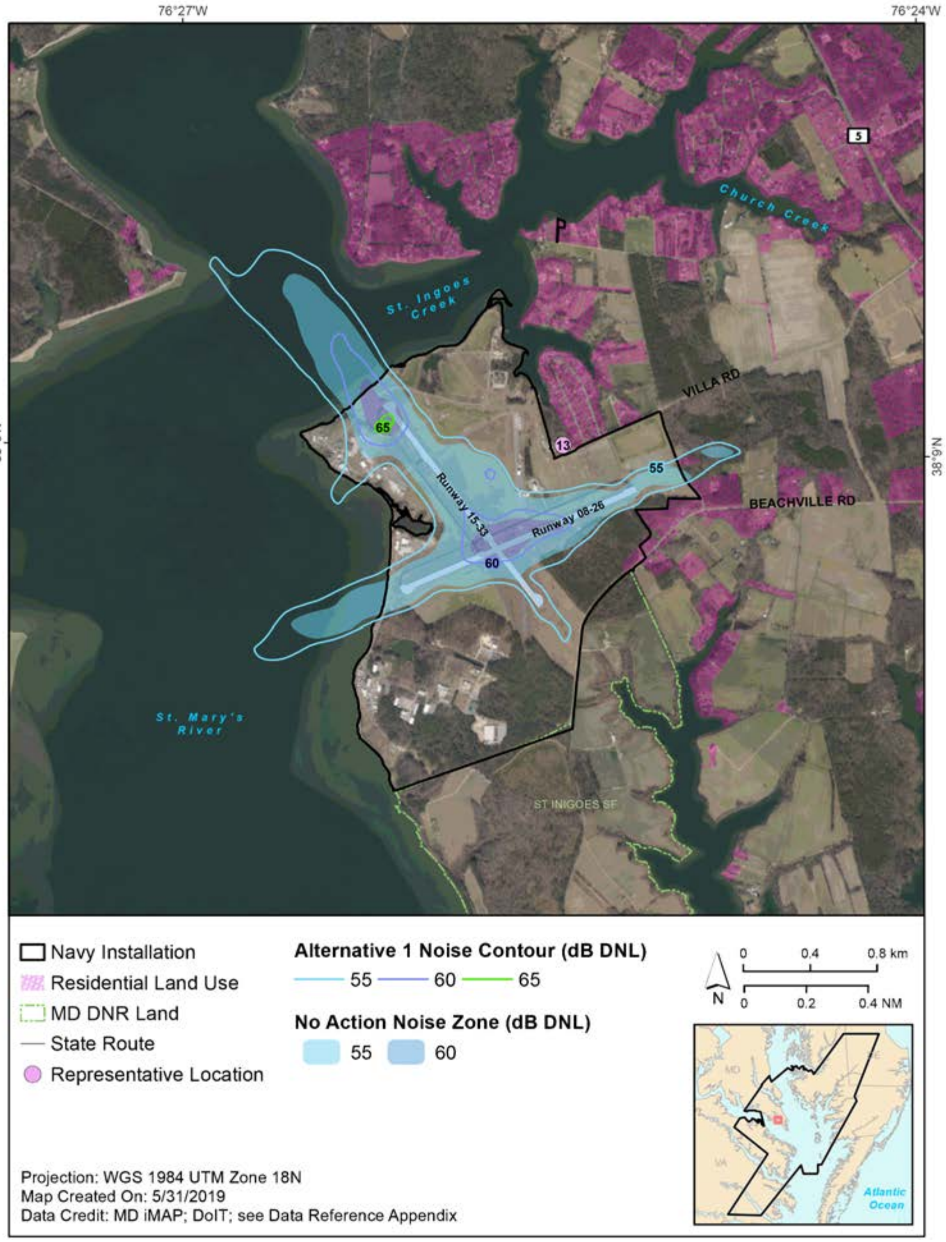

Figure 3-3. OLF Webster DNL Contours for Alternative 1

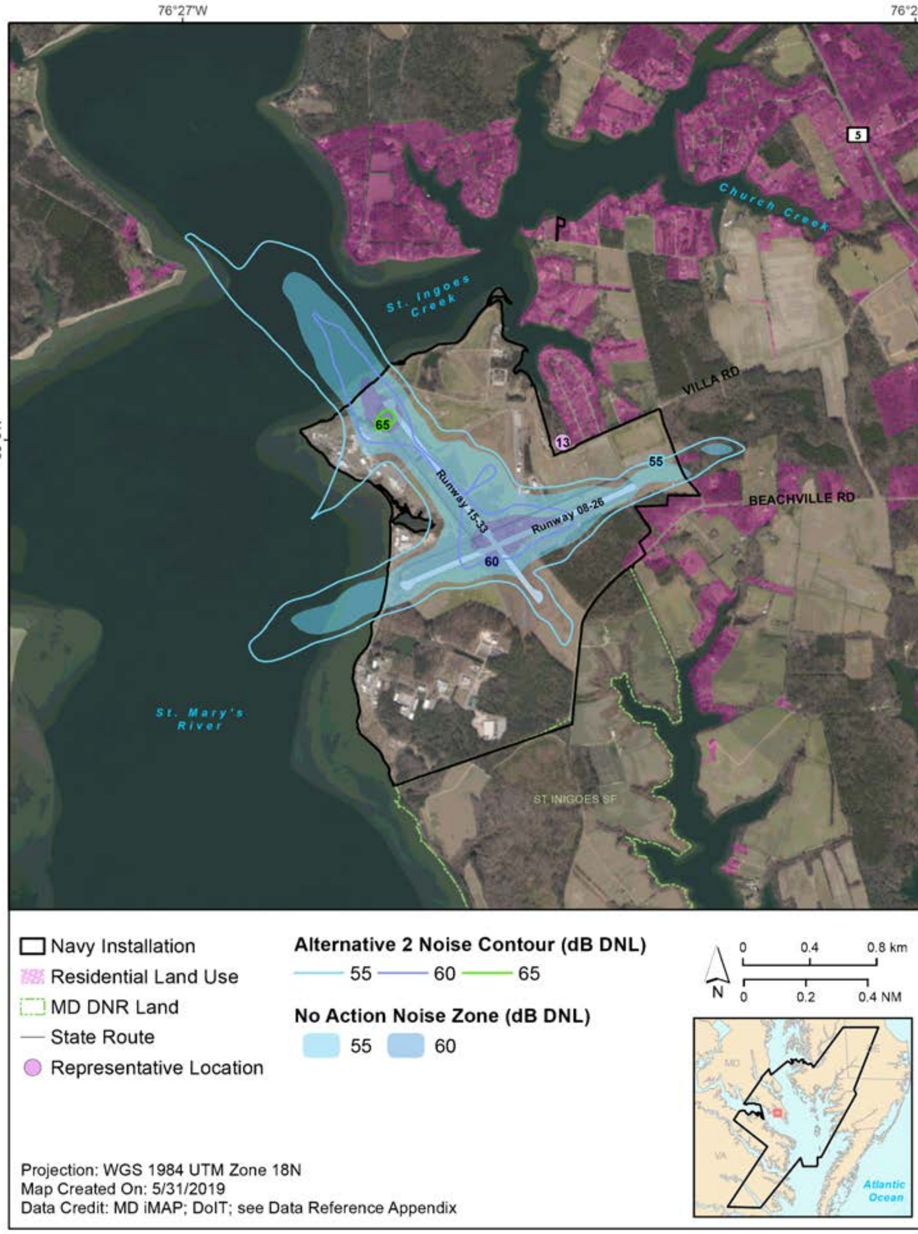

Figure 3-4. OLF Webster DNL Contours for Alternative 2

3.2.2 Noise Contour Description Points Analysis and Comparison with the No Action Alternative

The purpose of this section is to show the contributors behind the various DNL noise contour lobes and islands and to describe the differences between the No Action Alternative and Action Alternatives. Figure 3-5 shows the NAS Patuxent River noise contour description points and the No Action Alternative and Alternative 2 DNL contours. Alternative 2 is utilized for this description and comparison since Alternative 2 has a greater increase in flight hours compared to Alternative 1 over the No Action Alternative. The Alternative 2 DNL contours are 1-4 dB greater than the No Action Alternative DNL contours, with the greatest differences occurring over water (due to greater propagation of sound over water versus over land). Table 3-3 gives the explanations for the DNL contour shape, increase, or difference at each of the noise contour description points at NAS Patuxent River. The majority of the top contributors of the DNL contour shapes or increases are the VX-23 F/A-18E/F Super Hornet. Eight of the 15 noise contour description points are at DNL contour lobes resulting from VX-23 F/A-18E/F VFR closed pattern operations.

To compare the NAS Patuxent River No Action and Alternative 2 65 dBA DNL contours to the 2009 AICUZ 65 dBA DNL contours, Figure 3-6 presents the noise contour description points for the comparison. Table 3-4 gives the explanations for the differences in DNL between this analysis and the 2009 AICUZ. The largest difference between this analysis (No Action and Alternatives) and the previous analysis (2009 AICUZ) arises from differences in the modeled flight profiles for the F/A-18E/F Super Hornets. Over the past 10 years, new Super Hornet flight profiles have been refined at bases such as NAS Oceana and NAS Whidbey Island. The NAS Oceana Super Hornet profiles were used as the basis for this study's Super Hornet profiles, but the profiles were adjusted based on local course rules. These profiles were then validated by the VX-23 Super Hornet pilot and used in this study.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 3-3. Explanations of the Shapes, Increase, or Differences for the NAS Patuxent River No Action and Alternative 2 DNL Contours at Each Noise Contour Description Point

Location Number	DNL Level	Scenario	Top Contributor	Explanation
1	55	No Action and Alt 2	VX-23 F-18E/F 80% Static Run-ups	Low power runs from VX-23 (location #8) are propagating over the water more than land from VX-23 static run-up location.
2	65	No Action	Runway 06 VX-23 and TPS F-18E/F VFR Patterns	VX-23 and TPS F-18E/F operations increase under the alternatives, so the closed pattern operation that has only a small extrusion in the 65 DNL contour for No Action (e.g., location #2) has a much larger extrusion over land in the alternatives (e.g., location #5) as the DNL contour follows this closed pattern track as more operations are added. There is a decrease in power between the end of the downwind leg and the mid-turn to final, which creates a gap in the contours for the alternatives, but is less noticeable in the No Action due to fewer operations.
3	65	No Action		
4	65	Alt 2		
5	65	Alt 2		
6	70	Alt 2	Runway 24 VX-23 and TPS F-18E/F VFR Patterns	As the F-18E/F turns to final, the engine power increases and generates noise – this follows the track from the turn to final and is more pronounced in Alts 1 and 2 because there are a greater number of F-18E/F operations compared to the No Action Alternative.
7	70	No Action and Alt 2	VX-1 E-2 Low Power Turns	Parking run-ups for E-2.
8	85	No Action and Alt 2	VX-23 F-18E/F 80% Static Run-ups	VX-23 F-18E/F can run up to 80% power on the apron for parking runs.
9	85	No Action and Alt 2	OAETC Engine Runs for F-18A/C and F-18E/F	The Open-Air Engine Test Cell (OAETC) engine runs are directly next to the water and the noise propagates over the Bay toward Solomons Island.
10	65	No Action and Alt 2		
11	65	No Action and Alt 2	Runway 14 VX-23F-18E/F VFR Patterns	The top contributor at this point is a combination of the F-18E/F closed pattern track and the OAETC engine run-ups.
12	65	No Action	VX-23 F-18E/F Straight-in Arrival	The top contributor along each runway’s extended centerline are straight-in arrivals from the VX-23 Super Hornet.
13	65	No Action	VX-23 F-18E/F Straight-in Arrival	Change in straight-in arrival power at this location in combination with the GCA box pattern changes results in “arrowhead“ shape.

50

Table 3-3. Explanations of the Shapes, Increase, or Differences for the NAS Patuxent River No Action and Alternative 2 DNL Contours at Each Noise Contour Description Point

Location Number	DNL Level	Scenario	Top Contributor	Explanation
14	65	No Action and Alt 2	VX-23 F-18C/D VFR Pattern	The VFR Pattern for the F-18C/D has a shorter final than the F-18E/F, so this DNL lobe is closer to the runway than the lobe from the F-18E/F.
15	58	No Action	VX-23 F-18E/F VFR Pattern	This bubble in the 60 dBA DNL contour is a reduction (less than 60 dBA) because there is a Hornet (F-18C/D) pattern just above the bubble and a Super Hornet (F-18E/F) pattern just below the bubble. In some situations, this results in enough of a decrease between the tracks to create a “hole” in the DNL contour. This is not the case for Alternatives 1 and 2 because there is a higher number of Hornet and Super Hornet patterns that this “bubble” goes away (the DNL between the tracks is greater than 60 dBA for the alternatives).

Key: Alt = Action Alternative; dBA = A-weighted sound level; DNL = day-night average sound level; OAETC = Open-Air Engine Test Cell; VFR = visual flight rules.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

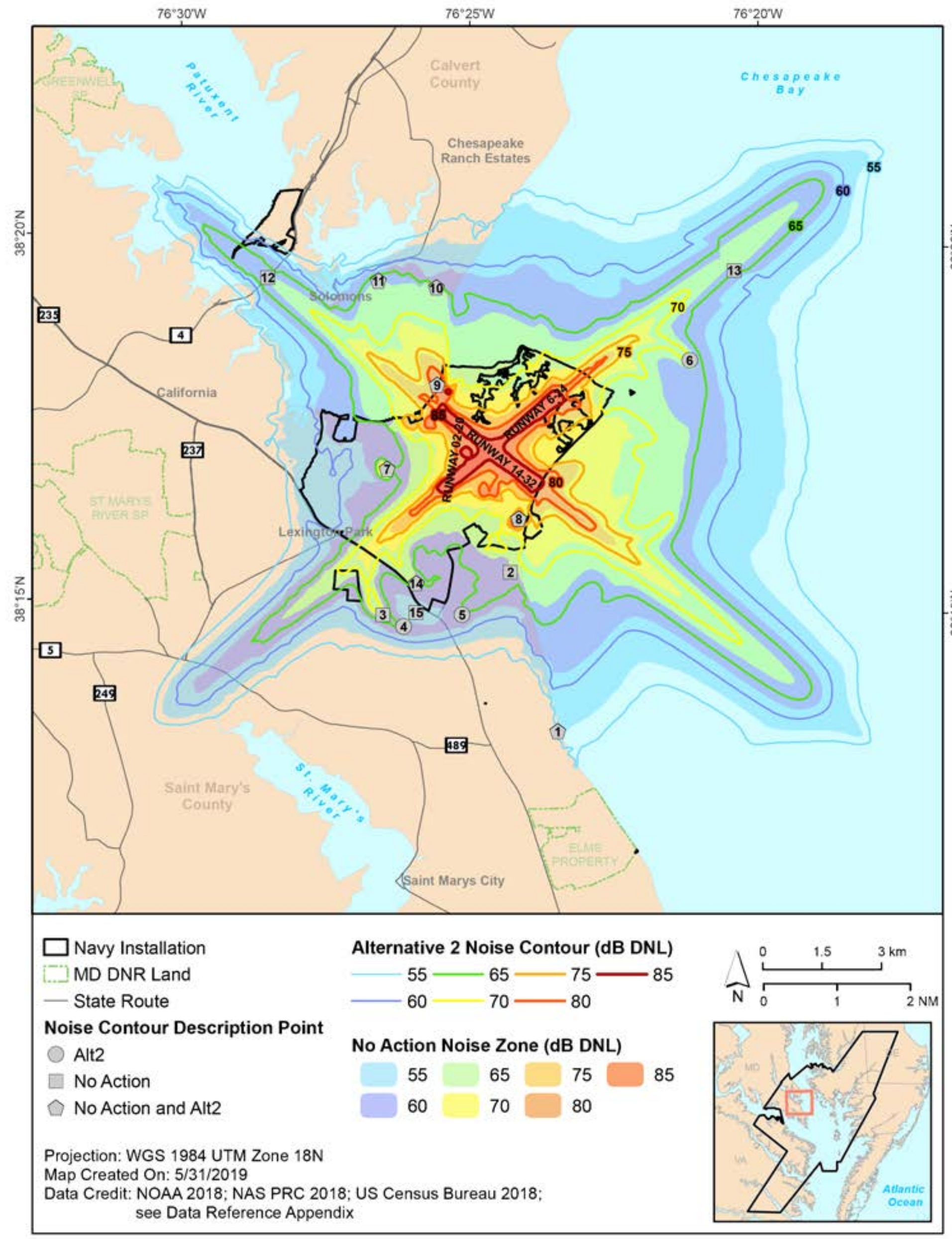

Figure 3-5. Noise Contour Description Points and Comparison with the No Action Alternative

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

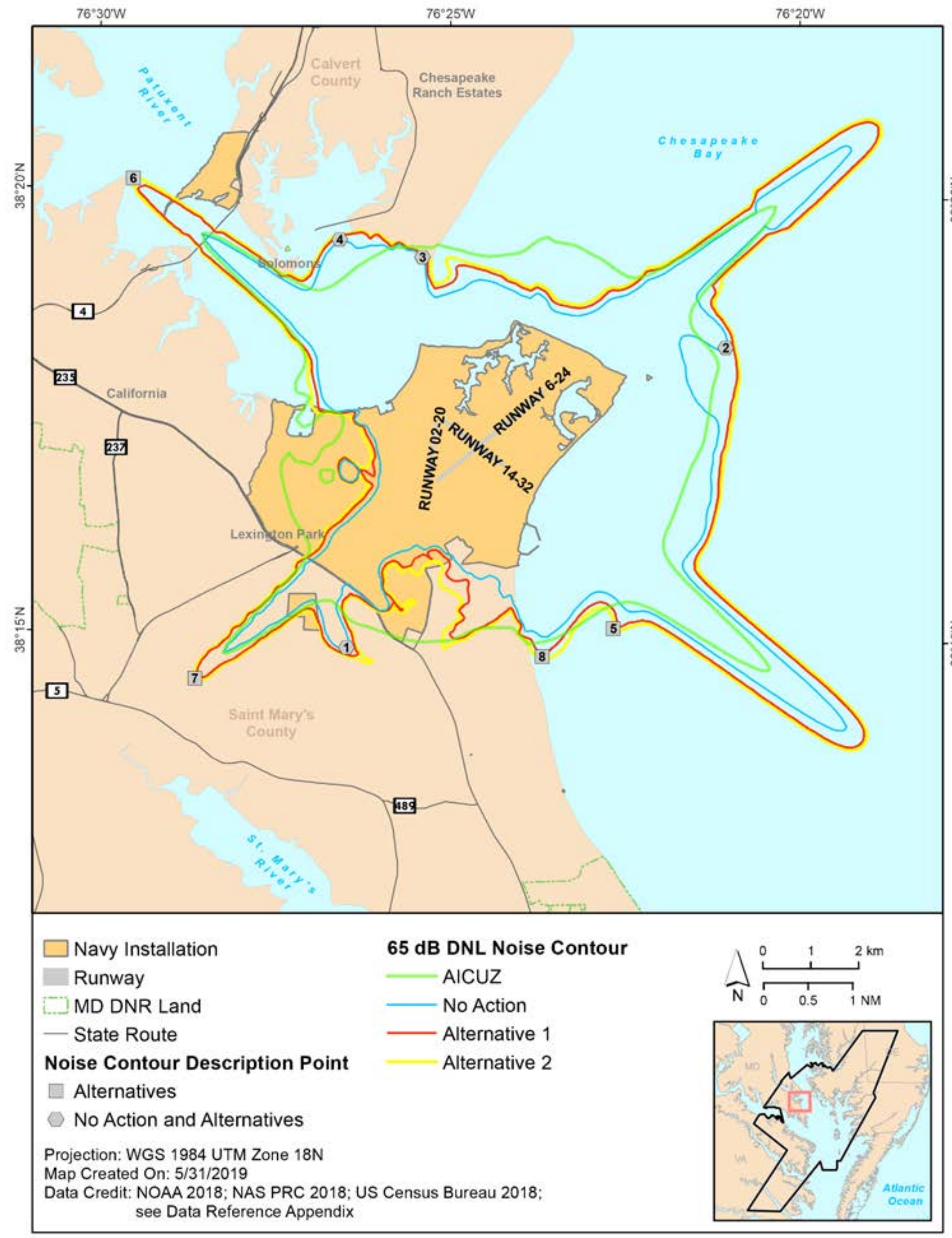

Figure 3-6. NAS Patuxent River DNL Noise Contour Description Points for 65 dBA DNL Contour Comparison of Alternative 2 and No Action to the 2009 AICUZ

53

Table 3-4. Explanations of Difference between the NAS Patuxent River No Action/Alternatives and the 2009 AICUZ for the 65 dBA DNL Contours at Each Noise Contour Description Point

<table>
<tr><th>Location Number</th><th>DNL Level</th><th>Scenario</th><th>Top Contributor</th><th>Explanation</th></tr>
<tr><td>1</td><td>65</td><td>No Action and Alternatives</td><td>VX-23 F-18E/F Super Hornet Runway 06 VFR Closed Patterns</td><td rowspan="5">Based on interviews with VX-23, modeled a wider Super Hornet pattern with a longer final that was modeled in the 2009 AICUZ. This pushes the DNL contours farther out because of the mid-turn to final has an increase in power, which is the contributor for these DNL lobes. For location #3, the OAETC Hornet engine runs are also a top contributor.</td></tr>
<tr><td>2</td><td>65</td><td>No Action and Alternatives</td><td>VX-23 F-18E/F Super Hornet Runway 24 VFR Closed Patterns</td></tr>
<tr><td>3</td><td>65</td><td>No Action and Alternatives</td><td rowspan="2">VX-23 F-18E/F Super Hornet Runway 14 VFR Closed Patterns</td></tr>
<tr><td>4</td><td>65</td><td>No Action and Alternatives</td></tr>
<tr><td>5</td><td>65</td><td>Alternatives</td><td>VX-23 F-18E/F Super Hornet Runway 32 VFR Closed Patterns</td></tr>
<tr><td>6</td><td>65</td><td>Alternatives</td><td>VX-23 F-18E/F Super Hornet Straight-in Arrivals to Runway 14</td><td rowspan="2">For the Super Hornet Straight-in Arrivals, based on interviews with the pilots along with previously modeled profiles at NAS Oceana, modeled an increase in power at approximately 5 NM from the runway threshold and at 1,600 ft. MSL altitude. This is different than what was modeled for the 2009 AICUZ, as these modeled updated profiles are a bit louder for straight-in arrivals.</td></tr>
<tr><td>7</td><td>65</td><td>Alternatives</td><td>VX-23 F-18E/F Super Hornet Straight-in Arrivals to Runway 06</td></tr>
<tr><td>8</td><td>65</td><td>Alternatives</td><td>VX-23 F-18E/F Super Hornet Parking Run-ups</td><td>Parking run-ups up to 80% NC are on the apron at VX-23.This noise propagates south over the water.</td></tr>
</table>

Key: AICUZ = Air Installations Compatible Use Zones; DNL = day-night average sound level; OAETC = Open-Air Engine Test Cell; NM = nautical mile; MSL = mean sea level, NC = engine performance parameter.

Figure 3-7 shows the noise contour description points for 54 Webster. These locations were placed at extrusions, lobes, or islands in the DNL contours at OLF Webster for the No Action and Alternative 2 to explain the reason for these features in the DNL contours. Table 3-5 presents the explanations for these DNL contour features and the reason for changes in the Alternative DNL contours relative to the No Action contours. The No Action and Action Alternatives DNL contours at OLF Webster are much smaller than the DNL contours presented in the 1998 EIS. The 1998 EIS modeled more fixed wing aircraft and helicopter operations at OLF Webster and no or very few UAS operations. However, more UAS operations are occurring at OLF Webster today. These UAS operations are generally quieter than the larger fixed-wing aircraft and helicopters that previously used OLF Webster. Since fixed wing aircraft and UAS aircraft cannot use the airfield concurrently at OLF Webster, the fixed wing and helicopters use OLF Webster less often than they did over two decades ago. The TPS usage of OLF Webster has remained nearly the same as in 1998, but there was a total of 69,836 operations for OLF Webster in the 1998 EIS while the current noise study has 7,303 total operations at OLF Webster. This difference in modeled operations is the main driver for changes to the noise contours.

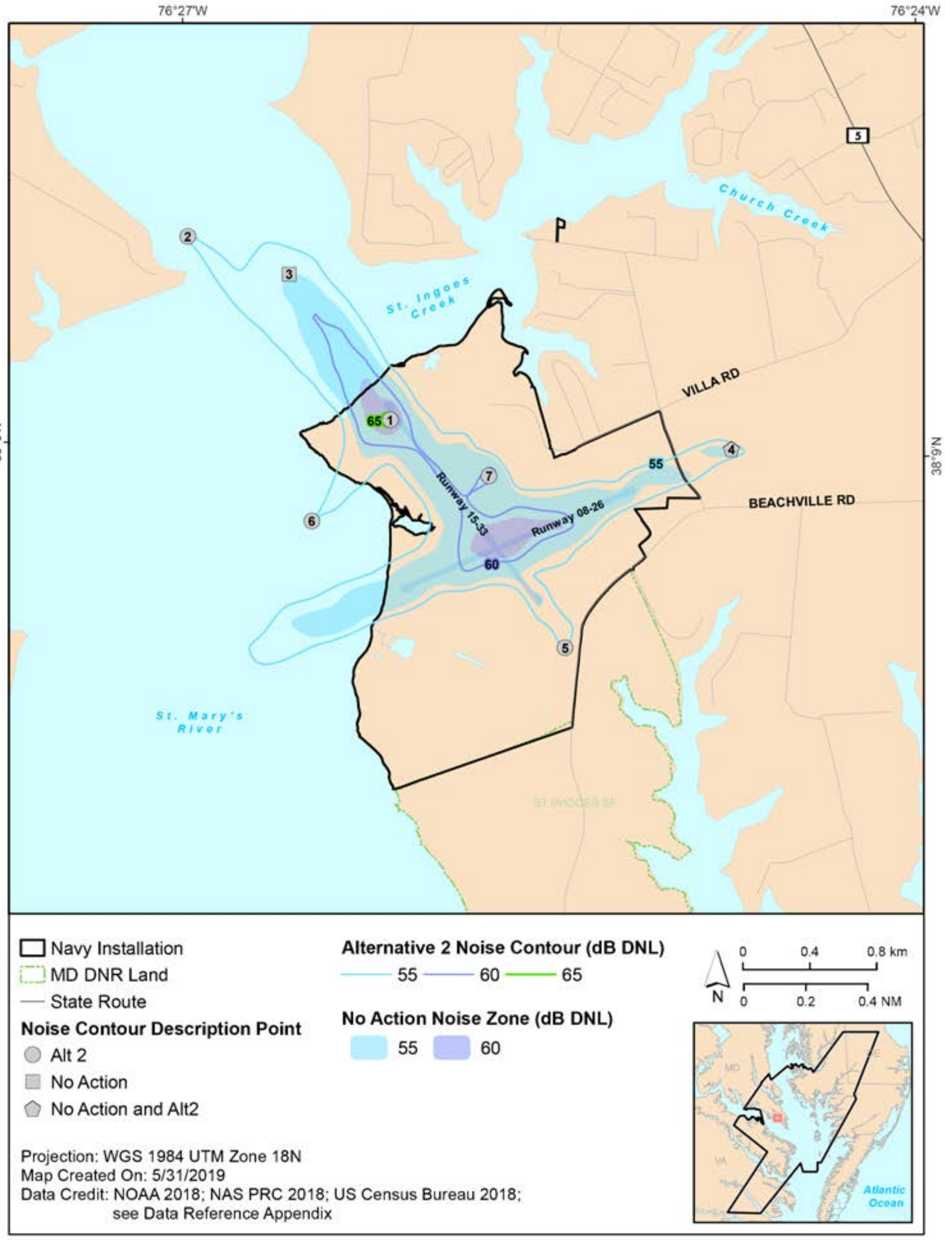

Figure 3-7. OLF Webster DNL Noise Contour Description Points with Alternative 2 and No Action DNL Contours

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 3-5. Explanations of the Shapes, Increases, or Differences for the OLF Webster No Action and Alternative 2 DNL Contours at Each Noise Contour Description Point

Location Number	DNL Level	Scenario	Top Contributor	Explanation
1	65	Alt 2	MQ-8 Firescout Departures from Spot 1	75% of MQ-8 departures are from Spot 1 (at location #1). Group 4 UAS are expected to increase by a factor of 2.1 and 2.3 for Alternative 1 and Alternative 2, respectively, so the DNL contours are greater for the alternatives than for the No Action.
2	55	Alt 2	MQ-8 Firescout Departure from Spot 1 to North	
3	55	No Action	Runway 33 T-6 VFR Closed Patterns	T-6 Closed Pattern profile for Runway 33 is at 100% takeoff power above this point.
4	55	No Action and Alt 2	Runway 08 T-6 VFR Closed Pattern	T-6 Closed Pattern profile for Runway 06 is at 100% takeoff power above this point.
5	55	Alt 2	Runway 15 T-6 VFR Closed Pattern	The contour is smaller for Runway 15 closed patterns because Runway 15 is the least utilized runway at Webster with only 14% annual average utilization.
6	55	Alt 2	MQ-8 Firescout Departures from Spot 1 to Southwest	After departing Spot 1, 30% of these departures head southwest, resulting in this sharp DNL contour to the southwest. There are 2.1 and 2.3 times more Firescout sorties for Alternative 1 and 2 (respectively) than in the No Action, so the contour is much more pronounced for the alternatives.
7	60	Alt 2	Test Pilot School H-72 Grass Patterns	40% of TPS H-60 and H-72 sorties go to Webster for pattern work and only 1% of HX-21, H-1, and H-60 go to Webster. The previous analysis (based on the 1998 EIS) had nearly 70,000 annual operations at Webster, while the current analysis only has 7,300 annual operations. This reduction in operations is the reason for the much smaller contours. The major contributor from the previous EIS analysis appeared to be helicopter grass patterns, but fewer helicopter operations were modeled this time around (based on squadron interviews).

Key: Alt = Action Alternative; DNL = Day-Night Average Sound Level; EIS = Environmental Impact Statement; Helo = helicopter; UAS = Unmanned Aircraft System; VFR = visual flight rules.

56

3.2.3 Proposed Action Alternatives DNL and SEL at Representative Locations

Alternative 1 overall DNL and maximum SEL of a single aircraft event at each of the representative locations are listed in Table 3-6, and the Alternative 2 DNL and maximum SEL of a single aircraft event at each of the locations are listed in Table 3-7. The locations were presented in Figure 2-14 of Section 2.4.2. The location with the highest DNL and greatest increase in DNL in Alternative 1 over the No Action is Cedar Cove Apartments (PO8) with 68 dBA DNL, which is a 2 dBA increase over the No Action. In Alternative 2, seven locations have a 2 dBA DNL increase over the No Action. There are no increases in the max SEL, which means that the same highest SEL contributor (within the top 20 contributors to the overall DNL) in the No Action is also the highest in Alternatives 1 and 2. Supplemental metrics at these locations are presented in Section 6.

Table 3-6. Alternative 1 DNL and Maximum SEL at Each Representative Location

Representative Location		DNL (dBA)			Max SEL (dBA)		
ID	Description	No Action	Alternative 1	Increase re No Action	No Action	Alternative 1	Increase re No Action
P01	Asbury Solomons	47	47	-	103	103	-
P02	Our Lady Star of the Sea School	58	59	+1	110	110	-
P03	Drum Point Club	64	65	+1	113	113	-
P04	Captain Walter Francis Duke Elementary School	48	49	+1	95	95	-
P05	Green Holly Elementary School	48	49	+1	93	93	-
P06	Chancellors Run Activity Center	45	46	+1	90	90	-
P07	Lexington Park Elementary School	59	60	+1	107	107	-
P08	Cedar Cove Apartments	66	68	+2	113	113	-
P09	Spring Ridge Middle School	46	46	-	96	96	-
P10	Elms Beach Park	52	53	+1	102	102	-
P11	Historic St. Mary's City	40	41	+1	94	94	-
P12	Harry Lundeberg School of Seamanship	42	42	-	86	86	-
P13	St. Ignatius Roman Catholic Church	47	48	+1	95	95	-
P14	Point Lookout State Park	23	24	+1	73	73	-
P15	Northumberland Elementary School	24	25	+1	73	73	-

Key: DNL = day-night average sound level; dBA = A=weighted decibels; max = maximum; SEL = sound exposure level.

Table 3-7. Alternative 2 DNL and Maximum SEL at Each Representative Location

Representative Location		DNL (dBA)			Max SEL (dBA)		
ID	Description	No Action	Alternative 2	Increase re No Action	No Action	Alternative 2	Increase re No Action
P01	Asbury Solomons	47	48	+1	103	103	-
P02	Our Lady Star of the Sea School	58	60	+2	110	110	-
P03	Drum Point Club	64	65	+1	113	113	-
P04	Captain Walter Francis Duke Elementary School	48	49	+1	95	95	-
P05	Green Holly Elementary School	48	50	+2	93	93	-
P06	Chancellors Run Activity Center	45	46	+1	90	90	-
P07	Lexington Park Elementary School	59	61	+2	107	107	-
P08	Cedar Cove Apartments	66	68	+2	113	113	-
P09	Spring Ridge Middle School	46	46	-	96	96	-
P10	Elms Beach Park	52	53	+1	102	102	-
P11	Historic St. Mary's City	40	42	+2	94	94	-
P12	Harry Lundeberg School of Seamanship	42	42	-	86	86	-
P13	St. Ignatius Roman Catholic Church	47	49	+2	95	95	-
P14	Point Lookout State Park	23	24	+1	73	73	-
P15	Northumberland Elementary School	24	26	+2	73	73	-

Key: DNL = day-night average sound level; dBA = A=weighted sound level, Decibel; SEL = sound exposure level.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

4 Patuxent River Complex Airspace Noise Analysis

4.1 PRC Airspace Operational Parameters

The PRC is composed of several specific airspace units. The modeled units are displayed in Figure 4-1. A field is provided in the FIST database for pilots to record airspaces used during flights; however, this data is entered inconsistently. Therefore, PRC airspace utilization was determined solely by pilot interviews for NAS Patuxent River squadrons. For each airspace unit, the following parameters were provided: annual operations, altitude distributions, average airspeed and power settings, and mission durations. The following subsections list the validated squadron specific airspace parameters. The percentage utilizations of aircraft sorties to each airspace area within the PRC may not add up to 100 percent. This utilization is based on all sorties, some of which do not utilize PRC, and thus, they are not modeled. Note that restricted areas R-4002 and R-4007 were not modeled because they are flown infrequently. During the interviews, no pilots mentioned flying in R-4002 or R-4007, although the larger restricted areas include parts of R-4002 and R-4007. There are overlapping restricted areas in the PRC.

4.1.1 Test Pilot School Airspace Parameters

For TPS PRC fixed-wing airspace utilization, 95 percent of all T-38 and T-6 sorties utilize R-4006 and R-4008 (combined area), 90 percent of F/A-18E/F sorties utilize R-4006 and R-4008 (combined area), 75 percent of C-12 and C-21 sorties utilize R-4006. For the TPS helicopters, 95 percent of H-60 and H-72 sorties utilize West, South, and East Helo Operating Areas (equal use among the 3 areas), and 5 percent of sorties utilize R-4006.

The altitude bands flown by these aircraft, durations within the airspace, average airspeeds, and average engine powers are listed in Table 4-1.

Table 4-1. Test Pilot School Airspace Operational Parameters

Airspace Altitude Profiles

Aircraft	Altitude Band Utilization (ft MSL)								Duration	Airspeed	Power
	1,000-3,000	1,000-4,000	4,000-6,000	5,000-10,000	5,000-6,000	6,000-10,000	6,000-18,000	10,000-20,000			
T-38				10%				90%	40 min	350-400 kts	90% RPM
T-6			5%				95%		1.2 hours	160 kts	50%
C-12/C-21					5%	95%			1.5 hours	150-180 kts	60% Torque
H-60/H-72 in West Helo		100%							1.5 hours	100-110 kts	N/A
H-60/H-72 in East and South Areas	100%								1.5 hours	100-110 kts	N/A
F-18				10%				90%	40 min	350-400 kts	90% RPM

Key: ft = feet; Helo = helicopter; kts = knots; min = minutes; MSL = mean sea level; N/A = not applicable; RPM = revolutions per minute.

58

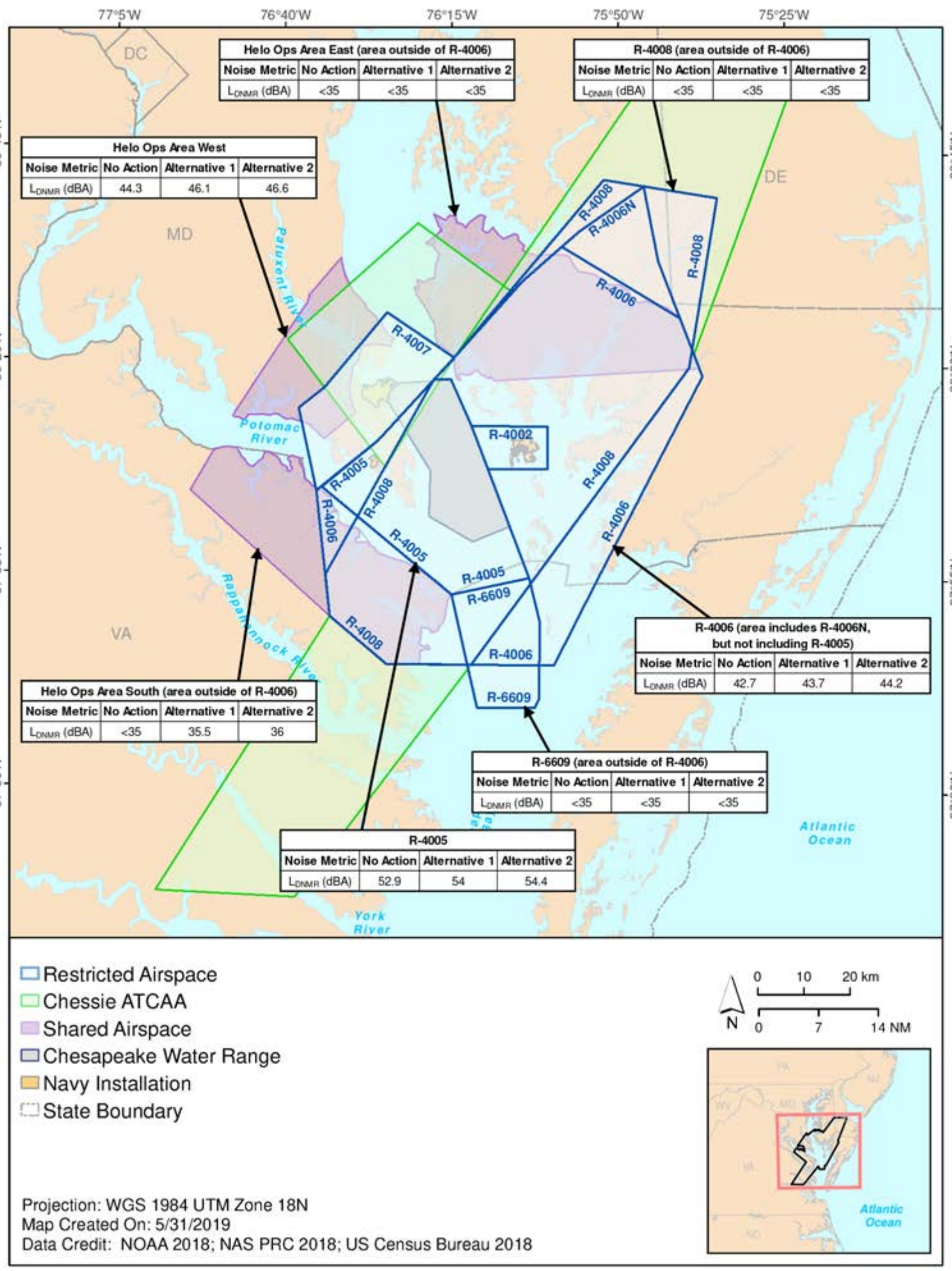

Figure 4-1. PRC Airspace Areas Modeled in the Noise Analysis

4.1.2 VX-23 Airspace Parameters

For VX-23 PRC airspace utilization, 6 percent of all sorties of F/A-18 (all variants) utilize R-4005 and 54 percent utilize the combined R-4006 and R-4008 area. For F-35 (both variants), 2 percent of all sorties utilize R-4005 and 18 percent utilize the combined R-4006 and R-4008 area. For T-45, 10 percent of all sorties utilize R-4005 and 89 percent utilize the combined R-4006 and R-4008 area. For MQ-25, 10 percent of all sorties utilize R-4005, 65 percent utilize R-4006, 5 percent utilize R-4008, and 5 percent utilize the test track.

The altitude bands flown by these aircraft, durations within the airspace, average airspeeds, and average engine powers are listed in Table 4-2.

Table 4-2. VX-23 Airspace Operational Parameters

Airspace Altitude Profiles

Aircraft	Altitude Band Utilization (ft MSL)						Duration in Area	AVG Airspeed	AVG power setting
	1,000-3,500	3,500-10,000	10,000-20,000	20,000-25,000	25,000-30,000	30,000-40,000			
F-18 in R-4005	100%								
F-18 in R-4006		40%	40%	20%			1.2 hours	350 kts	90% RPM
F-18 in R-4008					47%	53%			
F-35B/C in R-4005	100%								
F-35B/C in R-4006		40%	40%	20%			0.8 hours	300 kts	90% ETR
F-35B/C in R-4008					47%	53%			
T-45 in R-4005	100%								
T-45 in R-4006		40%	40%	20%			1 hour	325 kts	92% RPM
T-45 in R-4008					47%	53%			

Aircraft	Altitude Band Utilization (ft MSL)			Duration	Airspeed	Power
	2,000-5,000	15,000-25,000	25,000-30,000			
MQ-25 in R-4006		100%				
MQ-25 in R-4005	100%			4 hours	200 kts	50%
MQ-25 in R-4008			100%			

Key: AVG = average; ETR = engine thrust request; ft = feet; kts = knots; MSL = mean sea level; RPM = revolutions per minute.

4.1.3 Search and Rescue Airspace Parameters

Based on the squadron interviews, SAR does not utilize the PRC airspace, so only arrivals, departures, and patterns at NAS Patuxent River were modeled.

4.1.4 VX-20 Airspace Parameters

For VX-20 airspace utilization, 50 percent of all C-38 and C-12 sorties utilize R-4006 and 10 percent utilize R-4005. For P-8 and P-3, 20 percent utilize R-4006, 22 percent utilize R-4005, and 8 percent utilize R-4008. For E-2, 55 percent utilize the combined R-4006 and R-4008 area. For T-6 and C-130, 100 percent of all sorties utilize the combined R-4006 and R-4008 area. E-6B does not utilize the PRC airspace.

The altitude bands flown by these aircraft, durations within the airspace, average airspeeds, and average engine powers are listed in Table 4-3.

Table 4-3. VX-20 Airspace Operational Parameters

Aircraft	Altitude Band Utilization (ft MSL)								AVG Airspeed	Duration in the Area	AVG power setting
	600 AGL-3,000	3,500-5,000	5,000-10,000	10,000-25,000	15,000-20,000	18,000-40,000	20,000-27,000	25,000-40,000			
E-2/T-6					34%		66%		150 kts	3.5 hours	1,000 lbs/hr per side
P-8/P-3 in R-4005	100%								225 kts	4 hours	13,000 lbs thrust per motor
P-8/P-3 in R-4006		10%	40%	50%					225 kts	4 hours	13,000 lbs thrust per motor
P-8/P-3 in R-4008								100%	225 kts	4 hours	13,000 lbs thrust per motor
C-38(C-21) /C-12 in R-4005	100%								200 kts	4 hours	50% power
C-38(C-21) /C-12 in R-4006				100%					200 kts	4 hours	50% power
C-130 in R-4006		10%	40%	50%					225 kts	4 hours	850 CTIT

Key: AVG = average; CTIT = Celsius turbine inlet temperature; ETR = engine thrust request; ft = feet; kts = knots; lbs/hr = pounds per hour; MSL = mean sea level; RPM = revolutions per minute.

4.1.5 HX-21 Airspace Parameters

For HX-21 airspace utilization, 44 percent of all H-60 sorties are to the West Helo Operating Area, 5 percent are to the East Helo Operating Area, 5 percent are to the South Helo Operating Area, 15 percent are to R-4005, and 1 percent are to OLF Webster. For H-1, 70 percent of sorties are to the West Helo Operating Area, 24 percent are to R-4005, and 1 percent are to OLF Webster. For MV-22, 10 percent of all sorties are to West Helo Operating Area, 20 percent are to East Helo Operating Area, and 30 percent are to R-4005. For CH-53E/K, 50 percent of sorties are to R-4005N, 40 percent are to R-4005S, and 10 percent are to R-6609. For the Presidential VH-92 and H-3 (both modeled as CH-53E), 23 percent of sorties are to the West Helo Operating Area, 5 percent are to the East Helo Operating Area, 7 percent are to the South Helo Operating Area, 5 percent are to R-4005, and 2 percent are to OLF Webster.

The altitude bands flown by these aircraft, durations within the airspace, average airspeeds, and average engine powers are listed in Table 4-4.

Table 4-4. HX-21 Airspace Operational Parameters

Aircraft	Utilized Altitude Bands (ft MSL)								Airspeed	Duration
	surface-1,000	1,000-3,000	3,000-5,000	3,000-8,000	surface-4,000	4,000-10,000	5,000-18,000	10,000-24,000		
H-1 in R-4005	10%	75%		15%					100 kts	1.5 hours
H-1 in West area		100%							101 kts	1.5 hours
H-60 (all areas)	59%	40%		1%					102 kts	2 hours
V-22					10%	70%		20%	200 kts	2 hours
CH-53E/K		20%	60%				20%		120 kts	1.5 hours
Presidential VH-92 and H-3		100%							100 kts	1.5 hours

Key: ft = feet; kts = knots; MSL = mean sea level.

4.1.6 VX-1 Airspace Parameters

Most VX-1 sorties are to areas other than the PRC and are not modeled. For the modeled VX-1 airspace utilization, 34 percent of all E-2 sorties are to the combined R-4006 and R-4008 area. For P-8, 5 percent of all sorties are to the combined R-4006 and R-4008 area. For H-60, 20 percent of sorties are to the East Helo Operating Area.

The altitude bands flown by these aircraft, durations within the airspace, average airspeeds, and average engine powers are listed in Table 4-5.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 4-5. VX-1 Airspace Operational Parameters

Airspace Altitude Profiles

Aircraft	Altitude Band Utilization (ft MSL)						Duration in Area	AVG Airspeed	AVG power setting
	500 AGL-1,000	5,000-6,000	5,000-20,000	15,000-16,000	16,000-39,000	20,000-26,000			
H-60	100%						1 hr	70 kts	N/A
P-8		10%		38%	52%		4 hr	250 kts	77%
E-2			20%			80%	3.5 hr	150 kts	50% (1,000 lb/hr per side)

Key: AGL = above ground level; AVG = average; ft = feet; kts = knots; lb/hr = pounds per hour; MSL = mean sea level; N/A = not applicable.

4.1.7 VQ-4 Airspace Parameters

VQ-4 does not utilize the PRC airspace for training. Only arrivals, departures, and closed patterns at NAS Patuxent River were modeled.

4.1.8 VXS-1 Airspace Parameters

For VXS-1 airspace utilization, 90 percent of all P-3 sorties utilize R-4006 and 50 percent of all C-12 sorties utilize R-4006. The remainder of the P-3 and C-12 sorties are to other areas outside of the PRC and are not modeled. The altitude bands flown by these aircraft, durations within the airspace, average airspeeds, and average engine powers are listed in Table 4-6.

Table 4-6. VXS-1 Airspace Operational Parameters

Airspace Altitude Profiles

Aircraft	Altitude Band Utilization (ft MSL)				Duration in Area	AVG Airspeed	AVG power setting
	3,500-5,000	5,000-10,000	10,000-15,000	15,000-20,000			
P-3	1%	15%	1%	83%	5.5 hours	200 kts	2,500 HP per engine
C-12	1%	99%	0%	0%	1.5 hours	180 kts	55% Torque

Key: AVG = average; ft = feet; HP = horsepower; kts = knots; MSL = mean sea level.

4.1.9 UX-24 and MDARNG Airspace Parameters

For the airspace utilization of UX-24 and MDARNG (both operating out of OLF Webster), 20 percent of MQ-8 (modeled as UH-1) sorties are to R-4005W, 60 percent are to R-4005SW, 10 percent are to R-6609, and 10 percent are to R-4006S. For the RQ-21 and RQ-26 of UX-24 and the RQ-7 of MDARNG (all modeled as GASEPF), 25 percent of sorties are to R-4005W and 75 percent are to R-4005SW. The altitude bands flown by these aircraft, durations within the airspace, average airspeeds, and average engine powers are listed in Table 4-7.

Table 4-7. UX-24 and MDARNG Airspace Operational Parameters

Aircraft	Altitude Band Utilization (ft MSL)									Duration in Area	AVG Airspeed	AVG power setting
	2,000-3,000	3,000-10,000	3,000-3,500	5,000-10,000	8,000-9,000	9,000-10,000	6,000-7,000	7,000-10,000	3,000-6,000			
MQ-8 in 4005W	80%	20%								3 hours	55 kts	N/A
MQ-8 in 4005SW			80%	20%								
MQ-8 in 6009					80%	20%						
MQ-8 in 4006S							80%	20%				
RQ-7, RQ-21, RQ-26									100%	4 hours	58 kts	50% (5,000 RPM)

Key: AVG = average; ft = feet; kts = knots; MDARNG = Maryland Army National Guard; MSL = mean sea level; N/A = not applicable; RPM = revolutions per minute.

4.1.10 Transient Aircraft Airspace Parameters

A-10 and F-16 transients were modeled in the airspace analysis. These data came from ATC airspace records and represent an average of 1,347 flight hours over the 10-year period of CY 2008 – CY 2017. It is assumed that the PPR logs account for part of these transients that land at the NAS Patuxent River airfield. The A-10 and F-16 transients were modeled in R-4006 from 3,500 feet mean sea level (MSL) (floor of R-4006) to 25,000 feet MSL with equal distribution across this altitude band.

4.1.11 Military Training Routes

Logs were obtained for MTRs VR-1711, VR-1712, and VR-1713, since parts of these MTRs intersect the PRC. Although VR-1709 intersects the northern part of PRC, logs for VR-1709 were not provided. Five annual sorties were recorded on VR-1711, 66 were recorded on VR-1712, and 71 were recorded on VR-1713. This represents approximately one sortie per five days on VR-1712 and VR-1713. These events will be noticeable when they occur but will not generate any average noise footprint since they occur so infrequently; therefore, they are not modeled.

4.2 PRC Airspace Noise Analysis Results

Airspace testing and training has a large variability in aircraft mission types, maneuvers, and spatial utilization within each airspace, so the noise model uniformly distributes the operations across the entire modeled area. Thus, the calculated L_{dnmr} noise is also distributed equally within each airspace unit. Therefore, Table 4-8 presents the L_{dnmr} noise within each airspace area. The highest distributed noise exposure and the only L_{dnmr} that is over 50 dBA is in R-4005. The L_{dnmr} in R-4005 is 52.9 dBA for the No Action, 54.0 for Alternative 1, and 54.4 for Alternative 2.

While Table 4-8 shows the cumulative average annual noise exposure, noise from airspace testing and training operations are more infrequent and variable compared to airfield noise. To address single event noise events of aircraft utilizing the various airspaces, Table 4-9 presents the single event overflight SEL_r and L_{Amax} noise. The Route NoiseMap Model, MR_NMap, utilizes SELr to give a penalty for the high speed airspace operations. The higher the speed the aircraft is traveling in the airspace or along a route, the greater the penalty in the SELr. This table presents the single event noise exposure SEL_r and maximum noise level L_{Amax} for aircraft at the lowest altitude that they would possibly be flying in airspace area listed. These airspace altitude distributions, aircraft power settings and airspeeds were determined from interviews with the aircraft pilots and represent the average mission parameters the aircraft would be flying in these airspaces. It's important to note that quieter aircraft at a lower altitude can have greater noise impacts than louder aircraft at higher altitudes. For example, the HX-21 H-60 in the West Helo Operating Area at 100 feet above ground level (AGL) has higher SEL_r and L_{Amax} values than the VX-23 F/A-18C/D in R-4006 at 3,500 feet AGL.

Table 4-8. PRC Airspace Analysis L_{DNMR} (dBA) Results for Each Airspace Area

PRC Airspace Name	LDNMR Results		
	No Action LDNMR (dBA)	Alternative 1 LDNMR (dBA)	Alternative 2 LDNMR (dBA)
Helo Ops Area East (area outside of R-4006)	<35	<35	<35
Helo Ops Area South (area outside of R-4006)	<35	35.5	36
Helo Ops Area West	44.3	46.1	46.6
R-4005	52.9	54	54.4
R-4006 (area includes R-4006N, but not including R-4005)	42.7	43.7	44.2
R-4008 (area outside of R-4006)	<35	<35	<35
R-6609 (area outside of R-4006)	<35	<35	<35

Key: < = less than; dBA = A-weighted decibels; AGL = above ground level; L_{dnmr} = A-weighted onset-rate adjusted monthly day-night average sound level; PRC = Patuxent River Complex.

Table 4-9. PRC Airspace Single Event Overflight SEL_r and L_{Amax} Noise Results

Aircraft	Squadron	Airspace Area	Airspace Floor Altitude (lowest the aircraft will likely fly in the area)	Aircraft Power Setting	Aircraft Airspeed (kts)	SELR (dBA)	Lmax (dBA)
H-60	HX-21	West Helo Operating Area / R-4005	100 ft AGL	N/A	120	97	93
CH-53	HX-21	West Helo Operating Area / R-4005	1,000 ft AGL	N/A	100	95	88
H-1	HX-21	West Helo Operating Area	1,000 ft AGL	N/A	120	90	76
H-1	HX-21	R-4005	100 ft AGL	N/A	100	101	91
F-18E/F	VX-23	R-4005	1,000 ft AGL	90% NC	350	110	106
F-18C/D	VX-23	R-4005	1,000 ft AGL	90% NC	350	104	99
T-45	VX-23	R-4005	1,000 ft AGL	92% RPM	325	91	86
F-35B	VX-23	R-4005	1,000 ft AGL	90% ETR	300	114	108
F-35C	VX-23	R-4005	1,000 ft AGL	90% ETR	300	115	110
F-18E/F	VX-23	R-4006	3,500 ft AGL	90% NC	350	98	91
F-18C/D	VX-23	R-4006	3,500 ft AGL	90% NC	350	91	83
T-45	VX-23	R-4006	3,500 ft AGL	92% RPM	325	80	71
F-35B	VX-23	R-4006	3,500 ft AGL	90% ETR	300	102	93
F-35C	VX-23	R-4006	3,500 ft AGL	90% ETR	300	103	94
MQ-25 (C-21)	VX-23	R-4005	2,000 ft AGL	50% NC	200	68	57
P-8	VX-20	R-4005	600 ft AGL	13,000 LBS	225	110	107
P-3	VX-20	R-4005	600 ft AGL	4,000 ESHP	225	96	92
C-130	VX-20	R-4006	3,500 ft AGL	850 CTIT	225	78	70
T-6	TPS	R-4006	4,000 ft AGL	50% Torque	160	67	59
H-60	TPS	R-4006	1,000 ft AGL	N/A	100	85	76
T-38	TPS	R-4006	5,000 ft AGL	90% RPM	350	68	58

Key: AGL = above ground level; CTIT =Celsius turbine inlet temperature; dBA = A-weighted decibels; ESHP = equivalent shaft horsepower; ETR = engine thrust request; ft = feet; Helo = helicopter; kts = knots; lbs = pounds; L_{max} = maximum sound level in A-weighted decibels; L_{max} = maximum sound level; N/A = not applicable; NC = core engine speed; RPM = revolutions per minute; SEL = sound exposure level; SEL_r = onset rate adjusted sound exposure level.

5 PRC Supersonic Aircraft Noise and Aircraft Munitions Noise

5.1 Supersonic Aircraft Noise Analysis

PCBoom6 was used to model the sonic boom exposures for supersonic aircraft operations within the PRC. Although PCBoom is a single event sonic boom type model, the resulting individual sonic boom footprints were accumulated into a calculated CDNL grid for the presentation of cumulative sonic boom CDNL contours. The current DoD cumulative sonic boom model, BooMap3, does not accurately model the type of supersonic events occurring at PRC. BooMap3 estimated the sonic boom exposures from air combat maneuvering training. This training involves a wide distribution of supersonic maneuvering trajectories. However, supersonic events at PRC are primarily straight line segments, which are either level or in diving flight.

The 10 years of supersonic trajectory data were input into PCBoom to generate an ensemble of sonic boom footprints. These individual sonic boom footprints were combined to calculate the long-term exposure in the form of CDNL contours of the sonic booms. The supersonic trajectory data include aircraft type, start/stop distances and radials, start and stop altitudes, and maximum Mach number. The heading of the trajectory was calculated from the distances and radials, which were relative to the Patuxent River Very High Frequency Omni-Directional Radio Range Tactical Air Navigation Aid (VORTAC). The supersonic modeling assumes a standard acceleration for each aircraft starting at Mach 1 at the beginning of the segment. The aircraft accelerates to the maximum Mach number listed in the telemetry data, then maintains that Mach number. Standard deceleration of each aircraft is also assumed, and the aircraft decelerates from the maximum Mach number back to Mach 1 such that Mach 1 is reached at the end of the supersonic segment.

5.2 Aircraft Munitions Noise Analysis

AGNM version 2.0 (BaseOps integrated version) was used for aircraft munitions modeling. Aircraft in the PRC primarily utilize Hannibal and Hooper targets and both targets are used in the modeling. Rockets are limited to inert 5-inch and 2.75-inch forward firing aircraft rockets for inshore weapon use, and the expenditure rate is low. For modeling, it will be assumed that 100 percent of the rockets contain live motors. The Optimal Release Envelope for weapons on the H-60 was obtained during the interview process, but the fixed-wing optimal release envelope is unknown since it occurs so infrequently and varies by test program. Therefore, for the fixed-wing aircraft, the modeled optimal release envelope was chosen from recent data utilized in the Noise Study for Military Activities at the Fallon Range Training Complex (June 2018) since the same weapon/aircraft combinations at NAS Patuxent River are also used at Fallon Range. CDNL contours as well as L_{Pk} were generated from the aircraft munitions modeling. Since the supersonic aircraft activity and the aircraft munitions activity occur in the same general area (over the Chesapeake Bay Water Range), the CDNL results of the aircraft sonic boom analysis and aircraft munitions analysis were combined and presented on the same maps and are shown in Section 5.3.

5.3 Sonic Boom and Aircraft Munitions Noise Results

Figure 5-1 presents the combined sonic boom and aircraft munitions CDNL contours for the PRC. These CDNL results are in C-weighted decibels (dBC) to reflect the impulsive low frequency noise of sonic booms and aircraft munitions. The No Action sonic boom CDNL contour is less than 45 dBC, as only the 40 dBC level is shown in the map. The sonic boom 40 dBC footprint does extend outside of the Chesapeake Bay Water Range, but it does not go over land. The Hannibal and Hooper targets are shown on the map and the munitions CDNL contours extend south of Hooper target and surrounding Hannibal target. The different shape of the CDNL contours between the two targets is due to the different weapons systems, aircraft types, and run-in headings used for those targets.

Figure 5-2 and Figure 5-3 display the Alternative 1 and Alternative 2 CDNL contours for sonic boom and munitions noise for the PRC. The sonic boom 40 dBC contour extends over a much greater area under Alternatives 1 and 2 compared to the No Action Alternative. This increase arises from the increase in future year TPS and VX-23 F/A-18E/F Super Hornet operations for Alternatives 1 and 2. Additionally, the sonic boom exposure contribution to the CDNL increases slightly above 45 dBC. One small 45 dBC island appears in the southwest corner of the range for Alternative 1, and 3 small 45 dBC islands are calculated near the edge of the range for Alternative 2. For the aircraft munitions noise, the CDNL contours surrounding the two targets increased only slightly between the No Action and the Alternatives due to the overall increase in operations for each squadron. No other aspects of the aircraft munitions modeling changed between the No Action and the Alternatives. Overall, the calculated CDNL values are very low and near the lower limits of the model's accuracy.

Figure 5-4 presents the aircraft munitions peak noise results for all alternatives. The peak pressure (L_{Pk}) is the highest instantaneous, unweighted sound level over any given time period. Because it is a single event metric, the results are equivalent across all alternatives since the only difference in the munitions noise between the No Action and the Action Alternatives is the number of munitions expended. For munitions noise, the standard noise levels to display on maps are peak levels (pK) 115 dB_{PK} and 130 dB_{PK}. These munition levels are associated with complaint risk. For levels above 130 dB_{PK}, complaint risk is high. For levels between 115 dB_{PK} and 130 dB_{PK}, complaint risk is moderate, and below 115 dB_{PK}, complaint risk is low (Department of the Army, 2007).

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

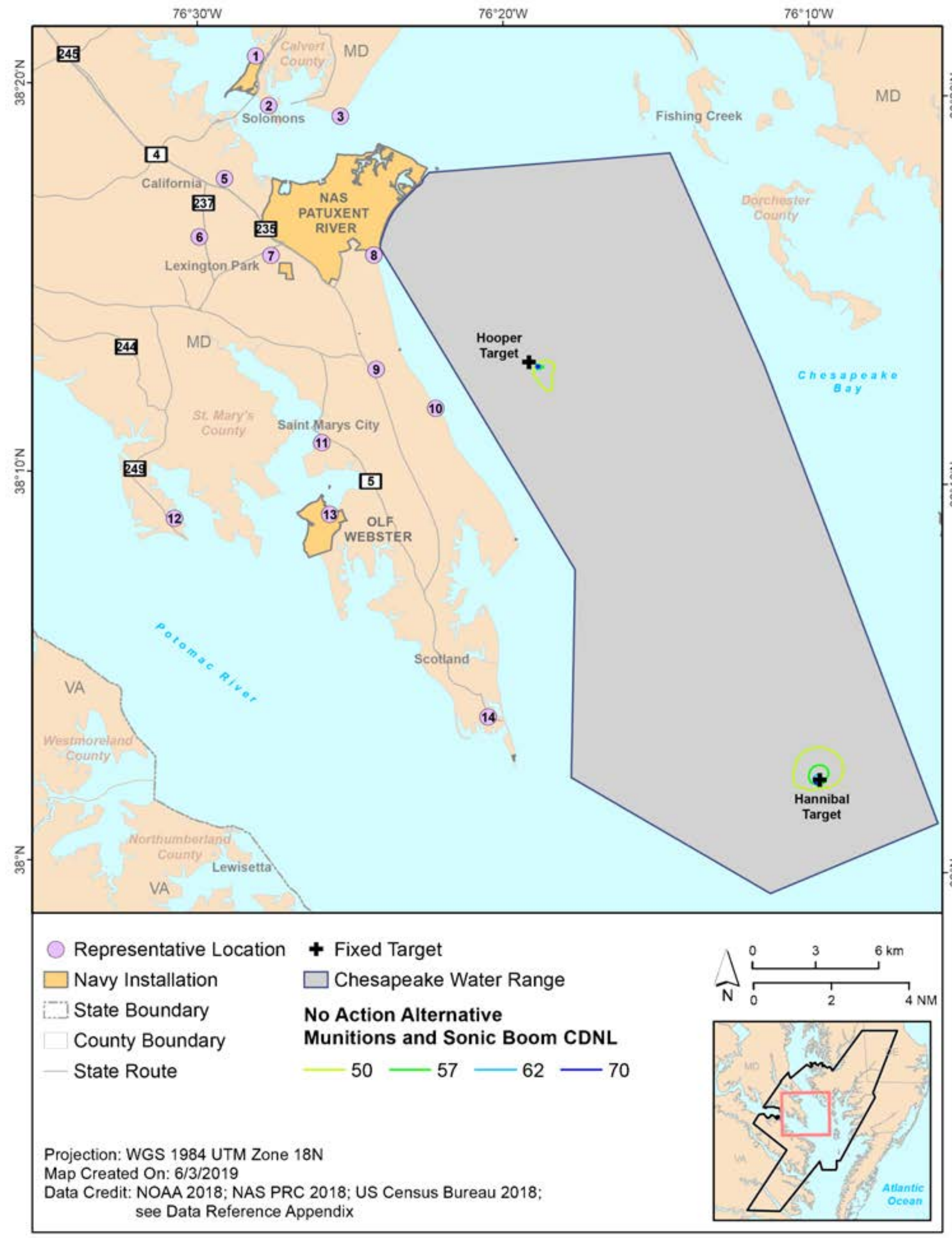

Figure 5-1. No Action Sonic Boom and Aircraft Munitions CDNL Results

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

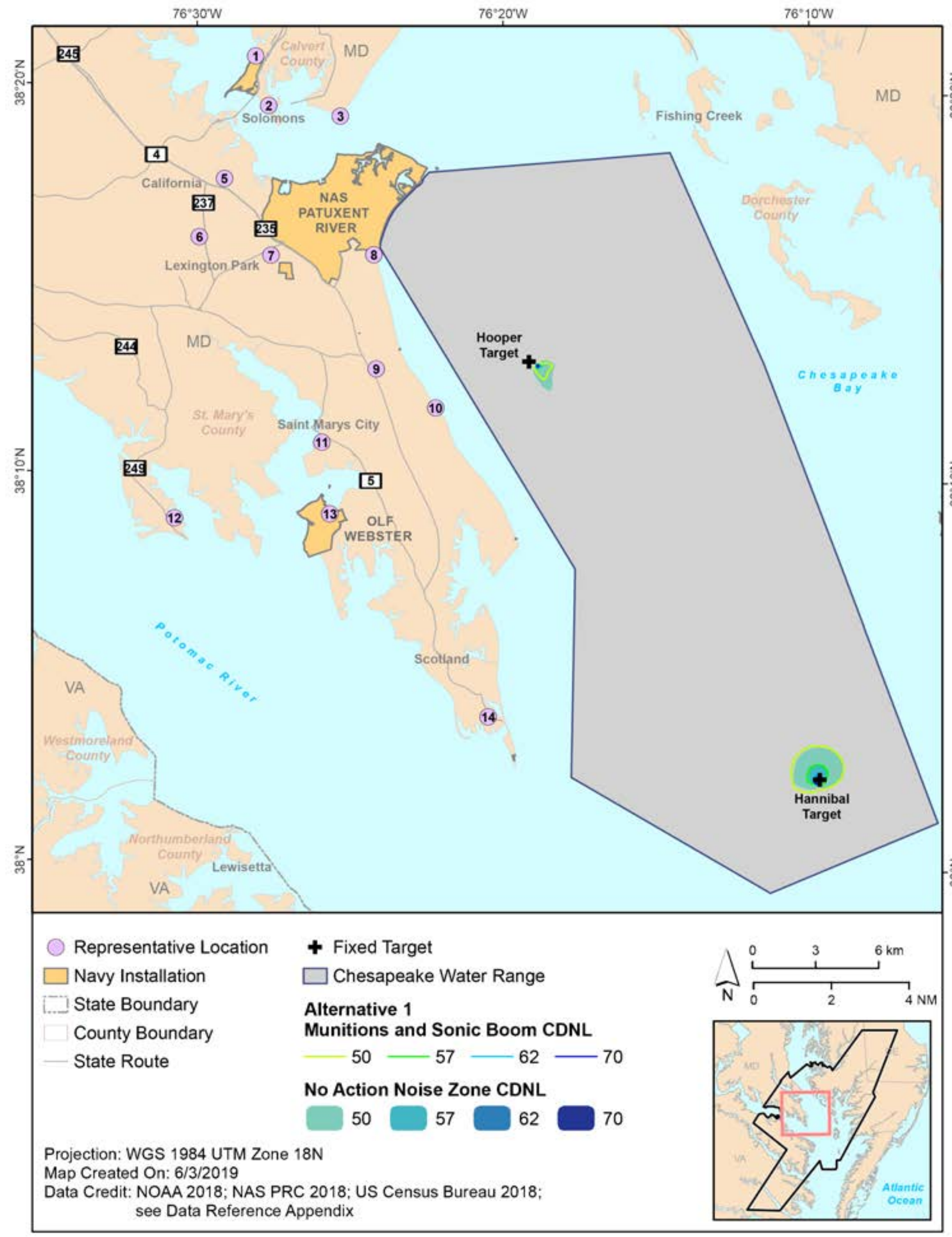

Figure 5-2. Alternative 1 Sonic Boom and Aircraft Munitions CDNL Results

68

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

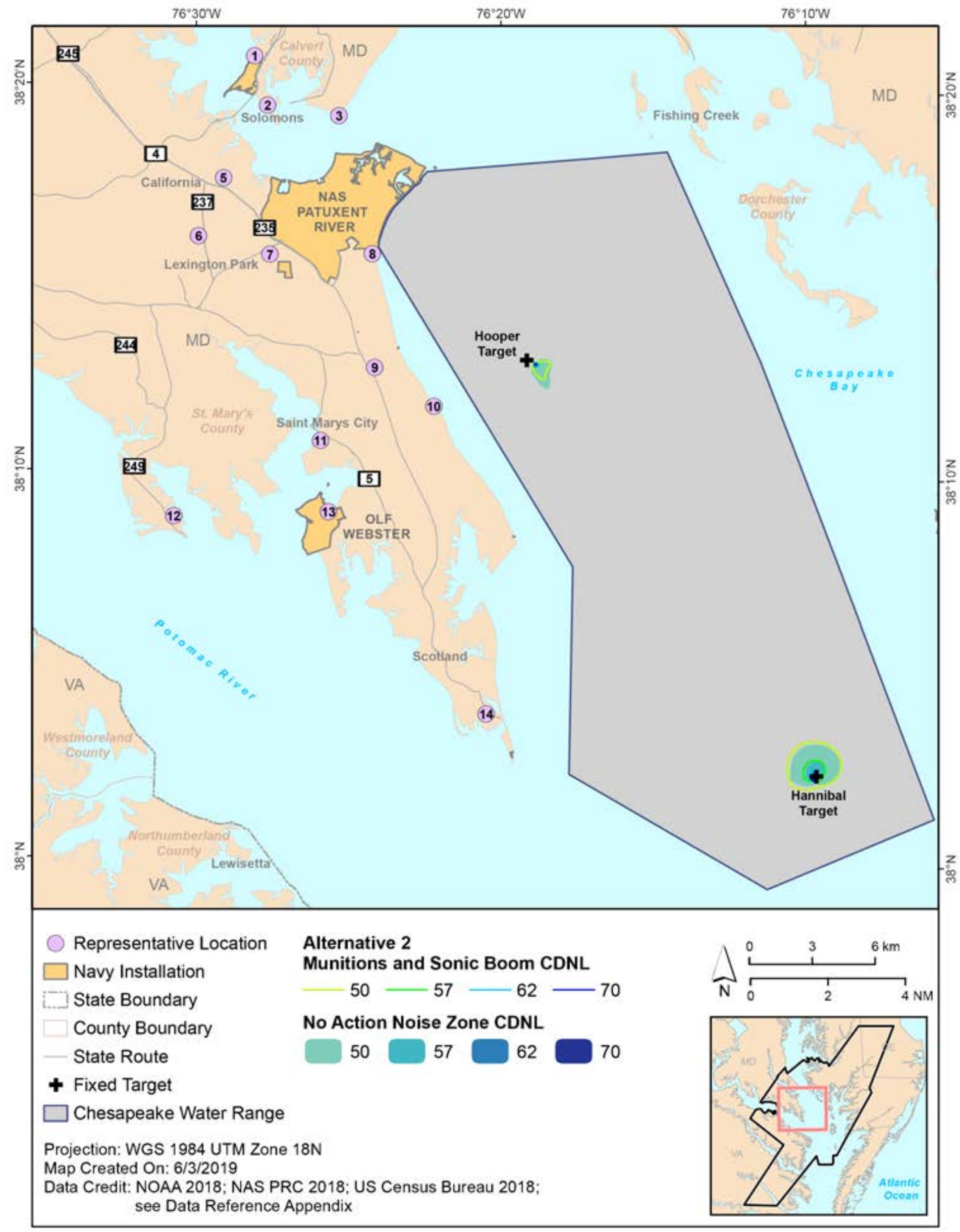

Figure 5-3. Alternative 2 Sonic Boom and Aircraft Munitions CDNL Results

69

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

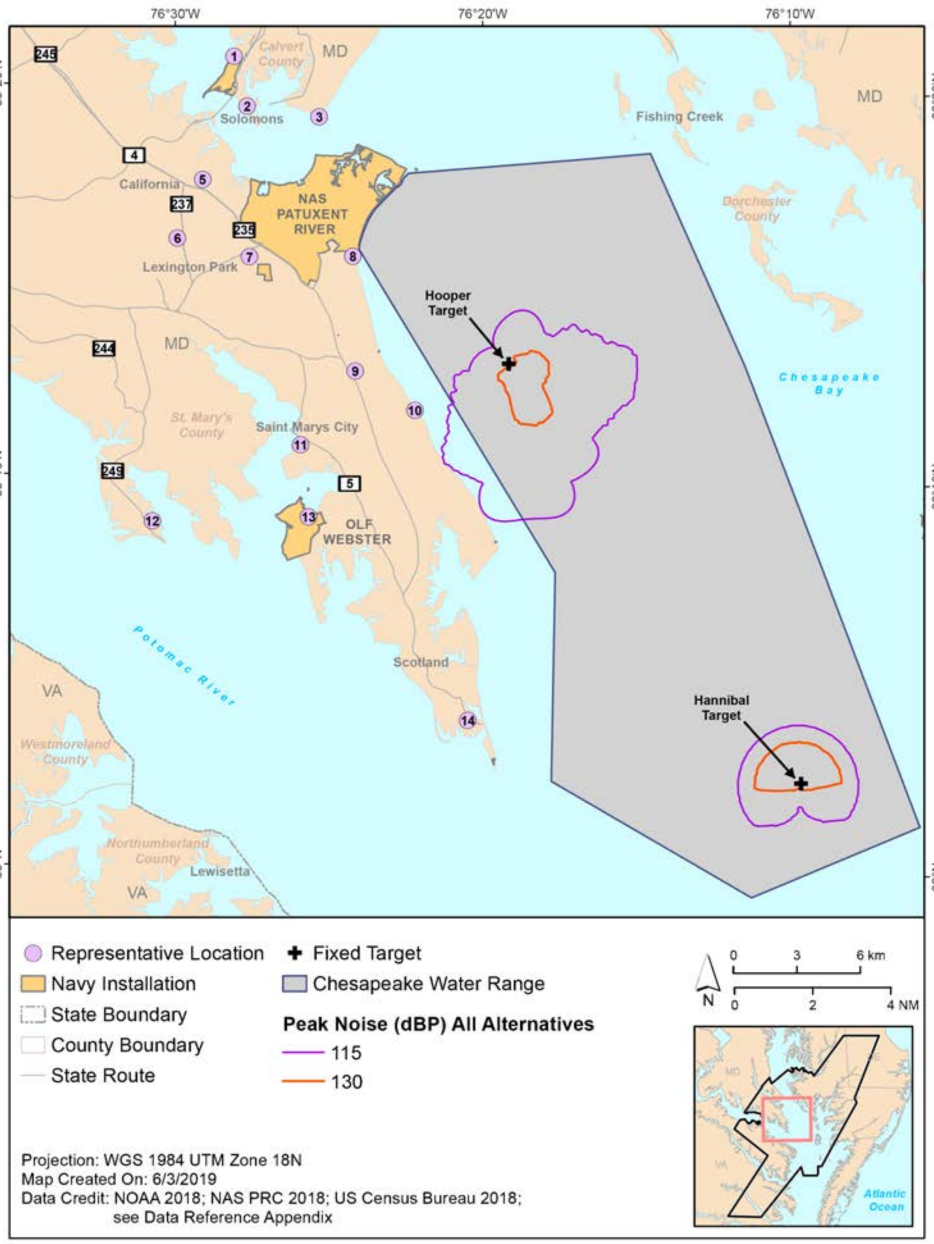

Figure 5-4. Aircraft Munitions Peak Noise Results

6 Supplemental Metrics Results

This section presents the supplemental metrics at the 15 points of interest in the areas surrounding NAS Patuxent River and OLF Webster. See Figure 2-14 for the map of these 15 locations. The important aspect of these comparisons is the variations between alternatives. The individual values provide some description of the long-term noise environment, but the day-to-day operations will vary throughout the year.

6.1 Outdoor Annual Number of Events Exceeding 80, 90, and 100 dBA L_{Amax}

This subsection presents the number of events that exceed L_{Amax} levels of 80, 90, and 100 dBA during a 24-hour day, multiplied by 365 to represent a full year. L_{Amax} is the maximum sound level of the aircraft overflight, so these annual events represent the number of annual events above three different levels of aircraft "loudness." Table 6-1, Table 6-2, and Table 6-3 present the No Action, Alternative 1, and Alternative 2 outdoor number of event exceeding levels of 80, 90, and 100 dBA L_{Amax}. Figure 6-1 gives some example sound levels for comparison to the 80, 90, and 100 dBA L_{Amax} level thresholds (FAA.gov, 2019).

Figure 6-1. Comparative Noise Levels in dBA

Table 6-1. No Action Outdoor Number of Annual Events Exceeding 80, 90, and 100 dBA L_{Amax}

Representative Locations		NA 80 Lmax (dBA)	NA 90 Lmax (dBA)	NA 100 Lmax (dBA)
ID	Description			
P01	Asbury Solomons	155	33	0
P02	Our Lady Star of the Sea School	1,689	268	17
P03	Drum Point Club	6,453	1,270	276
P04	Captain Walter Francis Duke Elementary School	923	0	0
P05	Green Holly Elementary School	310	0	0
P06	Chancellors Run Activity Center	24	0	0
P07	Lexington Park Elementary School	2,814	652	20
P08	Cedar Cove Apartments	8,088	3,612	544
P09	Spring Ridge Middle School	120	0	0
P10	Elms Beach Park	1,064	162	0
P11	Historic St. Mary's City	26	0	0
P12	Harry Lundeberg School of Seamanship	0	0	0
P13	St. Ignatius Roman Catholic Church	144	0	0
P14	Point Lookout State Park	0	0	0
P15	Northumberland Elementary School	0	0	0

Key: dBA =A-weighted decibels; ID = identification number; L_{Amax} = maximum sound level in A-weighted decibels; L_{max} = maximum sound level; NA=number of annual events.

Table 6-2. Alternative 1 Outdoor Number of Annual Events Exceeding 80, 90, and 100 dBA L_{Amax}

Representative Locations		NA 80 Lmax (dBA)			NA 90 Lmax (dBA)			NA 100 Lmax (dBA)		
ID	Description	No Action	Alternative 1	Increase re No Action	No Action	Alternative 1	Increase re No Action	No Action	Alternative 1	Increase re No Action
P01	Asbury Solomons	155	258	103	33	27	-6	0	0	0
P02	Our Lady Star of the Sea School	1,689	2,140	451	268	332	64	17	20	3
P03	Drum Point Club	6,453	7,751	1,298	1,270	1,581	311	276	331	55
P04	Captain Walter Francis Duke Elementary School	923	1,150	227	0	0	0	0	0	0
P05	Green Holly Elementary School	310	250	-60	0	0	0	0	0	0
P06	Chancellors Run Activity Center	24	43	19	0	0	0	0	0	0
P07	Lexington Park Elementary School	2,814	3,582	768	652	805	153	20	40	20
P08	Cedar Cove Apartments	8,088	9,386	1,298	3,612	4,566	954	544	921	377
P09	Spring Ridge Middle School	120	103	-17	0	0	0	0	0	0
P10	Elms Beach Park	1,064	1,444	380	162	263	101	0	0	0
P11	Historic St. Mary's City	26	45	19	0	0	0	0	0	0
P12	Harry Lundeberg School of Seamanship	0	0	0	0	0	0	0	0	0
P13	St. Ignatius Roman Catholic Church	144	241	97	0	0	0	0	0	0
P14	Point Lookout State Park	0	0	0	0	0	0	0	0	0
P15	Northumberland Elementary School	0	0	0	0	0	0	0	0	0

Key: dBA =A-weighted decibels; ID = identification number; L_{Amax} = maximum sound level in A-weighted decibels; L_{max} = maximum sound level; NA = number of annual events; re = in reference to.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 6-3. Alternative 2 Outdoor Number of Annual Events Exceeding 80, 90, and 100 dBA L_{Amax}

Representative Locations		NA 80 Lmax (dBA)			NA 90 Lmax (dBA)			NA 100 Lmax (dBA)		
ID	Description	No Action	Alternative 2	Increase re No Action	No Action	Alternative 2	Increase re No Action	No Action	Alternative 2	Increase re No Action
P01	Asbury Solomons	155	287	132	33	30	-3	0	0	0
P02	Our Lady Star of the Sea School	1,689	2,379	690	268	369	101	17	22	5
P03	Drum Point Club	6,453	8,614	2,161	1,270	1,757	487	276	368	92
P04	Captain Walter Francis Duke Elementary School	923	1,262	339	0	0	0	0	0	0
P05	Green Holly Elementary School	310	278	-32	0	0	0	0	0	0
P06	Chancellors Run Activity Center	24	48	24	0	0	0	0	0	0
P07	Lexington Park Elementary School	2,814	3,981	1,167	652	894	242	20	44	24
P08	Cedar Cove Apartments	8,088	10,458	2,370	3,612	5,074	1,462	544	1,023	479
P09	Spring Ridge Middle School	120	114	-6	0	0	0	0	0	0
P10	Elms Beach Park	1,064	1,605	541	162	292	130	0	0	0
P11	Historic St. Mary's City	26	49	23	0	0	0	0	0	0
P12	Harry Lundeberg School of Seamanship	0	0	0	0	0	0	0	0	0
P13	St. Ignatius Roman Catholic Church	144	268	124	0	0	0	0	0	0
P14	Point Lookout State Park	0	0	0	0	0	0	0	0	0
P15	Northumberland Elementary School	0	0	0	0	0	0	0	0	0

Key: dBA =A-weighted decibels; ID = identification number; L_{Amax} = maximum sound level in A-weighted decibels; L_{max} = maximum sound level; NA = number of annual events; re = in reference to.

6.2 Outdoor Speech Interference

This section presents the outdoor speech interference of the No Action Alternative and Action Alternatives, displayed in Table 6-4 through Table 6-6. Note that the school representative locations are not displayed because the 8-hour averaged metrics in Section 6.5 is used. For outdoor speech interference, the number of events per hour that exceeds 50 dBA L_{Amax} during both 0700-2200 and 2200-0700 time periods is the metric recommended by DNWG for outdoor speech interference. This is because sentence intelligibility decreases above sound levels of 50 dBA. This metric represents the potential number of outdoor speech interruptions per hour (average) during the day (0700-2200) and night (2200-0700) due to aircraft overflights. There is only an hourly daytime (0700-2200) increase over the No Action of one event per hour for P01 (Asbury Solomons) for Alternative 1, and one event per hour for P01 (Asbury Solomons) and P10 (Elms Beach Park) for Alternative 2.

Table 6-4. No Action Events per Hour Outdoor Speech Interference

Representative Locations		Annual Average Outdoor Daily Events per Hour	
ID	Description	Daytime (0700-2200)	Nighttime (2200-0700)
P01	Asbury Solomons	2	0
P03	Drum Point Club	6	0
P06	Chancellors Run Activity Center	3	0
P08	Cedar Cove Apartments	6	0
P10	Elms Beach Park	3	0
P11	Historic St. Mary's City	2	0
P12	Harry Lundeberg School of Seamanship	1	0
P13	St. Ignatius Roman Catholic Church	2	0
P14	Point Lookout State Park	0	0

Note: Number of events at or above 50 dB Lmax; reflects potential for outdoor speech interference.
Key: ID = identification number.

73

Table 6-5. Alternative 1 Events per Hour Outdoor Speech Interference

Representative Locations		Annual Average Outdoor Daily Events per Hour			
		Alternative 1		Increase re No Action	
ID	Description	Daytime (0700-2200)	Nighttime (2200-0700)	Daytime (0700-2200)	Nighttime (2200-0700)
P01	Asbury Solomons	3	0	+1	-
P03	Drum Point Club	6	0	-	-
P06	Chancellors Run Activity Center	3	0	-	-
P08	Cedar Cove Apartments	6	0	-	-
P10	Elms Beach Park	3	0	-	-
P11	Historic St. Mary's City	2	0	-	-
P12	Harry Lundeberg School of Seamanship	1	0	-	-
P13	St. Ignatius Roman Catholic Church	2	0	-	-
P14	Point Lookout State Park	0	0	-	-

Note: Number of events at or above 50 dB Lmax; reflects potential for outdoor speech interference.
Key: ID = identification number; re = in reference to.

Table 6-6. Alternative 2 Events per Hour Outdoor Speech Interference

Representative Locations		Annual Average Outdoor Daily Events per Hour			
		Alternative 2		Increase re No Action	
ID	Description	Daytime (0700-2200)	Nighttime (2200-0700)	Daytime (0700-2200)	Nighttime (2200-0700)
P01	Asbury Solomons	3	0	+1	-
P03	Drum Point Club	6	0	-	-
P06	Chancellors Run Activity Center	3	0	-	-
P08	Cedar Cove Apartments	6	0	-	-
P10	Elms Beach Park	4	0	+1	-
P11	Historic St. Mary's City	2	0	-	-
P12	Harry Lundeberg School of Seamanship	1	0	-	-
P13	St. Ignatius Roman Catholic Church	2	0	-	-
P14	Point Lookout State Park	0	0	-	-

Note: Number of events at or above 50 dB Lmax; reflects potential for outdoor speech interference.
Key: ID = identification number; re = in reference to.

6.3 Indoor Speech Interference

This section describes the potential of daytime (0700-2200) speech interference (see Section 2.1.7.1.2). Table 6-7, Table 6-8, and Table 6-9 provide the No Action, Alternative 1, and Alternative 2 average hourly number of events that have the potential to interfere with indoor speech. Note that schools are not included in this table because there is a separate metric used for calculating classroom speech interference. Since the noise model outputs the outdoor number of exceedances results, the windows open scenario assumes a 15 dBA NLR for interior levels with the windows open, and the windows closed scenario assumes a 25 dBA NLR for interior levels with the windows closed. For Alternative 1, there is less than 0.5 events per hour increase in the average daily events per hour for both the windows open and windows closed scenarios. For Alternative 2, P08 (Cedar Cove Apartments) and P10 (Elms Beach Park) have one more average indoor daytime event per hour than the No Action for the windows open scenario.

Table 6-7. No Action Events per Hour Indoor Speech Interference

Representative Locations		Annual Average Daily Indoor Daytime (0700-2200) Events per Hour (1)	
ID	Description	Windows Open	Windows Closed
P01	Asbury Solomons	1	-
P03	Drum Point Club	3	2
P06	Chancellors Run Activity Center	1	-
P08	Cedar Cove Apartments	3	2
P10	Elms Beach Park	1	-
P11	Historic St. Mary's City	-	-
P13	St. Ignatius Roman Catholic Church	1	-
P14	Point Lookout State Park	-	-

Note: With an indoor Maximum Sound Level of at Least 50 dB; assumes 15 dB and 25 dB of Noise Level Reductions for windows open and closed, respectively.
Key: ID = identification number.

Table 6-8. Alternative 1 Events per Hour Indoor Speech Interference

Representative Locations		Annual Average Daily Indoor Daytime (0700-2200) Events per Hour (1)			
		Alternative 1		Increase re No Action	
ID	Description	Windows Open	Windows Closed	Windows Open	Windows Closed
P01	Asbury Solomons	1	0	-	-
P03	Drum Point Club	3	2	-	-
P06	Chancellors Run Activity Center	1	0	-	-
P08	Cedar Cove Apartments	3	2	-	-
P10	Elms Beach Park	1	0	-	-
P11	Historic St. Mary's City	0	0	-	-
P13	St. Ignatius Roman Catholic Church	1	0	-	-
P14	Point Lookout State Park	0	0	-	-

Note: With an indoor Maximum Sound Level of at Least 50 dB; assumes 15 dB and 25 dB of Noise Level Reductions for windows open and closed, respectively.
Key: ID = identification number; re = in reference to.

Table 6-9. Alternative 2 Events per Hour Indoor Speech Interference

Representative Locations		Annual Average Daily Indoor Daytime (0700 2200) Events per Hour[1]			
		Alternative 2		Increase re No Action	
ID	Description	Windows Open	Windows Closed	Windows Open	Windows Closed
P01	Asbury Solomons	1	0	-	-
P03	Drum Point Club	3	2	-	-
P06	Chancellors Run Activity Center	1	0	-	-
P08	Cedar Cove Apartments	4	2	+1	-
P10	Elms Beach Park	2	0	+1	-
P11	Historic St. Mary's City	0	0	-	-
P13	St. Ignatius Roman Catholic Church	1	0	-	-
P14	Point Lookout State Park	0	0	-	-

Note: With an indoor Maximum Sound Level of at least 50 dB; assumes 15 dB and 25 dB of Noise Level Reductions for windows open and closed, respectively.
Key: ID = identification number; re = in reference to.

6.4 Sleep Disturbance

This section describes the potential of nighttime (2200-0700) sleep disturbance (see Section 2.1.7.1.3). Table 6-10, Table 6-11, and Table 6-12 provide the No Action, Alternative 1, and Alternative 2 annual average nightly (2200-0700) probability of awakening (percent). The probabilities of awakening are very minimal due to the low number of average daily 2200-0700 flights at NAS Patuxent River and OLF Webster. The Alternatives have only a slight 1 percent increase in probability of awakening at P08 with windows closed under Alternative 1. Under Alternative 2, there would be a 1 percent probability increase at P03 and P06 with windows open and at P08 with windows closed.

Table 6-10. No Action Potential of 2200-0700 Sleep Disturbance

Representative Locations		Annual Average Nightly (2200-0700) Probability of Awakening (%) [1]	
ID	Description	Windows Open	Windows Closed
P01	Asbury Solomons	0%	0%
P03	Drum Point Club	1%	1%
P06	Chancellors Run Activity Center	0%	0%
P08	Cedar Cove Apartments	1%	0%
P10	Elms Beach Park	1%	0%
P11	Historic St. Mary's City	0%	0%
P14	Point Lookout State Park	0%	0%

Note: Assumes 15 dB and 25 dB of Noise Level Reductions for windows open and closed, respectively.
Key: ID = identification number.

Table 6-11. Alternative 1 Potential of 2200-0700 Sleep Disturbance

Location of Interest		Annual Average Nightly (2200-0700) Probability of Awakening (%) (1)			
		Alternative 1		Increase re No Action	
ID	Description	Windows Open	Windows Closed	Windows Open	Windows Closed
P01	Asbury Solomons	0%	0%	-	-
P03	Drum Point Club	1%	1%	-	-
P06	Chancellors Run Activity Center	0%	0%	-	-
P08	Cedar Cove Apartments	1%	1%	-	+1%
P10	Elms Beach Park	1%	0%	-	-
P11	Historic St. Mary's City	0%	0%	-	-
P14	Point Lookout State Park	0%	0%	-	-

Note: Assumes 15 dB and 25 dB of Noise Level Reductions for windows open and closed, respectively.
Key: ID = identification number; re = in reference to.

Table 6-12. Alternative 2 Potential of 2200-0700 Sleep Disturbance

Representative Locations		Annual Average Nightly (2200-0700) Probability of Awakening (%) (1)			
		Alternative 2		Increase re No Action	
ID	Description	Windows Open	Windows Closed	Windows Open	Windows Closed
P01	Asbury Solomons	0%	0%	-	-
P03	Drum Point Club	2%	1%	+1%	-
P06	Chancellors Run Activity Center	1%	0%	+1%	-
P08	Cedar Cove Apartments	1%	1%	-	+1%
P10	Elms Beach Park	1%	0%	-	-
P11	Historic St. Mary's City	0%	0%	-	-
P14	Point Lookout State Park	0%	0%	-	-

Note: Assumes 15 dB and 25 dB of Noise Level Reductions for windows open and closed, respectively.
Key: ID = identification number; re = in reference to.

6.5 Classroom Speech Interference

For the classroom speech interference analysis, an 8-hour school day period was used instead of the full 24 hours or during acoustic day (0700-2200) or acoustic night (2200-0700). Table 6-13 provides the No Action estimated values for the average, school-day, outdoor noise levels ($L_{eq,8hr}$) along with the indoor noise levels ($L_{eq,8hr}$) and average number of hourly events that have the potential to interfere with classroom speech, both with windows open and windows closed. Table 6-14 and Table 6-15 present the Alternative 1 and Alternative 2 classroom speech interference results. The events per hour represent the number of single flyover events above a max sound level of 50 dBA, while the $L_{eq,8hr}$ is the equivalent sound level of these events averaged over 8 hours (duration of a school day). Thus, there could be multiple events per hour exceeding 50 dBA inside the classroom, but the equivalent sound level averaged over the full 8 hours could be less than 45 dBA. The results follow the similar trends for the DNL. For the average school day noise level, Alternative 1 generates a one dBA increase in the $L_{eq,8hr}$ relative to the No Action Alternative for all schools except for P12 and for both windows open and windows closed. For Alternative 2, two schools (P02 and P07) generate a two dBA increase in the $L_{eq,8hr}$ relative to the No Action Alternative for both windows open and closed, and all other schools generate a one dBA increase in the $L_{eq,8hr}$. There is no increase between the Alternatives and No Action for the number of events per hour above 50 dBA L_{Amax} within the classrooms (both with windows open and windows closed).

Table 6-13. No Action Classroom Speech Interference for Schools

Point of Interest		Annual Average Daily Indoor Daytime (0700-2200) Events per Hour (1)	
ID	Description	Windows Open	Windows Closed
P01	Asbury Solomons	1	-
P02	Our Lady Star of the Sea School	2	1
P03	Drum Point Club	3	2
P04	Captain Walter Francis Duke Elementary School	-	-
P05	Green Holly Elementary School	1	-
P06	Chancellors Run Activity Center	1	-
P07	Lexington Park Elementary School	2	1
P08	Cedar Cove Apartments	3	2
P09	Spring Ridge Middle School	1	-
P10	Elms Beach Park	1	-
P11	Historic St. Mary's City	-	-
P12	Harry Lundeberg School of Seamanship	1	-
P13	St. Ignatius Roman Catholic Church	1	-
P14	Point Lookout State Park	-	-
P15	Northumberland Elementary School	-	-

Note: (1) with an indoor Maximum Sound Level of at Least 50 dB; assumes 15 dB and 25 dB of Noise Level Reductions for windows open and closed, respectively.
Key: dB = decibels; ID = identification number; $L_{eq(8h)}$ = equivalent sound level averaged over 8 hours.

Table 6-14. Alternative 1 Classroom Speech Interference for Schools

Point of Interest		Annual Average Daily Indoor Daytime (0700-2200) Events per Hour (1)			
		Alternative 1		Increase re No Action	
ID	Description	Windows Open	Windows Closed	Windows Open	Windows Closed
P01	Asbury Solomons	1	0	-	-
P02	Our Lady Star of the Sea School	2	1	-	-
P03	Drum Point Club	3	2	-	-
P04	Captain Walter Francis Duke Elementary School	0	0	-	-
P05	Green Holly Elementary School	1	0	-	-
P06	Chancellors Run Activity Center	1	0	-	-
P07	Lexington Park Elementary School	2	1	-	-
P08	Cedar Cove Apartments	3	2	-	-
P09	Spring Ridge Middle School	1	0	-	-
P10	Elms Beach Park	1	0	-	-
P11	Historic St. Mary's City	0	0	-	-
P12	Harry Lundeberg School of Seamanship	1	0	-	-
P13	St. Ignatius Roman Catholic Church	1	0	-	-
P14	Point Lookout State Park	0	0	-	-
P15	Northumberland Elementary School	0	0	-	-

Note: (1) with an indoor Maximum Sound Level of at Least 50 dB; assumes 15 dB and 25 dB of Noise Level Reductions for windows open and closed, respectively.
Key: dB = decibels; ID = identification number; Leq(8h) = equivalent sound level averaged over 8 hours; re = in reference to.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 6-15. Alternative 2 Classroom Speech Interference for Schools

Representative Locations		Alternative 2					Increase re No Action				
			Indoor (1)					Indoor (1)			
			Windows Open		Windows Closed			Windows Open		Windows Closed	
ID	Description	Outdoor $L_{eq(8h)}$ (dB)	$L_{eq(8h)}$ (dB)	Events per Hour(2)	$L_{eq(8h)}$ (dB)	Events per Hour(2)	Outdoor $L_{eq(8h)}$ (dB)	$L_{eq(8h)}$ (dB)	Events per Hour(2)	$L_{eq(8h)}$ (dB)	Events per Hour(2)
P02	Our Lady Star of the Sea School	61	46	2	<45	1	+2	+2	-	+2	-
P04	Captain Walter Francis Duke Elementary School	46	<45	-	<45	-	+1	+1	-	+1	-
P05	Green Holly Elementary School	50	<45	1	<45	-	+1	+1	-	+1	-
P07	Lexington Park Elementary School	62	47	2	<45	1	+2	+2	-	+2	-
P09	Spring Ridge Middle School	48	<45	1	<45	-	+1	+1	-	+1	-
P12	Harry Lundeberg School of Seamanship	<45	<45	1	<45	-	+1	+1	-	+1	-
P15	Northumberland Elementary School	<45	<45	-	<45	-	+1	+1	-	+1	-
Number of Sites Exceeding 1 Intrusive Event per Hour				5		2			-		-
Minimum Number of Intrusive Events per Hour if Exceeding 1				2		2			0		0
Maximum Number of Intrusive Events per Hour if Exceeding 1				4		2			0		0

Notes:

(1) assumes 15 dB and 25 dB of Noise Level Reductions for windows open and closed, respectively.

(2) Number of Average School-Day Events per hour during 8-hour school day (0800-1600) At or Above an Indoor Maximum (single-event) Sound Level (L_{max}) of 50 dB.

Key: dB = decibels; ID = identification number; $L_{eq(8h)}$ = equivalent sound level averaged over 8 hours; re = in reference to.

6.6 Single Event Noise Analysis

For single event overflights, Table 6-16 displays the results of a comparative analysis that shows the differences in the SEL and L_{Amax} for the arrival, departure, and closed pattern flight profiles of the top contributing aircraft at NAS Patuxent River. Noise levels were calculated using NoiseMap Version 7.3 and the same operational data (e.g., flight tracks and flight profiles) were used to calculate the DNL noise contours. Representative location P03 (Drum Point Club) was selected as the analysis point for the departure and closed pattern flights, and P07 (Lexington Park Elementary School) was selected as the analysis point for the arrival flights. The profile selected for each aircraft was the one with the highest SEL at the analyzed location point. Actual individual overflight noise levels vary from the noise levels listed because of variations in aircraft configuration, flight track, altitude, and atmospheric conditions. The different climb out rates for the departures of the various aircraft result in different aircraft altitudes above P03 at the point with the highest SEL. This difference due to the aircraft profile differences results in a higher or lower SEL and L_{Amax} depending on the altitude of the aircraft.

Table 6-17, Table 6-18, and Table 6-19 list the top contributors to the overall DNL at each representative location for the No Action Alternative, Alternative 1, and Alternative 2. The top contributor is the aircraft that impacts the contours the most at that specific location. The top contributor can be different for the No Action Alternative than for the Action Alternatives because certain aircraft such as the F-35 were projected to have operation reductions from the No Action Alternative to the Action Alternatives, while other aircraft such as the F/A-18E/F had operation increases from the No Action Alternative to the Action Alternatives. This different weighting of operations can cause a contributor to rise or fall in the list of top contributors at a location. Aircraft contributors are the same for Alternatives 1 and 2, but the number of operations of each contributor is different.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 6-16. SEL and L_{Amax} Comparison of Aircraft Operations at NAS Patuxent River

Aircraft	Squadron	Operation Type	Engine Power	Airspeed (knots)	Altitude (feet MSL)	Slant Distance (feet)	SEL (dBA)	Lmax (dBA)
F-18E/F (Afterburner)	VX-23 and TPS	Departure	95% NC	300	4954	5301	99.7	90.9
F-18C/D (Afterburner)	VX-23		96.5% NC	250	3397	3553	104.3	92.1
F-35B (Afterburner)	VX-23		72% ETR	300	2503	2660	102.9	92.6
F-35B (Military)	VX-23		72% ETR	300	1829	2044	106.2	96.7
F-35C (Afterburner)	VX-23		100% ETR	272	2224	2272	107.7	100.7
F-35C (Military)	VX-23		100% ETR	265	1954	2175	109.2	101.7
T-38 (Afterburner)	TPS		100% RPM	230	1846	2032	99.1	88.1
F-18E/F	VX-23 and TPS	VFR Closed Pattern	84% NC	130	640	717	112.6	103.6
F-18C/D	VX-23		86.1% NC	140	556	550	111.2	108.3
F-35B	VX-23		40% ETR	180	887	943	100.8	93.2
F-35C	VX-23		28% ETR	200	910	964	98.3	89.4
T-38	TPS		90% RPM	180	1039	1409	85.7	64.4
F-18E/F	VX-23 and TPS	Straight-in Arrival	85% NC	135	704	2170	106.1	98.6
F-18C/D	VX-23		88% NC	140	782	2194	101.4	93.5
F-35B	VX-23		35% ETR	160	910	2237	90.2	79.3
F-35C	VX-23		28% ETR	235	864	2220	87.7	78
T-38	TPS		90% RPM	200	698	2169	80.2	71.3

Key: dBA = A-weighted decibels; ETR = engine thrust request; L_{Amax} = maximum sound level in A-weighted decibels; L_{max} = maximum sound level; MSL = mean sea level; NAS = Naval Air Station; NC = core engine speed; RPM = revolutions per minute; SEL = sound exposure level; TPS = Test Pilot School; VFR = visual flight rules.

Table 6-17. No Action Top Contributor to the Overall DNL at Each Representative Location

Representative Locations		Operation of Top Contributor to the Overall DNL for No Action					
ID	Description	Squadron	Aircraft	Operation Type	Annual Acoustic Daytime (0700-2200) Operations at this SEL	Annual Acoustic Nighttime (2200-0700) Operations at this SEL	SEL (dBA)
P01	Asbury Solomons	VX-23	F-35B	Straight-in to Slow Landing	11	0	101.5
P02	Our Lady Star of the Sea School	VX-23	F-18E/F	Straight-in Arrival	51	1	107.8
P03	Drum Point Club	VX-23	F-18E/F	VFR Closed Pattern	95	0	110
P04	Captain Walter Francis Duke Elementary School	VX-23	F-18E/F	IFR GCA Box Pattern	9	0	94.6
P05	Green Holly Elementary School	VX-23	F-18C/D	Afterburner Departure	160	1	92
P06	Chancellors Run Activity Center	VQ-4	E-6B	Departure	65	5	88.2
P07	Lexington Park Elementary School	VX-23	F-18E/F	Straight-in Arrival	98	2	106.1
P08	Cedar Cove Apartments	VX-23	F-18E/F	VFR Closed Pattern	176	0	112.6
P09	Spring Ridge Middle School	VX-23	F-35B	Straight-in to Slow Landing	33	1	95.9
P10	Elms Beach Park	VX-23	F-18E/F	IFR GCA Box Pattern	100	0	98.4
P11	Historic St. Mary's City	VX-23	F-18E/F	IFR GCA Box Pattern	22	0	94.3
P12	Harry Lundeberg School of Seamanship	VX-23	F-18C/D	Overhead Break Arrival	165	0	83.8
P13	St. Ignatius Roman Catholic Church	TPS	T-6	Webster Field VFR Pattern	305	0	89.4
P14	Point Lookout State Park	TPS	T-6	Webster Field Interfacility Arrival	24	0	73.1
P15	Northumberland Elementary School	VX-23	F-18E/F	Afterburner Departure	160	1	65.9

Key: dBA = A-weighted decibels; DNL = day-night average sound level; GCA = Ground Controlled Approach; ID = identification number; IFR = instrument flight rules; SEL = sound exposure level; TPS = Test Pilot School; VFR = visual flight rules.

Table 6-18. Alternative 1 Top Contributor to the Overall DNL at Each Representative Location

Representative Locations		Operation of Top Contributor to the Overall DNL for Alternative 1					
ID	Description	Aircraft Group	Aircraft	Operation Type	Daytime (0700-2200) Operations at this SEL	Nighttime (2200-0700) Operations at this SEL	SEL (dBA)
P01	Asbury Solomons	VX-23	F-18E/F	Straight-in Arrival	100	2	92.4
P02	Our Lady Star of the Sea School	VX-23	F-18E/F	Straight-in Arrival	100	2	107.8
P03	Drum Point Club	VX-23	F-18E/F	VFR Closed Pattern	185	0	110
P04	Captain Walter Francis Duke Elementary School	VX-23	F-18E/F	IFR GCA Box Pattern	18	0	94.6
P05	Green Holly Elementary School	VX-23	F-18E/F	Afterburner Departure	314	1	90.1
P06	Chancellors Run Activity Center	VX-23	F-18E/F	Afterburner Departure	314	1	85.8
P07	Lexington Park Elementary School	VX-23	F-18E/F	Straight-in Arrival	192	4	106.1
P08	Cedar Cove Apartments	VX-23	F-18E/F	VFR Closed Pattern	343	0	112.6
P09	Spring Ridge Middle School	TPS	T-6	Webster Field Interfacility Departure	55	0	92.2
P10	Elms Beach Park	VX-23	F-18E/F	IFR GCA Box Pattern	197	0	98.4
P11	Historic St. Mary's City	VX-23	F-18E/F	IFR GCA Box Pattern	42	0	94.3
P12	Harry Lundeberg School of Seamanship	VQ-4	E-6B	Departure	51	4	85.9
P13	St. Ignatius Roman Catholic Church	TPS	T-6	Webster Field VFR Pattern	349	0	89.4
P14	Point Lookout State Park	TPS	T-6	Webster Field Interfacility Arrival	27	0	73.1
P15	Northumberland Elementary School	VX-23	F-18E/F	Afterburner Departure	314	1	65.9

Key: dBA = A-weighted decibels; DNL = day-night average sound level; GCA = Ground Controlled Approach; ID = identification number; IFR = instrument flight rules; SEL = sound exposure level; TPS = Test Pilot School; VFR = visual flight rules.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Table 6-19. Alternative 2 Top Contributor to the Overall DNL at Each Representative Location

Representative Locations		Operation of Top Contributor to the Overall DNL for Alternative 2					
ID	Description	Aircraft Group	Aircraft	Operation Type	Daytime (0700-2200) Operations at this SEL	Nighttime (2200-0700) Operations at this SEL	SEL (dBA)
P01	Asbury Solomons	VX-23	F-18E/F	Straight-in Arrival	111	2	92.4
P02	Our Lady Star of the Sea School	VX-23	F-18E/F	Straight-in Arrival	111	2	107.8
P03	Drum Point Club	VX-23	F-18E/F	VFR Closed Pattern	205	0	110
P04	Captain Walter Francis Duke Elementary School	VX-23	F-18E/F	IFR GCA Box Pattern	20	0	94.6
P05	Green Holly Elementary School	VX-23	F-18E/F	Afterburner Departure	349	2	90.1
P06	Chancellors Run Activity Center	VX-23	F-18E/F	Afterburner Departure	349	2	85.8
P07	Lexington Park Elementary School	VX-23	F-18E/F	Straight-in Arrival	214	4	106.1
P08	Cedar Cove Apartments	VX-23	F-18E/F	VFR Closed Pattern	382	0	112.6
P09	Spring Ridge Middle School	TPS	T-6	Webster Field Interfacility Departure	61	0	92.2
P10	Elms Beach Park	VX-23	F-18E/F	IFR GCA Box Pattern	215	0	98.4
P11	Historic St. Mary's City	VX-23	F-18E/F	IFR GCA Box Pattern	47	0	94.3
P12	Harry Lundeberg School of Seamanship	VQ-4	E-6B	Departure	57	4	85.9
P13	St. Ignatius Roman Catholic Church	TPS	T-6	Webster Field VFR Pattern	387	0	89.4
P14	Point Lookout State Park	TPS	T-6	Webster Field Interfacility Arrival	31	0	73.1
P15	Northumberland Elementary School	VX-23	F-18E/F	Afterburner Departure	349	2	65.9

Key: dBA = A-weighted decibels; DNL = day-night average sound level; GCA = Ground Controlled Approach; ID = identification number; IFR = instrument flight rules; SEL = sound exposure level; TPS = Test Pilot School; VFR = visual flight rules.

82

7 References

American National Standards Institute, Inc. (ANSI). (2003). American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, Part 5: Sound Level Descriptors for Determination of Compatible Land Use. ANSI S12.9/Part 5-1998 (R 2003).

American National Standard Institute (ANSI) and Acoustical Society of America. (2008). Quantities and Procedures for Description and Measurement of Environmental Sound – Part 6: Methods for Estimation of Awakenings Associated with Outdoor Noise Events Heard in Homes. ANSI S12.9-2008/Part 6.

Bradley, K.A. (June 1996). *Routemap Version 2.0: Military Training Route Noise Model User's Manual*. Brooks Air Force Base, Texas: Armstrong Research Laboratory. AL/OE-MN-1996-0002.

Czech, J., and Plotkin, K. (November 1998). *NMAP 7.0 User's Manual.* Wyle Research Report. Torrance, CA: Wyle Laboratories. R 98-13.

Czech, J. (August 2014). *NMap 7.3 User's Manual,* DRAFT Report. Torrance, CA: Wyle Laboratories. Wyle Technical Note TN 14-13.

Department of the Army. (December 2007). *Environmental Protection and Enhancement*. Washington, DC: US Department of the Army. Army Regulation 200-1, 52-53.

Defense Noise Working Group (DNWG). (2009a). *Technical Bulletin: Using Supplemental Noise Metrics and Analysis Tools*. Washington, DC: US Department of Defense. March.

DNWG. (2009b). *Technical Bulletin: Sleep Disturbance from Aviation Noise*. Washington, DC: US Department of Defense. April.

DNWG. (December 2013). *Technical Bulletin: Speech Interference from Aircraft Noise*. December.

Downing, M. (November 2016). *Validation of Updates to NoiseFile Database and NoiseMap Modeling Software.* Asheville, NC: Blue Ridge Research and Consulting, LLC. Technical Note BRRC 16-16.

Downing, M., N. Zamot, C. Moss, D. Morin, E. Wolski, S. Chung, K. J. Plotkin, and D. Maglieri. (1998). "Controlled Focused Sonic Booms from Maneuvering Aircraft." *Journal of the Acoustical Society of America.* 104(1); pp. 112–121.

Federal Interagency Committee on Noise (FICON). (August 1992). *Federal Agency Review of Selected Airport Noise Analysis Issues.* Washington, DC: US Government Printing Office.

Federal Interagency Committee on Urban Noise (FICUN). (1980). *Guidelines for Considering Noise in Land-Use Planning and Control.* Washington, DC: US Government Printing Office. Report #1981-337-066/8071.

Fidell, S., Barger, D.S., and Schultz, T.J. (January 1991). "Updating a Dosage-Effect Relationship for the Prevalence of Annoyance Due to General Transportation Noise," *J. Acoust. Soc. Am.* 89, 221-233.

Finegold, L.S., Harris, C.S., and von Gierke, H.E. (1994). "Community Annoyance and Sleep Disturbance: Updated Criteria for Assessing the Impact of General Transportation Noise on People," *Noise Control Engineering Journal*, 42: 25-30.

Mohlman, H.T. (1983). *Computer Programs for Producing Single-Event Aircraft Noise Data for Specific Engine Power and Meteorological Conditions for Use with USAF Community Noise Model (NOISEMAP)*. AFAMRL-TR-83-020.

Moulton, C.M. (1992). *Air Force Procedure for Predicting Noise Around Airbases: Noise Exposure Model (NoiseMap) Technical Report.* Washington, DC: US Air Force. Report AL-TR-1992-0059.

Page, J., Plotkin, K., and Wilmer, C. (November 2010). *PCBoom Version 6.6 Technical Reference and User Manual*. Wyle Technical Report WR 10-10.

Plotkin, K.J. (May 1996). *PCBoom3 Sonic Boom Prediction Model: Version 1.0c.* Torrance, CA: Wyle Laboratories. Wyle Research Report WR 95-22C.

Schultz, T.J. (August 1974). "Synthesis of Social Surveys on Noise Annoyance. *J. Acoust. Soc. Am.* 64: 377-405.

Stusnick, E., K.A. Bradley, J.A. Molino, and G. DeMiranda. (March 1992). *The Effect of Onset Rate on Aircraft Noise Annoyance, Volume 2: Rented Home Experiment.* Torrance, CA: Wyle Laboratories. Wyle Laboratories Research Report WR 92-3.

Stusnick, E., K.A. Bradley, M.A. Bossi, J.A. Molino, and D.G. Rickert. (December 1993). *The Effect of Onset Rate on Aircraft Noise Annoyance, Volume 3: Hybrid Own-Home Experiment.* Torrance, CA: Wyle Laboratories. Wyle Laboratories Research Report WR 93-22.

US Environmental Protection Agency (EPA). (April 1982). *Guidelines for Noise Impact Analysis.* Washington, DC: US Enviromental Protection Agency. Report 550/9-82-105 and #PB82-219205.

Wasmer, F. and Maunsell, F. (2006a). "*BaseOps 7.3 User's Guide.* Gainesville, FL: Wasmer Consulting.

Wasmer, F. and Maunsell, F. (2006b). "*NMPlot 4.955 User's Guide.* Gainesville, FL: Wasmer Consulting.

Appendix A: Data Validation Tables

HX-21 Data Validation

FIST Annual Operations at NAS Pax River

Group	*10 year Average of Sorties*	*Unit / Description*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
MV-22	218	HX-21	365	50	Y	1.20	218	218	523	959
H-60	597	HX-21	365	50	Y	2.30	597	597	2746	3940
H-1 (includes TH-57 ops - modeled as UH-1N)	404	HX-21	365	50	Y	6.80	404	404	5494	6302
CH-53E (includes CH-46 ops - modeled as CH-53E)	97	HX-21	365	50	Y	2.60	97	97	504	698
Presidential VH-71 (modeled as CH-53)	23	HX-21	365	50	Y	3.00	23	23	138	184
Presidential H-3 (modeled as CH-53)	27	HX-21	365	50	Y	3.00	27	27	162	216

Operation Type Distribution

Operation	Type	CH-53K/E	All Others
Arrivals	Straight-in Arrival (course rule)	100%	98%
	PAR Arrival (1600 ft in area - large pattern).		2%
	Carrier Break Arrival		
	SFO Arrival		
	Straight-in to Slow Landing		
	Tactical - overhead break		
	Instrument approach		
		good	*good*
Departures	Military	100%	100%
	Afterburner Takeoff to Mil Climb		
	Short Takeoff to Mil Climb		
		good	*good*
Closed Patterns	Runway 220 Pattern (same as grass but shifted over to runway)	100%	
	IFR Pattern or GCA Box		10%
	grass pattern (VFR)		90%
		good	*good*

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

From Pad	H-60	H-1	V-22	CH-53K/E	Presidential VH-71 and H-3
To West (West Seaplane basin)	60%	75%	40%		
East (via River Mouth)	39%	24%	50%	10%	
Crossfield	1%	1%	10%	10%	
Depart Runway 14 straight-out (3-4 NM out into RA)				80%	
Depart via Turf then West					37.5%
Depart via Turf then East					12.5%
Depart via Runway then West					37.5%
Depart via Runway then East					12.5%
	good	*good*	*good*	*good*	*good*
To Pad	**H-60**	**H-1**	**V-22**	**CH-53K/E**	**Presidential S-92 and H-3**
From West (Bridge Arrival)	60%	75%	40%		
East (via River Mouth)	35%	20%	50%	10%	
Crossfield	1%	1%	10%	10%	
Gold Coast	4%	4%			
Runway 32 straight-in				80%	
Arrive via Turf from West					18.75%
Arrive via Turf from East					6.25%
Arrive via Runway from West					56.25%
Arrive via Runway from East					18.75%
	good	*good*	*good*	*good*	*good*

Key: GCA = Ground Controlled Approach; IFR = instrument flight rules; NM = nautical miles; PAR = precision approach radar; RA = Restricted Area; SFO = Simulated Flame Out; VFR = visual flight rules.

86

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Operation Type Distribution

Operation	Type	T-38/F-18	T-6	C-12/C-21	H-60/H-72
Arrivals	Straight-in Arrival	5%	5%	90%	100%
	Overhead Break Arrival	90%	90%	5%	
	Carrier Break Arrival				
	SFO Arrival				
	Straight-in to Slow Landing				
	Tactical - overhead break				
	IFR Straight-in	5%	5%	5%	
		good	*good*	*good*	*good*
Departures	Military		100%	100%	100%
	Afterburner Takeoff to Mil Climb	100%			
	Short Takeoff to Mil Climb				
		good	*good*	*good*	*good*
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	90%	90%	90%	90%
	SFO Pattern				
	IFR Pattern or GCA Box	10%	10%	10%	10%
	Touch and Go to Slow Landing				
		good	*good*	*good*	*good*

TPS Data Validation

10 year Annual Average of FIST Operations at NAS Pax River

Aircraft	*Sorties at Full Unit Strength*	*Unit / Description*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
C-12/C-26	359	TPS	240	48	Y	2.90	359	359	2082	2800
C-21 (LEAR jet)	214	TPS	240	48	Y	0.9	214	214	385	813
F/A-18E/F	258	TPS	240	48	Y	1.00	258	258	516	1032
UH-72	773	TPS	240	48	Y	6.00	773	773	9276	10822
UH-60	650	TPS	240	48	Y	3.5	650	650	4550	5850
T-6	867	TPS	240	48	Y	3.2	867	867	5549	7283
T-38	1197	TPS	240	48	Y	1.2	1197	1197	2873	5267

Key: GCA = Ground Controlled Approach; IFR = instrument flight rules; SFO = Simulated Flame Out; VFR = visual flight rules.

87

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

NAS Pax River Directional Flow Patterns of Based Aircraft

See the Track Map .pdf file for details on the flight tracks.

Departures	C-12/C-21 Rwys 06/14/32	C-12/C-21 Rwy 24	T-38/F-18/T-6 Rwys 06/32	T-38/F-18/T-6 Rwy 14	T-38/F-18/T-6 Rwy 24	H-60/H-72
Barren Departure	100%	90%	80%		65%	
Direct to Area		10%		90%	25%	
IFR Departure			10%	10%	10%	
Adam Departure			10%			
Helo West						75%
Helo Rivermouth East						15%
Helo Crossfield (South)						10%
	good	*good*	*good*	*good*	*good*	*good*

Arrivals	C-12/C-21	T-38/F-18/T-6	H-60/H-72
Piney VFR	57%	57%	
Barren VFR	38%	38%	
IFR Straight-in	5%	5%	
Helo West			75%
Helo Rivermouth East			5%
Helo East to Drum Point and up coast			10%
Helo Crossfield (South)			10%
	good	*good*	*good*

Key: IFR = instrument flight rules; VFR = visual flight rules.

88

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Operation Type Distribution

Operation	Type	MQ-4	C-38 (C-21) /C-12	P-8/P-3/C-130	E-2/ T-6
Arrivals	VFR Straight-in Arrival		25%	50%	67%
	Overhead Break Arrival				33%
	Carrier Break Arrival				
	SFO Arrival				
	Straight-in to Slow Landing				
	Tactical - overhead break				
	Instrument approach	100%	75%	50%	
		good	*good*	*good*	*good*
Departures	Military	100%	100%	100%	100%
	Afterburner Takeoff to Mil Climb				
	Short Takeoff to Mil Climb				
		good	*good*	*good*	*good*
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)		2%	50%	50%
	SFO Pattern				
	IFR Pattern or GCA Box		98%	50%	50%
	Touch and Go to Slow Landing				
			good	*good*	*good*

VX-20 Data Validation

FIST 10 year average VX-20 Operations (These will be modeled)

Aircraft	*Sorties at Full Unit Strength*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
MQ-4 (Modeled as C-21)	60	365	20	Y	0.00	60	60	0	120
C-21 (surrogate for C-38 and T-2)	233	365	39	Y	1.90	233	233	885	1351
P-8	148	365	52	Y	1.00	148	148	296	592
E-2	368	260	45	Y	1.20	368	368	883	1619
P-3	182	365	52	Y	1.70	182	182	619	983
C-12	82	365	52	Y	1.90	82	82	312	476
T-6	220	365	52	Y	3.40	220	220	1496	1936
707 (E-6B) Turbofans CFM-56	44	365	52	Y	1.20	44	44	106	194
C-130	339	365	52	Y	0.60	339	339	407	1085

Key: GCA = Ground Controlled Approach; IFR = instrument flight rules; SFO = Simulated Flame Out; VFR = visual flight rules.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

NAS Pax River Directional Flow Patterns of Based Aircraft

See the Track Map .pdf file for details on the flight tracks.

Departures	MQ-4	C-38 (C-21) /C-12	P-8/P-3	E-2/T-6 / C-130
South/West	0%	25%		40%
North/East (to Range or WA)	100%	75%		60%
COLIN intersection (12 DME) (just outside restricted area) IFR			14%	
SWABY departure IFR			14%	
Course rules departure (BARREN Rwy 06, PINEY Rwy 24)			40%	
Direct to Area			10%	
North towards GARED intersection IFR			17%	
386 airspace - Whiskey 386 test track - directly northeast (Salisbury SBY route)			4%	
386 airspace - Whiskey 386 test track - directly 13-14 southeast (Snowhill SWL route)			1%	
	good	*good*	*good*	*good*
Arrivals	**MQ-4**	**C-38 (C-21) /C-12**	**P-8/P-3**	**E-2/T-6 / C-130**
South/West	0%			40%
North/East	100%			60%
Straight-in (IFR)		75%	50%	
Course Rules VFR		25%	50%	
	good	*good*	*good*	*good*

Key: DME = distance measuring equipment; IFR = instrument flight rules; SBY = Salisbury Regional Airport; SWL = Snow Hill navigational aid; WA = warning area.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Operation Type Distribution

Operation	Type	F/A-18 C/D and E/F	F-35B	F-35C	T-45
Arrivals	Straight-in Arrival (VFR)	5%	5%	5%	5%
	Overhead Break Arrival	57%	34%	56%	38%
	PFO Arrival		1%	1%	38%
	Straight-in to Slow Landing		20%		
	Straight-in to Vertical Landing		15%		
	Instrument approach	38%	25%	38%	20%
		good	*good*	*good*	*good*
Departures	Military		1%	1%	100%
	Afterburner Takeoff to Mil Climb	100%	74%	99%	
	Short Takeoff to Mil Climb		25%		
		good	*good*	*good*	*good*
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	60%	41%	50%	40%
	FCLP Pattern (600 ft AGL left hand pattern)	5%	15%	15%	
	PFO Pattern		1%	1%	40%
	IFR Pattern or GCA Box	35%	27%	34%	20%
	Touch and Go to Slow Landing		1%		
	Touch and Go to Vertical Landing		15%		
		good	*good*	*good*	*good*

Key: VFR = visual flight rules; IFR = instrument flight rules; GCA = Ground Controlled Approach.

VX-23 Data Validation

10-year average FIST Data Annual Operations at NAS Pax River

Aircraft	*Sorties at Full Unit Strength*	*Unit / Description*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
F/A-18C/D	976	Assumes 50% of F-18 ops in FIST are A/B variant	365	52	Y	1.30	976	976	2538	4490
F/A-18E/F	976	Assumes 50% of F-18 ops in FIST are E/F variant	365	52	Y	1.30	976	976	2538	4490
F-35B	374	Assumes 60% of F-35 ops in FIST are B variant	365	52	Y	0.50	374	374	374	1122
F-35C	250	Assumes 40% of F-35 ops in FIST are C variant	365	52	Y	0.50	250	250	250	750
T-45	172		365	52	Y	2.00	172	172	688	1032

Key: FIST = Flight Information Scheduling and Tracking.

91

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

NAS Pax River Directional Flow Patterns of Based Aircraft
See the Track Map .pdf file for details on the flight tracks.

Runways 06 and 32 Departures	F-18A-F	F-35B	F-35C	T-45
Course Rules to East	50%	49%	49%	50%
Depart and Re-enter		1%	1%	
Swaby IFR to South	10%	10%	10%	10%
Piney VFR to South	40%	40%	40%	40%
	good	*good*	*good*	*good*

Runways 14 and 24 Departures	F-18A-F	F-35B	F-35C	T-45
Course Rules to East	7.5%	7.5%	7.5%	7.5%
Depart and Re-enter		1.0%	1.0%	
Swaby IFR to South	1.5%	1.5%	1.5%	1.5%
Piney VFR to South	6.0%	6.0%	6.0%	6.0%
Direct to Area	85%	84%	84%	85%
	good	*good*	*good*	*good*

Runway 06, 14, 24 Arrivals	F-18A-F	F-35B	F-35C	T-45
Course Rules arrival (Piney from south,	62%	70%	62%	80%
Instrument straight-in arrival	38%	30%	38%	20%
	good	*good*	*good*	*good*

Runway 32 Arrivals	F-18A-F	F-35B	F-35C	T-45
Course Rules arrival (Piney from south,	40%	48%	40%	40%
Instrument straight-in and Straight fron	60%	52%	60%	60%
	good	*good*	*good*	*good*

Key: IFR = instrument flight rules; VFR = visual flight rules.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Operation Type Distribution

Operation	Type	H-60	C-12
Arrivals	VFR Straight-in Arrival	98%	90%
	Overhead Break Arrival		5%
	Carrier Break Arrival		
	SFO Arrival		
	Straight-in to Slow Landing		
	Tactical - overhead break		
	Instrument approach	2%	5%
		good	*good*
Departures	Military	100%	100%
	Afterburner Takeoff to Mil Climb		
	Short Takeoff to Mil Climb		
		good	*good*
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	90%	90%
	SFO Pattern		
	IFR Pattern or GCA Box	10%	10%
	Touch and Go to Slow Landing		
		good	*good*

VFR is 70% in Turf area, 15% grass pattern, 15% Rwy02/20 pattern

Key: GCA = Ground Controlled Approach; IFR = instrument flight rules; SFO = Simulated Flame Out; VFR = visual flight rules.

Search and Rescue Data Validation

10-year Average FIST Data Annual Operations at NAS Pax River

Group	*Sorties at Full Unit Strength*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
H-60	472	365	52	Y	1.80	472	472	1699	2643
C-12 (remove from Alts)	471	365	52	Y	1.80	471	471	1696	2638

Key: FIST = Flight Information Scheduling and Tracking; NAS = Naval Air Station.

93

NAS Pax River Directional Flow Patterns of Based Aircraft		
See the Track Map .pdf file for details on the flight tracks.		
Departures	**H-60**	**C-12**
Depart East through Rivermouth (North flow)	90%	
Depart East in South flow	9%	
Depart South (hug the coast towards Norfolk)	1%	
Barren Departure (North Flow)		
Piney Departure (South Flow)		
Barren Departure		90%
Direct to Area		10%
	good	*good*
Arrivals	**H-60**	**C-12**
From East directly to NAWC pad	90%	
From East but arrive to pad from South	8%	
IFR Instrument Approach to Runway 32	2%	
VFR Piney Arrival (North flow)		
VFR Barren Arrival (South flow)		
Piney VFR		57%
Barren VFR		38%
IFR Straight-in		5%
	good	*good*

Key: IFR = instrument flight rules; NAWC = Naval Air Warfare Center; VFR = visual flight rules.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Operation Type Distribution

Operation	Type	E-2	P-8	Helos
Arrivals	VFR Straight-in Arrival	1%	5%	100%
	Overhead Break Arrival	50%		
	Carrier Break Arrival			
	SFO Arrival			
	Straight-in to Slow Landing			
	Tactical - overhead break			
	Instrument approach	49%	95%	
		good	*good*	*good*
Departures	VFR Departure	100%	5%	100%
	IFR Departure (Swaby and Salisbury)		95%	
	Short Takeoff to Mil Climb			
		good	*good*	*good*
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	50%	5%	100%
	SFO Pattern			
	IFR Pattern or GCA Box	50%	95%	
	Touch and Go to Slow Landing			
		good	*good*	*good*

Key: GCA = Ground Controlled Approach; IFR = instrument flight rules; SFO = Simulated Flame Out; VFR = visual flight rules.

VX-1 Data Validation

Pilot Estimated Annual Operations at NAS Pax River

Group	*Sorties at Full Unit Strength*	*Unit / Description*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
E-2	3	3 per week; 50 weeks; 3 hours per trip	365	50	W	1.00	150	150	300	600
P-8	5	4 per week; 50 weeks; 4 hours per trip	365	50	W	1.00	250	250	500	1000
H-60R/S	350	150 flights over 5 months. 350 flights per year	365	50	Y	0.60	350	350	420	1120

note: FIST data for VX-1 was 20 sorties per year. Since this data is incomplete, used pilot estimates instead

95

NAS Pax River Directional Flow Patterns of Based Aircraft

See the Track Map .pdf file for details on the flight tracks.

Departures	E-2	P-8	Helos
Depart East/North (Barren)	60%	60%	50%
Depart South/West (Piney)	40%	40%	50%
	good	*good*	*good*
Arrivals	**E-2**	**P-8**	**Helos**
VFR Piney Arrival (East/North flow)	60%	60%	50%
VFR Barren Arrival (West/South flow)	40%	40%	50%
	good	*good*	*good*

Closed Patterns: 5% of patterns are opposing side for P-8 and E-2

Key: VFR = visual flight rules.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Operation Type Distribution

Operation	Type	P-3	C-12
Arrivals	Straight-in Arrival	100%	100%
	Overhead Break Arrival		
	Carrier Break Arrival		
	SFO Arrival		
	Straight-in to Slow Landing		
	Tactical - overhead break		
	Instrument approach		
		good	*good*
Departures	Military	100%	100%
	Afterburner Takeoff to Mil Climb		
	Short Takeoff to Mil Climb		
		good	*good*
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	60%	60%
	SFO Pattern		
	IFR Pattern or GCA Box	40%	40%
	Touch and Go to Slow Landing		
		good	*good*

Key: GCA = Ground Controlled Approach; SFO = Simulated Flame Out; VFR = visual flight rules.

VXS-1 Data Validation

FIST 10 year average VXS-1 Operations (These will be mo

Aircraft	*Sorties at Full Unit Strength*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
NP-3 Orion	104	365	35	Y	2	104	104	416	624
C-12	45	365	52	Y	3	45	45	270	360

Note: FIST data only had total sorties per month, so used pilot estimates for number of patterns per sortie

97

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

NAS Pax River Directional Flow Patterns of Based Aircraft

See the Track Map .pdf file for details on the flight tracks.

Departures	P-3	C-12
East to 4006 (Barren)	57%	10%
North	5%	30%
South (Piney)	38%	60%
	good	*good*
Arrivals	**P-3**	**C-12**
Instrument Approach straight-in (6-7 NM final)	90%	
VFR from East (4006)	10%	10%
VFR from North		30%
VFR from South		60%
	good	*good*

Key: VFR = visual flight rules.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Operation Type Distribution

Operation	Type	E-6B
Arrivals	Straight-in Arrival	
	Overhead Break Arrival	
	Carrier Break Arrival	
	SFO Arrival	
	Straight-in to Slow Landing	
	Tactical - overhead break	
	Instrument approach	100%
		good
Departures	IFR Departure	100%
	Afterburner Takeoff to Mil Climb	
	Short Takeoff to Mil Climb	
		good
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	50%
	SFO Pattern	
	IFR Pattern or GCA Box	50%
	Touch and Go to Slow Landing	
		good

Key: GCA = Ground Controlled Approach; IFR = instrument flight rules; SFO = Simulated Flame Out; VFR = visual flight rules.

VQ-4 Data Validation

SHARP 10 year average VQ-4 Operations

Aircraft	*Sorties at Full Unit Strength*	*Unit / Description*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
707 (E-6B) Turbofans CFM-56	448	SHARP Data 10 year Average	365	52	Y	0.20	448	448	179	1075

99

NAS Pax River Directional Flow Patterns of Based Aircraft

See the Track Map .pdf file for details on the flight tracks.

Departures	E-6B
IFR Salisbury-Six	66.7%
IFR Swaby-Eight	33.3%
	good
Arrivals	**E-6B**
IFR Straight-in	100%
	good

Key: IFR = instrument flight rules.

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

Operation Type Distribution

Operation	Type	MQ-25
Arrivals	VFR Course Rules Arrival	100%
	Overhead Break Arrival	
	Instrument approach	
		good
Departures	Military Departure	100%
	Afterburner Departure	
	Short Takeoff to Mil Climb	
		good
Patterns	Catapult Departure to Fullstop Arrival	23%
	Military Departure to Arrested Landing (5.5 deg glideslope)	77%
	IFR Pattern or GCA Box	
	Touch and Go to Slow Landing	

Key: GCA = Ground Controlled Approach; VFR = visual flight rules.

MQ-25 Data Validation

Estimated MQ-25 Operations (starting FY22)										
Aircraft	*Sorties at Full Unit Strength*	*Unit / Description*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
MQ-25 (modeled as C-21)	120	FY 2022	100	20	Y	0.65	120	120	156	396

101

Aircraft Noise Study to Support the EIS for the Patuxent River Complex – June 2019

NAS Pax River Directional Flow Patterns of Based Aircraft

See the Track Map .pdf file for details on the flight tracks.

Departures	MQ-25
Course Rules Depart East/North (Barren)	60%
Course Rules Depart South/West (Piney)	40%
	good

Arrivals	MQ-25
VFR Piney Arrival (East/North flow)	60%
VFR Barren Arrival (West/South flow)	40%
	good

Key: VFR = visual flight rules.

UX-24 and MDARNG Data Validation

FIST 10 year average UX-24 Operations (These will be modeled)

Group	*Sorties at Full Unit Strength*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
UH-1 (surrogate for MQ-8)	151	240	48	Y	0.30	151	151	91	393
GASEPF (surrogate for RQ-21 and RQ-26A)	139	240	48	Y	1.40	139	139	389	667

note: GASEPF is General Aviation Single Engine Fixed Propeller

note: Maryland Air National Guard operates the RQ-7A/B: 56 annual sorties were added to the 83 annual RQ-21 and RQ-26 to make a total of 139 annual combined sorties of RQ-7/RQ-21/RQ-26

Key: MDARNG = Maryland Army National Guard.

102

Operation	Type	UH-1	GASEPF
Arrivals	Straight-in Arrival	100%	100%
	Overhead Break Arrival		
	Carrier Break Arrival		
	SFO Arrival		
	Straight-in to Slow Landing		
	Tactical - overhead break		
	Instrument approach		
		good	*good*
Departures	Military	100%	100%
	Afterburner Takeoff to Mil Climb		
	Short Takeoff to Mil Climb		
		good	*good*
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	100%	100%
	SFO Pattern		
	IFR Pattern or GCA Box		
	Touch and Go to Slow Landing		
		good	*good*

Key: SFO = Simulated Flame Out; VFR = visual flight rules; GCA = Ground Controlled Approach.

NAS Pax River Directional Flow Patterns of Based Aircraft

See the Track Map .pdf file for details on the flight tracks.

Departures	UH-1	GASEPF
Spot 1 North	45.0%	
Spot 1 South	7.5%	
Spot 1 Southwest	22.5%	
Spot 2 East	2.5%	
Spot 2 South	7.5%	
Spot 2 West	15.0%	
Route A		75.0%
Route B		12.5%
Route C		12.5%
	good	*good*
Arrivals	**UH-1**	**GASEPF**
Spot 1 North	45.0%	
Spot 1 South	7.5%	
Spot 1 Southwest	22.5%	
Spot 2 East	2.5%	
Spot 2 South	7.5%	
Spot 2 West	15.0%	
Route A		75.0%
Route B		12.5%
Route C		12.5%
	good	*good*

Transient Aircraft Data Validation

Total Transient Ops (FIST data plus PPR Logs):

Aircraft	*Sorties*	*# of Flying Days*	*# of Flying Weeks per Year*	*Basis of Sorties (# of days)*	*Patterns per Sortie*	*Annual Departures*	*Annual Arrivals*	*Annual Closed Pattern Operations*	*Total Annual Operations*
C-12	46	365	52	Y	1.3	46	46	120	212
C-130	52	365	52	Y	0.6	52	52	62	166
C-21	26	365	52	Y	0.6	26	26	31	83
F-18E/F	37	365	52	Y	0.8	37	37	59	133
F-35C	25	365	52	Y	0.5	25	25	25	75
GASEPF	62	365	52	Y	1.3	62	62	161	285
H-60	96	365	52	Y	2.2	96	96	422	614
MV-22	24	365	52	Y	2.2	24	24	106	154
P-3	38	365	52	Y	0.6	38	38	46	122
P-8	38	365	52	Y	0.6	38	38	46	122
T-38	27	365	52	Y	0.8	27	27	43	97
Totals:	**471**					**471**	**471**	**1121**	**2063**

Operation Type Distrubution

Operation	**Type**	**Transients**
Arrivals	Straight-in Arrival	100%
	Overhead Break Arrival	
	Carrier Break Arrival	
	SFO Arrival	
	Straight-in to Slow Landing	
	Tactical - overhead break	
	Instrument approach	
		good
Departures	Military	100%
	Afterburner Takeoff to Mil Climb	
	Short Takeoff to Mil Climb	
		good
Patterns	VFR Touch and Go Pattern (or Low Approach Pattern)	30%
	SFO Pattern	
	IFR Pattern or GCA Box	70%
	Touch and Go to Slow Landing	
		good

NAS Pax River Directional Flow Patterns of Transient Aircraft		
See the Track Map .pdf file for details on the flight tracks.		
Departures	**Fixed Wing Transients**	**Helicopter Transients**
Depart East/North (Barren)	60%	50%
Depart South/West (Piney)	40%	50%
	good	*good*
Arrivals	**Fixed Wing Transients**	**Helicopter Transients**
VFR Piney Arrival (East/North flow)	60%	50%
VFR Barren Arrival (West/South flow)	40%	50%
IFR Straight-in	0%	0%
	good	*good*

Key: VFR = visual flight rules; IFR = instrument flight rules.

Appendix B: Squadron and Aircraft Specific Flight Tracks

(intentionally blank)

Appendix C: Squadron and Aircraft Specific Representative Flight Profiles

(intentionally blank)

Appendix E
Air Quality Calculations

Table of Contents

E.1 Air Quality Example Calculations E-1

E.1.1 Aircraft Activities Emissions E-1

E.1.2 Aircraft In-Frame Maintenance E-3

E.1.3 Open-Air Engine Test Cell Facility E-4

E.1.4 Surface Vessel Activities Emissions E-4

E.1.5 Ground Support Equipment Emissions E-6

E.1.6 Munitions and Other Military Expended Materials Emissions E-9

E.2 Emissions Estimates Tables E-11

E.3 Record of Non-Applicability (RONA) E-17

E.4 References E-19

List of Tables

Table E-1 Representative Airframes and Emission Factor Sources E-1

Table E-2 Nonattainment Area Flight Operations E-2

Table E-3 Aircraft In-Frame Maintenance Emissions Factors E-3

Table E-4 Five-Year OAETC Emissions E-5

Table E-5 Representative Vessels and Emission Factors E-7

Table E-6 Ground Support Equipment Details E-8

Table E-7 U.S. Environmental Protection Agency Tier 1 and Tier 2 Emission Factors (g/HP-hr) E-9

Table E-8 U.S. Representative Munitions and Other MEM Emission Factors E-10

Table E-9 Total Annual Aircraft Flight Operations Emissions E-11

Table E-10 Aircraft In-Frame Maintenance Emissions E-12

Table E-11 Annual OAETC Operations Emissions E-13

Table E-12 Ground Support Equipment Emissions E-14

Table E-13 Annual Vessel Operations Emissions E-15

Table E-14 Munitions and Other MEM Annual Emissions E-16

Abbreviations and Acronyms

Acronym	***Definition***
$<$	less than
$\leq$	less than or equal to
$\geq$	greater than or equal to
AESO	Aircraft Environmental Support Office
AGL	above ground level
BT	bow thruster
cal	caliber
CO	carbon monoxide
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
cyl	cylinder
DODIC	Department of Defense Identification Code
EFC&FC	Engine Fuel Consumption & Emission Calculator
ft	feet
g/HP-hr	gallons per horsepower-hour
gal	gallons
gal/hr	gallons per hour
GSE	ground support equipment
HC	hydrocarbons
Helo OPAREA	Helicopter Operating Area
HP	horsepower
HP-hr	horsepower hour
hrs	hours
HSMST	High-Speed Maneuvering Surface Target
Hyd	hydraulic
ID	identification
in	inches
kW	kilowatts
lbs	pounds
L	liter
LANT	Atlantic
lbs-ft	pound-foot
LTO	landing and takeoff

Acronym	***Definition***
MEM	military expended materials
mm	millimeter
MPDE	main propulsion diesel engine
MPGE	main propulsion gasoline engine
MSC	Military Sealift Command
MT/yr	metric tons per year
MTU	Motor and Turbine Union
NA	not applicable
NAVAIR	Naval Air Systems Command
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
Navy	U.S. Department of the Navy
$NMHC+NO_x$	nonmethane hydrocarbons plus nitrogen oxides
No.	Number
NO_x	nitrogen oxides
OAETC	Open-Air Engine Test Cell
PM	particulate matter
PM_{10}	particulate matter less than or equal to 10 microns in diameter
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns in diameter
PRC	Patuxent River Complex
RONA	Record of Non-Applicability
SDST	Ship-Deployable Surface Target
SO_2	sulfur dioxide
SO_x	sulfur oxides
SSDG	ship-side diesel generator
SVHO	Super Vortex High Output
tpy	tons per year
UAS	unmanned aerial systems
U.S.	United States
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

This appendix discusses emission factor development and calculations including assumptions employed in the analysis presented in Section 3.2 (Air Quality) of Chapter 3 (Affected Environment and Environmental Consequences).

E.1 Air Quality Example Calculations

E.1.1 Aircraft Activities Emissions

The Proposed Action testing and training consists of various activities associated with manned and unmanned fixed-wing and rotary-wing aircraft. Aircraft activities of concern are those that occur from ground level up to 3,000 feet above ground level (AGL). The 3,000 feet AGL ceiling is the default atmospheric mixing height above which any pollutant generated would not contribute to increased pollutant concentrations at ground level (known as the mixing zone). All pollutant emissions from aircraft generated at greater than 3,000 feet AGL are excluded from this analysis. The pollutant emission rate is a function of the engine's operating mode, the fuel flow rate, and the engine's overall efficiency. Emissions for one complete flight for a particular aircraft are calculated using the specific engine pollutant emission factors for each mode of operation.

For this Environmental Impact Statement, emission factors for aircraft engines were obtained from the United States (U.S.) Department of the Navy's (the Navy) Aircraft Environmental Support Office (AESO) memoranda. For aircraft where engine data from AESO was unavailable, an appropriate surrogate aircraft's AESO emission factors were used.

Because operations in the Patuxent River Complex (PRC) Study Area include primarily testing operations, by nature, the numbers and types of operations vary greatly. To account for this, a conservative approach was used in which representative aircraft were chosen for each of four airframe classes: fixed-wing jet, fixed-wing propeller, rotary-wing, and unmanned aerial systems (UAS). Representative aircraft were selected based on their predominance of operations below 3,000 feet AGL (Table E-1).

Table E-1 Representative Airframes and Emission Factor Sources

Airframe Type	*Representative Aircraft*	*Emission Factors Source*
Fixed-wing jet	F/A-18	Aircraft Emission Estimates: F/A-18 Landing and Takeoff Cycle and In-Frame Maintenance Testing Using JP-5, AESO Report 9815I (U.S. Department of the Navy, 2017)
Fixed-wing propeller	C-12	Aircraft Emission Estimates: C-12 Landing and Takeoff Cycle and In-Frame Maintenance Testing Using JP-5, AESO Report 9910D (U.S. Department of the Navy, 2015)
Rotary-wing	H-60	Aircraft Emission Estimates: H-60 Landing and Takeoff Cycle, Cruise Time and In-Frame Maintenance Testing Using JP-5, AESO Report 9929C (U.S. Department of the Navy, 2016)
Unmanned Aerial Systems (UAS)	T-34	Aircraft Emission Estimates: T-34C Landing and Takeoff Cycle and In-Frame Maintenance Testing Using JP-5, AESO Report 9921D (U.S. Department of the Navy, 2019)

A portion of flight operations would occur in the Calvert County ozone marginal nonattainment area. Of all flight operations, activities below 3,000 feet AGL represent approximately 41 percent of operations under the No Action Alternative and 51 percent under Alternatives 1 and 2. Of that, approximately half of operations occur in the West Helicopter Operating Area (Helo OPAREA) and 0.83 percent occur in R-4007. Approximately 25 percent of R-4007 and West Helo OPAREA airspaces overlap Calvert County (nonattainment area); therefore, emissions were weighted, based on those factors, to estimate the portion of emissions occurring in the nonattainment area as follows:

West Helo OPAREA

Table 3.0-14 (Current and Proposed Annual Flight Hours by PRC Airspace) indicates the number of flights in the Helo OPAREAs. The hours were then further adjusted by the fraction that are below 3,000 AGL for each alternative (i.e., 41 percent for the No Action Alternative, 51 percent each for Alternatives 1 and 2). Section 3.0.2.3.4.1 (Air-Based Assets) indicates that about half of the flight hours flown in the Helo OPAREAs are conducted in the West Helo OPAREA. Therefore, it was estimated:

- No Action Alternative = 4,020 hours (hrs) x .41 below 3,000 AGL x .50 in West Helo OPAREA = 824.1 hrs
- Alternative 1 = 4,680 hrs x .51 below 3,000 AGL x .50 in West Helo OPAREA = 1,193.4 hrs
- Alternative 2 = 5,200 hrs x .51 below 3,000 AGL x .50 in West Helo OPAREA = 1,326 hrs

R-4007

Figure 3.0-2 (Sorties Conducted in PRC Restricted Airspace) provides the 10-year average sorties for each PRC restricted area. The total sorties is 11,281 and R-4007 is 94 (or 0.83 percent).

Similar to the Helo OPAREA calculation, Table 3.0-14 (Current and Proposed Annual Flight Hours by PRC Airspace) provides the restricted area values for each alternative.

- No Action = 16,080 hrs x .41 below 3,000 AGL x .0083 in R-4007 = 54.7 hrs
- Alternative 1 = 18,720 hrs x .51 below 3,000 AGL x .0083 in R-4007 = 79.2 hrs
- Alternative 2 = 20,800 hrs x .51 below 3,000 AGL x .0083 in R-4007 = 88 hrs

Adding operations in the West Helo OPAREA and R-4007 together results in the following (Table E-2):

Table E-2 Nonattainment Area Flight Operations

	No Action Alternative	*Alternative 1*	*Alternative 2*
Total hours for West Helo OPAREA and R-4007	878.8	1,272.6	1,414
Percentage Distribution of Representative Aircraft			
Fixed-wing jet	24.16%	20.95%	20.95%
Fixed-wing prop	23.87%	14.73%	14.73%
Rotary-wing	48.17%	57.85%	57.85%
UAS	3.81%	6.48%	6.47%
Total Hours for West Helo OPAREA and R-4007 by Aircraft Type			
Fixed-wing jet	212.3	266.6	296.2
Fixed-wing prop	209.7	187.5	208.3
Rotary-wing	423.3	736.2	818
UAS	33.5	82.4	91.5

Key: Helo OPAREA = Helicopter Operating Area; R- = restricted area; UAS = unmanned aerial systems.

No low-level flights are anticipated in the portion of the PRC Study Area overlapping the nonattainment area in Sussex County, Delaware, and thus there are no concerns with respect to General Conformity, which is not addressed further.

Using these data, pollutant emissions for each aircraft and activity were calculated by applying the equation below. Time-in-mode below 3,000 feet AGL was obtained using the data from the *Aircraft Noise Study to Support the Environmental Impact Statement for the Patuxent River Complex* (Appendix D, Noise Study).

Total minutes per landing and takeoff (LTO) and emission factors are from AESO's emission estimate reports, except the minutes-per-LTO was reduced by the total time for ground operation. This was done to match the time for noise profiles, as normally noise profiles do not include ground operations. However, the LTO emission factors do include the emissions from ground operations. Therefore, ground operations were included in AESO's calculations.

Emissions = TIM/MINxLTO-EF

Where:

Emissions = Aircraft Emissions (pounds per activity)

TIM = Time-in-mode below 3,000 feet AGL per noise study

MIN = Minutes per LTO cycle (minus the time for ground operations)

EF = Emission factor for one specific airframe LTO cycle, including emissions from ground operations associated with the LTO cycle

As the equation indicates, emissions were determined by estimating the total number of LTOs per airframe and then applying the appropriate AESO LTO emissions factors for the specified airframe.

Lead emissions were estimated by looking at actual usage of aviation gas at PRC over a five-year period. According to an aviation gas material safety data sheet from Shell, lead content is approximately 0.56 grams/liter (Shell Trading Company, 2020).

E.1.2 Aircraft In-Frame Maintenance

Emissions are generated by aircraft conducting routine in-frame maintenance runs. During tests, pilots operate engines at a range of operating modes while on the ground. Emissions associated with aircraft in-frame maintenance were estimated based on emission factors in AESO Memorandum Report No. 2020-14 *Averaged In-frame Maintenance Emission Rates for F/A-18, C-12, H-60, and T-34* (U.S. Department of the Navy, 2020). Emission factors are provided below in Table E-3.

Table E-3 Aircraft In-Frame Maintenance Emissions Factors

Airframe	*Averaged Fuel Usage (lb/hr)*	*Averaged In-Frame Maintenance Emission Rates (lb/hr)*						
		CO_2	*CO*	*THC*	*VOC*	*NO_X*	*$PM_{2.5}$*	*PM_{10}*
F/A-18	2,344.60	6,868.40	327.84	64.73	74.4395	24.45	14.66	14.66
C-12	355.70	1,133.80	5.84	1.44	1.656	1.80	1.49	1.49
H-60	266.00	847.00	6.09	0.76	0.874	1.23	0.84	0.84
T-34	126.50	399.80	1.93	0.15	0.1725	0.56	0.02	0.02

Key: AC = aircraft; CO = carbon monoxide; CO_2e = carbon dioxide equivalent; hr = hour; lb = pounds; NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 microns in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; THC = total hydrocarbons; VOC = volatile organic compound.

Emissions were then calculated as follows, based on the total annual in-frame maintenance hours for each representative airframe.

Emissions = OPSxEF

Where:

Emissions = Aircraft In-frame Maintenance Emissions

OPS = Total annual in-frame maintenance hours

EF = Averaged emission factor for specific airframe in-frame maintenance (lbs/hr)

E.1.3 Open-Air Engine Test Cell Facility

Emissions are generated by aircraft engine testing at the Open-Air Engine Test Cell (OAETC) facility. During tests, engines are operated approximately half of the time at idle and half at high power. Further, OAETC test activities are conducted intermittently, with many days of no activity. Because these are stationary sources, these emissions are tracked and reported annually in the Emissions Certification Reports submitted to the Maryland Department of the Environment. Table E-4 shows the reported emissions for the years available at the time this document was prepared (2013-2017) and the five-year average emissions. The five-year average is considered the baseline emissions for the OAETC. Under Alternative 1, the emissions are not projected to change from baseline levels. Alternative 2 emissions represent a 10 percent increase in operations from the baseline and Alternative 1. The majority of emissions are generated by the Jet Engine Test Instrumentation (JETI) test cells. However, emissions are minimal and operating hours are well below levels permitted under the Title V Air Operating Permit (Part 70 Operating Permit 24-037-0017).

E.1.4 Surface Vessel Activities Emissions

Surface activities consist of activities associated with vessel traffic. PRC Study Area Navy vessels including range support boats, combatant and patrol craft, motorized surface targets, and unmanned surface vehicles. Larger vessels also have generators operating onboard to provide electricity for non-propulsion functions and may also have separate bow thruster engines used in berthing. Each of these vessels incorporates different propulsion methods such as marine outboard engines, diesel engines, and gas turbines. Calculations are based on the combustion of fossil fuels (primarily diesel) in these engines and the time they run.

The Naval Sea Systems Command (NAVSEA) has compiled a database of all ships within their inventory and associated emissions factors for air pollutants produced from the vessel inboard and outboard gasoline and diesel engines. These engines are operated on a variety of vessels involved in testing and training activities. Emission factors were obtained from the NAVSEA Navy and Military Sealift Command (MSC) Marine Engine Fuel Consumption & Emission Calculator documentation for compression ignition and spark ignition engines. These vessels vary greatly in size, engine power, fuel consumption, and associated emissions. Therefore, vessels were classified by their length as being either small (less than 50 feet), medium (50 to 100 feet), or large (greater than 100 feet but less than 400 feet). Then, for each category, a representative vessel, based on greatest historical use, was selected to provide conservative emission factors and estimates.

Table E-4 Five-Year OAETC Emissions

Reporting Year	*Engine Test Cell Type*	*Registration No.*	*Pollutant (tpy)*						*CO_2e (MT/yr)*
			CO	*NO_X*	*PM_{10}*	*SO_2*	*VOC*	*CO_2e*	
2013	Jet Engine Test Cells	037-9-0038	11.40	4.37	0.81	0.39	1.11	707	641
	Helicopter Engine Test Cell	037-9-0039	0.21	0.26	0.08	0.05	0.02	120	109
	Turboshaft Engine Test Cell	037-9-0101	0.00	0.00	0.00	0.00	0.00	0	0
2014	Jet Engine Test Cells	037-9-0038	6.73	6.06	1.02	0.81	0.89	2,213	2,008
	Helicopter Engine Test Cell	037-9-0039	0.03	0.02	0.01	0.01	0.00	9	8
	Turboshaft Engine Test Cell	037-9-0101	0.10	0.22	0.00	0.01	0.03	15	14
2015	Jet Engine Test Cells	037-9-0038	4.37	6.34	0.96	0.68	0.64	921	836
	Helicopter Engine Test Cell	037-9-0039	0.01	0.01	0.00	0.00	0.00	6	5
	Turboshaft Engine Test Cell	037-9-0101	0.17	0.58	0.00	0.04	0.03	89	81
2016	Jet Engine Test Cells	037-9-0038	9.60	6.85	1.14	0.72	0.85	1237	1,122
	Helicopter Engine Test Bays	037-9-0039	0.02	0.01	0.00	0.00	0.00	6	5
	Turboshaft Engine Test Cell	037-9-0101	0.00	0.00	0.00	0.00	0.00	0	0
2017	Jet Engine Test Cells	037-9-0038	4.69	6.75	0.46	0.71	0.71	1578	1,432
	Helicopter Engine Test Cell	037-9-0039	0.06	0.08	0.02	0.01	0.01	35	32
	Turboshaft Engine Test Cell	037-9-0101	0.00	0.00	0.00	0.00	0.00	0	0
Five-Year Average	Jet Engine Test Cells	037-9-0038	7.36	6.07	0.88	0.66	0.84	1,333	1,209
	Helicopter Engine Test Cell	037-9-0039	0.07	0.08	0.02	0.02	0.01	35	32
	Helicopter Engine Test Cell	037-9-0086	0.00	0.00	0.00	0.00	0.00	0	0
	Turboshaft Engine Test Cell	037-9-0101	0.05	0.16	0.00	0.01	0.01	21	19
	OAETC Total Emissions		**7.48**	**6.31**	**0.90**	**0.68**	**0.86**	**1,389**	**1,260**

Key: CO = carbon monoxide; CO = carbon monoxide; CO_2e = carbon dioxide equivalents; MT/yr = metric tons per year; No. = number; NO_x = nitrogen oxides; OAETC = Open-Air Engine Test Cell; PM_{10} = particulate matter less than or equal to 10 microns in diameter; SO_2 = sulfur dioxide; tpy = tons per year; VOC = volatile organic compound.

Note: Total values shown may appear to differ slightly from additive sums due to rounding.

Table E-5 shows the representative vessels selected along with relevant engine data and associated emission factors. Detailed characteristics of these representatives are also provided in Appendix A (Patuxent River Complex Activity and Asset Descriptions).

The Navy and MSC Marine Engine Fuel Consumption & Emission Calculator is a database program that allows a registered user to determine (1) the amount of various pollutants given off by a Navy vessel or, alternatively, an engine of the type used aboard Navy vessels, and (2) the amount of fuel consumed by a Navy vessel over a period of time. The purpose of this program is to consolidate existing Navy vessel exhaust emission data into a single database, thereby allowing users to access this database via the Internet in order to calculate vessel exhaust emissions and fuel consumption for their particular needs (such as for Environmental Impact Statements or fleet fuel estimates). Currently, the pollutants that this application tracks are: nitrogen oxides (NO_x), sulfur oxides (SO_x), carbon monoxide (CO), carbon dioxide (CO_2), hydrocarbons (HC), and particulate matter (PM).

Emissions estimates for surface vessels were calculated using factors obtained from NAVSEA, multiplied by the engine horsepower and hours of operation.

Emissions = HP×HR/YR×EF×ENG

Where:

Emissions = Surface craft Emissions (pound per year)

HP = Horsepower (reflective of a particular load factor/engine power setting)

HR/YR = Hours per year

EF = Emission factor for specific engine type ENG = Number of engine

To determine the entire testing and training activity emissions, a calculation was conducted for each surface vessel type and for each pollutant and converted to tons. The baseline is defined as the level of testing and training activities identified in the No Action Alternative. These values were summed according to the appropriate pollutant to provide the cumulative emissions associated with surface vessel emissions activities.

Lead emissions were calculated as a fraction of the particulate matter less than or equal to 10 microns in diameter (PM_{10}) per the U.S. Environmental Protection Agency hazardous air pollutant profiles for marine vessels using distillate fuels. This assumes that lead emissions are 0.00015 weight fraction of the PM_{10} for category 1 and 2 engines (Environment Canada, 2012).

E.1.5 Ground Support Equipment Emissions

Ground support equipment (GSE) includes various gasoline or diesel equipment to support aircraft operations. Test stands, tow tractors, generators, loaders, and trucks are examples of equipment used regularly. Table E-6 shows the various types of GSE used along with the estimated hours of operation and relevant engine details. Details such as manufacturer, horsepower, fuel type, etc., were provided by the operators of Naval Air Station Patuxent River tenant squadrons. Parts-specific emission factors were not available; therefore, U.S. Environmental Protection Agency standard diesel emissions for the age-appropriate tier for the part (Tier 1 or Tier 2) were used to estimate emissions. Tier 1 and Tier 2 emission factors are provided in Table E-7.

Table E-5 Representative Vessels and Emission Factors

Vessel Size Class	Vessel Representative Type	NAVSEA EFC&FC Vessel ID Used	Engine Usage	Fuel Type	Engine Manufacturer	Engine Model	No. of Engines	Engine Rating (HP)	Emission Factors (lbs/HP-hr)[1]						
									CO	NO_x	PM_{10}	$PM_{2.5}$	SO_2	VOC	CO_2e
Range Support Boats															
Small (Less than 50 ft)	Fountain Boat	33BP1001	MPGE	Gas	Mercury	Verado	3	300	1.24	0.02	0.00	0.00	0.00	0.51	1.08
Medium (50 ft - 100 ft)	Patrol Boat 777	65PB777	MPDE	Diesel	GM/Detroit Diesel	8V92/8V-71TI	3	650	0.01	0.02	0.00	0.00	0.00	0.00	1.20
Large (Greater than 100 ft)	Relentless[2]	YDT-17/YDT-18	MPDE	Diesel	Caterpillar	3508B	2	1000	0.01	0.02	0.00	0.00	0.00	0.00	1.25
	Relentless[2]	YDT-17/YDT-18	SSDG	Diesel	Caterpillar	3306	2	168	1.24	0.02	0.00	0.00	0.00	0.51	1.13
	Relentless[2]	YDT-17/YDT-18	BT	Diesel	Caterpillar	3304	1	54	0.01	0.02	0.00	0.00	0.00	0.00	1.31
Combatant and Patrol Vessels															
Small (Less than 50 ft)	Rigid Inflatable Craft	11MRB0302	MDPE	Diesel	Cummings	QSB5.9	2	380	0.01	0.01	0.00	0.00	0.00	0.00	1.19
Medium (50 ft - 100 ft)	Mark V Patrol Boat	82NS9604	MDPE	Diesel	MTU	12V-394 TE94	2	2285	0.01	0.02	0.00	0.00	0.00	0.00	1.18
Large (Greater than 100 ft)	Cyclone-Class Patrol Ship	PC2/PC14	MPDE	Diesel	Paxman	16RP200M	4	3350	0.00	0.01	0.00	0.00	0.00	0.00	0.58
	Cyclone-Class Patrol Ship	PC2/PC14	SSDG	Diesel	Caterpillar	3306B	2	200	0.00	0.01	0.00	0.00	0.00	0.00	0.65
Motorized Surface Targets															
Small motorized propeller (Less than 50 ft)	HSMST	HSMST	MPGE	Gas	Mercury	200	2	200	1.24	0.02	0.00	0.00	0.00	0.51	1.14
Medium motorized propeller (50 ft - 100 ft)	QST-35B Seaborne Powered Target	100NS7801	MPDE	Diesel	Detroit MTU	Series 60	2	740	0.01	0.02	0.00	0.00	0.00	0.00	1.14
Small motorized impeller (Less than 50 feet)	SDST	NA[3]	NA	Gas	FX 2015 Cruiser SVHO	Yamaha 1812cc	1	250	0.61	0.02	0.00	0.00	0.00	0.25	0.43
Unmanned Maritime Systems															
Unmanned Surface Vehicles	HSMST	HSMST	MPGE	Gas	Mercury	200	2	200	1.24	0.02	0.00	0.00	0.00	0.51	1.14

Key: BT = bow thruster; CO = carbon monoxide; CO_2e = carbon dioxide equivalents; EFC&FC = Engine Fuel Consumption & Emission Calculator; ft = feet; HP = horsepower; HP-hr = horsepower hour; HSMST = High Speed Maneuvering Surface Target; ID = identification; LANT = Atlantic; lbs = pounds; MPGE = main propulsion gasoline engine; MPDE = main propulsion diesel engine; MTU = Motor and Turbine Union; NA = not applicable; NAVSEA = Naval Sea Systems Command; No. = number; NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 microns in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; SO_2 = sulfur dioxide; SDST = Ship Deployable Surface Target; SSDG = ship service diesel generator; SVHO = Super Vortex High Output; VOC = volatile organic compound.

Notes:

1. These data are generated using the NAVSEA EFC&EC software by Dave Coffin at Naval Facilities Engineering Command Atlantic (NAVFAC LANT).
2. Navy Vessel Relentless is a 145-foot ship, which has three operating diesel engines onboard as described under engine usage and in the key.
3. Emissions Factors Draft Environmental Assessment for Naval Special Operations Training In Western Washington State (2018).

Table E-6 Ground Support Equipment Details

Equipment Type	*No Action Alternative hours/year*	*Alternative 1 (+14.1%) hours/year*	*Alternative 2 (+22.7%) hours/year*	*Engine Manufacturer*	*Engine Model*	*Tier*
Test Stand, Hydraulic Portable, Diesel	2,271	2,591	2,786	Deutz	2012c Notes: 111 HP, 4-cyl turbocharges, tank capacity = 22 gal	Tier 2
Tow Tractor, Aircraft	9,918	11,316	12,169	Deutz	BF4M2011 88HP, 4-cyl, fuel capacity = 18.4gal	Tier 2
Power Plant, Mobile Electric	13,050	14,890	16,012	Detroit Diesel, General Motors Corp	Series 6-71 215 HP, 6-cyl, 2-cycle, fuel capacity = 30 gal	Tier 2
Loader, Air-Launched Weapons	1,253	1,429	1,537	Hatz	Model 2M40L/2M41Z-9353 40 HP, 2-cyl, 4-cycle direct injection air-cooled, tank capacity = 6 gal	Tier 2
MSU-200 NAVAIR Start Unit	10,962	12,508	13,450	(gas turbine powerhead) Hamilton Sundstrand	PH-47C4 396 HP consumes 37.4 gal/hr	Tier 2
Heavy-duty Land-based Tow Tractor	7,830	8,934	9,607	Cummins	QSB4.5 154 HP, 4-cylinder turbocharges, tank capacity = 45 gal	Tier 1
Truck, Lift Aerial Stores	1,044	1,191	1,281	Deutz	F2L1011 26.1 HP, 2-cylinder, air-cooled, fuel tank capacity = 6 gal	Tier 2
Truck, Transport, Ammunition-Loading	1,566	1,787	1,921	Ford Motor Company	[1] Ford F-750 6.7L PowerStroke V8 diesel engine - 270 HP/675 lbs-ft	Tier 2
Total hours[2]	47,894	54,646	58,763	NA	NA	NA

Key: cyl = cylinder; gal = gallons; gal/hr = gallons per hour; HP = horsepower; Hyd = hydraulic; L = liter; lbs-ft = pound-foot; NA = not applicable; NAVAIR = Naval Air Systems Command.

Note:

1. Source: (Ford, 2019)
2. Total values shown may appear to differ slightly from additive sums due to rounding.

Table E-7 U.S. Environmental Protection Agency Tier 1 and Tier 2 Emission Factors (g/HP-hr)

Engine Power	*Tier*	*Year*	*CO*	*HC*	*NMHC+NO$_x$*	*NO$_x$*	*PM$_{10}$*	*PM$_{2.5}$*
kW < 8	Tier 1	2000	6	0	7.8	0	0.75	0.75
(HP < 11)	Tier 2	2005	6	0	5.6	0	0.6	0.6
8 ≤ kW < 19	Tier 1	2000	4.9	0	7.1	0	0.6	0.6
(11 ≤ HP < 25)	Tier 2	2005	4.9	0	5.6	0	0.6	0.6
19 ≤ kW < 37	Tier 1	1999	4.1	0	7.1	0	0.6	0.6
(25 ≤ HP < 50)	Tier 2	2004	4.1	0	5.6	0	0.45	0.45
37 ≤ kW < 75	Tier 1	1998	0	0	0	6.9	0	0
(50 ≤ HP < 100)	Tier 2	2004	3.7	0	5.6	0	0.3	0.3
75 ≤ kW < 130	Tier 1	1997	0	0	0	6.9	0	0
(100 ≤ HP < 175)	Tier 2	2003	3.7	0	4.9	0	0.22	0.22
130 ≤ kW < 225	Tier 1	1996	8.5	1	0	6.9	0.4	0.4
(175 ≤ HP < 300)	Tier 2	2003	2.6	0	4.9	0	0.15	0.15
225 ≤ kW < 450	Tier 1	1996	8.5	1	0	6.9	0.4	0.4
(300 ≤ HP < 600)	Tier 2	2001	2.6	0	4.8	0	0.15	0.15
450 ≤ kW < 560	Tier 1	1996	8.5	1	0	6.9	0.4	0.4
(600 ≤ HP < 750)	Tier 2	2002	2.6	0	4.8	0	0.15	0.15
kW ≥ 560	Tier 1	2000	8.5	1	0	6.9	0.4	0.4
(HP ≥ 750)	Tier 2	2006	2.6	0	4.8	0	0.15	0.15

Key: ≥ = greater than or equal to; ≤ = less than or equal to; < = less than; CO = carbon monoxide; g/HP-hr = gallons per horsepower hour; HC = hydrocarbons; HP = horsepower; kW = kilowatts; NMHC+NO$_x$ = nonmethane hydrocarbons plus nitrogen oxides; NO$_x$ = nitrogen oxides; PM$_{10}$ = particulate matter less than or equal to 10 microns in diameter; PM$_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; U.S. = United States; VOC = volatile organic compound.

GSE emissions were calculated by multiplying the annual hours of operation by the horsepower of each piece of equipment by the appropriate tier and engine size emission factor. Emissions were then converted from grams to tons by applying a conversion factor.

Emissions = HP×HR/YR×EFxCF

Where:

Emissions = GSE Emissions (pound per year)

HP = Horsepower (reflective of a particular load factor/engine power setting)

HR/YR = Hours per year

EF = Emission factor for specific engine type, tier, and size

CF = Conversion Factor for grams to tons (1.10231e-6)

Lead emissions were calculated as a fraction of the PM$_{10}$ per the California Air Resource Board diesel fuel speciation profiles for the 2021 off-road diesel vehicle exhaust speciation. This assumes that lead emissions are 0.00001 weight fraction of the PM$_{10}$ (California Air Resource Board, 2020).

E.1.6 Munitions and Other Military Expended Materials Emissions

A wide variety of munitions and other military expended materials (MEM) are employed during testing and training activities in PRC Study Area. MEM were grouped by type, and a representative was chosen for each type based on the highest historical use and/or for which associated constituents were available. Emissions were only calculated for those munitions or MEM that generate emissions (e.g., those that are live-fired, contain a spotting charge, utilize combusted propellants, etc.). All munitions and MEM discussed in Section 3.0.2.3.3.4 (Non-explosive Munitions and Other Military Expended Materials), including aerial target jet-assisted takeoff bottles were included in the analysis, though all do not appear in the table, because they were grouped with another representative munition/MEM for emissions analysis.

Emission factors for representative surrogate munitions and other MEM were provided by Navy Ordnance Safety and Security Operation (NOSSA) from the U.S. Environmental Protection Agency's AP-42 compilations of emission factors from various sources. Emission factors are provided in Table E-8.

Available emissions factors (AP-42, Compilation of Air Pollutant Emission Factors) were utilized. These factors were then multiplied by the net weight of the explosive (or a conversion factor for pounds per item) and the number of times that the munition was used during baseline fiscal years 2008 through 2017. This calculation provided annual pounds per year of emissions, which were converted to tons per year for comparison purposes.

Emissions = EXP/YR×EF

Where:

Emissions = Ordnance Emissions (pounds per year)

EXP/YR = Explosives, propellants, and pyrotechnics used per year EF = Emissions factor

Table E-8 U.S. Representative Munitions and Other MEM Emission Factors

Type	*Category*	*DODIC ID*	*Emission Factor (lbs/item)*								*Emission Factor Source References*
			CO_2	*CO*	*NO_x*	*VOC*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*	*Pb*	
.50 cal blank	Small cal	A598	0.002	0.002	0.000	0.000	0.000	0.000	0.000	0.000	USEPA, 2008 AP-42 15.1.29 A598, M1A1 .50 Caliber Blank Cartridge
25 mm	Medium cal	M793	0.043	0.085	0.002	0.000	0.000	0.003	0.002	0.000	USEPA, 2008 AP-42 15.1.32 A976, M793 25-mm Target Practice Tracer Cartridge
2.75-in Rocket (Practice)	Rocket	H974	4.800	0.530	0.000	0.000	0.000	0.160	0.170	0.070	USEPA, 2008 AP-42 15.6.7 H974, 2.75-inch M267 Practice Warhead, MK66 Mod 3 Motor
Floating Smoke Pot	Marine Marker	K867	0.530	0.890	0.003	0.022	0.003	30.000	23.000	0.016	USEPA, 2008 AP-42 15.7.7 K867, M4A2 Floating Type HC Smoke Pot
Flare	Counter-measure Flare	L410	0.011	0.001	0.000	0.000	0.000	0.006	0.006	0.000	USEPA, 2008 AP-42 15.8.16 L410, M206 Aircraft Countermeasure Flare
Flare	Illumination Flare	L311	0.140	0.011	0.003	0.000	0.000	0.120	0.120	0.000	USEPA, 2008 AP-42 15.8.4 L311, M126A1 Red Star Parachute Signal Flare
2.75-in Rocket Flechette	Rocket	H459	2.400	1.500	0.026	0.000	0.000	0.110	0.100	0.051	USEPA, 2008 AP-42 15.6.1 H459, 2.75-inch Flechette, MK40 Mod 3 Motor
Simulant Launcher Grenade	Launchers/ Pods	G978	0.015	0.012	0.000	0.000	0.000	0.053	0.029	0.000	USEPA, 2008 AP-42 15.5.11 G978, M82 Simulant Screening Smoke Launcher Grenade

Key: AP-42 = Air Pollutant Emissions Factors; cal = caliber; CO = carbon monoxide; CO_2 = carbon dioxide; DODIC = Department of Defense Identification Code; ID = identification; in = inches; lbs = pound; MEM = military expended materials; mm = millimeter; NO_x = nitrogen oxides; Pb = lead; PM_{10} = particulate matter less than or equal to 10 microns in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; SO_2 = sulfur dioxide; U.S. = United States; VOC = volatile organic compound; USEPA = U.S. Environmental Protection Agency.

Note:

1. Emission Factors from USEPA AP-42 Section 15 (various dates)

E.2 Emissions Estimates Tables

The following tables (Table E-9 through Table E-14) contain data used for the emissions calculations for aircraft, aircraft in-frame maintenance, OAETC runs, GSE, vessels, and munitions and other MEM, respectively. These tables were converted from Microsoft Excel spreadsheets.

Table E-9 Total Annual Aircraft Flight Operations Emissions

Source	Annual Pollutant Emissions (tons per year)							CO_2e (MT/yr)
	CO	VOC	NO_x	$PM_{2.5}$	PM_{10}	SO_2	CO_2e	
No Action Alternative								
F-18	2,439	737	286	167	167	30	176,620	160,227
C-12	25.55	7.16	7.13	6.43	6.43	1.92	10,101	9,163
H-60	163	20.84	44.63	31	31	10.96	39,056	35,431
UAS (T-34)	0.52	0.05	0.13	0	0	0.03	295	267
Total A/C	**2,628**	**765**	**338**	**205**	**205**	**43**	**226,071**	**205,088**
Alternative 1								
F-18	3,033	916	355	208	208	37	176,943	160,520
C-12	28.4	7.96	7.92	7.15	7.15	2.13	8,532	7,740
H-60	285	36.32	77.76	54.02	54.02	19.1	61,579	55,863
UAS (T-34)	2.3	0.21	0.56	0.02	0.02	0.15	704	638
Total A/C	**3,349**	**961**	**441**	**269**	**269**	**59.38**	**247,758**	**224,762**
Alternative 2								
F-18	3,371	1,018	395	231	231	41	196,638	178,387
C-12	31.56	8.85	8.8	7.94	7.94	2.37	9,480	8,600
H-60	316	40.35	86.4	60.02	60.02	21.23	68,423	62,073
UAS (T-34)	2.36	0.21	0.57	0.02	0.02	0.15	752	682
Total A/C	**3,721**	**1,068**	**491**	**299**	**299**	**65**	**275,293**	**249,742**

Key: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year; NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 (or 2.5) microns in diameter; SO_2 = sulfur dioxide; UAS = unmanned aerial systems; VOC = volatile organic compound.

Note: Total values shown may appear to differ slightly from additive sums due to rounding.

Table E-10 Aircraft In-Frame Maintenance Emissions

Source	*Annual Pollutant Emissions (tons per year)*							*CO_2e (MT/yr)*
	CO	*VOC*	*NO_x*	*$PM_{2.5}$*	*PM_{10}*	*SO_2*	*CO_2*	
No Action Alternative								
F/A-18	143	32.56	10.69	6.41	6.41	1.28	3,004	2,725
C-12	2.52	0.72	0.78	0.64	0.64	0.19	490	444
H-60	5.31	0.76	1.07	0.73	0.73	0.29	738	669
T-34	0.13	0.01	0.04	0.00	0.00	0.01	27	25
Total Emissions	**151**	**34.05**	**12.58**	**7.79**	**7.79**	**1.77**	**4,259**	**3,864**
Alternative 1								
F/A-18	145	32.83	10.78	6.47	6.47	1.29	3,029	2,748
C-12	1.81	0.51	0.56	0.46	0.46	0.14	352	319
H-60	7.42	1.07	1.50	1.02	1.02	0.41	1,032	936
T-34	0.26	0.02	0.08	0.00	0.00	0.02	54	49
Total Emissions	**154**	**34.43**	**12.92**	**7.95**	**7.95**	**1.86**	**4,467**	**4,053**
Alternative 2								
F/A-18	161	36.51	11.99	7.19	7.19	1.44	3,369	3,056
C-12	2.01	0.57	0.62	0.51	0.51	0.15	391	355
H-60	8.24	1.18	1.66	1.14	1.14	0.45	1,146	1,040
T-34	0.29	0.03	0.08	0.00	0.00	0.02	60	55
Total Emissions	**171**	**38.29**	**14.36**	**8.84**	**8.84**	**2.06**	**4,967**	**4,506**

Key: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year; NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 (or 2.5) microns in diameter; SO_2 = sulfur dioxide; UAS = unmanned aerial systems; VOC = volatile organic compound.

Note: Total values shown may appear to differ slightly from additive sums due to rounding.

Table E-11 Annual OAETC Operations Emissions

Source	*Annual Pollutant Emissions (tons per year)*						*CO_2e (MT/yr)*
	CO	*NO_x*	*PM*	*SO_2*	*VOC*	*CO_2e*	
No Action Alternative							
Jet Engine Test Cells	7.36	6.07	0.88	0.66	0.84	1,333	1,209
Helicopter Engine Test Bays	0.07	0.08	0.02	0.02	0.01	35	32
Helicopter Engine Test Cell	0	0	0	0	0	0	0
Turboshaft Engine Test Cell	0.05	0.16	0	0.01	0.01	21	19
OAETC Total Emissions	**7.48**	**6.31**	**0.9**	**0.69**	**0.86**	**1,389**	**1,260**
Alternative 1							
Jet Engine Test Cells	7.36	6.07	0.88	0.66	0.84	1,333	1,209
Helicopter Engine Test Bays	0.07	0.08	0.02	0.02	0.01	35	32
Helicopter Engine Test Cell	0	0	0	0	0	0	0
Turboshaft Engine Test Cell	0.05	0.16	0	0.01	0.01	21	19
OAETC Total Emissions	**7.48**	**6.31**	**0.9**	**0.69**	**0.86**	**1,389**	**1,260**
Alternative 2							
Jet Engine Test Cells	8.09	6.68	0.96	0.73	0.92	1,466	1,330
Helicopter Engine Test Bays	0.07	0.08	0.03	0.02	0.01	39	35
Helicopter Engine Test Cell	0	0	0	0	0	0	0
Turboshaft Engine Test Cell	0.06	0.18	0	0.01	0.01	23	21
OAETC Total Emissions	**8.23**	**6.94**	**0.99**	**0.75**	**0.94**	**1,528**	**1,386**

Key: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year; NO_x = nitrogen oxides; OAETC = Open-Air Engine Test Cell; PM_{10} = particulate matter less than or equal to 10 (or 2.5) microns in diameter; SO_2 = sulfur dioxide; UAS = unmanned aerial systems; VOC = volatile organic compound.

Note: Total values shown may appear to differ slightly from additive sums due to rounding.

Table E-12 Ground Support Equipment Emissions

Source	HP	Tier	Annual Pollutant Emissions (tons per year)									CO_2 (MT)
			CO	VOC	NMHC +NO_x	NO_x	PM_{10}	$PM_{2.5}$	SO_2	Pb	CO_2	
No Action Alternative												
Test Stand, Hydraulic Portable, Diesel	111	2	1.03	0.07	1.36	1.29	0.06	0.06	0.00	0.00	50	45
Tow Tractor, Aircraft	88	2	3.56	0.27	5.39	5.12	0.29	0.29	0.01	0.00	274	248
Power Plant, Mobile Electric	215	2	8.04	0.76	15.15	14.40	0.46	0.46	0.02	0.00	554	503
Loader, Air-Launched Weapons	40	2	0.23	0.02	0.31	0.29	0.02	0.02	0.00	0.00	10	9
MSU-200 NAVAIR Start Unit	396	2	12.44	1.15	22.97	21.82	0.72	0.72	0.03	0.00	858	778
Test Stand, Hydraulic, Portable (Diesel)	154	1	0.00	0.00	0.00	9.17	0.00	0.00	0.01	0.00	238	216
Truck, Lift Aerial Stores	26.1	2	0.12	0.01	0.17	0.16	0.01	0.01	0.00	0.00	5	5
Truck, Transport, Ammunition-Loading	270	2	1.21	0.11	2.28	2.17	0.07	0.07	0.00	0.00	84	76
GSE Total Emissions			**26.63**	**2.38**	**47.63**	**54.42**	**1.64**	**1.64**	**0.06**	**0.00**	**2,072**	**1,880**
Alternative 1												
Test Stand, Hydraulic Portable, Diesel	111	2	1.17	0.08	1.55	1.48	0.07	0.07	0.00	0.00	57	52
Tow Tractor, Aircraft	88	2	4.06	0.31	6.15	5.84	0.33	0.33	0.01	0.00	312	283
Power Plant, Mobile Electric	215	2	9.18	0.86	17.29	16.43	0.53	0.53	0.02	0.00	632	574
Loader, Air-Launched Weapons	40	2	0.26	0.02	0.35	0.34	0.03	0.03	0.00	0.00	11	10
MSU-200 NAVAIR Start Unit	396	2	14.20	1.31	26.21	24.90	0.82	0.82	0.03	0.00	978	888
Test Stand, Hydraulic, Portable (Diesel)	154	1	0.00	0.00	0.00	10.46	0.00	0.00	0.01	0.00	272	247
Truck, Lift Aerial Stores	26.1	2	0.14	0.01	0.19	0.18	0.02	0.02	0.00	0.00	6	6
Truck, Transport, Ammunition-Loading	270	2	1.38	0.13	2.61	2.48	0.08	0.08	0.00	0.00	95	86
GSE Total Emissions			**30.39**	**2.72**	**54.35**	**62.10**	**1.87**	**1.87**	**0.07**	**0.00**	**2,365**	**2,145**
Alternative 2												
Test Stand, Hydraulic Portable, Diesel	111	2	1.26	0.08	1.67	1.59	0.07	0.07	0.00	0.00	61	55
Tow Tractor, Aircraft	88	2	4.37	0.33	6.61	6.28	0.35	0.35	0.01	0.00	336	305
Power Plant, Mobile Electric	215	2	9.87	0.93	18.59	17.67	0.57	0.57	0.02	0.00	680	617
Loader, Air-Launched Weapons	40	2	0.28	0.02	0.38	0.36	0.03	0.03	0.00	0.00	12	11
MSU-200 NAVAIR Start Unit	396	2	15.27	1.41	28.18	26.77	0.88	0.88	0.03	0.00	1,052	955
Test Stand, Hydraulic, Portable (Diesel)	154	1	0.00	0.00	0.00	11.25	0.00	0.00	0.01	0.00	292	265
Truck, Lift Aerial Stores	26.1	2	0.15	0.01	0.21	0.20	0.02	0.02	0.00	0.00	7	6
Truck, Transport, Ammunition-Loading	270	2	1.49	0.14	2.80	2.66	0.09	0.09	0.00	0.00	102	93
GSE Total Emissions			**32.68**	**2.92**	**58.45**	**66.78**	**2.01**	**2.01**	**0.07**	**0.00**	**2,543**	**2,307**

Key: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year; NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 microns in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Note: Total values shown may appear to differ slightly from additive sums due to rounding.

Table E-13 Annual Vessel Operations Emissions

Source	*Annual Pollutant Emissions (tons per year)*								*CO_2e (MT/yr)*
	CO	*NO_x*	*PM_{10}*	*$PM_{2.5}$*	*SO_2*	*VOCs*	*Pb*	*CO_2e*	
No Action Alternative									
Range Support Vessels	631.00	33.41	1.48	1.48	3.28	258.00	0.00	2,170.00	1,969.00
Combatant and Patrol Craft	1.92	3.64	0.12	0.12	0.70	0.31	0.00	348.00	316.00
Motorized Surface Targets	232.00	23.92	1.05	1.05	2.54	94.34	0.00	1,486.00	1,348.00
Unmanned Surface Vessels	0.01	0.11	0.00	0.00	0.01	0.00	0.00	6.28	5.70
Vessel Totals Emissions	**865.41**	**61.08**	**2.65**	**2.65**	**6.53**	**352.61**	**0.00**	**4,010.66**	**3,638.41**
Alternative 1									
Range Support Vessels	631.00	33.41	1.48	1.48	3.28	258.00	0.00	2,170.00	1,969.00
Combatant and Patrol Craft	2.02	4.30	0.16	0.16	0.70	0.31	0.00	359.00	326.00
Motorized Surface Targets	233.00	23.94	1.05	1.05	2.54	94.65	0.00	1,487.00	1,349.00
Unmanned Surface Vessels	0.09	0.85	0.02	0.02	0.12	0.03	0.00	50.25	45.59
Vessel Totals Emissions	**866.35**	**62.50**	**2.71**	**2.71**	**6.63**	**352.96**	**0.00**	**4,066.44**	**3,689.02**
Alternative 2									
Range Support Vessels	695.00	36.77	1.63	1.63	3.61	284.00	0.00	2,388.00	2,166.00
Combatant and Patrol Craft	2.22	4.72	0.17	0.17	0.77	0.34	0.00	394.00	358.00
Motorized Surface Targets	257.00	26.35	1.16	1.16	2.79	104.00	0.00	1,636.00	1,484.00
Unmanned Surface Vessels	0.10	0.94	0.02	0.02	0.13	0.04	0.00	55.28	50.15
Vessel Totals Emissions	**953.86**	**68.77**	**2.98**	**2.98**	**7.30**	**388.62**	**0.00**	**4,473.39**	**4,058.19**

Key: CO = carbon monoxide; CO_2e = carbon dioxide equivalent; MT/yr = metric tons per year; NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 microns in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Note: Total values shown may appear to differ slightly from additive sums due to rounding.

Table E-14 Munitions and Other MEM Annual Emissions

Source	Category	Quantity	Annual Emissions (tons per year)								
			CO_2	CO_2 (MT/yr)	CO	NO_x	VOC	SO_2	PM_{10}	$PM_{2.5}$	Pb
No Action Alternative											
.50 cal Blank	Small-Caliber	56,077	0.06	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.00
25 mm	Medium-Caliber	11,391	0.24	0.22	0.48	0.01	0.00	0.00	0.02	0.01	0.00
2.75-in Rocket (Practice)	Rocket	923	2.22	2.01	0.24	0.00	0.00	0.00	0.07	0.08	0.03
Floating Smoke Pot	Marine Marker	22	0.01	0.01	0.01	0.00	0.00	0.00	0.33	0.25	0.00
Flare	Countermeasure Flare	332	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flare	Illumination Flare	51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.75-in Rocket Flechette	Rocket	33	0.04	0.04	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Simulant Launcher Grenade	Launchers/Pods	7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No Action Alternative Total Munitions and Other MEM Emissions			**2.57**	**2.33**	**0.80**	**0.01**	**0.00**	**0.00**	**0.42**	**0.34**	**0.03**
Alternative 1											
.50 cal Blank	Small-Caliber	74,396	0.08	0.07	0.07	0.00	0.00	0.00	0.00	0.00	0.00
25 mm	Medium-Caliber	19,702	0.42	0.38	0.84	0.01	0.00	0.00	0.03	0.02	0.00
2.75-in Rocket (Practice)	Rocket	1,139	2.73	2.48	0.30	0.00	0.00	0.00	0.09	0.10	0.04
Floating Smoke Pot	Marine Marker	34	0.01	0.01	0.02	0.00	0.00	0.00	0.51	0.39	0.00
Flare	Countermeasure Flare	267	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flare	Illumination Flare	40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.75-in Rocket Flechette	Rocket	46	0.06	0.05	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Simulant Launcher Grenade	Launchers/Pods	14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alternative 1 Total Munitions and Other MEM Emissions			**3.30**	**2.99**	**1.26**	**0.01**	**0.00**	**0.00**	**0.63**	**0.51**	**0.04**
Alternative 2											
.50 cal Blank	Small-Caliber	81,836	0.09	0.08	0.07	0.00	0.00	0.00	0.00	0.00	0.00
25 mm	Medium-Caliber	21,672	0.47	0.42	0.92	0.02	0.00	0.00	0.04	0.02	0.00
2.75-in Rocket (Practice)	Rocket	1,253	3.01	2.73	0.33	0.00	0.00	0.00	0.10	0.11	0.04
Floating Smoke Pot	Marine Marker	37	0.01	0.01	0.02	0.00	0.00	0.00	0.56	0.43	0.00
Flare	Countermeasure Flare	294	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Flare	Illumination Flare	44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.75-in Rocket Flechette	Rocket	51	0.06	0.06	0.04	0.00	0.00	0.00	0.00	0.00	0.00
Simulant Launcher Grenade	Launchers/Pods	15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alternative 2 Total Munitions and Other MEM Emissions			**3.64**	**3.30**	**1.38**	**0.02**	**0.00**	**0.00**	**0.70**	**0.56**	**0.05**

Key: CO = carbon monoxide; CO_2 = carbon dioxide; in = inches; mm = millimeter; NO_x = nitrogen oxides; PM_{10} = particulate matter less than or equal to 10 microns in diameter; $PM_{2.5}$ = particulate matter less than or equal to 2.5 microns in diameter; Pb = Lead; SO_2 = sulfur dioxide; VOC = volatile organic compound.

Note: Emissions are rounded to the nearest hundredths place. Therefore, because the quantities are small, the table may show zero emissions where there are actually small amounts emitted. Also, total values shown may appear to differ slightly from additive sums due to rounding.

E.3 Record of Non-Applicability (RONA)

RECORD OF NON-APPLICABILITY

Navy Record of Non-Applicability (RONA) for Clean Air Act Conformity

The Proposed Action falls under the RONA category and is documented with this RONA.

Proposed Action

Action Proponent: U.S. Department of the Navy

Location: Patuxent River Complex, Portions over Calvert County, Maryland; Kent and Sussex Counties, Delaware; and Charles City, James City, Gloucester, and York Counties, Virginia

Proposed Action: Patuxent River Complex Testing and Training

Proposed Action and Emissions Summary: The Proposed Action (Preferred Alternative, Alternative 2) involves operation of military aircraft, aircraft in-frame maintenance, open-air engine test cells, ground support equipment, vessels, and non-explosive munitions and other military expended materials (MEM) in order to achieve requisite training and testing requirements. Aircraft would be in operation below 3,000 feet above ground level within the mixing layer in airspace overflying the Calvert County, Maryland, marginal nonattainment area for ozone. However, no low-level flight operations (below 3,000 feet above ground level) occur in the Kent or Sussex County, Delaware, portion of the Study Area, nor do any flights occur below 3,000 feet in Charles City, James City, Gloucester, or York County, Virginia, portions of the Study Area. Thus, no criteria pollutants are emitted in the Kent or Sussex County, Delaware, nonattainment area nor the Charles City, James City, Gloucester, or York County, Virginia, portions of the maintenance area. Proposed Action emissions were evaluated to assess compliance with the General Conformity Rule *de minimis* thresholds, as shown in the table below.

Proposed Action Ozone Precursor (NO_x and VOC) Emissions Compared to General Conformity Rule *De Minimis* Thresholds (Tons per Year)

Annual Emissions	*NO_x*	*VOC*
Baseline PRC Emissions in Calvert County, Maryland	9.61	22
Proposed Action Emissions in Calvert County, Maryland	13.99	30.94
Net Change from Baseline Emissions	4.38	8.94
de minimis Threshold	100	50
Potential Exceedance	No	No
Baseline PRC Emissions in Sussex County, Delaware	0	0
Proposed Action Emissions in Sussex County, Delaware	0	0
Net Change from Baseline Emissions	0	0
de minimis Threshold	100	50
Potential Exceedance	No	No
Baseline PRC Emissions in Kent County, Delaware	0	0
Proposed Action Emissions in Kent County, Delaware	0	0
Net Change from Baseline Emissions	0	0
de minimis Threshold	100	50
Potential Exceedance	No	No
Baseline PRC Emissions in Charles City County, Virginia	0	0
Proposed Action Emissions in Charles City County, Virginia	0	0
Net Change from Baseline Emissions	0	0
de minimis Threshold	100	50
Potential Exceedance	No	No

Proposed Action Ozone Precursor (NO_x and VOC) Emissions
Compared to General Conformity Rule *De Minimis* Thresholds (Tons per Year) (continued)

Annual Emissions	*NO_x*	*VOC*
Baseline PRC Emissions in James City County, Virginia	0	0
Proposed Action Emissions in James City County, Virginia	0	0
Net Change from Baseline Emissions	0	0
de minimis Threshold	100	50
Potential Exceedance	No	No
Baseline PRC Emissions in Gloucester County, Virginia	0	0
Proposed Action Emissions in Gloucester County, Virginia	0	0
Net Change from Baseline Emissions	0	0
de minimis Threshold	100	50
Potential Exceedance	No	No
Baseline PRC Emissions in York County, Virginia	0	0
Proposed Action Emissions in York County, Virginia	0	0
Net Change from Baseline Emissions	0	0
de minimis Threshold	100	50
Potential Exceedance	No	No

Key: NO_x = nitrogen oxides; PRC = Patuxent River Complex; VOC = volatile organic compound.

Affected Air Basins: Calvert County, Maryland, marginal ozone nonattainment area; Sussex County, Delaware, marginal ozone nonattainment area; Kent County, Delaware, moderate ozone maintenance area; Charles City County, Virginia, marginal ozone maintenance area; Gloucester County, Virginia, marginal ozone maintenance area; James City, Virginia, marginal ozone maintenance area; and York County, Virginia, marginal ozone maintenance area

Date RONA Prepared: March 17, 2021

RONA Prepared By: Brad Boykin, Leidos

Proposed Action Exemptions

The Proposed Action is exempt from the General Conformity Rule requirements based on the determination that the emissions are below the *de minimis* threshold for ozone precursors, nitrogen oxides (NO_x) and volatile organic compounds (VOCs).

Emissions Evaluation Conclusion

The Navy concludes that *de minimis* thresholds for ozone precursors (NO_x and VOC) would not be exceeded as a result of implementation of the Proposed Action. The emissions data supporting that conclusion is shown in the table above. The calculations, methodology, data, and references are contained in Section 3.2 (Air Quality) and Appendix D (Air Quality Calculations) of the Patuxent River Complex Environmental Impact Statement. Therefore, the Navy concludes that further formal Conformity Determination procedures are not required, resulting in this RONA.

RONA Approval:

Signature: MCDANIEL.LANCE.E.1204352972 Digitally signed by MCDANIEL.LANCE.E.1204352972 Date: 2021.03.22 12:59:34 -04'00'

Date: 22MAR21

Name: Lance E. McDaniel

Command: NAS PAtuxent River

E.4 References

California Air Resource Board. (2020). *August 2020 Speciation Profiles*. Retrieved from California Air Resource Board: https://ww2.arb.ca.gov/speciation-profiles-used-carb-modeling. December 8.

Environment Canada. (2012). *2010 National Marine Emissions Inventory for Canada, Final Report.* Prepared by SNC-Lavalin Environment. 507284 November 5, 2012. Retrieved from U.S. Environmental Protection Agency: http://www.epa.gov/ttnchie1/net/2008inventory.html. December 8.

Ford. (2019). *2019 F-650-750 F-750 SD Diesel Straight Frame*. Retrieved from Ford Motor Company: https://www.ford.com/commercial-trucks/f650-f750/models/f750-sd-diesel-straight-frame/. October 24.

Shell Trading Company. (2020). *Safety Data Sheet.* Houston, TX: According to OSHA Hazard Communication Standard, 29 CFR 1910.1200.

U.S. Department of the Navy. (2015). *Aircraft Emission Estimates: C-12 Landing and Takeoff Cycle and In-Frame Maintenance Testing Using JP-5.* San Diego, CA: Aircraft Environmental Support Office.

U.S. Department of the Navy. (2016). *Aircraft Emission Estimates: H-60 Landing and Takeoff Cycle, Cruise Time and In-Frame Maintenance Testing Using JP-5.* San Diego, CA: Aircraft Environmental Support Office.

U.S. Department of the Navy. (2017). *Aircraft Emission Estimates: F/A-18 Landing and Takeoff Cycle and In-Frame Maintenance Testing Using JP-5.* San Diego, CA: Aircraft Environmental Support Office.

U.S. Department of the Navy. (2019). *Aircraft Emission Estimates: T-34C Landing and Takeoff Cycle and In-Frame Maintenance Testing Using JP-5.* San Diego, CA: Aircraft Environmental Support Office.

U.S. Department of the Navy. (2020). *Averaged In-frame Maintenance Emission Rates for F/A-18, C-12, H-60, and T-34.* San Diego, CA: Aircraft Environmental Support Office.

This page intentionally left blank.

Appendix F
Endangered Species Act Documentation

Table of Contents

Appendix F Endangered Species Act Documentation .... F-i
F.1 U.S. Fish and Wildlife Service – Endangered Species Act Section 7 Correspondence F-1
F.2 National Marine Fisheries Service – Endangered Species Act Section 7 Correspondence F-4

This page intentionally left blank.

F.1 U.S. Fish and Wildlife Service – Endangered Species Act Section 7 Correspondence

DEPARTMENT OF THE NAVY
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
22347 CEDAR POINT ROAD UNIT 6
PATUXENT RIVER MARYLAND 20670-1161

7594
Ser: 042.21
17 March 2021

From: Executive Director, Data Analytics, Infrastructure and Technology Advancement Group
To: United States Fish and Wildlife Service (USFWS), Chesapeake Bay Field Office, http://ecos.fws.gov/ipac/

Subj: ENDANGERED SPECIES ACT SECTION 7 CONSULTATION FOR NAVAL AIR STATION PATUXENT RIVER TESTING AND TRAINING ACTIVITIES

Encl: (1) Public Release Version of Section 3.4.4.2 of the 2021 PRC EIS (CD)

1. In accordance with section 7 of the Endangered Species Act, the United States Navy (Navy) requests concurrence on our determination that Naval Air Station Patuxent River Complex (PRC) proposed activities in the middle Chesapeake Bay may affect, but are not likely to adversely affect listed species. The Proposed Action includes testing and training activities analyzed in the 1998 PRC Environmental Impact Statement (EIS) and subsequent Environmental Assessments. The incidental effects of the proposed action result from exposure to acoustic, physical disturbance, and other environmental stressors. These activities do not include use of explosives. Section 3.4.4.2 (Federal Threatened and Endangered Species Act – USFWS Jurisdiction) of the 2021 PRC EIS provides the required information pursuant to 50 C.F.R. §402.12(±) and is enclosed for your convenience.

2. We request concurrence on our may affect, not likely to adversely affect determinations for: eastern black rail (*Laterallus j. jamaicensis*), northeastern beach tiger beetle (*Cicindela d. dorsalis*), Puritan tiger beetle (*Cicindela puritan*), red knot (*Calidris canatus rufa*), and West Indian manatee (*Trichechus manatus*).

3. Although sea turtles occur within the PRC action area, there is no nesting expected within the action area; therefore, we are consulting on sea turtles with only the National Marine Fisheries Service.

4. We appreciate your continued support in helping the Navy meet its environmental responsibilities. You may contact Mrs. Crystal Ridgell (crystal.l.ridgell@navy.mil) should you have additional questions.

Amy J. Markowich

AMY J. MARKOWICH
Executive Director
Naval Air Warfare Center Aircraft Division, DAiTA

Copy to: Chief of Naval Operations (N45)
Naval Sea Systems Command

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Chesapeake Bay Field Office
177 Admiral Cochrane Drive
Annapolis, Maryland 21401
http://www.fws.gov/chesapeakebay

May 20, 2021

Amy Markowich
Executive Director
Naval Air Warfare Center Aircraft Division
Department of the Navy
22347 Cedar Point Road, Unit 6
Patuxent River, MD 20670

RE: "Not Likely to Adversely Affect" determination for Eastern black rail, northeastern beach tiger beetle, Puritan tiger beetle, red knot, and West Indian manatee and "No Effect" determination for northern long-eared bat for Testing and Training Activities in the Patuxent River Complex in Maryland

Dear Ms. Markowich:

The U.S. Fish and Wildlife Service (Service) has reviewed the draft Environmental Impact Statement (EIS) sent to our office on April 30, 2021, as well as project information from the Service's Information for Planning and Consultation (IPaC) online system. The comments provided below are in accordance with Section 7 of the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 *et seq.*).

The purpose of the proposed action is to perform military testing and training activities to support Navy military readiness requirements. The use of explosives is not included in these activities. Potential effects to species may result from exposure to acoustic, physical disturbance, energy, and other environmental stressors.

The Service has reviewed the draft EIS and concurs with the "not likely to adversely affect" determination for the Eastern black rail (*Laterallus jamaicensis jamaicensis*), northeastern beach tiger beetle (*Cicindela dorsalis dorsalis*), Puritan tiger beetle (*Cicindela puritana*), red knot (*Calidris canutus rufa*), and West Indian manatee (*Trichechus manatus*) due to avoidance and minimization measures being implemented, or effects of the proposed actions being insignificant or discountable.

There are no northern long eared bat (*Myotis septentrionalis)* maternity roosts or hibernacula within the vicinity of the project and no tree clearing proposed, so we concur with the "no effect" determination for this species.

TAKE PRIDE IN AMERICA

2

Except for occasional transient individuals, no other federally proposed or listed threatened or endangered species are known to exist within the project area. Should project plans change or if additional information on the distribution of listed or proposed species becomes available, this determination may be reconsidered.

We appreciate the opportunity to provide information relative to fish and wildlife issues. Thank you for your interest in these resources. If you have any questions or need further assistance, please contact Kathleen Cullen, of my staff, at 410/573-4579 or kathleen_cullen@fws.gov.

Sincerely,

Julie Slacum

Acting for
Genevieve LaRouche
Field Supervisor

F.2 National Marine Fisheries Service – Endangered Species Act Section 7 Correspondence

DEPARTMENT OF THE NAVY
NAVAL AIR WARFARE CENTER AIRCRAFT DIVISION
22347 CEDAR POINT ROAD UNIT 6
PATUXENT RIVER MARYLAND 20670-1161

7594
Ser: 041
17 March 2021

From: Executive Director, Data Analytics, Infrastructure and Technology Advancement Group
To: Section 7 Coordinator, National Marine Fisheries Service (NMFS), Greater Atlantic Region, nmfs.gar.esa.section7@noaa.gov

Subj: ENDANGERED SPECIES ACT SECTION 7 CONSULTATION FOR NAVAL AIR STATION PATUXENT RIVER COMPLEX TESTING AND TRAINING ACTIVITIES

Encl: (1) Public Release Version of Section 3.4.4.1 of the 2021 PRC EIS (CD)

1. In accordance with section 7 of the Endangered Species Act, the United States Navy (Navy) requests concurrence on our determination that Naval Air Station Patuxent River Complex (PRC) proposed activities in the middle Chesapeake Bay may adversely affect listed species. The Proposed Action includes testing and training activities analyzed in the 1998 PRC Environmental Impact Statement (EIS) and subsequent Environmental Assessments, as well as adjustments to current testing and training activities required to support projected Navy military readiness requirements into the foreseeable future and in the event of increased global conflict. The incidental effects of the proposed action result from exposure to acoustic, physical disturbance, and other environmental stressors associated with military readiness activities that do not include use of explosives. Section 3.4.4.1 (Federal Threatened and Endangered Species Act – NMFS Jurisdiction) of the 2021 PRC EIS provides the required information pursuant to 50 C.F.R. §402.12(±) and is enclosed for your convenience.

2. Based on the Navy's may affect, likely to adversely affect determinations, we are requesting formal consultation on: Atlantic sturgeon (*Acipenser oxyrinchus oxyrhynchus*) Chesapeake Bay DPS, shortnose sturgeon (*Acipenser brevirostrum*), green sea turtle (*Chelonia mydas*), Kemp's ridley sea turtle (*Chelonia mydas*), loggerhead sea turtle (*Caretta caretta*), and leatherback sea turtle (*Dermochelys coriacea*).

3. Although sea turtles occur within the PRC action area, there is no nesting expected within the action area; therefore, we will not be consulting on sea turtles with the United States Fish and Wildlife Service.

4. We request concurrence on our may affect, not likely to adversely affect determinations for: Atlantic sturgeon (*Acipenser oxyrinchus oxyrhynchus*) Carolina and New York Bight DPS, and critical habitat.

ENDANGERED SPECIES ACT SECTION 7 CONSULTATION FOR NAVAL AIR STATION PATUXENT RIVER COMPLEX TESTING AND TRAINING ACTIVITIES

5. We appreciate your continued support in helping the Navy meet its environmental responsibilities. You may contact Mrs. Crystal Ridgell (301-757-5282 or crystal.l.ridgell@navy.mil) should you have additional questions.

Amy J. Markowich

AMY J. MARKOWICH
Executive Director
Naval Air Warfare Center Aircraft Division, DAiTA

Copy to: Chief of Naval Operations (N45)
Naval Sea Systems Command

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
GREATER ATLANTIC REGIONAL FISHERIES OFFICE
55 Great Republic Drive
Gloucester, MA 01930

September 2, 2021

Crystal Ridgell
Naval Air Warfare Center Aircraft Division
U.S. Department of the Navy
23013 Cedar Point Rd., Building 2118
Patuxent River, Maryland 20670-1161

Re: Testing and Training Activities in the Patuxent River Complex

Dear Ms. Ridgell:

We have completed our consultation under section 7 of the Endangered Species Act (ESA) in response to your email received on July 14, 2021, and Draft Environmental Impact Statement (DEIS) regarding the above-referenced proposed project. We reviewed your consultation request document and related materials. Based on our knowledge, expertise, and your materials, we concur with your conclusion that the proposed action is not likely to adversely affect any National Marine Fisheries Service (NMFS) ESA-listed species or designated critical habitat. Therefore, no further consultation pursuant to section 7 of the ESA is required.

We would like to offer the following clarifications to complement your incoming request for consultation. Although you described the Patuxent Range Complex (PRC) study area in section 1.3 of the DEIS, we did not see a section in your ESA analysis describing the action area. Under the ESA's implementing regulations, "action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.2). We would like to clarify that, in addition to the PRC study area, the action area includes the area where listed species are exposed to underwater noise, vessel traffic and in-water devices, entanglement, and ingestion, the extents of which you discuss in your analysis.

In your status of the species section, you report that, "[o]nly Atlantic sturgeon belonging to the New York Bight, Chesapeake Bay, and Carolina [Distinct Population Segments] DPSs have been documented to occur within the PRC Study Area based on telemetry results…" While we agree that sturgeon tend to stay in areas closest to the natal estuary, the Mid-Atlantic, in particular, is an area used by all five DPSs. Based on what we know, it is reasonable to say that sturgeon belonging to the South Atlantic DPS and the Gulf of Maine DPS are less likely to occur within the Chesapeake Bay than sturgeon that belong to the Chesapeake Bay DPS, New York Bight DPS, or Carolina DPS; however, because that area of the Patuxent is mesohaline, it is possible that a Gulf of Maine DPS sturgeon and/or South Atlantic DPS sturgeon could be in that area. Therefore, we would be more inclined to say that the Chesapeake Bay array data suggests that Gulf of Maine DPS sturgeon and South Atlantic DPS sturgeon are less frequent visitors.

We would also like to offer the following clarifications to your analysis of the effects of sound pressure on ESA-listed sturgeon. The Fisheries Hydroacoustic Working Group was formed in 2004 and consists of biologists from NMFS, U.S. Fish and Wildlife, Federal Highways Administration, and the California, Washington and Oregon Departments of Transportation, supported by national experts on sound propagation activities that affect fish and wildlife species of concern. In June 2008, the agencies signed a Memorandum of Understanding documenting criteria for assessing physiological effects of pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted that these are onset of physiological effects (Stadler and Woodbury 2009) and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all species, including listed green sturgeon, which are biologically similar to shortnose and Atlantic sturgeon and for these purposes can be considered a surrogate (note: we do not expect any early life stages of sturgeon to be present in the action area, so the thresholds for fish below 2 grams are not relevant). The criteria are:

- Peak SPL: 206 decibels relative to 1 micro-Pascal (dB re 1 μPa).
- cSEL: 187 decibels relative to 1 micro-Pascal-squared second (dB re 1μPa2-s) for fishes above 2 grams (0.07 ounces).
- cSEL: 183 dB re 1μPa2-s for fishes below 2 grams (0.07 ounces).

For purposes of assessing behavioral effects of pile driving at several West Coast projects, NMFS has employed a 150dB re 1 μPa RMS SPL criterion at several sites including the San Francisco-Oakland Bay Bridge and the Columbia River Crossings. For the purposes of this consultation, we will use 150 dB re 1 μPa RMS as a conservative indicator of the noise level at which there is the potential for behavioral effects. That is not to say that exposure to noise levels of 150 dB re 1 μPa RMS will always result in behavioral modifications or that any behavioral modifications will rise to the level of "take" (i.e., harm or harassment) but that there is the potential, upon exposure to noise at this level, to experience some behavioral response. Behavioral responses could range from a temporary startle to avoidance of an ensonified area.

As hearing generalists, sturgeon rely primarily on particle motion to detect sounds (Lovell et al. 2005), which does not propagate as far from the sound source as does pressure. However, a clear threshold for particle motion was not provided in the Lovell study. In addition, flanking of the sounds through the substrate may result in higher levels of particle motion at greater distances than would be expected from the non-flanking sounds. Unfortunately, data on particle motion from similar impulsive sound sources is not available at this time, and we are forced to rely on sound pressure level criteria. Although we agree that more research is needed, the studies noted above support the 150 dB re 1 μPa RMS criterion as an indication for when behavioral effects could be expected.

Exposure to underwater noise levels of 206 dB re 1 μPa (peak) and 187 dB re 1μPa2-s (cSEL) can result in injury to sturgeon. Exposure to peak pressure levels that may result in injury is not anticipated to occur. In addition to the "peak" exposure criterion which relates to the energy received from a single pile strike, the potential for injury exists for multiple exposures to noise over a period of time. This is accounted for by the cSEL threshold. The cSEL is not an instantaneous maximum noise level, but is a measure of the accumulated energy over a specific period of time (e.g., the period of time it takes to install a single pile). When it is not possible to accurately calculate the distance to the 187 dB cSEL, we calculate the distance to the 150 dBs SEL. The further a fish is away from the sound source, the more sound producing activities it must be exposed to accumulate enough energy to result in injury.

At some distance, a fish is far enough away from the sound source that, regardless of the number of impulses it is exposed to, the energy accumulated is low enough that there is no potential for injury. For this project, the highest level of underwater sound would be produced by the firing of rockets at the surface (approximately 169 dB peak re 1 μPa), which is well below to the levels of noise that would result in potential injury to sturgeon. Given that sturgeon would only be exposed to levels of noise that cause behavioral modification, we expect sturgeon will move away from the sound source and never be exposed to potentially injurious levels of underwater noise.

Behavioral effects, such as avoidance or disruption of foraging activities, may occur in sturgeon exposed to noise above 150 dB RMS. Should sturgeon move into the action area where the 150 dB RMS isopleth extends, we expect that they will modify their behavior and swim away from the ensonified area. If any movements away from the ensonified area do occur, we do not expect the movements to have a measurable effect on essential sturgeon behaviors (e.g., foraging, resting, and migration), as the bay is sufficiently wide. Therefore, we agree with your conclusion that given the small distance a sturgeon would need to move to avoid the disturbing levels of noise, any effects will not be able to be meaningfully measured or detected, and are insignificant.

In your analysis of vessel interactions, you conclude that the effects would be discountable. We would like to clarify that, based on your analysis, the correct determination should be insignificant because the increase in risk of a vessel strike as a result of the addition of the project vessels to the baseline (rather than the increase in the vessels themselves) is too small to be meaningfully measured, detected, or evaluated. Similarly, in your analysis of the likelihood of Military Expended Materials (MEMs) ingestion by sturgeon and sea turtles, after you state that the risk is low and will cause an insignificant impact if ingested, you conclude that the effects would be discountable. We would like to clarify that, based on your analysis, the correct determination should be insignificant because the increase in risk of ingestion as a result of the addition of the MEMs to the baseline (rather than the increase in the MEMs themselves) is too small to be meaningfully measured, detected, or evaluated.

Lastly, we would like to offer some clarifications on your analysis of the action's effects on the physical and biological features (PBFs) of critical habitat designated for the Chesapeake Bay DPS of Atlantic sturgeon. Within the PRC study area, we have identified the following PBFs to be present: PBF 2 (aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 parts per thousand and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development); PBF 3 (water of appropriate depth and absent physical barriers to passage between the river mouth and spawning sites); and PBF 4 (water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the necessary temperature, salinity, and oxygen values). Due to the presence of these PBFs, we would like to clarify that because training and testing in designated critical habitat are limited to surface activities, which have the potential to impact the species rather than the conservation value of critical habitat, any impacts to the value of critical habitat to the species are extremely unlikely to occur and, therefore, discountable. These clarifications do not alter your analysis or conclusion and thus no further consultation pursuant to section 7 of the ESA is required.

Reinitiation of consultation is required and shall be requested by the lead federal agency or by us, where discretionary federal involvement or control over the action has been retained or is authorized by law and: (a) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in the consultation; (b) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this consultation; or, (c) If a new species is listed or critical habitat designated that may be affected by the identified action. No take is anticipated or exempted. If there is any incidental take of a listed species, reinitiation would be required. Should you have any questions about this correspondence please contact Brian Hopper at brian.d.hopper@noaa.gov or (410) 267-5649. For questions related to Essential Fish Habitat, please contact Jonathan Watson with our Habitat Conservation Division at jonathan.watson@noaa.gov or (410) 295-3152.

Sincerely,

Jennifer Anderson

Jennifer Anderson
Assistant Regional Administrator
for Protected Resources

ec: Watson, NMFS/HCD; Gray, Navy; Chappell, Navy
ECO: GARFO-2021-01763
File Code: H:\Section 7 Team\Section 7\Non-Fisheries\Navy\Informal\2021\Patuxent River Complex Training and Testing

4

This page intentionally left blank.